DTV Channel 6 Interference to FM Band Reception

Final Report

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Executive Summary

National Public Radio (NPR) commissioned this study to consider the interference potential of digitally modulated television (DTV) stations assigned to DTV Channel 6 on existing public radio stations operating in the lower noncommercial FM band, Channels 201-220 (88.1-91.9 MHz). While there was considerable historical interference between NTSC television stations assigned to Channel 6 and FM stations in the noncommercial FM band, there had not been a detailed consideration of this issue during the laboratory and field testing of DTV systems.

Presumably, digital transmission implies a certain immunity from interference, suggesting that the DTV signal might be less prone to interfere with or receive interference from low band FM. However, absent the availability of DTV receivers, the effect of low band FM signals on DTV Channel 6 stations was not included in the scope of this study.

The mask of a DTV signal is just like the mask of random noise filtered by a bandpass filter to 6 MHz of bandwidth. That is, DTV looks like noise on a spectrum analyzer, and that is what it looks like to a DTV receiver before demodulation. In conducting this study, NPR was concerned with how the noise presented by the density of the DTV mask might alter the FM interference experienced with NTSC television in the past.

The study is therefore limited to laboratory measurements, observations and calculated predictions of the real world interference. Computer modeling techniques were applied using the laboratory data to one NTSC TV channel 6 market (its DTV Channel 64 allotment is outside the established "core channel" region) and one DTV Channel 6 allotted market. The markets selected for analysis were Philadelphia, PA, and New Haven, CT.

The realities of DTV interference became evident on February 27, 1998, when low power biomedical telemetry devices using VHF television channel 9 failed to operate after WFAA-TV, Dallas began DTV broadcasting on the same channel. Several nearby hospitals experienced data loss in remote cardiac monitoring equipment. This event served as a wake-up call for the entire broadcast industry, as well as secondary and unlicensed users of broadcast spectrum to the potential of DTV interference.

Test Methodology

The study was conducted in two phases: Laboratory testing and a desired-to-undesired (D/U) ratio analysis/modeling. The laboratory tests were conducted using the digital radio testing laboratory at NASA's Lewis Research Center in Cleveland, OH. The Consumer Electronics Manufacturer's Association (CEMA) provided the space and test equipment for the laboratory.

Thomas B. Keller, President of T. Keller Corporation, served as senior consultant on the laboratory phase. He was assisted by David M. Londa, RF Test Manager, NASA Lewis Research Center and Robert W. McCutcheon, Test Engineer.

During the laboratory phase, signal to noise measurements were made with 6 FM radio receivers and up to 3 FM subcarrier receivers while increasing the undesired signal level (DTV) in 5 dB steps. The measurements were repeated for five different undesired DTV transmitter emission models, two desired signal levels and various desired signal center frequencies.

The receiver noise floors were recorded for two multipath scenarios, three desired signal center frequencies and three out of band emission types. All of the laboratory measurements appear in the attached laboratory test report shown in Section II. The measurements contained in the laboratory report can be used to calculate protection ratios and predict FM station coverage based on various undesired signal emissions and desired signal center frequencies.

William F. Hammett, P.E., and Stanley Salek, P.E., of Hammett & Edison, Inc., Consulting Engineers, handled the second phase of the study. They converted the D/U ratio laboratory data into "real world" conditions using computer modeling techniques.

At the request of NPR, Hammett & Edison made certain assumptions in converting the D/U ratio data from the laboratory work into "real world" analysis as follows:

1. That WPVI-TV, NTSC Channel 6 Philadelphia might find it desirable to remain as WPVI-"DTV" Channel 6 at the conclusion of the NTSC/DTV transition period. NPR believes that this is likely since the allotment changes expanded the core DTV channels to include low band VHF frequencies (channels 2 through 6), and, WPVI-TV was assigned DTV Channel 64 which is outside the final core DTV spectrum range, channels 2 through 51. NPR surmises that other television stations may wish to operate as DTV Channel 6 stations, preferring use of DTV Channel 6 where available over higher UHF DTV allotments. Like WPVI-TV, other television stations also received DTV allotments at high UHF channels that are now outside the final core DTV channel range. [1]

2. All transmitting and receiving antennas were considered to be horizontally polarized.

3. A typical elevation plane was used to replicate the elevation plane characteristics that would be deployed by a DTV facility.

[1]There are 190 television stations assigned to DTV Channel 52 or higher. Twelve of those stations presently occupy NTSC Channel 6 facilities.

WCTV-DT, D52, Thomasville, GA	KWQC-DT, D56, Davenport, IA
KVIE-DT, D53, Sacramento, CA	WCML-DT, D57, Alpena, MI
WABG-DT, D54, Greenwood, MS	KSRE-DT, D57, Minot, ND
WECT-DT, D54, Wilmington, NC	WKMG-DT, D58, Orlando, FL
WIPR-DT, D55, San Juan, PR	WLNS-DT, D59, Lansing, MI
KOTV-DT, D55, Tulsa, OK	WPVI-DT, D64, Philadelphia

Test Findings

The testing confirms that there will be interference between DTV Channel 6 stations and NCE-FM stations when their signal contours overlap. In the markets selected for modeling in this study, there will be significant interference to FM reception coverage in addition to the limitations that might be expected due to terrain factors.

The color maps shown in Section I show Terrain Integrated Rough Earth Models (TIREM) for New Haven and Philadelphia. The TIREM-computed D/U ratios treat the FM stations as the desired station and the DTV as the interfering station. In each market modeled, the DTV signal presence causes interference to the FM signal affecting in well populated portions of the FM listening area.

NPR believes that the study results fully justify its position that DTV Channel 6 allotments are not in the best interest of NPR member stations and its listening public. This study will be used to support that position as the FCC proceeds to implement its report and orders in the advanced television proceeding. In addition, NPR intends to share the results of this study with potentially affected stations.