OBSERVATIONS ON AM IBOC DAB
HYBRID MODE TEST RESULTS

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The following observations are based on data from field tests performed on the Ibiquity AM IBOC system.

1. Three of the four AM stations tested utilized directional arrays.

These stations include WWJ 950, WTOP 1500, and KABL 960.

2. AM bandwidth is utilized differently with AM IBOC than it is with analog AM.

With AM IBOC, most of the digital information is contained in the sidebands. Core or “primary” carrier information is located further from the carrier than enhanced “secondary and tertiary” data. Figure 1 illustrates the distribution of information across the band. Essentially, the AM sidebands carry more energy and information with AM IBOC than with conventional AM.

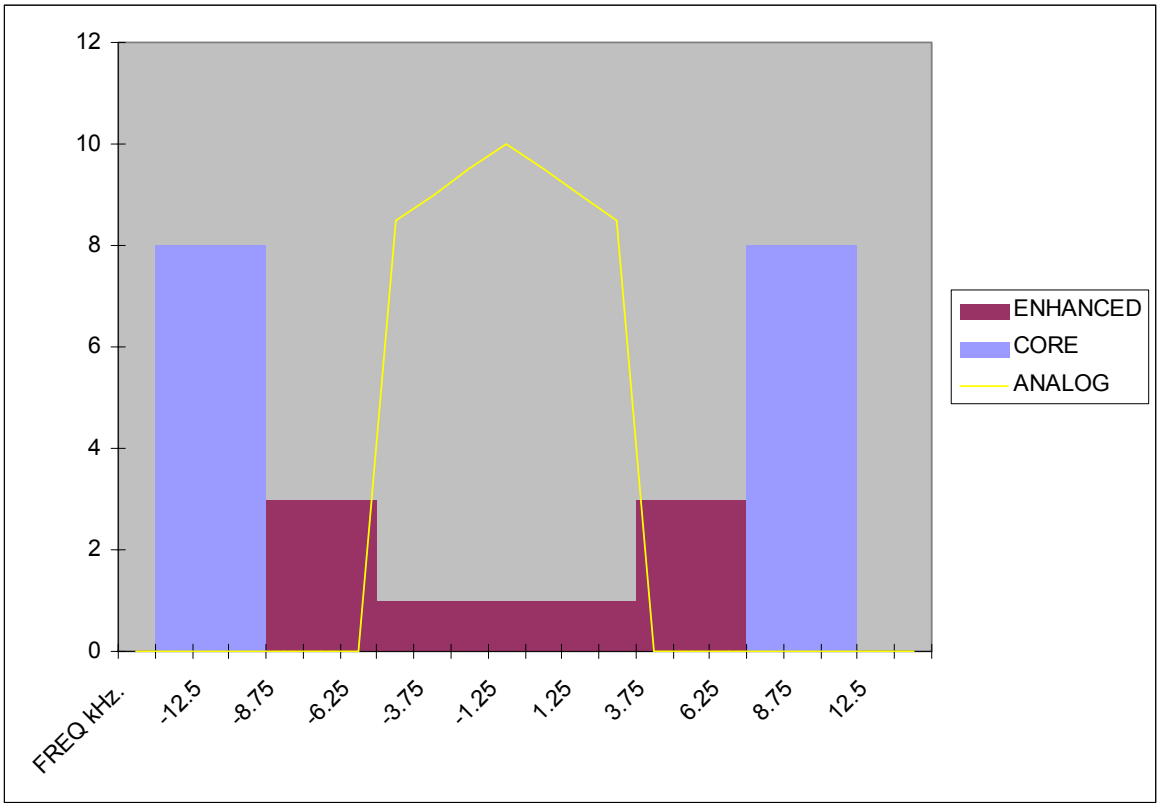

FIGURE 1: AM IBOC DAB, Hybrid Mode

3. In AM directional arrays, impedance bandwidth may vary with each radial.

"An ideal phasor would present a load to the transmitter that is the same pure resistance at all sideband frequencies. However, phasors consist of coils and capacitors, whose reactance varies with frequency; therefore, this ideal cannot be achieved. The term "impedance bandwidth" is used to describe the constancy of phasor input impedance across the entire range of sideband frequencies."[1]

Theoretically, the directional station phasor creates a band-pass filter on the radial on and near the pattern lobes, as shown in Figure 2, and conversely creates a

[1] *AM Broadcast Antenna Systems Part II: Antenna Coupling and Phasing Systems for AM Broadcasting,* National Association of Broadcasters Engineering Handbook, Eighth Edition, Edward Edison, P.E.

band-reject filter on and near the pattern nulls, as shown in Figure 3. The shape of the filter depends on the impedance of the components comprising the phasor.

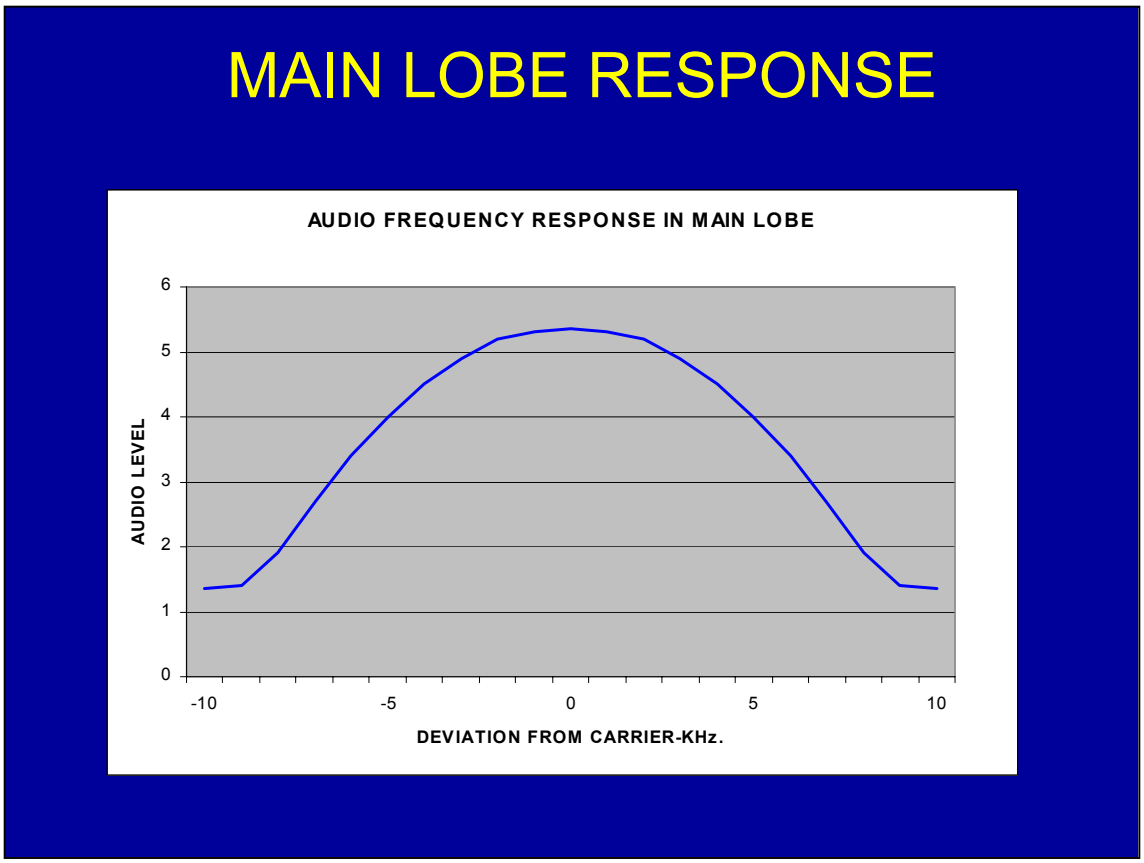

Figure 2. Phasor Filtering Effects in the Main Lobe

4. Degradation to the AM IBOC signal thought to be caused by impulse noise, multipath, adjacent stations, etc. may actually be caused by filtering by the phasor.

Maximum sideband filtering would occur in the main lobe of the directional signal, which is typically directed to the area of maximum population. This effect would not be present in all directional systems, only those with bandwidth impedance problems.

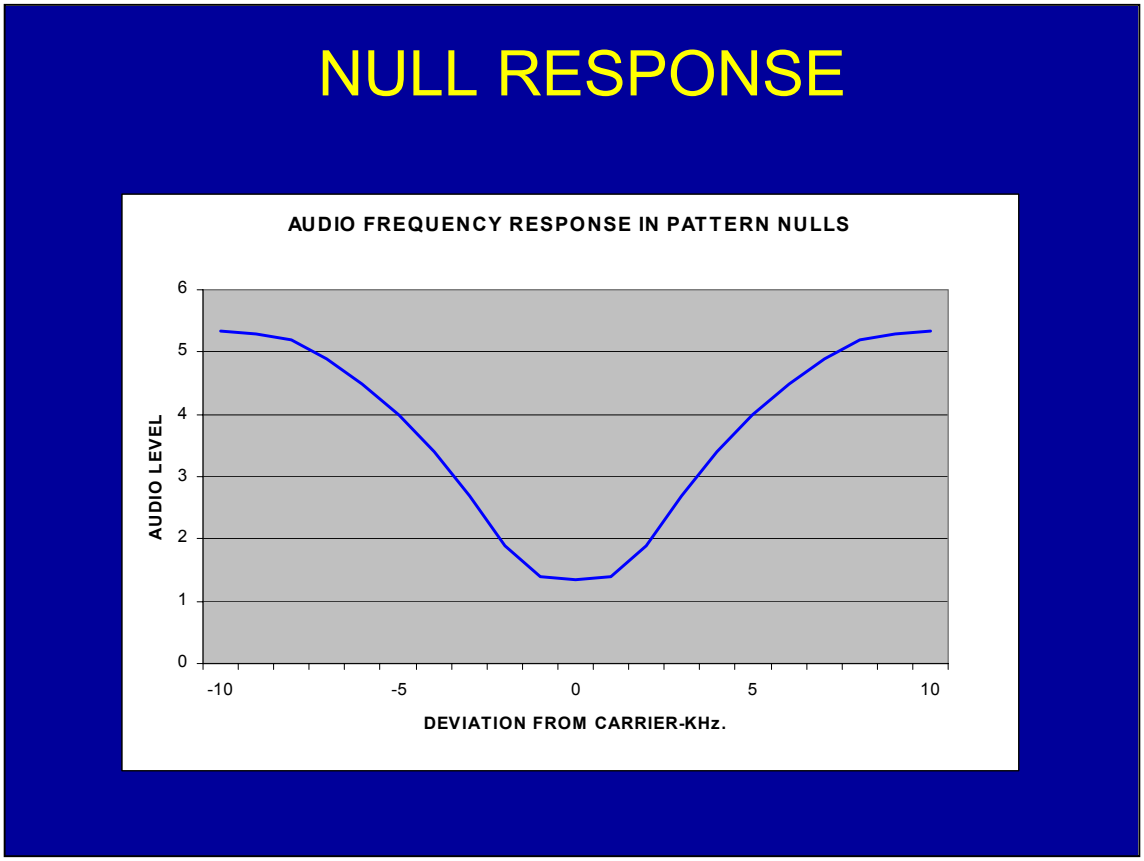

Figure 3. Phasor Filtering Effects in the Phasor Null

5. Digital degradation seems to be consistent with predicted phasor filtering effects.

Theoretically, phasor filtering effects would be more egregious in an array with more towers. WWJ is a 5 tower directional array operating at 6 kW day and night. The WWJ study shows what may be phasor degradation to the IBOC hybrid enhanced signal, particularly in the day pattern main lobe, approximately 0 degrees true north.

The typical pattern of digital degradation with the non-directional AM IBOC system is enhanced mode to core-only mode to analog mode. This is apparently due to the increase in S/N ratio due to distance and adjacent channel signals.

Along the WWJ 0 degree radial, the degradation is less well defined, mainly switching between the enhanced mode and core only modes. Degradation begins at approximately 5 mV/M, compared to 1-2 mV/M on most other pattern radials.

The atypical pattern of degradation in the WWJ 0 degree radial could be due to non-consant bandwidth impedance.

CONCLUSIONS

In addition to skywave, adjacent channel signal, multipath, impulse noise and other forms of interference, degradation of the AM IBOC signal in directional arrays could be caused by non-constant impedance bandwidth. Tests confirming or denying the effects of non-consant bandwidth impedance on AM IBOC systems should be performed.