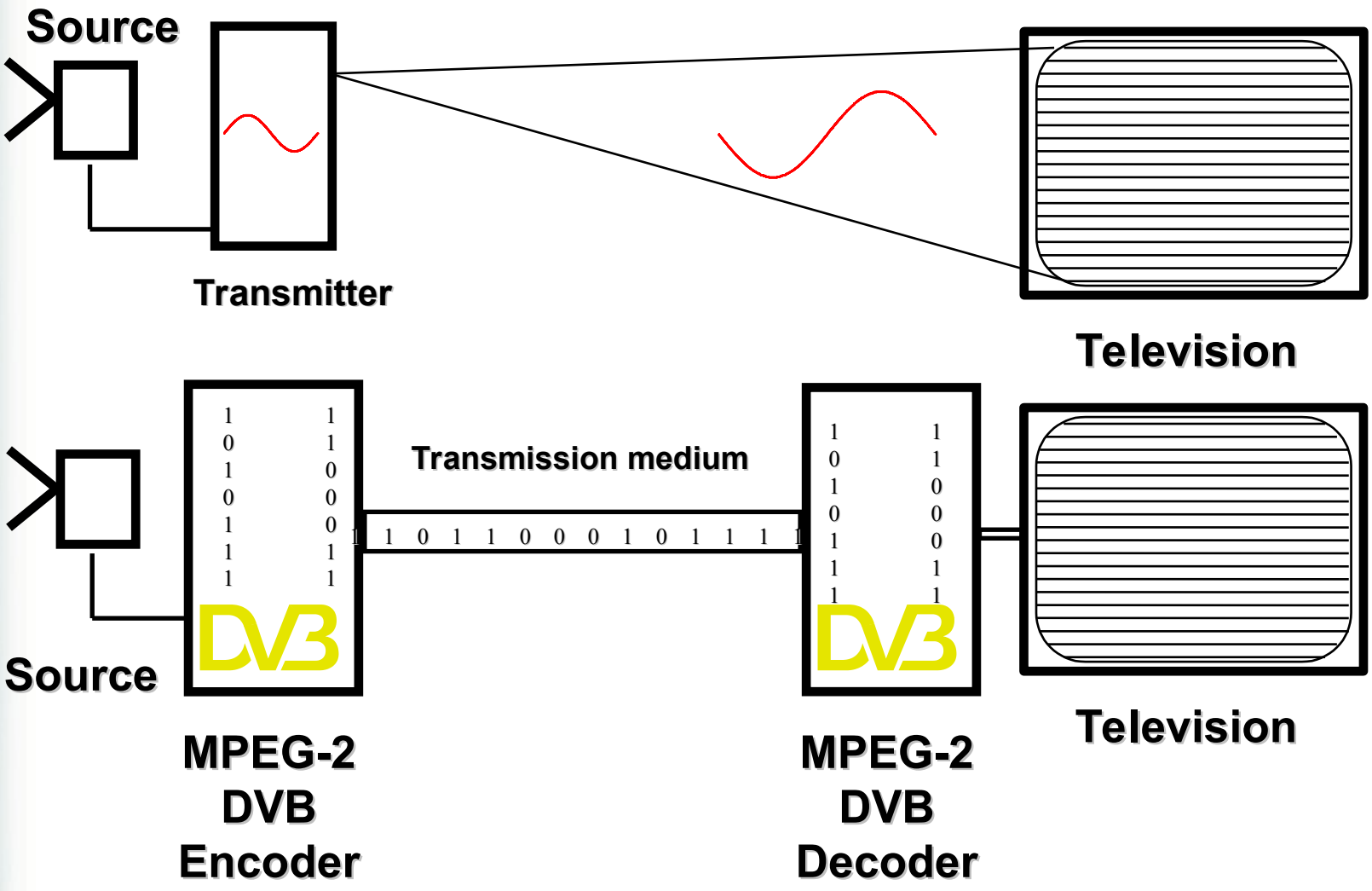
technical overview

http://www.dvb.org

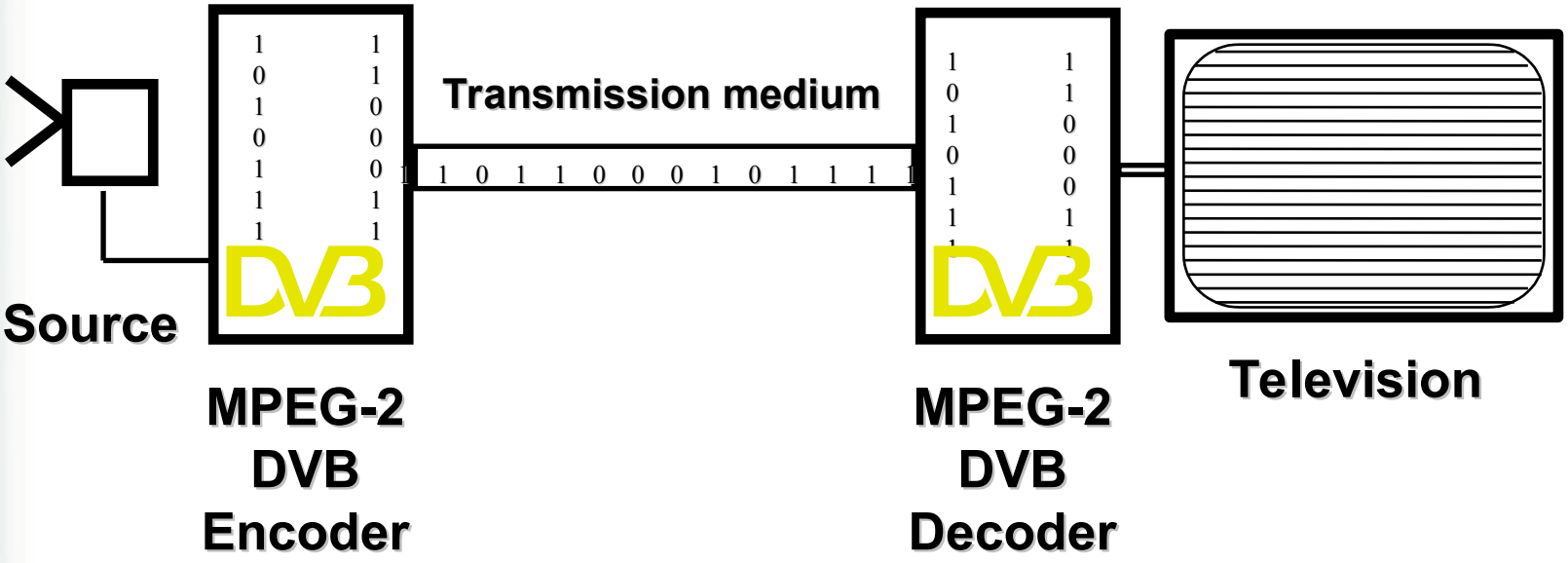
Digital vs Analogue TV



Why is Digital TV different?

- Digital TV squeezes the information that the viewer can't see or hear out of a standard analogue TV
- DVB uses:
  - Video compression - MPEG-2
  - Audio compression - MPEG Layer II
- That means you can fit much more TV into the same channel capacity as analogue TV
  - A satellite transponder using DVB can contain 6-8 times more TV programmes than analogue TV
- DVB is also completely digital, opening up the world of EPGs, Internet, data broadcasting, advanced interactive TV ……..

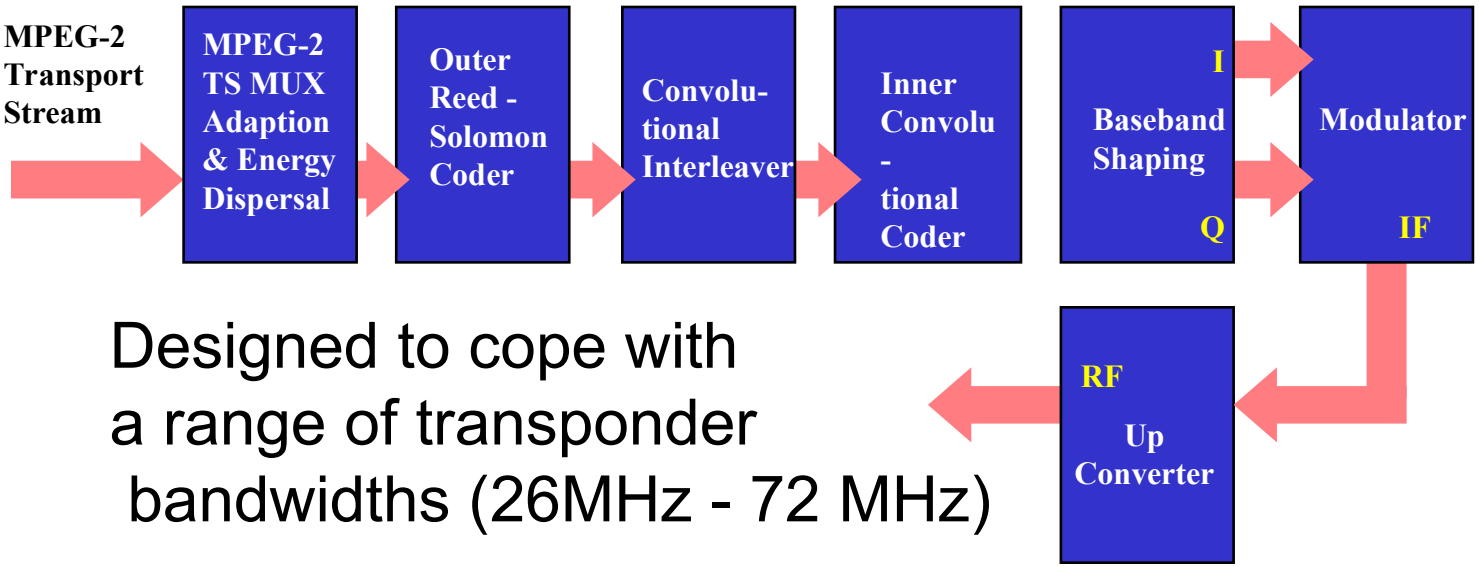
The DVB System



- Source video compressed
- Source audio compressed
- Data information prepared
- Video, Audio and Data streams multiplexed

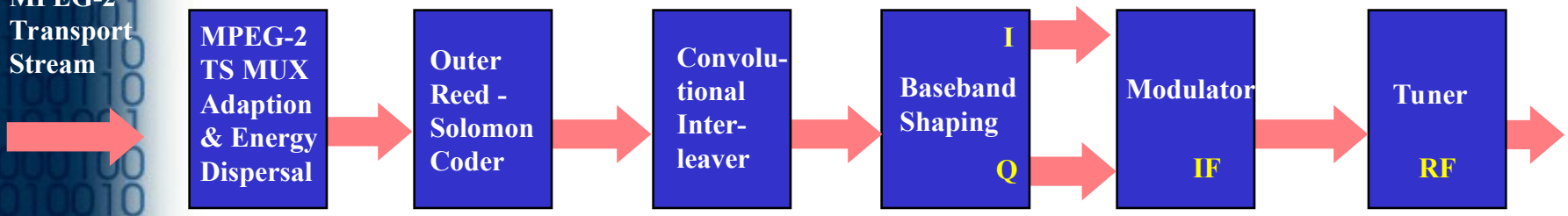
- Transmission by cable / satellite / MMDS / terrestrial
- Demultiplexing
- Decoding
- View on TV

DVB-S Satellite Transmission



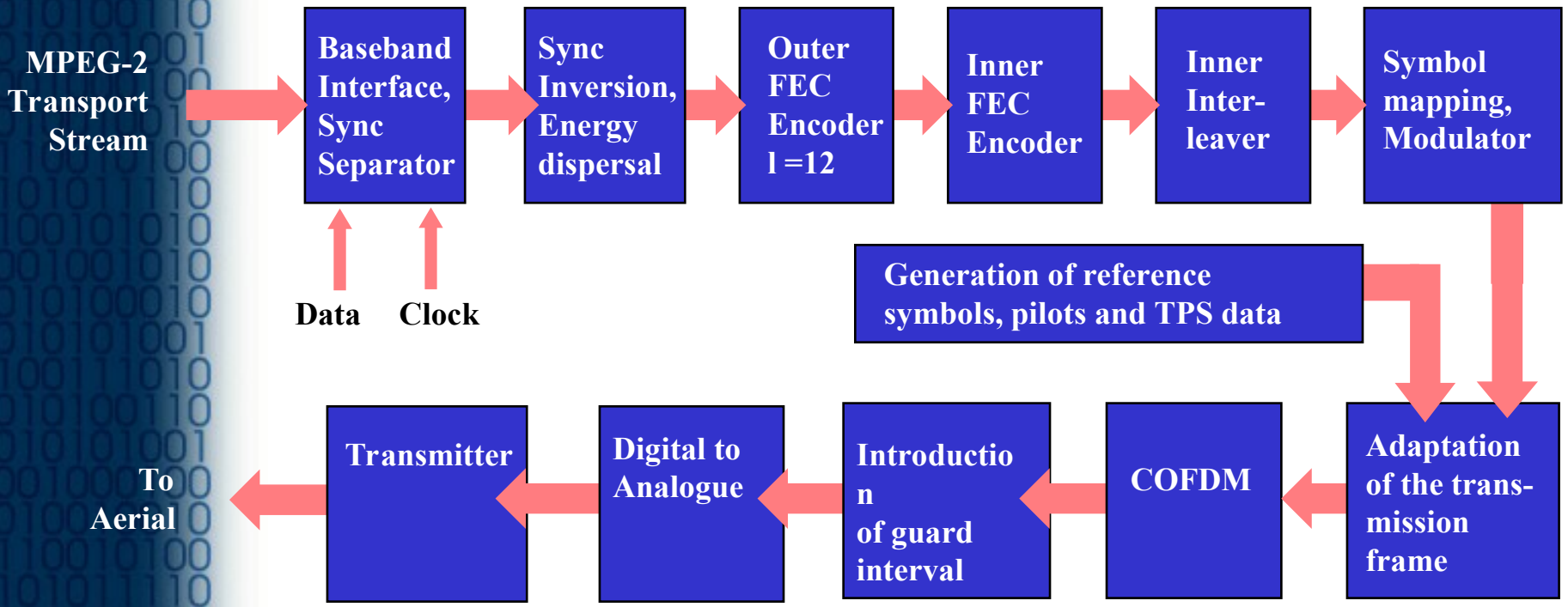
- Designed to cope with a range of transponder bandwidths (26MHz - 72 MHz)
- Single carrier system
- DVB-S is like an onion:
  - centre: payload
  - series of layers to ensure error protection
  - adapt the payload for broadcasting implemented satellite chain

DVB-C Cable Transmission



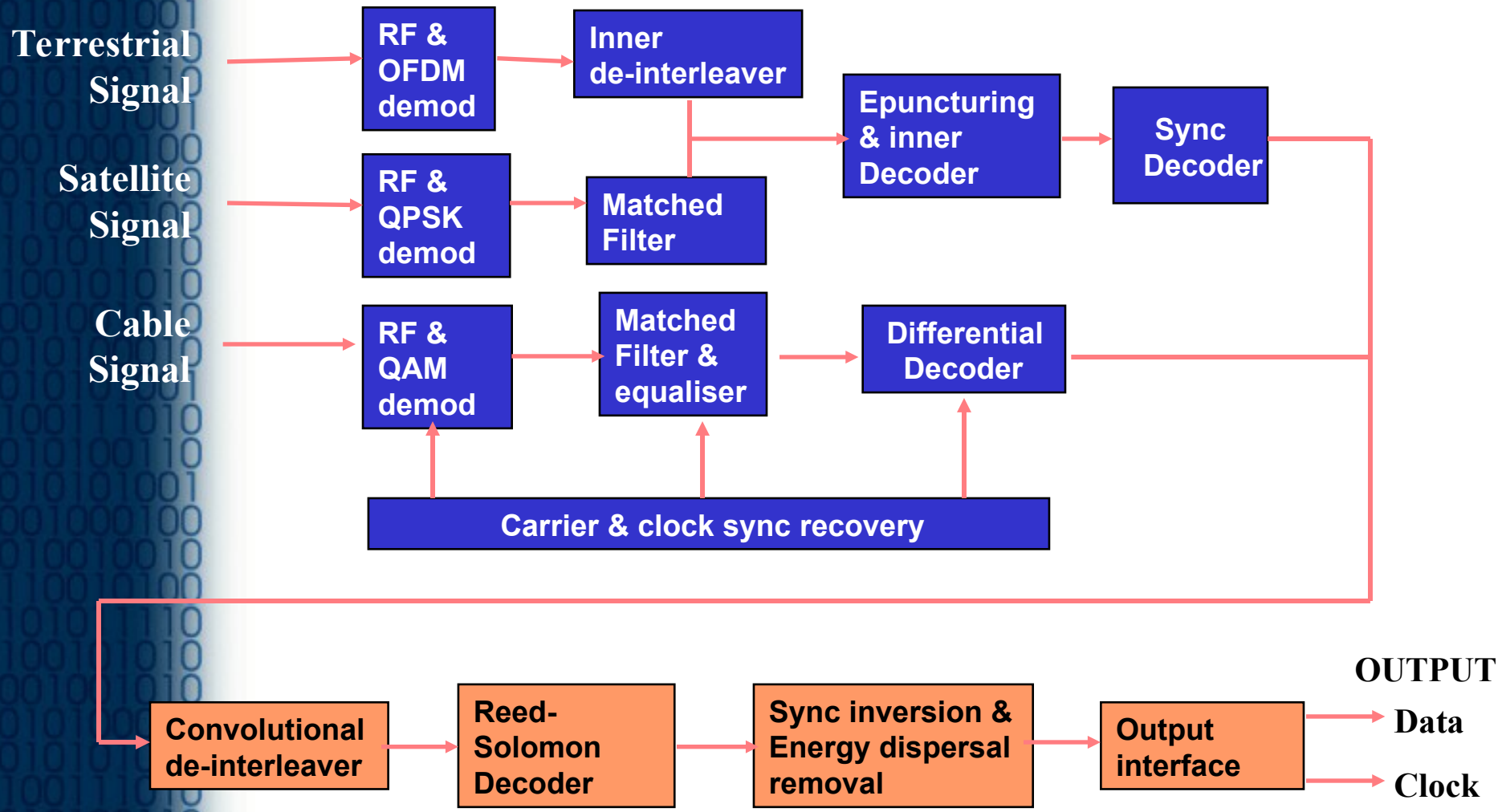
- Same core as satellite system to facilitate interworking
- No inner convolutional code
- System based around 64 QAM, but higher and lower order systems possible
- 8MHz channel, with 64 QAM can accommodate about 38.5 Mbits/s

DVB-T terrestrial transmission

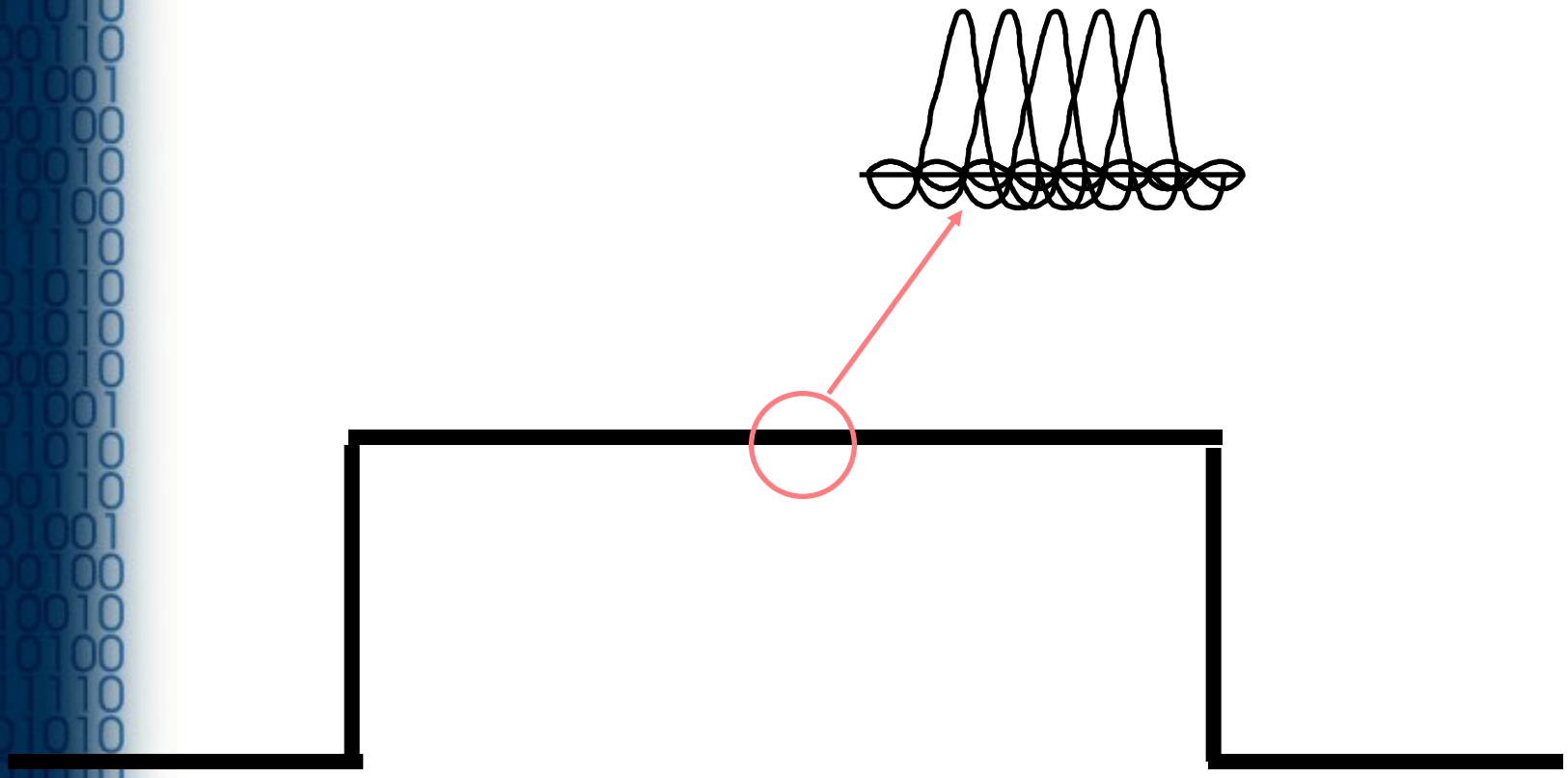


(without hierarchical modulation)

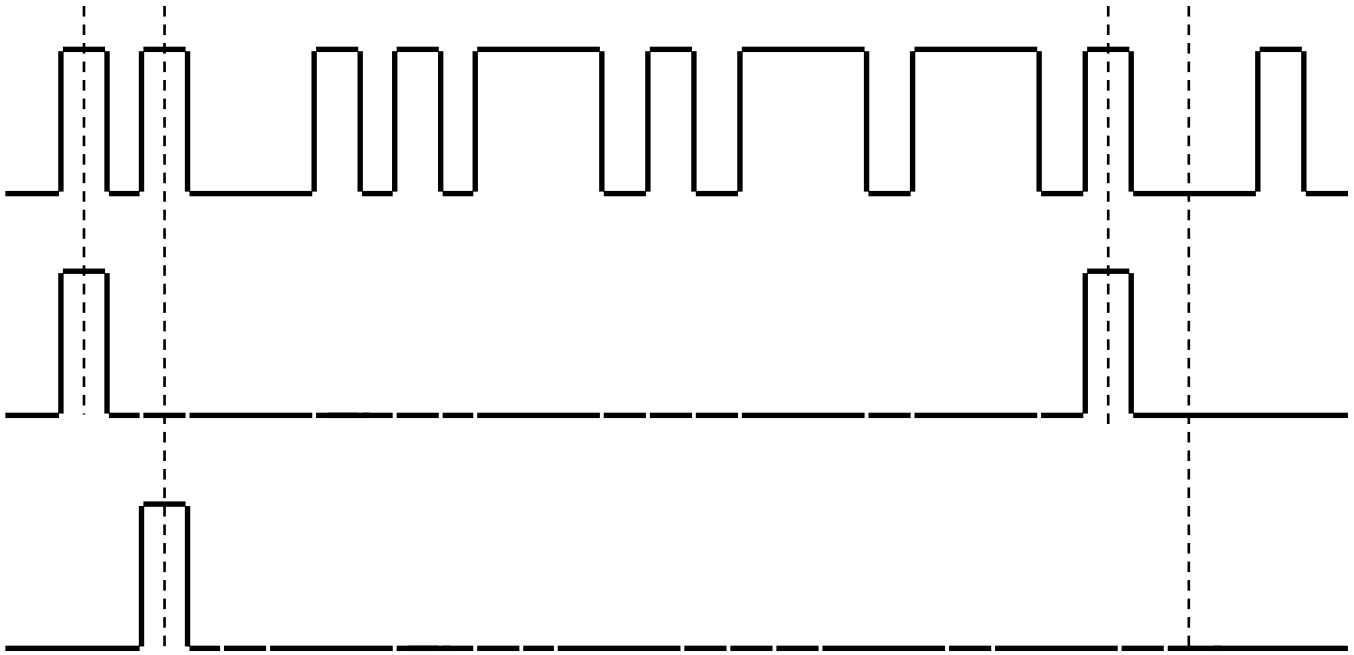
Common circuitry in the DVB Receiver



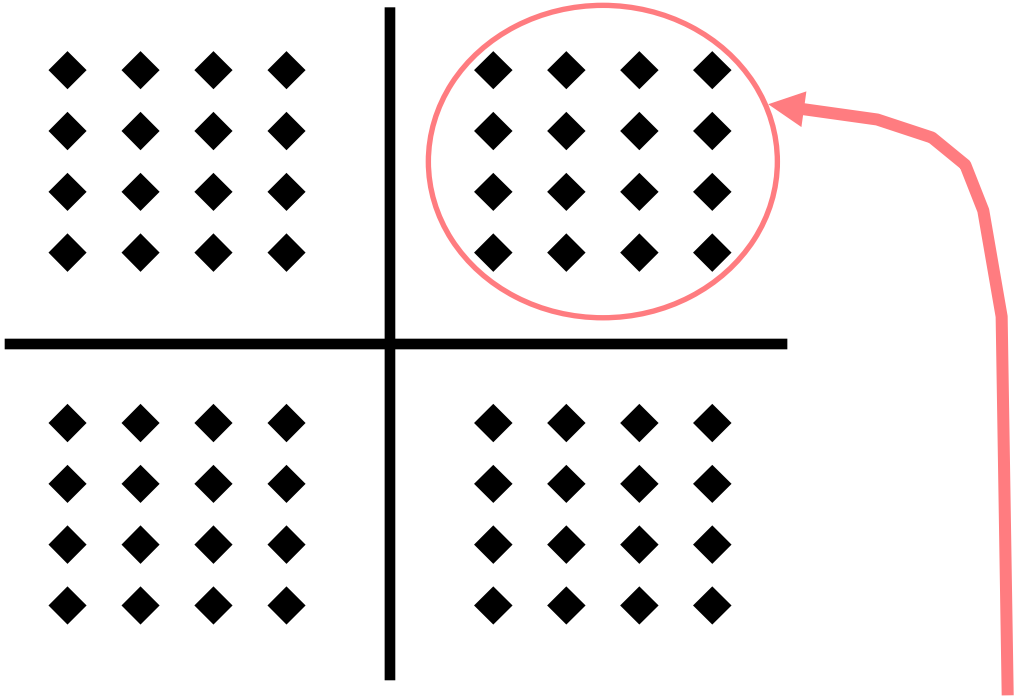
The COFDM signal



Separation of data streams



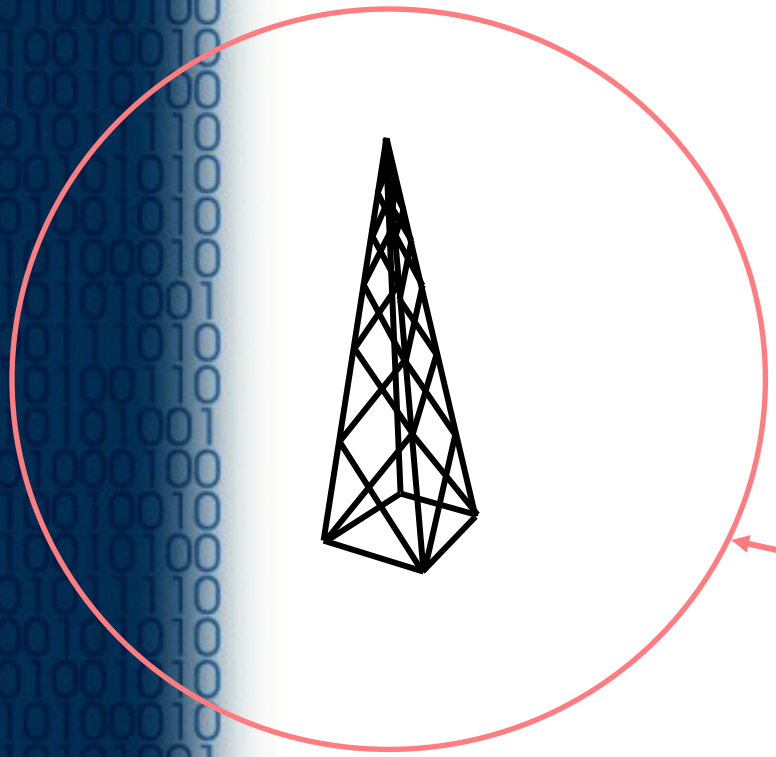
Multi-resolution QAM



When reception conditions and C/N degrade, 16 points of the constellation of the 64 QAM can be used as one point in a QPSK constellation

DVB-T 8k non-hierarchical modulation

Useful data rate: 24.88 Mbit/s in a data container defined by 8MHz channel B/W and 64-QAM modulation



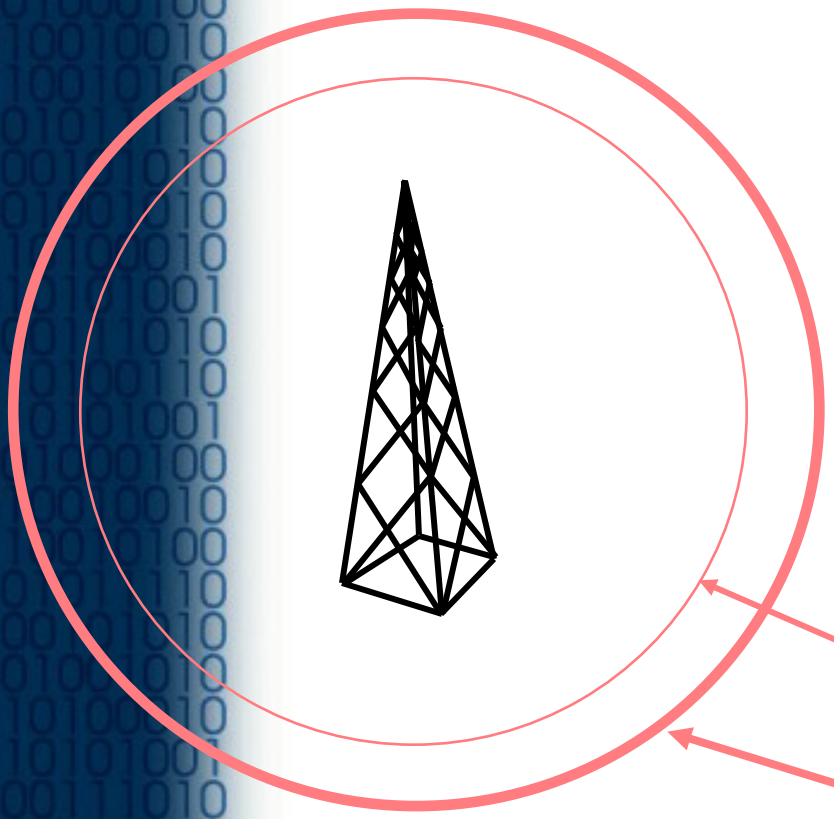
- Programme 1
- Programme 2
- Programme 3
- Programme 4

code rates for inner FEC : 5/6

C/N needed at edge of coverage typically 20 dB (Ricean channel)

DVB-T 8k (hierarchical modulation)

Useful data rate: 21.57 Mbit/s within a data container of two levels of robustness



Programme 1

Programme 2

Programme 3

Baseline Programme 4

64 QAM for ‘fragile’ part
16.59 Mbit/s

QPSK for ‘robust’ part
4.98 Mbit/s

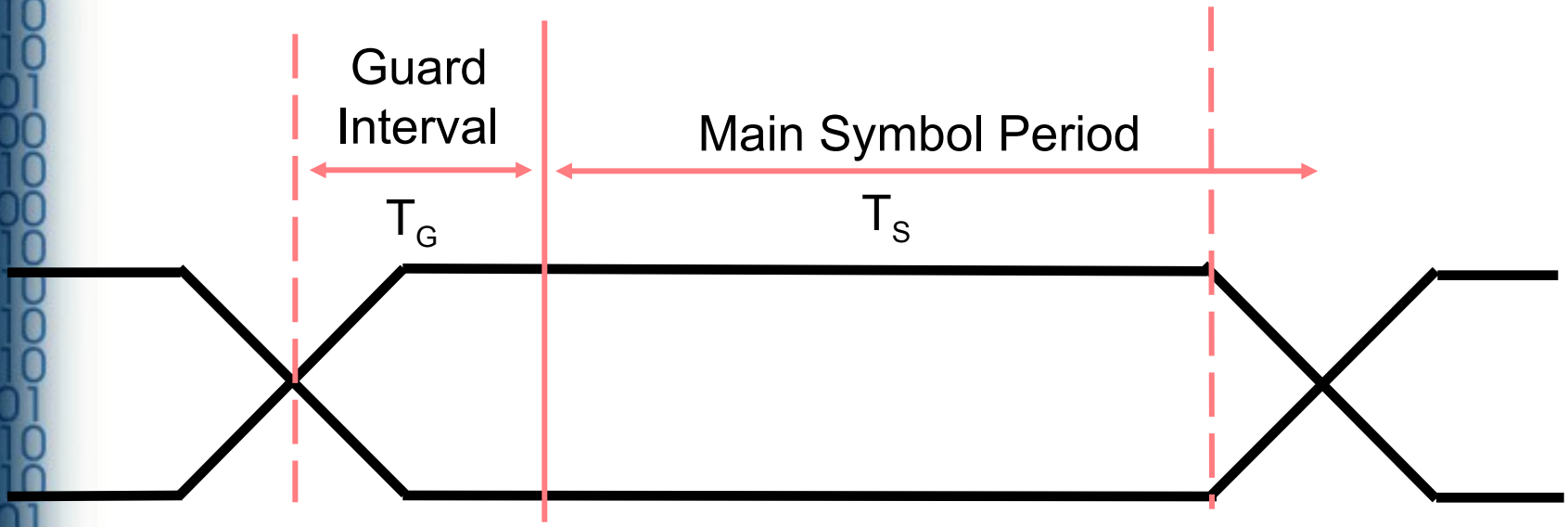
With multiresolution QAM used
code rates for inner FEC : 5/6, 1/2

C/N needed at edge of coverage (Ricean channel)

22.7 dB for ‘fragile’ part

7.1 dB for ‘robust’ part

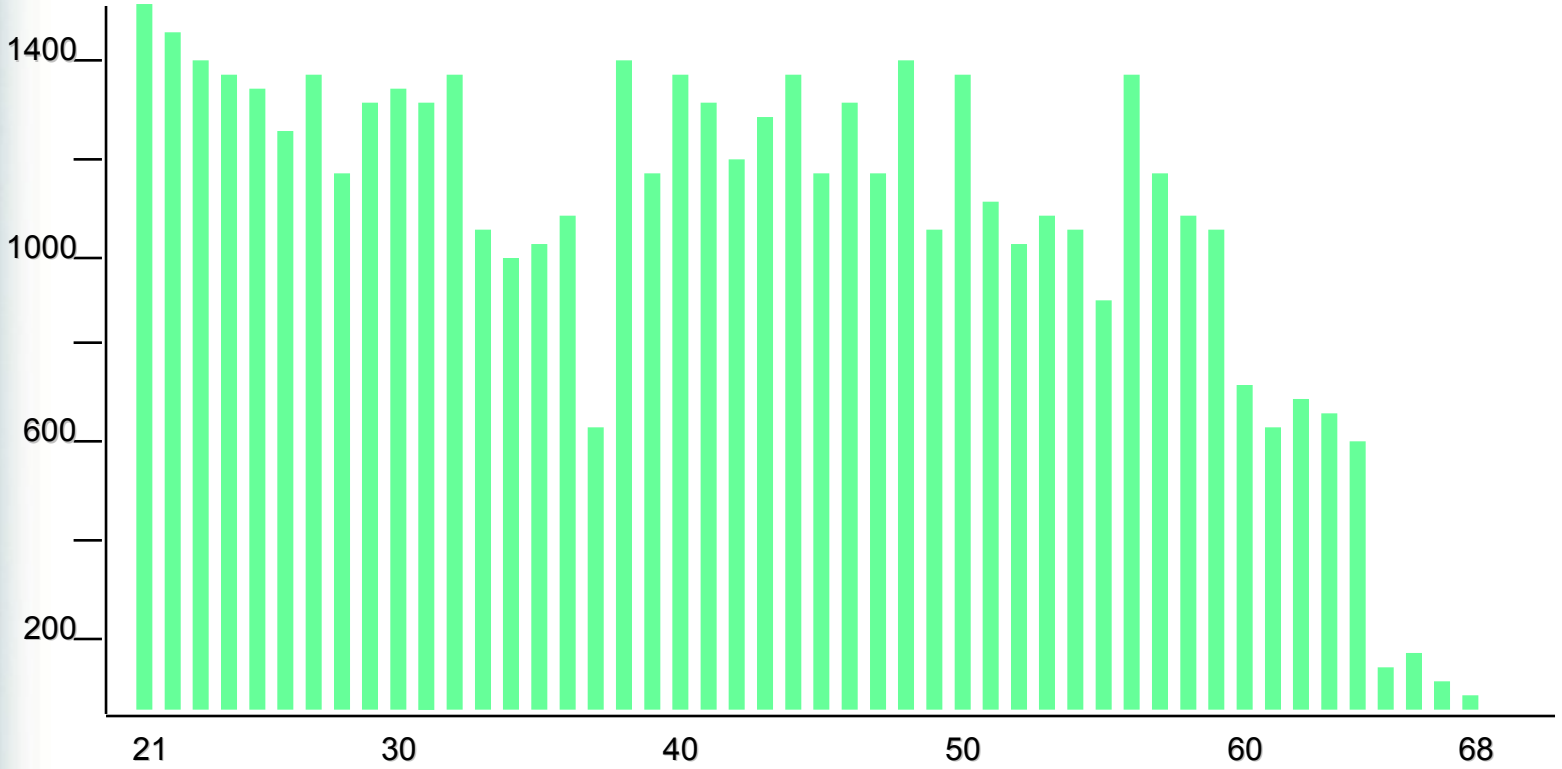
The Guard Interval



e.g. for a national service T_s = 1ms, T_G=0.25ms

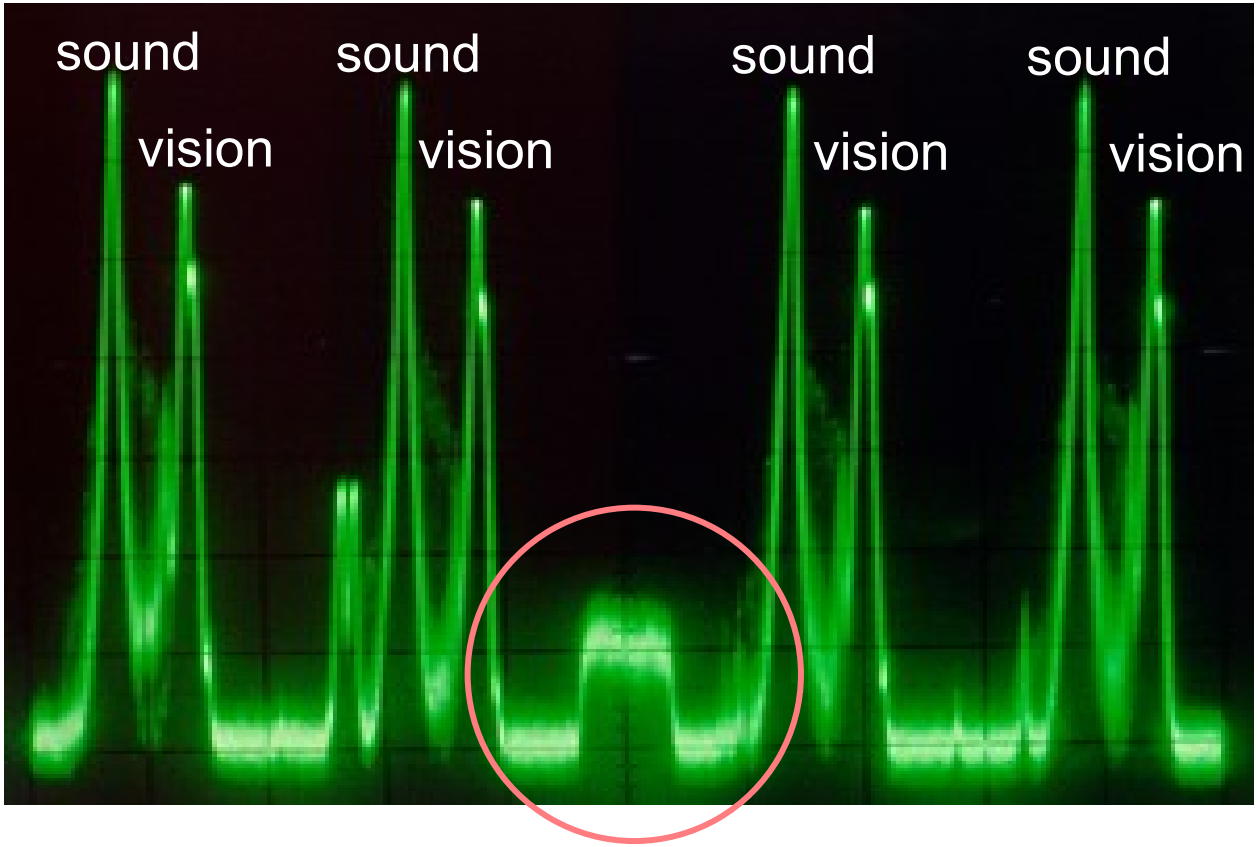
Current European UHF Spectrum usage

Number of transmitters per UHF channel



Implementation Scenario

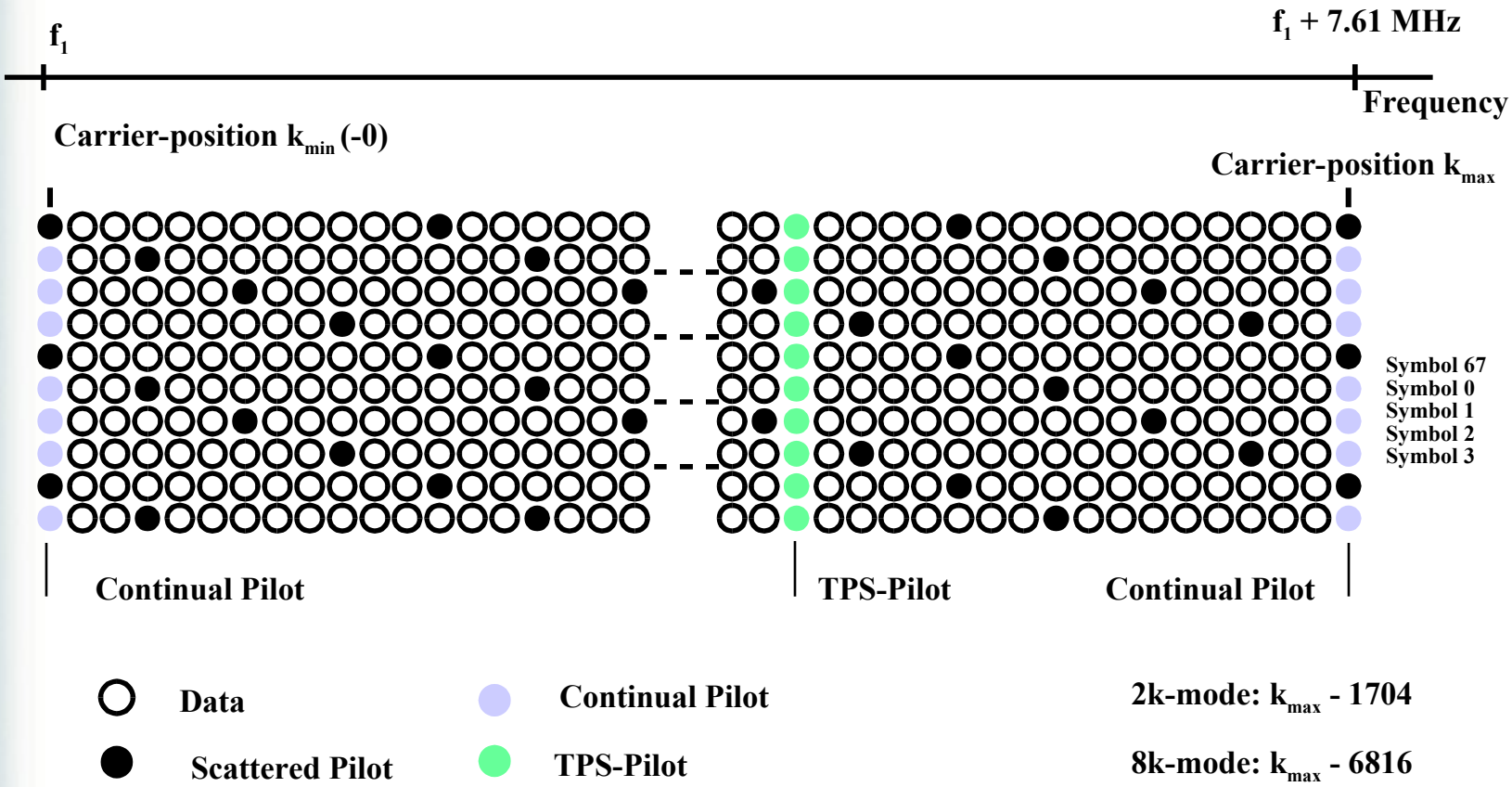
- OFDM DVB-T signal fits between existing analogue UHF carriers



DVB-T: key features

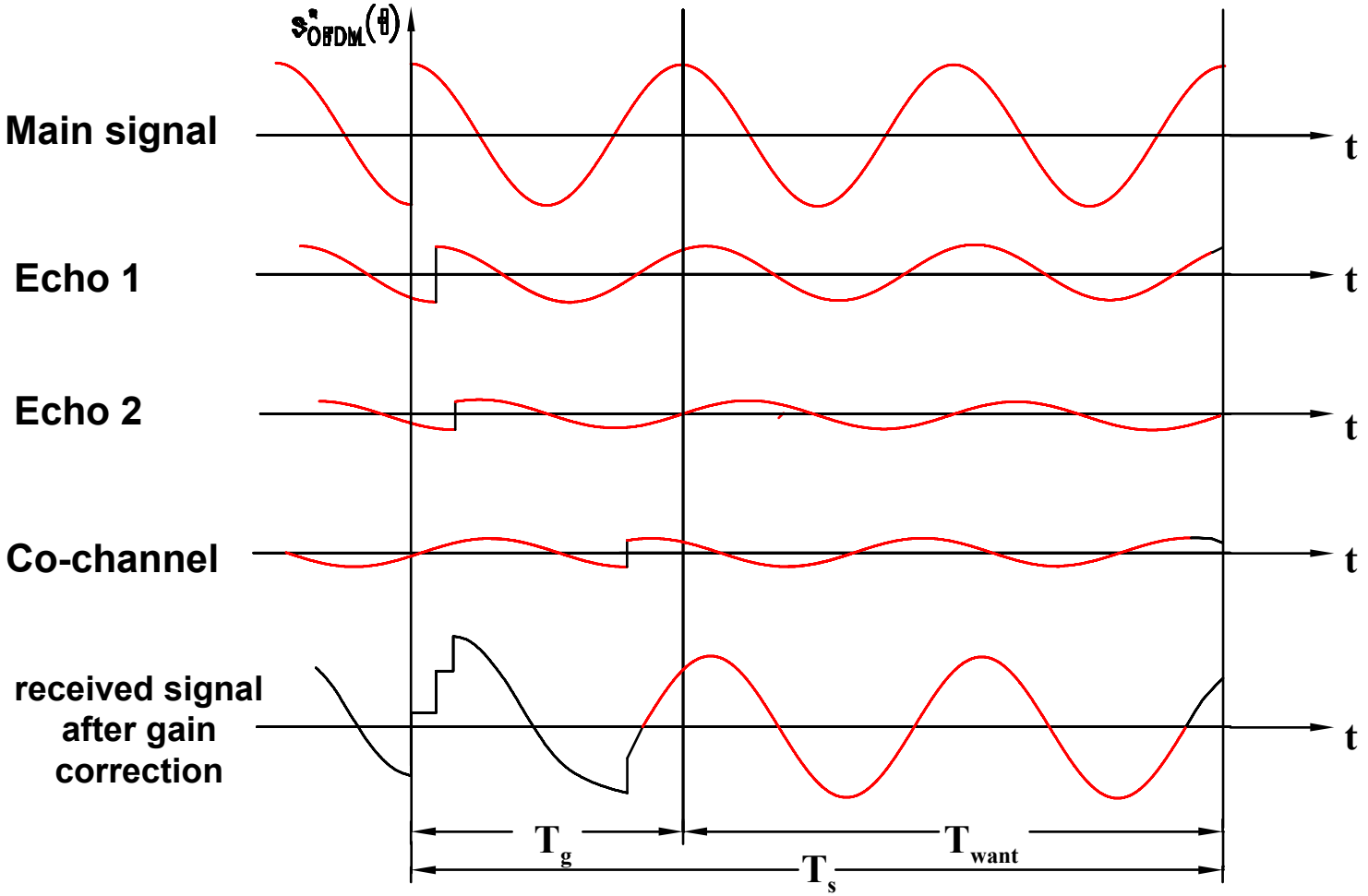
- Same core as DVB-S and DVB-C systems
- DVB-S punctured convolutional coding
- OFDM based QPSK or QAM modulation very rugged against multipath fading
- DVB-T offers a “2k” or and “8k” OFDM option
- Two level hierarchical channel coding and modulation possible
- Hierarchical MPEG-2 source coding not included
- Possibility of national or regional signal frequency networks.

Transmission frame for DVB-T

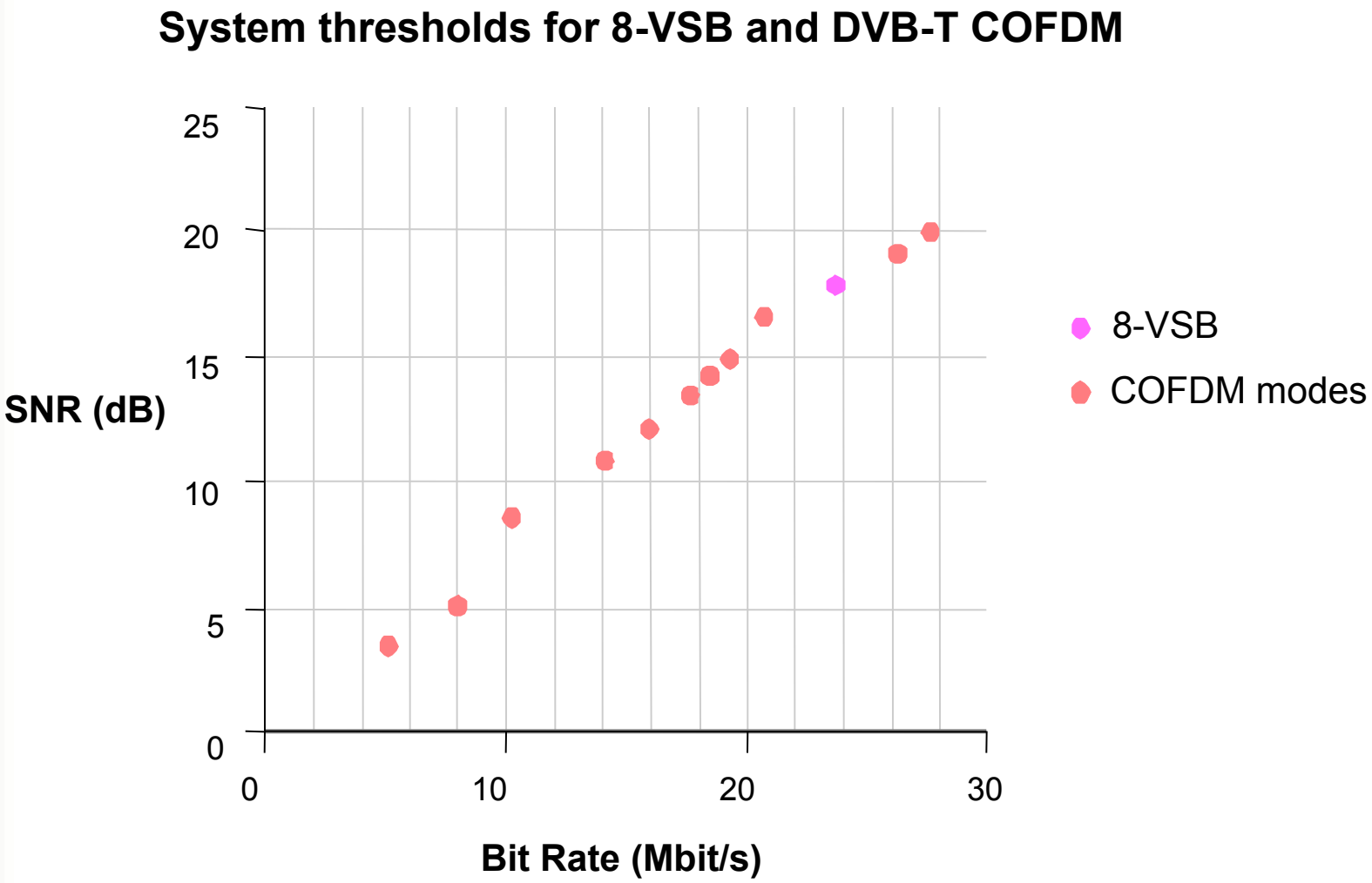


Carrier spacing in 2k-mode - 4464 Hz, in 8k-mode - 1116 Hz

The DVB-T Guard Interval



COFDM offers variable bit-rate



Digital TV is different!

Compared with analogue:

- digital TV requires less C/N
- digital TV is more tolerant of interference

BUT

- digital systems fail more abruptly

Clearly, expect to use new strategies in frequency planning

DVB-T offers choice of strategies

- COFDM in DVB-T tolerates multipath (echoes)
- COFDM can also tolerate ‘artificial multipath’ of a single-frequency network (SFN)
  - new concept in spectrum planning
  - spectrally-efficient in right circumstances
- multi-frequency networks (MFNs)
  - can interleave channels amongst analogue

Choosing a strategy

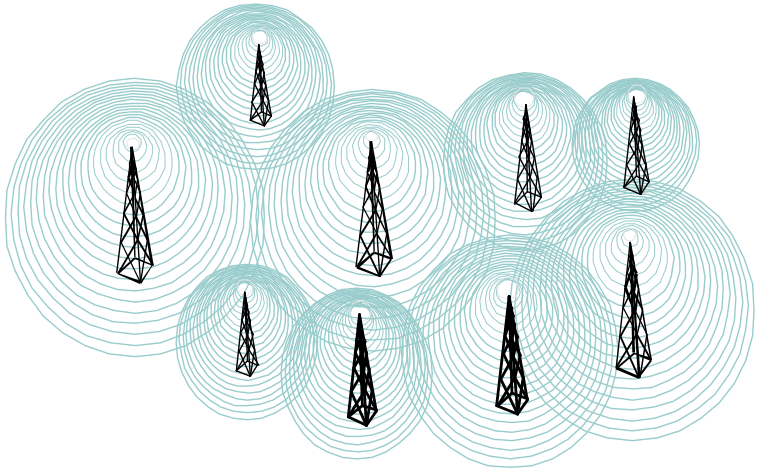
Every country has its own scenario ...

- different history of broadcasting TV
- different aspirations for the new digital service
- different existing spectrum usage
- different future spectrum availability
- different neighbours

... so each country must find its best solution

Single-frequency networks

- SFNs can offer improved spectrum efficiency
  - examples for DAB, DVB-T
- SFN requires an RF channel free over whole service area of network
  - reason why not chosen for UK DVB-T
- best results with a dense network of lower-power transmitters



Conclusions (i)

- planning digital TV services is different from analogue TV
- countries have different requirements
- DVB-T permits choice of planning methods
  - single-frequency networks (SFNs)
  - multi-frequency networks (MFNs)

  thus uniquely able to satisfy different needs of all countries

Conclusions (ii)

- SFNs can give greater spectrum efficiency
- MFNs can be interleaved amongst analogue
- European administrations have done a great deal of work to enable DVB-T introduction
- DVB-T is being introduced in Europe
  - firm plans in place in UK and Sweden for 1998
  - other countries will follow