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# NATIONAL RADIO SYSTEMS COMMITTEE



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## DAB Subcommittee Request for Proposals (RFP)

### In-band/on-channel (IBOC) DAB Terrestrial Broadcast Systems for the AM and FM Bands

August 14, 2000

**Respond by September 29, 2000 to:**

National Association of Broadcasters  
Science & Technology Department  
1771 N Street, N.W.  
Washington, DC 20036  
USA

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**NRSC DAB Subcommittee**  
**Request for Proposals (RFP)**  
**In-band/on-channel (IBOC) DAB Terrestrial Broadcast Systems**  
**for the AM and FM Bands**

**1.0 Purpose**

The purpose of this request for IBOC DAB terrestrial broadcast systems is to offer all interested parties with developed IBOC DAB systems an opportunity to participate in the NRSC DAB Subcommittee's IBOC DAB standards development process. In particular, the Subcommittee wishes to identify such parties that are not already involved in the DAB Subcommittee's IBOC system evaluation process which has been underway since 1Q 1998.

Failure to respond to this RFP by the deadline of 9/29/00 will not necessarily exclude a system from possible consideration as a standard, however, any system proposed at a later date will require Subcommittee approval to be considered, and such approval is likely to be predicated upon how far along the Subcommittee is in its standards-setting process at the time a system is proposed.

**2.0 Introduction and background**

**2.1 The National Radio Systems Committee (NRSC)**

The NRSC is jointly sponsored by the National Association of Broadcasters and the Consumer Electronics Association. Its purpose is to study and make recommendations for technical standards that relate to radio broadcasting and the reception of radio broadcast signals. The NRSC is a vehicle by which broadcasters and receiver manufacturers can work together towards solutions to common problems in radio broadcast systems.

Anyone who has a business interest in the technology being investigated by the NRSC is welcome to join the Committee and participate in its activities. Members of the NRSC are generally engineers, scientists, or technicians with in-depth knowledge of the subject being studied. In order to promote the free exchange of ideas during Committee work, members of the press are not allowed to attend NRSC meetings. However, members of the press are free to contact Committee chairpersons, NAB, or CEA with general questions about meetings. NRSC meetings are held on an as-needed basis, and NRSC members must participate at their own expense.

Currently, the NRSC has two active subcommittees: Digital Audio Broadcasting (DAB) and Radio Broadcast Data System (RBDS). Additional information on the NRSC, including a membership application, may be found on the Internet at <http://www.nab.org/SciTech/nrsc.asp>.

**2.2 In-band/On-channel DAB**

Broadcasting services worldwide are currently transitioning from analog to digital technologies, promising a host of benefits ranging from increased coverage and new services to vastly improved quality and robustness. For television broadcasters in the U.S., digital TV (DTV) services commenced in

November 1998 based upon technology standardized by the Advanced Television Systems Committee (ATSC).

For U.S. radio broadcasters, however, the move to digital broadcast technology has yet to take place. One of the primary reasons for this is the fact that the frequency bands used by radio broadcasters—535 kHz to 1705 kHz for AM, 88 MHz to 108 MHz for FM—are too crowded to accommodate a new, digital channel for each license holder as was possible in the TV band. Given this situation, there are only two options available—set aside a new frequency band in which to initiate a terrestrial digital radio service, or find a way to somehow “squeeze in” a new, digital signal along with the analog radio signals already occupying the existing radio bands.

The first option, establishing a new radio band, has been chosen by many countries around the world for their implementation of DAB. These so-called “new-band” digital radio services, many of which are now on-line and broadcasting, for the most part use a technology known as Eureka-147 digital audio broadcasting (DAB), a digital radio technology developed and standardized in Europe [9].

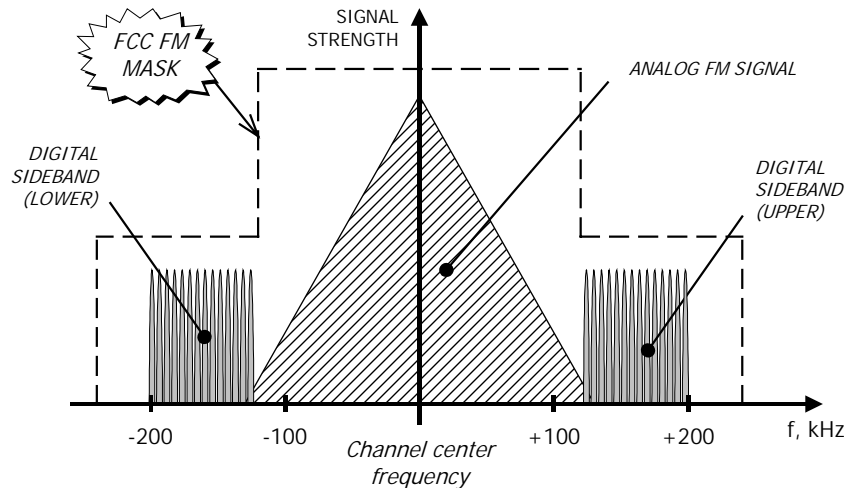
For a variety of reasons, the second option appears to be best for U.S. radio broadcasters to initiate digital service. A number of engineering firms believe this can be done utilizing a transmission technology known as in-band/on-channel (IBOC) DAB. Each of these companies is developing IBOC DAB technology for both the AM and FM bands, which they expect will allow broadcasters to fit in a digital signal along with the analog signal currently being broadcast, within the current spectrum allocation, and without causing undue harm to the existing analog signals.

Figures 1 and 2 illustrate proposed methods for doing this, for FM and AM radio signals, respectively. These examples are based on technical presentations made by a specific IBOC system developer, however other schemes are similar. In each case, digital carriers are placed next to (and in the AM case, below) the existing analog signal in such a way as to minimize interference with it, and at the same time, stay within the FCC RF spectrum occupancy limitations (“masks”). These masks are indicated in each figure by the dashed line.

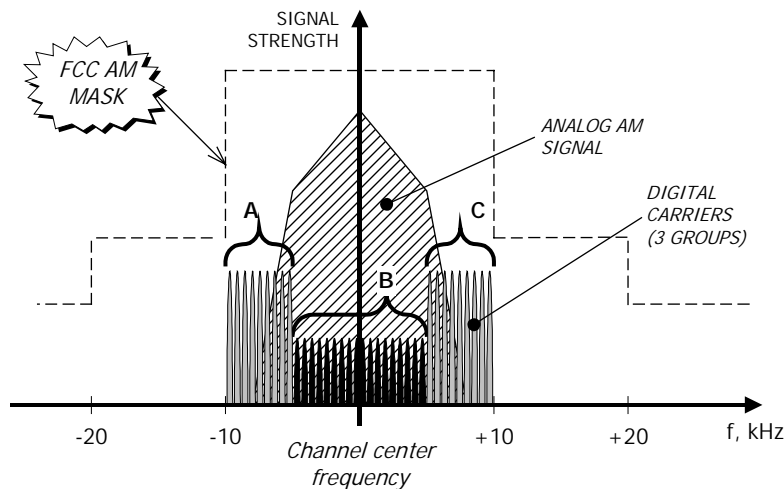
With systems like this, IBOC is expected to achieve “near-CD” audio quality with FM IBOC systems, and “FM-like” audio quality with AM IBOC systems. IBOC also is expected to support auxiliary digital services that broadcasters could use in a manner similar to the SCA services currently available on analog FM signals.

IBOC developers also are designing “all-digital IBOC” systems, which entirely eliminate the analog portion of the signal yet are compatible with the “hybrid IBOC” analog/digital signals shown in the figures. These all-digital systems would be phased in after there is sufficient market penetration of IBOC digital radio, and would provide for further improvements in the radio service.

Currently there is an open proceeding before the FCC on terrestrial DAB services in the U.S. [10]. The Commission has, within this docket, indicated its interest in IBOC DAB and in addition has recognized the NRSC as an expert industry body well-equipped to assist in the development of an IBOC DAB standard.



**Figure 1. Typical IBOC signal – FM band**



**Figure 2. Typical IBOC signal – AM band**

### 2.3 The NRSC's IBOC DAB Evaluation Program

As discussed in the previous section, the prospect of IBOC DAB, which appears to be in its final stages of development, promises to bring improved audio quality, new data broadcasting capabilities, and enhanced signal robustness to both the FM and AM radio bands. IBOC DAB is expected to bring forth these benefits at reasonable costs for broadcasters and consumers alike, and in addition, will utilize the current regulatory structure of the terrestrial radio service in the U.S., greatly easing the burden of transition on government agencies, as well.

Since the early 1990's the NRSC's DAB Subcommittee has been following closely the development of IBOC DAB technology. In a test program administered jointly with the Electronic Industries Association (EIA, at that time one of the co-sponsors of the NRSC) which concluded late in 1995, it became clear to the Subcommittee that IBOC technology had not yet progressed to the point of

viability, and in September of 1996 the Subcommittee suspended its activities until such time as there was sufficient progress to warrant renewed activity ([5-7], [11], [12], [14], [19], [30]).

In February of 1998 the Subcommittee was reactivated at the request of a new IBOC proponent, Digital Radio Express, Inc. (DRE), that had contacted the NRSC with claims of possessing viable AM and FM IBOC system designs [23]. Two other proponents—USA Digital Radio, Inc. (USADR), and Lucent Digital Radio, Inc. (LDR)—came forward to participate in the renewed activities of the Subcommittee, for a total of three proponents, all claiming AM and FM IBOC system development programs. Subsequent Subcommittee (and proponent) actions and progress have been well-publicized and reported on in detail within the broadcasting, communications, and electronics industry trade press ([1-4], [8], [13], [15-18], [20], [21], [24], [32]).

In 1998 and 1999, the Subcommittee established Test and Evaluation Guideline documents for the purpose of assisting the proponents in the self-testing programs each was conducting [25-27]. These documents served to identify the information that would be needed by the NRSC in determining how these IBOC systems compared with existing analog (AM and FM) radio systems. This part of the evaluation program culminated in the submission to the Subcommittee of technical reports by USADR (on 12/15/99) and LDR (on 1/24/00), which were studied by the Subcommittee's Evaluation Working Group, resulting in the release of two evaluation reports, adopted by the Subcommittee on April 8, 2000 ([22], [28], [29], [31]). (Note that by the time of the first submission to the NRSC, DRE and USADR had entered into an alliance whereby DRE was now supporting the technical efforts of USADR.)

Release of the Subcommittee's evaluation reports marked the culmination of what was commonly referred to as the "phase 1" evaluation effort of this "next generation" of IBOC DAB systems. In this phase 1 evaluation, each proponent independently evaluated their own system using their own facilities, procedures, etc., under the influence of the Subcommittee's Guidelines documents.

At the time of the issuance of this RFP, there are two IBOC DAB system proponents currently participating in the activities of the DAB Subcommittee, USA Digital Radio, Inc. and Lucent Digital Radio, Inc. As noted above, these parties each recently submitted technical information to the Subcommittee which was reviewed by the Subcommittee's Evaluation Working Group. On July 12, 2000, these proponents announced their intention to merge into a single company, iBiquity Digital Corporation, and as of this date this merger is undergoing legal review. The Subcommittee has been told by these proponents that once the merger is completed, iBiquity intends to continue its participation in the work of the NRSC. iBiquity has indicated that its new system will be a combination of the systems recently evaluated by the NRSC, "...the best of the best," in their words.

### **3.0 Goals of the Subcommittee**

The Subcommittee's Goals and Objectives are stated in Appendix A of this RFP. Any system submitted by prospective respondents to the NRSC for consideration must at the very least provide:

- A digital signal with significantly greater quality and durability than available from the AM and FM analog systems that presently exist in the United States;
- A digital service area that is at least equivalent to the host station's analog service area while simultaneously providing suitable protection in co-channel and adjacent channel situations;
- A smooth transition from analog to digital services.

With respect to its standards setting effort, respondents should note that any Subcommittee-developed standards will seek to fully specify the baseband and RF signal processing required to generate hybrid and all-digital IBOC DAB signals for transmission in the AM (535-1705 kHz) and FM (88-108 MHz) terrestrial broadcasting bands. The standards will address transmission of main channel audio signals as well as any supported auxiliary signals (audio, data, or otherwise). The Subcommittee expects that any resulting standards will be used by broadcast equipment manufacturers (for designing and building compatible transmission equipment); by AM and FM radio broadcasters (for design and construction of compatible broadcasting facilities); and by receiver manufacturers (for designing and building compatible reception equipment).

Furthermore, the Subcommittee is soliciting responses presenting complete systems, that is, systems which provide for IBOC DAB in both the AM and FM bands.

#### **4.0 Required elements for response**

In order to be considered completely responsive to this RFP respondents must, at a minimum, submit technical descriptions and system performance information as outlined below. These required elements are essentially those which were requested by the Subcommittee during its “phase 1” system evaluation (discussed in Section 2.0 above). Therefore, the Committee has in its possession this information for IBOC proponents who successfully participated in that first phase to completion (i.e. resulting in a positive evaluation report on their system being adopted by the Subcommittee). These proponents thus need only file a letter stating their intention to participate in this formal NRSC standards-setting process. No additional technical information will need to be included in their response to this RFP, provided that no significant system changes have been made which would invalidate the information received previously.

These requirements are designed to insure that respondent systems are fully developed, testable, and otherwise meet the Subcommittee’s criteria as stated in its Goals and Objectives to merit consideration as a potential IBOC DAB standard and undergo further, rigorous testing and evaluation by the NRSC.

#### **4.1 Detailed system description**

Respondents need to submit a written, detailed system description including:

- i) High level description and theory of operation;
- ii) Transmission equipment description / requirements;
- iii) Receiver equipment description / requirements;
- iv) Compliance with (or changes necessary to) FCC rules.

#### **4.2 Description of initial test procedures followed**

Any system submitted for consideration will need to have already undergone initial laboratory and field testing by its developers; the procedures used to conduct those initial tests must be submitted as part of the response to this RFP.

Note that Appendices A and B of the DAB Subcommittee’s Laboratory and Field Test Guidelines Documents ([25], [26]) include suggested laboratory test procedures which are based on the experience gained by the NRSC in its prior DAB test efforts. Respondents are instructed to review this

information and in particular, compare their test procedures with those included in the guidelines. It is especially important that respondents who have used test procedures which differ significantly from the suggested procedures provide detailed information on the procedures which were followed.

### **4.3 Initial test results**

Respondents must submit the initial test results of their AM and FM IBOC systems, obtained using the initial test procedures described in Section 4.2 above. Again, proponents are strongly encouraged to follow the NRSC IBOC System Test Guidelines ([25], [26]) when preparing a response, and indicate as part of their response which desired test results (as stated in the Guidelines) are included. Appendices C and D of the Guidelines (system test matrices) were developed to serve as “checklists” which proponents can include with their response, providing a straightforward way to indicate which requested test results have been obtained. The test results will be evaluated by the Evaluation Working Group of the DAB Subcommittee in accordance with the Subcommittee’s IBOC System Evaluation Guidelines [27].

### **5.0 Additional Information**

The Subcommittee’s IBOC DAB standards setting effort will consist of the following phases (responsible party indicated in braces): issuance of an RFP (request for proposals) for candidate technologies {NRSC sponsoring organizations}; review of submitted proposal(s) and selection of system(s) to be considered {NRSC DAB Subcommittee}; adoption of detailed laboratory and field test procedures {NRSC DAB Subcommittee}; independent testing of accepted system(s) utilizing the adopted test procedures {NRSC DAB Subcommittee}; evaluation of test results {NRSC DAB Subcommittee}; drafting and adoption of final report including recommendations (if any) for AM and FM IBOC standards {NRSC DAB Subcommittee}; drafting and adoption of IBOC standards documents {NRSC DAB Subcommittee}. Funding of the lab and field testing portions of this project will be provided by the proponents of the systems accepted for testing.

### **6.0 Availability of hardware for testing**

The selection of a standard for IBOC DAB technology will require uniform testing and evaluation of the candidate approaches in a manner and time frame to be established by the NRSC. The DAB Subcommittee is presently drafting the test procedures necessary to conduct these tests; once established, and once testing facilities have been procured, respondents will be asked to make available at no charge a fully functional system for NRSC testing and evaluation.

Respondents must state in writing, as part of their response to this RFP, their intention to provide said equipment. It is understood that failure to supply the equipment in accordance with the test plan established by the NRSC can be sufficient grounds for rejection of the proposed system.

### **7.0 Effective date**

Responses to this request must be received at the address below no later than 5PM September 29, 2000.

### **8.0 NRSC contact**

If you have any questions about this request please address them to:

National Association of Broadcasters  
Science & Technology Department  
1771 N Street, N.W.  
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## **Appendix A – DAB Subcommittee Goals & Objectives**



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5/14/98

## DAB Subcommittee

### Goals & Objectives

*(as adopted by the Subcommittee on May 14, 1998)*

#### Objectives

- (a) To study IBOC DAB systems and determine if they provide broadcasters and users with:
  - A digital signal with significantly greater quality and durability than available from the AM and FM analog systems that presently exist in the United States;
  - A digital service area that is at least equivalent to the host station's analog service area while simultaneously providing suitable protection in co-channel and adjacent channel situations;
  - A smooth transition from analog to digital services.
- (b) To provide broadcasters and receiver manufacturers with the information they need to make an informed decision on the future of digital audio broadcasting in the United States, and if appropriate to foster its implementation.

#### Goals

To meet its objectives, the Subcommittee will work towards achieving the following goals:

- (a) To develop a technical record and, where applicable, draw conclusions that will be useful to the NRSC in the evaluation of IBOC systems;
- (b) To provide a direct comparison between IBOC DAB and existing analog broadcasting systems, and between an IBOC signal and its host analog signal, over a wide variation of terrain and under adverse propagation conditions that could be expected to be found throughout the United States;
- (c) To fully assess the impact of the IBOC DAB signal upon the existing analog broadcast signals with which they must co-exist;
- (d) To develop a testing process and measurement criteria that will produce conclusive, believable and acceptable results, and be of a streamlined nature so as not to impede rapid development of this new technology;
- (e) To work closely with IBOC system proponents in the development of their laboratory and field test plans, which will be used to provide the basis for the comparisons mentioned in Goals (a) and (b);
- (f) To indirectly participate in the test process, by assisting in selection of (one or more) independent testing agencies, or by closely observing proponent-conducted tests, to insure that the testing as defined under Goal (e) is executed in a thorough, fair and impartial manner.