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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

Federal Communications Commission
Office of the Secretary

Satellite CD Radio, Inc.)	File Nos.
Application for Digital Audio)	49/50-DSS-P/LA-90
Radio Service Satellite System)	58/59-DSS-AMEND-90

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COMMENTS OF THE
NATIONAL ASSOCIATION OF BROADCASTERS

Domestic Facilities Division
Satellite Radio Branch

I. INTRODUCTION AND SUMMARY

By Public Notice^{1/} the Commission has asked for public comment, or petitions, regarding the above-captioned application of Satellite CD Radio, Inc. ("Satellite CD"). The application seeks Commission authority to construct, launch and operate a digital audio radio service employing a two space satellite system, along with a wealth of "urban area" terrestrial repeaters. Although the Commission's public notice indicates that the "application has not yet been accepted for filing,"^{2/} nonetheless the agency asks for interested parties' reactions to the application.

This is not the first time that the National Association of Broadcasters ("NAB")^{3/} has addressed the Satellite

^{1/} FCC Public Notice, Report No. DS-1015, released Oct. 19, 1990.

^{2/} Id.

^{3/} NAB is a nonprofit, incorporated association of radio and television broadcast stations and networks. NAB serves and represents America's radio and television stations and all the major networks.

CD proposals, let alone the entire range of digital audio broadcasting ("DAB") issues. This past summer, NAB filed comments^{4/} in response to the Satellite CD petition for rule making.^{5/} In that filing, NAB strongly opposed Satellite CD's petition -- a petition which addressed virtually the identical substantive issues broached in the application the Commission now has placed on public notice. Also, in comments^{6/} more recently filed in the Commission's inquiry proceeding on DAB,^{7/} NAB underscored its opposition to the kind of satellite-based or "hybrid" proposal advanced by Satellite CD. Copies of these earlier NAB pleadings are attached as Appendices I and II; their contents and arguments are incorporated here by reference.

Nothing has transpired in the period which has intervened since the filing of these earlier NAB comments that alters our position on these fundamental issues of spectrum allocation and domestic radio service. Below, in the context of the Satellite CD application, we reiterate these points and offer

^{4/} See Comments of NAB (RM-7400), filed Aug. 20, 1990.

^{5/} See Public Notice, "Office of the Secretary: Petitions for Rule Making Filed," June 18, 1990; see also FCC July 9, 1990 Public Notice "Office of the Secretary: Petition for Rule Making Filed," acknowledging Satellite CD's filing of a June 22, 1990 supplement to request for rule making.

^{6/} See Comments of NAB in Gen. Docket No. 90-357, filed Nov. 13, 1990.

^{7/} See Notice of Inquiry in Gen. Docket No. 90-357, 5 FCC Rcd 5237 (1990).

some specific, new commentary on several elements of the amended Satellite CD application.^{8/}

**II. GRANT OF THE SATELLITE CD APPLICATION NOW WOULD BE
INCONSISTENT WITH STATUTORY DIRECTIVES AND SOUND AGENCY
DECISIONMAKING.**

As NAB and many other parties filing comments in response to the Satellite CD petition for rule making have emphasized, grant of Satellite CD's application now would compromise the efforts of government and industry (1) to develop rational and well-crafted policies for the introduction of digital broadcasting in this country and (2) to best enable the United States to participate meaningfully and knowledgeably at the 1992 World Administrative Radio Conference.^{9/} Moreover, any near-term grant of the Satellite CD application would be in basic conflict with the most fundamental requirements of the Communications Act.

The record being established in Gen. Docket No. 90-357 points to a variety of issues -- some technical; some policy -- that have yet to be resolved by industry parties, let alone the government. During the pendency of this inquiry proceeding, it

^{8/} See "Amendment to Satellite System Proposal and Applications To Construct, Launch and Operate Space Stations in the Satellite Sound Broadcasting Service at 121° West Longitude," filed July 17, 1990. Satellite CD amended its application again on October 17, 1990.

^{9/} See Second Notice of Inquiry in Gen. Docket No. 89-554, FCC Rcd 6046 (1990).

would be absolutely unconscionable for the Commission to grant the permanent authority desired by Satellite CD. Such a grant not only would place the cart well before the horse procedurally, but would essentially sidestep the domestic rulemaking process as well as the international preparatory and negotiation processes.

Because the Commission is far from concluding its inquiry proceeding on DAB, and has not even begun a rulemaking proceeding that would look toward the adoption of final DAB rules, it currently is impossible for any positive Commission action on the Satellite CD application to meet the mandate of Section 309 of the Communications Act: to be consistent with the "public interest, convenience and necessity."^{10/} Moreover, in seeking a waiver of Section 319(d) of the Communications Act,^{11/} Satellite CD presents a parade of self-serving statements that, in ipse dixit fashion, ask the Commission to make a favorable public interest judgment only on the bare assertions of the applicant that such a grant will be in the public interest.

In its Public Notice seeking comment on the Satellite CD application the Commission acknowledges that "[a]ction on [Satellite CD's] application will be affected by the disposition of its petition for rule making as well as any action taken in connection with the Notice of Inquiry."^{12/} NAB agrees with this

^{10/} 47 USC § 309(a) (1990).

^{11/} 47 USC § 319(d) (1990).

^{12/} Public Notice, supra note 1.

statement -- a statement which would seem to rule out any grant of the Satellite CD application until after the Commission has completed its domestic rulemaking process. Moreover, and as NAB and many other parties have already observed, any such grant of permanent authority should await the conclusion of the global deliberations at the 1992 World Administrative Radio Conference.^{13/}

III. SATELLITE DELIVERY OF DIGITAL AUDIO, OR A "HYBRID" SATELLITE/TERRESTRIAL DISTRIBUTION SYSTEM, WOULD BE IN DIRECT CONTRAVENTION OF THE COMMISSION'S LONG-STANDING POLICIES IN SUPPORT OF BROADCAST LOCALISM AND SPECTRUM EFFICIENCY.

The record already established in the Commission's DAB inquiry reflects substantial support for the notion that digital audio should be introduced in this country as a "enhancement" of existing radio broadcast service.^{14/} In light of this growing support for terrestrial-only use of digital radio, the Commission would be hard pressed to find a rational foundation -- either now or in the future -- for grant of Satellite CD's "hybrid" approach towards digital audio distribution. Indeed, authorization of the

^{13/} See Comments of NAB, supra note 4, at 5-6. See also Comments of General Instrument Corp. (RM-7400), filed Aug. 20, 1990, at 9-11.

^{14/} See, e.g., Comments of NAB, supra note 6, at 11-19. See also Comments of United Broadcasting Co., filed Oct. 11, 1990 at 2-4; Comments of Mount Wilson FM Broadcasters, Inc., filed Oct. 9, 1990, at 4-9; Comments of William P. Suffa, P.E., filed Oct. 12, 1990, at 1-5; Comments of Universal Broadcasting Corp., filed Oct. 12, 1990, at 7-19.

Satellite CD plan -- either now or later -- would likely impair successful terrestrial introduction of digital radio.

Section 307(b) of the Communications Act, as well as the broadcast localism policies which have developed under this statutory directive, clearly guide the Commission away from the grant of Satellite CD's application. Indeed, the statute and established Commission policy point instead to the comparative merits of adopting a terrestrial-only system for digital audio. Moreover, by granting existing AM and FM broadcasters the opportunity to employ digital facilities -- a policy which would be lawful as well as rational^{15/} -- the Commission would rightfully rely upon established track records of local service and best take advantage of the current, equitable distribution of broadcast facilities across the nation.

Moreover, and as borne out by many of the comments submitted not only in opposition to Satellite CD's petition for rule making but also in the digital audio inquiry, satellite distribution of digital radio would be far less spectrum efficient than the employment of a terrestrial-based system.^{16/} This fundamental fact flows from the inability of a satellite-based system to "reuse" frequency spectrum to the degree that such spectrum can be employed in multiple locations via a

^{15/} See, e.g., Comments of NAB, supra note 6, at 11-24.

^{16/} See, e.g., Comments of NAB, supra note 4, at 10-16; Joint Comments of Shamrock Broadcasting, Inc., et al. (RM-7400), filed Aug. 20, 1990, at 13-14.

terrestrial-only distribution system. Clearly, the bloated spectrum demands of Satellite CD, coupled with only limited reuse options, would amount to an unconscionable waste of valuable spectrum.^{17/}

IV. THE SATELLITE CD APPLICATION AND PETITION DISPLAY A SERIES OF SERIOUS DEFECTS AND UNCERTAINTIES.

On three occasions since the submission of its May 18, 1990, application and petition, Satellite CD has been forced to amend its proposals. These amendments, submitted in June, July and October of 1990,^{18/} underscore the haste which characterized the preparation of the petition and application. NAB already has pointed out the many technical flaws in the petition for rule making, even as amended.^{19/} Rather than repeat a recitation of these errors here, NAB simply points to our earlier listing of those infirmities, as set forth in the attached copy (submitted as Appendix I) of NAB's comments in response to the Satellite CD petition for rule making. These comments also point to several

^{17/} In this regard, NAB refers the Commission to the points made in the appended NAB comments concerning Satellite CD's vast underestimation of its spectrum needs. That is, the proposed operation of "terrestrial repeaters" by Satellite CD likely would entail far more spectrum use than currently acknowledged by the applicant/petitioner. See Satellite CD application, supra note 1, Technical Appendix at 20-22. See also June 22, 1990 supplement to request for rule making, supra note 5, at 7-8.

^{18/} See notes 5 and 8, supra.

^{19/} See Comments of NAB, supra note 4, at 8-18.

inconsistencies and uncertainties reflected in the original Satellite CD application.

Additionally, NAB focuses the Commission's attention on other defects displayed in the amended Satellite CD application. First, we refer to Satellite CD's latest amendments which recommend radical technical changes to the original proposal. For example, in its second amendment, dated October 17, 1990, Satellite CD introduced a new system of frequency and time diversity to combat the effects of multipath propagation.^{20/} In its original application,^{21/} Satellite CD proposed four receiver types of increasing complexity as the sole method to combat this type of interference. Additionally, the second amendment provides little analysis of potential interference effects caused by the system's own terrestrial transmitter system to satellite reception.

Also, as the theoretical development of the system has proceeded, it seems as if Satellite CD has uncovered many technical deficiencies on their own. It is clear that a considerable amount of modeling and hardware testing, in addition to the theoretical basis, would be necessary to prove out the viability of Satellite CD's system. To approve Satellite CD's application without such test data would not be based on sound engineering practice.

^{20/} See October 17, 1990 Amendment Exhibit 1, "Technical Amendment to Communications Subsystem," at 1.

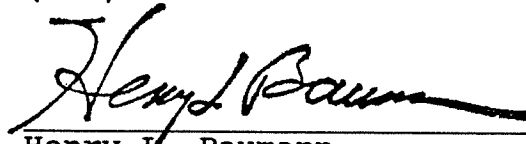
^{21/} Public Notice, supra note 1, at 13.

V. CONCLUSION

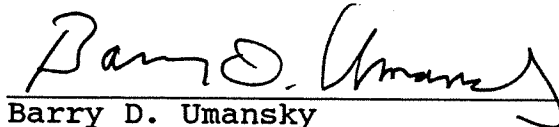
For the reasons stated herein and in NAB's comments responding to both the Satellite CD rulemaking petition and the Commission's inquiry on digital radio (attached as Appendices I and II, respectively), NAB urges the Commission not to accept the above-captioned Satellite CD application, let alone grant the application. To do so would run counter to statutory directives, rational communications policy and the ongoing efforts to develop a reasonable and well-crafted approach toward domestic and international implementation of digital audio.

Respectfully submitted,

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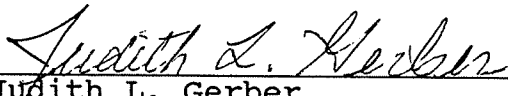
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November 30, 1990

CERTIFICATE OF SERVICE

I, Judith L. Gerber, do hereby certify a true and correct copy of the foregoing "Comments of the National Association of Broadcasters" was sent, via first class mail, on this date, November 30, 1990, to the following:

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Judith L. Gerber

APPENDIX I

Comments of the National Association of Broadcasters
in Response to RM-7400

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Amendment of Parts 2 and 25 of)
the Commission's Rules to Establish) RM-7400
a Satellite and Terrestrial CD)
Quality Broadcasting Service)

COMMENTS OF THE
NATIONAL ASSOCIATION OF BROADCASTERS

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August 20, 1990

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EXECUTIVE SUMMARY

NAB strongly opposes Petitioner's request for spectrum allocation and inauguration of a proposed, hybrid, space satellite and terrestrial system for digital audio broadcasting. The issues raised by Petitioner are but a few of the many matters which are the subject of: (1) the agency's newly initiated inquiry proceeding on digital radio; (2) this country's preparatory activities relating to the 1992 World Administrative Radio Conference (WARC-92), where digital radio broadcasting is one of the key issues for international decisionmaking; and (3) the study of a blue ribbon NAB Committee charged with the responsibility to review digital radio and aid the Association in our own assessment of the technology.

In light of the domestic inquiry and the pendency of WARC-92, any positive action on petitioner's request simply would be premature. Moreover, NAB's comments today point to myriad policy and technical infirmities in the Satellite CD plan. These problems range from transmission system uncertainties and receiver complexities to a basic conflict with the fundamental precepts of Section 307 (b) of the Communications Act -- a statutory provision which has guided the establishment of universal yet locally oriented broadcast service in this country.

We recommend that the agency dismiss or simply defer consideration of the subject petition. The Commission should focus its energies, instead, on the broad range of domestic and international policymaking and allocations planning which must precede any consideration of an actual domestic spectrum reallocation for any such digital service.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Amendment of Parts 2 and 25 of)	
the Commission's Rules to Establish)	RM-7400
a Satellite and Terrestrial CD)	
Quality Broadcasting Services)	

COMMENTS OF THE
NATIONAL ASSOCIATION OF BROADCASTERS

I. INTRODUCTION

On June 18, 1990, the Commission placed on public notice a Petition for Rule Making ("Petition"), submitted by Satellite CD Radio, Inc. ("Satellite CD" or "Petitioner"), that seeks the allocation of spectrum for a satellite-delivered digital sound broadcasting service.^{1/} Especially in light of the Commission's subsequent inauguration of a broad inquiry on digital audio broadcasting ("DAB"),^{2/} the National Association of Broadcasters ("NAB")^{3/} finds the request by Petitioner to be

^{1/} Public Notice, "Office of the Secretary: Petitions for Rule Making Filed," June 18, 1990. Subsequently, the Commission acknowledged Petitioner's filing of a June 22, 1990, Supplement to Request for Rule Making, Public Notice "Office of the Secretary: Petition for Rule Making Filed," July 9, 1990.

^{2/} See Notice of Inquiry in Gen. Docket No. 90-357, FCC 90-281, adopted August 1, 1990. NAB applauds the initiation of this inquiry as a meaningful first step in determining whether a DAB system would be beneficial to the public.

^{3/} NAB is a nonprofit, incorporated association of radio and television broadcast stations and networks. NAB serves and represents America's radio and television stations and all the major networks. NAB's comments today are filed timely in light of the agency's grant of extension of time requests submitted by NAB and by the Aircraft Flight Test Radio Coordinating Council. (Order Granting Extension of Time (DA 90-943) adopted by the FCC Chief Engineer on July 12, 1990.)

inappropriate and premature. NAB urges the Commission to dismiss the Petition without prejudice or, in the alternative, hold the Petition in abeyance until after completion of the Inquiry and the World Administrative Radio Conference ("WARC") proceedings slated for 1992.^{4/}

As explained below, NAB considers digital radio to be among the most important topics currently being discussed among broadcasters and government regulators. Consequently, we are taking several steps to ensure full broadcaster participation in those proceedings and in international conferences where digital radio is at issue. Key to domestic and international decisionmaking is thorough technical and policy assessment. These factors would be compromised were the Commission to grant petitioner's request here.

II. GOVERNMENT AND INDUSTRY RESOURCES SHOULD BE DEDICATED TO POLICY DEVELOPMENT AND INTERNATIONAL CONFERENCE PREPARATION, NOT TO THE PREMATURE INAUGURATION OF AN UNTRIED SERVICE.

NAB has given high priority status to the matter of digital radio. A major facet of NAB's approach to digital radio is our view that this technology should be considered as yet another potentially useful enhancement of the existing radio service -- in the same manner that reasonable power increases,^{5/}

^{4/} See, e.g., Notice of Inquiry in Gen. Docket No. 89-554, 4 FCC Rcd 8546 (1989).

^{5/} See Report and Order in BC Docket No. 79-265, 55 R.R.2d (P&F) 1015 (1984) (Class IV AM power increase); Report and Order in MM Docket No. 87-131, 2 FCC Rcd 7113 (1987) (Class III daytimer nighttime operation); and Report and Order in MM Docket No. 88-375, 4 FCC Rcd 2792 (1989) (Class A FM power increase).

stereophonic sound^{6/} and the AM NRSC standards^{2/} have improved the public's radio service. The agency's plan for additional AM Improvement and prospective migration of existing stations to the expanded AM band^{8/} should continue this progression.

Petitioner's plan for FCC adoption of an entirely new scheme for a new service runs counter to long-standing Commission policies of enhancing public service through existing services and licensees. Also, it is unnecessary for the Commission to consider adopting any radical departures from its very successful and statutorily based policies for authorizing broadcast service and enhancements to this service.^{2/}

A related, key element in the NAB position -- and one which will be the touchstone for most of our decisionmaking and advocacy on digital radio -- is NAB's opposition to space satellite delivery of digital radio transmission directly to the

^{6/} See, e.g., Report and Order in Docket No. 13506, 21 R.R. (P&F) 1605 (1961) (FM Stereo authorization); and Report and Order in Docket No. 21313, 51 R.R.2d (P&F) 1 (1982) (AM Stereo authorization). See also Notice of Proposed Rule Making in MM Docket No. 87-267, adopted April 12, 1990.

^{2/} See, e.g., Report and Order in MM Docket No. 88-376, 4 FCC Rcd 3835 (1989).

^{8/} See Notice of Proposed Rule Making in MM Docket 87-267, supra note 6.

^{2/} In this regard, we believe the Commission should reject the tortured Title II/Title III regulatory approach advanced by Petitioner. Its complexity and structure are simply unnecessary to afford a possible CD quality enhancement of the public's radio broadcast service. As NAB will address more fully in its comments in the Commission's digital radio inquiry, we believe that a potential move toward terrestrial-only digital transmission can be accomplished using much the same procedures and underlying allocations/assignment policies as have been employed by the agency for some time.

listener. Such a proposal -- as advanced by Petitioner here -- would be in direct contravention of the principles of broadcast localism,^{10/} that have guided the development of the American system of radio broadcasting. Moreover, and as explained below, space satellite delivery would be far less spectrum efficient than potential terrestrial delivery of a digital broadcast signal to the consumer.

Demonstrating NAB's resolve to participate fully in government activities relating to digital radio, NAB already has filed comments in the Commission's WARC-92 inquiry proceeding.^{11/} Also, we are represented on the Industry Advisory Committee for the 1992 ITU World Administrative Radio Conference and are participating in several informal working party meetings. We consider these preparatory and policymaking efforts to be critical to our industry and to our nation as we approach the 1992 WARC conference. NAB will continue to play an active role in these government-related activities.

In order to foster NAB's evaluation of the myriad digital radio issues that now are emerging -- and are encompassed in the Commission's Notice of Inquiry -- NAB has established a blue ribbon committee to conduct such assessment and help guide the Association. On the recommendation of that Task Force, NAB has decided to conduct an in-depth technical analysis of the

^{10/} See § 307(b) of the Communications Act of 1934, 47 U.S.C. § 307(b).

^{11/} See Comments of NAB in Gen. Docket No. 89-554, filed February 16, 1990.

spectrum demands that would be created were all existing, domestic AM and FM radio stations granted digital facilities.

Just as NAB has decided to dedicate significant resources to the newly initiated digital radio inquiry proceeding -- and to this country's preparations for WARC-92 -- we believe the Commission should adopt the same priorities. To grant Petitioner's request in the midst of this fundamental domestic and international decisionmaking would be at odds with rational communications policy and common sense.

Although, as of today, the Commission has not released the full text of its Notice of Inquiry in Gen. Docket 90-357, NAB expects the inquiry proceeding to subsume the other digital-related applications and petitions filed thus far,^{12/} as well as the Satellite CD petition we are addressing here. Again, the Commission should not grant any of these applications or petitions at least until it has completed its domestic inquiry and WARC-92 preparation. Indeed, the better and recommended course would be for it to forgo action on any of these petitions and applications until the conclusion of the WARC conference itself and any associated, regional satellite planning conferences.

^{12/} See, e.g., Application of Radio Satellite Corp. for Authority to Construct and Operate a 3.5 Meter KU-Band Transmit-Receive Earth Station, filed May 22, 1990; Application for Authority to Construct or Make Changes in an International or Experimental Broadcast Station, filed May 23, 1990, by Strother Communications, Inc. ("Strother"); and Petition for Rule Making filed by Strother on July 26, 1990.

The Notice of Inquiry, as well as the Commission's proceedings in preparation of WARC-92, are perfect vehicles for exploring the issues embodied in the instant petition. In these proceedings, Satellite CD will have a forum to advocate its proposals. Its rights -- and the rights of other current and potential users of these frequencies -- will be fully protected.

Moreover, the Industry Advisory Committee, which includes the participation of Satellite CD, is assisting in the preparation of a U.S. position for WARC-92. Arriving at a final position as to what U.S. policy should be regarding proposals in this frequency band will be difficult and time consuming. NAB again urges the Commission to complete the WARC-92 preparatory activities before making any decisions as to which new services in this band should have priority and be the subject of specific rule making. Indeed, notions of reasoned domestic policymaking militate in favor of awaiting the results of WARC-92 to determine where, how, and if at all, a satellite-delivered broadcasting service would fit into the world picture. While the U.S. is not bound by WARC decisions, it certainly can benefit from the information and experience gained at WARC-92.

Proceeding independently of the WARC-92 process would be unsound; there is no technical or policy basis sufficient to support an immediate domestic spectrum allocation to a broadcast satellite sound service. The proposed satellite service is totally untested and unevaluated. As the past has shown, faulty and inadequate information, that could result from premature rule making, can lead to unnecessary and perhaps fallow spectrum

allocations.^{13/} Furthermore, there has been no Commission determination of need for broadcast satellite digital sound which might justify a rush to judgment for the benefit of the public interest. Thus, the Commission should not act in haste to allocate the spectrum sought.

While some countries are experimenting with DAB,^{14/} they have different broadcasting systems and different needs. Some countries may desire expanded radio service -- and more nationwide radio service -- because their current over-the-air broadcasting service is either underdeveloped or cannot adequately serve the entire population of the country due to geography and/or population densities. The United States is not in either predicament. Today, radio stations bring service to our entire population, with 26.4 stations reaching an average county.^{15/} Our nation has come to rely on local broadcasters bringing news, information and entertainment of local interest to

^{13/} This very result occurred in Europe in 1977, when at a World Administrative Radio Conference on direct broadcast satellite service, the European countries insisted on adopting a DBS plan for all of Europe. The U.S. declined to do so, believing that new technological developments would, over the near term, change underlying regulatory assumptions. The U.S. was correct. The European plan is badly flawed, is not being used and clearly requires reexamination.

^{14/} We point to, for example, the European Broadcasting Union's Eureka project, which has been ongoing for several years in Europe, and current testing of DAB by a number of Canadian organizations.

^{15/} E. Cohen, "NAB National Radio Listening Study," NAB, November 2, 1988, at 3.

their local communities.^{16/} This ubiquitous broadcasting infrastructure reflects a sound U.S. policy commitment to localism in radio broadcasting, which is wholly at odds with the concepts embodied in the instant Petition.^{17/}

III. THERE ARE SERIOUS POLICY AND TECHNICAL INFIRMITIES IN THE SATELLITE CD PLAN.

There are many other technical and policy questions that have not been adequately addressed or, in some cases, not even addressed at all by Petitioner. First, major uncertainties surround Petitioner's proposed use of its suggested digital broadcasting technology, whether delivered terrestrially or by satellite. Satellite CD seeks a precise allocation for satellite delivered audio with specific channel plans and spectrum requirements. Yet, there have been no satellite-based experiments of any kind involving the power levels required for a true DAB satellite, either by itself or in connection with terrestrial repeaters or boosters.^{18/} The experiments in Europe

^{16/} As an example, 65 percent of respondents to the 1989 Television Information Office ("TIO")/Roper Study said they get most of their news about what is going on the world from television. America's Watching, TIO/Roper Report, at 14. Also, radio listeners want to hear news on the radio, particularly local news. See, e.g., "Listener Perceptions of Radio News," John W. Wright, II and Lawrence A. Hosman. 63 Journalism Quarterly 802-14 (Winter, 1986).

^{17/} In this regard, NAB believes that the Commission should place a higher priority on determining the efficiency and quality of a more localized terrestrial DAB service than a nationwide satellite-delivered service.

^{18/} By contrast, terrestrial DAB demonstrations are now occurring in Canada. Further U.S. study and demonstrations are planned for 1991. With this objective in mind, and as noted above, the NAB
(continued...)

and Canada involve terrestrial transmissions; satellite testing is in the future. However, Satellite CD concedes that a terrestrial component is absolutely critical if satisfactory service is to be provided to urban areas.

Moreover, the Satellite CD proposals regarding modulation and compression techniques are largely in the theoretical stage only. The details of the proposed encoding system compression capability are unclear. The Satellite CD application proposes use of an encoding and transmission technology developed by Dolby Laboratories; however, important details of this encoding algorithm technology are not presented.^{19/} If a proprietary encoding method is proposed for essentially a monopoly system, this could, in effect, give the Petitioner a government-sanctioned technology monopoly. Further, given the availability of EBU/Eureka technology, there is a

^{18/} (...continued)

Radio Board has established a Task Force on Digital Audio Broadcasting, which has already held two meetings and has scheduled a third to coincide with next month's NAB Radio Conference in Boston. That Task Force will explore the question of whether a terrestrial DAB service can be provided to portable units and moving vehicles at a quality level significantly higher than now available on AM or FM and, if so, what impact such service might have on the existing providers and consumers of local service.

^{19/} Application of Satellite CD Radio, Inc., filed May 18, 1990, at 3. Dolby AC-2, as with all data compression systems, performs subjective analysis on the incoming program, removing "inaudible" information in the encoding process. Since the proprietary mathematical algorithm for the system is not presented, no certainty exists regarding the system's purported capability of true "CD quality" performance. This is noteworthy in that the quoted AC-2 system parameters significantly fall short of typical compact disc specifications in frequency response and distortion performance.

question whether Petitioner's particular system would be adopted in Europe and elsewhere, thus frustrating one objective of the WARC-92 efforts: to achieve world-wide allocations for DAB.^{20/} Clearly, these issues need clarification and additional information, public comment, investigation and analysis.

Petitioner requests simultaneous FCC action on at least four very complex issues. But decisions as to frequency spectrum, channel plan, licensing and technical standards should not be conducted in an application process and must, instead, be in the context of thorough rulemaking proceedings. A proceeding on technical standards alone could be very time consuming, as the Commission's experience with the HDTV standardization process shows. The Commission cannot simply grant Petitioner's application, foreclose a public standard-setting process, and permit Petitioner, alone, to determine and control a new broadcasting technology. Given the public interest obligations of broadcasters, improvements to broadcasting technology require open proceedings, where consensus can be sought among the industries most likely to be affected.

Other technical aspects of the Satellite CD proposal are either unclear or unsupported. We first point to Petitioner's proposed terrestrial repeater power requirements. Petitioner states that "[T]he equipment used for the terrestrial

^{20/} The usefulness of worldwide allocations depends in significant part on the kind of technical system planned for use. Allocation and channeling decisions require specifications for bandwidth of emission, interference resilience, and power requirements, among others.

repeaters and the transmitters is virtually identical."^{21/} In fact, if the repeaters carry up to 66 channels and the transmitters a single channel, the power output of each would have to be far different if all channels were to have equal capability.

Moreover, the proposed satellite transponder antenna performance suggests the use of a 7-9 meter diameter antenna, that implies use of an unfurlable/deployable antenna. Petitioner thus presents two serious technical issues. First, to NAB's knowledge, antennas of this size have not yet been used for any commercial satellites, let alone a satellite designed for broadcast service; second, shaped beams using large-sized unfurlable antennas still need to be developed.

Satellite CD states that the system it proposes would be most efficient, because additional channels can be added one at a time, instead of in blocks of 8 or 16.^{22/} But because the capacities of any and all broadcast sound satellites must be predefined before they are launched, no possibility at all exists for the addition of channels once this limit has been reached. If the bandwidth efficiency of transmission is improved after the service is implemented and initial limits are reached, receivers then on the market could be made obsolete.

^{21/} Supplement to Satellite CD Petition, supra note 1, at 2.

^{22/} Id. at 6.

Satellite CD also claims a frequency re-use factor of 3.^{23/} However, in any one region, Petitioner proposes the use of 100 channel receivers configured to receive 66 channels from a satellite and the remainder from terrestrial links. With the proposed available spectrum divided into thirds, any one region could re-use only 10.2 MHz of the remaining 39.8 MHz for terrestrial use, especially in areas of satellite signal overlap. This calculates to much less than the quoted re-use factor of 3, with most remaining spectrum lying fallow outside its satellite-covered area. Also, we note that the proposed link budget power flux density limits in the 1525-1530 MHz band apparently exceed those limits established by the International Telecommunications Union.^{24/}

These are but a few of a parade of flaws contained in Petitioner's application. Together with some of petitioner's "quick fixes" to otherwise serious technical and policy issues,^{25/} these flaws invite the observer to conclude that Petitioner should be held to a least a minimum standard of due diligence in preparing and filing its papers with the Commission.

Also, it seems clear that one reason for the uncertain nature of Petitioner's operational and technical plans -- and the premature filing of the Petition -- is the rush to obtain a

^{23/} Id. at 20.

^{24/} See ITU Radio Regulations: Article 28, Section IV, and CCIR Report 955-1.

^{25/} E.g., Petitioner's proposed solution to multipath -- for antenna space diversity -- is unrealistic and impractical. See infra.

"pioneer's preference." This pioneer preference concept, advanced in a separate FCC proceeding^{26/} was opposed by NAB^{27/} on several grounds, including the expectation that the pioneer preference scheme would elicit prematurely filed applications and petitions, such as the materials submitted by Satellite CD.

Of further concern are multipath problems in satellite-based transmissions to moving vehicles and other mobile receivers. Although some modulation schemes, such as EBU/Eureka, offer good prospects for overcoming these problems, testing is needed to determine specific design parameters. Many variables enter into this decision, including bandwidth, frequency and power. The transmission technology suggested by Petitioner does not appear to have an inherent ability to reduce or eliminate the effects of multipath or terrain/building shadowing. Thus, terrestrial repeaters operating on the same channels as satellite downlink channels may interfere with each other, reducing potential spectrum efficiency. If the terrestrial repeaters operate on different channels, spectrum efficiency is even further reduced because a single DAB program would be receivable on more than one channel at a particular location.

Petitioner's suggested use of a complex four-antenna space diversity system^{28/} as a means to reduce multipath/fading

^{26/} See, e.g., Notice of Proposed Rule Making in Gen. Docket No. 90-217, 5 FCC Rcd 2766 (1990).

^{27/} See Comments of NAB in Gen. Docket No. 90-217, filed June 29, 1990.

^{28/} Petition, supra note 1, at 10.

effects is hardly a viable solution. Except for a very few high-end model receivers, even two-antenna space diversity systems for FM broadcast reception have not proven to be economical for the mass market of consumer receivers. Four-antenna space diversity is a "blue sky" technical response, offered "free" by Petitioner, in the hope that unsophisticated policymakers would believe that Petitioner's proposal is technically sound.

It is much too early in the debate -- a truly global debate -- to decide on a single set of key parameters. We have no agreement in the United States as to the amount of bandwidth necessary per channel, nor as to the total amount of bandwidth needed or the location of the band to be used for any satellite or terrestrially delivered DAB service. In fact, the policy proposals of Petitioner in these areas are completely arbitrary. Satellite CD proposes only one such band and one service configuration (service to three geographical areas from two satellites).^{29/} The Commission should not proceed with any allocation of spectrum until more information is obtained as to frequency options and bandwidth requirements. Whether or not spectrum sharing with other services is a viable possibility also needs consideration. Satellite CD acknowledges that its satellite service needs totally new spectrum and that it cannot share with existing communications systems. But further study is needed. Petitioner's application is simply premature.

^{29/} Id. at 9-10.

There is also a question as to whether a digital satellite service would be able to deliver a satisfactory service to urban areas. If not, a number -- perhaps hundreds or thousands -- of terrestrial "repeaters" would have to be installed in order to fill in the service gaps and ensure the availability of broadcast-quality coverage. It seems that creating a separate terrestrial broadcast system simply to provide the identical service to urban areas that would theoretically be offered to rural areas would be uneconomic and a waste of spectrum. Urban populations constitute approximately 74 percent of the total U.S. population^{30/} and advertiser supported broadcasting must be able to serve that audience.

Hence, by definition, perhaps as much as 74 percent of the population would have to be served primarily by terrestrial transmitters -- not by satellite. The satellite signals to those areas -- and the spectrum that would be used -- would be largely wasted and could become potential sources of interference to other services. The efficiencies and impact of this necessary but duplicative service and the problems of coordination, need careful study.

Indeed, a decision to offer digital radio by space satellite automatically amounts to a decision to use spectrum inefficiently from the perspective of providing diverse programming to listeners. Whereas a space satellite channel of

^{30/} 1980 Census of Population, Volume I, Characteristics of Population, Chapter C, General Social and Economic Characteristics, Part I, U.S. Summary, Document No. PC 80-1-C1, 1-15.

programming would yield only a single programming choice over a wide geographic area, terrestrial use of the same channel would yield additional choices, because the channel could be "reused" across the region. NAB plans to offer additional discussion of this spectrum efficiency issue in its comments in the Commission's DAB inquiry.

On a related issue, the actual Satellite CD proposal appears to impose a severe limitation on existing aeronautical telemetry operations now occupying this band.^{31/} Aeronautical telemetry operations currently use the proposed frequencies in major urban areas that includes Annapolis, Pensacola, Dayton, Boston and Washington, D.C. The Satellite CD Supplement to Petition for Rule Making provides some further information on how it intends to displace these facilities with "minimal disruption."^{32/} However, this allegation needs more careful analysis, as do the claims regarding aeronautical telemetry facilities listed in the government Master Frequency File.^{33/}

Indeed, the Satellite CD proposal might even require a displacement and relocation of existing service. NAB, whose members are existing users of valuable spectrum, is most sensitive to the risks created by applicants for new spectrum who extol the virtues of untried and untested services. NAB suggests that an extremely high threshold showing of compelling need be

^{31/} Petition at 15-17.

^{32/} Supplement to Petition for Rule Making, supra note 1, at 4-6.

^{33/} Id.

demonstrated before commencing rulemaking on a new service. Such a showing has clearly not been demonstrated here.

Another important consideration, as to whether to initiate rulemaking, is the fact that this is a very attractive band, heavily used at present and subject to many new demands. These new demands, however, would be ignored by the rule making sought by Satellite CD.

Finally, NAB notes the proposal by Satellite CD to allocate 10 MHz of bandwidth for exclusive terrestrial broadcast use. This terrestrial proposal has no relevance to the Satellite CD proposal for a satellite-delivered service (supplemented by terrestrial repeaters).

NAB urges that any Commission consideration of petitioner's proposal for a satellite system be on its own merits, and separately from consideration of a terrestrial system. However superficially attractive a "hybrid" system appears, satellite and terrestrial joint use of L-band frequencies would significantly discriminate in favor of the satellite service, and against a terrestrial service. While L band may be useful for satellites, it is very unsatisfactory, and perhaps unusable, for terrestrial service. Viable terrestrial

service should be attempted, if at all, at lower frequencies.^{34/} The Commission must carefully analyze the technical and policy consequences of a hybrid service at L-band. With current technology, there is no reason to compel the use of the same frequency band for both satellite and terrestrial uses.

Studies of the kinds of issues discussed above are critical preconditions to the institution of any kind of rule making. The broadcast industry has long favored improvements in technology designed to better serve its audience. It is possible that terrestrial digital audio may provide another such opportunity. But an adequate record of testing and experimentation is a prerequisite for spectrum allocation. The Commission's Notice of Inquiry^{35/} is but a first step to creating such a record; granting the instant Petition would place the cart well before the horse.

IV. CONCLUSION

For the reasons stated above, and which will be expanded upon in the comments NAB will be filing in the Commission's inquiry on DAB, we urge the agency to dismiss or


^{34/} See, e.g., Reference Data for Radio Engineers, Recommendations and Reports of the CCIR, Volume V, "Propagation in Non-ionized Media." This volume is replete with data showing superior propagation and performance, ideal factors for wide area coverage by broadcasting systems, at lower frequencies. See, e.g., Rec. 370 and Report 239-6. See also Longley, A.G. [May, 1976] "Location variability of transmission loss . . . land mobile and broadcast systems," Office of Telecommunications, Rep. PB 254472, National Technical Information Service.

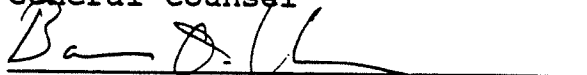
^{35/} Notice of Inquiry, supra note 2.

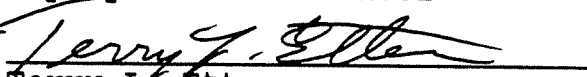
simply defer consideration of Petitioner's requests. Indeed, we urge the Commission to defer any such considerations of domestic spectrum allocation or authorization of service pending not only completion of the digital radio inquiry and WARC-92 preparatory activities but also completion of the WARC-92 conference and any associated planning conferences. To do otherwise would compromise considerations of reasoned spectrum planning and rational communications policy development; a decision to establish a new broadcasting service is not to be taken lightly or on a piecemeal basis.

Respectfully submitted,

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APPENDIX II

Comments of the National Association of Broadcasters
in Gen. Docket No. 90-357

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)
)
Amendment of the Commission's Rules) Gen. Docket No. 90-357
with Regard to the Establishment)
and Regulation of New Digital Audio)
Radio Services)

**COMMENTS OF THE
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EXECUTIVE SUMMARY

The National Association of Broadcasters ("NAB") urges the Commission to give thorough, in-depth study to all regulatory, engineering and service aspects of digital audio broadcasting ("DAB") technology and related matters. This DAB assessment, in both this inquiry and the inquiry relating to the 1992 World Administrative Radio Conference, will prepare the Commission and this nation to adopt DAB policies that are consistent with rational, established communications policy.

DAB, if inaugurated in this country, should be instituted on a terrestrial-only basis. Under this system, existing AM and FM radio station licensees would be given first opportunity to employ such digital audio technology. A grant of such opportunities would be lawful and consistent with existing Commission policy -- and would best foster market acceptance of DAB.

The Commission should consider DAB as simply another "enhancement" of existing radio broadcast service -- the implementation of which need not require the use of novel procedures or policies. Instead, traditional broadcast-related allocation and assignment policies should govern the introduction of DAB.

These NAB comments offer initial guidance on several of the technical and signal coverage issues that arise from the exploration of DAB technology. NAB has commissioned an in-depth study of these issues and hopes to present these data to the Commission near the end of the calendar year. This information will cover, among other things, the spectrum demands of a nationwide terrestrially-based DAB service. However, concerning UHF spectrum, NAB reiterates its belief that such spectrum should continue to be reserved for the implementation of advanced television service.

NAB's comments also address -- and strongly oppose -- the efforts of the Recording Industry Association of America to impose new FCC regulatory burdens and programming restrictions related to the broadcast of digital audio.

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)	
)	
Amendment of the Commission's Rules)	Gen. Docket No. 90-357
with Regard to the Establishment)	
and Regulation of New Digital Audio)	
Radio Services)	

**COMMENTS OF THE
NATIONAL ASSOCIATION OF BROADCASTERS**

I. INTRODUCTION AND SUMMARY

The National Association of Broadcasters ("NAB")¹ hereby submits its comments in response to the Commission's Notice of Inquiry² in the above-captioned proceeding.

As world consumer markets increasingly embrace digital technology, it follows that the broadcasting systems of the world would also seek to take advantage of new and improved technical means for delivery of radio programs. The American broadcasting system is not unique in this regard. NAB, representing the vibrant, diverse and successful American broadcasting system, seeks to participate actively in the development of digital audio broadcasting ("DAB") policies. We support study of DAB; we support consideration of DAB implementation on terms that are minimally disruptive for existing AM and FM broadcasters, their communities and listeners; we support development of digital radio technologies and urge study of available spectrum; and,

¹NAB is a nonprofit, incorporated association of radio and television broadcast stations and networks. NAB serves and represents America's radio and television stations and all the major networks.

²Notice of Inquiry ("Notice") in Gen. Docket No. 90-357, 5 FCC Rcd 5237 (1990).

most importantly, we support technical improvement of radio service to listeners nationwide.

These comments underscore and expand upon the positions NAB already has taken in response to a petition for a rule making submitted earlier by Satellite CD Radio, Inc.³ Here NAB again asks the Commission to give thorough, thoughtful study to digital audio broadcasting technology and related policies. This assessment should take place in this proceeding and the related proceeding the Commission has instituted to help prepare itself and the nation for the 1992 World Administrative Radio Conference.⁴ During the pendency of this assessment, the Commission should not authorize digital audio broadcasting services until carefully reasoned rules and policies are adopted.

Concerning this choice between terrestrial and space satellite delivery, NAB again emphasizes its support for -- and the statutory basis for -- a terrestrial-only system, were digital audio broadcasting inaugurated in this country. Only through a terrestrial distribution mechanism would the Commission be able to foster concepts of broadcast localism and the delivery of radio service designed to be responsive to the needs, interests and problems of our many and diverse communities.⁵ Indeed, satellite-delivered digital audio would do very little to foster these statutory goals.⁶

³Public Notice, "Office of the Secretary: Petitions for Rule Making Filed," June 18, 1990. In this Public Notice the Commission asked for comment on the Petition for Rule Making (RM-7400) submitted by Satellite CD Radio, Inc. See also Comments of NAB in RM-7400, filed August 20, 1990. We incorporate by reference the position taken by NAB in these earlier comments.

⁴See Second Notice of Inquiry in Gen. Docket No. 89-554, 5 FCC Rcd 6046 (1990).

⁵See, e.g., § 307(b) of the Communications Act of 1934.

⁶See Remarks of Alfred C. Sikes before the National Association of Black Owned Broadcasters, Sept. 27, 1990, at 4. Here Chairman Sikes noted that with a satellite DAB service, "there is relatively little likelihood it would -- or could -- provide the kind of local
(continued...)

In response to the Commission's suggestions in the Notice,⁷ we believe that any introduction of digital audio broadcasting in this country should be undertaken by providing digital audio opportunities to the licensees of existing AM and FM, commercial and non-commercial, radio broadcast facilities. This should be a necessary premise to the introduction of U.S. digital audio broadcasting. These broadcasters, with established track records of providing locally-oriented public service, should be given the opportunity to employ digital audio technology as yet another method of enhancing their public service operations. Such a policy would be similar to that the Commission has espoused for the "homesteading" of the expanded AM band.⁸ It also is supported by relevant judicial precedent.⁹

A central focus of any agency inquiry into the prospects for DAB must hinge upon the availability of spectrum for such a service. As discussed in detail below, NAB has commissioned studies designed to answer these central questions. We also have appointed a blue ribbon task force of NAB Board members to address the myriad DAB issues evolving in government and industry. These studies and analyses will help the broadcasting industry and the Commission assess the various alternatives for implementing digital audio broadcasting. NAB's studies will examine a variety of spectrum segments with the potential to afford DAB opportunities for existing

⁶(...continued)
news, information, and public affairs upon which so much of our broadcast culture now rests."

⁷Notice, supra, note 2 at ¶ 11.

⁸See, e.g., Notice of Proposed Rule Making in MM Docket No. 87-267, 5 FCC Rcd 4381 (1990), ¶¶ 64-99.

⁹See, e.g., National Black Media Coalition v. FCC, 822 F.2d 277 (2nd Cir. 1987).

broadcasters. We also are examining allocation techniques which would attempt to replicate existing broadcast service areas. However, with regard to the prospective availability of UHF television spectrum, NAB continues to support the reservation of this spectrum for advanced television service in the United States.¹⁰ UHF-TV spectrum should not be considered as an available alternative for digital audio broadcasting.

Additionally, NAB has reviewed many of the comments that already have been filed in the record of this proceeding.¹¹ Below, we respond to some of these filings, especially that filed by the Recording Industry Association of America ("RIAA"), NAB below offers its strongest possible opposition to RIAA's suggestion that the Commission adopt an artificial and unsound set of quasi-copyright rules and policies. Acceptance of these RIAA notions would be totally at odds with reasoned communications policy. As set forth below, NAB finds that RIAA, and those it represents, have several other alternatives for achieving their goals.

II. IN-DEPTH CONSIDERATION OF DAB IS IN THE PUBLIC INTEREST.

In the Notice, the Commission correctly suggests that digital radio technology could offer the potential for a significant improvement in the sound quality

¹⁰See Tentative Decision and Further Notice of Inquiry in MM Docket No. 87-268, 3 FCC Rcd 6520 (1988).

¹¹On Oct. 9, 1990, the Commission extended the date for the filing of comments in this proceeding. This extension of time was in response to a Joint Request for Extension of Comment Deadlines submitted October 5, 1990, by NAB, the Association of Independent Television Stations, the Association for Maximum Service Television, Inc., Bonneville International Corporation and Tribune Broadcasting Company. However, despite this extension of time, many parties already have submitted their initial comments in this proceeding.

of radio programming. Indeed, it is this pursuit of enhanced quality that has guided the Commission in several recent proceedings. Among these are proceedings dealing with AM Improvement¹² and advanced television.¹³

The Commission's statutory responsibility to study the uses of radio¹⁴ supports reasonable pursuit of technological innovations that can be implemented in a fashion that will enhance, rather than negatively impact, existing communications service. Also, NAB believes that any pursuit of digital audio broadcasting by the Commission should not be at the expense of AM radio improvement. That is, NAB strongly supports the concept of improving the AM radio medium and, in addition to participating in FCC proceedings in this regard, has undertaken a series of industry-based steps aimed at complementing federal regulatory changes also aimed at improving AM radio.¹⁵ The timetable and overall prospects for digital audio broadcasting are still indefinite. As such, the Commission should continue its ongoing efforts to improve conventional radio broadcasting services. Moreover, by strengthening the existing AM and FM radio system, the Commission will better equip these existing licensees with the resources needed to pioneer digital audio broadcasting.

¹²See Notice of Proposed Rule Making in MM Docket No. 87-267, supra note 8.

¹³See Notice of Inquiry in MM Docket No. 87-268, 2 FCC Rcd 5125 (1987).

¹⁴See § 303(g) of the Communications Act of 1934, 47 USC § 303(g).

¹⁵For example, NAB was a partner, with the Electronic Industries Association ("EIA") in developing the several National Radio Systems Committee Standards for AM radio. We also are working with the EIA to develop a certification mark program for AM radio receivers.

A. Digital audio broadcasting should be considered as an "enhancement" of existing radio service.

As acknowledged by the Commission in its Notice, the FCC is presented with several, varied alternatives for introducing digital audio broadcasting in this country.¹⁶ In addition to promoting a satellite, a terrestrial or a hybrid approach, these proposals also suggest use of common carrier regulatory approaches as well as more conventional Title III broadcast licensing.

We believe that DAB simply can be another in a series of enhancements of conventional AM and FM radio broadcast service. To the original AM and FM broadcast transmission service, the industry and FCC have added AM Stereo, FM Stereo, FM Subcarrier Authorizations, FMX technology, and assorted remote control and telemetry technologies. The broadcasting industry would like to consider enhancing the delivery of audio programs with DAB technology. The industry should be permitted technically to evolve and take advantage of superior transmission technologies without unduly disrupting the public's current receipt of radio service. If the FCC fails to treat DAB as an enhancement of existing radio service, the broadcasting industry will have less of an incentive to make available digital transmission technology as soon as possible. For these reasons, the Commission should not feel compelled to employ a radically new

¹⁶See, e.g., Petition for Rule Making (RM-7400), supra, and June 22, 1990, Supplement to Petition for Rule Making, each filed by Satellite CD Radio, Inc.; Application of Radio Satellite Corp. for Authority to Construct and Operate a 3.5 Meter KU-Band Transmit-Receive Earth Station, filed May 22, 1990; Application for Authority to Construct or Make Changes in an International or Experimental Broadcast Station, filed May 23, 1990, by Strother Communications, Inc. ("Strother"); and Petition for Rule Making filed by Strother on July 26, 1990. See also Satellite CD Radio, Inc. Application for a Digital Audio Radio Service Satellite System (File Nos. 49/50-DSS-P/LA-90, 58/59-DSS-Amend-90), FCC Public Notice No. D5-1015, released Oct. 19, 1990; Strother Supplement to Petition for Rule Making, filed Sept. 5, 1990.

regulatory approach toward implementation of digital audio service; the existing regulatory framework has worked well, and we see no reason to depart from established procedure, law and policy.

B. The Commission should analyze all aspects of DAB technology.

The Notice recognizes the need to obtain complete information on DAB through its solicitation of information on many DAB facets, including DAB's potential for improved quality and service, its impact on existing radio services, implementation scenarios and regulatory issues. NAB welcomes these Commission efforts to develop a full, wide-ranging record on DAB issues. A thorough discussion of these factors will help clarify the desirability and public interest benefits of DAB. NAB urges the Commission to give DAB the same careful scrutiny and study it would any other proposed new enhancement, weighing the appropriate costs and benefits associated with its potential implementation.

C. Performance Benchmarks Are Needed To Properly Evaluate DAB.

The Commission requests information on whether technical performance benchmarks should be used to judge the degree of improved audio quality provided by DAB.¹⁷ NAB offers, in Table 1, below, some general comparisons of the technical quality provided by various audio services.

¹⁷Notice, supra note 2, ¶9.

TABLE 1

Technical Comparison of Audio Services

<u>Parameter</u>	<u>AM</u>	<u>FM</u>	<u>TV</u>	<u>CD</u>	<u>DAB</u>
frequency response (Hz)	50-10k	50-15k	50-15k	20-20k	20-15k/20k*
stereo separation (dB)	40	50	30	80+	80+
dynamic range (dB)	50	60	60	80+	80+
signal/noise ratio (dB)	50	55	55	90+	90+
interference performance	poor	fair	fair	----	*
multipath performance	----	fair	good	----	good*
fading performance	fair	fair	fair	----	good*

* - system dependent

Source: NAB Science and Technology

From these general features, the greatest advantages DAB would offer the radio listener are its potentially greater frequency response, stereo separation, dynamic range, signal-to-noise ratio and multipath performance (for some systems) -- rivaling the listening experience provided by compact discs. The Commission should carefully consider all these factors in an assessment of DAB transmission technology.¹⁸

¹⁸Some factors, such as multipath performance, are likely to be more important to broadcasters, especially FM broadcasters, than other factors, such as frequency response. Multipath interference is an acute problem, while few FM listener complaints are lodged because of poor frequency response, which should not be surprising. The actual listening environment for radio (often an outdoor location or automobile) often does not support full "CD" quality sound; and human sensitivity to high audio frequencies diminishes with age. International standards on hearing thresholds up to 6 kHz in frequency show more than 17 dB loss between the ages of 30 to 60 years. See International Standard "Acoustics - Determination of occupational noise exposure and estimation of noise-induced hearing impairment," ISO 1999:1990-01-15, at Annex B. More recent high frequency studies show a hearing loss of up to 30 dB in the frequency range of 15 kHz to 20 kHz between the ages of 18 to 26 years. See "High-frequency Audiometric Assessment of a Young Adult Population," Green, David M., *et al.*, Journal of the Acoustic Society of America, February, 1987, Vol. 81, at 485-94.

Besides technical issues, listener habits may also influence the Commission's consideration of system design. For example, if the intended DAB audience is primarily in automobiles or using portable receivers, then the ambient noise levels in those environments would greatly mask the desired DAB features of enhanced dynamic range and signal-to-noise ratio and, thereby, limit DAB's technical appeal. If, instead, the intended audience is primarily at indoor locations, then technical planning factors and assumptions could be defined (e.g., receiver performance, antenna characteristics, coverage areas and population, etc.) to properly design the desired technical performance objectives and maximize both quality and service to the public. Only 27.9% of the existing radio audience is in automobiles throughout all day-parts, with 47.6% listening at home and 24.4% at "other" locations (primarily in the office).¹⁹

Finally, features unique to DAB -- especially the potential for elimination of multipath and fading interference -- must become significant factors in the Commission's analysis; these features offer unique benefits and can be marketed in ways that enhance the prospects for rapid public acceptance of DAB. Thus, the Commission should view the establishment of a new DAB service based on an overall analysis of system design, with emphasis on the performance features unique to DAB.

¹⁹See Radio Facts For Advertisers, 1989/1990, Radio Advertising Bureau, Inc., New York, N.Y.

D. Coverage estimates for digital systems must use more appropriate technical assumptions

The Commission requests information on predicting the coverage areas provided by DAB.²⁰ For the reasons discussed below, the Commission should revise its propagation curves and service assumptions prior to adopting rules that would enable prediction of the coverage of DAB systems.

NAB has performed initial work that estimates the power and coverage potential of a terrestrially based DAB system, using as a model the Eureka-147 DAB system -- a system that provides 14 stereo programming channels in a 3.5 MHz wide channel.²¹ NAB's study shows that using a 1,000 watt effective radiated power will provide a maximum coverage radius of approximately 43 miles at 100 MHz, and 31 miles at 500 MHz. However, unlike AM, FM or TV signal degradation in the presence of increasingly weaker signal carrier-to-noise ratios, a digital signal may degrade abruptly once a signal level decreases below a threshold for an acceptable bit error rate. For prediction of digital audio broadcasting coverage, NAB's study suggests that use of higher probability location and time variability factors are warranted than are now assumed in the current F(50,50) propagation curves. This study also suggests that further work should include the study of frequencies above 1 GHz. Further details on these DAB coverage matters are provided at Appendix A to these comments.

²⁰Notice, supra note 2, ¶ 10.

²¹See Rau, M.C., Claudy, L.D., Salek, S., "Terrestrial Coverage Considerations for Digital Audio Broadcasting Systems," September 6, 1990, presentation to the fall Broadcast Symposium of the IEEE Broadcast Technology Society. This report appears at Appendix A to these Comments.

III. MANY FACTORS SUPPORT COMMISSION ESTABLISHMENT OF TERRESTRIAL-ONLY DAB SYSTEMS.

Establishing a new high quality sound broadcasting service via terrestrial-only methods has numerous advantages over satellite or satellite/terrestrial hybrid delivery systems. Below, NAB provides below a preliminary analysis of these policy, economic and technical considerations, and presents a rationale in favor of terrestrial digital audio broadcasting. As developed herein, satellite sound broadcasting -- direct-to-the-listener -- cannot, by its nature, provide programming oriented towards the needs of local communities. The provision of new sound broadcasting services would be far better implemented, from a policy, economic and technical view, through a terrestrially-based system. Thus, a terrestrial approach to DAB should be preferred by the Commission. "CD-radio" can be delivered terrestrially in less radio spectrum, with more program and ownership diversity, with the same technical quality as a satellite-delivered service, and without risking the viability of the entire U.S. radio industry.

A. Commission policies should favor local, free, over-the-air broadcasting.

The current radio broadcasting system in the United States is based on certain major policy premises that encourage (1) promotion of diverse locally-based programming that is only available on local terrestrial channels, and (2) the provision of the best technically available service. Accordingly, local or sub-regional coverage by terrestrially-based transmitters is limited in order to promote both spectrum efficiency and to advance this concept of "localism," resulting in programming of news, information and entertainment oriented to the unique needs of the community served.

National programming is today available via the national radio network industry. Many local stations are affiliates of one or more networks, and clear national news and special reports as part of their particular, market-driven mix of national and local programming. The network/local affiliate system works very well; the network supplies news that often is collected from affiliate stations. The existence of local affiliates strengthens the radio network and, in turn, the local affiliate receives quality national news and special programming.

Terrestrial broadcasting -- whether or not using advanced technologies -- better promotes the statutory goal of advancing broadcast localism than would a satellite service.²² Unlike BSS (Sound) -- broadcast via satellite directly to the nation's homes and listeners -- local broadcast stations fulfill Congressional localism directives. These stations hold public interest obligations to provide responsive, locally-oriented programming to their respective audiences. Moreover, enhancement of local broadcast signals would provide even greater incentive for the public to access the local news and information provided by these local broadcasters. Under this policy and regulatory framework, existing radio broadcast stations today provide extensive service to the American public.²³ No change in the Commission's policy of promoting broadcast localism is warranted.

²²See Section 307(b) of the Communications Act of 1934, as amended.

²³The American public is well served by the ever increasing number of over-the-air radio stations. The average U.S. county receives signals from 26.4 stations, with even the smallest counties (1,000 or less of population 12 years of age or older) receiving on average 10.5 stations. In the largest counties (i.e., more than 500,000 in 12+ population), the average number of stations received was 81.4. NAB National Radio Listening Study, November 2, 1988.

B. Commission DAB policies should be designed to minimize the economic impact on local radio stations and existing national networks.

Spectrum needs for any new satellite sound broadcasting service or terrestrially-based broadcasting service, using any number of intriguing new advanced technologies, have not yet been demonstrated definitively. Nor is the relative spectrum priority of any new digital audio broadcasting service vis-a-vis other communications services. However, if such a DAB satellite service were to be allotted precious spectrum resources, a critical aspect of the resulting policy that demands to be considered, at length, prior to any decision, is the potential economic impact of such a service on existing broadcast services.

Obviously, there is considerable uncertainty regarding the technical specifications and/or the regulatory framework that would apply to a new satellite sound broadcasting service -- both of which significantly would affect future market conditions. Consequently, any determination today of the economic impact of a new satellite service on current radio services only can be speculative. However, a few observations about possible market directions are possible at this time.

Generally, satellite applications in the 1990s will continue to be constrained by the limits of current technology (i.e., encouragement of general operations that offer point-to-multipoint services). Even with the pending launch of a new generation of satellites equipped with multiple, shaped spot beam capabilities, transmissions are likely to be geographically limited to footprint coverage areas greater than 500,000 square kilometers. As a result, satellite sound broadcasting services obviously are to be anchored on national or regional distribution architectures.

Any success of satellite-based audio broadcast services would likely be at the expense of local broadcast stations, in that satellite services would affect the amount of advertising placed on local radio stations, and the related cost of air time on the station's rate card. Due to the inherent non-local nature of satellite-distributed services, if commercial satellite audio broadcasting services were to be based on advertising, rather than on subscription fees, a substantial percentage of the revenues would likely come from existing national and/or regional advertisers. Consequently, the existing foundation of advertising revenues, supporting current local radio services, would be affected, perhaps significantly.

The radio industry's share of all U.S. advertising expenditures is estimated at 6.7 percent for 1990, fluctuating in the 1980s within a range from 7.0 percent in 1982 to 6.6 percent in 1987 and 1988.²⁴ Current radio advertising revenues total \$8,420 million annually, with almost one-fifth -- 18.2 percent -- coming from national and regional advertisers.²⁵

Should radio's national/regional advertising revenues migrate to new satellite-delivered audio services, conceivably this could translate into a potential loss of almost a fifth of the total economic base of the entire radio broadcasting industry in the United States. While total loss of all national/regional revenues is possible, a more likely scenario is a loss of an increasing percentage of national/regional ad dollars. The

²⁴McCann-Erickson, Robert Coen, 1990 advertising estimates.

²⁵Radio advertising revenues for 1989 totalled \$8,420 million, divided by source as \$1,530 million national/regional (spot) (18.2%), \$6,463 million local (76.8%) and \$427 million network (5.0%). Radio Facts For Advertisers, 1990, Radio Advertising Bureau, New York, NY.

negative effects of incremental losses cannot, and should not, be minimized as they very quickly also could lead to severe deficits for radio.

Financial profits for the entire radio broadcasting industry would drop to zero if less than a third of radio's present national/regional advertising revenues were diverted to a satellite-delivered service. Considering that radio's national/regional advertising revenues for 1989 totalled \$1,530 million, loss of only 30 percent of these revenues (\$459.0 million) would more than negate the entire \$450.5 million profit realized by the radio industry in 1989.²⁶

The viability of local radio stations in the United States could be seriously threatened by major advertising market realignments caused by communications policies promoting two rival radio distribution markets -- one local, and one national/regional. The effect of heavy losses in national/regional revenues would not likely be evenly distributed among local broadcasting stations. The impact would most likely fall hardest on the class of stations most vulnerable at this time -- AM stations.

The already fragile economic condition of AM stations makes them acutely vulnerable to bottom-line pressures that could result from major media advertising shifts prompted by the availability of direct satellite audio services. The fragility of AM already is well recognized, as about 1 in 20 licensed AM stations -- about five percent of all AMs -- are listed as dark, according to the FCC's own Mass Media Bureau.²⁷

²⁶ 1990 NAB/BCFM Radio Financial Report, National Association of Broadcasters, Washington, DC.

²⁷ Federal Communications Commission, Mass Media Bureau, reported the number of stations dark as: 246 AM, 17 FM, 20 UHF-TV, 0 VHF-TV, Broadcasting, October 1, 1990.

In 1989, the profit margin of the average radio station was a modest 5.35 percent, down from 6.9 percent in 1988. In separate categories, the average profit margin in 1989 for FM stations was 5.1 percent; for AM/FM stations the average profit declined to 3.9 percent, and for AM daytimers the average profit margin dropped precipitously to a negative 5.4 percent.²⁸ With this as the baseline financial outlook today, the potential impact of considerable revenue losses from new satellite radio broadcasting services is of major concern for the nation's AM stations, as well as for many FM stations.

Some discussion is warranted regarding the suggestion that "new" advertising sources will somehow surface with the introduction of a satellite-delivered radio service. Proponents of satellite-delivered DAB assert that a whole "new" segment of advertisers will emerge and, therefore, the economic viability of satellite-based advertiser-supported radio services will not be at the expense of local radio broadcasting services.

Today, total advertising revenues from all media sources in the United States continue to expand, although this expansion has been at a much slower rate in recent years. From 1980 to 1985, total U.S. advertising revenues increased at a compound annual rate of 12.1 percent. However, the rate of growth declined by almost half to 6.9 percent in the 1985-1990 period. This general pattern applies also to radio

²⁸1990 NAB/BCFM Radio Financial Report, National Association of Broadcasters, Washington, DC.

advertising revenues where the compound annual rate growth was 11.9 percent in the early 1980s, dropping to only 6.4 percent in the last five years.²⁹

In terms of absolute dollars, the total U.S. media advertising pie continues to grow. But the recent declining rate counters suggestions that advertising dollars entering the market from "new" advertisers will be robust. Rather, the amount of advertising expenditures from "new" sources is likely to be fairly limited, if such sources emerge at all. One final point: given the overall financial outlook for the foreseeable future, a tightening economic market also may mean lower financial margins for all businesses. In such a climate, existing advertising sources as well as budgets may constrict, and new entrants in the advertising market are not apt to materialize to support untested new media. Thus, with the advent of a satellite-audio service configured on a nationwide distribution model, financial support is more likely to be siphoned from radio's national advertising base rather than from new, unknown and unidentified sources.

In comparison to new satellite-based audio broadcasting services, however, new local terrestrially-based digital audio broadcast services could be expected to share, and perhaps enhance, the existing pool of advertising revenues available now to radio broadcast stations. Quantification of the economic impact of new local terrestrial digital radio stations will require future study. Such digital radio operations could technically improve the delivery of local broadcasting services. And, as complementary services, terrestrial operations would comprise less of a threat to the economic viability of existing stations than national/regional satellite radio services. Indeed, were current terrestrial

²⁹Id.

stations able to operate in the digital mode, these stations' economic viability likely would increase -- perhaps significantly.

C. Consumer expectations/demands should be assessed carefully.

Much has been made of the growing consumer demand for higher quality audio products and services, with digital-based technologies being the primary force behind these consumer demands. Digital compact disc players are now in 22 percent of all U.S. households, rising from a mere 2 percent household penetration level in 1986. Digital audio tape ("DAT") equipment, only recently available in the U.S., also is poised for rapid consumer acceptance.

Despite the introduction of these and other non-broadcast audio and video services, the overall level of radio listenership has remained fairly steady.³⁰ However, the introduction of a new, national radio broadcast competitor could be expected to have a more direct effect on audiences and advertisers than any of today's non-broadcast media services. The system and concept of broadcasting is well-known and understood by American audiences. Due to this familiarity factor alone, satellite-delivered digital audio services may have an edge in competing with non-broadcast distribution media. And more to the point, services that generally sound, operate, and are received over-the-air, "just like radio," on automobile, home stereo, and portable receivers, might attract specific segments of the listening audience (i.e., especially those in mobile vehicles) and thus affect local broadcasting stations much more than do CDs, DAT or new cable audio services.

³⁰ The Arbitron Co. reports the level of radio listening per day for audiences ages 12 years old and over as: Spring 1989 - 3 Hrs:42 minutes,; Summer 1989 - 3:39, Fall 1989 - 3:31, Winter 1989 - 3:40, and Spring 1990 - 3:30.

Again, the burden is not likely to be evenly divided; it would likely fall on stations located in very rural or mountainous regions of the country, as well as on those in smaller markets, many of which are now providing the only local services available to the communities they serve.

As a national sound broadcasting service, satellite systems would have no incentive for programming news, information, or entertainment oriented towards serving the needs of a local community. Such local service is an integral element, and a statutorily-mandated regulatory responsibility, of all terrestrial broadcast stations in the United States. Broadcast licenses are awarded for local operations, contingent upon a demonstration of providing continuing service directed to meeting the needs of the community served.

Without such broadcast obligations, it would be a "free ride" for satellite "broadcast" services. To exploit 50 years of audience familiarity with American radio broadcasting, and second, to cream skim and/or cherry pick among lucrative advertisers and key audience segments, would all be at the expense of, and with detriment to, one of the proudest traditions in U.S., and world communications -- free, local radio broadcasting.

D. DAB spectrum requirements deserve in-depth study.

The spectrum requirements for a new satellite, satellite/terrestrial hybrid, or terrestrial-only broadcasting system are far from certain. However, some assumptions can be made at this time regarding terrestrial-only delivery methods.

A terrestrial-only method could re-use frequencies nationwide, since coverage and interference limitations could be well-defined, thus maximizing ownership diversity and program voices. If, for example, a DAB system were conceived to be a "replacement" system, accommodating all existing radio broadcast stations, technology exists to permit terrestrial DAB to operate with a total bandwidth that would be much less than full CONUS satellite service, which may require up to 60 MHz nationwide, with no U.S. frequency re-use possible.³¹ NAB is giving further study to total spectrum requirements for terrestrial DAB. (See Appendix B.) Additionally, satellite radio systems likely would require gap-fillers, or terrestrial repeaters, to ensure broadcast-quality reception in urban or shadowed areas, adding to the expense of satellite audio systems. These satellite/terrestrial hybrid systems would require extensive use of terrestrial repeaters, perhaps totaling in the thousands, in all major urban areas.

NAB has initiated a study of the spectrum requirements for digital audio broadcasting, limiting it to: (1) use of the technology developed by the Eureka project No. 147 consortium; (2) terrestrial DAB applications; (3) application of DAB technology for existing AM and FM stations; and (4) locations in the spectrum where terrestrial DAB technology can be implemented. This study will presume that available DAB facilities will be segregated into an appropriate number of classes of facilities, in approximate proportion to the existing classes of AM/FM broadcast stations, and will analyze total spectrum requirements, frequency bands up to 2500 MHz, and compare these requirements with those proposed for domestic and international satellite digital broadcasting technologies. This study is scheduled for completion by the end of 1990.

³¹See Satellite CD Petition for Rule Making, *supra* note 16, at 26-29.

NAB intends to supplement the record of this inquiry proceeding with the result of this study. For the Commission's information, a copy of NAB's request for proposals in this study is attached as Appendix B.

Historically, one of the principal benefits of satellite distribution of broadcast signals is the increased quality that results from a well-designed satellite and its link budget. However, the technical quality of terrestrial digital radio systems can equal that of a digital radio satellite system. With the technology now available for digital broadcasting, it is not necessary to use satellites to deliver CD-quality audio. In brief, "CD-radio" can be delivered terrestrially, in less radio spectrum, with more program diversity, with the same technical quality as a satellite-delivered service and consistent with the localism policies of established communications law. In NAB's view, satellite digital radio is not needed by the United States and would not serve this country in the efficient manner as would terrestrially-delivered DAB. The Commission has full discretion to reject satellite-delivered DAB. And, while Section 307(b) of the Communications Act and the localism policies which have developed under this statutory direction may not totally bar the FCC from embracing satellite-delivered DAB,³² they certainly point instead to the comparative merits of a terrestrial-only system.

IV. EXISTING RADIO BROADCASTERS SHOULD HAVE PREFERRED ACCESS TO DAB.

In the Notice, the Commission asks for public comment on whether it should provide existing terrestrial audio broadcasters with a "migration or transition

³²See, e.g., National Association of Broadcasters v. FCC, 740 F.2d 1190, 1197-98 (DC Cir. 1984).

priority" in a new digital audio service.³³ NAB strongly supports this concept of existing station migration to DAB technology were DAB implemented in this country.

As noted above, NAB believes that the move toward digital audio broadcasting technology should be achieved in a fashion similar to that which has governed other enhancements to radio broadcast service. American broadcasters and this country's listening public each have a substantial stake in the existing broadcast system -- a system that should not be faced with substantial dislocation under any move toward digital audio broadcasting technology. Thus, the Commission should rely upon existing radio broadcasters to bring about these technological advances, an approach that is lawful³⁴ and similar to the Commission's policy that grants certain existing AM broadcasters a preference in vying for new FM facilities³⁵ and which the Commission has proposed for allowing existing AM broadcasters to "homestead" the expanded AM band.³⁶ In the event that this country will employ digital audio broadcasting domestically, then we urge the Commission to adopt policies that will take advantage of existing local programming expertise and the existing "revenue streams" of current

³³See Notice, *supra* note 2, ¶ 11.

³⁴The Commission is not barred from adopting this migration scenario by the Supreme Court's Ashbacker Radio Corp. v. FCC decision, 326 U.S. 327 (1945). The Supreme Court has held, in United States v. Storer Broadcasting Co., 351 U.S. 192 (1952), that the Commission may establish substantive criteria for applicants and dismiss ineligible applicants without holding a hearing. *Id.* at 193-97. The Commission, thus, has full authority to categorize existing AM and FM licensees as those parties qualified to apply for DAB facilities. See also Hispanic Information & Telecommunications Network, Inc. v. FCC, 865 F.2d 1289, 1294 (D.C. Cir. 1989).

³⁵See Second Report and Order in MM Docket No. 84-231, 101 FCC 2d 638 (1985); NBMC v. FCC, *supra* note 9.

³⁶See, e.g., Notice of Proposed Rule Making in MM Docket No. 87-267, *supra* note 8.

broadcast stations. As noted above, NAB is conducting technical studies to determine the technical and allocations policy aspects of affording each existing terrestrial radio broadcast station a digital audio broadcasting opportunity. Assuming that such studies will result in positive conclusions, then we recommend that the Commission, at least for the initial licensing of DAB operations, grant existing broadcasters the opportunity to occupy the band.³⁷

Such an approach makes good communications policy sense. Established broadcasters with knowledge of local communities will best be able to provide enhanced broadcast service to the listening public. Also, because it may be many years before enough DAB-capable receivers are in the hands of the listening public, prompt inauguration of DAB service, operating at the licensee's choice, and on a "simulcast" basis with the existing facility, will provide an orderly transition from analog to digital reception by the listening public.

At this juncture, at the inquiry stage of this initial assessment of digital audio broadcasting, it is not necessary for the Commission to consider the position it should take regarding continued AM and FM station operation. We take this view in large part because of the basic uncertainty as to the future of DAB. Our initial perception is that the strength of AM broadcasting -- the provision of radio service over wide geographic areas -- merits continued AM operation in this country. Similarly, because of the American public's substantial investment in current AM and FM

³⁷NAB notes that this position also has been taken in comments filed in this proceeding by, among others: Mount Wilson FM Broadcasters, Inc., filed Oct. 9, 1990; United Broadcasting Co., filed Oct. 11, 1990; and Universal Broadcasting Corp., filed Oct. 22, 1990.

receiving equipment, the Commission should be very hesitant in any consideration of whether to withdraw such broadcast service.

Insofar as the characteristics of DAB service areas are concerned, NAB currently is exploring the technical possibilities. That is, it may be that there would be sufficient spectrum to allow the Commission to "replicate" service areas of existing facilities, either through the use of higher powered DAB transmitters or through the use of multiple DAB transmitters to provide roughly the same service areas that existing licensees offer to listeners.³⁸

Finally, regarding existing broadcaster pioneering of DAB service, NAB would support the notion of existing non-commercial licensees having similar opportunities with digital facilities. Such a mechanism could amount to a "set aside" of certain DAB frequencies or, instead, the Commission could, were adequate spectrum provided, afford non-commercial as well as commercial broadcast licensees digital opportunities, regardless of the digital frequency ultimately assigned to each licensee.

V. SPECTRUM REQUIREMENTS AND SELECTION OF FREQUENCY BAND NEED FURTHER STUDY.

As discussed, supra, NAB is studying the total spectrum requirements needed to implement a terrestrial DAB system, including appropriate frequency bands. We expect to have the results of this study by the end of this year and, in the interim, we urge the Commission not to rush to any decisions on the critical issue of spectrum

³⁸Under one scenario, an existing licensee operating a wide area, analog station, could afford DAB service through a network of DAB transmitters that, as in cellular radio, would provide service to fixed and mobile listeners.

requirements and preferred frequency bands without establishing an extensive record upon which to base such decisions. Judgments about preferred frequencies for terrestrial DAB must be based on an overall analysis of system design, that includes performance tradeoffs among its various elements, including transmission antenna size and gain; coverage objectives; attenuation (free space, building, foliage); receive antenna size and gain; receiver performance assumptions; and, importantly, the technical features (modulation, encoding, interference impact, etc.) of the system to be used. Until these elements are studied further and defined, and mindful of the overall performance objectives to be achieved, NAB urges the Commission to keep open its options for preferred frequency bands.

However, one option proposed by the Commission for DAB -- using the UHF-TV band in the 728-788 MHz (television channels 57-66) range -- deserves discussion at this time.³⁹ Almost 100 existing television stations operate on these channels, distributed more or less uniformly throughout the United States.⁴⁰ These frequencies are critically needed to implement advanced television service to the public. Such availability must be preserved pending further developments in MM Docket No. 87-268,⁴¹ dealing with implementation of advanced television service in the United States. NAB urges the Commission to continue to reserve allocated UHF-TV spectrum for the needs of advanced television.

³⁹See Second Notice of Inquiry, Gen. Docket No. 88-554, supra note 4, ¶ 100.

⁴⁰See Broadcasting Yearbook, at C-95 (1990).

⁴¹See Notice of Inquiry in MM Docket No. 87-268, supra note 13; see also, Tentative Decision and Further Notice of Inquiry in MM Docket No. 87-268, supra note 10.

VI. THE COMMISSION SHOULD REJECT RIAA'S INVITATION TO ADOPT QUASI-COPYRIGHT AND/OR PROGRAMMING RESTRICTIONS ON DIGITAL AUDIO.

In its comments, the RIAA requests, inter alia, that the Commission condition the grant of digital audio broadcast licenses on requiring that licensees will "fully protect" copyright interests.⁴² Specifically, RIAA urges the FCC to

- 1) prohibit digital audio services from transmitting more than an individual selection from a particular album during a limited time period unless consent of the record owner is obtained;
- 2) require digital audio services to acquire licenses from the copyright owners of sound recordings they retransmit;
- 3) recommend to Congress that it grant public performance rights in sound recordings;
- 4) require digital audio services to transmit all subcode information embodied in recordings in usable form.

At the outset, NAB submits that much of what RIAA proposes is either clearly outside the FCC's jurisdiction and/or is of dubious constitutional validity. NAB is unaware of any provision of the FCC's jurisdictional mandate that would permit it, solely on the copyright rationale set forth by RIAA, to impose a requirement on a broadcast station limiting it to playing one cut from a disc or cassette, or which would require a broadcast station to acquire a license from the copyright owner of a digital audio sound recording prior to retransmitting it. As the Supreme Court held in Sony Corporation v. Universal City Studios, Inc., 464 U.S. 417, 431 (1984), "it [is] settled that the protection given to copyrights is wholly statutory [and that the] remedies for

⁴²See Comments of RIAA in Gen. Docket No. 90-357, filed Oct. 12, 1990, at 8.

infringement 'are only those prescribed by Congress'" (quoting Thompson v. Hubbard, 131 U.S. 123, 151 (1889)).

RIAA's assertion that the FCC's 1972 syndicated program exclusivity rules constitute a "similar regulatory system" to that which it is proposing, and that they were based on a similar rationale, is specious. The FCC's 1972 syndex rules were promulgated pursuant to its powers to implement communications policy and its ancillary jurisdiction over cable by remedying a situation in which "the broadcasting industry spent billions of dollars to create and purchase programming, [while] cable operators could retransmit those programs at their operating cost without making any payments to their program suppliers." Malrite TV of New York v. FCC, 652 F.2d 1140, 1145-1146 (2d Cir. 1981). Specifically, the rules were designed to give "program owners and broadcasters the ability to contract to exhibit their material on an exclusive basis"⁴³ or, in other words, to promote freedom of contract by allowing parties to enforce the exclusivity provisions of their contract. RIAA, on the other hand, is proposing that the FCC require a digital audio broadcaster to obtain a license, not required under the copyright laws, from a supplier which currently often provides his product gratis in the hopes the broadcaster will play it, and that the broadcaster be limited in the number of cuts it can play sequentially.

RIAA has provided no communications policy rationale to support its proposed new financial burdens on broadcasters, or which would justify placing new

⁴³See Notice of Inquiry and Notice of Proposed Rule Making in Gen. Docket No. 87-24, 2 FCC Rcd 2393, 2395 (1987).

limitations on broadcasters' programming discretion. In short, RIAA has established neither the jurisdictional basis nor the factual predicate for such regulation.

RIAA's mandatory licensing and "one cut" proposals also raise serious First Amendment questions. In this regard, RIAA is required to demonstrate that its proposals would promote "an important or substantial governmental interest . . . which translates in the rulemaking context into a record that convincingly shows a problem to exist and that relates the proffered solution to the statutory mandate of the agency." Home Box Office, Inc. v. FCC, 567 F.2d 9, 50 (D.C. Cir. 1977). As previously noted, RIAA has not related its proffered solutions to the FCC's statutory mandate. More significantly, it has failed totally to show that, in fact, a problem exists. Rather, its prayer for regulation rests solely on conjecture and speculation about the imminent demise of a multi-billion dollar industry resulting from a proposed technology for which spectrum has not yet been allocated. Accordingly, RIAA's proposals should also be rejected on the grounds that they are extraordinarily premature.

NAB also acknowledges that similar issues have been raised, on behalf of the RIAA, at the United States Copyright Office⁴⁴ and in the Congress.⁴⁵ In the Copyright Office Notice of Inquiry, soliciting comments by December 15, 1990, the public is asked to comment on seven specific questions relating to the copyright-related consequences of a move toward digital audio broadcasting. The Copyright Office also asks a series of questions concerning cable-related carriage of digital audio, the

⁴⁴See Notice of Inquiry in Docket No. RM 90-6, 55 Fed. Reg. 42,916 (Oct. 24, 1990).

⁴⁵See, e.g., S. 2358 and companion bill H.R. 4096, each titled the "Digital Tape Recorder Act of 1990." The bills were pending as the 101st Congress came to a close.

"scrambling" of broadcast signals and the possible imposition of "royalties" on the sale of blank tape and/or digital recording equipment.

The move toward digital audio broadcasting, while significant, is but another potential enhancement of the broadcast service. We do not view this enhancement as providing any foundation whatsoever for revisiting long-standing communications and copyright policies. Indeed, in both the near and long term, there undoubtedly will be other such technological improvements of broadcast services. But the FCC should not -- and cannot -- undertake an independent analysis of the copyright implications of each of these new technologies.

In particular, and although RIAA has not raised this proposal in the instant FCC inquiry, we strongly oppose the notion that digital audio broadcasting should operate only on an "encryption" or "scrambled" basis. To adopt such restrictions, the Commission would move in a direction completely opposite to that which the Communications Act directs it to proceed. This country's over-the-air broadcast service is based upon an advertising-supported and "free" system. To require the American public to pay directly for enhanced quality audio would appear strongly at odds with these basic statutory requirements. Moreover, any such limitations, be they of a quasi-copyright nature or otherwise, would pose serious implications not only for American broadcasting, but for the Commission's overall communications policy. That is, the matters raised by RIAA are not simply "copyright" issues. They go to the very heart of the domestic system of over-the-air broadcasting. Any adoption of the RIAA's principles here would have a direct adverse impact not only on broadcasters, but also on the listening public and on the Commission's statutory responsibilities.

As a further reason for rejecting RIAA's proposals, we note that bills recently pending in the Congress have addressed many of these concerns⁴⁶ and, based upon a recording industry and receiver manufacturer industry compromise, have proposed a copy code, technological mechanism to ensure reasonable limits on duplication of copyrighted works. Such a legislative solution -- which would allow limited copying, either from digital audio tape, over-the-air broadcasting, or other sources -- seems far preferable than to have the Federal Communications Commission adopt a contorted set of new regulations that (1) only would inhibit the establishment of a digital audio service and (2) would place untoward and unconstitutional limits on the broadcast of information to the American audience.⁴⁷

VII. CONCLUSION

For the reasons stated above, NAB urges the Commission to give a thorough assessment to the various policy and technical issues arising in this DAB inquiry. During the pendency of this inquiry and the Commission's inquiry involving preparations for the 1992 World Administrative Radio Conference, the Commission should not inaugurate any DAB services, until appropriate rules and policies have been adopted. Were the Commission to decide, following this inquiry and the completion of appropriate rulemaking proceedings, to inaugurate digital radio service in this country,

⁴⁶See id.

⁴⁷Also, it appears that RIAA has advanced yet another plan that would impose a 7.5% royalty on receiving equipment and a 1.2 cent per minute royalty on the sale of blank digital audio tapes and other recording media. See "Silence on Taping Fees," Television Digest, Nov. 5, 1990, at 16. Thus, it would seem that RIAA, and those whom it represents, have a series of alternatives that would be far preferable to the involvement of the FCC in areas totally beyond its jurisdiction and expertise.

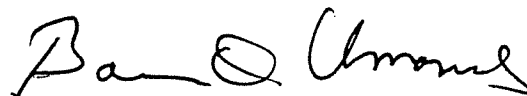
then we strongly urge that this service be on a terrestrial basis with existing AM and FM radio licensees being given the first opportunity to pioneer and implement this technology.

Respectfully submitted,

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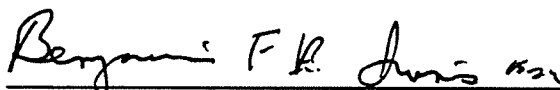
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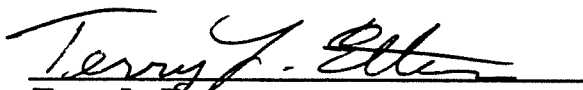
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APPENDIX A

**TERRESTRIAL COVERAGE CONSIDERATIONS
FOR
DIGITAL AUDIO BROADCASTING SYSTEMS**

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Presentation For: IEEE Broadcast Technology Society,
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**Terrestrial Coverage Considerations
for
Digital Audio Broadcasting Systems**

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Abstract

Terrestrial delivery of DAB is receiving an increasing amount of attention with scenarios being considered ranging from a supplement to existing AM and FM broadcasts to complete replacement of current services.

Practical implementation of a terrestrial DAB service requires a system-level examination of relevant technical factors including receiver technology, propagation characteristics, reliability of service and so forth. This paper identifies some of the considerations necessary for designing an allocation and allotment system. The Eureka/EBU DAB proposal is used as a model for a candidate DAB service. Planning factors required for predicting coverage are examined. Example calculations of coverage under certain assumptions are presented and tradeoffs are identified.

Assuming a 1 kW ERP, at 100 MHz it is estimated that a Eureka-type of DAB broadcasting system will provide a maximum coverage of approximately 43 miles. At 500 MHz, the coverage is estimated to be approximately a maximum of 31 miles. The graphs contained in this presentation are starting points for the design of suitable allocation systems for digital broadcasting that use VHF or UHF frequencies. Use of VHF and UHF propagation graphs with more rigorous location and time probability factors than the current F(50,50) curves is strongly suggested. Frequencies above 1 GHz should also be studied.

Washington, D.C.
September, 1990

**Terrestrial Coverage Considerations
for
Digital Audio Broadcasting Systems**

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Good Afternoon. I'd like to thank the IEEE Broadcast Technology Society for the opportunity to participate in this conference. The title of this presentation is Terrestrial Coverage Considerations for Digital Audio Broadcasting Systems. This is a summary of ongoing work at the NAB Science & Technology department. We plan to submit a full report for publishing consideration in the IEEE Broadcast Technology Society Transactions.

Terrestrial delivery of DAB is receiving an increasing amount of attention. Implementation scenarios range from a supplement to existing AM and FM service to complete replacement of these services. And a large number of frequency spectrum bands have been identified as potential candidates to host a new DAB service.

To actually plan on implementing a digital audio broadcasting system, there are many issues that must first be considered. Among these issues are technical considerations necessary to plan an allocation and allotment system. But even before an allotment plan can be precisely discussed, it is necessary to analyze and understand the problems and techniques inherent in attempting to predict the coverage of digital audio broadcasting systems.

Today we can identify some of the considerations necessary for designing a DAB terrestrial broadcasting system. We use the Eureka/EBU DAB proposal as a model for a candidate DAB service. We perform some example calculations of DAB link budgeting under identified assumptions as a function of receiver sensitivity. Finally, we will discuss the necessary planning factors and suggests a model for calculating terrestrial DAB coverage.

Let's begin with a brief review of DAB technology and focus on the EBU/Eureka 147 DAB system. The EBU/EUREKA project No. 147 DAB system is currently considered to be the most highly developed and sophisticated DAB system proposal. Consequently,

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we can use EBU/Eureka as a model system for purposes of analyzing the considerations inherent in predicting terrestrial DAB coverage.

In this slide we have collected some of the technical advantages of the EU-147 DAB system. They are (1) 20 kHz audio bandwidth; (2) COFDM multiplexing; (3) low C/N requirements for full quality transmissions; (4) immunity to multipath; and (5) high spectrum efficiency.

The first step in EBU/Eureka encoding is to substantially reduce the data rate of the source audio. The data rate begins at 768 kB/s, equivalent to sixteen bit parallel data sampled at 48 kHz. EU-147 uses the MUSICAM bit rate reduction system. This compression scheme was originally developed by the IRT in Germany; MUSICAM stands for "Masking pattern-adapted Universal Sub-band Integrated Coding and Multiplexing." MUSICAM takes advantage of the psychoacoustic properties of human hearing and eliminates irrelevant information. The bit rate is ultimately reduced to 128 kB/s, for a reduction ratio of 6:1. Further development is underway that would reduce the data rate to 96 kB/s, for an 8:1 ratio. Beyond that, further data rate reduction is not envisioned at present.

The source audio is divided into 32 frequency bands or sub-bands and digitally processed. Exploiting the psychoacoustical phenomenon of auditory masking, the information to be transmitted associated with a given sub-band may be reduced or eliminated according to its likelihood of being psychoacoustically masked by either (1) higher amplitude audio energy in the same or nearby frequency bands, or (2) if the audio is below the threshold sensitivity of the ear.

The resulting data stream is then coded using a powerful convolutional coding method called COFDM.

This sophisticated modulation method uses frequency division multiplexing to split the coded information into a large number of closely spaced, low data rate channels.

To illustrate the technique, in this slide 32 carriers are used to carry 8 separate programs. Each program is transmitted on 4 widely separated carriers. The highlighted carriers transmit redundant information.

Specific carrier frequencies are generated using FFT techniques and satisfy orthogonal relationships, allowing their spectra to overlap, increasing spectral efficiency. The carrier arrangement and resulting spectrum is shown here. 4-state phase shift keying modulation is used. The program data is interleaved in time and frequency with large enough spacing to use portions of the propagation channel that are statistically independent. This technique enables the EU-147 system to reduce and even eliminate

multipath interference.

Now, let's see how coverage for a Eureka-type system could be estimated. In this presentation, we are using a EU-147 configuration of 14 stereo audio channels in a 3.5 MHz wide channel. In this bandwidth, there will be several hundred carriers. Based on our best information from Europe, this configuration is the design target for EU-147 terrestrial implementations. This is the system EBU and Eureka is bringing to Las Vegas for NAB '91. We shall use this configuration as a basis for our calculations in this presentation.

Specifying the service area for a digital audio broadcasting service will require a somewhat different analysis than conventional AM and FM allocations planning for analog transmission services. Among other considerations, the perceived degradation of a digital service may evidence itself in an entirely different manner than an analog service. Because of this, the traditional notion of what constitutes a broadcasting service area requires re-examination for a digital system. It is necessary to use a different approach to defining the coverage area for DAB systems. For the EU-147 system, specific recommended parameters have yet to be finalized, pending selection of a frequency band and implementation scenario. However, the planning factors that must be considered in determining an allocation plan for systems such as EU-147 are generic and important to consider at this time.

Before we get to the actual link budget and service area calculations, we must first consider the important matter of propagation and service definitions.

The service areas of conventional AM and FM broadcast radio systems are ultimately based on a reasonable determination of minimum acceptable performance. This can be a difficult concept to define precisely due to the subjective nature of what specific signal-to-noise ratio constitutes "minimum acceptable performance." As we are about to discuss, the treatment of digital systems such as EU-147 must be somewhat different.

U.S. AM allocations are based on contour protection techniques where service decreases linearly with distance from the transmitter. Primarily, AM is an interference-limited service. For co-channel satisfactory reception, about 26 dB C/I is necessary to provide AM service.

FM radio performance, on the other hand is somewhat insensitive to diminishing field strength until a threshold point is reached beyond which degradation proceeds rapidly with further signal level decreases. The nature of the degradation depends on receiver characteristics. Ultimately, based on CCIR reports, service is limited by an interference threshold that is approximately 37 dB C/N for mono service, and higher for stereo service.

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Propagation curves provided in the FCC Rules and CCIR documents allow allocations engineers to predict the field strength for a given power output, antenna configuration and height at a given distance from the transmitter. Because factors such as terrain roughness, multipath effects and daily and seasonal changes in atmospheric propagation are involved, predictions of received field strength must be characterized in statistical terms. The FCC's well-known F(50,50) curves indicate expected levels of time and location variability in terms of percentage of locations and time for which the field strength values will be accurate. These curves present field strength values that will be exceeded by at least 50% percent of the locations for at least 50% of the time. To insure a given level of service for a higher percentage of locations or a higher percentage of time, corrective factors must be added.

Conventional AM and FM analog services are somewhat forgiving in this regard, because slight degradations beyond the F(50,50) field strength values calculated generally produce only modest degradations in system performance. Digital systems, however, are not so forgiving.

In predicting the coverage of terrestrial DAB systems, the first question is, should we use the existing FCC F(50,50) curves for VHF and UHF? We believe they should not be used, at least not without the addition of more rigorous time and location probability factors.

Of course, the physical mechanisms of signal attenuation due to propagation effects identically apply to digital as well as analog transmission systems. However, the result of degraded digital signal transmission produces very rapid reduction of service quality compared with the relatively soft degradation of analog systems.

In the EU-147 DAB system, service area planning is tied directly to system tolerable bit error rates. In simpler digital transmission systems, decreasing signal strength can be directly related to increased bit error rate (BER) and consequent degradation of service. As digital transmission systems become more complicated, such as by the addition of error correction and convolutional coding, increasing BER is more likely to not correspond to a gradual increase of noise floor level as is otherwise typical of analog system degradation. For these types of digital transmission systems, the loss of service quality associated with incorrect data reception may be severe and unpredictable. Thus, a very rigorously defined maximum allowable BER can be used to define the limits of complex-system digital service areas. Because small data errors can cause catastrophic loss of service quality, the use of Channel Coding schemes that provide protection against errors is virtually mandatory, at least for the design of broadcast-quality service areas. Without such coding protection, the resulting useful service area of a digital transmission system may be very small. Thus, digital systems have a need for coding

schemes with error correction that allow larger bit error rates to be tolerated in transmission without incurring overall degradation of service. The necessary added bits raise a difficult series of design tradeoffs, because they decrease system throughput and affect spectral efficiency.

This slide shows the BER performance of the coded and un-coded COFDM signal for the Eureka 147 system without error correction. The curves labeled C sub c and C sub d represent a range based on alternative decoding schemes. c represents coherent detection, and d represents differential detection. In the final system design only one method, of course, would be selected, and economics of manufacturing will play a major role. The graph itself plots acceptable bit error rate versus E_b/N_0 , the energy per useful bit, divided by the noise spectral density that, for this case, is proportional to C/N within a couple of dB. In contrast the dotted lines represent uncoded data -- straight OFDM, not coded. So the use of coding can preserve low bit error rates at low C/N ratios. Recall that the C/N for AM is about 26 dB and for FM better than 37 dB.

In this slide we show what happens when error correction techniques are added to the bit stream. The straighter the Cc and Cd lines the closer we are to the ultimate coding efficiency for acceptable bit error rate under the lowest C/N characteristics. Note that the margin between full service and no service is a very thin brick wall -- the width of one of the C sub c or C sub d lines.

In AM, FM and TV broadcasting the specified threshold for C/N is tied to subjectively-evaluated minimum standards of audio or video quality. Carrier-to-noise ratios below these thresholds still provide service, albeit degraded broadcast service. Compared to the more gradual nature of AM, FM or TV service degradation in the presence of increasingly weaker C/N ratios, the abrupt nature of digital service degradation, as clearly indicated in this slide, strongly suggests the consideration of propagation curves that use more rigorous location and time probability standards.

The "forgiveness" of analog systems and relatively slow changes of propagation characteristics insures that some level of service will exist at most of the other locations most of the time. With error-protected digital transmissions, however, continuous data recovery above a minimum C/N threshold is required. So in the prediction of digital audio broadcasting coverage, service definitions are less forgiving at the limits of coverage, and, accordingly, use of higher probability location and time variability factors are warranted. Thus in the development of propagation curves for a digital broadcasting service, it is advisable to develop and plan curves at the F(90,90) or even F(99,99) level to insure the existence of service within the predicted coverage pattern. For a stand-alone transmitter, F(99,99) would provide the most reliable indicator of broadcast service. Since the EBU/Eureka DAB system is capable of employing on-channel

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boosters without service degradation, perhaps the use of $F(90,90)$ curves is more appropriate as an allocations planning tool. Using these curves, service everywhere within the coverage pattern would be virtually error-free while service outside the coverage pattern would be virtually non-existent. For those in the audience interested in the calculation details, our upcoming propagation calculations for VHF and UHF are based on CCIR Rec. 370-5.

Now let's take a look at the other factors that comprise the calculation of a digital broadcasting station's service area.

Here is the link budget model we are using at the receiver end to develop estimates of DAB coverage. Given a minimum tolerable carrier-to-noise ratio and the equivalent input noise of the receiver, the minimum signal field strength E that must exist at the receiving antenna can be determined. In conjunction with appropriate propagation loss curves and planning assumptions of receive antenna height, the transmitted power level required for any given service area can then be defined. E is the minimum field strength necessary at the receiver's antenna for satisfactory operation. For purposes of today's presentation, we are ignoring line losses and assuming the receive antenna is a half-wave dipole. These assumptions provide a best case DAB coverage scenario.

In this slide we have the basic thermal noise calculation, kTB .

And here we have the calculation with noise expressed in dB relative to 1 microvolt. R is input resistance of the receiver.

Finally, the intrinsic thermal noise at the receiver input turns out to be about 2 microvolts, or 6 dBu.

N_r , the total noise at the receiver input can be computed as the ideal input noise level plus the noise figure of the receiver. This noise figure represents the noise generated at the receiver input above and beyond an ideal input. Using a receiver noise figure of 6 dB as a typical value, the total receiver input noise would then be 12 dBu.

Now we are ready to consider C/N . As we have shown, the range of potential C/N ratios lies between 5 and 30 dB, or more, and depends on the selected coding schemes and error correction modes. A minimum carrier-to-noise ratio of 9 dB has been suggested for the Eureka DAB system, and this is what we will use for planning purposes.

Up until now we have been talking about voltage at the receiver antenna terminals, and also about field strength at the antenna. To continue with the link budget these two must be related to each other, and this can be done by use of the so-called dipole factor.

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Transforming to an impedance of 300 ohms, we have this formula for calculation of the dipole factor, $K_{sub d}$.

For purposes of today's presentation we have picked two frequencies in the VHF and UHF bands, 100 and 500 MHz. Carrying the calculations through for these frequencies, For 100 MHz, $K_d = .965$ or -3 expressed in dB. At 500 MHz, $K_d = -14.3$ dB. Now we can calculate necessary field strength, E. For 100 MHz, $E = 21.3$ dBu. For 500 MHz, $E = 35.3$ dBu.

Knowing the desired field strength E, propagation curves can be used to determine the extent of service area for a DAB system at a given power output level. As noted earlier, we tentatively recommend use of field strength levels that can be insured for a high percentage of locations and a high percentage of time for planning a DAB service. We have calculated the estimated coverage of DAB systems based on F(50,50), F(90,90) and F(99,99) service models.

This slide shows our coverage estimates for a DAB system operating at 100 MHz. The graph portrays ERP, in dB above 1 kilowatt, vs. radius of anticipated service in kilometers with miles in parenthesis. This is based on average terrain, and 150 meters transmit antenna height, and a receive antenna height of 10 meters. We are aware, of course, of the relative appropriateness of using these factors.

Here are the same set of conditions at 500 MHz. Here are the two graphs combined.

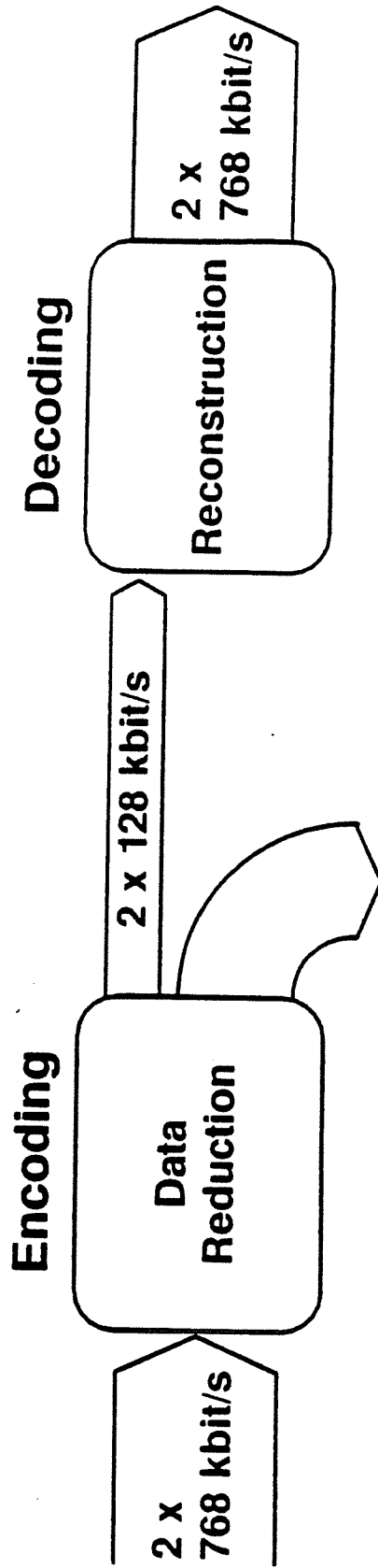
Assuming a 1 kW ERP, at 100 MHz we estimate that a Eureka-type of DAB broadcasting system will provide a maximum coverage of approximately 43 miles. At 500 MHz, the coverage is estimated to be approximately a maximum of 31 miles. We feel these graphs are starting points for the design of suitable allocation systems for digital broadcasting that use VHF or UHF frequencies. We recognize that frequencies above 1 GHz should also be studied.

Obviously there are a great many difficult policy decisions that confront the industry. It is critical that the industry have as much technical information as possible about how a DAB system could be implemented and the nature of its performance characteristics. This is the goal of our studies.

I'd like to thank Lynn Claudy and Stan Salek of NAB's Science & Technology department for their help in the preparation of this paper. We are very open to comments and suggestions, and we would be happy to answer any questions. Thank you, it is a pleasure to be here today.

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Source Coding



AF Bandwidth: 20 kHz

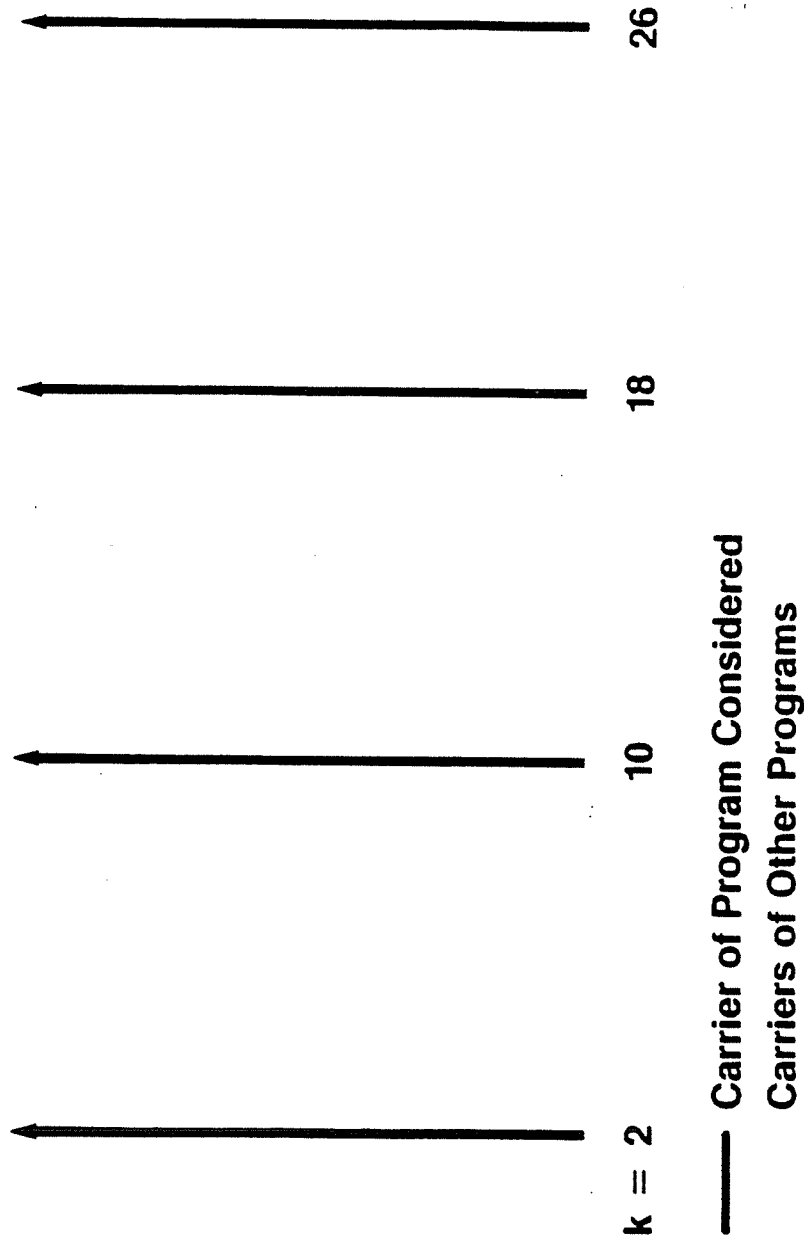
Sampling Rate: 48 kHz

Resolution 16 bit

Source: EBU

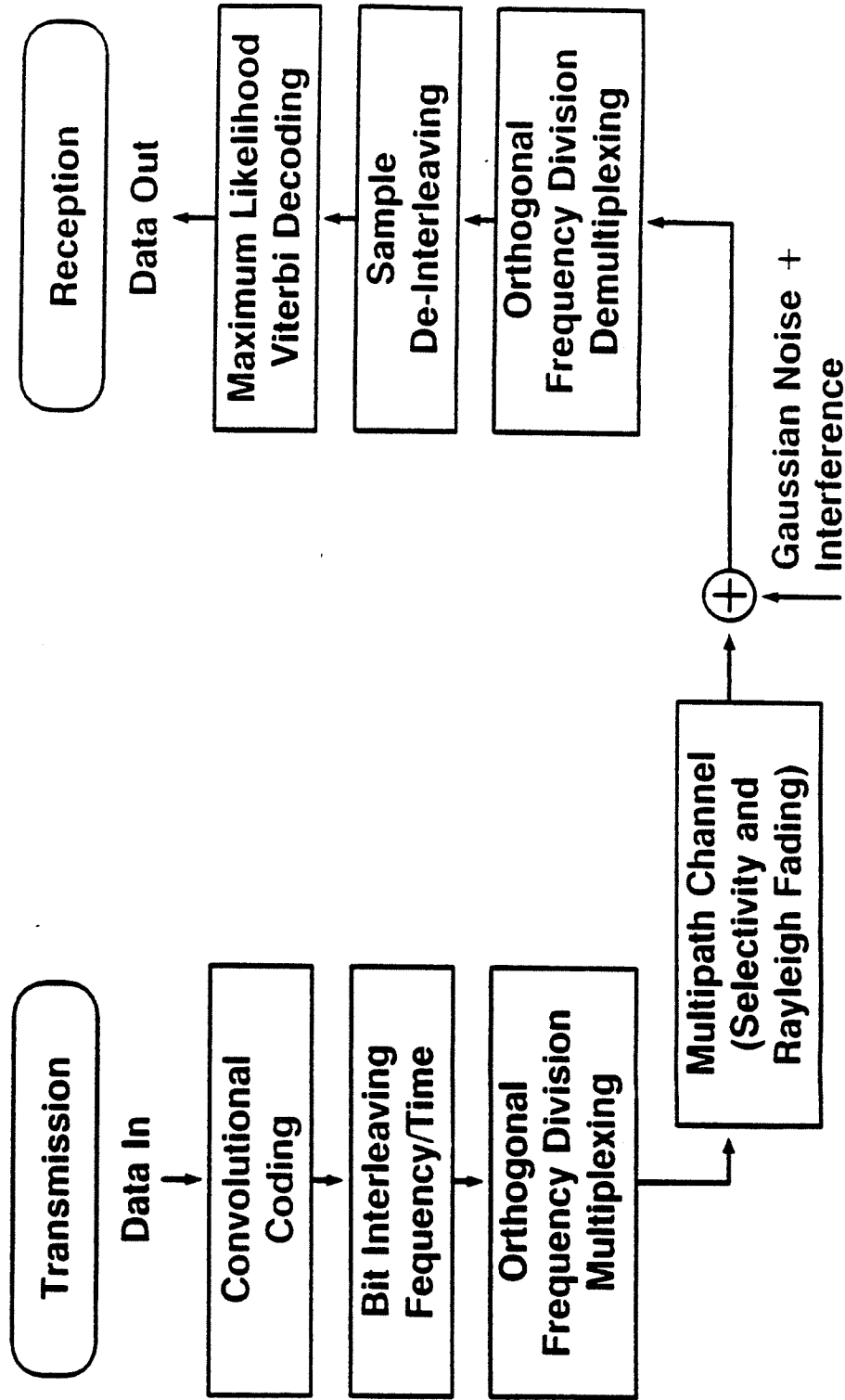
Distribution of Carriers for One Program

(32 Carriers: 8 Programs, 4 Carriers Each)

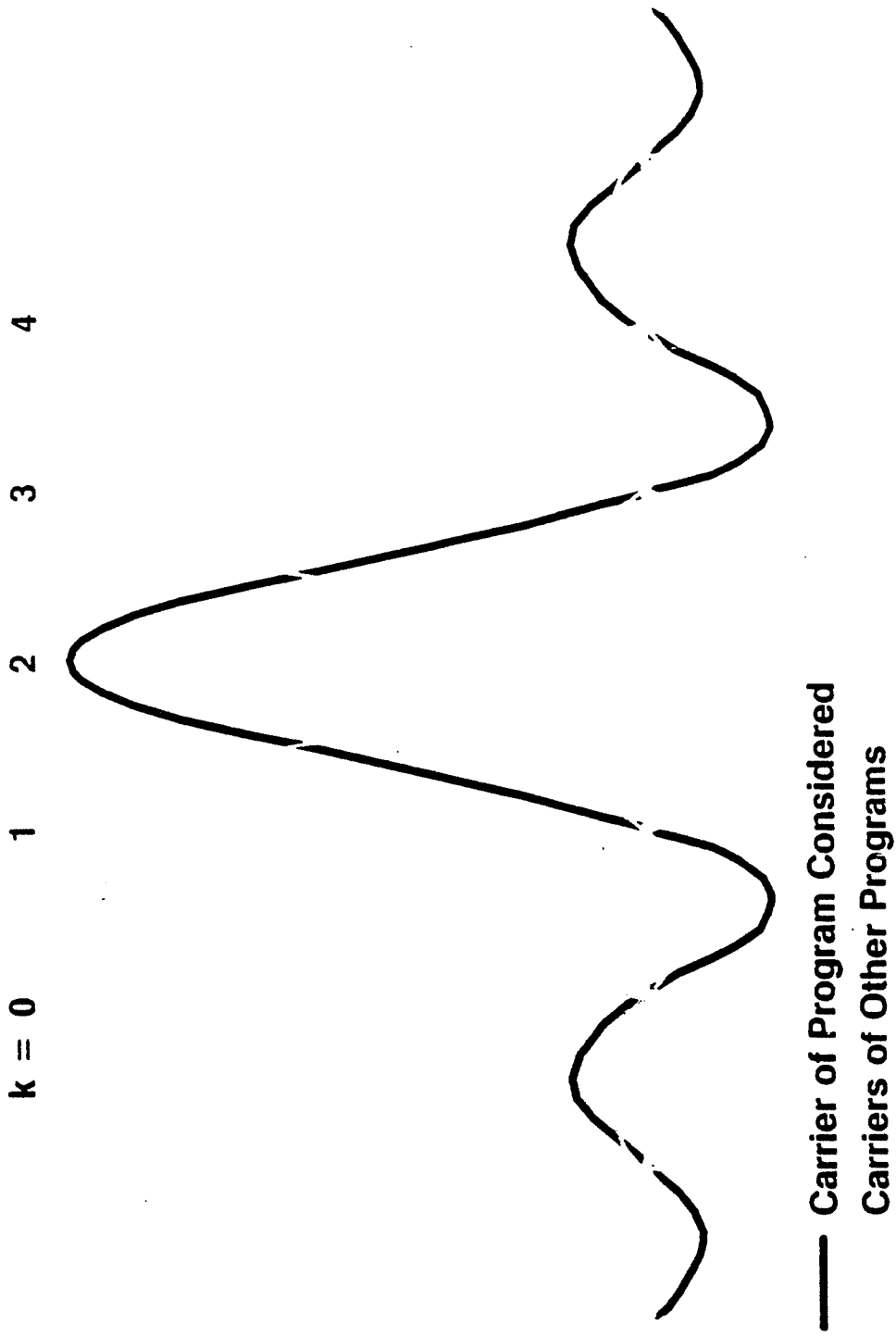


Source: CCETT

COFDM Modulation And Coding System In The Multipath Environment

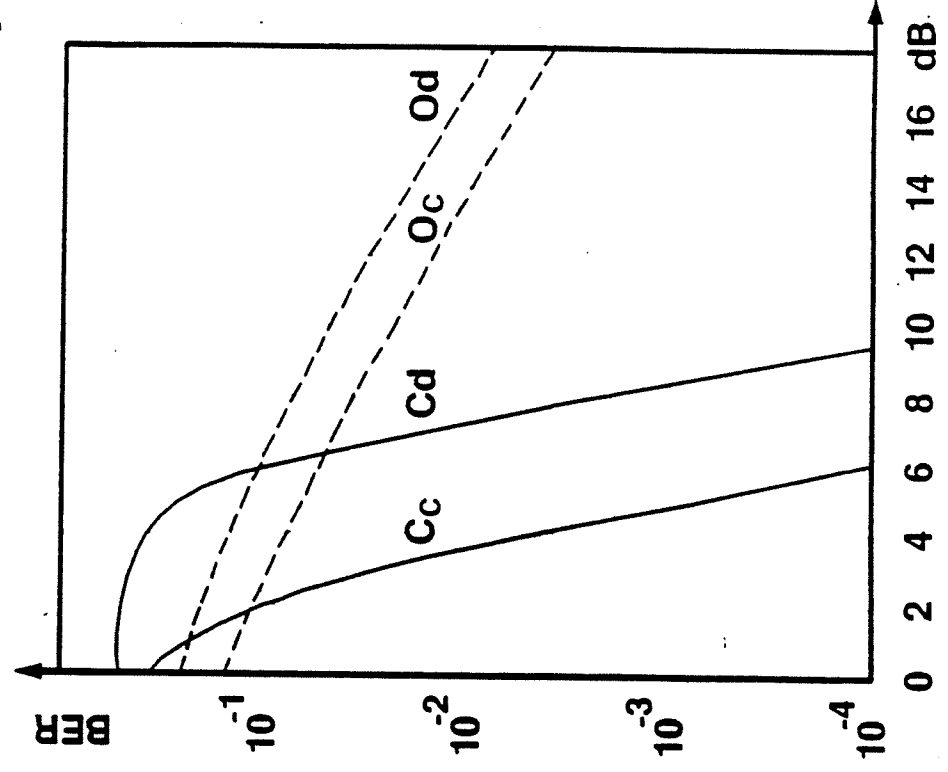


OFDM Signal Spectrum



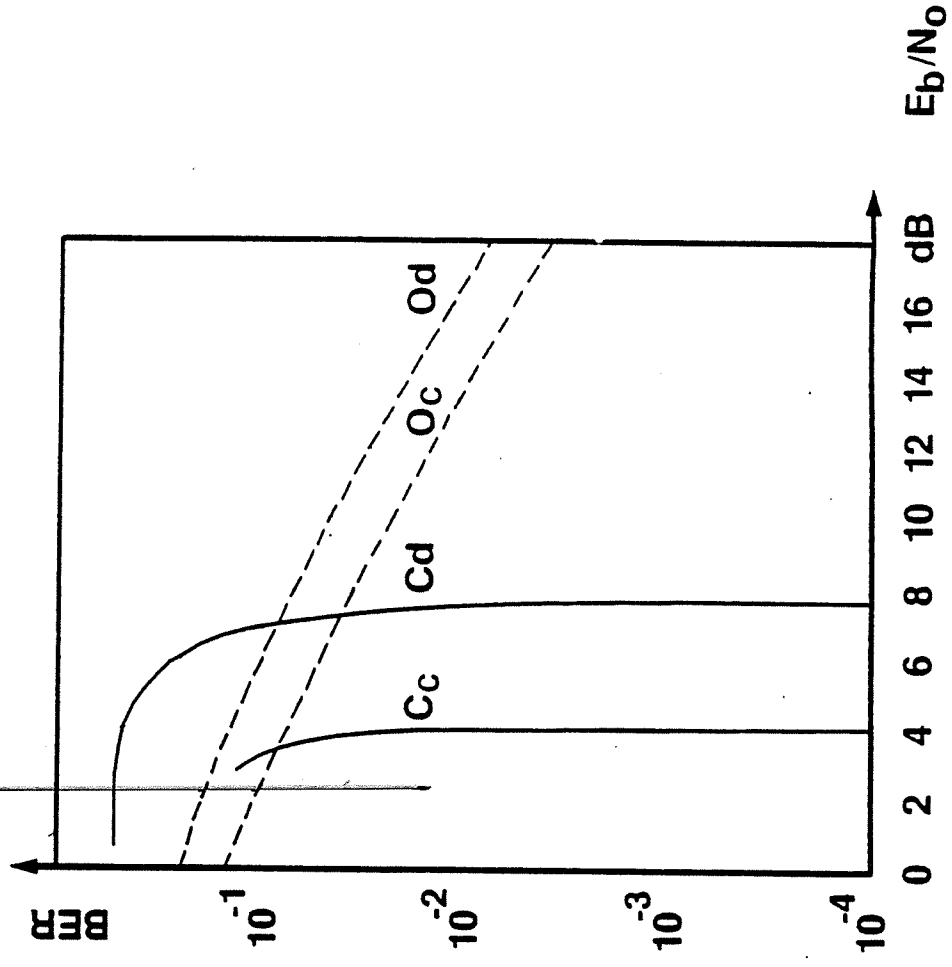
Source: CCETT

Bit-Error Ratio Performance (No Error Correction)



Source: CCETT

Bit-Error Ratio Performance (With Error Correction)



Source: CCETT

LINK BUDGET AND THERMAL NOISE CALCULATIONS

A model for use calculating service area is as follows:

$$E = V_i + N_r + \text{CNR} - K_D - G + L + T_F + L_F$$

where E = minimum acceptable field strength at a receiver (in dBu, or dB above 1 microvolt/m)

V_i = thermal noise of receiver input (in dBu, or dB above 1 microvolt)

N_r = noise figure of receiver input

CNR = minimum carrier to noise ratio for acceptable service

K_D = dipole factor (in dB)

G = receive antenna gain (in dB)

L = transmission line loss (in dB)

T_F = time variability factor (in dB)

L_F = location variability factor (in dB)

For purposes of this discussion, antenna gain for the receiver will be assumed to be unity and transmission line loss will be assumed to be negligible.

Thermal noise power generated at the input of an ideal receiver is equal to kTB where

k = Boltzmann's constant = 1.38×10^{-23} W/K-Hz

T = temperature in degrees Kelvin

B = bandwidth of input

In terms of noise voltage, with input resistance R ,

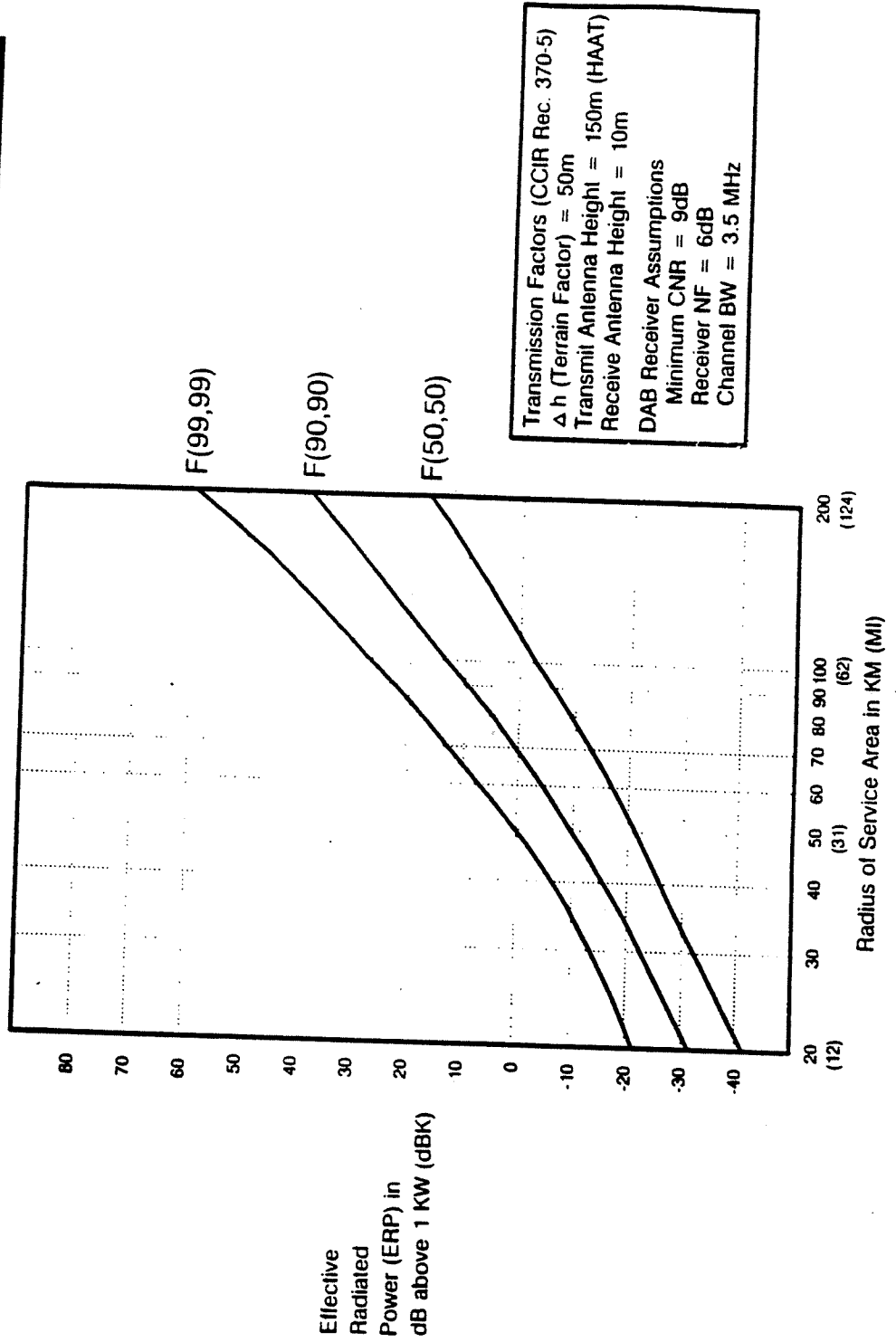
$$V_i = \sqrt{kTRB/10^{-6}}$$

where V_i is in microvolts or

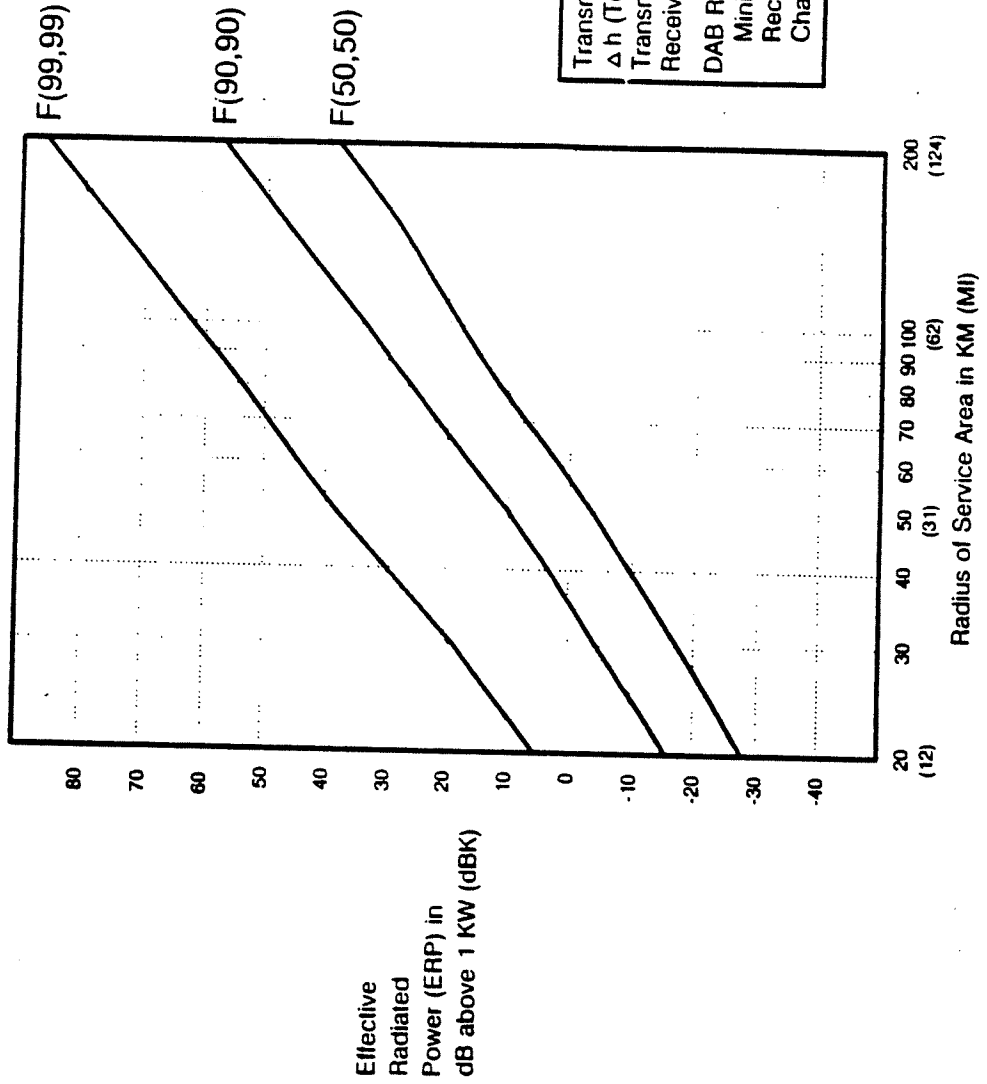
$$V_i = 20 \log(\sqrt{kTRB/10^{-6}})$$

where V_i is in dB relative to a microvolt (dBu).

Required ERP vs. Coverage Area Radius for Terrestrial DAB Service at 100 MHz



Required ERP vs. Coverage Area Radius for Terrestrial DAB Service at 500 MHz



Transmission Factors (CCIR Rec 370-5)
 Δh (Terrain Factor) = 50m
 Transmit Antenna Height = 150m (HAAT)
 Receive Antenna Height = 10m
 DAB Receiver Assumptions
 Minimum CNR = 9dB
 Receiver NF = 6dB
 Channel BW = 3.5 MHz

APPENDIX B

**REQUEST FOR PROPOSALS
FOR
DIGITAL AUDIO BROADCASTING SYSTEM
SPECTRUM STUDY**



Science and Technology
1771 N Street, N.W.
Washington, D.C. 20036-2891
(202) 429-5346
FAX: (202) 429-5343

Request for Proposals for Digital Audio Broadcasting Spectrum Study

September, 1990

NATIONAL ASSOCIATION OF BROADCASTERS
Digital Audio and Satellite Sound Broadcasting Task Force
c/oNAB Science & Technology
1771 N St., N.W.
Washington, D.C. 20036
(202) 429-5346
Fax: (202) 429-5343, or 5410

I. Purpose.

NAB's Digital Audio and Satellite Sound Broadcasting Task Force ("DAB Task Force") asks for proposals for study of the spectrum requirements for digital audio broadcasting. The DAB Task Force limits the scope of this study to (1) use of the technology developed by the Eureka project No. 147 consortium, in conjunction with the European Broadcasting Union (EBU); (2) terrestrial DAB applications; (3) application of DAB technology for existing AM and FM stations; and (4) locations in the spectrum where terrestrial DAB technology feasibly can be implemented. These issues are further discussed below.

NAB's DAB Task Force will use the findings of this study to formulate and develop policies related to DAB technology.

II. Background.

For several years, the Eureka project No. 147 consortium¹ in cooperation with the EBU² have been developing digital broadcasting technology. The system, designed for terrestrial or satellite use, is capable of transmitting 14 to 16 simultaneous compact disc-quality stereo audio channels in 3.5 to 6 MHz total bandwidth, using a single transmitter. Additionally, a sophisticated transmission algorithm is used to eliminate multipath distortion effects common in current terrestrial FM broadcasting. In fact, the system is designed to take advantage of multipath reflections, using them to reinforce, rather than upset, the main channel signal. European broadcasters have found

¹Eureka project No. 147 is a consortium among the research laboratories of European public service broadcasters, manufacturers, and universities. There are a total of 14 project partners.

²EBU is a union of the public service broadcasters of Europe, including the countries that border on the Mediterranean.

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preliminary mobile demonstrations to be impressive, with the signal exhibiting considerable robustness over varying terrain conditions.

The technology was first demonstrated in Geneva at the WARC(ORB) conference in the summer of 1988, then at ITU-COM 1989 convention, and most recently in a series of demonstrations and tests in Canada. Informative and thorough presentations were made at the 1990 NAB Convention in Atlanta.

On August 1, 1990, the Federal Communications Commission (FCC or Commission) began a Notice of Inquiry proceeding (Gen. Docket No. 90-357) that asks many important questions related to digital broadcasting technology. Among the principal issues in the Inquiry are the relative merits of terrestrial or satellite approaches to implementation of DAB technology and their associated spectrum requirements. The Commission is interested in the impact digital radio would have on existing audio services and the regulatory structure or structures needed to ensure that the public benefits of digital radio are most efficiently realized. The FCC also seeks comment on the possibility of providing digital audio programming in the existing FM radio broadcasting allocation.

The spectrum that may be required for satellite implementations is being extensively discussed as part of the deliberations of a government/industry advisory committee to prepare the FCC for a 1992 World Administrative Radio Conference ("WARC-92").³ No comparable effort is underway at the present time to assess the spectrum requirements that may be needed for a terrestrial implementation of DAB.

On June 22, 1990, NAB's Radio Board of Directors formed a Task Force to develop policies and recommendations on DAB technology. The Task Force has held three meetings, and, on August 8, decided to commission this RFP for a study on the spectrum requirements for terrestrial DAB, using the Eureka 147 system as a basis for the transmission technology.

III. Research Questions.

1. How much frequency spectrum is required to accommodate all existing AM and FM station licensees with a digital broadcasting facility? The study should be undertaken with two premises: (1) that available DAB facilities have identical coverage areas; and (2) that available DAB facilities are segregated into an appropriate number of classes

³To be held in early 1992, the WARC-92 has an agenda item, No. 2.2.3 (a), to consider "the allocation of frequency bands of the broadcasting-satellite service and the associated feeder links for the broadcasting-satellite service (sound) in the range 500-3000 MHz, as indicated in Resolution 520 (Orb-88), including the accommodation of complementary terrestrial sound broadcasting uses within this allocation."

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of facilities in proportion to the existing classes of AM/FM broadcast stations.

2. How does the answer to (1), above vary with increasing frequency? Frequency bands under consideration extend from the FM broadcasting band to 2500 MHz.
3. In which frequency band(s) could the broadcasting industry obtain the amount of spectrum required by (1), above?
4. How does the amount of spectrum required by (1), above, compare with existing domestic and international proposals for satellite digital broadcasting technologies?

IV. Specifications.

NAB will require the chosen Contractor to submit a Final Report that must include the following sections:

A. Executive Summary. This section summarizes the report and highlights key findings, conclusions and recommendations. It discusses the scope of the study and the study's goals.

B. Table of Contents.

C. Research Report. This section should be a complete report of the research conducted. It should thoroughly answer the above research questions, include appropriate engineering calculations, and list all supporting documents and/or computer programs. The Report should be a stand-alone document, including -- as appendices, if necessary -- copies of particularly important and supporting documents, tables, graphs, or other documents that help to support the findings and conclusions of the study.

D. Annotated Bibliography. This section should list all readily available technical research, papers, experiments, government documents, etc. that a reader of this report might wish to see. For each entry, the Contractor shall include a short synopsis of the document's relevance including its conclusions.

V. Criteria for Selection.

NAB will select a Contractor based upon the following criteria:

A. Capability of Performing Research. RFP's should include a statement of the qualifications of all persons who would be expected to work on this project together

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with their expected functions and available resources. Equally critical is the ability and desire to perform research within the desired time frame.

B. Value to NAB Members. NAB members include many small market radio stations nationwide. As such, NAB requires efficient use of Contractor resources in the judgement of NAB. RFP's should include a detailed description of how Contractor proposes to allocate resources and charge fees to NAB. A fixed price contract is required.

C. Expected Report Completeness. Very important to NAB is the expected completeness of the Contractor's research. "Completeness" includes specificity of report findings, conclusions, and recommendations. Completeness of the final report will be a factor in award of follow-up contracts, if any, on additional or different matters.

D. Schedule for Completion. NAB's members consider the issue of digital audio broadcasting a critical one for the business's future. As such, information and studies concerning DAB must be performed as soon as possible. The radio industry needs the best information as soon as possible in order to formulate industry policies concerning DAB. Prospective contractors should propose a timetable for completion of the research. Contractors will be expected to meet the date that is proposed. Ideal from NAB's viewpoint is a complete report by December 31, 1990.

VI. Form of the Proposal.

Contractors shall submit Proposals to NAB in the following form:

A. Cover Letter summarizing contents of Proposal. The cover letter shall be signed by the person or persons who will be principally responsible for the research.

B. Qualifications and Resources available to Contractor to perform the desired research.

C. Proposal for conducting research. This section of the Proposal shall as specifically as possible set forth a specific plan for assembling the necessary information and making the desired recommendations.

VII. Timetable.

A. Proposals will not be accepted after October 10, 1990.

- B. NAB will Notify Acceptance/Non-Acceptance of Proposals no later than October 19, 1990.
- C. Contract Signed by October 31, 1990.
- D. Interim Progress Report and Final Report due per Contractor Proposal.

VIII. Other Matters.

NAB Science and Technology has developed a model for predicting the coverage of a EBU/Eureka facility. NAB also has estimates of required co-channel and adjacent channel protection ratios. In presenting proposals for consideration, prospective contractors may assume that models for predicting coverage and determining protection ratios will be available.

IX. Notice.

NAB reserves the right to make changes in the scope or nature of any research which it may fund, in consultation with the researcher or research company winning the grant. If no fully acceptable proposals are submitted, NAB also reserves the right not to commission any research.

Issuance of this Request for Proposals does not constitute endorsement of any particular digital technology (such as EBU/Eureka 147), past or future FCC policies or rules, and cannot be used to infer any plans or policies for NAB. Acceptance of any proposals as discussed herein is not endorsement for the contractor or the contractor's services on these or any other matters. NAB will fully own and reserve all rights with respect to the content of the final report.

X. NAB Contact Personnel.

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