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TV TechCheck
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CHINA APPROVES DTV STANDARD

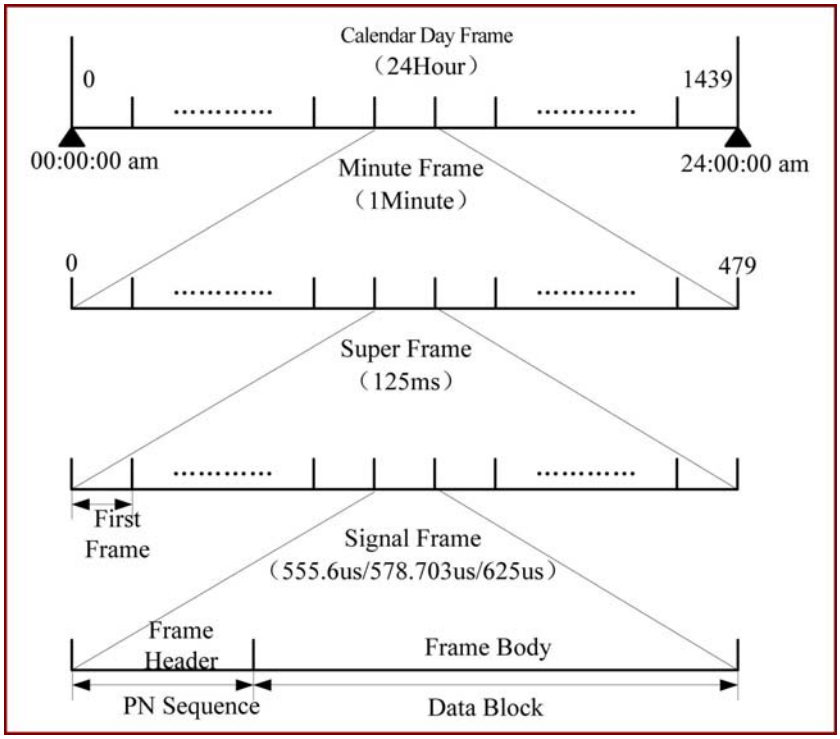
A new digital terrestrial TV standard was recently announced, from China, adding yet another standard to the list which until now included ATSC (developed in the U.S.), DVB-T (developed in Europe), and ISDB-T (developed in Japan). Some of the details of this new standard were presented last month at the IEEE Broadcast Symposium (Washington, DC, http://www.ieee.org/bts/) in a technical paper (excerpted here) entitled "A Technical Review of the Chinese Digital Terrestrial Television Broadcasting Standard," by Jian Song, et. al., Dept. of Electronic Engineering, Tsinghua National Laboratory for Information Science and Technology, Tsinghua University, Beijing, China.

Introduction – China officially started development of the Chinese DTTB standard in 1994, and is technically ready to announce the DTTB standard in 2006 after 12 years of hard work. The brief history is as follows:

- 1994 - Call for proposals from the Chinese government with the requirement of higher bandwidth efficiency, larger coverage, low-power consumption as well as high mobility. The proposal must support standard definition TV (SDTV)/HDTV, fixed/mobile and indoor/outdoor reception;
- 1999 - DMB-T (digital multimedia broadcasting-Terrestrial, from Tsinghua Univ.) and ADBT-T (Advanced Digital Television Broadcasting-Terrestrial, from Shanghai Jiaotong Univ.) were submitted;
- 2002 - Lab tests and field trials for proposed systems and analysis of intellectual property (IP) status;
- Academy of Broadcasting Science proposed TiMi Terrestrial Interactive Multiservice Infrastructure;
- 2004 - Three competing proposals started to merge together; and
- 2006 - Lab and field testing of system based on merged proposal and the standard announced.

Technical details – include the following:

- FEC code is concatenation of outer BCH (762, 752) derived from BCH (1023, 1013), and inner low density parity check (LDPC) code with three different coding rates (0.4, 0.6, 0.8);
- Signal constellation and mapping: the output of FEC is converted to the nQAM symbol stream with the first encoded input bit of each symbol as LSB. CDMB-T (acronym used to describe Chinese DTV Standard; see last paragraph for additional information) supports the following constellations: 64QAM, 32QAM, 16QAM, 4QAM, and 4QAM-NR. Power normalization is utilized during the symbol mapping to keep the average power from different mappings roughly the same. 4QAM-NR is different from the rest of the mappings and is actually the combination of NR coding and 4QAM;
- Time interleaving: convolutional interleaver is applied across many OFDM signal frames with B as the number of interleaving



branches and M as the interleaving depth. There are two modes, with B/M equal to 52/240 and 52/720, respectively;

- Frequency interleaving is done within one OFDM frame body which consists of 36 information symbols and 3744 data symbols. The total length of the frame body is 3780 symbols;
- Frame structure: the whole CMB-T system takes a hierarchical frame structure (see figure). From the top to the bottom, they are the Calendar Day Frame (starting from 00:00:00am each day, for example, Beijing Time), the Minute Frame lasting exactly one minute, the Super Frame with duration of 125ms, and the Signal Frame;
- Each Signal Frame consists of the Frame Header (FH) and Frame Body (FB). The baseband symbol rates for both FH and FB are the same, which is defined as 7.56 Msps. FH uses the pseudo-noise (PN) sequence of three different lengths as 420, 595, and 945 symbols, respectively to support different applications and this is why this unique baseline technology is called Time-domain Synchronous Orthogonal Frequency Division Multiplexing (TDS-OFDM). FH always takes the 4QAM modulation scheme with the same I and Q components. Each FB of the Signal Frame lasts exactly 500μs (3780×1/7.56μs);
- System information: the 6-bit system information is used to provide the receiver the necessary demodulation and decoding information including constellations, LDPC rates, interleaving modes, as well as FB information. Spread spectrum technology is used to protect this information with 4QAM mapping.
- FB data processing: CDMB-T has two options for the number of subcarriers C within each FB. One for C=1, which is the single-carrier mode. Two pilots can be inserted as an option at ±0.5 symbol rate into the FB data after the Signal Frame is formed. The total power of these pilots is -16dB lower than the total signal power. The other option is the multi-carrier approach of C=3780 with subcarrier spacing of 2 kHz;
- The squared root raised cosine filter is used to shape this baseband signal with a roll-off factor α=0.05.

Measurement results – before the standard was announced, extensive tests both in the lab and in the field were conducted by a third party under strict conditions for one month. The tests were quite comprehensive, covering stationary and mobile, indoor and outdoor reception, as well as at low and high data rates. The following are some measurement results using receivers developed by Tsinghua's research team. As CDMB-T only defines the transmission format and each demodulator chip vendor can have its own unique implementation design, these results only provide performance reference. Much better performance can be achieved when well-established world-class companies enter this market and come up with better designs and implementation schemes.

Channel	C/N in dB			
	High Throughput		Low Throughput	
	S	M	S	M
Gaussian chnl.	*15.3*	*15.2*	*2.2*	*1.9*
Brazil A	18.1	16.3	3.7	2.7
Brazil B	22.2	18.3	4.9	3.5
Brazil C	21.5	17.6	5.0	3.4
Brazil D	23.3	18.4	6.1	4.1
UK long paths	20.4	16.8	3.3	2.5
Short paths	25.4	19.5	6.9	4.5

Shown in the table is the C/N performance with FH length of 420 and M=720 under different channel fading models for single (S) and multicarrier (M) modes. Failure is claimed when the bit-error-rate is higher than $3X10^{-6}$ after FEC decoding, lasting more than 1 minute. During the test, we chose the stationary channel models of Brazil A, B, C, D, UK long paths, and short path models (Gaussian channel results also shown in the table). The high throughput is defined as using 64QAM modulation with FEC code rate of 0.6, and the low throughput case refers to the combination of 4QAM and FEC code rate of 0.4.

Dr. Song has indicated that while the paper refers to this new system as "CDMB-T," there is no "official" acronym yet for this system, but the current "favorite" is "DTMB" (for Digital Terrestrial/Television Multimedia Broadcasting). For additional information or to receive a copy of the full paper, contact Dr. Song at jsong@tsinghua.edu.cn.

Trial Publication of SMPTE Standards for AFD and Bar Data

The SMPTE S22 Image Formatting group, chaired by Graham Jones of NAB, has completed the initial work on standardizing the carriage of Active Format Description and Bar Data in the studio domain

using ancillary data in SDI and HD-SDI video. These standards will enable manufacturers to produce equipment that will allow broadcasters to populate these fields in the transmitted ATSC bitstream. They will also enable professional format converters and aspect ratio converters to perform optimal aspect ratio conversion when carried out in the studio.

The following Draft Standards have been posted for trial publication:

SMPTE 2016-1 Format for Active Format description and Bar Data
SMPTE 2016-3 Vertical Ancillary Data Mapping of Active Format description and Bar Data

The documents are available on the SMPTE Web site at:
http://www.smpte.org/smpte_store/standards/trialpub.cfm.

Interested parties are urged to review these draft standards and provide comments to SMPTE Director of Engineering Carl Girod at cgirod@smpte.org or to Graham Jones at gjones@nab.org. The closing date for comments is 12/6/06.

Reminder! Digital EAS Requirements Kick In At Year's End

Effective December 31, 2006 the FCC's rules will require that all digital television (DTV) and digital radio broadcasters participate in all national EAS activations. Participation in state and local EAS activations remains voluntary, but if broadcasters choose to transmit state and local EAS messages on their digital channels, they must do so on all program streams, in compliance with Part 11 of the FCC's rules.

Call for Proposals for NAB2007 Extended Until November 8

If you have a suggestion for a presentation for the 2007 NAB Broadcast Engineering Conference you still have time to submit it. For additional information on how to submit your suggestions just go to the NAB Call for Proposals Web site at: http://www.nabshow.com/nab2007/callForProposals.asp.

VSB Seminar Offerings

ATSC Digital Television Transmission System 8-VSB Measurement Seminar
Wednesday, November 1, 8:30 am – 5:45 pm
KNME-DT Studios, Albuquerque, NM

This one-day seminar focuses on the types of VSB transmission system measurements that are desired in the laboratory, at transmitter sites and at remote field sites

ATSC Digital Television 8-VSB Transmission System Fundamentals & Measurement Seminar
Wednesday, November 8 from 1:00 –6:00 pm
Thursday, November 9 from 8:30 am-5:45 pm
Tutwiler Hotel, Birmingham, AL

This seminar will help you develop an understanding of the 8-VSB transmission system basics as well measurement techniques that are desired in the laboratory, at transmitter sites and at remote field sites. Both seminars will be presented by Gary Sgrignoli of Meintel, Sgrignoli & Wallace. For more information on either of these seminars contact Gary Sgrignoli at (847) 259-3352, gary.sgrignoli@ieee.org or check out the Meintel, Sgrignoli and Wallace Website at www.mswdtv.com.