

Past, Present and Future of TDMB



Dr Thierry Werling
Christian Schepke
Dr Chan Yeob Yeun

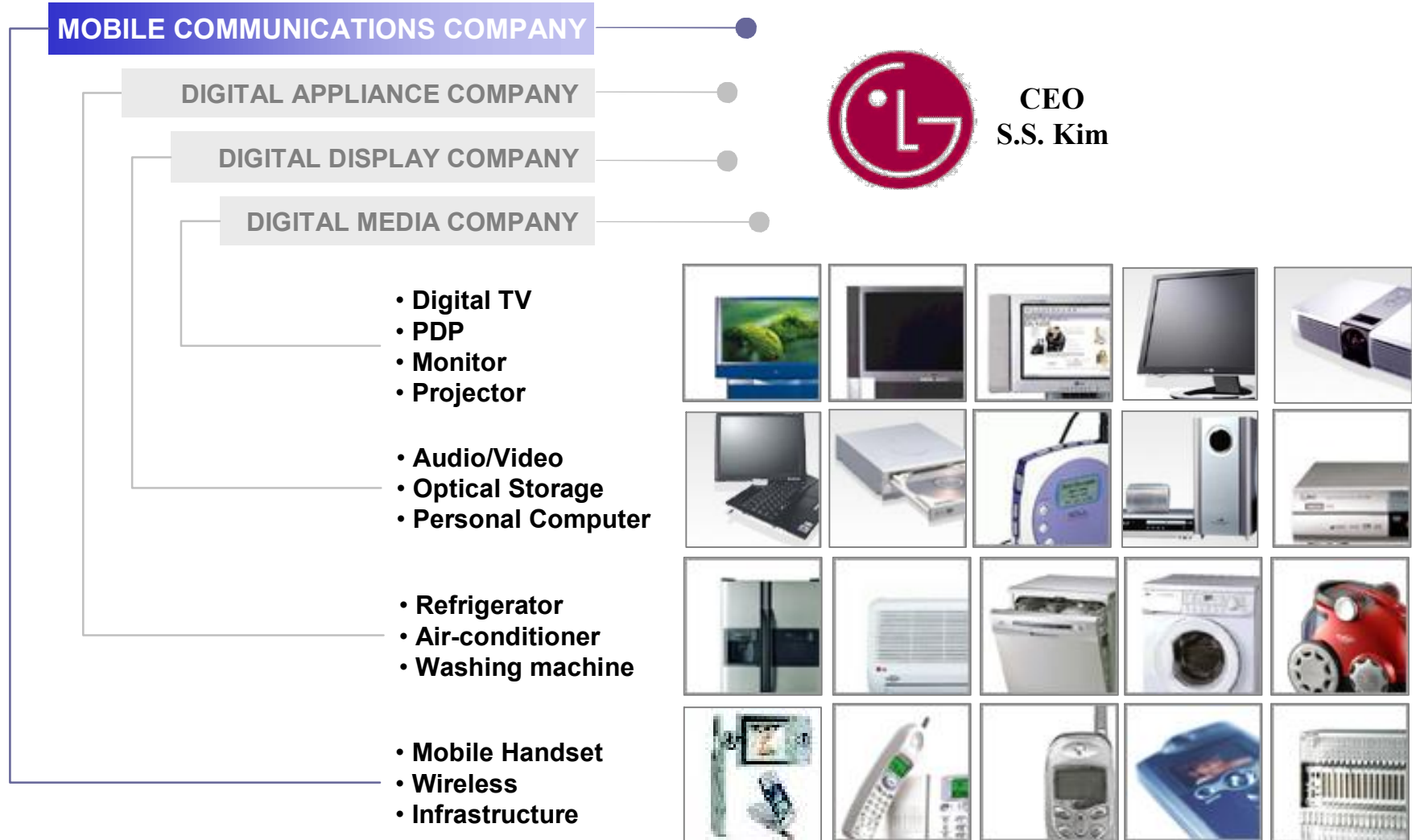


Mobile VCE, Mobile TV, 22th November, 2005

1. Introduction - Company Overview

LG Electronics is a Global Leader in Electronics, Information and Communications Products


(Total Revenues: US\$ 29.9 Billion, Overseas Subsidiaries & Marketing Units: 76, Worldwide Employees: +64,000)



2. TDMB & LG's Technology Leadership – T-DMB Milestone

LG's Technology Leadership in the Convergence of Digital TV to Cellphone



1997	DAB captured attention in Korea	KBS and ETRI installed first DAB System
1999	An official SG organized on DAB system in Korea	
2000	DAB task force group organized	Eureka-147 for tentative standard 
2001	Driving a Committee for DAB and Public hearing	1st meeting of M2B
2002	Drafting a Korean standard for DAB/DMB within NGBF (Next Generation Broadcasting Forum) -Specification for audio and multiplex	KBS, SBS, MBC, and ETRI started DAB Trial Perstel introduced DR101 (Handheld Audio Receiver)
2003	Announcement of Technical Specification (TTA) - Audio and multiplex specification Test broadcast of moving pictures	First T-DMB public demonstration (ETRI, SBS) DMB Encoder (Pixtree, OnTimetek)
2004	Announcement of Technical Specification (TTA) -Video specification	DMB field testing in Seoul Metropolitan area -Example services on public buses (KBS)
	Drafting TTA standard for data service T-DMB international forum (June) Exhibition of TDMB with WorldDAB at IBC2004 Drafting ETSI standard in WorldDAB Forum to endorse ETSI (Jan., 2005) Prepare contribution for October ITU-R 6M/6E	LG unveiled World 1st T-DMB SoC including DMB receiving and A/V Decoding (Oct. 18) Handheld Receiver released -LG, Samsung, Perstel, etc
2005	Commercial Service in Korea (3Q 2005)	Exhibition in CES, MMC, 3GSM World Congress, CeBit, IFA, IBC
	Announcement of World First 3G TDMB Cellular Phone Exhibition of 3G TDMB at IFA2005 and IBC2005	LG unveiled World First 3G + T-DMB cellular phone with T-DMB receiving (Aug. 30)

3. LG's TDMB Products (1/2) – Products overview



- Terrestrial-DMB
- 2.5" QVGA WIDE LCD
- 3D Stereo Sound
- 16phi Dual Speaker
- Retractable Antenna
- 130 MB Camera
- MP3 Player



- 6.5" TFT-LCD WIDE
- Portable/Vehicle type
- Tuning System: OFDM
- LCD Module: LBO65WQ3 (400x240)
- Operating Environment: Humidity ~80%
- Storage Environment: ~ 85%
- Power AC100~240V, 60Hz



- GSM/GPRS/WCDMA and T-DMB
- High resolution 2.2" QVGA WIDE LCD
- Bluetooth, External Memory (T-Flash)
- MP3 Player
- 3D Stereo Sound



- 14-inch wide LCD screen (1280x768)
- watching and recording terrestrial broadcast
- channel registration
- broadcasting-reception sense indication
- picture capture and channel scanning
- pentium M1.6GHz CPU
- 512MB Double Data Rate2 (DDR2) memory

3. LG's TDMB Products (2/2) – T-DMB Cellphone

World 1st Terrestrial DMB Cellphone by LG's DMB SoC & Handset Design Technologies



● Core Technologies

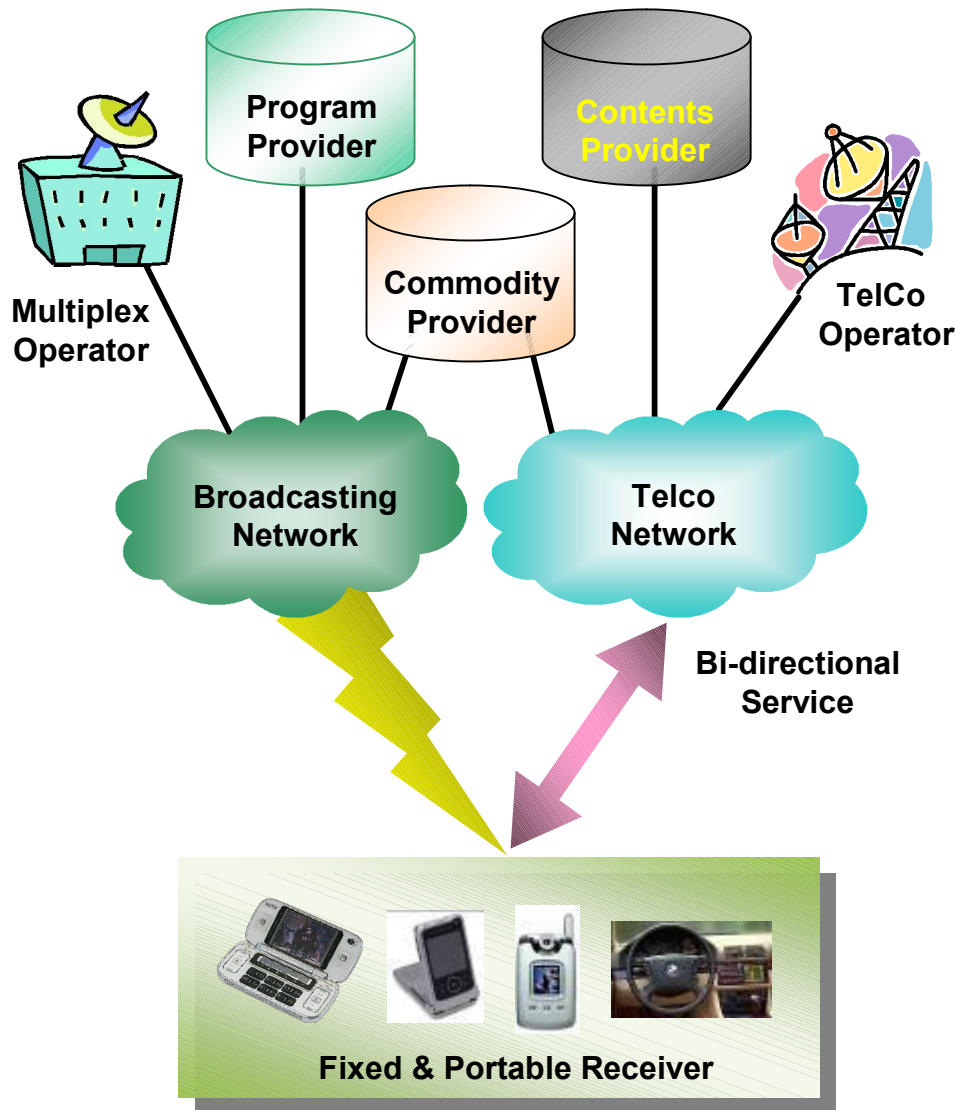
- One-Chip of T-DMB Receiving + AV Decoding
- Small-sized Tuner / Antenna (VHF)
- High-quality Video: H.264 CIF 25/30 fps
- High-quality Audio: MUSICAM (192kbps) and BSAC (AAC + for European market if required)
- PVR Function: Seamless watching TV after calling
- Analog Composite Video Output (NTSC, PAL)

● Phone Feature

- UMTS/GSM Call available
- 2.4" Wide LCD (320x320), 260K Color
- 1.3 Mega-pixel CCD Camera
- MP3 Player
- 3D Surround through Dual Speaker



4. TDMB Services (1/4) - Overview



Core Technologies

- MPEC-2 TS
- MPEG-4 SL & BIFS
- Middleware
 - JVM, Brew etc
- Various Backward Channels
 - GPRS, EDGE, W-CDMA, Wi-Fi, WiBro etc.



Data Service

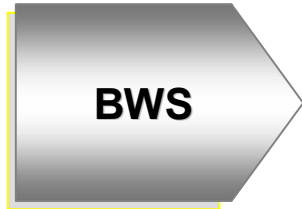
- BWS(Broadcasting Web Site) Service
- DLS & Slide Show on DAB
- IP Tunneling Service
- EPG (Electronic Program Guide) Service



Interactive Service

- TTI (Traffic & Traveler Information) Service
- TM (Television Mobile) - Commerce
- AV Synchronized Interactive Data Service

4. TDMB Services (2/4) - Broadcast Independent Services (BWS, TPEG)



BIFS

<Binary Format for Scene>



Fig. BWS Service

- Road Traffic Message
- Public Transport Info
- Congestion Information
- Parking Info



Fig. TPEG Service



4. TDMB Services (3/4) - Broadcast Synchronized Data Service

Interactive Drama

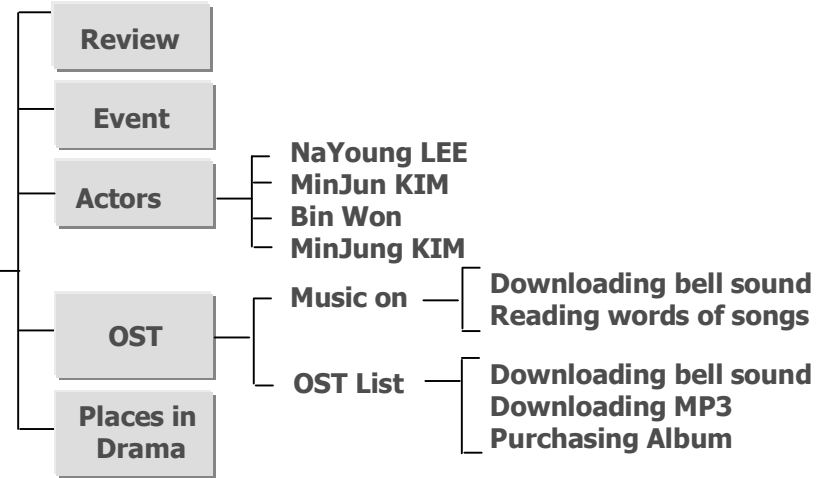


Fig. Interactive Service in Drama

Interactive News

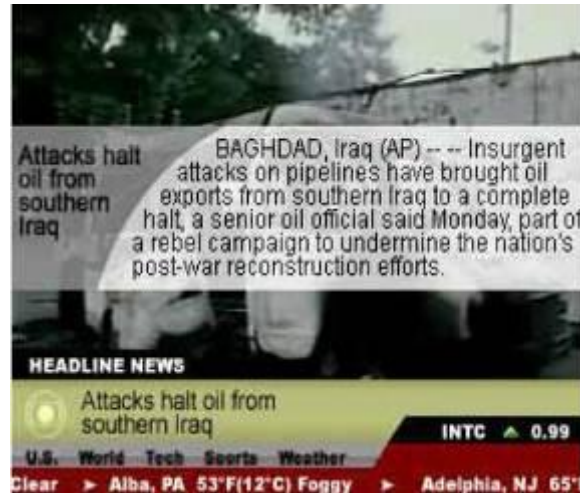


Fig. Interactive Service in News



Fig. Interactive Service in Advertisement

Interactive Advertisement

4. TDMB Services (4/4) - Personal Video Recording (PVR)



PVR (Personal Video Recording)

Recording on broadcasting

Schedule TV recording

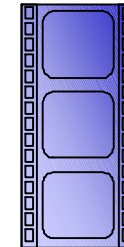
Screen capture

Time shift



Fig. PVR Service Features

- **Recording time is dependant on the size of Flash Memory**
- **Conditions in T-DMB system**
 - **TS : 512kbps DMB stream**
 - **Flash memory : 128 Mbytes**
- **Recording time:**
 - $128 \times 1024 \times 1024 \times 8 / (512 \times 1024) = 2048 \text{ sec} = 34 \text{ min}$



*More than 30 minutes
of TV record*



5. Business Model – Emergence of live services

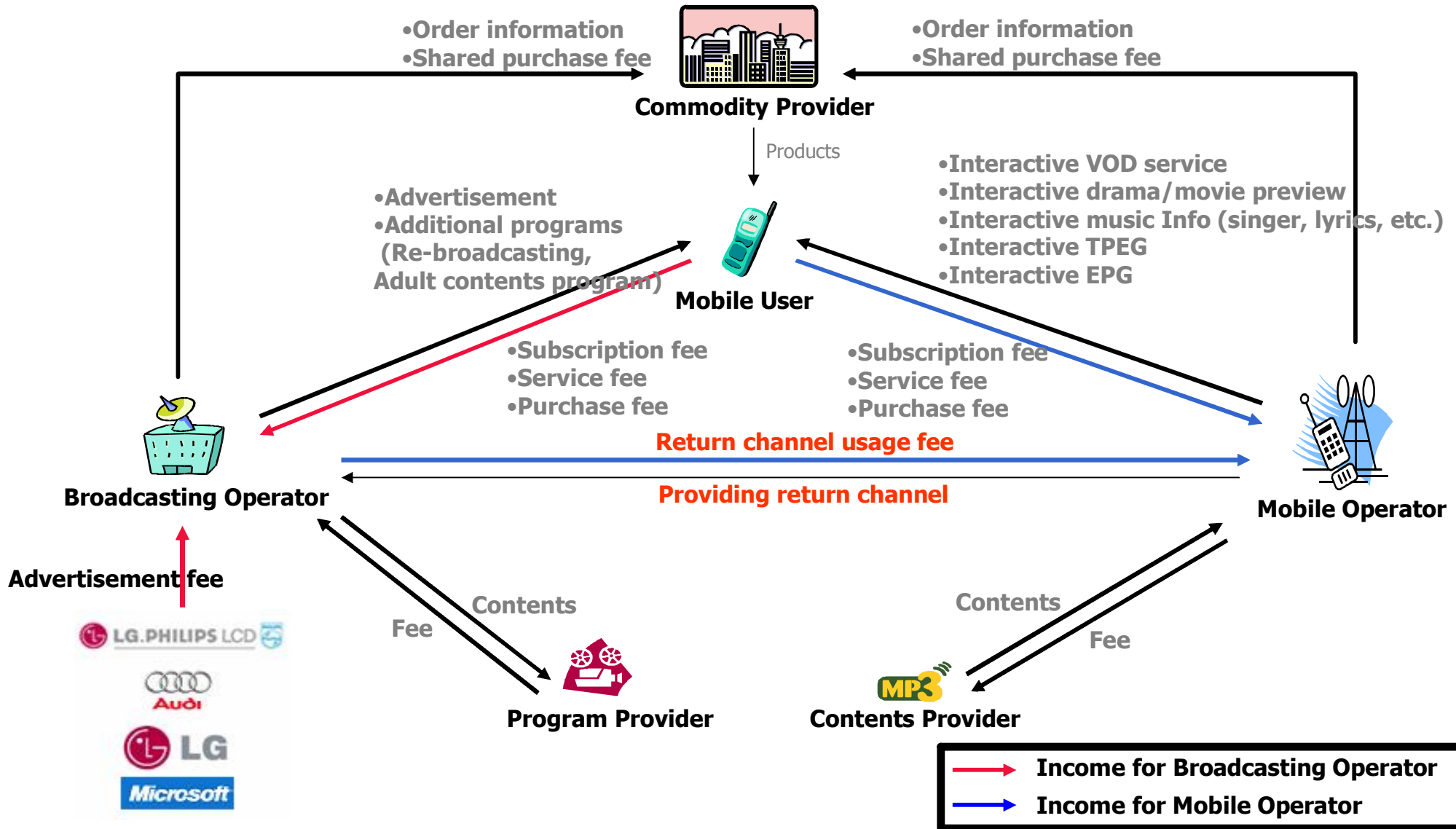
Link: <http://www.3g.co.uk/PR/Sept2005/1943.htm>

"Since launching the service, hundreds of thousands of customers have accessed and subscribed to the service in order to watch live TV shows on the move."

"Recent Orange data reveals that Orange customers in the UK mainly watch TV during work breaks (36.1%). They also used the mobile TV service while travelling (18.5%), when waiting for friends or in a queue (12.6%) and at home (10.1%)."

"Orange found its customers were mainly using the service to “snack” on, as opposed to watching full programmes. In both France and the UK, the average mobile TV customer watched TV on the mobile for 35 minutes each month. "

5. Business Model – General overview



● Multiplex Operator

- Revenues increase from the advertisements
- Personalized broadcasting by Conditional Access
- Minimum investments in the migration of T-DMB from DAB

● Telco Operator

- Convergence between broadcasting and mobile
- Revenues from the the increased data traffics: Higher ARPU with Live TV and associated services (VoD, AoD, ...)
- Better Live TV service capacity compare to cellular network

● Program/Contents Provider

- Revenue from making the new contents
- Benefits from Digital Copyright
- Maximize the utilization of contents by various operators

● Industries

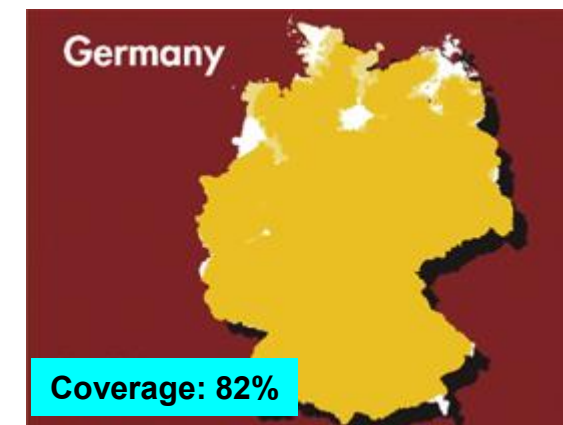
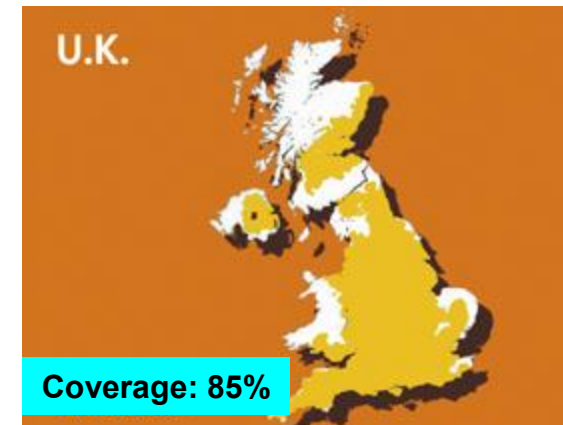
- Expand business into the new media coverage
- Sells goods or services through a convenient media consumption environment



7. Why TDMB (1/2) - DAB status in Europe

- DAB (radio) and T-DMB (TV) services: Signals from DAB and DMB have similar coverage
- Very low start up cost for T-DMB with an existing DAB networks

Country ITU-code	Number of VHF transmitters (not number of stations) IN VHF BAND III ONLY		Percentage of households that can already, or are expected in the near future to, receive the quoted number of VHF multiplexes			Number of T-DAB receivers in use	Date of last update
	Already in operation	Total after one year from now	1 MUX	2 MUX	3 MUX or more		
AUT	5	5	30			100	30-06-2004
BEL	31	32	99	40	0	40000	30-06-2004
BIH	0	0				0	
CZE	0	0	0	0	0		30-06-2004
D	105	215	83	35	8	> 35.000	30-06-2004
DNK	32	52	95	90		>9000	30-06-2004
EST	1	1				>5	30-06-2004
F	1	1	< 0.05			-	30-06-2004
FIN	18	18	42			<1000	30-06-2004
HNG	2	2					30-06-2004
HOL	5	10	18				30-06-2004
HRV	1	1	20	-	-	6	30-06-2004
I	59	70	-	-	-	-	30-06-2004
IRL	-	-	-	-	-	-	30-06-2004
LTU	1	1	25			≥ 5	30-06-2004
LVA	-	-	-	-	-	-	30-06-2004
MDA	0	0	0			0	
NOR	32	46	39	25		2000	30-06-2004
POL	1 ⁽¹⁾	1 ⁽¹⁾	8			5	30-06-2004
POR	45	48	85				30-06-2004
RUS	-	-	-	-	-	-	30-06-2004
S	15	(85)	35			~2000	30-06-2004
SUI	15	15	57			2000	30-06-2004
SVK	-	-	-	-	-	-	30-06-2004
SVN	0	2	15	-	-	20	30-06-2004
TUR	1						
UK	245	320	91	77	68	470,000	30-06-2004
UKR	-	-	-	-	-	-	22-02-2002



(Source: http://www.digitalradio.nl/Catalyst/EN/articles/EN_02_TheStatusofT-DABinEurope.htm)

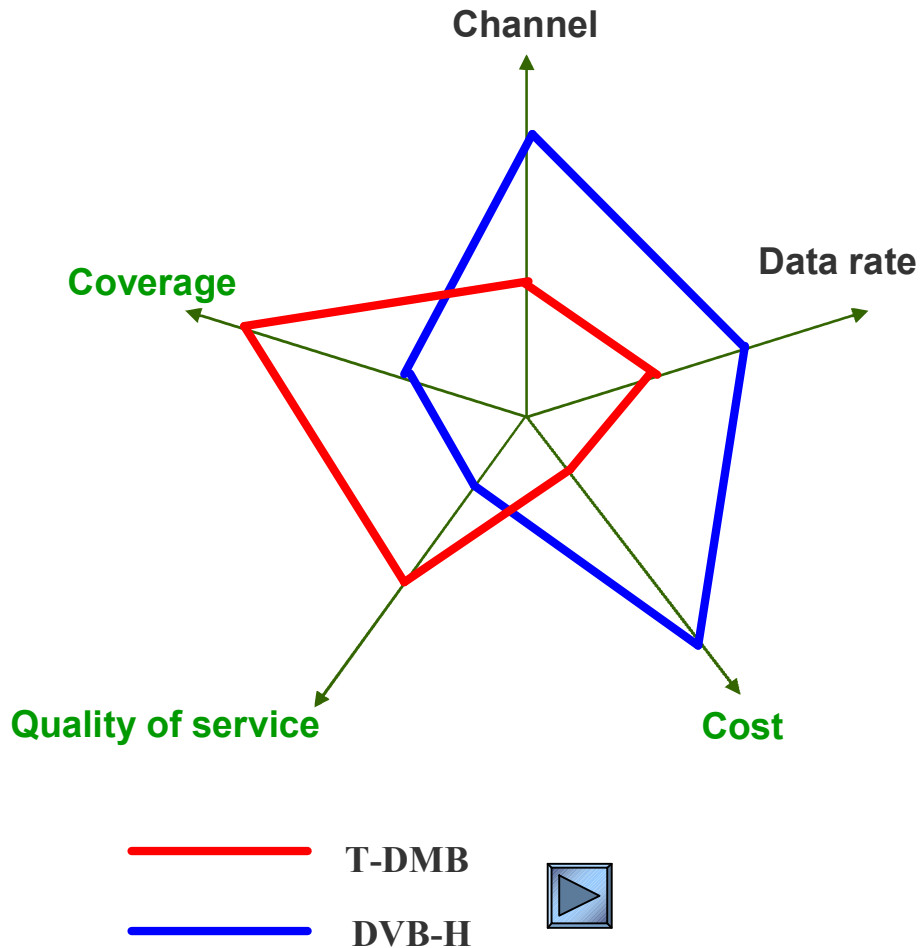
7. Why TDMB (2/2) - T-DMB vs. DVB-H

T-DMB

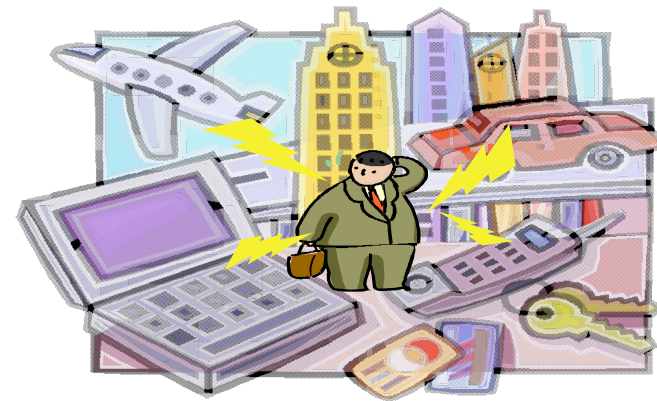
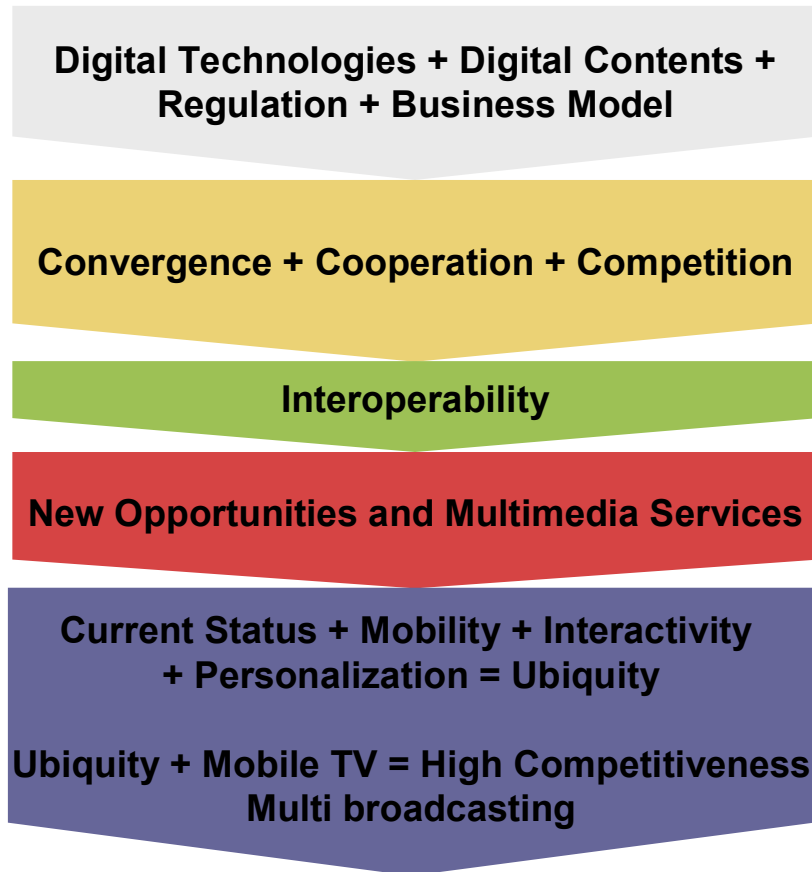
- **Single Frequency Networking is employed to increase capacity of transmitter**
- **Providing better quality of Video service**
- **More efficient usage of frequency resource due to assigning independent frequency range to operators**
- **Simple receiver structure and robustness to fading**
- **Signal from DAB and T-DMB are equal (coverage)**
- **Very low start up costs for T-DMB with an existing network**
- **Provide faster channel/program time switch**

DVB-H

- **DVB-H could offer higher data rates (16 QAM mode)**
- **Provide more channels services per multiplex**
- **Complicated receiver structure so prone to fading**



Adaptation of Mobile TV to Ubiquitous Network Society



- Realization of the digital dividend
- Every viewers will enjoy the personalized “**TVonMobile**” and have an opportunity to be a broadcaster
- Changing of the population lifestyle

9. T-DMB Status in Europe - Tests & Trials Map (2005)

T-DMB test:

- Finland: Digita interested to test
- Italy: RTL, H3G
- UK: Radioscope
- Norway: NRK
- Paris: TF1 & Bouygues Telecom

T-DMB trial:

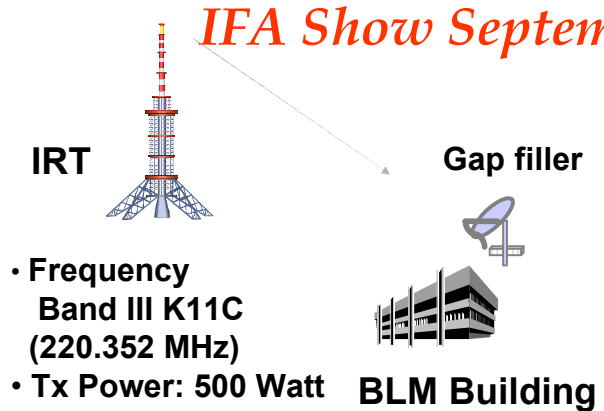
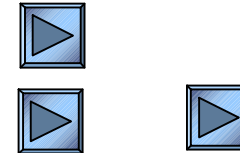
- Regensburg & Munich– by BLM, BDR, BMT, LG, Samsung, ETRI, Mic Korea.
- France (Paris): VDL-TF1, Bouygues Tel, LG, Samsung, Perstel. DMB service on air.
- France (Paris): New DMB trial?



10. Demo & Summary

LG Electronics, a global leader in the innovation and development of cutting-edge handsets in GSM, CDMA, and WCDMA mobile communications, exhibits the realization of the dream, "TV on Mobile," at BLM in September 2005 and T-DMB Paris trial since 15th Oct. 2005.

BLM Test April 2005 in Germany
IFA Show September 2005 in Germany



EU IST Celtic Project at Regensburg in Germany (Kick off 22 April 2005 and commencing T-DMB trial services in October 2005)



10. Demo & Summary

TF1-VDL (with Bouygues Telecom) trial in France



DMB multiplex: TF1, LCI, Europe 1, Europe 2

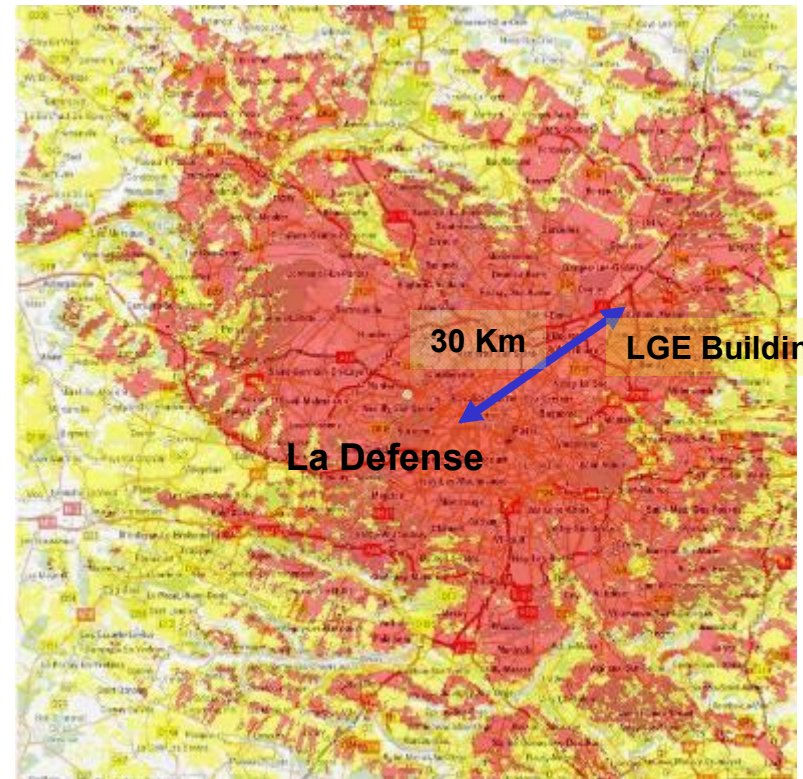
**La Defense
2000**



- Frequency Band III 11B (218.640 MHz)
- Tx Power: 3 kW



LGE Building



T-DMB trial services since the 15th October 2005



Q&A

Thank you!

VHF frequency range for TDMB - EU

Band III

5A	174.928MHz	8A	195.936MHz	11A	216.928MHz
5B	176.640MHz	8B	197.648MHz	11B	218.640MHz
5C	178.352MHz	8C	199.360MHz	11C	220.352MHz
5D	180.064MHz	8D	201.072MHz	11D	222.064MHz
6A	181.936MHz	9A	202.928MHz	12A	223.936MHz
6B	183.648MHz	9B	204.640MHz	12B	225.648MHz
6C	185.360MHz	9C	206.352MHz	12C	227.360MHz
6D	187.072MHz	9D	208.064MHz	12D	229.072MHz
7A	188.928MHz	10A	209.936MHz	13A	230.784MHz
7B	190.640MHz	10B	211.648MHz	13B	232.496MHz
7C	192.352MHz	10C	213.360MHz	13C	234.208MHz
7D	194.064MHz	10D	215.072MHz	13D	235.776MHz
				13E	237.488MHz
				13F	239.200MHz

L-Band

LA	1452.960MHz	LI	1466.656MHz	LQ	1480.352MHz
LB	1454.672MHz	LJ	1468.268MHz	LR	1482.064MHz
LC	1456.384MHz	LK	1470.080MHz	LS	1483.776MHz
LD	1458.906MHz	LL	1471.792MHz	LT	1485.488MHz
LE	1459.808MHz	LM	1473.504MHz	LU	1487.200MHz
LF	1461.520MHz	LN	1475.216MHz	LV	1488.912MHz
LG	1463.232MHz	LO	1476.928MHz	LW	1490.624MHz
LH	1464.944MHz	LP	1478.640MHz		



UHF frequency range for DVB-H - EU

Band IV

21	470~478MHz	29	534~542MHz
22	478~486MHz	30	542~550MHz
23	486~494MHz	31	550~558MHz
24	494~502MHz	32	558~566MHz
25	502~510MHz	33	566~574MHz
26	510~518MHz	34	574~582MHz
27	518~526MHz	35	582~590MHz
28	526~534MHz	36	590~598MHz

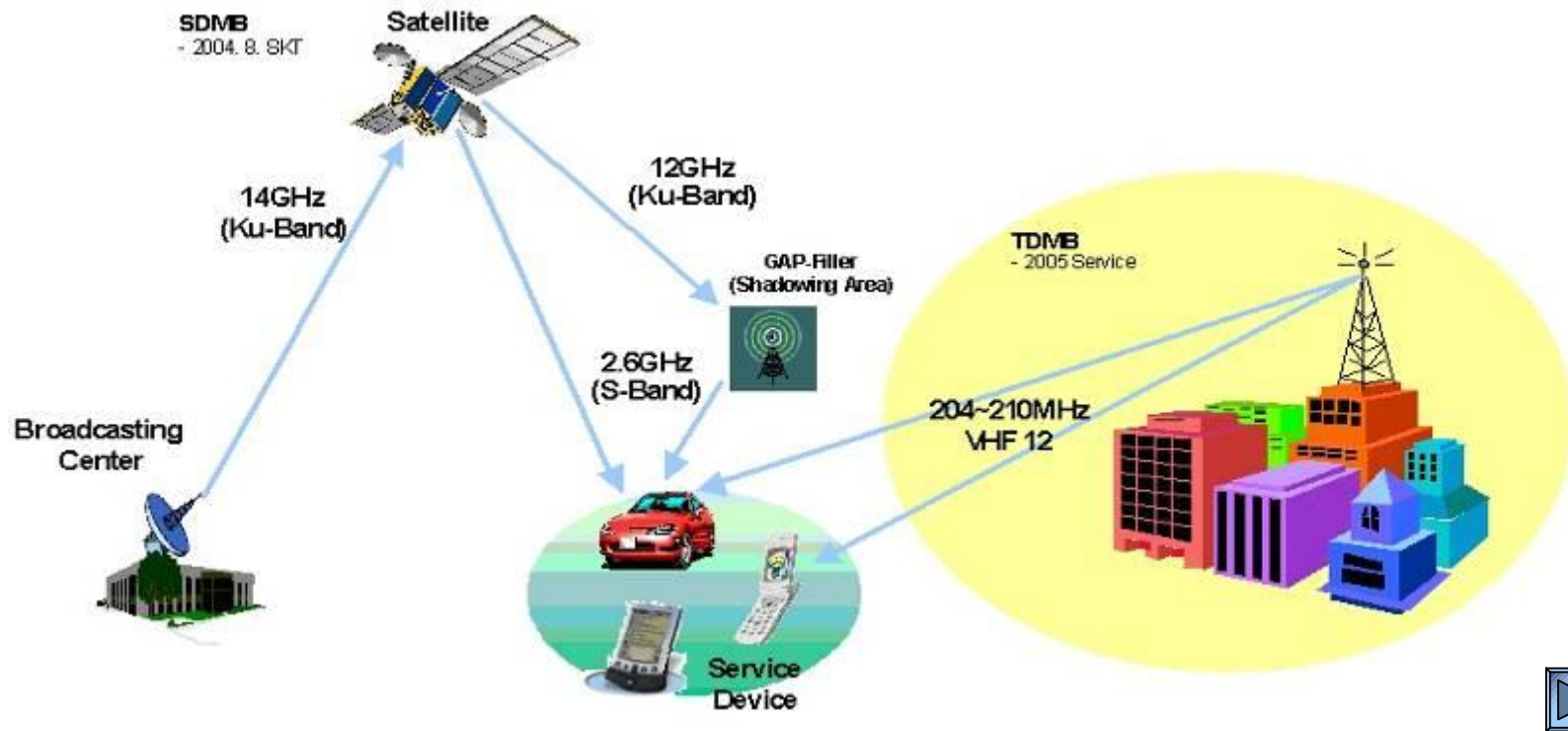
Band V

37	598~606MHz	49	694~702MHz	61	790~798MHz
38	606~614MHz	50	702~710MHz	62	798~806MHz
39	614~622MHz	51	710~718MHz	63	806~814MHz
40	622~630MHz	52	718~726MHz	64	814~822MHz
41	630~638MHz	53	726~734MHz	65	822~830MHz
42	638~646MHz	54	734~742MHz	66	830~838MHz
43	646~654MHz	55	742~750MHz	67	838~846MHz
44	654~662MHz	56	750~758MHz		
45	662~670MHz	57	758~766MHz		
46	670~678MHz	58	766~774MHz		
47	678~686MHz	59	774~782MHz		
48	686~694MHz	60	782~790MHz		





SDMB and TDMB - Korean DMB Service

SDMB	25MHz Bandwidth. 25 Audio Channel, 11 Video Channel, 3 Data Channel
TDMB	6MHz Bandwidth by Service Operator. 13 Audio Channel, 7 Video Channel, 8 Data Channel (Ch8 and Ch12)



DMB/DVB-H comparison in Details

	DVB-H	T-DMB
Standardization	ETSI EN 302 304(Nov. 2004)	ETSI TS 102 427 (Jul. 2005)
Spectrum	UHF (470MHz-862MHz) 	Band III (174MHz-240MHz),  L-band (1.452GHz – 1.490GHz)
Channel Bandwidth	5, 6, 7, and 8MHz	1.536 MHz/block (3 blocks in 6MHz)
Transmission	OFDM (2k,4k,8k mode)	OFDM (4k mode)
Modulation	QPSK, 16QAM	DQPSK
# of Channel	Video (~30), Audio (15), Clipcast	Video (1 ~2), Audio (2~3), Data (1~2) in one block
Channel switching-time	6 s~10 s (expected)	3~4 s (practical)
Physical Layer Based on	DVB-T	DAB (Eureka-147)
Multiplexing	MPEG-2 TS	MPEG-2 TS, MPEG-4 SL
IPDC	O	N/A, Considering in next step
Video Codec	H.264	H.264
Audio Codec	AAC+	BSAC, MUSICAM, AAC+
Display	Up to QVGA 25fps	Up to QVGA 30fps

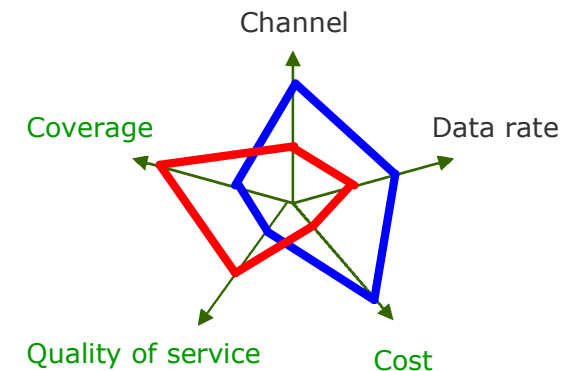
In Korea, VHF Ch. 8 and Ch. 12, that is total 12MHz, is used and the total channel plan is video 7, audio 13, and data 8.

DVB-H

- Offers higher data rates
- Provide more channels services
- Complicated receiver structure so prone to fading

T-DMB

- Simple receiver structure and robustness to fading
- Very low start up costs for TDMB with an existing DAB network
- Provides faster to switch channels and better quality of video service



— T-DMB
— DVB-H

Technical Comparison between T-DMB, DVB-H, S-DMB, and MediaFLO

	T-DMB	DVB-H	S-DMB	MediaFLO
Platform	EUREKA 147(Europe System A)	DVB-T	System E (Japan)	N/A
Modulation	$\pi/4$ DQPSK	QPSK	QPSK / BPSK	QPSK, 16QAM
Transmission	OFDM	OFDM	CDM	OFDM (4k mode)
Error Control	RS + Convolutional Code	RS + Convolutional Code (FEC on IP MPEFEC)	RS + Convolutional Code	RS(16,12 or 14 or 16)
Video Compression	MPEG-4 AVC / H.264	MPEG-4 AVC / H.264	MPEG-4 AVC / H.264	MPEG-4 AVC / H.264
Audio Compression	MPEG-4 BSAC MPEG-1 Layer2 (MUSICAM)	MPEG-4 AAC+	MPEG-2 AAC+ SBR	AAC+
Bandwidth	1.536 MHz	5, 6, 7, 8MHz	25 MHz	6 MHz (5,7,8 MHz available)
Frequency	174 ~ 216 MHz (VHF)	470 ~ 838 MHz(UHF)	Uplink 13.82 ~ 13.88 MHz Downlink 2.63 ~ 2.65 MHz	UHF 716-722MHz(US)
Frequency Efficiency	High	High	Low	N/A

DVB-T : Digital Video Broadcasting Terrestrial
DQPSK : Differential Quad Phase Shift Keying
QPSK : Quad Phase Shift Keying
OFDM : Orthogonal Frequency Division Multiplexing
COFDM : Coded Orthogonal Frequency Division Multiplexing
RS : Reed Solomon
AAC : Advanced Audio Coding
MPEG : Mobile Picture Expert Group
SBR : Spectral Band Replication

T-DMB : Terrestrial Digital Multimedia Broadcasting
DVB-H : Digital Video Broadcasting – Handhelds
S-DMB : Satellite Digital Multimedia Broadcasting
FLO : Forward Link Only



TDMB System – TDMB System Architecture

- DMB Service is built based on DAB (Eureka-147) system
- Newly adding with video service components (AVC / BSAC, MPEG-4 BIFS)

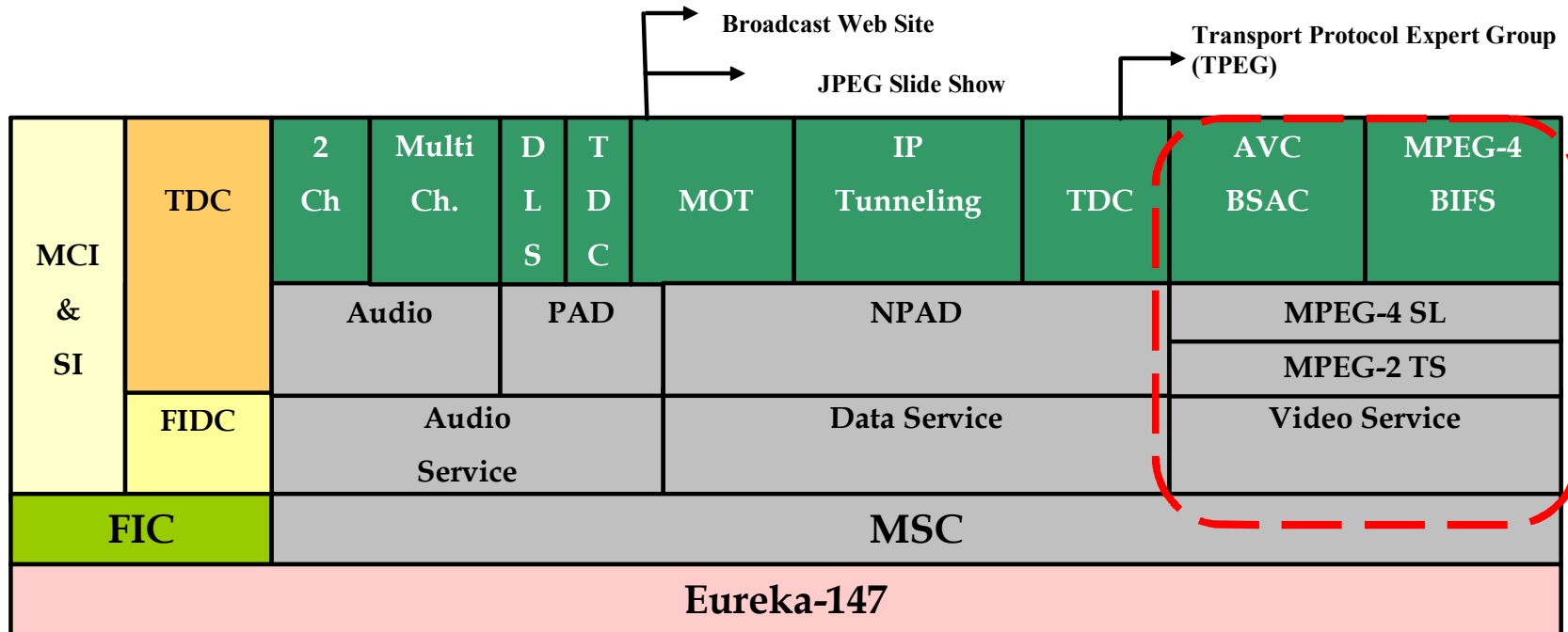


Fig. TDMB Service Protocol

MCI : Multiplex Configuration Information
SI : Service Information
TDC : Transparent Data Channel
FIDC : Fast Information Data Channel
FIC : Fast Information Channel
MSC : Main Service Channel
PAD : Program Associated Data
NPAD : Non Program Associated Data
DLS : Dynamic Label Service
MOT : Multimedia Object Transfer
AVC : Advanced Video Coding

BSAC : Bit Sliced Arithmetic Coding
BIFS : Binary Format for Scene



- Combine multiple programs into a single stream
- Fixed length packet size (188bytes)
- Strong against Error environment

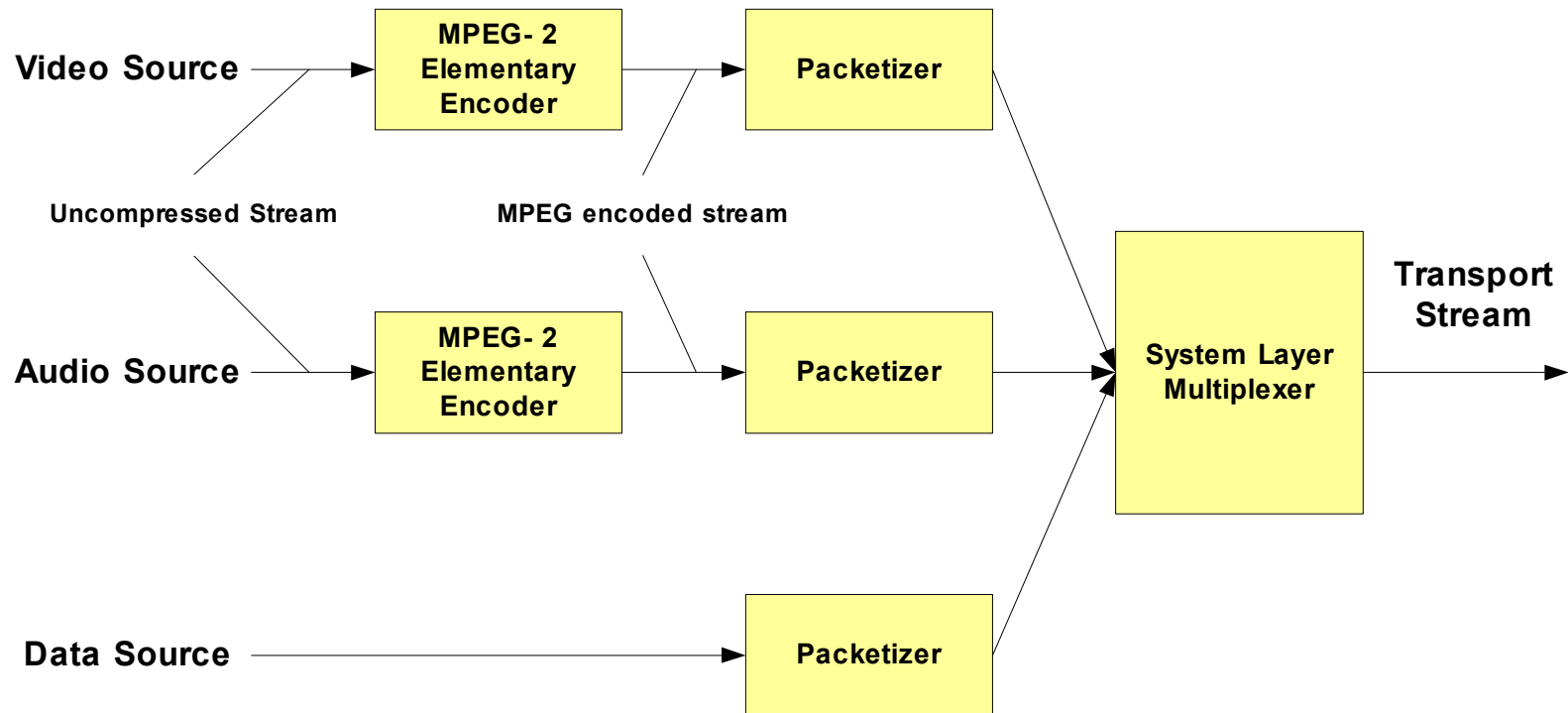


Fig. MPEG-2 Transport Stream System Layer

● Synchronization Layer

- Packetized Layer with Time Stamp
- Synchronization of Elementary Stream
- Scene technology information
- SL Header from SL configure descriptor
- SL_Payload composing by Access Unit

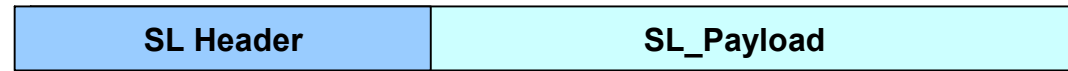


Fig. MPEG-4 SL Structure

● BIFS (Binary Format for Scene)

- Coded representation of a parametric scene description format
- Define scenes
- Scene Description Language (VRML)
- Powerful to represent and transmit the complex interactive multimedia scenarios
- Information about the objects
 - (time and place of appearance)
- Animate MPEG-4 Objects
- Describe interaction with MPEG-4 Objects

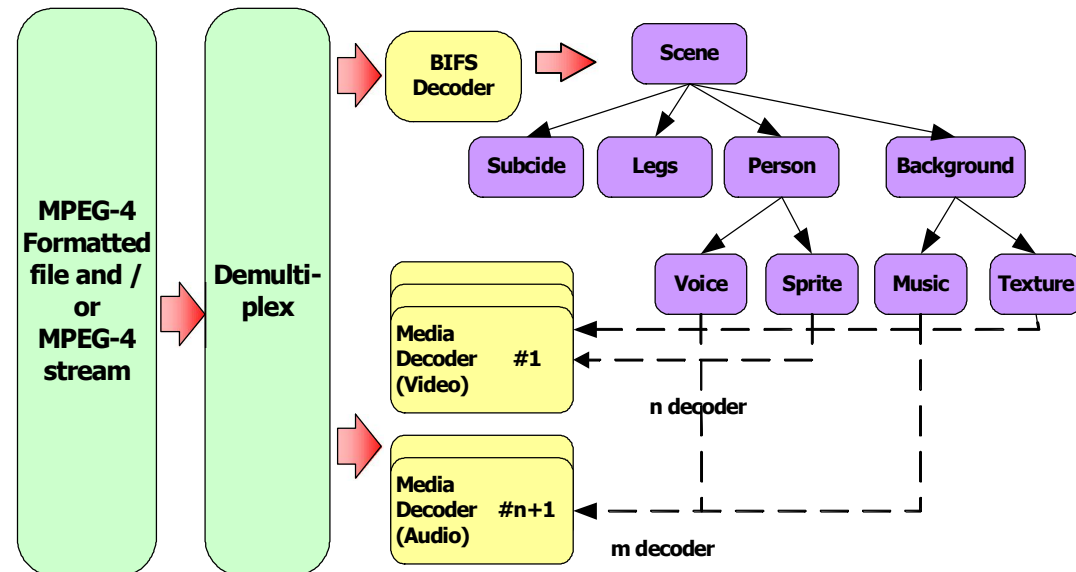


Fig. MPEG-4 BIFS System decoder



● H.264

- MPEG-4 Video(ISO/IEC 14496-part 10 H.264)
- H.264 is a video compression standard. Its compression efficiency is 2~3 times higher than MPEG4 part2
- Access Time is half second
- Can support up to 768kbps, but TDMB generally use 384kbps and support 32 ~ 96Kbps in Stereo

● BSAC (Bit Sliced Arithmetic Coding)

- MPEG-4 Audio(ISO/IEC 14496-part 3 ER BSAC)
- Standardized in 2001 by Samsung, AT&T, and Dolby
- Access Time is 0.05sec
- Half percentage of bandwidth of MP2
- Guaranteed CD quality audio
- Max bit rate : 128kbps

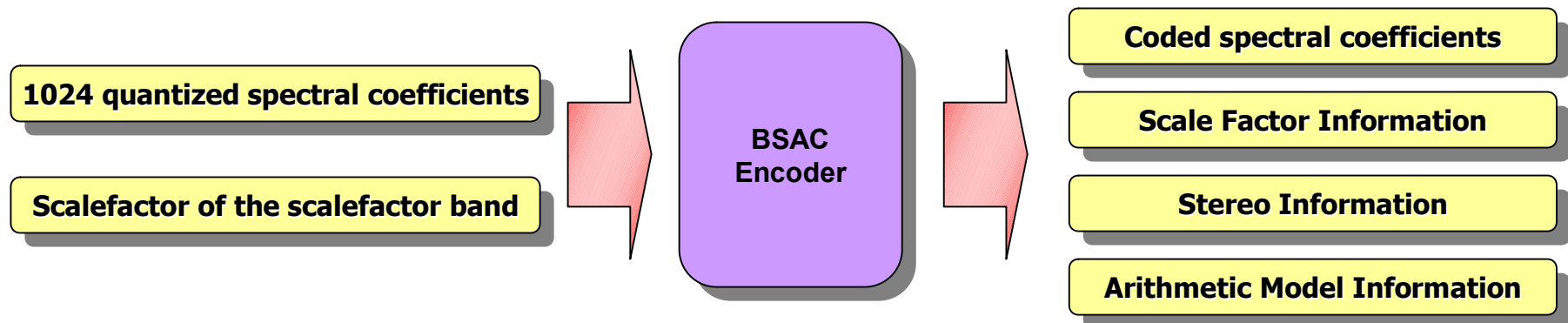


Fig. BSAC Encoder



- DMB supports Electric Program Guide(EPG) for **live link display** for one click access
- EPG can provide a variety of services using various data services such as PVR/DLS/BWS, etc.

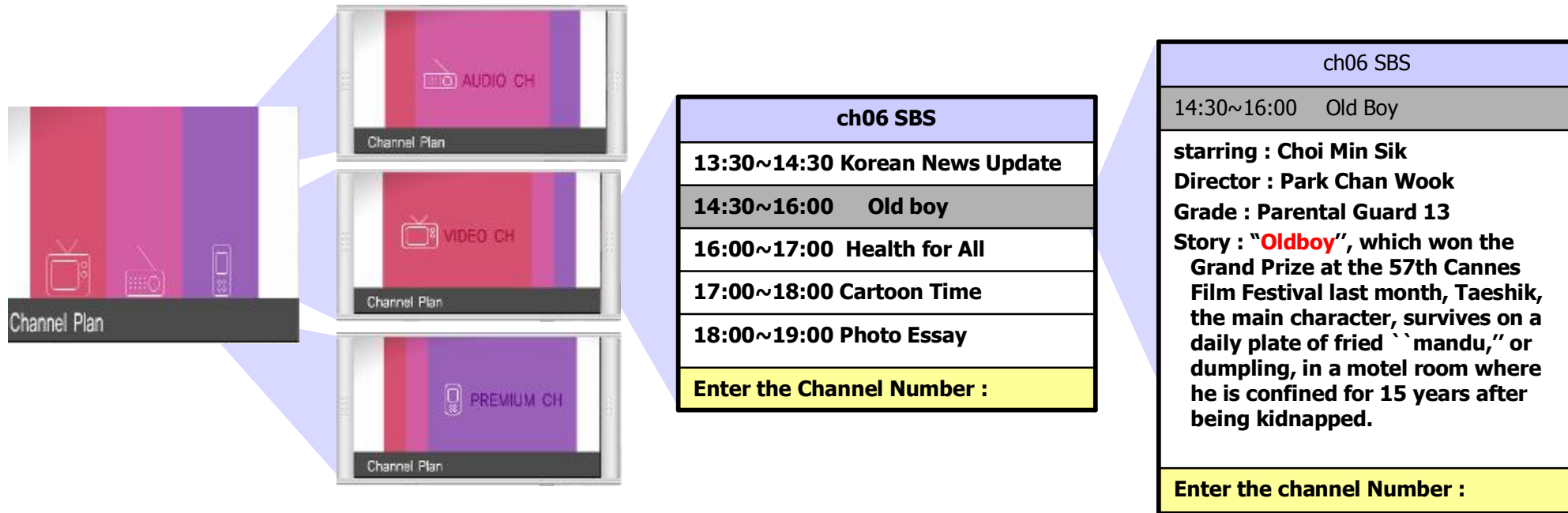


Fig. EPG service features

