



Terrestrial DMB System Development in Korea

June 17, 2004

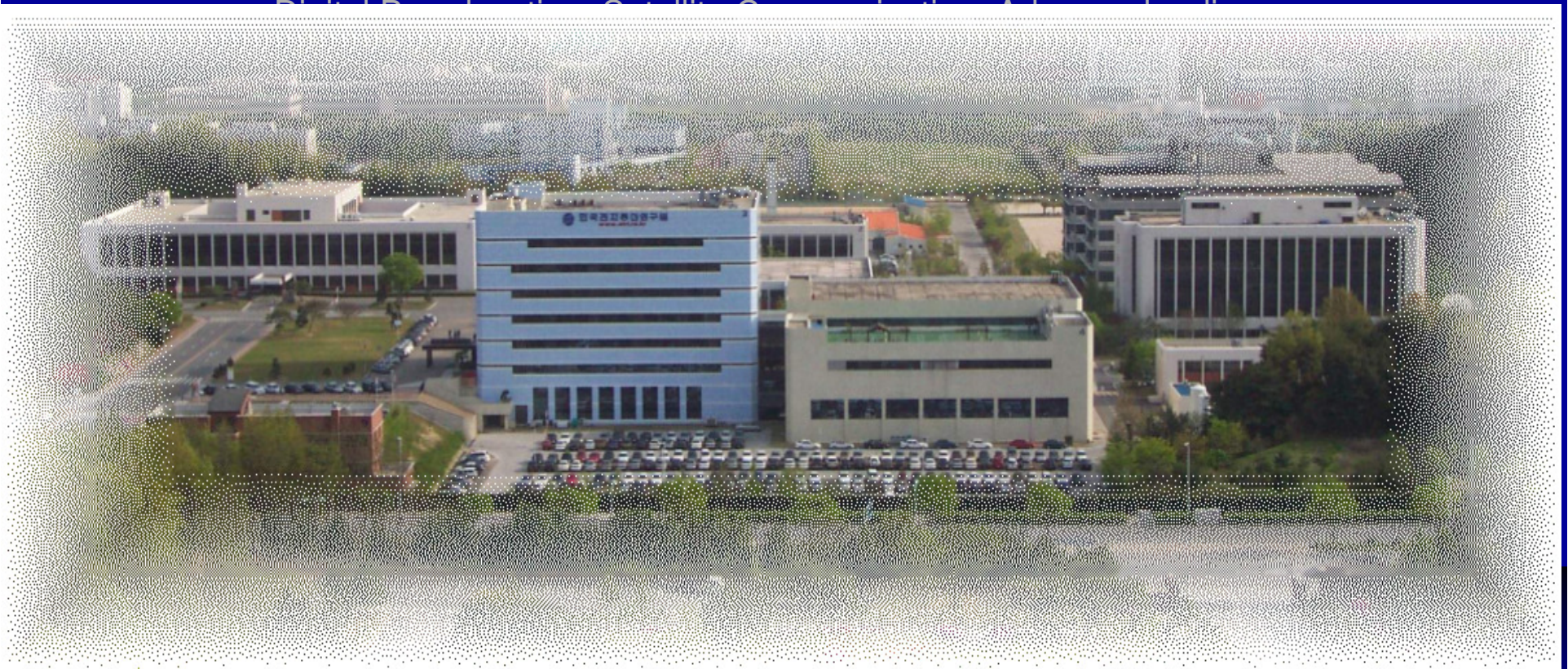
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ETRI, Digital Broadcasting Division

- Electronics and Telecommunications Research Institute 
- Located in Daejeon Science Town
- CDMA, Mobile, Telecom, Semiconductor, Home network, ...
- ◆ Digital Broadcasting Research Division

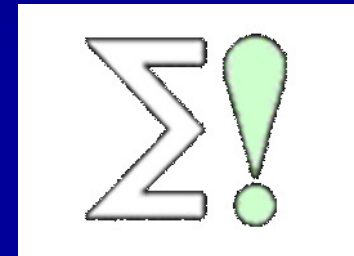


Research Institut-

Digital Broadcasting Research Division

Eureka-147 and DAB

- **Eureka-147 Project** : Consortium of broadcasters, network providers and consumer electronics related manufacturers for DAB standard (started with 16, currently, more than 50)
 - CD-quality audio and variable bit-rate data service
 - **Terrestrial SFN**, Satellite and Cable network
 - Interoperability with GSM, GPS and Internet
 - **Robust mobile and handheld reception**
 - **Flexible Service Multiplex**



DAB : Digital Audio Broadcasting
SFN : Single Frequency Network
EBU : European Broadcasting Union

Eureka-147 System Parameter

Signal		COFDM			
Modulation		DQPSK			
Channel Coding		Convolutional : variable rate, constraint length=7			
Time Interleaving	ms	Depth = 384			
Frequency Interleaving	MHz	Width = 1.536			
Effective Data Rate	Mbps	0.8 ~ 1.7 Mbps			
System Bandwidth	MHz	1.536 MHz			
MODE		I	II	III	IV
Application		Terrestrial (SFN)	Terrestrial	Satellite/Cable	Terrestrial
Frequency Band	GHz	< 0.375	< 1.5	< 3	< 1.5
Sub carriers		1,536	384	192	768
Sub carrier interval	KHz	1	4	8	2
Guard interval	μs	246	62	31	123
Symbol length	μs	1,000	250	125	500
Frame length	ms	96	24	24	48

COFDM : Coded Orthogonal Frequency Division Multiplexing
DQPSK : Differential QPSK

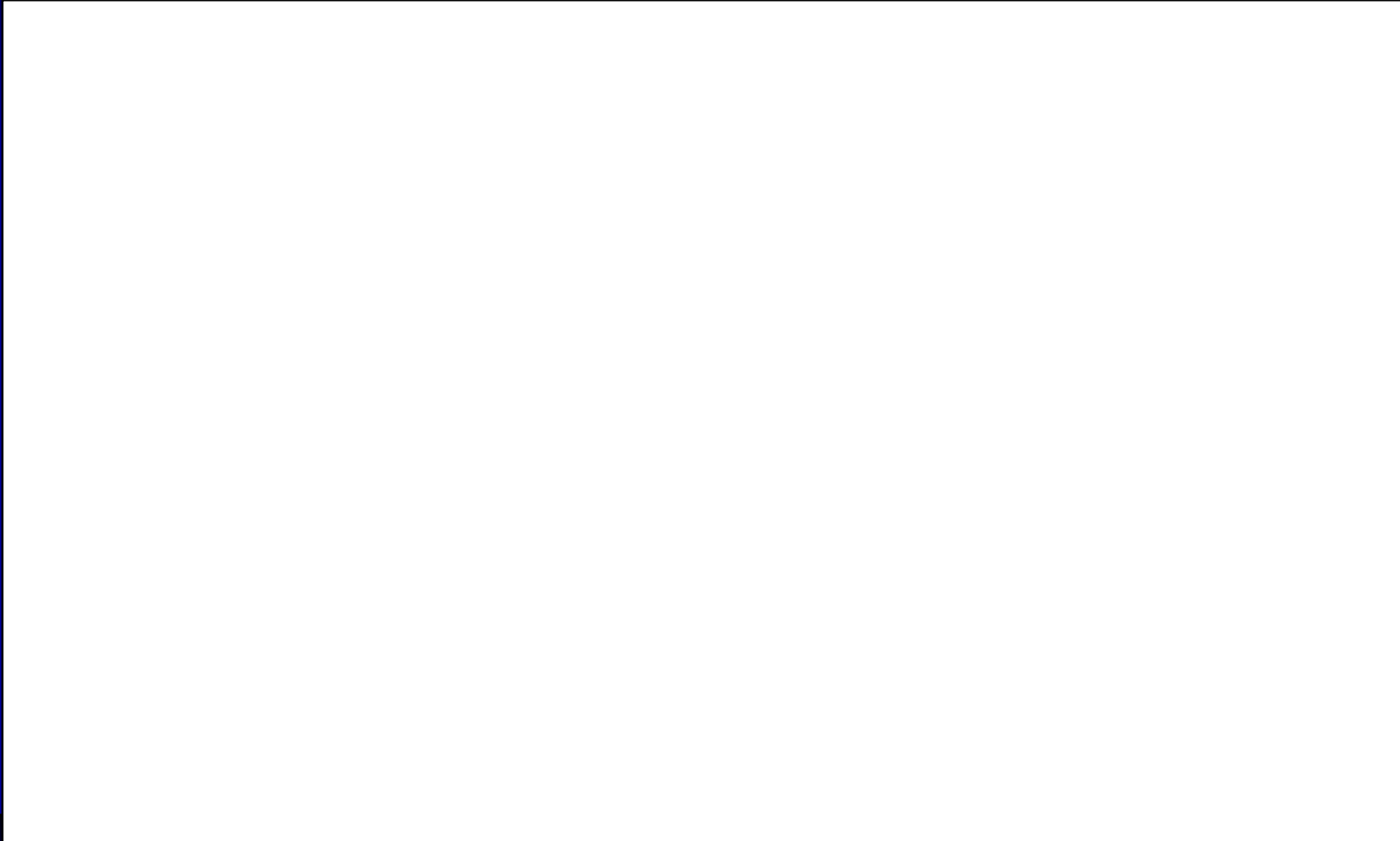
DMB ?

- ▣ Mobile Multimedia Broadcasting in Korea
- ▣ Digital Multimedia Broadcasting
 - ▣ High-quality audio with video service through DAB framework
Listening → Watching while listening
 - ▣ Small sized TV → PDA type receivers → Mobile phone
- ▣ Data Capacity
 - ▣ Maximum multimedia application data rate is 1.7 Mbps/block
 - ▣ 3 video or 10 audio channels are possible in one TV channel(6 MHz)
- ▣ Services
 - ▣ Mobile TV
 - ▣ LBS, Telematics
 - ▣ Many applications
 - ▣ News, weather, stock, etc.

DMB history in Korea



Service and Standard



AVC : Advanced Video Coding, PAD : Program Associated Data, TDC : Transparent Data Channel, BWS : Broadcasting Web Site
BSAC : Bit-sliced Arithmetic Coding

DMB Standards in Korea

- TTAS.KO – 07.2004

“Radio Broadcasting Systems; VHF Digital Multimedia Broadcasting (DMB) to mobile, portable and fixed receivers”

- DSCTy, Korean Characters

- TTAS.KO – (TBD)

“Radio Broadcasting Systems; Specification of the video services for VHF Digital Multimedia Broadcasting (DMB) to mobile, portable and fixed receivers”

- Video encoding, Channel coding

- TTAS.KO – (TBD)

“Radio Broadcasting Systems; Specification of the data services for VHF Digital Multimedia Broadcasting (DMB) to mobile, portable and fixed receivers”

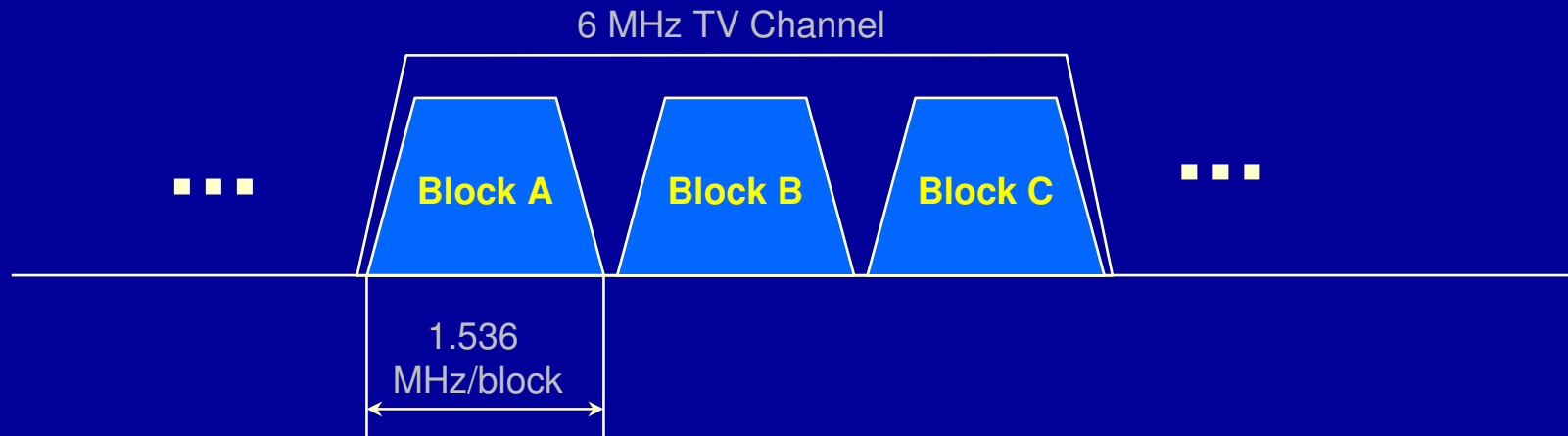
- PAD, NPAD, TDC, IP-tunneling, Slideshow, BWS, EPG, ...

TTAS : TTA Standard

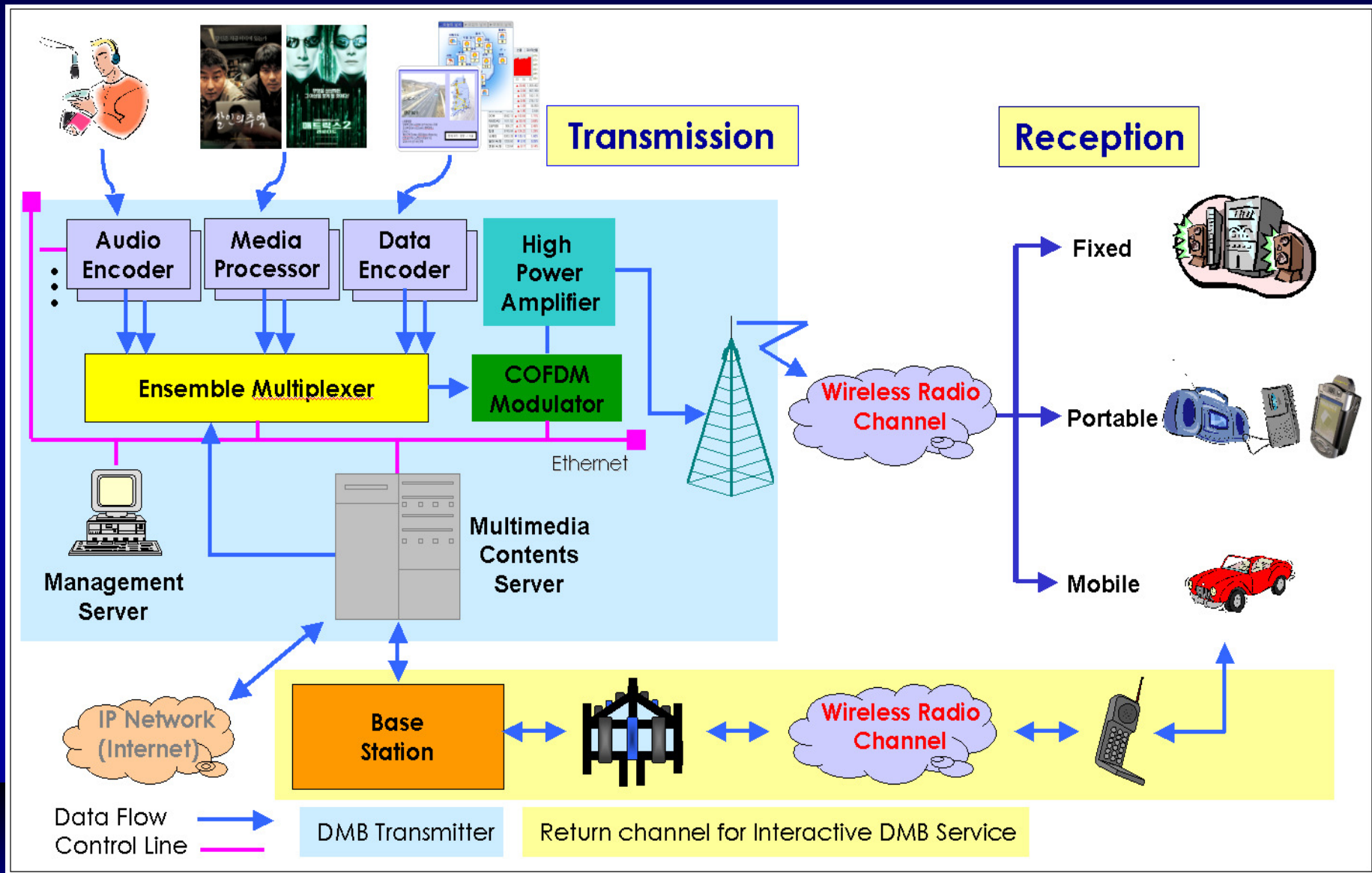
DSCTy : Data Service Component Type

DMB Spectrum Plan

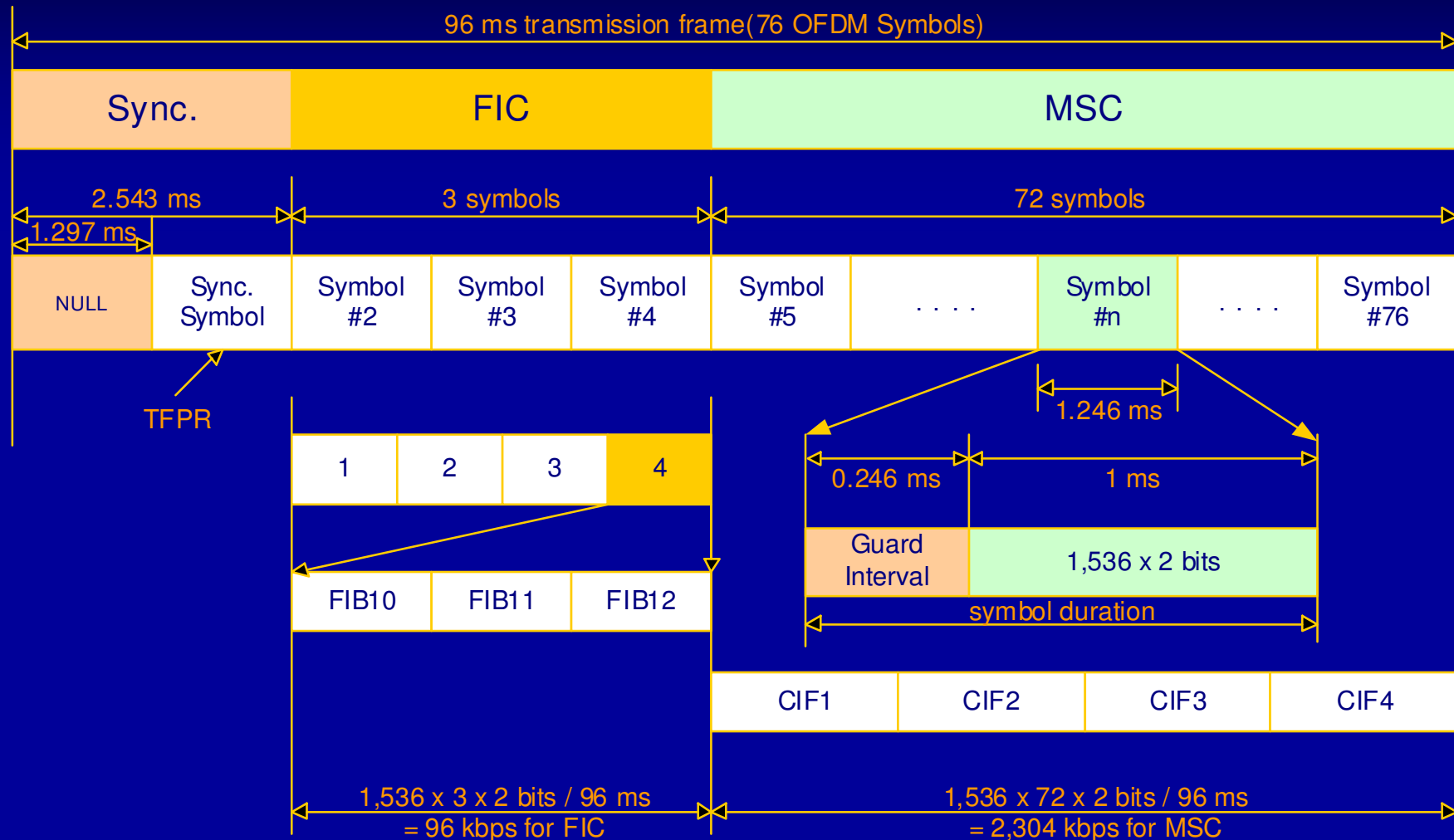
- Three blocks in one TV channel



DMB Service Structure

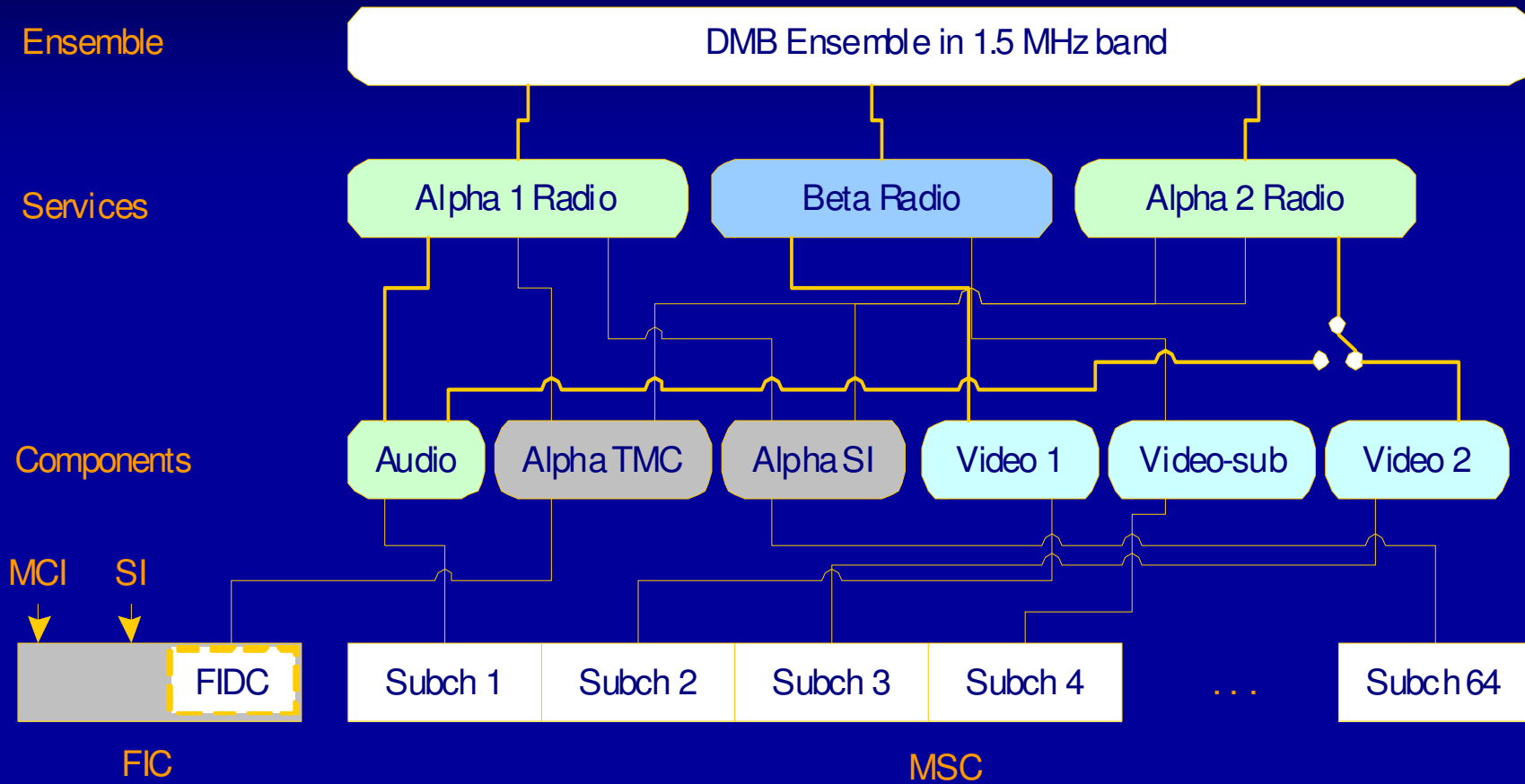


DAB/DMB Frame Structure (Mode I)



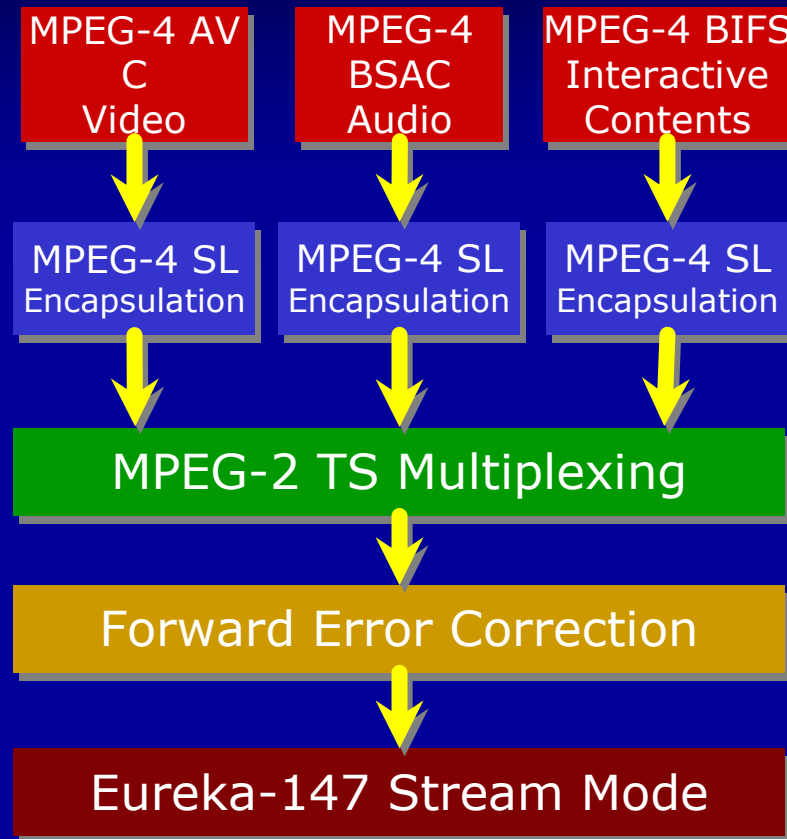
FIC : Fast Information Channel, FIB : Fast Information Block, MSC : Main Service Channel,
TFPR : Time-Frequency-Phase Reference, CIF : Common Interleaved Frame

DMB Ensemble Structure



TMC : Traffic Message Channel, MCI : Multiplex Configuration Information, FIDC : Fast Information Data Channel

Media Multiplexing



- Eureka-147 Stream Mode
- FEC :
 - RS + Convolutional Interleaving
- Transport : MPEG-2 TS
- Adaptation : MPEG-4 SL
- Video :
 - MPEG-4 AVC Baseline Profile
- Audio : MPEG-4 BSAC
- Graphics & Data :
 - MPEG-4 System Core2D Profile

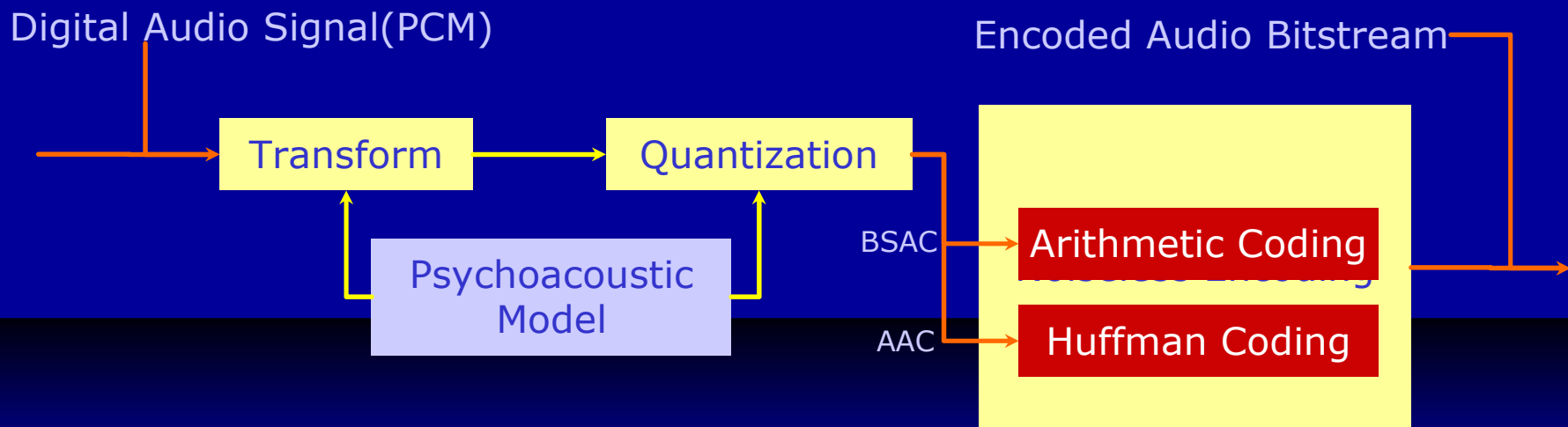
AVC : Advanced Video Coding, BSAC : Bit Sliced Arithmetic Coding, FEC : Forward Error Correction

MPEG-4 AVC

- **Advanced Video Coding** (ISO/IEC 14496-10)
- **ITU-T H.264**
- JVT from December 2001
 - ITU-T VCEG (Video Coding Expert Group)
 - ISO/IEC JTC1 SC29 WG 11 MPEG Video Group
- H.26L as a starting point
- High encoding complexity
- 3 profiles
 - **Baseline**
 - Main
 - Extended

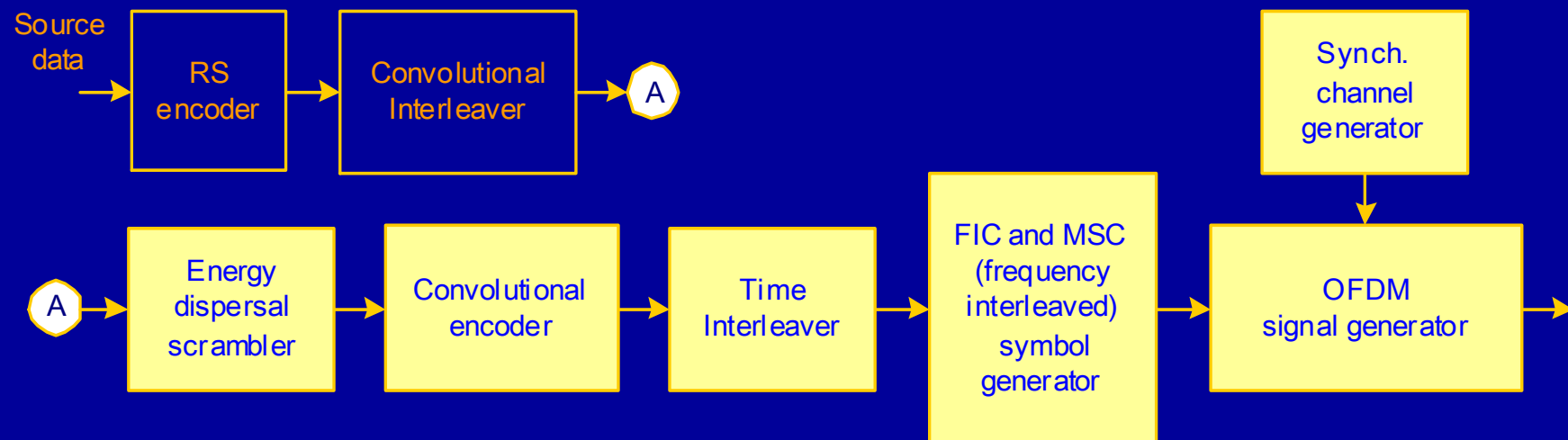
MPEG-4 BSAC

- Bit Sliced Arithmetic Coding
- ISO/IEC IS 14496-3:2001
- Fine Granular Scalability
 - 16kbps/ch(base layer) ~ 64kbps/ch(top layer)
 - step size : 1 kbps/ch
- Change of noiseless coding tool from AAC-LC
- Comparable coding performance with AAC



FEC for Mobile Reception

- Eureka-147 is designed basically for Audio Service
 - BER level of 10^{-4}
- Required BER is under 10^{-8} for Mobile Video Service
 - Additional RS code and Convolutional Interleaver



Reed-Solomon Code

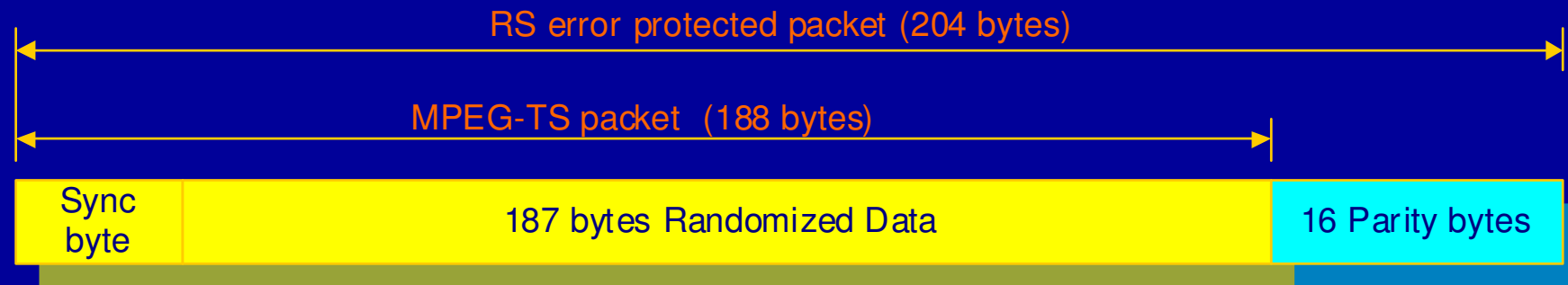
- Shortened RS (204, 188, t=8), derived from RS (255, 239, t=8)

- Code generator polynomial

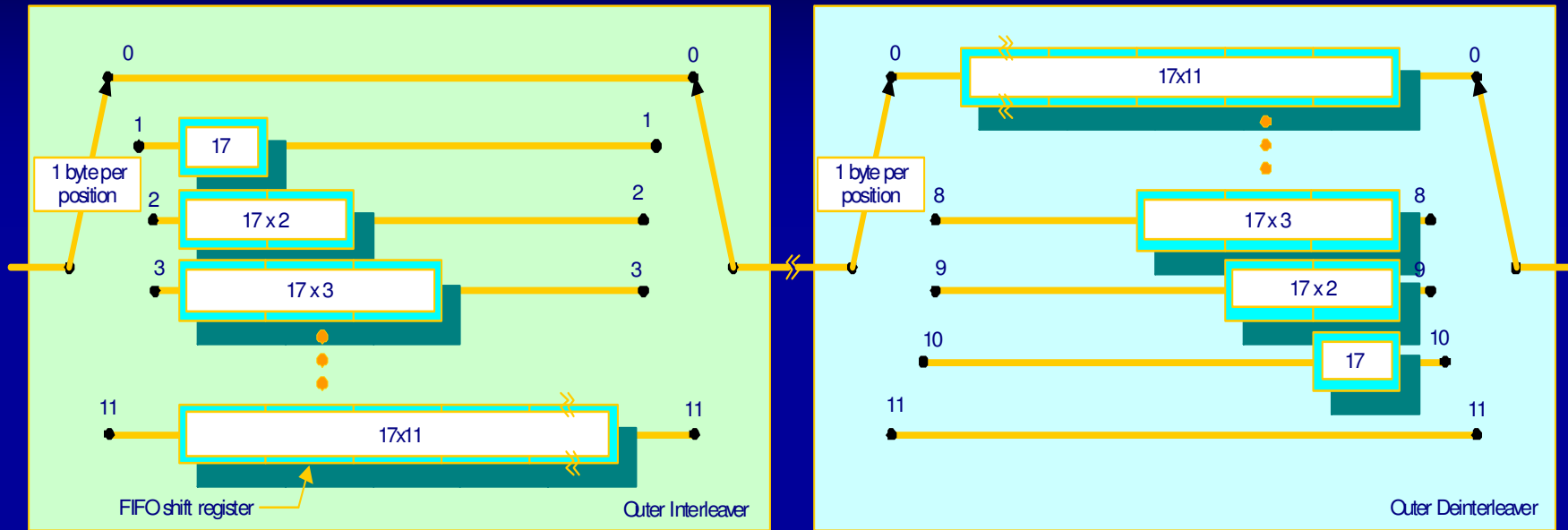
$$g(x) = (x + \lambda^0)(x + \lambda^1)(x + \lambda^2) \cdots (x + \lambda^{15}), \quad \text{where } \lambda = 02_{\text{HEX}}$$

- Field generator polynomial

$$p(x) = x^8 + x^4 + x^3 + x^2 + 1$$



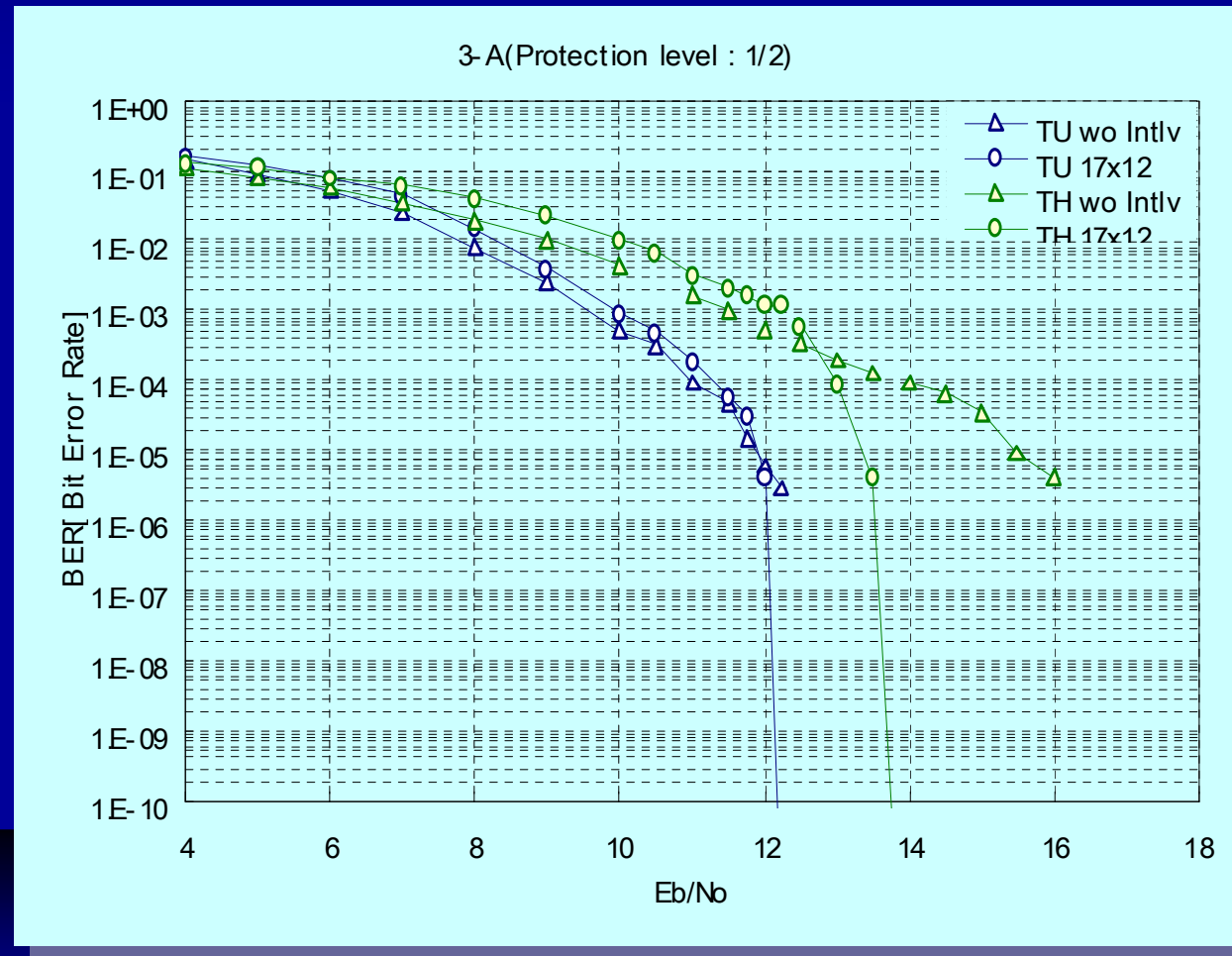
Convolutional Byte Interleaver/Deinterleaver



- ❑ Interleaving depth : $I = 12$
- ❑ Unit size of FIFO shift register : $M = N/I = 17, N=204$
- ❑ Sync byte always passes through branch '0'

Simulation Result

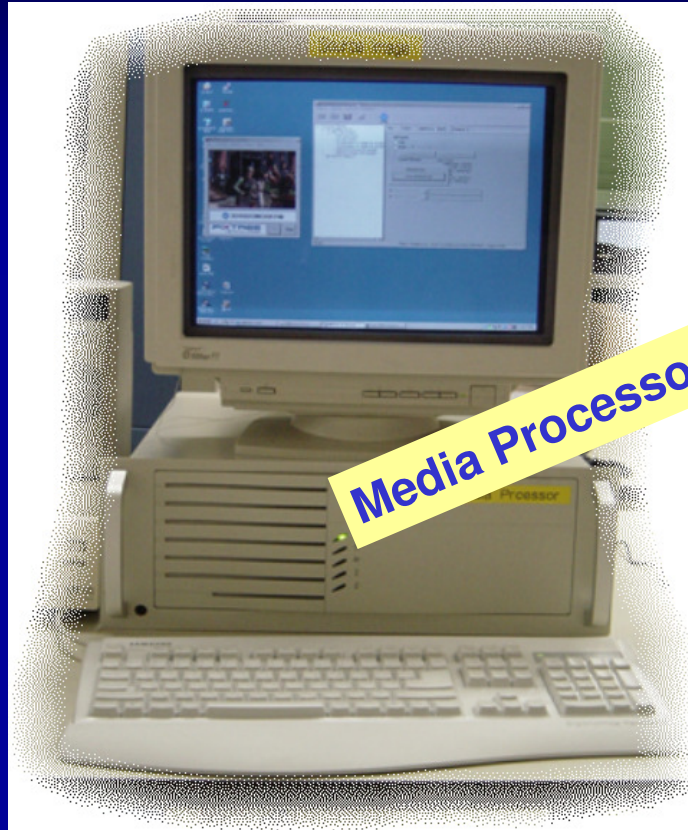
- Target BER = 10^{-8}
- TU(Typical Urban), TH(typical Hilly)
- 3-A(1/2)
- $F_c = 230$ MHz
- $V = 72$ km/h



DMB Test System(ETRI)



Transmission of DMB



Media Processor

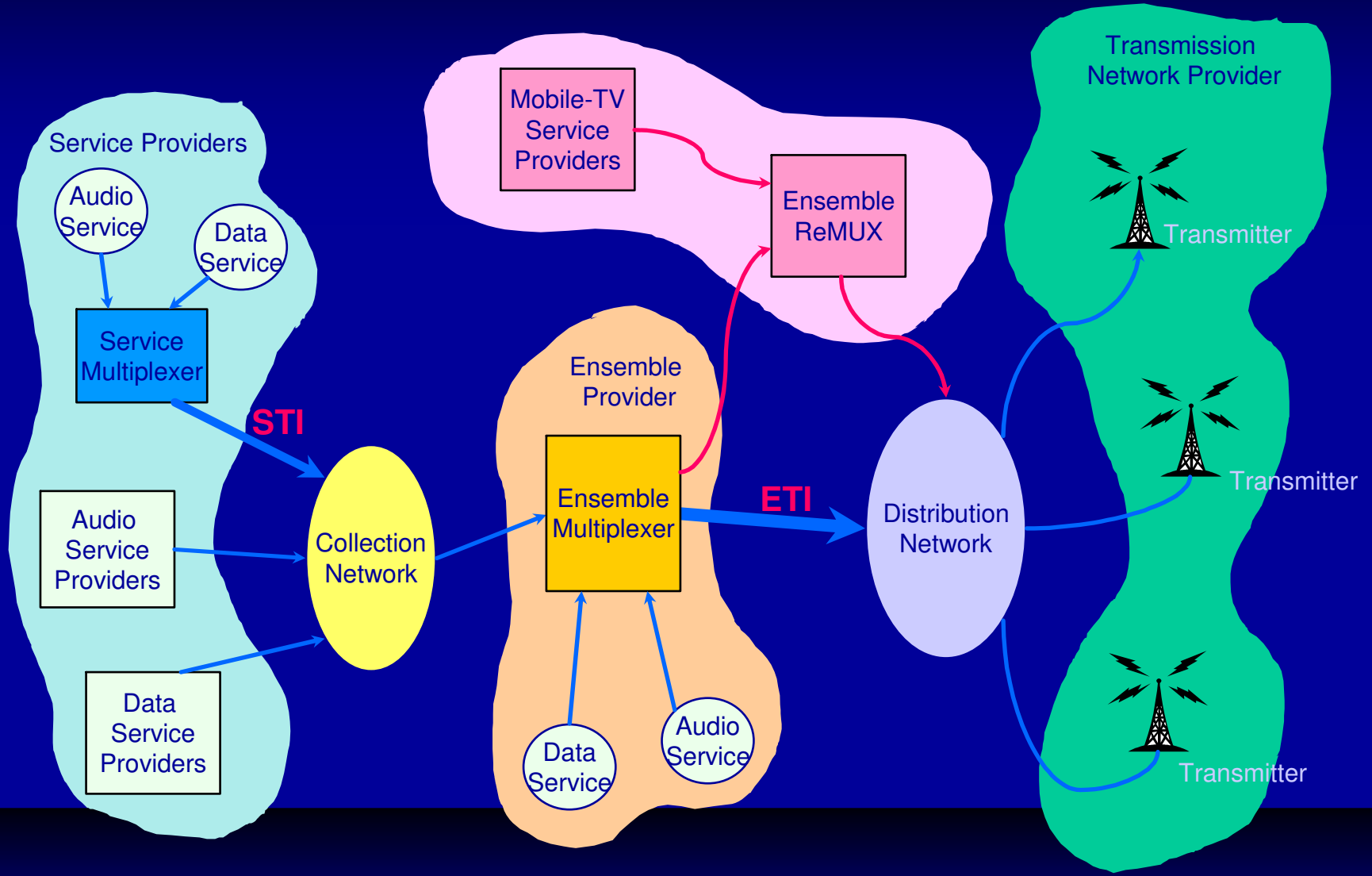


DMBcaster



Ensemble Remultiplexer

Terrestrial DMB Network



STI : Service Transport Interface(ETSI ETS 300 797)

ETI : Ensemble Transport Interface(ETSI ETS 300 799)

DMB Applications

- ▣ Mobile TV
 - ▣ Mobile TV for high speed vehicle and cellular phones
- ▣ Telematics
 - ▣ **TPEG** for **TTI** and Navigation
 - ▣ **DGPS** Services
 - ▣ Location Based Services
- ▣ Data Services
 - ▣ Broadcasting Website
 - ▣ Slide show

TPEG : Transport Protocol Expert Group
TTI : Traffic and Traveler Information
DGPS : Differential GPS

Mobile TV

- Mobile TV for high speed vehicle and cellular phones
 - Speed up to 120 km/h

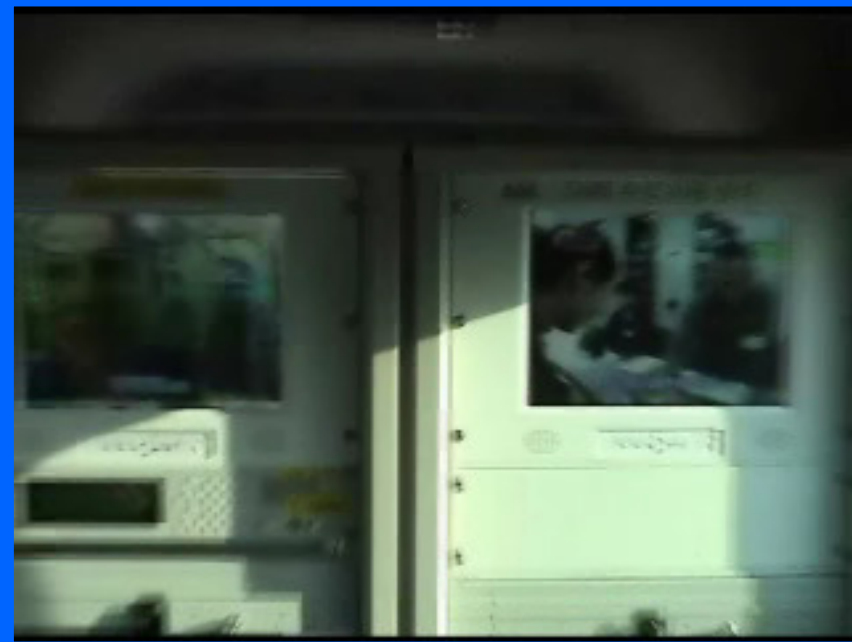


NTSC vs. Mobile TV (Apr. '03)

in central city



Mobile TV Field Test (Nov. '03)



LBS and Telematics

- ▣ User friendly navigation service
 - ▣ PDA or Notebook
 - Mobile phone Solution
 - ▣ Live Traffic Information
 - ▣ Massive Traveler/Location Information



Live Traffic Information



Weather



Stock

종목명	현재가	전일대비
▶ 삼천당재약	1500	10
▶ 대아건설	4050	110
▶ 중앙석유	20494	100
▶ 신안석유	4050	20
▶ 안국약품	2130	20
▶ 무림제지	9500	200
▶ 이화공업	10500	500
▶ 피에스텍	3050	60
▶ 삼일기업공사	5750	90
▶ 벽약사	8800	150
▶ 한주제약	1100	50

News

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Conclusion

- ▣ Change of the Digital Broadcasting Environment
 - ▣ High data rate, Mobile reception requirement
 - ▣ Harmonious service of Broadcasting and Communication
- ▣ Terrestrial DAB in Europe
 - ▣ High-quality audio and flexible rate data services
- ▣ DMB in Korea
 - ▣ Mobile multimedia broadcasting through terrestrial DAB
 - ▣ Regional, as well as nation-wide networks of high-quality mobile multimedia services
 - ▣ As well as Mobile TV, DMB is strong and powerful candidate for delivering data for telematics and LBS service

Thank You !



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