RADIO'S DIGITAL DILEMMA: BROADCASTING IN THE 21st CENTURY

BY

JOHN NATHAN ANDERSON

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Doctoral Committee:

Professor John C. Nerone, Chair and Director of Research
Associate Professor Michelle Renee Nelson
Associate Professor Christian Edward Sandvig
Professor Daniel Toby Schiller

ABSTRACT

The interaction of policy and technological development in the era of "convergence" is messy and fraught with contradictions. The best expression of this condition is found in the story behind the development and proliferation of digital audio broadcasting (DAB). Radio is the last of the traditional mass media to navigate the convergence phenomenon; convergence itself has an inherently disruptive effect on traditional media forms. However, in the case of radio, this disruption is mostly self-induced through the cultivation of communications policies which thwart innovation. A dramaturgical analysis of digital radio's technological and policy development reveals that the industry's preferred mode of navigating the convergence phenomenon is not designed to provide the medium with a realistically useful path into a 21st century convergent media environment. Instead, the diffusion of "HD Radio" is a blocking mechanism proffered to impede new competition in the terrestrial radio space. HD Radio has several critical shortfalls: it causes interference and degradation to existing analog radio signals; does not have the capability to actually advance the utility of radio beyond extant quality/performance metrics; and is a wholly proprietary technology from transmission to reception. Despite substantive evidence in the record clearly warning of HD Radio's fundamental detriments, the dominant actors in the policy dialogue were able to quell these concerns by dint of their economic might and through intensive backstage discourse directly with the Federal Communications Commission. Since its official proliferation in 2002, HD Radio's growth has stagnated; some early-adopter stations are actually abandoning the protocol and receiver penetration is abysmal. As a result, the future of HD Radio is quite uncertain. Domestically, the entire process of HD Radio's regulatory approval can be seen as a capstone in the history of communications regulation which favors neoliberal ideology over empirical engineering data and a vocal public interest. However, the apparent failure of digital radio is not confined to the United States: the dilemma of DAB's adoptive weakness is a global and technologically agnostic phenomenon. Perhaps this says something about the inherent *necessity* of digitizing radio, and invites significant confusion over the future *identity* of "radio" as we know it today. If DAB were to fail, the outcome would invite entirely new ways of thinking about the future of broadcasting in a convergent media environment.

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Chapter 1: Identifying Radio's Digital Dilemma

Radio broadcasting is the last of the traditional analog mass media to negotiate the communicative phenomenon known as "convergence." Convergence refers to the ongoing digitalization of all media and embraces the notion that previously separate mediums will inevitably "converge" in such a way so that the distribution of information takes place over a uniform conduit, such as the Internet.[1] From a purely technological standpoint, this definition is useful. However, scholars and policymakers that study convergence often fail to address all three important factors which make the phenomenon possible, of which the development of new technologies is only one; the other two include industry strategy and public policy.[2]

Communications policy often "downplay[s] the way in which technological change is the product of political will, rather than inexorable logic."[3] At every technological turn toward communicative "progress" - with digitalization and convergence being the topics *du jour* - policymakers promise us that new communications technologies will "fundamentally make our media system more democratic." Yet with every new advancement, corporate interests skew regulatory development to entrench the priorities of commerce.[4]

Far from being a utopian phenomenon, convergence opens up the potential for potent unsettlement.[5] In fact, convergence operates within limits, including the notion that "the evolution of the physical embodiments of [convergent technology] is shaped by the social and cultural context in which they are embedded."[6] Henry Jenkins noted that convergence within a corporate media structure, "from the ground," looks more like "great big dysfunctional families, whose members aren't speaking with each other and pursue their own short term agendas even at the expense of other divisions of the same companies."[7] Despite its apparent messiness, critical communications scholars watching convergence in action are certain of one thing: it is shaped by "the abiding principles of a capitalist political economy,"[8] which seeks to bring the "entire 'ideological' sphere of society...into the market orbit."[9]

Changes taking place in the realm of radio broadcasting are quite illustrative regarding the perversely negative effects that convergence can have on a medium undergoing disruptive change. On one hand, as discussion of media digitalization gained steam during the 1990s and the commercialization of the Internet engendered the formal study of convergence, the U.S. radio

broadcast industry and the regulators that oversaw it remained surprisingly insular in their outlook for the medium. This was to be a decade of consolidation and the reconfiguration of radio relative to its mission to serve "the public interest, convenience, and necessity" into a fully-entrenched marketplace paradigm. Convergence, on radio's radar, was a tool which allowed the programming of multiple stations from one location and was utilized more for cost-savings than for the creative or communicative expansion of broadcasting itself. As the World Wide Web began its explosive growth following the passage of the Telecommunications Act of 1996, radio broadcasters, to put it bluntly, saw the development as simply another means by which to promote a radio station. By the time regulators, media professionals, and scholars began to grapple with the economic implications of convergence, the radio industry as a whole wasn't even fully aware that the phenomenon was underway.[10]

The expansiveness of the Internet and the introduction of satellite radio broadcasting served to change this ignorance; the digitalization of radio became a growing topic of debate within the U.S. broadcast industry. It initially defined digitalization *as* convergence, when in reality digitalization is only the first step in the convergence process. With the support of a neoliberal regulatory agenda elucidated by the Federal Communications Commission, commercial and public radio broadcasters began to add digital components to their AM and FM signals. However, as David Sedman has noted, a new radio service "generally requires four levels of adoption: (1) Approval by a governing body (such as the FCC in the United States); (2) Acceptance by the broadcast station; (3) Consent from the consumer electronics industry to design and market a new technology; [and] (4) Adoption by the mass buying public."[11]

The digital audio broadcast (DAB) technology developed by the U.S. radio industry and sanctioned by the FCC actually represents the worst possible iteration of digital radio, and does more to fragment the medium's participation in the convergence phenomenon than it does to embrace it. Only one of Sedman's four criteria (approval by the FCC) has been met. Obtaining this approval was not a difficult process: driven by what David Harvey has termed the "market exchange ethic" of neoliberalism,[12] regulators did not even bother to examine the technological implications of radio's digitalization, much less its potentially deleterious impact on the communicative efficacy of radio itself. Despite the fact that the radio industry chose a digital

broadcast framework which made it more difficult to participate in convergence and might actually harm legacy analog radio service, communications regulators cast the digitalization of radio as an economically evolutionary necessity, trusting in radio's "market leaders" to craft the formative policies that would best serve their own needs and, by dubious extension, the needs of the public.

Regulators have not always been so laissez-faire. The FCC has wrestled for decades with how the "public interest, convenience and necessity" is actually embodied in regulation of media, and at times has actually considered democratic principles in its decision-cycle. However, neoliberal ideology now defines communication policy's operative rationale in wholly economic terms, which effectively absolves regulators of the need to understand new technologies and their effects on the democratic potentiality of our media environment. Communications policymakers no longer function as servants of the people from whom they ostensibly derive regulatory power; they are now facilitators of the ethos of corporate capitalism. The end-state of such a situation is regulatory capture, and in the case of digital radio, the evidence is quite distinct. The over-reliance on economic metrics has led to the unleashing of a form of broadcasting that may do more harm than good to radio's importance as a mass medium. Although the United States leads the world in its dogged adherence to neoliberalism, the ideology's effects are heavily felt in all developed countries and, as a result, has similarly confounded their exploration of digital radio broadcasting. Irrespective of the specific form of government, communications policymakers have uniformly treated the digitalization of radio in a similarly single-dimensional fashion and effectively reaped the same results.

Radio's digital dilemma arises from the conflict between the traditional strengths of the medium and the perceived interests of broadcasters badly navigating a convergent media environment governed by a captive regulator. Can terrestrial radio broadcasting find a meaningful place? If not, what damage might the process of broadcast digitalization do to radio's analog service, which is still a viable and popular method of mass communication? Broadcasters are struggling to define their interests in the face of competitors that digitization and convergence have engendered. New forms of radio, such as satellite broadcasting, portable digital music storage devices and, more recently, the ability to stream audio content via the Internet to "receivers" such as phones and in-vehicle entertainment suites, began to draw listeners away

from traditional broadcasting in the 1990s. From the perspective of the listener, the identity of "radio" is now in flux.[13] As a result, those that have historically claimed ownership over radio as a unique medium may find themselves usurped. This dissertation attempts to explain the conditions that led terrestrial radio to this impasse. I argue that the political and economic decisions locking terrestrial broadcasters into substandard digital broadcast technologies promise to marginalize their usefulness as media outlets in the 21st century.[14] I will show how the regulatory process - which is ostensibly designed to maximize the functional utility of all media - conspired to produce such a potentially deleterious outcome. The future of radio broadcasting (as currently conceived and executed) may already be in jeopardy.[15] If the ubiquity and "naturalization" of analog radio is disrupted by new digital technologies, it will have detrimental knock-on effects that will make it more difficult to "establish the medium's significance" in our contemporary media environment.[16]

I. Learning from the Neoliberalization of Radio Regulation

Today, the dominant regulatory paradigm, defined by David Allen as "corporate rationalization," directly controls the development of new media technologies, and little room is allowed for critiques of the political-economic structure in which they are being deployed.[17] In the process, the "sovereignty of citizens over the state" has been undermined, and the status of "citizen" has been gradually replaced by the "consumer."[18] This has led to a situation where corporations, heavily privileged by their accumulation of capital relative to the public, have a voice in the communications policymaking process which is nearly impossible for the public to match, much less effectively debate the merits of regulatory inclinations and outcomes. The design of digital audio broadcasting, in effect, is built around the primary goal of acting as a blocking mechanism to prevent new competition in the terrestrial radio space.[19] A power elite developed the technology in the image of their own self-interests, which undermines the way in which radio be democratically used.[20] In fact, the story of the digitalization of radio broadcasting may be one of the clearest examples of how a stringently neoliberal ideology can destroy democratic media systems as they fall under a private paradigm of control, where even regulators cannot intervene. The result may represent an example of Joseph Schumpeter's "creative destruction," in which a new technology threatens to push out an old one."[21] However, the

process has already produced negative consequences regarding the integrity of terrestrial broadcasting itself.[22]

This situation inevitably leads "researchers...to analyze what is arguably the root cause of the problem rather than concentrate on marginal effects."[23] How and why did policymakers willingly choose an outcome for digital radio that saddles the medium with net detriments? This is best addressed by looking at the rationales which govern the activities of the FCC. What Paul Starr calls "constitutive choices" are decisions made during the creation of media systems which affect "how things are built and how they work - their design and rules of operation." Oftentimes, constitutive choices are made through the process of "slowly crystallizing cultural practices or gradual economic and political change," but in some cases they arise in "bursts set off by social and political crises, technological innovation, or other triggering events, and at these pivotal moments the choices may be encoded in law, etched into technologies, or otherwise embedded in the structure of institutions."[24] Constitutive choices have three primary effects on the nature of democratic communications: they determine "the general legal and normative rules concerning such issues as free expression, access to information, privacy, and intellectual property; second, the specific design of communications media, structure of networks, and organization of industries; and third, institutions related to the creation of intangible and human capital - that is, education, research, and innovation."[25] Good constitutive choices are made when all three factors are taken into account and balanced in such a manner as to maximize the democratic potentiality of a communicative system or act.

The constitutive choices of digital radio were made with casual disregard of public input and by those with access to proprietary information, which has negatively affected the trajectory of its development and proliferation.[26] Historically, the development of radio broadcasting in the United States has taken place under priorities which heavily favor "economic forces shaped through political decisions," and with casual disregard for normative concepts such as freedom of expression, public access to the airwaves, and the intellectual property aspects of broadcast technology.[27] Starr himself argues that from the inception of broadcast regulation, commercial forces worked "to create a set of rules...that virtually amounted to a system of private regulation of politics."[28] Through a convergent lens, radio's digitalization represents a struggle which

Lawrence Lessig has identified as being "between *old* and *new*. The story...is about how an environment designed to enable the new is being transformed to protect the old" [emphasis in original].[29] At its most basic level, the story of digital radio highlights the primacy of neoliberal principles in the development of communications policy, and the role of regulators as overseers - not intervenors - in the act of its promulgation. From this perspective, the development of digital radio broadcasting in the United States is a parable for the larger history of communications policy.

Thomas Streeter has argued that this sort of communications regulation couches the function of policymaking as "actions as a matter of neutral, technological necessity in service of the social system."[30] If such systems are increasingly characterized by "technologically enabled commodification and exchange of intangibles," broadcast policymaking "provides us with an example of one way that such commodification can be accomplished, and of the problems that are likely to be encountered if that path is taken."[31] Broadcast regulation has promoted institutions that are "dependent on government privileges and other forms of collective constraints." Although such regulation harkens to "the classical ideals of private property and the free marketplace, American...broadcasting, under close inspection, calls the coherence of those ideals into question."[32] The neoliberal foundation of broadcast policy "sets the terms and broad boundaries of acceptable action within which interest group struggles can take place."[33] Considering that the "key players" of broadcasting in the United States "have always been organized along corporate lines," this guarantees that neoliberal ideology "permeate[s] the institution of...broadcasting at numerous levels,"[34] and creates a stratification of power among constituents involved in communications policymaking - where the "core [is] dominated by an alliance of corporate and government elites" and a subaltern "economic periphery of smaller enterprises and a political periphery of electoral politics" exist.[35]

This has led to a what Streeter terms a "functionalist social vision" of broadcast regulation, in which the "furtherance of technological and economic progress" are priorities to which democratic principles are given lip service. The "apparently illiberal outcomes" of this process are "thus reconciled with liberal goals by framing the issue as a matter of system maintenance; maintaining the system [is] less a matter of rights than one of neutral technological

necessity and overriding public purpose - all in the service of broadly liberal goals."[36] In this context, the "character of American 'broadcast policy' becomes clear":

> broadcast policy is a realm for experts, not for "politics" in the broad sense of governance in a democratic society...And when those inside the delimited broadcast policy world knowingly acknowledge that policy is political, they mean political in the sense of maneuvering for gain - low politics. The world of policy, they readily acknowledge, has become infected by the processes associated with self-interested strategizing and struggles. But they don't describe the subject matter...as "broadcast politics" because this might imply high politics: matters of value, structure, and legitimacy that they and their sponsors have little interest in opening for consideration."[37]

If such a paradigm has dominated U.S. broadcast regulation from its inception, it becomes easier to understand how such poorly designed constitutive choices for the digital future of radio are facilitated.

According to Hugh Slotten, adherence to "technocratic values" allows regulators to "legitimate complex decisions in terms of narrow technical concerns. Boundaries [are] constructed between technical and nontechnical criteria to facilitate policy-making processes and give authority to final decisions."[38] Doing so provides a clever foil with which to avoid addressing the thorny issues of a new communications technology's sociopolitical implications.[39] "Being practical" in the context of regulation simply means "that one somehow contribute to the larger project of using neutral expertise to integrate broad liberal principles within a corporate consumer economy."[40] Neolilberal ideology invokes technocratic justifications for regulation over democratic ones, in the belief that the marketplace is the only meaningful forum for public discourse. As a result, communications policymakers equate the "public interest" component of regulation "more and more rigidly with the supposedly neutral and desirable state of marketplace competition,"[41] which predisposes communications regulators away from engaging in policymaking in any substantively democratic fashion.[42]

The fact that "a nontrivial part of public policy is determined in secret, and that much of what is public is either too costly, or is largely unintelligible to the vast majority of the electorate, is quite enough to falsify...pluralist assumptions" about the democratic nature of communications regulation.[43] The FCC's historic rationale to promulgate policy in the "public interest, convenience and necessity" has faded as policymakers redefine the phrase in purely economic terms. The end result, according to Ithiel de Sola Pool, "can turn out to be

inappropriate to more habile forms of the technology which gradually emerge as the technology progresses. This is when problems arise, as they are arising so acutely today,"[44] especially in a context where the actual science of digital radio is considered more important as a means to justify the continuance of neoliberal regulatory ideology than as a mechanism to fundamentally improve the communicative aspects of the medium.

Institutionally, communications regulation in the United States occurs under burdensome constraints and pressure from several directions (constituents, Congress, and the courts). These impediments lead regulators to ignore or downplay actual public sentiment regarding the policies they promulgate - especially when the public attempts to assert a larger role in the policymaking process than regulators have already allowed for. Mark J. Braun has catalogued the "immense workloads and small staffs" that "contribute to a hectic FCC decision-making environment,"[45] which only becomes more turgid when policymaking becomes publicly controversial. Walter B. Emery calls the Commission's resources "pathetically inadequate,"[46] leading to policymaking done in an ad-hoc, typically conservative fashion, as the FCC attempts to placate all the groups that pressure it, rather than thinking proactively about the issue at hand.[47] These structural weaknesses in the FCC have led to a situation which former Commissioner Nicholas Johnson described as "a 'subgovernment' of industry lobbyists, specialty lawyers, trade associations, trade press, congressional subcommittee staff members, and commission personnel who dominate" the policymaking process.[48] The agency's practice of *ex parte* meetings, whereby constituents meet in person with regulators to discuss and decide policy issues, promotes regulatory capture. *Ex parte* conversations are a favored tool by which regulated industries manipulate the policy process to their own ends.[49] In a contemporary example, broadcast industry executives and lobbyists met behind closed doors with policymakers more than 200 times during the FCC's 2003 debate over the revision of media ownership rules; the agency ultimately promulgated policy in line with the desires of industry actors, even though 97% of public comment received on the issue vehemently opposed this outcome.[50]

Regulatory capture is also promoted by a reliance on regulated industries for information that directly dictates the trajectory of policy outcomes. The FCC's lack of meaningful, independent analytical ability has been in clear decline for more than 30 years.[51] Increasingly, the

agency accepts data collected by the industries it regulates and uses it to directly formulate policy.[52] If the data underlying a new policy favors a particular outcome, it is quite likely that such an outcome will result.[53] According to Philip Napoli, "On many points, commercial data collection and public policy needs fail to align. Commercial data is structured around the financial, investment, and marketing needs of media corporations and investors." Although the FCC conceivably "answers to a more complex concept of the public interest, which balances economic efficiency with concerns for equity, diversity, and constitutional rights,"[54] the end result of reliance on industry analysis from which to craft communications policy means that "the communications industry's social and political functions are diminishing in importance relative to its economic function in the eyes of the FCC."[55] Regulatory agencies simply cannot keep up with the industries they are charged with regulating. At the very moment when our "information society" requires both citizens and policymakers to be better-versed in the intricacies of the technologies which define their lives,[56] the FCC appears to be moving toward what Sandra Braman characterizes as "narrative simplicity, even as the data upon which state narratives are placed become more diverse and complex."[57]

Within the agency itself, the makeup of key management staff has gradually shifted away from people with legal or technical backgrounds to those with expertise in politics and economics.[58] This leads to the promulgation of regulation "without a sound empirical basis" that "contribute[s] to...inconsistency and ambiguity...in communications policy."[59] Former FCC Commissioner Jonathan Adelstein found the FCC's data collection process and decision cycle so devoid of actual facts that he dubbed the agency's activity "faith-based regulation."[60] Instances such as the FCC's 2003 media ownership rules review, according to Mark Cooper, were conducted without "any hint of intellectual or public policy integrity," and in recent years, when staff research has not meshed well with the political objectives of the FCC Chairman, it is suppressed outright.[61] When private interests trump the "public interest" and regulators can no longer can claim independence from the industries they ostensibly oversee, the process of regulatory capture occurs, and the FCC is undoubtedly a captured regulator.[62]

Where does the public fit in broadcast policymaking? Following the passage of the Communications Act of 1934, it was denied a formal voice in FCC proceedings until the

imposition of the Fairness Doctrine and subsequent judicial decisions which upheld the principle of public agency in the regulatory process.[63] Even so, there are many obstacles to obtaining data relevant to regulation, ranging from "opaque pricing structures and restrictive licenses for commercial data, to legal barriers to access, to the basic adversarial nature of contemporary communications policymaking" itself.[64] The public at large thus cannot afford to engage in the intensive level of policy discourse claimed to be required by the FCC.[65] Public interest groups have repeatedly tried to intervene in communications policy debates, but the FCC has no coherent way of dealing with such input. The treatment of public comment is left up to the discretion of FCC staff working on a particular issue and they are free to disregard it as they see fit.[66] Although electronic means of filing public comment now exist, FCC staff expect commenters to "do their homework," and are much more inclined to disregard comments if they arrive in the form of petitions.[67] Non-governmental "media reform" organizations may make "the public" more visible in the eyes of regulators, but that does not guarantee a policy outcome in the public interest.[68]

In the United States, the dominance of neoliberalism over all other ideologies in the process of radio regulation has deep roots. Robert McChesney, Susan Douglas, Mark Lloyd, Susan Smulyan, and Thomas Streeter all assert that critiques of capitalism were ill-considered during the formative years of radio policymaking,[69] even though this exclusion was openly contested along the way.[70] Public push-back against the initial commercialization of broadcasting, while spirited, ultimately failed, for a variety of reasons - the main one being its inability to compete with corporate capital.[71] The history of radio broadcasting, as McChesney puts it, "has the earmarks of a history written by the victors,"[72] as it casts the development of contemporary broadcast regulation as a natural process when it most definitely was not.

The historical highlights of neoliberalism's ascendancy in the context of radio policy dovetail well with the constitutive choices made about the medium's digital future. Douglas notes that the Radio Act of 1912 set a "watershed" precedent: "that only consolidated institutions...could anticipate, implement, and protect 'the people's' interest in spectrum use."[73] C. Twight implicates regulators with repeatedly and strategically distorting technical information

in order to pursue the implicit political-economic objectives of the Radio Act of 1927.[74] The Federal Radio Commission's first major policy action, the imposition of General Order 40, fundamentally skewed use of the airwaves toward commercial interests.[75] When allocating FM spectrum more than a decade later, the FCC would couch the move in terms of technicalities while obscuring the political-economic motives behind the action.[76] Most recently, the Telecommunications Act of 1996 "boldly equated the public interest with a competitive economic environment," put a heavy burden on regulators to justify their existence, and mandated they pare their powers back wherever economic interest may demand it.[77] McChesney now calls any idea of proactive broadcast regulation under current conditions a "living absurdity" and "tragicomedy," given that notions of public service by broadcasters, who are granted "government rights of scarce monopoly licenses," is almost wholly defined by commercial interests.[78] Public service as a measurable metric of regulatory action has fallen out of favor with the FCC, except in situations where such activities may serve to increase the monetization of broadcasting itself.[79] More than 30 years ago, Dallas Smythe contended that a neoliberal regulatory environment would not be good for the democratic potentiality of broadcasting;[80] his observations, unfortunately, have proven to be prescient.

Scholars have long asserted that intellectual property concerns controlled the technological development of radio,[81] and that such concerns left little "interpretative flexibility" in the formulation of broadcast policy.[82] Digital broadcasting in the United States involves wholly proprietary technology,[83] whose proliferation was sanctioned with little substantive discussion on the possible consequences of such a structure.[84] The story of radio's digitalization in many ways represents the capstone of a neoliberal communications policy goal defined by Nicholas Garnham as "a struggle to turn all information into private property and therefore a struggle of private profit rather than the claimed development of a system to provide information widely and cheaply to all."[85] In such an environment, the public is discouraged from participating in the policymaking process, ignored if it does, and generally notified of the outcomes after all constitutive choices have been made.[86] This belies the notion that any meaningful semblance of "public interest" in the literal sense of the phrase has any place in contemporary communications

policy, and explains the opaque and seemingly inchoate manner by which regulators fostered the development and proliferation of digital radio.[87]

The end result is a democratically dysfunctional communications policymaking regime; it is not a question of whether media policies will be made, but in whose interest.[88] The history of broadcast regulation does not paint a bright picture. It is already clear that the FCC's modus operandi often substitutes "the act of evaluating and studying a problem or policy for the act of actually dealing with a problem or making policy."[89] Several scholars have addressed this conundrum. Erwin Krasnow and Lawrence Longley postulate that "[l]egal and ideological symbols play a significant role in the process....Often stock phrases become cherished in and of themselves….Thus ideological concepts [become] symbols which [supersede] real actions in importance."[90] Sandra Braman comments that while policymakers may *think* they are designing rules and institutions using the language of facts, "their role in policy-making is more likely to belong to the rhetoric of decision-making processes rather than their content."[91] Dallas Smythe concurs in the explicit context of radio regulation, where "[t]he elements that make up a market simply do not exist on the broadcaster-program-audience axis. We are left therefore with metaphors - figures of speech, repeated by rote - that conceal the reality" of neoliberal influence on the policymaking process. [92] Philip Napoli observes that "the foundational principles of communications policy are used as rhetorical vessels to justify post hoc regulation, and typically do so from the point of view of dominant stakeholders in the process."[93] When applied to the case of digital radio, the inevitable dominance of neoliberalism on contemporary communications policy becomes painfully clear.

It does not have to be this way. In 1993, I began a seven-year career in commercial radio journalism, a field in which I worked full-time upon receiving my undergraduate degree in 1996. Nobody warned me about the implications the Telecommunications Act would have on my chosen vocation. The spasm of consolidation and cost-cutting unleashed within the radio industry hit the practice of journalism first and deepest; by 1999, as the assignment editor for a state radio news network, I literally listened to local radio newsrooms disappear as their existence conflicted with the maximal profitability of commercial broadcasting. By the end of 2000, I could not in good faith continue working in the world of commercial radio journalism.

During this period of alarm and introspection, I began reporting online about the proliferation of unlicensed or "pirate" radio stations in the United States; following the passage of the Telecom Act, pirate stations flourished as a movement of electronic civil disobedience against the neoliberal principles of broadcast regulation, most popularly identified as the evisceration of localism in radio. In 1998, the FCC accepted public petitions to create a noncommercial low-power FM (LPFM) community radio service. By 2000, the FCC had officially sanctioned the service, representing an historic first in media policy: the creation of radio stations facilitated directly by and for the public.[94] As a journalist, I wrote extensively about the evolution of LPFM; in the process, I explored the inner workings of the FCC's policymaking process. In my first iteration of graduate school, I produced a master's thesis about the legal history of unlicensed broadcasting in the United States and its connection to the creation of LPFM.[95]

I literally stumbled across references to digital radio in the process of writing my thesis, but it was not until 2002, when the FCC formally approved its proliferation, that I began to seriously assess the scope and importance of this development. Having started my graduate education with the goal of understanding how and why radio broadcasting has changed so much in such a short period of time, I complete my formal studies with new questions about the future of the medium. Instead of being treated as a substantive issue that stands to radically transform radio, digital broadcast policy has been reduced to a marketplace-paradigm heavy on metaphor but light on empiricism. According to McChesney, if "the critical question facing us is whether the new technologies can rejuvenate...political democracy or whether the corporate, commercial domination of...the communication industries will be able to subsume the technologies within the profit net and assure that the corporate domination of both U.S. society and the global political economy remain unquestioned and unchallenged,"[96] the case of digital radio points dramatically in the latter direction. Although "critical scholarship remains a minority phenomenon"[97] and substantive debate "regarding the control and structure of the media" may be difficult under such circumstances, when the future of radio broadcasting is at stake it is incumbent upon scholars to pay closer attention to the issue and learn lessons from the development of digital radio policy that may be applied to resist the neoliberal paradigm affecting our entire convergent media environment.[98] The solution to this problem is not the further diminution of regulation: it is the

reconfiguration of communications policy more firmly in line with democratic principles which, although they have been historically marginalized, do exist and deserve far more than lip service.

II. Using Dramaturgical Analysis to Probe Technology and Policy

To conduct a proper exploration of the technological and policy development of digital radio, the research methodology of dramaturgical analysis is useful. As the root word implies, dramaturgy is used to characterize an item or subject by certain performative aspects and provide context to the variety of factors which form the locus of a dramaturgical process. Dramaturgical analysis has existed in some form for hundreds of years,[99] but was first applied to the social sciences by sociologists and has been employed in various fields ranging from organizational management to media studies.[100]

Where many types of research methodologies focus on *texts*, dramaturgical analysis allows for the examination of the *actors* behind the texts, seeking to explain their actions in the context of a discursive process.[101] In this regard, dramaturgical analysis is useful because it allows the examination of the bonds between action and meaning.[102] While some scholars have limited the usefulness of dramaturgical analysis to the illustration of a "confrontation of villains and heroes in a staged spectacle," thinking of the methodology in such a manner is overly shallow.[103] With regard to policy studies, the understanding of the bond between action and meaning is key to critically and constructively analyzing the mechanisms by which policy is made. Dramaturgical analysis also provides an insight into the social and material logic of media texts and actors[104] and allows the construction of a conceptual framework within which practically useful conclusions can be derived.[105] Some scholars see this type of analysis as key to reclaiming any notion of democratic principles in contemporary U.S. policymaking.[106]

In the specific case of media policy, Jan Ekecrantz believes dramaturgical analysis is very effective in illuminating "intricate institutional and other power relations, which imbue them with meaning and constitute their *sine qua non* in the first place."[107] Under the neoliberal paradigm, "acting" done well is not seen as acting, but as reality itself.[108] In such an environment, one can never be sure "what is real or what is play," which calls into question the authenticity of actors and their performances.[109] The regulatory analyses of Sandra Braman, Erwin Krasnow and Lawrence Longley, Philip Napoli, Dallas Smythe and Thomas Streeter imply that much of what

passes for media policy is dramaturgical.

Sociologist Erving Goffman has been instrumental in opening up the utility of dramaturgical analysis to the social sciences more generally. Goffman provides a pragmatic approach to the application of the methodology:[110] "Meaning and performance may be seen as a continuous process of bargaining and temporary accommodation between individuals and groups. Order may be seen as that which is improvised, maintained and dissolved by the interpretation and actions of the social actors associated with it."[111] Actors do not simply "assert that their conceptions of the good or plans for the future are intrinsically superior to those of their fellow citizens. Positions must be secured by strong arguments, not merely by strong arms or strong credentials." Goffman-style dramaturgical analysis thus provides an excellent vehicle to observe the actions of power-maintenance in a modern neoliberal society.[112] It allows the powerful to advance ideas that are given "credibility relative to their standing," as well as providing "a generalized immunity to perceptions of risk and danger that their activities might otherwise produce."[113] In the context of digital radio policymaking, these two points are critical to understanding the process which led to such questionable outcomes for the future of the medium.

Much of the dramaturgy conducted in modern society involves the practice of rituals which Peter K. Manning argues can be distortionary to core notions of "truth" on which the structure of social power rests.[114] Such rituals can depress truth and sanction lies: power becomes synonymous with truth, whether or not "truth" actually exists.[115] According to Manning, "Rituals are in some sense an index of social power, because they close off and truncate complexity of meaning, challenging and flattening the response to the predictable, the acceptable, the sanctioned....Power collapses variety in meaning, authority stabilizes it."[116] In the maintenance of institutionalized trust, irony becomes a bellwether by which power may also be measured. Manning asserts that "[t]he higher the trust in the industry, the lower the level of information required and produced by the industry."[117] This diminished desire for information on which to construct media policy based on the assumed trustworthiness of actors can lead to ironic outcomes, many of which can be detrimental to society at large.[118]

Goffman-style dramaturgical analysis also explores the control of information by and between actors and the "audience." Power may be exercised by the "concealment of discrediting

information about actors and the gathering of intelligence about audiences. It means presenting performances which persuade audiences but hiding the planning and rehearsals of these performances."[119] In general, "powerful interests do not maintain their control as much by persuading us to believe them but, more often, by preventing us from knowing what they are doing."[120] This is a succinct descriptor of the history of U.S. communications policymaking, and of radio's digital transition more specifically.

In order to use Goffman's dramaturgical analysis as a tool to assess power relations within contemporary communications policymaking, it is important to define some key terms in his methodological framework.

Stages are the places where dramaturgical action takes place.[121] In Goffman's model, there are three stages on which dramaturgy occurs. "Onstage" is the forum where dramaturgy is played out in front of an audience. In the onstage environment, the characters, their perspectives, and rhetoric relative to the "plot" are apparently transparent. However, much of the practical negotiation of power between actors takes place elsewhere: "offstage" and "backstage." In the offstage environment, the realm of acceptable discourse may differ significantly from onstage, as actors converse in language not meant for the audience. Some, but not all, of the dramaturgy that takes place offstage is observable; actors use this lack of transparency to negotiate alliances that refine their onstage performances.

Knowledge of backstage activity, Goffman asserts, is crucial to understanding the power relations that an audience later observes. Whether onstage or offstage, actors must still behave "in character"; backstage, much may be set aside in order to construct or contest new power-relations. Backstage dramaturgy does not necessarily mean actors entirely "step out of character," but they are most likely to do so in this forum. This makes illuminating backstage dramaturgical behavior crucial to understanding public representations of power-sharing.

Goffman's practice of dramaturgical analysis also centers around the idea of metaphor. This word need not be taken literally; in fact, "metaphor" is more properly defined in this context as frames or agendas elucidated by actors backed up by rhetoric which may or may not be truthful. The main role of metaphor in dramaturgical analysis is to contest the definition of truth itself to fit the desires of any given actor and adjust the "plot" in a specific direction.

Traditionally, metaphor "acts as a compass, which serves to orient us." However, if the metaphor on which dramaturgical discourse occurs is not based on truth, it can alter the path of social development in an undemocratic fashion. Therefore, "we can become more aware of the powerful effects metaphors have on our thinking and behavior by focusing on and analyzing them."[122] Metaphors also act as interpretative shortcuts among actors in a dramaturgical setting. Shared understanding "become[s] the insider wisdom, the insider's sense of what's practical, interesting, and original and what's foolish, trivial, and outdated."[123]

In the case of this dissertation, Goffman's template of dramaturgical analysis is useful because it provides a conceptual framework that makes the communications policymaking process understandable to a larger audience and allows for the use of vernacular shortcuts which more easily explain what can sometimes be the impenetrable language of regulation.[124] Streeter notes that communications policymaking takes place in an interpretative community where shared meanings of certain metaphors are taken for granted, and there is ample evidence that such behavior does not produce the most rational outcomes.[125] In this context, the stages are realms for "experts, not for 'politics' in the broad sense of governance in a modern neoliberal society"; thus fundamental matters such as "value, structure and legitimacy" become difficult to debate and democratically refine.[126]

Applying dramaturgical analysis to the digital radio debate first requires definition of the main aspects of the template. *Onstage* is defined as the FCC fora in which public discussion over DAB policy occurs, such as periods of comment and reply-comment in rulemaking proceedings. In this arena, not only are all actors represented, but their metaphorical objectives are most clear to the audience, which has some level of agency (if only by voice) in the process. *Offstage* is defined as discourse that takes place in the industry trade press. Although the trade press is publicly available, very few members of the public are aware it exists, much less follow it regularly. Therefore, dramaturgy conducted offstage is often more frank and truthful than the actors' portrayal of their operative metaphors onstage, and can be useful for ferreting out the "truth" (or lack thereof) behind the behavior of actors involved in digital radio policymaking. *Backstage* is defined as *ex parte* discussions between actors involved in policymaking and regulators themselves. While *ex parte* discussions are ostensibly private, a summary of them

must be included in any active FCC docket. Examining backstage discourse helps to reveal the controlling metaphors of policy discussion and assess the relative power of the actors engaged in the onstage dramaturgy.

Secondly, the actors in the development and promulgation of digital radio must be defined. Of these, there are many, and to simplify matters actors are grouped into "character-constituencies" who share common metaphors,[127] which are classified as follows:

The FCC is both a stage and a character. As the keeper of the stage, the FCC is responsible for setting and maintaining the ground-rules of onstage discourse. At the same time, the FCC is an important arbiter of whether digital radio ultimately succeeds or fails, primarily through the imposition of constraints put on the introduction, proliferation, and maintenance of the technology. Perceived by other character-constituencies as the actor which retains final say over which metaphors will drive the policymaking process, the FCC engages in surprisingly little public dialogue, instead preferring to consider the words and deeds of preferred constituents in the dramaturgy in an attempt to promulgate what it believes to be the best policy, biased by its own historical and institutional understanding of radio regulation.

The Industry encompasses all corporate proponents of digital audio broadcasting. This includes iBiquity Digital Corporation, the technology's proprietor; the nation's largest broadcast conglomerates, all of whom are investors in iBiquity and collectively control the majority of radio industry revenues; the National Association of Broadcasters, which has worked to facilitate a metaphor of inevitability surrounding the adoption of digital radio; and application-development companies, who have expressed interest in the technology's convergent potential. Industry actors are the primary protagonists in the digital radio policy dramaturgy: they direct the "plot" toward an outcome most advantageous for them, and their operative metaphors about digital broadcasting are the ones against which the FCC judges all others.

Public Broadcasters differ from the industry in that their support of digital radio has been enthusiastic but historically qualified, due to the conflicting service objectives of commercial and public radio. As such, public broadcasters follow their own operative metaphors about what DAB may be useful for. In some instances, these metaphors are at cross-purposes to the industry's, though public broadcasters remain useful ancillary protagonists in their support of the industry's chosen digital radio technology and were instrumental in advancing it through the

regulatory gauntlet by manipulating the institutional credibility they have with policymakers.

Independent Broadcasters are defined as any owner, engineer, or staff member of a radio station not directly affiliated with the technology's proprietors. They are strong antagonists in the policy dramaturgy. Although independent broadcasters represent the majority of radio stations in the United States, they deploy strong oppositional metaphors to define the future of radio and engage in the most contentious dialogue regarding its digitalization.

Consulting Engineers are broadcast-certified scientists not employed by a single station or broadcast conglomerate. Initially, they worked to concretize the industry's operative metaphors about digital radio, but later openly questioned its technical viability. They are also predisposed to define "truth" in forward terms which leave little room for irony and deception.

Electronics Manufacturers include the makers of broadcast transmission and reception equipment, the trade association that represents them (the Consumer Electronics Association), as well as end-users of such components, such as automobile manufacturers. One might think that electronics manufacturers would be closely aligned with the broadcast industry on the issue of digital radio, but instead they portray a justifiable reticence to its adoption. This makes electronics manufacturers another important antagonist within the policy dramaturgy, albeit defined more by inaction than action.

The Public plays an important role in the digital radio dramaturgy. It includes two sub-constituencies: individual citizens with the knowledge and desire to participate in the policymaking process directly, and nonprofit groups who intervene in issues of communications policy on behalf of the public. Much like independent broadcasters, the public advances oppositional metaphors about the future of radio based upon their practical use of the medium.

Finally, it is important to lay out the dominant metaphors which have controlled the digital radio policy debate. They are surprisingly few in number, and in some cases contradictory.

The dominant operative metaphor is that *it is inevitable that radio become a digital medium*. Stemming from industry anxiety about convergence, as well as an institutional orientation within the FCC to embrace new technologies without a full understanding of their implications, cementing this metaphor early on as foundational to subsequent policy development was of the utmost importance. Secondly, *digital radio need not be significantly*

superior to its analog equivalent. Why this must be so is directly related to the form of DAB technology preferred by the broadcast industry, which essentially does not have the capability to do much more than digitize a station's preexisting analog signal. The obvious question of adopting a digital service that has no qualitative superiority over its analog counterpart is ignored by the protagonists and regulators in the policy debate. Relatedly, *sacrifices must be readily made to analog radio service in order to introduce digital broadcasting*. This is the most contentious metaphor in the dramaturgy because it hints at the potentially disruptive nature of digital radio technology and makes the premature assumption that there is little value left in analog broadcasting.

How these metaphors are employed by the various character-constituencies provides for feisty policy discourse, though ultimately the outcome of the FCC's digital radio deliberations was preordained due to the overarching influence of neoliberalism on the regulatory paradigm, which predisposes favoring the perspectives of certain character-constituencies over others. Employing these metaphors involved a tortuous process where disagreements over the fundamental meaning of key words and terms were contested, brought into compromise, or dismissed.

Dramaturgical analysis can serve a powerful purpose in the study of emergent communications policy.[128] Sue Curry Jansen believes that a "semantic rescue mission" is urgently required to create a language, especially within our media environment, that favors democratic discourse over words "taken...hostage" by existing holders of power.[129] The dramaturgical exploration of media policy is an effective method by which to facilitate and sustain this process.

III. Dissertation Source Materials

In order to conduct a dramaturgical analysis of digital radio's development and proliferation, several primary and secondary sources are utilized. Since digital radio has received scant attention from media scholars, there is little direct academic foundation from which to start. Thus it is necessary to examine the entirety of the dramaturgy that is directly germane to the digital radio policymaking process itself. This information spans more than 20 years.

The primary sources for this dissertation are the FCC's Notice of Proposed Rulemaking on digital terrestrial radio (RM-9395) and the rulemaking itself (Mass Media Bureau Docket 99-

325). The former was promulgated in November of 1998; the latter was published for public comment on November 1, 1999. Both dockets contain the entire archive of comments filed by all character-constituencies, as well as subsequent FCC orders that have been promulgated to foster digital radio's adoption. The entire archive of both proceedings is available online via the agency's Electronic Comment Filing System;[130] all filings are chronologically ordered, though the ECFS allows for searches along a variety of themes such as date, identity of filer, and type of correspondence. For this dissertation, the entire record of comments, reply comments, notices, letters, and policy documents filed in RM-9395 and MM 99-325 were collected and analyzed. As of December 31, 2010 there are more than 1,450 individual filings between the two proceedings.

Not all FCC filings are created equal. Uniformly archived as PDF documents, the length of filings can vary widely, from a single-paragraph comment submitted by a member of the public to 700+ page technical documents filed by the industry. After removing duplicate and corrupted documents, the number of useful filings in the dockets is closer to 1,300. More than 85% were used directly in the construction of this dissertation. The cumulative size of the FCC's archive of digital radio policymaking documentation is not easily quantifiable, but is estimated to range in the thousands of pages of material. These filings directly elucidate the onstage performance of actors in the policy dramaturgy and provide a revealing glimpse into their backstage behavior. This gives a clear picture of the motivations of character-constituents and is extremely important in scrutinizing the operative metaphors that have controlled (or conflicted with) policy outcomes.

In addition, two archives of secondary source material are utilized; both are trade publications. *Radio World* is the preeminent industry newspaper for broadcast station owners, managers, and engineers.[131] Published biweekly, each 50-page issue provides an excellent forum in which to observe the offstage behavior of character-constituents directly related to the radio industry, whether they are protagonists or antagonists in the policy dramaturgy. Although *Radio World* relies wholly on industry advertising for support and thus displays an editorial bias in favor of industry desires, the publication's change in tenor over time with regard to digital radio can be clearly mapped; it has enough integrity to openly welcome opposing points of view, thus making for a useful lens through which to observe how various character-consituents debated the

operative metaphors of digital radio policymaking offstage. *Radio World* served to supplement many official FCC filings with more candid assessments of digital radio technology and its prognosis for success. A trip to the Library of Congress allowed for the reading of more than 300 issues of *Radio World*, covering the start of the intra-industry DAB conversation (1988) through to the present state of affairs (ending in April 2010).

Similarly, the trade publication for public radio, *Current*, was examined to glean information on the offstage dialogue of noncommercial broadcasters.[132] *Current* is also published biweekly, and its archives were reviewed through the same timeframe as was *Radio World*. *Current* is a smaller publication, with each issue comprising between 20 and 30 pages. Once all research materials were centrally collected and organized, the distillation/analysis process began; this resulted in approximately 900 pages of refined research material from which this dissertation draws.

IV. Chapter Synopses

Chapter 1 describes the theoretical and methodological underpinnings of this dissertation, as well the source material from which it is constructed. Chapter 2 charts the initial developmental trajectory of U.S. digital radio broadcasting. Covering a timeline between 1988 and 1998, the chapter summarizes the offstage discussion that took place before the FCC became directly involved with the DAB issue. During this phase, definable character-constituencies began to congeal, focused around three pivotal moments in the decade: the consideration and discarding of non-domestic forms of DAB technology; the imposition of the Telecommunications Act of 1996 and its effects on the radio industry's digital broadcast objectives; and the formal commencement of an FCC rulemaking on the subject. Surprisingly, this period illustrates deep-seated disagreement between various character-constituents, both about the necessity for and viability of digital radio broadcasting itself. These early schisms, and their subsequent fallout, would significantly affect how the policy dramaturgy would evolve.

Chapter 3 provides a critical overview of the fundamental detriments of U.S. digital radio technology. This critique is boiled down into three main categories. The first involves spectral integrity: the mixing of analog and digital radio signals on the AM and FM dials not only favors the property rights of incumbent broadcasters, but has the demonstrated potential to degrade existing analog broadcast service. The second critique involves bandwidth capacity: unlike

newer forms of digital broadcast technologies such as satellite radio, digital television, and webcasting, terrestrial radio is not endowed with a new distribution channel to exploit. Although the designers of U.S. DAB technology proclaim it can be used to provide a panoply of new services, in reality this is untrue: digital radio broadcasting neither extends the medium's communicative effectiveness nor provides it with a useful vector into a convergent media environment. Finally, the wholly proprietary nature of the U.S. digital radio standard is explained. One private corporation, iBiquity Digital, controls all the patents for the transmission and reception of domestic DAB signals. Openly likening its business model to Microsoft, iBiquity envisions a future where two licenses will be required by broadcasters: one from the FCC for the use of broadcast spectrum, and another from iBiquity for the permission to transmit digitally. Not only does this represent a significant shift in the gatekeeper-function of the FCC itself, but a closed system stifles innovation and inflates adoption costs for both the radio broadcaster and listener.

Chapter 4 begins the dramaturgical analysis of the FCC's digital radio rulemaking in earnest. Protagonists begin to deploy, refine, and buttress their operative metaphors, while antagonists conduct a thorough and critical analysis of the shortcomings of the U.S. DAB system. Irrespective of a lack of substantive, impartial, and independent testing of the technology, coupled with a concerted effort of backstage lobbying by its protagonists at the FCC, regulators approved the deployment of digital radio in 2002, even though little was known about its inner workings and implications for analog broadcasting. This speaks volumes to the relative disengagement of the FCC in the DAB development and testing process and the power of neoliberal ideology in the adoption of new communications technology and policy.

Chapter 5 chronicles the initial rollout of digital radio in the United States. During this period, serious technical faults are found with DAB technology when deployed in the real world; this generates a flurry of offstage discussion about whether or not digitalization is actually good for the medium itself. Independent broadcasters, members of the public, and consulting engineers all bring forth compelling evidence of digital radio's fundamental detriments. Offstage, broadcast engineers and electronics manufacturers debate the validity of the industry's operative metaphors; some radio stations who were early-adopters of DAB abandon their digital signals. Protagonists work furiously to engineer fixes to the multiple problems of the technology

identified "in the wild"; they petition the FCC not to intervene, trusting marketplace innovation to assuage all concerns. As a result, regulators approve further rules governing digital radio deployment which *loosen* restrictions on its proliferation and exacerbate its real-world consequences.

Chapter 6 ends the dramaturgical analysis and reviews the current state of U.S. digital radio. The number of DAB-capable stations on the air has stagnated. Transmitter manufacturers lament little to no demand for digital radio equipment; consumer electronics companies, reticent about the technology's development from the outset, do not help matters by refusing to mass-produce compatible receivers. As a result, the term "digital radio" itself begins to evolve, now encompassing other radio-like services such as portable digital music players, satellite radio and streaming via wireless broadband. The detrimental attributes of digital radio signals cause consumer confusion and consternation. In effect, radio broadcasting stands to diminish its importance as a mass medium by ceding a tried-and-proven distribution method for one which disincentivises terrestrial radio listening. The end result, dramaturgically speaking, is a tragedy leavened with farce: DAB's protagonists truly believed they were charting a clear course toward entre into a convergent media environment when, in effect, their efforts may actually lead to the obsolescence of legacy radio broadcasting. The farce comes from the fact that the operative metaphors on which digital radio policy are based clearly have no solid technical foundation, although all of its proponents (including the FCC) still believe they do.

Chapter 7 examines digital radio in a global context. The United States was not the first to explore digital broadcasting, and many countries have adopted DAB technologies vastly different from the U.S. model. Irrespective of this, however, there is compelling evidence to suggest that the failure of digital radio is a technologically-agnostic phenomenon fostered by broadcast policies that are universally neoliberal in orientation. Countries that began their efforts at digital radio policymaking long before the United States are now in the process of reevaluating their activities; DAB transmitters are being turned off as they have captured little to no audience share; and radio listeners, regardless of nationality, are similarly confused as to why regulators look to degrade or replace a medium which has worked well for so many decades with something inferior and more expensive to receive. Further research on this worldwide phenomenon is absolutely necessary to get a grasp on what the future of digital radio (regardless

of its form) portends.

The concluding chapter highlights the weakness of substance on which digital radio policies are based, offers lessons from the story of digital radio that may be useful in the broader world of convergent media policy, and contemplates the future of radio broadcasting following the potential failure of its chosen mechanisms of digitalization. Antagonistic actors in the dramaturgy repeatedly assert that it is not the means by which radio is delivered that counts; it is the content it provides. Digital radio essentially forfeits many of the attributes which made the medium historically unique, which marginalizes its utility in the eyes of the public and opens up the identity of radio itself to contestation. A potential outcome of radio's digital transition is perhaps not to have one at all; were that to occur regulators might wholly reconsider the relative importance of radio in a 21st century media environment, as well as the primacy of neoliberal principles which have led to such confusing and potentially deleterious outcomes regarding convergent media policies more generally. Such deliberation would undoubtedly invite further developments that complicate the challenge to radio's identity. For those who still find value in radio broadcasting, it is not the concept of the medium that needs reclamation, but its purpose.

Notes to Chapter 1

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69. See Mark Lloyd, *Prologue to a Farce: Communication and Democracy in America* (Urbana: University of Illinois Press, 2006), p. 119; Robert W. McChesney, *The Problem of the Media: U.S. Communication Politics in the Twenty-First Century* (New York: Monthly Review Press, 2004), p. 47, 226; McChesney, *Telecommunications, Mass Media, and Democracy,* p. 10, 264-265; Susan Smulyan, *Selling Radio: The Commercialization of American Broadcasting, 1920-1934* (Washington, D.C.: Smithsonian Institution Press, 1994), p. 6, 162, 166; and Streeter, p. 37.

70. See Patricia Aufderheide, *Communications Policy and the Public Interest: The Telecommunications Act of 1996* (New York: Guilford Press, 1999), p. 8; McChesney, *Telecommunications, Mass Media, and Democracy,* p. 92-187, 196-225, 261; Smulyan, p. 1; and Streeter, p. 275.

71. See McChesney, *Rich Media, Poor Democracy,* p. 125-126; Mills, p. 247-248; Smulyan, p. 69-70; and Streeter, p. 39.

72. McChesney, *The Political Economy of the Media,* p. 179.

73. Susan J. Douglas, *Inventing American Broadcasting, 1899-1922* (Baltimore: Johns Hopkins University Press, 1987), p. 236-237.

74. C. Twight, "What Congressmen Knew and When They Knew It: Further Evidence on the Origins of U.S. Broadcasting Regulation," *Public Choice*, vol. 95, no. 3/4 (1998), p. 269-271.

75. See McChesney, *Telecommunications, Mass Media, and Democracy*, p. 29, 255, and Starr, p. 349, 351.

76. Hugh Richard Slotten, "Rainbow in the Sky: FM Radio, Technical Superiority, and Regulatory Decision-Making," *Technology & Culture*, vol. 37, no. 4 (October 1996), p. 709.

77. See Aufderheide, p. 61, 105-106, and Patricia Aufderheide, "Shifting Policy Paradigms and the Public Interest in the U.S. Telecommunications Act of 1996," *The Communication Review*, vol. 2, no. 2 (1997), p. 272, 274-275.

78. See McChesney, "Forward," in Hilliard & Keith, p. x, and McChesney, *The Problem of the Media*, p. 45.

79. Hakanen, p. 12.

80. Dallas W. Smythe, "Radio: Deregulation and the Relation of the Private and Public Sectors," *Journal of Communication*, vol. 32, no. 1 (Winter 1982), p. 200.

81. See Id., p. xix, and Daniel J. Czitrom, "The Ethereal Hearth: American Radio from Wireless Through Broadcasting, 1892-1940," in *Media and the American Mind: From Morse to McLuahan* (Chapel Hill: University of North Carolina Press, 1982), p. 70.

82. Randall Patnode, "Path Not Taken: Wired Wireless and Broadcasting in the 1920s," *Journal of Broadcasting & Electronic Media*, vol. 49, no. 4 (2005), p. 397.

83. Anderson, p. 15.

84. Lawrence Lessig, *Free Culture: How Big Media Uses Technology and the Law to Lock Down Culture and Control Creativity* (New York: Penguin, 2004), p. 12.

85. Garnham, p. 127.

86. Nicholas Garnham, "Information Society Theory As Ideology: A Critique," *Studies in Communication Sciences*, vol. 1 (2001), p. 164.

87. See Gandy, p. 8, and Streeter, p. xi-xii, xv.

88. McChesney, *The Political Economy of the Media*, p. 452.

89. Krasnow and Longley, p. 26.

90. Id., p. 81.

91. Braman, p. 325.

92. Smythe, p. 197.

93. Napoli, p. 226.

94. See Andrew Opel, *Micro radio and the FCC: media activism and the struggle over broadcast policy* (Westport, CT: Praeger, 2004).

95. John Anderson, *A Can of Worms: Pirate Radio and Public Intransigence on the Public Airwaves* (Madison, WI: unpublished master's thesis, University of Wisconsin-Madison, 2004), available online at http://diymedia.net/stuff/acanofworms.pdf (January 2, 2011).

96. Id, p. 235.

97. McChesney, *The Political Economy of the Media*, p. 353.

98. Id., p. 350.

99. Iain L. Mangham, "Via Contemplativa: The Drama of Organizational Life," *Organization Studies*, vol. 26, no. 6 (2005), p. 956.

100. Jan Ekecrantz, "Collective Textual Action: Discourse, Representation, Dramaturgy and Public Interaction in the Media Sphere," *Nordicom Review*, vol. 18, no. 2 (Nov. 1997), p. 22.

101. See Peter M. Hall, "Asymmetry, Information Control, and Information Technology," in David R. Maines and Carl J. Couch, eds., *Communication and Social Structure* (Springfield, IL: Charles C. Thomas, 1988), p. 355; Ekecrantz, p. 21; and Dan Kärreman, "The Scripted Organization: Dramaturgy from Burke to Baudrillard," in Robert Westwood and Stephen Linstead, eds., *The Language of Organization* (London: Sage, 2001), p. 108.

102. Bruce E. Gronbeck, "Symbolic Interactionism and Communication Studies: Prolegomena to Future Research," in David R. Maines and Carl J. Couch, eds., *Communication and Social Structure* (Springfield, IL: Charles C. Thomas, 1988), p. 328..

103. Ekecrantz, p. 32.

104. Terje Rasmussen, "Social Interaction and the New Media: The Construction of Communicative Contexts," *Nordicom Review*, vol. 18, no. 2 (Nov. 1997), p. 64-65.

105. Ekecrantz, p. 23, 38.

106. See Sue Curry Jansen, *Censorship: The Knot That Binds Power and Knowledge* (New York: Oxford University Press, 1988), p. 20, 195-197; Joel O. Powell, "Diplomatic Discourse and the Process of Negotiation," in Maines and Couch, p. 285-287; and Hall, p. 349.

107. Ekecrantz, p. 38.

108. David M. Boje, John T. Luhman, & Ann L. Cunliffe, "A Dialectic Perspective on the Organization Theatre Metaphor," *American Communication Journal*, Volume 6., Issue 2 (Winter 2003), p. 3.

109. Id., p. 4.

110. See Erving Goffman, *The Presentation of Self in Everyday Life* (New York: Doubleday, 1958), and Erving Goffman, *Frame Analysis* (New York, NY: Harper Books, 1974).

111. Mangham, p. 948.

112. See Jansen., p. 210; Mangham, p. 948; Peter K. Manning, "The Truthfulness of Organizational Communication," in Maines and Couch, p. 98; and Hall, p. 350..

113. Manning, p. 101.

114. Id., p. 106.

115. Id., p. 107

116. Id., p. 104.

117. Id., p. 109.

118. Powell, p. 297.

119. Hall, p. 343.

120. Id., p. 350-351.

121. Kärreman, p. 92-93.

122. Joy Hart, "Organizational Orienteering: Charting the Terrain," *American Communication Journal*, vol. 6., iss. 2 (Winter 2003), p. 1.

123. Streeter, p. 144.

124. Kärreman, p. 107.

125. Streeter, p. 114.

126. Id., p. 128, 148.

127. Only the major characters in the dramaturgy are represented here. Others, like the recording industry, make "cameo" appearances, but are not substantive to the ultimate formation of DAB policy. In addition, while it is possible to identify character-constituents, they are not homogenous masses; individual characters within a constituency may disagree with the metaphorical orientation of the actors which represent them, but these instances are relatively few and minor.

128. Jansen, p. 26.

129. Id., p. 5.

130. To examine the docket of MM 99-325, visit http://fjallfoss.fcc.gov/ecfs/comment_search/; click the link to remove the date restriction, and type "99-325" or "RM-9395" (without quotes) into the "Proceeding" field.

131. *Radio World* also publishes a significant amount of content online at http://www.rwonline.com/ (September 19, 2010).

132. *Current* also publishes online; see http://www.current.org/ (September 19, 2010).

Chapter 2: The Developmental Trajectory of U.S. Digital Radio

During the 1990s, the character-constituencies that would ultimately promulgate digital audio broadcasting in the United States began to crystallize. At first, U.S. broadcasters tentatively agreed to adopt the same DAB technology as the rest of the industrialized world; however, reticence among regulators to allocate new spectrum necessary for the promulgation of DAB service effectively forced broadcasters to invent a wholly new technology that could deployed on the existing AM and FM bands. As research into "in-band" DAB technology progressed, the broadcast industry supported certain developers not on the merits of their research, but based upon who financed the work. Two major developers of in-band DAB technology would emerge, but only one would be selected as the U.S. standard. Not surprisingly, the DAB developer with the most ties to the broadcast industry ended up gaining the upper hand.

The Federal Communications Commission was wholly uninvolved in the intra-industry debate over digital radio development and did nothing during the decade to constructively advance the issue. Had regulators been actively engaged in the early stages of DAB research, there might have been a real possibility that the technology which the industry ultimately put forth for approval would represent a significant advancement in radio broadcasting more broadly; instead, the FCC allowed incumbent broadcasters to develop a DAB system which served their economic needs first and effectively ignored all other metrics by which to judge the technology's actual viability.

Early prognostications about what DAB would be had no basis in empiricism: by the time the FCC was presented with a DAB technology framework, its proprietors had only proven that the simultaneous transmission of both analog and digital radio signals were possible. During the early stages of DAB research, broadcasters identified satellite radio as the primary competitive threat that would eat away at their listening audiences and, in turn, cut into their revenue streams. They were obsessed with the fact that satellite radio would be digital from its inception while terrestrial radio remained analog. Thus, broadcasters' desire for digital radio was based around the concept of digitalization itself, not around any tangible benefits that digitalization would provide.

This created an important early schism between two constituencies necessary for the

successful adoption of any digital radio technology - broadcasters and receiver manufacturers. In a nutshell, broadcasters saw their eventual digitalization as necessary to compete with other forms of digital audio distribution, of which satellite radio was the first and only recognizable "threat" to the industry during the time of DAB development. However, manufacturers of radio receivers did not support the concept of in-band DAB and wanted the U.S. radio industry to adopt the global DAB standard; the former would require electronics manufacturers to develop and produce entirely new radio receivers for the domestic market, while the latter would have allowed the production and marketing of existing digital receiver technology. Given the chimerical nature of in-band DAB's supposed "improvements" to terrestrial radio, electronics manufacturers tried repeatedly throughout the decade to advance the notion of a global DAB standard while broadcasters placed priority on a technology that, while unproven, would give them firm control over the pace and principles of any digital transition.

The pre-policy dramaturgy of DAB is archived in the trade press. Since the FCC would not be formally engaged in the digital radio transition until 1998, the work of the decade - and its rationalization - would first be debated within *Radio World* and *Current*. Both cater to specific constituencies within the broadcast industry - commercial and public broadcasters. As such, those constituencies which assumed positions of dominance within the pre-policy dramaturgy were awarded this power by dint of being the target audiences of the publications that most thoroughly covered the DAB development process. In the case of *Radio World*, its coverage would focus on the companies working to develop in-band DAB technology and the sentiments among commercial broadcasters about which developer seemed to offer the most profitable and least disruptive method by which radio stations could digitize their signals. *Radio World* also extensively covered the period of trial-and-error that occurred during the early days of DAB development, but always from the perspective of unarticulated "progress," defined within the operative metaphor of "digital equals better." Problems that developed during the in-band DAB development process were characterized as growing pains, as opposed to possible red flags that in-band DAB technology could not realistically provide broadcasters with a robust analog-to-digital transition path.

Current, the trade publication of public broadcasters, played up the role of public radio as an innovator within the in-band DAB space; in fact, claims about the technology's functionality

were more grandiose in *Current* then they were in *Radio World*. Part of this may be explained by actors within the public radio environment seeking to achieve a place of primacy within the DAB development process; as it became clear over the decade that a commercial broadcaster-endorsed DAB technology would prevail, public broadcasters focused primarily on preventing the marginalization of public broadcasters on the digital radio issue more generally. Both commercial and noncommercial broadcasters made unsubstantiated claims about in-band DAB's utility, but these were tendered as part of a larger strategic effort to position constituencies with agency during the development process and subsequent FCC rulemaking on terrestrial digital radio.

I. Premature Consensus in the Face of Satellite Radio

On August 1, 1986, public radio broadcaster WGBH-FM in Boston successfully simulcast its programming over a digital sideband adjacent to WGBH-TV's analog signal. Although details of the experiment are unclear, it represented the first documented instance of a U.S. radio station making a tentative foray into the world of digital audio broadcasting.[1] The test had no significance beyond proving the theory that digital audio could be transmitted as its own unique data stream. Other than this single test, the U.S. radio broadcast industry was yet not oriented toward actively pursuing a digital radio transition when the FCC first raised the issue in 1990 as part of a wide-ranging proceeding on the digitization of radio.[2] The rulemaking was designed to explore and facilitate various forms of digital broadcasting; primarily, it was focused around the creation of a new satellite-delivered digital audio radio service (SDARS) but also left open the possibility for setting fundamental ground-rules regarding the development of terrestrial DAB.

In reaction to the FCC's rulemaking, the industry's first step was to convene a private working group of commercial and public broadcasters to contemplate U.S. radio's digital future. Mike Starling, one of NPR's top engineering experts, co-chaired this initiative. The group sponsored a seminar for U.S. and European broadcasters to discuss terrestrial DAB;[3] by the end of 1990, Starling would claim that "from all indications, [the adoption of a terrestrial DAB standard] is on the fast track at the FCC."[4] John Wilner, a staff writer for *Current*, explained the importance of NPR taking an early leadership role in DAB development: "In an effort to avoid

the mistakes of the 1920s, when what was then called 'educational' radio was tacked onto the nascent commercial broadcasting system as an afterthought, NPR and other public radio organizations are eager to secure a position in the digital movement." Said Starling, "Our support for [DAB] has really been based on positioning public radio so that we can take advantage of it and participate in it. The only way to compete with those people is to become one of them."[5] Public radio, as a constituency within the U.S. broadcast industry, was the first to actively drive thinking about innovation within the DAB space, but not because of the technology's inherent possibilities; rather, public broadcasters sought a place within the DAB development process that would give them an element of control over the technology's creation in such a way as to minimize their own potential marginalization in the face of a transition which they recognized would be driven by commercial broadcasters.

Initially, the U.S. broadcast industry seemed prepared to adopt the apparent global standard of DAB, then known as Eureka 147, and the National Association of Broadcasters formally passed a resolution pursuing further domestic study and development of Eureka at its annual convention in January of 1991.[6] The Eureka system was conceived in 1981 by a German-based consortium, with research and development assistance from the country's corporate sector and several European public-service broadcast agencies.[7] Notably, Eureka 147 DAB worked on swaths of spectrum not traditionally allocated to radio broadcasting at the time. Initial testing of the Eureka system began in 1985 and was formalized in 1986; its first field demonstration took place in Geneva, Switzerland in 1988.[8] As development of the technology matured, the capabilities of the Eureka 147 system became better known.

Unlike traditional, terrestrial analog broadcasting, the Eureka 147 system is designed around the use of "multiplexes," or single transmitters which occupy an entire range of spectrum in a given geographic area. "Stations" were offered slices, or "channels," of spectrum available on a multiplex. These channels provided each station with the capability of delivering a high-quality audio stream or the option of carving up its channel into multiple program streams, some of which might be audio, others which might provide any content capable of digital conveyance. Eureka 147 also had the benefit of being cross-compatible with other digital media distribution networks; its data-stream could be carried by satellite and across cable networks where point-to-

point, over-the-air terrestrial extension of a multiplex proved infeasible.[9]

System specifications for the Eureka 147 system were finalized in 1994, and the International Telecommunication Union (ITU) recommended it as a global DAB standard the same year.[10] EuroDAB, a collective effort to cement Eureka 147 as the pan-European standard, was launched in 1995.[11] The British Broadcasting Corporation and Swedish Broadcasting Corporation launched the first full-time DAB services in September of 1995;[12] other countries, within Europe and beyond, began active pilot projects involving both digital audio and datacasting using the Eureka platform.[13] After lining up the commitment of several broadcasters and receiver manufacturers,[14] Canada formally adopted the Eureka system;[15] its transition was driven by the expectation of the "value added services," such as datacasting, that DAB might bring to the broadcast marketplace.[16] By 1997, the Eureka system was considered "a de facto standard in Europe, Canada, Mexico, and many other countries";[17] the president of EuroDAB, David Witherow, confidently predicted that Eureka 147 was "on its way to becoming - if it is not already - a world standard for digital radio."[18]

As the U.S. broadcast industry began thinking about digitalization, it first set general service goals for any proposed DAB technology. These coalesced into six "performance and service objectives": "compact-disk quality sound, immunity from multipath and other interference, no objectionable interference with other services, minimization of transmission costs as well as reception complexity and costs, additional data capacity, and degradation at the reception threshold with a minimum of objectionable artifacts."[19] At the time, Eureka 147 was the only DAB system in existence which could address all of these criteria.[20] A live demonstration of the Eureka technology at the National Association of Broadcasters' annual conference in 1991 received an enthusiastic response and led to the organization's formal endorsement.[21]

Since the Eureka system used spectrum not allocated for broadcasting, the U.S. radio industry and FCC examined the availability of such spectrum domestically. At the time, the frequencies on which the Eureka system could be deployed were in geographically-sporadic but systematic use for military applications like flight- and missile-test telemetry.[22] Within two

months of the NAB's passage of its resolution endorsing Eureka 147, the Pentagon formally objected to the Department of Commerce's National Telecommunications and Information Administration (NTIA) - the regulator of all government-used spectrum - about appropriating that spectrum for digital broadcasting.[23] A short but intense flurry of lobbying ensued; the FCC suggested three other patches of spectrum for terrestrial DAB using Eureka 147 technology, but all were shot down by the NTIA.[24] An attempt to legislatively force a spectrum set-aside, mostly carried forth by public broadcasters, also failed in Congress.[25]

By January of 1992 the radio industry realized it did not have the political muscle to wrest new spectrum from the Pentagon, and the FCC seemed unwilling to force the issue on its behalf. This resulted in the effective abandonment of *any* form of alternate-band digital audio broadcasting in the United States.[26] Seeing no immediate alternative to Eureka on the horizon, and noting that industry consensus around a DAB technology died with the banishment of Eureka in the United States, the FCC separated (and effectively terminated) its terrestrial DAB proceeding.[27] Its rulemaking now focused solely on SDARS, from which the Sirius XM satellite radio service is its final result.[28] This provoked much the consternation of the radio industry,[29] which viewed the proposed launch of SDARS later in the decade as a make-or-break deadline by which terrestrial broadcasters also needed to go digital.[30] By detaching the development of digital terrestrial radio from its larger digital radio rulemaking, the FCC effectively ceded control over DAB development to broadcasters exclusively.

The looming rise of satellite radio worried broadcasters in two identifiable ways. SDARS promised increased programming choice, which the radio industry feared would entice listeners away from their stations. Less listeners would translate into lower station ratings and a concomitant depression in advertising rates, thereby fiscally weakening the entire broadcast industry. Secondly, SDARS would be a fully-digital service, and the working assumption at the time was that digital satellite broadcasts would provide programming at a higher audio quality than traditional analog AM and FM stations were capable of. Although both of these assumptions had no empirical evidence to support them at the time, and a fundamental access distinction existed between terrestrial and satellite radio - the latter would require a monthly subscription by listeners, while the former was free to anyone with a receiver - these attributes

were considered threatening enough to force the U.S. broadcast industry to begin its own DAB research and development initiatives. Since Eureka 147 was the only DAB system in existence at the time, the industry would have to create its own from whole cloth.

II. "Coming to Grips" With In-band DAB

Although the Eureka 147 system had been endorsed by the NAB, it did not have the unanimous support of its membership. Not only would the process of multiplexing harmonize the transmission power (and resultant coverage area) of all competing stations in a market, but broadcasters feared "a marketer's nightmare" in trying to educate the listening public about any alternate-band transition.[31] Therefore, the fear of new competition in a multiplexed DAB environment probably played as much of a role in quashing the notion of alternate-band DAB in the United States as did the military and NTIA's opposition.[32] Indeed, there were some corporations, like Westinghouse, which had interests in both broadcasting and the military; Westinghouse had invested millions of dollars in avionics infrastructure that used spectrum now proposed for digital broadcasting.[33] The appearance of an intra-broadcaster division this early into the DAB development project would plague the U.S. radio industry for nearly a decade. There is also evidence that the NAB made the decision to endorse Eureka 147 out of self-interest: under the tentative agreement reached (but never ratified) by the NAB and the Eureka 147 consortium, the NAB would have "developed plans for the association's profit-making arm to license the technology to American stations for a fee." This would have been a radically new role for a trade association that ostensibly worked to increase the overall economic health of its membership.[34]

The record also shows that, from the outset, the U.S. radio industry had not put all of its eggs in the Eureka basket. An alternative to Eureka, code-named "Project Acorn," was originally founded by Westinghouse in 1989. Having started as a relatively informal science experiment, over the next two years the Gannett Corporation and CBS Radio would officially join the venture, while public radio executives and engineers also signed on to the effort. Project Acorn was an attempt to develop an "in-band" DAB system - one where analog and digital signals would coexist on the traditional AM and FM broadcast bands. This would solve the problem of needing to move all stations to new spectrum; maintain the variable coverage of stations under

existing FCC allocation rules; and, most of all, protect incumbents' investments in the existing radio broadcast marketplace.[35] Technically speaking, it was a task previously considered impossible without harming existing analog radio service. The conundrum boils down to one of the most fundamental rules of radio-frequency physics: if you add new RF energy into an area of spectrum already occupied, interference is bound to result. Nevertheless, in-band DAB would be officially endorsed as public radio's preferred digital transition plan in a CPB study released in 1993; it expected FCC approval of the Project Acorn concept "within a year or so."[36] Public radio engineers suggested an analog/digital radio transition would take, at minimum, 10 to 15 years, probably beginning with "simulcasts of our old medium on our new medium."[37] The NAB similarly expected any digital radio transition to take "a long time."[38]

At the same convention where the NAB debuted Eureka 147 with much fanfare, a muted display of Project Acorn's DAB concept was also demonstrated.[39] The first display unit was actually a mockup, which could only illustrate what the effects might be of placing digital data underneath and around a typical FM broadcast signal. By 1992, Westinghouse, Gannett, CBS, and other interested broadcasters (including Cox Radio, ABC, and Emmis Communications) founded a separate company, USA Digital Radio (USADR) to consolidate their research and development efforts toward the creation of a workable in-band DAB system. Housed as a subsidiary of Westinghouse and initially based in Chicago,[40] USADR functioned with employees on loan from investor-companies, and farmed out most of its early research to consultants and contract engineering laboratories.[41] The FCC took no active role - either as participant or observer - in this early research.

That same year, the Corporation for Public Broadcasting announced it would spend $350,000 on research into digital audio broadcasting. The CPB was optimistic about the ways by which in-band DAB would allow broadcast radio entre into a convergent digital media environment.[42] At the same time, NPR's point-person on all things digital, Mike Starling, urged the public radio community to envision DAB not as a mechanism by which to provide a cornucopia of new services, but rather as an improvement to existing broadcasting as conventionally understood: "It's not really the sound *quality* but the *absence* of distortion and noise that's the biggest improvement," he wrote in *Current*.

Although Starling acknowledged that in-band DAB might bring the opportunity to introduce some new services to the radio broadcast environment, these would be minor relative to broadcasting's primary role of audio content distribution.[43] More importantly to Starling was that public broadcasters had secured a seat at the table during the start of in-band DAB development: "Digital radio is still at the talking stage in this country....We are extremely fortunate to have a more formalized presence in telecommunications policymaking than our predecessors....We have a blank sheet of paper for the design of the role of public radio in the American public's future."[44] How this would be actualized was, at the time, technically indescribable. The CPB itself suggested that prognostications about DAB's potential at the present juncture were premature, "because technology only defines what *can* be - the consumer's wants and needs, the interaction of competing products in a marketplace, economics, finance and regulation collectively define what *will* be."[45] This did not stop some commentators from predicting a fundamental shift in radio's identity: some suggested "tailored bit-streaming" would become a major application, and display screens and printer ports would subsequently be installed in receivers, morphing them into multimedia devices.[46]

At 4 a.m. on August 29, 1992, public radio station WILL-FM in Urbana, Illinois became the first radio station in the United States to successfully conduct an experimental hybrid analog/digital broadcast.[47] Apparently, the prototype hardware was developed at an unnamed laboratory on the campus of the University of Illinois at Urbana-Champaign, to which a part of USADR's research had been contracted. When WILL-AM/FM/TV General Manager Donald Mulally inadvertently tumbled to the project, he "volunteered the FM station as a guinea pig." The first hybrid/digital FM broadcast transmitted the digital portion of the signal at one one-thousandth the power of WILL's analog signal.[48] Engineers were impressed at the proof-of-concept so much that the prototype was packed up and displayed at the National Association of Broadcasters' annual radio convention the following month. Unfortunately, only "one hand-built prototype receiver" could decode this first foray into hybrid analog/digital FM broadcasting, and nothing substantive was reported about its audio fidelity or signal robustness.[49] Meanwhile, in Cincinnati, Ohio, USADR began testing hybrid AM broadcasts on an experimental station licensed for the purpose by the FCC; although the agency was not actively involved in the in-

band research and development process - much less willing to consider the practical implications of adopting such a DAB system - it was eminently comfortable providing broadcasters with as much latitude as they could handle for experimental purposes.

Now that a crude proof-of-concept had been demonstrated, other companies, potentially sensing the profits to be made from digitizing the radio broadcast industry, launched their own research and development projects on in-band DAB. Among them was AT&T and its then-subsidiary, Lucent Technologies.[50] Lucent began development of an in-band DAB system as a means by which to spin off existing research on digital audio technology into markets that could be readily monetized.[51] While both USADR and Lucent had pounced on the idea of a hybrid analog/digital FM broadcast system, USADR was the only company to initially field a hybrid AM broadcast scheme.[52]

Although competition in the innovative phase of in-band DAB seemed like a positive development, the introduction of a second DAB proprietor actually served to highlight the technical challenges of in-band digital radio and pushed constituents within the broadcast industry toward taking sides in the development process. Unlike USADR, which had the direct financial support of several major broadcasters and regularly tapped their insights on radio's digital future as part of its research, broadcasters saw Lucent as a disruptive "outsider" whose ideas of DAB might not mesh with the industry which would ultimately deploy it. Although Lucent had plenty of scientific intelligence and capital by which to pursue the technology's development, the fact that the broadcast industry did not have direct ties to its DAB program worried many. If a major goal of the radio industry was to have control over the development of its digital future, it would be more likely to succeed in this endeavor under the auspices of a company it controlled than one with which it had no substantive relationship.

By 1994, the National Radio Systems Committee (NRSC) was engaged to oversee the testing of competing DAB technologies, and established a DAB Subcommittee to facilitate the process. The NRSC is a private consortium of representatives from the broadcasting, broadcast equipment, and consumer electronics industries. Other interested parties can join the NRSC following application and/or invitation; for example, the FCC has a handful of members on the NRSC, but they act in an ex-officio manner. Typically, the NRSC is a place where industry

works out consensus on new broadcast technology standards, and then forwards its endorsement to the FCC for formal approval.[53] Discourse between NRSC members is kept private; its meetings are closed to the public and press. With regard to the NRSC's DAB Subcommittee, there was no "evenness" with regard to the representation of constituencies: the vast majority were broadcasters who, incidentally, worked for companies that invested in USADR, and the DAB Subcommittee was chaired by a commercial broadcast engineer. By agreeing to the placement of responsibility for evaluating in-band DAB systems in the hands of a private consortium, the FCC effectively ceded any input or authority over the technology's development and testing process and signaled tacit approval that any outcome would be embraced by regulators.

At the time, *Current* conducted a comparative cost-analysis for each station to convert to any flavor of DAB; USADR's price-range came in the lowest ($20-75,000) while Eureka 147 conversion was pegged at around $45-95,000 per station, with costs for implementation of the Lucent system falling between the two. However, the article did note that since Eureka involved multiplexing, the actual conversion costs under such a system could be shared by each participating broadcaster in a multiplex.[54] It took two years for the NRSC to develop DAB field-testing and system-evaluation guidelines.[55]

Notably, the first round of NRSC test guidelines did *not* subject the competing technologies to a comparative analysis; rather, it simply set out to test their inherent viability. By this point in time, the criteria for an "adequate" DAB system had shifted slightly: a "winning" technology would be robust to interference and other propagation characteristics (especially with regard to FM); offer "CD-quality [fidelity] standards"; not interfere with existing analog broadcast stations; and offer digital coverage equivalent to a station's analog service area. Questions about the deployment of ancillary services, such as datacasting, were not factored into the NRSC's initial consideration. Early reports from the NRSC on laboratory testing of all proposed in-band DAB systems "posted poor performers in every category."[56] One of the largest problems of in-band DAB was the susceptibility of digital radio signals to interfere with their "host" analog stations. Bench-tests using a "representative" sample of radio receivers revealed this fundamental flaw in every proposed system.[57] Although the NRSC kept quiet on the results

of its initial in-band DAB evaluation, its was inevitable some of the details would be leaked. Given the disappointing results of the laboratory tests, preparations for the field testing of in-band DAB systems slipped into 1995.[58]

Despite a the lack of a workable technology, USADR - with help from the NAB and trade press - began to paint a picture of inevitability about the adoption of in-band DAB in the United States. At the Los Angeles World Media Expo in September of 1994, USADR created a "static, in-booth demonstration" of its digital radio system, which included a controlled exhibition of hybrid analog/digital AM and FM broadcasts.[59] USADR representatives told Expo attendees that the company was already in discussion with equipment-manufacturers to mass-produce DAB transmission and reception components.[60] NAB DAB Task Force Chairman Alan Box declared USADR's system to be ready for deployment; the AM system, he boasted, "sounds as good as our current FM analog signals," while FM DAB sounded as good as a CD. Other in-band DAB proponents such as Lucent also had models of their equipment on display, and promised their own "static" demonstrations at forthcoming broadcast conventions.[61] None of these claims rested on any solid technical foundation. NRSC tests had conclusively proven that the developmental state of in-band DAB was quite immature, and that the technology did not yet meet the criteria necessary for viability, much less adoption.

As the developer with the most backing from broadcasters themselves, it was important for USADR to demonstrate its technology first, so as to gain a perceived place of primacy within the DAB development process and reassure non-investor broadcasters that its technology would be a feasible one. Given that there was no fallback to an in-band digital broadcast solution, and existing technical data on in-band DAB systems was admittedly weak, radio broadcasters *had* to show support for their homegrown DAB system - otherwise the notion of radio's digitization lacked traction for further research and development. Based around the nebulous threat of incipient satellite radio services, broadcasters at the time backed in-band DAB out of an inarticulate need to "go digital" for the simple sake of doing so.

As USADR began a concerted campaign of promoting the potential strengths of its technology, it received a large vote of confidence from the NAB. In a *Radio World* commentary published in February of 1995, NAB executive vice president John Abel attempted to articulate

the potential of radio's digital future. In doing so, he cast DAB not as simply complimentary to existing analog radio services, but as a revolutionary mechanism by which broadcasters could expand the range of information they could provide.

> The industry has yet to comprehend or understand what digital broadcasting means. To a large extent, radio broadcasters continue to think of 'digital broadcasting' as a higher quality sound through digital audio broadcasting (DAB). But DAB is only one application of digital broadcasting: or to say it another way, DAB is simply an extension of the concept of digital broadcasting. Digital broadcasting *does not necessarily mean higher quality; digital broadcasting means the flexibility to achieve multiple purposes for the broadcast signal and certainly one of those applications is sound* [emphasis added].

Predicting that "tomorrow's digital receivers will be more like today's computers," Abel insinuated that the reception of radio would merge into other devices, like household appliances and mobile telephony, which would open up many new possibilities for digital radio broadcasting. Forecasting potential uses such as "multiple audio signals into a digital data stream; real-time traffic updates; weather updates and other emergency announcements...displayed/played on demand," Abel believed broadcasters could use the technology to create new "bit streams...allocated to e-mail paging, PDAs, signaling devices like utility load management, data transmissions, fax transmissions, differential global positioning system (D-GPS)" and the like. "Theoretically, all of these additional transmissions could be accomplished while still providing a real-time broadcast as is done now." Going far beyond the initial goals for the technology as articulated by in-band DAB developers, Abel urged the industry to look past the provision of audio service to drive the development and uptake of DAB: "As we become digital wireless broadcasters in the revolutionary conversion to digital broadcasting, we can provide services we never would have dreamt of in the past. The future of digital broadcasting is bright and need not be feared."[62]

Though neither of in-band DAB's main developers, USADR and Lucent Technologies, promised such functionality in their systems, Abel's commentary suggests that broadcasters hoped the technology would not only give them qualitative parity to future satellite radio services, but would open up new revenue streams related to digital media distribution more generally. Such hypothetical benefits served to gloss over the known technical immaturity of in-band DAB development and urged the formation of consensus among broadcasters that a digital future was not only inevitable, but could be quite lucrative. Although there was no scientific

basis for these claims about in-band DAB technology, both USADR and Lucent did not caution against such wishful thinking. For its part, the FCC remained mum on the issue.

During the annual industrywide NAB convention in April, 1995, Las Vegas public radio station KUNV-FM was outfitted to broadcast a hybrid analog/digital signal,[63] while a hybrid AM demonstration-station broadcast live from the convention floor. USADR gave half-hour bus tours around carefully-planned routes within the city to demonstrate the viability of its system.[64] Although proponents admitted that the AM side of the technology needed more work before market-size demonstrations could be undertaken, USADR strongly asserted that AM broadcasters were guaranteed a meaningful place in any digital radio transition.[65] In fact, the AM demonstration unit on the NAB convention floor had been assembled only two weeks before the show.[66] Unbeknownst to convention attendees, USADR was collecting field data from these demonstrations, which it would later submit to the NRSC for evaluation.[67]

At the NAB convention, Milford K. Smith, vice president of engineering for Greater Media, Inc., a USADR investor, led an engineer's roundtable on the promises of in-band DAB.[68] It was not without its fireworks: European engineers could not understand why the United States appeared to be bucking the global trend toward Eureka 147 and worried about the potential for interference that would be created by intermixing analog and digital radio signals.[69] NRSC Chairman Charles Morgan, then a vice president for engineering with Susquehanna Radio Corporation, another USADR investor, candidly responded, "We are basically studying to determine whether an in-band on-channel system will be substantially better than what we have today."[70] Morgan effectively elucidated the first informal metric by which in-band DAB would be evaluated: was it better than analog? This was a far cry from the potential of DAB envisioned by Eureka 147 supporters, and a much lower standard then the NRSC's own evaluative criteria for a successful in-band system. Morgan also hinted that the NRSC's formal release of its DAB laboratory studies would occur in late August, though the Committee would likely take until the end of the year to analyze developers' data and make any solid conclusions about the technology.[71]

Elsewhere at the NAB convention, USADR announced tentative agreements with a transmitter and semiconductor manufacturer to produce hardware for its embryonic technology.[72]

All FCC Commissioners, save Chairman Reed Hundt, took the company's bus ride, though Hundt did inquire as to just how much "new spectrum" the system would require.[73] The response to this critical question could not be found on the bus, though Tony Masiell of CBS Radio - one of USADR's corporate cofounders - did admit that radio stations would need to expand their spectral footprints in order to accommodate the broadcast of both analog and digital signals. Simply put, USADR's system proposed to double the spectral footprint of every FM radio station and quadruple the footprint of every AM station in the United States. The implications of this proposal on the traditional spectral allocation regime of the U.S. radio broadcast system went unquestioned at the time.[74] European attendees of the NAB convention good-naturedly challenged their U.S. counterparts to put in-band DAB into a head-to-head test against the Eureka 147 system - though all agreed any in-band technology required further refinement for a realistic comparison to be meaningful.[75]

By the end of the 1995 NAB annual convention, *Radio World*'s Thomas R. McGinley, who rode the bus, noted that "[e]ven system skeptics and critics had to admit that the systems pressed the envelope to...perform very impressively in the almost-real world of a developmental mobile receiver traveling the side streets of the Las Vegas strip." This did not stop the publication of an editorial urging the FCC to take a closer look at USADR's technology, with an eye toward sanctioned proliferation.[76]

Despite these entreaties, there was no clear industry consensus on the idea of in-band DAB; another article in the same issue of *Radio World* examined a sampling of Usenet-published reaction toward the NAB demonstrations and found them decidedly mixed, if not downright critical.[77] Some convention attendees who monitored USADR's demonstration stations on their own noted "splatter" which affected both AM and FM frequencies near the experimental outlets. Remarked one observer, "I cannot think of a single FM broadcaster who would add DAB if it caused the current signal to sound noisy, scratchy or inferior. And channel splatter of the magnitude that was present at the show would cause chaos in those markets where there are a lot of stations. I hoped USA Digital Radio is also aware of these problems and has some plans to address them."[78] Robert C. Tariso, chief engineer of the highly-rated WLTW-FM in New York, was more emphatic:

> We will...have to come to grips with whether analog AM and FM can really coexist with this additional RF signal...no broadcaster in his or her right mind will destroy his or her existing business in the hope that digital will catch on. Remember, in the beginning 99.999 percent of the public will still be listening to conventional AM and FM receivers....Digital broadcasting appears so far to be an effort to throw out the baby with the bath water. Let's try and understand more fully what we have...before we wipe the slate clean and start over. If we do not, perhaps the same laws of physics will plague a digital system as well. Trading one set of problems for another may not prove to be beneficial.[79]

These early rumblings of unease about the compatibility of in-band digital and analog radio signals from rank-and-file broadcast engineers were brusquely brushed aside. Several *Radio World* reports and editorials in the summer and fall of 1995 suggested that the continuation of research into out-of-band DAB systems, such as Eureka 147, simply delayed the eventual validation of a U.S. developed in-band solution.[80] The editors of *Radio World* observed that a worldwide DAB standard was "an agreeable thought but not necessarily an economic need." They were convinced the United States, with its affluent base of 200+ million consumers, could swing the global DAB trajectory toward the as-yet unproven in-band solution, and implored the broadcast industry to assume tighter control of the DAB testing and validation process.[81] USADR and Lucent prepared more demonstrations for the annual NAB Radio Show in the fall of 1995,[82] one of which would include a Lucent-sponsored "field trip" similar to the show USADR scripted in April. The test-riders had no means by which to compare the Lucent system to any analog counterpart.[83]

Nevertheless, the NRSC began plans in late 1995 to test all proposed DAB systems in one U.S. market. San Francisco was chosen for its diverse terrain, in order to challenge each technology to its maximum extent regarding signal coverage and robustness.[84] Not surprisingly, there were significant difficulties securing temporary authorizations from the NTIA to establish Eureka 147 transmission facilities in the testing zone;[85] coupled with worries from consumer electronics manufacturers that the NRSC would construe any testing protocol to maximize beneficial outcomes for an in-band DAB system, the field testing schedule slipped into 1996.[86]

The suspicion of consumer electronics manufacturers that the NRSC's field tests would not be objective was well-founded. Due to their material investment in the development of an in-band DAB system, broadcasters had a predisposed preference for that technology, while the

consumer electronics industry held out hopes that a Eureka 147-style plan for the United States could be crafted.[87] The consumer electronics industry was skeptical from the outset that a practical in-band DAB solution was even possible; it was also quite wary of the way USADR flew "hand-picked" groups of broadcasters to its testing sites to demonstrate its technology in a hyper-controlled environment.[88] The consumer electronics industry sensed a forced patina of solidarity around the in-band DAB idea, which was publicly inflamed by an October, 1994 news/analysis piece published in *Radio World*. "Can a trade organization representing one faction of those who will decide the fate of DAB in the U.S. purport to perform objective tests on the one hand and support a caucus of its large members on the other hand?," asked *Radio World*'s editors. "And what happens if all systems perform well, but not exactly in a way that's comparable? Would the [consumer electronics industry] ignore broadcasters' stated position to support only [in-band DAB]?"[89]

Such criticism was not necessarily fair: the consumer electronics industry had already conducted its own independent analysis of potential in-band DAB systems, made the process transparent to both the NAB and NRSC, and, in the end, declared them them infeasible.[90] Initial attempts by the broadcast industry to cast doubt on the credibility of these tests were quashed in a declarative letter published in *Radio World* by all who oversaw the work and analyzed its results, including some broadcast engineers.[91] Despite the empirical evidence assembled by these tests, in-band DAB proponents would undertake a smear campaign against the science behind the consumer electronics industry's evaluation.[92] In response to this criticism, the Electronics Industry Association (EIA) - later to become the Consumer Manufacturers Association (CEMA) in 1996-97 and the Consumer Electronics Association (CEA) in 1999 - agreed to retest all DAB systems. The validity of the test protocols was confirmed by *Radio World* observers.[93] In February of 1996, the consumer electronics industry released the results of its DAB retesting.

Described by *Radio World* as a "dramatic hit," the EIA concluded that in-band digital broadcasting would create destructive interference to both the "host" analog signals along which digital data would reside and to adjacent stations, whether they also broadcast digitally or not. This problem was most significant on the AM band. USADR acknowledged these problems, but downplayed them, and vowed that the equipment tested in the NRSC's San Francisco assessment

would be dramatically improved from the units tested by the EIA.[94]

When the EIA polled its membership on raising the necessary funds to support DAB field tests, the reaction was not positive.[95] James B. Wood, President and Chief Engineer of Inovonics, Inc., a manufacturer of a variety of broadcast equipment in Santa Cruz, California, boiled the bad blood down into simple sentiments. "We recently received a letter in the mail...asking not for our ideas about digital radio, but for a contribution between $10,000 and $40,000 (whatever we might have in petty cash?) to fund the EIA and/or the NRSC evaluation of proposed systems. What does this say about digital radio in the U.S.?"[96] By the mid-1990s, a notable chasm existed between radio broadcasters and receiver manufacturers: the former was committed to an in-band digital radio solution, while the latter had not only proven that such technology was undesirable, but expressed open dismay at the idea of having to build a receiver base to support it. The lack of strategic alignment between broadcasters and receiver manufacturers over the future of U.S. digital radio would continue to resonate throughout the technology's later development and proliferation.

By the time of the annual NAB convention in April of 1996, broadcasters were scratching their heads over the future of digital radio. The EIA's tests called into question the very viability of in-band DAB, and the NRSC had yet to weigh in on the issue. No proponents held demonstrations or generally promoted their technology at the convention. Equipment for the NRSC's field tests had not yet even been fully built.[97] The mood at the NAB convention was one of in-band DAB facing "its darkest hour." Existing test results of in-band DAB were openly termed "disappointing." Yet proponents stood up in panel discussions and gave impassioned speeches that the faults of in-band DAB were simply part of the growing pains associated with developing any new technology, not rooted in a fundamental conflict with physics. The preferred system simply needed time to "mature."[98]

III. The Telecommunications Act's Impact on Digital Broadcasting

1996 would prove to be a pivotal year, both for the developmental trajectory of U.S. digital radio and the radio industry itself. That year saw the passage of a new Telecommunications Act which, among other things, greatly deregulated ownership of the U.S. radio industry. Prior to 1996, the number of stations a single entity could own was tightly

capped, at both the local market level and nationally. The new rules dramatically relaxed the number of broadcast outlets a single company could own in any given market and abolished the national station ownership limit.[99] Within six years of the Act's passage, the number of commercial radio station owners would decline by 34% while the number of actual stations rose 5.4%.[100] As a result, much like the housing bubble of the last decade, prices for individual radio stations, especially in major markets, ballooned out of all proportion to their actual potential to generate revenue. As the radio industry consolidated, new radio conglomerates, such as Clear Channel, thrived in the grow-big-grow-fast-cut-costs environment, while older media companies such as Westinghouse looked to increase the "synergy" between their existing media holdings. Such conglomerates would end up controlling the majority of the industry's revenue stream: by 2002, one broadcast company controlled, on average, 40% of the advertising revenue in any given market; in 23% of Arbitron-ranked radio markets, the top two broadcasters controlled more than 80% of market revenue.[101]

Between 1996 and 2000 radio industry advertising revenue grew by nearly 54%.[102] Furthermore, a large infusion of investment capital into the industry took place; several companies leveraged their operations on Wall Street, and the market capitalization of the radio broadcast industry rocketed from the hundreds of millions to hundreds of billions of dollars. Considering that many of those who had taken maximum advantage of consolidation were investors in the development of in-band digital radio broadcasting, it was inevitable that some of the largesse engendered by consolidation would find its way into DAB development. For its part, the FCC was mandated by the 1996 Telecom Act to assume a panoply of new oversight and enforcement responsibilities which extended far beyond broadcasting, and was legislatively directed to favor economic metrics (under the guise of "competition analysis") over all others in the pursuit of future regulation. Burdened by an increased regulatory workload in which broadcast regulation assumed a lower priority, and faced with a radio industry undergoing an historically unprecedented increase in economic clout, the FCC effectively ceded any meaningful involvement in DAB development to the new industry behemoths.

USA Digital Radio represented the "insider" proponent of the radio's digital future; as consolidation placed the fiscal fulcrum of the industry more firmly in the hands of

conglomerates, and considering that USADR was the child of one, the industry's largest commercial broadcasters lined up to invest in its venture. During 1996, Westinghouse acquired CBS; CBS announced plans to acquire Infinity Broadcasting; and the Gannett company sold its radio assets. All of the original "Project Acorn" investors were now consolidated under one corporate roof. Westinghouse placed USADR under the direction of its Baltimore-based Wireless Solutions division and appointed Robert Struble to oversee the USADR effort.[103] According to Struble, until this reorganization the corporate perspective behind in-band DAB development had been had been one of "a big science project...it wasn't really a whole-hog effort." Within a year of the Telecom Act's passage, USADR had lined up 15 of the 20 largest radio conglomerates as investors in its venture, which collectively controlled "more than two thousand radio stations, served thousands of other affiliate stations, beamed signals to a potential audience of more than 110 million people, and took in nearly half of all radio industry revenues in the United States."[104]

USA Digital Radio engineers presented a paper at the 1996 NAB Radio Show outlining an "improved" in-band DAB system, which would theoretically provide "virtual CD-quality stereo audio" for FM broadcasters as well as capacity for ancillary datacasting; USADR's improved AM system would deliver audio "quality comparable to present analog FM," along with a trickle of datacasting overhead. USADR engineers predicted they would finish their simulations of the new system by 1997.[105] Sometime in late 1996 or early 1997, Lucent and USADR discussed the idea of combining their efforts toward a single in-band DAB standard; the partnership sparked for 10 months but later died, due to USADR's concerns about the influence of non-broadcast constituents on the DAB development process.[106]

Telecommunications Act-related consolidation also spurred conglomerate broadcasters to upgrade the physical plants of their radio stations, so as to maximize their value in the event of future sale (a process later popularly recognized in the housing bubble as "flipping"), or as part of a "clustering" process where the operation of several radio stations was consolidated into a single location. This led to a surge in orders for analog AM and FM transmission plants, thus inadvertently pushing the short-term implications of DAB development aside, and signifying that the U.S. radio industry considered DAB to be a long-term issue economically. Enthusiasm for

any form of DAB, especially in small and medium-sized radio markets, was nearly nonexistent in the wake of the Telecom Act.[107] Regardless, the largest players in the industry had begun to line up behind USADR; rhetoric expressed in the trade press hailed the move as an historic step forward in the progress of U.S. digital radio.[108] This did not stop some, particularly in the consumer electronics industry, from imploring that study of Eureka 147 should be continued.[109]

At an NAB-sponsored broadcast engineering conference in 1996, all eyes and ears were focused on the progress of in-band DAB research. Attendees generally agreed that the interference issues inherent to in-band DAB were "probably...solvable." The NAB blamed pessimism about its chosen technology on "press coverage," which did not exist outside of the trades. FCC staff held two meetings with members from the USADR and Lucent DAB development teams, as well as with NAB representatives. The agency's sentiment expressed in the meetings favored an industry-sponsored DAB solution; proponents of an alternate-band DAB technology, such as Eureka 147, were greeted "somewhat skeptical[ly]." Even so, the mood among those gathered at the conference was certainly not united: 'To me, [in-band DAB development involves] a lot of solutions looking for problems," said Carlos Altgelt, a supervisor in the Automotive Components Division at the Ford Motor Company. Ford product design engineer Joseph Huk put the situation in stark terms: "The only [DAB system] that is going to succeed is the one that doesn't cause interference and provides a better quality service."[110]

The summer and fall of 1996 were tortuous times for the proponents of an in-band digital radio solution. As the NRSC finalized its field-test preparations, a scuffle developed between the technology's primary developers, USADR and Lucent. Each company provided some of the equipment to be used by the NRSC, and each company felt the terms under which the tests would be conducted left them at a disadvantage. This wrangling would delay field tests by at least two months.[111] Further complicating matters, some of the stations in San Francisco that had originally volunteered to be guinea pigs for the NRSC had been sold following the passage of the Telecom Act, and the new owners wanted no part in the testing process.[112] In a dramatic gesture, USADR pulled its DAB system from the NRSC's analysis. This left only the Lucent and Eureka 147 systems to be tested in San Francisco.[113] Some commentators opined that the results would "simply yield a lot of data and no consensus on a U.S. DAB standard."[114]

NRSC field evaluation of the Lucent in-band FM DAB system commenced in July. Philip Kayne, a *Radio World* correspondent who rode along for a part of the test, was impressed by the automation and computerization of the data collection, as well as the methodology behind the process. Kayne gave the Lucent version of in-band DAB a thumbs-up: "I firmly believe that 'digital FM' of this quality can become the broadcast standard of the future," he reported.[115] As the results of the tests were being compiled, *Radio World* scored an exclusive interview with NAB President Eddie Fritts. Fritts thought the fieldwork was useful for testing the concept of in-band DAB, but strongly highlighted the fact that not all proponents had been tested. For this he squarely blamed the the consumer electronics industry, which in his view was still biased toward an alternate-band DAB solution and had, through its members on the NRSC, "controlled [the DAB exploration process] from day one." Fritts then offered the NAB "as a secretariat to facilitate testing of in-band [DAB] in a fair and impartial, underlined, capitalized, manner."[116] Given that many major NAB members were now investors in USA Digital Radio, Fritts' commentary signaled a general industry intent to back the company as DAB's leading proponent.

Before the interview, the editors of *Radio World* had tentatively proposed that the U.S. radio industry "should begin to feel a little pressure to move forward on this technology," given the global adoption rate of Eureka 147 at the time.[117] Following the Fritts feature, the publication clamored for the broadcast industry to "step up and take control of the development of DAB testing for the United States....The focus of U.S. testing should be directed at finding an in-band system that fits the bill for U.S. radio....Receiver manufacturers will not ignore the U.S. consumer market; it is safe to say they will cater to it."[118] If necessary, the NAB should "commandeer the...testing process and ensure its fairness to all proponents involved."[119] Despite these calls to action, field-tests of the Lucent in-band FM DAB system had to be halted because the station involved in the evaluation had been sold and the new owners declined to continue the experiment.[120]

Consumer electronics manufacturers crowed about the collapse of the field tests. CEMA president Gary Shapiro pronounced it a "failure of both system performance and real interest from broadcasters" and "calls into question the future of [in-band DAB]."[121] Further salting the wound, Shapiro wrote a scathing commentary to *Radio World* in the parting month of 1996. "So,

they finally admitted it!," he wrote.

> After accusing us of all sorts of sins, including bad testing and unfairness...By their own admission, the USADR system [has major interference issues]....These are the *same* findings shown by the EIA/NRSC lab tests...in1995....[CEMA] is owed a major apology. [CEMA] was painted as being one-sided by both USADR and [*Radio World*]. USADR consistently claimed its system worked fine and that our process was flawed. However, we committed to fair and impartial testing and that is what we provided. I won't hold my breath waiting for the apology. Until USADR changes its management team and [*Radio World*] adds some healthy skepticism, I will doubt any of their future claims without further unbiased, third-party testing.

In an editor's note, *Radio World* stood by its coverage.[122] Within a year, all formal cooperation between CEMA and the NAB on the issue of digital radio, outside of the auspices of the NRSC, would dissolve. CEMA's co-chair on the NRSC's DAB Subcommittee was essentially reduced to a figurehead. CEMA would try one last time to influence debate in 1998 by taking the extraordinary step of independently and formally endorsing the Eureka 147 system for use in the United States: of all the protocols examined, "only the Eureka 147 DAB system offers the audio quality and signal robustness that listeners would expect...in all reception environments." CEMA concluded that in-band DAB was "not feasible at this time due to deficient performance." However, CEMA pledged to refrain from conducting official "advocacy of any system at the request of the broadcasters who said they needed more time to correct the flaws of the [in-band] system."[123]

By this point in the pre-policy dramaturgy, several of the character-constituencies and their perspectives on a digital future for radio broadcasting were now identifiable. Commercial and public broadcasters were the primary proponents of an in-band digital broadcast transition, with USA Digital Radio as the favored developer. The degree to which broadcasters supported the technology varied by the size of the company, most notably between larger USADR investors, who were perennial sources for trade-press boosterism, and smaller non-investors, who were not. Public broadcasters made a strategic decision early on in the DAB development process to support the wishes of their commercial counterparts, so as to secure themselves a seat at the table during the crafting of rules involving the use of digital radio. Independent broadcasters, primarily through the words of rank-and-file broadcast engineers, expressed a healthy skepticism about the viability of in-band DAB, though they were not yet as prevalent in the offstage dialogue as they would later become. Most importantly, any semblance of a unified

front among all industrial sectors involved in radio broadcasting had collapsed: consumer electronics manufacturers were strongly opposed to the development of an in-band digital radio system, and effectively stepped aside during the course of the decade to allow broadcasters to carry the burden of its development and proliferation alone. Although regulatory intervention could have been beneficial to moderate the intra-industry squabbles over the digital future of radio, the FCC was missing in action.

IV. Setting the Stage for DAB Policymaking

Proponents of an in-band DAB system spent 1997 attempting to make analog and digital radio signals peacefully coexist on the same spectrum. From the perspective of public broadcasters, the "daunting technical problems and a general lack of enthusiasm for the transition" hampered these efforts. Some proponents implored the FCC to take a more active role in the DAB development and testing process. According to Don Lockett, vice president of technology for National Public Radio, "Until there's a mandated timetable, as in television, I don't see that progress happening in radio." USADR told the NAB it would have a workable in-band DAB system ready for peer review within 18 months - sometime by mid- to late 1998. Milford Smith, vice president of engineering at USADR investor Greater Media, Inc. and chairman of the NRSC DAB Subcommittee, frankly described the situation as dire: he characterized USADR's research as "a maximum effort and perhaps the final effort at trying to make this thing work." The company, in his view, was "basically going back to the drawing board." Lucent's field demonstrations were not hot news; USADR's continued failure to demonstrate a viable in-band DAB system was.

Skip Pizzi, a technology manager for Microsoft with ties to public broadcasting - and who would later become a member of the NRSC and a regular *Radio World* commentator on DAB - viewed the work of USADR and Lucent as "kind of like a fairy tale, technologically speaking, but seductive from a business point of view." However, he also warned the stakes were high. "It's never a good idea to have a business concept in place before the technology can allow it," said Pizzi. "There's no Plan B in the United States."[124] In its budget request for 1997, the Corporation for Public Broadcasting asked for $22.5 million to ready its member-stations for an eventual DAB transition. The total subsidized cost of the transition was estimated to be $50 million, and the figures were completely based around the notion of a workable in-band DAB

solution. According to NPR's Don Lockett, stations could expect to incur "upgrade" costs between $100,000 and $125,000 to broadcast a hybrid analog/digital signal - a figure five times the lowest cost-estimate first projected by *Current* in 1993. As for alternate-band DAB solutions, Lockett suggested that "radio may face a complex simulcast transition like TV - scrambling for frequencies and paying costs three times greater" than what an in-band DAB solution would offer: "Most people don't want to talk about this yet."[125]

Despite the falling-out between broadcasters and consumer electronics manufacturers, 1998 was positioned to be a fruitful year in the development of digital radio. Both USADR and Lucent scientists expected to "conduct over-the-air field tests of their DAB systems by autumn. They'd like to see transmitter and receiver manufacturers begin the rollout process in 1999, followed by 10 to 15 years in which stations would...broadcast a hybrid [in-band DAB] system, compatible with both analog and digital receivers."[126] In February, emboldened by such optimism, the NRSC prepared to formally and comprehensively evaluate in-band DAB proposals alone.[127] According to David Maxson, a member of the NRSC's DAB Subcommittee who wrote the definitive engineering textbook on in-band DAB as it is presently constituted in the United States, the NRSC's initial goals were simple and twofold: "[C]an [in-band DAB] be better than analog? The next question, if the answer to the first were yes, is what the impact of [DAB] on existing analog service; can they coexist?"[128] These were the same questions raised by NRSC chairman Charles Morgan at an NAB engineering conference three years prior. They would now become the primary technical metrics on which all future NRSC action would be based.

Although the NRSC declared it would only consider in-band DAB systems for future evaluation, the dearth of actual knowledge about either USADR's or Lucent's systems precluded it from developing test specifications.[129] Instead the NRSC would "would tell [in-band DAB] proponents for what information that NRSC was looking, and, in a general way, how it should be accomplished."[130] This gave increased latitude to in-band DAB proponents to massage their data toward the objective of what seemed to be guaranteed NRSC endorsement. With leadership of the NRSC, and especially its DAB Subcommittee, firmly in the hands of people who worked for broadcasters invested in USADR, it was clear by this point that henceforth large broadcasters would be making the primary decisions behind the proliferation of DAB in the United States.

The FCC said nothing about this radical shift in the methodological objectives of the NRSC's DAB testing protocol.

The rejuvenation of the NRSC's DAB Subcommittee in 1998 spurred a flurry of new activity within the development sphere. A new competitor in the race to make in-band DAB work appeared on the scene. Digital Radio Express (DRE) announced it would have its own "prototype" of an FM in-band DAB system available for examination by midyear. According to *Radio World*, DRE's cofounder, Derek Kumar, was once a subcontractor involved in USADR's preliminary DAB research. USADR subsequently scrapped his designs after its 1996 reorganization, and Kumar continued to work on DAB independently.[131] In initial meetings with the NRSC, DRE's technology did not impress, though Committee members said they were open to any in-band DAB technology which demonstrated a semblance of viability. Partially in response to the debut of DRE, USADR and Lucent resumed joint development work on an audio encoding algorithm for use with their systems.[132] At the time, the NAB's director of advanced engineering, David Layer, characterized the NRSC's goal as simply to "evaluate [DAB] technology and determine whether it's viable or not."[133] Though this fundamental question had yet to be answered, the NRSC hoped that it could complete field-testing of all in-band DAB competitors by the end of the year with "the beginning of industry rollout by summer of 1999."[134] FCC approval of any in-band DAB system, it would seem, was already a foregone conclusion, despite the technical challenges it still faced.

As further details about the functionality of an in-band DAB system began to emerge, more rank-and-file broadcast engineers began to question the actual potential of the technology. Mike Worrall, the assistant chief engineer for a cluster of stations in Los Angeles, was not impressed with the projected audio quality of in-band digital broadcasts; he predicted that digital radio would sound worse than analog. "[W]hy are we as an industry willing to consider a universal transmission *standard* that is completely and totally dependent on audio bit-rate reduction?", he asked in *Radio World*. "Why is [DAB] seen as such a necessary development for terrestrial broadcasting...if the audio quality *by definition* will be compromised?...I'm beginning to sense that the emperor has no clothes."[135] E. Glynn Walden, the director of Engineering for CBS Radio and a man whose involvement with in-band DAB dated back to Project Acorn (later

described by *Radio World* as a "cofounder" of USADR), responded within one publication cycle to ameliorate Worrall's suspicions. According to Walden, USADR and Lucent's digital audio encoding algorithms were more sophisticated than garden-variety techniques such as MP3 compression; their technology used "perceptual audio coding" which could provide "digital CD quality within the broadcast channel." Walden further claimed that USADR had already performed a battery of listening tests involving its encoding algorithm, which purportedly "demonstrated that trained listeners cannot identify which source is the CD and which is [in-band DAB]....[it] delivers on quality - quality that is perceptually identical to that of a CD."[136]

Walden's portrayal of USADR's developmental strides was buttressed by two informal technical articles in *Radio World* by USADR subcontractors. According to them, "The [in-band DAB] approach...meets the needs of regulatory agencies because there is no need to allocate scarce spectral resources for DAB. Also, the process of analyzing station-to-station interference scenarios is not needed because DAB is designed to operate properly with the current allocation scheme."[137] Although this did not comport with what was already known about in-band DAB functionality, the FCC declined comment on these claims.[138]

In March of 1998, *Radio World* sat down with Walden for an interview about USADR's developmental work. He began by advancing the dominant operative metaphor behind radio's digitalization: "The world is going digital. We are going to make (DAB) optimized for broadcasting and for our listeners. If we don't do that, we have nothing. We're going to be in business for a long time. We have to train people to convert radio stations to digital. We have 10 years of implementation issues." In the next breath, Walden predicted in-band DAB stations would be on the air within a year, with receivers available to the public by the 2000, and that there would be "nothing analog" left on the air by then.[139] He also revealed more detail about collaboration between USADR and Lucent; it suggested that the two companies were discussing the merger of their development efforts.[140]

The following month, *Radio World* anticipated that "advances in [DAB] research and the pending launch of satellites to provide direct digital radio to U.S. listeners" would speed the momentum of DAB implementation, most likely within the next 18 months.[141] Later that April, at the NAB's annual convention in Las Vegas, proprietors of USADR and DRE debated the merits

of their DAB systems in front of interested broadcasters. USADR positioned itself as the front-runner in the race to develop a workable in-band DAB technology; it announced that field-testing of its AM and FM systems would commence "during the first quarter of 1999" on 16 stations.[142]

Shortly following the NAB convention, Lucent Technologies created a subsidiary, Lucent Digital Radio, to move its DAB development process forward. LDR's president, Suren Pai, would not say how much investment capital the subsidiary had been seeded with, other than that it was "substantial." In the mind of its parent company, LDR had developed a significant amount of intellectual property that was critical to the basic functionality of in-band DAB; consolidating this effort under a single structure was expected to increase the net value of its research. Pai also announced that Lucent was "walking away from" collaboration with USADR to develop a system that does "not use technology that it [LDR] does not currently own."[143] This included the audio encoding algorithm that Lucent had developed, which USADR had already announced it would use in its own DAB system. Lucent would now keep the codec for itself, and USADR would have to develop an alternate algorithm, unless it desired to license Lucent's.[144]

With the benefit of hindsight, the creation of Lucent Digital Radio had multiple missions. Lucent attempted to corner the market on important components of in-band DAB technology; if LDR could not "win" the overall development race, at least it could force USADR to share the wealth by controlling intellectual property necessary for the system's functionality. Relatedly, by taking its expertise in digital audio compression methods away from USADR, LDR forced its competitor to reallocate developmental resources, presumably in a move designed to slow down USADR's research and give LDR a chance to design a fully integrated AM and FM in-band DAB system. Pai also predicted that LDR DAB-enabled stations would be on the air within 18 months.[145]

The disentanglement of USADR and LDR's joint research introduced complications into the testing and verification of in-band DAB's usefulness. Furthermore, the Digital Radio Express DAB system was too new to form any realistic impressions about. Most importantly, opined *Radio World*, nobody had yet directly answered a fundamental question on the minds of many broadcasters: can an in-band DAB signal provide better quality than legacy analog service without harming it?[146]

During the summer of 1998, each DAB proprietor jockeyed within the trade press for the position of perceived forerunner in the development race. USA Digital Radio unveiled expanded research and development facilities in Columbia, Maryland and announced it had commenced limited field tests of its FM DAB system. It expected its technology would hit the market by 2000 and the digital radio transition to be completed within 10 years.[147] Digital Radio Express reported that it had a volunteer station on which to field-test its system, and an experimental license from the FCC for the work had already been acquired.[148] By September of 1998, USADR and DRE reported the completion of limited field tests of its systems, while LDR claimed to be not far behind. Meanwhile, the NRSC announced it hoped to have a package of in-band DAB testing guidelines drafted and ready for industry comment by October.

For their part, FCC staff said they would expedite the processing of applications for experimental authorization to conduct hybrid analog/digital broadcast tests, but otherwise would passively observe the NRSC evaluation.[149] *Radio World* reported that broadcasters would have welcomed the FCC's more proactive involvement at this stage: according to members of the NRSC's DAB Subcommittee, there was difficulty in settling on DAB test criteria as all three proponents kept significant technical details of their systems "close-to-the-vest." According to the NAB's David Layer, "As an engineer, I find it hard to get satisfaction from the proponents in terms of what they're doing. But I'm just going to have to deal with that, because from a business standpoint, they're doing the right thing." Due to this complication, the NRSC had already agreed to farm out the actual implementation of its testing criteria to third-party laboratories; Layer said this move was inevitable because "Frankly, if the committee's work is going to be accepted, the committee needs to be able to say more than, 'The proponents handed us this data and we looked it over.'"[150] *Radio World* later reported that in-band DAB proponents were willing to bypass the NRSC at this stage and submit their designs directly to the FCC for review if necessary, so long as the NRSC's drafting of a testing protocol remained "painstakingly slow." Both USADR and Lucent expected that FCC consideration of in-band DAB would occur within 12 to 24 months.[151] The FCC made no comment on these overtures nor expressed any interest in deeper engagement with the NRSC testing process.

By the fall of 1998, the business model of in-band DAB proponents had become clear.

Lucent Digital Radio had already hinted that its corporate mission was to fast-track proprietary applications to market, but not necessarily manufacture them. Similarly, USA Digital Radio and Digital Radio Express announced they had no plans to actually build their systems, but would instead license their technology to transmitter and receiver manufacturers for construction. USADR's Robert Struble was the most explicit about the race to develop in-band DAB being one not of technological progress, but of intellectual property: "We will provide technology to [equipment manufacturers] and then receive a license and stream off them. So the business model is actually real attractive. We don't have to build the plants, we don't have to hire millions of people to go do this stuff. We just need to make sure the technology works...and then go out and strike some deals with these folks."[152]

Given that all three companies were more explicit about their intended business models than the actual feasibility of their technologies, broadcasters openly wondered just what the potential of digital radio might actually be. An important point of consensus first articulated in 1995 now crystallized: the expectations of an in-band DAB system were to be set low. At this stage, the NRSC's primary metric for determining any system's viability would simply be that it demonstrate better performance than analog radio; questions of DAB's detrimental effects to analog signals and extended applications of digital radio spectrum were pushed to the back burner. Public radio engineers endorsed this metric at their annual 1998 conference, where attendees agreed that any DAB system "must be significantly better than current analog radio service in order to have any chance to gain traction in the marketplace." The NAB's Radio Board subsequently approved a similar resolution.[153] In the main, 1998 provided more news about the progress of corporate maneuvering between in-band DAB's proponents than about the developmental progress of the technology itself. Industry observers were left with a sense of optimism, tinged with a feeling of caution; they knew digital radio was in the works, but remained uninformed about its practical application.

USA Digital Radio would force the development issue on October 7, 1998, when it filed a Petition for Rulemaking with the FCC, asking the agency to begin the certification process for its in-band DAB technology. USADR president Bob Struble said the filing was prompted in part by conversations with equipment manufacturers and was designed to inspire enthusiasm among

them by demonstrating a modicum of regulatory engagement with the issue of digital radio. Simultaneously, USADR tendered several filings with the U.S. Patent and Trademark Office covering terminologies to describe in-band DAB that it claimed to have invented. USADR predicted the FCC would take 18 to 24 months to act on its Petition. Meanwhile, the NRSC had still not yet formalized the terms under which it would evaluate the three in-band DAB contenders.[154] Unsurprisingly, USADR's competitors were critical of the FCC filing. Lucent Digital Radio was utterly dismissive; Digital Radio Express called the filing "premature." DRE founder Derek Kumar said the filing "in effect, circumvented input from representatives of interested parties taking part [in the NRSC process]," and he threatened lawsuits if USADR received the patents and trademarks it desired.[155]

Radio World deemed the Petition a mixed blessing. Although it would focus industry attention firmly around an in-band DAB solution, the fact that the technology's proprietors were not working collaboratively - and one of them had circumvented the NRSC by taking the issue of in-band DAB approval directly to the FCC - hinted at a bumpy road ahead for the creation of a single, nationwide DAB standard. The publication asked all three proprietors about the possibility of future collaboration; their responses were characterized as "lukewarm."[156] This prompted *Radio World*'s editor, Paul McLane, to pen a provocative commentary pleading with the FCC to take a more proactive role in the DAB development process.

> We have talked seriously about DAB for eight years or so, and the process has seen numerous setbacks and detours....USADR clearly wants to assert 'ownership' of the [in-band] DAB issue....The challenges for USADR now are to justify the content of its filing, to show that it has not circumvented the NRSC process, to show fellow broadcasters that the plans of this CBS-backed enterprise are consistent with the goals of all radio owners. And, of course, to show that the USADR system actually works....The people who run Lucent know that they could be seen as outsiders, an extension of the phone company....Among their challenges now is to demonstrate that their commitment is real...that they understand the financial and technical needs of broadcasters. And, of course, that the Lucent system actually works....The challenges for DRE are to communicate its goals to the industry, to demonstrate that it has the financial resources to see this project through over the next several years, to dispel its image of a minor player. And, of course, to show that the DRE system really works.[157]

The implicit suggestion made by McLane was that the FCC work with in-band DAB proponents to foster collaboration, instead of letting the marketplace develop separate DAB standards which might be implemented at the discretion of any given station. Such an outcome could balkanize

the adoption of DAB technology, dooming it in a manner similar to the adoption of multiple analog AM stereo standards in the 1980s. He noted that FCC intervention was required to force a "grand alliance" between DTV technology developers, which ultimately led to industry consensus behind a single DTV standard. While this did not seem in the offing with regard to DAB, McLane suggested that it was critical to radio's digital transition. The FCC remained silent on the salient points of McLane's commentary.

USADR's Petition for Rulemaking is more important as a marker of where in-band DAB developers stood relative to each other than as a status report on the actual feasibility of the technology. Filing a Petition for Rulemaking does not guarantee FCC regulatory action on an issue; indeed, given the agency's passivity during the formative years of the digital radio debate, and coupled with a dearth of substantive technical data on the feasibility of any in-band DAB system, there was ample room for regulators to intervene beyond simply starting a policy discussion on the issue. The FCC ignored or declined several opportunities to involve itself in DAB development, and by accepting USADR's Petition for Rulemaking in the absence of strong technical rationales, the agency effectively signaled that it would go along with whatever digital broadcast solution the radio industry would come up with, irrespective of its detrimental effects on analog radio service or the realistic potential of DAB itself.

Had the FCC expressed concerns with the checkered record of digital radio development during the 1990s, it could have conceivably altered the trajectory of digital radio's promulgation away from the underdeveloped and questionable points of advocacy proffered by in-band DAB proponents and toward the development of a digital radio service that offered tangibly meaningful improvements to the broadcast status quo. However, the FCC's increasingly institutional orientation toward economic metrics as the primary rationale for policymaking, especially in the wake of the Telecommunications Act of 1996, made such a course of action apparently politically infeasible. At the very least, the FCC's acquiescence allowing market actors to proceed with the promulgation of a technology they did not fully understand represents a significant abdication of regulatory responsibility with regard to the agency's trustee-function involving the integrity of the public airwaves.

With the FCC on the sidelines, the National Radio Systems Committee's DAB Subcommittee became the forum-of-choice for the technical vetting of any DAB system, and

over time key positions within the NRSC were assumed by broadcasters with direct ties to USA Digital Radio. However, USADR apparently felt the strategic need to position itself as a front-runner in the DAB development race before the NRSC's evaluation of competing systems had even begun. In retrospect, USADR's Petition can be seen as insurance that formalized consideration of DAB would continue even if the NRSC's own evaluative mechanisms broke down as they did in 1996. This fear was real: as a supposedly collaborative effort between those involved in the transmission and reception of radio, the NRSC's decision to support a technology *not* endorsed by consumer electronics manufacturers had strong political fallout during the 1990s. CEMA's parting shot in 1998, endorsing the out-of-band Eureka 147 DAB system after nearly a decade of broadcast industry-backed development on a different track, effectively signified the end of goodwill between receiver-makers and broadcasters over the DAB issue. While CEMA representatives (and those of its member-companies) would continue to take part in NRSC proceedings, the direction of the DAB Subcommittee's work would now effectively be controlled by the broadcasters on board. The effects of this early rift between broadcasters and consumer electronics manufacturers would take years to manifest themselves, and not to the benefit of anyone.

Perhaps most importantly, the fact that USADR felt it had enough political and economic momentum behind its in-band DAB technology to ask the FCC for endorsement of its system is itself an important indicator of USADR's perceived position in the DAB development sphere. Not only had it corralled the majority of material and rhetorical support from post-1996 radio conglomerates, but the U.S. public radio system played an important role in facilitating USADR's DAB explorations; it provided all of the station-platforms on which the technology was initially demonstrated and declared early on in the decade that public radio would not be shunted aside by commercial radio concerns as it was when analog spectrum was first allocated more than 80 years ago.[158] Although National Public Radio and the Corporation for Public Broadcasting also did not fully understand the technical implications of an in-band DAB system, leadership at these organizations made the strategic decision to align themselves with the will of the commercial radio industry, and ultimately with USADR.

The fact that DAB policy discussion began on flimsy technical grounds is no accident. As the 1990s demonstrated, the initial development of an in-band digital radio system was plagued

with problems. The primary challenge was to develop a mechanism by which analog and digital signals could coexist on the same spectrum: the early record of laboratory and field testing simply did not justify the inherent viability of in-band DAB technology. In fact, the move by USA Digital Radio to jump-start a policy discussion on DAB even before any in-band technology had been proven to even be marginally functional should have raised alarm in some quarters of the constituencies involved in the DAB development process, and especially among regulators. Indeed, independent broadcasters openly questioned the viability of any in-band DAB system and were unimpressed by the stated goal of adopting a technology that only provided a level of service "better than analog." Unfortunately, these concerns were swept aside by in-band DAB proponents, aided by a trade press which reinforced notions that DAB was inevitable and early critics of the technology were uninformed or sought to interfere with "progress."

Consolidation within the radio industry, fomented by the Telecommunications Act of 1996, shifted a large segment of its economic power behind a single in-band DAB proponent; the combined might of USA Digital Radio's supporters was ultimately justification enough to effectively preclude all but its protocol as the digital future of domestic radio broadcasting. This occurred before the FCC even became actively involved in the issue and was exacerbated by regulators' unwillingness to influence the developmental process prior to the start of the policy discussion. Consensus among those anointed as "players" in the DAB debate ultimately revolved around an inarticulate sense of urgency, sparked by the creation of a satellite digital radio service, that *all* radio *must* go digital, and that an in-band solution was the only economically feasible and least disruptive way of making that transition. As Chapter 3 will illustrate, placing faith in the future policy of U.S. digital radio on what was still essentially a concept technology at the time would lead to potentially dangerous consequences for the future of both analog and digital broadcasting.

Notes to Chapter 2

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4. Michael Starling, "Public Radio's Eye on the Future," *Current,* vol. IX, no. 23 (December 17, 1990), p.20.

5. John Wilner, "A little DAB will do ya," *Current,* vol. XI, no. 2 (February 3, 1992), p. 3.

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11. See Mary Ann Seidler, "Euro DAB Moves to Next Phase," *Radio World*, February 8, 1995, p. 11, 14, and n.a., "DAB Forum Promotes Eureka Agenda," *Radio World*, June 28, 1995, p. 13.

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15. See Brian O'Neill, "Digital Audio Broadcasting in Canada: Technology and Policy in the Transition to Digital Radio," *Canadian Journal of Communication*, vol. 32, no. 1 (2007), p. 74-75, and Jurgen, p. 58.

16. See O'Neill, p. 75-77, and Careless, "L-Band DAB Ancillary Service Introduced," *Radio World*, April 5, 1995, p. 6.

17. See Petition for Rulemaking filed by USA Digital Radio Partners, L.P., RM-9395, October 7, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=217027 (May 6, 2010), p. 16-17, and David Sedman, "Radio Transmission," in Peter B. Seel and August E. Grant, eds., *Broadcast Technology Update: Production and Transmission* (Boston: Focal Press, 1997), p. 163.

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21. Jack Robertiello, "The Competition," *Current,* vol. X, no. 4 (March 4, 1991), p. 7.

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30. Editorial, "Satellite DAR: A Call to Action," *Radio World*, February 8, 1995, p. 5

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32. See Ala-Fossi and Stavitsky, p. 64, 68, and Maxson, p. 31.

33. Ala-Fossi and Stavitsky, p. 69.

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61. Judith Gross, "In-Band DAB Keeps Moving Forward," *Radio World*, November 16, 1994, p. 13.

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68. John Marino, "NAB Boasts Varied Technical Agenda," *Radio World*, March 22, 1995, p. 61.

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Chapter 3: The Fundamental Detriments of IBOC-DAB

According to the National Radio Systems Committee, a successful digital audio broadcast technology is one which provides "a significant improvement over the analog systems currently in use."[1] To understand the chosen U.S. DAB system's inherent inability to achieve this goal requires an overview of its fundamental detriments. This chapter is not designed to be a thorough deconstruction of the U.S. DAB protocol, but rather to highlight significant and unresolved problems with the technology which make it difficult - if not impossible - to employ on a nationwide basis, and to provide background for the salient points of controversy which occur in the following chapters. The specific metrics by which U.S. DAB technology is judged - the use of "no new spectrum" and a quality of broadcast considered to be "better than analog" - are difficult to meet with the country's chosen protocol, due to its invasive spectral occupancy and lack of meaningful bandwidth capacity. Coupled with the technology's wholly proprietary nature, U.S. DAB technology faces several major hurdles to successful implementation.

I. Spectral Occupancy

In Chapter 2, two general categories of digital radio broadcast technologies were referred to, for the sake of simplicity, as "in-band" and "alternate-band" DAB. The United States has chosen an in-band digital audio broadcast protocol called "In-Band-On-Channel," or IBOC DAB. "IBOC" implies that analog and digital audio signals peacefully reside on the same swath of spectrum. This is untrue.

As shown in Figure 3.1, an IBOC hybrid analog/digital FM signal appropriates new spectrum to broadcast the digital portion of the transmission. The triangle represents an FM station's analog signal; the squares on either side represent the digital "sidebands" of the IBOC signal. An "extended hybrid" mode allows stations to widen their digital sidebands toward the center of their analog signal, sacrificing some analog quality for more digital capacity if desired.[2] Traditionally, the FCC has allowed analog FM stations to occupy up to 200 kilohertz (KHz) of spectrum; hence the FM dial is divided into channels that are 200 KHz wide. However, figure 3.1 clearly shows that a hybrid analog/digital IBOC FM signal actually occupies nearly 400 KHz of spectrum. These digital sidebands are redundant (i.e., they carry duplicate information) in case one of them is interfered with by an adjacent channel signal, since the sidebands technically

reside on the adjacent channels of its analog FM host.[3]

If the FCC's FM allocation rules require a spacing between stations of at least 200 KHz, and an FM-IBOC hybrid analog/digital signal occupies twice that space, how is IBOC allocation even permissible under current broadcast rules? Looking again at Figure 3.1, the entire FM-IBOC waveform is outlined by what is described as the "FCC FM Mask." Historically, the FCC has maintained emission masks for analog transmissions;[4] these rules were originally implemented to protect stations from potentially interfering transmissions by their neighbors on the dial. For example, sometimes a transmitter malfunctions, and this can cause off-frequency emissions to occur. Or a station may overmodulate its signal, thereby "splattering" its transmission onto adjacent frequencies. The FCC's spectral mask is designed to prohibit such transmissions and, if they do occur, to minimize their harm to neighboring radio stations.

Proponents of IBOC have cleverly appropriated the spectrum covered by the FCC's emission mask around each station as the station's own.[5] While it is true that IBOC digital sidebands do fall within the mask, this is an abuse of the rule's original intent. In simple terms, the FCC's spectral mask was designed to provide a "guard band" of fallow spectrum between stations to protect against *spurious and transient* emissions - *not* to be utilized as spectrum intended for the continuous transmission of energy. Where once the outer edges of the mask were left empty to accommodate any rogue or unintended transmissions, IBOC employs this guard-band in order to function. Although IBOC emissions may "conform" to the limits of the emissions mask, they do so in a spirit wholly unintended by the FCC's original rulemaking - a fact seemingly lost on the FCC itself.[6] In fact, the NRSC had to convince the FCC to expand its spectral mask rules in order to accommodate FM-IBOC hybrid signals, otherwise some of the "spurious noise" generated by the system would be legally unallowable.[7]

David Maxson has gone so far as to redefine what a radio "channel" is to justify the deployment of IBOC: "[T]he concept of a 'channel' as an immutable protective boundary is mistaken, because the channel is a more complex concept than simply a fixed bandwidth reserved for the exclusive use of one transmission."[8] These rhetorical gymnastics are necessary to redefine decades of spectral allocation policy in order to implement a digital radio technology which has the potential to interfere with not only its analog host, but adjacent stations as well,

even though "the rules for station allotment and spectral occupancy still anticipate substantial out-of-band emissions."[9] However, the notion that IBOC appropriates new spectrum on which to function is made clear by looking at the all-digital FM broadcast mode, illustrated in Figure 3.2. IBOC's all-digital spectral footprint is an aggregate 396.8 KHz[10] - double that of an analog FM station's footprint - and the power of the digital sidebands are raised to protect a station's core digital capacity. This implies that, once a station commences IBOC transmissions in hybrid (analog/digital) mode, it will use this newly-utilized spectrum in perpetuity. This has caused many engineers, including NPR's point-man on DAB, Mike Starling, to urge the redefinition of U.S. DAB technology as "in-band-adjacent-channel," or "IBAC," since that is what it actually represents.[11] However, doing so would tacitly acknowledge that the domestic digital radio system requires more spectrum to work than what is currently allowed under analog broadcast allocation rules. By appropriating all useable spectrum under the FCC mask, incumbent broadcasters effectively double their footprints on the dial.

The digital portion of an FM-IBOC station's signal cannot replicate the full coverage area of its analog counterpart, given that the digital sidebands are broadcast, at most, at a power level equivalent to just 10% of the analog transmission; thus, while a hybrid digital FM signal is likely to provide coverage to a portion of an FM station's service area, it cannot cover its entire analog broadcast footprint.[12] According to IBOC's proprietors, the technology "cannot overcome the strong interference that exists beyond the edge of coverage, nor was it designed to."[13] NPR field tests could not conclusively predict the coverage area of an FM-IBOC signal, calling predicted digital coverage of any given FM station a "hypothes[i]s until tested."[14] Penetration of FM-IBOC signals in buildings is extremely poor and, in come cases, described as "impossible."[15] NPR found that the digital portion of an FM-IBOC transmission has an indoor signal penetration potential of less than half its analog counterpart. According to NPR, "Resurgence in the use of outdoor antennas could be promoted" to address this problem, but that would be "an unlikely candidate to significantly affect user patterns."[16] This especially worries public broadcasters, as half of an average public radio station's revenue is based on listener contributions, and any broadcast technology which degrades a station's coverage area represents a threat to their fiscal health.[17]

Furthermore, the danger of self-interference exists between the analog and digital portions of an FM-IBOC radio signal, especially in the extended hybrid broadcast mode. Considering that the digital sidebands overlap the edges of a station's analog signal, there is the potential for digital data to leak through the filters of analog radio receivers and cause audible interference to analog FM radio broadcasts. This interference sounds like "white noise" on analog receivers. Essentially, extended hybrid FM-IBOC transmissions not only appropriate new spectrum on which to broadcast the requisite digital sidebands, but sacrifice analog bandwidth in order to increase the signal's digital capacity. There is no concrete way to prevent the increased likelihood of self-interference between the analog and digital portions of any given FM radio station. The extended hybrid mode of FM-IBOC was never thoroughly evaluated by the NRSC.[18]

IBOC's proprietors have developed a workaround to the problem of diminished digital coverage area. When a digital signal begins to degrade, an IBOC receiver "gracefully" blends to to the analog signal of the same station, thereby avoiding the "cliff effect" quite common to other digital audio platforms.[19] Proponents of the technology qualify the blend-to-analog function as a mechanism to guarantee that an "IBOC signal can never be worse than, and is usually much better than, the performance afforded by existing analog service."[20] They also assert that the audio quality of a digital radio signal is significantly better than its analog counterpart; however, given the paucity of bandwidth allocated to the transmission of digital sidebands, and their fractional power relative to analog transmissions, this is a debatable assertion.

IBOC advocates admit that FM analog-to-digital and digital-to-digital interference is a real concern.[21] According to an unnamed broadcast transmission equipment vendor quoted in *Radio World*, the question of IBOC's interference potential cannot be answered "until some stations go digital" - in other words, until the technology is applied in the real world.[22] There are various ways by which interference may occur in an IBOC environment, in addition to the basic insertion of new RF energy into already-crowded broadcast spectrum. One involves the phenomenon of "spectral regrowth," which occurs when analog and digital FM signals combine in such a way as to generate harmonics that can affect both the host analog signal and stations on first-adjacent channels to the interfering broadcaster.[23] Another is digital-to-digital intermodulation, which can affect the reception of stations on the FM dial that are located two to

three channels away from an IBOC-enabled broadcaster.[24] Figure 3.3 represents how two FM stations, both operating with IBOC sidebands, might cause destructive interference to each other. Not only do portions of their analog signals overlap, but the digital sidebands associated with both stations directly impinge upon the analog transmissions of each other. Sideband redundancy helps little in situations like these, considering that a station's analog signal is the "fallback" when reception conditions make the digital signal unlistenable. Additionally, while IBOC proprietors claim there is little interference potential between FM stations located at least two channels apart, as evidenced by Figure 3.4, the effects of intermodulation and spectral regrowth belie the impression that such interference is impossible.

Consulting engineer Michael Couzens claims this digital allocation framework will create significant problems for low-power FM (LPFM) stations, which may only broadcast at an analog power level of 100 watts or less. To put this in perspective, the University of Illinois' public radio station, WILL-FM, operates at an effective radiated analog power of 100,000 watts. WILL also runs an IBOC signal, which gives it the ability to place 10,000-watt digital sidebands on the adjacent channels of its analog signal, located at 90.9 MHz. Were WRFU-LP, the Urbana-Champaign Independent Media Center's LPFM station, located adjacent or nearly adjacent to 90.9 (which, fortunately, it is not), would its 100-watt analog signal stand a chance against a digital sideband transmission 100 times more powerful? The question of IBOC's destructiveness to LPFM stations is a hotly-debated issue and, to this point, inconclusively answered.[25] Listeners do not understand the nature of the interference caused by FM-IBOC digital sidebands and therefore may believe there is something wrong with their receivers, when the problem is actually due to the imposition of new RF energy on the radio broadcast spectrum.[26]

Generating an FM-IBOC waveform is no easy task. It turns out that getting analog and digital radio signals to coexist takes a lot of effort.[27] To combine the analog and digital portions of an FM radio signal, a transmitter requires approximately 35% more power, and operates at a 20% reduction in efficiency.[28] One broadcast engineer noted that stations will probably need to feed ten times the power into their IBOC-compatible transmitters in order to generate the necessary hybrid analog/digital output; the rest of that power will dissipate as heat, increasing the electrical and cooling requirements of all broadcast transmission facilities that employ the

technology.[29] A mechanism of transmitting the digital sidebands separately from an analog FM signal has been tested and approved by the FCC, but this does not significantly reduce the chances of analog-to-digital or digital-to-digital interference, and may increase the potential for self-interference.

Finally, there is no "average" cost associated with adding IBOC functionality to an FM radio station; the price of the "upgrade" will vary depending on the age and existing condition of its transmitter plant, as well as the effective radiated power at which the station is licensed to broadcast.[30] In the long run, larger stations will pay more to broadcast in IBOC than smaller stations.[31] Once the feat is accomplished, the only way to verify that the analog and digital signals have combined successfully is to view the IBOC waveform on a spectrum analyzer.[32]

On the AM side of IBOC technology, the potential for interference is much worse. According to David Maxson, the basic nature of the FCC's analog AM station allocation rules exacerbates this situation: "If we knew a half-century ago what we know now, things might have been different, but it is obviously far too late to make wholesale changes to the station assignment scheme, and the laws of physics are quite immutable."[33] In simple terms, "Every digital communication system is a trade off between data throughput and robustness against channel impairments."[34]

While an FM station is allocated 200 KHz per channel, an AM station must get by with just 5% - or 10 KHz - per channel. As is the case with FM-IBOC, AM-IBOC appropriates the FCC's emissions mask on which to place digital information. Indeed, one of IBOC's early developers explained the technology as "an expansion of the use of the AM band."[35] As shown in Figure 3.5, whereas an analog AM station uses just 10 KHz of spectrum, an AM-IBOC hybrid analog/digital signal triples that footprint. Furthermore, the sidebands AM-IBOC signals are not uniform emissions; each are subdivided into dozens of "subcarriers." In order to work around the limits of the FCC's AM emissions mask, the NRSC and IBOC's proponents calculate the overall power density of AM digital sidebands by measuring *one* subcarrier and using that as a reference point to infer the overall power of the entire sideband. As at least one broadcast engineer has pointed out, this evaluation is technically disingenuous.[36]

Unlike hybrid FM-IBOC signals, AM-IBOC transmissions actually place digital data

directly underneath the analog signal.[37] To accommodate the underlying data, the analog signal must be transmitted monophonically; thus a portion of spectrum devoted to analog AM broadcasting is preemptively appropriated, to the detriment of existing analog service quality.[38] Although this design was justified as nondestructive given the weak channel-sensitivity of cheap, modern AM radios,[39] listeners may still notice the underlying digital transmission as a "hiss" on their receivers and, as in the case of FM-IBOC interference, will not understand the source of the noise. If and when AM stations go all-digital, as shown in Figure 3.6, their spectral footprints will actually decrease - but will remain double the width of existing analog channels.[40]

The analog/digital hybrid mode of AM-IBOC carries with it a plethora of interference concerns. Whereas the problems with FM-IBOC are many, they pale in comparison to the propagation characteristics inherent to the AM band. AM signals travel in two ways - through the ground (these are called "groundwave" signals, and they are the signals you pick up from your local AM station), and through the sky (these are called "skywave" signals, and are most notable at night, when AM signals bounce off the ionosphere to cover great distances). According to system developers, AM-IBOC was developed to accommodate groundwave coverage only, so problems that exist between stations whose skywave signals interfere is ironically not considered a problem at all. Figure 3.7 illustrates how AM-IBOC stations on adjacent channels to each other easily overlap their transmissions. At night, due to the increased range of many high-power AM stations, the potential for interference grows from a local to a regional or national phenomenon. Since hybrid AM-IBOC stations triple the spectral footprint of any station, the potential for interference to second-adjacent channels, as illustrated in Figure 3.8, is also very real, and can be similarly destructive over large areas at night. As with FM-IBOC, the intermodulation of AM-IBOC signals can cause interference up to three channels from the offending station.[41]

Thus, AM-IBOC transmissions can cause interference to both the groundwave and skywave signals of AM radio stations.[42] A conservatively projective statistical analysis of IBOC interference problems on the AM band found that approximately two-thirds of those stations currently licensed to operate at night could most likely do so in a hybrid analog/digital mode without serious problems; most of the rest would have to modify their broadcast power and directionalize their signal patterns to avoid or mitigate digitally-induced interference. Ninety-five

AM stations currently authorized to operate at night - about three percent of the total number of licensed AM stations in the U.S. - might have to cease broadcasting due to unresolvable IBOC-related interference.[43]

Further complications to the successful deployment of AM-IBOC technology involve the intricacies of AM broadcast antenna systems. Unlike FM stations, which place antenna componentry on a single mast or tower, AM stations use arrays of antenna towers and wires buried in the ground (called "radials," which extend from each tower) to transmit their signals. As a result, the U.S. AM radio station allocation scheme is much more complicated than its FM counterpart. Due to the skywave propagation characteristics of AM broadcasting, some stations must reduce power after sunset or leave the air entirely; others must directionalize their radiation patterns so as to protect stations in other locales. Applying IBOC technology to such complicated antenna systems, which vary greatly from station to station, opens up new problems with regard to the compatibility of IBOC on the AM band. Because the primary digital sidebands of hybrid AM IBOC signals are deliberately placed at the edges of the station's spectral footprint, it makes them highly susceptible to corruption by antenna system design issues.[44] In order to accommodate an IBOC signal, many AM stations may have to completely redesign and rebuild their antenna arrays, introducing a hidden cost to IBOC which has not yet been fully quantified.[45] Station-to-station AM-IBOC interference manifests itself as a "bacon-frying effect" on analog radios and, in all other cases of IBOC-related interference, is not likely to be noticed by listeners for what it really is.[46]

The basic prevailing industry view is that while IBOC DAB may have its drawbacks, its potential "improvements" to the radio broadcasting experience are worth making "compromises" for.[47] Although the laboratory-science behind the technology asserts there will be no significant problems, limited field-testing, combined with the proliferation of stations now implementing the IBOC protocol, does not seem to justify such dismissiveness. Even though the ultimate benefits of IBOC may arrive when all stations go completely digital, there is no mandated timetable to do so, and while the potential destructiveness of the hybrid IBOC system is acknowledged, there are many in the industry content to leave these issues unresolved.[48] As consulting engineer Doug Vernier, who worked closely with NPR on IBOC development issues, concludes, "The scale of

IBOC interference on analog coverage is unknown," and such interference is most likely to manifest itself in situations where there are "short-spaced stations, overpower grandfathered stations, stations that have contour overlap despite meeting minimum spacing requirements, dual antenna installations, and 'grungy' installations."[49] Introducing a new digital broadcast service in ignorance of its potential destructiveness to existing analog services, with which it must cohabitate indefinitely, does not seem like wise policy.[50]

II. Bandwidth Capacity

"Bandwidth" is loosely defined as the capacity to carry digital data; the higher the bandwidth, the larger the informational carrying capacity. As benchmark figures, most home broadband connections have a minimum bandwidth of 512 kilobits per second (kbps) or higher; many services are now offered in the multiple-megabit range. 3G and 4G wireless telephony also offer bandwidth capacity measured in megabits. Individual digital television (DTV) channels occupy 6 MHz of broadcast spectrum (or 15 times the footprint of a typical hybrid FM-IBOC station); each channel contains enough bandwidth to transmit slightly more than 19 megabits per second (mbps) of digital data. Hybrid FM-IBOC stations have a digital bandwidth capacity of approximately 150 kbps (in the extended hybrid mode)[51] and AM-IBOC stations are capable of transmitting approximately 64 kbps of digital data.[52] Even in their all-digital configurations, FM-IBOC signals can carry just 300 kbps of digital data, while AM-IBOC is projected to top out at 96 kbps.[53] Due to the aforementioned channel capacity constraints, IBOC is simply incapable of providing broadband-level digital data distribution services.

The bandwidth restrictions of the IBOC DAB system has not stopped its supporters from exploring other uses for their digital sidebands. Several "value-added" features have been suggested, such as "multicasting," or the ability to split an FM-IBOC digital signal into multiple program streams (there is not enough bandwidth to multicast in AM-IBOC), and "datacasting," or the provision of non-audio digital data. Examples of datacasting include iTunes tagging (which allows listeners to "bookmark" songs they hear on the radio for later purchase online), Dolby 5.1 surround sound, traffic and navigation services, recording-on-demand, and subscription audio content.[54]

IBOC developers are also pondering several ways to either mimic interactivity or provide

such functionality via a separate wireless information conduit. Some believe linking DAB receivers to in-car GPS systems will allow radio stations to serve up locale-specific advertising to listeners depending on where they are and in which direction they may be traveling. A service called Visual Radio, developed jointly by HP and Nokia, proposes to link artist and song information conveyed by FM-IBOC radio stations to enhanced content streamed on-demand to compatible mobile phones. Others are exploring interactivity as a means to provide real-time station audience measurement.[55] Many of these features, such as multicasting, were not originally built into the IBOC feature-set; for example, FM-IBOC multicasting was developed by NPR following a crash program in 2002 - long after its proprietors petitioned the FCC to approve the DAB standard. Therefore, the ability to multicast or datacast were not initially conceived as primary rationales for IBOC's adoption, but rather as additional incentives for stations to expand their program and service offerings by an unspecified but relatively minor degree.

These "value-added services" are mostly unavailable on AM, where digital bandwidth is already insignificant.[56] In addition, non-audio digital services require dedicated bandwidth to function properly, which forces each radio station to choose whether or not to sacrifice digital audio fidelity for the provision of non-audio content. Proponents of IBOC claim that applications such as multicasting and datacasting use "opportunistic data": for example, if an FM-IBOC station airs programming that does not call for high fidelity (such as a news or talk program), the station can conceivably decide on the fly to devote some of its digital data stream to other uses.[57] However, given IBOC's inherent bandwidth constraints, no radio station can provide the complete panoply of the system's features: a station may multicast, or broadcast in surround-sound, or provide other non-audio services, but it may only choose one or two features from the suite.

IBOC-enabled stations are not likely to share their spectrum and application-windfall with other broadcasters. Milford K. Smith, Jr., Chairman of the NRSC's DAB Subcommittee, has commented that the industry was not interested in accommodating new entrants via the IBOC platform. "Potentially unprofitable demographic segments," he opined, were more likely to find the Internet a better place "to seek mass distribution of their product."[58] Thus, while the promise of increased audio fidelity and the provision of additional applications is claimed to be a

benefit of IBOC DAB, the technology's practical limitations call these new uses of the radio spectrum into question.

IBOC's primary touted feature is an increase in audio fidelity, defined as "CD-quality" sound on FM and "FM-quality" sound on AM.[59] True, uncompressed audio requires 1.4 mbps of bandwidth; therefore, IBOC radio signals must significantly reduce the bandwidth of source audio to fit the system's constraints. This is performed by a codec, which stands for "encoder/decoder," and is essentially an algorithm designed to compress digital audio data. Not all codecs are created equal: for example, the widely-used MP3 format is a lossy algorithm which reduces the bandwidth of uncompressed digital audio by about 90%.[60] IBOC's proprietors experimented with several codecs before developing one called HDC (Hybrid Digital Coding).[61] It is known as a *perceptual* codec: according to Ken C. Pohlmann, "physical identity is waived in favor of perceived identity. Using a psychoacoustic model of the human auditory system, the codec...identifies imperceptible signal content (to remove irrelevancy) as bits are allocated. The signal is then encoded efficiently (to avoid redundancy) in the final bitstream." Noise from the psychoacoustic modeling of digital audio is inherent to a perceptual audio codec system, but the main question becomes how *much* noise is tolerable before the human ear notices it.[62] In theory, while all psychoacoustic-based codecs are lossy, they are designed to trick the human ear into not perceiving any loss of acoustic range.[63] The Hybrid Digital Coding algorithm compresses audio at a ratio of approximately 15:1,[64] thanks to a series of "carefully-engineered perceptual tricks."[65]

Laboratory tests and field observations do not reflect well on the technology's actual audio quality. David Maxson claims that 96 kbps is the "absolute minimum at which a credible [FM-IBOC] stereo signal can be transmitted,"[66] and disputes claims that IBOC can create the sound it promises: "By building a broadcast system that compresses audio into such a narrow data stream, we would be profoundly affecting one of the features of our current radio broadcast system....Compressed digital broadcasts will sacrifice some of the details of musical dynamics that analog FM is capable of delivering."[67] In other words, depending on program type, analog FM might sound *better* than its IBOC equivalent, considering that analog audio is not digitally encoded for broadcast. Since the imposition of digital sidebands preclude an AM station from

broadcasting a stereo analog signal, the perceived relative "improvement" of AM-IBOC audio quality is actually accomplished largely by the degradation of the analog transmission.

One engineer involved in IBOC development noted that the system's audio quality is optimized for use in vehicles, where road noise and other distractions can mask any of the HDC codec's flaws.[68] Sony Electronics has commented that the "near-CD" fidelity of IBOC transmissions may "be less tolerable by the public"[69] as the overall quality of consumer audio electronics improve.[70] Satellite radio also utilizes a digital compression algorithm to broadcast its signals but, unlike IBOC, these signals do not have to share spectrum with incumbent analog transmissions. Therefore, while satellite radio employs mechanisms of bandwidth efficiency to cram multiple channels into a single digital signal, the entire bandwidth afforded to satellite radio can be utilized for this purpose, resulting in less of a need to sacrifice digital audio quality in order to protect neighboring incumbent broadcasters (of which there are none). IBOC DAB's audio quality relative to digital satellite radio has never been evaluated.

When put to the test, IBOC's codec must be judged subjectively. Typically, a mechanical ear is used to measure the fidelity of codecs, but it cannot effectively judge the "perceptual tricks" used in the Hybrid Digital Codec to fool a real human brain.[71] IBOC's proponents tested their codec by using a generally-selected sampling of people and a cadre of "expert listeners" to compare the quality of HDC-encoded audio relative to other source material, most notably analog FM broadcasts.[72] Expert listeners are important because they "are more familiar with peculiar and subtle artifacts....The reference [audio sample] must be of the highest quality, and the testing conditions must be designed to attack the codec at its weakest points."[73] In order for such a test to be valid, it must meet a set of International Telecommunication Union performance guidelines, which include stressing the algorithm under scrutiny.[74] It is not clear that this test was actually done, given that the reference samples were simply analog FM sound clips as opposed to uncompressed digital audio. Although IBOC's proprietors claim their codec performed in such a manner as to be "perceived by typical listeners as 'virtually' the same as a CD,"[75] the data underlying this statement does not support it.

The metric by which the NRSC ultimately evaluated IBOC audio quality was one of compromise; not only was HDC's "success" defined simply by the provision of fidelity "better

than analog," but the NRSC's evaluation also contained qualifiers that effectively authorized some level of audio degradation resulting from the intermixing of a station's analog/digital hybrid signals. It allowed a successful IBOC standard to compromise analog audio fidelity in order to maintain the robustness of the digital signal."[76] This further lowered the benchmark of what was considered acceptable audio quality. When the listening test data was revealed, IBOC's codec performed mediocre at best. AM listener test data was never released, but the FM figures paint a disturbing picture. Figure 3.9 breaks down, by percentage, the general audience-sample which compared FM-IBOC audio quality to analog FM broadcasts. 82% of the respondents rated IBOC audio as sounding *equal to* or *worse than* analog FM; only 18% heard an improvement in fidelity. Among expert listeners, as shown in Figure 3.10, the results were strikingly similar; 85% found IBOC's audio quality to be equal to or worse than analog FM, with just 15% perceiving that digital sounded better. But perhaps the most damning result of the listener tests were those that used expert listeners to compare analog FM and hybrid FM-IBOC sound samples under conditions involving potential interference. The results are shown in Figure 3.11: of the 100 respondents in the test, 82% judged the FM-IBOC signal to sound the same or worse than its parent analog FM transmission.

In addition, the Hybrid Digital Codec does not work well with other digitally-encoded audio. When compressed digital audio is re-compressed by another codec, a process called "transcoding" takes place, which can result in the generation of artifacts which further degrades the final audio output.[77] Many radio stations already use compressed digital audio in some form; encoding it for broadcast through the HDC algorithm opens up many new possibilities for degraded audio.[78] Therefore, stations are encouraged to rebuild their entire air-chain so that uncompressed audio is fed directly to the IBOC encoder/transmitter, or, if prior encoding is unavoidable, that stations use only one "family" of codecs to minimize transcoding artifacts in an IBOC signal.[79] This, too, is a hidden cost that must be considered in a radio station's digitalization.[80] IBOC's proprietors have subsequently "clarified" that the "HD" in IBOC's trademarked name, "HD Radio," does not stand for "High Definition,"[81] although early marketing efforts suggested otherwise.[82] This change in the meaning of "HD" has been termed "disingenuous" by *Radio World*.[83]

III. Proprietary Nature

Perhaps the least discussed feature of IBOC DAB is its wholly proprietary nature. After a few years of developmental competition, IBOC's two major proprietors (Lucent Digital Radio and USA Digital Radio) merged to form iBiquity Digital Corporation in 2000 (see Chapter 4). With the creation of iBiquity, all of the intellectual property used in IBOC DAB technology was brought under one roof.[84] iBiquity has no qualms with leveraging this position; in fact, it is inherent to its business model.

For broadcasters, there is a one-time licensing fee payable to iBiquity in order use the technology;[85] for a time, iBiquity considered setting the license fee based on a station's market size and audience share, but dismissed that formula as overly complicated.[86] If a station wishes to deploy value-added applications, such as multicasting or datacasting, it will be charged an amount equal to 3% of quarterly net revenue derived from the applications or $1,000 per year, whichever is greater.[87] iBiquity will not charge for software upgrades that fix bugs in the IBOC system, but as new features are added to the protocol those, too, will come at a price.[88] For example, iBiquity has acquired the intellectual property rights to technology that would allow the encryption of subscription-based programming on the IBOC platform, so fees to use that feature will also flow to the company.[89]

iBiquity's broadcaster licensing terms clearly state that the contract is perpetual; that a broadcaster does not own the IBOC software; and may not sell or otherwise transfer IBOC technology to another party, except in cases where a radio station is sold, although such a transfer may only occur after written permission is obtained.[90] Furthermore, iBiquity retains the right to audit a station's financial records at any time and revoke a station's license agreement after 30 days of licensing fee nonpayment.[91] In the event of a radio station in fiscal difficulty, iBiquity retains the right to allow the broadcaster to continue to use the IBOC system, provided a 1.5% interest charge is tacked onto the station's unpaid license balance.[92] If iBiquity software does any material damage to a radio station, the company is indemnified for costs in excess of $200,000.[93] These terms were promulgated against the recommendations of iBiquity's own broadcaster advisory council.[94]

As a result, iBiquity wholly controls who may broadcast in the U.S. digital radio domain.

Until now, such gatekeeper-authority rested solely in the hands of the FCC, which seems unconcerned about this fundamental shift in power that IBOC's proprietary nature portends.

For IBOC DAB receiver manufacturers, the terms of license are similarly strict. Licenses are nontransferable; all products that contain IBOC technology must be labeled on the outside as such; derivative works are disallowed under penalty of law; and license terms are only good for five years. Monetarily, receiver manufacturers must pay a one-time fee (the amount of which is undisclosed) and a "per unit" royalty "based on a percentage of the aggregate total gross invoiced [receiver] sales." Per-unit royalties are to be paid quarterly. Receiver manufacturers must also agree to open their books to iBiquity and submit "quarterly sales reports along with royalty payments."[95] Adding IBOC functionality is expensive relative to other receiver-features: whereas a chipset to provide analog FM radio reception might cost a consumer electronics manufacturer forty cents, with no perpetual charge, the price of an IBOC receiver chipset is in the range of $12, and comes with residual costs.[96]

Finally, all developers of IBOC-related applications must first run their proposals by iBiquity and, if they are approved, must pay to use the programming language that iBiquity has written for application-development.[97] The FCC's operative governance on this intellectual property issue dates back to a rulemaking from 1961 - well before the advent of modern computing, much less the intricate problems that come with the constraints of proprietary technology in the realm of software.[98]

Public radio stations initially reacted very strongly against IBOC's proprietary nature. At the 2002 Public Radio Conference, Nevada Public Radio General Manager Lamar Marchese asked an FCC representative, "How is the FCC coming down on this perpetual franchise granted with no competition?" Marchese received much applause, but no substantive answer. Instead, iBiquity President and CEO Robert Struble responded nonchalantly, "We are a business. We do have to make some money."[99] Public radio broadcasters subsequently banded together to seek some relief from iBiquity's pay-to-play system.[100] Ultimately, iBiquity and the Corporation for Public Broadcasting hammered out a deal for CPB-qualified stations that waived the one-time license fee for early adopters, capped it at a discounted rate for the rest, and removed the perpetual fees for the use of applications such as multicasting and datacasting.[101] Even so, by

2005, the CPB had spent more than $8.8 million on proprietary IBOC hardware and software to help public radio stations affect a digital conversion.[102]

Perhaps most importantly, technical information about the IBOC DAB standard has not been fully disclosed. According to the terms of the National Radio Systems Committee's broadcast standard-setting process, standards must include two forms of documentation: normative and informative. Normative documents contain "a detailed description of a component of the standard. To be compliant with the standard, a device or system *must* satisfy not only the general criteria in the main standard document, but also the detailed criteria contained in those normative references that relate to the workings of the device." As of now, all normative documents included in the NRSC's IBOC standard remain the property of iBiquity Digital Corporation.[103] Informative references, on the other hand, are used to "help the reader understand something about the standard that may not be evident by reviewing the...normative references. An informative reference may contain, for instance, an example of an implementation of the standard, or material that provides background information on a specification." An informative reference for the IBOC standard, for example, would include specifications on the codec used to process audio. iBiquity has declined to provide complete normative or informative references for the HDC codec, leaving those with an interest in exploring IBOC without a complete set of documentation with which to tinker.[104] The company explained that it had "compelling reasons" for not releasing this information, and its recalcitrance on the issue forced the NRSC to publish an IBOC standard that does not include a codec. This provides iBiquity with the opportunity to change or modify this aspect of its system with no meaningful review or oversight, which could add future costs to the implementation of IBOC DAB.[105]

iBiquity's refusal to disclose this information forces transmitter and receiver manufacturers into the company's intellectual-property straitjacket. According to David Maxson, "In theory, a manufacturer could develop a product that is...compliant but that has not earned the right to use the HD Radio name and logo. In practice, the manufacturer would find it necessary to license iBiquity patents to manufacture and sell its...product. While doing so, the manufacturer may be enticed...to take the next step and join the HD Radio family."[106] Nondisclosure also subverts patent expiration on IBOC technology.

Although the National Radio Systems Committee ostensibly approves standards that are open on a Reasonable and Nondiscriminatory (RAND) basis,[107] it is difficult to see how that applies to the certification of the IBOC digital radio system. In *Radio World*, Skip Pizzi lamented that

> there is something fundamentally troubling about a digital broadcasting format designed by a unilateral, proprietary group and not driven by an open standards process....If the FCC rubber-stamps a format proposed by private interests, it will be neglecting due diligence and abdicating its ultimate responsibility as a steward of the public interest.[108]

Pizzi was not alone in his criticism: Paul Signorelli, Chief Technology Officer for Impulse Radio, a developer of digital radio broadcast applications, opined that a proprietary approach would not spur innovation in the IBOC arena. "Ironically, it seems iBiquity would rather own all of nothing rather than a large piece of something huge," he wrote. "So let's not simply let them assuage us with talk of openness. We're dumb, but not that dumb."[109] David Maxson agreed:

> With such dominance of the technology comes the potential for too much control in the hands of one enterprise. As the regulatory authority, the FCC should be certain that all standards and policies encourage competition in all levels of the IBOC marketplace....Innovators should not be forced to get the permission of the dominant competitor to develop new ideas. Licensure of the core technologies should be at arms length from the activities that develop features that utilize the technology.[110]

Suspicion of IBOC's proprietary nature can be found among all constituencies involved in the digital radio issue, but is most severe among independent broadcasters, consulting engineers, and the public. Many worry that by adopting IBOC technology, the United States is forcibly balkanizing global digital radio compatibility, creating a universe of "undesirable diversity" in an embryonic technological space.[111] For its part, iBiquity has demonstrated a powerful sense of hubris when confronted with these concerns. At the 2002 NAB annual convention, Robert Struble directly likened the company to Microsoft: "We're a software company. If you buy a transmitter, you'll need new software from us."[112] That same year, iBiquity claimed it would reap some $600 million per year in licensing revenue by 2010.[113]

The three fundamental flaws of IBOC DAB cannot be overcome through redesign or other remedial measures. The spectral footprint of hybrid IBOC signals - twice as large as that of an FM analog station, and three times the size of an analog AM station - is required for its most basic operation, and this can cause destructive interference to both IBOC host-broadcasters and

neighboring stations on the dial. In the case of AM-IBOC, the potential impact of interference may be regional or national in scope. With regard to bandwidth capacity, IBOC provides very little compared to other 21st century digital information conduits. It falls far short of providing broadband-level service, and its lack of interactivity is a hindrance that IBOC developers and broadcasters are still seriously pondering. The promise of providing radio service that sounds "better than analog" is a dubious one; furthermore, IBOC's "value-added services" such as multicasting and datacasting are underwhelming and can only be deployed at the sacrifice of digital audio fidelity. Finally, the end-to-end proprietary nature of IBOC stifles its uptake as well as innovation in the digital radio space. Ironically, when IBOC's supporters formally engaged the FCC in policymaking to cement the standard as the future of U.S. digital radio, these issues were hardly on the agency's radar. The result was a controversial standards-setting process where IBOC's fundamental flaws would repeatedly come back to haunt it.

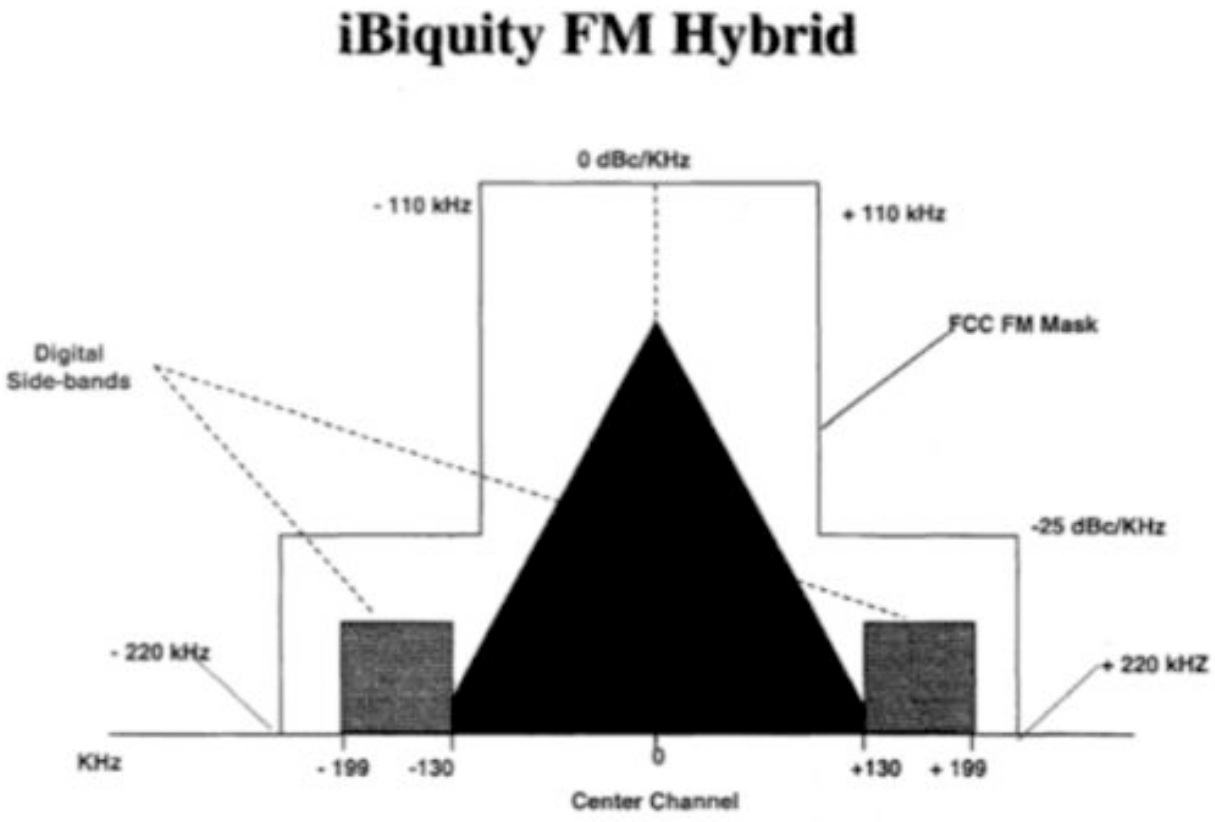

Figure 3.1. Spectral schematic of a hybrid analog-digital FM signal.[114]

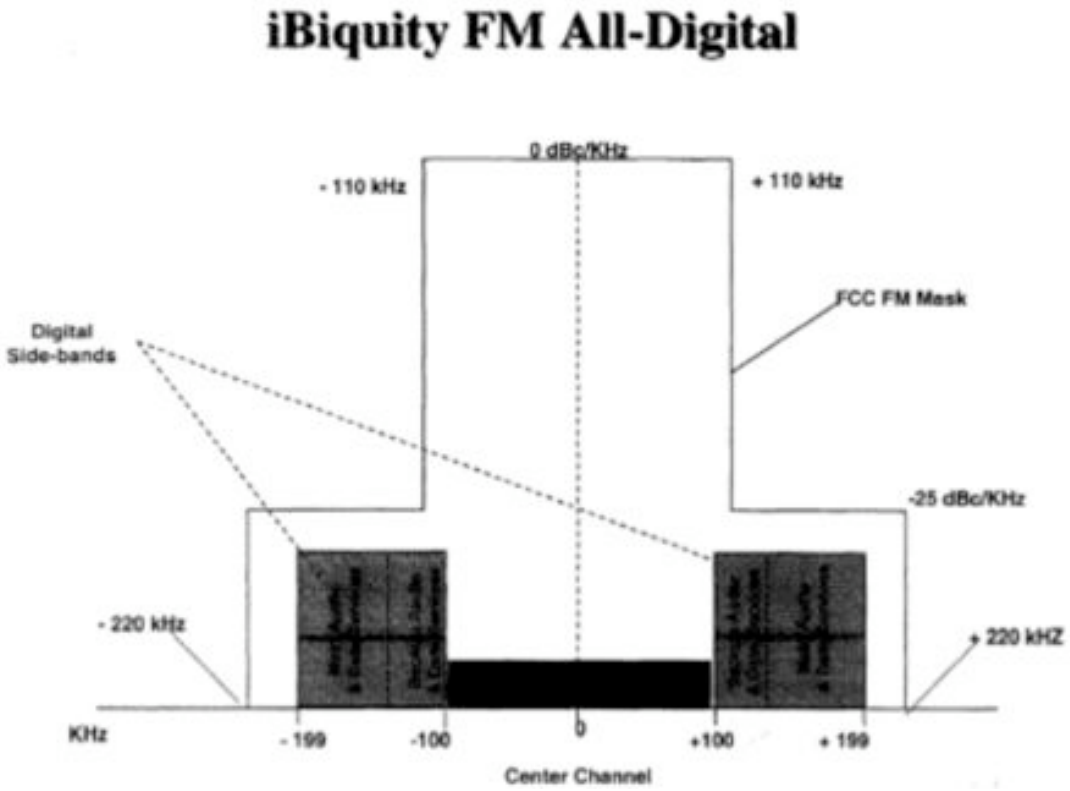

Figure 3.2. Spectral schematic of an all-digital FM signal.[115]

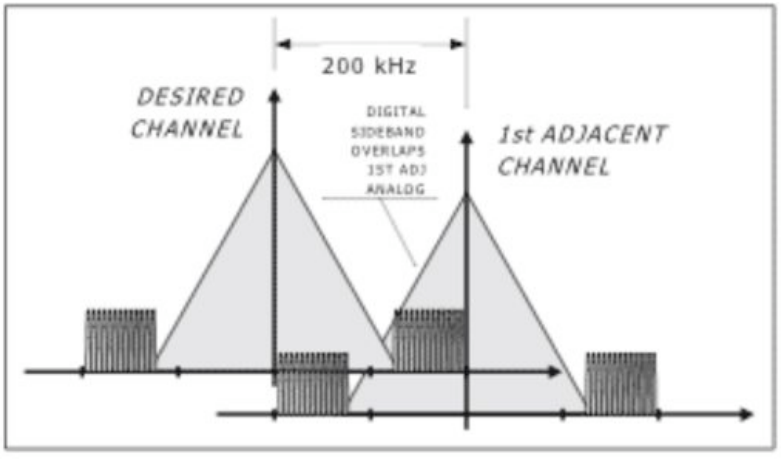

Figure 3.3. Example of two FM-IBOC stations on adjacent channels, with analog and digital signals overlapping each other.[116]

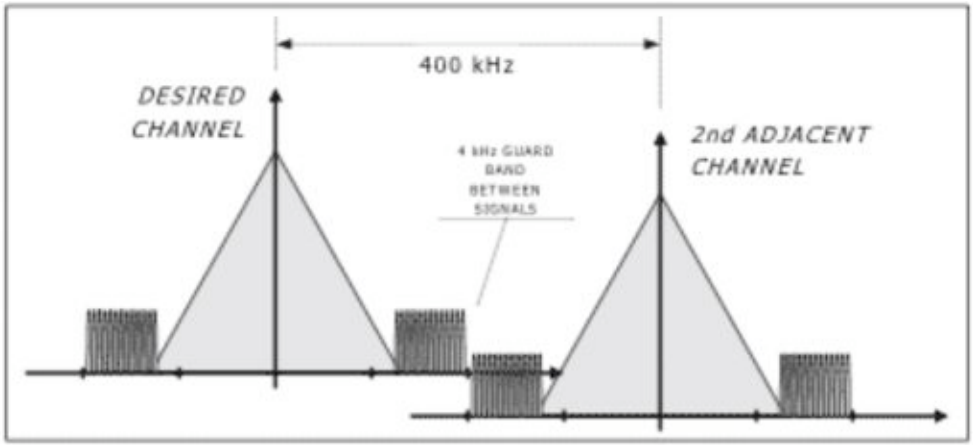

Figure 3.4. Example of two FM-IBOC stations on second-adjacent channels to each other.[117]

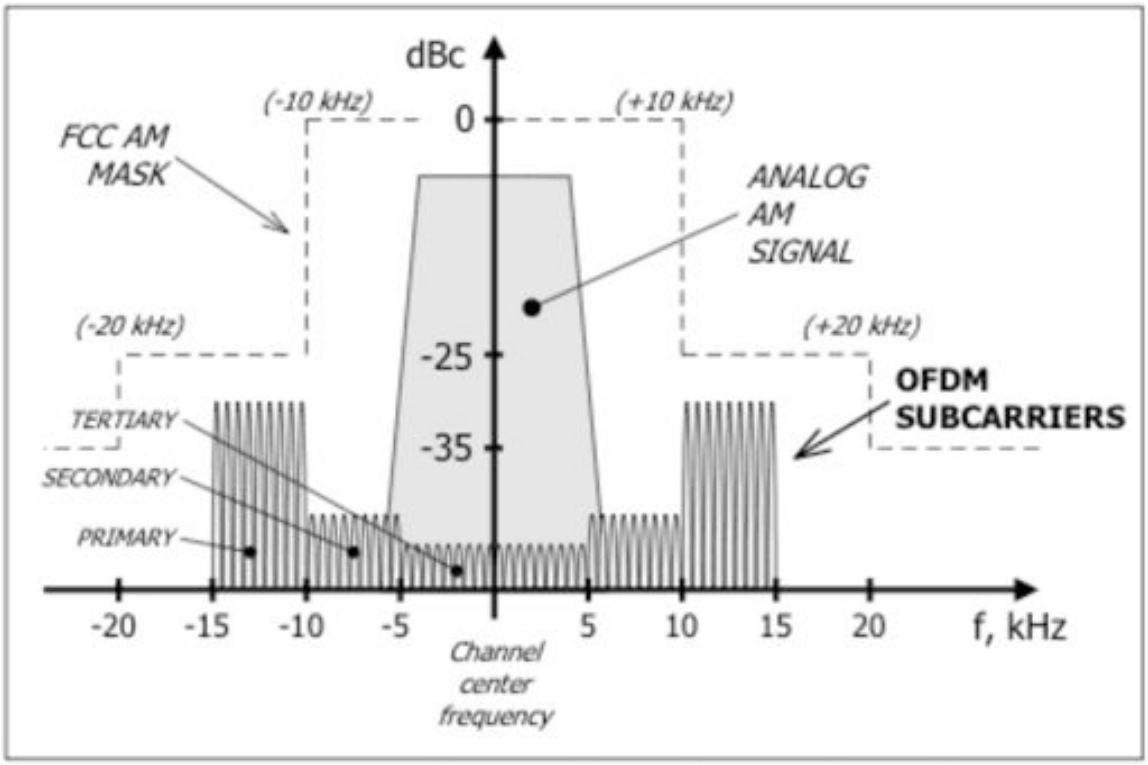

Figure 3.5. Spectral schematic of a hybrid analog/digital AM-IBOC radio signal.[118]

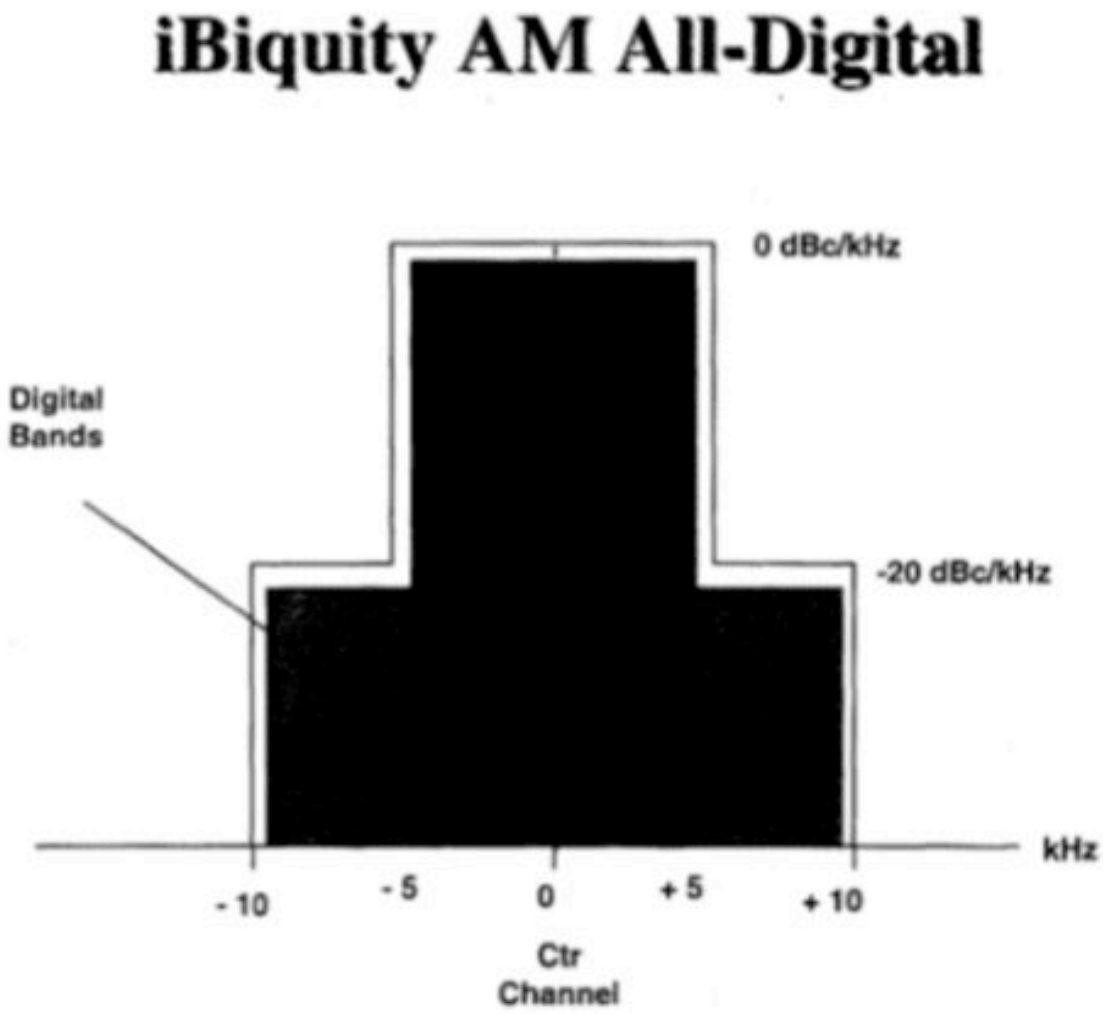

Figure 3.6. Spectral schematic of an all-digital AM-IBOC signal.[119]

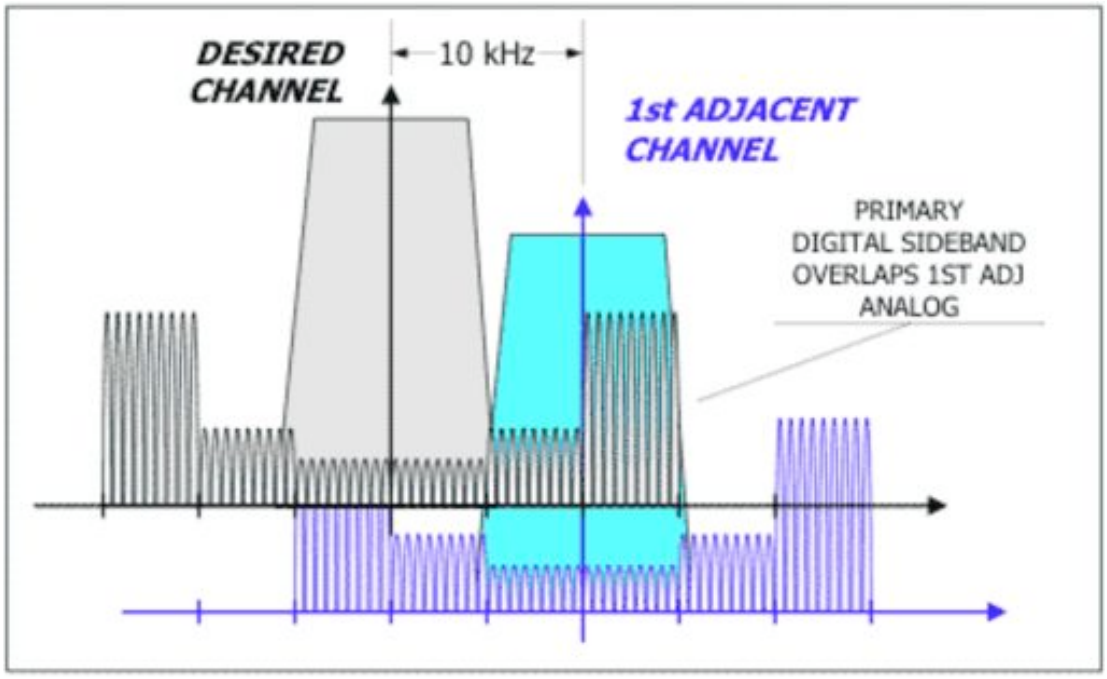

Figure 3.7. Illustration of how two hybrid AM-IBOC stations on adjacent channels can cause interference to each other.[120]

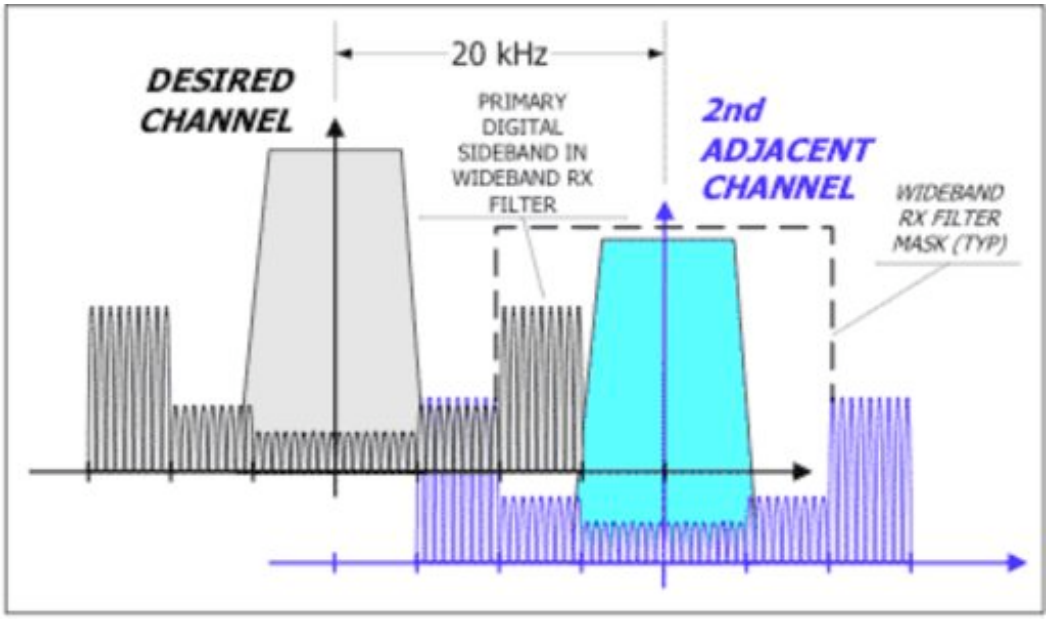

Figure 3.8. Illustration of second-adjacent channel interference between two hybrid AM-IBOC stations.[121]

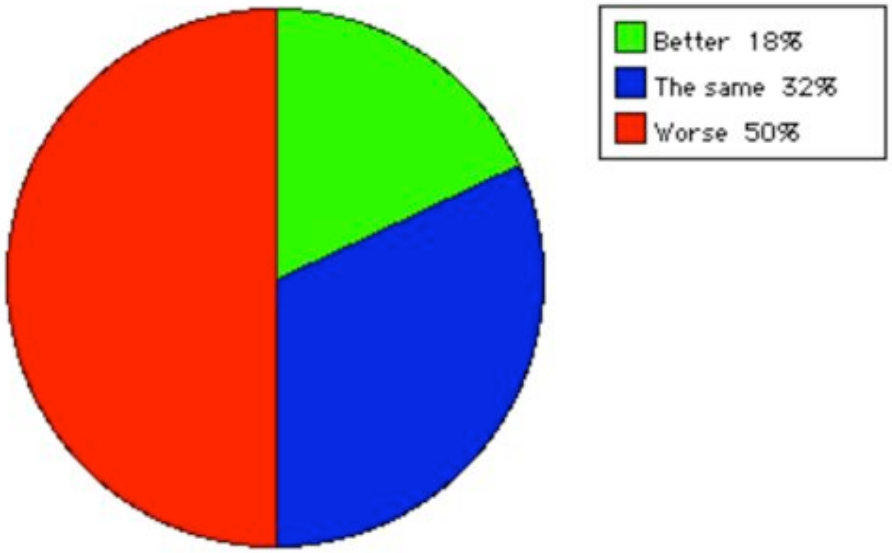

Figure 3.9. Percentage of general-public listeners grading IBOC audio quality relative to analog FM (n=1600).[122]

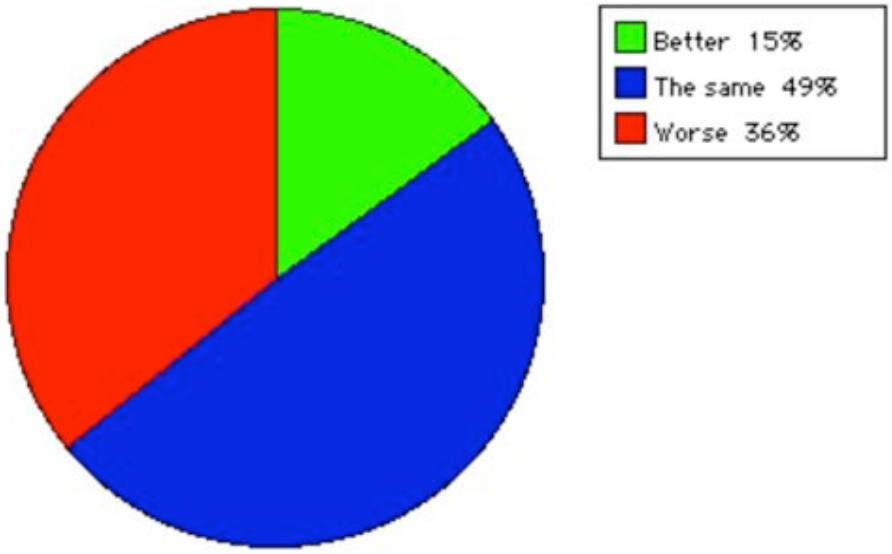

Figure 3.10. Percentage of expert listeners grading IBOC audio quality relative to analog FM (n=100)[123]

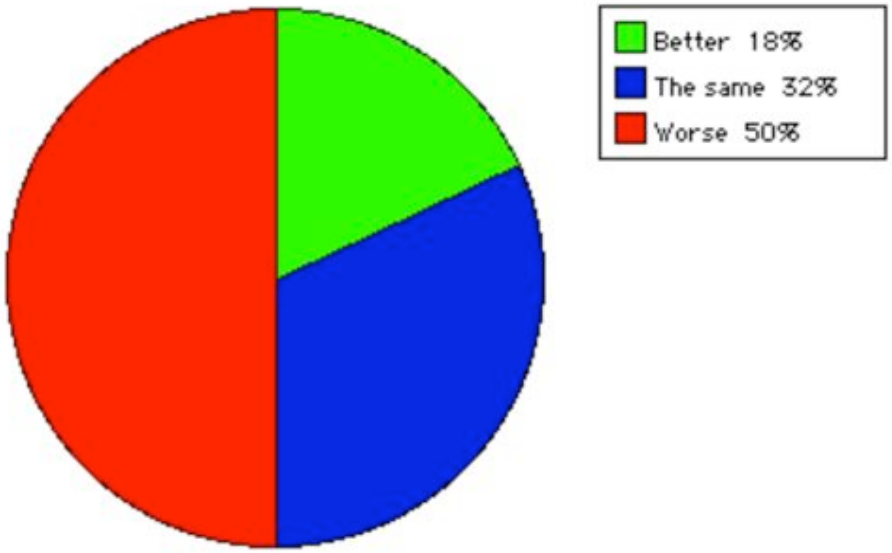

Figure 3.11. Percentage of expert listeners grading IBOC-FM audio quality in an "intrusive" environment where interfering signals exist (n=100).[124]

Notes to Chapter 3

1. NRSC DAB Subcommittee, "Evaluation of USA Digital Radio's Submission to the NRSC DAB Subcommittee of Selected Laboratory and Field Test Results for its FM and AM Band IBOC System," April 8, 2000, filed as ex-parte notice by the National Association of Broadcasters, MM 99-325, May 12, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006514213 (December 19, 2009), p. 5.

2. David P. Maxson, *The IBOC Handbook: Understanding HD Radio Technology* (Burlington, MA: Focal Press, 2007), p. 80.

3. Ken C. Pohlmann, *Principles of Digital Audio, 5th Edition* (New York: McGraw-Hill, 2005), p. 653.

4. See 47 CFR Sec. 73.317 (FM) and 47 CFR Sec. 73.44 (AM), January 12, 2010 (July 3, 2010).

5. Comments of Scott A. Clifton, MM 99-325, May 25, 2004, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511338271 (January 16, 2010), p. 1-2.

6. Federal Communications Commission, *Notice of Proposed Rulemaking: Digital Audio Broadcasting Systems and Their Impact On The Terrestrial Radio Broadcast Service*, Audio Services Division, Mass Media Bureau (MM) Docket 99-325, November 1, 1999 (December 11, 2009), p. 4-5.

7. Maxson, p. 241, 256.

8. Id., p. 267.

9. Id., p. 365.

10. Pohlmann, p. 654, 656.

11. See Mike Starling, "Call it IBAC," *Radio World*, May 22, 2002, p. 62; Robert Gonsett, "Call it IBAC," *Radio World*, May 22, 2002, p. 62; Comments of Barry McLarnon, MM 99-325, June 14, 2004, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365435 (January 17, 2010), p. 12; and Comments of Clifton, p. 1.

12. See NPR Labs, *Report to the Corporation for Public Broadcasting: Digital Radio Coverage & Interference Analysis (DRCIA) Research Project , Final Report*, May 16, 2008, http://www.nprlabs.org/publications/reports/200807151043-DRCIAFinalReport-Full.pdf (September 15, 2009), p. 21, and Maxson, p. 52, 421.

13. Jeff Detweiler, "FM Coverage Area," *Radio World*, February 13, 2002, p. 5.

14. Maxson, p. 421, 423-424.

15. Russ Mundschenk and Milford Smith, "Why a Full 10 dB Increase Is Necessary," *Radio World Engineering Extra*, October 14, 2009, p. 16.

16. NPR Labs, p. 42-43.

17. Id., p. 31.

18. McLarnon, "Skip Pizzi and HD," *Radio World*, June 6, 2007, p. 53.

19. See USA Digital Radio, Inc., *Submission of Report*, MM 99-325, December 21, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006009927 (December 11, 2009), p. 9-10, and Id., Appendix B, p. 20.

20. Id. Appendix H, p. 17.

21. Maxson, p. 246-247, 255, and USA Digital Radio, Inc., Appendix F, p. 6, 20.

22. Leslie Stimson, "Ibiquity: Time to Roll Out IBOC," *Radio World*, March 27, 2002, p. 7.

23. Bob Surette, "Spectral Regrowth Can Affect Digital Performance," *Radio World Engineering Extra,* April 4, 2007, p. 1, 12, 14, 16, 18, 22, 24, 26, 28.

24. Maxson, p. 252.

25. See Michael Couzens, "Readers write: NPR should have better ways to compete than thwarting new noncom radio stations," *Current*, November 11, 2009, http://www.current.org/tech/tech0922lpfmletter.shtml (December 6, 2009), and Marko Ala-Fossi and Alan G. Stavitsky, "Understanding IBOC: Digital Technology of Analog Economics," *Journal of Radio Studies*, vol. 10, iss. 1 (2003), p. 71. According to the FCC's LPFM rules, LPFM stations are classified as a "secondary" broadcast service, which means not only are they prohibited from generating any interference of their own, but they are wholly unprotected from interference caused by other stations. See 47 CFR 73 Sec. 73.809, January 12, 2010 (July 3, 2010).

26. See Steve Behrens, "More power for HD Radio, more buzz on analog," *Current*, vol. XXVII, no. 15 (September 2, 2008), p. 8.

27. Maxson, p. 369.

28. Id. p. 369.

29. Richard J. Fry, "Ready for FM IBOC? Here's a Q&A," *Radio World*, October 26, 2001, p. 21.

30. Bob Clinton, "How to Prep Now for IBOC Later," *Radio World*, May 23, 2001, p. 8, 20.

31. Fry, "FM IBOC Planning Worksheet," *Radio World*, February 13, 2002, p. 20.

32. Maxson, p. 386.

33. Id., p. 351.

34. Comments of Lucent Digital Radio, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111664 (December 14, 2009), Appendix I, p. 2.

35. Id., p. 3.

36. McLarnon, "Enough Is Enough," *Radio World*, December 5, 2007, p. 5.

37. Maxson, p. 81.

38. See Jeff R. Detweiler, "Conversion Requirements for AM & FM IBOC Transmission," iBiquity Digital Corporation White Paper, n.d., http://www.ibiquity.com/i/pdfs/Conversion_Requirements.pdf (August 13, 2009), p. 4; Comments of USA Digital Radio, Inc., Appendix I, p. 4, footnote 2; and Pohlmann, p. 658.

39. Maxson, p. 261-62.

40. Steven A. Johnson, "The Structure and Generation of Robust Waveforms for AM In Band On Channel Digital Broadcasting," iBiquity Digital Corporation White Paper, n.d., http://www.ibiquity.com/i/pdfs/Waveforms_AM.pdf (August 13, 2009), p. 4.

41. Maxson, p. 258.

42. Id., p. 358.

43. John Anderson, "Digital Radio in the United States: Privatization of the Public Airwaves?" *Southern Review,* vol. 39, no. 2 (2006), p. 10.

44. Maxson, p. 341.

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Chapter 4: FCC "Deliberation" of HD Radio

Between 1998 and 2002, the proponents of IBOC DAB would work to formally establish the dominant operative metaphors of the technology and its advocate for its selection as the future of U.S. radio broadcasting. Although the question of whether analog and digital radio signals could peacefully coexist remained an open one, USA Digital Radio forced the issue by filing a Petition for Rulemaking with the Federal Communications Commission on October 7, 1998.[1] Touting its long-standing connection to the broadcast industry and claiming that "commercial [IBOC] transmission systems will be available within 18 months,"[2] USADR asked the Commission to "immediately make a finding that IBOC will be the method of transmission for DAB in the United States."[3]

USA Digital Radio claimed its technology had wide support within the industry when it actually had the support of a minority of station-owners who happened to control the majority of industry revenue. Since the FCC's regulatory paradigm favors economic metrics over all others, the consensus among broadcast conglomerates in favor of IBOC technology was equated by regulators with nearly-universal support within the industry itself. This disconnect would become painfully apparent within the policy dramaturgy. With tacit support from public broadcasters, who represent the majority of noncommercial stations in the nation, regulators undertook digital radio policymaking on the mistaken premise that the entire industry backed IBOC as the preferred technology by which radio broadcasting could navigate a digital, convergent media environment. Given the contentious record of public comment that would result from USADR's Petition for Rulemaking, the FCC's ultimate approval of IBOC would only be possible if the agency remained willfully ignorant of the technology's real-world implications.

Left similarly unaddressed by regulators was any exploration of alternatives to IBOC. As a rule, industry incumbents will prefer a technological development which strengthens their incumbency; as a product of industry investment and sanctioned by the industry's standards-setting body, IBOC appeared to be the least painless and most profitable way to digitize radio broadcasting in the United States. Although there was no concrete evidence that IBOC would function well (i.e., in a manner that could ultimately supplant existing analog services) - much less a clamor among the listening public for the digitization of radio broadcasting - the industry's

largest station-owners effectively gambled on the marketplace primacy of IBOC as a transitional technology with no competitor. For its proponents, IBOC did not have to be substantially better than the analog signals it might replace, just good enough to set the digital paradigm for radio's future.

There is no evidence that external factors played any significant role in the industry's decision to push for the approval of IBOC DAB. For example, the pending launch of digital satellite radio service was not actually a meaningful threat to broadcasters' inherent ability to profit by serving specific locales well, though SDARS was invoked to imbue the regulatory approval of IBOC with a sense of urgency. Secondly, the Internet was still in its infancy - most people online did not yet have broadband connections - so the concept of webcasting was not recognized as a viable competitor to "traditional" radio broadcasting. It is difficult to characterize USA Digital Radio's supporters as anything other than oblivious to the dynamic landscape for emerging, broadcast radio-type services that the Internet would engender. The FCC, having been disengaged from the IBOC development process, took many of its proponents' assertions at face value, including those that positioned multicasting and datacasting as features which would revolutionize the act of broadcasting itself, even though those features were not fully developed or documented at the time. Dissenting voices - of which there were many - were simply considered outside the realm of acceptable policy discourse that had been defined by the Petition for Rulemaking itself, and were thus ignored or marginalized by the FCC. Regulators, too, simply ignored the technology's fundamental detriments and refused to considerer any alternative digital radio technologies.

I. Justifying the Compulsion to Digitize

Establishing the dominant operative metaphor - that radio must go digital - was USADR's first task. It accomplished this by characterizing its technology as the "means to preserve the special role broadcast radio plays in American life," which was left undefined.[4] The FCC's impending satellite radio rulemaking was cited as a competitive threat to the radio broadcast industry - not because of its inherent originality as a new broadcast audio service, but primarily because it was digital and terrestrial radio was not. More importantly, IBOC technology was construed as the only viable solution to bring radio broadcasting into the digital era. Observing that finding new spectrum for digital radio was "exceedingly difficult, if not

impossible," USADR asserted that any other path to digitization would "create tremendous turmoil in the radio industry, disrupting service to the public, and impose a significant administrative burden on regulatory authorities."[5] USADR's Petition for Rulemaking also laid the foundation for the second operative metaphor, that DAB need not be substantially superior to existing analog radio service. No significant elements of the USADR technology, save for a projected improvement in audio broadcast fidelity and couple of references to nebulous "new services" that the protocol might provide, were discussed by USADR in its Petition.

In fact, most of USADR's Petition for Rulemaking emphasized the third operative metaphor: that sacrifices must be made to analog service in order to accommodate IBOC broadcasts. USADR admitted that "a number of technical tradeoffs" would be required to make IBOC work, but if implemented correctly, it could be adopted "without disruption in service to the public."[6] USADR claimed that any new interference introduced into the broadcast bands by digital radio would be "self-masking" and that existing analog service "should not be significantly affected by introducing IBOC DAB signals into the environment."[7]

In effect, what USADR accomplished by filing the first digital radio Petition for Rulemaking was to cast itself as the leading developer of IBOC technology in the eyes of policymakers. By 1998, USADR had enjoyed the backing of the radio industry in some shape or form for nearly a decade, while Lucent Digital Radio was a latecomer to the IBOC development game and seen as an outsider with no direct experience in the business of broadcasting. Although USADR and LDR's IBOC systems were far from deployment-ready, USADR hoped that triggering a policymaking process on the technology would serve in a tactical sense to clear the field for a single standard. The Federal Communications Commission officially acknowledged USADR's Petition and allowed public comment on it for two and a half months.[8]

Industry proponents immediately rallied to the USADR call. Bonneville International Corporation agreed with the need for expedited regulatory approval of IBOC, citing satellite radio as the prominent catalyst for doing so.[9] Clear Channel practically begged the FCC to referee further development of the technology in order to avoid implementation hurdles such as those that plagued the DTV transition process.[10] Susquehanna Radio Corporation, whose top engineering executives were involved with the National Radio Systems Committee's study of

IBOC, endorsed the technology as in "the best interest of both the broadcasters and the public."[11] Many large national broadcasters, such as Disney, CBS and the Gannett Company (the latter two being founders of USADR) joined this chorus.[12] Cumulus Media summed up the primary operative metaphor - and the nebulous understanding of convergence on which it rested - most succinctly: "The driving force behind this digital revolution is clear; for most applications, digital is simply superior to analog."[13] Heftel Broadcasting Corporation, the largest owner of Spanish-language radio stations at the time, and Radio One, the largest owner of radio stations in the country targeted toward African-Americans, urged the FCC to sanction IBOC broadcasting "with all due speed."[14] By the end of the first round of public comment on its Petition, USADR claimed that it had equity investment from 12 of the largest radio broadcasters in the United States, as well as an infusion of funding from Chase Capital Partners.[15]

Others within the industry, while supportive of IBOC in concept, urged the FCC to take more care with the evaluation and eventual approval of any digital radio technology. National Public Radio artfully acknowledged all operative metaphors behind the industry's push toward digitalization but cautioned the FCC not to foreclose consideration of "alternative approaches to DAB if IBOC proves infeasible or so burdened with compromises that the benefits of a digital transition are fundamentally undermined."[16] NPR's initial Comments, while facially supportive of IBOC, represent the only preliminary filing from a constituency intimately involved with the technology's development that suggested it may yet fail. Others, such as Greater Media and the Radio Operators Caucus (an "informal group" of 20 radio broadcast engineers employed with regional broadcast conglomerates that represented "hundreds of...stations"), agreed in principle with a DAB rulemaking but did not want USADR's technology to be chosen as the de facto standard simply on the basis that it had filed first.[17] This was a point readily agreed to by IBOC's other primary developer, Lucent Digital Radio, and the newcomer, Digital Radio Express.[18]

Independent broadcasters and consumer electronics manufacturers expressed significant concerns about the technical weaknesses of IBOC DAB. Big City Radio, a company with a handful of stations on the peripheries of major markets, asserted that IBOC technology had not been adequately evaluated and "risks significant - and even fatal - interference to many existing AM and FM licensees."[19] Big City also cued in on the economic momentum behind the Petition:

"That a large number of parties supporting an immediate Notice of Proposed Rule Making now have business interest in USADR is another reason to discount their support for USADR's proposal. The Commission should not credit the advocacy of USADR's investors as a reason for moving hastily on its Petition, especially when USADR's proposed technology has been only incompletely simulated and even less sufficiently tested."[20] Ford Motor Company told the FCC that it could only support an IBOC system so long as it would not harm existing analog signals - a guarantee which the technology could not provide.[21] Similarly, the Consumer Electronics Association emphasized the need for a more complete test-record on IBOC performance before any rulemaking could begin in earnest.[22]

USA Digital Radio noted these concerns but asserted that its technology was "in a final stage of development and there is consensus on an IBOC approach. Hesitation on the part of the Commission is unnecessary and will prolong the wait for digital radio." It disagreed with the need to protect analog radio service, given that the ultimate goal of its Petition was to transition terrestrial radio to an all-digital broadcast mode. Finally, to amplify its growing support within the radio industry, USADR referenced "a recent study of broadcasters" which suggested that "approximately 30% of radio stations are likely to convert to digital broadcasting within the first two years, with 56% likely to convert within the first five years."[23] It is unclear from USADR's comments whether non-investor broadcasters were consulted in the compilation of the survey.

Members of the public came out wholly against IBOC DAB as the preferred technology for U.S. radio's digital future. The Citizen's Media Corps of Brookline, Massachusetts noted that the industry had initially supported an alternate-band DAB system; it still believed that such a system "would be in the best interests of the citizens of the United States....It is by no means a foregone conclusion that new spectrum cannot be found. What is not lacking is spectrum, it is the will to prioritize finding that spectrum over the objections of the very powerful radio industry lobby."[24] The Prometheus Radio Project, a primary facilitator for the development of new, noncommercial low-power FM (LPFM) radio stations,[25] also questioned the political-economic rationale behind IBOC; while its proponents vaguely promised some sort of better radio service, Prometheus recommended that "the FCC find independent data about what the American public really wants from radio before going ahead with a plan that ignores the potentialities for more

channels."[26] Relatedly, the Amherst Alliance, an ad-hoc coalition of aspiring LPFM applicants and interested citizens, implored the agency look beyond the economic rationales of IBOC proponents: "We know [the industry] ha[s] invested considerable sums in Research & Development...If IBOC is not implemented, these sums may never be recovered....We will take a moment to savor the irony of institutions which loudly proclaim the need for a 'laissez-faire' economy, with minimal government regulation, while looking to government for recoupment of a potentially bad investment."[27]

Additional context for the developmental status of IBOC at the time could be found offstage, through discourse documented in the trade press. Less than a month after USADR's Petition was formally accepted by the FCC, Lucent Digital Radio President Suren Pai told *Radio World* that his company was preparing to field-test both its FM and AM-IBOC systems.[28] During the November, 1998 NAB Radio Show, all three proponents of IBOC showed off "simulated" versions of their systems to broadcasters, as opposed to the more intricate displays proffered by USADR and LDR just a few years earlier.[29] Public broadcasters' trade newspaper, *Current*, reported that the NRSC had asked all IBOC proponents to tender test results to the industry standards panel by December 15, 1999, so as to expedite its evaluation process in the wake of USADR's Petition for Rulemaking. NPR's chief technology officer, Don Lockett, conceded that USADR "has the lead in clout, if industry politics count for anything at the FCC." However, he was also surprisingly candid about the potential for IBOC to fail. "This is the last round for IBOC, I would say," he told *Current*. "Based on what I learned in the first round of testing, it has to work [soon] or we have to move on to something else.""[30]

Backstage discussions at the FCC involving IBOC's top proprietors commenced early on in the regulatory process and would continue long after deadlines for public comment had passed. These meetings strongly shaped the digital radio rulemaking which the FCC would ultimately promulgate. USADR met with Commissioner Susan Ness, a representative of Chairman William Kennard, and senior Media Bureau staff within days of filing its Petition. In these meetings, USADR emphasized the need for quick action on the approval of IBOC technology, on the meager premise that "digital" equaled "better."[31] During 1999, USADR representatives would meet with FCC Commissioners, their advisors, and senior staff nearly 20

times to advance the operative metaphors of IBOC technology and press for expeditious action on a DAB rulemaking.[32] Lucent Digital Radio also made ex parte presentations to FCC Commissioners and key staff, but did not begin its backstage activities until nearly five months after initial public comment on USADR's Petition had closed. LDR's backstage dialogue with policymakers was more nuanced; it spent a lot of time explaining the merits of its own IBOC technology and urged the FCC to take a considered and measured approach to any DAB rulemaking.[33] All ex parte presentations, either from USADR or LDR, ignored the notion of alternate-band DAB as a viable policy outcome.

On November 1, 1999, the FCC officially issued a Notice of Proposed Rulemaking (NPRM) to explore the concept of terrestrial digital radio.[34] Claiming that IBOC could provide higher-quality sound and the potential for broadcasters to "offer the public an array of new auxiliary services," the technology was contextualized by regulators as a means "to significantly enhance the American radio broadcast service."[35] The FCC admitted that such systems "have not been conclusively proven to be technically viable at this point in time, yet great strides have been made and the systems certainly hold real promise." However, the NPRM tacitly skewed the subsequent policy discourse toward an IBOC solution to the DAB issue. Acknowledging that "CEMA and other documentation" demonstrated that alternate-band DAB technology may be superior to IBOC, "No proponent of a Eureka-147 or other non-IBOC DAB system has filed comments in response to USADR' s *Petition*. We currently are unaware of any such proponents in the United States." This statement was untrue: independent broadcasters, consumer electronics manufacturers, and the pubic all suggested the exploration of non-IBOC alternatives in their initial comments on USADR's Petition, but the FCC set precedent early on to ignore these constituencies in the policymaking process. In short, although other digital radio systems existed, they were not considered feasible as the domestic radio industry had no interest in them; a comparative analysis of DAB technologies, which would have clearly highlighted the fundamental detriments of IBOC early on, would not be required by the FCC. However, the FCC did question two of the operative metaphors pushed by the industry: it wished for a digital radio service that would provide "vastly improved" service to the public, and one that "does not weaken the vitality" of existing radio services.[36]

The FCC's NPRM took at face-value many of IBOC proponents' claims about its technology, including those not grounded in any technical fact.[37] Such commentary illustrates the detachment of the FCC in the IBOC development process and the relative ignorance of the agency about the real-world implications of deploying the system. Finally, the FCC squarely put the notion of overseeing the progress of DAB development in the hands of the radio industry: it dismissed the idea of establishing an FCC-coordinated advisory committee to study digital radio, citing its historical use of the NRSC for the advancement of new radio technologies, and concluded, "We believe that it is necessary and appropriate to rely to some degree on the expertise of the private sector for DAB system evaluations and, ultimately, recommendations for a transmission standard." However, it did request that all testing and evaluation of DAB systems be filed in the official record for additional analysis by interested parties.[38]

This left radio conglomerates with three nominally competitive IBOC systems to consider and the task of consolidating them into a single DAB standard for FCC certification. USA Digital Radio filed a 333-page technical report it had submitted to the NRSC detailing the testing it had accomplished to-date on its IBOC system.[39] The report also revealed that USADR and Digital Radio Express had effectively merged their development efforts; USADR would continue to explore IBOC technology, while DRE would concentrate on the development of applications for it.[40] DRE's capitulation in the race to own the U.S. DAB standard more strongly positioned USADR as the front-runner over Lucent in the digital radio development process. USADR went into great detail describing the strength of its company; it now claimed the financial backing of radio conglomerates which boasted "coverage in 196 of the 270 Arbitron-rated markets, access to 200 million listeners and combined revenues equating to 46% of the radio industry' s total revenues."[41] More than "forty world-class engineers and scientists" were tasked to the USADR IBOC project, which already had "27 patents, with numerous pending patent applications covering broad aspects of IBOC DAB technology."[42] USADR effectively implied that the radio industry had already settled on a digital broadcast standard, and the only thing holding up its adoption and implementation was a regulatory blessing.

With the FCC content to sit on the evaluative sidelines, the focus of IBOC's technical endorsement firmly resided with the National Radio Systems Committee. USADR explicitly

opted to provide the NRSC with "only the level of information it views as necessary to demonstrate an improvement over analog." The withholding of data was justified by a desire to protect proprietary information.[43] With regard to the fundamental technical weaknesses of IBOC, USADR's portrayal of its technology was upbeat. Interference to existing stations would not be a problem because "degradation due to the environment, such as noise and the analog portion of first adjacent [channels], dominates over any additional noise added by baseline DAB."[44] Not only did USADR's report claim that IBOC would generate no significant interference, but that its testing program specifically examined worst-case scenarios not likely to be found in the real world.[45] USADR confidently claimed there was no reason to string along a policy proceeding on digital radio, given that its technology was "tested," "ready," and supported by the industry's largest players.[46]

Within a month of USADR's technical filing, the FCC was spiked with dozens of comments from supposedly independent broadcasters - who coincidentally used identical wording in their correspondence - endorsing the USADR system and asking for its immediate promulgation."[47] USADR also relied heavily on its investors to make the case for why its technology was the only viable solution for the future of domestic broadcasting. Their arguments praised the IBOC protocol and vilified any notion of an alternate-spectrum DAB option. Several USADR investors, in conjunction with the NAB, coordinated the filing of complementary IBOC assessments with the FCC.[48] Of USADR's broadcast-investors, only Greater Media conceded that while the developer's technical submissions were "admittedly limited," and that there was still room for IBOC to fail, progress at the NRSC (in which Greater Media was involved) should give the FCC enough confidence to preemptively select the technology as the U.S. digital radio standard.[49] USADR filed follow-on comments urging the FCC to sanction the proliferation of its technology by the end of 2000. Expeditious Commission action was necessary "in order to avoid a stalemate between different components of the industry," referencing the disparate levels of enthusiasm for IBOC between broadcasters, who flooded the FCC's docket with positive comments, and consumer electronics manufacturers, who either ignored the start of the DAB policy proceeding or weighed in on the side of a cautiously thorough rulemaking that considered all possible digital radio technologies.[50]

Not to be left behind, Lucent Digital Radio filed a 191-page technical synopsis of its IBOC technology with the FCC and NRSC within three months of the FCC's Notice of Proposed Rulemaking.[51] Lucent claimed its technology would use no new spectrum, preferring to characterize the necessary expansion of each station's footprint on the dial as "refarming." To its credit, Lucent did candidly admit that there would be tradeoffs between analog and digital reception quality on the AM and FM bands, but such compromises were "variables" that should be left up to individual stations to accommodate.[52] Lucent also declared that any alternate-band DAB development and proliferation in the United States would run "counter to the public interest....The Commission should be a facilitator of new technologies and services being delivered to the public, including doing whatever is necessary to allow existing licensees to upgrade their facilities in a manner consistent with the overall regulatory scheme of broadcasting."[53] If the word "overall" is replaced with "incumbent," the emphasis of Lucent's comment rings very true.

In order to illustrate the industry's willingness to move quickly on the issue, the NAB, on behalf of the NRSC, filed the latter's evaluative criteria for a successful IBOC digital radio system with the FCC on January 24, 2000. While coy on the definition of performative metrics, the filing did explain the concepts that IBOC test methodology would be built upon, with the primary criterion being that it represent "a significant improvement over existing analog services."[54] The NRSC's ultimate goal was to "develop a testing process and measurement criteria that will produce conclusive, believable and acceptable results, and be of a streamlined nature so as not to impede rapid development of this new technology."[55] However, the Committee did admit that "a number of compromises and tradeoffs among key aspects of the system" would have to be made in order to make IBOC function in the real world: "Only after a system's data has been evaluated and the technical performance pinned to a system's tradeoffs and compromises is known will it be possible to say if an IBOC system represents a significant improvement over analog services. Even then, such an assessment will be challenging."[56] Even though the NRSC was surprisingly candid about the developmental hurdles left to overcome involving IBOC and did not discount its potential to be unworkable, the Committee's declarative path is clear: it would investigate IBOC DAB solutions for radio's digital transition above all

others, and would exhaust all avenues with regard to such development before entertaining the exploration of alternative DAB technologies.

In the wake of the FCC's NPRM, other character-constituencies were not as cavalier about IBOC's prospects. Public broadcasters qualified their advocacy. Instead of framing digital radio's technical appraisal in terms of what worked best for the radio industry, National Public Radio cautioned that "[t]he process for evaluating potential systems should be sufficiently open so that the positive and negative attributes of individual systems can be assessed to determine which is the best of the competing systems, as well as whether, on balance, the public interest would be served by authorizing the implementation of that system."[57] NPR also categorized the Commission's performative goals for IBOC DAB as "simply unrealistic": IBOC could not provide increased signal robustness, improved audio fidelity, and new digital program or data services all at the same time.[58] NPR urged the Commission to stay proactively engaged in the testing and evaluation of DAB systems.[59] Similarly, the Station Resource Group, "a national membership organization of forty-five leading public radio licensees that operate some 170 stations," gently attempted to dispel the Commission's hopes that a digital transmission infrastructure would be the sole mechanism by which terrestrial radio could navigate a convergent media environment. Instead, SRG suggested that the FCC look at IBOC as only one vector that terrestrial broadcasting could use to compete in a digital media world.[60]

Consumer electronics manufacturers again attempted to emphasize the deficiencies of IBOC DAB. Sony, the world's largest manufacturer of consumer electronics, acknowledged that radio's digital transition was inevitable, but asked the FCC to select a standard that could effectively compete against other digital audio distribution conduits, which were multiplying quickly.[61] Sony suggested IBOC was simply not robust or flexible enough to entice listener interest; the impetus for a digital radio transition would ultimately be "either derived from a variety of new channels or new value-added services,"[62] neither of which IBOC could yet promise to deliver. It suggested that the Commission remain open to alternate-band digital radio technologies.[63] "As a first step, it is important to evaluate IBOC performance as it compares to current AM and FM analog [radio]. In order to draw conclusions, however, new band alternatives need to be available to provide a reference for comparison....Although there is no

similarity with implementations, there is value in comparing performance of the digital systems and the complexities of implementations."[64]

Receiver manufacturers working specifically in the automotive space also urged careful consideration of a digital radio transition. Visteon Automotive Systems, one of the world's largest producers of manufacturer-installed radio receivers, observed that should a substandard DAB protocol be chosen, it would cause consumer confusion and dismay.[65] Conceding that the creation of an alternate-band DAB system "would probably not be economically practical,"[66] any IBOC solution that degraded analog radio reception that listeners were used to or did not "offer value for the additional costs that will be incurred by the broadcasters and by the public to implement the service" was undesirable.[67] Visteon observed that simply adding digital broadcast capability to existing AM and FM stations "would not, in itself, promote diversity in programming."[68] As a means of heading off consumer dissatisfaction with any new digital radio service, Visteon suggested the FCC create an advisory committee to examine the implications of imposing IBOC DAB. It did not favor the NRSC as the venue for standards-evaluation because it already seemed predisposed to support IBOC above all others; "As such, it is too narrowly focused to provide all of the data that the FCC will need to make a reasoned decision and to select the best DAB alternative."[69] Finally, Visteon proposed a public education program to explain to listeners how and why their existing analog reception may change in the face of IBOC. "For example, they will need to understand why their analog reception will not be as robust as it once was and that, initially, digital broadcasting service areas might not equal those of the older analog technology until the technology is fully implemented."[70]

The Consumer Electronics Association boiled down its critique of IBOC to a finer point. It challenged the technology's proponents to "convincingly demonstrate that an IBOC-delivered audio experience is attractive to listeners [and] sufficient to persuade consumers to purchase new radio receivers."[71] With more than 710 million analog radio receivers in use in the United States, CEA implored the Commission to become better-versed in the negative impacts of IBOC technology on existing analog radio service.[72] CEA requested the FCC set benchmarks for any digital radio system that would guarantee fidelity higher than what current iterations of IBOC could provide.[73] In addition, it wanted the FCC to keep open the possibility for alternate-band

DAB services;[74] to that end, CEA submitted a 42-page concept analysis to the FCC of a "new mobile multimedia broadcast service" deployed on reclaimed swaths of analog UHF television spectrum.[75] This would be the last time that any major industry-related constituency would substantively raise the notion of alternatives to IBOC.

Consulting engineer David Maxson, a member of the NRSC's DAB Subcommittee, filed his own comments in response to the FCC's NPRM. Although he supported IBOC in concept and disputed the notion that such a system represented a spectrum-grab of any real value,[76] he was well-aware of its technical deficiencies. "Because of the limited data capability," Maxson wrote,

> IBOC in its hybrid mode (with analog still present) does not appear to break radio broadcasting into this brave new world in the manner that DTV appears to do for television....The main feature of a hybrid IBOC system is its anticipated improved robustness over analog. Is improved robustness enough of a draw to get people to change out millions of analog radios for new DAB radios over a few years?

"If radio broadcasters did not fear that their investments would be at risk for proposing a DTV-like solution, we suspect one might have been developed," he commented.[77] Ultimately, Maxson challenged the FCC to approve a digital radio service primarily from the perspective of the radio audience, not on the basis of economic rationales proffered by the industry. "[W]e believe the Commission has a duty to be the advocate for consumer benefit in selecting a final approach," he wrote. "Because the nature of free over-the-air broadcasting requires ubiquitous, low cost reception, it should not be left to the marketplace to decide how it should be done."[78]

The primary antagonists of IBOC implementation were independent broadcasters and the public. Many of them had followed the turgid development of IBOC systems during the 1990s and were not impressed. In general, they viewed any IBOC system as fundamentally flawed and were somewhat taken aback by the possibility that the FCC seemed amenable to the degradation of analog radio service in order to introduce an unproven technology. Gene A. Benedictson, owner of Washington state-based Clarkston Broadcasters, Inc., noted that "[s]o far all of the money and support seems to be coming from the huge broadcasting groups that have huge money resources to dip into. Small market radio can't afford to spend money like that."[79] Willis Broadcasting Corporation, a minority-owned licensee of more than three dozen stations, commented that "on the assumption that the two major proponents of IBOC DAB are able to

demonstrate superior audio quality and robust resistance to interference, IBOC DAB should have everyone's vote." But if that were not so, the FCC should not "shirk its responsibility" to make alternate arrangements with regard to digital radio.[80]

This concern was amplified by the U.S. Small Administration's Office of Advocacy, which suggested the FCC had not done due diligence with regard to weighing the costs of imposing a DAB system on small-to-medium broadcasters who did not have the capital necessary to undertake a digital conversion.[81] The Commission, argued the SBA, "offers little evidence, and may not have any evidence, that digital audio broadcasting is technically feasible, compatible with analog broadcast (including low-power FM), and cost effective for broadcasters." Only after solidly justifying the need for radio's digitalization could "the Commission reasonably conclude that digital conversion would serve the public interest."[82]

Members of the public offered the most explicit critiques of an IBOC-led digital radio transition. Several individuals were mystified that a regulatory agency specializing in communications technology could overlook the potentially detrimental nature of expanding the spectral footprint of all radio stations.[83] Others questioned just where the impetus for "improving" radio broadcasting via digital technology was coming from.[84] Richard Hartnett of London, Ohio, was "perplexed" by major broadcasters' desire to go digital. "Before considering this issue, please let the public know what you are proposing. I have not seen any press on this in the public press....The listeners should have as much input as industry."[85] Alan Ricotta of Naples, Florida observed, in contradiction to the industry's dominant operative policy metaphor, that "[d]igital does not always mean better."[86] The Virginia Center for the Public Press remarked that "[b]ooks are still popular ... in spite of being 'obsolete'. So...the notion that analog radio is 'obsolete' and that this is the best excuse to replace it with digital radio should NOT be accepted without question."[87] The VCPP also provided the first independent report of FM-IBOC interference, monitored on two receivers, during previous USADR field tests.[88]

Public comment focused on the motives behind an industry-prompted digital radio transition. The Amherst Alliance suggested the rush to approve IBOC DAB was "a flawed attempt to address program content problems," such as the diminution of local programming in the wake of post-Telecom Act broadcaster consolidation, "with a technological 'fix' -- and we

doubt it will generate the results which broadcasters expect."[89] Others noted the disparity of support for IBOC between large broadcast conglomerates and the rest of the radio industry, and openly questioned whether the move toward digitalization was intentionally designed to squeeze out smaller competitors and fatten the pockets of IBOC proponents and investors above all else.[90] Many radio listeners suggested the FCC leave existing analog radio service alone and implement DAB on other spectrum, for which several swaths were suggested.[91] Ted M. Coopman of Santa Cruz, California, writing on behalf of 15 community media groups and 29 individuals from 13 states, noted that an alternate-band digital radio system could raise billions of dollars in revenue from the auction of new DAB frequencies. "Simply granting additional spectrum to broadcasters...for this conversion is nothing more than a give-away of national resources to for-profit business interests."[92]

For its part, industry proponents of IBOC either ignored, dismissed, or misconstrued the concerns of antagonists. USA Digital Radio asserted that "the comments of a few small broadcasters expressing concern about the cost of IBOC reflect a misunderstanding of the nature of the flexible IBOC implementation process rather than a fundamental disagreement about a transition to DAB."[93] Lucent Digital Radio reiterated the primary operative metaphor - that "there is no justification for AM and FM radio broadcasters to be left in the analog world, notwithstanding the Commission's decision on whether additional spectrum is justified for radio broadcasting."[94] Both Lucent and the National Association of Broadcasters chastised the Consumer Electronics Association for casting doubt on IBOC's viability by questioning the integrity of CEA's own analysis.[95]

As protagonists cast IBOC as an absolute necessity for the future survival of radio, antagonists questioned not only the viability of the technology but the need for DAB itself. The Virginia Center for the Public Press focused on what it saw as the core value of radio, which was technologically-neutral: "Duncan Radio Research suggests that the public would actually prefer a wider variety of formats and programming values (owners) with the same level of audio quality. In other words, the best thing that can be done for radio vis-à-vis the listeners is to encourage as many new entrants in the business of producing programming as absolutely possible. The current DAB proposals actually would produce the opposite, less owners and less

stations with less range for less people."[96]

Backstage, following the first round of comment and reply-comment on the FCC's NPRM, IBOC's proprietors strengthened their personal contacts with the FCC. USADR and Lucent both met with key FCC staff in March and April of 2000 to convince them to prioritize IBOC in its DAB deliberations and demonstrate prototypes of their technology.[97] In a pernicious use of the FCC's ex parte rules, the National Association of Broadcasters filed the NRSC's first digital radio system evaluations with the agency on May 12, 2000 - more than three months after the window for initial public comment on the proceeding had closed. Given the report's conclusions, there is good reason why the NAB first leaked this information backstage.

The NRSC followed the wishes of IBOC's proponents and limited its technical review to those systems alone.[98] However, the NRSC's initial conclusions about IBOC were far from a ringing endorsement; it simply did not have the necessary information on which to formulate a firm opinion. USA Digital Radio, for example, submitted "at least partial results" for only 18 of the 67 FM lab tests specified in the NRSC's evaluative criteria. USADR's record of timely and comprehensive information declined from there: "For FM field tests, of the 12 tests specified in the guidelines, partial results for 5 were submitted. For AM lab tests, of the 25 specified tests, partial results on 8 were submitted. Finally, for the AM field tests, of the 8 specified tests, partial results for 1 were submitted."[99] This made it "impossible" for the NRSC to "state unequivocally that USADR' s IBOC technology provides a significant advance over current analog system performance in the AM and FM broadcasting bands,"[100] much less provide more granular observations regarding USADR's performance in the context of interference tolerance, signal robustness, audio fidelity, or the creation of new, digital-only broadcast applications.[101] As for Lucent Digital Radio, it did not fare much better: "For FM lab tests, of the 67 specified in the guidelines, at least partial results were submitted for 5. For FM field tests, of the 12 tests specified in the guidelines, partial results for 4 were submitted. For AM lab tests, of the 25 specified tests, partial results on 5 were submitted. Finally, for the AM field tests, of the 8 specified tests, partial results for 0 were submitted."[102]

II. IBOC Proponents Merge, Demand Action

The spring and early summer of 2000 passed with little policy movement on digital radio.

This pause ended on July 12, when USA Digital Radio and Lucent Digital Radio announced their formal merger into a new entity named iBiquity Digital Corporation. Robert Struble, CEO of USADR, became iBiquity's new chief, while LDR's president Suren Pai was appointed co-chairman of the board. iBiquity announced plans to combine the two IBOC systems into one that cribbed from the best features of both; in doing so, it expected to shave "a year or two" off the time necessary for the FCC to sanction its technology.[103] Struble was confident in the future of iBiquity's digital radio system: "IBOC is going to be on the air in a year. It's on the air now, but I think it's going to be on the air commercially in a year in dozens, if not hundreds of stations. The plan currently calls for us to have commercially available transmission equipment by the NAB show in Vegas in April 2001." iBiquity now had a lock on all intellectual property associated with the IBOC protocol. To electronics manufacturers, Struble was blunt: "You guys want to sell radios in 5 or 10 years, you *have* to build IBOCs or you need to work with us" [emphasis in original].[104] While the merger was primarily contextualized as a means by which to provide "regulatory clarity" regarding the developmental status of IBOC, it also highlighted the technology's third primary weakness - its wholly proprietary nature. Upon hearing about the merger, Mike Burns, chief engineer at public radio station WAMU in Washington, D.C., remarked that it was "kind of is a loss for all of us. I just would have loved to see a double-blind competition where the benefits and detriments of each system were exposed....That would have been kind of fun."[105]

iBiquity subsequently announced several advancements, including verbal commitments from a few consumer electronics manufacturers to produce IBOC-compatible receivers;[106] the first tests of the datacasting component of its FM-IBOC system, along with the recruitment of application-developers;[107] potential evaluation of the technology by the International Telecommunications Union;[108] and its first formal meeting with the National Radio Systems Committee. Yet the mood at the 2000 NAB Radio Show was one of uncertainty. *Radio World* editor Paul McLane reported that the gamut of opinion among broadcast managers and engineers ranged from an undeveloped sense of urgency about approving a DAB system, "magnified by [competition from] satellite radio," to a failure to see any need for digital broadcasting.[109] By November, after "two months of intense work," iBiquity reported that it had integrated the

USADR and LDR IBOC technologies into a single framework. iBiquity predicted it would have comprehensive FM-IBOC test results ready for NRSC review by September of 2001 and AM-IBOC data "in early 2002."[110] The NRSC announced it would step up its meeting schedule to "complete the evaluation" of IBOC technology[111] - an evaluation which remained, from many perspectives, sorely incomplete.

This was reflected in offstage comments by independent broadcasters and members of the public. In a letter to the editor of *Radio World*, Christopher Maxwell, Secretary of the Virginia Center for the Public Press, reiterated the popular sentiment that it was the improvement of radio content - not the adoption of new broadcast technology - which stood to reinvigorate radio. "People don't listen to the Internet because it sounds great; people suffer the Internet audio hassles because the Internet has the programming variety they can't get on the usual FM dial," Maxwell wrote.

> And that is why IBOC digital audio broadcasting... is going to be a catastrophic failure. IBOC will destroy the listening range of many of the smaller independent commercial, religious and community/college radio stations that serve the "unheard third" of American listeners who are escaping the...dial as we speak. To bring them back...we need more variety of programming and you get that with more channels.[112]

Scott Todd, a broadcast engineer in Cambridge, Minnesota, told *Radio World* that he "used to be bullish on IBOC, but now I believe it is just bull."[113] Dana Puopolo, the chief engineer of KKBT-FM in Los Angeles, cast the foundation of iBiquity as a mechanism by which to maintain the industry's non-competitive status quo.[114] Macon, Georgia-based Good News Network's chief engineer, Glenn Finney, advocated for the adoption of spread-spectrum broadcast technology, which had already been implemented in the arena of wireless telephony, and would not restrict the proliferation of digital broadcasting to the AM and FM bands alone.[115]

Backstage, iBiquity and its representatives made a flurry of ex parte presentations to the FCC advocating an IBOC-only solution for radio's digital transition. Between July 2000 and the end of the year, iBiquity would meet once a month with the FCC to discuss the "submission of additional data about IBOC system testing" with an eye toward expeditious Commission approval.[116] In a letter to Mass Media Bureau Chief Roy Stewart, iBiquity claimed that the FCC's formal support of IBOC would "remov[e] any uncertainty and accelerat[e] the time when AM and FM broadcasters can join the digital revolution and provide the benefits of digital

technology to the American public." There was "no public policy benefit to continuing consideration of new spectrum for DAB when the means exist to reuse the existing spectrum and spectrum shortages threaten the future viability of other wireless services."[117]

In 2001, iBiquity reorganized its 80-person workforce into two locations; Suren Pai was removed from any real position of power within the company, although he remained a member of iBiquity's board of directors; and the company announced its technology licensing scheme.[118] iBiquity initially refused to discuss how much radio transmitter and receiver manufacturers would pay to license IBOC technology, but conceded there would be "an ongoing cost for each unit manufactured." Most controversially, radio stations would also be required to pay licensing fees to broadcast digitally. iBiquity proposed various incentives to encourage early adoption of the IBOC technology, which typically involved the waiving or capping of certain fees; these included special license terms for broadcast conglomerates who were equity investors in the company.[119] By the end of 2001 iBiquity had yet to sign a licensing commitment with any receiver manufacturer,[120] though it did clinch deals with two transmitter companies and three electronics component firms, one of which was an iBiquity investor.[121] By September of 2001, iBiquity claimed to have spent "nearly $1 million on developing its technology so far," compared to the $100 million XM Satellite Radio budgeted for 2002 on marketing alone.[122]

During 2001, iBiquity and the National Association of Broadcasters kept up the backstage discourse with FCC Commissioners, their senior advisors, and Media Bureau staff, pushing IBOC as the only viable solution for digital radio in the United States and asking ever more assertively for "prompt FCC action to endorse" the technology.[123] Shortly after iBiquity submitted "comprehensive" testing data to the NRSC, the Committee announced its intent to render an evaluation of IBOC to the FCC by the end of the year. According to FCC Mass Media Bureau Associate Chief Keith Larson, who was repeatedly briefed by iBiquity in private, "the...product has tremendous potential," though the agency remained concerned about the technology's potentially deleterious impact on analog radio service.[124] On October 9, 2001, iBiquity representatives gave a detailed PowerPoint presentation to FCC officials about the company and its plans for IBOC. iBiquity's investors were described as including "14 of the nation's largest broadcasters (including the top 8); 2,300 radio stations with access to 208 million

listeners; In Top 50 markets alone, owner stations have a 60% share; Owners account for more than half of radio industry revenues."

By the first half of 2002, iBiquity expected "some form of FCC endorsement" of IBOC, which would pave the way for the company and its broadcast-investors to roll out 50 stations in six target markets by the end of the year. Under the heading for a slide entitled, "What Can the FCC Do?," iBiquity tersely listed the following: "Endorse IBOC as the approach US will pursue for digital radio. Discontinue consideration of new spectrum alternatives. Allow stations to begin conversion. Ask for details needed to set IBOC standard."[125]

On November 29, 2001 the NRSC's DAB Subcommittee formally endorsed iBiquity's IBOC system as the digital framework for U.S. FM radio broadcasting. Like the NRSC's first evaluation, it surfaced as an ex parte (i.e., out-of-bounds for public comment) filing tendered by the NAB and CEA.[126] Wholly based on iBiquity-compiled data, the 215-page report parrots almost completely the company's technological promises.[127] Based "on a full set of FM-IBOC system laboratory and field test data collected in strict accordance with NRSC-developed test procedures"[128] - which constituted a total of eight stations in three markets[129] - the NRSC concluded that "the iBiquity FM IBOC system as tested by the NRSC should be authorized by the FCC as an enhancement to FM broadcasting in the U.S., charting the course for an efficient transition to digital broadcasting with minimal impact on existing analog FM reception and no new spectrum requirements."[130] However, claims of improved digital audio fidelity in the NRSC's endorsement were strongly qualified,[131] the potential for analog-to-digital interference was confirmed, and the NRSC reported it still did not have enough information in hand to grade the feasibility of ancillary digital radio services such as multicasting and datacasting.[132]

To complement the record, iBiquity released the entirety of its test data, amounting to roughly 700 pages of material.[133] This avalanche of information made two notable claims. The first was a prediction that less than .6% of any given FM station's listeners would experience interference problems related to the broadcast of a hybrid FM-IBOC signal.[134] Secondly, iBiquity boasted that its FM-IBOC field-test program "so far has accumulated over 8.5 on-air years of...testing, at sometimes much higher power levels than proposed," and "produced *not one* single complaint of interference by an auto receiver manufacturer, the broadcasters, the FCC or

the listening public" [emphasis in original].[135] Considering that public knowledge of the technology's existence was slim to none - and those members of the public who did know about the technology had already panned it - these claims were a canard.

The FCC formally acknowledged the NRSC and iBiquity's submissions on December 19, 2001 and invited public comment on them for three months.[136] Industry proponents took the opportunity to cast IBOC as the only realistic path toward a digital radio future in the United States. As with the first round of comment on the NPRM, the second wave of filings included another barrage of industry-incited astroturf. Several broadcasters, ranging from conglomerates to religious networks to stand-alone commercial stations, as well as a leavening of broadcast equipment manufacturers, all cajoled the FCC to "take several steps."

> The Commission should clarify that it is no longer pursuing an out-of-band solution for terrestrial digital radio. iBiquity's demonstration of the viability and benefits of IBOC eliminate the need for examination of alternative approaches. The Commission should also endorse both IBOC as the specific solution for terrestrial digital radio and the iBiquity system. Finally, the Commission should take steps toward the adoption of a formal IBOC standard to encourage broadcasters, receiver manufacturers and consumers to upgrade to digital. This should include proposing rules that enable the introduction of IBOC at the earliest possible date.[137]

The astroturf campaign was inadvertently unmasked by KONP Radio in Port Angeles, Washington, who failed to fill the first blank in the script: "On behalf of [BROADCAST COMPANY X], I am submitting these comments...."[138]

Other IBOC proponents filed more eloquent testimony, but all worked to advance the industry's operative metaphors in a campaign to cement IBOC DAB as the de facto digital radio standard. iBiquity and the NAB led the choir. "It has been more than two years since the Commission issued the NPRM," wrote iBiquity. "During that time, there has been tremendous technical and business progress in the development of IBOC. Today, the technology is poised for commercial introduction. Continued Commission silence on the path it will pursue for implementation of DAB...will chill the commercial introduction of this innovative and unique technology."[139] Any technical disputes, it claimed, were settled by the NRSC's endorsement; thus "[t]here should be no further questions about the viability of IBOC technology, its usefulness or the ability to implement IBOC in the field."[140] iBiquity also announced that IBOC transmitters would be ready for sale by April of 2002, and claimed that FM-IBOC-equipped stations would

be on the air in 11 markets by the end of the year.[141] Although no receiver manufacturer had yet formally committed to manufacturing IBOC-compatible radios, the company predicted they would "be initially available at a small premium over existing receivers but it is anticipated that prices will come down as the volume of receivers sold increases."[142] iBiquity confidently predicted that FCC endorsement of its technology would encourage receiver manufacturers to come to the table.[143]

The NAB was even more adamant about FCC action on IBOC. The technology was cast as "the radio industry's preferred route to a digital future."[144] Technically, the NAB summed up the status of FM-IBOC in simple terms: "it works; it's ready."[145] Any "open questions" about the protocol's viability had been settled by the NRSC, leaving the FCC with no conclusive reason to stall its approval of the technology.[146] The NAB told the FCC it should declare that "FM IBOC will be *the* digital technology for terrestrial radio broadcasting in the United States for the FM band and to specifically delineate the necessary remaining steps for rapid authorization and introduction of digital radio broadcasting for the greater public and industry good" [emphasis in original].[147] Furthermore, the NAB expressed confidence that endorsement of AM-IBOC would arrive from the NRSC sooner rather than later, and suggested the FCC fold its approval of AM-IBOC into "whatever process is occurring leading to Commission authorization. The time is now ripe and the Commission should act without delay."[148] During the open public comment period, the NAB met backstage with several senior FCC staff members to punctuate the need to "expedite" the IBOC rulemaking.[149]

Several iBiquity broadcast-investors carried the tune. Susquehanna Radio Corp. commented that while the NRSC report did point to some "shortcomings" in the FM-IBOC technology, as a whole the system offered "a definite improvement over existing FM in the United States."[150] Infinity Broadcasting, now spun off from USA Digital Radio cofounder CBS, "strongly urge[d] the FCC to endorse and help facilitate rapid implementation of this superior, cutting-edge technology."[151] Bonneville International observed that "[r]adio broadcasters face substantial technical challenges and significant competitive circumstances in the age of digital communications," and asked the FCC approve the proliferation of FM-IBOC "as soon as possible to provide broadcasters the ability to compete and be participants in this new

environment."[152] More to the point, Emmis Communications justified FCC approval of the technology if only to "giv[e] broadcasters reassurances that their investment in this national technology will be rewarded."[153]

National Public Radio suggested that IBOC would thrive only if it had the potential to provide new *program* services, not just better-sounding audio.[154] Multicasting, in the eyes of NPR, held the greatest potential for making DAB useful: "While we do not diminish the potential value of text-based and other datacast services, NPR believes that digital radio, like its analog counterpart, should first and foremost serve the public's listening needs."[155] Since iBiquity had not yet developed a multichannel broadcast capability for FM-IBOC, NPR respectfully suggested that the FCC had a duty to promote such a feature in the form of pursuing "progressive regulatory policies to assure the flexible use of the iBiquity...system to provide new and innovative program services."[156] NPR essentially expanded the scope of the NPRM to urge the FCC to both mandate new functionality in iBiquity's technology and leave open the door to competition from DAB technologies other than IBOC.[157] The Station Resource Group filed comments critical of iBiquity's licensing model, noting that "[*f]ees that are paid by public broadcasters to iBiquity owners are simply resources that will be displaced from public service programming*" [emphasis in original]. SRG feared that public and other noncommercial broadcasters might not be able to afford IBOC, and worried that under the proposed licensing structure they would "be treated simply as radio competitors," perpetuating fiscal constraints on noncommercial broadcasters that have gone historically unrecognized by the commercial radio industry.[158]

Many equipment manufacturers also advocated for regulatory approval of FM-IBOC. Texas Instruments (an iBiquity investor) and Alps Electric USA both reported that they were ready to begin manufacturing components for IBOC-compatible receivers, and urged swift FCC action to prime the pump for this new marketplace.[159] Transmitter-manufacturer Harris Corporation referenced the primary operative metaphor driving proponents' advocacy: "If tomorrow's terrestrial broadcaster is to occupy the dominant and important role it plays today in the lives of Americans, then changes must begin to occur immediately in the technology, equipment and regulatory structure of this industry."[160] Receiver manufacturers Visteon and

Kenwood Corporation acknowledged reaching development and licensing arrangements with iBiquity; Kenwood predicted it would have IBOC-compatible radios on the market within a year.[161] The Consumer Electronics Association concurred with the conclusions of the NRSC and urged the FCC to "act swiftly to adopt a single standard for FM IBOC technology."[162] This seemed to signal the trade association's submission to the fact that an alternate-band DAB system was no longer a viable regulatory outcome. However, CEA also suggested that "[a]ll intellectual property included in the standard must either be available free of charge to those wishing to use it, or it must be licensed under reasonable terms in a non-discriminatory manner to anyone who wishes to use it."[163] CEA reminded the Commission to "take note of the fact that many of the commenters in this phase of the proceeding are investors in iBiquity or have entered into special contractual or licensing agreements with iBiquity. While their input to the proceeding is valuable...the Commission should also consider the interests of parties who...do not currently have an established relationship with iBiquity."[164]

By this time, the majority of independent broadcasters who filed comments with the FCC were openly skeptical of IBOC. Many asserted that the technology had no perceived net benefit. Chuck Conrad of Kilgore, Texas, who first entered broadcasting by building an LPFM station and then flipping it for a full-power FM station, worried about the NRSC's acknowledgment of IBOC's interference potential, which he believed was being downplayed: "Why do we want to do something that we are pretty sure will cause problems down the road?"[165] Anthony Hunt, general manger of Ball State University's public radio station, directly challenged the operative metaphor that IBOC need not be significantly superior to analog. "In addition to running a station," he wrote, "I also teach college courses. A survey of my class indicated that a majority of my 19-year-old students do not listen to radio. They do not like the music presented to them, so they are looking elsewhere. Now they can find what they want by downloading the music they like, eliminating the need for radio altogether."[166] Hunt believed that IBOC would not address this trend among younger listeners, and unless the FCC found a technology that did "the decision to adopt IBOC will ultimately drive the radio industry into telecommunications obscurity."[167]

The National Federation of Community Broadcasters (NFCB) also chimed in on radio's digital transition. In acknowledgment that it was late to the stage, the NFCB did not directly

oppose iBiquity's technology per se, but did observe that "IBOC is not the best, and may be the worst system that could be devised." Although it minimized transitional risk for existing radio broadcasters, IBOC made "no provision for new stations or new program services. That may be understandable from the view point of the large entities that recently invested many billions to accumulate dozens, or even hundreds of stations in common control. But the FCC is under no duty to follow the investors' risk aversion calculus to its every logical conclusion, where it is regulation itself that has deterred entry and frustrated fresh competition."[168]

Aspiring LPFM broadcasters similarly worried about IBOC's effects on their micro-power signals. Redhawk Community Radio, an LPFM applicant in Temecula, California, worried that digital radio interference might "displace the frequency for which we have applied and many other frequencies as well."[169] Duane Wittingham of Macomb, Illinois, one of the owner/managers of WTND-LP, expressed deep concern that "evidence and comments by some organizations that are NOT owners or members of iBiquity [and] the National Association of Broadcasters...may turn out to be valid issues and thus could destroy radio reception for many Americans."[170]

Other independent broadcasters took issue with the proprietary nature of iBiquity's technology. Radio Kings Bay, Inc. of Kingsland, Georgia was extremely dismayed by iBiquity's licensing scheme. "In...manufacturing venues, such licensing fee costs are funneled back down to radio stations or consumer end users as part of equipment purchase pricing. The perverted notion of a...license royalty fee on individual radio stations clearly raises the bar for a potential Commission sanctioned shakedown of our business where no industry pattern for such egregious extortion previously existed.[171] Likening the scheme to "a per user Microsoft software license" (a comparison iBiquity CEO Robert Struble had already made), Radio Kings Bay characterized iBiquity's business model as "pure sophistry and nothing short of an Enron caliber attempt to maximize corporate profits without any regard for broadcast operators like RKBI, a last-of-a-dying-breed 'mom and pop' community radio station serving a small South Georgia market."[172]

If the public was simply skeptical in the first round of public comment on the FCC's digital radio NPRM, by the turn of 2002 it was downright hostile to the idea of IBOC. Several

commenters pointed out the potential for interference that FM-IBOC induced by design,[173] and the especially deleterious effect that interference might have on independent, locally owned stations.[174] The Amherst Alliance proposed judging the merits of IBOC by a simple "litmus test": "Does this so-called 'reform,' or 'improvement,' increase or decrease the number of voices being heard?"[175] In the collective mind of Amherst, the potential for IBOC's digital sidebands to interfere with the signals of other stations made the answer an unqualified "no." In fact, "[i]n the view of most Members of [the Alliance], radio Digitalization is still seen as an expensive, and potentially counterproductive, effort to resolve problems of substance -- poor quality programming, lack of enough news coverage, lack of enough local coverage, lack of enough innovation, lack of enough variety and far too many commercials -- with technological 'glitz' and glitter."[176] Philipp E. Meyer of Cambridge, Massachusetts might not have been the most eloquent commenter, but was certainly the most passionate. "DO NOT LET THIS OCCUR!!!," he wrote. "Let's look out for the interests of the people here...not the interest of a few gigantic profit-driven corporations. Radio belongs to you, me, and our grandchildren. Not to the CEO's and controlling shareholders of a few big media and telecom companies. Leave the FM Dial FM. Help us get more stations, more choice, more freedom."[177] Edward Czelada of Imlay City, Michigan openly questioned the long-term viability of IBOC: "Why should we switch...if the audio quality is only subjectively better than analog FM? In 10 years we may have a better idea what is the best method for transmitting digital audio."[178]

Other members of the public questioned the apparent imbalance of benefits that would accrue to large broadcast conglomerates should IBOC be approved by the FCC.[179] The Virginia Center for the Public Press expanded upon its initial criticisms. "The FCC errs in assuming IBOC would be of any value to the public interest. In fact, it is quite contrary to the public interest," it declared.[180] "The unchallenged assumption that broadcasters are entitled to a one-to-one replacement of their analog station with a digital station is simply the worst kind of Corporate Welfare, a 21st century equivalent of the Divine Right Of Kings."[181] Mark Nagel of Santa Rosa, California pointed out that military hurdles to using spectrum compatible with Eureka 147 DAB technology in the United States no longer existed. "[J]ust a few months ago, the FCC...announced that in a complete reversal of 1992 decisions, the Commission is now

reallocating portions of [Eureka-147 spectrum] for private civilian uses. Thus it is now politically and technically possible as well as more economically advantageous to re-investigate America joining the rest of the world in using the world accepted standard for Digital Audio Broadcasting."[182]

At the very least, the public begged the FCC to engage in independent testing of IBOC instead of relying solely on industry-provided data funneled through the NRSC.[183] In the words of William Stribling of New York City, "I am...concerned about the continuing escalating loss of the public airways to private interest whose interests are not in the public interest."[184] Some citizens continued to question the need for a digital radio conversion; Dana J. Woods of Richmond, Virginia reminded the FCC that "for every letter such as this that you receive, there are probably literally tens of thousands of Americans who are not even aware of this unsavory conversion plan and its implications."[185]

The industry response to this barrage of increasingly incisive opposition to IBOC was to ignore, dismiss, or misconstrue the issues causing conflict between the actors. The National Association of Broadcasters was adamantine: "NAB, along with virtually all industry commenters, call on the FCC to rapidly follow the now ineluctable steps leading to digital broadcasting for America's radio broadcasters and the listening public."[186] iBiquity asserted that "No technical problems associated with IBOC have been identified, and no credible regulatory or business impediments to the implementation of IBOC have been presented,"[187] and that "[t]he comments in this proceeding fully support the conclusions of the NRSC...on this issue. It is important to note that no one has provided any evidence to the contrary."[188] This declaration simply refused to acknowledge the scores of comments filed against the imposition of IBOC by independent broadcasters and members of the public, some of whom had documented the existence of the technology's fundamental detriments. From iBiquity's viewpoint, "the public interest would be better served by a regulatory approach that has a presumption in favor of IBOC."[189] On questions of the technology's proprietary nature, iBiquity promised it would comply with existing FCC rules governing patented technologies, invoking a policy promulgated more than 40 years ago and never revised since.[190] In response to NPR's suggestion that alternate-band DAB systems be left open to consideration, iBiquity argued that any such

exploration was "a separate issue not relevant to this technical proceeding and [should be addressed] in another forum."[191]

Offstage, conversations took place that suggested deep disunity within the broadcast community over the potential benefits of FM-IBOC. Charles Morgan, senior vice president of Susquehanna Radio and chairman of the NRSC, admitted in *Radio World* that "A search of [our evaluation] will show flaws that we wish were not there, but it will also reveal many reasons why broadcasters should embrace this new form of FM broadcasting." However, "[f]or IBOC to succeed, we will need a cooperative effort between iBiquity and broadcasters to get stations on the air quickly...if broadcasters do not move forward and support IBOC, it and iBiquity will fail - and if IBOC fails, we, the broadcasters, will also suffer."[192] The NRSC would later hint that significant problems still existed with iBiquity's AM-IBOC system, which might preclude its full-time use by radio stations.[193] *Radio World* reported that "consistently, FCC staff engineers and commissioners have indicated that the agency wants to help radio with the digital transition, that they recognize the importance of DAB and have confidence in the NRSC,"[194] despite the growing amount of public comment to the contrary.

iBiquity pushed ahead with its business plan, working with a handful of consumer electronics manufacturers to have digital radio receivers on store shelves by the beginning of 2003 and planning marketing campaigns in the markets where IBOC would first be introduced.[195] The company deflected criticism of its broadcaster licensing fee, portraying it as "consistent with those of other high-end, low-volume software applications and reflects a much smaller component of the licensing revenues iBiquity will receive compared to those from [equipment] manufacturers."[196] The NAB and NRSC took no official position on iBiquity's business model, and *Radio World* reported that "a source close to the Commission said he doubted the agency would 'put a wet blanket on this transition by getting into'" the licensing fee controversy.[197] iBiquity CEO Robert Struble now claimed the company had spent between $100-$150 million in research and development costs and "we've got to get something back" for that investment.[198]

National Public Radio, having declared onstage that FM-IBOC could not be feasible without a multicast function, announced offstage that it had formed a Digital Transition Advisory Committee with an explicit focus on designing a multicast application for the iBiquity system.

Although NPR suspected commercial broadcasters were not enamored with the idea of multicasting due to the potential fragmentary effect it might have on shrinking radio audiences, it saw the feature as a way to draw disenchanted listeners back to the medium and provide IBOC DAB with an identifiable "killer application." NPR used part of its 2002 digital conversion subsidy from the Corporation for Public Broadcasting to explore multicast technology and entered into negotiations with iBiquity over an equitable licensing fee structure for stations that might choose to multicast.[199] Mike Starling, the man in charge of NPR's exploration into multicasting, was quite candid about the need for such functionality: "The lack of a federal effort for multimode [multicast] digital radio standards could make IBOC a short-lived deadend and delay the advent of successful digital radio."[200] If the FCC refused to foster innovation in the DAB space, public broadcasters would take up the slack.

Dissent within the ranks of broadcasters over IBOC forced a bit of offstage introspection. Gary D. Sharpe, a veteran broadcast engineer, commented in *Radio World* that "[p]ersonally, I just cannot see any justification for IBOC...except as a way for equipment manufacturers to force up a staggering market....We are unfortunately already committed. Too bad. We've lost creativity in radio, now we are going to lose listeners entirely."[201] Microsoft's Skip Pizzi, now part of *Radio World*'s regular roster of commentators, worried that IBOC was specifically tailored to appeal to commercial broadcasters. "While controlling one's own destiny is a laudable goal and cherished promise of American enterprise," he wrote, "the push for IBOC has run roughshod over another important American principle: consensus. It thereby violates one the of the basic rules of the road in today's technology development. It hearkens back to an earlier, less-enlightened time, when corporate power and oligarchic hegemony could unilaterally control the path and market development of an industry."

From its conception, IBOC was "fundamentally a blocking policy, primarily intended to retain the status quo for incumbent broadcasters. From an engineering standpoint, it's been a transition plan in search of a technology, with its primary requirements oriented toward damage control rather than growth." In Pizzi's view, there was little impetus for broadcasters to adopt IBOC en masse: "In fact, it is largely agreed that IBOC is a less-than-optimal migration path, yet it persists." He lamented IBOC as an indicator of "how important the business aspects of radio

broadcasting are in the United States, and how reduced the public service value of the medium has become."[202] Although *Radio World* formally came out as an editorial proponent of IBOC in March of 2002, editor Paul McLane recognized that iBiquity "can appear prickly about questions that I consider legitimate points of discussion," and urged the company to improve its image.[203] The onus, regarded McLane, was still on IBOC's proponents to justify its potential benefits:[204]

> It's not sufficient for [IBOC] supporters to say, "The world is going digital, and radio can't be left behind."...Managers will be asked to spend money on IBOC hardware, IBOC fees and IBOC promotion....Owners will want to see their return....One thing is clear from the questions being asked: iBiquity Digital still has work to do to educate broadcasters about the basics of digital radio and why stations should spend money on it....iBiquity and the NRSC should get that little problem solved, and pronto.[205]

III. AM-IBOC Inflames Controversy

Less than a month after public comment had closed on the question of the FCC's potential endorsement of FM-IBOC, iBiquity tendered its own report to regulators on the feasibility of its AM-IBOC system.[206] iBiquity claimed that the test results demonstrated its system "offers significant benefits that cannot be matched by analog AM operations....[including] improved audio quality...accompanied by strong signal durability....The test program also determined that AM IBOC can be introduced without a harmful impact on existing analog AM operations."[207] The NRSC seemed inclined to agree, telling the FCC that "AM IBOC will transform AM broadcasting through dramatic improvements in AM audio quality....This will allow AM broadcasters to diversify their program offerings and compete for listeners with high quality non-broadcast audio and entertainment offerings....Any concerns about the potential impact of IBOC are outweighed by the tremendous benefits IBOC will offer AM broadcasters."[208]

Within ten days of iBiquity's submission to the FCC, the NAB filed, on the NRSC's behalf, the latter's formal evaluation of iBiquity's AM-IBOC system.[209] Its conclusions were mixed. Considering that AM broadcast signal propagation has very different properties than FM, and that both IBOC modes fattened the spectral footprint of every radio station, the NRSC observed that implementing AM in an interference-free manner was next to impossible, and such interference would most likely be noticed by some listeners.[210] This problem was noted by two observers to the NRSC field tests, which involved just four AM radio stations.[211] "Clear Channel

raised concerns about a potential greater impact of AM IBOC on analog AM reception than is indicated by the data in the AM IBOC Test Data Report. C. Crane Company expressed concerns about the impact of potential AM IBOC interference on listeners distant from AM stations."[212]

Most notable was the omission of any test data from iBiquity on the performance of an AM-IBOC signal at night, when skywave propagation increased a station's range - and the potential for a digital signal to create destructive interference over a larger area. The NRSC recommended that AM-IBOC be implemented during the daytime only, and even even suggested that nighttime operation of IBOC be restricted until such time as all-digital broadcasts became the norm.[213] The NRSC concluded that "there are some unanswered questions that can only be answered by deploying the AM IBOC service on a larger scale than was possible for this test program. Such deployment is the only way to characterize a medium-wave service like AM IBOC with real certainty."[214] Three days after the NRSC tendered its latest report, the FCC opened a third round of public comment designed to interrogate the technical merits of iBiquity's AM-IBOC system.[215]

Backstage, iBiquity CEO Robert Struble met with representatives of the FCC's Media Bureau, lobbying the agency to produce a Report and Order endorsing the rollout of IBOC on both bands by August 31, 2002.[216] Publicly, iBiquity proclaimed in its comments that "[t]he NRSC's recommendation that the Commission proceed with a daytime only service while additional nighttime testing is conducted" actually "reflects the NRSC's enthusiasm about AM IBOC and the NRSC's belief that the benefits to the public of IBOC should not be delayed....At the same time, this approach provides iBiquity and the broadcast industry with additional time to analyze the potential impact of AM IBOC on nighttime analog service and to develop an industry consensus on the best approach for nighttime [digital broadcasting]."[217] iBiquity's bottom-line concern was its bottom line. "Commission endorsement of AM and authorization of digital service, even on an interim basis pending development of final IBOC rules, will foster iBiquity's commercialization schedule and the prompt introduction of the benefits of IBOC technology."[218]

The National Association of Broadcasters supplemented iBiquity's enthusiasm. "NAB believes that IBOC is critical to the future of broadcasting in the AM band and believes that AM

must be included with FM in the initial authorization and deployment of IBOC service and receivers, so that it will be insured a place in radio's digital future."[219] Advancing AM-IBOC deployment, argued the NAB, would "provide for real world experience with IBOC operations, particularly within the difficult AM environment."[220] Although FM-IBOC, in the NAB's opinion, would provide " a qualitative improvement to existing FM quality with few identifiable drawbacks," AM-IBOC, "by contrast, will allow a dramatic – perhaps a transformative – change in AM quality." Such a transformation "may require acceptance of more interference than would be acceptable in a more desirable listening environment, such as FM," but the "constraints on current AM quality" would make this a "tradeoff of limited new [analog] interference for vastly improved digital quality."[221]

iBiquity's broadcast-investors were qualified, but unified, in their basic support of AM-IBOC. Susquehanna Radio recognized that AM-IBOC was "not without its shortcomings," and explicitly acknowledged the real potential for interference, but concluded that "the gains of the system far outweigh the losses."[222] Infinity Broadcasting characterized AM-IBOC's interference potential as "minimal, manageable, and should not be cause to delay the implementation of the IBOC AM system, as the problems that arise from potential interference in certain circumstances during the hybrid phase will be far outweighed by the vast benefits that will be realized from iBiquity' s IBOC technology."[223] Cox Radio, Inc., went so far as to ask the Commission to implement a plan to phase out analog AM broadcasting in order to alleviate the potential interference concerns raised by IBOC implementation.[224] Only Disney, of all major broadcasters (and an iBiquity investor), urged a semblance of caution: "To adopt a digital system that creates interference at night in legacy receivers may be the equivalent of burning the bridge you are standing on." That said, "[Disney] also recognizes that, like the sign in the highway construction zone which says 'Temporary Inconvenience, Permanent Improvement,' some compromises are unavoidable during the conversion process."[225]

Noting that "virtually every other means of electronic mass media is transitioning to or otherwise deploying digital technology," National Public Radio endorsed the NRSC report approving AM-IBOC for daytime deployment. "Public AM radio stations must have the option of transitioning to digital technology as well in order to further their public interest mission, or

risk falling further behind other mass media in signal quality."[226] However, NPR vehemently opposed the suggestion of phasing out analog broadcasting,[227] and further questioned iBiquity's broadcaster-licensing regime. NPR worried that license fees would be "unreasonably burdensome, particularly for public broadcasters who have limited resources. Therefore, the technology should be licensed for use by noncommercial educational radio stations either without charge or under terms and conditions that are reasonable and predictable under the circumstances."[228]

Among equipment manufacturers, the split of enthusiasm for IBOC between broadcast-electronics companies and receiver vendors was now palpable. Transmitter-maker Nautel worried that "continued absence of an FCC endorsement of IBOC will slow this commercial launch and prevent the introduction of IBOC technology."[229] Harris Corporation, which had already paid iBiquity a licensing fee to manufacture IBOC-compatible transmitters, agreed.[230] However, the C. Crane Company - a receiver manufacturer which had raised concerns about AM-IBOC-generated interference during NRSC testing - urged the FCC to defer any endorsement of digital AM radio until its interference characteristics, especially at night, were more fully understood. "We are in a free market economy and consumers are not asking for this service," C. Crane observed. "Millions of listeners will lose their choice of radio if full or partial conversion is achieved....Our country's AM broadcast system has served us well. Any new system that is to serve us as well or better should not be implemented while still a work in progress."[231] The Consumer Electronics Association expressed renewed concerns about the IBOC system, specifically focusing on the potential for AM-IBOC interference.[232] CEA suggested the FCC mandate that an AM-IBOC station be required to mitigate any interference it caused to neighboring broadcasters.[233]

One consulting engineer, Glen Clark & Associates, agreed with the CEA's assessment of AM-IBOC. "[Existing] AM frequency-allocation rules requires conventional AM transmissions to extend no further than 10 kHz on either side of the carrier frequency....The Commission's system of allocating AM licenses was founded on that base presumption," Clark explained. "The proposed IBOC system extends beyond the limits proscribed in [existing rules]." Since the majority of the digital data in the AM-IBOC system is "actually transmitted in spectrum which is

part of the two first-adjacent channels, the presently-proposed system is...an IBAC ('In Band Adjacent Channel') system." Clark candidly questioned whether the FCC's current AM station allocation rules provided "sufficient separation between stations" to make AM-IBOC even viable.[234]

Independent AM broadcasters were openly dismayed with the results of the NRSC's evaluation of AM-IBOC. The Kentucky-based AM Broadcasters Association commented that consolidation precipitated by the Telecommunications Act of 1996 had detrimentally affected the competitive environment for AM broadcasting. In the Association's view, AM-IBOC would simply make the situation worse by funneling licensing money from small broadcasters (who already operated close to the margins) to large broadcasters (the majority of which were invested in "iBiguity"). That led the Association to ask a critical question: "Is it the FCC's desire to give these few companies which control 50% of all commercial radio in the US complete control over the digital broadcasting of radio signals in the US and hold all stations hostage by requiring a royalty payment on a government mandated broadcast standard?"[235]

Frederick R. Vobbe of Lima, Ohio, a broadcast engineer with more than 30 years of experience, observed that post-1996 industry consolidation had decimated engineering staffs at stations around the country, and as a result "there is not the attention paid to interference issues. One can successfully argue that if [AM analog] stations can not change power or pattern at their assigned times, how can you be sure IBOC will be turned off at local sunset, and returned at sunrise? Since the station(s) nor the Commission can police this issue reasonably the danger to the public is high."[236] Vobbe also pointed out that AM-IBOC, given the nature of skywave propagation, had the potential to interfere with stations in neighboring countries, and thus may contravene international treaties governing frequency allocation.[237] A Canadian lawyer, Philip Rafuse, echoed this concern.[238]

Some AM station owners argued that IBOC implementation should be put on hold until the interference potential of the technology was better known.[239] Neal Newman, the chief engineer of WTTM-AM in Princeton, New Jersey, related his experiences of working at a station that had been AM-IBOC test bed. He questioned the validity of an evaluatory regime partially developed and wholly paid for by iBiquity.[240] Many independent broadcasters simply could not

see the economic benefit of deploying AM-IBOC on small-market stations and, like public broadcasters, worried that iBiquity's licensing scheme would make their marginal fiscal situation a dire one.[241]

Nearly identical sentiments against AM-IBOC were found among the public. Interference was clearly a problem, and it puzzled many commenters why the FCC and NRSC were not treating the issue with the seriousness it deserved.[242] According to Harry L. Helms of Ridgecrest, California,"It is perhaps difficult for those living in the eastern United States to fully appreciate how spotty and unreliable daytime AM coverage can be in the western states, even in a populous area such as California....However, the events of September 11 have forcefully demonstrated there is still a clear need for AM signal coverage over wide areas to provide a means of communications to the public in the event of a national emergency." Therefore, concluded Helms, "[a]dopting IBOC for AM broadcasting---with its accompanying adjacent channel noise and reduced daytime coverage---would leave large areas of the western United States and their population without a potentially vital means of communications in a time of crisis."[243] Joesph Fela of Plainfield, New Jersey filed a report detailing his experiences of hearing test AM-IBOC signals emanating from New York and catalogued his reception problems when the digital sidebands were present.[244] Keven M. Tekel, a citizen with radio engineering experience, tendered his own receiver analysis using eight separate models that demonstrated the potential for digital interference on the AM dial.[245]

Upon learning that AM stations would have to sacrifice analog fidelity for digital transmission, many members of the public openly criticized the notion of intentionally degrading incumbent radio service for the benefit of an unproven technology.[246] Others worried about the proprietary nature of iBiquity's business model.[247] From the listeners' perspective, the allure of AM-IBOC was nonexistent; a part-time digital radio service, with questionable reception characteristics and audio fidelity, was essentially a nonstarter.[248] Michael Erickson of North Babylon, New York, challenged the primary operative metaphor: "Digital is NOT always better." Radio's inherent problem, in Erickson's view, was more related to "WHAT is on the air and NOT how it sounds from a technical standpoint (we can all thank the Telecommunications Act of 1996 for this)....You can research to your heart's content, but people simply get tired of

the same product over and over."[249] According to the Virginia Center for the Public Press, any radio broadcast technology that "decreases the number of stations a small business may advertise on, reduces the number of stations a nonprofit may have PSAs on, reduces the number of stations that a listener may turn to for different programming choices will ACCELERATE the public, nonprofit and small business abandonment of the existing [radio dial]."[250] David S. Forsman of Lewiston, Idaho suggested that it "would be better for the FCC to choose one good system than having to send broadcasters and listeners through a succession of inferior ones."[251] From the perspective of the Amherst Alliance, "If the Federal Communications Commission is willing to give as much weight to the views of actual radio listeners, and of potentially threatened small broadcasters, as it assigns to the views of those with a direct financial stake in mandatory implementation of the IBOC technology, then the Commission's next course of action should be obvious" - the consideration of alternate DAB technologies which would provide more listener choice and did not harm existing analog radio services.[252]

As in the previous two rounds of onstage activity, IBOC proponents ignored, dismissed, or misconstrued the growing opposition from several quarters. iBiquity had the temerity to claim that "[t]he record...shows that in the past eighteen months IBOC has been transformed from a developing technology into a commercial product awaiting imminent introduction. The public interest will be best served by prompt FCC endorsement of IBOC to support upcoming launch of commercial receiver sales next year."[253] Commenters who opposed AM-IBOC were characterized as arguing that "AM broadcasters should be relegated to the analog world with no digital future. This is not a credible argument in a world where all other analog radio services are migrating to a digital future." With regard to increasing concerns about its proprietary nature, iBiquity dismissed them with confidence, noting there was no real Commission precedent for the active regulation of proprietary broadcast technology.[254] Jumping to iBiquity's defense, Greater Media claimed that the NRSC IBOC test program was "the most thorough program of its kind in the history of radio broadcasting" and guaranteed "a fair, accurate and unbiased evaluation of the system."[255]

Such hubris did not sit well with broadcast engineer Scott Todd: "I'd like to rebut iBiquity's comments that there is overwhelming industry support for IBOC. The ones who are so

enthusiastic are the corporate suits who think a little technical tinkering is going to reverse declining listenership caused by inept programming....I don't see the enthusiasm amongst the rank and file engineers....I know that I'll be fighting against it at my company."[256]

As conflicts between character-constituents grew onstage, iBiquity proceeded with its timetable for the public launch of its digital broadcast technology. It raised $45 million, mostly from venture capital funds, and projected the attainment of profitability by as early as 2003.[257] It closed three more licensing deals with transmitter-manufacturers,[258] announced its intent to conduct further field testing on AM-IBOC's nighttime propagation characteristics,[259] and re-branded the technology with the friendly moniker of "HD Radio." According to *Radio World*, "iBiquity's first choice was iDAB," but feared the potential of trademark litigation from Apple Computer."[260] The National Radio Systems Committee relatedly created a working group with the goal of crafting formal transmission standards for HD Radio, thus preparing to put a milestone-imprimatur on iBiquity's technology.[261]

iBiquity's upbeat news was offset by reportage chronicling growing discontent with HD Radio's fundamental deficiencies. *Radio World* reportbacks from the fall 2002 NAB Radio Show suggested the number of HD-contrarians within the radio industry was on the rise.[262] This was reflected in reader-feedback to the publication, which increasingly questioned in pointed terms whether HD Radio actually represented an improvement over analog, or was instead designed to degrade analog radio so as to make HD *seem* like an improvement.[263] Scott Clifton, the director of engineering at SportingNews Radio in Chicago and a man with a history of HD development work dating back to Project Acorn, proclaimed his discouragement in no uncertain terms

> at what politics have done to the IBOC system. The shortfalls of the AM system seem to be getting handled like political damage control....What are the real benefits to either the industry or the consumers? Going digital for the sake of saying it [sic] digital is not the way to go, but appears to be the driving force behind IBOC....Everyone should be sharpening their pencils to draw out a new design that actually improves the broadcasters' and consumers' product. I am tired of seeing the audio quality being sacrificed in an effort to get IBOC on the air....Let's consider new spectrum![264]

Radio World itself chastised iBiquity for not doing more pre-launch public education to increase the potential for marketplace adoption.[265] Further complicating matters, Clear Channel - the largest broadcast conglomerate in the United States and an iBiquity investor - openly questioned

the feasibility of HD Radio. In an interview with *Radio World*, the company's senior vice president of capital management, Bill Suffa, admitted he was not completely sold on the technology. "The whole...thing is one of economics. I don't know what they are...from a financial basis, it's very difficult to justify going to [HD] at this time." Suffa lamented the fact that no HD receivers were available yet, which he cited as a reason to delay broadcaster-investment. He also expressed concern about iBiquity's licensing fee structure.[266]

Consternation over iBiquity's licensing policies began to resonate offstage. Tom Taggart, a partial owner of two FM radio stations in West Virginia, told *Radio World* that "[t]he fees will kill [HD Radio]. This will be a toy for the big groups in the major markets....iBiquity's demand for fees up front is a sure sign that they know [HD] is doomed to failure. Otherwise, they would be content to collect a royalty of a few pennies on the sale of each...receiver. But they know that turkeys can't fly, so they are going to be paid up front and get out."[267] The chief engineer of a radio station in Nebraska reported that when iBiquity's licensing scheme was explained at his local Society of Broadcast Engineers meeting, the news broke "like wind when someone cuts the cheese."[268]

Columnist Skip Pizzi expanded concerns of HD Radio's proprietary nature beyond the fiscal dimension: he contended that the "$100+ million spent to date on iBiquity's work was expended primarily as a prophylactic investment by commercial broadcasters to ensure that their passage to the digital world would be made on their own terms."[269] Now that the effort was nearing fruition, Pizzi asked the industry to look back on what it had wrought: "What I primarily object to today are iBiquity's proposed protectionist constraints on [HD] technology," he wrote. "I fear these artificial restrictions will reduce [HD] to insignificance in the consumer marketplace, and thereby cause it to fail....The current plan is unbalanced in commercial broadcasters' favor, and is therefore a risk." HD Radio "may be the only bullet in broadcasters' digital conversion arsenal. If that one shot misses, the battle will likely be lost. If someone notices the weapon is mis-aimed, it is their duty to try to correct the problem before the shot is fired."[270]

In response to this backlash, iBiquity announced a plan to waive the up-front licensing fees for stations that committed to HD Radio broadcasting by the end of 2002. Scott Stull,

iBiquity's director of broadcast business development, assured readers of *Radio World* that the company "will work with broadcasters to develop a license fee model that is acceptable to both parties."[271] The publication was unimpressed: "The waiver is good news, but it comes too soon and ends too quickly for many broadcasters....Offering a waiver now, when the biggest groups are the ones that can afford to commit, only advances the perception held by some critics that iBiquity tilts toward its investor partners at the expense of smaller non-investors. Further, this waiver asks managers to commit to ordering equipment before the FCC has even indicated whether it approves of the concept, and in what form."[272]

Backstage, contacts between the FCC and iBiquity grew in frequency as 2002 ground on. Between May and August, executives and senior representatives of the company met at least once a month with FCC officials to brief them on the company's development progress and to press for the unrestricted proliferation of HD Radio. Initially, iBiquity wanted FCC endorsement of its technology "by the end of Summer 2002."[273] That gradually slipped to "early September."[274] In June, iBiquity told Chairman Michael Powell that it hoped the FCC would act expeditiously "to endorse IBOC and authorize interim AM daytime and FM IBOC operations,"[275] and later repeated this plea to Commissioners Michael Copps and Kevin Martin.[276] iBiquity was not the only one paying personal visits to the FCC: National Public Radio made two trips in September and October to educate Commissioners and senior staff about its FM-HD multicast development work.[277]

IV. HD Radio Unleashed

Despite the apparent disagreement between actors, which was noticeable by now on all stages, The FCC gave iBiquity its blessing on October 10, 2002 and selected HD Radio as "the technology that will permit AM and FM radio broadcasters to introduce digital operations efficiently and rapidly." With a simple application for authorization, AM and FM stations were given the permission to commence HD broadcasting at their discretion.[278] Formal standard-setting procedures for the technology were deferred to a future rulemaking.[279] The policy trajectory could not have been clearer: "[W]e select the hybrid AM and FM IBOC systems tested by the NRSC as de facto standards for interim digital operation....[T]he Commission will no longer entertain in this proceeding any proposal for digital radio broadcasting other than [HD

Radio]."[280]

The FCC praised HD Radio as a "remarkable technical achievement," but acknowledged that it could not be implemented "without some service ramifications."[281] Citing the NRSC's "comprehensive test program," the FCC agreed with policy protagonists that "the record in this proceeding presents compelling evidence that...[HD] has the potential to significantly improve" the quality of broadcast radio.[282] Surprisingly, the spectrum-expansion necessary to implement HD Radio went unaddressed in the Reportand Order. The FCC took at face value the comments of "the NRSC and the majority of commenters that the potential for new interference from [HD] operations is insignificant when compared with the advantages and opportunities inherent in this digital technology."[283] This "majority" could only be constructed by ignoring the wide-ranging opposition to HD Radio that had been filed in the proceeding. Regulators approved the unrestricted use of FM-HD sidebands, including iBiquity's extended hybrid mode, and also authorized stations to experiment with multicasting. With regard to AM, the FCC heeded the NRSC's advice and did not authorize nighttime HD broadcasting on a blanket basis until further testing was completed. Although it expressed sympathy "to the concerns of those commenters who object to the loss of the 'legacy' AM analog service," the FCC rationalized its approval of the technology by noting that its uptake was voluntary, even as it foreclosed the consideration of alternative DAB technologies.[284]

Acknowledging that many individual citizens and independent broadcasters supported the consideration of HD Radio alternatives, the FCC deemed such an approach infeasible, due to "no appreciable support within the broadcast industry," and declared that it would "no longer consider this approach in this proceeding."[285] With regard to iBiquity's licensing model, the FCC cast its decision as an opportunity to assess whether iBiquity and other patent holders "are entering into licensing agreements under reasonable terms and conditions that are demonstrably free of unfair discrimination. The Commission will monitor this situation and seek additional comment as warranted." The FCC characterized the licensing costs provided by iBiquity as not unreasonable "when compared with digital conversion costs in other services," and re-emphasized the voluntary nature radio's digital transition.[286]

After the unanimous decision, three Commissioners issued public statements addressing

HD Radio. Kathleen Abernathy and Kevin Martin, speaking jointly, acknowledged that there may be "some interference with existing services, but but we believe that the impact will be minimal and is outweighed by the benefits of digital audio broadcasting....In the interim, we expect that broadcasters will work closely with the affected parties to resolve these issues without intervention from the Commission."[287] Ultimately, however, it was Commissioner Michael Copps who unwittingly summed up the FCC's ignorance of and predisposition toward "faith-based regulation" on the issue of digital radio. "A few questions remain to be settled, including *how the [HD] system will function in the real world*; what is the potential for and extent of interference that [HD Radio] could cause to existing services; and the technical feasibility of nighttime [AM-HD] transmissions," he remarked [emphasis added]. Copps expressed confidence that keeping an eye on the pulse of the radio industry would suffice to address any problems that might arise.[288] *Radio World* called the FCC ruling "historic" and reported that the NRSC and iBiquity were in deliberation to fast-track a formal HD Radio standard for FCC approval by mid-2003.[289] NPR "applauded" the FCC's nod toward multicasting.[290]

The initial policy development of digital radio in the United States was marked by actors primarily speaking past one another, selectively engaging in dialogue with those that held apparent political or economic sway over the official endorsement of HD Radio by the FCC. iBiquity Digital Corporation's aggressive work backstage, coupled with its impressive stable of broadcast conglomerate support, was adequate enough for the FCC to certify the proliferation of HD Radio without conducting any independent evaluation or analysis. Large broadcasters, having invested in the development of HD Radio for more than a decade, saw the technology as a digital transition mechanism that they could not only control, but profit from. Public broadcasters played a low-key but important role in HD Radio's formal introduction; while they remained implicitly committed to the technology, when intra-industry doubts began to appear about its functionality, they reacted autonomously and proactively to work on developing an application - multicasting - that could provide the technology with a unique value above and beyond simply being "better than analog."

Concerns expressed by the public and within the industry - ranging from individual

citizens to independent broadcasters - were ignored with few exceptions in the policymaking process, although the number and vehemency of these concerns was unprecedented for such a technical rulemaking. Listeners themselves repeatedly hammered at a core theme: improvements to radio in the United States required new *content*-based development, not a technological panacea. Ironically, although it was the Telecommunications Act of 1996 which provided the catalyst for industry consolidation (and increased investment in iBiquity), the public ultimately blamed regulatory detachment for decimating the programming quality and diversity of radio. By and large, they clamored for improvements to broadcast service, but *not* by digital means. The FCC effectively considered the proliferation of HD Radio as an economic exercise with little need for technical justification and completely devoid of any meaningful homage to a "public interest," except as defined by dominant industry actors. With the sanctioned privatization of U.S. digital radio technology, the FCC signaled its clear intent to facilitate the ongoing neoliberalization of broadcasting.

In the end, iBiquity and its broadcast-investors got what they wanted: a technological monopoly on U.S. radio's digital future and permission to begin the monetization process. However, by the time the FCC acted to endorse HD Radio, sentiments were far from unanimous on the inherent progressiveness of the technology itself. Although its protagonists dominated the first act of the FCC's digital radio rulemaking and secured significant policy commitments in the process, the actual practical viability of the HD protocol was far from guaranteed.

Notes to Chapter 4

1. Petition for Rulemaking filed by USA Digital Radio Partners, L.P., RM-9395, October 7, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=217027 (May 6, 2010).

2. Id., p. 13.

3. Id., p. iii.

4. Id., p. 5-6.

5. Id., p. 18.

6. Id., p. 7.

7. Id., p. 63, 76.

8. Federal Communications Commission, *Public Notice*, RM-9395, November 6, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5000705996 (May 6, 2010).

9. Comments of Bonneville International Corporation, RM-9395, December 22, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001000964 (May 6, 2010).

10. Comments of Clear Channel Communications, Inc., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100634 (May 6, 2010).

11. Comments of Susquehanna Radio Corporation, RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100628 (May 6, 2010).

12. See Comments of the Walt Disney Company, et. al., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100643 (May 6, 2010); Comments of the Gannett Co., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100654 (May 6, 2010); and Comments of CBS Corporation, RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100658 (May 6, 2010).

13. Comments of Cumulus Media, Inc., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100655 (May 6, 2010), p. 5.

14. See Comments of Heftel Broadcasting Corporation, RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100661 (May 6, 2010), and Comments of Radio One, Inc., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100767 (May 6, 2010).

15. Notice of USA Digital Radio, RM-9395, January 8, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001201713 (March 6, 2010).

16. Comments of National Public Radio, Inc., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001000948 (May 6, 2010).

17. See Comments of Greater Media, Inc., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100650 (May 6, 2010), and Comments of the Radio Operators Caucus, RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100640 (May 6, 2010)..

18. See Comments of Lucent Technologies, Inc., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100780 (May 6, 2010); Opposition to Petition for Rulemaking from Digital Radio Express, Inc., RM-9395, December 24, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100823 (May 6, 2010); and Reply Comments of Lucent Technologies, Inc., RM-9395, January 25, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001302431 (May 6, 2010).

19. Comments of Big City Radio, Inc., RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100623 (May 6, 2010).

20. Reply Comments of Big City Radio, Inc., RM-9395, January 25, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001302349 (May 6, 2010).

21. Comments of Ford Motor Company, RM-9395, December 23, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100665 (May 6, 2010).

22. Reply Comments of the Consumer Electronics Manufacturers Association, RM-9395, January 25, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001302323 (May 6, 2010).

23. Reply Comments of USA Digital Radio, Inc., RM-9395, January 25, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001302350 (May 6, 2010).

24. Reply Comments of Citizens' Media Corps, RM-9395, December 22, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001000962 (May 6, 2010).

25. See Federal Communications Commission, Media Bureau, Audio Services Division, *In the Matter of Creation of a Low Power Radio Service* , MM 99-25, January 29, 1999, http://fjallfoss.fcc.gov/ecfs/proceeding/view?z=syf0&name=99-25 (October 8, 2010).

26. Comments of the Prometheus Radio Project, RM-9395, December 24, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001100862 (May 6, 2010).

27. Comments of the Amherst Alliance, RM-9395, December 22, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001000961 (May 6, 2010), p. 6-7.

28. Thomas R. McGinley, A Closer Look at Lucent DAB," *Radio World*, November 25, 1998, p. 6-7.

29. See McGinley, "No DAB Bus Rides," *Radio World*, November 25, 1998, p. 7, and Leslie Stimson, "DAB: Leaping or Inching Forward?," *Radio World*, December 23, 1998, p. 1, 7-8.

30. Steve Behrens, "Field testing resumes for radio's digital best hope," *Current*, Vol. XVIII, No. 15 (August 16, 1999), p. 1, 19.

31. See ex parte Letter from USA Digital Radio Partners, L.P., RM-9395, November 12, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5000704231 (May 6, 2010); ex parte Notice of USA Digital Radio Partners, L.P., RM-9395, November 25, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5000705864 (May 6, 2010); ex parte Notice of USA Digital Radio Partners, RM-9395, November 20,1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001000629 (May 6, 2010); and ex parte Notice of USA Digital Radio Partners, RM-9395, December 16, 1998, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001000781 (May 6, 2010).

32. See ex parte Notice of USA Digital Radio, Inc., RM-9395, March 23, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001804545 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, April 9, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001904288 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, April 9, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5001904288 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, April 29, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5002104472 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, May 4, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5002303917 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, May 4, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5002303917 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, May 4, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5002303919 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, May 5, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5002303925 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, September 3, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004609326 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, September 9, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004610124 (May 6, 2010); ex parte Notice of USA Digital Radio, RM-9395, September 14, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004709603 (May 6, 2010); ex parte Letter from USA Digital Radio, RM-9395, September 22, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004709714 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, September 23, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004710165 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, September 29, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004710843 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, September 29, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004710844 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, September 28, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004710855 (May 6, 2010); ex parte Notice of USA Digital Radio, Inc., RM-9395, October 1, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004711006 (May 6, 2010); and ex parte Notice of USA Digital Radio, Inc., RM-9395, October 7, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004711938 (May 6, 2010).

33. See ex parte Notice of Lucent Digital Radio, et. al., RM-9395, June 15, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5002805608 (May 6, 2010); ex parte Notice of Lucent Digital Radio, RM-9395, June 21, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5002906045 (May 6, 2010); ex parte Notice of Lucent Digital Radio, Inc., RM-9395, September 16, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004709584 (May 6, 2010); ex parte Notice of Lucent Digital Radio, Inc., RM-9395, September 16, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004709597 (May 6, 2010); ex parte Notice of Lucent Digital Radio, et. al., RM-9395, October 13, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004711985 (May 6, 2010); ex parte Notice of Lucent Digital Radio, et. al., RM-9395, October 13, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004712035 (May 6, 2010); and ex parte Notice of Lucent Digital Radio, et. al., RM-9395, October 13, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5004712344 (May 6, 2010).

34. See Federal Communications Commission, Mass Media Bureau, Audio Services Division, *Notice of Proposed Rulemaking: Digital Audio Broadcasting Systems and Their Impact On The Terrestrial Radio Broadcast Service*, (MM) Docket 99-325, November 1, 1999 (December 11, 2009).

35. Id., p. 2.

36. Id., p. 8-9.

37. Id., p. 10-16.

38. Id., p. 21-22.

39. Submission of Report of USA Digital Radio, Inc., MM 99-325, December 21, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006009927 (December 11, 2009).

40. Id., p. 4.

41. Submission of Report of USA Digital Radio, p. 3.

42. Id., p. 4.

43. Id., p. 1-2, 5.

44. Id., p. 11-13.

45. See Id., p. 11, and Appendix D, "Summary of ATTC FM IBOC Compatibility Tests," p. 3-4, in Id.

46. Id., p. i.

47. See Comments of WTRW Incorporated, MM 99-325, January 10, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110605 (December 11, 2009); Comments of KMSO-FM, Rochester Radio Group, and KSOB/KSQB-FM, MM 99-325, January 11, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110698 (December 11, 2009); Comments of Resort Radio Systems, MM 99-325, January 11, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110769 (December 12, 2009); Comments of KOFO-AM, MM 99-325, January 13, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110828 (December 12, 2009); Comments of WAJI-FM and WLDE-FM, MM 99-325, January 13, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110832 (December 12, 2009); Comments of KOOL 103.5 WASE, MM 99-325, January 13, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110833 (December 12, 2009); Comments of Cox Radio, Inc., MM 99-325, January 20, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111515 (December 13, 2009); Comments of Perception Media Group, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111399 (December 12, 2009); Comments of Gulf Coast Broadcasting Company, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111397 (December 12, 2009); and Comments of Wright Broadcasting Systems, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111402 (December 12, 2009).

48. See Comments of Chase Capital Partners, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111473 (December 13, 2009); Comments of Susquehanna Radio Corp., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111604 (December 13, 2009); Comments of Hispanic Broadcasting Corporation, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111606 (December 13, 2009); Comments of Cox Radio, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111611 (December 13, 2000); Comments of Gannett Co., Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111614 (December 13, 2009); Comments of Entercom Communications Corporation, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111615 (December 13, 2009); Comments of Infinity Broadcasting Corporation, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111722 (December 15, 2009); Reply Comments of Radio One, Inc., MM 99-325, February 22, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006113682 (December 19, 2009); and Comments of the National Association of Broadcasters, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111616 (December 13, 2009).

49. Comments of Greater Media, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111724 (December 15, 2009).

50. Comments of USA Digital Radio, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111617 (December 14, 2009).

51. Comments of Lucent Digital Radio, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111664 (December 14, 2009).

52. Id., p. 17-19.

53. Id., p. 35.

54. Comments of the National Association of Broadcasters, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111762 (December 15, 2009), p. 1.

55. NRSC DAB Subcommittee, "Goals and Objectives," as adopted May 14, 1998, in Id., p. 1.

56. NRSC DAB Subcommittee, "In-band/On-channel (IBOC) Digital Audio Broadcasting (DAB) System Evaluation Guidelines" adopted April 17, 1999, revised May 25, 1999, *supra* Footnote 56, p. 12-13.

57. Comments of National Public Radio, Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111447 (December 12, 2009), p. 5.

58. Id., p. 2, 6.

59. See Id., p. 2-3, 6, and Reply Comments of National Public Radio, Inc., MM 99-325, February 22, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006113726 (December 19, 2009).

60. Comments of Station Resource Group, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111456 (December 12, 2009).

61. Comments of Sony Electronics Inc., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111457 (December 12, 2009), p. 2.

62. Id., p. 2-3.

63. Id., p. 7.

64. Id.

65. Comments of Visteon Automotive Systems, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111609 (December 13, 2009), p, i, 1, 4, 10-11.

66. Id., p. ii.

67. Id., p. i, 6-7.

68. Id., p. 8.

69. Id., p. ii, 12.

70. Id., p. 11.

71. Comments of the Consumer Electronics Association, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111726 (December 15, 2009), p. ii-iii.

72. Id, p. 4-10.

73. Id., p. 11.

74. Id., p. ii, 13-14.

75. See Appendix B, "Concept Design for a Mobile Multimedia Broadcast Service." *supra* Footnote 73.

76. Reply Comments of David P. Maxson, MM 99-325, February 23, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006113879 (December 19, 2009), p. 10.

77. Id., p. 19-20.

78. Id., p. 24.

79. Comments of Clarkston Broadcasters, Inc., MM 99-325, December 29, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110156 (December 11, 2009).

80. Comments of WIllis Broadcasting Corporation, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111401 (December 12, 2009).

81. Comments of the U.S. Small Business Administration, Office of Advocacy, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111451 (December 12, 2009).

82. Id., p. 5-6.

83. See Comments of David S. Forsman, MM 99-325, December 15, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5005909585 (December 11, 2009), p. 2; Comments of Ted M. Coompan, et. al., MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111423 (December 12, 2009), p. 4; Comments of Pete Tridish, MM 99-325, January 24, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111484 (December 13, 2009), p. 2, 4-5; and Reply Comments of REC Networks, MM 99-325, February 14, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006112853 (December 19, 2009), p. 4.

84. See Comments of Blair Alper, MM 99-325, December 23, 1999, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006009673 (December 11, 2009), and Comments of Virginia Center for the Public Press, MM 99-325, January 27, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006111486 (December 12, 2009), p. 6.

85. Comments of Richard Hartnett, MM 99-325, January 10, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110544 (December 11, 1999).

86. Comments of Alan Ricotta, MM 99-325, January 17, 2000, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5006110886 (December 12, 2009).

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Chapter 5: The Troubled Proliferation of HD Radio

With the FCC's initial approval of HD Radio, its proponents may have thought they were free and clear to implement the technology with few restrictions, and that its proliferation would be a given. After all, the FCC confirmed the operative metaphors behind the radio industry's chosen technological platform and constructed policy so as to make HD the only allowable digital radio mechanism in the United States. However, as more stations began to implement HD Radio and iBiquity Digital Corporation worked to refine its technology, its fundamental faults became increasingly clear. This further alienated independent broadcasters and the public, who were already of the mind that such a questionable and proprietary technology threatened the viability of terrestrial radio itself. They ramped up their opposition to HD Radio through increased dialogue with the FCC. However, much like the initial debate over the technology's introduction, the agency did not embrace this input and, in fact, worked with HD Radio's proponents to further promote the technology and its uptake. Ironically, these regulations only exacerbated growing concerns with the protocol.

I. Backlash to the HD Radio Ruling

Within 10 days of the FCC's initial rulemaking giving FM and AM stations the green light to implement HD Radio, two very different petitions were tendered to FCC imploring it to reconsider its decision. The Amherst Alliance, along with 33 other individuals and grassroots organizations, chastised the FCC for failing to consider legitimate opposition in the digital radio rulemaking.[1] "Just as the right of parties to be heard, and not prejudged, lies at the foundation of the law," wrote the Alliance et. al., "so does the principle that the law should be impartial. While there are endless exceptions to the law's general rules, and while even a uniform rule may sometimes be tailored to particular circumstances, those who shape the law are accountable for explaining why different parties are treated differently."[2] The Alliance accused the FCC of ignoring important information regarding HD Radio's deficiencies "when there was no compelling reason to do so."[3]

Consulting engineers Glen Clark & Associates of Pittsburgh, Pennsylvania also filed a Petition for Reconsideration, but it asked the FCC to expand its Report and Order to give AM stations the opportunity to broadcast digitally at night. "Although a minority of AM stations

operating with [HD] at night would cause significant interference to distant stations on first-adjacent channels," Clark argued that "the number of stations which would cause interference is small. It is unnecessary to preclude all nighttime use of [AM-HD] because of a minority of cases."[4] It cited policy precedent allowing stations to "enter into mutual-interference agreements" and noted that in some cases, especially those involving the largest AM stations in the country, two stations that might interfere with each other were more likely than not to be owned by the same broadcaster, which could self-police its own airwaves to ameliorate any interference problems that arose.[5]

Amherst's Petition spurred a surprising amount of support from members of the public who had either participated in the initial DAB rulemaking or were directly affected by the interference HD Radio caused to their own listening experience. Kyle Drake, a radio engineer in Plymouth, Minnesota, observed that while "many engineers at the FCC and myself see eye-to-eye on [the potential for HD-related interference]...they have still promoted the adoption of the service without even basic testing for interference concerns."[6] REC Networks argued that the FCC should "turn it all off and go back to the drawing board."[7] James Jason Wentworth of Fairbanks, Alaska argued that the radio industry labored "under the mistaken belief that a technological change, such as the implementation of [HD Radio], would increase radio listenership. This is incorrect. Improving the quality and increasing the variety of radio programming, as well as appealing to more demographic groups, are the only ways to attract more radio listeners."[8] Such sentiments were strongly echoed by "experienced broadcast radio enthusiast" Kevin Tekel of Warren, New Jersey, who worried that the adoption of a proprietary digital broadcast technology "might very well represent the final corporate takeover of the radio broadcasting industry and the end of independently owned radio stations."[9] Tekel was not alone in this concern: at the August, 2002 annual Grassroots Radio conference, which drew more than 100 employees and volunteers from 38 community radio stations nationwide, attendees approved a resolution opposing HD Radio's continued implementation without further study of its detrimental effects on the AM and FM bands.[10]

Several radio listeners filed detailed reports with the FCC explaining HD-related interference caused by both AM and FM broadcasters. Commenters ranging from Arizona to

Florida, and many places in between, told the FCC about "rushing water" noises caused by digital hash from AM-HD stations in New York, Cincinnati and Chicago that had already ruined nighttime reception of AM signals in their home communities.[11] The public was critical of Glen Clark's petition to expand the use of AM-HD. Charles L. Hutton of Seattle, Washington observed that the FCC's AM allocation rules and interference protection criteria were "based on transitory analog modulation conditions. Those deployment rules do not take into account the 'always on' nature of the digital primary and secondary [HD] sidebands." Until the FCC was willing to "model, quantify and perform field studies of nighttime [HD] interference, it is extremely premature (and likely incorrect, given early proof of [HD] interference) to consider approval of nighttime [AM-HD] operations."[12] Other members of the public noted that neither iBiquity, the NRSC, nor the FCC had adequately considered the diversity of radio receivers that existed in the marketplace, and warned that many inexpensive models would suffer significant HD-related interference.[13]

Independent broadcasters also told the FCC that identifiable technological problems with HD Radio merited further scrutiny.[14] Frederick R. Vobbe of Lima, Ohio - a broadcast engineer, amateur radio operator, and coordinator of his county's emergency-management communications - asserted that the HD Radio system's penchant to cause interference posed "serious harm" to existing stations and the public's right to hear them.[15] "While those of us who are engineers can understand this concept, and know what is happening," wrote Vobbe, "the average public hears this noise and blames the station they are listening to, rather than the offending adjacent channel interference."[16] Vobbe also provided extensive observations about the existence of a digital "hissing" noise that affected analog AM stations "well over 1,000 miles away" from the offending broadcaster. For example, at night, reception of some of the most powerful stations in Chicago was "rendered useless" by digital sideband noise from an AM-HD broadcaster in New York.[17] Vobbe advocated for the suspension of HD transmissions and the testing of alternate DAB systems by a "neutral, third party. The Commission does not want the perception of ignoring all options in a race to go 'digital,' nor should the Commission show preference towards any one party."[18]

On January 22, 2003, the FCC officially recognized the Petitions for Reconsideration and

called for further comment on them.[19] The industry reacted loudly to this perceived threat. iBiquity reported that as of February it had "approximately 130 AM and FM stations" in 26 states committed to deploying HD Radio technology, up from a dozen test stations the year before. This alone, it argued, was a "strong indication" of industry support for its technology."[20] iBiquity accused the Amherst Alliance of using "any possible procedural argument in an attempt to delay the introduction of [HD] services."[21] Although it acknowledged the potential for AM-HD signals to cause interference, especially at night, iBiquity dismissed this concern with a note that it was studying the issue to "improve" the situation.[22] The National Association of Broadcasters characterized the Amherst petition as full of "frivolous charges and makeweight issues...[and] appears intended only to throw sand in the gears of the deployment of the only realistic digital solution for terrestrial radio in this country."[23]

The public was not willing to be brushed off so easily. The Virginia Center for the Public Press cited NRSC correspondence which suggested that the standards-setting group knew of AM-HD interference problems as early as March of 2002.[24] "The only benefit of [HD Radio]," wrote the VCPP, "will be the ability to legally jam a weaker adjacent signal from the dial under the mistaken assumption that people will then have no choice but to listen to the jamming station....Hopefully [HD Radio] will make itself obsolete before too many broadcasters are bankrupted by [it].[25] Citing the "rising tide" of public consternation about HD Radio and actual reports of interference in the record, the Amherst Alliance chastised the Commission for making a rush to judgment on radio's digital future.[26] The "bottom line point," wrote the Alliance, was that

> the Commission's conscious compilation of a minutely focused information base left the Petitioners with little publicly accessible knowledge and/or arguments for developing constructive alternatives to the iBiquity version of...Digital Radio technology. Lacking the financial resources we needed, the Petitioners were not able to develop much independent information for developing constructive alternatives....Meanwhile, lacking the resolve it needed, the Commission was not willing to develop much publicly available independent information on alternatives to the iBiquity...technology -- for use by the citizens it is supposed to serve.[27]

After languishing for more than a year at the FCC, the Amherst Alliance and 63 other interested parties filed a Petition for Expedited Relief asking the FCC to formally rule on its Petition for Reconsideration.[28] The FCC chose not to act.

Meanwhile, the industry pushed for the expansion of HD Radio beyond the limited parameters set by the FCC's initial approval. In 2003, iBiquity Digital Corporation and the NAB tendered studies justifying the unrestricted nighttime use of AM-HD. The NAB formed an ad-hoc technical group with iBiquity to study the interference issue. This group conducted very limited laboratory and field testing, but the NAB was confident enough to proclaim that concerns of AM-HD interference would be marginal at best, and that the benefits of extending the reach of digital radio far outweighed any harm to analog reception.[29] iBiquity predicted that, in a "worst case scenario," less than 5% of AM listeners would be impacted by digital sidebands bouncing off the ionosphere and interfering with analog signals at night, and any resultant interference would be in the fringe coverage areas of the affected analog stations.[30] In a nutshell, although iBiquity and the NAB admitted that AM-HD would cause some interference at night, its impact was downplayed and listeners were expected to simply deal with it.

This was not an acceptable conclusion to the public. Eric S. Bueneman of Hazelwood, Missouri filed a detailed listening report providing an outsider's perspective on the iBiquity/NAB testing regime. The interference he documented "proves, once and for all, that the AM, FM and shortwave bands ARE NOT SUITED for digital radio. [HD] is NOT THE ANSWER to radio's alleged 'problems'."[31] Canadian commenter Philip J. Rafuse implored the FCC to consult with Industry Canada on the cross-border interference that was likely to result if AM-HD stations commenced nighttime operation nationwide.[32]

Public broadcasters, acting wholly on their own, met with FCC officials in an effort to convince the agency to make multicasting a permanent feature of the FM-HD broadcast protocol. In December of 2003, NPR representatives sat down with senior staff to tout the potential of multicasting.[33] Less than three months later, NPR made a personal presentation of its own technical study on the feasibility of multicasting.[34] It concluded that not only was it technically feasible to split an FM-HD signal into multiple program channels, but their audio quality was adequate and these sub-channels would reliably cover most of an FM station's primary analog service area.[35] Multicasting, argued NPR, would provide HD Radio with its killer application and jump-start listener uptake: "The driving force behind public radio's digital transition is not just the improved audio quality and reduced interference, but the expanded public service and

programming opportunities demonstrated and proven by [multicasting]."[36] NPR spent most of the month of March, 2004 at FCC headquarters meeting individually with every Commissioner's senior legal advisor, touting the necessity of formally integrating multicasting into the HD Radio protocol.[37] "Commercial stations are not completely enthused," reported *Radio World*, "as they see secondary audio channels as potential threats to fragment their formats and market-share."[38]

Shortly after the FCC's initial Report and Order approving the proliferation of HD Radio, the Corporation for Public Broadcasting hired consulting engineer Doug Vernier to help plan NPR's digital transition, and WUSF-FM in Tampa, Florida became the first NPR affiliate to place an order for an HD transmitter.[39] The CPB announced it would make $4.5 million available to qualified stations to help cover digital conversion costs.[40] iBiquity CEO Robert Struble told *Radio World* he expected the FCC to formalize HD Radio as the nationwide DAB standard by the end of 2003.[41] The company also announced another licensing incentive program, slashing one-time broadcaster fees for the first 125 stations to adopt the technology after February 1, 2003. All noncommercial stations who agreed to implement HD before June 1 would have the initial license fee waived completely.[42] 35 radio station group-owners announced plans to implement HD Radio on some 300 stations in 40 markets by the end of the year. Most of the companies committed to the transition had an equity stake in iBiquity;[43] the company expected the number of HD-compatible stations to double by the end of 2004.[44]

These seemingly positive developments were not reflected in commentary tendered by working broadcasters in the trade press, who spoke frankly in their letters to the editor of *Radio World*. Although the industry had worked diligently to convince the FCC to approve its chosen digital broadcast standard, there was little apparent momentum to convert stations to digital broadcasts until the full implications of doing so could be ascertained. Just because the industry got the policy it wanted did not necessarily mean that stations would begin the conversion process straightaway. Frank McCoy of American Media Services in Chicago echoed earlier concerns that HD Radio was nothing more than a blocking move to prevent new competition on the radio dial.[45] KRCO-AM operations director Mike Shane called the imposition of HD Radio "a spectrum grab by those currently in possession of frequencies to keep future competition off the air....Why *else* would there be such a push for a signal that nobody will be able to hear, and

when they are able, won't be excited enough to do anything about it?...I am ashamed to have missed this obvious point up till now and even more ashamed to be part of this business that, with complicity from the FCC, is perpetrating a major scam on the American listening public.[46] Christopher Maxwell, secretary of the Virginia Center for the Public Press, agreed. With the "relatively quick death of [HD Radio]," he argued the industry could "move to an 'intelligent' digital audio broadcast standard....But then again, by then, maybe we will all be getting our radio via repeating 802.11 towers with Winamp on our Palm Pilots. So maybe it'll be a moot point as far as broadcasters kill off that waning interest by jamming each others signals and reducing the variety available even as wireless internet increase[s] the number of options there."[47]

Even *Radio World* staff were not overly excited about HD Radio's proliferation. Editor Paul McLane lamented the lack of any substantive public education effort on the part of iBiquity and was shaken by the rising tide of skepticism among broadcasters about the technology.[48] Some openly complained that the combination of station equipment upgrades and iBiquity's licensing plan would make HD conversion unaffordable for most small- to medium-market broadcasters.[49] Larry Tighe, owner of WRNJ-AM in Hackettstown, New Jersey, reiterated the call for broadcasters to refocus on localism in programming as a source of industry growth, not on an unproven technology which seemed to have more detriments than benefits. "I'll make a better rating with a carbon microphone in my studio than an [HD] station if my content is superior to theirs," sniffed Tighe. "Now let's see who's correct after you spend all that money."[50]

Concerns involving HD interference and audio fidelity were hot topics offstage. *Radio World* observed that the technology "pits large group owners against smaller station owners and splits NAB's radio membership."[51] Some broadcasters reported their own HD-related interference experiences on both the AM and FM bands.[52] Al Germond, the owner of seven radio stations in Missouri, implored the industry to engage the listening population for help in documenting interference problems. "If [HD Radio] turns out to be deleterious to broadcasting," he warned, "this will become a grassroots issue that should become a concern to both the House and Senate Commerce Committees."[53] Editorially, *Radio World* diplomatically expressed concern about the potential for HD-related interference to grow as more digital broadcasters took to the air. "It is hard for us to stand by and ignore the obliteration of any station on the dial due to

interference. Some stations already are up against the ropes and a defection of listeners due to interference could conceivably hasten such a station's demise. But we are hoping for the best the technology has to offer and are looking toward the future as a larger picture."[54]

The radio industry was surprised by a May, 2003 decision of the NRSC to suspend standard-setting work on the HD Radio protocol. Following the technology's preliminary endorsement by the FCC seven months prior, iBiquity "upgraded" its system by replacing its audio codec with a wholly proprietary one, so as to maintain its monopoly on the intellectual property aspects of HD Radio.[55] Unfortunately, according to the NRSC, this new codec performed so poorly - especially at low bit rates like those used with AM-HD and FM-HD multicasting - that the entire viability of HD Radio's digital audio encoding mechanism was called into question. The consensus of NRSC members was that the "new and improved" HD Radio produced audio quality that was simply "unacceptable." This revelation disrupted industry plans to get HD stations on the air and, more critically, the timetable for receiver manufacturers to turn out compatible and compelling products.[56]

Radio World reacted strongly to this pitfall. "The key for iBiquity now is to get a hustle on what 'better' means and get it done, as quickly as possible," it urged. "Perhaps the receiver rollout is blown for 2004. Maybe not. But better to fix this now than wait to dump a problem in the laps of receiver makers and consumers. We urge iBiquity to be as forthright and as open as possible with the industry as it seeks solutions to this problem."[57] The NRSC standards-setting process was characterized as "far too secretive, and not well-defined....Why do we find ourselves so far along on the HD Radio rollout with a core piece of the digital radio puzzle not yet firmly in place?," wrote editor Paul McLane. " [T]he NRSC should open its meetings to all concerned parties - including those of us who cover the industry on your behalf....Public debate and news coverage will ensure vigorous scrutiny, to everyone's benefit."[58] *Radio World* reported that the standards-setting "pause" was required because "the NRSC could not proceed and remain legitimate." At least one transmitter manufacturer with an equity investment in iBiquity halted the manufacturing of HD-compatible units until the issue could be sorted out.[59] *Radio World* also reported that, due to the codec controversy, the number of stations asking the FCC for authorization to broadcast in HD dropped significantly.[60] The Amherst Alliance made sure to

formally notify the FCC of this controversy, while iBiquity held an emergency ex parte meeting with senior agency staff to downplay the problem.[61]

It took three months for iBiquity to replace its failed codec. During this period of retrenchment, the company laid off Project Acorn facilitator and USA Digital Radio cofounder E. Glynn Walden, along with two other managers; these were followed by 32 more redundancies.[62] Industry sentiment toward iBiquity turned increasingly sour. Milford Smith, chairman of the NRSC's DAB Subcommittee, said he was "incredibly shocked and disappointed" by the layoffs and believed Walden had represented "the most reliable and dependable contact" at iBiquity. *Radio World* reported that the personnel cuts were due to the codec controversy as well as the company's cash burn-rate, estimated to be $2.1 million per month. Although the publication reported that iBiquity raised "roughly $100 million" in a recent round of financing, direct investment from broadcasters had dropped significantly and the shortfall had to be made up by overtures to venture capitalists.[63] iBiquity CEO Robert Struble denied the company was in a fiscal squeeze, although *Radio World* reported that the company was quietly seeking more broadcast-investors beyond the national conglomerates, with little success.[64]

Broadcasters sounded off in the trade press with increasing skepticism. "Unless and until the public *demands* [HD Radio]," wrote consulting engineer Gary Jordan in a *Radio World* guest commentary, "the big guys investing the big bucks will have to stand tall before the investors one day. The simple reality is the listening public is happy with conventional radio broadcasting in the USA."[65] Commentator Skip Pizzi deplored the fact that HD Radio remained in "such an immature, unstable and speculative state," and worried that the iBiquity's layoffs gave good reason for the industry to question the "corporation's ongoing viability" and "management sensibility." Several professional broadcast engineers sent letters to *Radio World* further detailing real-world experiences with HD-induced interference to analog stations.[66] Others reiterated the argument that programming improvements, not technological "upgrades," were necessary to revive the radio business, and that HD Radio's uptake involved inherent compromises, the likes of which had not been fully explained to the industry.[67] Some broadcasters openly called on the FCC to re-open its exploration of digital radio to include

protocols other than HD.[68] The NRSC's Charles Morgan minced no words about the slow rollout: "Without broadcasters taking the lead and investing in [HD] installations, I fear that [HD] may become stalled or simply die a slow death. If that happens, I believe we will see some form of new-band terrestrial radio....Existing broadcasters will have no assurances that they will have the same role in this new service as they have today."[69]

By 2004, the visibility of HD Radio in the marketplace remained virtually nil. Although some receiver manufacturers produced limited numbers of aftermarket automotive receivers for the holiday shopping season,[70] it was not until January 5, 2005 that Nathan Franzen of Cedar Rapids, Iowa became the first person in the U.S. to purchase an HD Radio receiver. The event made headline news in both *Radio World* and *Current*.[71] FCC Media Bureau chief Ken Ferree predicted that radio's digital transition would go much more smoothly than the DTV changeover, but *Radio World* characterized the "prospects and timeframe for wide-scale adoption by consumers" as "still anyone's guess."[72] The NAB later bestowed E. Glynn Walden with its Radio Engineering Achievement Award for his pioneering work involving HD Radio; after being let go from iBiquity he became vice president of engineering for Infinity Broadcasting, an iBiquity investor.[73]

II. Parsing HD Radio's Fundamental Detriments

As HD Radio's proliferation looked increasingly questionable in the real world the broadcast industry became more emphatic about its necessity in the policy world. The industry creatively recontextualized the FCC's desire to implement "further rules" governing the technology into a crusade to push the agency toward "final rules" deciding the question of HD Radio's place of primacy once and for all. Proponents did not blame anemic listener interest in HD on the technology or iBiquity's business model, but "regulatory uncertainty" which only the FCC could fix by laying to rest any doubts about the technology's viability and permanently authorizing its use.[74] Although Disney admitted that the potential profits of HD Radio "appear small, especially in the short term," permanent selection of HD as the sole U.S. DAB standard would "would encourage stations to construct and implement digital service."[75] Infinity Broadcasting celebrated the "extraordinarily encouraging" feedback received from "its engineers and other station personnel who have experienced improved [HD] service firsthand."[76] The

National Association of Broadcasters asked the FCC to "grant delegated authority to the Media Bureau to consider and...approve on a blanket basis new transmission techniques and apparatus that will enable broadcasters to bring the benefits of [HD] technology to the listening public in more efficient and/or cost-effective ways, further expediting the digital transition and providing additional incentives to initiate [HD broadcasting]."[77] However, very few HD-supporters favored a mandatory analog/digital conversion deadline. Most corporate proponents and all but three state broadcasters' associations petitioned the FCC to allow marketplace forces to govern the transition, on the premise that analog broadcasting would remain "the mainstay of radio broadcast service for years to come."[78]

With regard to questions of interference raised by the proliferation by HD Radio, industry proponents were not quite as unified as they were earlier in the DAB rulemaking, though they still worked to downplay this defect of the digital broadcast protocol. Most early-adopter iBiquity investors with large stables of FM stations promised to convert the majority of their stations in an orderly manner over the next several years.[79] Entercom Communications Corp, which had implemented FM-HD broadcasts on four of its 71 FM stations, reported "the conversion to hybrid service to be a relatively simple process with no serious difficulties. The hybrid service has resulted in minimal disruptions to the stations' analog service and has not been a drain on the stations' resources."[80]

On the issue of AM-HD interference, many broadcasters advocated for its full-time authorization.[81] Cox Radio, Inc. admitted that there was a "reasonable assumption that adjacent-channel interference can result at nighttime," and upon the receipt of any "credible" interference complaint it entreated the FCC to "halt the operations of the alleged source of [HD] interference immediately."[82] Clear Channel openly questioned whether the AM analog station allocation rules could be successfully applied to the HD system and suggested the FCC rethink this fundamental principle.[83] On the more radical end of the issue, broadcasters like Buckley Broadcasting and Greater Media expressed their willingness to write off expanded nighttime (skywave) coverage in favor of robust digital service. Buckley dismissed its "fringe listeners" and commented that rising ambient noise levels on the AM band already made skywave propagation unreliable.[84] Greater Media went so far as to designate AM skywave service an anachronism:

> [T[he fact is that wide-area nighttime skywave service, while a fascinating propagation phenomena and very much a part of radio's historic past, is largely irrelevant in today's world. The number of persons deriving radio service via skywave propagation is tiny. Most persons under the age of 40 do not even know that this propagation mode exists, let alone listen to it. The need for a medium wave wide area skywave service in the U.S. has largely passed....This is, by far, the most significant compromise attendant to 24-hour AM digital operation. However, the upside...is worth the attendant deterioration of the skywave service component inasmuch as the vast majority of these stations' listeners and advertisers are within the groundwave service areas. For AM to have a future, it must transition to digital. To transition fully to digital will require this necessary compromise.[85]

Greater Media cited no ratings data to prove that skywave listening no longer mattered to listeners of AM radio. Many agreed that the industry could sort out interference complaints among itself, and existing FCC remediation policies were adequate to the task.[86]

Among HD Radio's proponents, only iBiquity rose to answer criticism of its proprietary nature. "iBiquity believes its agreements have complied with the requirement to use fair, reasonable and nondiscriminatory terms," wrote the company. "The Commission has rarely, if ever, interjected itself into defining what constitutes compliance with these requirements. Based on iBiquity's existing licensing process, it would be extraordinary and unnecessary for the Commission to take any action on this topic."[87]

For the first time onstage, proponents of HD Radio stood virtually alone in their optimism for the technology. Independent broadcasters had never been so diametrically opposed to the expansion of HD Radio as they were when its proponents sought to implement "final rules." They accused the FCC of being "enamored with all things digital" without responsibly studying HD's detrimental effects on a well-established, regularly-used mass medium.[88] Independent broadcasters focused in detail on two of HD Radio's three fundamental weaknesses: the potential for interference and iBiquity's proprietary nature.

Interference problems were now a significant matter of debate in the FCC rulemaking. Independent FM broadcasters lamented the fact that not enough data had been collected to guarantee even the most basic interference protections to analog service.[89] Some even tendered analyses of existing instances of FM-HD interference.[90] With regard to AM-HD, independent broadcasters pulled no punches. Oklahoma-based Reunion Broadcasting, among others, noted that although there were just some 30 AM-HD stations broadcasting nationwide by mid-2004,

these stations were causing enough harm to the band to raise serious concerns.[91] The potential for interference from unrestricted AM-HD proliferation was a significant concern of small broadcasters.[92] Many pleaded with the FCC to only allow AM-HD broadcasts at night after careful examination of a station's potential to interfere with others.[93] Whereas proponents believed the industry could resolve interference complaints by themselves or with minor FCC intervention, "[t]his 'do it now, fix it later' approach, wrote Reunion Broadcasting, "simply increases the uncertainty for each broadcaster seeking to move forward with digital broadcasting.....The public interest is not served by an unrestrained increase in interference that reduces the number of voices available to the listening public."[94] Several broadcasters filed reception reports detailing AM-HD interference affecting the communities they served, noting an explosion of "white noise," "hissing," and "buzzing" on the AM dial.[95]

Many independent broadcasters also reported that they either could not or would not adopt iBiquity's technology due to its expensive and proprietary nature.[96] Georgia-based Radio Kings Bay, Incorporated called iBiquity's licensing fee a "disgraceful extortion payment" that created "an inherent adhesion license, the terms of which are clearly and unmistakably one-sided."[97] Paul Dean Ford characterized the Commission's entire DAB rulemaking as one "in step with private vested interests" and called iBiquity's licensing scheme a "questionable fiat from within."[98] KYPK-AM of Terrell, Texas warned of the "Commission sanctioned monopoly" that would result from iBiquity's "unprecedented power over, and control of, the market. Historically, this country has viewed such monopolistic control as undesirable and as an impediment to commerce." The station encouraged the FCC to impose open source requirements on iBiquity's technology. "Ongoing or large lump sum royalty payments or fees proposed initially by iBiquity will only serve to slow progress in the adoption of [HD Radio]."[99]

Public broadcasters engaged in onstage dialogue about HD Radio's specifics to an unprecedented degree. National Public Radio's primary goal was to cement multicasting as a necessary feature in the HD system. NPR organized nearly 150 of its affiliate stations, the educational institutions they were wedded to, and loyal listeners to deluge the FCC with positive sentiments about their experience with or belief in the potential of multicasting to increase program diversity.[100] Puget Sound Public Radio, licensee of KUOW in Seattle, reported to the

FCC that it had committed more than $100,000 to providing multicast programming.[101] Northeast Indiana Public Radio promised to use multicasting to target the underserved Hispanic audience in its community;[102] KNAU-FM of Flagstaff, Arizona planned the same for Native Americans.[103] These promises assumed that underserved listeners would flock to stores to buy new, expensive HD Radio receivers in order to take advantage of specialized digital programming, and there was no evidence to suggest that was likely. Both NPR and CPB cast multicasting as "the driving force" behind HD Radio's success and the only substantial mechanism by which the technology would improve listener experience in a digital broadcast environment.[104] NPR would intensify its public campaign with a series of ex parte meetings with senior advisors to FCC Commissioners and Media Bureau staff emphasizing the need for multicasting to be required by rule in the HD Radio feature suite.[105]

The split between transmission and reception equipment manufacturers over the future success of HD Radio grew wider. Transmitter and other broadcast equipment-makers assured the FCC there was adequate demand in the industry to make an HD transition not only fiscally sustainable, but inevitable; they urged maximum latitude in the implementation of digital broadcasting and minimal regulatory oversight.[106] Harris Corporation even conducted an ex parte meeting with the senior counsel to all sitting Commissioners asking them to expedite further development of the DAB rulemaking.[107] The enthusiasm of receiver manufacturers was much more restrained. The Consumer Electronics Association supported HD Radio in principle but urged the FCC to vigorously investigate AM-HD interference issues.[108] Surprisingly, no receiver manufacturer participated openly in the opening policy debate surrounding the FCC's second NPRM; only Kenwood Corporation - like Harris, an iBiquity investor - met privately with senior Commission advisors to discuss the HD Radio rulemaking, expressing concerns similar to those tendered by the CEA.[109]

The public was not intimidated by the FCC's apparent ignorance of its concerns; it redoubled the effort to demonstrate that not only would HD Radio ultimately be detrimental to listener choice, but that they simply didn't want it. "There is a fallacy that 'digital' is always better than analog," reiterated John Pavlica, Jr. of Toledo, Ohio, "and that is not always the case."[110] The Amherst Alliance pointed out that "[t]here has been no persuasive documentation

that millions of radio listeners, let alone tens of millions of them, are demanding a rapid shift to... any version of Digital Radio. In fact, to the extent that radio listeners and groups which represent them have expressed an opinion on [HD] in this Docket, they have overwhelmingly opposed its implementation, not demanded it."[111] Several media reform organizations, in a collective comment, took umbrage with the idea that HD signals used "no new spectrum." "This technology...allows broadcasters to engage in activity which is the equivalent of constructing additional buildings on their spectrum sidewalks, taking space they have not been previously allowed to use." Given "a media environment increasingly characterized by concentrated ownership, commercially-driven content, and a lack of civic engagement," the self-styled "Pubic Interest Coalition" suggested the FCC use its HD rulemaking to "represent a new stage in the ongoing evolution of the public interest standard: a needed reassessment in light of dramatic changes in communications technology, market structures, and the needs of a democratic society."[112]

Interference concerns remained a major point of contention. Douglas E. Smith of Pleasant View, Tennessee observed that HD Radio violated " a fundamental assumption of the allocation system: the assumption that energy at the outer edges of the signal will be only intermittently present....In [the HD environment], this energy is present at all times. The increase in interference potential is obvious, and large. It's like the difference between your neighbor's dog barking once, and it barking all day long. You'll tolerate the former; the latter may drive you to consider certain actions not acceptable to the Humane Society."[113] Eric S. Bueneman warned HD Radio "would prove devastating to the radio industry as a whole; robbing this country of literally hundreds of independent radio stations," and called the FCC's action on the topic "reckless."[114] Several individuals filed comments directly opposing the full-time expansion of AM-HD broadcasting;[115] many included detailed reception reports of what damage the few AM-HD stations already on the air caused to the band at night.[116] Electrical engineer Charles Hutton of Seattle accused the FCC of acting on "incomplete and carefully selected tests...yet actual listening by third parties gives a drastically different picture."[117]

HD Radio's proprietary nature also continued to chafe the citizenry. Douglas Smith suggested iBiquity be regulated so as to take away its ability to hike license fees in times of

corporate distress and recommended that, after a certain period ot time, the company should turn its intellectual property over to the public domain.[118] The intimate fiscal ties between iBiquity and the nation's largest radio conglomerates, argued the Amherst Alliance, "creates for a number of broadcasters an inherent conflict-of-interest that makes them questionable judges of which Digital Radio technology is really best for radio."[119] The FCC's singular reliance on industry data, argued the Public Interest Coalition, was clearly designed "to further the interests of the entities that submit it....The data is not compiled in a manner that would aid independent academic research. Because most of the data presently relied upon by the FCC is proprietary and thus unavailable for others to use," there was no honest way to quantify the promised benefits of HD Radio.[120]

If the Commission was utterly committed to the proliferation of HD Radio, public commenters suggested creative ways to use the technology in order to reduce consolidation in station ownership and increase program diversity. William Jones of Raleigh, North Carolina proposed the FCC pool the "additional channel capacity" afforded by HD and auction it off to aspiring broadcasters.[121] Only two individuals - HD Radio's first public listener, Nathan Franzen, and an investment banker in North Carolina - filed comments in support of permanently authorizing the technology.[122] Others implored the FCC to consider other alternative DAB systems;[123] Scott A. Clifton of Naperville, Illinois suggested phasing out the AM band entirely in favor of a new-spectrum digital radio service.[124]

This backlash could no longer be perfunctorily dismissed by HD Radio's proponents. iBiquity disputed the notion that its technology used new spectrum with a profoundly circular argument:

> The HD Radio system is "refarming" otherwise unusable spectrum in both the AM and FM bands....The Commission's emission limits on analog signals create what is essentially a "guard band" between stations. This band cannot be used for any purpose or the technical integrity of the existing adjacent station would be compromised. Even though broadcasters do not "occupy" this band, they effectively "use" it by precluding anyone else from using that spectrum. It is this delicate balance that has insured the technical viability of the U.S. radio industry. [HD] technology allows broadcasters to use that otherwise unusable spectrum....Collectively the broadcast industry is agreeing to accept additional interference to existing services in limited cases in order to facilitate an industry-wide upgrade to digital service. iBiquity objects to the...characterization of this as a spectrum grant.[125]

iBiquity called the growing concerns of HD-related interference "overblown" and argued that its "exhaustive testing" of the technology mitigated against the need to conduct a comparative DAB analysis.[126] The NAB singled out complaints of "mercurial" AM-HD interference only to dismiss them as "theoretical or analytical engineering concerns."[127] Since iBiquity's test data was the "*only* hard test data" in the record [emphasis in original], the NAB argued that public and independent broadcaster consternation over interference concerns was meaningless.[128] Greater Media characterized the growing detail of AM-HD listener complaints as the fruit of "compromises inherent in the...system [that] are acceptable and necessary if there is to be a future for AM radio."[129] Notably, National Public Radio jumped to iBiquity's defense, asserting that opening up digital radio signals to new broadcast-entrants would require "a sweeping new regulatory regime...that would, in fact, undermine the DAB transition and [is], therefore, contrary to the public interest."[130] Meanwhile, iBiquity began another backstage lobbying campaign with senior FCC staff urging acceleration of the DAB rulemaking;[131] these personal contacts with regulators attempted to mitigate the growing record of public dissatisfaction with HD Radio.

By this point in the policy dialogue, it was clear that any firm alliances between the primary protagonists in the rulemaking had broken down. Proponents of HD Radio now consisted almost exclusively of iBiquity and its investor-broadcasters. Public broadcasters expressed an unprecedented degree of caution about HD's interference potential and focused above all else on promoting the FM-HD multicasting function. Electronics manufacturers tacitly approved the promulgation of HD technology, but were not yet mass-producing digital radio receivers. Consulting engineers detailed technical concerns which the NRSC had failed to thoroughly examine. Independent broadcasters feared the noisy and monopolistic nature of HD Radio. And the public, which had always been critical of the technology, objected more strongly to its imposition.

Offstage, intra-industry and listener concern over the detrimental nature of HD Radio blossomed. By mid-2004, only 100 HD-enabled stations were on the air nationwide, and iBiquity hired three marketing professionals to help promote the technology's uptake by broadcasters.[132] iBiquity and its investor-companies also produced a steady stream of news giving HD Radio a

semblance of momentum. Clear Channel announced it would spend up to $100 million over the next decade to convert its stations to HD, though the decision was spurred by unpublished "incentives" that reduced the company's license fee burden.[133] "Industry observers" predicted broadcasters would spend "approximately $115 million...over the next few years" to upgrade their stations to digital.[134] iBiquity expected the first mass-produced tabletop receivers would hit the market by the spring of 2005, with a total of 15 to 20 HD receiver models (for car and home) on sale by the end of the year. BMW hinted that it would include HD Radio as a standard feature "in some models" of its automobiles, but declined to provide concrete details.[135]

Radio World found a consulting engineer who predicted HD Radio would reach marketplace criticality in 2009.[136] iBiquity announced an "historic agreement" with 21 radio group owners to convert 2,000 stations in the top 100 radio markets by the end of 2005 and leaked details of a new license-discount program to entice HD adoption; Entercom and Greater Media pledged to convert *all* their stations within a matter of months.[137] When a radio station in Puerto Rico went HD in 2005, iBiquity touted the milestone as "position[ing] the technology for widespread adoption outside the continental U.S."[138] The company raised another $30 million in financing, mostly from venture capital firms; *Radio World* totaled the company's equity investment at $135 million since its founding in 2000.[139] The Corporation for Public Broadcasting reported that as of September, 2004 it had invested $20 million to help 147 noncommercial stations with HD conversion projects, including $250,000 in grants to explore the functionality of datacasting and $2.5 million to experiment with multicasting.[140] By the end of 2004, 50 public radio stations would be broadcasting in some form of HD, and CPB had funded 262 station-conversion projects.[141] NPR encouraged its FM affiliates to petition the FCC for multicasting authority, so as to demonstrate industry willingness to adopt the feature.[142] It also unveiled plans to offer five "turnkey" music formats to fill multicast programming (classical, jazz, folk music, adult album alternative, and electronic music - the latter provided by a webcaster).[143] NPR also announced it was experimenting with the transmission of Dolby 5.1 Surround Sound on FM-HD stations, even though a station could not provide that service and multicast at the same time.[144]

That was the good news. In May, 2004, *Radio World* reported that a handful of AM-HD stations had turned off their digital sidebands due to interference concerns; iBiquity claimed these stations were aberrations, unrepresentative of HD Radio's effects on AM reception nationwide.[145] In October, Clear Channel ordered all of its AM stations to reduce the bandwidth dedicated to their *analog* signals, in hopes of "cleaning up" the band for HD adoption.[146] *Radio World* also reported that the Canadian Association of Broadcasters and Canadian Broadcasting Corporation asked its own broadcast regulators, Industry Canada, to "notify the FCC that the authorization of [AM-HD] transmissions, especially at night, will very likely result in harmful interference to Canadian signals."[147] The publication continued to receive a steady stream of letters from broadcasters documenting AM-HD interference in their communities.[148]

Some early-adopter broadcasters took to the trades in an attempt to assuage industry discontent. Thomas R. Ray III, chief engineer of AM-HD station WOR in New York, admitted that AM's digital transition would take upwards of 20 years and required compromises to analog signals, but that any other outcome was untenable. "[HD Radio] isn't the three-headed monster it's been portrayed to be. It's time for a change in our industry. Education...is the key to understanding and using this new technology to our greatest advantage. Remaining the same while the world marches past us will place terrestrial AM and FM broadcasting among the dinosaurs, rendering us irrelevant."[149] John Arndt, the assistant chief engineer at Greater Media's Philadelphia station cluster, called HD critics "naysayers" and downplayed any concerns of interference.[150] *Radio World*'s anonymous commentator, "Guy Wire," latched onto the "naysayer" moniker to portray HD critics as Luddites.

> Just because it's digital doesn't mean it's better, they say...This reminds us all of the horse-and-carraige fans of the 1890s. Proponents of the newly invented automobile back then had to prove their case....HD Radio right now is like the first automobiles to travel unpaved roads. Think about what it will offer in another five or 10 years. History is squarely on the side of better technology as it pushes aside older, less efficient methods....The stage is set. Radio is entering a new era propelled by new technology. It's really very simple. The digital bus with HD Radio onboard has left the terminal. Be on it or be under it.[151]

Radio World Engineering Extra Tech Editor Michael LeClair similarly touted digitalization as inevitable, and HD the only path toward progress: "[I]t is not possible to stand still as other broadcast media surpass the performance of an older technology. The eventual result for [radio],

should stations decide not to pursue improvement, will be the loss of new revenue and a slow decline into irrelevance."[152] Hal Widstein, General Manager of KWED-AM in Seguin, Texas, challenged "[HD] dissenters" to demonstrate a better digital radio technology, although he admitted that he had not followed the FCC proceedings during which such an effort had been tried and rejected.[153]

These arguments flew with other, smaller broadcasters like a lead balloon. Edward P. De La Hunt, owner of De La Hunt Broadcasting in Park Rapids, Minnesota, declared that he would be "damned if any of my facilities will ever sign on to creating interference to other broadcasters."[154] Several station owners expressed shock in *Radio World* that the industry was willing to accept a degradation of analog service in exchange for the promises of a relatively untested product.[155] Alan H. Dunkin of Atlanta, Georgia felt that broadcasters who bought into the notion that increasing harm to analog broadcasting was a reasonable compromise in the implementation of HD Radio should "[g]et out of the business now while there is still something to save. Let those of us who still give a damn about quality try to save what's left."[156]

The general manager of Oxford, Mississippi's WOXD-FM, Ron Cox, wondered how small-market broadcasters were supposed to pay iBiquity's license fee when hundreds of stations across the country "struggle to pay the electric bill from month to month."[157] Radio consultant Tim Johnston related the story of a client-station who spent $100,000 on HD upgrade work "for nothing but bragging rights and a technology to which no one can listen...Let's stop this pony before it takes us over the cliff."[158] Robert C. Savage, president of WYSL-AM in Avon, New York, called on the industry to return to the drawing board and come up with a DAB system that served the interests of all broadcasters. Otherwise, "[we] will rue the day we permitted a single manufacturer - not an objective industry consortium - to...impose [a digital radio] standard on the band that only benefits certain...broadcasters, and to the detriment of others."[159] The Christian Broadcasting System's CEO, Jonathan R. Yinger, called on independent broadcasters "at this late hour" to "stand up and make our voices and concerns heard. If we don't, our...stations will be *un*heard."[160]

The lack of receivers in the marketplace exacerbated the uncertainty surrounding HD Radio's ultimate viability. By the end of 2004, aftermarket auto HD receivers cost between

$500-1000, while tabletop units sold for more than $300 each.[161] *Radio World* blamed the lack of receivers on reluctance within the consumer electronics industry to adopt the technology,[162] while Art Reis, the chief engineer for Crawford Broadcasting Co.'s Chicago cluster, laid fault at the feet of iBiquity. "Where is the marketing support that is supposed to help launch...HD Radio into the public mainstream of the electronics industry? Where are the ads on radio, TV and in print?," asked Reis. "As it stands now, iBiquity isn't even on the public's radar screens. Just walk into any Radio Shack and ask about iBiquity or HD Radio. You've got questions, they've got blank stares....That, folks, is a danger sign....The time to make the big marketing move is now, iBiquity. You, and radio broadcasting in this country, have too much to lose to not get the population of the United States on your bandwagon and keep them there.[163]

III. Developing the HD Radio "Standard"

In the face of simmering industry and widespread public opposition to the detriments of HD Radio, its proprietors doubled down their bets with the FCC, on the assumption that the agency would do nothing to interrupt the regulatory trajectory leading to the technology's dominance of U.S. digital broadcasting. On May 18, 2005, the National Radio Systems Committee tendered a formalized HD standard to the FCC. "NRSC-5," as it was known, was not your typical broadcast technology standard: most are open for review, in order to generate industry consensus around them. The NRSC's standard only detailed the AM- and FM-HD hybrid analog/digital waveforms and included placeholders for such features as multicasting and datacasting, due to the fact that no substantive data had been tendered to the Committee on their functionality.[164] Petitioning the FCC to establish HD Radio as the official U.S. DAB standard would legally preclude any discussion of or action on competing technologies. The FCC tendered the NRSC proposal for public comment within a month of its submission.[165]

Industry investors and proponents of HD Radio lined up again to cast the technology as radio's only hope to navigate a convergent media environment. Disney believed that adopting NRSC-5 "would give much greater certainty to broadcasters...who are expending significant resources to convert their FM and AM stations to [HD Radio]."[166] The NAB boldly claimed that the development of NRSC-5 was "open, inclusive, lengthy, exhaustive and conducted under rigorous due process procedures,"[167] and implied that "the future of radio broadcasting in the U.S.

rests on" the FCC's approval of the standard.[168] Susquehanna Radio Corp. looked forward to the day when "our 'interim operation authority' will be replaced with permanent [HD] licenses."[169]

The honesty of the NRSC standard-setting process was called into question. Impulse Radio, a developer of DAB datacasting solutions, told the FCC about pressure within the NRSC to achieve consensus on NRSC-5, even though it and others had significant concerns about the lack of solid technical information on which to judge the standard. Impulse accused iBiquity of blocking moves within the NRSC to open the HD standard up for use beyond its own proprietary feature-sets. "We believe...without question that iBiquity has wielded an undue amount of dominance over this standard setting process," wrote Impulse Radio. "It has been the sole proponent of technology; it has, by action and inaction, influenced the time line for consideration of the various parts of the standard, and has used its leverage as the dominant voice in the proceedings to gain unfair competitive and commercial advantage."[170] Debates went on for "months and months" as the NRSC wrestled with proposing a DAB standard that had "missing" components, such as normative and informative references on the protocol's codec and ancillary features.[171] None other than Microsoft argued that, by leaving significant aspects of HD Radio technology out of the NRSC-5 standard, iBiquity could "remain outside the NRSC patent licensing policies," which raised risks that the company would exploit its licensing regime and generated "uncertainty" that was "likely to slow product development and deployment."[172]

Public broadcasters, as a constituency, deferred to National Public Radio to speak for them on the standards issue. National Public Radio called the promulgation of a standard "a significant technical milestone" and urged the FCC "to approve the standard without delay."[173] Although it was not pleased by the lack of codec specifications within NRSC-5, NPR expressed confidence that iBiquity would not leverage its monopoly power over the technology.[174] It also echoed industry proponents' desires to keep the new features of HD Radio unregulated.[175]

If independent broadcasters had been reticent about HD Radio before, during the standards-debate they became apoplectic. Timothy C. Cutforth, a broadcaster and consulting engineer, worried that the endorsement of an incomplete technical standard would create "vast wastelands of interference" and "petrify DAB innovation" in the straightjacket of iBiquity's proprietary framework. "If this system is adopted piecemeal as proposed, then the FCC will have

traded Manhattan for a few shiny beads and disregarded their very reason for existence."[176] Many passionately argued that the tradeoffs necessary to implement NRSC-5 were not worth the compromises it would cause to the integrity of analog broadcasting.[177] Industry assertions that HD Radio caused no interference were belied by the record; independent broadcasters also reiterated the fact that most American radio listeners had no basic knowledge with which to identify digital radio interference.[178] More stepped forth with real-world reports of HD-related interference to their stations.[179] Ralph McBride, the owner of stations in the Beaumont, Texas area, likened the standards argument to

> sort of modern range war, with the FCC playing circuit judge. A huge combine is coming to town, and it is moving the fences of existing property owners, with the permission of the sheriff....So the combine bandits are making money coming and going, and shutting out all competition, with the help of the corrupt "local" law enforcement. It is my most sincere hope that in the end, the FCC rides into town wearing the white hats we think of them wearing.[180]

Independent broadcasters also contextualized the push to cement NRSC-5 as something driven by an irrational "GOOD of achieving DIGITAL" that seemed to "outweigh all existing rights of analog broadcasters and the rights of the listening public."[181] Aritaur Communications, licensee of WMVY-FM in Newport, Rhode Island, urged the Commission "to realize that it would do the public great harm to have one broadcasting clique" controlling the future of digital radio. "Neither NRSC nor its members are in the business of governance," argued Aritaur. "This proceeding is an opportunity for the Commission to stand in the bully pulpit and set expectations for full disclosure of this technology."[182] WRPQ-AM in Baraboo, Wisconsin told the FCC it felt betrayed by its trade organization, the NAB, for uncritically supporting NRSC-5 to the detriment of the nation's independent broadcasters.[183]

Consulting engineers urged the FCC to undertake the standard-setting discussion with thoughtfulness. Although David Maxson noted that FM-HD broadcasters to date had been "highly successful" in avoiding widespread interference to analog neighbors, the potential for such interference remained quite real, and that the real-world implications of AM-HD interference remained effectively unresolved. If the FCC was prepared to implement HD Radio as a standard, " a reference method or methods of verifying compliance should be articulated," something neither iBiquity nor the NRSC had yet done.[184] Engineer George M. Frese provided

further evidence of AM-HD interference plaguing the northwest United States.[185] Canadian broadcast engineer Barry McLarnon cited chapter and verse of international frequency allocation treaties and asserted that HD Radio did not comply with them. "Simply stating that interference will not increase significantly because existing emission masks are respected is a subterfuge that hides the problem," McLarnon wrote.[186] This was buttressed by correspondence from the Mexican Technical Secretary of the Plenum, which called upon the FCC to withhold any expansion of HD Radio until questions of cross-border interference were better understood.[187] Both Mexican and Canadian authorities were now on the record with concern about HD-related interference. McLarnon also revealed that "a sizable number of the [NRSC DAB] subcommittee members (seven) felt that NRSC-5 was incomplete and should not be committed to a vote....These members were persuaded to abstain rather than cast a negative vote," thus shattering the illusion that true industry consensus existed on the standard.[188] George Frese added an emotional plea: "Don't throw away tomorrow by following somebody else's pipedream today. Pipedreams are caused by a flawed understanding of the needs of the people, natural laws of physics, along with an overactive ambition for personal gain."[189]

Many commenters asked the FCC to amend NRSC-5 itself to guarantee interference-protection to analog broadcasters, which would have required a major redesign of the HD Radio protocol.[190] More listeners came forward with reception horror stories, including audio submissions, of digital "hissing," "hash," and "whizzing" produced by existing HD Radio stations.[191] Paul W. Smith of Sarasota, Florida begged for a ban on all nighttime AM-HD broadcasting "until such date that analog broadcasting ceases and the all digital signal can be placed In Band On Channel as the name suggests."[192] Paul and Lucille Burkardt, a visually-impaired couple in Watertown, Massachusetts, requested that the HD standard "be respectfully abolished, and that normal quality standards be restored to all stations concerned."[193]

Members of the public were also suspicious of NRSC-5's proprietary nature. Jonathan E. Hardis of Gaithersburg, Maryland, who cared enough about the issue to request membership on the NRSC, echoed reports that disagreement within the Committee was forcefully quashed to provide the illusion of industry consensus on the standard to the FCC.[194] He accused the NRSC of "cross[ing] over "from making technical judgments...to making regulatory judgments," for which

the FCC was the proper forum.[195] Hardis blamed iBiquity for defaulting on its obligation to disclose information "that they themselves had volunteered to provide" earlier in the standard-setting process.[196] By "concealing rather than teaching the essential knowledge required to build compatible devices," Hardis warned the HD standard would stifle innovation in the U.S. DAB space.[197] David L. Hershberger characterized the partly "secret" nature of NRSC-5 as an open door for a "perpetual windfall" of licensing fees to iBiquity and its investor companies.[198]

Doug Dingus of Portland, Oregon called HD Radio "a technology not yet cooked." Given the "lack of demonstrable public demand for digital radio and the number of outstanding issues," he wrote, "I find it hard to justify a narrow window for technology change, particularly when the quality and cost expectations are being changed as well. If the radio industry is truly seeing a listener crisis, while failing to properly address content issues, said decline cannot be used as a solid justification for a rapid implementation of digital radio, simply because the two problems are not related."[199] Radio listeners reiterated their sentiment that HD Radio was a technology they simply didn't want. "HD seems an ill conceived, 'rushed to market' relic from the 1990's, rendered obsolete by subsequent technological developments," commented Paul V. Zecchino of Englewood, Florida. "If interference is of no consequence, why do HD promoters thwart discussion of it and ridicule those who do?"[200] Gregory O. Smith of Brookeville, Maryland called the imposition of NRSC-5 a giveaway of "our free airwaves to a few corporate thugs....Few HD radios have been sold, as consumers have not bought into this farce....This FCC sole-source, non-competitive contract award to iBiquity is a total travesty!"[201] Nickloaus E. Leggett of Reston, Virginia - whose petition to create a new LPFM service led to its creation[202] - commented that "[i]f broadcast radio continues with its highly automated operations, it will continue to become a music box that merely grinds out canned entertainment with no local connection at all. In this situation, it would make sense to replace most of broadcast radio with music streams sent out over the Internet and reallocate many broadcast frequencies to some other purpose."[203]

Seven years into the FCC's rulemaking on digital broadcasting, media reform organizations finally began to engage in debate over the fundamental detriments of HD Radio. Only one of them - J.H. Snider of the New America Foundation - recognized HD for what it was. "[T]he radio broadcasters' political genius was to redefine the meaning of the word 'channel'

and to develop a standard that would abide by that definition," he explained. "With this Orwellian verbal magic, they could have their cake and eat it too; they could double their spectrum holdings to facilitate their digital radio transition without calling the doubling a 'second channel.'"[204] Incumbent commercial broadcasters, Snider argued, had nearly a decade to "create facts on the ground" in order to foster the imposition of HD Radio with little to no independent oversight.[205] He also blamed the public interest community for strategic missteps that resulted in a lack of diligence with regard to radio's digital future.

> Central to the political genius of the radio broadcasting lobbyists was their understanding of the limitations of the press and public interest community. They understood that the press and public interest community were both uninterested in technical details and technically illiterate. They were confident that they wouldn't read the details and, if they did, wouldn't understand their significance....During the period in the late 1990s and early 2000s when the key digital radio decisions were being made, the public interest community, and the press they educated, were focused on the low power FM debate. LPFM only required a tiny fraction of the FM spectrum whereas [HD Radio] used up huge amounts of it. But low power FM was nevertheless a great issue for the grassroots driven public interest community because everyone understood FM, many individuals and organizations throughout America wanted to be their own FM broadcasters, and the time horizon for implementing LPFM suggested the closest thing you can get to immediate gratification in a spectrum policy proceeding. In the end, [HD Radio] would get more than 95% of the white space between the FM channels but virtually no one in the public interest community would link the issues and alert the press.[206]

Snider concluded that it was "essential that the FCC stop relying on standards developed by the broadcast industry. These clever and politically motivated standards are designed to constrain, in a highly biased fashion, the range of policy options available to the FCC."[207] Other than Snider's incisive memorandum, inexplicably filed as an attachment to an ex parte submission from the Campaign Legal Center, those representing "media reform" in the United States effectively overlooked the fundamental controversies of HD Radio during the standard-setting process.

Broadcast-investors attacked such criticism. Crawford Broadcasting told the FCC that it had to approve an incomplete standard as "the window during which [HD] technology can be successfully implemented in the terrestrial radio broadcast service is narrow; any delay would be detrimental – and perhaps ultimately fatal, particularly for AM."[208] Clear Channel was "comfortable" with NRSC-5 as-is, and did not expect iBiquity to gouge them in the future.[209] The heads of the NRSC's DAB Subcommittee, Charles Morgan (Susquehanna Broadcasting), Milford K. Smith (Greater Media) and Andy Laird (Journal Broadcast Group), provided the FCC

with their own perceptions of the Committee's standards-development work; in essence, they claimed that since dissenters like Jonathan Hardis and Impulse Radio did not stand their ground during the NRSC's decisionmaking process, they had consented to the standard by default.[210] iBiquity, the NAB, and CEA also worked to dismiss HD "naysayers." They argued that existing concerns were nothing more than re-hashes of arguments settled and buried by the FCC's initial DAB Report and Order of 2002.[211]

HD Radio's primary broadcast proponents -both commercial and noncommercial - were concerned enough with the diversity of opinion in the record to launch another backstage lobbying campaign with key FCC officials to minimize delay of the agency's approval of NRSC-5.[212] However, they were not alone in making personal contacts with regulators; Microsoft representatives met or corresponded with the senior legal advisors of all Commissioners to express "serious concerns about the adequacy of NRSC-5, particularly the failure of the standard to specify an initial codec or a registration and signaling mechanism for optional codecs. These concerns should be fully considered and addressed by the Commission before adopting any digital broadcasting standard."[213]

Offstage, in the trades, the confidence expressed by HD Radio's proponents in the policy proceeding was belied by an increasing sense of panic that the technology would not find adoptive traction. More independent broadcasters related to *Radio World* their experiences with HD-induced interference to analog broadcasts, alternatively described as sounding like "garbage," "1,000 demonic cicadas," "nasty hiss," "havoc," and "digital crap."[214] Early adopters of HD Radio reported that the digital signal was not as robust as advertised, nor was it demonstrably better than its analog equivalent.[215] iBiquity responded with promises of license-fee caps and announced imminent developments such as new datacasting features and a plethora of HD-compatible receivers preparing to flood the market.[216] NPR continued to push multicasting as HD Radio's killer application.[217] "The shouting is over," proclaimed NRSC DAB Subcommittee co-chairman Milford Smith. "Let's work together on moving forward rather than lusting after an analog past which is already becoming, by technology standards, ancient history."[218]

To that end, a cartel of a dozen investor-broadcasters formed the HD Radio Alliance in 2006, in order to coordinate marketing, promotion, and multicast activities in major markets.[219]

Alliance members committed to setting aside $200 million worth of airtime to run spots promoting HD Radio.[220] The Alliance would also oversee the rollout of commercial multicast stations in such a way as to preclude digital program competition in any given market.[221] Most commercial multicast streams would be derivations on an existing FM station's primary format.[222] Peter Ferrara, a former executive at Clear Channel, was tapped to head the Alliance: "From an anti-competitive standpoint, if the industry didn't work together, in a cohesive manner, with consistent messaging, and providing the consumer the benefit of new and unique choices, diverse choices, the technology either will take a long time to emerge or may not happen at all," Ferrara told *Radio World*.[223] But even he was not unabashedly optimistic: "Since I started this job...I've felt somewhat like the guy in the Ed Sullivan show keeping all of the plates spinning in the air on little sticks."[224] The HD Radio Alliance first launched a branding campaign entitled "Are You Def Yet," touting HD Radio's "high definition" quality, and coordinated with retailers in New York, Los Angeles and Detroit to make HD Radio receivers available to the public.[225] Clear Channel established a "Format Lab," similar to NPR's foray into multicast syndication, to provide its stations with pre-producced content to fill secondary digital radio channels.[226] In 2007, the Alliance increased its airtime-commitment to HD promotion to $250 million for the year.[227]

Many broadcasters were not buying the hype. By 2006, more than one-third of CPB-member stations expressed no desire to "upgrade" their facilities to HD.[228] Cox Radio, an iBiquity investor, installed AM-HD on "three or four" of its stations and then turned it off when listeners complained about the interference digital signals caused to analog broadcasts.[229] Open hostility toward iBiquity was now a regular theme in the trade press. "Why has the FCC allowed iBiquity to rape the small-market stations with exorbitant license fees, not to mention huge capital investment with little or no return?," asked Tom Andrews, president of Lake Cities Broadcasting Corp. in Angola, Indiana. "What happens when the commission mandates [HD] implementation by a particular date? Soon the flashing red lights standing sentinel on the outskirts of Smallville, USA will be extinguished."[230] More than one broadcaster told *Radio World* that multicasting would not succeed if its programming amounted to nothing more than non-local variants on the cookie-cutter formats that dominated contemporary broadcasting.[231]

Larry Roy called the expense of iBiquity licensing "a showstopper for many smaller broadcasters."[232] Jack Hannold hoped HD Radio would fade away before more broadcasters invested "prematurely and unwisely" in the technology.[233] Jim Jenkins, the owner of WAGS-AM in Bishopville, South Carolina, predicted that if HD Radio lived on, "[o]nly the 'big guys' will have enough money to play."[234] Jerry Arnold, the director of engineering for four stations in Terre Haute, Indiana, believed iBiquity would petition the FCC to mandate HD compatibility as soon as it realizes "that a huge majority of...broadcasters are resisting their suggestion to go [digital]."[235] Paul Dean Ford figured the only solution to increased digital interference on the AM band was simple reciprocity: "If any particle of fairness is left in [the FCC], it must immediately change AM rules to allow analog broadcasters to interfere with [HD] stations way above and beyond the strict rules now in effect, in order to maintain some semblance of a service area that is and/or will be destroyed by this unbelievable debacle of digital AM....Has the FCC ever heard of the Golden Rule?"[236]

The dearth of digital radio receivers became an increasingly sensitive topic within the radio industry. Four years after the FCC's initial approval of HD Radio, there were few to be found. Commercial and noncommercial broadcasters reported that when they went out to their local electronics retailers and asked for "HD Radio," sales staff steered them toward satellite radio receivers; if a store had an HD display unit, more often than not it wasn't even plugged in.[237] An NPR plan to distribute 50,000 HD Radio receivers had to be scaled back to a paltry purchase of 500, because the "radios failed to materialize." In addition, since NPR did not receive permission from iBiquity to sell the receivers, it was forced instead to "share them with board members, university officials and backers of their digital conversion campaigns."[238] At the 2006 NAB annual convention only a handful of demo HD receivers could be found on the exhibition floor, belying earlier claims that consumer electronics manufacturers widely supported the technology.[239] Portable HD radios were nonexistent, because iBiquity's receiver chipset was still too large and power-hungry to fit into such a device.[240]

Listener demand for HD Radio was similarly insubstantial. Gartner Research predicted that just 9% of U.S. households would have digital radio receivers by 2009.[241] A Bridge Ratings survey of radio listenership forecast the 2010 HD audience at just 8.84 million - "trailing well

behind satellite radio and even audio streaming to mobile phones."[242] It also reported that only 13% of respondents even knew what HD Radio was, while just 7% "said they were 'very' or 'somewhat interested' in owning an HD receiver."[243] "Significant consumer resistance" existed due to suspicion among listeners "related to the benefits of HD Radio."[244] Public broadcasters began to hedge their bets by using alternate digital audio distribution mechanisms, such as the Internet and cellular telephony, to provide HD multicast streams to a larger potential audience.[245] iBiquity CEO Bob Struble revised his "critical mass" forecast from 2009 to 2018.[246] Halfway through 2007, Bridge estimated the national HD listening audience at just 450,000 per week.[247]

If listeners were uninterested - or worse, sullied - on the HD Radio experience, asked broadcast engineer Brian Crawford, "for whom are we doing it?"[248] Industry consultant Mark Ramsey dubbed HD's promised improvements to broadcasting "vaporware" and urged his colleagues to take a cold, hard look at the roots of listener apathy:

> Does it bother anyone else that every article written in any neutral publication, meaning a wide circulation newspaper as opposed to an industry trade, can never seem to reconcile the puffery with the usage or lack thereof? Is it good PR for potential listeners to be reminded that most people still aren't listening?...For HD Radio, we're selling the selling hard. Since listeners buy benefits and don't buy "selling," whom is this selling for? Could the answer be "Wall Street"?...It's really about time the powers-that-be in our industry faced up to that.[249]

Many broadcasters - and even *Radio World* by the end of 2006 - openly called for the FCC to reconsider alternate DAB systems.[250] Others counseled a more radical course of action - dropping digitalization and getting back to the fundamentals of radio's pre-1996 business model. "I've read and listened to all the radio group heads, most of them fairly smart people...talk about how HD Radio will be the thing that saves radio from satellite, iPods, Internet radio and all the other things eroding radio listening," opined Bob Raleigh of Jones Radio Networks. "I've not read or heard one person talk about how we are going to train new radio talent to be compelling on-air talent, how we are going to better serve our community with localism, teach our PDs to be more than a music director on steroids, build a stronger news staff, offer better weather coverage, get involved with community events, or how to simply be better at being entertaining and informative. It appears we are all going down the same road we've already been down."[251] HD Radio is "change for the sake of change," remarked Jerry Arnold. "It's not the medium, it's the

message" that needed improvement.[252]

Perhaps the best example of growing industry revolt against digital broadcasting came in an extended *Radio World* interview with Edward De La Hunt, inspired by his earlier criticism of the technology. Hunt is the father of Edward De La Hunt, Jr. - associate chief of the FCC's Audio Services Division and, later, its Deputy Chief of Engineering. Hunt the Younger's career with the FCC spanned the entire initial developmental and policymaking process of HD Radio; he retired from public service to work for the family broadcast business in 2006, the same year Hunt the Elder was elected into Minnesota's Broadcaster Hall of Fame. "Everybody is forgetting about the small markets, where profit margins, where they exist, are very narrow," said Hunt Sr. "The other day I closed 30 schools because of the weather. I was wondering if I could have done that any better on digital as on analog....It seems foolish to me to buy any kind of system that obsoletes what we already have....[Other] small owners think it's ridiculous." However, if you mentioned HD to Hunt Jr., "his eyes light up; he thinks it's the greatest thing since sliced bread. The rest of the family says 'No, no, no.' It's an FCC 'thing'....They don't look at the solid technical stuff. They look at who they like and don't like."[253] Hunt then listed more examples of how his radio stations served their listeners and, in the process, repudiated the most significant "accomplishment" of his son's career.

> [HD Radio is] not going to make my fundraising any better, it's not going to make my community service any better. I don't own these radio stations. I own the equipment. I'm a franchise holder of a license to serve the people of this country. Broadcasters need to come back to the idea that they're here to serve. If they don't want to come back to that, I guess they deserve what they get.[254]

Hunt's interview resonated with many other broadcasters. "He's right on the money and I salute his core values," responded Harvey Twite, general manager of KEDU-LP in Ruidoso, New Mexico. "What we need now is a scientist who can clone him."[255] Jack Taddeo, president of WLKN-FM in Park Ridge, Illinois agreed wholeheartedly. "Ed speaks volumes when he says he doesn't need or want HD...service inflicted on his stations because he's plenty busy broadcasting local sports, news, etc. without having to decide where to spend the 'extra' money he makes from his operation."[256] Robert A. McClanathan, a professional engineer based in Portland, Oregon, deemed Hunt's remarks "technically correct" and hoped "all...station owners...read this interview and seriously evaluate the consequences of their technical decisions and the impact it

will have on their listeners."[257]

IV. FCC Endorses HD Expansion

In the late spring of 2007, the FCC's Media Bureau published more detailed rules governing the proliferation of HD Radio. Although the agency was not prepared to formally adopt the NRSC-5 standard, "Radio stations and equipment manufacturers need to move forward with the DAB conversion, and we need not wait until after final action is taken on the [standard] to provide such guidance to them."[258] This "guidance" gave permission for FM-HD stations to deploy iBiquity's "extended hybrid" mode for the purposes of unrestricted multicasting and datacasting; it also codified the use of separate analog/digital FM antennas and unleashed full-time AM-HD broadcasting.[259] Although "the iBiquity...system places digital information on frequencies immediately adjacent to the analog signal," any compromises to the integrity of existing analog radio service were worth the tradeoff.[260] The FCC also declined to put any new public interest obligations on a broadcaster's digital programming and only required stations to provide an HD signal qualitatively equal in fidelity to its analog one; this important metric was left undefined.[261] FM-HD stations were allowed to lease their multicast streams to third parties, but existing broadcasters were prohibited from renting the spectrum of stations they did not own.[262] Broadcasters were "encouraged" to experiment with the all-digital mode of HD Radio, but the FCC declined to formally sanction the mode pending the review of technical data which did not yet exist.[263] It also deferred action on a mandatory analog/digital transition deadline: "[T]here is no evidence in the record that marketplace forces cannot propel the DAB conversion forward, and effective markets tend to provide better solutions than regulatory schemes."[264]

Noting that iBiquity had "abided by the Commission's patent policy up to this point in the DAB conversion process," the FCC refused to regulate the company's license fees.[265] It dodged the question of international interference: "While we are optimistic that we will be able to resolve any outstanding issues with Canada and Mexico or other countries, these issues remain subject to ongoing negotiations."[266] All pending Petitions for Reconsideration were summarily denied. "[N]o technical support" existed to buttress counterclaims of HD-related interference; from the agency's perspective, the public interest would not be served "by further delay of the long-contemplated digital conversion of the terrestrial radio service."[267] The Commission also

promised to conduct annual surveys of HD broadcasters to keep a pulse on the technology's proliferation.[268]

Republican Commissioners rejoiced the passage of the second Report and Order. FCC Chairman Kevin Martin believed that more substantive HD rules would "promote radio's transition from the analog world to the digital one," though he did not specifically articulate how that might occur.[269] Commissioner Deborah Taylor Tate was pleased that the agency allowed "the market to determine the pace of the transition and the stations to determine how to use their digital bandwidth. The flexibility...will unleash the creativity of the market and, hopefully, provide opportunities to new entrants, resulting in improved radio service for all Americans."[270] "Thank goodness the private sector did not wait for the government to act.," remarked Commissioner Robert McDowell. "The Commission has delayed adopting these standards...while we debated whether to foist additional regulations on this budding technology...the Order ensures that terrestrial radio has the technical capacity to remain competitive with satellite radio services and other media."[271]

The FCC's two Democrats were less sanguine about HD Radio's prospects, and both dissented in part with the second Report and Order. Commissioner Michael Copps stated that "the digital transition involves more than just developing new technical standards. Digital broadcasting has the power to reconfigure the communications landscape in good and powerful ways—if we get our policies right." He expressed significant concerns about allowing the wholesale proliferation of HD Radio without new digital public interest obligations. "The item sidesteps what I believe is a fundamental responsibility of the Commission: to determine what the public interest means in the digital age."[272] Commissioner Jonathan Adelstein agreed: "[I]t is another missed opportunity for the Commission to promote diversity, another dream deferred. After years of ignoring the issue, punting the question, and delaying a constructive dialogue to develop meaningful solutions, it is really disappointing that the Commission has once again failed to step up to the plate." The sheer unwillingness of the FCC to ask "general and open questions how the 'public interest, convenience and necessity' can best be served by radio broadcasters in the digital age" was "unacceptable." Apparently unaware of the spirited debate already in the record, Adelstein called for more public input on the issue of digital radio

broadcasting.[273] In summary, the FCC's decision allowing the unrestricted proliferation of HD Radio seemed to have been made in a vacuum - its protagonists satisfied and its antagonists ignored or dismissed.

Almost immediately, two Petitions for Reconsideration disputing the FCC's second Report and Order were filed by the public. Jonathan Hardis castigated the FCC for ignoring the wholly proprietary nature of the HD Radio system. "The Commission cannot hand out patents that provide better deals than the ones earned at the Patent Office....Technical specifications that either explicitly or implicitly rely on essential details that are well-guarded trade secrets amount to perpetual Government patents to those privileged to know the secrets. They stifle competition and innovation....The history of this proceeding is tarnished by deceit."[274] The HD Radio proceeding was "not about a cute little digital add-on to traditional radio, something that consumers may accept or reject at their option. Instead, this proceeding is about the permanent redefinition of the broadcast radio service in the United States."[275] Rather than rewarding iBiquity et. al. for "abiding" by a 40-year old patent policy, Hardis felt the FCC should be "issuing sanctions for their quiet bait-and-switch."[276]

A coalition of public interest groups also filed a Petition for Reconsideration. The New America Foundation, Prometheus Radio Project, Benton Foundation, Common Cause, Center for Digital Democracy, Center for Governmental Studies, and Free Press disagreed with the Commission's cavalier attitude regarding the widening of every radio station's spectral footprint. "The Second Report & Order is premised on the unexamined and unsupported assumption that the Commission is not assigning new spectrum for mutually exclusive commercial uses to incumbent licensees," they argued. "This spectrum may be worth billions of dollars, and may allow incumbents to provide additional program streams, engage in datacasting, and provide other types of services. Yet, the FCC neither requires licensees to pay for the use of this additional spectrum nor to provide any additional benefits to the public in return for its use."[277] The FCC failed "to address the question of whether it should hold auctions or take other action to prevent unjust enrichment" by incumbent broadcasters. "Instead, it asserts in some places that it is not authorizing broadcasters to use spectrum beyond their existing channels, while it acknowledges that it is, in other places."[278] Finally, although the second Report and Order called

for further inquiry on "enhanced public interest requirements, there is no guarantee that such requirements will in fact be adopted."[279]

HD Radio's protagonists were quick to discount the backlash. iBiquity claimed both Petitions for Reconsideration provided no "new evidence or legal justification to make changes" to the Commission's newly-minted rules. "In fact, the petitions merely repeat arguments each Petitioner presented earlier in this proceeding, which arguments the Commission consistently has rejected. Commission's precedent, the record in this proceeding and the public interest all demand that the Commission dismiss the petitions and uphold the Second Report and Order."[280] Citing its $200 million investment in HD Radio, iBiquity claimed that marketplace forces would trump any semblance of public consternation with the technology.[281] iBiquity claimed that media reform groups misunderstood the technical rationale behind HD Radio and assured the FCC that new digital features would provide plenty of opportunities to serve the public interest in the absence of proactive regulation.[282] Speaking directly to Jonathan Hardis' claims that its technology was unfairly proprietary, iBiquity responded that it had "made extensive patent disclosures and licensing commitments to the NRSC and the Commission....iBiquity believes it is very significant that the complaints about access to information from perennial critics such as Mr. Hardis have never been backed up by any complaints from the equipment manufacturers and broadcasters that use HD Radio technology."[283] It characterized Hardis' Petition as "nothing more than bitterness for industry rejection of his views."[284]

The National Association of Broadcasters buttressed iBiquity's position. It asserted that the Petitions for Reconsideration were "bottomed on a faulty premise" and represented a "simply wrong" understanding of HD Radio technology.[285] The NAB requested the FCC dismiss Hardis' Petition because the adoption of HD Radio by stations remained entirely voluntary, and thus concerns about a technological monopoly were misplaced.[286] National Public Radio also filed formal opposition to the Petitions for Reconsideration. "As is abundantly clear from the Second Report and Order and prior decisions in this proceeding," wrote NPR, "there is nothing revelatory about the presence of certain proprietary technology in the iBiquity [HD Radio] system....Even if the use of proprietary technology in the iBiquity system had not been addressed, [the Hardis Petition] provides no basis for reconsidering the Second Report and Order

absent evidence that iBiquity is exploiting the situation inappropriately."[287] NPR also denied there was any "fundamental inconsistency" in allowing radio stations to expand their spectrum holdings without public interest obligations attached.[288] Entertaining the petitions would "harm...the DAB transition and the new public services NPR and others are developing."

> Reconsidering the Second Report and Order in response to the...Petitions would, at a minimum, cast a significant cloud of uncertainty over the future of DAB. That is because each of the Petitions challenges the basic decision to authorize the iBiquity system and not merely some incidental aspect of it. Accordingly...we urge the Commission to consider the potentially catastrophic consequences for the future of digital radio and the public.[289]

Such wholesale scrutiny of HD Radio, which arguably should have been conducted by the FCC five years prior, was simply outside the realm of acceptable policy discourse.

Hardis and his new-found public-interest allies would not be so cavalierly dismissed. "NPR warns of 'harm' and 'potentially catastrophic consequences,'" replied Hardis. "If so, I would think that iBiquity would be highly motivated to do the right thing [and make the HD Radio standard more open] — once the Commission holds them accountable."[290] Hardis challenged the NAB's notion that adoption of HD Radio was purely voluntary. "This may well be true from NAB's vantage point as an association of broadcasters. My Petition is from a different vantage point, that of an individual consumer, a near-daily user at the receiving side of the broadcast radio service." From that perspective, "'voluntary' is not an apt description....NAB [argues] that since today's [HD] operations are 'only interim in nature' and since all-digital broadcasting might be a long way off, the Commission shouldn't concern itself with that end-point today. I agree that the nose of the [HD] camel is now only slightly in our tent. But when would it be a better time to ensure that the camel is healthy?"[291] Hardis asserted that iBiquity was "so bereft of counter-argument that their opposition is reduced to distortion, falsehood, irrelevancy, and ultimately, impugning the motives of those who dare to speak up."[292] The New America Foundation et. al. also did not take its lumps lying down. "Oppositions' arguments do not obscure that the [HD Radio] system increases the bandwidth occupancy of broadcasters," they wrote. "At best the incumbents' arguments highlight the glaring need for the FCC to perform a 'reasoned analysis' and provide a clear rationale for [its] decision."[293]

Offstage, the FCC's further endorsement of HD Radio encouraged the technology's

proprietors to explore the development of new features. iBiquity announced a development agreement with the Rupert Murdoch-owned NDS Group to develop a pay-radio application known as "conditional access." This technology, branded "RadioGuard," would allow stations to encrypt a portion of their digital audio streams and charge individual listeners for the right to access them. Such functionality, however, would not be backward-compatible with existing HD Radio receivers.[294] Thomas. E. Ruckenwald, NDS's director of data applications, boasted that services which "provide consumer choice and simultaneously enhance the financial strength of broadcasters tend to be in the best public interest."[295]

To demonstrate its own fiscal strength, iBiquity opened a new research and development laboratory, designed to develop chipsets for portable HD Radio receivers, which spoke volumes about the consumer electronics industry's lack of enthusiasm for the technology.[296] iBiquity also celebrated the fact that 1,500 HD Radio stations were now on the air, though this number represented less than 10% of all broadcast radio stations in the United States.[297] The Corporation for Public Broadcasting opened another funding window for digital conversion assistance, after having already doled out nearly $30 million in HD-related subsidies.[298] Meanwhile, the HD Radio Alliance re-chartered itself for a third year and reported its member-stations would devote $230 million worth of airtime to HD promotion activities in 2008. Alliance members were also allowed more flexibility to experiment with competing multicast formats.[299] In May of 2008, iBiquity announced it raised another $15 million in venture capital.[300]

Despite the puffery, the intra-industry dialogue as documented in *Radio World* was overwhelmingly pessimistic about HD Radio's future. In the minority were those who supported the technology. John Schneider, a sales manager at Quincy, Illinois-based transmitter manufacturer Broadcast Electronics, blamed critics within the industry for slowing the HD transition: "These naysayers from within our own industry would probably complain about the quality of the lifeboats on a sinking ship....If we all don't get behind it as our best chance for survival, the train will leave the station and we will all be looking for a new line of work."[301] Stephen Poole, the chief engineer of Crawford Broadcasting Co.'s Birmingham, Alabama station cluster, declared that "until the naysayers can propose a real, feasible, doable and cost-effective alternative to help AM grow and survive in an increasingly competitive (and increasingly

digital!) marketplace, I'm finding myself increasingly uninterested in what they have to say."[302] Crawford Broadcasting's Art Reis continued the trope: given the FCC's recent endorsement of HD Radio, "why are the naysayers griping about the 'slow pace' of HD Radio acceptance?...This is a great lesson for you doomsayers out there who predicted that HD Radio is a flawed technology that will never be accepted by the public. It's about time that you all became part of the solution instead of part of the problem."[303]

The majority of intra-industry dialogue, however, expressed growing concern with HD Radio's viability. More listeners submitted reports to *Radio World* detailing their HD-related interference problems.[304] "I don't believe [HD Radio] is legal," wrote Chuck Ermatinger of St. Louis, Missouri. "It has made a nightmarish mess out of the AM broadcast band. There's no escape from it, and it's ruining my AM listening. It's been bad enough hearing it in the daytime, but at night, stations are wiping each other out....If [iBiquity] thinks I'll buy one of its blasted receivers, it's wrong."[305] In Brooklyn, New York, Steven Daniel reported to *Radio World* that AM-HD interference at night had "made a dramatic, even shocking, difference" to his listening experience.

> I used to listen to a lot of stations in the Northeast corridor, but now I'm limited to a few local powerhouse stations....The rest of the dial is a useless wall of interference. I'm willing to complain about this and write a few letters, but I doubt it will do any good. I expect that, in a month or so, I'll miss listening to my radio at night and will break down and purchase a stand-alone Internet radio. I figure that's the next best thing to "real" radio.[306]

James O'Neal of Falls Church, Virginia asked station owners "with [HD] and clear frequencies" to "put their money where their mouths are. If you're not interested in serving other than a local audience, please power down. You'll save a lot of money on electricity and transmitter costs and keep things clear for the stations that do want to reach audiences beyond their city limits signs."[307] Amateur radio operator Karl Zuk of Katonah, New York expressed disbelief that the industry was willing to sacrifice a proven technology that "can achieve direct nationwide distribution using a $10 handheld receiver" with a digital version that cost 30 times more.[308]

Small-market AM station owners reported destructive interference from major-market stations hundreds of miles away. "I can testify that my coverage has indeed suffered," wrote Larry Langford, the owner of two small AM stations in Michigan. "[AM-HD interference]...has

taken out an entire market for me...along the resort shore of Lake Michigan. Those who support [AM-HD] say that Ibiquity will work out the kinks and have a solution. Who are they kidding? If it's the digital carrier that is causing the hiss on the analog signal, there is no way to 'fix' that."[309] Langford termed FM-HD technology "junk science," and AM-HD "science fiction."[310]

On October 1, 2007, 16 AM-HD stations owned by iBiquity broadcast-investor Citadel Radio turned off their digital sidebands. *Radio World* reported the move was due to "interference complaints from listeners and stations on adjacent channels, the latter from both Citadel- and non-Citadel-owned stations in and outside the markets....Listeners who have complained say they hear hiss and adjacent-channel stations say they hear noise on the channel." Citadel clarified that most of the complaints originated from self-interference - that is, interference between high-power Citadel-owned AM stations.[311]

The following month, station WYSL-AM in Avon, New York filed the first formal complaint with the FCC seeking AM-HD interference remediation. Based on "more than 100 hours" of interference recordings covering "more than 700 miles in field tests," the complaint alleged WYSL's signal was being stomped on by 50,000-watt CBS-owned WBZ in Boston, which operated on an adjacent channel to WYSL. Neither CBS nor the FCC would comment on the complaint; WYSL's owner, Bob Savage, established "an anti-[HD] website" to call for a Congressional investigation into what he termed the "cruel steamrolling of independent AM operators, and a nighttime medium-wave morass certain to drive away what's left of the dwindling AM-band audience."[312] In letters to *Radio World*, Savage argued that the interference he suffered "poses a threat to public safety and communications....If CBS continues to delay and dither, we'll have no choice but to file a federal lawsuit and seek an injunction, and at the same time we may petition the FCC for a refund of our regulatory license fees. We pay good money for the use of our frequency, and WYSL is being deprived of our spectrum use by the very agency which charges for it."[313] Savage further characterized AM-HD as having "all the consumer appeal of a $200 electric fork," with the "destructive potential capable of wiping out what remains of entrepreneurial radio in the United States....Dismissing the everyday use of a billion perfectly serviceable analog AM radios to favor an estimated 357 HD-AM listeners makes perfect sense. If the FCC were only around in April 1912, maybe we could have outlawed

icebergs."[314]

HD interference problems were not confined to the AM dial. Doug Vernier, a consulting engineer working on a study of FM-HD interference for NPR, reported in a front-page *Radio World Engineering Extra* article that changes iBiquity made to its FM-HD spectral mask actually allowed more digital energy onto adjacent channels than previously predicted. He confirmed the increased potential for FM-HD interference by conducting signal contour analyses and collecting real-world listener reports.[315] Vernier also noted that several stations broadcasting in FM-HD reported "that their analog air monitors exhibit white noise in the background. Perhaps the most serious threat to the hosting station is when [analog and digital FM signals are broadcast separately]."[316] He also debunked proponents' claims that the technology used no new spectrum:

> What we have done with the introduction of [HD] is to superimpose a new transmission method over an existing allocation system, hoping it will work. In many cases it does, but there are more cases coming to light every day where there are problems....There are those who say, 'Don't look a gift horse in the mouth'; *the FCC gave us the use of this new spectrum,* so let's make the best of it. Being neighborly to the stations and their listeners seems to have taken a back seat over a more hedonistic view of 'Let's push on and make amends for what we have done later.'" [emphasis added][317]

Radio World reported that several anonymous but well-respected broadcast engineers and station executives were frustrated with the "fraud" of HD Radio; they wanted to turn off the digital sidebands on their AM and FM stations but were prevented from doing so by corporate management.[318] At the 2008 Consumer Electronics Show, *Radio World* columnist Skip Pizzi observed that "[s]entiment against [HD Radio] is gradually morphing from a fringe movement to a serious threat....If any other major broadcast groups drop [HD], the format will be in serious trouble."[319]

Many within the industry were not surprised by these revelations. By 2008, there was still virtually no listener demand for HD Radio, and at least one transmitter manufacturer reported diminishing enthusiasm among broadcasters. Of the 255 transmitters Valatie, New York-based Energy-Onix Broadcast Equipment Co. sold in 2007, all were analog-only models.[320] Seven straight years of flat local radio advertising sales and a dearth of affordable HD receivers also deepened the gloom among broadcasters.[321] Without firm commitments from vehicle manufacturers to include HD Radios as standard equipment, *Radio World* predicted most stations

would abandon their digital signals within 10 or 20 years.[322] Wilifred Cooper told the publication that he attended the fall 2007 NAB Radio Show hoping to purchase an HD Radio and was "impressed with the [HD] theme" of the convention. However, "retro radios were being sold in the NAB Radio Show store, the kind also able to play LP records. No HD Radio receivers were for sale."[323] Radio audience researcher Thom Moon took a trip around the Cincinnati metropolitan area looking for HD receivers and found just a handful of models in stock. Very few store clerks knew much about how HD Radio worked or how to sell its virtues.[324] Repeating the experience in New York, Moon found that "HD Radios were a bit easier to find....But education of salespeople about HD Radio technology and the ability of potential customers to sample real HD-R broadcasts are problematic."[325]

The public was certainly not jumping to the sound of HD Radio. A Bridge Ratings survey published in the summer of 2007 projected "booming expected growth for Internet radio...and wireless Internet...in the coming decade, with terrestrial radio...essentially flat, then eroding toward 2020, and HD Radio use bubbling along only near the bottom." The number of surveyed listeners who were "very interested" in purchasing an HD receiver actually declined - from 9 to 7%[326] Research firm Parks Associates projected HD Radio's national audience would grow from a paltry 4.2 million in 2008 to 30 million in 2012 - the most optimistic numbers of HD Radio uptake yet published, but representing less than 10% of analog radio's regular listenership.[327]

None of this bad news surprised many people. Fred Weinberg of Las Vegas told *Radio World* that HD was "going nowhere fast" because "nobody ever asked the vast majority of radio station owners" about their expectations for a viable digital radio service. "What passed for leadership in our industry made the best deal they could to make themselves richer, and the owners of the other 8,000 licensed stations were just expected to go along....The smartest thing the HD Radio promoters can do is sell out to someone who actually understands the business."[328] Kent Lankford, the owner of an AM/FM combo in Lawrenceville, Illinois took pride in signing his stations off the air every night, and firing them up every morning. "We are proud to be the only live broadcasters in the Lawrenceville, Ill. and Vincennes, Ind. areas," he wrote. "When we broadcast, there is a heartbeat at the facility....Old fashioned, yes, but it works well here. [HD Radio]: Not needed in many smaller markets. Service: Always needed."[329] *Radio World*'s Skip

Pizzi openly questioned the future fiscal health of iBiquity and warned that the decision to place radio broadcasting's digital future in the hands of a single corporation could threaten the entire industry. "Ironically, the unusual licensing structure of [HD Radio] may also be *slowing* the transition because it has kept some (particularly the larger) consumer electronics manufacturers from adopting the format due to their lack of comfort with the unorthodox approach" [emphasis in original].[330] By mid-2008, *Radio World* declared that it had "become clear to us that radio's health and growth do not rely on any one tool or platform but rather on a willingness to be flexible, to try something new and not be afraid to fail at one project and then try another."[331] Naysayers were no longer a fringe element in the industry.

Between 2004 and 2008, HD Radio's protagonists convinced a compliant FCC to allow the technology to proliferate, regardless of the growing record of its fundamental detriments. Apparently working off the mantra, "if you build it, they will come," major-market broadcast conglomerates and National Public Radio teamed up to provide a front which suggested to the Commission that industry support of the HD Radio was widespread. However, a growing amount of discontent with HD Radio was registered on-, off-, and backstage. Incredibly, the FCC seemed blind to this uprising. Relying on incomplete and skewed technical information from iBiquity Digital Corporation, the National Association of Broadcasters, and the National Radio Systems Committee, the agency sanctioned expanded use of HD Radio despite its shaky performative metrics. The real-world results were inversely proportional to regulatory expectations: every time protagonists "won" a policy skirmish with independent broadcasters, consulting engineers, and the public, tangible perceptions of the technology soured.

After eight years in existence, iBiquity still did not have a viable business model, staying alive through periodic infusions of venture capital. Funding from radio broadcasters themselves dwindled to nearly nothing as the industry endured a recession. HD Radio's ballyhooed promotional campaign consisted of commercials aired using unsold spot inventory on investor-stations and reached nobody of consequence, as demonstrated by HD's miniscule listening audience - especially relative to other nascent forms of radio such as satellite broadcasting and webcasting. Receiver manufacturers may have had the last laugh: although they had cautioned the FCC about HD's pitfalls early on, their public objections dwindled while their actions spoke

louder; nobody stepped up to mass-produce HD receivers. Although the characters in this dramaturgy first blamed each other for HD Radio's tepid proliferation, as time wore on it became clearer that the faults of the system were inherent, and the arguments of antagonists had a point. No amount of regulatory permissiveness could fix a digital broadcast technology which overpromised and underdelivered. As the second decade of the 21st century loomed, radio's digital future was murkier than ever.

Notes to Chapter 5

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271. Statement of Commissioner Robert McDowell, MM 99-325, May 31, 2007 http://www.fcc.gov/fcc-bin/audio/DOC-271699A6.pdf (February 11, 2010).

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274. Petition for Reconsideration of Jonathan E. Hardis, MM 99-325, July 9, 2007, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5514701189 (February 19, 2010), p. 2.

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279. Id., p. 17-18.

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Chapter 6: HD Radio's Questionable Future

The FCC's Second Report and Order in 2007 authorizing HD Radio to proliferate with few restrictions or any real oversight was the most significant policy victory for its proponents during the technology's brief history on the air. However, no amount of regulatory permissiveness could make up for HD Radio's fundamental shortfalls. The question of the protocol's true extensibility and proprietary nature became wider points for debate within the radio industry (though not within the FCC). Meanwhile, the growth of other digital audio distribution platforms - especially those involving the Internet - eroded the listening audience for terrestrial broadcast radio. During the last half of the decade, the collective uptake of digital audio services *not* related to broadcasting overtook the growth of HD Radio itself. Part of this was due to a recession that hit broadcasters hard during the 2000s, which led to cuts in the resources stations and their owners could devote to new, HD-exclusive programming. While local programming on FM-HD multicast streams, for example, was promised by broadcaster-proponents, there is little evidence that such services actually exist to any meaningful degree.

For AM broadcasters, problems involving digital-to-analog interference effectively halted the expansion of HD service in the United States. In fact, as the inherent deficiencies of digital broadcasting on the AM band became more widely recognized, usage of the AM-HD protocol by iBiquity's own broadcast-investors has declined, and is now confined primarily to a handful of major markets. Many early-adopters have turned off their digital sidebands completely. However, so long as the largest AM broadcasters in the country continue to dabble with HD Radio, interference from their activities will continue to affect smaller stations who share frequencies with "clear channel" broadcasters around the country.

On the FM side, HD's proponents were initially satisfied with the authority to experiment with the technology's "value-added" applications, such as multicasting, datacasting and conditional access services. However, six years of real-world experience showed that FM-HD also did not perform as advertised. Without a guarantee that FM-HD programming could reach a potential audience equivalent to existing analog FM broadcasts, questions of the technology's long-term viability loomed large among broadcasters. This would lead HD-backers on a final two-year policy push to allow FM stations to increase the power of their digital sidebands. From

a regulatory perspective, this request was contextualized as an "improvement" to HD Radio which might diminish the apathy among the majority of the nation's broadcasters regarding its adoption. However, FM-HD interference had long been identified as an issue of concern, at least by independent broadcasters, the public, and within trade press discourse, and the move to increase the allowable digital power any station might broadcast with provoked further consternation about the trajectory of digital radio in the United States. HD's proponents again moved in what appeared to be a counterintuitive direction, hoping to facilitate the uptake of the technology by effectively raising the probability of harm it would cause to the legacy analog broadcast system. In doing so, they exacerbated what had been a minor controversy with FM-HD technology into another colorful argument over the validity of HD Radio itself as a useful mechanism that allowed broadcasters to navigate a convergent media environment. The fight over an FM-HD power hike was clearly a remedial action by proponents of the technology, yet the FCC would continue to contextualize their actions as "progress" where none really existed.

I. Proposing a Boost to FM-HD Power

Almost a year to the day after the FCC promulgated comprehensive rules on the operation of HD Radio, several commercial and public broadcasters petitioned the agency to raise the power level of digital FM signals.[1] The group requested the FCC allow stations to increase the power of their FM-HD broadcasts by a factor of ten (equal to 10% of an FM station's analog transmission output).[2] Proponents argued this increase was necessary because FM-HD signals simply did not come close to replicating the coverage area of their analog host. In fact, FM-HD signals were so weak that their reception was nearly impossible within buildings.[3] Unbeknownst to the rest of the industry and the listening public, the broadcasters petitioning for the power increase had already received permission from the FCC to conduct field experiments with increased FM-HD power levels. They used one CBS-owned station in Los Angeles to collect their data. According to their filing, under the original power level, existing FM-HD signals could be received "at only one of the test locations and analog reception was described as noisy or poor at 75% of the test locations." When the power was increased, "the digital signal could be received reliably at 75% of the test locations and at selected locations in the remaining 25% of the buildings."[4]

National Public Radio quietly completed a 50-station simluation-analysis of the effects of a blanket FM-HD power increase on analog radio reception. The results of this study were personally presented to FCC senior staff. Unfortunately for the the proponents of the power increase, NPR's research did not paint a painless picture with regard to analog-to-digital interference. NPR's report did conclude that an FM-HD power hike would increase the reliable service area of the digital signal, especially in a mobile listening environment. However, it would come with a significant cost.

> Mobile analog FM covered population would be reduced an average of 26% for the sample stations. Interference would affect some stations severely in portions of their analog mobile service area: 41% could lose one-third or more of their covered population and 18% would lose more than half of their population. With 10% [FM-HD] transmission power: Indoor and portable [FM-HD] covered population totals would be 83% and 81% of analog coverage, respectively. Analog FM indoor and portable covered population totals are reduced by 22% and 6%, respectively. Interference would affect some stations severely in portions of their analog indoor service area: 27% could lose one-third or more of their covered population and 16% could lose more than half of their population.[5]

In other words, not only did the proposed increase in power stand to exacerbate the potential for interference between FM stations, but raising the power of FM-HD sidebands could also cause detrimental self-interference between the analog and digital components of an FM station. NPR noted that listener reports of interference under existing FM-HD power limits were "minimal," but chalked that up to public ignorance about how digital radio interference manifested itself.[6]

Despite these conclusions, NPR suggested some change was necessary to increase the robustness of FM-HD Radio signals and asserted that any solution would have to be transmission-based in nature.[7] NPR's analysis predicted that a 10-fold increase in FM-HD power would "cause substantial interference" to analog radio listening;[8] yet "[t]he question of getting from here to there without substantial penalties to analog coverage is likely a matter of successive, calculated strategies, potentially trading off some increments in analog interference risk for more digital coverage, commensurate with increases in digital receiver penetration."[9] The report ultimately advised the FCC not to implement any rules that would dramatically decrease the analog coverage area of FM radio stations.[10] Additionally, NPR cautioned that raising the FM-HD power level tenfold "could [double] original HD transmission cost projections" - an extremely unattractive option for cash-strapped noncommercial radio stations.[11] Although NPR

concluded that "no convenient basis is evident" to provide a blanket 10-fold increase in allowable digital power, it did not formally oppose the basic concept.[12] The tacit signal to the FCC was that NPR would be willing to support some form of FM-HD power increase, but worried about its implementation in uncontrolled circumstances and the implications it might have on analog listenership during the ongoing digital radio transition.

In response to the NPR study, iBiquity Digital Corporation filed its own "test report" with the FCC on the feasibility of increasing FM-HD power levels. Its conclusions could not have been more different from NPR's. iBiquity engaged the services of investor-broadcasters in three major markets; they obtained experimental authorization to broadcast with digital power 10 times in excess of what was then allowable by FCC rules. iBiquity concluded that such operation dramatically increased the robustness of FM-HD signals without any "meaningful increase in the potential for harmful interference."[13] This conclusion was construed to suggest that a blanket power hike was not actually a substantive change to existing HD operational regulations: "broadcasters have become comfortable that the introduction of digital broadcasting does not present a credible risk of harmful interference to existing analog broadcasting."[14]

Were any problems to arise, iBiquity again expressed confidence that the FCC's own interference-remediation procedures could handle them.[15] The National Association of Broadcasters, CBS Radio, and the HD Digital Radio Alliance all contacted the FCC expressing support for a blanket tenfold FM-HD power increase. Although the NAB acknowledged that the action "may create new instances of interference in certain situations," it believed "that the benefits to be gained for FM broadcasters and FM listeners will far outweigh the limited additional interference predicted by iBiquity's studies."[16] This was an argumentative point straight from the script used to promote the imposition of full-time AM-HD broadcasting. iBiquity executives met with senior staff from the FCC's Media Bureau in October, 2008 and made a PowerPoint presentation on the need for a blanket FM-HD power increase. Notably, the presentation spent much of its time downplaying the negative findings of NPR's interference study and pledged cooperation between all segments of the radio industry toward the goal of raising FM-HD power.[17]

The FCC's Media Bureau issued a public notice formally requesting comments on the

proposed power hike.[18] The resultant dialogue was more feisty than proponents had expected. iBiquity hammered home the notion that a power increase was necessary to make FM-HD reception viable, especially for its multicasting application which, unlike a station's primary programming, had no analog fallback.[19] The company cast NPR's interference analysis as unrealistic. "Throughout its many years of testing the HD Radio system, iBiquity has always found field tests offer the most accurate prediction of digital compatibility and performance," it claimed. iBiquity suggested NPR's report painted a "worst case scenario" regarding a tenfold FM-HD power hike: it argued that all stations would not simultaneously increase their digital power levels, and iBiquity expected that "digital receiver penetration levels will be much more dominant long before all stations have adopted digital broadcasts. At that point, the impact of digital on existing analog signals will become much less important.[20]

Furthermore, iBiquity announced its intent to work with broadcast-investors to create more facts on the ground by applying for additional experimental authorizations to explore the implications of an FM-HD power increase.[21] The "Backyard Broadcasting Group," the benign moniker for a plethora of iBiquity investor-companies such as CBS, Bonneville, Clear Channel, Emmis, Entercom, Greater Media, and several transmitter manufacturers, among others, filed comments encouraging expeditious action on the issue. It, like iBiquity, suggested the power increase would have "a tolerable potential for interference" in "limited" situations.[22] Noting that NPR had "publicly stated that it is not fundamentally opposed to - and sees the need for - a digital power increase," the Group similarly painted NPR's interference analysis as an "unrealistic prediction" of any real-world impact such an increase might have.[23] It further reminded the FCC that the industry had collectively spent "in excess of $225 million on HD Radio technology" to date, and that a denial of their request could put that investment in jeopardy.[24] The National Association of Broadcasters construed iBiquity's study as providing "a sufficient and strong basis" for the FCC to improve a blanket power increase.[25] The modification was necessary "for the evolution of digital radio....Moreover, with over 85% of stations yet to convert to digital, authorizing a power increase now will be more efficient because stations just starting HD service will be able to build fuller digital facilities and avoid the expense and disruption of a retrofit at a later point."[26]

Only two public broadcasters thought iBiquity's et. al.'s proposal would be trouble-free. John W. Harelson, a board member of KMCE-FM in Manitou Springs, Colorado, thought the notion of protecting analog radio signals from digital interference represented an unwise bias toward an "older, inferior" broadcast technology to the detriment of a "newer, superior one." "If increased digital power should cause interference to analogue signals," argued Harelson, "it would encourage conversion to digital technology, which, in the long term, will be in the best interest of all concerned." Seton Hall University's public radio station, WSOU, also supported the industry's request for a blanket tenfold power increase, though it believed the threat of increased interference as noted by NPR should move the FCC to implement any changes "slowly over time."[27]

The majority of public broadcasters reacted negatively to iBiquity's assertion that any power increase would be painless. Minnesota Public Radio, which had signed on to the initial request for an FM-HD power hike, backed away from that stance, to the point of formally dissociating itself with the originating petition.[28] "We are...committed to the integrity of the FM spectrum as a whole, and it would be inconsistent for us to...object to the many incursions on the integrity of the spectrum...while at the same time ignoring the interference that could be caused by an indiscriminate increase in power for HD," wrote MPR. "We know and trust the thorough methods that NPR Labs has demonstrated in the past, and believe that this current HD testing is representative of what we could realistically expect if the HD power increase of 10% was allowed to pass. MPR recommends that the Commission seriously consider approving a solution that allows the broadcasters to find an HD power level that works with their neighbors and would not sacrifice analog reception."[29] It also argued that increased FM-HD interference would damage its ability to fundraise, as " support from...many individuals and organizations will not be sustainable if the audio that they receive on their radios is not clean, clear and free of the scratchy, annoying noise that a close-by HD signal could impose over the analog."[30] MPR announced that it was in discussion with NPR, iBiquity and others to "develop a measured approach" to an FM-HD power increase, and requested the FCC defer consideration of the issue until "those organized efforts" bore a compromise.[31]

The Association of Public Radio Engineers observed that both iBiquity's and NPR's

studies projected a "significant" increase in digital-to-analog interference and requested the FCC explore alternate methods to help improve the robustness of FM-HD Radio signals.[32] One suggestion would allow stations to asymmetrically increase the power of their digital sidebands; if an FM station had a nearby neighbor to one side of its channel but not the other, perhaps that station could increase its digital power in the spectral direction where interference was less likely to present a problem.[33] The APRE also believed no power increase should be implemented until further study of its implications could be conducted.[34] NPR itself strongly defended the validity of its interference analysis report, detailing the care and transparency with which it had accumulated its data.[35] Conceding in principle that an increase in FM-HD power was necessary, NPR asserted that a blanket 10-fold increase would be "insidious" and could endanger the fiscal viability of public radio stations.[36] "Materially degrading the technical quality of a station's signal is therefore more than an aesthetic issue," argued NPR. "It would likely mean the loss of listeners because most people will simply stop listening once reception becomes poor....Ultimately, the interference would mean diminished resources to sustain the station's service, let alone fund a robust transition to HD Radio....Particularly in difficult economic times, the consequences for some stations could be dire."[37] NPR announced that it "had begun intensive technical planning to carry out additional testing to address this and related issues in the next few months," and also urged the FCC to defer any decision until that information was assembled.[38]

Equipment manufacturers were of mixed minds about an FM-HD power increase. Only one transmitter manufacturer, Energy-Onix Broadcast Equipment Company, filed comments, and those were firmly against a power hike. "I strongly recommend that the FCC does not permit any increase in the existing HD radio subcarrier powers," wrote company president Bernard Wise. "This action will destroy the economics and technical reception of FM broadcasters."[39] On the other hand, two automobile manufacturers - Ford and BMW - commented in support of the FM-HD power increase. Both construed the proposal as key to stimulating listener acceptance of the technology.[40] The Consumer Electronics Association was more circumspect about the implications of an FM-HD power hike. "Consumer demand for analog audio receivers still greatly exceeds demand for digital audio receivers. Although CEA anticipates that a power increase will accelerate consumer demand for digital audio receivers, CEA respectfully urges the

Commission to condition any power increase authorization on compliance with technical rules providing adequate interference protection to analog receivers."[41] CEA further suggested the FCC look outside iBiquity and NPR - now considered the technology's two primary innovators - for more forthright analysis of digital-to-analog HD interference.[42]

Independent broadcasters redoubled their efforts to oppose any exacerbation of HD Radio's fundamental flaws. Reising Radio Partners, the licensee of an AM/FM combo in Columbus, Indiana, requested the FCC conduct its own independent tests instead of relying on industry-concocted data to authorize a potentially destructive change to the HD Radio rules. Reising was extremely critical of the proponents of the FM-HD power hike, especially the National Association of Broadcasters, which it asserted no longer honestly represented the interests of all radio licensees.[43] "Neither the 87% of broadcasting conducted outside the [HD Digital Radio] Alliance nor the Public should pay the price for a failed technology with cost prohibitive receivers and reduced service areas," declared Reising.[44] Broadcast engineer Robert R. Hawkins of Edinburgh, Indiana drew on his 41 years of experience in the field to forcefully oppose an FM-HD power hike. "While the current system technically does work at 1% injection, it doesn't work well. The request for an increase from 1% to 10% injection is not unlike building a 'trucks only' lane on the interstate and later being told that for it to work properly, the speed limit would have to be increased to a level that would not be safe for traffic in adjacent lanes. This should have been considered before the [HD] standard was approved."[45] Hawkins, along with other independent broadcasters, provided observations of interference caused by existing FM-HD power levels in a variety of markets.[46] Some stations used NPR's interference-prediction methodology to calculate the disruption to their analog service areas that would occur should a blanket power increase be approved.[47] All believed any increase should be conducted on a station-by-station basis and that the FCC needed to monitor the potential of increased interference very closely.[48]

The destruction of analog FM listening was a common theme among the comments of independent broadcasters. "The sooner that analog FM is unusable, the sooner it can be turned off," commented broadcast engineer Brian J. Henry of Napa, California. "I am disturbed that in our rush to convert...for the sake of going digital we are irreversibly damaging our existing

broadcast services that currently provide service to the vast majority of radio listeners. I find it absolutely absurd that we are attempting to replace highly spectrum efficient, fully linear modes of transmission that work extremely well with one that is spectrally inefficient, uses substantial amounts of data compression and has questionable performance."[49] If the FCC's mandate was to serve the public interest by providing an FM broadcast environment where robust radio reception was the goal, "I find it hard to see how increasing the level of interference to mature broadcast services that have millions of listeners by one that has thousands fulfills that objective."[50]

Small- to medium-market radio station owners - both commercial and noncommercial - openly worried that the onus of increased interference would fall disproportionately on them, thereby depriving listeners of choice in markets least likely to have much to begin with.[51] "You were promised the new technology, if permitted, would revitalize and, indeed, revolutionize terrestrial radio," commented Edward F. Perry, Jr, president of WATD-FM in Marshfield, Massachusetts. "You accepted the premise, granted the petition, but the promised benefits never materialized. The digital proponents are now before you again admitting the technical design flaws in their system and seeking an even larger piece of an already congested FM spectrum to try and make their system work....Why should you trust them a second time when every extra watt of power in the guardband creates additional danger to the quality of conventional FM signals?"[52]

"Existing FM digital operation probably interferes with more analog listeners than the number of receivers available to hear the digital broadcasts," commented broadcast engineer Paul Dean Ford of Dennison, Illinois. From his perspective, the bottom line was that "[i]ncreased digital signals increase interference to analog signals. The FCC is mandated to provide increased broadcast service. This proposal decreases broadcast service. Gradually increasing the 'noise floor' degrades all broadcasting. The public has not requested, nor is it buying [HD Radio]...HD now is merely filling the spectrum with annoying noise. Do not increase the noise."[53] Talley Broadcasting Corporation, the licensee of three radio stations in "rural mid-Illinois," termed the proposal for a blanket FM-HD power increase "arbitrary, capricious, [and] irresponsible in the extreme."[54]

Digital emissions, by their nature, are noise-like, and most people cannot distinguish a

> digital interference source the way that they can analog sources. So, the vast majority of the victims of [HD]-caused interference do not recognize what is really happening. Therefore, they do not complain....The Commission therefore cannot grant blanket approval for such a radical increase in noise and interference levels. The toothpaste must remain in the tube.[55]

The Educational Information Corporation, licensee of noncommercial station WCPE-FM in Raleigh, North Carolina, contextualized the power hike proposal as a sign of HD Radio's failure as a viable digital broadcast technology and urged the FCC to explore alternative DAB systems.[56]

Consulting engineers were similarly critical of the FM-HD power increase proposal. Canadian Barry McLarnon questioned the reliability of studies compiled by vested interests in the technology and asked the FCC to dismiss their request on that basis alone.[57] Douglas Vernier, who oversaw NPR's FM-HD interference analysis project, was even more candid about its results than NPR. "It is true that U.S. broadcasters and the Commission have bought into a digital radio system that has some advantages over the current FM analog system, but it also true that it poses a threat to our analog system to which a vast majority listens," he commented.[58] Having presented numerous papers at broadcast engineering conferences and NAB trade shows on the subject of FM-HD interference,[59] Vernier thought the drive for a digital power increase was an inefficient attempt to "improve" what was a flawed technology by design. "It is not surprising that we see interference to analog FM stations since with [HD Radio] we are attempting to impose a different allocation procedure on a system for which it was never intended," he explained. "With the [HD] system we are squeezing in signals into spaces which for years have acted as guard bands between the channel assignments. Any interference that we see now will be amplified in full if the...power increase is given a carte blanche."[60]

Gaithersburg, Maryland-based Mullaney Engineering argued that degrading the listenability of analog FM broadcasting to "save" a digital broadcast technology that was "too big to fail" was unwise. "This sounds just like the arguments being offered by many financial institutions & manufacturers in their weak justification of why Congress must bail them out of the mess that in some instances they were responsible for creating. iBiquity has nobody to blame for its problems but itself."[61] It also suggested the time was ripe for the FCC to explore other DAB technologies, given the weak proliferation of HD Radio.[62] The firm of Cohen, Dippell and

Everist urged the FCC to brook no compromise to analog service, and observed that "a workable methodology needs to be developed that permits a determination of whether or not harmful interference to existing analog service will result."[63] It suggested that it was the Commission's duty to devise digital-to-analog interference metrics given that no industry consensus existed on the issue.[64]

Members of the public latched onto NPR's interference analysis in opposition to an FM-HD power increase.[65] Several expressed disbelief that broadcasters would willingly degrade reliable analog radio service for a digital technology that had no demonstrable listener support.[66] H. Donald Messer, who served on the National Radio Systems Committee during the construction of the NRSC-5 standard, reported that the NRSC had worked to set the initial FM-HD power levels very carefully, with the minimization of digital interference to analog broadcasts in mind.[67] Messer noted that "[i]t took over a decade to get to agreement...over the composition of NRSC-5....If the digital coverage area is not to the liking of the system's proponents and endorsers, it is up to them to show conclusively...that this increase is not unduly detrimental to other authorized users of this band."[68] Jonathan Hardis argued that the lack of industry consensus around the issue was "all the more reason why the Commission should not be bullied into a hasty decision,"[69] and he savaged iBiquity's study. "The Commission must recognize [iBiquity's] test report for what it is: an advocacy document that was conceived and then edited to advance a narrow, competitive commercial interest. There is nothing inherently wrong with that - except when such a document alone might be relied upon to decide the public interest."[70] The Prometheus Radio Project, National Federation of Community Broadcasters, and New America Foundation jointly filed comments opposing any FM-HD power increase.[71] Prometheus et. al. believed the blanket request advanced its position that the addition of digital sidebands constituted a new spectrum allocation, and should be treated by the FCC as such.[72]

Only two members of the public commented in favor of an FM-HD power increase. Brian Kirby of Lisle, Illinois could not conceive that the radio industry would knowingly degrade the reception of its stations and was of the opinion that the entire industry would undergo "a slow death" if HD Radio's proliferation was compromised in any way.[73] Kevin Redding of Adamsville, Tennessee noted that current FM-HD power levels were simply

inadequate to reliably cover rural America, and no other option to correct this problem existed.[74]

II. FCC Puts Power Hike in Play

In May of 2009, the FCC issued a curious notice asking for more public comment on the idea of an FM-HD power increase. The request was framed in such a way as to disinvite discussion about the inherent necessity of a power hike and encourage comment on how much of an increase should be allowed.[75] This implied that regulatory support for some digital power increase was inevitable. The National Association of Broadcasters used the opportunity to dismiss independent broadcaster and public opposition as "without merit and contrary to the public interest."[76] Claiming to represent a "tremendous range of broadcasters," the NAB reiterated that iBiquity's FM-HD interference analysis was more scientifically sound than NPR's, and urged the Commission to allow a blanket tenfold power increase so as to "not...hobble the vastly greater number of stations that will want to optimize the digital service they provide to their audiences when real world testing indicates such can be done without significant or widespread interference impacts."[77] "Backyard Broadcasting" similarly touted the superiority of iBiquity's interference study and suggested that an FM-HD power increase be authorized only for commercial broadcasters, so as to give noncommercial broadcasters the additional time they desired to study the issue.[78] iBiquity proclaimed there was "a virtual consensus" among commenters that an FM-HD power increase was necessary, and argued that protecting "incumbent" analog services had the potential to "choke off the emerging technology."[79]

"Backyard Broadcasting," along with several additional iBiquity investors, warned the FCC that the lack of an FM-HD power increase would put the "significant investments" made in HD Radio so far "at risk," in large part due to the reticence of receiver manufacturers who quailed at the idea of investing in a radio technology that was hard to tune in.[80] Questions of potential digital-to-analog interference were dismissed as a "non-problem," though they offered up a compromise proposal to increase FM-HD power levels by a factor of four instead of ten: "An interim increase to that level, while inadequate to completely solve the coverage and building penetration problems which beset [current] operation...would allow at least some broadcasters to improve their HD Radio service....[E]xperience with [it] will serve to further

validate the findings that operation at higher digital power levels will not create widespread harmful interference."[81]

iBiquity and Charles River Broadcasting Company - a subsidiary of broadcast-investor Greater Media - filed further "technical studies" in support of a tenfold FM-HD power increase. "Put..bluntly, in many building types, digital reception is simply impossible on well performing table model receivers and similarly nonexistent on the new class of portable receivers about to be introduced into the market place," they reported. "Although an incremental digital power [increase] may serve to partially mitigate the situation for plug in receivers in some fixed locations, only a full 10 dB increase will permit reliable service to portable receivers and result in a close approximation of analogue coverage, two very basic and critical listener expectations."[82]

Among major broadcast conglomerate early-adopters of HD Radio, only Entravision Holdings - one of the largest Spanish-language radio broadcasters in the country - stepped forward to publicly oppose the industry's push for a blanket power increase. Citing NPR's research as well as its own experience with digital-to-analog interference, Entravision asked the FCC to defer on the issue. "At the heart of the broadcast regulatory policy is a station's right to interference-free operation and interference from DAB operations on adjacent channel radio stations therefore contravenes the public interest."[83]

National Public radio solidly stood by its interference analysis and initially opposed any "interim" FM-HD power enhancement. It reported that it had convened a "Peer Review Group" of "other industry parties" to look for a way to implement a managed FM-HD power increase.[84] Should such a compromise be achievable, NPR requested the FCC impose "an obligation on stations operating with increased power to give potentially affected stations prior notice so that those stations might alert their listeners or conduct their own interference measurements."[85] Any increase in FM-HD power levels was "no small matter," argued NPR. "Unless the Commission is prepared to revisit the evolutionary approach of transitioning from analog to hybrid analog/digital and, eventually, to a purely digital radio system, the Commission cannot grant the proposed power increase and simply disregard the adverse consequences for analog service."[86] To the extent that commercial supporters approved of a blanket power increase, NPR argued that

"they largely rely on diversionary rhetoric rather than addressing the technical merits of the issue."[87]

Several public broadcasters supported NPR's cautious approach, suggesting that any further experimentation should be transparent, collaborative, and incremental, and urged the Commission to defer a decision until additional NPR-led research into the interference question was completed.[88] Rhode Island Public Radio, the licensee of WRNI-FM, reported to the FCC that iBiquity's earlier field experiments with increased FM-HD power levels had caused destructive interference to its analog signal, and it had contacted technical experts at NPR to assess the problem. As they field-documented the interference,

> Greater Media and iBiquity came on the scene and insinuated themselves into the testing and evaluation of the reception conditions in all of the measurements. [A Greater Media representative] was present in the NPR van, which was tailed by an iBiquity van occupied by iBiquity and Greater Media personnel....It was apparent...that the purpose of Greater Media's and iBiquity's presence was not to promote accurate, real-world results, but instead to minimize any evidence of actual interference to the analog signal of a first adjacent station.[89]

HD Radio's commercial proponents reacted forcefully to this disclosure. iBiquity and the National Association of Broadcasters claimed there were "no legitimate complaints" of FM digital-to-analog interference, and cast the power increase as vitally important to spur marketplace acceptance of HD Radio.[90]

In the wake of an increasingly antagonistic public broadcast constituency, the NAB finally acknowledged that "the record in this proceeding shows significant concerns about the successful implementation of HD Radio," but blamed these faults on regulatory failure to approve an FM-HD power increase. "Further delay in doing so will only exacerbate uncertainty that may be creeping into the digital radio marketplace," making the need for an FM-HD power increase "compelling."[91] Commercial HD proponents attacked Rhode Island Public Radio's allegation that iBiquity and its broadcast-investors disrupted their interference-analysis project. WRNI's "scenario" represented "only an isolated allegation that hardly reflects an interference pandemic."[92] Clear Channel ginned up another quick field test on one of its FM stations to buttress iBiquity's position that a tenfold digital power increase would be relatively harmless, and that public broadcasters' concerns were invalid.[93] Greater Media called Rhode Island Public

Radio's accusation of malfeasance "egregiously distorted or fallacious," based on "allegations and innuendo that have no factual underpinning" and would "undermine the integrity of the FCC's procedures."[94] iBiquity asserted that the "caustic nature" of RIPR's interference report to the FCC not only harmed the development of industry consensus on an FM-HD power increase, but cast significant doubt on the objectivity of NPR's ongoing interference analysis project. It challenged NPR to "make its personnel available to the Commission staff to address any concerns the Commission may have," and suggested that NPR's "continued silence on this subject will ultimately undercut the industry's and the Commission's confidence that the test program was conducted in an appropriate fashion."[95]

Consulting engineers, independent broadcasters, and the public were nearly unified in their opposition to an FM-HD power increase. Consulting engineers warned the FCC it was treading into uncharted territory without adequate scientific data to make a decision on the issue. Barry McLarnon called it "remarkable" and "foolish in the extreme" that the Commission would even consider a power increase given the lack of respectable technical justification. He characterized iBiquity et. al.'s FM-HD experiments as "subterfuge" and demonstrative of a "lack of critical analysis that has been a characteristic of the [HD] system since its early days."[96] McLarnon also accused the FCC of an inclination to regulate radio's digital transition for the benefit of a minority of broadcasters who had a fiscal stake in iBiquity, "ignor[ing] or dismiss[ing] documented complaints of interference."[97] The power-hike proposal, concluded McLarnon, "ignor[ed] the laws of physics."[98] Douglas Vernier reminded the Commission that the protection of analog FM radio broadcasting was a prime directive in its mission to serve the public interest. Although he believed some increase in FM-HD power was necessary to save the viability of digital radio, "we should not precede [sic] blindly to implement a uniform across-the board increase. All relationships between stations are not the same. Despite the preambles of self-interest, an [FM-HD] power increase can take place if it is done in a studied manner which preserves the technical integrity of analog broadcast."[99] Referring to "numerous situations where station engineers and management have noted [HD] interference," Vernier cautioned the FCC not to make new policy just to "see how many complaints we get."[100]

Manassas, Virginia-based Cavell, Mertz & Associates implored the FCC to wait until

further research on a power hike was completed: "There is no known benefit to rush to a decision that has the potential to disrupt the entire FM allocations methodology in order to satisfy the wishes of a minority of broadcasters....The future of the FM Broadcasting Service should not be decided based on the anecdotal experience of such a small sample."[101] Mullaney Engineering reported receiving "numerous calls from Analog FM stations complaining about the 'real world' loss [to their] Analog service area....The listening public does not care if this loss of service is legally defined as interference, they only know that they used to be able to receive their favorite FM station at their home, work or while traveling in the area but now they can't receive it anymore." Mullaney predicted that an FM-HD power hike would "encourage many of the listeners of FM radio stations to seek out other alternate technologies."[102] Klein Broadcast Engineering commented that "[t]he integrity of the analog FM Broadcasting Service is on the line here."[103] It, too, suggested that "a significant number of instances" of FM-HD-related interference already existed and provided details of a case between two stations in California on which it had been called to investigate.[104]

Independent broadcasters presented a plethora of reasons why an FM-HD power hike was a bad idea. Simmons Media Group of Salt Lake City, Utah felt a power increase would be "contrary to the best interests of the majority of...licensed broadcasters who primarily operate with analog devices, to favor the large market, well funded broadcasters who wish to boost the coverage of their digital signals at the expense of their analog competitors." Should an increase be approved, "the FCC would essentially enable larger well funded broadcasters to enjoy signal advantages and competitive opportunities not available to smaller, locally owned broadcasters. We believe allowing digital broadcasters these proposed power increases would *further harm* smaller analog broadcasters who are struggling for their survival" [emphasis in original].[105] Creative Educational Media Corp., the licensee of six noncommercial FM stations and five FM translators, reiterated the request that the FCC conduct its own independent analysis of the implications of an FM-HD power increase. "All radio licensees such as Creative have been given licenses to operate on the channels assigned by the FCC," it noted. "We think it is the duty of the FCC to make policy that does not tread on the rights of Creative as a broadcaster. Creative should not have to accept less signal coverage and interference from another station on the sole

reason that the station has gone to [HD] operations."[106] Positive Alternative Radio, a religious broadcaster with 23 FM stations and 47 translators, commented that the "white noise" nature of digital-to-analog interference made it difficult for broadcasters and listeners alike to discern its true source.[107] "The scarce resources of the Commission should be spent judiciously," it recommended. "Allowing power increases subject to listener complaints or the agreement of individual station licensees is not an appropriate spectrum policy....[HD] stations...that are allowed to infringe upon the analog signal of another radio station would institute a complete breakdown in the protection regulations already set forth by the FCC."[108]

Harry Ruhweidel, a broadcast engineer with more than 42 years of experience, entreated the FCC to base any power-increase decision on more than "anecdotal accounts and questionable lab studies designed to ignore many real life conditions." He argued that it was not logical for the Commission to "disrupt a primary broadcast service for the sake of adopting 'technology' that benefits only a few patent holders financial interests."[109] He and other independent broadcasters also suggested the FCC open up its rulemaking to consider alternatives to HD Radio, given the technology's stagnation in the marketplace.[110] Leroy C. Granlund, a working broadcast engineer with "fifty years of experience in the design, construction, operation, and maintenance of radio and television broadcast facilities in the U.S. and worldwide,"[111] commented that HD proponents had "selectively edited" their analyses to portray any power increase as without significant risk.[112] Considering that "99 percent of all listeners can receive only analog FM at this time," Granlund could not countenance jeopardizing this service to promote a languishing digital "upgrade."[113] Butler, Maryland-based Talley Broadcasting Corporation observed that "[t]he trade press and specialized web sites devoted to the topic of [HD] Interference are rife with horror stories of interference to analog Broadcasts....There is no need to rush here."[114] Estimating the number of HD Radio receivers actually in the hands of listeners only numbered "in the hundreds of thousands," while "hundreds of millions" of analog receivers were in use, Talley urged the FCC to "keep in mind that the tail does not wag the dog."[115]

Several independent broadcasters, cognizant that the FCC seemed predisposed to sanction some sort of FM-HD power increase, forcefully requested the agency implement a proactive remediation program to minimize any increase in digital-to-analog interference that

would occur.[116] James K. Davis, the manager of a commercial FM station in Indian River Shores, Florida, noted that it was already difficult enough for radio broadcasters to retain listeners "in an age of increased 'new media' competition. Poor reception should not be a cause for listeners to migrate away from our services."[117] Michael Gehring, in the 36th year of his radio career, indicted the nation's largest broadcasters for "pushing their collective weight around…spending money lobbying, and dictating to their smaller brethren what they want done. It is solely self-serving."[118] Press Communications accused the country's consolidated broadcast corporations of acting in outright contradiction to the public interest. "With all due respect," commented Press, "the 'successful roll-out' of a private commercial venture is *not* a valid basis for Federal spectrum management policy. That is especially true when that private commercial venture is asking the Commission, in effect, to reallocate FM spectrum and, in so doing, jeopardize the ability of the vast majority of the U.S. commercial radio industry to continue to serve their listeners" [emphasis in original].[119]

Although the public had been effectively ignored during the HD Radio policymaking process, that did not stop it from attempting to halt the expansion of what it had clearly identified as an inferior and destructive digital broadcast protocol. Aaron Read of Geneva, New York suggested that any increase in FM-HD power levels would contravene long-standing interference-protection precedents that had served radio well for several decades.[120] Jonathan Hardis accused HD proponents of presenting justification for a power increase that didn't "even approach...the standard of comprehensive and impartial testing."[121] Edgar Reihl suggested that the lack of widespread HD-related interference complaints could not be construed to paint the technology as nondestructive. "It is becoming increasingly clear that the [AM-HD] system is a colossal failure," he declared. "Now iBiquity would like the Commission to grant a tenfold increase in the digital sideband power on the FM band, without waiting for important technical studies to be completed....The AM radio band has already been effectively 'trashed' by interference from [HD] transmissions. This must not be allowed to happen to the FM band."[122]

Ultimately, radio listeners reiterated the fact that they simply did not want HD Radio. Gregory Smith of Gaithersburg, Maryland characterized the technology as "all about what broadcasters want, not consumers....Few HD Radio...receivers have been sold, and most have

been returned for dropouts, poor coverage, and bland programming,."[123] He suggested the entire protocol "should be abandoned, or moved outside the existing...broadcast frequencies."[124] James Wilhelm of Fairmont, West Virginia, seconded Smith's motion. "Any other response by the Commission would be irresponsible and not in the public interest and give the appearance that the Commission is showing favoritism."[125] Wilhelm believed the success or failure of HD Radio should rest in the hands of receiver manufacturers and listeners, "not on a handout from the FCC....I challenge iBiquity to prove the need for a power increase based on solid evidence of consumer acceptance."[126] He noted that "[t]he general public is silent and slow in understanding the scope of the transition to digital radio giving commercial interests a louder voice. Is it the desire of the Commission to take advantage of this lack of public understanding and allow the interests of [HD proponents] to take precedence by essentially force-feeding a hybrid system on the public?"[127] The Prometheus Radio Project echoed these concerns to argue that the preservation of analog FM broadcasting should continue to take precedence at the FCC for the foreseeable future.[128]

As the comments over the proposed power hike flew back and forth, many constituencies personally reached out to FCC Commissioners and staff to make their cases. On behalf of the public, the Media Access Project met five times between April and November, 2009 with senior staff in each Commissioner's office as well as the management of the FCC's Media Bureau. All meetings focused on the lack of substantive data to justify an FM-HD power increase, and urged the Commission to proceed on the issue with extreme caution.[129] MAP's forceful entrance into backstage dialogue was spurred by the organization's late realization of what FM-HD interference might to do LPFM stations - a service to which it had made a significant investment in advocacy. One large religious broadcaster, the Educational Media Foundation, also made special trips to Washington, D.C. to urge the FCC to protect LPFM and translator stations from digital-to-analog interference.[130]

However, these efforts paled in comparison to corporate lobbying on behalf of HD Radio's proponents. iBiquity met repeatedly with each Commissioner's senior legal advisors and key employees in the Media Bureau to downplay concerns about an FM-HD power increase.[131] iBiquity went to far as to claim that any increased digital interference to analog FM signals

would be largely masked by "existing thermal and man-made noise."[132] iBiquity's backstage performances were supplemented by the Broadcaster Traffic Consortium, a group of large broadcasters with investments in iBiquity, which urged the FCC to implement an FM-HD power hike in order to improve the robustness of nascent datacasting services.[133] Public broadcasters also supplemented iBiquity's efforts, telling senior Commissioner and Media Bureau staff that while they did not oppose an FM-HD power increase outright, such an effort needed to be managed carefully, and hinted that further analysis on the issue would be forthcoming by the end of 2009.[134]

Only Rhode Island Public Radio, whose flagship station had already been the source of controversy over FM-HD power testing, broke with the public broadcast constituency in an ex parte contact to implore the FCC not to "run roughshod over the considerably older and significantly more deeply embedded analog service. [HD Radio] was sold to the broadcast industry on the principle that digital could coexist peacefully with analog. We begged to differ with that claim in our comments and reply comments, based on our real-world experience." RIPR suggested that iBiquity and major broadcasters' smear campaign against its engineering staff for bringing a case of FM-HD interference to light suggested an "ill grace" and "signals a willingness to employ a scorched-earth means to their ends."[135]

III. Openly Debating HD Radio's Viability

Offstage, trade press discussion of the proposed power increase was feisty. One one hand, NPR's HD Radio point-man, Mike Starling, reported that a blanket increase would result in problems "to the detriment of existing analog FM signals," and that the potential for interference would vary "greatly from city to city."[136] On the other, Caryn G. Mathes, the general manager of WAMU-FM in Washington, D.C. and a self-proclaimed "evangelist for HD Radio," boasted that her station had "several full-time employees" that "produce more than 50 hours a week of live original programming for our multicast channels," and contextualized an FM-HD power hike as necessary to promote the vitality of HD Radio's multicast function.[137]

However, such heavy investment in multicasting was an exception, not the rule, in the public radio universe, and use of the application to date seemed to diminish the constituency's long-standing claim that multicasting would radically expand program choices for radio listeners.

NPR found itself with an "unexpected shortfall in revenue" in 2009, which led the organization to deprioritize investments in HD Radio programming, make a 7% cut to its workforce, and leave 21 open positions unfilled.[138] One of NPR's multicast filler-feeds, the Classical Public Radio Network, was shuttered on June 30, 2009 due to a lack of new funding and weak station subscription-growth.[139] A *Current* survey of public radio executives found that most stations multicasting did so with canned programming. "Enthusiasm was muted" for HD Radio: most believed the technology would never become a major component of terrestrial radio broadcasting; 20% expected HD Radio to wither and die on the vine; only 4% expected HD Radio to grow quickly.[140] Tom Ammons, a technician with public radio station WQED-FM in Pittsburgh, hoped that "we don't end up with an FM band that is mostly fuzz." He observed that HD Radio was "stalled": "With less than 1 percent of our listening audience capable of HD listening, it's hard to argue that our management should put resources into multichannel programming. All of this should give us pause about the inherent limitations of HD Radio as it stands." Ammons suggested broadcasters explore an out-of-band, all-digital service immediately. "Do we have to wait for wireless Internet radio to blow us out of the water before we move to an all-digital mode?," he asked. "Will it be too late then? I fear that I already know the answer."[141]

Among commercial broadcasters, *Radio World* reported that many engineers felt "anxiety and even doubt about the success of HD Radio."[142] Bert Goldman, the vice president of engineering for Independence Media and a member of the NRSC, told the publication that "everyone I've turned my [FM-HD interference projections] over to has gone into hiding or said it's conservative...I would like nothing more than to have someone tell me that I'm all wrong and why. Unfortunately nobody has yet done that, and if my suspicions are correct, then substantial harm could be inflicted on hundreds of FM analog stations that count on their fringe...signals." Goldman was also displeased that proponents of an FM-HD power increase completely circumvented the NRSC in its testing to justify the hike to the FCC.[143] Richard Brown of Washington Crossing, Pennsylvania warned that "studies from manufacturers of HD Radio tend to slant toward their own concerns, lacking objectivity and impartiality, with conflict of interest."[144] Several broadcasters noted that, as of 2009, there was still no standard way to monitor the successful operation of an HD Radio signal, which provided significant potential for

all sorts of interference-related problems.[145] Dave Obergonner, a broadcast engineer in St. Louis, reported that he personally measured FM stations running HD sidebands in excess of their licensed *analog* power. "This is a basic, fundamental flaw in the HD Radio system that will cause all kinds of grief in the future if [digital] power levels are increased, and the radios are in greater circulation," wrote Obergonner. "The only winners in this game will be the larger group-owned, larger-market stations who can afford this. Smaller-market (mostly independent) stations will pay a dear price nonetheless, with considerably increased interference....The rich get richer, and the smaller stations go bankrupt."[146]

Robert Savage, whose AM station already suffered from ongoing HD-related interference, opined that it was "tragic how we continue to argue and tinker with a technology left behind by the listening public and the majority of broadcasters long ago, while wireless Internet radio and other compelling platforms thrive and grow."

> This is not the time to pit broadcaster against broadcaster over HD Radio interference issues. We need to present a united front, clean our programming house and offer real, not illusory value to our listeners and advertisers instead of endlessly wrangling over a technology nobody in the real world cares about.[147]

These sentiments were strong enough that *Radio World* published an editorial urging HD Radio's proponents and the FCC to not "blindly move forward with an across-the-board digital power increase that robs Peter to pay Paul. Legacy stations deserve protection from interference."[148] However, the publication also held out hope that mass-produced HD receivers would be in the hands of consumers "beginning in perhaps 2011 or 2012 (though obviously the recession could play into that)," and suggested that any further tweaks to improve the viability of digital broadcasting should take place before that point in time.[149]

Offstage, among broadcasters, there appeared to be growing recognition that the HD Radio protocol itself was simply not robust enough to provide terrestrial radio with a meaningful foothold in a convergent digital media environment. "The [HD] transition is evolutionary in every sense of the word," wrote Skip Pizzi. "This implies that it could take geologic epochs of time to elapse before it concludes. And this may be just too slow for the species to survive....The fact that FM analog radio is 'good enough' for most consumers doesn't help."[150] Michael Baldauf, a programming consultant in Pueblo, Colorado, told the industry that new content, not

new technology, would entice listeners back to traditional radio broadcasting. "You can come up with a bazillion channels, digital or analog, but if it all comes out of the same pre-recorded, canned, MP3-quality, low-creativity cookie cutter, the audience is not going to be there," he warned. "Success lies in the ability to find ways to embrace your audience. If you aren't willing to be at every possible public event, hang up station banners, give out bumper stickers, do contests and giveaways and become part of the life of your listeners and advertisers, you aren't in the right business."[151] Without direct connections to the communities it served, Ed Dulaney of the Rocky Mountain Radio Network forecast that "radio will become a secondary service....But until we get our act together and start taking radio seriously again, not even HD Radio will get us out of this hole we've dug."[152]

Radio World editor Paul McLane questioned whether anyone in the industry even had the knowledge to "appeal in a compelling way to a modern media consumer, particularly someone born after, say, 1980."[153] "Perhaps the problems started with deregulation," suggested Bill Parris, who managed several stations in Washington, D.C. and Baltimore. "Rolling up losing stations into market clusters reduced the root of radio's resilience....The long-term effects are proving near-fatal: a lack of new ideas, a lack of creators, and a management structure driven exclusively by cost reduction....For more than a decade we have been making a lousy product and getting away with it."[154] If broadcasters could find no budget for the creation of compelling multicast programming, industry consultant Mark Lapidus suggested they "let someone else take a chance with your digital spectrum."[155] A listening test conducted by Amanda Alexander, the chief engineer of Crawford Broadcasting's Denver station cluster, found that the majority of HD-enabled broadcasters in the market had automated multicast streams: "I never heard a person other than the voice doing the liner for the station."[156] The same was found in Boston, where one station broadcast duplicate content - a simulcast of its analog signal - on *two* HD multicast channels, for no practical purpose.[157]

Tom Taggart, the owner of two FM stations in St. Mary's, West Virginia, declared he had "no intention of wasting money on [HD Radio]....[T]he idea that there will be a wave of consumer [HD] receivers that...include...special features...is a pipe dream."[158] In 2009, HD Digital Radio Alliance president Peter Ferrara resigned from his post, citing "time for a

change."[159] iBiquity also laid off "an undisclosed number of people" that year, though CEO Robert Struble assured the industry that the company was in firm financial shape.[160]

At the 2009 NAB Radio Show, discussions between commercial and public radio station engineers and managers over the issue of an FM-HD power increase were described as "acrimonious" with "some very unpleasant hallway talk that lent a sour 'us vs. them' feel to the proceedings."[161] *Radio World* conducted an interview with FCC Audio Division chief Peter Doyle, who remarked that "it's clear to the commission that the current power level is 'fraught with problems' and...the agency has seen a slowdown in the number of notifications from stations converting to [HD Radio]. And while the commission has received interference complaints...'There is no formal complaint before us.'" What a "formal complaint" would need to consist of before the FCC would investigate instances of HD-induced interference was left undefined.[162] Such a remark was astounding given that at least two AM stations had indeed filed formal complaints with the FCC alleging destructive interference to their analog signals, and the record of the HD Radio proceeding was replete with comments detailing problems on both the AM and FM bands.[163] NPR's Mike Starling defended his employer's FM-HD interference analysis and advocated for civil dialogue between commercial and noncommercial broadcasters on the issue.[164] In a commitment to resolving the FM-HD impasse, NPR announced its HD Radio research would be rolled into a larger "Technology Research Center" with 77 employees and an operating budget of approximately $1 million per year.[165]

In reality, a compromise on the FM-HD power increase issue had already been reached between the technology's primary proponents. Less than a month after Starling made his appeal to commercial broadcasters offstage, NPR filed an ex parte report with the FCC calling for a blanket fourfold increase in the power of FM-HD sidebands, with a maximum tenfold power hike allowed provided stations could show little risk of destructive interference. The report was the product of collaborations between NPR, iBiquity, CBS Radio, Clear Channel, and Greater Media,[166] and utilized a very small sample of stations for actual field analysis.[167] This, combined with subjective listening tests - where participants were exposed to the sounds of FM-HD interference at various digital power injection levels[168] - led the "Joint Parties" to conclude that a fourfold FM-HD power increase provided the "median ratio" for raising a station's digital power

without severe negative consequences. Although the results "do not necessarily justify a proposed blanket increase," the Joint Parties expressed confidence that, with further industry research and FCC assistance, a power hike would be relatively painless for all involved.[169] This report was, in essence, a capitulation by NPR to the year-old power-hike "compromise" proffered by "Backyard Broadcasting."

The day after filing its report with the FCC, NPR issued a news release touting its collaboration with iBiquity. "We are delighted that the radio industry is now poised to push this technology ahead together," said iBiquity CEO Robert Struble. "We've found practical and balanced solutions that will greatly improve reception while limiting interference to existing analog operations." NPR's Mike Starling believed public broadcasters "are optimistic about the future of HD Radio...and eager to continue to work with iBiquity on the developments that will make this power increase work to everyone's advantage – stations, listeners, and receiver makers."[170] The day of the news release, iBiquity filed comments with the FCC formally requesting an FM-HD power increase along the lines requested by the Joint Parties. "The parties believe the framework they have outlined...addresses the concerns that have been expressed about a digital power increase," the company wrote. "Broadcasters remain committed to providing their listeners with the best digital service possible. iBiquity and NPR urge the Commission to expeditiously authorize a digital power increase consistent with the [compromise]."[171] The National Association of Broadcasters declared that the deal "will enable digital radio broadcasters to improve digital coverage, better replicate their analog service and insure reliable reception of new multicast signals....The record in this proceeding is now complete."[172] iBiquity, the NAB, and NPR followed up quickly with personal visits to FCC headquarters urging expeditious action on the power increase.[173]

The speed with which this compromise was reached left few with adequate time to criticize it. The New Jersey Broadcasters' Association provided the most substantive critique. It called any increase in FM-HD power levels "a violation of the spirit and letter of the law, substantively adverse to public policy, and counterproductive to the rules promulgated by the FCC." It believed any increase would be "severely deleterious" for the coverage of area of many New Jersey FM radio stations, which already suffered from congested channel conditions caused

by the existence of major broadcast markets bracketing the state, and reminded the agency that the NAB, NPR, and iBiquity did not speak for all broadcasters on the issue.[174] The power proposal worked "at cross purposes to achieving the goals both Congress and the Commission have long expressed: localism, diversity of voices, equal opportunity opportunities, and intelligent local content. The obvious truth is that this HD power increase is being pushed through the Commission without reasonable opportunity for parties adversely and irreparably impacted by this pronouncement from even being heard as to what type of 'deal' is being considered."[175]

Less than three months after the compromise had been unveiled - and without formal solicitation of any public comment on it - the FCC blessed the Joint Parties' request. After observing that the number of FM stations applying for HD broadcast authorization had been in decline since 2007,[176] the FCC asserted that allowing an FM-HD power increase would change this trajectory.[177] Based upon "analysis and data, as well as five years of interference-free FM hybrid digital operations...we are convinced that an immediate voluntary [fourfold digital power] increase...is appropriate, with the option for stations to request a full tenfold power hike."[178] The FCC directly appropriated the latest NPR-led interference analysis report to justify the move.[179] Remarkably, where the question of interference remediation was concerned, the FCC elucidated an incredibly difficult route by which formal complaints would receive attention. It put the onus on victim-stations suffering interference to provide

> at least six reports of ongoing (rather than transitory) objectionable interference. For each report of interference, the affected FM licensee must submit a map showing the location of the reported interference and a detailed description of the nature and extent of the interference being experienced at that location....The complaint must also contain a complete description of the tests and equipment used to identify the alleged interference and the scope of the unsuccessful efforts to resolve the interference.[180]

Historically, those who propose to expand or repurpose the use of occupied spectrum bear the regulatory onus to justify that their activity will not harm incumbent users. Requiring that the burden of proof to demonstrate harm be placed on stations affected by FM-HD interference, rather than on those likely to cause it, turned decades of spectrum integrity policy on its head. The technical knowledge, time, and resources necessary to satisfy this burden of proof is far outside the scope of an independent broadcaster or listener. Listeners themselves were

effectively cut out of the interference-reporting process, despite the fact that the policy record clearly showed that digital radio interference was an ongoing problem. It also sent a strong message that the FCC didn't really want to be bothered with the real-world implications of HD Radio, thereby promoting the further promulgation of the technology on the basis of willful ignorance about its fundamental detriments and in line with a neoliberal ideology surrounding media regulation more generally.

The FCC's decision sent shockwaves through consulting engineers, independent broadcasters, and the public. Several immediately filed appeals of the latest Order. Mullaney Engineering was aghast: "It is an insult to the existing FM licensees, some of which have paid hundreds of thousands of dollars to the Federal Treasury to secure their licenses, to pretend that [HD Radio] does not cause interference to existing Analog FM service areas because vested interests in iBiquity's...radio system have negotiated or redefined the definition of what is 'objectionable' interference."[181] Alan Jurison questioned the underhanded way in which NPR and iBiquity achieved their compromise, and the manner by which the FCC opaquely decided the issue.[182] Leroy Granlund called the FCC's interference reporting requirements "unrealistic and impractical."[183] Religious station WRBS-FM in Baltimore, Maryland reported that it already received "significant interference" from nearby stations broadcasting in HD, and declared that the "scope of lost listenership and revenue will be incalculable, causing clear irreparable harm to [the station]."[184]

Press Communications accused iBiquity of "blatantly misrepresent[ing] the system they promoted."[185] It excoriated the FCC's new interference-reporting requirements: "Listeners today have a myriad of choices that did not exist decades ago and are about to get more. To suggest that a broadcaster would have to aggregate 6 continuous complaints and then have to wait months for the complaints to be remediated is ridiculous," equivalent to "asking people to explain their sightings of UFOs."[186]

> Let's call this Order for what it really is, an unparalleled assault on analog FM Radio listeners and to further reorder the competitive landscape to the favor of higher power large market broadcasters. The role of the Commission is to ultimately protect the consumer, not some special interests who have yet to prove the public really wants (or for that matter needs) the product HD Radio is selling....We should ask ourselves whose interest, need and convenience does this order serve; the fewer than 5% of radio listeners who have ever heard an HD broadcast or the 95% plus of the American public who rely

> on analog FM radio on a daily basis....The answer seems more than obvious. The path the Commission has taken [supports] a minority of broadcasters who made a bad bet on a flawed technology and now can hopefully salvage their investments and maybe their reputations.[187]

Jonathan Hardis claimed the FCC "exceeded its delegated authority" by blindly accepting the Joint Parties' power increase compromise.[188] "The proposition of a tenfold power increase, to put it bluntly, is primarily a gambit to occupy spectrum that would otherwise be put to other uses," Hardis wrote. "Here, the remedy (a massive power increase) is vastly disproportionate to the supposed problem."[189] There was "no logical nexus" that explained the FCC's Order or its rationale; Hardis felt this demonstrated HD Radio proponents' desire to "put...business interests ahead of the public interest."[190] The Prometheus Radio Project accused the FCC of blatantly ignoring its own record, where HD Radio's fundamental weaknesses had been so well documented.[191] As a result, "[FCC] Staff failed to provide a reasoned basis for its actions, failed to consider all of the evidence presented to it, and failed to articulate a rational connection between the presented facts and its decision."[192]

The National Association of Broadcasters reacted strongly to the backlash. It asserted the FCC acted properly on "the basis of a well-developed and lengthy record," and did not ignore critical comments - it "simply disagreed with the objectors' arguments."[193] iBiquity claimed the FCC's decision was properly executed and designed to "advance the Commission's digital radio broadcasting goals," and argued that all appeals to the latest Order were focused "principally on those parties' overall displeasure with digital broadcasting rather than specific issues with the digital power increase authorized" by the Commission.[194] NPR again declared that consideration of any appeal would "upset...the digital radio transition itself."[195] Although the Commission "has acknowledged that the introduction of radiofrequency energy into a mature spectrum band requires trade-offs between service and interference," NPR felt the "rigorous" remediation procedures put into place would assuage any concerns.[196] The FCC supported the proponents: it dismissed all appeals without prejudice.[197] Although many of the appeals have since been re-filed, the Commission has effectively ignored them. Without the time and resources for critics of HD Radio to press their case, this situation is likely to continue indefinitely.

IV. HD Radio's Second Decade

By the end of 2010, it was clear that HD Radio was still looking for traction in the marketplace. Stations did not leap at the chance to implement higher FM-HD power levels, leading the FCC's Peter Doyle to term the industry response to the opportunity "disappointing." A year after the passage of the latest Order, only 150 FM stations had applied to boost their digital power.[198] Just 135 stations added HD functionality in 2009.[199] By April of 2011, the FCC reported that just 1,627 radio stations - 16% of the national total - had installed HD technology, and the number of new implementations had slowed to "maybe a handful" each month. [200] *Radio World* editor Paul McLane lauded the "remarkable support from our nation's regulators," but cautioned that "[t]he day has not yet come when digital FM has earned priority over analog."[201] Bob Savage of WYSL quipped that when "the first decision ordering an interfering station to reduce power" occurred, "I'm buying you a steak dinner. It will never happen."[202] Two FM-HD-related interference complaints have since been formally filed with the FCC, but there is no regulatory inclination to investigate them.[203] 18 months after the FCC's order allowing the FM-HD power boost, *Radio World* published a two-part article by Dave Hershberger, a senior scientist at transmitter-manufacturer Continental Electronics, detailing the increased likelihood of self-interference between FM analog and boosted digital signals; he urged stations to proceed with extreme caution on any FM-HD power increase.[204]

AM-HD Radio is now effectively in decline. Several major broadcast-investors in iBiquity, including Bonneville, Citadel, Clear Channel, and Disney/ABC, have shut off some or all of their AM-HD signals at night due to the interference their stations produced.[205] Although iBiquity has revised its hybrid AM waveform in an attempt to better protect the integrity of stations' analog signals,[206] the change effectively reduces the digital carrying capacity of AM-HD Radio, which is unlikely to convince many stations to invest in it.[207] Several broadcast engineers and executives contacted by *Radio World* to describe the state of AM-HD in 2010 refused to go on the record, "citing the sensitivity of the subject and company policy."[208] Barry McLarnon now keeps a running online tabulation of AM-HD stations on the air: as of January 8, 2011, out ot a total of 4,786 existing AM stations,[209] just 235 (a shade under 5%) are broadcasting in HD, and of those, only 80 are confirmed to be operating in digital at night. Approximately 60 stations have

abandoned the protocol completely.[210] Heberto Limas-Villers, the owner of two AM stations in Denver, Colorado, worried that AM-HD would eventually devalue all AM radio stations, regardless of whether they broadcast in analog or digital. "[T]he future of the AM band is, at best, bleak," he told *Radio World*. "You used to pay so much money to belong to the 'exclusive club' of FCC license holders. When the exclusive club is no longer, how much is an AM license going to be worth? In the end, radio is a business and you need to make so much to pay the bills. If the value of AM licenses drops so much, what are we, the small radio owners, working so hard for?"[211]

From an "unscientific online survey" of readers, the Clear Channel-owned trade publication *Inside Radio* reported that 44% of respondents believe HD Radio will never reach the "tipping point" where it could conceivably replace analog broadcasting.[212] Mike Vanhooser, the president of Dallas-based Nova Electronics, observed that the industry was stuck with an "albatross," and encouraged the larger, non-consolidated segment of the radio industry to "take the albatross from around their neck and make their *analog* signal an engineering masterpiece...and put some programming worth listening to on it....Radio was a fantastic medium when it was all live and always different. Digital repeater radio doesn't cut it. Get back to what works, and you will be surprised at the results" [emphasis in original].[213] Larry Tighe, owner of WRNJ-AM in Hackettstown, New Jersey, felt that "if broadcasters got back to the business of programming the main channel to serve their communities and stop trying to emulate a satellite service, their bottom lines might come off the floor and make radio again what it is supposed to be: an asset to the community of license."[214] Energy-Onix president Bernard Wise declared he would boycott future industry conventions out of shame "to be associated with the NAB in their promotion of this inferior system."[215] Some "naysayers" have newly-elevated status within the radio industry; *Radio World* commentator Skip Pizzi, who became increasingly critical of HD as it proliferated, was hired by the NAB in December, 2010 as its "director of digital strategies";[216] since his promotion, however, he has not made any public statements about the future of the technology.

Listener uptake of HD Radio also reflects a crippled state of affairs. In a presentation at the 2008 NAB Radio Show, Jacobs Media general manager Paul Jacobs presented ethnographic

research on the audio consumption habits of young adults. “Mild groans went up in the broadcasters’ conference when one respondent, asked whether she had a radio, said that she might have one ‘in the top of my closet,’ though it might not work.”[217] Jacobs told broadcasters that he would have loved to show segments demonstrating young listeners’ engagement with HD Radio, “but only two of them even knew what it was, and it was clear that they didn’t know what they were talking about.”[218] In a 2009 survey of 30,000 public radio listeners, nearly half expressed awareness of HD Radio, but only 3% had actually bought HD-capable receivers. Of the rest, 11% said they were “very likely” to purchase an HD receiver, while 65% reported they were “somewhat” or “not at all likely” to jump on the HD Radio bandwagon.[219] Another Jacobs Media listener survey reported that 40% of respondents didn’t know enough about the technology to form a firm opinion of it, while 37% complained that digital receivers were too expensive. Overall familiarity with HD Radio “dropped from 70 percent in 2007 to 60-some percent in 2008, according to the findings.”[220]

That same year, Arbitron and Edison Research published a report which concluded that 66% of listeners surveyed were not interested in HD Radio, while only 6% responded that they were “very interested.” A separate study from American Media Services put national listener awareness of HD Radio at a paltry 33%.[221] Bridge Ratings published two alarming studies in 2009 and 2010 which clearly show public interest in radio broadcasting more generally trending lower, while the use of alternate digital media distribution systems experienced significant growth.[222] According to the research, terrestrial radio listening reached a downward tipping point in 2002-2003, while the “collective momentum of digital [audio] alternatives” began to outpace terrestrial radio listening in 2007 - suggesting that HD Radio was, from its policy-inception, an also-ran in the convergent media environment of digital audio listening.[223] Arbitron estimates that overall radio listening fell 16% in the last decade, and 23% among listeners between the ages of 18 and 24.[224]

The decline in traditional radio listening has been exacerbated by a radio industry in deep recession. In 2008, the Radio Advertising Bureau reported that station revenues were down 9% from the year before;[225] in 2009, that decline had doubled.[226] The RAB observed that the only industry growth through this period came in the category of revenue from station web sites,

which increased 13% between 2008 and 2009.[227] Although radio revenues recorded their first uptick in a decade in 2010,[228] there is no guarantee that a long-term recovery awaits. Industry analysts BIA/Kelsey expect weak revenues for terrestrial radio to continue for the foreseeable future, while online audio distribution services are poised to add 30% to their bottom lines between now and 2013.[229] Broadcast-investors in iBiquity no longer have the fiscal wherewithal to support the company, as reflected by an enormous devaluation of publicly-traded broadcast company market capitalization. At the end of 2008, shares in Entercom nose-dived from a peak of $66.56 to 78 cents a share; Citadel dropped from $22.08 to 25 cents; Emmis from $58.09 to 50 cents; Cumulus from $53 to $1.28; Spanish Broadcasting from $40.25 to 19 cents; Salem from $33.08 to 88 cents; Cox from #35.31 to $6.19; CBS from $45 to $7.79; and Saga from $29 to $4.18. At the end of 2010, these stocks continued to trade at a fraction of their all-time highs. Clear Channel re-privatized itself after taking a beating on Wall Street during the first half of the decade.[230] The value of radio stations themselves is also dropping precipitously: in the heyday of consolidation following the Telecommunications Act of 1996, station valuations averaged about 15 times their yearly revenue potential. That multiple is now down to nine, and dropping.[231] In 2008, for the first time since the passage of the Telecom Act, the value of radio station transactions dipped below $1 billion.[232]

All of these factors have obviously put a strain on the ability of broadcasters to invest in HD Radio station conversions. *Radio World* reported in 2009 that an informal survey of executives in charge of capital expenditures at broadcast conglomerates found many planned to delay their digital conversion campaigns.[233] Beasley Broadcast Group chief technology officer Mike Cooney confirmed that his company was backing down on "HD conversions in the small markets and started putting money more in things that have a quicker return on investment for the capital money."[234] In 2009 Crown Broadcast, a transmitter-manufacturer, reported that inquires about HD-compatible equipment were virtually nonexistent.[235] According to Tim Bealor, vice president of sales for Broadcast Electronics, "Unless we can figure out a way for broadcasters to make back their investment, [HD adoption] be a futile effort."[236] The sentiment was echoed by Mike Troje, sales manager for Continental Electronics. "It's a task to come up with what the right responses are for the industry when we don't know what the end game is."[237]

Paragon Media Strategies CEO Mike Henry declared radio's traditional business model to be broken. "The old radio model is now seriously underwater from the perfect storm of advertising declines and new competition," he told *Radio World*. "The new radio model combines hyper-local content and community-building with multi-platform distribution and revenue streams."[238] This is not a business model which those who control the majority of radio industry revenue appear ready to embrace.

Irrespective of HD Radio's fundamental flaws and general industry weaknesses, the critical metric which will decide digital broadcasting's fate is the number of available HD receivers in the marketplace. Although consumer electronics manufacturers gradually backed away from direct opposition of the technology during the early stages of public policy proceedings, their inaction on receiver production may give them the last laugh. In the summer of 2010, iBiquity reported that three million HD Radio receivers had been sold since 2002, representing a market penetration of just .04%.[239] Although the company claimed that it signed licensing agreements with 140 companies to develop HD Radio receiver components and products,[240] the gear has not appeared.

In November of 2008, J.R. Russ toured electronics stores in Philadelphia and found a paucity of receiver choices; in locations that actually had HD Radios, most were nonfunctional and the sales staff knew nothing about the technology. "How can broadcasters expect the public to get excited about HD Radio when it can't be uniformly heard everywhere?," asked Russ. "How can retailers sell the product if they don't stock it. Or if the products they do have on hand can't be demonstrated and employees are clueless? How can manufacturers justify building the product if it doesn't sell for these reasons?"[241] Aaron Read, who works at an HD-capable FM station in upstate New York, reported similar dismal news. "Most stores don't carry any receivers at all. The few that do, like RadioShack and Best Buy, often 'hide' them in a distant corner and don't hook up the antenna to the display unit....[G]iven the overall lack of originality in the formats, I fear there is little compelling reason for a listener to invest the $100+ for an HD Radio in our area."[242] Portable media devices capable of receiving HD Radio signals are similarly scarce. Microsoft discontinued production of its Zune media player in 2011, removing from the marketplace the only third-party portable device with HD functionality.[243]

In vehicles - a location where terrestrial radio broadcasting has traditionally enjoyed a significant competitive advantage for the listener's attention - HD Radio now occupies an ancillary position. Some luxury automakers, such as BMW, Jaguar, Mercedes, and Volvo, only offer HD Radio as a factory-installed option in select models.[244] A *Radio World*-sponsored sampling of vehicle dealerships in eastern Missouri found little to no customer demand for the product, and little to no knowledge of HD Radio among car salespeople; dealers "will respond when customers demand information, not before."[245] Longtime HD evangelist Tom Ray III, the chief engineer at WOR-AM in New York, was frustrated when he bought a new Ford and assumed iBiquity's claims that the automaker included HD Radio as a standard option were truthful.

> Lisa, the sweet sales person, promptly pointed to the Sirius sign and said that the car came with Sirius. Um, no, I told her. I said HD Radio. She got the head of the parts department. Nope — never heard of it. She got the head of the service department. Nope — never heard of it. She brought over the owner of the dealership, who went to his office and came back with what amounted to a ream of paper. It contained nothing about HD Radio from Ford. I drove off the lot the next day with the factory AM/FM radio that came with the car.[246]

Even iBiquity CEO Robert Struble now realizes radio's place of primacy in the dashboard is at risk, and it will have to "fight for its position."[247]

At the 2011 Consumer Electronics Show, Toyota announced it would include HD Radio in its new Entune in-vehicle entertainment system, which integrates the capability to stream Internet-delivered radio into the mobile listening environment.[248] Ford's SYNC information suite already allows for the "tethering" of smartphones to the dashboard.[249] In fact, the dominant trend among automakers and the consumer electronics companies which support them is to add Internet streaming capability to receivers much faster than they are adopting HD Radio; at CES 2011, Kenwood, Pioneer, and Sony all rolled out aftermarket auto receivers that allow drivers and passengers to tune in webcasts.[250] iBiquity claimed that its digital broadcast technology was present in 17 brands of vehicles, covering "more than 85 vehicle types," and 36 individual models included HD Radio as standard equipment.[251] However, no automaker has yet committed to provide their newly-developed digital entertainment systems as standard equipment across all makes and models, and it remains to be seen whether the addition of HD functionality on the

coattails of a larger investment in Internet-delivered radio reception will provide the broadcast protocol with enough momentum to spur widespread listener adoption. Traditional broadcast outlets could simply provide Internet simulcasts of their on-air signals in order to take advantage of the growing listener move toward online radio listening, but in 2009 industry analysts observed that less than half of all radio stations were webcasting.[252]

The dearth of digital radio receiver penetration is not helped by the fact that two legal firms are exploring class-action lawsuits on behalf of luxury vehicle owners who were enticed into purchasing HD receivers only to find that reception of digital signals is skittish and actual improvement to the fidelity of broadcast radio is questionable. The lawyers plan to target vehicle manufacturers on the grounds of deceptive advertising.[253] If this probe gains traction, it could kill what tepid enthusiasm the auto industry has for HD Radio.

It is thus unsurprising that HD Radio's proponents are undertaking radical action to try and resuscitate the market for the technology. In February, 2010 iBiquity reduced the one-time licensing fee for radio stations from an average of $25,000 to $10,500 and agreed to accept payment in installments.[254] In September, iBiquity and Citadel Media announced a new initiative whereby stations could convert to HD on the barter system, exchanging advertising inventory for capital expenditure, including the initial license fee.[255] Since Citadel is fronting the money and receiving the advertising inventory, this arrangement calls into question the viability of iBiquity's broadcaster-license revenue stream. The fact that a broadcast-investor is attempting to subsidize the uptake of HD Radio speaks volumes about the fiscal strength of iBiquity to successfully market its wares.

No broadcaster has yet turned a profit on their investment in HD Radio. Some stations have leased FM-HD multicast channels to third parties, which have ranged from condom makers to professional hockey teams.[256] Perhaps the ultimate irony is that HD proponents are exploiting *analog* signals to carry content that goes unheard by the nonexistent digital masses. In 2006, the National Association of Broadcasters petitioned the FCC to allow AM radio stations to purchase FM translator stations. These low-power repeaters, argued the NAB, would help AM broadcasters overcome increasing noise on their band and guarantee them coverage of their primary service areas at night; in 2009 the FCC approved the practice. It also gave AM owners

of FM translators the right to utilize HD Radio technology on their translators, providing a back door to the full functionalities of the protocol, such as multicasting, which the AM-HD system is incapable of offering.[257] FM radio station owners are also resorting to unique measures in order to recoup their investment in HD Radio programming through non-digital conduits. CBS Radio imports analog signals from stations in major markets and feeds them as FM-HD multicast channels in smaller ones.[258] FM-HD stations are also purchasing translator stations in order to simulcast - in analog - the content of their digital multicast streams. Cumulus Broadcasting has been the most aggressive at positioning these simulcasts not as enticements for listeners to try HD Radio, but rather as entirely new analog program outlets.[259] "Not using new local channels for new local programming ideas feels like a lost opportunity and might invite further criticism that radio is not putting its spectrum to best use for local service," worried *Radio World*.

On the policy front, there is really nothing the FCC can do to further stimulate interest in HD Radio, short of mandating a digital transition deadline as it did in the DTV proceeding. There is no information to suggest that any of HD Radio's proponents, much less the FCC, support such action, especially since its voluntary acceptance was a primary justification for implementing the technology in the first place. Instead, the National Association of Broadcasters is advocating a legislative mandate for the inclusion of FM-HD Radio chips in mobile telephones. The trade association believes that if listener trends are moving away from traditional, terrestrial broadcasting and toward Internet-delivered audio accessed through smartphones, it is incumbent upon broadcasters to have purchase in this new receiver space.[260] However, the NAB has much less political capital in Washington, D.C. than it enjoyed just a dozen years ago, when the drive to implement HD Radio was just getting underway.

If unable to advance a mobile phone HD mandate on its own, the NAB hopes to co-opt the music industry into its campaign. Record labels have negotiated the payment of performance royalties from other digital audio distribution outlets; historically, the radio industry has been exempt from the payment of such royalties,[261] but the music industry no longer sees the necessity of maintaining this privilege, given radio's decreased importance within the larger realm of digital listening technologies that now exist. As part of ongoing negotiations over this issue, the NAB Radio Board published a "Term Sheet" in October 2010 which stipulated the performance

royalty rates broadcasters were willing to pay. These rates were directly dependent upon a cooperative initiative between the broadcast and music industries to get Congress to pass legislation involving a "Radio Chip Mandate" in mobile computing devices. If such an effort failed, the NAB offered to pay more in performance royalties.[262] The music industry wasted no time hammering the proposal, calling it an unwarranted complication to negotiations which, until the promulgation of the Term Sheet, appeared to be heading toward an amicable resolution.[263]

The Consumer Electronics Association was incensed that its constituents might be forced to include radio chips in their devices. "Members of Congress rightly judge their constituents to be in no mood for government mandates or interference with the marketplace," CEA president Gary Shapiro told the NAB. "We have yet to identify one member of Congress willing to support your attempt to impose old FM technology on new portable products. As the representatives of an innovative and forward-looking industry, CEA will vigorously oppose any effort to force manufacturers by legislative fiat to include legacy technology in devices....Radio is a legacy horse and buggy industry trying to put limits on innovative new industries to preserve its format monopoly." Shapiro explicitly noted that the "additional inclusion of HD radio in the proposal will likely be harmful to manufacturer enthusiasm for and adoption of this technology....We suggest you delete the technology mandates and recognize the free market works."[264]

If the free market is working, it is not in favor of HD Radio. This has prompted deep introspection among broadcasters about the future viability of traditional broadcasting itself. "Will it fight fire with fire and move to selected microformats, or come full circle and return to a variety schedule?," Skip Pizzi asked in *Radio World* 18 months before he went to work for the NAB. "Or could some form of hyperlocalism find its way back into broadcasters' DNA, emerging from an almost forgotten chromosome?...At the moment, everyone acknowledges these questions, but no one has many answers."[265] A new consensus is developing that suggests the bridge to radio's profitable place in a convergent media environment will be through devices and platforms that do not involve its traditional distribution infrastructure.[266] Pizzi advises that HD Radio be seen as "the long-term, speculative play in the portfolio, and balance it with other components on a faster and more likely track to new media [return on investment]."[267] However, radio historian Matthew Lasar questions whether terrestrial radio itself will be an also-ran as a

digital audio distribution platform, given the swift adoption of listener-customized streaming services such as Pandora, Slacker and Last.fm.[268] This skepticism is reinforced by the fact that smartphone owners - the fastest growing segment of mobile telephone users - seldom use their devices for any sort of interaction with an AM or FM broadcaster, and have no inclinations to start doing more of it.[269]

It is fair to say that HD Radio is on life support in the United States. Even after getting the FCC to authorize more digital-to-analog interference in order to stimulate FM-HD adoption, broadcasters, receiver manufacturers and listeners still seem unwilling to invest in the technology. The policy and marketplace development of HD Radio is not a story of evil people doing stupid things, or stupid people doing evil things; characterizing this saga in such a manner fails to indict the system of policymaking which ignorantly allowed a self-indulgent radio industry to facilitate its own marginalization through the implementation of a digital broadcast technology fraught with problems.

There is no one actor to blame for the current condition of HD Radio. Its evolution was guided by tactical impulses instead of strategic thinking about the phenomenon of convergence and its implications. This process began with the passage of the Telecommunications Act of 1996, which fundamentally transformed the radio industry, giving a minority of players an inordinate amount of political and economic leverage to promulgate a digital audio broadcast standard incapable of competing in a convergent media environment. The fight for - and possible failure of - HD Radio in the United States will most likely be the lasting legacy of a wrongheaded law which unleashed consolidation and cost-cutting, turning radio away from its traditional strengths of localism and program diversity, and transforming it into what is now a hollow husk of a mass medium. The HD Radio policy proceeding also represents a capstone in the long history of the FCC as a captured regulator, as it repeatedly ignored or dismissed substantive questions of who and what represents “the public interest” raised during the policymaking process, and moved further away from basing decisions on solid technical information in favor of purely economic rationales.

However, while the United States represents the most dramatic case of traditional radio’s inability to navigate the digital transition, the viability of digital broadcasting is questionable on

a global scale. Whereas HD Radio may represent the worst of available digital audio broadcast technologies, no DAB system has yet gained any meaningful purchase anywhere. The technologically-agnostic failure of digital audio broadcasting has not yet been fully examined, but there is enough evidence to suggest that radio's digital dilemma is real and worldwide.

Notes to Chapter 6

1. Letter from American Public Media Group et. al., MM 99-325, June 10, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515176769 (February 20, 2010).

2. Id., p. 1.

3. Id., p. 2-3.

4. Id., p. 5-6.

5. National Public Radio, "Report to the Corporation for Public Broadcasting: Digital Radio Coverage and Interference Analysis (DRCIA) Research Project, Final Report," May 19, 2008, filed in an ex parte Letter and Report from National Public Radio Inc, MM 99-325, July 18, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515183116 (February 20, 2010), p. 5-6.

6. Id., p. 9.

7. Id., p. 6.

8. Id.

9. Id., p. 22.

10. Id., p. 34.

11. Id., p. 41.

12. Id., p. 43.

13. Report of iBiquity Digital Corporation, MM 99-325, June 10, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515163271 (February 20, 2010), p. 3-4, 8.

14. Id., p. 2.

15. Id., p. 20.

16. Comments of the National Association of Broadcasters, MM 99-325, June 13, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515177643 (February 20, 2010), p. 1.

17. Ex parte Notice of iBiquity Digital Corporation, MM 99-325, October 16, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515325724 (February 20, 2010).

18. Federal Communications Commission, Media Bureau, Public Notice, "Comment Sought on Specific Issues Regarding Joint Parties' Request for FM Digital Power Increase and Associated Technical Studies," MM 99-325, October 23, 2008, DA 08-2340 (May 10, 2010).

19. Comments of iBiquity Digital Corporation, MM 99-325, December 5, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336621 (February 20, 2010), p. 2, 4-5.

20. Id., p. 7-8.

21. Id., p. 8.

22. Comments of Backyard Broadcasting Group et. al., MM 99-325, December 5, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336648 (February 22. 2010), p. iii.

23. Id., p. ii, 13.

24. Id., p. 3.

25. Comments of the National Association of Broadcasters, MM 99-325, December 5, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336693 (February 23, 2010), p. 2.

26. Id., p. 4.

27. Comments of Seton Hall University - Radio Station WSOU-FM, MM 99-325, November 24, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515334397 (February 20, 2010).

28. Comments of Minnesota Public Radio, MM 99-325, December 4, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336422 (February 20, 2010), p. 3.

29. Id., p. 4-5.

30. Id., p. 6.

31. Id., p. 7.

32. Comments of the Association of Public Radio Engineers, Inc., MM 99-325, December 5, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336716 (February 23, 2010), p. 2-4.

33. Id., p. 5.

34. Id., p. 7.

35. Comments of National Public Radio, Inc., MM 99-325, December 5, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336654 (February 23, 2010), p. 5-7.

36. Id., p. ii.

37. Id., p. 10-11.

38. Id., p. 15-16.

39. Comments of Energy-Onix Broadcast Equipment Co., Inc., MM 99-325, November 25, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515334703 (February 20, 2010).

40. See Comments of Ford Motor Company, MM 99-325, December 2, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336123 (February 20, 2010), and Comments of BMW of North America, Inc., MM 99-325, December 4, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336543 (February 20, 2010).

41. Comments of the Consumer Electronics Association, MM 99-325, December 5, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515336734 (February 23, 2010), p. 4.

42. Id., p. 5.

43. Letter from Reising Radio Partners Incorporated, MM 99-325, July 7, 2008, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5515182157 (February 20, 2010), p. 1.

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Chapter 7: Digital Radio Around the World

Although the United States' failure to successfully implement digital radio broadcasting may be the most comprehensively documented to date, problems of regulatory dysfunction and marketplace uncertainty affect all digital audio broadcast technologies, including the oldest of the bunch (Eureka 147, known in Europe simply as "DAB") and the newest entrant (Digital Radio Mondiale). This chapter is not meant to definitively chronicle the global scene for digital radio, which could well be its own dissertation; a true comprehensive analysis along these lines remains to be done. Instead, this exploration highlights those countries which have tried to implement digital radio technologies and offers potential reasons why these efforts also seem to be stagnant. In sum, it is very clear that the failure of terrestrial digital radio broadcasting is technologically agnostic, though the reasons for its inhibited uptake in other countries differ compared to the situation in the United States.

I. The Technological and Regulatory Fragmentation of Digital Audio Broadcasting

The development of Eureka 147 DAB began in 1985 under the auspices of collaboration between European broadcast and receiver equipment manufacturers, as well as public service broadcast organizations from several countries.[1] German scientists invented the audio codec inherent to the Eureka 147 system, while French engineers developed its broadcast waveform. Similarly to HD Radio, a primary driver of early Eureka 147 development was the creation of a digital broadcast standard with functionality far beyond the simple provision of audio. In 1987, formal study and promotion of the Eureka 147 project was founded by a consortium of 19 broadcast and electronics organizations from France, Germany, the Netherlands and the United Kingdom.[2]

The Eureka consortium contextualized its technology as a means by which European broadcasters could "take the lead in the digital terrestrial radio space and, hopefully, promulgate a world standard."[3] The commercial implications of this goal drove the technology's initial development: according to Brian O'Neill and Helen Shaw, "Strengthening the competitiveness of the European audiovisual industry has been a mainstay of European policy since the mid-1980s with an emphasis on the development of a single market, support for regulatory harmonization and an enhanced, centralized role for the European Commission in the

communications sector."[4] Eureka 147 was cast as a means by which European electronics manufacturers could capture the high ground in this nascent broadcast technology and place themselves in a more favorable position to compete against Asian electronics manufacturers.[5] To facilitate this outcome, early Eureka 147 proponents believed that its successful implementation could only be achieved by pan-European regulatory consensus, with each country agreeing to harmonize their spectral allocation and DAB operational rules so as to provide a digital radio technology which would be truly continental in scope. However, during the time of Eureka's development, progress in the technologies of mobile telephony and the Internet also surged; surprisingly, these advancements "had little immediate impact - if any - on research and development of digital broadcasting systems in Europe or in the US."[6] This would prove to be a strategic oversight, as mobile telephony would later become a primary vector for the provision of Internet-based digital audio delivery in Europe; were Eureka 147 compatible with mobile telephony from the outset, it might have found early purchase in this growing receiver-market.

A continental consensus over digital radio never materialized. Instead, countries approached DAB using the templates of their existing analog radio broadcast systems. This would have significant negative effects on the proliferation of Eureka 147 technology throughout Europe, and it quickly soured Asian consumer electronics manufacturers on the notion of entering the Eureka 147 receiver market, as they were not interested in manufacturing new radio products which might work in one European country but not in another.[7] Consequently, activities toward the implementation of DAB in any given country had to navigate the incumbencies found in each nation's system of broadcast organization. As a function of design, Eureka 147 broadcasts are best suited for providing regional or nationwide program coverage, reflecting an historic mission of European public service broadcast institutions. Therefore, Eureka's uptake has been most successful in countries where public service broadcasters dominate the radio industry.[8] However, the lack of DAB's ability to accommodate local programming has been a major factor in its tepid adoption.[9] Additionally, during the time between the technology's development and proliferation, many European countries experienced significant growth in the commercial sectors of their radio industry, which has primarily catered to local audiences. As the political and economic power-balance between commercial and public service broadcasters has

shifted, so has the regulatory paradigm of DAB, which further complicates its implementation.

Qualitatively, the operative rationale for digital radio broadcasting in Europe was not substantive enough to spark deep interest among regulators or the listening public with regard to justifying the apparent "need" to digitalize the medium. Like HD Radio's proponents in the United States, Eureka 147 consortium members ultimately sold the promise of increased audio quality and a vaguely-defined potential for ancillary services such as datacasting as the principles by which a digital radio transition would succeed.[10] According to Stephen Lax, this positioning invited a conundrum: "As a technological solution to a perceived problem, DAB would be considered by most to be successful, but it is by no means clear what the nature of the 'problem' actually is."[11]

By 1995, European broadcast regulators defined the swaths of spectrum on which Eureka 147 broadcasts could be implemented. Unlike HD Radio, the Eureka system uses "multiplexes," or single digital transmission outlets which are designed to cover a specific geographic area. Multiplex operators are licensed separately from broadcast stations, who are no longer responsible for their own transmission infrastructure. In a manner similar to cable television, stations feed DAB programming into a multiplex where it is then bundled with other program services and fed out over a single digital broadcast channel. Receivers then decode the multiplex signal and play back the program stream that the listener desires. How the multiplex system is operated, and which stations can be on them, differs from country to country: most nations reserve space for their incumbent public service broadcasters while the rest of the capacity is typically determined by auction, with stations leasing space on a multiplex for a fixed period of time. In simple terms, the multiplex operator handles the broadcast function while the stations provide the programming. In a typical Eureka 147 multiplex operation, depending on how the bandwidth is divided, a multiplex transmitter could originally carry between five to ten "radio stations."[12] Although this represented a fundamental shift in the method of radio transmission (by consolidating its infrastructure), Eureka's developers and backers noted that it would not directly impinge upon legacy analog radio stations, which would operate normally while the Eureka system was deployed.

In 1995, the British Broadcasting Corporation became the first broadcaster to implement

a multiplex DAB transmission system. Hailed as "a new dawn for radio," the milestone was characterized as the most significant development in radio history since the introduction of FM stereo broadcasting. The Eureka 147 consortium confidently predicted that its technology would ultimately replace analog AM and FM service completely; it pointed to surveys which showed "great interest" in DAB among one in four German, Spanish, British, and French listeners.[13] That same year, with the support of the European Broadcasting Union, the European DAB Forum (EuroDAB) was founded to promote Eureka's spread throughout the continent. This was later reconstituted as the WorldDAB Forum in 1997, suggesting strong confidence among the technology's proponents that the Eureka system would quickly catch on worldwide. One of the Forum's primary talking points emphasized the fear that, unless its technology took hold, radio broadcasting would be left behind as an analog adjunct to an increasingly digital media environment.[14]

The initial hype surrounding the launch of Eureka 147 DAB was quite impressive. Five companies exhibited Eureka-compatible transmitters at the National Association of Broadcasters' annual convention in 1996.[15] Receiver penetration estimates projected that Europeans would purchase 50 million DAB receivers in the first ten years, with sales quickly rising to 35 million per year thereafter.[16] An International Symposium on Digital Audio Broadcasting held in 1996 attracted more than 500 participants from around the world. Australia announced it would begin testing of the Eureka system. France, India, and Italy were in the midst of DAB experiments; the Netherlands and Denmark announced progress toward the provision of nationwide DAB service. Germany, Switzerland and Canada also unveiled plans to start DAB testing programs.[17] By 2002, the WorldDAB Forum represented companies and organizations spanning 25 countries.[18] Sony and Microsoft formally joined the WorldDAB Forum in 2003 and 2004, respectively;[19] by 2003, more than 284 million people could theoretically receive some sort of Eureka-based DAB signal and 400 digital program services were available in 20 different countries.[20] In 2006, the Forum changed its name again, to WorldDMB ("digital multimedia broadcasting,"); by this point, more than 1,000 DAB services had been launched in 40 nations, reaching 500 million potential listeners.[21]

In reality, however, the proliferation of Eureka-based DAB was struggling at best.

Broadcasters told receiver manufacturers early on that the technology's success or failure rested firmly in their hands; without affordable receivers, there would be no listener uptake and the technology would languish.[22] A year after the BBC launched the first Eureka-based DAB service, no receivers were yet in mass production. The delay was based, in part, on inter-Forum squabbles over the Eureka datacasting standard. Considering that datacasting had been construed as the first feature of DAB to take the service beyond the provision of audio content, a unified datacast protocol was seen as necessary to promulgate a pan-European DAB service. However, the British and Germans had each developed their own datacast protocol, and the Eureka framework could only accommodate one of them. This dispute would not be settled - and thus no datacast-capable receivers would be produced - until 1998. Thus, DAB service was launched by early-adopter broadcasters with minimal datacasting functionality, and early DAB listeners were not attuned to the feature, much less its potential.[23]

Amplifying the problem was the patchwork manner in which Eureka systems were implemented across the continent. The technology could be applied on different swaths of spectrum, depending on geographic availability. Thus, DAB multiplexes in one country were not contiguous to those in a neighboring country; this created obvious complexities for receiver manufacturers hoping to produce interoperable radios. They and EuroDAB estimated in 1996 that an interoperable receiver would first enter the market with a price point "below $750."[24] After spending an estimated €300 million on DAB transmission development by 1999, there was still no affordable means by which to listen to the new service.[25] In 2002, two British companies announced the development of Eureka-compatible chipsets that were cheap and easy to mass-produce, which would bring the DAB receiver price-point down "to the equivalent of about $140." By this point, however, malaise among listeners regarding DAB was palpable, and a simple discount in receiver price would not be enough to stimulate them. The lack of interoperable and inexpensive DAB receivers forced some countries to abandon further DAB testing and curtail existing digital broadcast services.[26] Survey data from several European countries showed very little listener interest in DAB, even among those that actually knew something about it.[27]

The failure of DAB to gain a real hold anywhere lies not just with receiver

manufacturers. The spotty nature of national commitments to DAB, a lack of any real pan-European sense of regulatory urgency over the issue, and further innovations within the Eureka 147 development community itself have fragmented any hopes of a coordinated analog-to-digital radio transition, even within individual nations. On the regulatory front, incentives for broadcasters to adopt the Eureka system differ from country to country. For example, in the U.K., analog radio broadcasters were given automatic extensions to their existing licenses if they committed to providing content within the DAB network. However, in Finland and Denmark, regulators simply made the addition of DAB content a requirement for all analog radio licensees.

In all instances, commercial broadcasters seemed to have been treated as afterthought-constituencies during the formative DAB policymaking process.[28] This is likely due to historical bias within the structure of European broadcasting: unlike the United States, where commercial broadcasters dominate the regulatory proceedings and the entire system is oriented in such a way as to serve their concerns first, state-run public service broadcasters have traditionally occupied this privileged position in Europe. As the primary constituents behind the development of Eureka 147, they ultimately established the frameworks by which DAB policy would be implemented, and their needs superseded those of commercial broadcasters.

Reticence within the commercial broadcast industry to DAB was amplified by a strategic miscalculation on the part of Eureka 147 proponents, who assumed that public service broadcasters would maintain their place of primacy within European broadcasting indefinitely, and that commercial broadcasters would always follow the lead of their state-run colleagues. However, the political and economic position of public service broadcasters relative to commercial broadcasters over the last two decades has changed as commercial radio industries grew. Commercial broadcasters' lack of enthusiasm for a digital transition has been exacerbated by an economic slowdown which, since 2008, has hit the European radio industry quite hard. The BBC actually abandoned plans to launch a major DAB channel, and several commercial DAB program providers have forfeited their multiplex channels because of falling revenue.[29] With the sentiments of commercial broadcasters ranging from lukewarm to cynical on the potential for DAB, this has further aggravated anxiety among receiver manufacturers and retailers about investing in a new digital product that may not contain the same program diversity

as its analog counterpart.[30] Although WorldDMB has announced plans to develop an interoperable DAB receiver that will work across Europe, no such receiver yet exists.[31]

Similarly, the European Commission is simply uninterested in pursuing substantive policy regarding radio's digital transition. The EC, argues Brian O'Neill and Helen Shaw, has been preoccupied with Europe's digital television transition, and thus "have left the success or failure of DAB in the hands of 'market players.'"[32] These battles subsequently default to the national level for resolution, where by and large a lack of "urgency and political priority" has "deferred the question of whether AM and FM broadcasting needed to be replaced" at all. The lack of regulatory engagement at both the continental and national level sharpened the tensions between market players to which the development, proliferation, and marketing of DAB were left.[33]

Further complicating matters for proponents of the Eureka system was technological progress itself. More than 20 years have passed since DAB's initial development and several upgrades and new variants to the Eureka 147 system have been released. These include DAB+ (essentially an upgraded version of the original DAB system, with a more efficient audio codec), DVB (digital video broadcasting, with two variants - one for televisions and one for portable media devices), and DMB (digital multimedia broadcasting, which can convey many forms of digital content to a variety of devices). All branch from the original Eureka 147 design, but none are cross-compatible with each other. Therefore, for countries which have already implemented a DAB system, if they choose to upgrade they must completely replace their entire multiplex transmission infrastructure. Some countries are considering implementing new Eureka variants to complement incumbent DAB systems; others are shutting down old multiplexes with the intent of replacing them with upgraded ones; still others are canceling all DAB-related projects until the marketplace either decides on a single Eureka-based standard or receivers become interoperable between them all.[34]

According to Marko Ala-Fossi, "The genie had now been let out of the bottle. Suddenly, after 2005, DAB was not only competing with all the other digital systems but also with its own derivatives, which were obviously considered as substitutes to each other as well."[35] The primary rationale for European radio digitalization - a desire for improved audio quality - was suddenly

subsumed by competition within the technological suite regarding superiority between variants. In the words of Brian O'Neill, Marko Ala-Fossi, Per Jauert, Stephen Lax, Lars Nyre, and Helen Shaw, "Although the technical functionality of radio may have been extended, to the extent to which it has substantially changed or improved radio in *practical* or *editorial* terms remains a matter of debate. Traditional forms of broadcasting continue to dominate on new digital platforms, with little obvious exploration or experimentation with the communicative novelties that new media might offer" [emphasis in original].[36]

The actual multimedia capacity of DAB, especially relative to the capacity of the Internet, has turned out to be "relatively modest." In addition, the original receivers marketed for the DAB system either did not have datacast-reception functionality or only provided rudimentary, text-based services like station or program information.[37] Listeners, already burned by high prices for receivers that offered few perceived improvements to radio, and further sullied by a lack of pan-European interoperability, have not been rushing out in droves to purchase newer, more expensive DAB receivers to take advantage of the technology's upgraded variants.

Today, the pan-European perspective on radio's digital transition is a muddy one. While there is consensus that "[b]ringing radio into the digital era means more than simply changing its mode of delivery into digital form,"[38] the steps by which this will occur remain unclear. After conducting interviews with radio broadcasters in the U.K., Canada, Ireland, and Finland, Ala-Fossi concluded that there is "no single platform or technology" that respondents could agree upon that constitutes a viable mechanism for radio's digital transition.[39] Competition between platforms, audience fragmentation, and uncertainty among radio broadcasters and regulators has probably led to "less consensus now about the future of radio than at any time in the past."[40] Depending on one's perspective, argues Ala-Fossi, "radio is currently either facing the danger of fragmentation or is surviving by infiltrating new platforms and becoming more polymorphic."[41]

In practical terms, European broadcasters and media scholars now see radio as a multi-platform medium, with distribution via incumbent analog technology, DAB variants, satellite and the Internet all playing a factor in radio's future.[42] Analog radio broadcasting remains alive and well, and is expected to continue to play a significant role in the radio space: at its annual conference in February 2010, the Association of European Radios - a continental trade group

representing more than 4,500 commercial broadcasters - approved a resolution opposing any mandatory analog/digital sunset date.[43] Lax argues that the exhortation of radio's inherent necessity to digitize will not subside anytime soon, but the medium's digital transition should be more properly construed as a technical exercise instead of being driven by "economic, and to some extent, ideological considerations" which have marginalized DAB over the last twenty-plus years.[44] O'Neill and Shaw assert that although Eureka 147 development was initially portrayed as a replacement for analog broadcasting, it was really about "find[ing] the best or most innovative neutral digital audio solution - it was, by the very nature of who framed the questions, to find the best and most innovative digital radio solution with would best serve the needs of the status quo."[45] Around the world, Eureka 147 variants have found minimal purchase at best in a handful of countries - but in no place is the technology's future truly guaranteed.

II. Digital Radio in the United Kingdom

The most intensive research done on the proliferation of Eureka 147-based DAB technology has focused on the U.K., the first country to adopt the broadcast standard and the only country in which DAB has received what could be called wide-ranging discussion in terms of affected constituencies. A key point of consternation over DAB development in the U.K. has been the government's decision to cede direct control over the operation of multiplexes. Instead of licensing individual stations on each multiplex, the multiplex operators themselves are private corporations, granted license terms by the national government. In turn, multiplex operators pay a yearly fee to the government for the privilege of operating the transmission system. Stations wishing to be heard on DAB multiplexes must pay the multiplex operator a lease fee for carriage on one or more multiplexes. Rates for carriage on a U.K. DAB multiplex vary from market to market. The BBC is reserved space on most multiplexes.

In order to entice analog broadcasters to produce programming for the DAB system, regulators offered to extend the terms of their existing analog licenses as an incentive for DAB participation.[46] This practice was formalized as standing policy in 2007,[47] and thus automatically favored broadcast incumbents as preferred entrants in the new digital radio environment. At the time of the BBC's launch of its first exclusive Eureka-based DAB service, U.K. radio regulators were well into a 15-year campaign of commercializing what had historically been a government

monopoly on broadcast spectrum. The resultant growth in the political and economic power of commercial broadcasters in the U.K. began to reshape the DAB service itself. Multiplexes, for example, were established in such a way as to roughly replicate existing radio markets. The net effect, concludes Richard Rudin, has been to "greatly restrict the flexibility of the system - at the local level DAB is no more efficient in the use of frequency spectrum than analogue."[48]

In 1996, the passage of the U.K. Broadcasting Act unleashed an unprecedented wave of consolidation within the country's commercial radio industry. DAB deployment was affected: national broadcast conglomerates began to simulcast programs from one station on national multiplex agreements and got into the business of owning and operating the multiplexes themselves.[49] This not only further diminished the importance of localism on DAB services, but also allowed vertical integration to occur within the nascent digital radio industry.[50] Grant Goddard, a U.K. radio professional with 30 years' experience in programming, management, consultation, and regulation, believes commercial broadcasters were driven "to invest in DAB infrastructure, rather than content, because it created an opportunity to control this new broadcast platform. Radio stations might be good at radio, but that does not mean they will necessarily be good at running other businesses," including oversight of an embryonic digital broadcast protocol which was initially designed by state-supported public service broadcasters and intended to "revolutionize" the practice of radio broadcasting. Goddard concludes that because the radio industry's ultimate motivations to adopt DAB had little to do with the listener, "the consumer became lost in the execution strategy."[51] What few promises had been made to the public, such as a significant increase in the fidelity and digital extensibility of radio broadcasts, would ultimately go unfulfilled.[52]

U.K. broadcasters and regulators thus launched DAB with many hopes that it would catch on simply by existing. There were no "robust and wide-ranging discussions as to what DAB could do, or what it should be used for; the main focus for attention seems to have been on the subject of how best, technically, to deliver it."[53] Proponents of the U.K. DAB system focused on the buildout of multiplexes first and trumpeted their initial program diversity. By early 2001, more than 40 DAB program streams were on the air in the London area alone.[54] In 2002, the BBC launched its first DAB-only station, 1Xtra, featuring an urban contemporary music

format.[55] In December of that year, the first portable DAB receiver went on sale in the U.K. Depending on the model's features (such as the ability to time-shift programming), prices ranged from approximately $155 to $300.[56] In 2003, the BBC announced it would launch five DAB-only national radio services and develop supplementary multiplex systems to increase local program content.[57] The addition of local DAB multiplexes did increase program diversity, leading to digital radio channels devoted to subjects ranging from Islam to environmental news to gay and lesbian niche programming.[58] By the end of the year, DAB proponents hoped to sell 500,000 receivers.[59]

A decade into the U.K.'s DAB deployment initiative, its fortunes took a dramatic turn for the worse. Questions regarding the audio fidelity of DAB channels became a crucial point of debate in 2004. The conflict pitted program diversity against audio quality: some multiplex operators believed it was more important to divide their bandwidth up into as many program streams as possible - in the process sacrificing the amount of dedicated bandwidth per channel - or carrying fewer program streams in the higher, promised fidelity.[60] By 2004, the BBC's official position on the parsing of multiplex channels favored program diversity over fidelity, thus undermining the original selling point of DAB in the U.K.[61]

The shift toward cramming as many program streams as possible into every multiplex has led to a situation where "bitrates are determined the minimum necessary for acceptable listening, not the maximum or even the recommended levels for effective audio performance....Multiple bit streams and compression, therefore, are extended to the highest acceptable limit resulting in a quality of transmission that is frequently described as 'worse than FM.'"[62] While regulatory studies of the issue have been inconclusive, the lack of receiver uptake, coupled with the decision to intentionally degrade DAB's chief "improvement" over analog radio, have worked against the technology's inherent potential to offer improved audio fidelity.[63] Further complicating matters, complaints of spotty digital coverage became an increasing concern as the number of multiplexes grew. Regulators' response to this problem was not to investigate the conditions of the multiplexes themselves, but instead to require retailers of DAB receivers to install signal-amplifiers in their stores to provide potential buyers with a good initial listening experience. Imagine the disappointment when those listeners took the radios home and found

that they didn't work as well as advertised.[64]

The first decade of the twenty-first century also saw the U.K. radio industry fall into a recession, with significant consequences for further DAB deployment. Analog station valuations have plummeted since the consolidation frenzy of 1996, thereby depleting national broadcast conglomerates of equity from which to draw DAB development capital.[65] Multiplex ownership has also consolidated significantly, inflating lease rates for channels on DAB multiplexes and reducing program diversity on the digital dial.[66]

In 2008, many commercial analog broadcasters abandoned their DAB program services citing prohibitive operational costs.[67] What is left are automated, cookie-cutter formats with no live digital programming that demonstrate no substantive improvement over existing analog radio services.[68] In 2009, three new DAB program providers joined the national commercial multiplex network; one of them is government-subsidized, though separate from the BBC. On local multiplexes, the growth of noncommercial DAB programming is advancing, but it's difficult to project exactly how such program providers can stay afloat without some sort of direct subsidy of their own.[69] Goddard believes DAB service providers are losing an average of £27 million per year, which "represents around 5% of commercial radio's revenues, a significant impact on an industry which is only marginally profitable overall at present."

> The nub of the problem is this: digital radio stations presently account for 5.3% of listening to commercial radio, but digital radio stations attract only 0.3% of commercial radio revenues. Here is a massive economic disconnect that requires much more than a mere increase in productivity or some kind of performance improvement. Doubling or even tripling these stations' revenues would barely dent the problem.[70]

With regard to the BBC itself, there are subtle movements afoot to back away from further investment in DAB-specific programming; the institution has increasingly invested more money in alternate digital audio distribution platforms such as those based around the Internet, like podcasting and streaming-on-demand.[71] Goddard notes that"[t]he most listened to exclusively digital radio station in London is BBC 1Xra, which ranks 22nd and attracts only a 0.5% share of listening in the market."[72] In contrast, the BBC Asian Network "is listened to less now than it was almost seven years ago, when only 158,000 DAB radios had been sold....For the BBC, it is becoming increasingly hard to justify spending, for example, £12.1m per annum on the Asian

Network when its peak audience nationally is only 31,000 adults."[73] U.K. regulators have sanctioned the deployment of advancements in the Eureka suite of digital broadcast technologies, such as DAB+ and DMB, but there is simply no momentum to be had to upgrade an "upgrade" to radio services which has not provided a meaningful return on broadcaster investment.[74]

After more than a decade of regular service in the U.K., only 9.2% of commercial radio listening is conducted via DAB, while 79% of all new radios sold are still old-fashioned analog models.[75] In February of 2010, the Society of Motor Manufacturers and Traders, which represents more than 500 companies in the U.K. automotive industry, submitted a report to the government detailing its opposition to any government mandate involving digital radio receivers in vehicles, citing the "reputational risk" that electronics manufacturers and automakers themselves would assume by installing such components in their vehicles.[76] In 2007, there were 34 million cars on U.K. roads, but only 200,000 had DAB receivers installed. The same year, 2.4 million new vehicles were purchased in the U.K., but only 20,000 buyers chose to install their own DAB receiver.[77] In the decade since regular DAB service was introduced in the U.K., more than 7 million DAB receivers have been sold, but in 2009 alone, more than 8 million analog receivers were purchased.[78]

Regulators would now like to see low-cost conversion modules made available to bring DAB reception capability to analog radio receivers. Unfortunately, this is unlikely to happen: Intellect, the trade group which represents U.K. consumer electronics manufacturers, told Parliament in February, 2010 that "there are currently no products on the market that can adapt an analogue radio to receive DAB signals," nor are there any plans to start manufacturing such a device, citing a lack of consumer demand.[79] Two 2009 listener surveys published by U.K. broadcast regulator Ofcom show no real listener demand for DAB. 64% of those polled said they were not likely to purchase a DAB receiver; 20% were on the fence; while only 16% expressed any interest in active engagement with digital radio.[80] The second survey found that 91% of listeners were satisfied with the analog radio service they receive, "a proportion that has risen in recent years. This demonstrates that dissatisfaction with existing radio provision is extremely low, making it very difficult for any new platform to attract a substantial audience by offering content that will gratify consumers' few unsatisfied demands."[81]

Goddard claims DAB listening in the U.K. "fell off a cliff during the last quarter of 2009. This did not appear to be the result of any specific strategy shift (no station closures, only one minor format change) but more the result of increasing public malaise about the whole DAB platform and the radio content that is presently being offered on it….Total listening to digital radio stations is back down to the level it achieved in 2007."[82] By 2010, the schism within the industry was clear: the largest commercial broadcasters still held out some hope for DAB, as did the BBC, because both had deeply invested in the technology, while smaller commercial and community broadcasters were most pessimistic about DAB's future. All agreed, however, that due to the technological limitations of Eureka 147 technology and its lack of unified support among the nation's broadcasters, analog service would remain a crucial component in the future of U.K. radio from 2015 onward.[83]

Regulators and proponents are trying a multitude of measures in hopes of turning around a slumping DAB service. In 2008, Ofcom proposed that stations should be freed of local program origination requirements in exchange for participation in the DAB network. Commercial broadcasters argued that without localism requirements, they might find more money to spend on DAB program production. The key question is whether such a value is worthy of sacrifice as a stopgap measure to belatedly entice broadcasters onto a platform that seems to have no meaningful purchase with radio listeners, in part, because it essentially duplicates the programming already heard over analog conduits.[84] Commercial broadcasters have floated proposals to restrict existing broadcasters from distributing digital content over any mechanism other than DAB, and suggested giving away one DAB receiver to every household in the U.K.; these have gained no traction.[85]

In 2009, British broadcast regulators suggested forcibly migrating all radio services to DAB by 2013. This angered many commercial broadcasters who lack the capital to invest in DAB programming; they were also very concerned about losing the majority of their listening audiences when the analog signals are turned off. Similarly, auto manufacturers reacted negatively to the proposal, as they see no consumer demand for a technology bereft of innovative programming and promised quality improvements.[86] The government published the Digital Economy Bill in 2009, which codified enticements for broadcasters to adopt the DAB platform.

The bill automatically extends the analog license duration of commercial stations who agree to produce DAB content and gives them breaks on analog license fees paid to the government. Although regulators have since mentioned 2015 as a hard deadline for an analog/digital radio transition, such language is conspicuously missing in the Digital Economy Bill.[87]

The government is also apparently unwilling to push for a receiver mandate in handheld devices, without which Goddard believes the chances of DAB maintaining a foothold in the U.K. are slim to none.[88] Having failed to motivate listeners to make an expensive purchase in a technology with no discernible return on investment, and having failed to produce enough compelling content from the outset to entice listener uptake, Goddard concludes the future of digital radio in the U.K. is up for grabs.[89] The future will most likely be multi-platform - program distribution will occur over the existing digital radio transmission infrastructure as well as the Internet, and perhaps as an adjunct to digital television broadcasting - and the industry's salvation will be found most likely in a return to a focus on the production of compelling content.[90] "Perhaps we do not need more new radio stations, or even existing local commercial radio brands rolled out nationally as faux new digital brands," argues Goddard. "What we need is the ability for consumers to access engaging radio content, when, where and how they want it. The days of listener loyalty to one radio station are fading fast."[91]

III. Digital Radio Elsewhere in Europe

The story of digital radio in the United Kingdom represents the most positive picture of DAB on the European continent. Elsewhere, the condition of the technology's promotion and uptake is much more confused. In Ireland, for example, regulators adopted a "wait and see" approach to the idea of digital radio. Due to a lack of FM spectrum congestion, a preexisting local programming focus by Irish stations (both commercial and noncommercial), and a healthy community radio sector, neither regulators nor broadcasters identified a compelling need to adopt any DAB technology quickly. As a result, all constituencies seem satisfied with the analog state of Irish radio,[92] and regulators are turning their interest instead toward the eventual promulgation of the Eureka digital video broadcast (DVB) standard, which incorporates the provision of digital audio as just one functionality among many.[93]

Back on the continent, France's on-and-off affair with DAB is representative of the

technology's unstable state. In 2009, France settled on the digital multimedia broadcasting (DMB) standard of the Eureka suite - which opened up the digitalization of media beyond radio - and proposed a timetable to cover 95% of the national population with DMB service by 2013. Commercial radio broadcasters are "increasingly ambivalent" over this proposal, however, expressing concern that the infrastructure will favor homogenized national content over local digital radio coverage. Some have even begun legal action against French broadcast regulator CSA in opposition to the rollout plan.[94] In the final months of 2009, CSA pushed back its timetable to launch a DMB network to the end of 2010, citing recalcitrance among broadcasters to invest in an unproven technology with no discernible business model.[95]

Even within the government, some call the DMB launch proposal "implausible" and suggest that a viable economic model for digital radio needs to be identified before an estimated €600 million to €1 billion is spent over the next two years on the rollout of digital broadcasting in France.[96] In November of 2009 the trade lobby for France's commercial broadcasters met with regulators and reiterated their opposition to any digital radio transition. According to the Bureau de la Radio, "the cost of the [digital radio] project is not compatible with the economics of the radio medium and does not allow plans for the launch of digital radio to proceed under positive conditions."[97] Even so, the CSA warned that unless a digital radio service of some sort was launched by 2010, there would likely be no digital future for French radio.[98] The expected launch did not take place; analog broadcasting in France remains mostly unruffled by the country's digital radio experimentation.[99] French regulators have since announced a two to three-year "moratorium" on further DAB development, preferring instead to spend more time studying the DAB experiences of other countries before formulating a revised plan to implement digital broadcasting.[100]

Given that French engineers played an integral role in the development of the Eureka 147 system, the country's level of noninvolvement in its uptake is surprising. The same cannot be said for Germany, where DAB has been tried and failed to take root. Regulation of spectrum allocation is a state-level function in Germany, not a federal responsibility; as a result, there has never been a coordinated plan for a national rollout of DAB service. In 1996, Bavaria became the first German state to license a multiplex, containing two channels from public service

broadcasters and three from commercial broadcasters.[101] However, less than a year after its launch, the trade association for commercial German broadcasters announced it was withdrawing support for DAB programming. Commercial broadcasters complained about the "harmonizing" coverage nature of the DAB multiplex system, the DAB program subsidies given to their public broadcast-competitors, and the lack of receivers in the marketplace.[102] By 2002, although state governments continued to offer multiplex licenses,[103] there were few takers.[104] German Chancellor Gerhard Schroeder confidently predicted analog radio could be turned off by 2015, but the marketplace penetration of DAB shows no upward momentum at all.[105] During the first decade of the 21st century, broadcasters tinkered with alternatives to DAB, including DAB+, DVB, and other technologies, but the lack of consensus on a digital radio technology and its use has consigned these practices to the experimental level.[106]

In 2009, German broadcast regulators rejected a call for an additional €42 million in funding to continue building out its DAB network, because "substantial elements of the criteria agreed previously with broadcasters had not been met and the viability of the projects could not be demonstrated." Analog FM broadcasts would not end until 2020 at the earliest, because it was not expected that DAB would account for 90% of all radio listening until that point in time - an admittedly optimistic forecast. German commercial broadcasters helped nix the funding request; Hans-Deiter Hillmoth, deputy head of the German private broadcasters' association (VPRT) remarked, "Currently there is no viable business model [for DAB]."[107] Germany's two national commercial stations have subsequently discontinued DAB programming.[108]

German commercial broadcasters further pressed the issue in a January, 2010 report declaring analog FM the dominant radio platform for the foreseeable future. It suggested regulators recognize that FM broadcasting has the most market penetration and listener coverage, is the most spectrally-efficient of all radio broadcast systems, and still has room for technical improvement that will not introduce uncertainties and large potential investments for little return such as DAB systems require.[109] German broadcast regulators would like to "re-launch" digital radio in 2011, perhaps using DAB+ or DMB, but will only do so if there is empirical evidence of significant interest among radio broadcasters and listeners. Such evidence has yet to be found.[110]

Germany's neighbors have not fared much better. In Switzerland, one commercial

broadcaster carried the flame for the implementation of HD Radio. Tests commenced in 2007 and were declared successful in 2008.[111] The following year, four more commercial stations began broadcasting in HD,[112] but further deployment suddenly screeched to a halt. Markos Ruoss, the owner of Swiss station Radio Sunshine, which had facilitated the exploration of HD Radio in the country, suddenly ended his association with iBiquity in August of 2010. With him went the rest of the handful of broadcasters who had also experimented with HD Radio.[113] In the meantime, Swiss regulators moved ahead in 2009 with a proposal to launch DAB+ service; five of the eight licenses up for grabs expired without any applicants for them.[114]

In Austria, Germany's 2009 decision to not invest further in DAB has caused much conversation but no firm decisions regarding the country's digital radio future.[115] Austrian broadcast regulators have subsequently announced that the country's digital radio transition is on indefinite hold, as there is no consensus on which form of DAB technology to adopt. Commercial broadcasters in Austria believe the only way that a DAB launch could succeed is under some sort of pan-European standard, which is politically infeasible.[116] In Poland, plans were outlined in 1995 to launch a Warsaw-area multiplex with at least four program channels, and the multiplex's spectral allocation was adjusted in 1997, but no further progress has been made.[117]

Elsewhere in Europe, the situation of DAB implementation remains haphazard at best. After a trial run, the Dutch DAB Foundation ended its experimental broadcasts in 2000 because "there is no government policy on licensing DAB frequencies." Lack of DAB-compatible receivers was cited as a significant problem.[118] Commercial and public broadcasters have halfheartedly tinkered with the technology in the interim, to no perceptible gain. Ten years later, the government of the Netherlands adopted a "carrot and stick" approach to rejuvenate the proliferation of DAB. According to Goddard, in November of 2010 regulators "offered existing national commercial radio stations automatic renewals of their licenses for a further six years until 2017, if they agree to broadcast on the DAB platform for the next six years and to cover at least 80% of the country. This renewal will avoid the licenses being re-auctioned in 2011, as required by existing law." Dutch commercial broadcasters have not reacted favorably to the plan; one noted that their analog station reaches more people online than it does over the network of

DAB transmitters it's been operating for three years. Others cite the high upfront capital investment costs in building a DAB network, and complain about the continuing lack of receivers in the Dutch marketplace. "Originally, there had been a government plan to turn off FM radio broadcasts completely by 2015, but this has been dropped."[119]

Spain has a similar communications regulatory system to Germany, in that the licensing of broadcasters falls to state and local governments. This has led to a radio industry with a focus on local and regional content.[120] Spain formally adopted the Eureka 147 standard in 1997, but it has never been a high priority among regulators.[121] Instead of setting up a national DAB network, Spain has licensed low-power multiplexes to operate at the municipal or regional level: as a result, "local radio has never been omitted, but neither has it been given any priority" in the DAB space.[122] Because localism has been a bedrock of Spanish broadcasting, the harmonizing aspects of DAB simply contravened widely-held service priorities for Spanish broadcasters.[123] In 2008, the WorldDMB Forum assessed the situation in Spain to be "at a standstill, as...radio groups remain unsure due to the perceived threat to their [analog] markets."[124] In 2009, Spanish regulators declared the DAB system "obsolete" and a "road to nowhere."[125] In Catalonia, the state of DAB was characterized as in "a technical coma." Of 48 DAB licenses issued by the radio regulator there, only 23 stations are on the air and "are reported to have no impact on radio audiences.[126]

In Norway, although state broadcaster NRK has suggested the end of analog broadcasting could arrive as soon as 2014, the number of analog receivers sold there still outpaces DAB receivers by a factor of eight.[127] Between 1998 and 2008, Norwegians purchased a total of eight million radios, of which 300-400,000 were DAB receivers.[128] In 2009, NRK proposed the government conduct a cost analysis of switching off analog FM broadcasts altogether. The idea received no political traction.[129] In 2010, sales of Internet-streaming radio receivers surpassed the sale of DAB receivers. The Norwegian Electronics Industry Association now estimates that there are somewhere between 12 and 15 million FM radios in regular use, while only 290,000 DAB receivers remain in circulation. The NEIA continues to recommend that consumers purchase analog radios over DAB receivers. The idea of a digital/analog switchover is not popular: 78% of broadcasters oppose a hard transition deadline, while just 18% seem open to the idea.[130] This has

not stopped Norway's Culture Ministry from proposing a plan to implement DMB service and terminate analog broadcasting by 2017, but the plan is filled with so many caveats that an actual analog-broadcast sunset by that deadline is practically infeasible.[131]

Sweden was an early-adopter of Eureka 147 technology, but began turning it off in 2002 after failing to realize the promised improvements of the protocol.[132] In December of 2005, the government of Sweden announced it would not invest any more money in its DAB infrastructure. Instead, the country explored the notion of piggybacking digital radio service on the country's digital television infrastructure (DVB).[133] This did not pass muster;[134] now the country is considering the re-launch of DAB service with the improved DAB+ variant sometime in the 2010-2011 timeframe. Although Sweden has had some form of DAB service on the air since 1995, it only reaches 35% of the national listening population. Trial service of DAB+ began in limited form in 2009; the results of this experiment have yet to be made public.[135] DAB+ receivers are for sale in Sweden, though they cost about $200.[136]

In Denmark, regulators are currently debating the next round of funding for public broadcasters; a part of this discussion involves the potential of setting an analog/digital radio transition deadline. Although a timeframe of 2016-2018 has been bandied about, the idea of any hard transition is opposed by a large portion of the country's broadcasters, both private and public. Only 1.5 million DAB receivers have been sold in Denmark as of 2010, which accounts for just 8% of total radio listening.[137] Danish broadcasters interviewed by Ala-Fossi suggested analog FM broadcasting would be the dominant form of radio through at least 2015, and the most logical mechanism for radio's digitalization is the Internet.[138]

In Finland, public broadcasters were supposed to lead the DAB vanguard, with commercial broadcasters to follow. This did not occur: public broadcaster YLE began DAB broadcasts in 1998 only to discontinue them three years later, "clearly see[ing] little future in the technology."[139] Finland has since focused on the DVB variant of the Eureka system, and hopes to provide digital radio as a subsidiary function through this protocol. In 2005, DAB-only broadcasts were discontinued in Finland, effectively ending the country's experimentation with digital radio as a stand-alone medium.[140]

In the remaining European countries that have experimented with Eureka 147 variants,

none have progressed beyond the trial stage. Hungary began testing Eureka 147 transmissions on December 1,1995; another multiplex was installed to complete DAB coverage of Budapest in 1998, but there has been no further significant development. In Slovenia, test DAB broadcasts began in 1997, but have not progressed beyond the experimentation stage. In the Czech Republic, broadcast regulators would like to test the Eureka 147 system, but there are no strong domestic proponents pushing the issue. The state-owned broadcaster in Romania hoped to have two DAB transmitters in operation by the end of 1999, but that, too, has only materialized in experimental form.[141] In Greece, regulators established a DAB multiplex for the 2004 Summer Olympics, but have not made any significant move to expand the service since then.[142] Malta has launched a DAB+ network, but the island nation needs little spectrum and few multiplexes to provide national coverage; even here an analog-to-digital radio transition is not a priority.[143]

IV. Digital Radio Outside Europe

The same can be said for many non-European adopters of the Eureka 147 technology as well. In Israel, the government is now accepting bids from private companies to build out either a DAB+ or DMB network, or both. Authorities expect to subsidize the buildout to the tune of roughly $6.4 million. There is no timetable on implementation.[144] Several countries in South America have investigated the Eureka feature set, but only Brazil seems committed to an actual buildout.[145] The country is also not foreclosing other options: Brazilian regulators have given stations the authority to experiment with both HD Radio and Digital Radio Mondiale.[146]

As of yet, no single digital radio technology seems to be in a position to take its proliferation to the next level. Australia began testing the DAB standard in 1998 as an offshoot of its exploration into the country's DTV transition, but no plan was formally proposed for the digitalization of radio until 2005, when Australian regulators committed to the Eureka suite.[147] Within a year they were rewriting their proposal to accommodate the new DAB+ variant, set to launch in 2009. To entice incumbent broadcasters into the DAB sphere, a six-year grace period was written into law that would disallow new programming entrants into the system.[148] Although the DAB+ service was launched on time, it is too soon to judge it a success. DAB+ service is restricted to Australia's largest cities, and the country is simply too large to put up the number of multiplex-repeaters required to cover the entire continent. Therefore, Australian regulators are

considering other digital radio technologies, such as Digital Radio Mondiale, to bring digital radio to non-urban areas. There is no timeframe on when this may occur. Furthermore, spectrum planning for the DAB multiplex system restricts program choice to less than what is currently available on analog radio service; O'Neill notes that "the large community radio sector has struggled to gain sufficient spectrum, even for some of its city-wide services, and has expressed its unhappiness with the provision for community radio." There is also concern that Australia's late start gives DAB+ a disadvantage considering that plenty of other digital audio delivery mechanisms now exist which can do what DAB+ does just as well - or even better. "Industry interests concede that digital radio may be a long term project, relying on a strategy of embedding services with younger audiences on the understanding that a sustainable level of adoption may take many more years."[149]

In Asia, South Korea waited for developments in the Eureka suite to shake themselves out and have chosen the DMB standard as its digital broadcast future. However, the Korean DMB system uses a codec that is incompatible with its European cousin.[150]"Trial services" of Eureka 147 have taken place in China, Singapore, India, Indonesia, Vietnam, and Taiwan, but none have yet progressed to a stage of organized proliferation.[151] The only country that seems to have designed a "successful" digital audio broadcast service is Japan - and it did so by avoiding the built-in bias to design a technology around the specific medium of radio. Instead, Japan developed the Integrated Services Digital Broadcasting (ISDB) protocol, which provides interactive audio, video, image, and text support across a wide range of devices, including radio and television receivers, portable media devices, and mobile telephones.[152] Ala-Fossi says what sets Japan apart from the rest of the industrialized world when it comes to radio's digitalization is that the country pursued network *convergence*, or the idea of digitizing all broadcast media en masse, while regulators elsewhere focused on network *digitalization*, or the transition of broadcasters in a piecemeal fashion.[153] In this regard, Japanese regulators appear to have cast the phenomenon of convergence itself not as a specter which threatens the distinctiveness of previously-separate forms of media, but rather as a means by which to promote innovation among media producers by offering them a seamless technological mechanism by which to navigate the phenomenon. ISDB does not require different types of broadcasters to invest in their

own digital distribution networks, and Japanese broadcasters - unlike their counterparts elsewhere - have not appeared to approach the analog/digital transition with a predisposition to hold onto their legacy distribution conduits.

Closer to home, Canada and Mexico have both had active yet troubled forays into digital radio broadcasting. Between 1994 and 1995, Canada formally endorsed the Eureka 147 system and developed a plan to award "conditional" licenses to early adopters of the technology; it also required significant commitments from broadcasters regarding the amount of original programming required for the new service. This chilled commercial broadcasters' enthusiasm toward the notion of DAB adoption.[154] These requirements were quickly diluted, and Canadian broadcasters began organized DAB tests in 1995.[155] At first, regulators hoped to use a mixture of terrestrial and satellite-based transmitters to bring digital radio service to the entire country, but the plan ran afoul of the United States, which objected to the use of spectrum that it had reserved for military test telemetry purposes (the same reason why Eureka 147 was nixed in the U.S.). Canadians were therefore forced to remove the satellite portion of their transmission system, which severely compromised its plans to provide digital radio service to its highly dispersed rural population.[156]

In November of 1995, the Canadian Radio-television and Telecommunications Commission (CRTC) published a draft allotment of DAB spectrum for the country and began the process of soliciting British-style licensees for multiplexes. All AM and FM radio broadcasters would be granted a "transitional license" without the need for a public hearing - a move designed to engender interest in DAB among the Canadian broadcast community. These would be replaced "virtually automatic[ally]" with permanent DAB licenses at a later date. Private Canadian broadcasters began preparing for the transition, with many expressing the hope of transmitting DAB signals sometime within 1996.[157] As investment costs in the infrastructure became better understood, however, broadcaster interest in the technology cooled. The Canadian Broadcasting Corporation suffered a 10% decline in revenue in 1996, yet remained DAB's primary proponent. Others began to openly question whether the promises of increased audio fidelity would be enough to sell the technology to a disinterested public.[158]

Meanwhile, Canadian regulators moved forward with a plan to license multiplexes

around the country and experimented with new multiplex configurations in a drive to lower the cost of national network buildout.[159] DAB receivers were expected to hit the Canadian market in "mid to late 1997."[160] Between the end of 1996 and 1997, the CBC and many commercial broadcasters announced the launch of DAB multiplexes in Canada's largest metropolitan areas; the CBC hoped to have 75% of its existing analog radio audience covered by DAB transmissions by 2002.[161] As coverage pitfalls in the Canadian national DAB network were identified, the system was tweaked and by 2002 broadcasters seemed confident enough in the technology to tentatively invest in DAB-only programming.[162] Auto manufacturers, which had been watching the development of DAB technology closely, appeared to give the platform a boost when General Motors of Canada announced in 2002 that it would factory-install DAB receivers in its cars.[163] Receiver price-points were trending down toward the CN$100 mark. By 2002, there were 57 stations broadcasting in DAB, reaching 35% of the Canadian population.[164]

However, receivers were nowhere to be found: although the average cost of a Canadian DAB receiver was US$75 by 2004, they were not yet widely available.[165] General Motors of Canada, citing "difficulties...over supply of equipment," subsequently rescinded its commitment to include DAB receivers as standard options in their vehicles. Initial listener reaction to DAB was underwhelming; complaints circulated that the fidelity was not as good as advertised, and digital signals were not as robust as their analog counterparts. Many of the promised DAB-exclusive program services never materialized from commercial broadcasters, who simply used the technology to simulcast their analog signals.[166]

By 2005, commercial broadcasters openly decried the lack of a viable business model for DAB.[167] In 2006, the Canadian Association of Broadcasters argued that it was "simply not realistic to assume that a successful digital transition will be no more than the replacement of the existing business with minor additions and adjustments. Nor does digital transition necessarily mean the destruction of the old business and the creation of a new one."[168] However, back in 1995 - when the initial regulatory decision to adopt DAB was made - the impetus *was* to replace analog radio with a digital platform, and no adaptations were made for the introduction of new technologies, such as Internet-based audio distribution, which eventually outpaced the perceived advantages of DAB in Canada.[169] By 2006, 62 of the 73 licensed DAB multiplexes in Canada

were on the air, reaching a potential audience of just 11 million listeners. Receivers were still difficult to find; official radio audience measurement services don't even bother to quantify DAB listenership anymore.[170]

In 2006 the Canadian government ordered a complete reassessment of its digital radio transition plan and opened up the field to Eureka alternatives.[171] This resulted in a brief Canadian affair with HD Radio. After first being "unimpressed" by initial demonstrations of the technology in 1995,[172] Canadian broadcasters, led by the largest commercial conglomerate, Corus Radio, urged regulators to allow HD experimentation in 2006.[173] This was authorized in 2007, and for a year the technology was tested by both public and commercial broadcasters.[174] A report tendered by CBC/Radio Canada concluded that they would "make no further investments in [HD Radio] until the interest of other Canadian broadcasters is gauged and while it monitors the rollout of data services and applications in the United States."[175] The interest of other Canadian broadcasters never firmly materialized; by 2009, more station owners were concerned about HD-related interference from U.S. stations than they were about adopting the technology themselves.[176]

Canada's digital radio transition received a double-whammy in 2010. Declaring DAB to be "in limbo" and "in peril," the CBC shuttered four DAB channels in Montreal in June. This was interpreted as part of an industrywide move away from the Eureka 147 platform.[177] That same month, the Canadian Association of Broadcasters disbanded.[178] Suddenly, there was no coherent broadcaster constituency left to advance the cause of digital radio in Canada. Regulators have since proposed reallocating DAB spectrum for fixed and mobile wireless devices; ultimately they would like to see broadcasters develop a digital platform that complements existing analog broadcasting services, but the broadcast community is wholly unprepared to assume such a task.[179]

In summary, the Canadian experience can be described as one that, "[d]espite extensive regulatory intervention to protect Canadian interests, the pace of technological change and the dominant influence of U.S. interests have made the transitional path to digital radio even more uncertain than it was 10 years ago."[180] O'Neill says the Canadian sojourn through digital radio technologies "underscores the weakness of a laissez-faire or market-driven approach" to a digital

radio transition.[181] Today, Canadian broadcasters, like their counterparts around the world, still believe that analog broadcasting will rule the roost in the short term, but radio's digital future will be multiplatform, and that the Internet will play an increasingly important role in the medium.[182]

Mexico is following somewhat in the footsteps of the United States, in that it is exploring HD Radio as the primary mechanism by which to facilitate a digital radio transition, but the technology lacks intra-industry consensus on its viability. In 1995, as Mexican regulators debated the merits of existing digital radio technologies, the radio industry was torn between Eureka 147 and HD Radio. Initially, Mexican regulators made moves to allocate spectrum for the promulgation of a Eureka-based DAB system.[183] However, neither Eureka 147 nor HD Radio moved out of the testing stage until 2004 - the same year that the FCC promulgated detailed rules on the domestic use of the HD Radio protocol. *Radio World* reported that "a group of engineers from the Mexican equivalent of the NAB" hoped to recommend a digital radio system to regulators by 2005.[184] In 2007, after the FCC's promulgation of an HD Radio "standard," Mexican regulators allowed stations within 200 miles of the U.S. border to commence broadcasting in HD; many of these stations are targeted toward U.S. audiences.[185]

Mexican regulator Cofitel subsequently received reports of HD-related interference to Mexican analog stations; in 2008, it wrote to FCC Chairman Kevin Martin urging the agency to certify HD Radio as in compliance with all international broadcasting treaties, citing the interference reports it had accumulated.[186] Although the FCC promised to respond to the concerns, Mexican authorities expected any resolution of the issue would take "the next couple of years."[187] In 2009, the Mexican government announced a plan to wean all AM broadcasters off analog spectrum voluntarily; no timetable was given, nor was a technology selected to facilitate this transition.[188] The following year, *Radio World* reported that Mexican regulators were set to select HD Radio as the country's national digital radio standard. At the time, 10 Mexican FM stations and 11 AM stations were broadcasting in HD, all within the 200-mile buffer zone with the United States. It was estimated that it would cost the Mexican broadcast industry somewhere between $280-$840 million in capital expenditures to adopt HD Radio.[189] Significant uptake of HD broadcasting by Mexican stations has not occurred.

HD Radio itself has no real global presence. Although iBiquity and the trade press claim that HD Radio has been tested or gained "significant interest" in dozens of countries, all of them have either frozen their experimentations or selected a different digital audio broadcast standard instead.[190] Only the Dominican Republic, Mexico, Panama, the Philippines, and Puerto Rico have formally adopted HD Radio as their digital broadcast technology of choice.[191] None of these countries have the sort of market mass necessary to strengthen HD Radio's position among global DAB competitors.

V. Net Effect of Digital Radio Mondiale

Even the latest entrant in the digital radio race, Digital Radio Mondiale (DRM), may end up as little more than the newest also-ran. In March of 1998, members of research institutes, equipment manufacturers, and broadcasters from more than 30 countries met in China under the banner of the Digital Radio Mondiale Consortium to discuss developing a new digital radio standard specifically for the AM and shortwave bands. Unlike HD Radio, DRM would be all-digital from the start, replacing analog signals at the outset of its implementation; it would also be based on open source technologies, eliminating any proprietary impediments to innovation and proliferation.[192] By 2001, a mobile DRM receiver was demonstrated at Germany's largest consumer electronics show; in 2002, the International Telecommunications Union endorsed DRM for use on the AM and shortwave bands, and the DRM Consortium expected the mass production of DRM receivers to begin shortly afterward.[193]

In 2003, The BBC, Voice of America, Deutsche Welle, DeutschlandRadio, Radio Netherlands, Radio Canada International, and Swedish Radio all began shortwave broadcasts in DRM, targeting all continents on the planet except Antarctica.[194] Two major U.S. transmitter-manufacturers, Harris and Nautel, both committed to building DRM-compatible transmitters in short order.[195] Regulators in many countries saw DRM as a "drop-in replacement for existing...allocations," and therefore a potential technology by which to jump-start stalled or stuttering digital radio conversion efforts.[196] In 2003-04, the DRM Consortium and WorldDAB Forum announced a joint promotional agreement between their technologies, and all existing patents on the DRM technology were pooled to promote further innovation within the DRM space.[197] Between 2005 and 2008, more than 50 AM and shortwave broadcasters around the

world adopted DRM technology, producing more than 350 program-hours per day in DRM mode, and several countries began test programs to evaluate the possibilities of widespread DRM deployment.[198] H. Donald Messer, director of the Spectrum Management Division of the U.S. International Broadcasting Bureau, resigned his post in 2005 to work full-time with the DRM Consortium.[199] That same year, the Consortium also announced plans to develop an FM variant of its technology (DRM+), thus positioning DRM as the only digital radio broadcast protocol that could digitize the entire gamut of existing analog broadcast stations in place.[200] The DRM+ standard was certified for global deployment in 2007.[201]

However, like the two digital radio technologies that preceded it, DRM suffers from a lack of qualitative improvements and strong commitments from regulators, broadcasters, and receiver manufacturers. While DRM offers a perceptible increase in audio fidelity over analog, and allows multicasting on every band, the disruptive nature of entirely replacing incumbent analog signals with digital ones is a risk no broadcaster or state seems willing to take.[202] Sony Corp., a member of the DRM Consortium, has declined to actually manufacture DRM-compatible receivers, and no company seems poised to break the technology into the vehicular market. As of 2006, only 1.3 million DRM radios had been sold.[203] About the only broadcasters demonstrating any realistic uptake are those in the shortwave band, where DRM is the only digital broadcast option they have. U.S. shortwave stations are organizing to petition the government to end the prohibition of broadcasting to domestic audiences so U.S. listeners might more fully enjoy the benefits of DRM on shortwave.[204] Should DRM come to dominate shortwave broadcasting, that mode alone does not have enough broadcaster or listener mass to change the confused trajectory regarding the digitalization of the rest of analog broadcasting worldwide.

Although multiple digital radio technologies are now in deployment to some degree around the world, none of them have achieved a level of penetration that challenges the incumbency of analog broadcasting, much less be taken seriously as viable replacements to analog radio itself. In fact, even in those countries where digital radio transition plans have advanced the most, both broadcasters and regulators now admit that any terrestrial digital broadcast system will ultimately be complementary to analog radio. Despite the fact that all

digital audio broadcast systems seem to resist the phenomenon of convergence, in that they all attempt to maintain a unique distribution network for radio broadcasting alone, the belief that radio *must* eventually go digital refuses to die. The real question now, on a global level, is not whether this will take place, but in what form it will occur. It is clear that simply converting broadcast radio signals from analog transmissions into radiated bitstreams will not be sufficient to provide the medium with a viable path into a convergent media environment. In fact, it seems increasingly likely that, in the future, radio will be delivered via multiple digital platforms that look nothing like the analog distribution infrastructure of the 20th century.

One can cite regulatory missteps and false starts, economic shifts in the balance of power between various constituencies in national radio industries, and the recalcitrance of radio makers and listeners to actually invest in digital broadcasting for the lack of a successful digital radio transition anywhere. Irrespective of the blame game, if the apparent stagnation of terrestrial radio's digital conversion is a global and technologically agnostic phenomenon, perhaps this says something about the inherent *necessity* of digitizing radio, and, with the development of non-broadcast digital audio distribution technologies, invites significant confusion over the future *identity* of "radio" as we know it today. These implications, as yet, have been left almost wholly unexplored: they were ignored in the early stages of thinking about digital radio broadcasting, and remain unresolved in the surviving iterations of technologies still trying to take root.

Notes to Chapter 7

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Chapter 8: Confronting Radio's Digital Dilemma

Radio's digital dilemma is quite real. The circumstances that led to this dilemma are now clear. What remains to be seen is whether the policy trajectory of the medium's digitalization is amenable to proactive modification, and whether broadcasters themselves have the wherewithal to adapt to a convergent media environment irrespective of the technology they ultimately use. Initial attempts have not been successful, thanks to the disruptive implications of digitizing radio signals and the lack of regulatory engagement with the consequences of such action. Simply becoming "bit radiators" does not address shifting expectations among the listening public about what "radio" in a digital environment can offer. So long as broadcasters and regulators continue to address the phenomenon of convergence in such a single-dimensional, neoliberal fashion, this dilemma will only become more complicated and challenging.

I. Neoliberalism Complicates the Digital Radio Transition

When ideology trumps science, seemingly rational actors can make arguments and decisions with a degree of ignorance that is painful to behold. Fundamentally, the broadcast industry's narcissistic oblivion regarding the speed of convergence, and an FCC which was enamored with the word but had no clear interpretation of its meaning, led to the deployment of a technology unsuited for the successful digitalization of radio. However, given the amount of investment made in HD Radio, it is not likely to be abandoned anytime soon. This will have consequences, one of which is the opening of legitimate debate regarding the future of terrestrial broadcasting from perspectives beyond those historically defined. This could have constructive implications - provided that the grip of neoliberalism on media policy can be weakened.

Among the broadcast incumbency, the critical interventions of public broadcasters in the development of HD Radio cannot be overstated. As an afterthought to the Public Broadcasting Act of 1967, National Public Radio has always occupied a secondary position of power within the political economy of the U.S. media environment. However, HD Radio represents the first time public broadcasters have promoted their future in such close consort with the commercial "competitors" to which they are supposed to be alternatives. Initially reticent about the technology, public broadcasters ceded the future of radio to the wishes of their commercial brethren, if only to preserve future agency in the process of the digital transition. This decision marked an important consensus between the policy actors whose ideas the FCC valued most

when considering radio's digitalization; this consensus legitimized the adoption of HD Radio in the mind of regulators. National Public Radio not only developed important features of HD Radio (such as multicasting and conditional access, directly subsidizing a proprietary innovation), but produced important technical data for FCC consumption that provided a patina of legitimacy to the technology that otherwise would not have existed. This complicity is important because it demonstrates the complete alignment of dominant broadcast incumbents under a paradigm not just favored but created by the commercial. Although seemingly more astute than commercial broadcasters about the implications of convergence, NPR also did not recognize the inherent insufficiency of simply digitizing terrestrial radio's existing broadcast platform.

The sheer volume of critical public comment registered both on- and offstage - especially among knowledgeable industry participants and committed radio listeners - represents an indictment of HD Radio as a worthwhile DAB technology and illustrates the captured nature of the FCC on fundamental questions of spectrum allocation, access to the airwaves or any meaningful homage to the public interest. As J.H. Snider noted in Chapter 5, the sheer political beauty of the HD Radio policymaking process was to force constitutive choices about the technology concurrent with FCC deliberation on the creation of a new Low Power FM (LPFM) radio service. While those who would later sow the seeds of the modern media reform movement advocated for crumbs of analog spectrum under highly restrictive conditions, incumbent broadcasters were constructing a digital future for radio that would, at best, marginalize these new stations and, at worst, silence them.

The failure to engage in the early debates over digital radio's development was a tragic mistake on the part of modern broadcast reformers. The data (or lack thereof) regarding HD Radio's technical viability should have been red flags to any public interest advocate thinking about the future of the medium; this condition was the impetus for the research which led to this dissertation. Had an informed and engaged public been organized around the issue of digital radio when its key regulatory principles were being constructed, it - combined with the open hesitance of independent broadcasters (who, even now, represent the majority of radio licensees) - might have provided an opportunity for coalition-building that could have forced a more comprehensive and honest consideration of digital radio itself. In hindsight, LPFM turned out to

be an inopportune distraction that diverted the potential for organized opposition to the fundamental re-provisioning of spectrum that HD Radio represents.

By the time any form of organized opposition to this principle appeared , the operative metaphors that digital radio was meant to address, as proffered by conglomerates and public broadcasters, were too ingrained in the regulatory paradigm to challenge effectively. It is somewhat remarkable that the lack of bona fide consensus around the viability of HD Radio was clear in the trade press long before the implementation of digital broadcasting began, and went unrecognized for what it portended regarding the sordid outcomes of digital radio policymaking. In fact, the offstage environment became more aligned with the perspectives of HD Radio's critics as its regulation developed. However, this process, like the arousal of an organized public interest constituency to resist HD Radio, began too late and moved too slowly. The record illustrates missed opportunities for changing the developmental trajectory of digital radio broadcasting, but does not provide much clarity on identifying new opportunities to proactively influence HD Radio's future evolution.

It seems increasingly likely that the success or failure of digital radio's adoption lies in the hands of consumer electronics manufacturers. They were from the outset opposed to the technology's development and proliferation, but the political and economic power of the broadcast industry among regulators during the formative years of policymaking wholly outclassed them. As the development of HD Radio continued, consumer electronics manufacturers adopted a public position of cautious optimism about the technology while effectively ignoring it in the real world. Not only have they declined to partake in substantial research and development tasks, forcing broadcast-proprietors to shoulder that burden alone, they have refused to invest in the manufacture and marketing of digital radio receivers. The actual performance of the technology in the real world does not provide incentives for consumer electronics manufacturers to include HD compatibility in their products. Lacking their active support, a primary ingredient necessary for the technology's successful proliferation has never materialized. Now that other variants of "radio" exist, and their methods of delivery are beginning to approach levels competitive with terrestrial broadcasting, this further marginalizes HD Radio's position, especially when consumer electronics manufacturers embrace these new digital radio technologies while shirking HD compatibility.

Taking the dashboard as an example, what was once a listening space traditionally dominated by terrestrial radio broadcasting is now up for grabs. Satellite radio subsidized its position in the car: it gave auto manufacturers a cut from listener subscription fees up front in order to entice them to add satellite reception capability to vehicles. This made the sale of each vehicle more profitable for its manufacturer. Although satellite radio continues to be a marginal player in the contestation of radio's digital identity, the expansion of program choice it provided engendered competition for listening in the car. Today, anticipating market trends in wireless broadband access, vehicle manufacturers are creating entertainment centers which allow drivers to link other digital media devices into them. Current iterations of this technology, which tether smartphones to the dashboard or, in some vehicles, provide direct mobile wireless broadband access, adds webcasting to the radio menu, further fragmenting listenership. It is clear that vehicle manufacturers are making these investments on the assumption that "radio" is no longer limited to the AM or FM broadcast bands. Radio itself is but one of several types of media that can be accessed in the car, and multiple forms of radio are now available. Without the active support of consumer electronics manufacturers, terrestrial digital radio broadcasting will languish. Satellite-like subsidies to encourage its adoption are out of the question: its proponents can't afford them.

iBiquity Digital Corporation, the product of a "grand alliance" of HD Radio's proprietors, was founded to consolidate the core development of HD Radio and provide a sense of market-consensus around the protocol which would convince regulators to sanction its proliferation. By the time iBiquity was founded, HD Radio's technical framework was more than a decade old and showed its age. The failure of HD Radio's business models has left iBiquity without an independent and sustaining source of revenue.[1] The digital conversion rate of stations is pathetically slow; receiver manufacturers are opting out of a technology which has no discernible value-added benefit for their products; and innovation within the HD Radio space is hampered greatly by its proprietary constraints. Wobbling along on infusions of radically devalued radio company stock and venture capital cannot continue indefinitely. However, as the product of the most powerful broadcast incumbents, iBiquity has no recourse except to struggle on with making "improvements" to its inherently flawed technology. The best broadcast-investors can seem to manage in terms of tangible support for HD Radio is the devotion of unused advertising minutes

to a promotional campaign; this does not pay any bills, much less recoup investments made in the technology or spur innovative practices with it.

The potential failure of HD Radio in the marketplace highlights the destructively overarching influence of neoliberalism on media policy and exposes the limitations the ideology places on innovation involving new media technologies. Ironically, it may just be the best thing to happen to radio in a long time. The collapse of HD Radio would force a radical rethinking of radio's place within a convergent media environment. But so long as a perception that HD Radio might still succeed exists, policy options outside the incumbent-controlled paradigm will not gain currency unless two outcomes regarding the technology's adoptive failure are met.

The first is the abandonment of an all-digital broadcast conversion. At present, there is no willingness on the part of any constituency to advocate a hard analog/digital transition deadline for radio as there was with digital television.[2] Proponents of HD Radio promised they could navigate a digital transition in stages. The first stage, hybrid analog/digital broadcasting, has stalled; yet an all-digital form of HD Radio is the technology's logically assumed end-state. iBiquity has not produced any substantive data on the actual functionality of its all-digital mode and there is little demand among the broadcast industry or the FCC to advance its development. Given the amount of investment HD Radio has attracted from broadcasters, there is little chance that any proponent will countenance its renunciation. However, this period of hybrid uncertainty cannot last forever, especially when the speed of convergence and the decline in terrestrial radio listenership that it has encouraged are taken into account.

There will come a time when HD Radio's proponents must make a concerted effort at all-digital broadcast adoption, regardless of whether or not the technology is ripe. This would most likely involve an FCC mandate invoking a deadline for an analog/digital radio transition. The experience of DTV does not suggest that this process will be timely or orderly, and the FCC has so far avoided important questions about HD Radio's proprietary nature by making its uptake purely voluntary. Those broadcasters who believe they can risk their legacy analog audience by going all-digital may try, but HD Radio's near-invisibility among the general public makes this an unlikely proposition. Therefore, if the all-digital mode of HD Radio is never realized, the likelihood of its eventual demise increases, at which time the policy and practical objectives of digital radio could be reassessed.

Secondly, broadcasters may attempt to coerce consumer electronics manufacturers to include HD reception capability in their growing portfolio of digital media devices. A forced imposition is not likely to succeed. Broadcasters want electronics manufacturers to include extraneous technology which is not only proprietary, but increases the complexity of product design and manufacture to such a degree that device-makers have no logical pecuniary motivation to bother. In contrast, the Internet Protocol (IP)-based streaming element of new radio services provides functionality within existing digital media infrastructures for which many products are already designed. Consumer electronics manufacturers passively influence the uptake of "alternatives" to terrestrial radio broadcasting by ostracizing HD Radio functionality. To require all devices capable of receiving "radio" to be HD-compatible would almost certainly take an act of Congress. From a neoliberal perspective, the current dearth of stand-alone HD receiver adoption mitigates against such action: the marketplace has already spoken. Regardless, the NAB's latest attempt to enlist the support of the music industry in an interoperability campaign under the guise of performance royalty negotiations demonstrates that the radio industry has not given up on the idea of imposing incumbent broadcast reception capability on new digital media devices. The consumer electronics industry, whose political clout is on the rise relative to broadcasters and record companies, has and will continue to resist any receiver mandate attempt vigorously.

If the adoption of the all-digital mode of HD Radio never comes to pass, and devices designed to receive it remain scarce, only then might consideration of radical options to change the domestic digital radio trajectory become possible. Such consideration will have significant consequences for the medium of radio as we've traditionally understood it. Additionally, there are industry forces at work that seek to repurpose radio spectrum for other uses, and regulators have a new hunger for spectrum by which to promote the wireless provision of broadband Internet access.

Broadcasters have already employed their channel allocations for digital, non-broadcast purposes. SiriusXM provides a Federal Aviation Administration-approved service that transmits real-time weather information for use by pilots. In 2002, Clear Channel experimented with providing Internet access via DTV. Subscribers installed a special receiver card into their PC; downstream data was delivered on the sideband of Clear Channel-owned DTV stations at speeds

of up to 768 kbps. Disney launched the Moviebeam service in 2006, leasing portions of local DTV channels to transmit movies-on-demand to subscribers. A similar network called iBlast, founded by a league of broadcast and publishing companies, feeds movies, music, games, and software via DTV sidebands. News Corporation has launched U.S. Digital Television: this venture uses DTV spectrum to broadcast 12 encrypted basic cable channels to subscribers for $20 per month, designed to undercut the bottom end of cable TV's subscriber base.[3] None of these experiments have achieved any real traction, given that existing broadband Internet access platforms and on-demand cable television already provide such services more efficiently than a DTV conduit can.

In the context of radio, the problem is that a single AM or FM channel, even fully digitized, does not contain enough bandwidth capacity to provide broadband-standard services. However, given the consolidated state of the industry, especially in major markets, *cumulatively* organizing radio bandwidth is theoretically possible - with the use of a technology other than HD Radio, which is designed to work within the context of individual radio stations. Bandwidth aggregation would radically change the identity of radio in its own right. The fact that economic incentives exist for incumbent broadcasters to reemploy their spectrum for purposes other than broadcasting must be seriously considered as a potential market-driven outcome of radio's digitalization.

A more realistic evolution in the policy of digital radio broadcasting may be found in the government's desire for the increased development of broadband access. In 2010, the FCC released a National Broadband Plan, which called for the reclamation and repurposement of several hundred megahertz of spectrum for wireless broadband provision.[4] The agency is looking far and wide for such spectrum, including among incumbent users of the airwaves. In November, the FCC promulgated a Notice of Proposed Rulemaking seeking to reclaim some 120 MHz of DTV spectrum for the provision of wireless broadband.[5] Considering that a single DTV channel covers approximately 6 MHz, the FCC seeks to repurpose 20 DTV channels' worth of spectrum for wireless broadband access. Broadcasters have vowed to resist this effort, claiming a property right to the airwaves which is rooted in neoliberal ideology - an ironic assertion considering that the $60 billion spectrum-subsidy which made DTV possible has already allowed broadcasters to

experimentally repurpose the spectrum on their own. This will complicate regulators' efforts to fundamentally change the use of broadcast spectrum through new rules of allocation.

AM radio spectrum is not a good candidate for such repurposement, given the paucity of bandwidth occupied by the entire band and the propagation characteristics of AM signals. In addition, as noted in Chapter 6, AM broadcasters are using the back door of FM translator stations to simulcast their signals in an environment where HD Radio has some recognizable functionality. This suggests a shift toward FM as the singular terrestrial digital radio platform of the future. The FM dial occupies a cumulative 20 Mhz of spectrum, and its properties are ideal for wireless broadband provision. The line-of-sight and building-penetration capabilities of FM radio signals are similar to those found in the VHF band of television.[6] Should HD Radio fail to guarantee the broadcast industry its digital spectrum subsidy, the FCC might very well open the door to refarming FM spectrum as part of its campaign to develop a national wireless broadband infrastructure.

Although the political and economic power of the radio industry mitigates against this possibility in the short term, if radio revenue and listenership continues to decline the medium could conceivably reach the point of popular obsolescence more quickly than traditional television broadcasting. Regulators are unlikely to fundamentally shift their perspective on a medium's future viability until it has tried and failed to digitize, and the failure of HD Radio is incipient. An increasing willingness on the part of regulators to repurpose broadcast spectrum would almost certainly mark the end of radio's distinctiveness as identified by the historic possession of a spectrum subsidy. Incumbency, argues Stuart Benjamin, is "[o]ne of the major impediments to spectrum liberalization," and broadcasting may not be the "highest valued use of the spectrum" anymore. Barring wholesale repurposement, Benjamin believes that regulators should allow incumbent spectrum occupants increased flexibility over its use.[7] However, simply providing incumbents with flexibility to use the spectrum as they see fit - as we have seen in the case of both DTV and DAB - does not guarantee communicative innovation.

If broadcast radio spectrum is repurposed for the provision of broadband, either through internal or external forces, that will denote a radical reinterpretation of radio as we've known it. Although spectrum reappropriation is the most unlikely outcome of digital radio policymaking

considered here, it may be the one most worthy of further exploration. In the words of Michael McCauley, it is the duty of media scholars engaged in policy studies to not let "vested interests...define their questions or their area of inquiry or in such a way as to see 'realistic' policy proposals as those which will be acceptable to the vested interests in the short term and without a struggle. It is always dangerous in such an undertaking to try to guess what will be acceptable and it can act as a distraction from the very real difficulties of working out and then fighting for what you believe to be true."[8] With convergence in play, perhaps untethering "broadcasting" from "radio" is the best possible outcome for the medium in the long term.

II. Implications for the Future of Broadcasting and Communications Policy

Examining the dramaturgy of digital radio policy helps to explain how and why the navigation of convergence will be arduous for the medium's incumbents. It draws attention to the metaphors each actor uses in the policymaking process, provides a mechanism by which those metaphors can be interrogated for substance, and allows the critical examination of policy outcomes in the context of the rationales that drove them. Although the digitalization of radio was cast by its proponents as a purely technical exercise, the dramaturgy of radio policy shows that the science behind DAB was *not* a primary motivator for this activity. The promised "improvements" digitalization would bring to the medium were steeped more in rhetoric than demonstrable fact. When conflicts arise between the operative metaphors of contemporary digital radio policies and their practical application, it begs the question whether such regulation is actually constructive, or even rational.

The fact that communications policy is firmly grounded in the precepts of neoliberalism has not helped matters. Regulatory dysfunction involving radio's digital transition was precipitated by broadcast incumbents who attempted to navigate the phenomenon under conditions they could wholly manipulate. These conditions were defined almost exclusively in economic terms and favored increasing private control over the airwaves above all other possible outcomes, even in countries where state-run public service broadcasters initially dominated the medium. Contextualizing the development of digital radio within a neoliberal paradigm allowed its proponents and regulators to ignore or downplay the inherently disruptive nature of convergence and mitigated against the adaptation and innovation necessary of incumbents to find purchase in an increasingly digital media world. Not only were the technologies of DAB

designed without taking the collaborative and extensible aspects of convergence in mind, but as DAB service was deployed its lack of ability to adequately address these aspects confused and sullied several important constituencies on the viability of digital broadcasting.

The Federal Communications Commission has been remarkably aloof regarding the development and promulgation of digital radio. The signs of the agency's capture by neoliberal principles are clear: the decision to adopt HD Radio was made with no independent analysis, a willful disregard of direct and meaningful public input, and with the use of economic metrics above all else to justify the industry's chosen technology. Over the years, the FCC has shed its ability to make empirically-sound judgments; this comes at a time when these skills, given the pace of emergent digital media development, are more necessary then ever. Perhaps the FCC sees such innovation as "a threat to its standard definitions and procedures."[9] If true, then the dilemma of digital radio policy in the United States has significance beyond technological ignorance or the simple favoritism of one constituency over another; it opens up for contestation the core ideology of the policymaking process and its outcomes.

Dallas Smythe's concern that "market forces" would come to dominate the "allocation of the spectrum as a whole" is now the operative rationale of communications policymakers in the 21st century; the story of digital radio just happens to be the most stark example of this regulatory paradigm in action.[10] That the digital transition itself is stalled does not seem to concern regulators so long as historical precedents involving the promulgation of a neoliberal policy agenda are honored. A spectrum-subsidy remains at the core of the broadcast business model, and HD Radio provides two benefits to incumbents for the price of one: it increases the private control of available radio spectrum and provides them with the power to govern the functionality of *all* stations which operate in the digital domain. The FCC, as a captured regulator, placed its faith in the "free market" to successfully move radio broadcasting from an analog to digital environment; not only have market forces failed to engender a constructive digital transition, but in abdicating their responsibilities during the formative years of digital radio development regulators have deprived themselves of the ability to take decisive remedial action.

The fact that HD Radio is utterly proprietary - the creation of investments made by the

nation's largest broadcasters - clearly demonstrates who is in control of terrestrial radio's digital future. The policy and promulgation of HD Radio is a legacy with strong roots in the Telecommunications Act of 1996, which firmly cemented the primacy of neoliberalism in the regulation of digital communications. Were it not for the frenetic consolidation of radio station ownership during the critical years of HD Radio's development, the technology just might have withered and died on the vine had the FCC took the time and effort to seriously consider its fundamental detriments. Instead, the economic heavyweights of the radio industry embraced the "digital equals better" myth and framed the adoption of digital broadcasting as necessary to "compete" with vaguely defined competitors that threatened their legacy business model.

Considering that the constitutive choices about HD Radio were made before convergence was clearly identified, it is no surprise that digital radio actually complicates navigation of the phenomenon for incumbent broadcasters. Since the policy process to justify radio's digitalization did not require any substantial rationales beyond those offered by its proponents, policy was made with casual heedlessness about what real-world effects digitalization would have on the medium itself. The technocratic nature which underlies the neoliberal paradigm was actually undermined by the chosen digital broadcast technology. The result was the adoption of a DAB technology with little justification beyond a chimerical economic potential. Viewed in its entirety, this potential of HD Radio is far outweighed by its detrimental effects on the maximally efficient use of the public airwaves - which ironically may have deleterious economic effects on the radio industry over the long term.

By the time HD Radio wended its way through an FCC overwhelmed by its other duties as executor of the Telecommunications Act, the agency effectively abdicated the future of radio regulation to the most economically powerful coalition of broadcasters. Contemporary digital radio policy represents the triumph of neoliberalism in the history of broadcast regulation, and that has cursed broadcasters to deploy a technology resistant to convergence. This explains why analog broadcasting remains the primary site of terrestrial radio's practical value in the eyes of the majority of broadcasters and listeners. Convergence is very real in the sense that consensus is developing around the use of IP-based communication as a "universal language" by which digital media will be distributed. The Internet shows us a glimpse of what a future, convergent-in-the-real-sense digital media infrastructure may look like.[11] At the same time, the Internet itself

is a network of networks whose practical makeup is more an amalgam than a unified entity. Its regulation also remains in an uncomfortable state of flux, and there are many signs that neoliberal influences on Internet policy may serve to disrupt its communicative potential. At present, the Internet is "transparent" only in the sense that the language of content distribution is universal, allowing access to digital media over a plethora of devices that speak the language of the Internet Protocol. The fact that radio is now heard on-air and online, via wired and wireless conduits, diminishes the perceived necessity of the medium's incumbent transmission infrastructure. Attempts so far to develop a technological bridge between this infrastructure and the convergent media environment are simply not working.[12] Ultimately, this calls into question the identity of radio as it has been historically defined.

In 1999, U.K. broadcasters firmly believed that, without digitalization, analog radio would become obsolete within 10 years. That deadline has passed, and more than a decade of digital broadcast operation seems to suggest that, for the foreseeable future, digital radio will play a supplementary role to its analog counterpart.[13] This clearly contravenes the "digital equals better" myth. Structural changes in the ownership, operation and regulation of radio broadcast systems took their own toll on the medium's inherent utility prior to its attempted digitalization. Thus when existing DAB systems are compared to the analog state of affairs it is no surprise that consumer electronics manufacturers and the public see little value in digitizing the status quo.

From the perspective of incumbent broadcasters, digitizing the status quo was a rational opening move in addressing convergence. It protects the elementary value of their investments - in this case, the occupation of valuable spectrum. Although HD Radio is now openly criticized as "a business and allocation plan in search of technology"[14] and "a tactical move, a short-term corporate survival kit and, perhaps, an obstacle to further development of radio as a digital medium,"[15] its primary benefit to incumbent broadcasters is the gift of new spectrum on which to deploy a digital signal. The fact that the applications designed to "enhance" the radio experience - datacasting, multicasting, and a complicated yet underwhelming attempt at mimicking interactivity[16] - have failed to gain any purchase in the broadcast marketplace highlights the constricting design of extant digital radio technologies. Simply put, cramming digital sidebands onto already-crowded analog broadcast spectrum or replicating analog programming on a new

broadcast platform are inefficient and non-innovative methods of digitizing radio.[17]

The constriction of innovation by design and policy complicates evaluation of radio's digital transition. With the lack of any meaningful consensus around a fully-digital audio broadcast standard, was well as no consensus around the notion of abandoning legacy analog service, the supplementary nature of digital radio relative to analog broadcasting will continue to be reinforced.[18] However, due to convergence, radio now carries in the minds of a growing number of listeners a greater expectation of quality and service than that provided by terrestrial broadcasters.[19] From the point of view of incumbent broadcasters, securing the spectrum to deploy DAB technology was primarily an effort to preserve a place of primacy within a wireless digital audio space, and little more. As a result, current DAB technology does nothing to address the strategic question of how incumbent broadcasters will maintain relevance within a convergent media environment, much less adapt to the public's shifting definition of what radio really is. Among listeners, the medium has been redefined to include subscription-based satellite broadcast services as well as a plethora of customizable Internet-based audio content providers such as Pandora, LastFM, Slacker, Spotify, and the larger world of podcasting. It is no longer the exclusive purview of the AM and FM broadcast bands.

This has forced many incumbent broadcasters to distribute their program content outside the traditional broadcast infrastructure. For example, Clear Channel aggregates the webcast-streams of its radio stations in an online portal, while NPR has secured distribution of its programming over the SiriusXM satellite radio network. They also utilize the Internet directly to expand their presence in our digital media environment by producing content that speaks the "universal language" of convergence from inception. As incumbents move online outside of DAB to compete directly with new digital radio services, their distinctiveness relative to these new services is blurred, further complicating the identity of radio in the 21st century.

Many new digital radio services remove the human element from the provision of content, relying instead on algorithms designed to "learn" a listener's tastes and suggest programming for them. This is why webcasters don't openly call themselves broadcasters: they aggregate audiences by catering to the desires of each individual listener, and the human element remains an important ingredient in the authenticity of broadcasting. When incumbent radio

broadcasters marginalized the human element of their programming in favor of a more highly consolidated and automated industry, they forfeited a distinctiveness which has not gone unnoticed by listeners. They have repeatedly complained - in the FCC's digital radio rulemaking and elsewhere - about the lack of program diversity and localism in today's radio environment. This suggests that the public still finds value in the act of broadcasting, which cannot be wholly replicated or displaced by newer forms of digital radio.

Regulatory and industry de-emphasis of broadcasting's key ingredients has detrimentally affected traditional radio listenership, In conjunction with the flourishing of new digital radio systems, this has led to open questions about whether broadcasting as it has been practiced in the 20th century is actually relevant in the 21st. Incumbents may find the answer to that question by reinvesting in the attributes of the medium which made it unique in the first place. Many independent broadcasters and listeners believe a restoration of the core attributes of broadcasting will entice listeners back to terrestrial radio, but they all speak within the context of the analog. How radio stations might be able to profitably port the practice of broadcasting into a convergent media environment remains to be substantively explored.

Legacy media systems have a long history of difficulty navigating disruptive change. Early conceptions for use of the radio spectrum assumed it would simply extend the practice of telegraphy. Gone unacknowledged by AT&T, among others, were innovations during the early 20th century that used radio for means other than the point-to-point relay of Morse-coded messages. Broadcasting defined the medium of radio.[20] However, this did not stop AT&T from unsuccessfully attempting to assert wireless telegraphy as radio's "killer application," which caused the company to miss opportunities to utilize its wired network in a manner that could have ingratiated it in the act of broadcasting itself.[21] In the same regard, broadcasters first cast convergence as a phenomenon that would simply extend the practice of radio; now that radio is being redefined, they resist accommodating the inevitable changes. These lessons need not be repeated in the digital domain.

That said, it is dangerous to romanticize the phenomena of satellite radio and webcasting as services which may subsume the identity of radio entirely. SiriusXM, the monopoly provider of U.S. satellite radio, has a subscriber base of just 20 million listeners (6% of the country's

population) after more than 10 years on the air. Since the company has already achieved profitability, increasing its subscriber base is but one of several options that may drive the company's future growth.[22] In the arena of satellite radio, providing ubiquitous service is not the ultimate outcome, whereas the development of terrestrial radio was designed with that goal in mind.

Ongoing industry and policy developments regarding access to the Internet itself impart a significant element of uncertainty to the growth and maturity of webcasting. Companies that dominate Internet access and the promulgation of online content are pushing for regulatory conditions that would give them increasing power over the basic functionality of new media.[23] For example, where unlimited data consumption used to be the norm with regard to Internet access, caps are being imposed by broadband service providers which could significantly limit a listener's ability to "tune in" radio online.[24] Although the business model behind the customized provision of IP-delievered digital audio content is profitable,[25] the commodification of broadband cannot help but have detrimental impacts on the communicative potential of the Internet itself.[26] Paragon Media Strategies analyst Larry Johnson believes that traditional radio broadcasters should not overreact to the "threat" of Internet broadcasting; as of 2010, webcasting accounted for just 4% of all radio listening. Johnson considers it more important right now "for terrestrial stations to be on the menu as delivery of Internet audio becomes more prominent in the way we listen to radio and audio services" than it is to duplicate or co-opt the attributes of new entrants.[27]

So long as legacy radio broadcasters maintain an inexpensive and nearly ubiquitous conduit for the distribution of audio, and concentrate innovation within that conduit, they should maintain a position of influence within a convergent media environment. However, present iterations of DAB technology actually work against this outcome. There is an increasingly popular short-term view among independent broadcasters and radio listeners that perhaps the best way to navigate convergence is to set aside digitalization in favor of improving the act of broadcasting. There is little doubt that radio as we've known it will one day be all-digital in nature, but the mechanisms by which radio broadcasters will evolve in that direction remain underdeveloped. Unfortunately, the attempted digitization of existing radio stations is but the first step in an arduous process which has years, if not decades, left to play out. The longer that

broadcasting itself remains marginalized, the more likely it is that the the crisis of identity among those that have historically claimed ownership of "radio" will be exacerbated. The answer to this quandary may not be found in a technological panacea, but rather in a renewed focus on the core attributes of radio broadcasting which has served it so well for so many years.

In the midst of great uncertainty regarding radio's digital future, there still exists a strong sentiment within the public that believes the FCC's mandate to serve the "public interest, convenience and necessity" should have some literal meaning. In the time preceding the industry's consolidation, this was primarily expressed through concepts of localism, which helped to facilitate program diversity and strengthened the communicative act of broadcasting itself.[28] Many believe that, were the FCC to simply return to some core principle of localism in the regulation of radio, the dilemma of digitalization could be addressed productively and without danger to the integrity of the medium;[29] at least a few FCC Commissioners and staff appear inclined to agree.[30] However, the dominance of neoliberal ideology on media policy in the wake of the Telecommunications Act of 1996,[31] coupled with the disruptive influence of new digital media technologies which contest the identity of "radio" itself, means that a return to localism alone is not likely to alter a system of broadcast policy which has a built-in bias away from this principle. This raises the uncomfortable question of whether a "a viable broadcast reform movement" to "enhance radio's public service function in the digital era"[32] has meaningful currency in a convergent media environment, where the notion of broadcasting itself is being openly challenged.[33]

So long as spectrum-incumbents firmly control both access to and the means of digital development of the airwaves, the likelihood of proactively influencing the evolutionary trajectory of digital radio through conventional means is greatly diminished.[34] Perhaps this issue can only be effectively addressed after the broader goal of strengthening media literacy among the public is achieved.[35] Media literacy is widely defined as the promotion of knowledge about the technical and organizational attributes of media systems, as well as the fostering of skills to effectively use the tools of media production and critically evaluate content. The speed of innovation regarding digital media technologies and distribution platforms makes the imparting of basic digital media literacy skills absolutely necessary before an aroused public can

constructively affect change in a convergent media environment. As it stands, brush fires are being battled over individual, specialized aspects of convergent media policy, the vast majority of which are being lost; under these conditions, where radio does not attract any meaningful attention among the milieu of developments in the world of digital media, the perils of HD Radio simply do not register on anyone's radar.[36] The deficiency of media literacy within the policymaking process itself, which does not deal well with speedy and uncertain evolution in new communications technologies, is clearly on display here.[37]

The "'sovereign citizen vision' of community and civic life supported crucially by a web of accessible electronic pathways and services" that Patricia Aufterheide believes needs to be "imagined, discussed, nurtured, and experimented with" in order to actualize a more democratic media environment has not yet materialized,[38] and the functional inability to simultaneously address media policy through the lens of convergence and in the context of meaningful public interest standards only exacerbates this problem.[39] The increasing propertization of digital media itself is clearly a step in the wrong direction,[40] and suggests that "support for a neo-liberal ideology that views government restrictions as political impediments to the success attainable via the free market" will continue to control contemporary media policymaking, despite its well-documented detriments.[41]

A heightened focus on the principles of media literacy would raise the effectiveness of public intervention into issues of media policy by demystifying the apparently complex phenomenon of convergence. This would help to build a base of collective knowledge that could be employed across issues to holistically engage in media reform and, ultimately, resist the neoliberal paradigm which has captured the policymaking process. Key to claiming agency in the regulatory development of new technologies is to act "before an unplanned commercial system becomes entrenched," so that their social value can be assessed.[42] Throughout the history of broadcast regulation, regulators have failed "to affirm a considered vision of what broadcasting should be, only following and accommodating the evolution of business models."[43] There is no reason why such behavior should continue, especially when the identity and future viability of an such an important medium as radio broadcasting is in a state of significant change.

Tim Wu suggested that new media technologies go through a "Cycle" of openness and

closure. Openness spurs innovation and uptake, while closure is precipitated by attempts to control a technology's monetization. "History also shows that whatever has been closed too long is ripe for ingenuity's assault: in time a closed industry can be opened anew, giving way to all sorts of technical possibilities and expressive uses for the medium before the effort to close the system likewise begins again."[44] In the context of digital radio's development, the phase of openness was truncated (or, in the United States, did not really occur at all); the designs of DAB systems were predisposed to closure. Using Wu's rubric, digital radio represents at best a sustaining innovation, in that is ostensibly designed to "improve" radio broadcasting, but is more properly evaluated as a disruptive innovation, in that it has allowed for the introduction of competing technologies that call themselves "radio" to upset broadcasting as we've understood it for the last 100 years.[45]

Most importantly, radio's digital dilemma should not be seen as an excuse for giving up on the medium, especially in its analog form. The only place where digital radio broadcasting has been attempted in any substantive fashion is the industrialized world, and its track record does not suggest that legacy stations will be successfully digitized in the near future. In developing countries, analog radio still occupies an important place in the media environment and will continue to do so. In fact, efforts are afoot to merge analog community radio projects with digital media literacy efforts, suggesting that not only does "traditional" radio have a long life yet to live, but the practice of broadcasting itself can thrive in a convergent media environment.[46] Perhaps the industrialized world can learn from these experiences. Furthermore, until broadband Internet access is realistically ubiquitous, it is unlikely that the provision of radio by this means will usurp the primacy of the legacy broadcast infrastructure.[47] Those who still care about the future of radio need to remain engaged in structural analog broadcast reform efforts and aspire to a more comprehensive education about the implications of convergent media policy more generally.

Eric Klinenberg asserts that media reformers can draw lessons from the environmental movement of the 1960s, which brought a network of disparate interests together to fundamentally reshape the world in which we live; there is no reason why such a media-environment movement is not possible.[48] The impetus for interests to coalesce in the manner

which Klinenberg suggests ultimately takes such a movement far beyond radio, with eyes firmly locked on the goal of influencing the pace and "rules" of convergence itself. Understanding and working to change the trajectory of radio's digital future would be a good object lesson from which to steepen the learning curve of contemporary media reform efforts. Under present circumstances, the convergence phenomenon will continue to "be a kind of kludge - a jerry-rigged relationship among different media technologies - rather than a fully integrated system. Right now, the cultural shifts, the legal battles, and the economic consolidations that are fueling media convergence are preceding shifts in the technological infrastructure. How those various transitions unfold will determine the balance of power in the next media era."[49] Recognizing and resisting the marketplace metaphor which now controls nearly all frames of acceptable discourse around media policy and practice is key to shaping a convergent media environment with maximum democratic potentiality.

The development of digital radio makes plainly clear that a purely neoliberal view of information organization and regulation does not lead in the direction of results which foster democratic discourse, much less a recognizable public sphere.[50] Until "fundamental issues of power" are addressed within modern political culture, efforts at media reform will remain balkanized, issue-specific, and by and large unsuccessful.[51] Without meaningful autonomy from corporate capital on subjects of convergent media policy, it is likely that regulators will make even more of what seem like arbitrary and capricious decisions on important subjects regarding the future of all digital media.[52] Only after the public "attempt[s] to understand how the world works" can it be empowered to seek democratic change.[53] Properly contextualized, radio's digital dilemma could provide an opportunity for convergent media reformers to make a strong beachhead from which to address future issues with even higher stakes and the confidence to succeed in those struggles.

Notes to Chapter 8

1. Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven, CT: Yale University Press, 2006), p. 303.

2. Digital Television's transition, at least in the U.S. context, cannot be effectively used as a comparison to the policy trajectory of digital radio broadcasting, as the Telecommunications Act of 1996 granted new digital broadcast spectrum to TV broadcasters in order to facilitate the conversion, while no such incentive existed for radio broadcasters. For more on the DTV transition and its significant differences to the trajectory of digital radio's transition, see J.H. Snider, *Speak Softly and Carry A Big Stick: How Local TV Broadcasters Exert Political Power* (Lincoln, NE: iUniverse, 2005), p. 195-496.

3. John Anderson, "Digital Radio in the United States: Privatization of the Public Airwaves?" *Southern Review,* vol. 39, no. 2 (2006), p. 18-19.

4. Federal Communications Commission, "Spectrum," in *National Broadband Plan: Connecting America,* April 21, 2010, http://www.broadband.gov/plan/5-spectrum/ (December 5, 2010).

5. Federal Communications Commission, Notice of Proposed Rulemaking, *In the Matter of Innovation in the Broadcast Television Bands: Allocations, Channel Sharing and Improvements to VHF*, Docket No. ET 10-235, November 30, 2010, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-10-196A1.pdf (December 5, 2010).

6. In fact, VHF Channels 5 and 6 are contiguous to the FM radio band, spanning 76-88 MHz. In other countries, such as Japan, this spectrum is used directly for FM radio broadcasting.

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8. Nicholas Garnham, ed. Fred Inglis, *Capitalism and Communication: Global Culture and the Economics of Information* (London: Sage, 1990), p. 102.

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12. Marko Ala-Fossi and Alan G. Stavitsky, "Understanding IBOC: Digital Technology of Analog Economics," *Journal of Radio Studies*, vol. 10, iss. 1 (2003), p. 65.

13. Stephen Lax, Marko Ala-Fossi, Per Jauert and Helen Shaw, "DAB: the future of radio? The development of digital radio in four European countries," *Media, Culture, & Society*, vol. 30, no. 2 (2008), p. 153.

14. Michael P. McCauley, "Radio's Digital Future: Preserving the Public Interest in the Age of New Media," in Michele Hilmes and Jason Loviglio, eds., *Radio Reader: Essays in the Cultural History of Radio* (New York: Routledge, 2002), p. 511.

15. Ala-Fossi and Stavitsky, p. 75.

16. See iBiquity Digital Corporation, *HD Radio System: Persona Radio Project Overview*, November 5, 2010, http://diymedia.net/stuff/PersonaRadioProject.pdf (May 30, 2011).

17. Anderson, p. 17-18.

18. Brian O'Neill, "Digital Audio Broadcasting in Canada: Technology and Policy in the Transition to Digital Radio," *Canadian Journal of Communication*, vol. 32, no. 1 (2007), p. 87.

19. McCauley, p. 513.

20. See Susan J. Douglas, *Inventing American Broadcasting, 1899-1922* (Baltimore: Johns Hopkins University Press, 1987), p. xv, xiv.

21. See Randall Patnode, "Path not taken: Wired wireless and broadcasting in the 1920s," *Journal of Broadcasting and Electronic Media*, vol. 49, no. 4 (2005), p. 383-401.

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33. See Jo Tacchi, "The need for radio theory in the digital age," *International Journal of Cultural Studies*, vol. 3, no. 2 (2000), p. 292-293, and O'Neill, p. 73-74.

34. Thomas Streeter, *Selling the Air: A Critique of the Policy of Commercial Broadcasting in the United States* (Chicago; University of Chicago Press, 1996), p. 194-195.

35. See John Dewey, *The Public and its Problems* (Chicago: The Swallow Press, 1954), p. 166-167; Mark Lloyd, *Prologue to a Farce: Communication and Democracy in America* (Urbana: University of Illinois Press, 2006), p. 279, and Henry Jenkins, *Convergence Culture: Where Old and New Media Collide* (New York: New York University Press, 2006), p. 259.

36. See Robert W. McChesney, *The Problem of the Media: U.S. Communication Politics in the Twenty-First Century* (New York: Monthly Review Press, 2004), p. 296-297, and Russell Newman and Ben Scott, "The Fight for the Future of Media," in Robert W. McChesney, Russell Newman, and Ben Scott, eds., *The Future of Media: Resistance and Reform in the 21st Century* (New York: Seven Stories Press, 2005), p. 26.

37. Pierre Larouche, "Dealing With Convergence at the International Level," in Damien Geradin and David Luff, *The WTO and Global Convergence in Telecommunications and Audio-Visual Services* (Cambridge, UK: Cambridge University Press, 2004), p. 393.

38. Aufderheide, *Communications Policy and the Public Interest: The Telecommunications Act of 1996* (New York: Guilford Press, 1999), p. 107.

39. See Dan Schiller, *Digital Capitalism: Networking the Global Market System* (Cambridge, MA: The MIT Press, 1999), p. 209, and Jeff Chester, *Digital Destiny: New Media and the Future of Democracy* (New York: The New Press, 2007), p. 192-208.

40. Lawrence Lessig, *The Future of Ideas: The Fate of the Commons in a Connected World* (New York: Random House, 2001), p. 93, 177.

41. Jonathan A. Obar, "Beyond Cynicism: A Review of the FCC's Reasoning for Modifying the Newspaper/Broadcast Cross-Ownership Rule," *Communication Law and Policy*, vol. 14, no. 4 (Autumn 2009), p. 484, footnote 24.

42. Robert W. McChesney, "Will the Internet Set Us Free?," from *Rich Media, Poor Democracy: Communication Politics in Dubious Times* (New York: The New Press, 2000), p. 126-127.

43. Id., p. 85.

44. Wu, p. 6.

45. Id., p. 20.

46. Tacchi, p. 295.

47. Barry Melville, "Digital Challenges for Community Broadcasting," *Media International Australia*, iss. 120 (2006), p. 11.

48. Eric Klinenberg, *Fighting For Air: The Battle to Control America's Media* (New York: Metropolitan Books, 2007), p. 13.

49. Jenkins, p. 17.

50. See David S. Allen, *Democracy, Inc.: The Press and the Law in the Corporate Rationalization of the Public Sphere* (Urbana: University of Illinois Press, 2005), p. 157, and Oscar H. Gandy, Jr. *Beyond Agenda Setting: Information Subsidies and Public Policy* (Norwood, NJ: Ablex Publishing Company, 1982), p. 210-211.

51. Robert W. McChesney, *Telecommunications, Mass Media, and Democracy: The Battle for Control of U.S. Broadcasting, 1928-1935* (New York: Oxford University Press, 1993), p. 269.

52. Philip M. Napoli, *Foundations of Communications Policy: Principles and Process in the Regulation of Electronic Media* (Cresskill, NJ: Hampton Press, 2001), p. 95, 280-281.

53. Robert W. McChesney, *The Political Economy of the Media: Enduring Issues, Emerging Dilemmas* (New York: Monthly Review Press, 2008), p. 443.

Appendix A: Public Radio's Concerted Support for Multicasting

During a month-long period in mid-2004, public broadcasters and their allies conducted a massive public comment campaign to convince the FCC that the multicasting feature of FM-HD Radio would be the technology's salvation. Developed by NPR, the multicast function initially received tepid support from commercial broadcast interests; were it not for a strong showing of support among incumbent broadcasters, there was the chance that the FCC would not authorize the functionality on a permanent basis.

As the FCC considered further rules on the HD Radio Service, NPR, its affiliates, university executives, station board members, state and regional public radio networks, and loyal listeners flooded the FCC with correspondence near the end of the public comment period urging the agency to authorize multicasting as a permanent part of the HD Radio feature suite. Unlike "astroturf" campaigns conducted during the HD Radio rulemaking by the NAB, multicasting-supporters generally wrote their own individual comments - although it is clear that they shared similar talking points. The size of the campaign is unprecedented in the HD Radio rulemaking, dwarfing the cumulative astroturf campaigns run by the NAB during 12 years of policy discussion.

Word-processing programs choke on footnotes that are more than five pages long; this appendix is a chronological list of all public radio broadcasters' and supporters' comments on HD multicasting, less the handful that were cited in-text for illustrative purposes.

May 28:

1. Comments of WUMB Public Radio, Miami University, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511348715 (January 16, 2010).

2. Comments of KUAF-FM, University of Arkansas Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511349903 (January 16, 2010).

3. Comments of Wyoming Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511350596 (January 16, 2010).

June 1:

4. Comments of Anthony Hunt, Indiana Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511359708 (January 16, 2010).

5. Comments of WXEL-FM, West Palm Beach, FL,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511359615 (January 16, 2010).

6. Comments of WMFE-FM/TV, Orlando, FL,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511359264 (January 17, 2010).

June 2:

7. Comments of KUAT Communications Group, University of Arizona,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511361183 (January 16, 2010).

8. Comments of John Shelton, Ellettsville, IN,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511361064 (January 16, 2010).

June 3:

9. Comments of Durwood Felton, Richmond, VA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511362354 (January 17, 2010).

June 8:

10. Comments of WNPR, Connecticut Public Radio,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365142 (January 17, 2010).

June 10:

11. Comments of Don Rinker, Alaska Public Broadcasting Commission,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365332 (January 17, 2010).

12. Comments of WILL AM/FM/TV, Urbana, IL,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365327 (January 17, 2010).

13. Comments of KUAC FM/TV, University of Alaska,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365336 (January 17, 2010).

14. Comments of Boise State Public Radio,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365361 (January 17, 2010).

15. Comments of KRBW AM/FM, Barrow, AK,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365340 (January 17, 2010).

16. Comments of Terry Anderson, Lawton, OK,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365345 (January 17, 2010).

17. Comments of James L. Linder, Wichita, KS,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365368 (January 17, 2010).

18. Comments of Candace France, Yakima, WA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365367 (January 17, 2010).

19. Comments of Thomas E. Richardson, Moscow, ID,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365349 (January 17, 2010).

20. Comments of Donna L. Zuba, Kennewick, WA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365333 (January 17, 2010).

June 11:

21. Comments of Mark Norman, Lawton, OK,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365405 (January 17, 2010).

22. Comments of Maine Public Broadcasting,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365396 (January 17, 2010).

23. Comments of WDAV, Davidson College,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365392 (January 17, 2010).

24. Comments of WFIU-FM, Indiana University,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365389 (January 17, 2010).

25. Comments of KWGS-FM/KWTU, Tulsa, OK,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365388 (January 17, 2010).

26. Comments of WVIK, Augustana
College,http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365385 (January 17, 2010).

27. Comments of KRVS-FM, Lafayette, LA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365381 (January 17, 2010).

28. Comments of WUFT/WUJF-FM, University of Florida,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365379 (January 17, 2010).

29. Comments of Perry Metz, Bloomington, IN,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365401 (January 17, 2010).

30. Comments of Chuck Leavens, South Park, PA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365391 (January 17, 2010).

June 14:

31. Comments of Mark Handley, President, New Hampshire Public Radio,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365484 (January 17, 2010).

32. Comments of Public Radio Partnership, Louisville, KY,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365521 (January 17, 2010).

33. Comments of Carolyn Day, Development Director, KUVO-FM, Denver, CO,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365522 (January 17, 2010).

34. Comments of WKMS-FM, Murray State University,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365526 (January 17, 2010).

35. Comments of Public Radio in Mid-America, St. Louis, MO, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365546 (January 17, 2010).

36. Comments of Talbert T. Gray, Elizabeth City, NC, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365538 (January 17, 2010).

37. Comments of James V. Paluzzi, General Manager, Boise State Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365552 (January 17, 2010).

38. Comments of WIlliam L. Stengel, Wichita, KS, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365569 (January 19, 2010).

39. Comments of Yellowstone Public Radio, Montana State University-Billings, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365567 (January 19, 2010).

40. Comments of Ms. Lee Starkel, Wichita, KS, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365565 (January 19, 2010).

41. Comments of KOSU-FM, Stillwater, OK, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365560 (January 19, 2010).

42. Comments of North Dakota Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365558 (January 19, 2010).

43. Comments of Daniel L. Campbell, Memphis, TN, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365482 (January 17, 2010).

44. Comments of the Executive Committee of the Board of Trustees of Fordham University, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366379 (January 24, 2010).

45. Comments of University Radio Foundation, Inc. (WFAE/WFHE-FM), Charlotte, NC, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511434888 (January 24, 2010).

June 15:

46. Comments of WUSF, Tampa, FL, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365579 (January 17, 2010).

47. Comments of WRTI-FM, Philadelphia, PA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365577 (January 19, 2010).

48. Comments of WIUM/WIUW, Western Illinois University, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365576 (January 19, 2010).

49. Comments of WDUQ-FM, Dusquene University, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365572 (January 19, 2010).

50. Comments of KISU Radio, Pocatello, ID, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365621 (January 19, 2010).

51. Comments of Wichita Radio Reading Services, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365614 (January 19, 2010).

52. Comments of KMUW-FM, Wichita, KS, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365607 (January 19, 2010).

53. Comments of WGBH Radio, Boston, MA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365599 (January 19, 2010).

54. Comments of WXPR Public Radio, Rhinelander, WI, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365596 (January 19, 2010).

55. Comments of WKSU, Kent State University, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365593 (January 19, 2010).

56. Comments of WERU-FM, East Orland, ME, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365590 (January 19, 2010).

57. Comments of Darrell Penta, Waltham, MA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365583 (January 19, 2010).

58. Comments of Roseyle C. Swig, San Francisco, CA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365626 (January 19, 2010).

59. Comments of WRTI-FM, Philadelphia, PA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365637 (January 19, 2010).

60. Comments of Nancy St. Clair Finch, Richmond, VA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365629 (January 19, 2010).

61. Comments of Vermont Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365692 (January 19, 2010).

62. Comments of Tamara O. Breeden, Wichita, KS, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365688 (January 19, 2010).

63. Comments of KUSP (Santa Cruz) and KBDH (San Ardo), CA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365684 (January 19, 2010).

64. Comments of Northwest Public Radio,, Pullman, WA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365682 (January 19, 2010).

65. Comments of WJSU-FM, Jackson, MS, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365678 (January 19, 2010).

66. Comments of Texas Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365676 (January 19, 2010).

67. Comments of the School Board of Miami-Dade County, FL, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365675 (January 19, 2010).

68. Comments of KQED, Inc., San Francisco, CA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365671 (January 19, 2010)

69. Comments of John Lilly, Minneapolis, MN,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365660 (January 19, 2010).

70. Comments of Public Broadcasting Atlanta,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366336 and
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366337 (January 24, 2010).

71. Comments of Michael K. Dugan, Morganton, NC,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366425 (January 24, 2010).

72. Comments of WABE, Atlanta, GA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366427 (January 24, 2010).

June 16:

73. Comments of Ross W. Pierce, Wichita, KS,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365817 (January 19, 2010).

74. Comments of Mike Wood, Wichita, KS,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365900 (January 24, 2010).

75. Comments of Pat V. Hayes, Wichita, KS,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365729 (January 19, 2010).

76. Comments of Carol A Cartwright, member, NPR Board of Directors; President, Kent State University, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365701 (January 19, 2010).

77. Comments of WUMB-FM, Boston, MA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365697 (January 19, 2010).

78. Comments of Patricia Monteith, WUMB Radio, Boston, MA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365696 (January 19, 2010).

79. Comments of North Texas Public Broadcasting, Dallas, TX,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365752 (January 19, 2010).

80. Comments of WHYY-FM, West Philadelphia, PA,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365748 (January 19, 2010).

81. Comments of the Curators of The University of Missouri,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365788 (January 19, 2010).

82. Comments of WJCT-FM, Jacksonville, FL,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365786 (January 19, 2010).

83. Comments of Oregon Public Broadcasting,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365771 (January 19, 2010).

84. Comments of KMUW Radio, Wichita, KS, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365769 (January 19, 2010).

85. Comments of WEMU-FM, Eastern Michigan University, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365766 (January 19, 2010).

86. Comments of WMHT-FM, Schenectady, NY, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365765 (January 19, 2010).

87. Comments of WCAL, St. Olaf College, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365764 (January 19, 2010).

88. Comments of State of Wisconsin Educational Communications Board, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365763 (January 19, 2010).

89. Comments of Eric DeWeese, Pasadena, CA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365762 (January 19, 2010).

90. Comments of KSMU-FM, Springfield, MO, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365761 (January 19, 2010).

91. Comments of New York Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365759 (January 19, 2010).

92. Comments of WCVE-FM, Richmond, VA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365757 (January 19, 2010).

93. Comments of WAER-FM, Syracuse, NY, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365865 (January 16, 2010).

94. Comments of WPRL-FM, Lorman, MS, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365853 (January 19, 2010).

95. Comments of Public Radio KUMR-FM, Rolla, MO, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365844 (January 19, 2010).

96. Comments of WVTF Public Radio, Roanoke, VA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365835 (January 19, 2010).

97. Comments of Hampton Roads Educational Telecommunications Association, Inc., Norfolk, VA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365826 (January 19, 2010).

98. Comments of KXCV/KRNW, Maryville, MO, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365848 (January 19, 2010).

99. Comments of WBHM, University of Alabama, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365845 (January 19, 2010).

100. Comments of KPVU, Prairie View, TX, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365830 (January 19, 2010).

101. Comments of WWNO, University of New Orleans, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365808 (January 19, 2010).

102. Comments of the James Madison University Board of Directors, Licensees of WMRA, WXJM, WMRL, and WMRY, Harrisonburg, VA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365790 (January 19, 2010).

103. Comments of KUNM, University of New Mexico, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365789 (January 19, 2010).

104. Comments of Friends of KEXP, Seattle, WA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365827 (January 24, 2010).

105. Comments of KUT Radio, University of Texas at Austin, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365880 (January 24, 2010).

106. Comments of Aspen Public Radio, Boulder, CO, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365950 (January 24, 2010).

107. Comments of KPLU Radio, Tacoma, WA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365946 (January 24, 2010).

108. Comments of Paul Delaney, Washington, D.C., http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365944 (January 24, 2010).

109. Comments of Capital Public Radio, Sacramento, CA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365939 (January 24, 2010).

110. Comments of WNCU, Durham, NC, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365936 (January 24, 2010).

111. Comments of Station Resource Group, Takoma Park, MD, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365935 (January 24, 2010).

112. Comments of KCLU, Thousand Oaks, CA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365934 (January 24, 2010).

113. Comments of Newark Public Radio, Newark, NJ, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365932 (January 24, 2010).

114. Comments of Capital Community Broadcasting (KTOO-FM), Juneau, AK, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365921 (January 24, 2010).

115. Comments of WGTE Public Broadcasting, Toledo, OH, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365918 (January 24, 2010).

116. Comments of KCRW-FM, Santa Monica, CA, ://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365915 (January 24, 2010).

117. Comments of Southern California Public Radio, Los Angeles, CA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365911 (January 24, 2010).

118. Comments of WDET-FM, Detroit, MI,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365910 (January 24, 2010).

119. Comments of WAMU, American University,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365895 (January 24, 2010).

120. Comments of Minnesota Public Radio,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365894 (January 24, 2010).

121. Comments of WXPR Public Radio, Three Lakes, WI,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511365887 (January 24, 2010).

122. Comments of the WFCR-FM, University of Massachusetts,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366333 (January 24, 2010).

123. Comments of WBFO-FM, University of Buffalo,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366334 (January 24, 2010).

124. Comments of Public Radio Arizona,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366335 (January 24, 2010).

125. Comments of the University of South Florida,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366363 (January 24, 2010).

126. Comments of Friends of Public Radio Arizona,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366412 (January 24, 2010).

127. Comments of Eastern Public Radio,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366413 (January 24, 2010).

128. Comments of Clement Geitner, Vale, NC,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366416 (January 24, 2010).

129. Comments of Murray State University,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366420 (January 24, 2010).

130. Comments of Wisconsin Public Radio,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366421 (January 24, 2010).

June 17:

131. Comments of Garza Baldwin, Charlotte, NC,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366783 (January 24, 2010).

132. Comments of J.J. Carmola, Charlotte, NC,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366785 (January 24, 2010).

133. Comments of Angela Beaver Simmons, Hickory, NC,
http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366524 (January 24, 2010).

134. Comments of Nebraska Public Radio Network, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366781 (January 24, 2010).

June 18:

135. Comments of Community Radio for Northern Colorado, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511434890 (January 24, 2010).

136. Comments of WYPR 88.1 FM, Baltimore, MD, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511436303 (January 24, 2010).

June 21:

137. Comments of the WABE Board of Directors, Atlanta, GA, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366933 (January 24, 2010).

138. Comments of Nevada Public Radio, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511366932 (January 24, 2010).

139. Comments of WFAE/WFHE Board of Directors, Charlotte, NC, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511434956 (January 24, 2010).

June 23:

140. Comments of Lawrence M. Kimbrough, WFAE Board member, Charlotte, NC, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511434957 (January 24, 2010).

June 30:

141. Comments of Linda Saunders, Phoenix, AZ, http://fjallfoss.fcc.gov/ecfs/comment/view?id=5511436299 (January 24, 2010).