Digital Satellite Broadcasting and HDTV Services in Japan

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History of Satellite Broadcasting in Japan

May 1984: NHK started experimental broadcasting using BS-2a.

Jun. 1989: NHK started regular service(NTSC) and experimental HDTV broadcasting using BS-2b.

Apr. 1991: BS-3 was in use. JSB started pay TV service.

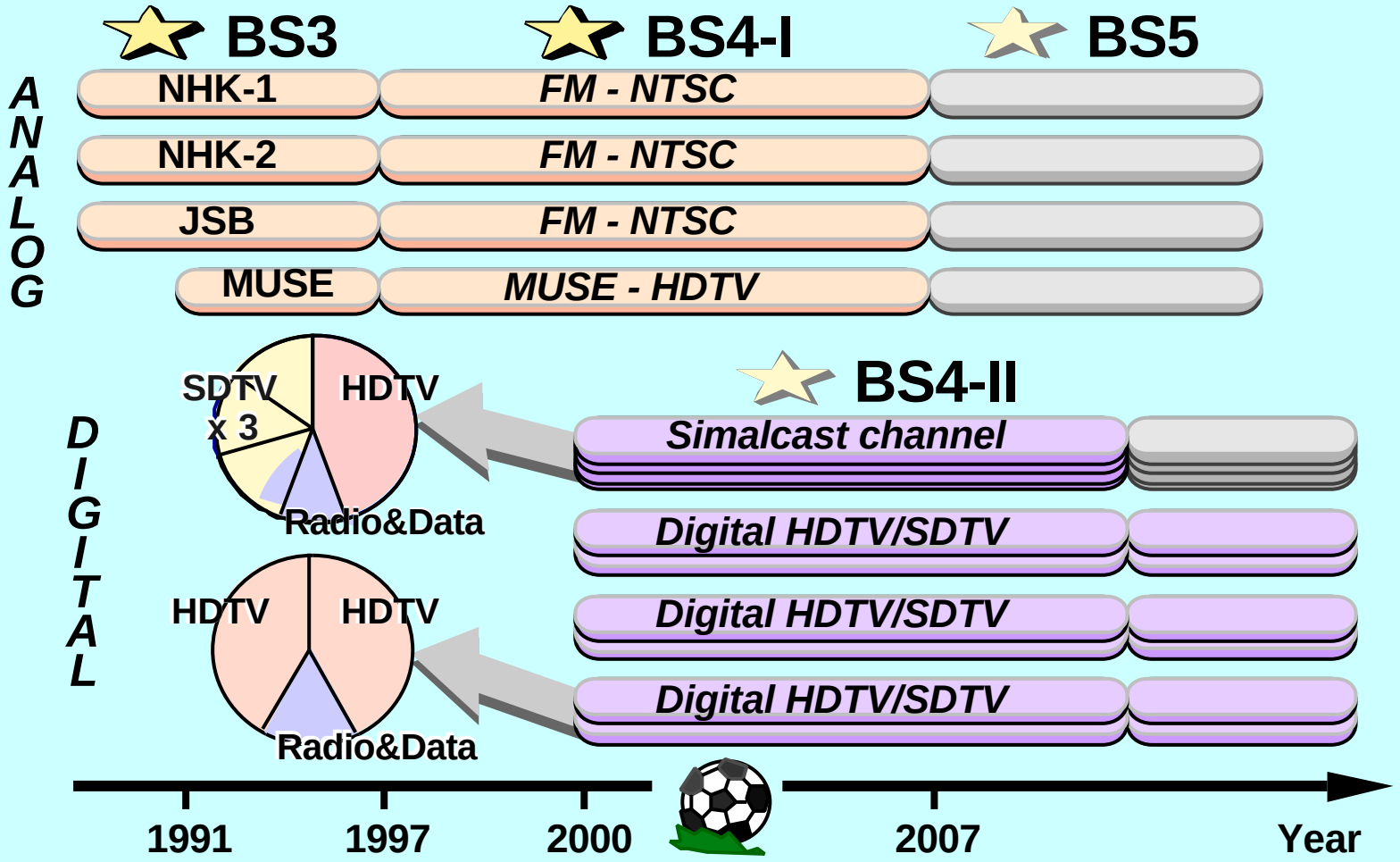
Mar. 1996: Number of households that receive satellite broadcasting exceeded 10 million.

Aug. 1997: BS-3 was replaced by BS4-1.

Mar. 2000: Number of households that receive satellite broadcasting reached 14 million.

Dec. 2000: Launch of digital satellite broadcasting using ISDB-S.

Outline Scenario for Digital Satellite Broadcasting



Features of ISDB-S

- Large transmission capacity
  - two HDTV programs in one satellite channel
- Hierarchical modulation
  - minimum service available during heavy rain
- Operational flexibility
  - mixed transmission of HDTV and SDTV
  - independence between broadcasters who share one transponder
- Extensibility
  - EPG, data broadcasting, downloading, etc.

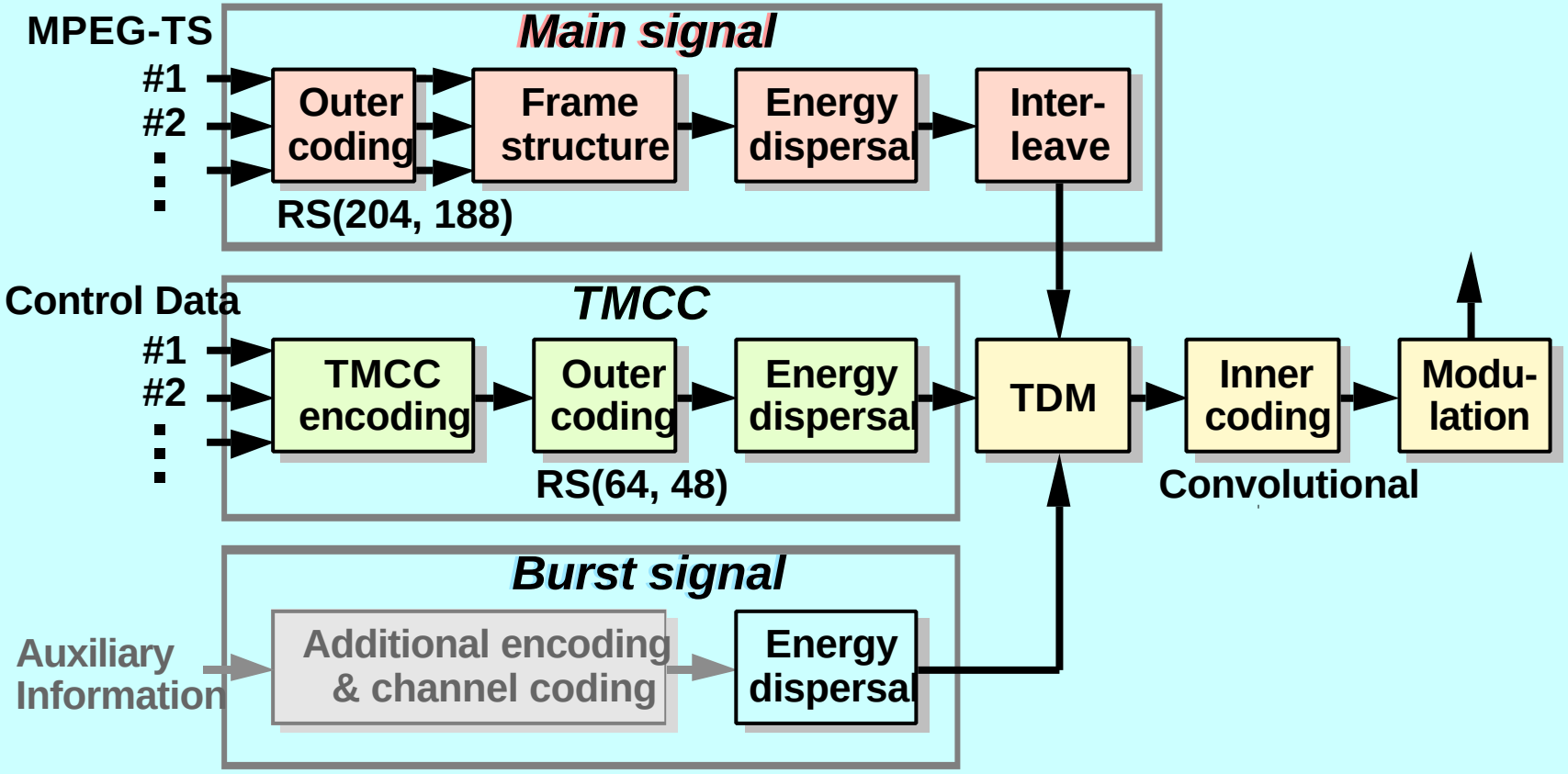
Summary of the system characteristics

Modulation scheme	**TC8PSK/QPSK/BPSK**
Raised cosine roll-off factor	**0.35（ square root）**
Transmission symbol rate	**28.86 Mbaud**
Video coding	**MPEG-2** **MP@HL for 1080i** **MP@ML for 480i** **MP@H14 for 480p**
Audio coding	**MPEG-2 AAC**
FEC (Outer code)	**Reed-Solomon (204,188)**
FEC (Inner code)	**Convolutional (constraint length k=7)**
Inner code ratio	**1/2 for BPSK** **1/2, 2/3,3/4, 5/6, 7/8 for QPSK** **2/3 for TC8PSK**
Transport Layer	**MPEG-2 systems**
Packet size	**188 bytes**

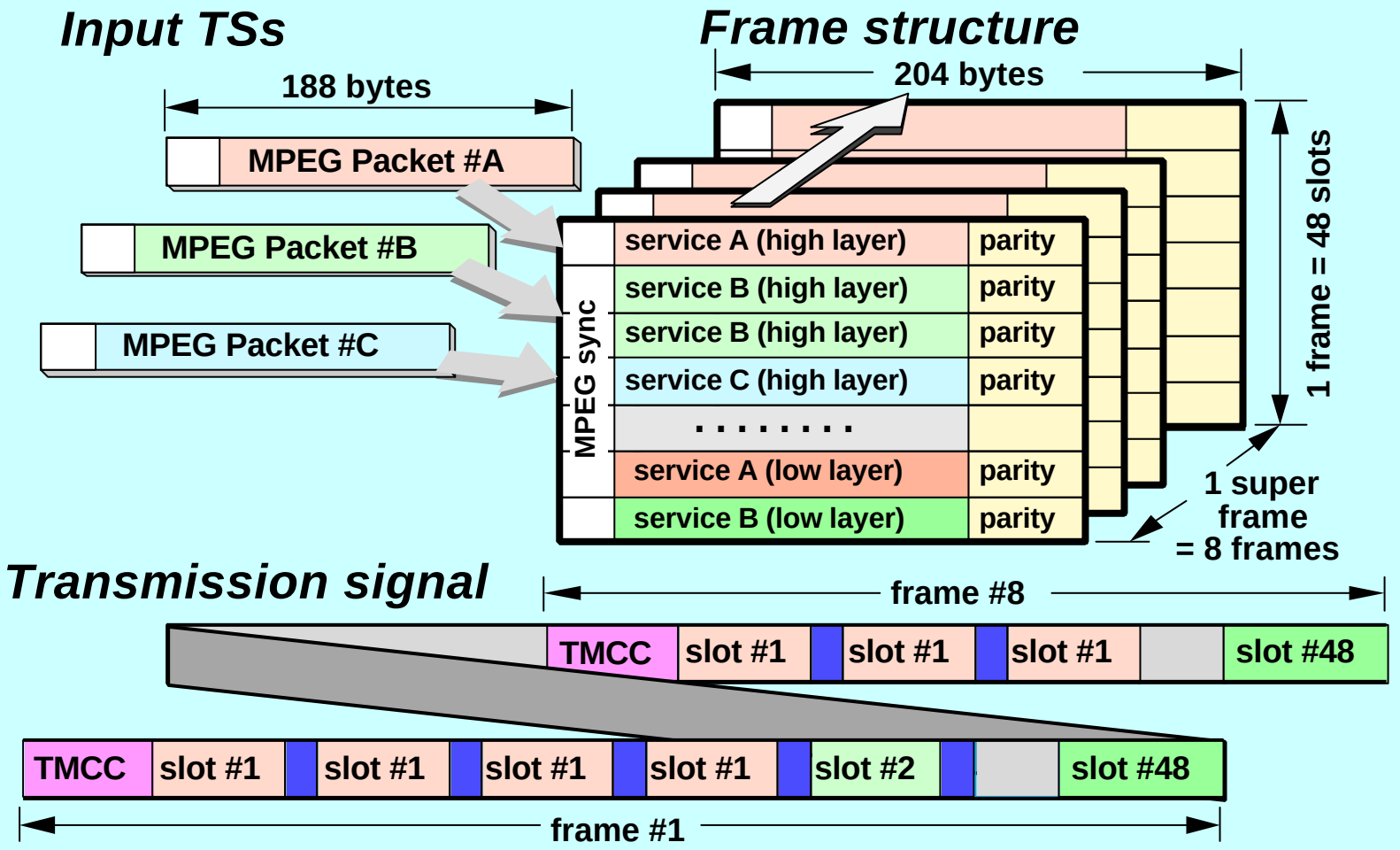
RF Bandwidth
34.5 MHz

Payload Bit Rate
52 Mbps (max.)

Block Diagram of Channel Coding



Frame Structure and Transmission Signal



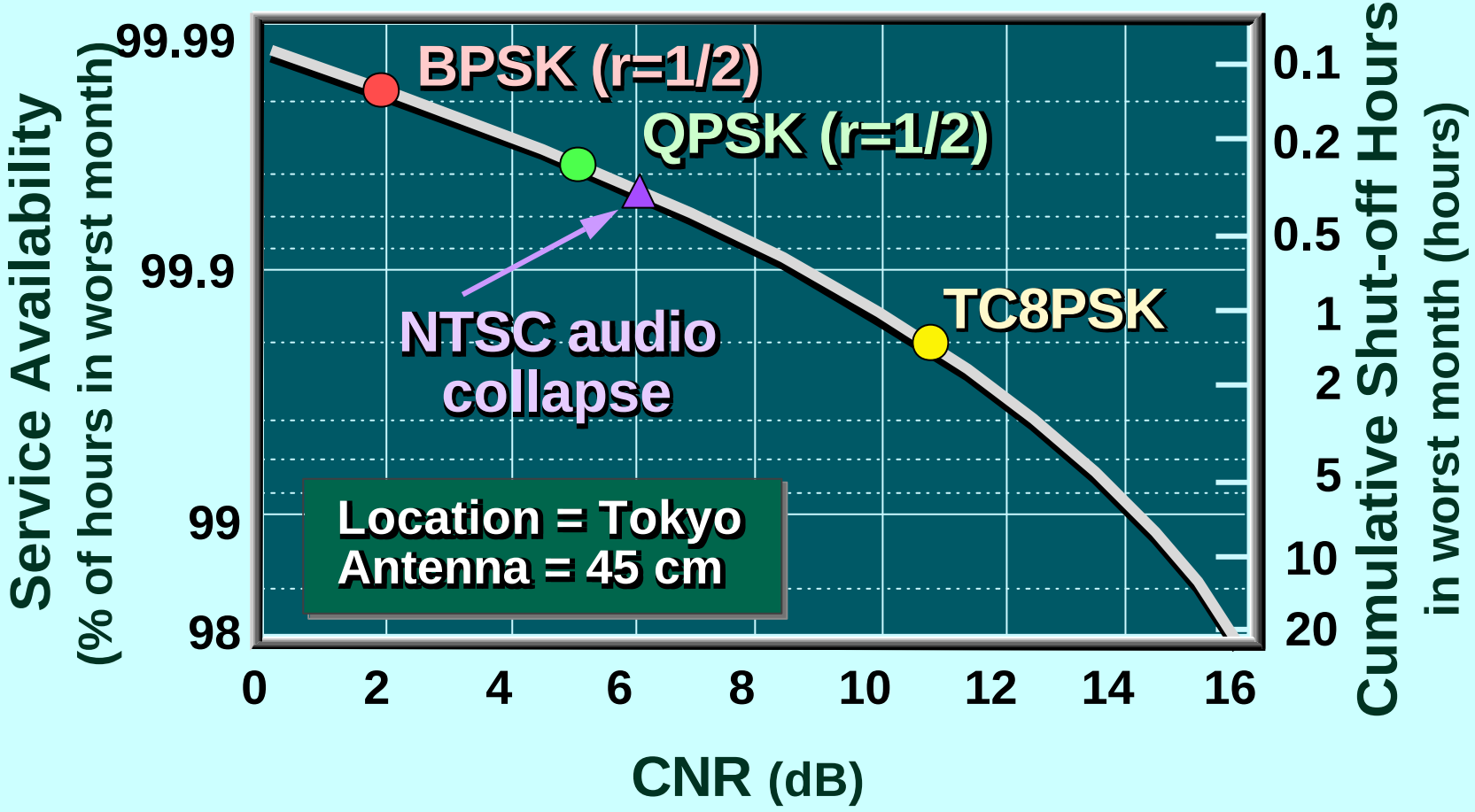
Transmission and Multiplexing Configuration Control (TMCC)

TMCC carries:

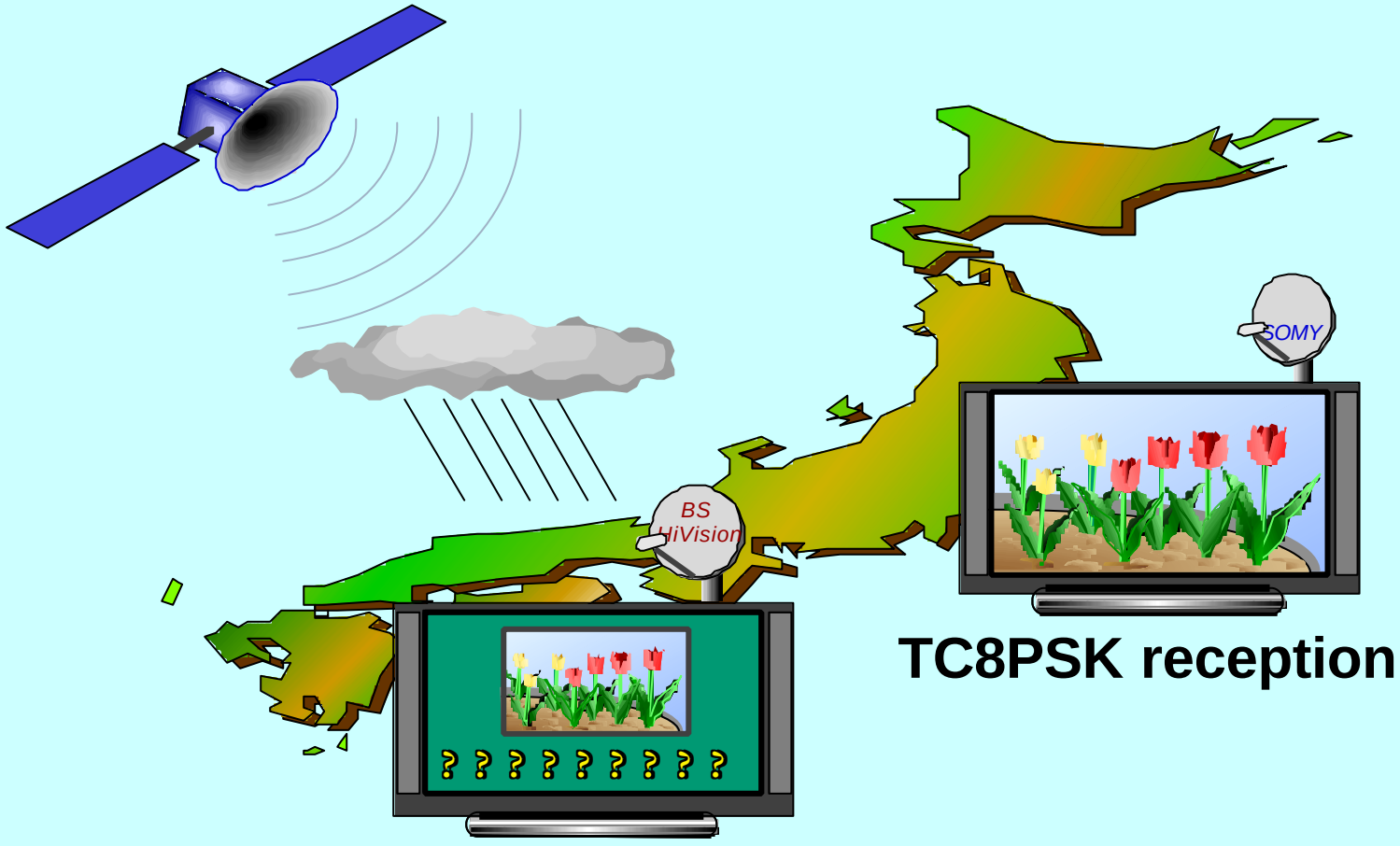
- frame synchronization
- modulation scheme and coding rate applied to each slot
- TS identification for each slot
- emergency alert signal
- information about site-diversity operation, etc.

TMCC is modulated with BPSK
and coded with RS(64,48)

Service Availability of 12GHz Satellite Broadcasting



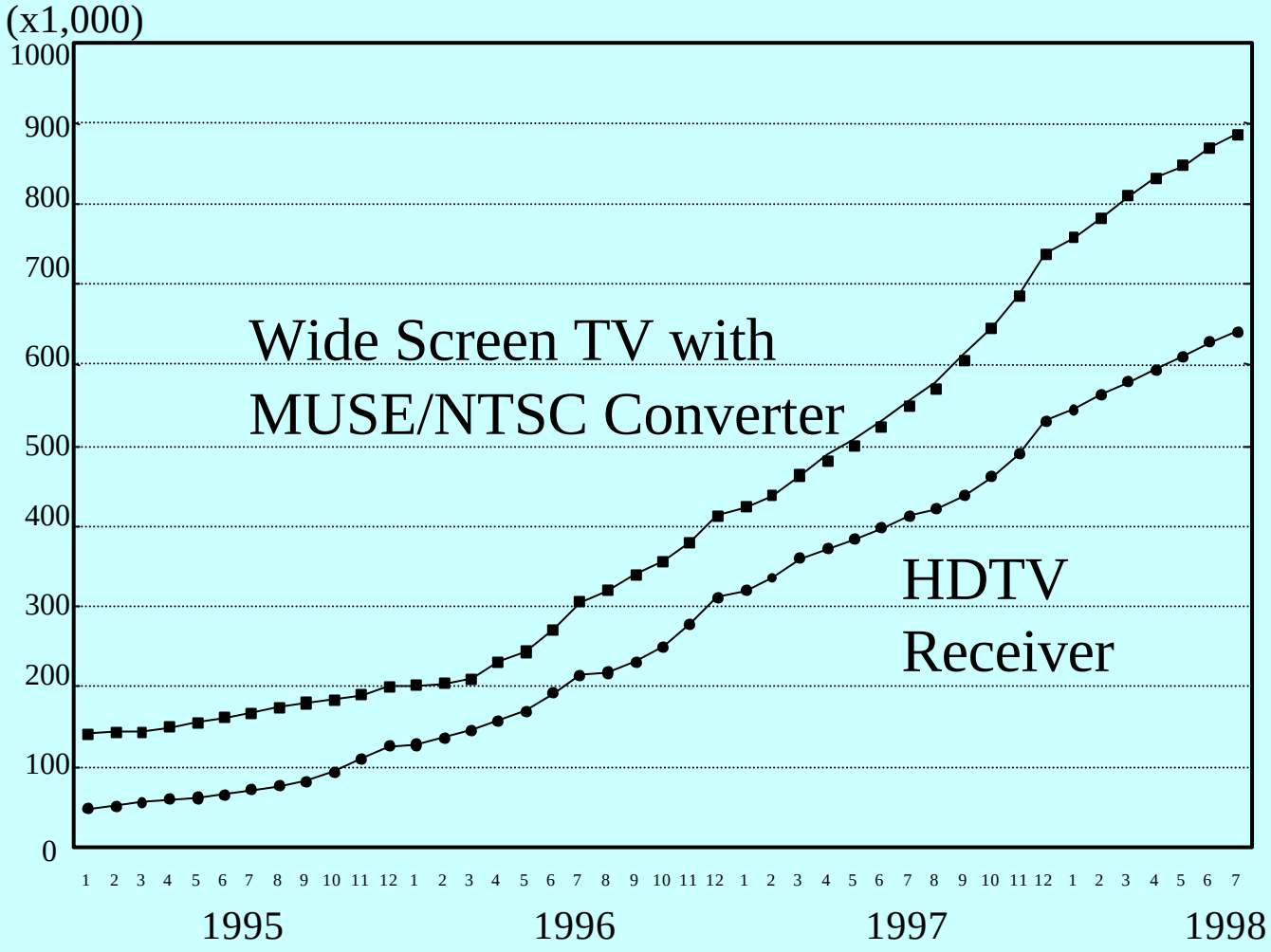
Example of Hierarchical Transmission



TC8PSK reception

QPSK/BPSK reception

Penetration of HDTV Receivers in Japan

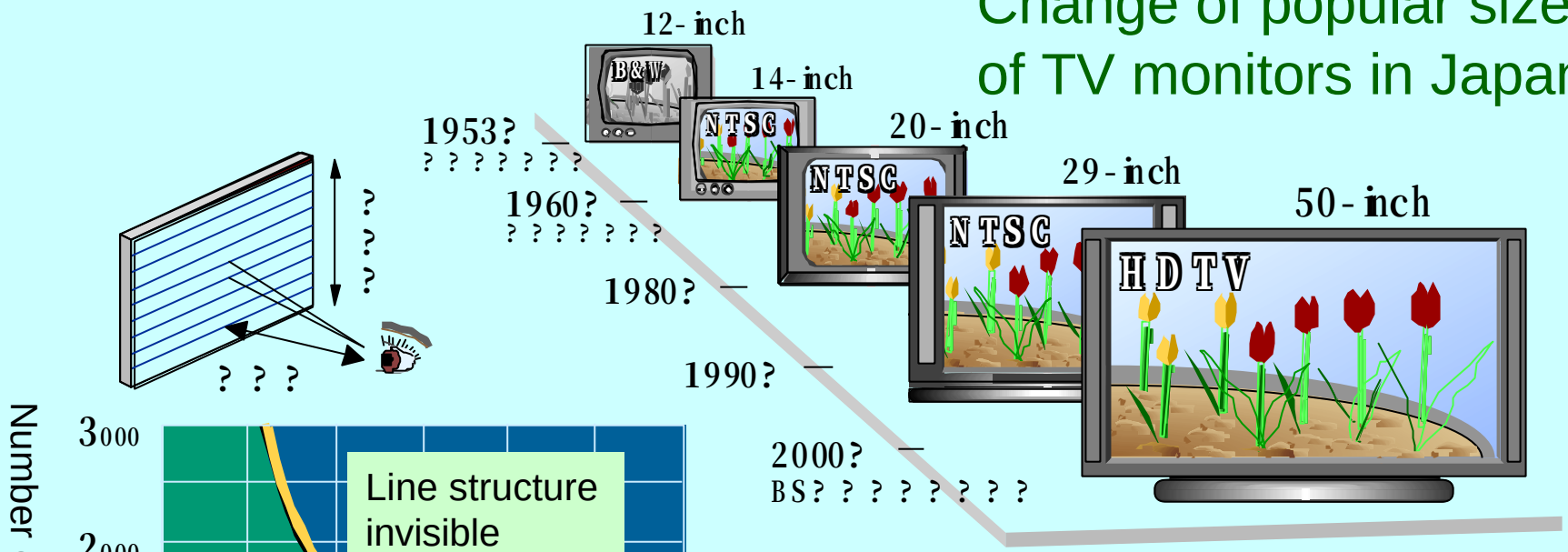


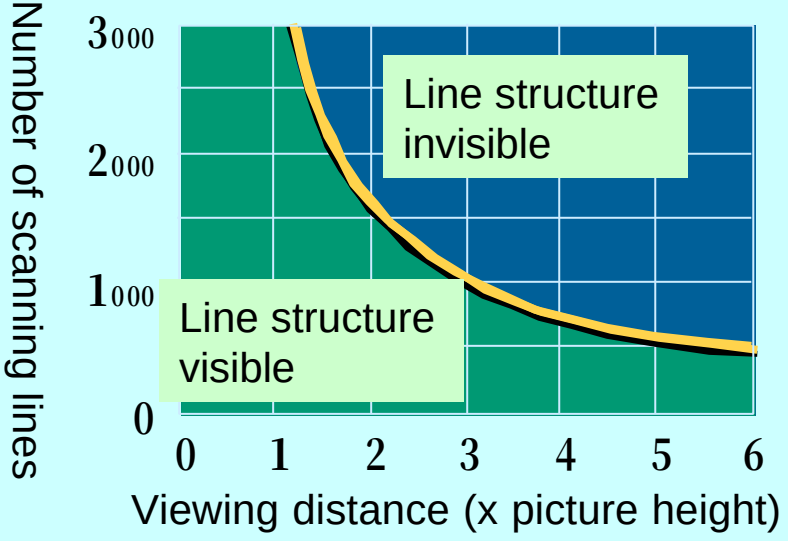
reached

934,000
at Aug. 1998

657,000
at Aug. 1998

Relationship between viewing distance and required number of scanning lines

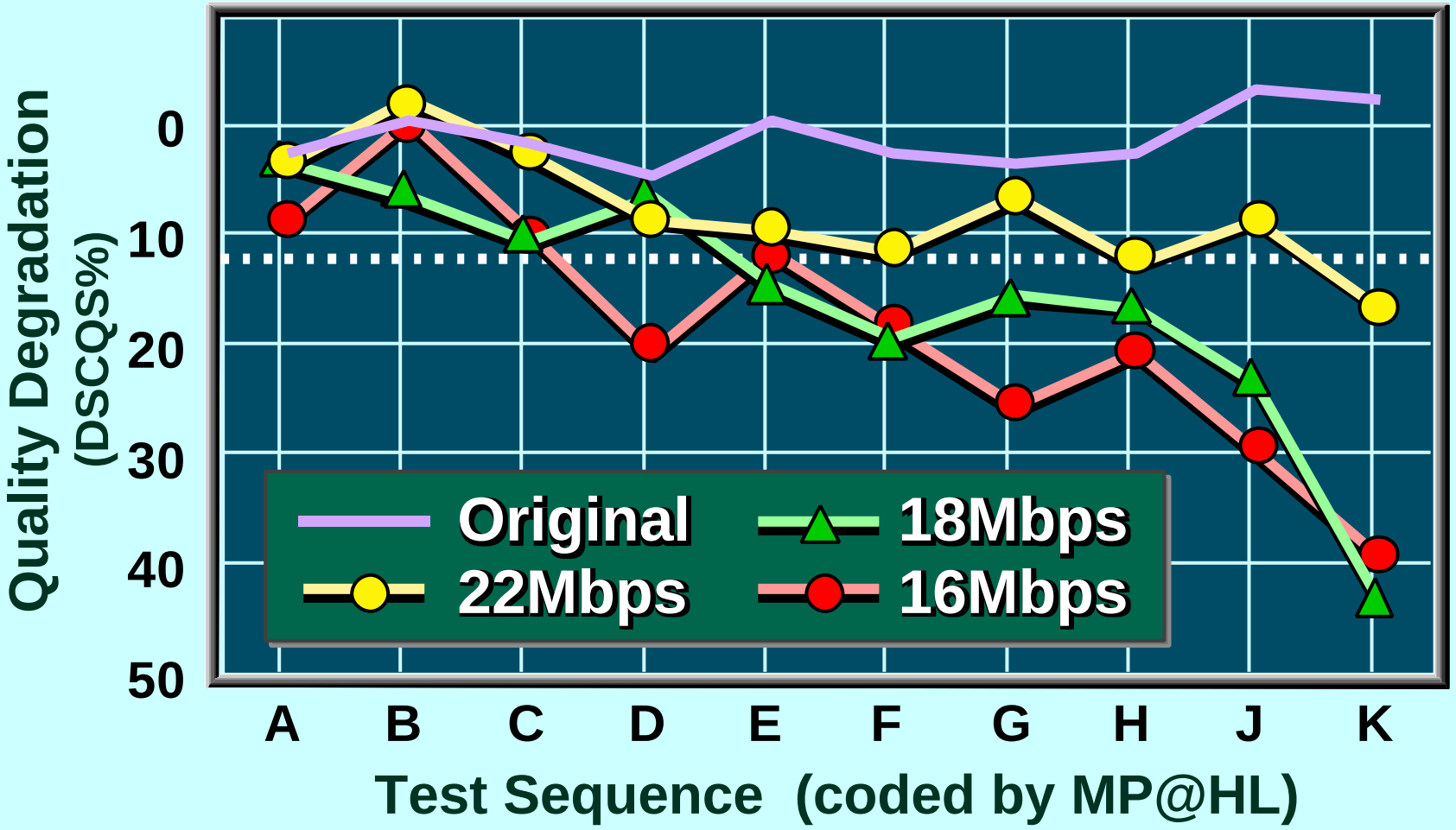




- Popular size has become larger
- Viewing distance remains unchanged (about 2m)

⇒ HDTV is suitable for the digital age

Subjective Assessment of HDTV Picture Quality



Conclusions

- ISDB by satellite starts in December 2000
- The ISDB-S system
  - large transmission capacity of 52 Mbps/ch
    - two HDTV programs can be transmitted
  - robust transmission against heavy rain
    - multiple modulation schemes and hierarchical transmission
  - high operational flexibility
    - independence between broadcasters who share one transponder
- HDTV services in Japan
  - ISDB-S is expected to play a central roll on digital HDTV