

FCC Field Operations Bureau July 27, 1994

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### **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



- 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



- 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



• 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.

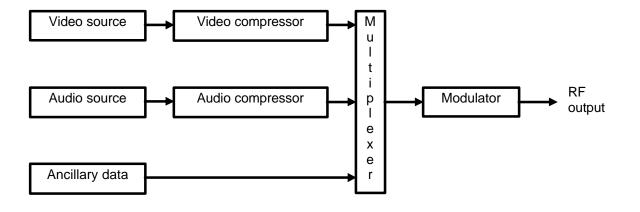


- AT&T
- David Sarnoff Research Center
- General Instrument
- MIT
- Philips North America
- Thomson Consumer Electronics
- Zenith Electronics Corporation



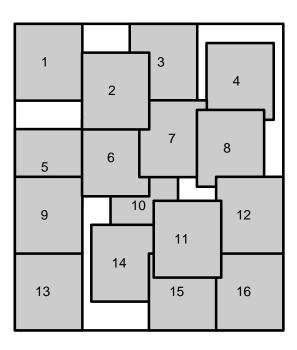
- Video formats:
  - 1280 (H) x 720 (V) progressive scan at 60 Hz, 30 Hz, and 24 Hz
  - 1920 (H) x 1080 (V) interlaced scan at 60 Hz, progressive scan at 30 Hz and 24 Hz
  - Vertical rates also at 59.94 Hz, 29.97 Hz, and 23.98 Hz.
- Video compression:
  - MPEG-2 (Main Profile at High Level)
- Audio compression: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

## **Grand Alliance Encoder**



#### Video Compression Encoder Video Difference picture New picture Pre-processer Quantizer DCT Predicted picture Inverse quantizer Previous picture Motion Picture Inverse Motion DCT estimator compensated memory predictor **Encoded coefficients** Motion vectors Buffer fullness Entropy Control data encoder Buffer Packetizer PES packets



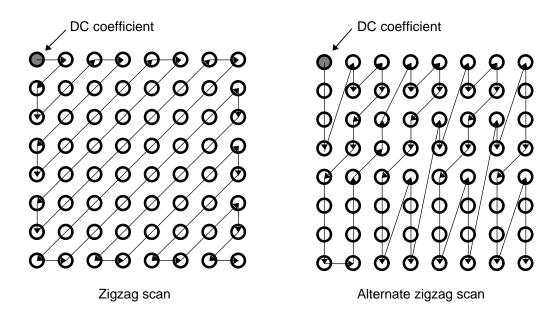


1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Blocks of previous picture used to predict new picture.

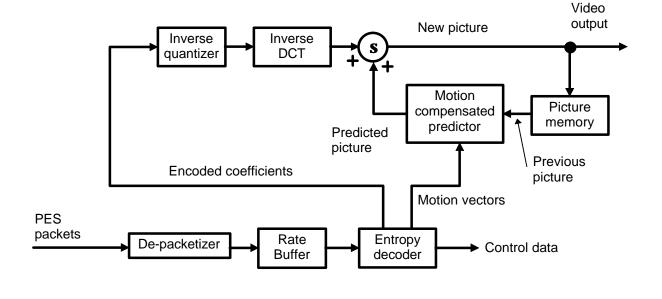
Previous picture after using motion vectors to adjust block positions.

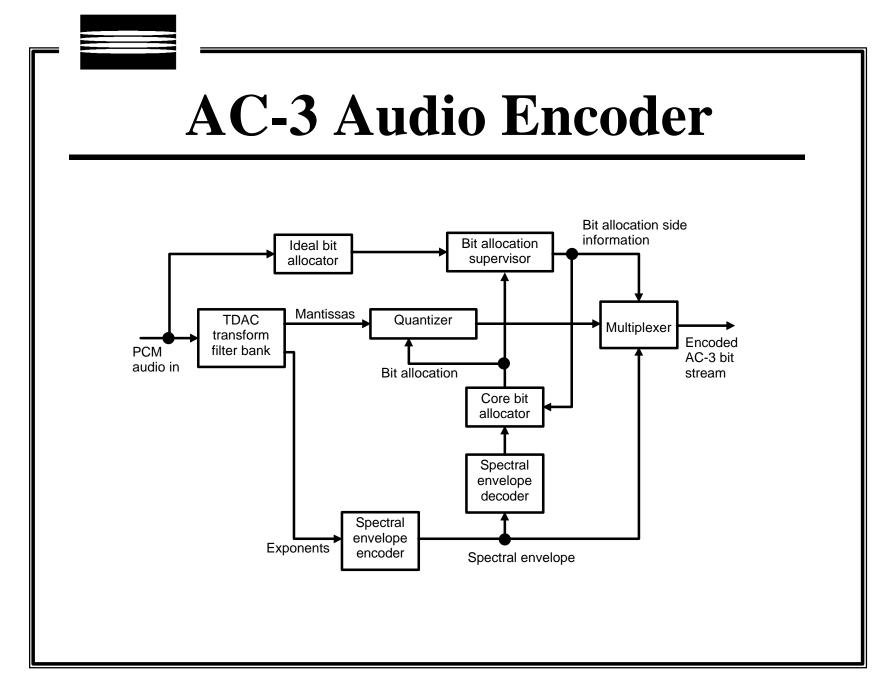




## **Coded Video Sequence** Backward motion Forward motion prediction prediction Ρ Display order Transmission order 2 12 11 14 13 16 Intra coded picture Bidirectionally coded picture Predictively coded picture

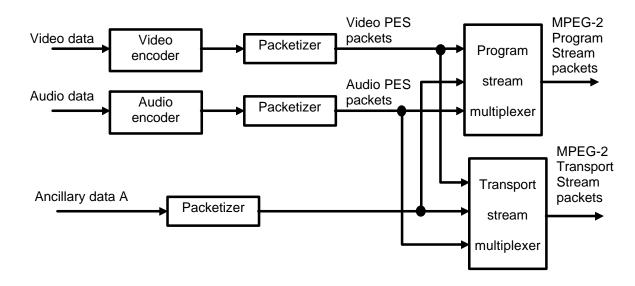
# Video Compression Decoder





#### AC-3 Audio Decoder Mantissas Inverse quantizer Encoded Bit allocation **PCM** Bit allocation AC-3 bit audio out side information stream Core bit Inverse TDAC Demultiplexer allocator filter bank Spectral envelope Spectral decoder Exponents envelope

## **MPEG-2 Packets**



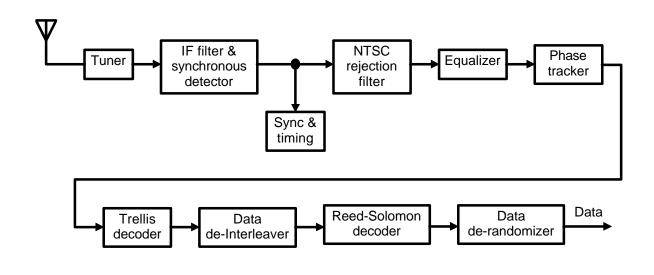
Program Stream packets are designed for relatively error-free environments. Transport Stream packets are designed for environments where errors are likely. The Grand Alliance HDTV System uses Transport Stream packets.

#### System Level Multiplex Program A Video PES packets Transport Studio A Audio PES packets stream MUX System Ancillary data A level multiplex MUX Program B Video PES packets Transport Studio B Audio PES packets stream MUX Ancillary data B

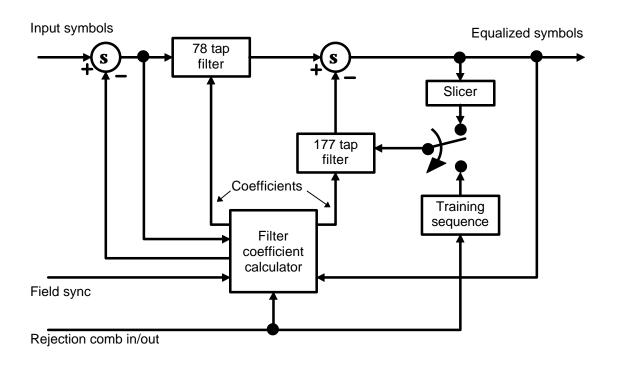
## **VSB** Data Frame - 832 symbols -Field sync #1 312 Data + FEC segments 48.6 Field sync #2 ms 312 Data + FEC segments 1 segment = 77.7 μs

#### **VSB** Transmitter Data Reed-Solomon Data **Trellis** Data interleaver randomizer encoder encoder Segment sync **VSB** RF Pilot Multiplexer modulator upconverter insertion Field sync

## 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.



- 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!