**ΕΕΤΤ**
**ΨΗΦΙΑΚΟ ΜΕΡΙΣΜΑ**
Προκλήσεις & Ευκαιρίες στη Νέα Ψηφιακή Εποχή

# **DVB-T**: Τεχνολογικές Εξελίξεις & Εφαρμογές

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# Contents

- ERT Digital
- Digital Video Broadcasting- Terrestrial 2 DVB-T2
- Ultra High Definition Television

# ERT DIGITAL

- 2006: pilot operation of Digital Video Broadcasting-Terrestrial, ERT
- 2008:
  - Prisma +
  - Cine +
  - Sport +( Info +, 3.5 hours program from sport + frequency )
  - RIK SAT

- Pan-Hellenic population coverage: 70%
- 20% Penetration in population total

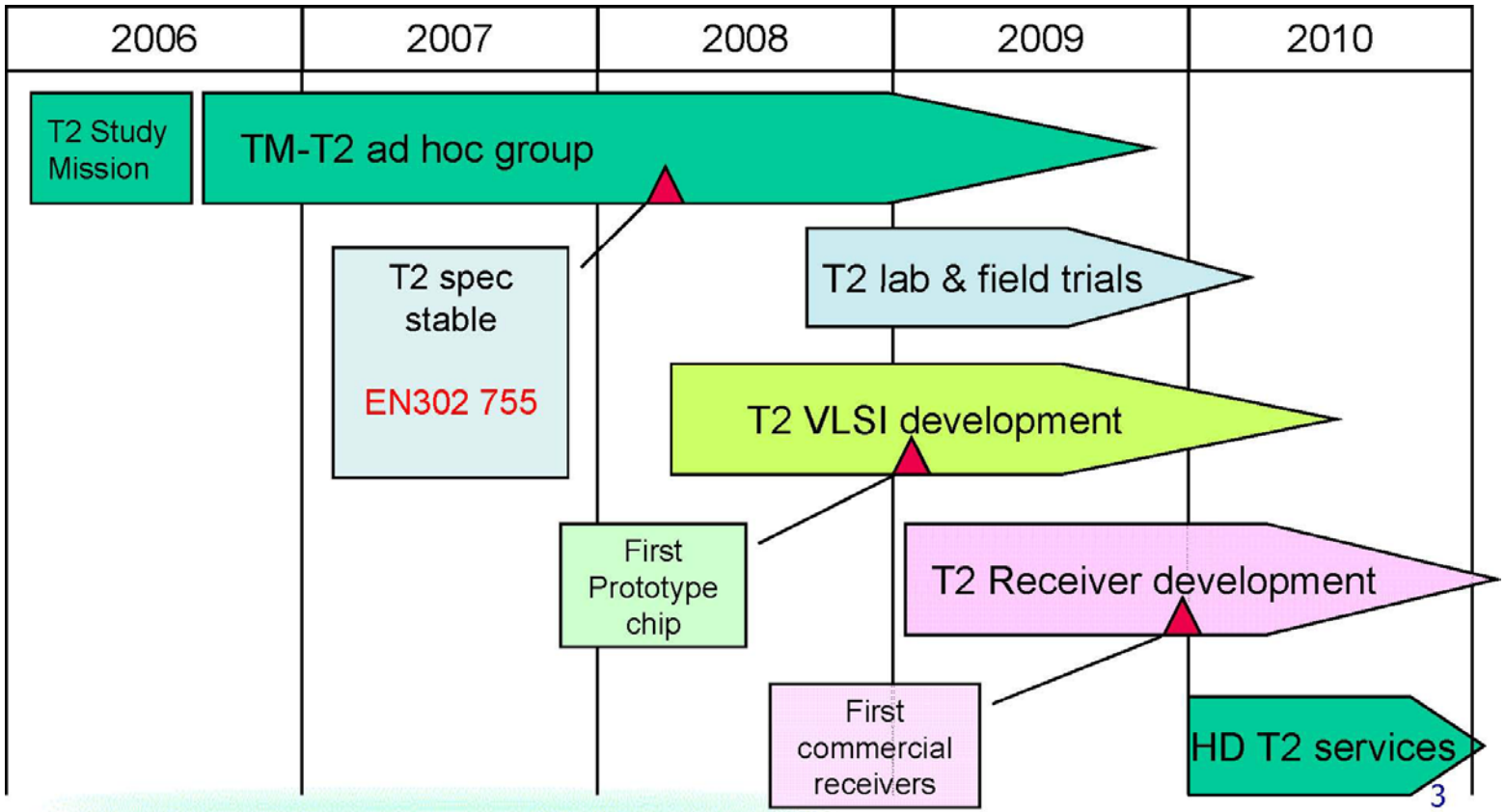
# ERT DIGITAL

## 2009: 2nd Head End Ready to Broadcast

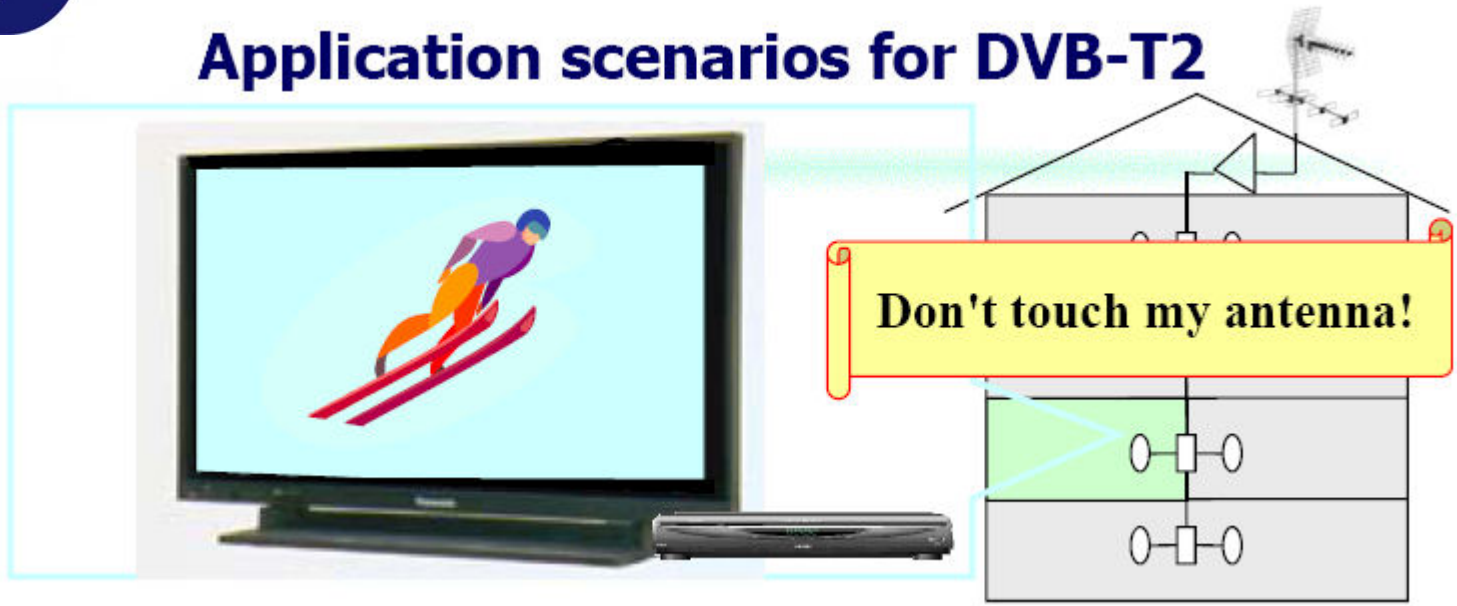
- NET
- ET-1
- ET-3
- GREEK PARLIAMENT

# T2 is the 2nd generation system for Digital Terrestrial TV

**The T2 development time line in DVB**



# Application scenarios for DVB-T2




**HDTV (and SDTV) Broadcasting in VHF/UHF**

- Fixed reception via current (collective and individual) antenna systems

Second priority:

- Protable reception (rabbit ear antena)
- Mobile reception (vehicular)

Not considered:

- cross-polar diversity (MIMO)
- Next Generation Handheld (other task force)

# Compatibility

Current DTT decoders are not compatible with HDTV
Therefore new decoders are required

- T2 & MPEG-4 (H264) will be the new standard for terrestrial DTT
- The new T2decoders will be capable of receiving DVB-T signals (DVB-T+MPEG2)

## Compatibilities guaranteed by T2:

- Current transmitting sites
- current receiving installation (single polarisation) (Don't touch…)
- GE06 plan

Compatible spectrum mask
same or better protection ratios
better impulsive noise rejection (> 10 dB)
larger allowed SFN transmitter inter-distance (eg: up to 80 Km)

# Where DVB-T could be improved?

DVB-T is 10 years old, and in between the silicon technology made huge steps forwards (from 500 nm in 1996 to 50nm in 2009: a factor of 100 in allowed complexity!!!)

The key elements which could be improved compared to DVB-T:

New generation FEC (error protection) & higher order constellations

- capacity gain 25-30%

OFDM carrier increase from 8k to 32k:

- In SFN, TG = 1/16 instead of 1/4 (overhead gain 16x5/17x4 ->17.6%)

Scattered Pilot optimisation according to GI, continual pilot minimisation:

- up-to 7-8% overhead reduction

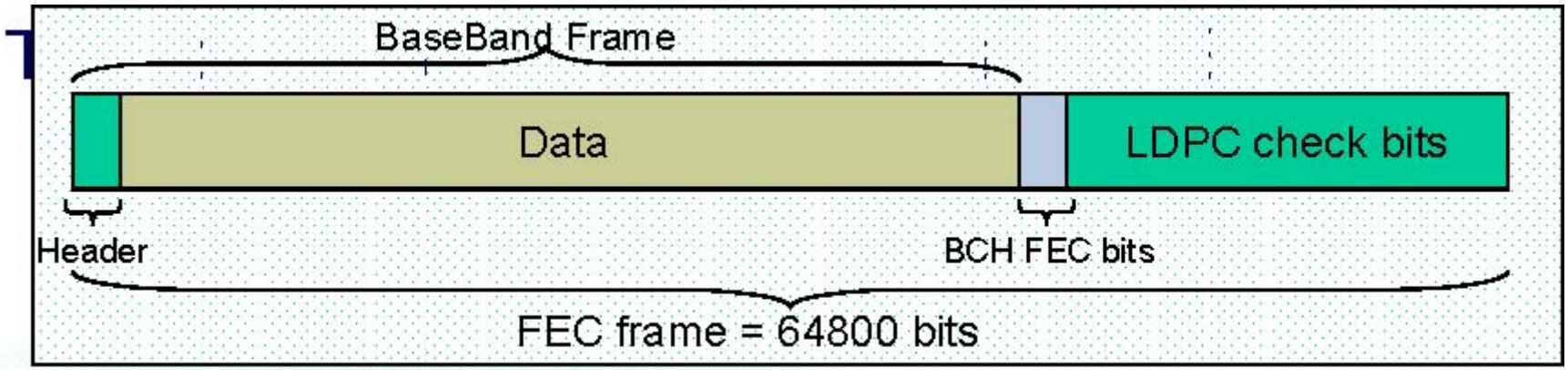
Power “peak” reduction (Peak to Average Power Reduction, PAPR) of the OFDM signal (better exploitation of HPA, 1-2 dB gain)

- More "revolutionary" innovations: Time-Frequency Slicing, MISO

# Key features: Compatibility with S2

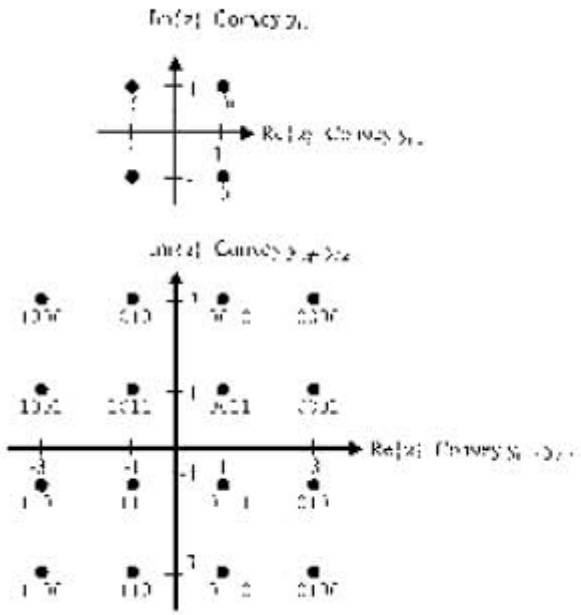
## General DVB principles

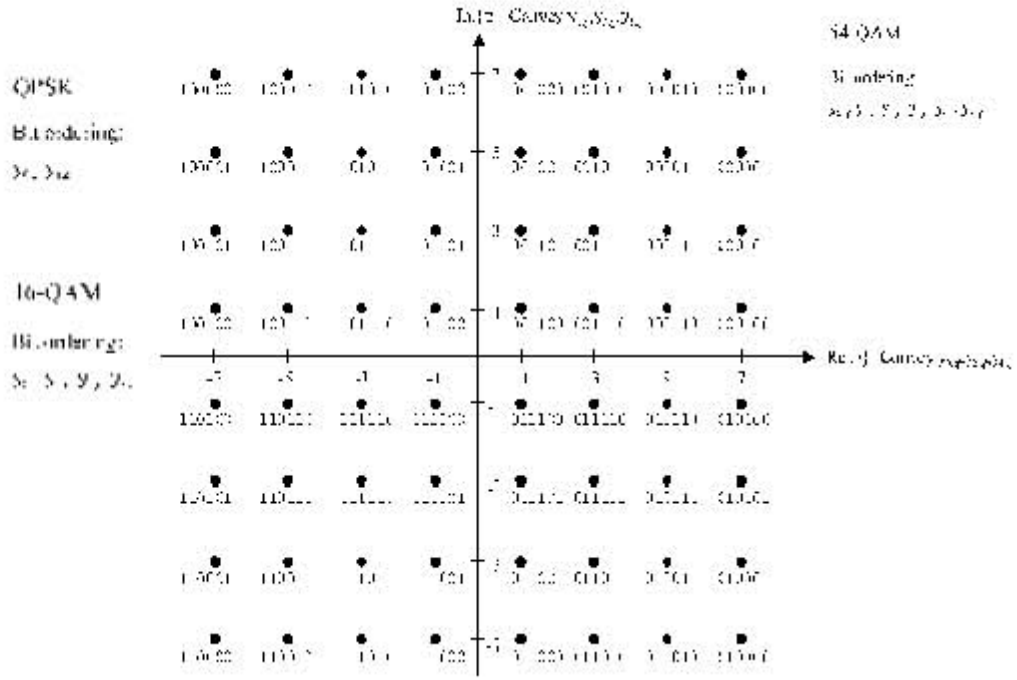
- DVB should aim to provide a coherent family of standards
- There should be easy translation between standards
  e.g. between S2 and T2
- Don't re-invent solutions when they already exist within other DVB standards



# Constellations

- DVB-T offered: QPSK, 16QAM, 64QAM

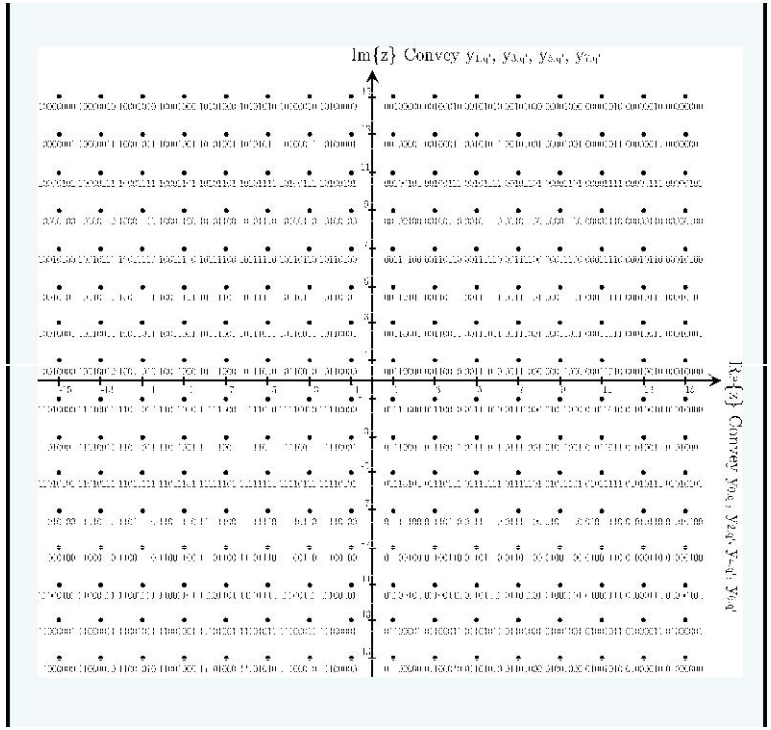




# T2 adds a new Constellation

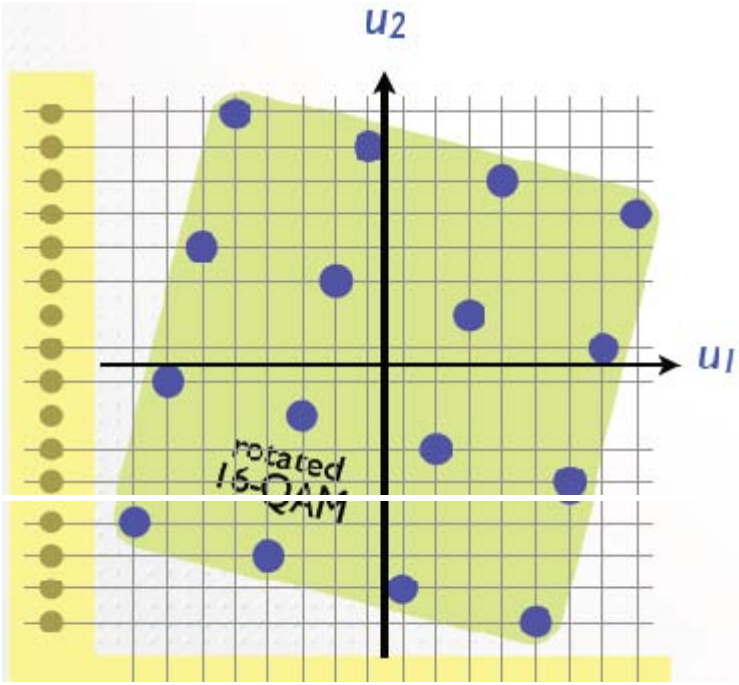
## T2 includes 256 QAM Mode

- Carries 8 bits/ data cell (c.f 6 bits / data cell for 64 QAM)
- Enables greater capacity, exploiting improved FEC performance of LDPC
- Studies show that typical tuner phase noise should not be a problem



# Rotated constellations (1)

OFDM problem: when frequency selective fading (e.g. 0 dB eco ) deletes a carrier, many bits are lost all together: only the FEC can recover them. If the code rate is high (eg: 4/5 or 5/6), we have a large C/N loss




1. data are mapped over a "normal" constellation (eg: 16-QAM): the I axis transports 2 bits, the Q axis 2 bit

2. The constellation is rotated: each axis (I,Q) now carries information of all the 4 bits

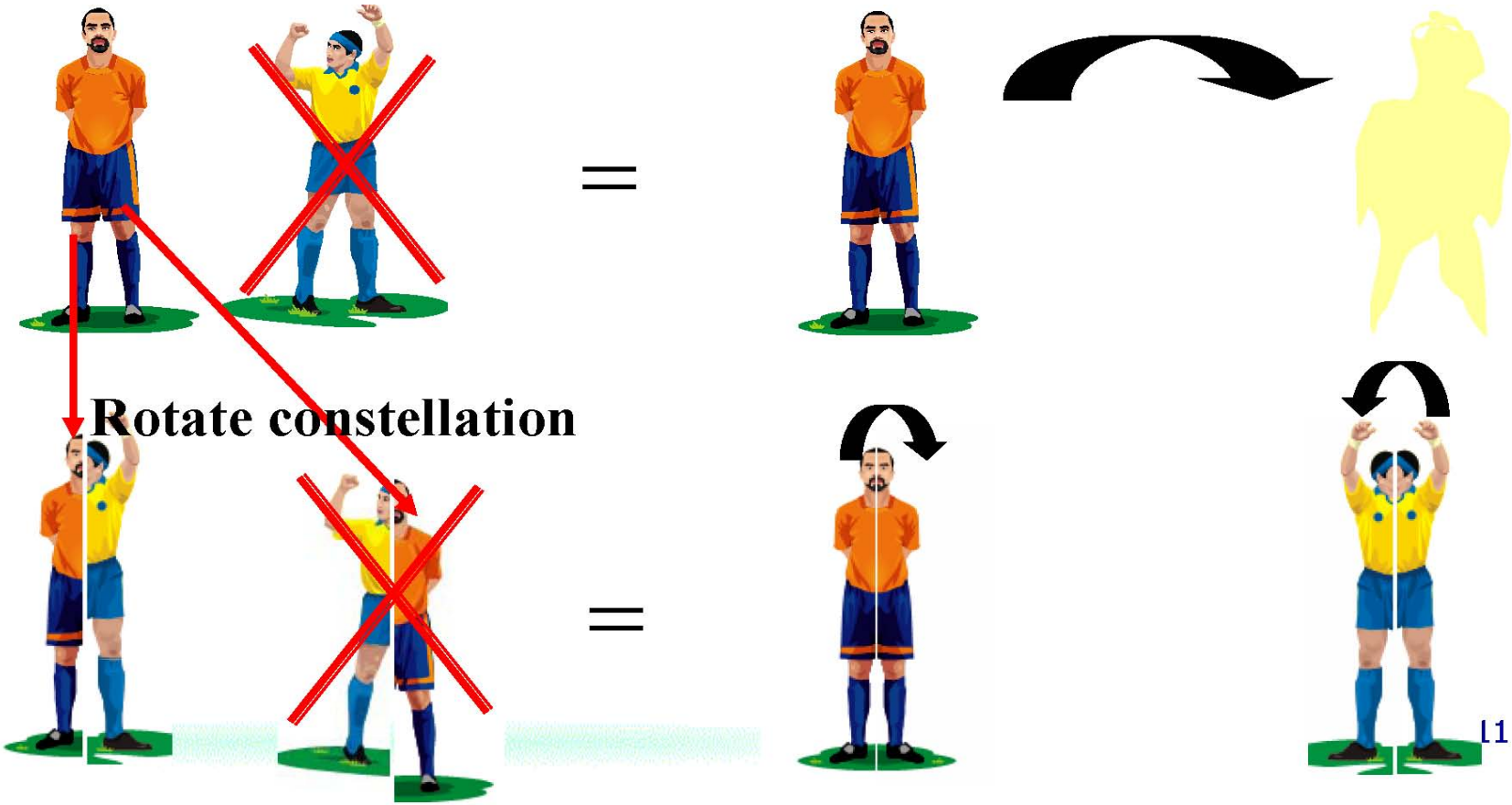
3. The I axis of a constellation is "married" with the Q axis of ANOTHER constellation (different cells)

4. Now the FEC can better reconstruct the 4 bits

# Rotated constellation (2)
# A simple example

One carrier is killed by Multipath

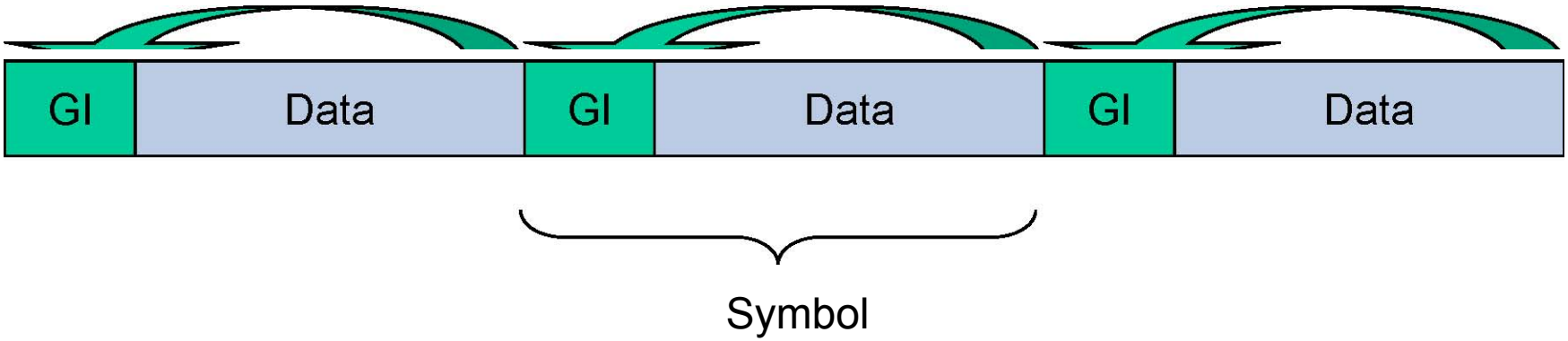
The code reconstricts the destroied info



# Key Features: Modulation (1)

T2 uses conventional Guard-Interval OFDM (GI-OFDM)

- as in DVB-T, GI "absorbs" intersymbol interference due to echoes




Each symbol carries data on a large number of separate carriers

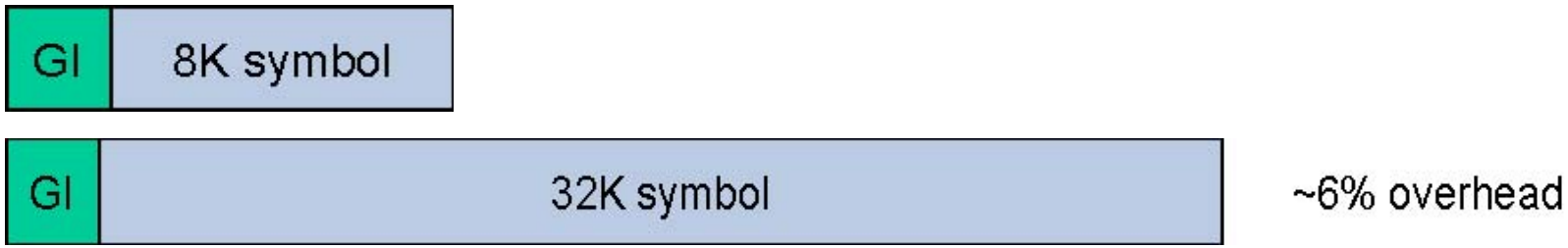
- 1K, 2K, 4K, 8K, 16K, 32K options are available in T2
  16K and 32K: to give improved SFN performance
  1K for bandwidth and frequency flexibility
- Increasing the number of carriers increases the symbol period:

(1 ms for 8K;….; 4 ms for 32K)

# Key Features: Modulation (2)

## Increasing the symbol period

- Can reduce guard interval overhead for given size of SFN
- Can increase SFN capability for a given fractional GI




T2 extends guard interval range to allow reduced overhead and additional flexibility

•GIs in T2: 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4

# MFN (SFN) Capacity estimate

## MFN (SFN) Capacity estimate

| | DVB-T | T2 |
|---|---|---|
| Modulation | 64QAM | 256QAM |
| FFT size | 2K (8K) | 32K |
| Guard Interval | 1/32 (1/4) | 1/128 (1/16) |
| FEC | 2/3 CC + 188/204 RS | 3/5 LDPC + 0.3%BCH |
| Scattered Pilots | 8% | 1% (CD3) |
| Continual Pilots | 2.6% | 0.35% |
| P1/P2 overhead | 0% | 0.7% |
| Bandwidth | Standard | Extended |
| Capacity | 24 Mbit/s<br>(19.91 Mbit/s) | 35.4Mbit/s<br>(33.3 Mbit/s) |

Capacity = DVB-T + 47% (67 % in SFN)
3-4 HDTV channels in MPEG-4 (or 12 SDTV)

# (Personal) considerations on performance

- Somebody seems to feel that T2 is somewhat "fast and dirty"
- This is simply false:

  T2 is "nearly" the best achievable design with today technology (near Shannon!!!), under the condition:

  ..don't touch my antenna
- Removing such condition, the capacity per UHF channel might be nearly doubled (use of cross-polarization).
- Is the "don't touch" condition reasonable?

  if antenna and cabling are changed... wouldn't the user complain?

  Wouldn't he go for a satellite dish???


# What's beyond HDTV?

**Ultra High Definition Television**

# The research alliance

Tokyo, 8 February 2007: Directors of BBC, IRT, NHK and Rai Research Centers signing a research collaboration agreement, witnessed by EBU

# What's UHDTV?

## Ultra-High Definition TV

Technology under development by NHK, under the name

**SHV (Super Hi Vision)**

for a future broadcast with **high sensation of reality**

- **16 times more pixels than conventional HDTV**

  Resolution of 7,680 × 4,320 pixels = about 33 millions pixel per frame

* four times as wide and four times as high as existing HDTV, which has a maximum resolution of 1920 × 1080 pixels.

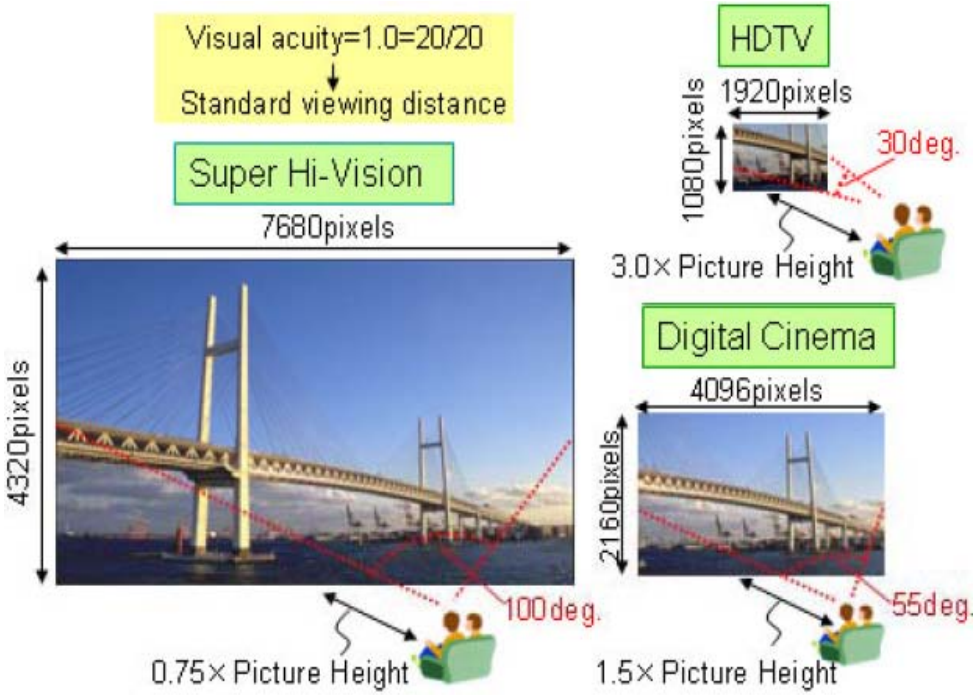
  Standard horizontal viewing angle, for an invisible pixel: 100°

* With HDTV it was 30°

- 22.2 multichannel sound

  The new 3-D audio system with 24 loudspeakersdramatically enhances presence

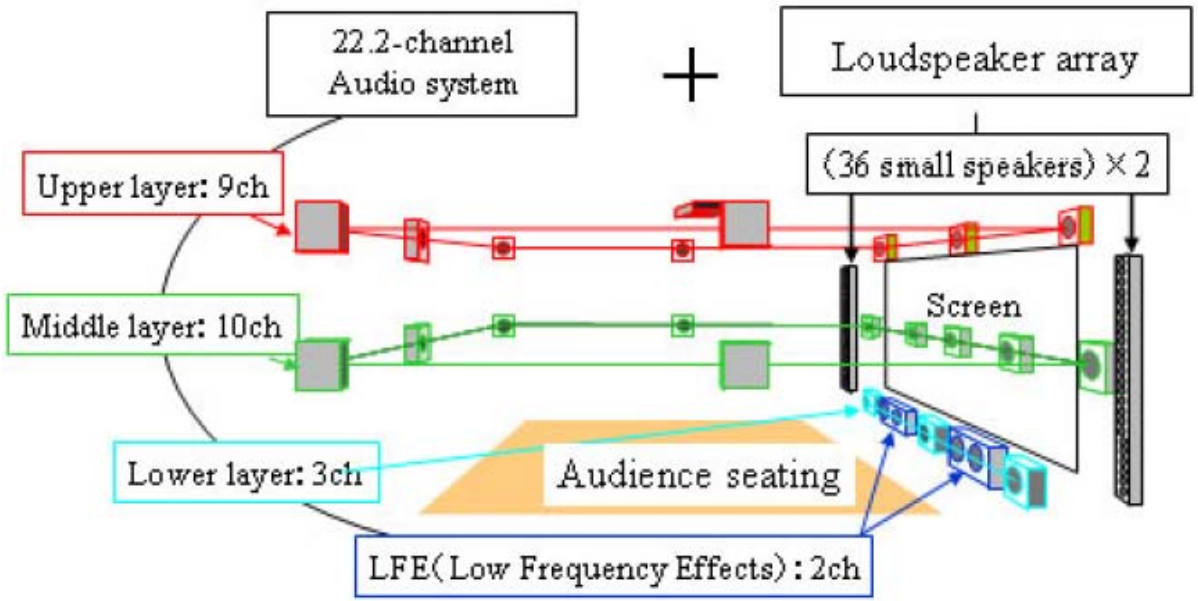
# Image format of SHV




*The individual scanning lines are not visually noticeable even when relatively close to the screen, reflecting the high resolution of the system.*

A **angle wider viewing** conveys a stronger reality sense of reality.

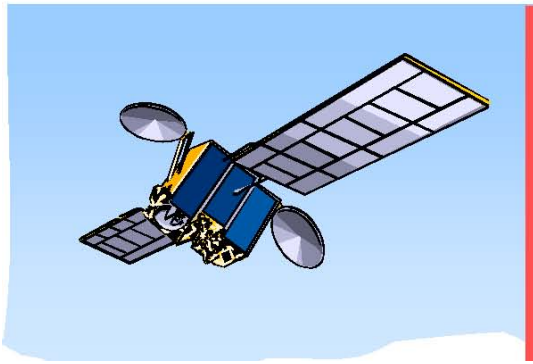
# Audio system configuration




3 vertical layers of loudspeakers to produce **three - dimensional sound**

# How SHV can be broadcast?

## Satellite configuration

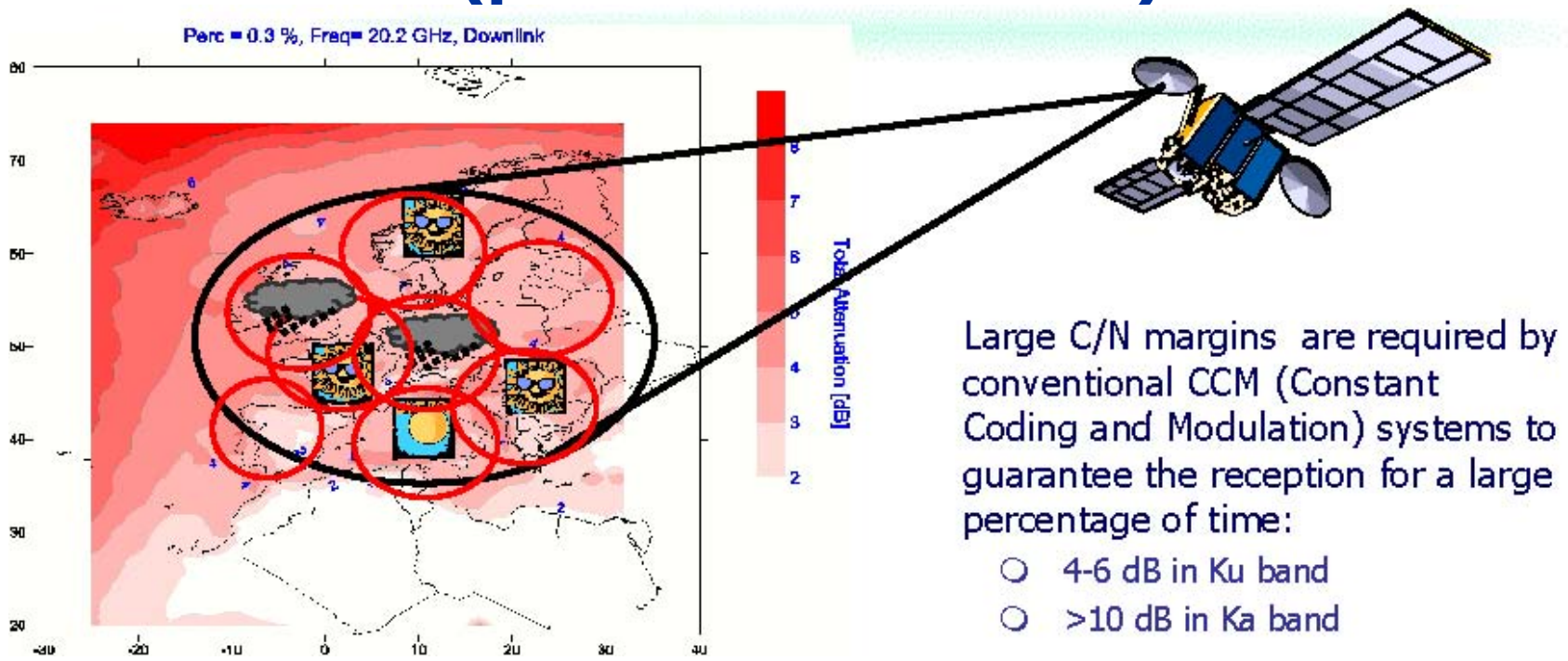


Estimated Bit rate requirements
MPEG-4 AVC compression:
1x HDTV requires 10 Mbps
SHV=16x HDTV would require ~160 Mbps

72 MHz transponder, bit-rate 150 Mbps
DVB-S2 configuration 8PSK 5/6, 60 Mbaud, 20% roll-off
Satellite Transponder operated near the saturation
Required SNR at the receiver of about 10-11 dB

**Ku band is good for propagation, but it is heavily exploited**
**Can Ka band (around 20 GHz) assigned to broadcast services in Torremolinos 1996 be used?**

# Ka band: heavy rain attenuations (peaks of > > 10 dB)




Large C/N margins are required by conventional CCM (Constant Coding and Modulation) systems to guarantee the reception for a large percentage of time:

- 4-6 dB in Ku band
- >10 dB in Ka band

***Dynamic Multi-spot coverage: the satellite power is dynamically concentrated on rainy spots***

DVB-S2/ACM ( Adaptive Coding and Modulation) can reduce the bit-rate when a spot is affected by rain

# How can we broadcast SHV?

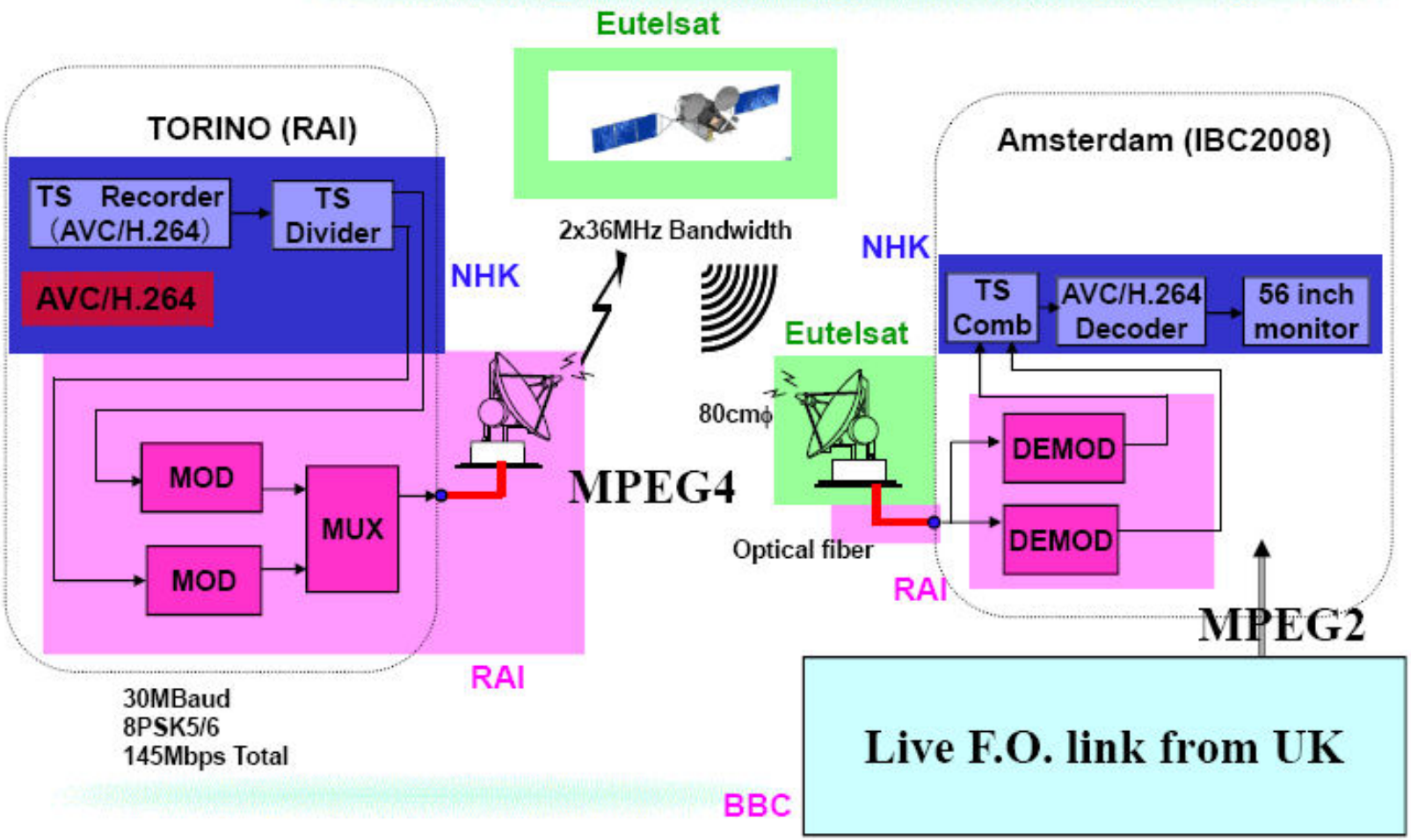
*Terrestrial channel*

Estimated Bit rate requirements:
MPEG-4 AVC
TS of about 160 Mbit/s

The terrestrial scenario is more difficult for the high bit rates of UHDTV

- DVB-T2 configuration 256QAM 3/5: capacity 33-35 Mbit/s
- SHV would require simultaneous use of **4-5 UHF channels**
- Unless new compression algorithms are developed beyond MPEG4, SHV over terrestrial channels is critical
- Perhaps broadband over Next Generation Networks (FTTH) may be a more suitable delivery media

# SHV Satellite Transmission @ IBC2008



# Conclusions: the future of high quality broadcasting

DVB-S2 and DVB-T2 are the future standards for HDTV

Quality in broadcasting may evolve in the future years beyond HDTV, but in which direction?

- increased resolution (SHV).
  - But are our homes large enough for a 2-3 m screen?
- increased frame rate
  - better quality for sport, fast motion,...
- 3D television for a definite immersive experience
  - driven by play-station technologies


Thank you for your attention