NAB TV TechCheck

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HD-ENG Field Test Report

Television broadcasters are transitioning to digital electronic newsgathering (ENG) technology which operates in the 2 GHz frequency band (see the December 10, 2007 issue of TV TechCheck for the latest regulatory information on this transition). A session at the upcoming NAB Broadcast Engineering Conference (BEC, April 12-17, 2008, Las Vegas, NV – see below for additional information) called "TV News and Live Production" includes a paper by Walter Sidas, Gregory Coppa, and Robert Seidel of CBS describing the results of HD-ENG field tests performed by CBS in the New York City area, which is excerpted here.

INTRODUCTION – this paper presents the results of HD-ENG field tests performed by CBS. It describes the objectives, methodology, and field tests performed in an urban environment using compressed HD signals at bit rates from 18 to 28 Mbps. The microwave signals were transmitted using the new, FCC-mandated 2 GHz, 12 MHz channel plan and employed Coded Orthogonal Frequency Division Multiplexed (COFDM) modulation. The tests were performed using a typical ENG vehicle, modified to incorporate an HD encoder and the COFDM modulation equipment. Six COFDM configurations were tested to determine the maximum bit rate that could be reliably delivered.

DESCRIPTION OF TEST PROGRAM – the test program's primary objective was to determine the optimal operating parameters of digital microwave transmission and reception using the new 2 GHz, 12 MHz channel plan in an urban environment using compressed HD signals at bit rates from 18 to 28 Mbps. A series of tests were performed to determine operational parameters required to achieve the highest bit rate possible for reliable HDTV transmission. These tests used one ENG van and recorded parameters for quasi-error free HDTV transmission. The tests concentrated on collecting reception data from "difficult" transmit sites that required a "bounce." A variety of line-of-sight (LOS) locations, considered "easy" transmit sites with increasing distances from the Empire State Building, were measured for all data rates to determine the relationship between data rate and transmit distance.

SYSTEM DESCRIPTION – the DVB-T transmission system utilizes COFDM made up of 2,000 carriers that are spaced a few KHz apart across the operating signal bandwidth of 8, 7 or 6 MHz. The modulation format of all carriers is operator selectable as QPSK, 16-QAM or 64-QAM. The different modulation systems have different minimum Carrier-to-Noise (C/N) ratios that must be taken into consideration when analyzing the data. The minimum C/N is also different for the type of channel model. A Gaussian channel, where the direct receive signal is only impaired by white noise, will have the lowest C/N requirement. A Ricean channel, where the signal path is impaired by a number of echoes of varying levels and phases, will have a slightly higher C/N for the same modulation. A Rayleigh channel, which has no direct line of sight and has multiple echoes similar to the Ricean channel, has the highest C/N requirement of the channel models and is closest to actual field conditions. For Quasi-Error-Free (QEF) reception, a bit error rate of 2x10-4, after FEC is applied, is required. Shown in the table are the C/N ratios required to achieve QEF for the Gaussian, Ricean, and Rayleigh channels.

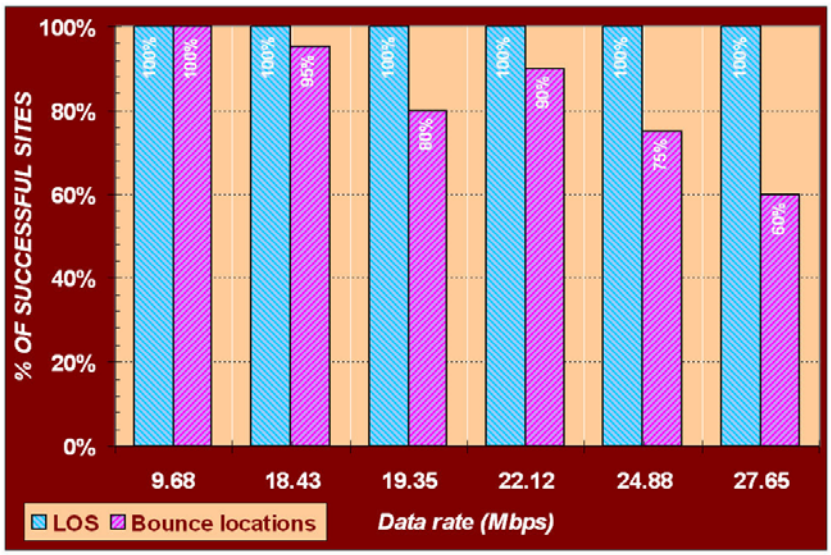
Required C/N for Quasi-Error-Free Reception after FEC (BER ≈ 2e-4)

Data rate (Mbps)	Modulation type	FEC code rate	Channel type		
			Gaussian (dB)	Ricean (dB)	Rayleigh (dB)
9.68	QPSK	7/8	7.7	8.7	16.3
18.43	16-QAM	5/6	13.5	14.4	19.3
19.35		7/8	13.9	15.0	22.8
22.12	64-QAM	2/3	16.5	17.1	19.3
24.88		3/4	18.0	18.6	21.7
27.65		5/6	19.3	20.0	25.3

HDTV DATA RATE TESTING – HDTV data rate testing was undertaken to determine the maximum data rate that could be transmitted using a DVB-T 8 MHz pedestal in a 12 MHz channel. It should be noted that the 9.68

Mbps MPEG-2 data rate was only used for antenna sighting and is insufficient to provide “broadcast quality” HDTV transmissions, since the HD-ENG signal will be concatenated with the ATSC compression process when it is broadcast to the home. Shown in the bar chart below are the percentage of successful sites for LOS and “bounce” locations within a 35-mile radius for the 6 data rates under test. For the LOS sites, a 100% success rate was achieved for all 6 data rates with only 1 watt of transmitted power. The bounce locations were those that required a bounce of the transmitted signal off adjacent buildings to reach the Empire State Building. The maximum transmission distance for any bounce site was 27.5 miles. The baseline data rate of 9.68 Mbps, which was used for sighting the antenna, had a 100% success rate for all bounce locations. The 18.43 and 22.12 Mbps signals had comparable success rates of 95% and 90% respectively. This is expected since these two modulation schemes have the same minimum C/N requirement of 19.3 dB for a Rayleigh channel (as shown in the table). The 19.35 Mbps signal had a receive success rate of 80%. This lower success rate is attributed to the higher C/N noise requirement of 22.8 db for a Rayleigh channel.

RESULTS – many of the most difficult ENG locations in the canyons of New York City; such as Gracie Mansion, United Nations, City Hall, Lincoln Center, Wall Street Area, World Trade Center provided reliable HD-ENG transmission paths using a variety of data rates. The success rate of these tests indicates the HD-ENG using an 8 MHz DVB-T pedestal can provide reliable transmission paths for both line of sight and bounce locations. Because high definition signal quality is of paramount importance, all six of these data rates should be loaded as pre-sets in the transmission encoders and modulators. This will afford the broadcaster the greatest flexibility and the highest quality for ENG.



This paper will be presented on Monday, April 14, 2008 starting at 4PM in room S226/227 of the Las Vegas Convention Center. It will also be included in its entirety in the *2008 NAB BEC Proceedings*, on sale at the 2008 NAB Show. For additional conference information visit the NAB Show Web page at www.nabshow.com.

ATSC Digital VSB Measurements Seminar

Monday, March 10, 2008
Great Lakes Broadcasting Conference
Grand Rapids, Mich.

A one-day seminar on the ATSC’s digital television (DTV) vestigial sideband (VSB) transmission system measurement methodologies will be presented on March 10 in Grand Rapids, Mich. Presented by DTV transmission engineer, Gary Sgrignoli, the seminar identifies and describes the pieces of test equipment needed for VSB testing in the laboratory, at transmitter sites and at remote field sites.

For additional information contact Gary Sgrignoli, Meintel, Sgrignoli & Wallace at (847) 259-3352 or Gary.Sgrignoli@IEEE.org.

2008 NAB Broadcast Engineering Conference Summary of Presentations

Check out the papers that will be presented at the 2008 NAB Broadcast Engineering Conference in Las Vegas, April 12 -17, 2008. Find registration, housing or additional information on the NAB Show at http://www.nabshow.com/.