



AM All-Digital IBOC Field Test Report

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1 Overview

This report documents the results of field tests of the iBiquity AM all-digital mode. This report highlights the improved performance that will be achieved by converting from the IBOC hybrid mode to all-digital broadcasting.

1.1 IBOC Signal

The AM IBOC hybrid mode contains the analog AM signal (with tertiary digital carriers underneath) and the primary and secondary IBOC digital carriers inserted on both sides. The total power of the digital carriers is approximately 12 dB below the total power in the analog host. The IBOC signal is generated using an iBiquity AM IBOC exciter. Figure 1 depicts a spectral representation of the AM hybrid mode. The rectangular areas contain the primary and secondary subcarriers, and the trapezoidal area represents the analog host AM signal and tertiary carriers.

In the AM all-digital mode, the analog signal is removed and replaced by the primary digital carriers. These carriers are transmitted at a higher level than in the hybrid mode, providing more robust digital service. The region between +5 kHz to +10 kHz carries the secondary digital carriers and -5 kHz to -10 kHz the tertiary digital carriers. Figure 2 depicts a spectral representation of the IBOC AM all-digital mode.

For both modes, the primary digital carriers contain the core, monophonic audio material. The secondary and tertiary carriers hold enhanced stereo and higher spectral content audio and ancillary data.

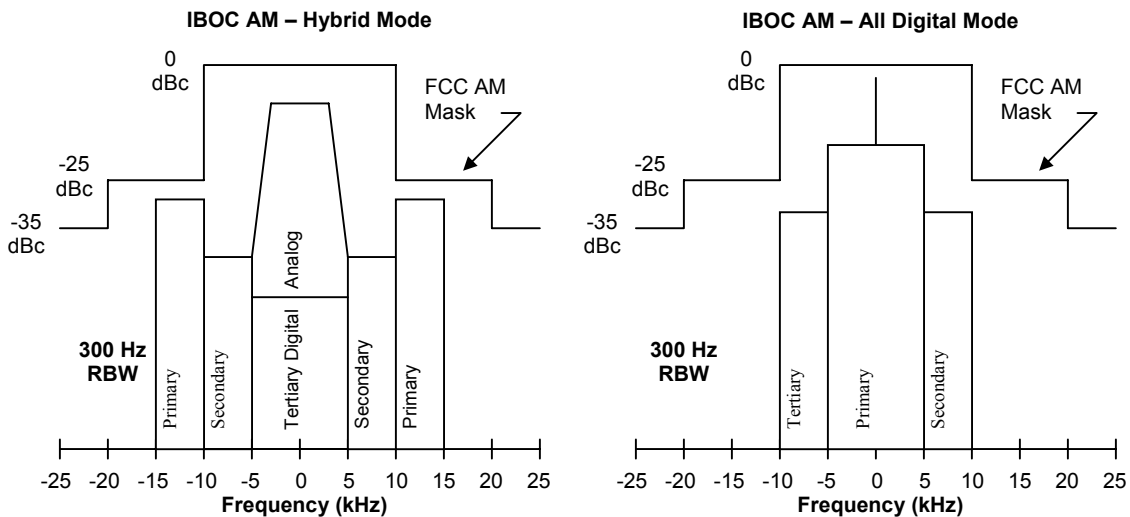


Figure 1 - AM Hybrid IBOC Spectrum

Figure 2 - AM All-Digital IBOC Spectrum

1.2 Transmitter Test Sites

The IBOC all-digital tests were conducted using WTOP-AM, Washington, D.C. and WD2XAM, Cincinnati, Ohio.

WTOP, a Class A AM commercial radio station, has been operating as an IBOC test station for over one year. The transmitter is located at 39° 02' 30.0" N latitude and 77° 02' 45.0" W longitude and broadcasts with a power of 50.0 kW, DA-2. A report on the hybrid mode operations using WTOP was included in iBiquity's 2002 test report to the NRSC. iBiquity has thoroughly characterized hybrid mode performance on WTOP, and this information provides an excellent benchmark for comparison to the all-digital mode. Because all-digital testing replaces the amplitude modulated carrier with digital carriers, the radio station is rendered unlistenable on traditional analog receivers. Therefore, in an effort to minimize the effect on WTOP's audience, iBiquity was compelled to conduct its tests during the experimental period, from midnight to 6 AM.

WD2XAM, an experimental Class D AM non-commercial radio station, is located at 39° 18' 16.0" N latitude and 84° 28' 40.0" W longitude and broadcasts 10 kW, ND - Day, on 1660 kHz. It has operated as an IBOC test station for many years. Data from WD2XAM hybrid field testing also was included as part of iBiquity's 2002 test report to the NRSC. These all-digital tests show that class D facilities stand to greatly benefit from the signal robustness and audio quality that the all-digital system provides.

1.3 Operating Power

For these tests, iBiquity set the all-digital operating power of each transmitting facility so that the level of the center frequency all-digital reference carrier was 3 dB below that of the reference unmodulated analog carrier. It is important to note that iBiquity has not selected a final power level for the all-digital system. Nonetheless, tests at this power level provide a baseline for all-digital operations. Decreasing the power will reduce digital coverage whereas a power increase will increase digital coverage.

1.4 Station Configuration

WTOP and WD2XAM were connected to an IBOC exciter, as shown in Figure 3, to generate the AM all-digital IBOC signal.

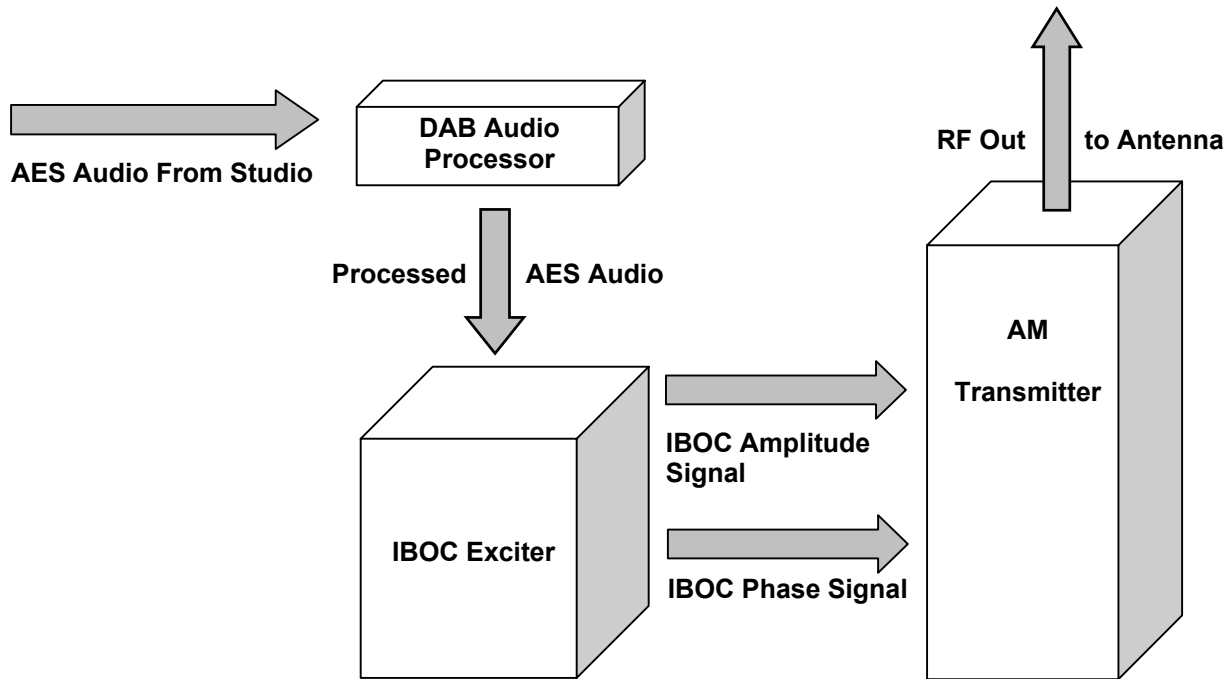


Figure 3 - Diagram of Typical IBOC All Digital AM Transmitter Setup

1.5 Van Configuration

The mobile test platforms used to collect field test data were identical in equipment and configuration to those used for the NRSC Hybrid IBOC AM testing.

1.6 Route Selection

In order to allow for a direct comparison with the results of hybrid operations, iBiquity conducted the all-digital tests using the same test routes that were used for NRSC hybrid mode testing in 2001. At WD2XAM, additional routes were run in the all-digital mode to provide more data.

2 Test Results

2.1 WTOP

The all-digital tests confirm that the all-digital mode offers significantly greater digital coverage than the already extensive digital coverage offered by the hybrid mode of operation. Figure 4 illustrates the digital coverage for all-digital broadcasts using the WTOP night antenna during the midnight to 6 AM experimental period. The effect of skywave interference on this station's night coverage is well documented. WTOP's nighttime interference free contour of 2 mV/m is below that of the daytime 0.5 mV/m. WTOP's analog night coverage degrades dramatically as the listener approaches Baltimore, Maryland, 50 km from the transmitter. Figure 4 shows robust all-digital coverage up to Baltimore's Ft. McHenry Tunnel. Figure 5 contains the results of NRSC hybrid testing from 2002 and is included for comparison with the all-digital results.

2.2 WD2XAM

Tests conducted on WD2XAM also demonstrate the extension of digital coverage that is obtained by adopting the all-digital mode of operation. Figure 6 profiles the all-digital coverage. Comparison to the hybrid mode coverage from the NRSC tests shown in Figure 7 shows that a daytime Class D station operating in the all-digital mode can attain digital coverage extending to the 0.1 mV/m contour.

3 Field Test Summary

These field test results have demonstrated the enhanced performance of the iBiquity AM All Digital IBOC system in a real-world environment and have validated the results of extensive simulations and laboratory performance tests. The digital coverage tests in this report illustrate that the IBOC All Digital mode offers coverage superior to IBOC hybrid.



Figure 4 – WTOP All-Digital Performance (Night)

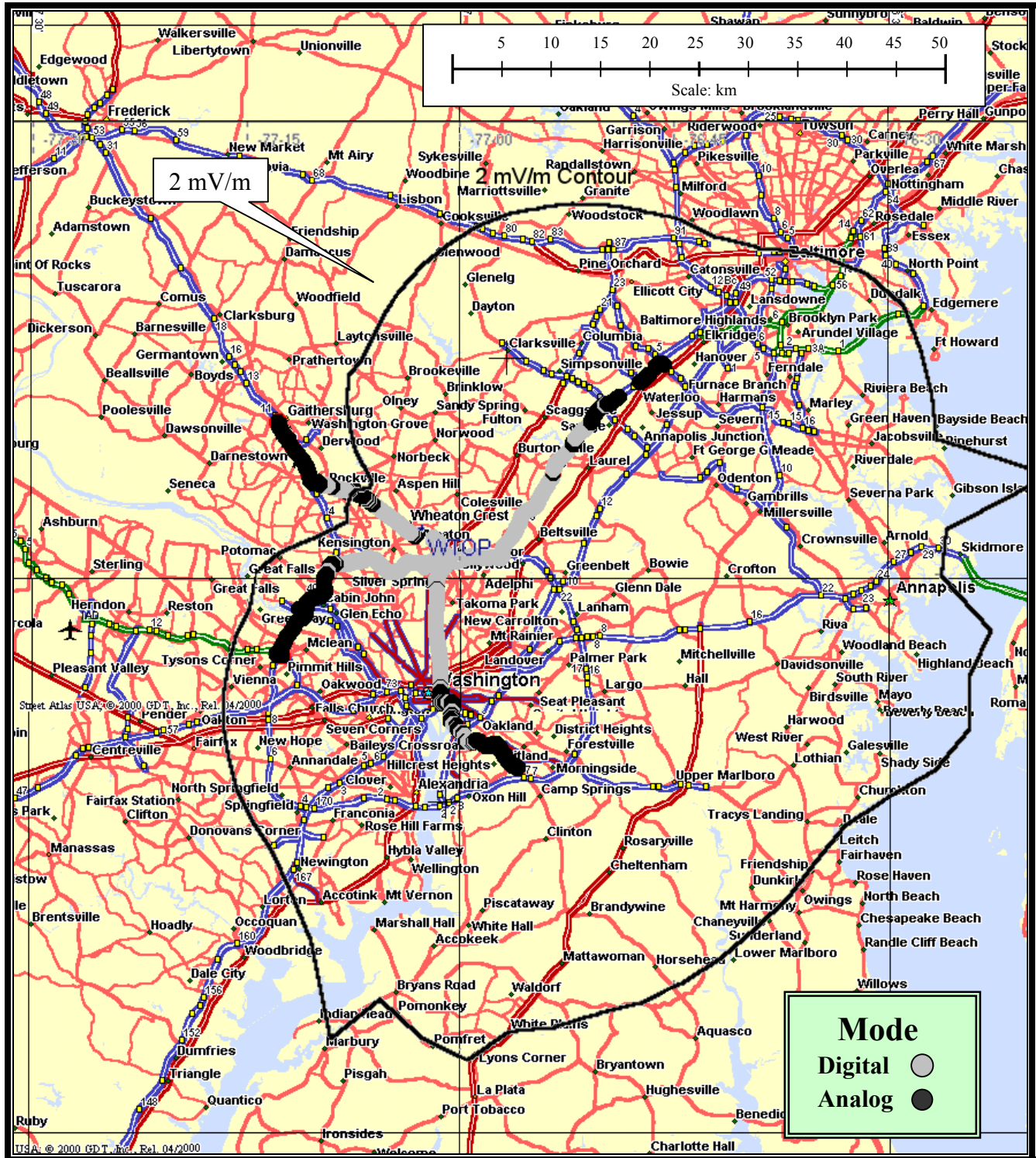


Figure 5 – WTOP Hybrid Performance (Night - from NRSC Testing)

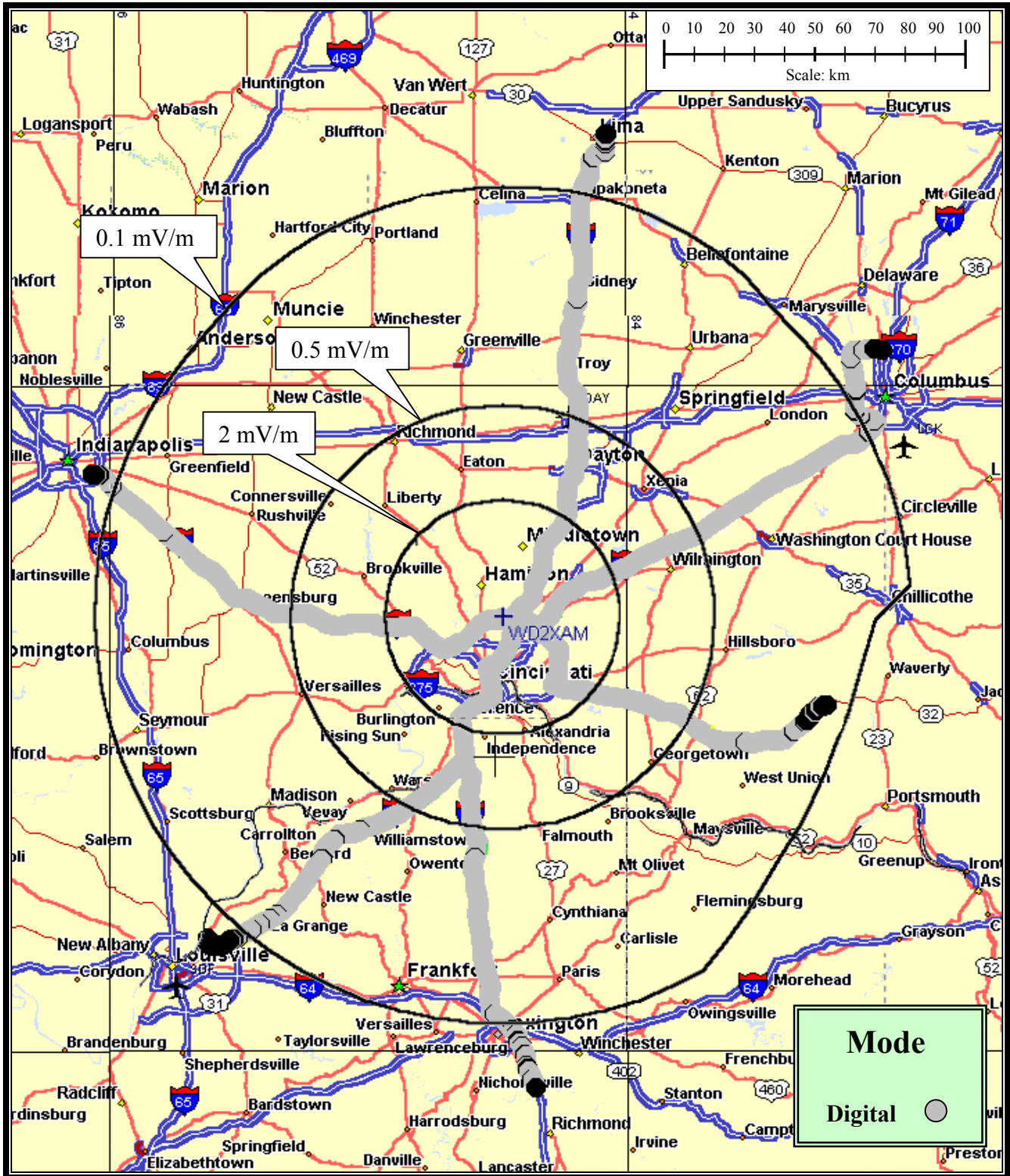


Figure 6 – WD2XAM All-Digital Performance (Day)

