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

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In the Matter of	)	
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Amendment of Part 73 of the Commission's Rules To Permit the Introduction of Digital Audio Broadcasting in the AM and FM Broadcast Services	)	RM-9395
In the Matter of	)	
	)	
Amendment of the Commission's Rules with Regard to the Establishment and Regulation of New Digital Audio Radio Services	)	GEN Docket No. 90-357

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LUCENT TECHNOLOGIES INC.

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I. INTRODUCTION AND SUMMARY

Lucent Digital Radio (Lucent), a new venture of Lucent Technologies and its development unit, Bell Laboratories, is at the forefront of digital audio technology and is developing digital technology for the AM and FM radio bands. It submits these comments as part of its effort to facilitate the early introduction of digital radio.

Lucent agrees with the following major propositions set out in USADR's Petition.[1/]

- In the United States, digital radio systems should use In-Band On-Channel (IBOC) technology.

1/ *Amendment of Part 73 of the Commission's Rules to Permit the Introduction of Digital Audio Broadcasting in the AM and FM Broadcast Services,* Petition for Rulemaking, RM-9395 (submitted Oct. 7, 1998).

- The Commission very likely will be required to mandate standards governing digital radio.

- The Commission should initiate a process designed to permit it to specify the standards early in the year 2000.

Generally, Lucent believes that *de facto* or voluntary transmission standards work best for the public and affected industries. The circumstances of broadcast radio, however, lead to the conclusion that in all probability *de jure* standards will be required. There are obvious compatibility issues with regard to transmitters and receivers, and equally obvious needs for coordinated action by broadcasters and consumers to bring about a successful transition. The Commission by its actions has recognized that different circumstances have required different approaches to standards. It has not adopted standards for subscription-based services, such as cable, Direct Broadcast Satellite (DBS), Personal Communications Service (PCS), and cellular. But the Commission recently did adopt a basic transmission standard for digital television broadcasting, finding that the unique distribution method of broadcasting and the benefits it bestows on consumers required adoption of a transmission standard to ensure that the public would continue to have access to the public benefits available through broadcasting. The same considerations augur for a digital radio standard.

There are more than 12,000 AM and FM radio stations in the United States, and Americans own more than 550 million radios. About 50 million radios are sold in the U.S. each year. Radio advertising revenue amounted to $13.6 billion in calendar 1997, most of it local in nature. It therefore is of great interest and importance to consumers that a transition from today's analog technology to tomorrow's digital technology be accomplished smoothly and seamlessly, and that the system implemented be the best that technological, commercial and public service considerations will sustain.

Lucent's systems for both AM and FM are expected to be fully developed and tested in the field by the end of 1999. The systems that Lucent will field test in 1999 for both AM and FM radio employ unique characteristics of digital technology to meet specific objectives that were established with market needs and existing analog technology in mind. Lucent believes that among the basic objectives that any Digital Audio Broadcast (DAB) system should meet are the following:

- Coverage should be equal to or better than that attained by existing stations;
- Audio quality should be significantly superior;
- Efficiency should be increased;
- Compatibility with analog systems must be ensured;
- Enhancements to the emergency alert system (EAS) should be enabled; and
- A full range of additional features should be facilitated.

A system that meets these minimum objectives will permit implementation of IBOC broadcasting without turning off the analog signal. Such a system will allow broadcasters to continue analog broadcasts as well as initiate digital broadcasts, and continue transmitting both for an indefinite period. The capacity of the digital signal will increase when the analog signal is shut off (the all-digital mode), but the choice of whether and when to shut down analog can be left to the individual broadcast licensees and made on a station-by-station basis.

Lucent is convinced that the technology to accomplish a smooth transition is attainable, and will be proven within the year through field testing. While others also are developing and testing prototype equipment that will transmit digital signals within the existing bands used by analog broadcast stations, Lucent has designed its system specifically to facilitate a seamless transition for both broadcasters and consumers.

Digital audio transmission technology is now beginning to take root in radio networks around the world with advent of systems based on Eureka-147 in Europe and Canada, and emerging satellite radio services in the United States (CD Radio and XM, formerly AMRC) and other parts of the world (WorldSpace in Africa and Asia). It is time for a terrestrial digital audio broadcast system to be developed and implemented in the United States. Competitive considerations require it, as do substantial opportunities for wealth creation and concomitant improvements in consumer welfare.

Consumer demand for DAB exists. A Lucent-commissioned consumer study shows that over two-thirds of the radio buying population between the ages of 16-52 is interested in digital radios for the audio content-related innovations offered by enhanced AM and FM systems. Such a system would provide listeners with significantly enhanced audio quality, improved signal robustness, datacasting services such as financial market information or breaking news, as well as other services that are in the public interest including Enhanced Emergency Alert (EAS) System and intelligent highway services (such as digitized road maps and traveler information).

B. Digital Audio Broadcasting Offers Vast Improvements Over Analog Radio

Digital audio broadcasting is the most fundamental advance in radio technology since the introduction of FM stereo radio. It will provide the public interference free reception of high-quality sound, interactive listening choices, and additional new services.

1. Improved Sound Quality

Digital radio will move radio in the United States to the next plateau of audio performance by providing listeners with enhanced sound quality more closely resembling original source material and digital recordings. Lucent anticipates that AM DAB systems will

offer sound quality comparable to today's stereo FM systems, and FM DAB systems will deliver near CD quality sound.

2. Increased Signal Robustness

DAB's enhanced audio signals will be more robust and less susceptible to interference from other radio broadcasts than today's analog signals. Lucent's IBOC system will be virtually free of multipath and other forms of interference that impair current analog broadcast reception. This is true in both the hybrid mode, when digital and analog signals are broadcast simultaneously, and the all-digital mode.

3. New Services

DAB's enhanced datacasting capabilities also will lead to the development of other useful services, not originally contemplated by DAB designers and regulators, that will benefit the public. While neither the Commission nor the proponents can specify what these services will be, the history of digital technology assumes that they will emerge once the enabling implementation occurs. In fact, these unpredictable applications may well prove to be the most significant consequence of the adoption of DAB.

Datacasting radio services could be used to provide financial market information and breaking news, up to the minute traffic and road conditions (including suggestions for alternate routes), transportation and travel updates (flight and train arrivals and departures as well as hotel vacancies and room prices), and electronic newspapers. Datacasting for auto-oriented information services would transmit digitized road maps and combined position determination navigation systems such as GPS to facilitate the negotiation of city streets. This service will be particularly important and useful to emergency vehicles, taxis, buses, mail delivery vehicles, as well as frequent travelers.

4. Enhanced Emergency Alert System

Lucent also believes that DAB can offer an automated and feature rich digital EAS system, which will co-exist in both the hybrid and all-digital modes of IBOC broadcasting. Possible features include automation of public safety information dissemination, including transmission of the National Weather Service's bulletins and alerts; and the ability for local public safety agencies to selectively reach out to people in their homes, cars, and elsewhere to warn of dangerous conditions, including disasters of any sort.

III. IBOC DESIGN OBJECTIVES TO MEET MARKET NEEDS

In considering the various elements that make up the design for a digital system, Lucent has concentrated on the needs of both broadcasters and consumers. As the Commission has recognized, digital technology will offer better service to the public and new opportunities to broadcasters. Since the allocation of new spectrum for terrestrial digital radio broadcasting is extremely unlikely, Lucent has designed its systems around the IBOC concept and technologies.

Lucent's system has been designed to achieve four basic goals:

- To ensure a smooth transition for broadcasters and consumers from an analog to a digital environment while protecting analog broadcasting throughout the transition;
- To provide spectrally efficient technology that will permit radio broadcasters to provide dramatically improved performance on their existing frequency assignments;
- To permit broadcasters to make these improvements with a minimum of implementation costs; and
- To facilitate a transition that can be accomplished with government and industry working together.

A. Consensus Among Government and Industry on the Technological Attributes of a Standard Is Essential and in the Public Interest

The Commission first opened a DAB rulemaking to look at both satellite and terrestrial DAB systems and issues over eight years ago.[3/] Satellite digital systems have been licensed, but further consideration of terrestrial DAB has been delayed while proponents continued to develop their systems.

Defining broadcaster-friendly and consumer-friendly objectives for a digital system that meet regulatory goals and policies is of paramount importance. Any digital system that would replace existing AM and FM analog systems must satisfy all affected that implementing a particular technological digital standard would benefit consumers and promote public policy goals. High among necessary attributes are ensuring compatibility with the existing analog system during a phase-in hybrid period and providing superior audio quality to the public.

There is no question that using digital IBOC technology to implement DAB in the AM and FM bands has the significant benefits described in the Petition and discussed above. It is precisely because of these significant benefits and the unique nature of the in-band solution that it is important to discuss and reach consensus on the basic attributes of the preferred digital IBOC system and to have those attributes tested before specific changes to Commission rules are proposed and considered. While Lucent has developed the basic technology and designed several systems, there are multiple different pairings of attributes possible that would be capable of delivering digital audio in an IBOC configuration. But certain configurations will be preferable for some parties and different configurations for others. The objective must be to

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[3/] *Amendment of the Commission's Rules with Regard to the Establishment and Regulation of New Digital Audio Radio Services*, Notice of Inquiry, 5 FCC Rcd 5237 (1990).

develop the mix of attributes that will best meet current and future demands of broadcasters, listeners, and the Commission for a robust and flexible digital audio delivery system.

In this regard, USADR's Petition is disappointing. While it generally gets the process and timetable issues right, it fails to focus on the specific objectives that any system must meet in order to satisfy the public policy objectives of the Commission and to be successfully implemented by broadcasters in a commercially viable manner. A meaningful discussion of the essential elements both of the digital system itself and for transitioning from analog to digital is necessary to reach a consensus of all the affected parties.

Given the current state of untested claims by all proponents, including Lucent, the public would best be served by the Commission accepting comment on these matters in GEN Docket No. 90-357, followed by a Further Notice of Proposed Rulemaking within the year, but, after laboratory and field testing have been accomplished. This schedule would ensure that public policy considerations are taken into account, and also that any specific proposed standard actually works in the real world before the Commission proposes specific changes to its rules. To act before the technology of specific systems is proven in the field would risk adoption of a less than optimal system design. It also would risk regulatory delay occasioned by the need to go back and amend the proposed rules changes in fundamental ways.

By its nature, extracting additional capacity out of the existing spectrum for digital service without disrupting the existing analog service is a complex technical problem, but the type of technology problem with which Lucent is familiar. There has been considerable skepticism concerning the technical viability of IBOC. After considerable research, Lucent has concluded that a technical solution to implementing DAB using IBOC is technologically feasible. An open question, however, is the commercial viability of such a solution. Based on its

experience with wireless technology invention and large scale deployment, Lucent believes it critical to collect extensive computer simulation, field test, and market research data before proposing specific rule changes.

Lucent approaches IBOC technology development with technological feasibility and commercial viability as the main objectives. Lucent is committed to providing the Commission with comprehensive information for rapid decision making by the end of 1999.[4/] Specific rule changes and technology solutions should not be proposed before the technical and commercial viability of the proposed technology has been demonstrated. Hence Lucent proposes this alternative approach, which it believes in practice will lead to more rapid implementation of a high quality DAB IBOC solution and avoid costly major revisions during the process.

Lucent tentatively proposes the following attributes as those to which particular attention should focus:

- Coverage equal to or better than that attained by existing analog AM and FM stations;
- Audio quality significantly superior;
- Efficient use made of the spectrum;
- Compatibility with analog systems; and
- A full range of features enabled, including an automated and enhanced Emergency Alert System.

B. Coverage At Least Equal to Existing Stations

Lucent believes that DAB IBOC must be introduced so as to create maximum commercial value to benefit broadcasters and consumers alike. To do so, it is necessary that the

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[4/] One of the advantages of using GEN Docket No. 90-357 is that relevant information can be provided informally and episodically, as soon as it becomes available.

digital coverage in both hybrid mode (during the transition) and the all-digital mode be comparable to existing AM and FM station coverage. Field tests demonstrating such coverage will:

- Unambiguously establish the commercial viability of the IBOC system tested;
- Maintain station analog demographics for digital; and
- Continue listener reception expectations.

The system proposed by USADR requires that under poor reception conditions listeners' receivers switch back and forth between the digital and the analog signal. There are several implications of this approach. The limitations it imposes lead to questions of commercial viability. The use of analog as a back up may at first appear reasonable, but could lead to consumers being denied the benefits of the higher quality digital signal in a significant part of the coverage area. This raises questions about the commercial viability of such a system. Use of the analog signal as the back up mechanism under poor channel conditions unnecessarily restricts the ability of broadcasters to implement some transition approaches, since this approach requires that the analog and digital signals carry identical programming to cover the whole geographic area.

The toggling between digital and analog under poor channel conditions may actually lead to the listener perceiving both the digital and the analog services as being of poorer quality than before introduction of the digital IBOC system. It is extremely difficult to properly match the analog and digital signals so that a listener will not experience significant changes in perceived audio quality when switching quickly between modes.

Lucent believes that this technology restraint is not necessary. In designing its IBOC solution, Lucent utilized a number of technologies developed by Bell Laboratories such as high quality, low bit rate audio coding, multi-streaming, and multi-descriptive to maximize the

coverage of a digital signal. While switching back to the analog signal can be implemented, with proper system design it is unlikely to be necessary. When a listener receives a signal within the coverage area that is degraded either by interference, multi-path or other effects, the perceived audio quality is at least as good, and in most cases better than, the station's analog broadcast.

C. Significantly Superior Audio Quality

Lucent believes that consumers must experience better audio quality with an IBOC DAB system than with existing AM and FM signals. The term "digital audio" has become synonymous in the consumer marketplace with high quality audio. In order for IBOC DAB to be accepted, it is important that the digital audio quality is significantly better at those locations within the station coverage area where consumers experience the poorest reception with AM and FM today.

While USADR lists audio quality as a general IBOC DAB requirement and emphasizes that digital transmission is key to enhancing the listening experience, the solution it proposes contains no new techniques for ensuring that listeners attain an enhanced audio quality perception throughout a station's geographic coverage area. In fact, the solution proposed for dealing with poor conditions is to merely switch back to analog, which could actually degrade listeners perception from purely analog FM. In contrast, Lucent's IBOC solution uses newer multi-streaming and multi-descriptive digital techniques together with state-of-the-art audio coding techniques to provide consumers, through the digital signal, with a noticeable improvement in audio quality under all channel conditions where the host analog signal would be obtained.

D. Improved Spectrum Efficiency

Lucent believes the capacity and efficiency of an IBOC DAB system must be better than that of today's AM and FM broadcasts in both hybrid and all-digital modes. There are compelling reasons why all broadcast and communications services have or are in the process of migrating to digital transmission. Pre-eminent among these reasons, of course, are the improvements in transmission quality and capacity. Improvements in quality, particularly when achieved at low or no incremental cost, have a direct perceived benefit to the consumer regardless of the service being considered. In the broadcast service, improvements in transmission capacity also have important benefits to consumers. Efficient utilization of spectrum leads to more and better services being provided consumers without the allocation of additional scarce spectrum. Digital technology will enable new integrated public service delivery capabilities.

While USADR states that its proposed system is spectrally efficient, there is little evidence in the system description to support this assertion. The use of blending to analog as a back up mechanism to ensure reception in poor signal areas precludes the transmission of distinctive content on the analog and digital channels. The proposed system therefore does not permit taking advantage of efficiency improvements made possible by the implementation of digital, a very serious deficiency.

In addition, USADR's proposed FM all-digital system design will force surrounding analog stations to either shut down, accept additional interference or convert to all-digital at whatever the cost and penetration of receivers in the local market. This effectively drives down the radio capacity in the market. By contrast, Lucent's all-digital system will not adversely affect analog or digital stations operating on adjacent, second adjacent, or any other channel.

E. Compatibility With Existing Systems

Lucent believes that compatibility with existing systems is an essential attribute of DAB. There are many complex economic and public policy issues surrounding the transition of AM and FM broadcasting to digital and the improved service that can result from digital broadcasting. Lucent believes it important to select a technology that provides broadcasters with the flexibility to control the types of programming and services that can be provided on the digital channel.

The ideal IBOC digital system would:

- Not interfere with the host station signal reception in hybrid mode. In the case of FM service this includes subcarriers.
- Be able to be overlaid on existing broadcast signals in both hybrid and all-digital implementations without precipitating any changes in adjacent radio stations.
- Permit a flexible approach to developing rules and improved services.
- During its initial phase, not result in obsolete AM and FM receivers.
- Facilitate hybrid receivers that have the capability to receive all-digital transmissions.

While the general IBOC DAB requirements listed by USADR include compatibility as one of the priorities for a digital system, the FM all-digital design as proposed will cause unacceptable interference to adjacent analog stations. This is an example of a technology solution imposing unnecessary constraints and precluding an efficient and equitable digital transition plan. In contrast, Lucent's all-digital IBOC solution is compatible with analog and hybrid modes, leaving to the policy makers the issue of mandatory transition to digital.

F. Incorporate Full Range of Features

The transition to DAB is taking place in countries throughout the world through the implementation of various digital systems. In Europe, for example, the transition is based on Eureka 147 technology. In the United States, two satellite digital audio broadcast systems have been licensed to deliver CD-quality audio and related new features to consumers.

Lucent believes that it is important that the next generation of terrestrial radio broadcasting maximize the quality of services delivered, subject to the constraints imposed in the regulatory environment, marketplace structure, existing spectrum bandwidth, and spectrum availability. In view of what likely will be a lengthy transition period from analog to all digital, it is important for commercial viability that the hybrid mode be used during the transition to deliver significant improvement in audio quality. In addition, to the extent possible, the system should be structured with "headroom" to allow incorporation of future technological advances.

In designing an IBOC DAB system that facilitates future improvements to the broadcast system, Lucent has identified features to support delivery of enhanced integrated public services such as emergency information (EAS); weather service alerts; traffic emergencies; and local alerts. Lucent's system also provides general capabilities such as end to end digital delivery of audio and auxiliary data services with the capability for the dynamic assignment of "virtual capacity," allowing for a variety of programming options on a station by station basis.

IV. FIELD TESTS ARE ESSENTIAL AND MUST PRECEDE REQUESTS FOR SPECIFIC RULES CHANGES

A. Comprehensive Field Tests Have Not Been Conducted

Proposals for IBOC DAB are exciting, and seemingly promise both AM and FM broadcasters a smooth and seamless transition from analog to digital technology using only the

spectrum currently allocated to radio broadcasting. The promise held out to radio broadcasters is that there need not be any disruption to existing services with the right IBOC system. However, as USADR acknowledges, successful introduction of IBOC DAB presents significant technical issues that must be resolved through field testing prior to initiation of broadcasts:

> The system must be able to operate in an environment with significant co-channel and adjacent channel interference. The system must also be able to operate without noticeably increasing interference to host co- and adjacent channel analog transmissions.[5]

B. Interference Must be Resolved Through Technology, Not Rules Changes, After Appropriate Tests

USADR claims that the major technical issues surrounding IBOC DAB have been resolved: "a review of the technical material . . . demonstrates the performance of the USADR IBOC DAB system in a multitude of technical environments."[6] However, the only technical material provided as support for this assertion appears to be based on simulation or laboratory testing. Simulation, while necessary, is only an initial step in the development of a wireless system. Lucent's extensive experience in the development of digital wireless systems confirms that, in addition to simulation, a design must be tested in a laboratory, and then subjected to field tests in a number of propagation environments.

Field testing is necessary because simulations do not capture real radio propagation characteristics or real terrain effects. The mathematical models used in simulations do not always accurately reflect the simultaneous effects of interference, multi-path, ambient noise, and fading conditions. USADR has taken the first step in testing and characterizing AM and FM

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[5] Petition at 41.

[6] *Id.* at 104.

band channels without the presence of the digital signal; however, the testing of the hybrid digital signal must be performed under many conditions and in many markets.

Lucent is confident that its system will prove technically superior in a number of ways meaningful to the Commission, to broadcasters, and to the public. However, Lucent equally is concerned that a premature introduction of IBOC DAB could threaten existing broadcast services and dampen the prospects for a successful transition from analog to digital. Due to its depth of experience with new technologies, Lucent well understands that significant differences almost certainly exist between theory and practice, between computer simulations in a laboratory and actual observed results during comprehensive field testing. Lucent therefore urges the Commission to require company-conducted field tests of all proposed IBOC DAB systems before the Commission contemplates rules changes based upon simulations instead of actual observable results in the field. Toward this end, Lucent is participating in the National Radio Systems Committee (NRSC) to develop a baseline plan for field testing.

Particular care must be taken with proposals to change emission mask standards and other interference protection criteria because the characteristics of analog AM and FM transmitters and receivers are <u>not</u> going to change because the Commission liberalizes its emission mask regulations. The only thing likely to change is the number of complaints that the Commission will receive from irritated consumers if the introduction of digital broadcasting causes interference to analog systems. It is especially noteworthy that USADR argues that its system will not cause any interference and allow a market-based transition, yet requests changes to rules to permit interference to the analog signals in the all-digital mode.[7] It is even more noteworthy

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[7] Petition at 20; *cf.* at 53-55.

that it has no field tests that would inform the Commission as to how USADR's system actually will operate on the air under the multitude of conditions that will be encountered in the field in the normal course of operations.

Until comprehensive field tests have been conducted that reveal the real world interference characteristics of USADR's, Lucent's, and any other proponents' IBOC DAB systems, an FCC rulemaking to consider changes to its interference criteria is at best premature. Lucent does note USADR's statement that it has conducted some preliminary tests and proposes more detailed field tests to commence in the "first quarter of 1999."[8/] As has been aptly noted, however, "You'll never convince a broadcaster that a computer simulation is real life . . . The test is in the testing."[9/] The importance of testing in the world of time and space was readily apparent in the recent experience with the introduction of digital broadcast television. An analysis of these tests -- and the surprising results they produced -- puts into sharp focus why detailed field tests must precede consideration of technical rules changes and the introduction of digital radio broadcasting.

C. Lessons of the Digital Television Field Tests

Prior to making a final recommendation on a DTV format, the FCC's Advisory Committee on Advanced Television Service (ACATS) planned field tests for its selected system. After years of theoretical modeling and computer simulation at the multi-million dollar Advanced Television Test Center (ATTC) Laboratory constructed just outside of Washington, D.C., for the sole purpose of testing advanced television systems in as real a simulated

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8/ *Id.* at 13.

9/ *Communications Daily*, "Digicipher Gets Good Reviews, but 'The Test is in the Testing,' October 4, 1990, pg. 4.

environment as possible, the selected system was subjected to a comprehensive field test to determine its broadcast characteristics in the real world. The tests were conducted in Charlotte, North Carolina, at an expense of more than one million dollars. They were administered by an executive committee made up of a professional test manager and representatives from the Public Broadcasting Service ("PBS"), the Association for Maximum Service Television ("MSTV"), and CableLabs.

The purpose of the DTV field test was to evaluate the performance of the proposed system under real word conditions of multipath and other propagation phenomena such as impulse noise and co-channel interference. It is to be noted that these same phenomena were carefully simulated in the ATTC laboratory and the committee went into the field tests with a high degree of confidence that nothing unexpected would occur. In order to ensure that the test results presented as accurate a picture of real world broadcast characteristics as possible, the Field Testing Task Force took great measures to select a suitable transmission site for the tests.[10/] Charlotte was selected because its topography and demographics would permit the observation of system performance under varying conditions of propagation. Terrain near Charlotte ranges from relatively smooth earth to sufficient irregularity to assure that some receiving locations, although within nominal line-of-sight for smooth earth, would be obstructed. In addition, Charlotte allowed receiving locations to be placed in communities with fairly dense population, as well as smaller communities, and even rural environments.

[10/] *Field Test Results of the Grand Alliance HDTV Transmission Subsystem,* submitted to the Advisory Committee on Advanced Television Service of the Federal Communications Commission, September 16, 1994.

The primary testing consisted of over-the-air reception measurements at 199 locations. The receiving locations were placed on eight radials extending 55 miles, divided into two large grids and three smaller grids, called clusters.[11] In addition to the basic radial and grid measurements, three supplementary tests were performed: UHF co-channel interference, UHF reception on indoor antennas, and reception from a directional UHF transmit antenna.

The preparation and implementation of these field tests required the expenditure of large amounts of time and capital resources, but their benefit became readily apparent as the tests produced results that were not predicted by any preceding theoretical models or computer simulations.

The most surprising results of the field test related to interference caused by DTV transmissions on channel 6. Channel 6 had been specifically chosen because there were no regularly assigned channel 6 broadcast stations in the Charlotte area and it was believed to pose the least likelihood of interference. However, "use of channel 6 produced unanticipated results and *an opportunity to observe phenomena not usually taken into account in the allotment of channels for broadcast purposes.*" [emphasis added][12]

One unexpected result of these field tests was interference caused to adjacent channel FM radio broadcasts. Although channel 6 occupies the 82-88 MHZ band, interference was experienced by FM broadcast stations operating in the 88.1-91.9 MHZ band.[13] This unexpected adjacent channel interference clearly illustrates the need for comprehensive field testing, and

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11/ *Id.* at 8.

12/ *Id.* at 10.

13/ *Id.* at 11.

should be of particular concern to IBOC DAB, which will need to avoid both co- and adjacent channel interference. Comprehensive field tests will ensure that similar unexpected interference phenomena either do not exist, or are fully understood prior to the adoption of IBOC DAB service rules.

Another unexpected interference phenomena revealed by the DTV tests involved interference to *cable* channel 6. Upon initiating testing on channel 6, numerous complaints of interference on cable channel 6 were received. CableLabs commenced a study to identify the causes of the interference and found that some interference was caused by pickup on the cable system, some interference was caused by direct pickup within the television receiver, but that the most common source of the interference was the cabling used to connect a VCR to a television set.[14/] These are the kinds of findings that make field tests essential. It would be impossible to predict or accurately model the kinds of interference experienced in these tests.

While the DTV field tests produced a number of unexpected negative results, there were equally unexpected positive results. Upon conclusion, these field tests revealed that not only was HDTV service available everywhere that NTSC service was available, but a number of sites produced satisfactory reception at levels "below that which laboratory testing had indicated to be the limit of HDTV service."[15/]

There is no question that detailed theoretical computer modeling and laboratory testing are part of the fundamental framework for the introduction of new broadcast technology. However, it should be equally clear that detailed field tests are also necessary. As the experience

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14/ *Id.*

15/ *Final Technical Report: Federal Communications Commission Advisory Committee on Advanced Television Service,* dated October 31, 1995, pg. 30.

with DTV introduction shows, no amount of lab testing can take the place of real world field tests that provide the opportunity to observe phenomena that are beyond the scope of even the most detailed computer model.

V. MANDATED STANDARDS ARE LIKELY TO BE NECESSARY AFTER ADEQUATE FIELD TESTING

Lucent agrees with USADR that, because radio is an "open" system, mandated standards are likely to prove necessary after adequate field testing of the various competing technologies. While Lucent believes that *de facto* or voluntary standards generally best serve the public and affected industries, the circumstances of broadcast radio lead to the conclusion that, in all probability, *de jure* standards will be required in this instance. There are substantial issues with regard to legacy transmitters and receivers, and a need for coordinated action by broadcasters and consumers in deploying new transmitters and receivers. Also, consumers have a well-developed set of expectations about the quality of broadcast transmission. There is a very substantial commercial interest in meeting these expectations. Our society relies heavily on radio to make markets and bring together buyers and sellers. The $13.6 billion of radio advertising revenue reported for 1997 is only a small fraction of the value of the overall benefit of radio to the nation's economy.

The Commission recognized the unique position of free, over-the-air broadcasting with respect to the need for standards setting when it adopted the digital television standard. The Commission found that more than one sustainable transmission standard:

> might result is compatibility problems and increase the risk that consumer DTV equipment purchased in one city would not work in another city; that a receiver would not display all the broadcast channels in a city; or that a digital television set purchased one year might not work several years later. *Such results would hurt consumers and*

make it more difficult to preserve a universally available broadcast television service. (Emphasis added.) [16]

Broadcast radio is similar to broadcast television in the relevant aspects, and very different from subscription-based wireless services. While input during the regulatory process is essential from all affected parties and consensus should be encouraged, the unique universality of advertiser-supported broadcasting and the reliance that most Americans place on receiving news, information, and entertainment through broadcasting indicate that adopting a digital standard for radio broadcasting, as the Commission did for television broadcasting, would benefit the public.

USADR's Petition does not firmly conclude that *de jure* standards should be imposed, a reservation that is prudent in the absence of full testing. Rather, the assertions in the Charles River Associates (CRA) Report accompanying the Petition are qualified:

> "If the benefits of a common standard are very great, government action to break the resulting logjam ***is likely*** to be desirable." (emphasis added).[17]
>
> "A Government-mandated digital radio standard ***may*** be required." (emphasis added).[18]
>
> "The distinction between private voluntary and government standard setting may be too strong. In most cases, government standard setting has involved the participation of both private standard-setting bodies and industry members."[19]
>
> "***It is likely*** that government involvement will be necessary . . . ." (emphasis added).[20]

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[16] *Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service*, Fourth Report and Order, 11 FCC Rcd 17771 at para. 34 (1996).

[17] CRA Report at 7.

[18] Id. at 9.

[19] Id. at 17.

[20] Id. at 22.

Standards can be imposed with confidence only after the results of additional testing and other relevant information are submitted and analyzed. Information on both the supply side (the equipment capabilities) and the demand side (probable consumer preference as to desired features) must be assessed before standards are defined and adopted. Standards should, of course, be mandated only to the minimum extent necessary to achieve compatibility, with other specifications best left to the interplay of market forces.

Lucent agrees with USADR, however, that the testing and acquisition of information should take place expeditiously and that the Commission should be prepared to set any necessary standards early in the year 2000 in order to provide consumers with the substantial benefits of the new technology as quickly as possible.

Lucent also submits that the field tests contemplated here should be conducted by the proponents without any government-imposed constraints. The primary reason for avoiding the procedural complexities of Government-controlled testing is the tendency of the requirements to render the tests "process-oriented" rather than "result oriented." This tendency, which can interfere with the achievement of an optimal system, is inherent in the regulatory process. Indeed, modern proposals for deregulation have focused on the need for avoiding "process orientation" in favor of market-oriented approaches.[21/]

> The new regulatory theories propose a shift in the focus of control from the method of achieving given results to a focus on the results themselves. The choice of method is left, within broad boundaries to the regulated. If a profit-motivated member of a regulated community has a sufficiently significant stake in

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21/ *Burlington Northern Railroad Co. v. United Transportation Union*, 848 F.2d 856, 864 (8th Cir. 1988).

> achieving a given result, it will accomplish that result but, given its own self-interests, will do so in the cheapest manner possible.[22]

The Commission has already countenanced this general approach, stating:

> We believe that those who seek to deploy new technologies or new configurations of existing technology in communications networks should be given wide latitude to test whatever they think might enable them to deliver more and better services to consumers. They are in the best position to decide which technological configurations are most promising, and they will bear the risks connected with development.[23]

This approach to testing, already adopted by the Commission, requires that the proponents rather than the Commission undertake the necessary testing of IBOC systems. This should result in the most efficient outcome without inordinate delay. Should testing instead be undertaken subject to Commission supervision, either directly by the Commission or through a federal advisory committee, the inherent tendencies to favor process at the expense of substance would come into play. These tendencies are particularly counter-productive in circumstances such as these, because they inhibit adjustments that lead to superior system design and tend to cull out in their incipiency technologies that might have proven to be superior if thoroughly tested.

VI. THE NEXT STEP SHOULD RELY ON AN EXISTING NOTICE OF INQUIRY

Use of an existing proceeding rather than a new Notice of Proposed Rulemaking is required at this stage to address the important technical and policy issues and properly to update

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22/ Wilkins and Hunt, *Agency Discretion and Advances in Regulatory Theory: Flexible Agency Approaches Toward the Regulated Community as a Model for the Congress-Agency Relationship*, 63 Geo. Wash. L. Rev. 479, 527-28 (1995).

23/ *1998 Biennial Regulatory Review -- Testing New Technology*, Notice of Inquiry, 13 F.C.C. Rcd 21879 (1998).

the record expeditiously. Issuance of an NPRM without fully developing the record may in fact delay the process.

A. An Existing Docket is Available to Address All the Important Technical and Policy Issues and Properly Establish the Record

USADR has petitioned the Commission to immediately initiate a rulemaking proceeding to develop rules for IBOC DAB, including the establishment of a DAB transmission standard. Lucent agrees with the goal of making DAB available as quickly as possible. Lucent believes that the most efficient and logical way to do this is by using the existing Notice of Inquiry (NOI) in GEN Docket No. 90-357 to fully develop the record. This will allow the timely implementation of the most technologically advanced IBOC DAB system.

USADR's request for an NPRM is premature and granting it could be ill-advised. As evidenced from USADR's Petition, there is not enough IBOC-related technical data available to begin drafting DAB rules. The Petition relies entirely on theoretical data and simulations. It is not based on field trials because none have yet been conducted. As explained previously, without field trials it is simply not feasible to specify rules that reflect and sustain an optimized DAB system. Moreover, it is impossible to insure that interference to current broadcast stations will not be significant without field tests and the detailed characterizations of the hybrid and all-digital IBOC DAB systems that follow field tests.

Because these considerations make it impossible for the Commission to issue a usefully detailed Notice of Proposed Rulemaking, the existing NOI should be used instead. All that is required is issuance of a Public Notice announcing that relevant information on IBOC DAB will be filed in GEN Docket No. 90-357. Proceeding in this fashion will enable the Commission and interested parties to address the important technical and policy issues thoroughly and effectively,

given the present state of development of DAB. This would allow the Commission and the interested public to follow the development of IBOC DAB through the field trials and update the record assembled in this open proceeding without further delay -- receiving information as it becomes available to the system proponents. And ultimately it will allow the Commission to formulate as soon as possible the basis for an NPRM that is both well focused and reflective of an optimized version of DAB.

In this regard the procedural history of GEN Docket No. 90-357, which addressed both terrestrial and satellite DARS, is especially instructive. The Commission issued an NOI in response to two petitions for rulemaking in the DARS proceeding where developing a full and complete record was also critical. As the record developed, and when it became apparent that satellite DARS was technically feasible, and terrestrial DARS was not, the Commission issued a joint NPRM and Further NOI.[24/] The NPRM served to develop rules for satellite DARS. The Further NOI served to continue to develop the record for terrestrial DARS, and more specifically "the possible conversion of analog AM and FM broadcasting to digital broadcasting within the existing bands."[25/]

In issuing the Further NOI, the Commission specifically stated that "during the intervening two years much information has been developed, particularly of a technical nature, that may bear upon how terrestrial DARS should be introduced in this country. . . . [and] . . . consequently, we solicit comment that will update the record on recent DARS developments."

24/ *Amendment of the Commission's Rules with Regard to the Establishment and Regulation of New Digital Audio Radio Services*, Notice of Proposed Rulemaking and Further Notice of Inquiry, 7 FCC Rcd 7776 (1992).

25/ Id. at 7781.

As Commissioner Duggan noted in his Separate Statement, "this aspect of our action [the NOI] is important: Some of the assumptions we made about terrestrial services just 24 months ago may no longer be valid."[26] Commissioner Duggan was referring to the Commission's comment in 1990 that it was not likely that AM radio channels could be converted to digital modulation.[27]

Similarly, as recently as December 1997, a CEMA study concluded that the IBOC system's bandwidth is too narrow to overcome inherent multipath and interference problems.[28] Progress in IBOC DAB technology, however, has continued at a rapid pace. Today, satellite-based DAB is in the process of commercialization, having overcome numerous technical hurdles. There is now a need to update the DARS proceeding regarding terrestrial DAB, and collect and develop as much real world data on IBOC DAB as possible.

B. Issuance of an NPRM Without Fully Developing the Record May Delay Rather than Expedite the Process.

Issuance of an NPRM without fully developing the record by means of the NOI may delay the implementation of IBOC DAB. The absence of hard technical data and insufficient input from industry on the real world application of IBOC DAB technology will lead to administrative law's iterative process of Further NPRMs and Reconsiderations. The delay inherent in the adoption of weakly supported or hurriedly constructed rules is not the worst

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[26] Separate Statement of Commissioner Ervin S. Duggan, *Amendment of the Commission's Rules with Regard to the Establishment and Regulation of New Digital Audio Radio Services*, Notice of Proposed Rulemaking and Further Notice of Inquiry, 7 FCC Rcd 7776 (1992).

[27] *Amendment of the Commission's Rules with Regard to the Establishment and Regulation of New Digital Audio Radio Services*, Notice of Inquiry, 5 FCC Rcd 5237, 5238 (1990).

[28] Consumer Electronics Manufacturing Association R-3 (Audio Systems) Committee, DAR Subcommittee, *Technical Evaluations of Digital Audio Radio Systems - Final Report*, (December 1997).

consequence however. The adoption of inadequate and ineffective rules could jeopardize the successful implementation of IBOC DAB.

An NPRM that reflects the lessons learned in the field trials will ensure that the best possible IBOC DAB systems is implemented in a timely manner.

VII. CONCLUSION

Lucent believes that digital radio broadcasting in both the AM and FM bands has a bright future in the United States. Unlike digital television, moving to digital transmission for radio will not require that each broadcaster be assigned an additional channel for a transition period, thus avoiding one of the most difficult aspects that occurred in the digital television proceedings. Utilizing the latest technologies to implement a digital IBOC system also would permit consumers to continue to use legacy analog receivers while others graduate to the new digital systems.

Lucent believes that using the latest digital solutions will permit an IBOC system to cover the same service area as a broadcaster's analog service, empowering each broadcaster independently to continue or discontinue analog service. This digital technology is being readied for field testing in early 1999, and within 12 months Lucent expects to have demonstrated

through real-life field tests that both its AM and FM systems will bring new benefits to broadcasters and their listeners without objectionable impairment to the existing analog systems.

Respectfully submitted,

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December 23, 1998

CERTIFICATE OF SERVICE

I certify that on this 23rd day of December, 1998, a copy of the foregoing Comments of Lucent Technologies Inc. was mailed first class U.S. mail, postage prepaid, to the Petitioner at the below address.

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