# Evolving Media Delivery Platforms 2015

## Apia, Samoa


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**A Vice-Chair of World Broadcasting Union – Technical Committee (WBU-TC)**

**Distinguished Lecturer of IEEE Broadcast Technology Society**

# Evolving Platforms


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# Broadcasting Industry

- Demographics – mixed – young and aging nations
- Geography – borderless – satellite and OTT
- Economic development
- Disposable income
- Growth
- Innovation
- NGTV - UHDTV (UHDTV-1 and UHDTV-2)

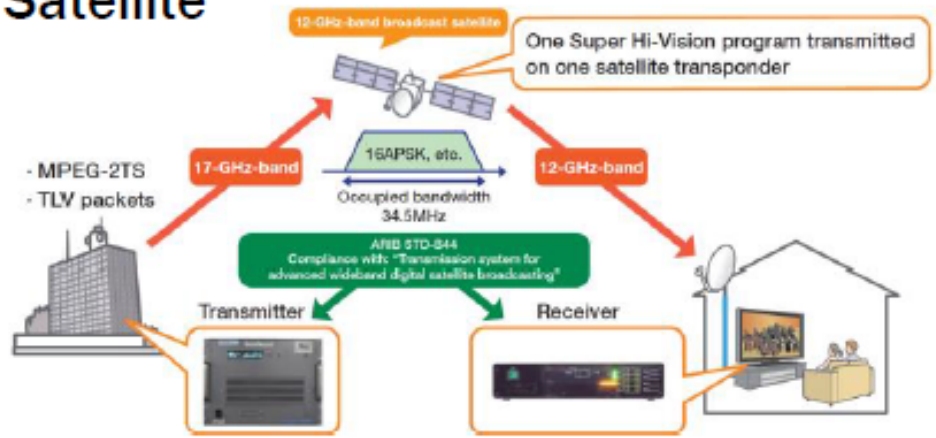
# Enhancing Broadcasting

- Hybrid and Interactive Services
- Mobile Broadcasting

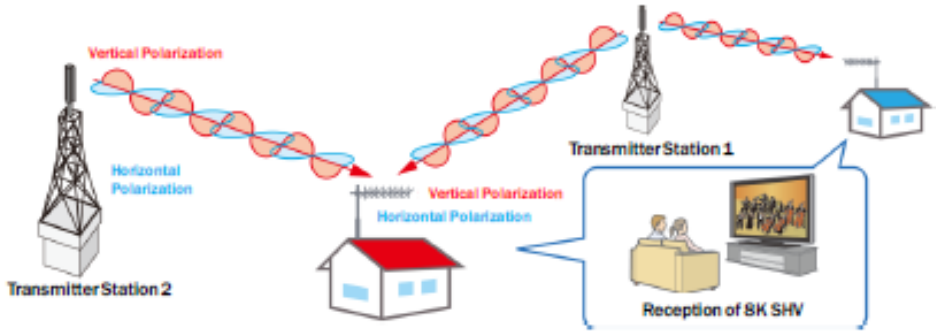
# Platforms

## Terrestrial, Cable, Satellite and now IP [Courtesy of NHK]

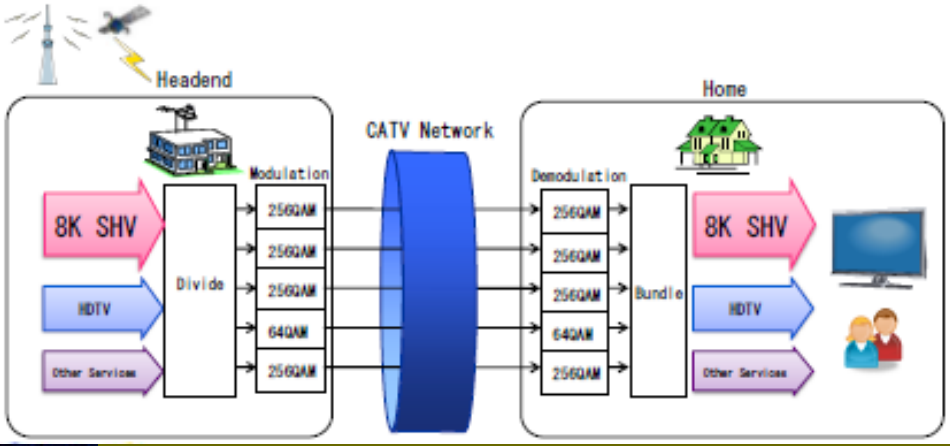
### Satellite




### Terrestrial




### CATV




### IP Transmission

# Aim

To provide insight into the network architecture and functionality of the different delivery technologies: with emphasis on Mobile

- T-DMB
- ISDB-T (OneSeg/mm)
- DVB-T2 Lite
- Wi-Fi offload
- Hybrid MB - Tower Overlay over LTE-A+
- Application in different countries - Japan, Korea, Europe….

# How to deliver content ?

- Over-the-air ( OTA) – most efficient
- Over-the-cable (OTC) – most secured
- Over-the-broadband or Over-the-top (OTT) – growing form of delivery

- How to access content?
  - Free-to-access
  - Pay-to-access

# Casting – Information delivery

- Unicast is the term used to describe communication where a piece of information is sent from one point to another point. In this case there is just one sender, and one receiver.

- Multicast is the term used to describe communication where a piece of information is sent from one point to a set of other points.

- Broadcast is the term used to describe communication where a piece of information is sent from one point to all other points. In this case there is just one sender, but the information is sent to all receivers.

# Network Architecture

- Internet - network of networks - enables P2P Communication
- Mobile/Cellular are networks - enables P2P Communication via BS (Base Station)
- Both above networks are not designed for broadcasting
- Mobile/Cellular networks - for unicasting
- Internet – for unicasting and multicasting
- Broadcasting NWs has been designed to broadcast – Radio, Television and Data Broadcasting (NWs are broadcast networks by design)
  - Architecture is high tower high power (in general)

# Digital Broadcasting Transmission Technologies

- DVB
- ISDB
- ATSC
- DTMB

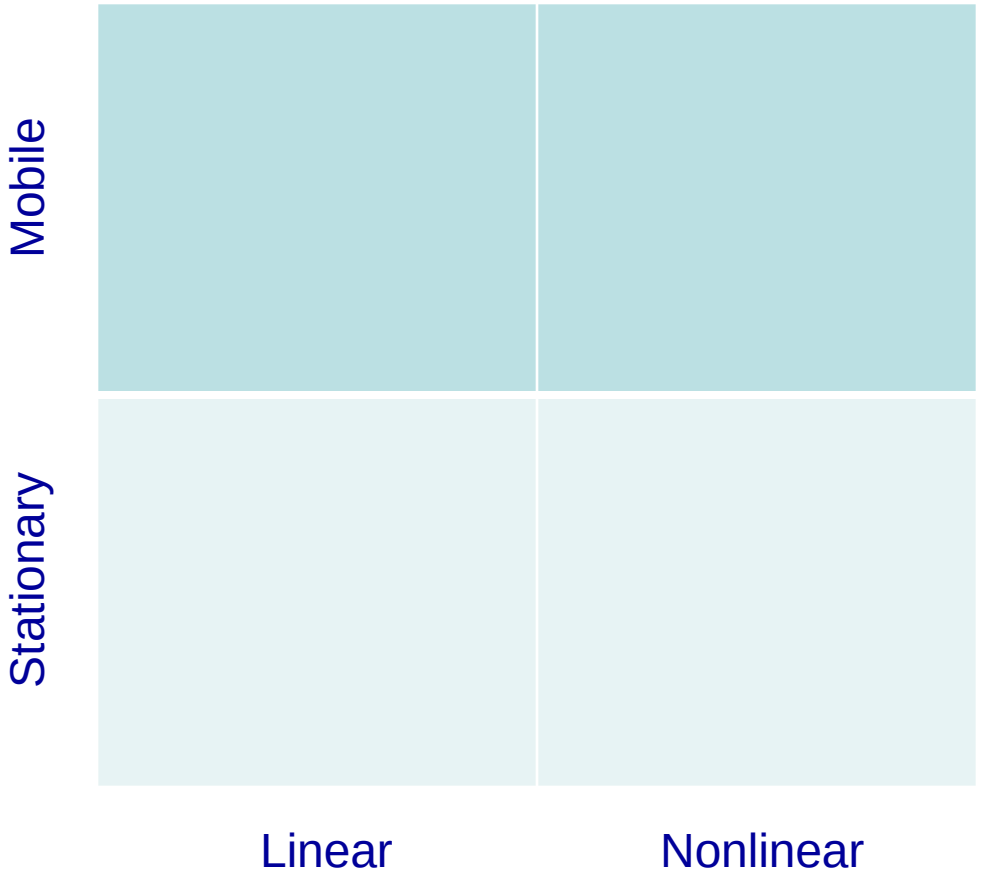
- Delivery
  - Terrestrial
  - Satellite
  - Cable
  - Virtual pipe - IP

- DAB
- DAB+
- T-DMB

- Delivery
  - Terrestrial
  - Satellite

# Media/TV consumption to be served

- Stationary vs. Mobile
- Linear vs. Nonlinear




**Source: Dr Amal Punchihewa © MMRG**

# MTV - Mobile Television Services

- T-DMB - 2005
- ISDB-Tmm - April 2012
- ATSC-M -
- DVB-T2 Lite

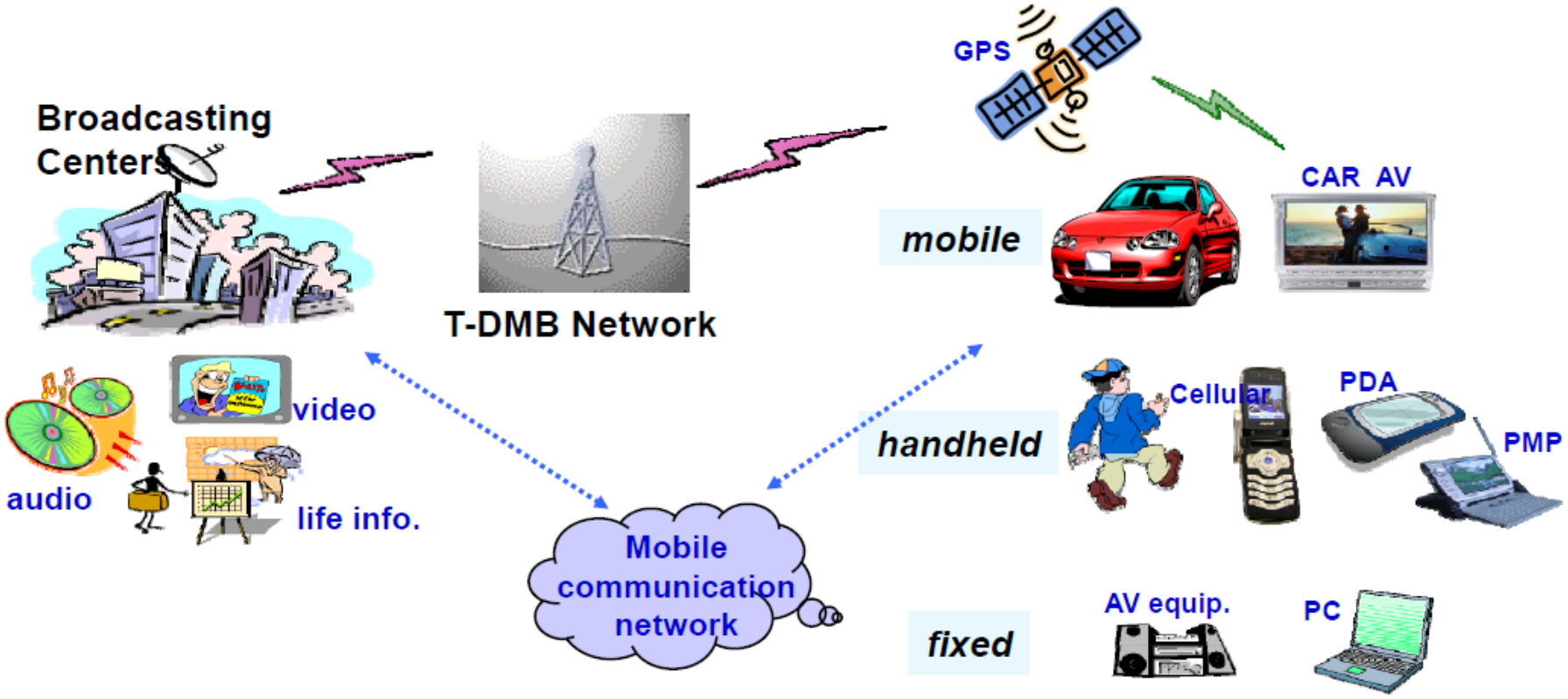
DVB-T 1997, DVB-H 2004, T-DMB 2005, DVB-T2 in 2008, DVB-T2 Lite

# What is T-DMB ?

## Video standard extension of Digital Audio Broadcasting (DAB)

Commenced around May 2005

- Fully compatible with Eureka-147
- Provides video and data services as well as CD-quality audio service



# T-DMB Service Features

**Mobile**

**Mobile multimedia broadcasting services**

- *anytime, anywhere with any devices*

**Personal**

**Personalized services by handheld receivers**

- *Mobile phone, PDA, Notebook PC, PMP, etc.*

**Interactive**

**Bi-directional interactive services linked with mobile communication networks**

- *TTI, PPV, on-line shopping, internet access, etc.*

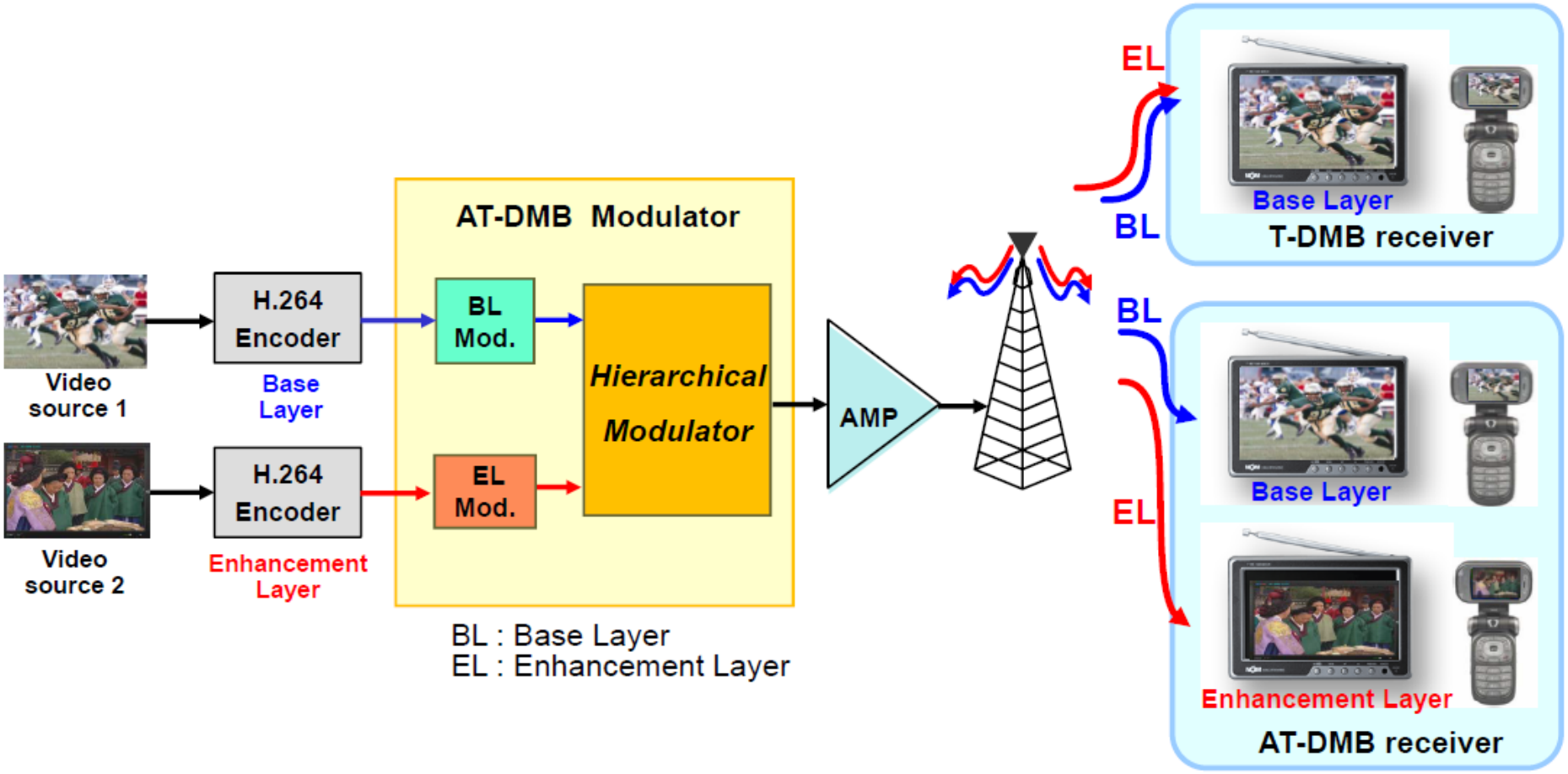
**Personal Mobile Interactive Multimedia Broadcasting Services**

TTI : Traffic and Travel Information, PPV: Pay Per View

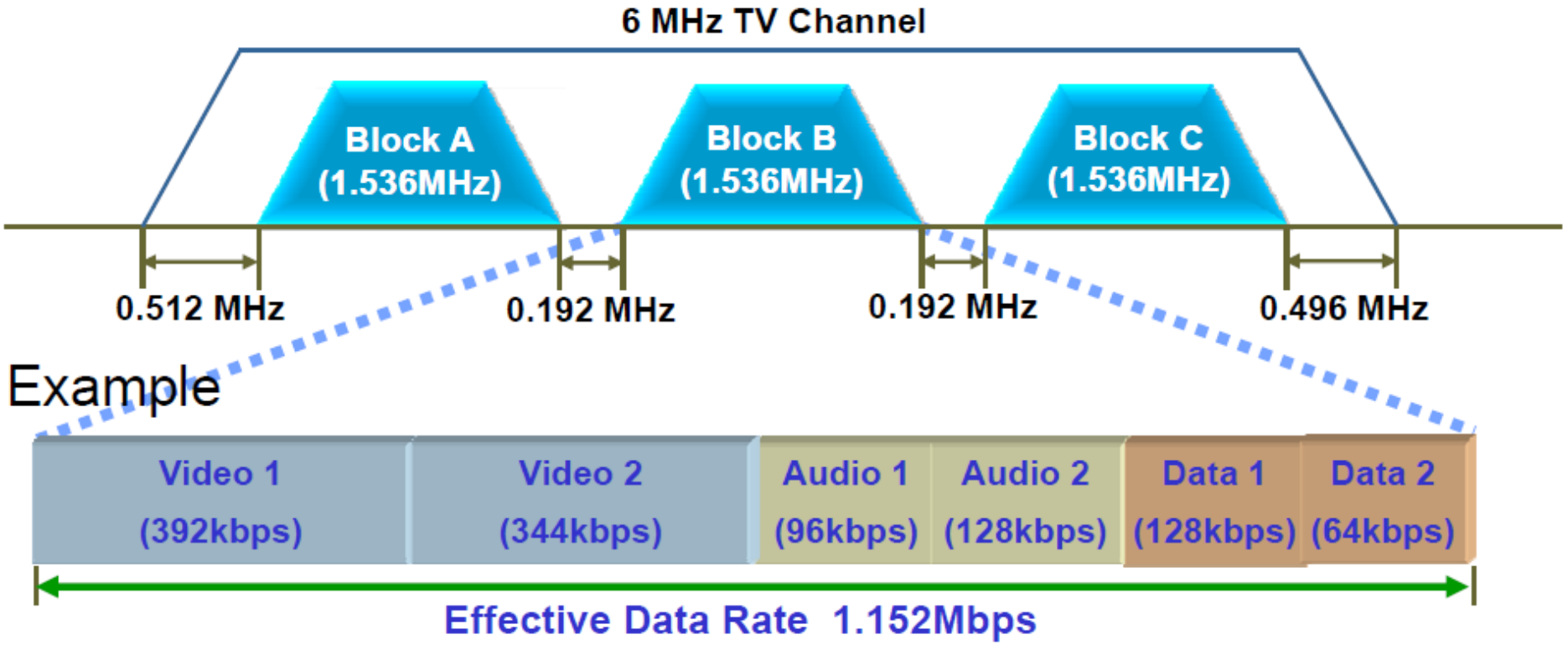
# Eureka 147 Specifications

| | | | | | |
|---|---|---|---|---|---|
| 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** | | | |
| Transmission Mode | | **I** | II | III | IV |
| Application | | **Terrestrial (SFN)** | Terrestrial /Satellite | Terrestrial /Satellite | Terrestrial /Satellite |
| 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 |

# T-DMB


AT-DMB Modulator
Video source 1
H.264 Encoder
Base Layer
Video source 2
H.264 Encoder
Enhancement Layer
BL Mod.
EL Mod.
Hierarchical Modulator
AMP
BL : Base Layer
EL : Enhancement Layer
EL
BL
Base Layer
T-DMB receiver
BL
EL
Base Layer
Enhancement Layer
AT-DMB receiver

# T-DMB Frequency Allocation



# T-DMB Services

## Audio only service

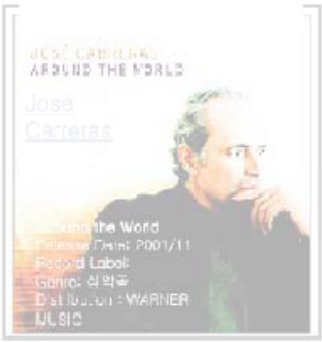
- Stereo (CD-like)

## Video service

- Video : VCD quality (7" LCD)
- Audio : Stereo (CD-like )
- Program related Data

## Data service

- Electronic Program Guide
- Headline news, Weather
- Traffic, Navigation
- Slide show, Broadcasting Web Service, etc.


CD Like High Quality Audio
Additional Data Service

R-Commerce
Purchase
CD/Ticket

# T-DMB Devices

## Types of T-DMB Devices in Korea

ETRI

### Phone

T-DMB in GSM / CDMA / WCDMA Phones available

### In-Car/PMP

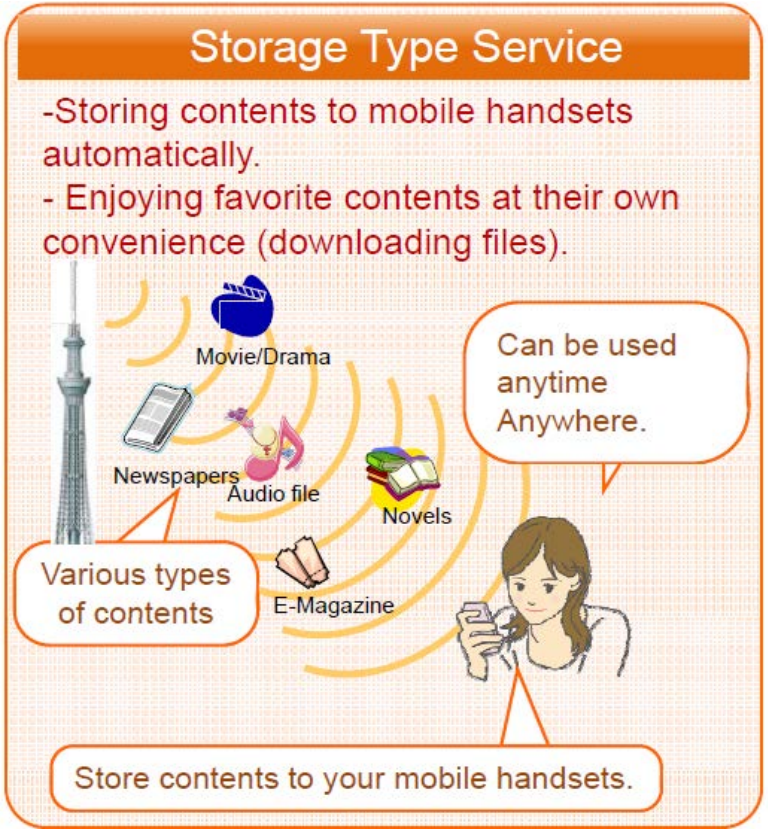
### Digital Camera

### Laptop & USB

# ISDB-Tmm - Services

## Services

- Real-time service
- Download service

# Technical Features of ISDB-Tmm

## (1) High Quality Media Coding

- ITU-T H.264 / MPEG-4 AVC
- MPEG HE-AAC, MPEG Surround

## (2) Advanced Inter-media Interaction

- Interaction between communications and broadcasting

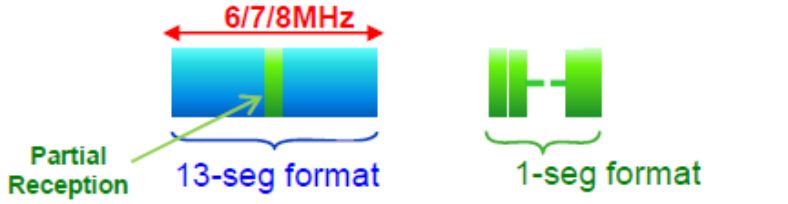
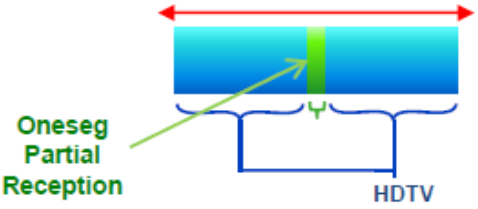
## (3) High Efficiency File Delivery Protocol

- Efficient File Transmission for Mobile Environments with AL-FEC
- Lost data in broadcast channel can be compensated with communication channels

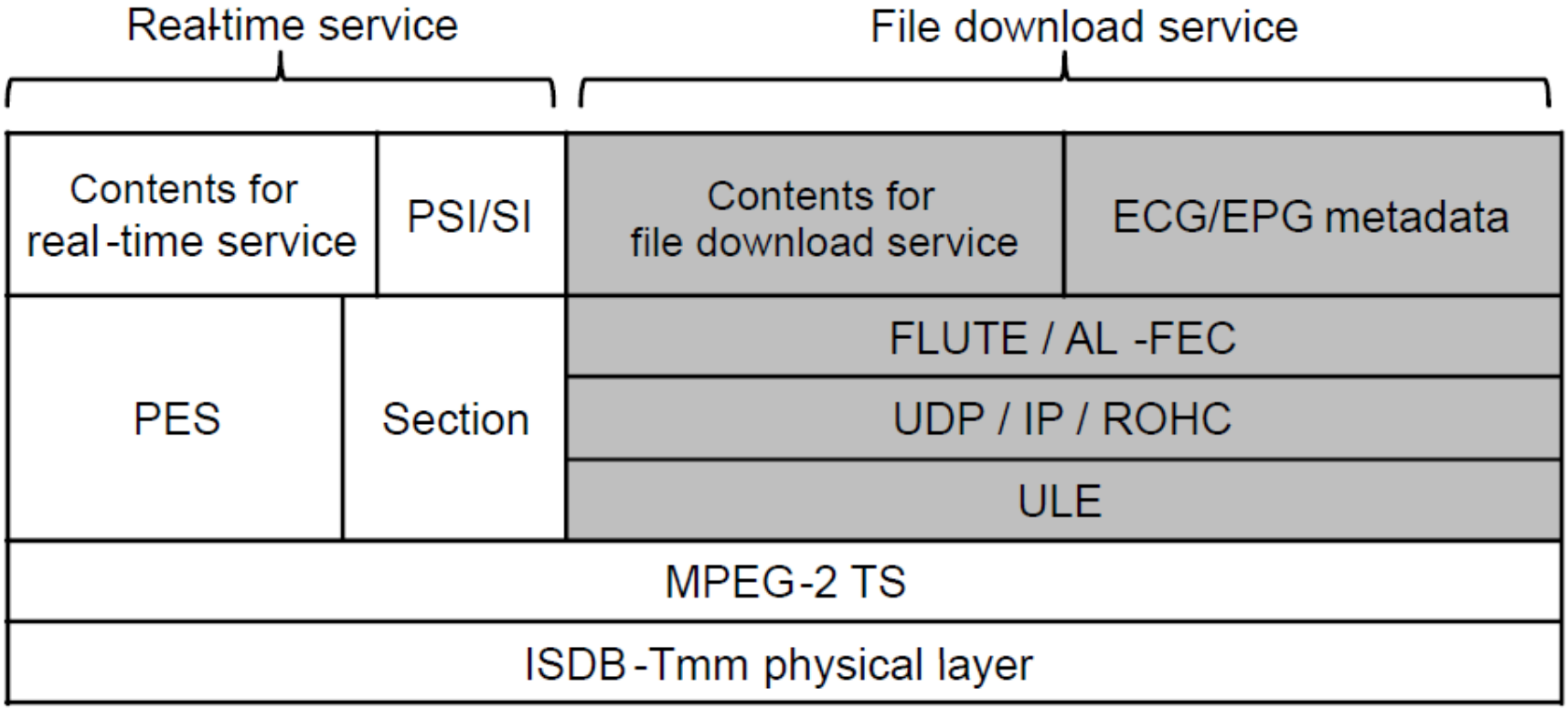
## (4) Advanced Power Saving Mechanism

- Partial segment reception is supported
- Intermittent reception for file download is supported by using advanced meta-data

# Technical Specifications of ISDB-Tmm

| | ISDB-Tmm | ISDB-T (Terrestrial Digital TV, "One-seg") |
|---|---|---|
| Segment Allocation | **Any combination of 13-seg/1-seg format**<br>  <br>ISDB-T<br>ARIB STD-B31 / ITU-R BT1833<br>ISDB-TSB<br>ARIB STD-B29 / ITU-R BT1833 | **6/7/8MHz (13 segments)**<br>  <br>e.g. 2-layer Hierarchical Reception (including partial reception) |
| Multiplexing | MPEG-2 Systems | |
| Modulation | OFDM (DQPSK, QPSK, 16QAM, 64QAM) | |
| Frequency Band | VHF Band | UHF Band |
| Transmission Data Rate | 7.3Mbbps / 13 segments (16QAM)<br>561kbps / 1 segment(16QAM) | One-seg:416kbps / 1 segment (QPSK) |

# ISDB-Tmm Protocol Stack

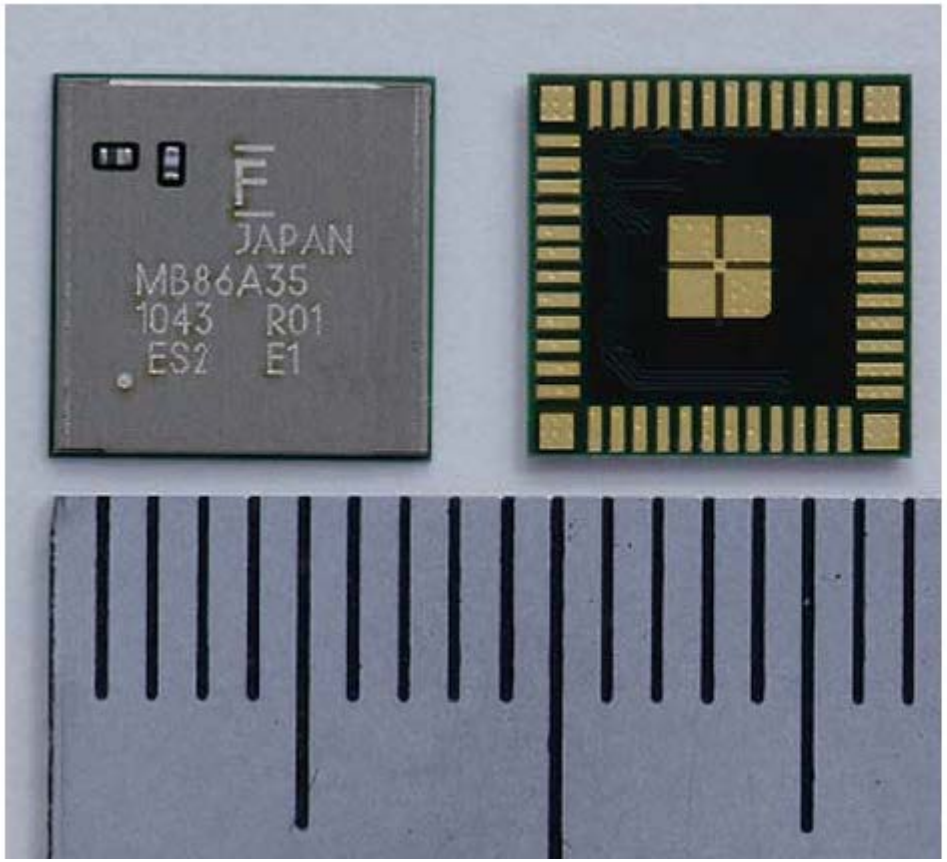



UDP: User datagram protocol
IP: Internet protocol
ROHC: Robust header compression
ULE: Unidirectional lightweight encapsulation
TS: Transport stream

SI: Service information
PSI: Program specific information
EPG: Electronic program guide
ECG: Electronic contents guide
PES: Packetized elementary stream
FLUTE: File delivery over unidirectional transport
AL-FEC: Application layer forward error correction

# Tuner Hardware

- Advances in chip design…

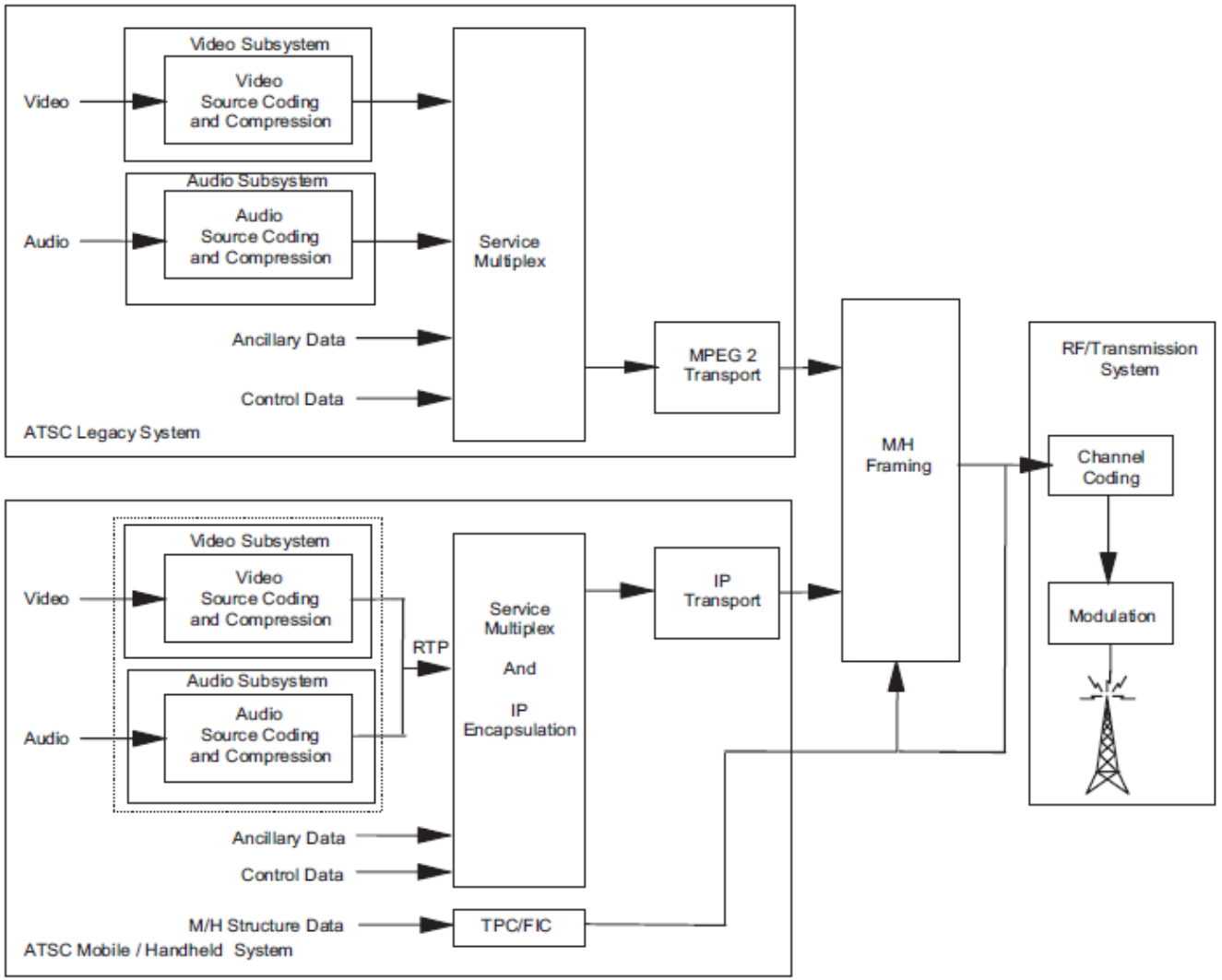



- ISDB-T
- ISDB-T (One-seg)
- ISDB-Tsb
- ISDB-Tmm
- DVB-T
- 6/7/8MHz multi-band

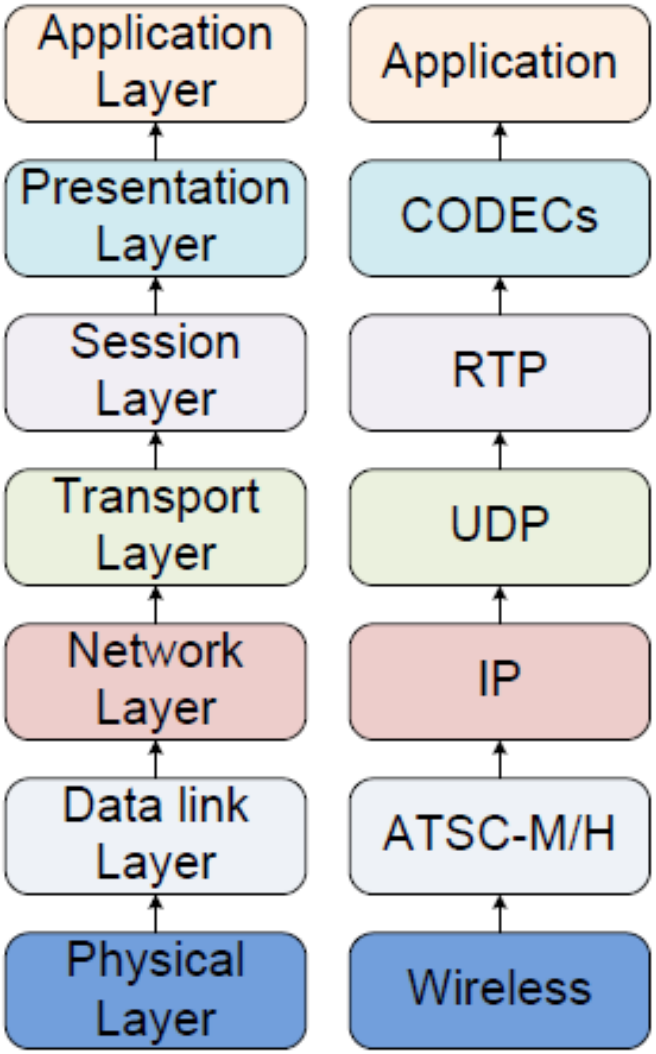
In a single mobule

Source: http://jp.fujitsu.com/

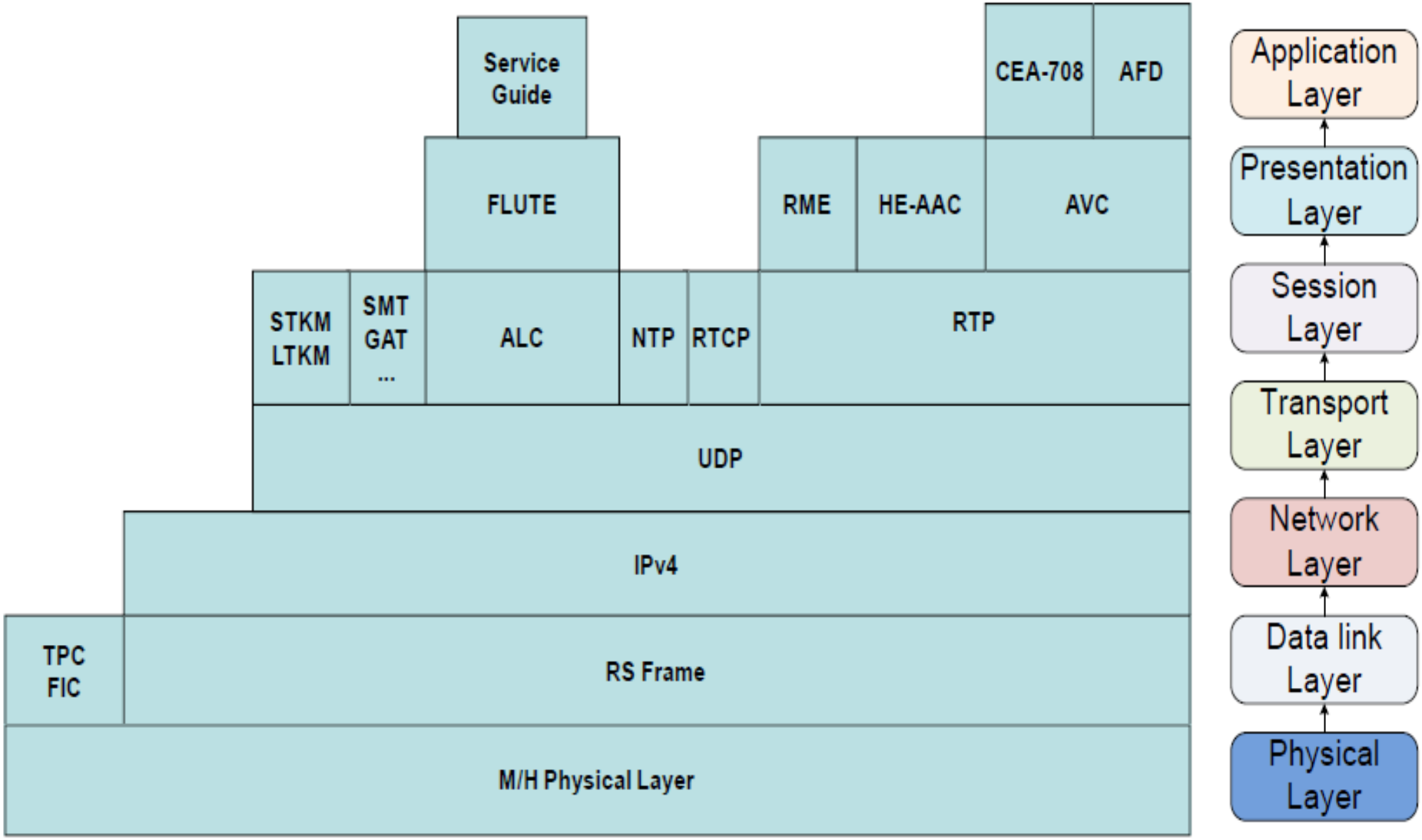
# ATSC-M


Video Subsystem
Video
Source Coding and Compression
Video
Audio Subsystem
Audio
Source Coding and Compression
Audio
Service Multiplex
Ancillary Data
Control Data
MPEG 2 Transport
ATSC Legacy System
Video Subsystem
Video
Source Coding and Compression
Video
Audio Subsystem
Audio
Source Coding and Compression
Audio
RTP
Service Multiplex And IP Encapsulation
IP Transport
Ancillary Data
Control Data
M/H Structure Data
TPC/FIC
ATSC Mobile / Handheld System
M/H Framing
RF/Transmission System
Channel Coding
Modulation

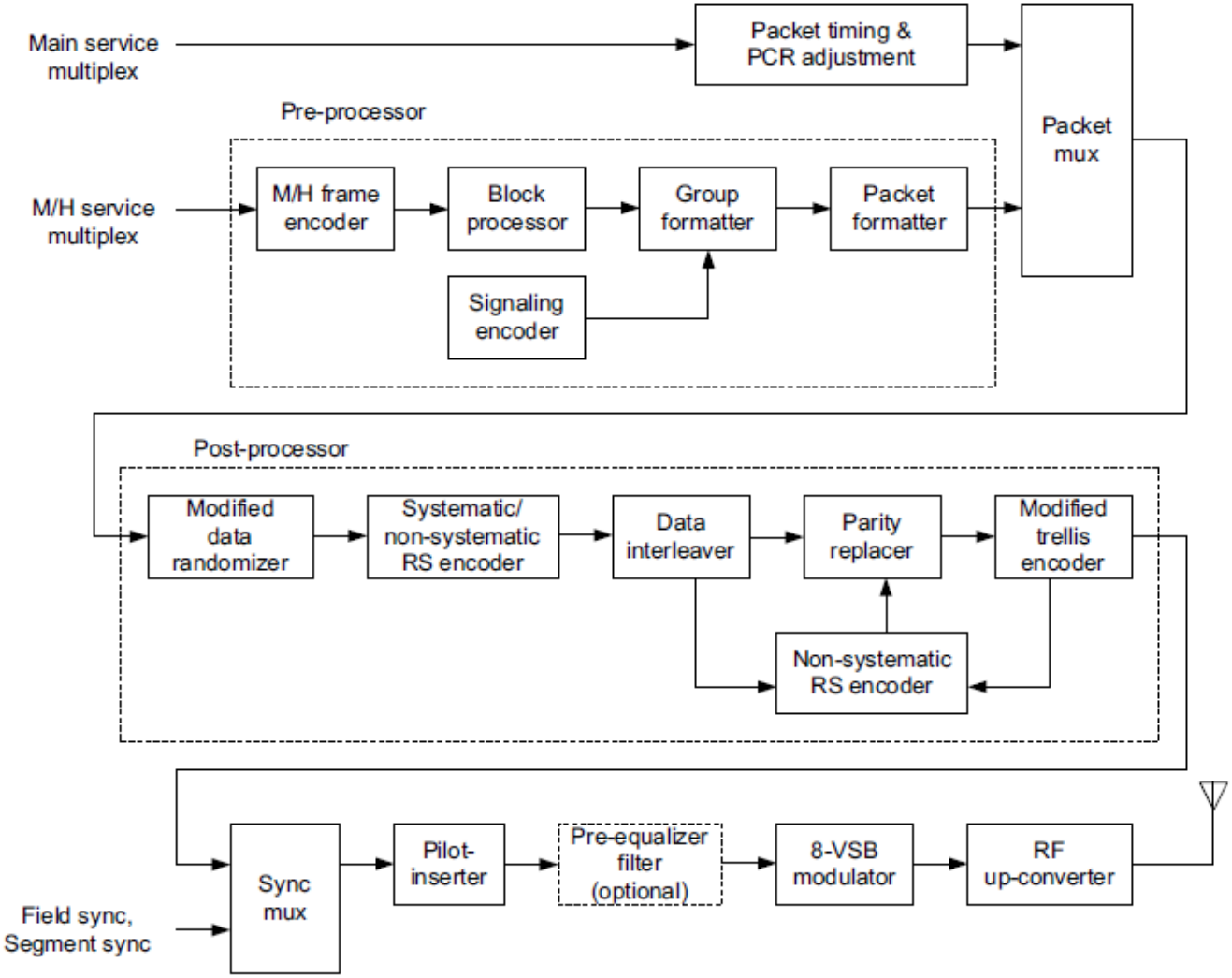
# OSI reference model with ATSC-M/H components



# ATSC Protocol stack



# ATSC-M Transmission

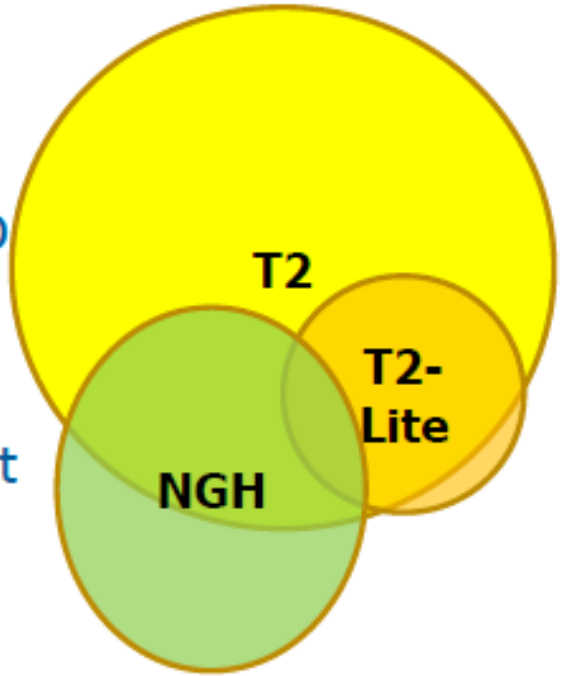


# DTV-T

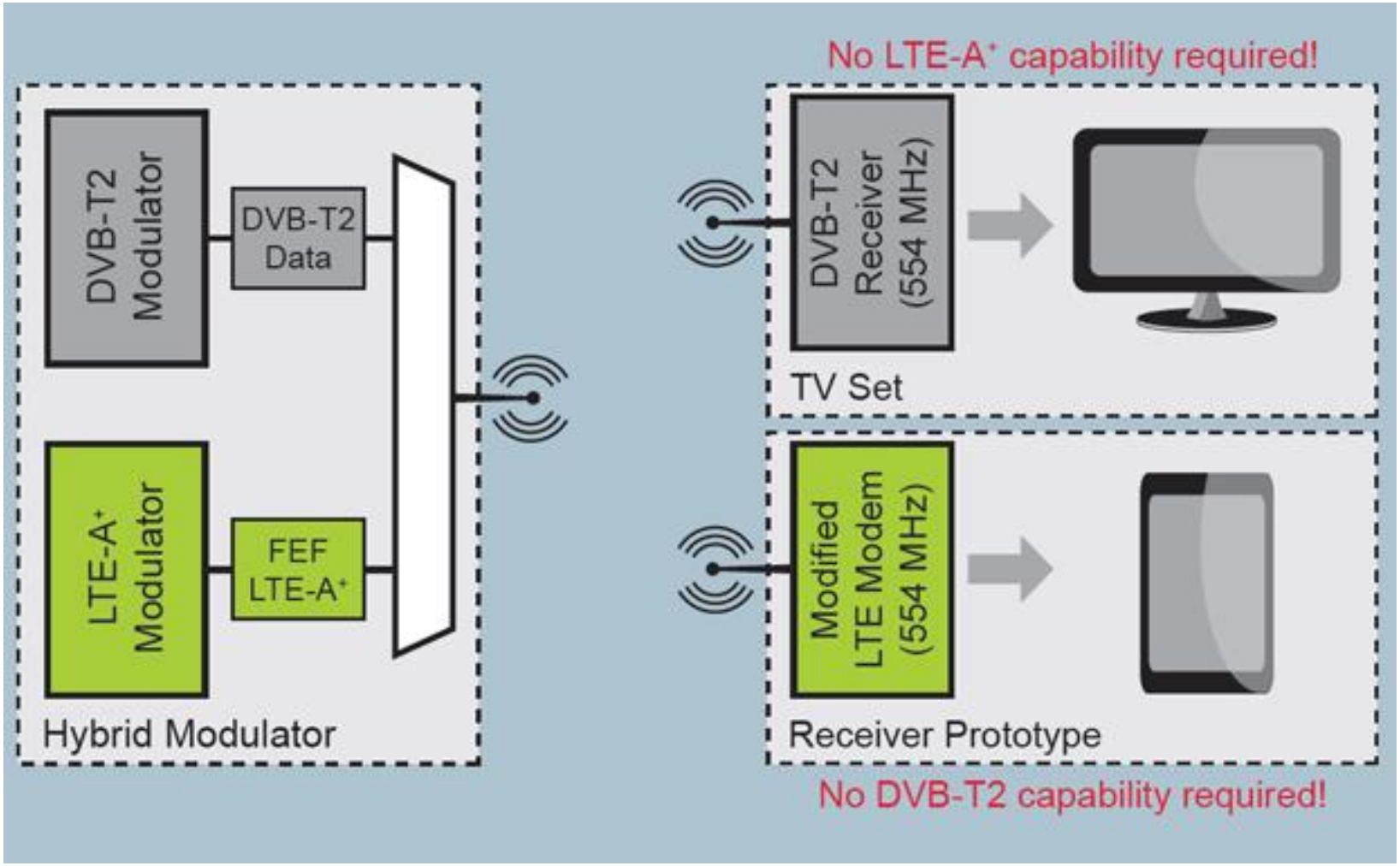
| Technology | Main Features |
|---|---|
| ATSC | ▪ A 8-VSB Transmission technology developed by ATSC<br>▪ Suitable for HDTV |
| DVB-T | ▪ COFDM transmission technology developed by Europe's DVB Group<br>▪ Advantageous in mobility |
| ISDB-T | ▪ BST OFDM(Band-segmented Transmission OFDM) transmission technology<br>▪ Developed by Japan |

# Broadcasting to Mobile - NGH

- DVB-T2 covers fixed as well as mobile use cases
- DVB-T2-Lite is basically a subset of T2 to support mobile for terrestrial broadcasters
  - Ideal solution for a broadcast network to start mobile services
  - Will be supported in DVB-T2 chipsets
  - FEF-TDM structure allows total flexibilty
- NGH is the ultimate air interface for all types of mobile broadcast
  - Can be combined with T2
  - Highest efficiency and operational flexibility



# DVB-T2 Lite


No LTE-A+ capability required!
DVB-T2 Modulator
DVB-T2 Data
LTE-A+ Modulator
FEF LTE-A+
Hybrid Modulator
DVB-T2 Receiver (554 MHz)
TV Set
Modified LTE Modem (554 MHz)
Receiver Prototype
No DVB-T2 capability required!

# T2 Transmission Parameters

| | DVB-T2 | T2-Lite |
|---|---|---|
| Data rate | 25.24 Mbit/s | 1.02 Mbit/s |
| Channels | 1 x UHD TV | Mobile TV |
| Video coding | HEVC | H.264 |
| Number of carriers | 16K | 16K |
| Modulation | 256 QAM | QPSK |
| Inner coding | 2/3 | 1/2 |
| Guard interval | 1/128 | 1/128 |
| Pilot Pattern | PP7 | PP7 |
| Frame Length (data symbols) | 70 | 70 |
| Required C/N Ratio | 20.3 dB | 2.9 dB |

# DVB-T2 Lite specifications

- A maximum bitrate of 4 Mbits/sec for each service
- Limitations on the FFT size to exclude the 1K and 32K carrier modes
- Prohibition of the use of rotated constellations in 256-QAM
- Possibility for only short FEC frames (Nldpc = 16200)
- Limitation of the size of the time interleaver memory (approximately half the size of normal DVB-T2).
- two new LDPC error control code rates, 1/3 and 2/5, more options for mobile reception
- Through use of FEF allowing different FFT size and Guard interval in transmissions
- T2 lite signal ignored by normal DVB-T2 receiver

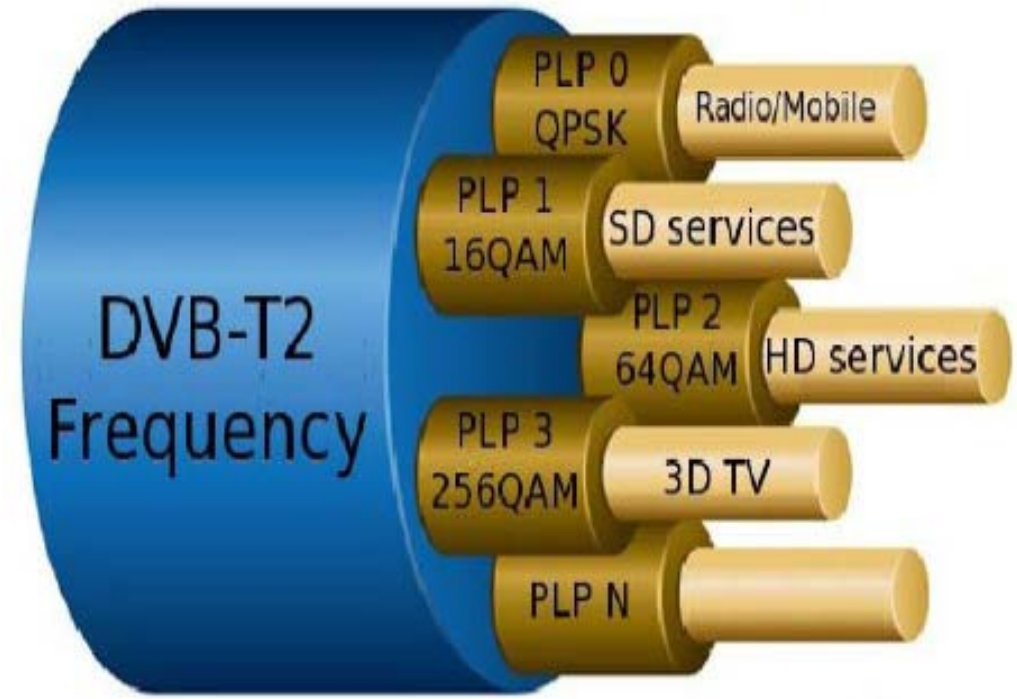
# Mobile reception

- The commercial focus on DVB-T2 is primarily on stationary reception (beyond SDTV), but DVB-T2 is also designed to work well in mobile/handheld conditions
  - deep time interleaving
  - supports power saving by time slicing
  - enables the introduction of “T2-Lite” or DVB-NGH services via Future Extension Frames (FEF)
  - T2-Lite is part of the DVB-T2 standard (from v.1.3.1)
  - DVB-NGH is based on DVB-T2

Reduced complexity leads to smaller silicon size (-50%) and lower power consumption

# Wide range of bitrate vs. robustness

- Space division multiplexing

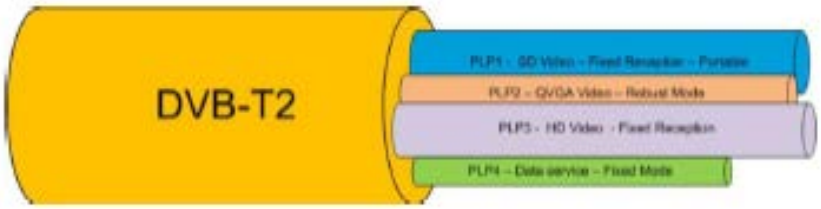


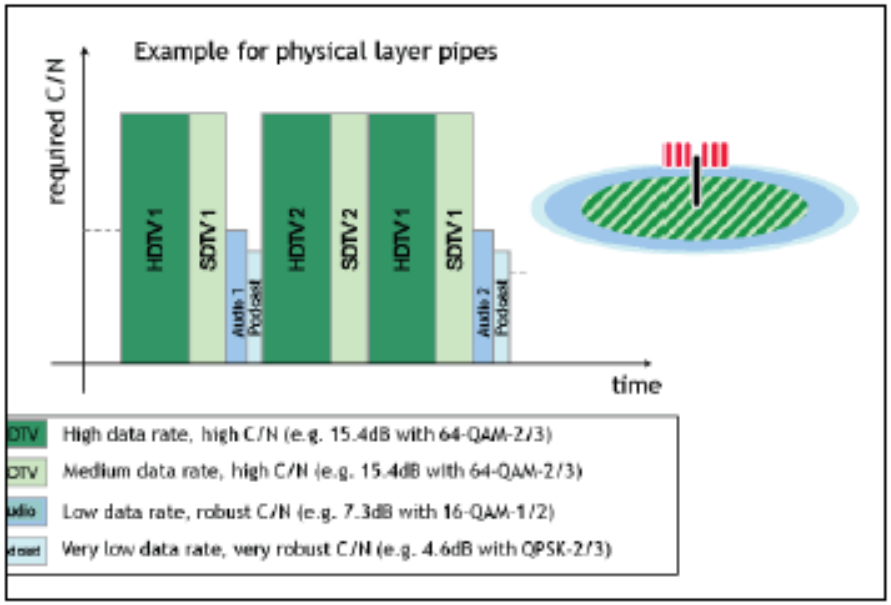

**Common parameters :** 8 Mhz channel, FFT size 8K, pilot pattern PP1 and Guard Interval 1/4

| PLP | Content | Reception | Modulation | Code rate | Bit rate | C/N |
|---|---|---|---|---|---|---|
| 1 | HD/3D | Rooftop antenna | 256 QAM | 3/4 | 18.6 Mbps | 23 dB |
| 2 | SD | Indoor antenna | 16 QAM | 3/5 | 4 Mbps | 11 dB |
| 3 | Mobile/radio | Mobile reception | QPSK | 1/2 | 0.5 Mbps | 3 dB |

# Multiple PLPs

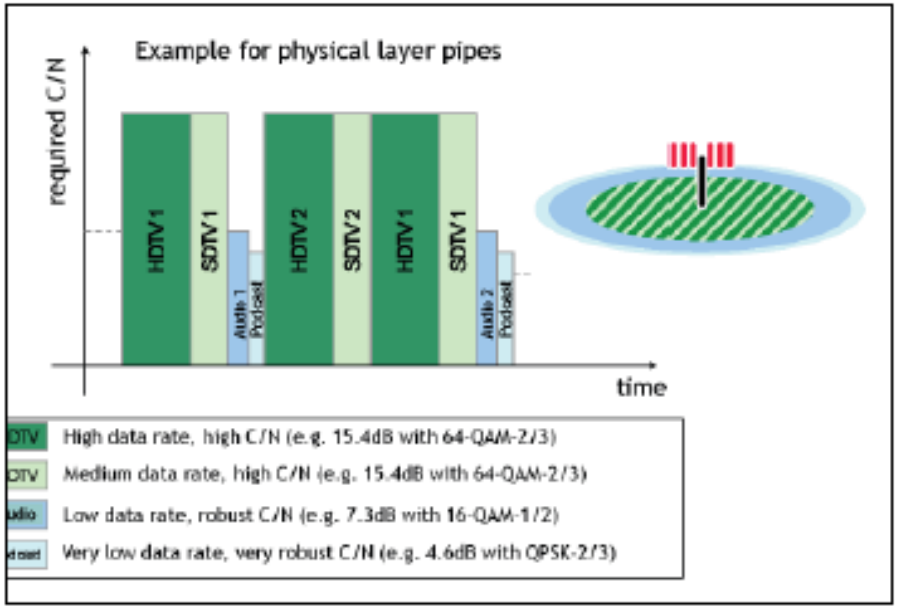
- Possibility to prioritize robustness for selected “high-priority” services
  ⇨ prioritized services (e.g. public service) will “serve longer” in bad reception conditions
- Capacity and coverage can be further improved by Time Frequency Slicing (TFS), which uses multiple PLPs
  - Each PLP is frequency hopping over several RF channels ⇨ increased frequency diversity
- Limitation ⇨ different FFT size not allowed

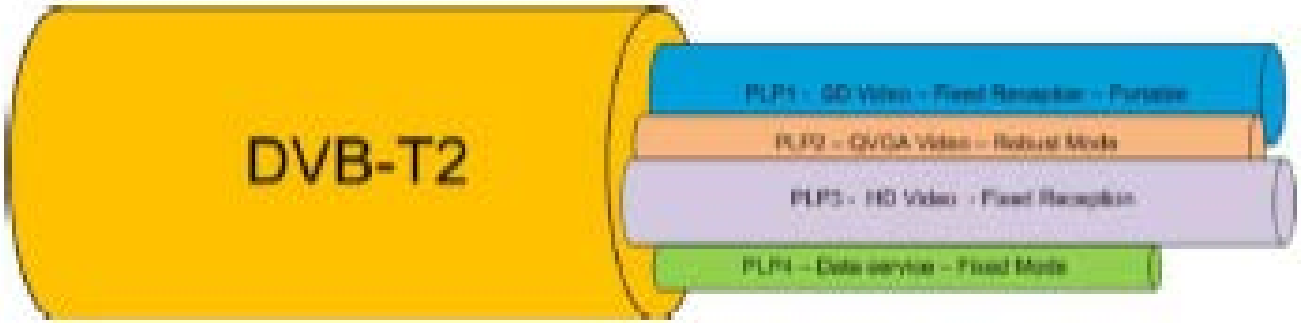


# Multiple PLPs

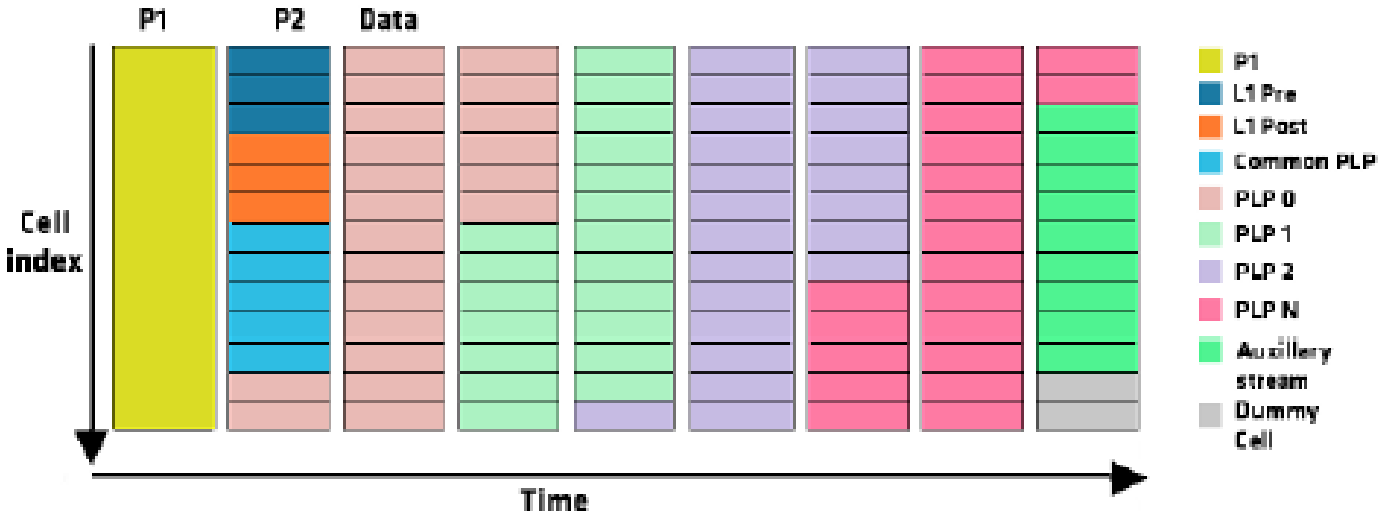
- Possibility to reach different kinds of receivers and reception conditions with a single RF signal
  - HDTV to roof-top directional antennas in PLPs with ”normal” robustness PLPs
  - Mobile receivers with robust PLPs



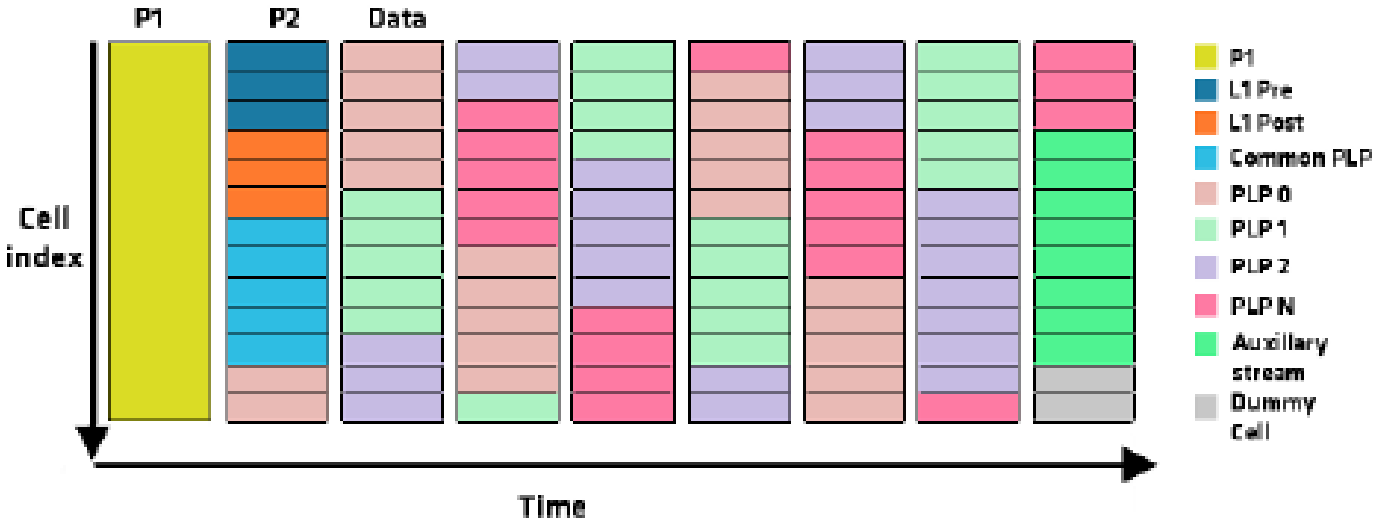



# PLP for various services

Power saving PLP

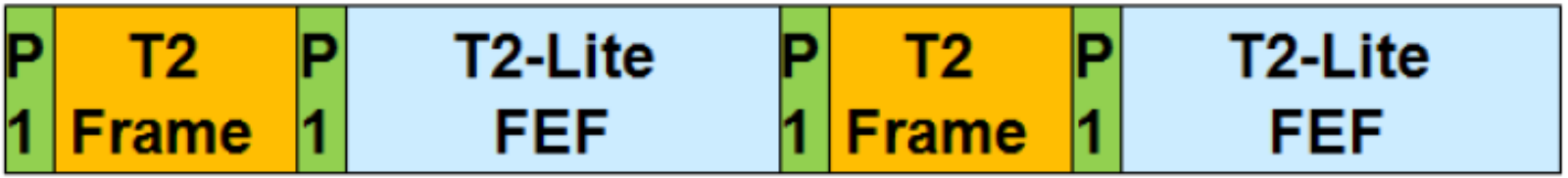



Time slicing Mobile robustness



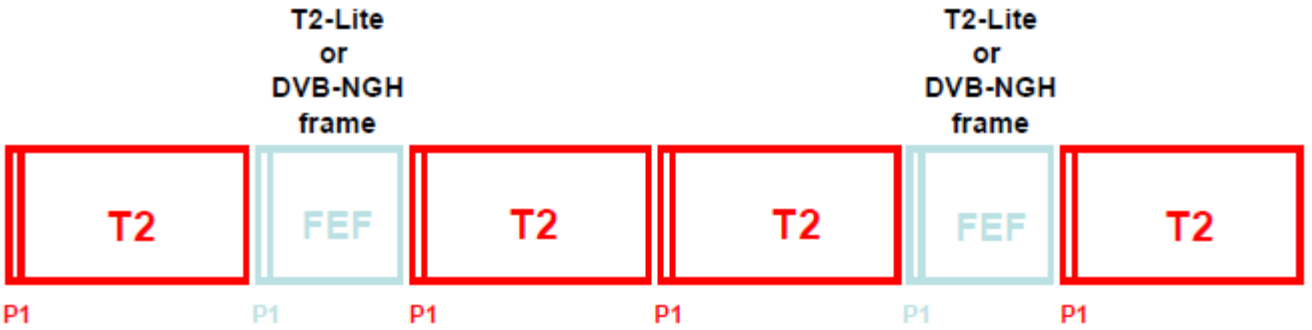
# Future Extension Frames (FEF)

- DVB-T2 is based on a Frame structure
- Each Frame starts with a P1 preamble specifying the content type
- FEF allow to mix different FFT sizes and guard intervalls in one channel.
- FEF allow to combine different technologies in one frequency channel
- FEF could also support LTE frames together with T2



# Future Extension Frames (FEFs)

- A mechanism that allows a future system to be sent as “Future Extension frames” in T2 time slots
  - No restrictions in the allowed content of the FEF
  - FEF may use DVB-T2 Lite (mobile, specified subset of DVB-T2)
  - Future transmission of the DVB Next Generation Handheld (DVB-NGH) standard currently developed by DVB
- The FEF mechanism does not exist in DVB-T
- Allows flexible capacity allocation to fixed and mobile services by adjusting the size of T2 frame and FEF



# To summarise

- Broadcasting requires more spectrum for future needs
- Access to content without gatekeepers
- Foster innovation in Hybrid broadcasting