DTMB/DTMB-A Deployment Progress Report & Future Plan

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TV Broadcasting Networks

Users: TV set 470 Million, Cable TV 115 Million, Radio 500 Million. Audio population coverage 95.4%, TV population coverage 96.6%. ~100 Million TV each year

70652 Broadcasting and repeating stations, Cable distribution network 3.7Million Km long

4 Satellites, 29 Satellite transponders, 1.18 Million Satellite stations, 90,000 Km Microwave network, 2587 Microwave stations, 23,6000 Km long Optical Cable network.



DTMB is one of **ITU-R** Standards

International Telecommunication Union



International Telecommunication Union



Recommendation ITU-R BT.1368-9 (12/2011)

Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands

> BT Series Broadcasting service (television)

Recommendation ITU-R BT.1306-6 (12/2011)

Error-correction, data framing, modulation and emission methods for digital terrestrial television broadcasting

> BT Series Broadcasting service (television)

> > ITU



Requirement on DTTB Services

Service Mode

- Basic mode: Broadcasting
- Fixed (Indoor and Outdoor) and Mobile (Portable and Handhold) Reception
- > HDTV, SDTV, Audio, & Multimedia services
 2005 Trial
 2008 Massive Deployment
 >50% population is covered



DTMB 8/6MHz Payload Data Rate

•Data throughput calculation

$$Rate = \frac{3744}{PN + 3780} \times Ri \times Rm \times Fb(Mbps)$$

Fb (BW), Fb=7.56 (8MHz/ 5.67(6MHz) PN length (GI), PN=420/945 Rm (Number of bits per second per hertz), Rm=2/4/5/6 Ri (FEC code rate), 0.4, 0.6, and 0.8

FEC Rate		0.4		0.6		0.8	
BW		8MHz	6MHz	8MHz	6MHz	8MHz	6MHz
PN 420	4QAM	5.414	4.061	8.122	6.092	10.829	8.122
	16QAM	10.829	8.122	16.243	12.281	21.658	16.244
	64QAM	16.243	12.281	24.365	18.274	32.486	24.365
PN 945	4QAM	4.813	3.610	7.219	5.414	9.626	7.219
	16QAM	9.626	7.220	14.438	10.829	19.251	14.438
	64QAM	14.438	10.829	21.658	16.244	28.877	21.658

E-QAM Mapping

According to Set Partitioning Theory, Equivalent QAM (E-QAM) Mapping is derived by occupying a subset of standard QAM constellations



DTMB standard 16QAM constellation & illustration of E-4QAM (b3b2b1b0=B1XB0X, X is 0 or 1)

5 • Bit Order $(\mathbf{b}_{5}\mathbf{b}_{4}\mathbf{b}_{3}\mathbf{b}_{2}\mathbf{b}_{1}\mathbf{b}_{0})$ • . -3 -7 -5 -1 I -5 •

DTMB standard 64QAM constellation illustration with E-4QAM/ E-16QAM

Datacasting Service over DTMB



Stationary receipt of DTMB

In-home TV

- Indoor antenna+ Digital TV with built-in Terrestrial and Cable tuner
- Indoor Antenna+STB+Analog TV
- Support HDTV and SDTV

• Focus media

- Antenna+STB+ Monitor
- Support HDTV and SDTV
- 18Mb/s in each analog channel(6MHz)
 - At least 7~8 SDTV
 - ▶ 1~2 HDTV



In-home TV



Government information







Public news

-Mobile Applications of DTMB



车 清保日

Handheld/Mobile Reception for DTMB Broadcasting



Bidirectional broadcasting system using TDS-OFDM

Application

- Beijing Olympic game torch relay
- > Multi-channel video mobile transmission in urban area
- >Multimedia report and inquiry for policeman
- Command system
- Main feature
 - >Frequency band: VHF/UHF
 - ► Bandwidth: 6/8 MHz
 - ≻Mobility: ≥130km/h
 - ➢Downlink coverage: 70 Km
 - ➢Uplink coverage : 5-15 Km
 - ≻Urban, country side
 - ➢Payload: 5.4Mbps@8MHz





MING-T Project (ICBN Concept)



Same core technologies for PLC



Data coupled into power cable











Powerline Communication Application (cont'd)



The highest payload data throughput is 108Mbps within 20MHz by using 256-QAM and LDPC rate of 0.8



Crowded World with Fixed Spectrum Assignment



Cognitive Radio

"Cognitive Radio" is a radio that can change its transmitter parameters based on interaction with the environment in which it operates. (by FCC 2005)



Broadband Access in TV Band based on CR



Requirements for future DTTB system

- □ Higher spectrum efficiency (30% or more)
- **Better receiver sensitivity**
- **Better mobile reception performance**
- □ Multi-service support
- **Diversity to improve the converge of SFN**
- □ Interactive broadcasting service support
- ⇒Efficient utilization of the spectrum released from analog broadcasting systems

Technical Features of DTMB-A

- □ Flexible frame structure
- □ Newly proposed Gray-APSK modulation scheme
- □ Advanced multi-rate LDPC code
- □ Newly proposed P1 signaling
- Multi-service support incorporating various FFT sizes and guard interval sizes
- **Transmit diversity based on TDS-OFDM**
- Positioning based on time-frequency signal processing

Flexible Frame Structure

Cycle convolution reconstruction



Modulation and Channel Coding

Bit interleaved code modulation – Iterative demapping and decoding (BICM-ID)

Gray-APSK+BICM-ID



256/16 APSK Constellations



Advance LDPC Code

QC-LDPC

Length of 61440 and 15360

Code rate of 1/2, 3/5, 2/3 and 5/6

Bit interleaver pattern for various code rates and modulation schemes

Payload Rate (Mbps)

K=512, N=4096

Code Rate	1/2	2/3	5/6	
QPSK	6.05	8.06	10.08	
16APSK	12.10	16.13	20.16	
64APSK	18.14	24.19	30.24	
256APSK	24.19	32.26	40.32	

K=256, N=32768

Code Rate	1/2	2/3	5/6
QPSK	7.44	9.92	12.41
16APSK	14.89	19.85	24.81
64APSK	22.33	29.77	37.22
256APSK	29.77	39.70	49.62

Multi-service Support



Multi-service Support (cont'd)

- Signaling to carry important parameter for various services (including time-frequency resource allocation pattern, code rate, modulation scheme and etc.)
- **TDM/OFDM to support different FFT sizes for** various services (mobile or fixed)
- **FH-OFDM** to obtain frequency diversity

Time-Frequency Positioning

□ Use of TPS parameters for ranging ⇒ DTMB backward compatibility

PN-MC for ranging

⇒Positioning for new type of services

Simulation Results

Different positioning algorithms and Cramer Rao Lower Bound (CRLB)



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Brief Introduction



数字电视国家工程实验室(北京) NATIONAL ENGINEERING LAB. FOR DTV(BEIJING)

- Managed by NDRC of China
- Included 13 founders
- Response for Technology R&D , Oversea promotion and International standardization
- Involved in all oversea promotion acts of DTMB

Cooperation Form



DTVNEL is willing to carry out various forms of cooperation with any country interested in choosing DTMB/DTMB-A, include but not limited the following:

Assist the national digital TV network planning and design; provide the technique assistance and consulting for the related engineering tasks;

 Establish joint DTV technology R&D center, to develop together the new technologies, new products and new business mode, including the sectors of education, medicine, e-government, environment, industry and agriculture, etc;

 University-level cooperation, digital television technical and engineering personnel training, including graduates, engineers and technicians;

Help to obtain the necessary fund and financial support from China to develop the digital TV industry.



Thanks a lot! Any questions ?