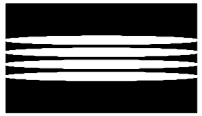


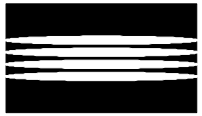
Tutorial on the Grand Alliance HDTV System

FCC Field Operations Bureau

July 27, 1994

Robert Hopkins

ATSC

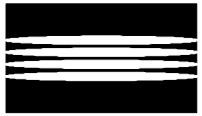


Tutorial on the Grand Alliance HDTV System

- Background on USA HDTV
- Why there is a Grand Alliance
- Basic Grand Alliance HDTV System specifications
- Tutorial using block diagrams of Grand Alliance HDTV System
- Issues for FCC Field Operations Bureau

Background on USA HDTV

- ATSC formed in 1982
- FCC Advisory Committee on Advanced Television Service formed in 1987
- Over 20 proposals for ATV broadcasting
- First digital HDTV proposal in 1990
- Field narrowed to four digital HDTV and one analog HDTV proposals
- Proposals tested during 1991 and 1992



No Single Winner from Testing

- Four digital HDTV systems were found superior to the analog system
- Each digital HDTV system had some superior characteristics
- No one digital HDTV system was considered to have overall superiority

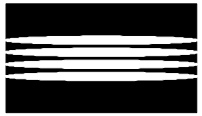
Why There Is a Grand Alliance

- The Advisory Committee suggested the four digital HDTV proponents get together in a “Grand Alliance” combining the best parts of each system.

- On May 24, 1993 the “Digital HDTV Grand Alliance” was formed.

Grand Alliance (GA) Members

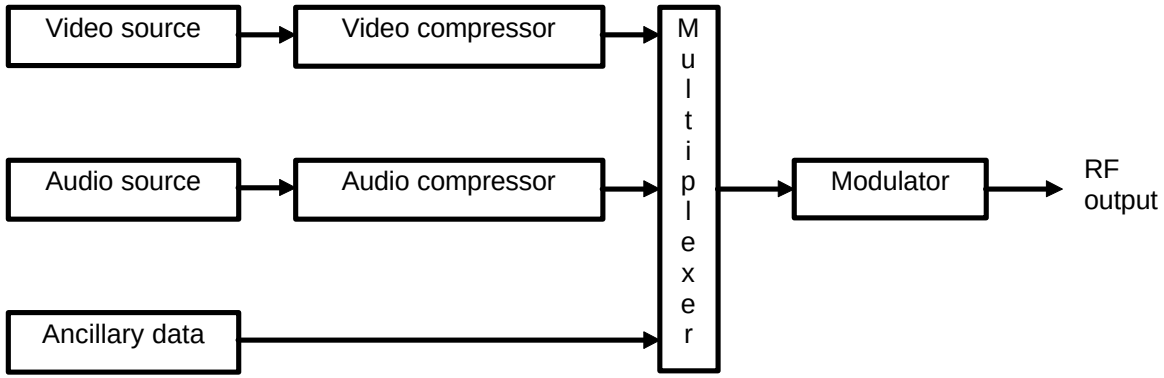
- AT&T
- David Sarnoff Research Center
- General Instrument
- MIT
- Philips North America
- Thomson Consumer Electronics
- Zenith Electronics Corporation



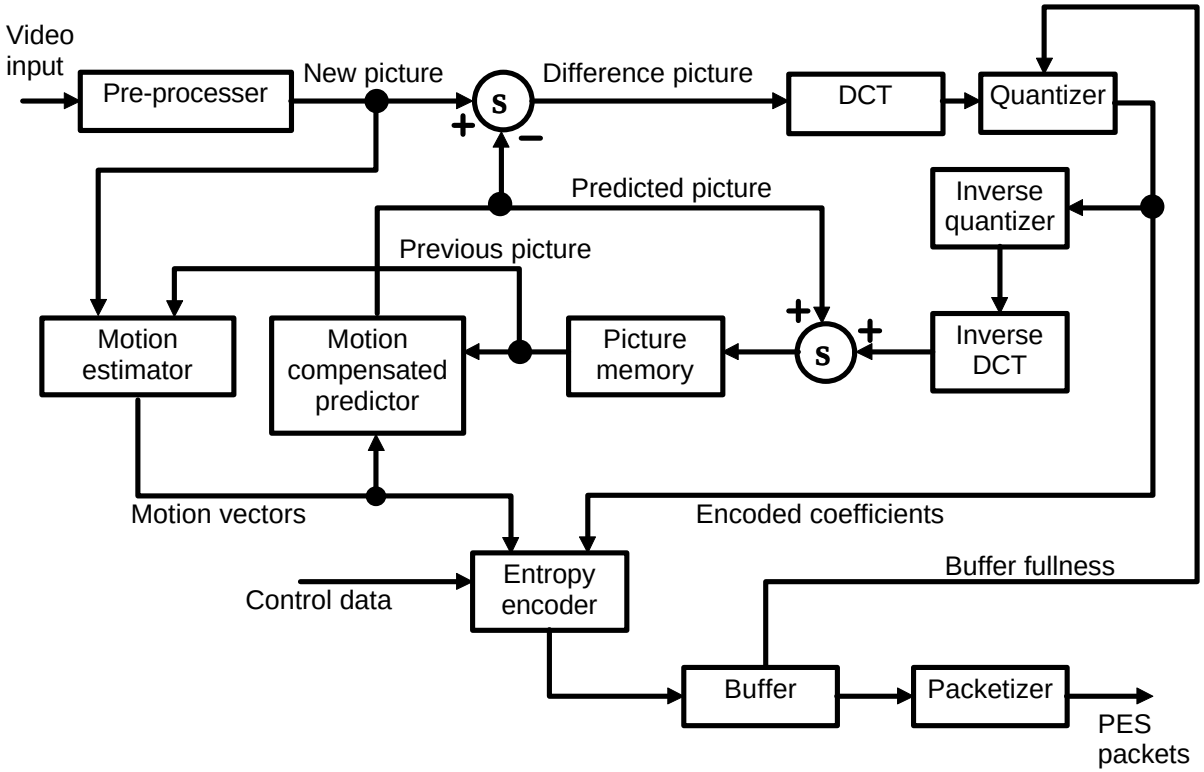
Basic GA Specifications

- Video formats:
  - 1280 (H) x 720 (V) progressive scan at 60 Hz, 30 Hz, and 24 Hz
  - 1920 (H) x 1080 (V) interlaced scan at 60 Hz, progressive scan at 30 Hz and 24 Hz
  - Vertical rates also at 59.94 Hz, 29.97 Hz, and 23.98 Hz.
- Video compression:
  - MPEG-2 (Main Profile at High Level)
- Audio compression:
  - Dolby AC-3
- Transport:
  - MPEG-2 Transport Stream
- RF modulation
  - 8-VSB

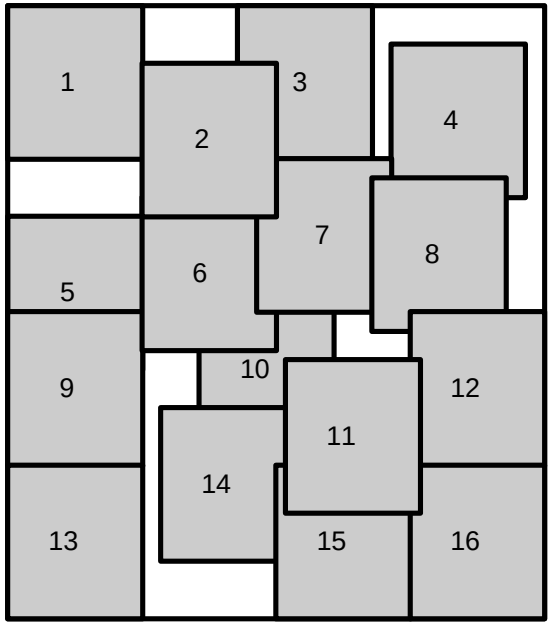
Grand Alliance Encoder



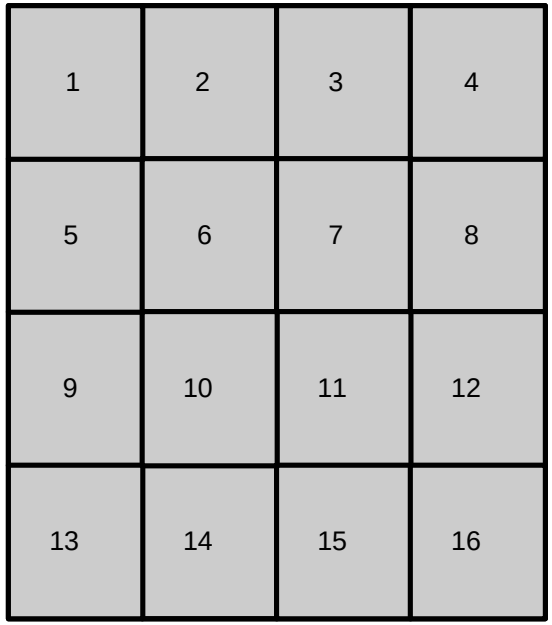
Video Compression Encoder



Motion Prediction Blocks

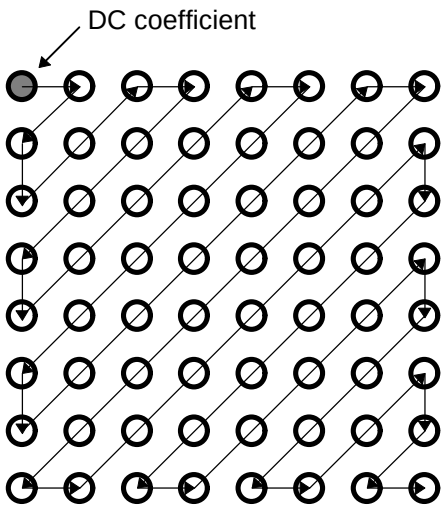


Blocks of previous picture used to predict new picture.

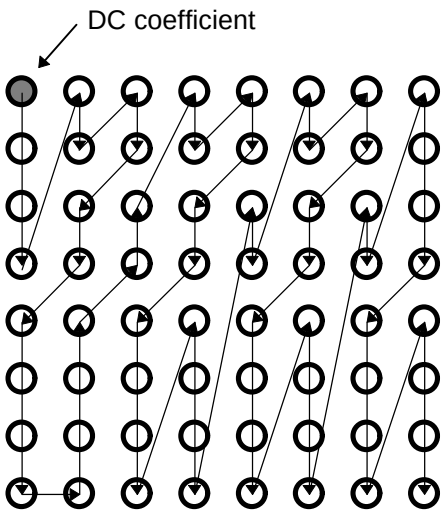


Previous picture after using motion vectors to adjust block positions.

DCT Coefficients

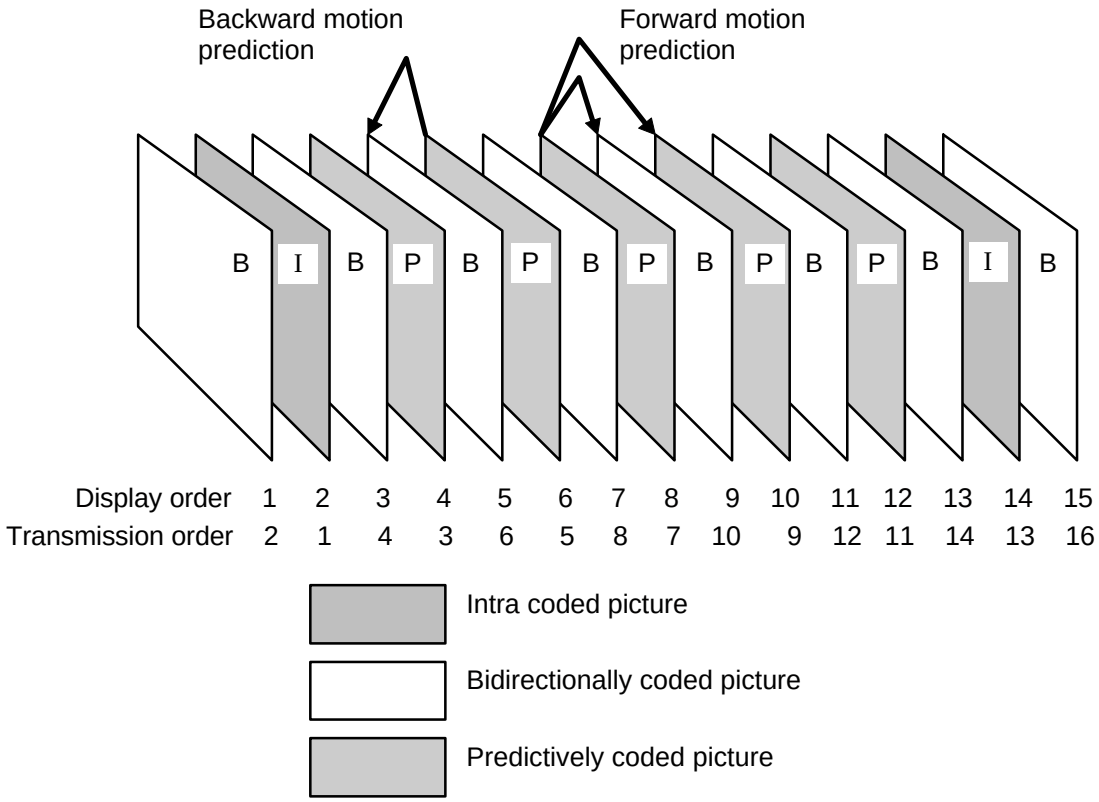


Zigzag scan

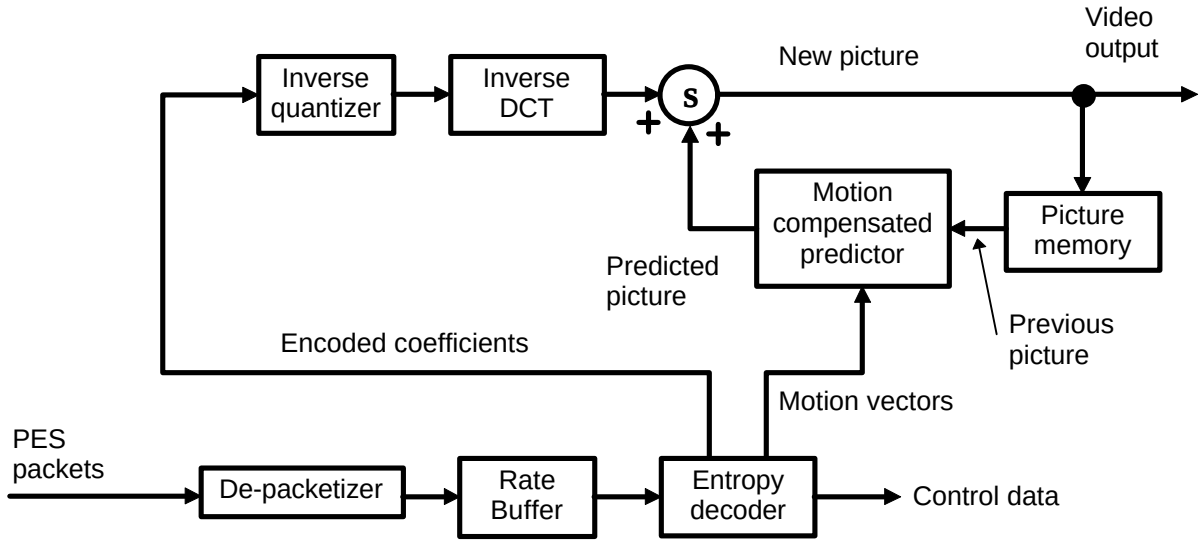


Alternate zigzag scan

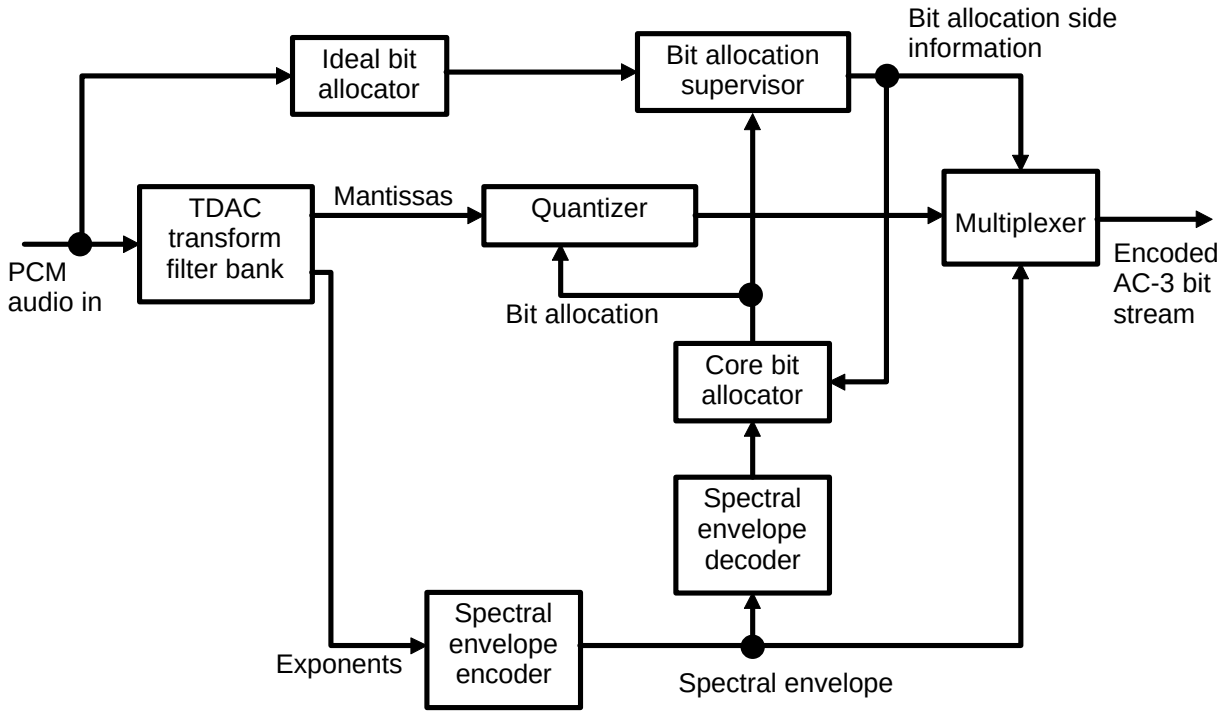
Coded Video Sequence



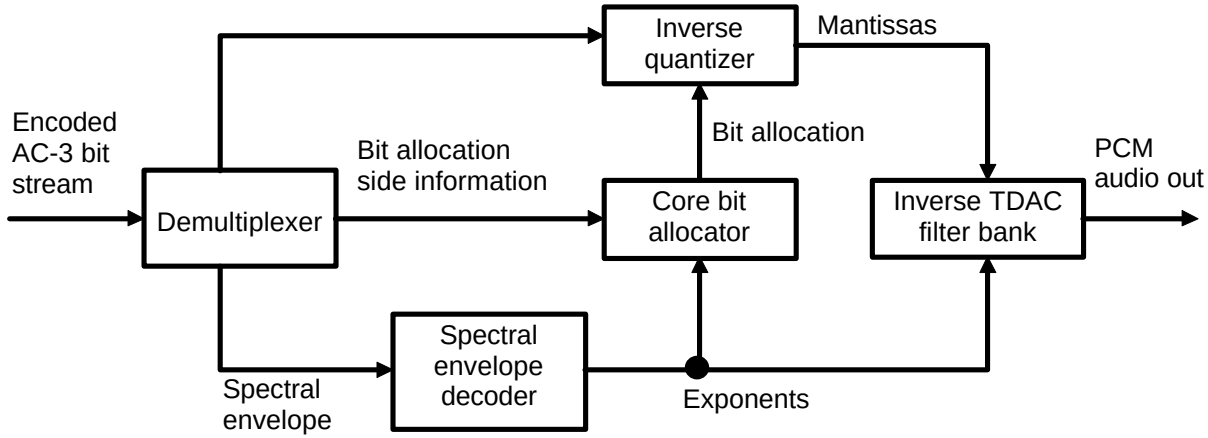
Video Compression Decoder



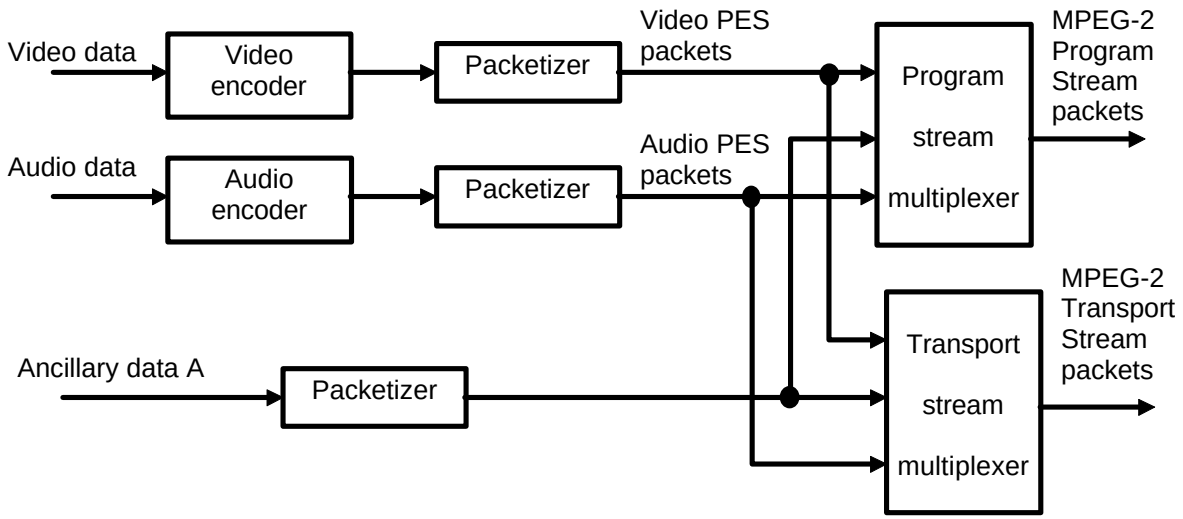
AC-3 Audio Encoder



AC-3 Audio Decoder

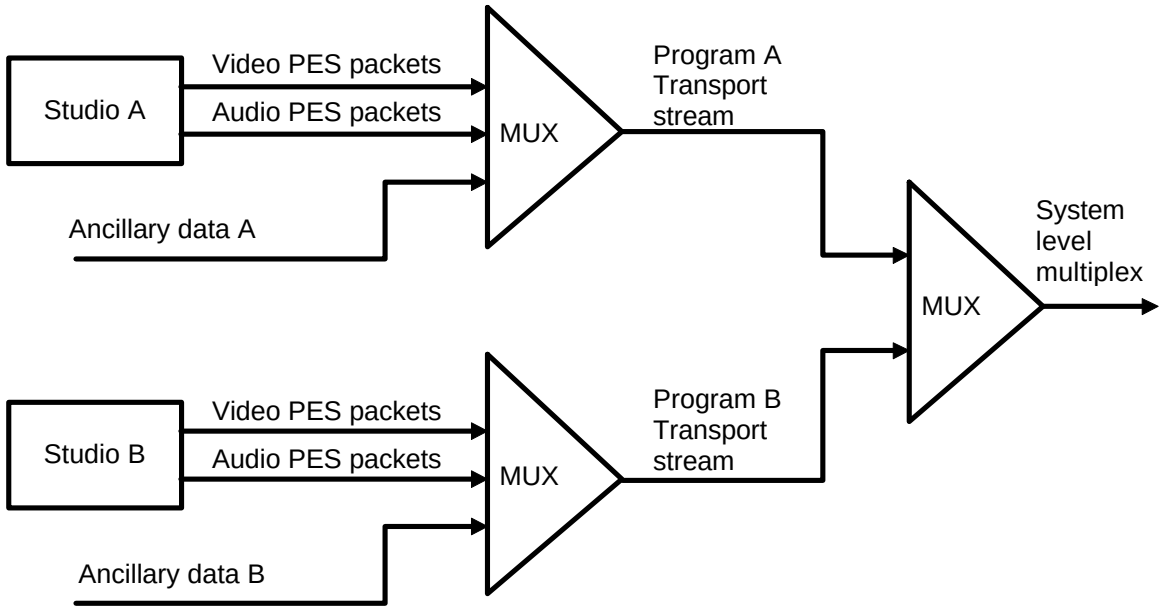


MPEG-2 Packets

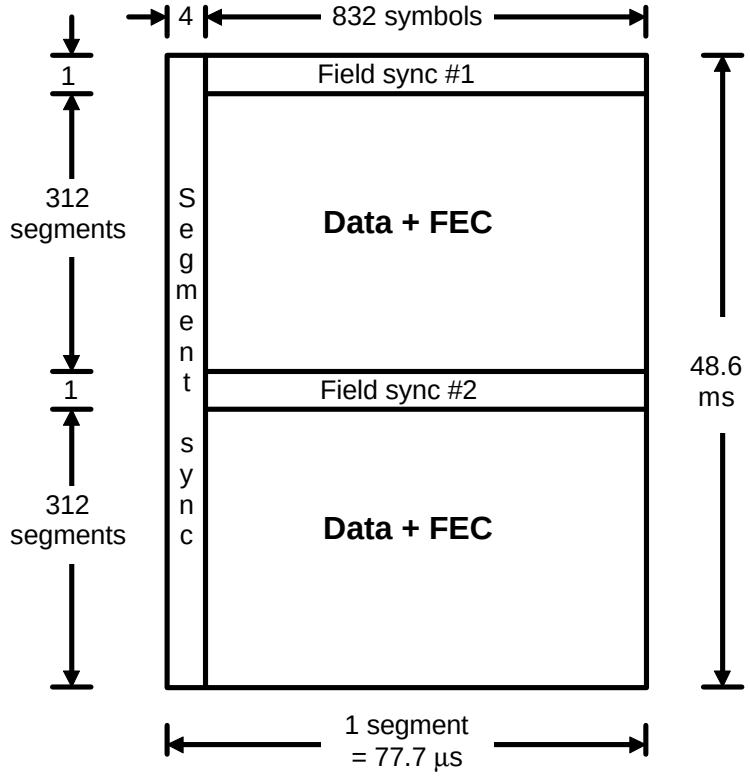


Program Stream packets are designed for relatively error-free environments. Transport Stream packets are designed for environments where errors are likely. The Grand Alliance HDTV System uses Transport Stream packets.

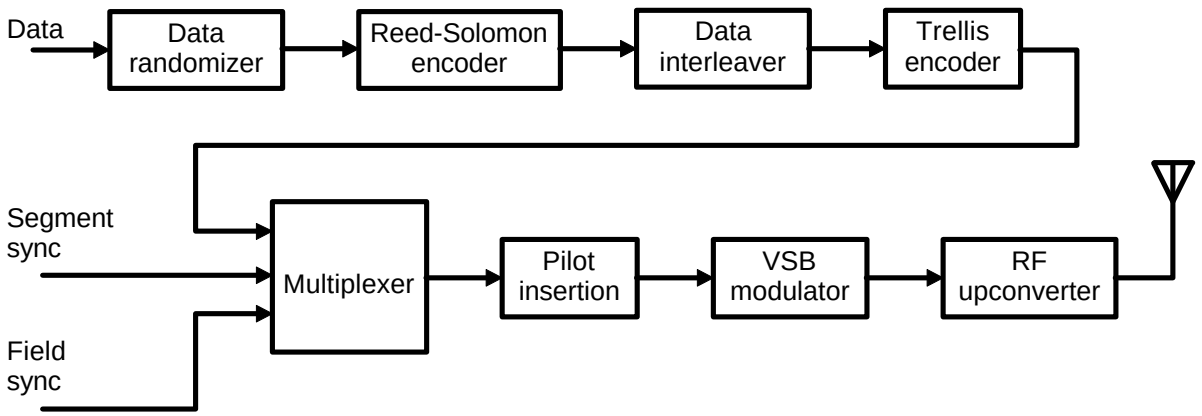
System Level Multiplex



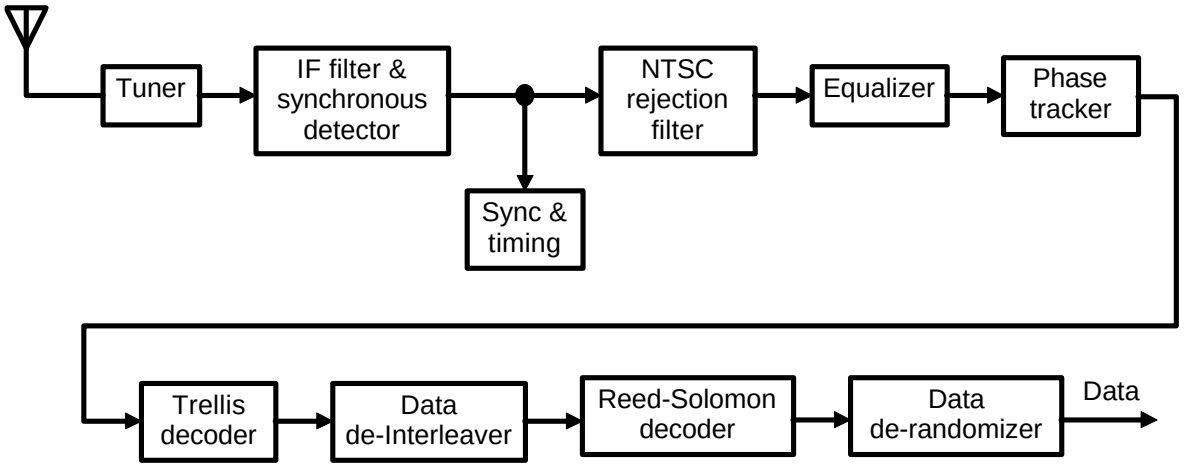
VSB Data Frame



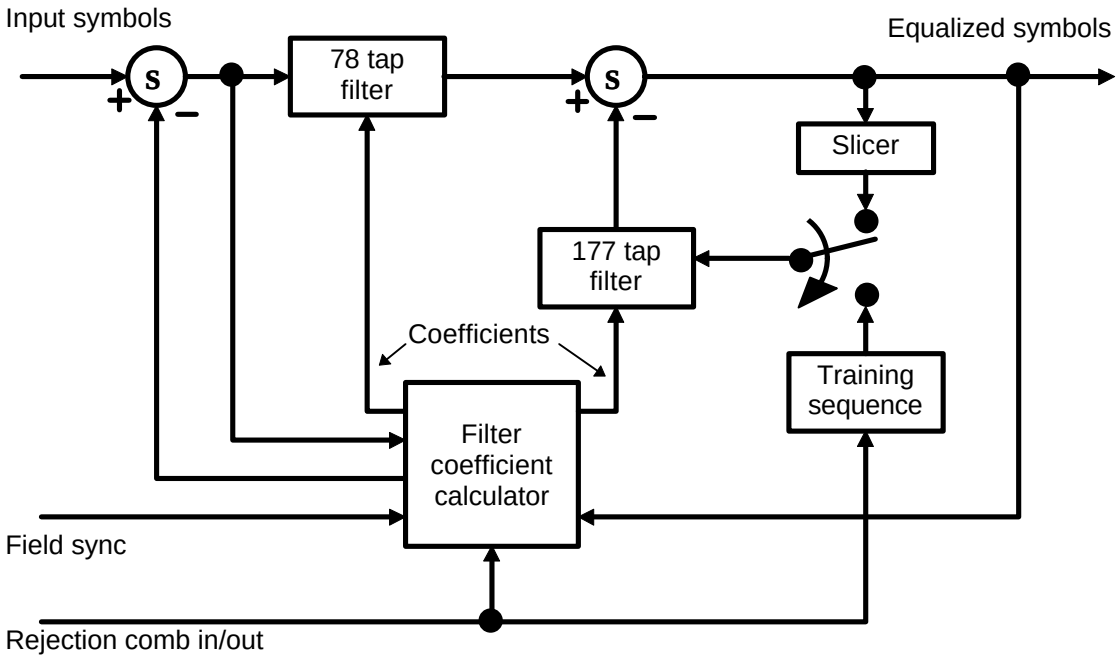
VSB Transmitter



Grand Alliance VSB Receiver



Grand Alliance VSB Equalizer



FCC Field Operations Bureau Issues

- Co-channel and adjacent channel interference into NTSC will increase slightly. The visual effect will be the same as if the signal got weaker — more "snow."
- Interference into digital HDTV will not affect pictures and sound, but it will cause the digital HDTV threshold signal level to increase. This is true for co-channel interference, adjacent channel interference, electrical interference, ghosts, etc.

FOB Issues (continued)

- Propagation effects will be the same as they are for NTSC (for example, inversion layers).
- People who buy HDTV will pay more money; they will put up good antennas; and they will expect fast resolution of interference problems.

FOB Issues (concluded)

- Anticipate Advisory Committee recommendation to FCC in Spring 1995.
- Anticipate FCC Rules by end of 1995.
- Anticipate some digital HDTV on-the-air in 1998.
- TV monitoring equipment in trucks and in field offices will need to be in place.
- So, budget now!