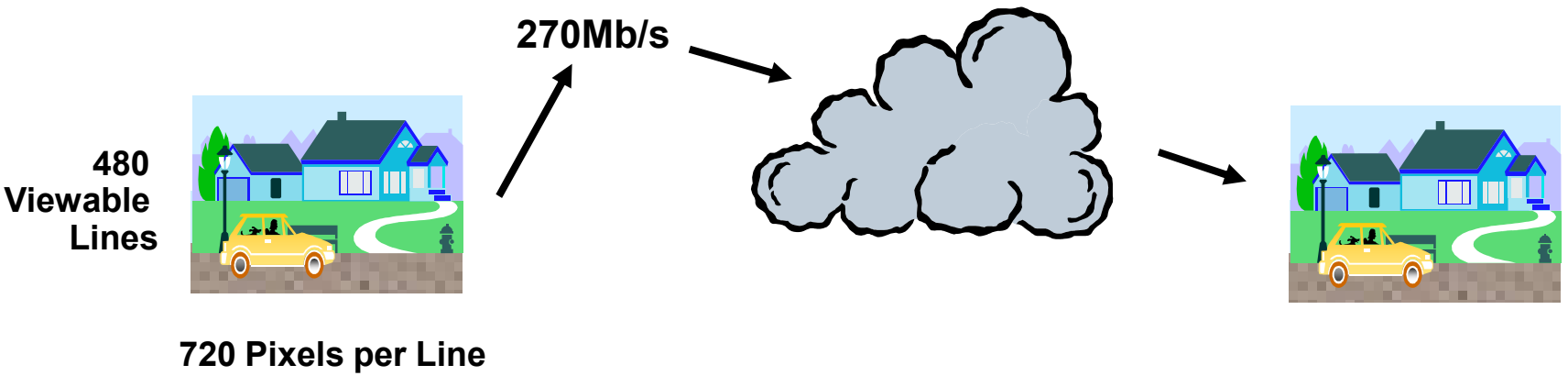
DTV Compressed Video System & Test Solution

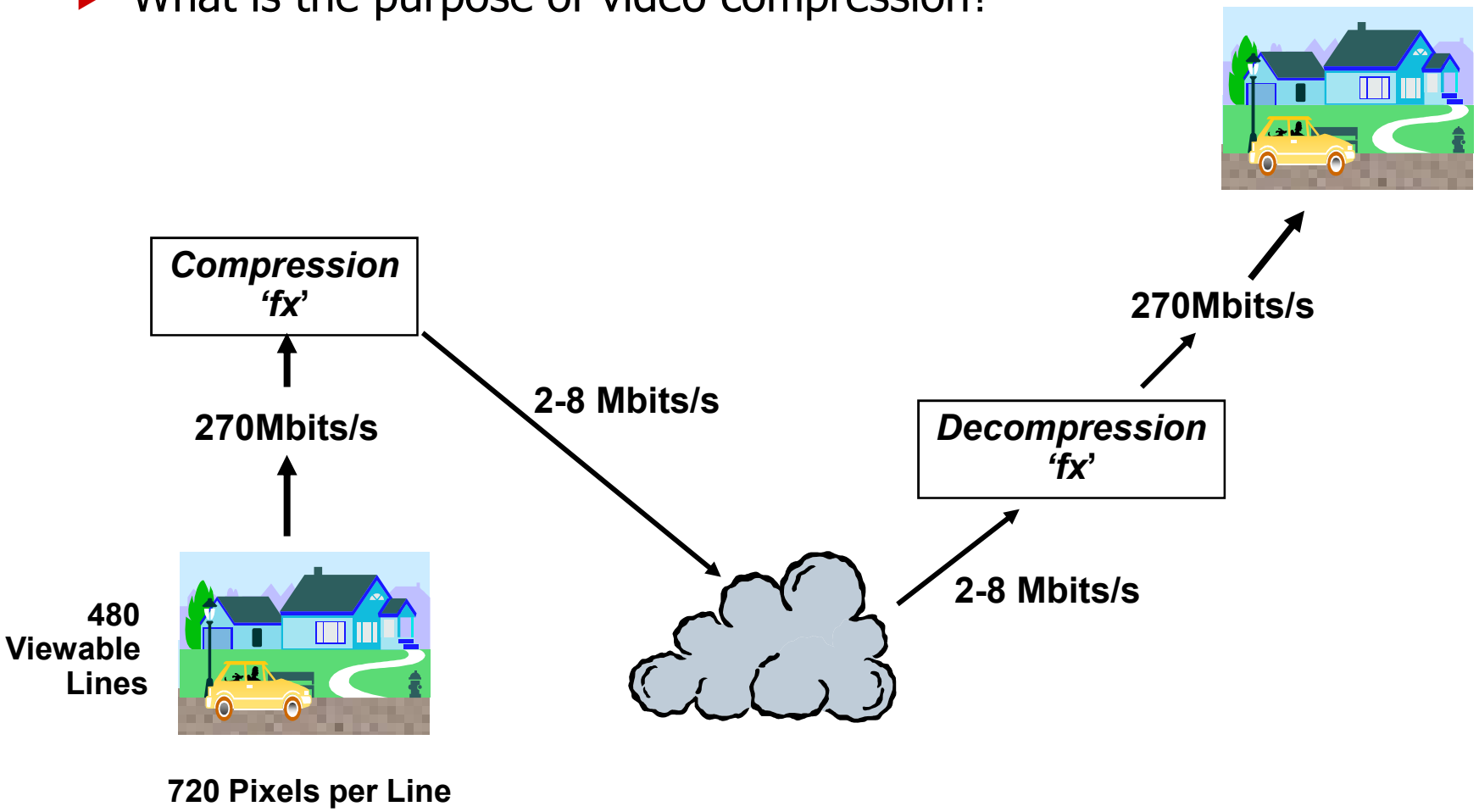
Video Compression - Purpose Of

- What is the purpose of video compression?
  - Reduce the amount of data required to be transmitted to create the picture at the receiver.
  - MPEG2 (Moving Picture Expert Group) is one type of compression out of several selected for DTV.
  - Being used by ATSC and DVB.
  - 19.39Mb/s using 8VSB modulation can fit in 6MHz bandwidth.
  - FCC is allocating 6MHz per terrestrial broadcast channel.



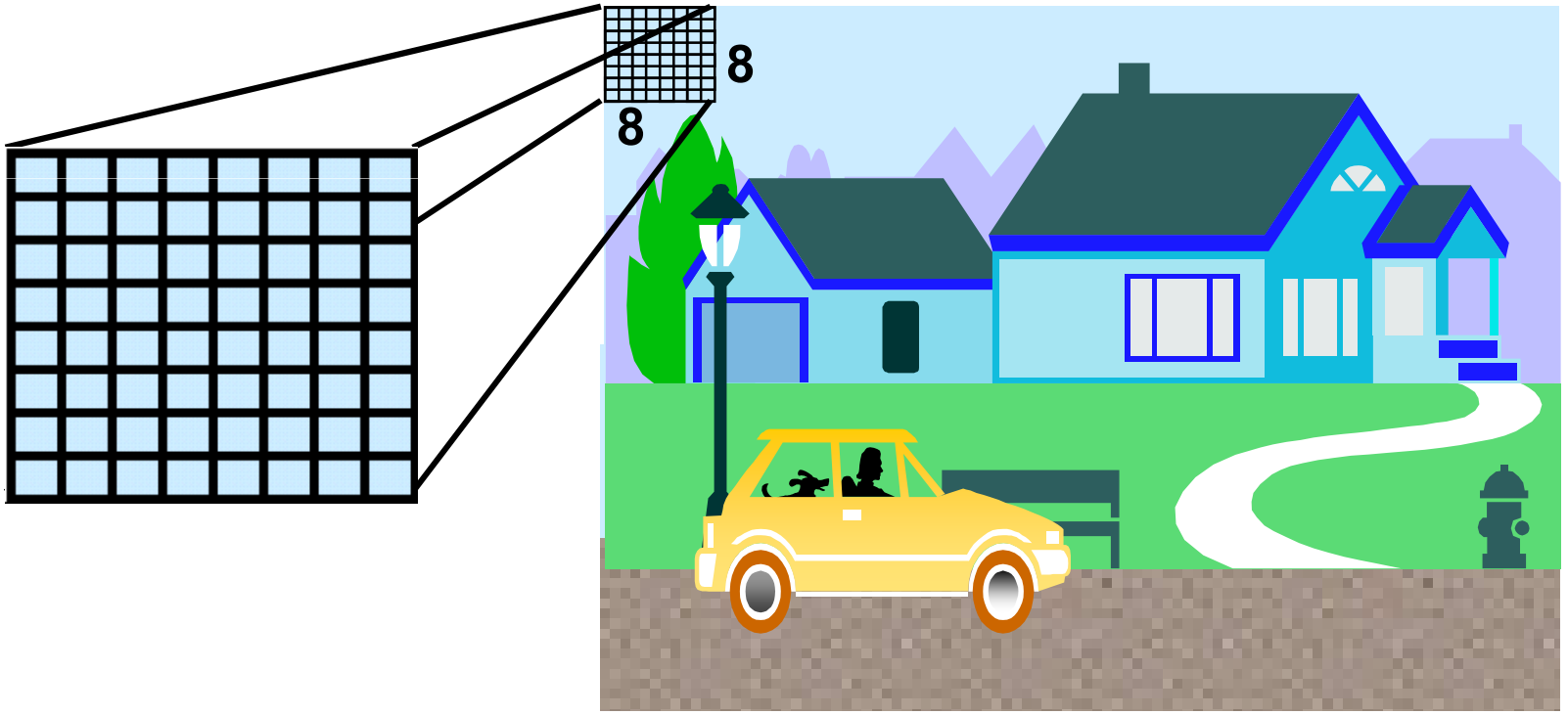
Video Compression - Purpose Of

- What is the purpose of video compression?

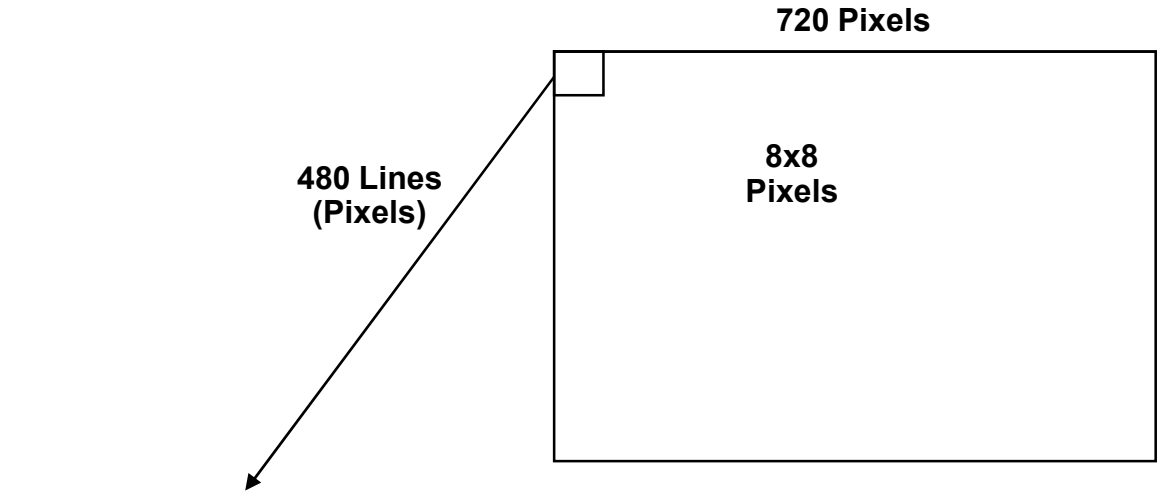


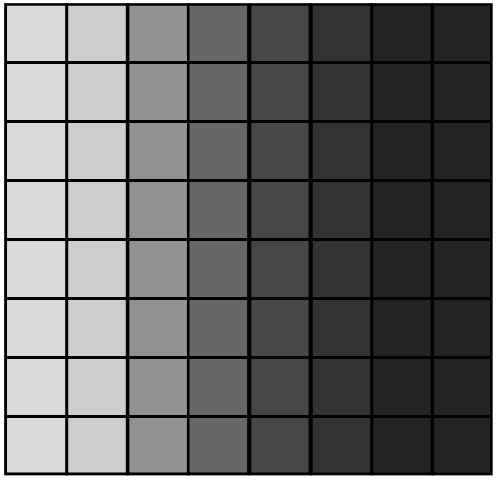
MPEG2 Spatial Compression

- Based on Discrete Cosine Transfer (DCT) Process
  - 8x8 Pixel Group
  - In this example, all 64 pixels are the same, the color of the sky.



DCT Example





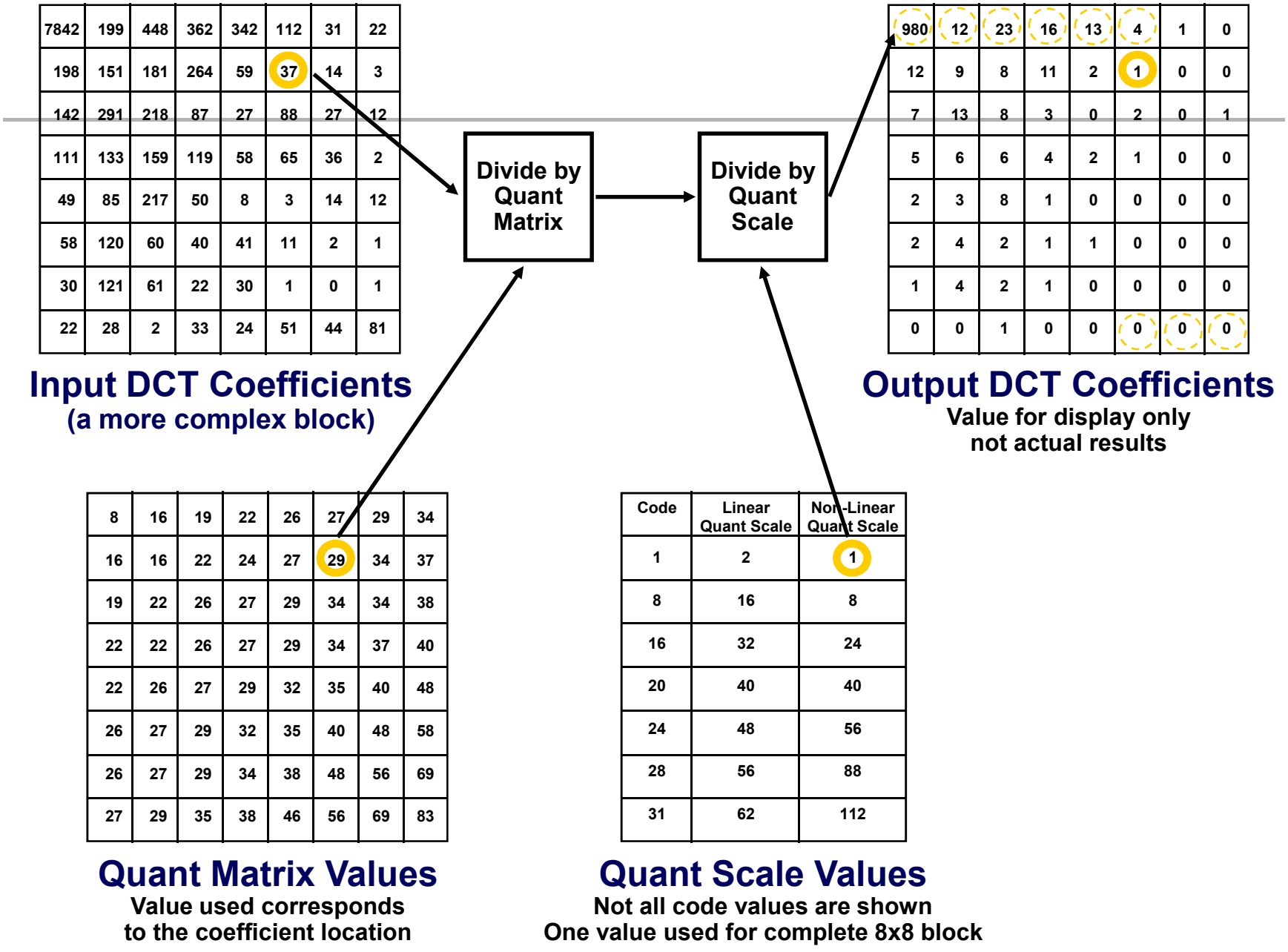
Picture

223	191	159	128	98	72	39	16
223	191	159	128	98	72	39	16
223	191	159	128	98	72	39	16
223	191	159	128	98	72	39	16
223	191	159	128	98	72	39	16
223	191	159	128	98	72	39	16
223	191	159	128	98	72	39	16
223	191	159	128	98	72	39	16

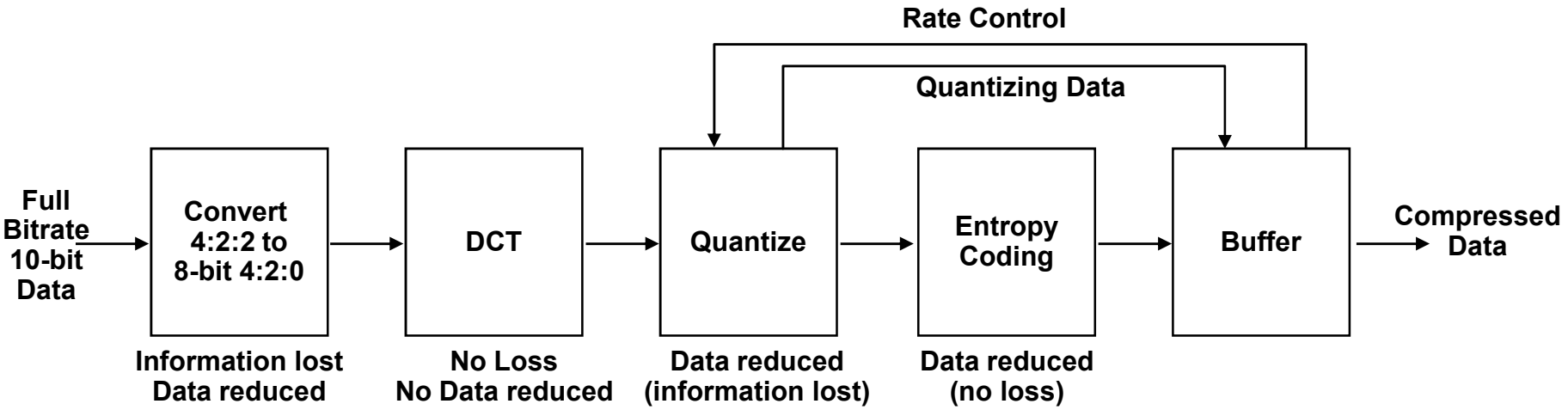
Sample Values

43.8	-40	0	-4.1	0	-1.1	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

DCT Coefficients


7842 199 448 362 342 112 31 22
198 151 181 264 59 37 14 3
142 291 218 87 27 88 27 12
111 133 159 119 58 65 36 2
49 85 217 50 8 3 14 12
58 120 60 40 41 11 2 1
30 121 61 22 30 1 0 1
22 28 2 33 24 51 44 81
Input DCT Coefficients
(a more complex block)
Divide by Quant Matrix
Divide by Quant Scale
980 12 23 16 13 4 1 0
12 9 8 11 2 1 0 0
7 13 8 3 0 2 0 1
5 6 6 4 2 1 0 0
2 3 8 1 0 0 0 0
2 4 2 1 1 0 0 0
1 4 2 1 0 0 0 0
0 0 1 0 0 0 0 0
Output DCT Coefficients
Value for display only
not actual results
8 16 19 22 26 27 29 34
16 16 22 24 27 29 34 37
19 22 26 27 29 34 34 38
22 22 26 27 29 34 37 40
22 26 27 29 32 35 40 48
26 27 29 32 35 40 48 58
26 27 29 34 38 48 56 69
27 29 35 38 46 56 69 83
Quant Matrix Values
Value used corresponds
to the coefficient location
Code
Linear Quant Scale
Non-Linear Quant Scale
1 2 1
8 16 8
16 32 24
20 40 40
24 48 56
28 56 88
31 62 112
Quant Scale Values
Not all code values are shown
One value used for complete 8x8 block

IntRA-Frame Coding



Quantizing

Reduce the number of bits for each coefficient.
Give preference to certain coefficients.
Reduction can differ for each coefficient.

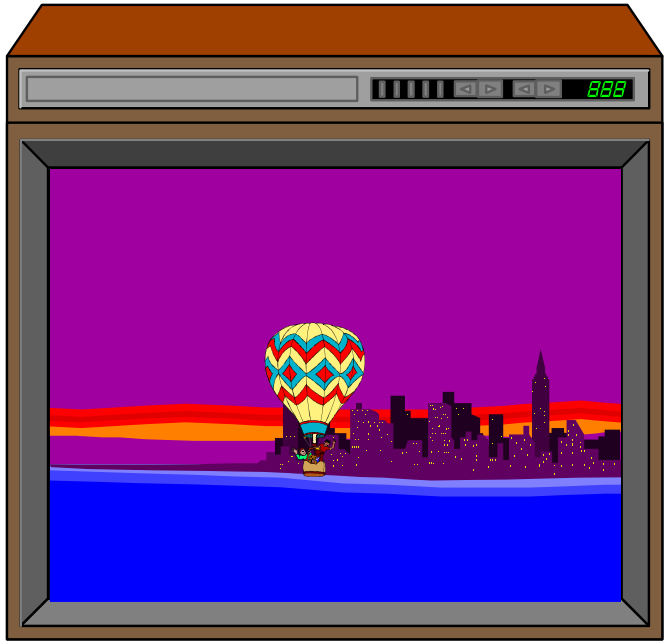
Entropy Coding

Variable Length Coding
Use short words for most frequent values (like Morse Code)

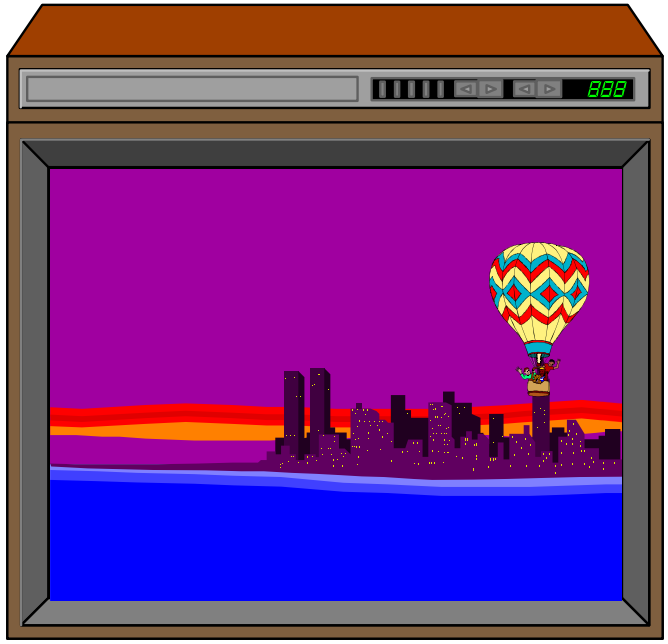
Run Length Coding
Send a unique code word instead of strings of zeros

MPEG2 Temporal Redundancies

- Frame to Frame redundancies
  - New location same data
  - New data uncovered



I Frame



P Frame

Motion Prediction

Temporal Redundancy

I Frame

Complete Frame Encoded

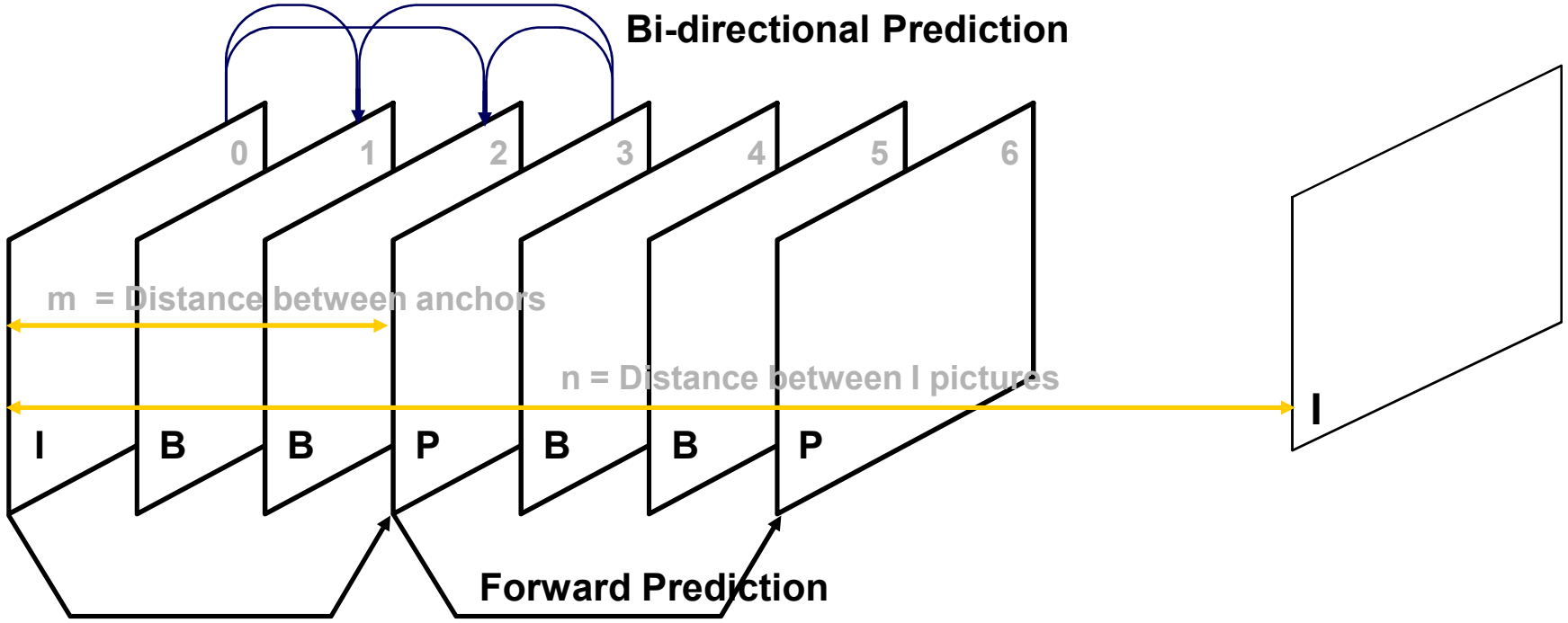
B Frame

Only Motion Encoded
Ball Bi-directionally from I & P
Revealed Knee from P frame

P Frame

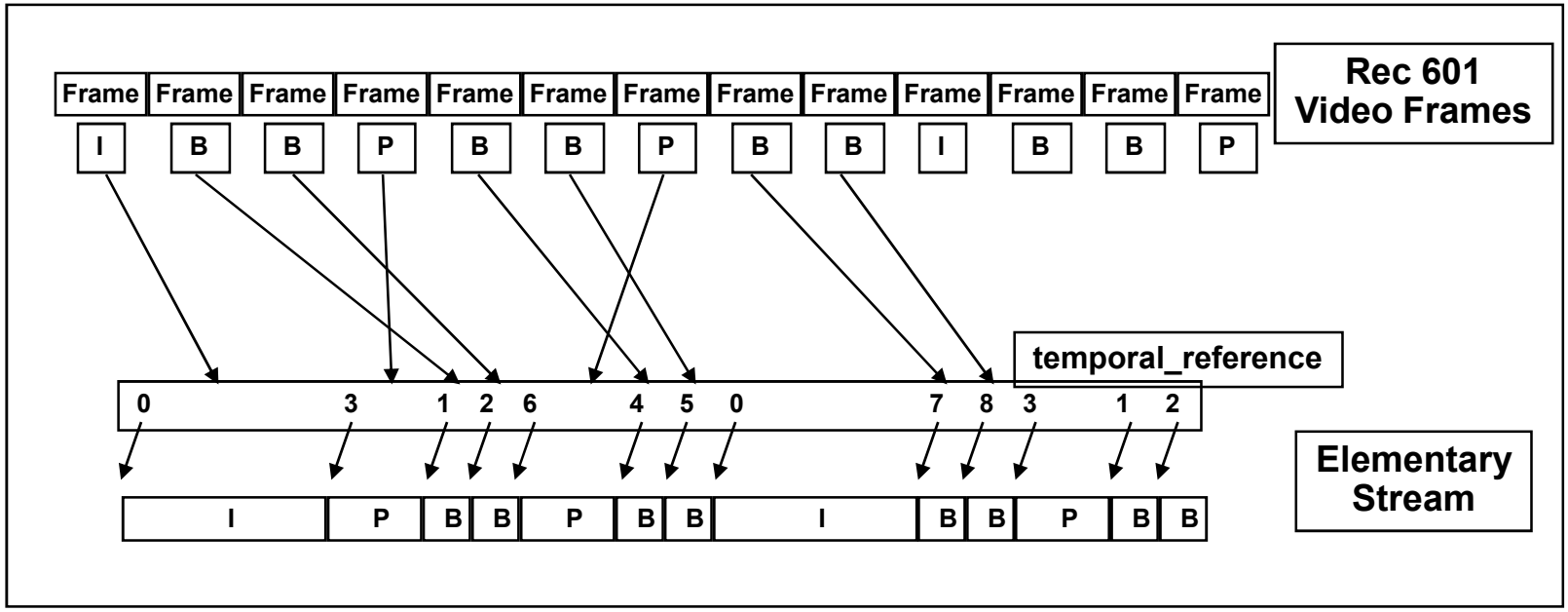
Ball Encoded with Motion Vector from I frame

Group of Pictures



I pictures: Intra-coding only
P pictures: Contain forward motion compensation
B pictures: Contain forward, backward and bi-directional motion compensation

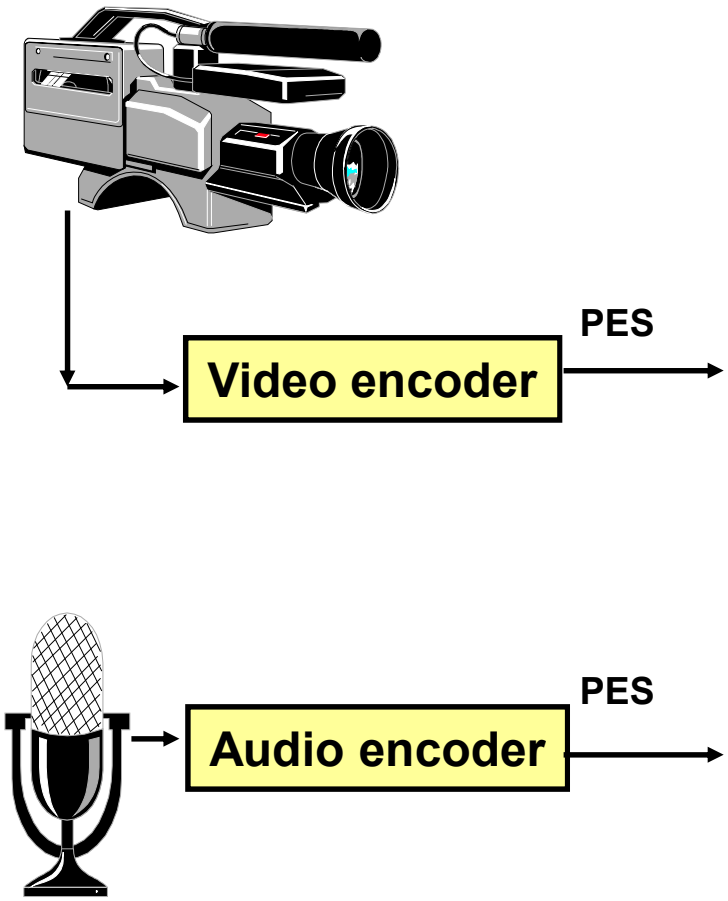
Time Sequence of Pictures



MPEG2 Levels and Profiles

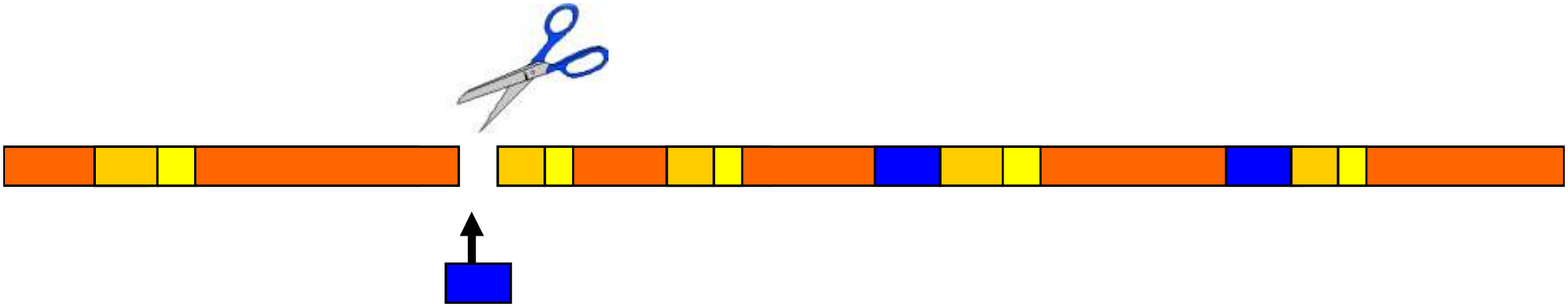
LEVEL \ PROFILE	SIMPLE	MAIN	4:2:2 PROFILE	SNR	SPATIAL	HIGH
HIGH		4:2:0 1920 x 1152 80 Mb/s I, P, B	4:2:2 1920 x 1088 300 Mb/s I, P, B			4:2:0. 4:2:2 1920 x 1152 100 Mb/s I, P, B
HIGH-1440		4:2:0 1440 x 1152 60 Mb/s I, P, B			4:2:0 1440 x 1152 60 Mb/s I, P, B	4:2:0, 4:2:2 1440 x 1152 80 Mb/s I, P, B
MAIN	4:2:0 760 x 576 15 Mb/s I, P	4:2:0 720 x 576 15 Mb/s I, P, B	4:2:2 720 x 608 50 Mb/s I, P, B	4:2:0 720 x 576 15 Mb/s I, P, B		4:2:0, 4:2:2 720 x 576 20 Mb/s I, P, B
LOW		4:2:0 352 x 288 4 Mb/s I, P, B		4:2:0 352 x 288 4 Mb/s I, P, B		

MPEG-2 Compression Process



- Encoder Generates Access Units
  - Video Access Unit is a Frame (I, B or P)
- A sequence of Access Units
  - Elementary Stream (ES)
- Split Into packets
  - Packetised Elementary Stream (PES)
  - Either all video or all audio
  - Variable length packets (64 Kbytes maximum)
- PES Header Contains Timing Information
  - Presentation Time Stamp (PTS)
    - when to display packet contents
  - Decoder Time Stamp (DTS)
    - when to decode packet contents

From ES to PES



PES header

Access unit Start Code

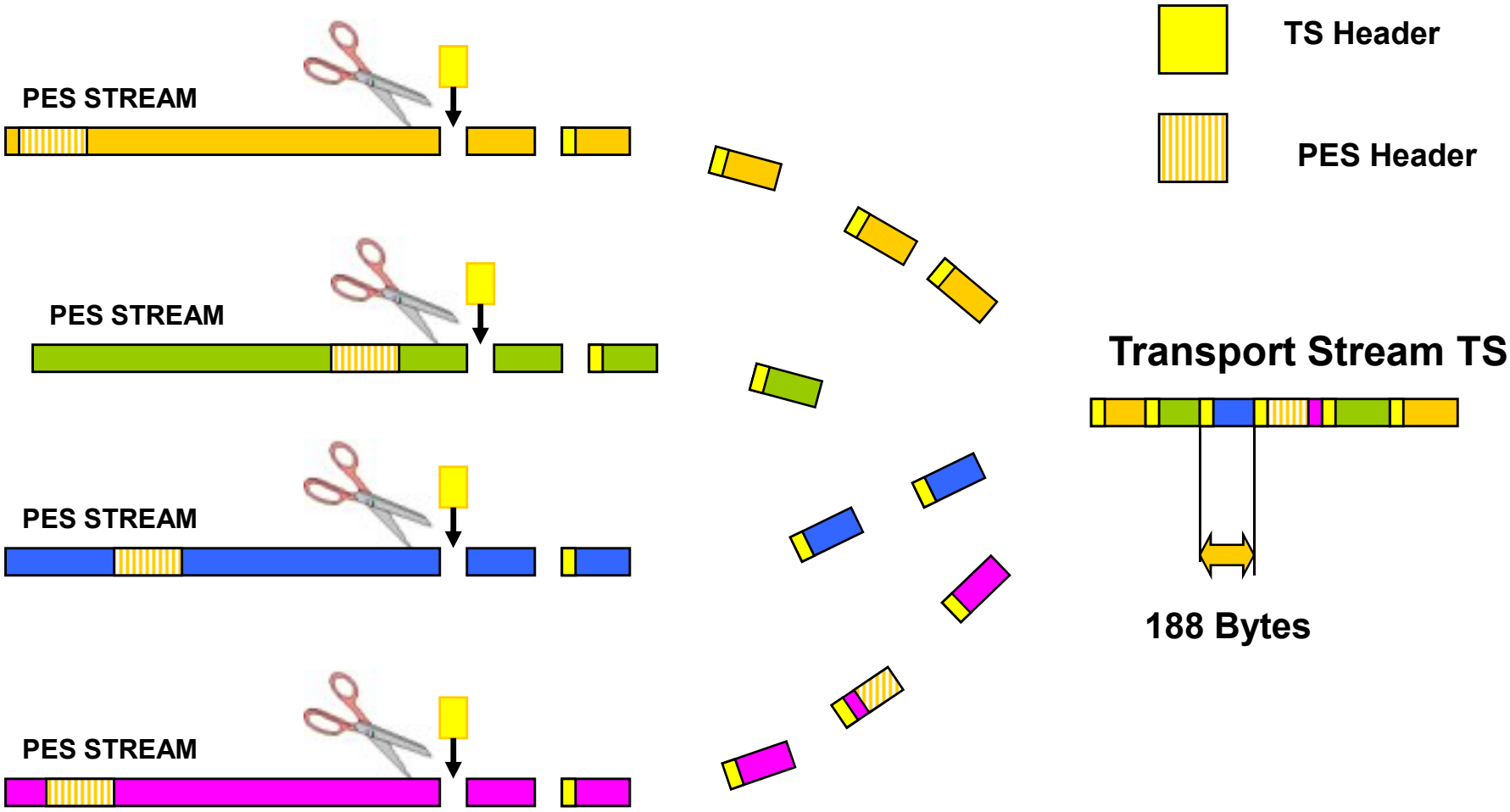
Access unit Header

Access Unit payload

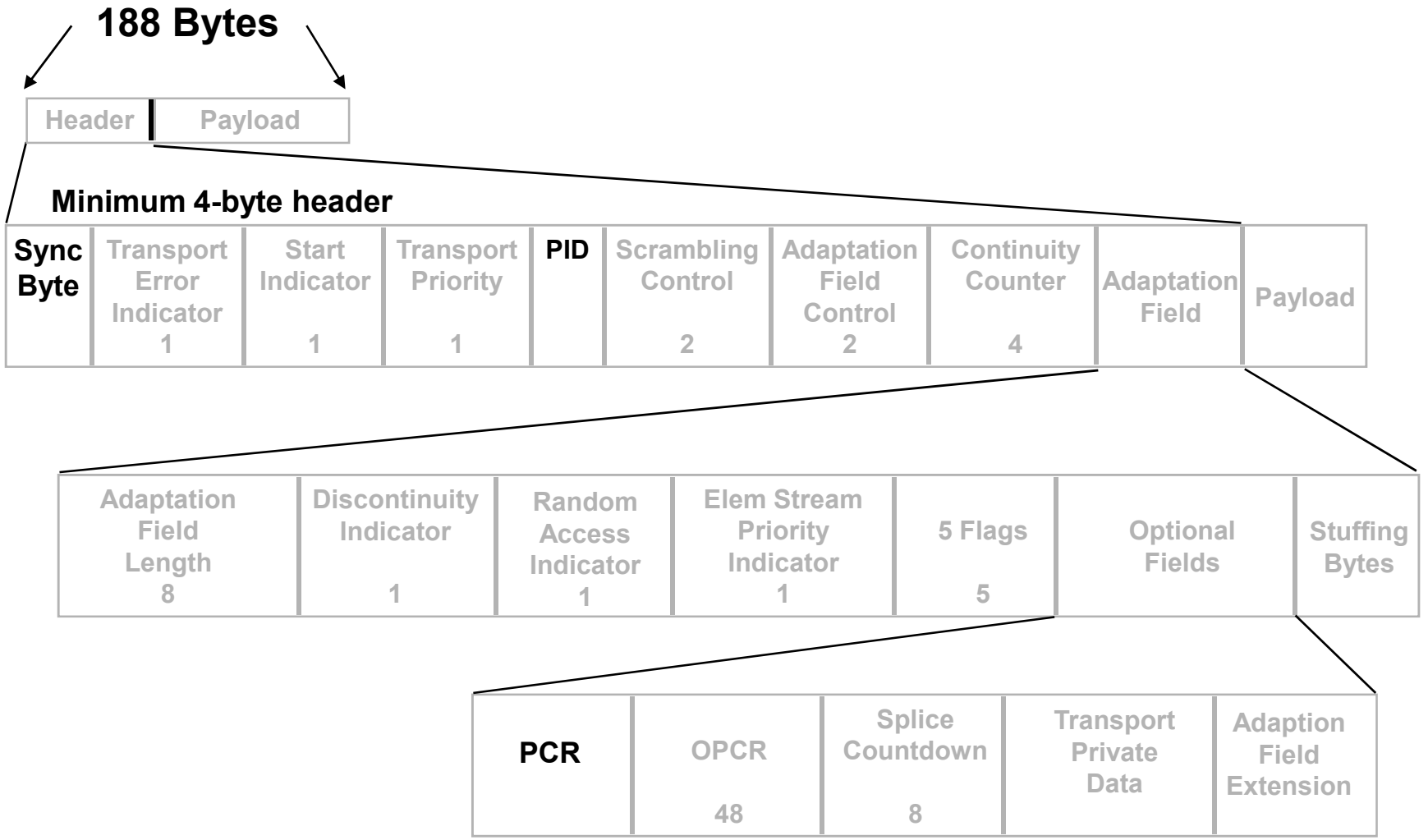
PES header

- Elementary stream is just a stream of access units
- They are cut up, and headers added, every header has at least stream ID and maybe a lot more
- At this point, basic timing information is added to the stream in the PES header, PTS & DTS - the timestamps.

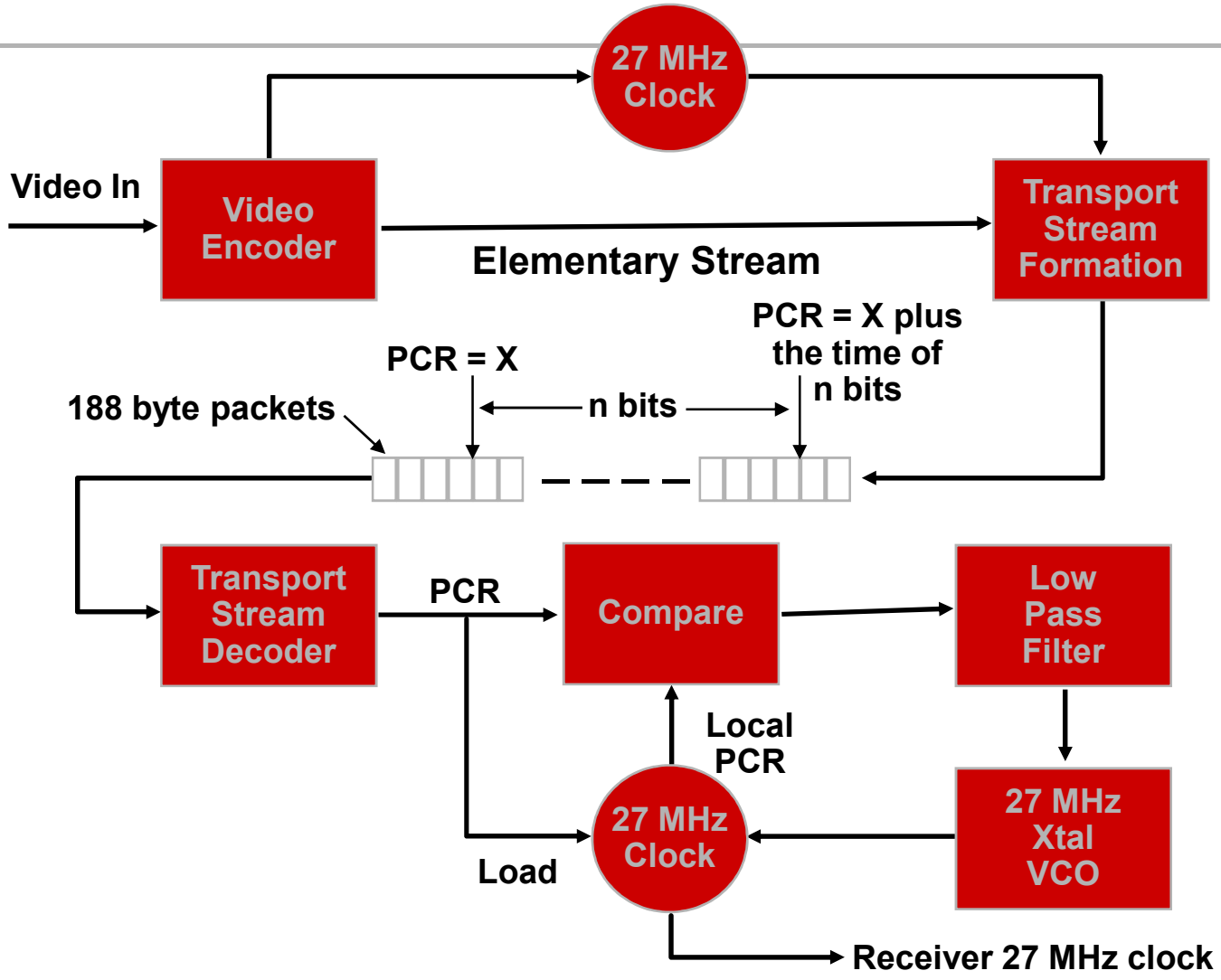
From PES to TS



Transport Packet Header



Reference Clock Synchronization

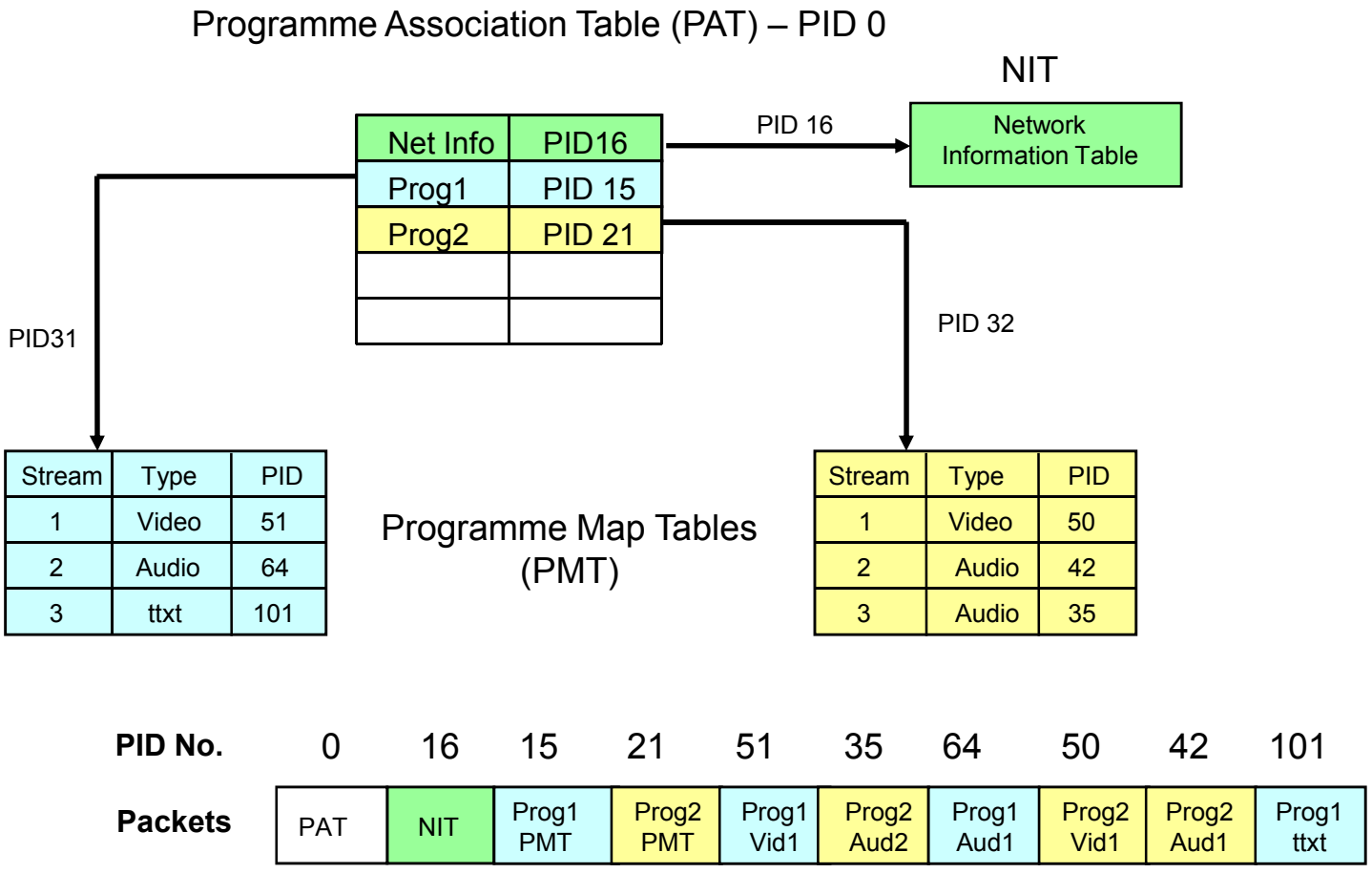


Decoding the Transport Stream

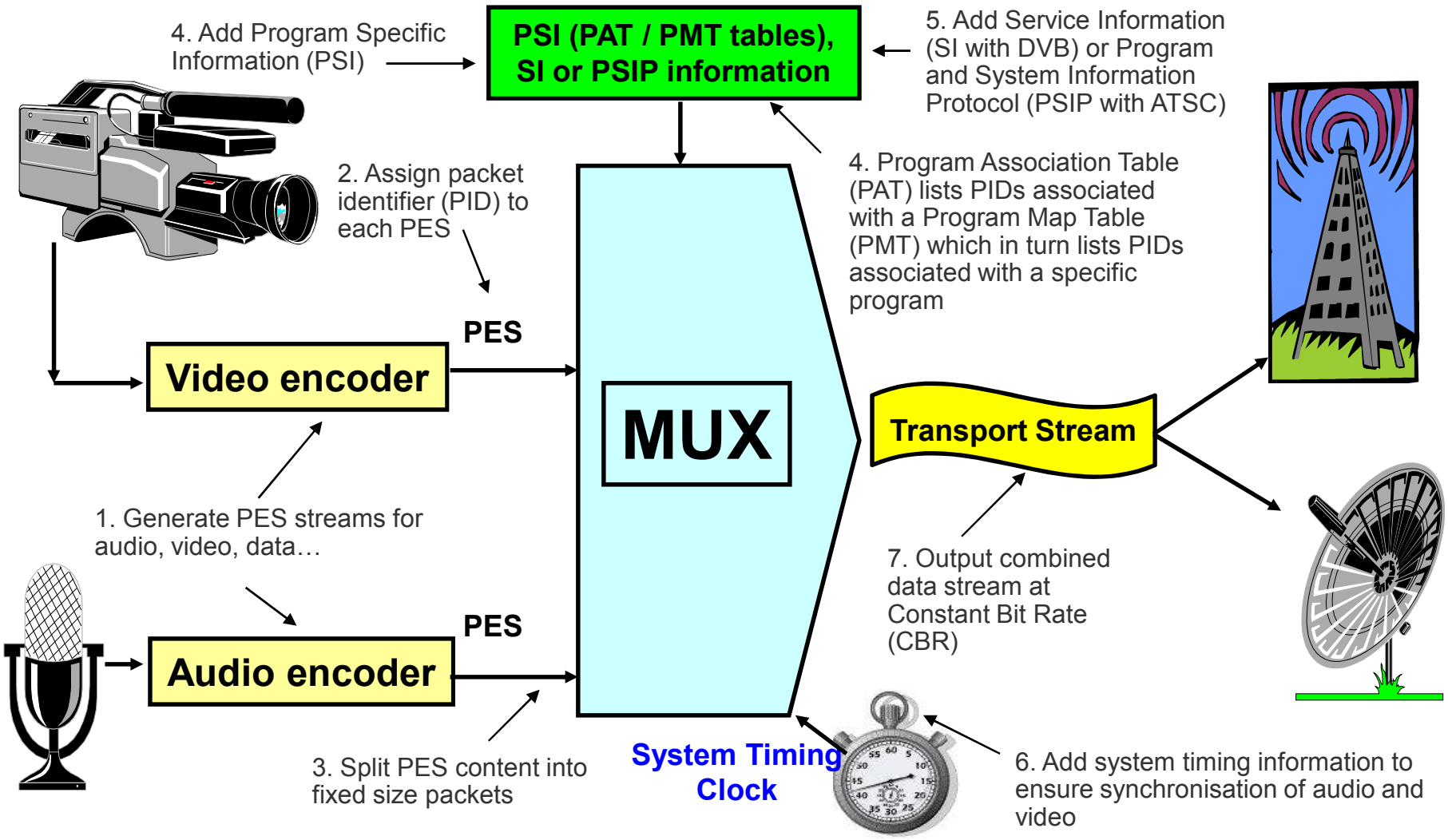
Program Specific Information (PSI)

- Program Association Table (PAT)
  - PID = 0, must be present in every transport stream
- Program Map Table (PMT)
  - PID values assigned by transmission system (DVB, ATSC, etc.)
- Conditional Access Table (CAT)
  - PID = 1 (EMM = entitlement management message)
- Network Information Table (NIT)
  - PID values assigned by transmission system
  - DVB considers this part of System Information (SI)
- Null Packets
  - PID = 8191 ($1FFF_{hex}$ = 13 ? $_{binary}$)

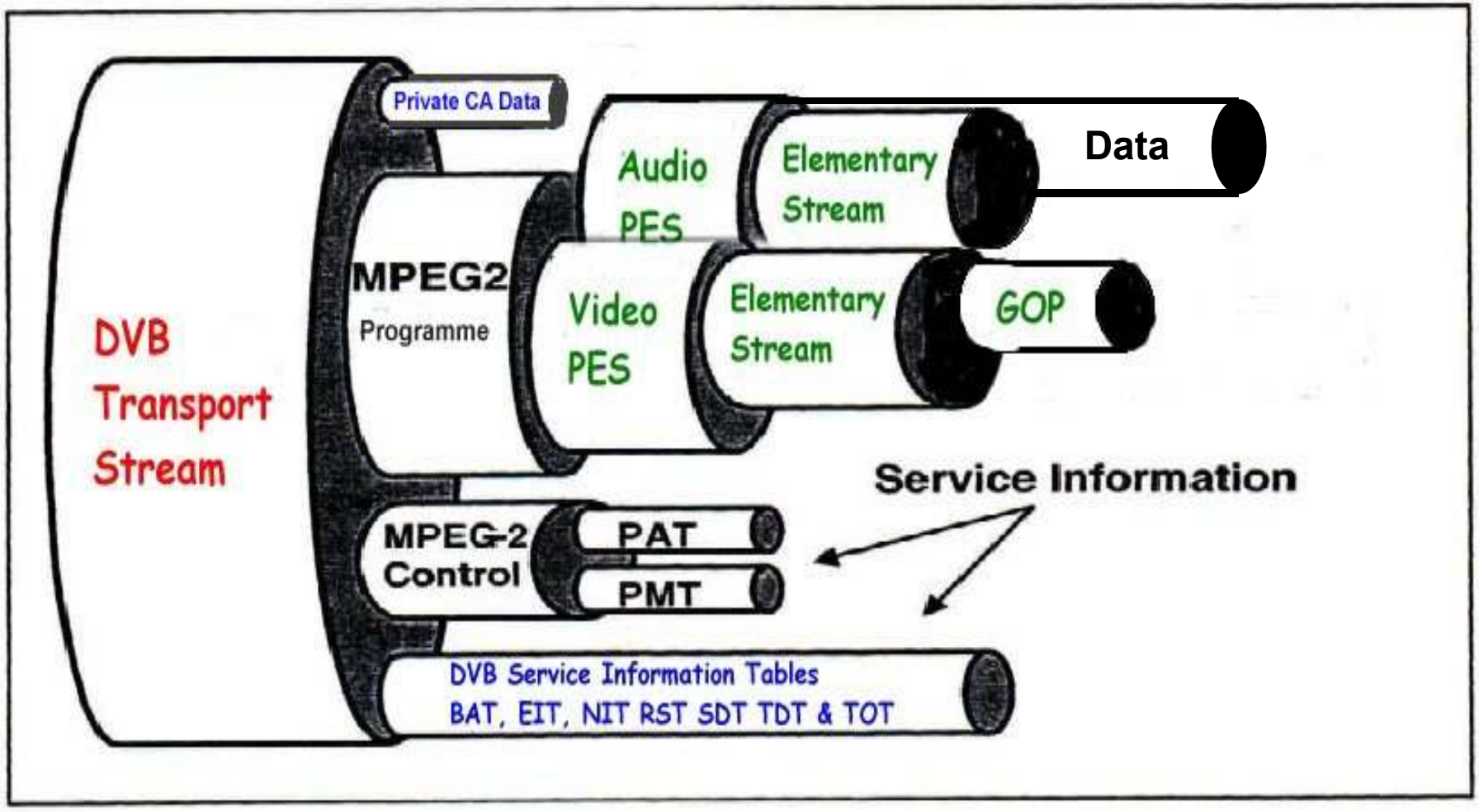
Program Specific Information (PSI) Tables



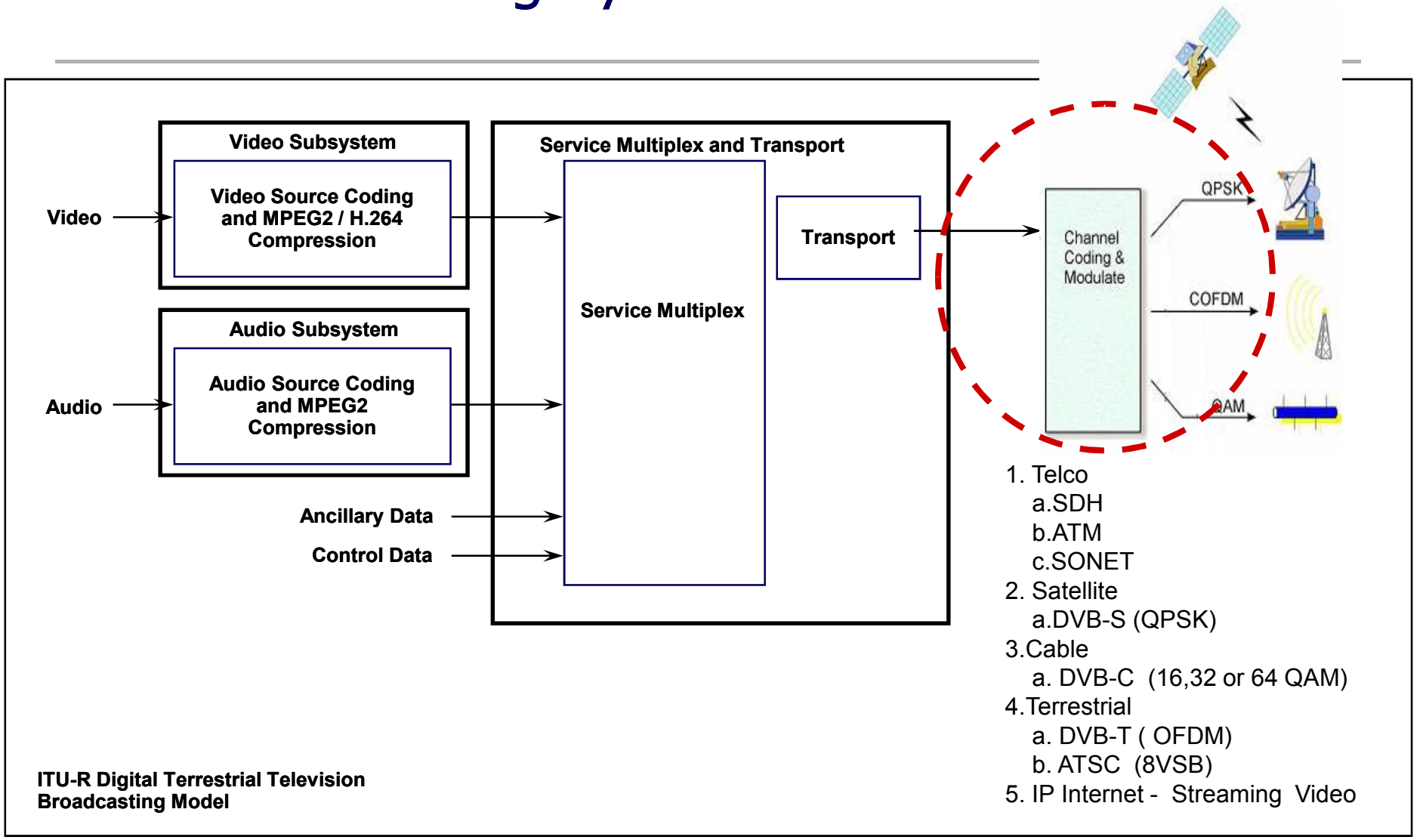
MPEG-2 Transport Stream



Transport Stream As a Carrier



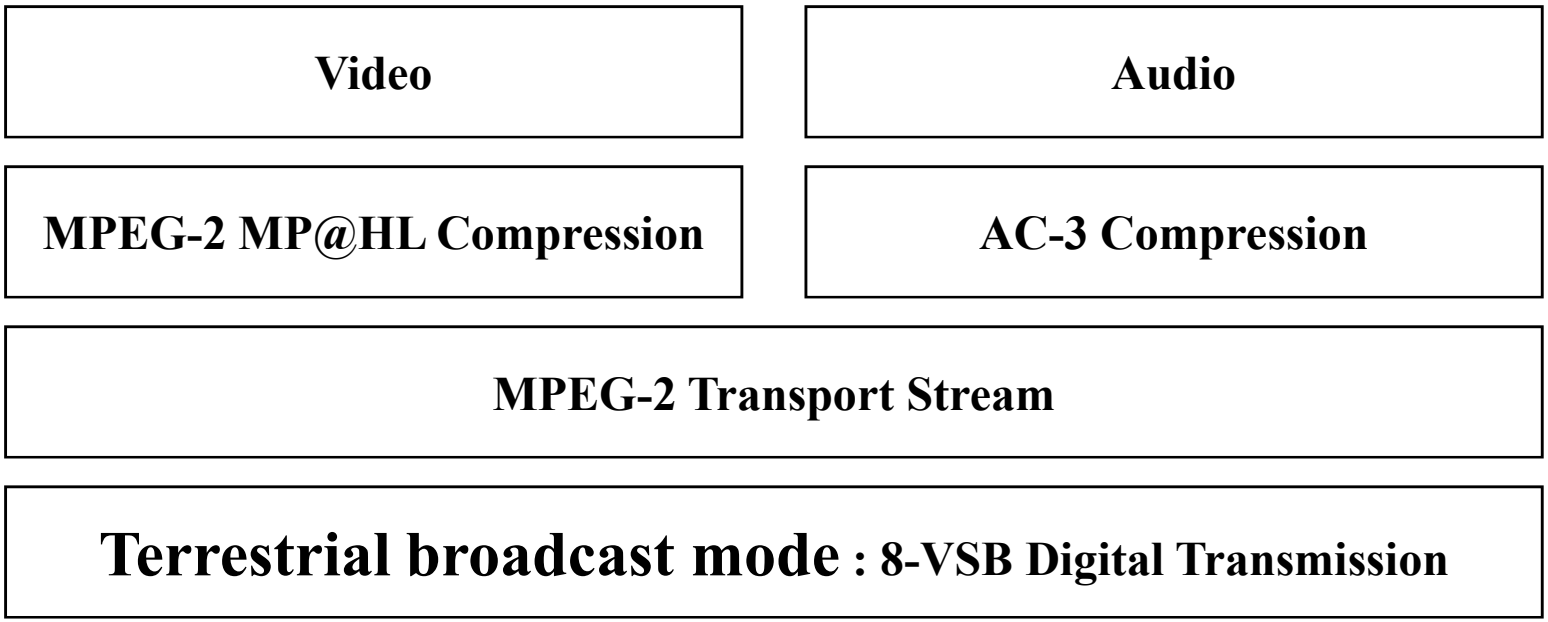
DTV Broadcasting System



ITU-R Digital Terrestrial Television Broadcasting Model

1. Telco
   a.SDH
   b.ATM
   c.SONET
2. Satellite
   a.DVB-S (QPSK)
3.Cable
   a. DVB-C (16,32 or 64 QAM)
4.Terrestrial
   a. DVB-T (OFDM)
   b. ATSC (8VSB)
5. IP Internet - Streaming Video

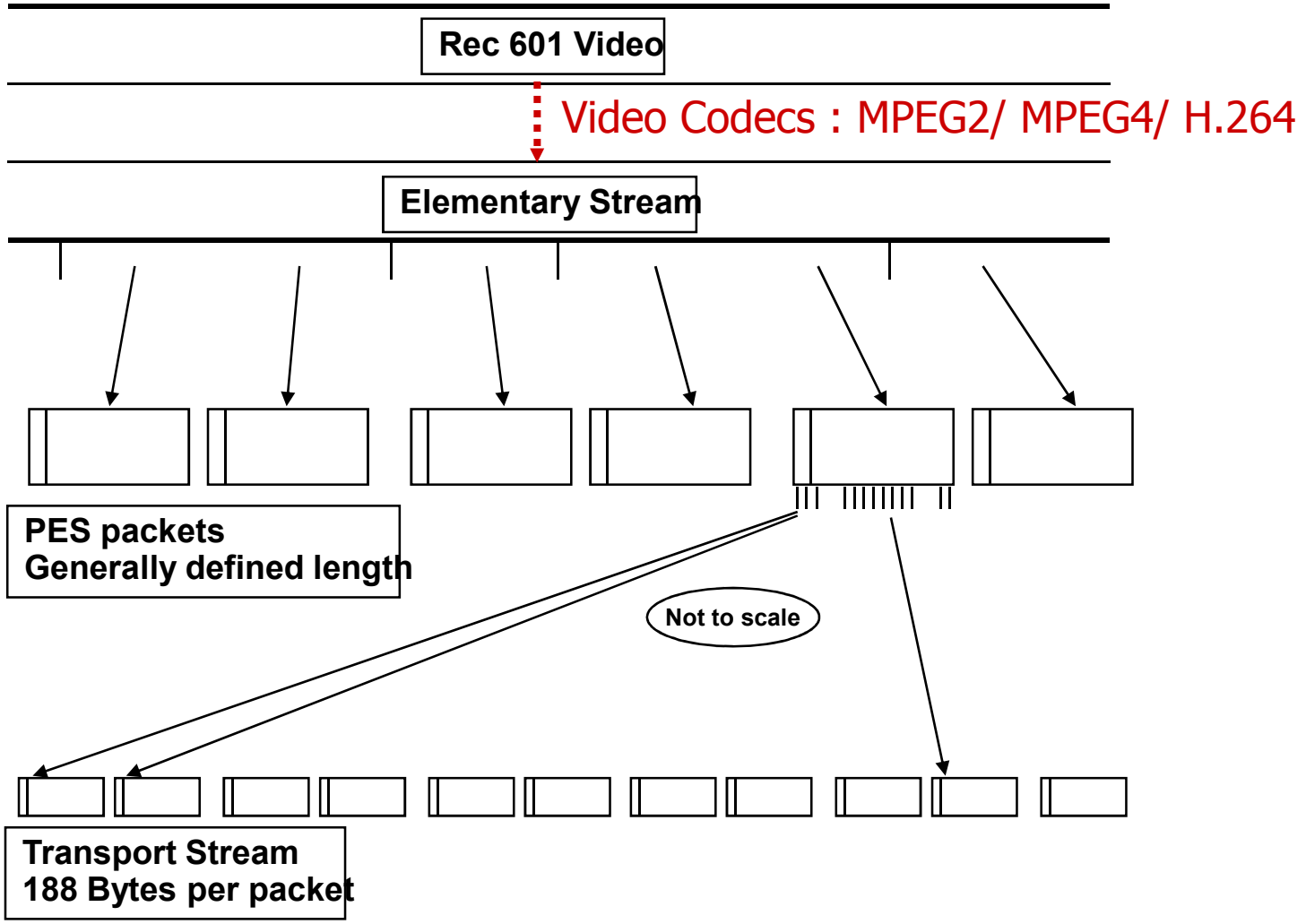
Elements of the ATSC DTV System



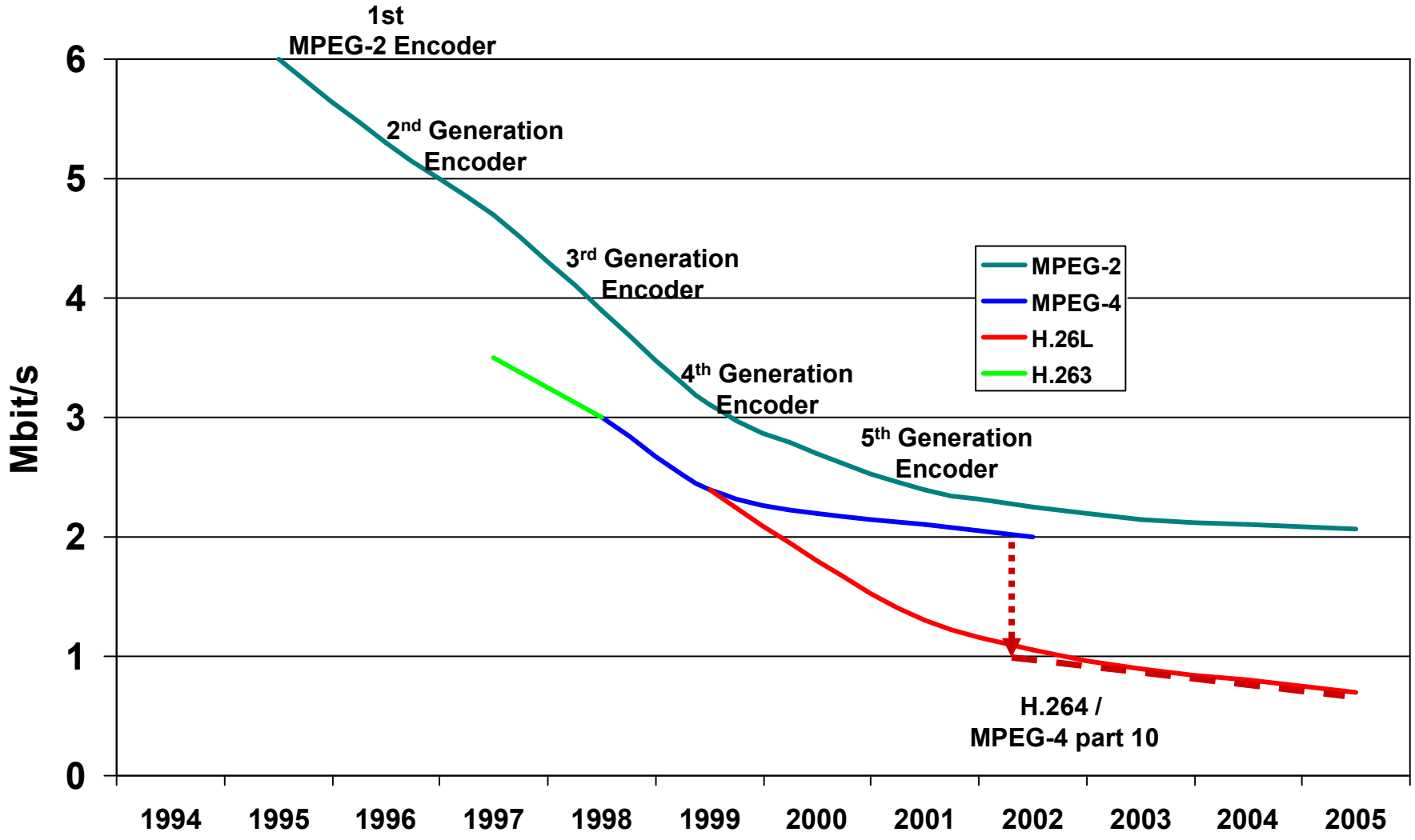
Elements of the DVB DTV System

Video	Audio
MPEG-2 MP@ML Compression MPEG-4 AVC HP@L4視訊格式	MPEG II Compression HE-AAC音訊格式
MPEG-2 Transport Stream	
Terrestrial broadcast mode, OFDM (2k or 8k) Satellite transmission, QPSK Cable transmission, 16, 32, or 64 QAM	

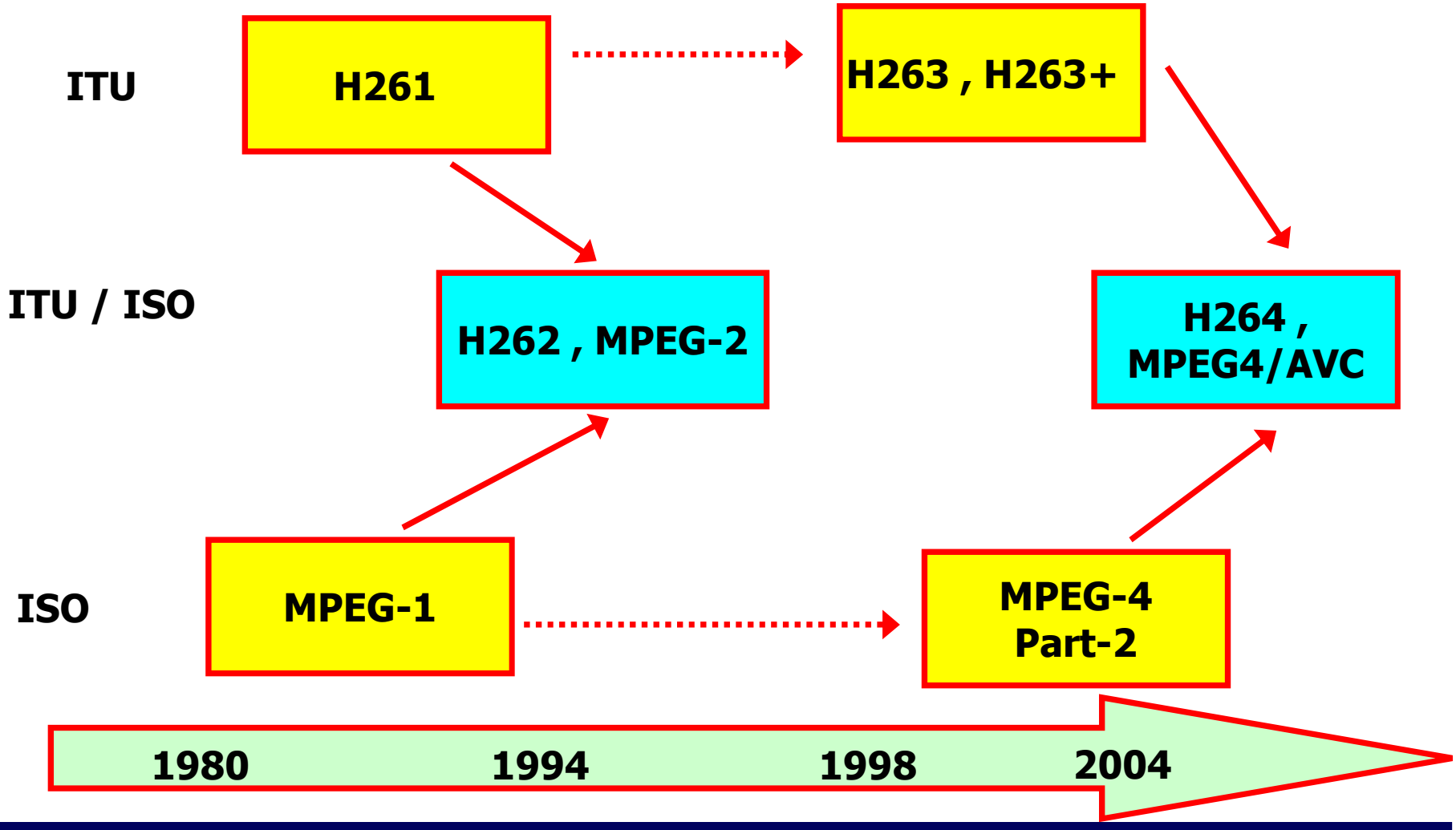
Transport Stream Formation



Bit-Rate Evolution



Evolution of the Standards

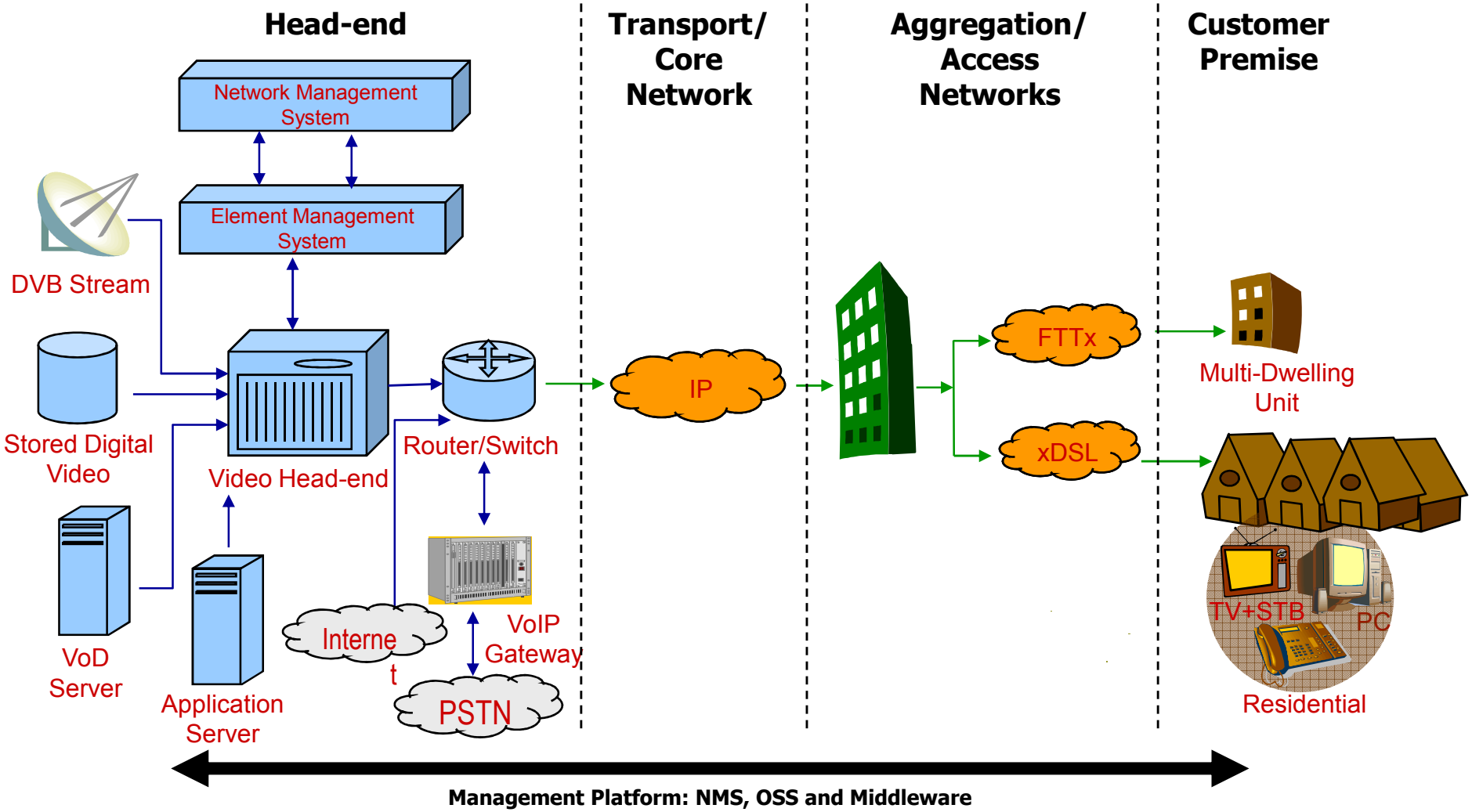


Use of Key H.264 Profiles

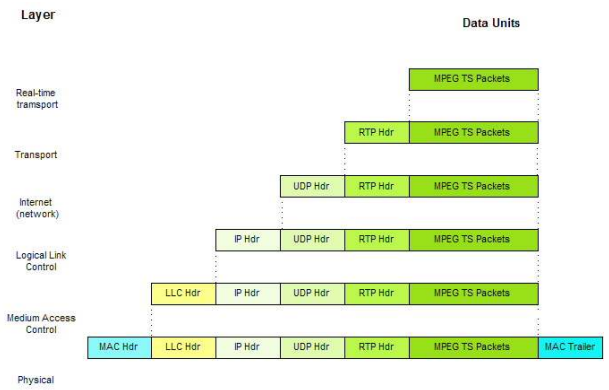
- Baseline
  - Cell phone/PDA
  - Has error-resilience tools
- Main
  - Broadcast, DVD+, CE apps
  - No error-resilience tools
- Extended
  - Streaming, wireless
  - Main – CABAC + Error Res.

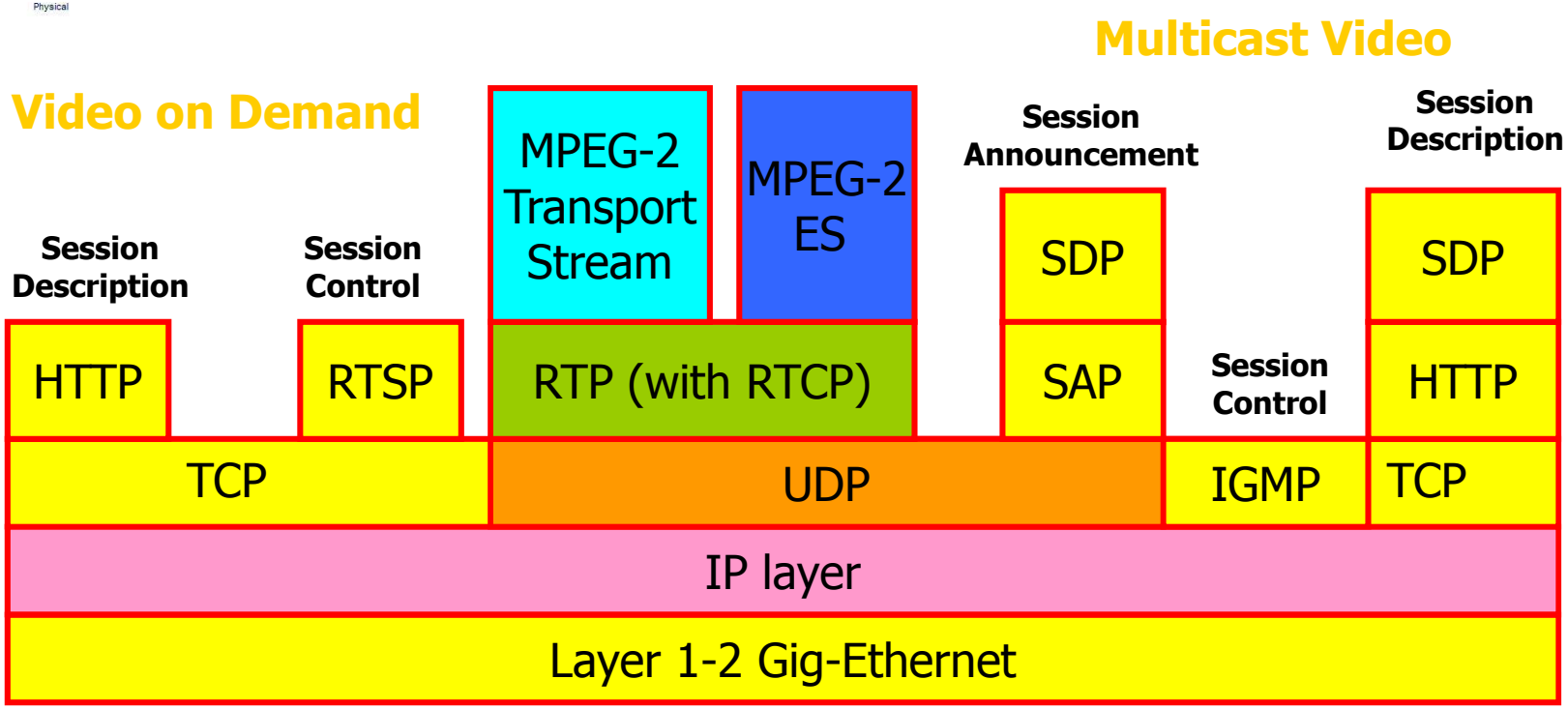
- FREXT for HDTV in progress
- High Profile with Fidelity Range Extensions (FRExt, with High/10, High/4:2:2 and High/4:4:4)

IPTV System Overview – Physical

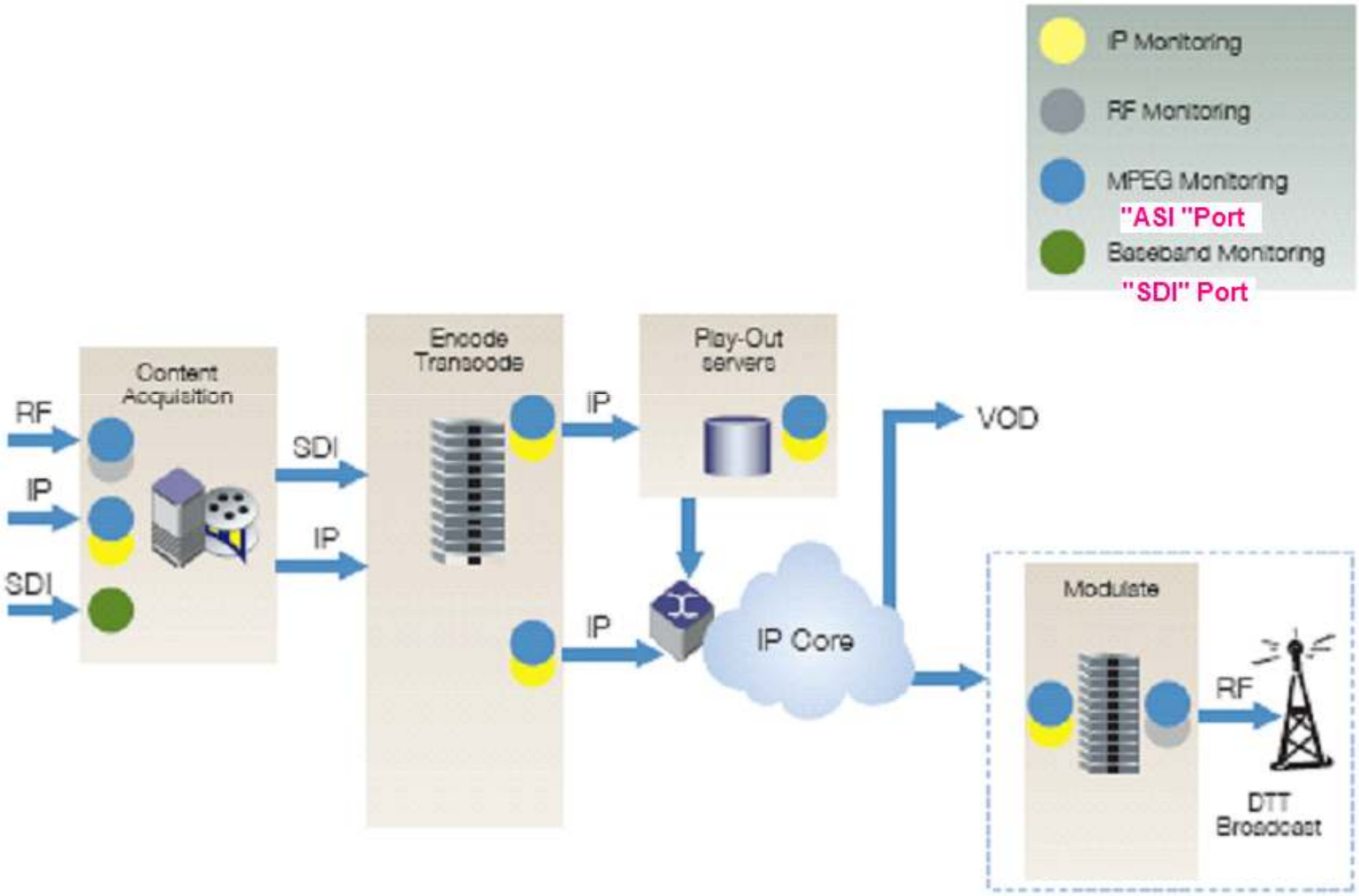


Protocol Stack & Layers relating to Video over IP





Typical Monitoring Points Terrestrial Hybrid System

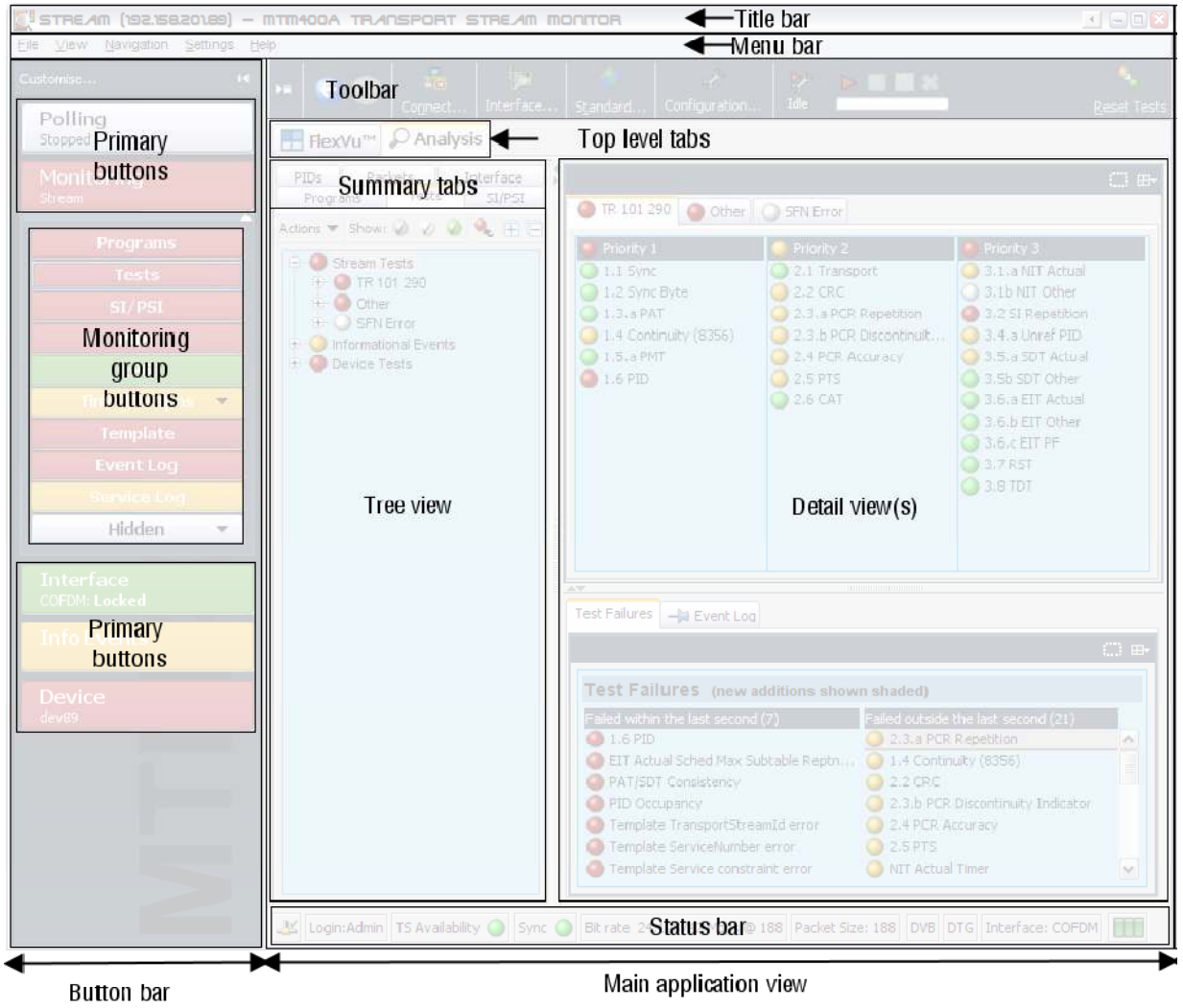


Simplifying DTV & IPTV Monitoring . . . . . .
The MTM400A with *FlexVu*Plus™ delivers

2007 Technical Emmy for MPEG Monitoring Technology

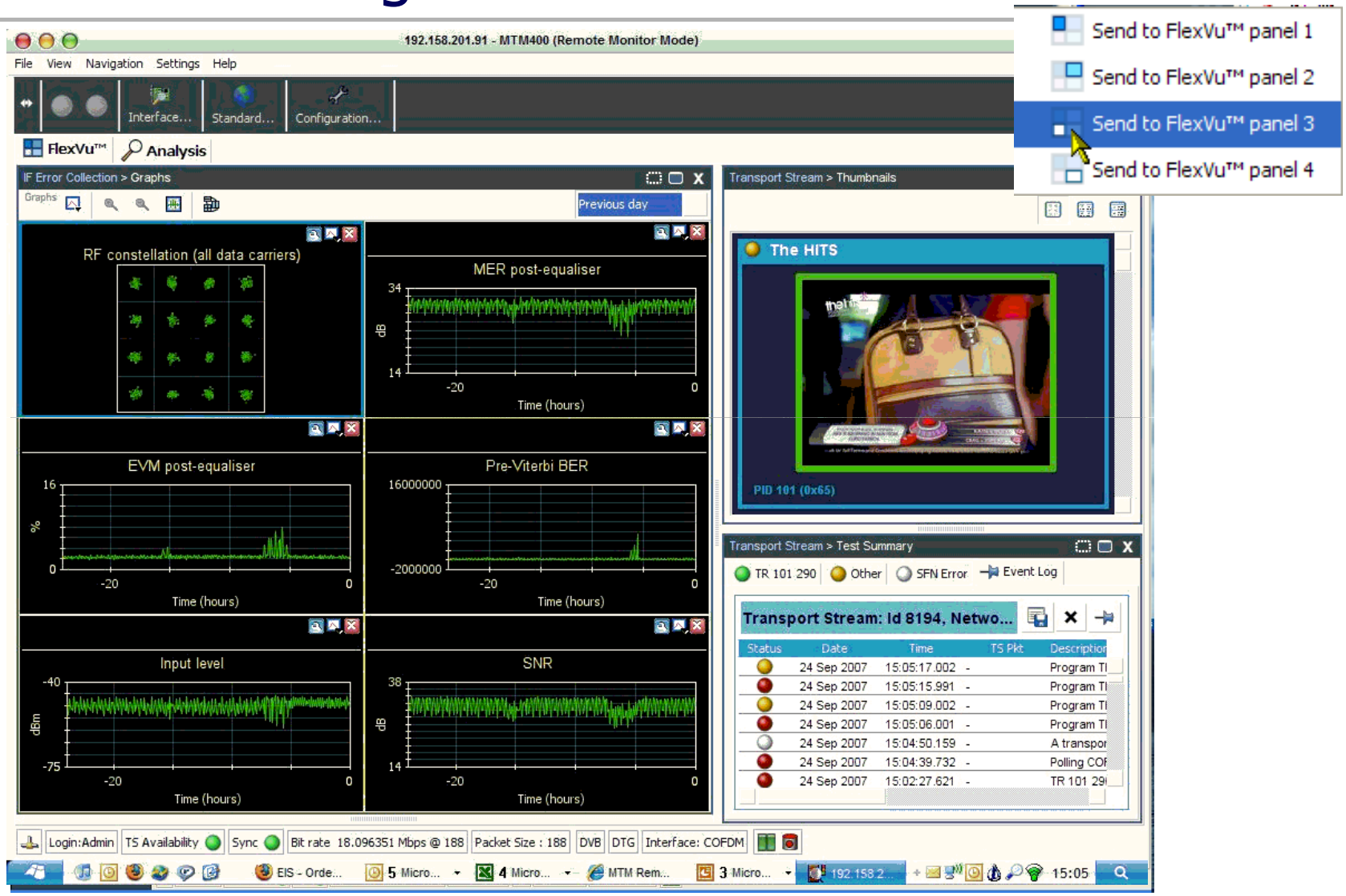
- Complete solution for real-time transmission monitoring of MPEG transport streams over RF, IP, and ASI interfaces.

MTM400A Remote User Interface Paradigm

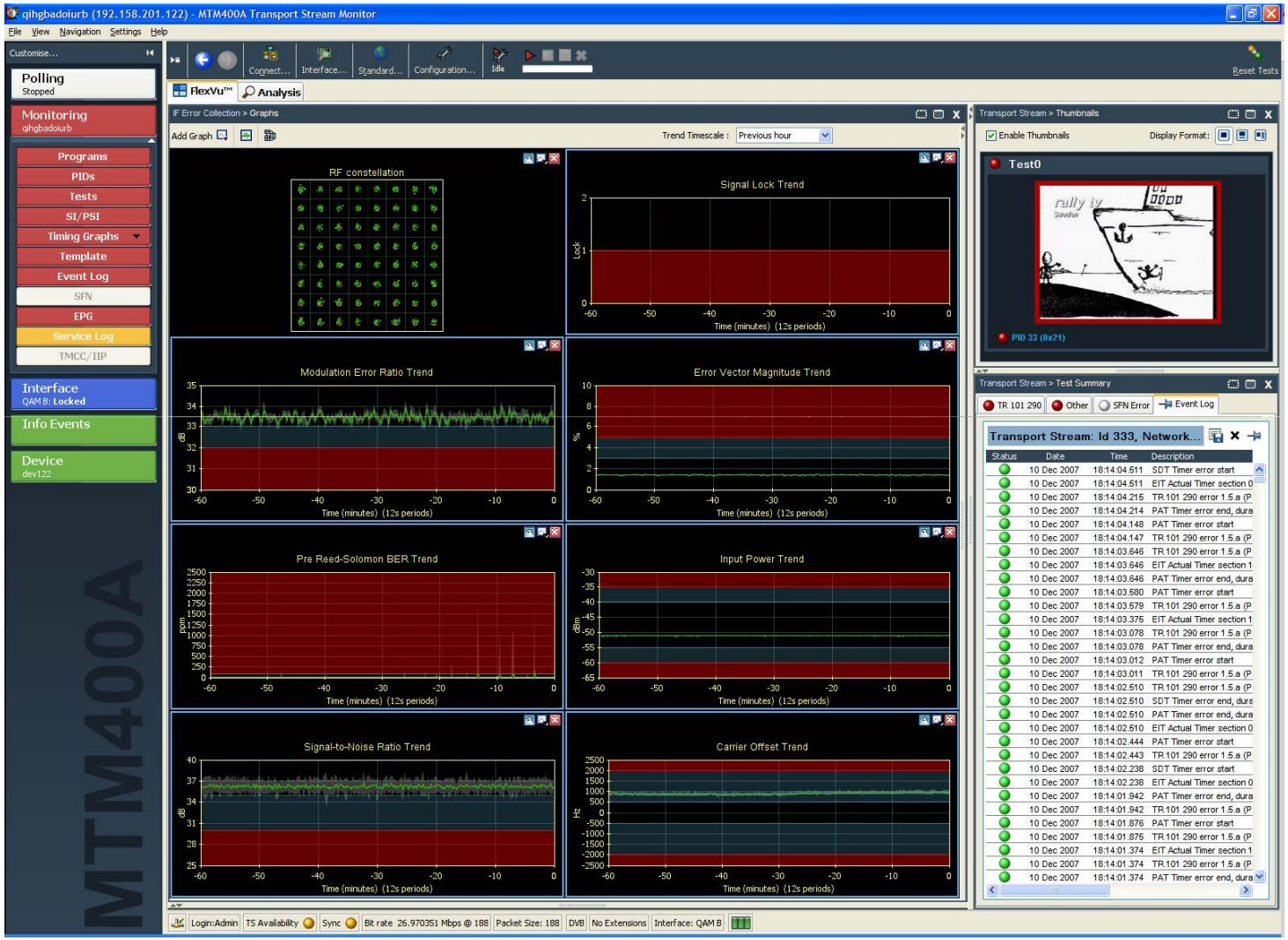


Deep diagnostic with "*One click*"

FlexVu™ Plus – Digital Terrestrial TV



*FlexVu*Plus™ for Cable with Seven Day RF Trending with ***unique*** Deep diagnostic with "***One click***" Level Alarming

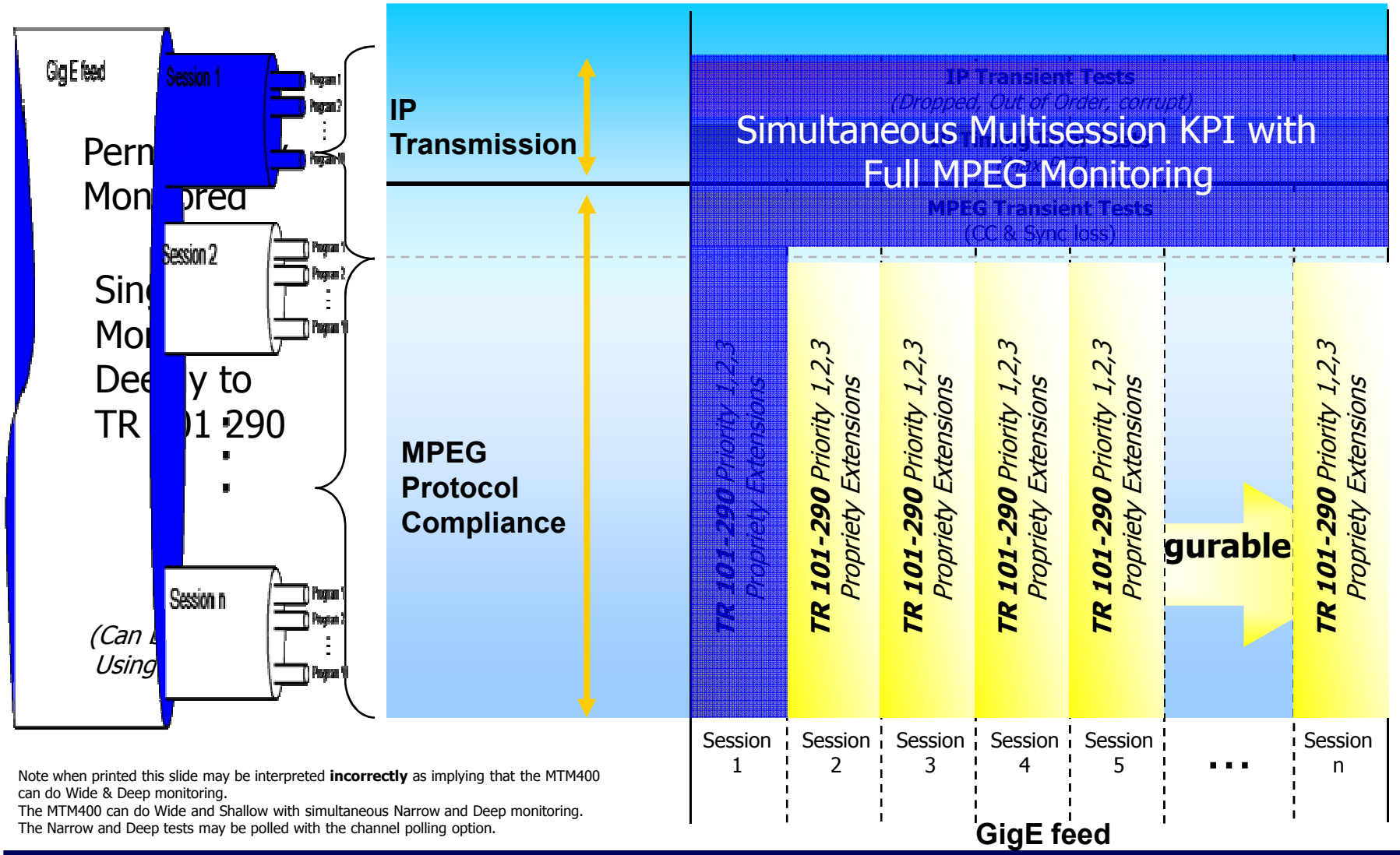


Tektronix®

*FlexVu*Plus™ for IPTV with Seven Day IP Trending
NEW Electronic Program Guide (EPG) view with *unique* Dual Level Alarming

Tektronix®

MTM400 GigE Monitoring



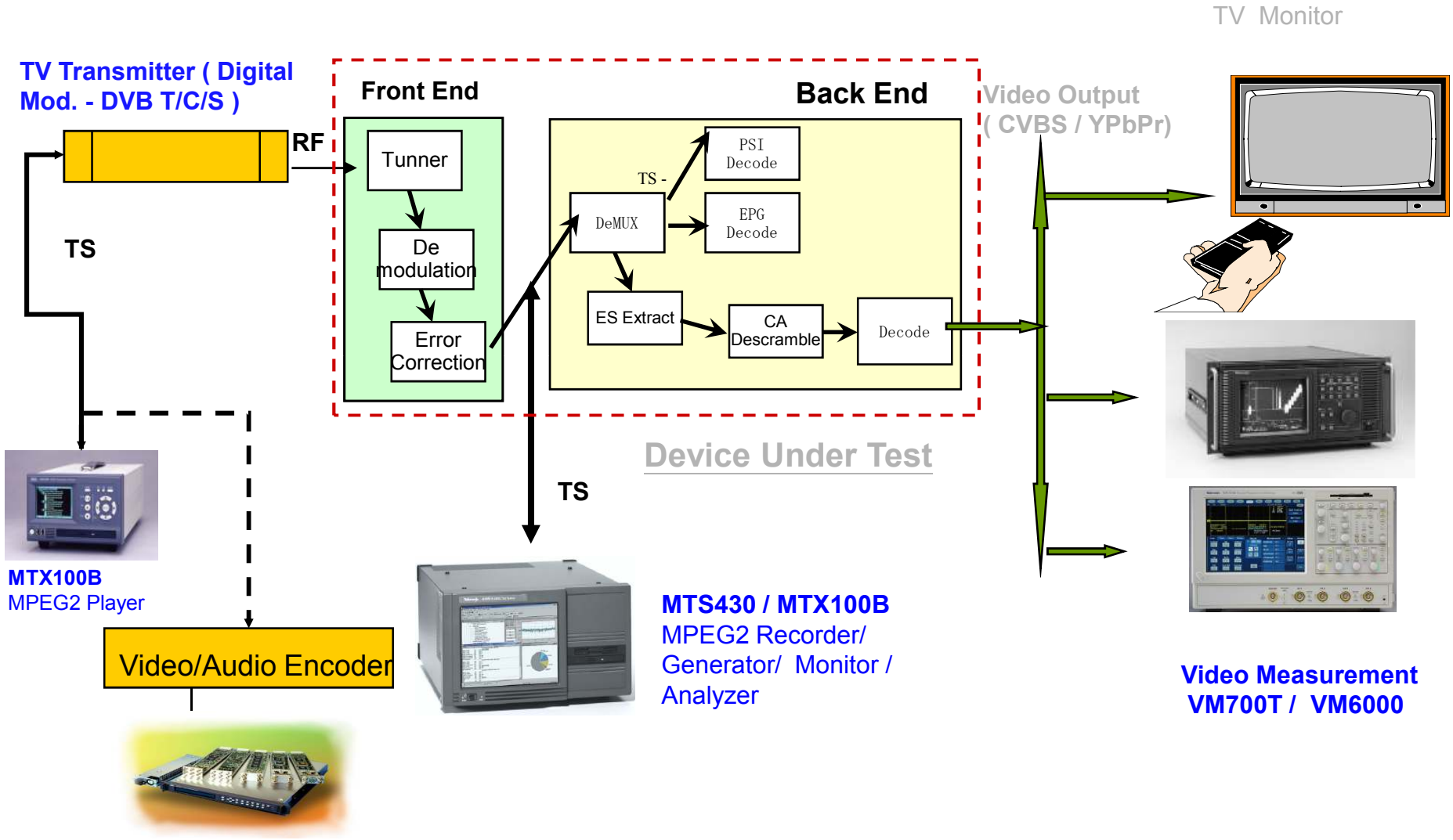
Note when printed this slide may be interpreted **incorrectly** as implying that the MTM400 can do Wide & Deep monitoring.
The MTM400 can do Wide and Shallow with simultaneous Narrow and Deep monitoring.
The Narrow and Deep tests may be polled with the channel polling option.

Multisession KPI monitoring

Critical Key Performance indicators that are permanently monitored across IP and MPEG layers

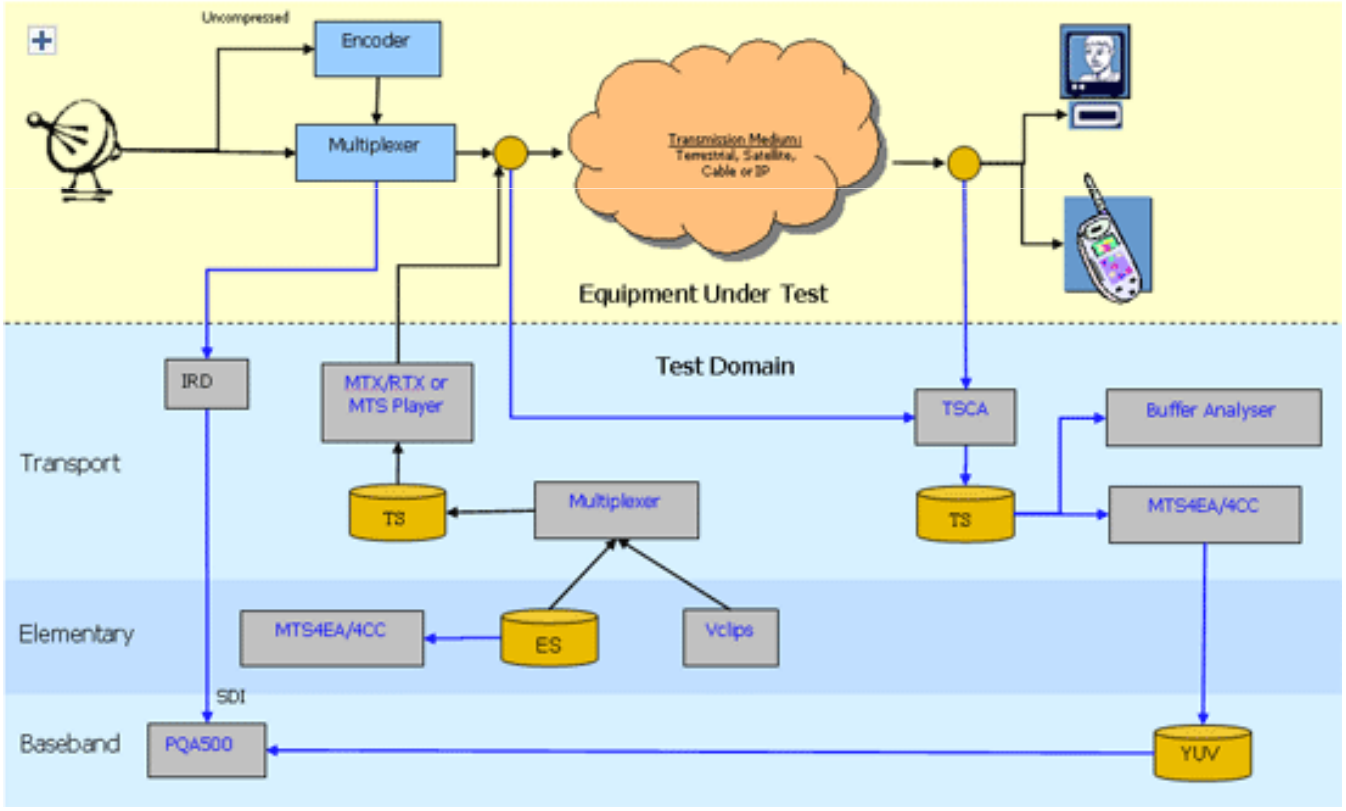
- Ethernet Frame Check Sum
- IP Header Check Sum
- Dropped packets
- Out of order packets
- Packet Inter-arrival Time (PIT)
- Sync byte
- Sync Loss
- Continuity Counter (4 bit counter & header)

DTV Video Testing Concepts



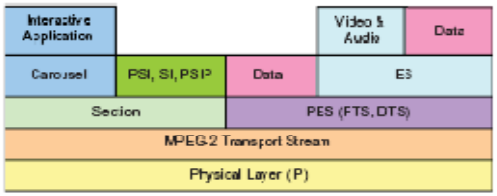
MPEG Test & Analysis Software

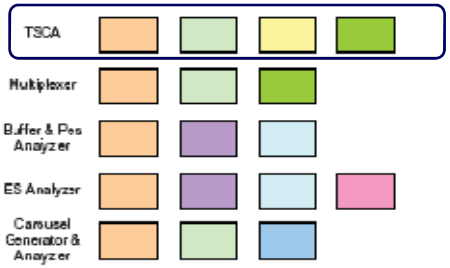
- Product Summary
  - MTS430/415/400P/MTS4SA MPEG Analysis
  - MTS4EA Elementary Stream Analyzer
  - Vclips and Tclips Test Streams

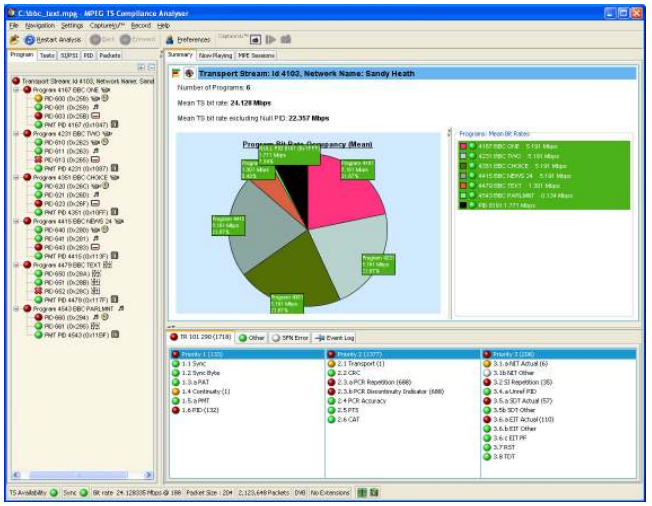


Transport Stream Compliance Analyzer (TSCA, TSCR)

- TSCA combines a high-speed analysis engine with built-in intelligence (CaptureVu™), which allows ultra-fast pinpointing and debugging of intermittent faults in MPEG Transport Streams.
- TSCR is a Real-time version of the TSCA analyzer operating on Transport Streams received through the PC's Ethernet port.
- TSCR includes Cross Layer time-correlated IP and TS measurements, alarms and error logging together with stream recording.
- Both the TSCA and TSCR offer the CaptureVu™ technology and PCR measurement and graphing capabilities.
- Video thumbnail decode of video streams and associated ES header information, including H.264.







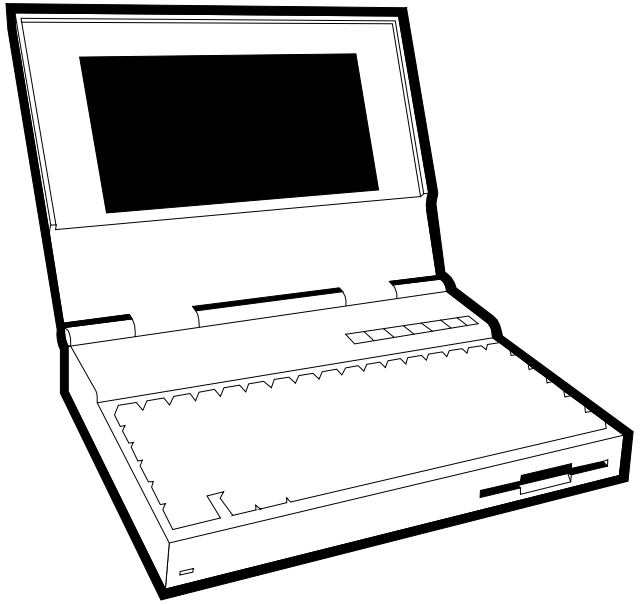
Platform MTS430/415 & 400P

- MTS415 Outline Spec
  - Includes TSCX, TSCA, Buffer Analyser, PES Analyser, MTS4CC (inc CODEC options) , Player & Tclips as standard
  - Optional Multiplexer
- Storage:
  - 2x72 GB SCSI for Stream Storage
  - 80GB system IDE HDD
  - SCSI Bus Extension – unlimited storage

- MTS400P Outline Spec
  - Includes TSCX (real-time analyzer as standard
  - Options for TSCA, Multiplexer, Buffer & PES Analysers , **Player** and IP Video interface
- Storage:
  - 182GB for Stream Storage
  - 20GB system IDE HDD

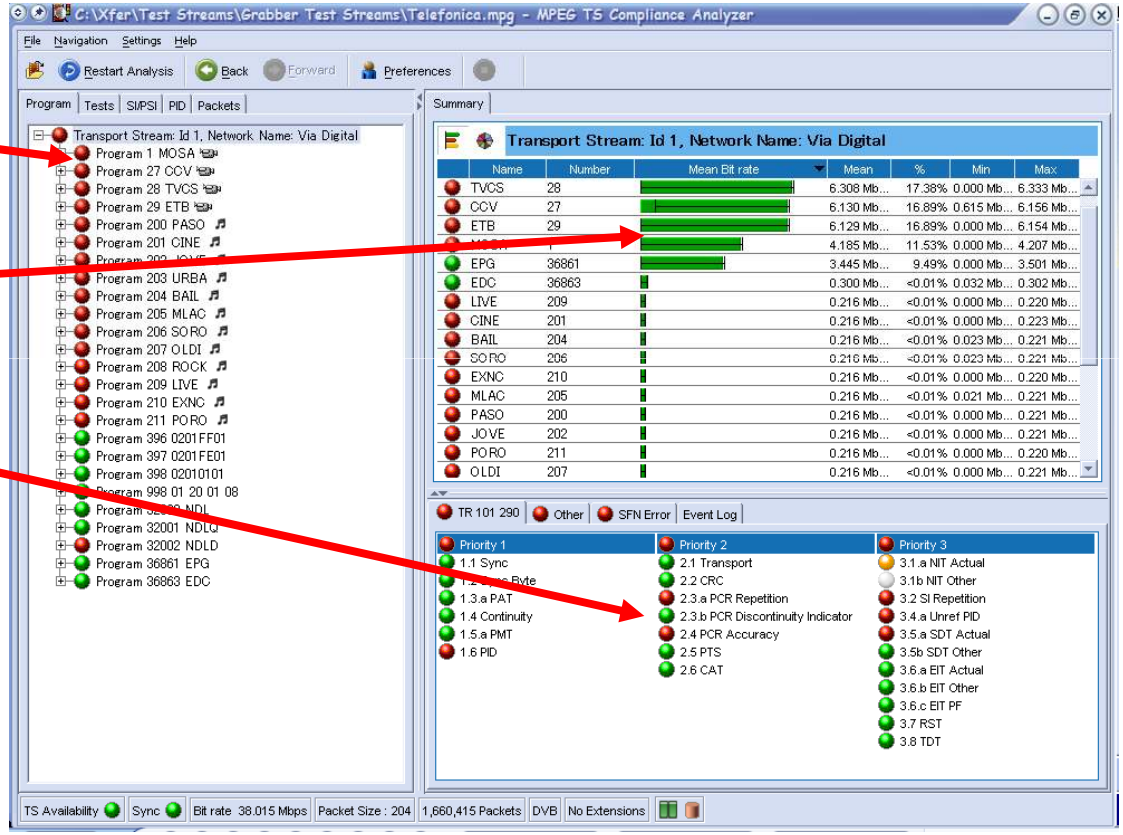
Making Sophisticated Analysis more affordable

- MTS4SA
  - Standalone Software for Windows™ NT, 2000 and XP
- Options:
  - Real Time MPEG over IP Analyzer with CaptureVu™
  - Deferred Time Analyzer with CaptureVu™
  - PES & Buffer Analyzer
  - Carousel Analyzer
  - Carousel Generator
  - Multiplexer
  - Elementary Stream Analysis

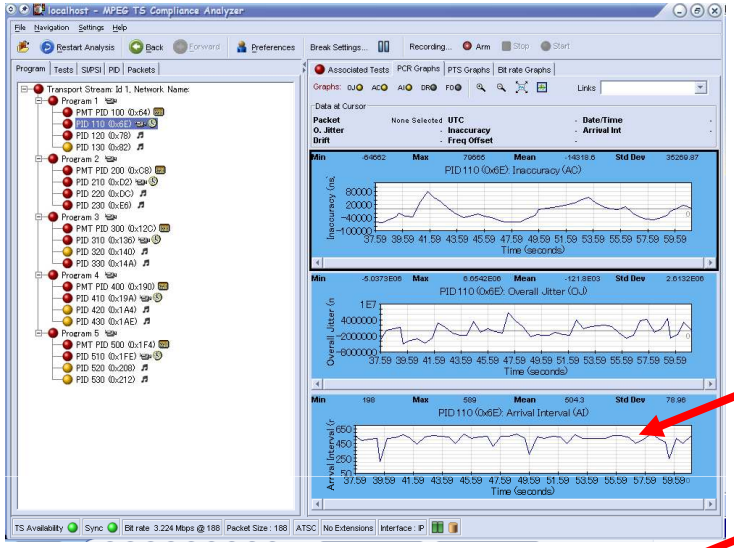


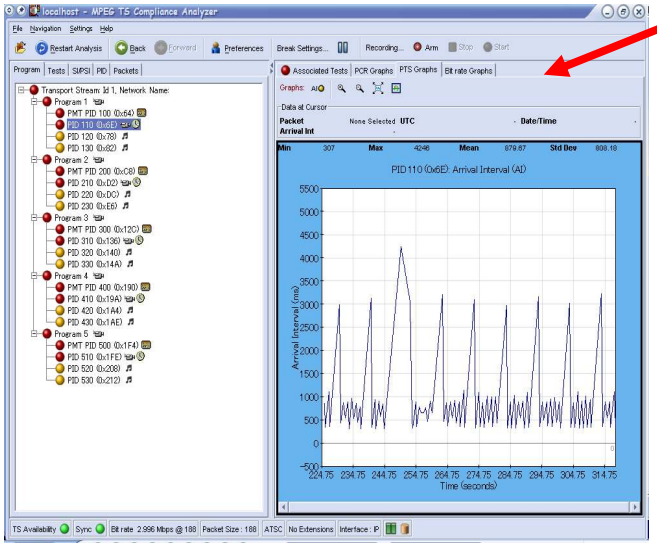
Transport Stream compliance Analyzer

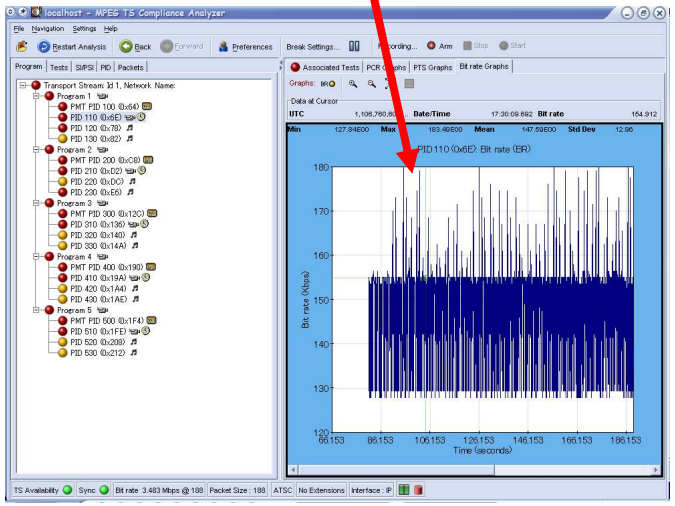
- Same User Interface for Real Time and Deferred Time Analysis
  - Highlights errors on specific Programs
  - Visual indication of stream occupancy
  - Direct access to errors including ISDB-T, ISDB-TB (Brazil), DVB, ATSC
- Brings expert power to the novice user



Real Time MPEG Timing Analysis



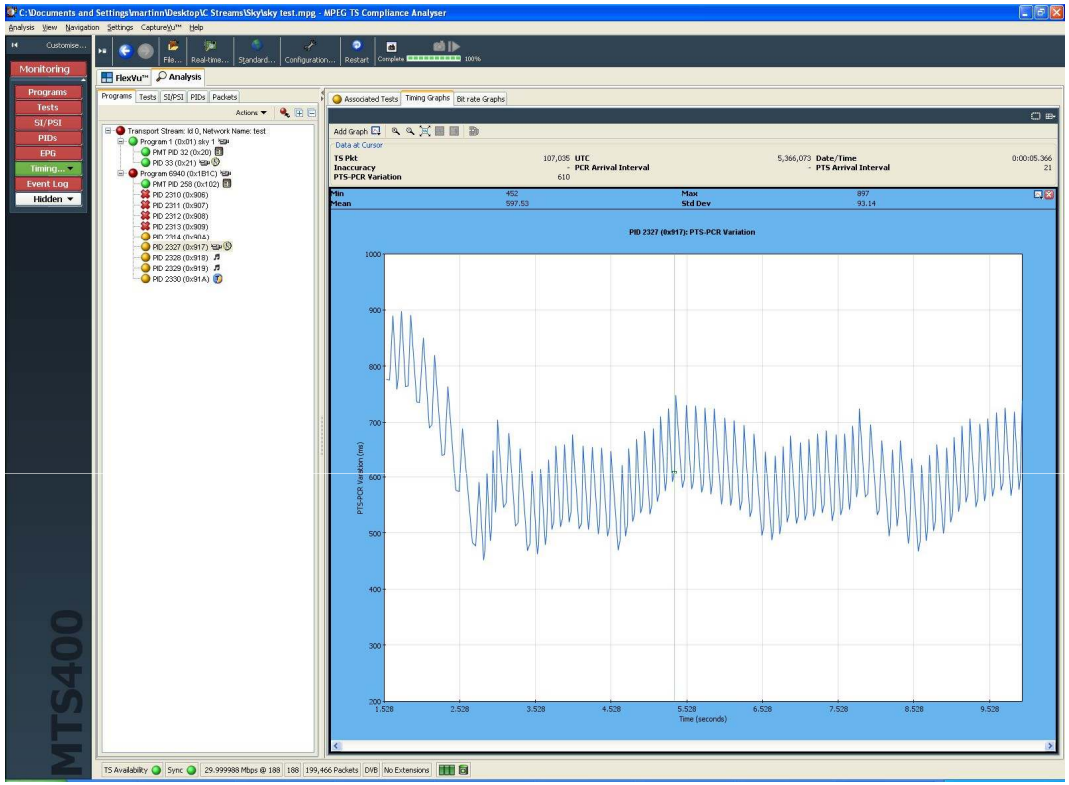




- Same functionality as Real Time ASI Transport Stream Analysis *including*
  - CaptureVu™
  - Time Stamped PCR Analysis (OJ, Accuracy, Arrival Time, Drift and Frequency Offset)
  - PTS timing Analysis
  - Bit Rate Analysis

PTS – PCR Graph

- Useful for detecting encoder timing problems likely to cause receiver T-STD problems.
- Plots the PTS to PCR time difference for each PTS
- The graph is independent of CODEC type
- It is located in the Available Graphs tab for every ES carrying PTS data
- Also included in MTM400A v3.1



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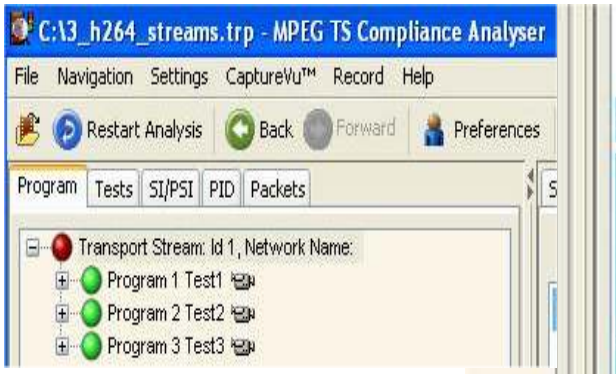
H264 Detailed thumbnails



Pixel Shape: **1:1 (Square)**
Chroma Format: **4:2:0**

Program 2 (0x2) Test2

Stream type

27 (0x1B) (AVC - H264 video stream)

Video Attributes

Coding Mode: **CABAC**
Profile and Level: **Main @ 4**
Horizontal Size: **1280 (if 16x16 macroblock)**
Vertical Size: **720 (if 16x16 macroblock)**
Pixel Shape: **1:1 (Square)**
Chroma Format: **4:2:0**

PID 36 (0x24)

Program 3 (0x3) Test3

Stream type

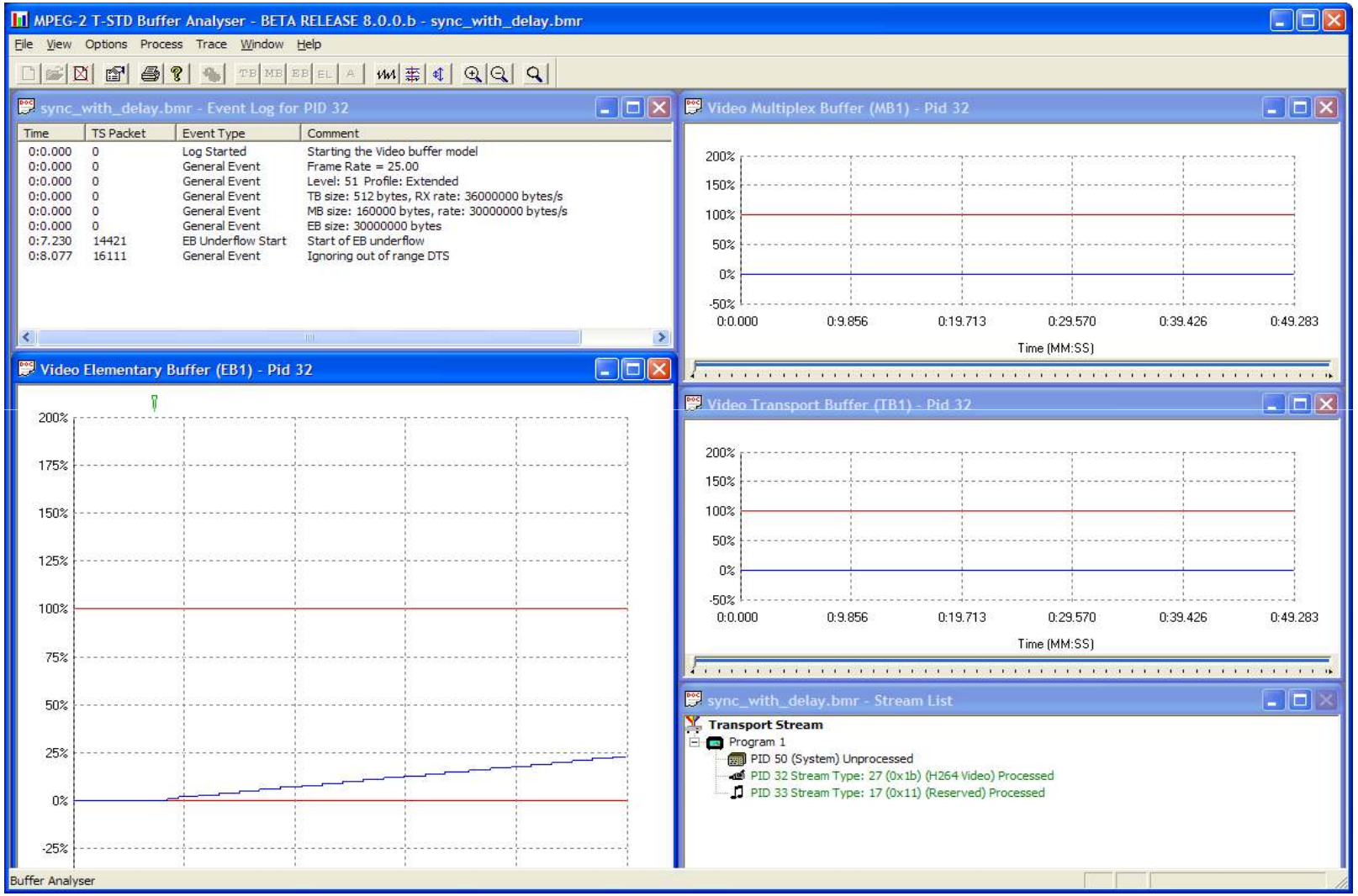
27 (0x1B) (AVC - H264 video stream)

Video Attributes

Coding Mode: **CABAC**
Profile and Level: **High @ 4.1**
Horizontal Size: **1280 (if 16x16 macroblock)**
Vertical Size: **720 (if 16x16 macroblock)**
Pixel Shape: **1:1 (Square)**
Chroma Format: **4:2:0**

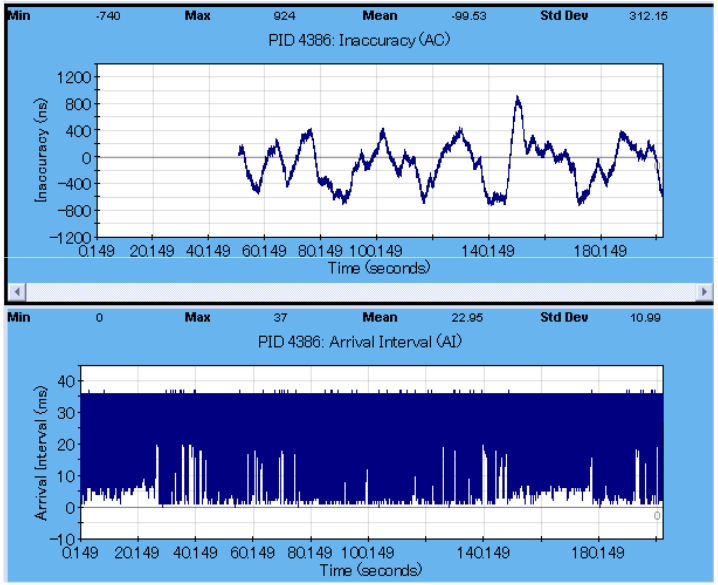
PID 37 (0x25)

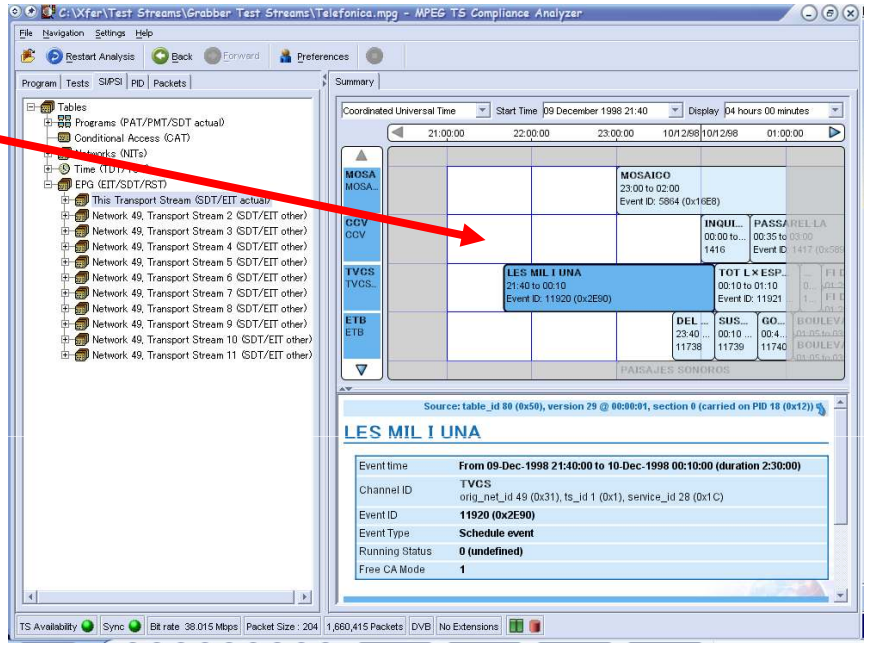
H.264 TSDT Buffer Analysis Details



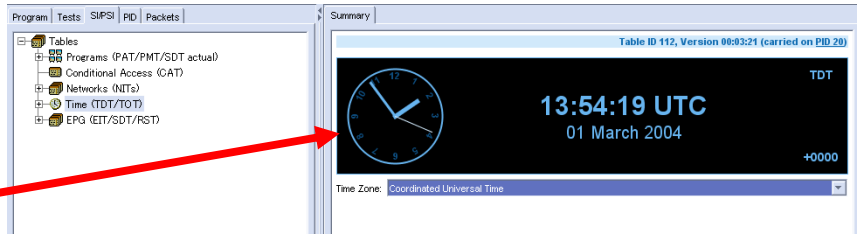
Major Features - Provide Information not Data

- Real Time & Deferred Time EPG
  - ISDB-T, DVB, ATSC



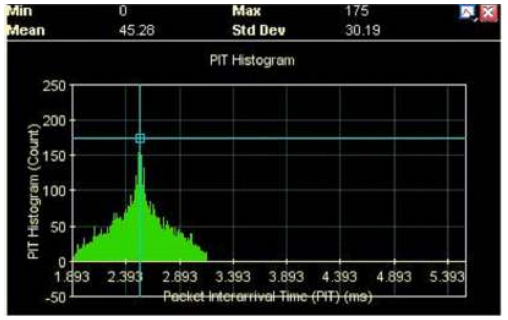


- Meaningful Graphical Displays
  - TDT Table Information

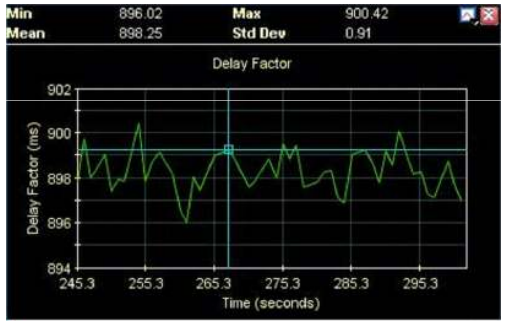


Video Over IP Analysis

- IP Network Performance Statistics
  - Packet Arrival Interval Histogram
  - delay factor (DF)
  - media loss rate (MLR)
  - displayed as a single result; "*DF* : *MLR*"
- IP Session Capture and deferred time IP file analysis
  - De facto standard PCAP file format compatible with Wireshark (Ethereal)
- IP measurements and stats available in real time and deferred time
  - Packet Loss, Out of Order Packets, Checksum
  - Instantaneous PIT – Mean, Max, Min
  - MDI, PIT Histogram
- Can be used simultaneously with ASI or RF interface



Packet Arrival Histogram



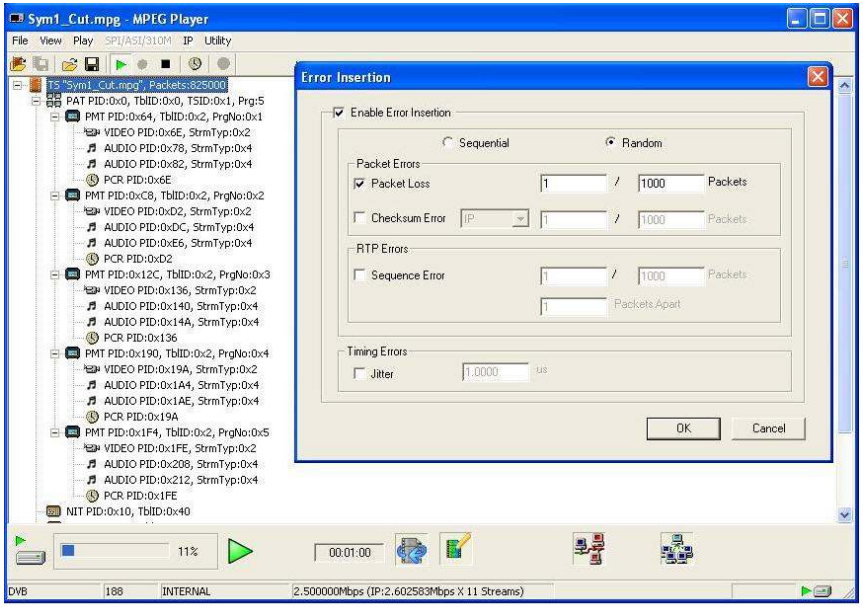
MDI – Delay Factor

MDI – Media Loss Rate

Video over IP Generation

Features

- Error Insertion Capability
  - Packet Drops
  - Checksum Errors
  - Sequence Errors and Jitter
  - Manual error generation capabilities
- Support for Parametric playout - Burst mode
  - both timing and packet number based
- Advanced Mode with Protocol header customization capabilities
  - Source and destination ports and addresses
  - MAC address, transport checksum, network checksum
  - User editing of any packet header field parameters
- Session replication to simultaneously encapsulate and play a TS over many IP sessions
- Single session playout up to 240Mbps and multi session playout up to 300Mbps

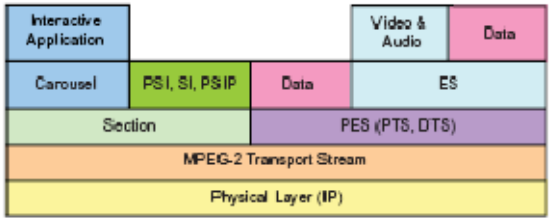


Benefits

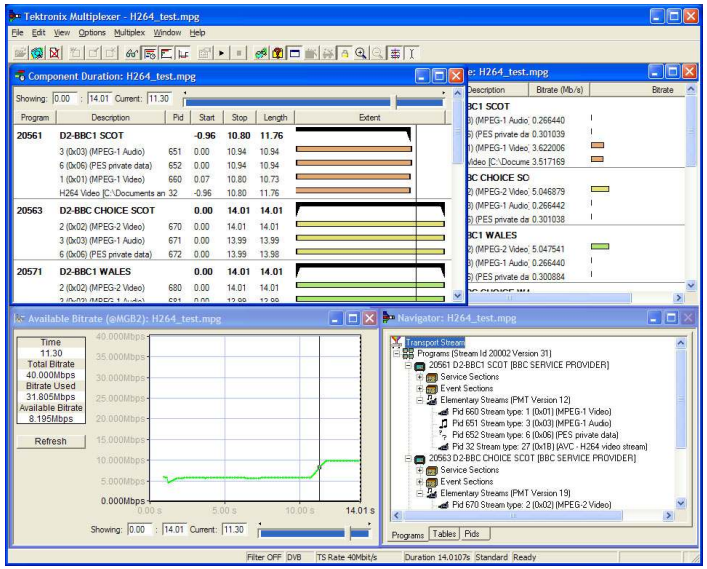
- Combination of IP (UDP & RTP) playout and analysis enables easy compliance verification of DUT
- Error insertion capabilities ensure designs are reliable on real world networks

Continuously loop stored streams and create errors to ensure quality of products

Multiplexer

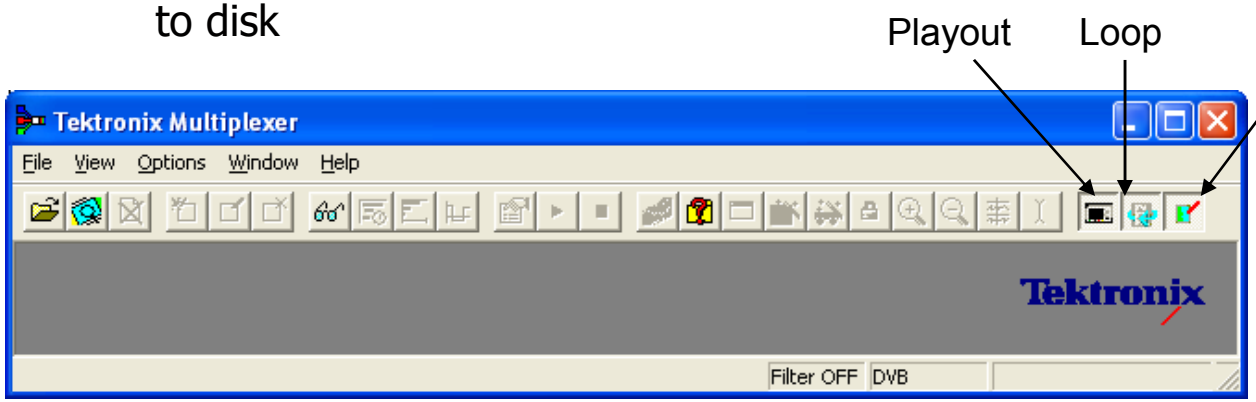


- Use the **Multiplexer/Re-multiplexer/De-multiplexer** application to create and modify multi-program Transport Streams with custom **SI/PSI/PSIP information**
- **Multiplex video and audio Elementary Streams** into a Transport Stream.
- **Create your own test streams** to validate and debug your designs more quickly
- **Create errored streams** to perform parametric stress testing
- Create or modify test streams containing **H.264 content**
- Support for all types of H.264 stream timing – the most powerful H.264 stream creation application available
- Easily provide flexible test sequences for quality assurance of solutions and for compliance test against standards
- Multiplexes test streams from the Tclips or VClips test stream libraries



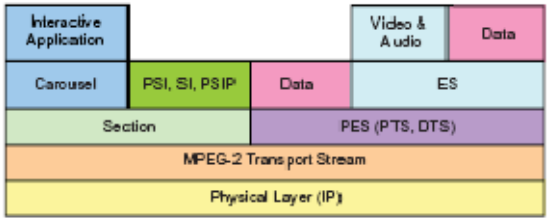
Software Updates: Multiplexer

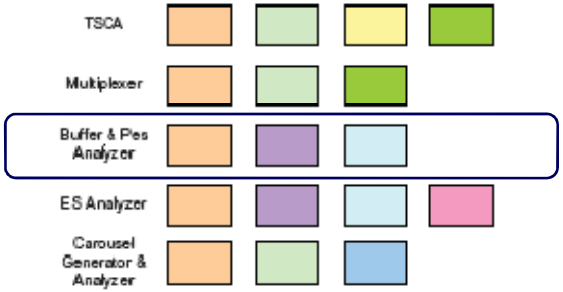
- New ISDB-TB and One Segment regions to the ISDB base standard.
- Supports the mandatory MPEG-4 AAC CODEC for stream generation
  - Includes Main, High Efficiency (HE) and Low Complexity (LC) profiles
  - Includes LATM Multiplex and LOAS Transport formats
  - All channel configurations up to 5.1
- Consistent with other CODEC support
  - Import MPEG-4 AAC ES and Pes streams
  - Export MPEG-4 AAC ES and Pes from a source Transport Stream
- Integrated playout
  - User option to play out generated stream directly through Player, rather than save to disk

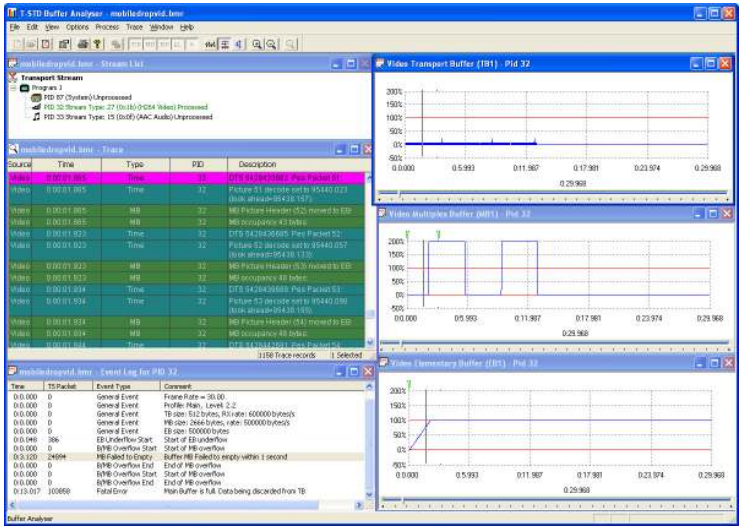


T-STD Buffer Analyzer

- Verifies conformance of a stream to the T-STD buffer model
  - based upon the DTS values within the PES header
- Determines if any of the internal buffers will be caused to either underflow or overflow.
- Consequences of these conditions will be freeze frames and receiver resets.
- Testing of next generation codec designs to ensure conformance to TS buffer requirements
  - Supports H.264 video and MPEG-4 AAC audio codecs

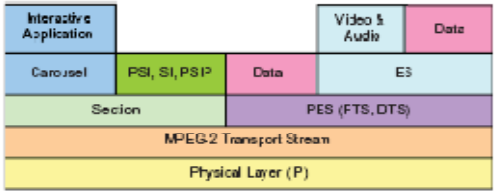


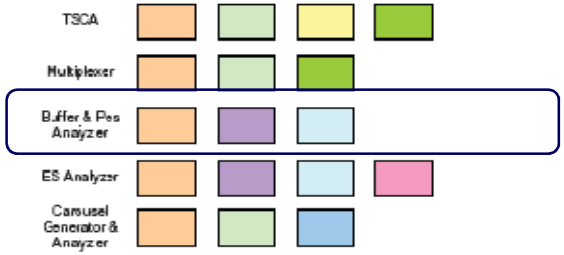


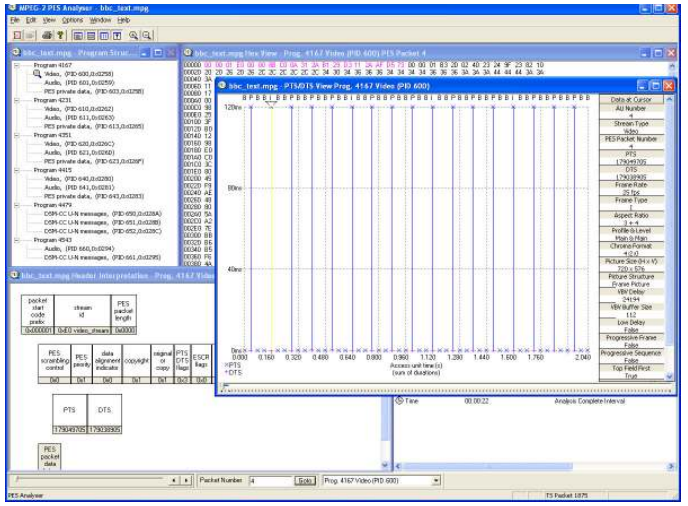


Packetized Elementary Stream (PES) Analyzer

- Verifies conformance of the PES header contents to the MPEG, DVB and ATSC standards.
- Verifies the header and identifies errors associated with each PES packet which contains the decode and presentation timestamps (DTS and PTS) for the contained Elementary Stream.
  - Verifies errors in these timestamps may cause resets or picture freeze problems at the receiver in extreme cases.
  - They are more typically the cause of lip sync problems where the timestamps of associated video and audio streams are not synchronized.
- Shows major ES layer parameters for each frame, such as frame rate and aspect ratio







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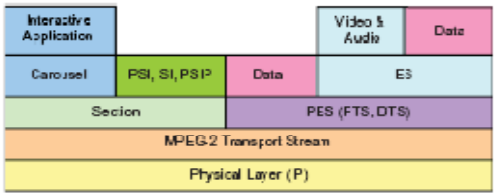
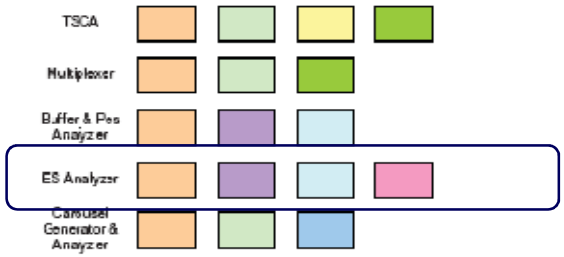
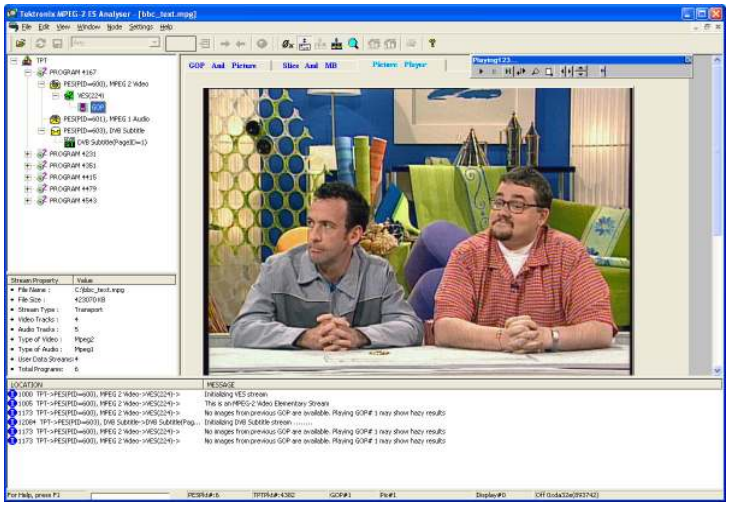
MPEG-2 Elementary Stream (ES) Analyzer

- Views the moving picture from within a PES stream and carries out a whole range of sophisticated tests on the lower layers of an Elementary Stream within a Transport Stream.
- Analyzes and displays a range of extended media formats, including audio, ATSC Closed Captions, DVB Subtitles and Teletext associated with video Elementary Streams.
- For analysis of MPEG-4, AVC/H.264 and VC-1 as well as MPEG-2 Elementary Streams, please refer to the MTS4EA.

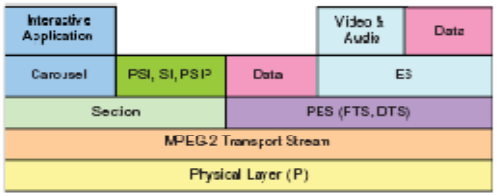


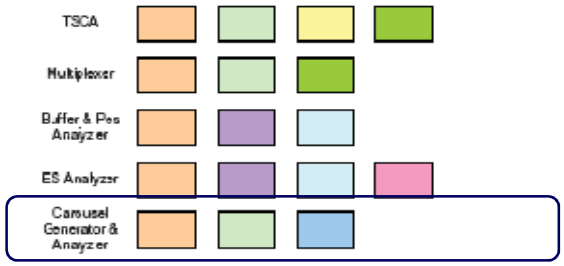


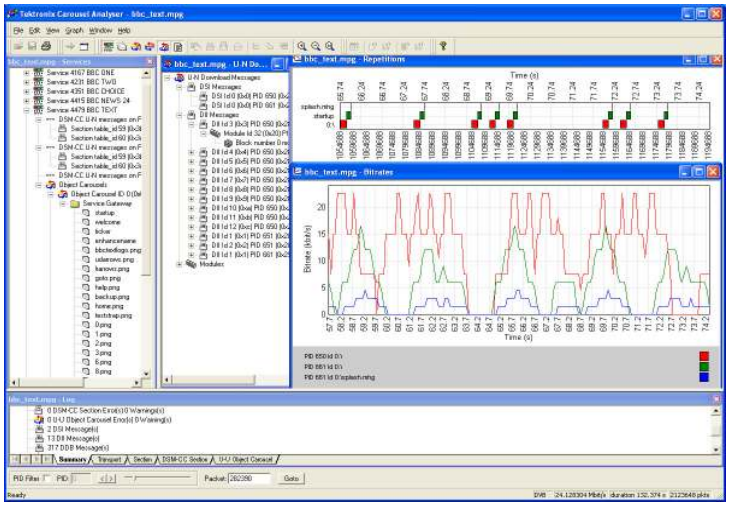


Carousel Analyzer

- Verifies the content of both Data and Object Carousels in a Transport Stream file for
  - compliance with the relevant standards (MPEG-2 DSM-CC, DVB (including MHP), DTT (MHEG-5) or ARIB
  - optimizing the settings between transmission bandwidth and responsiveness of the user experience.

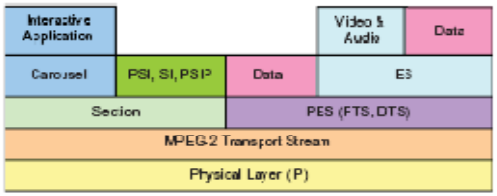


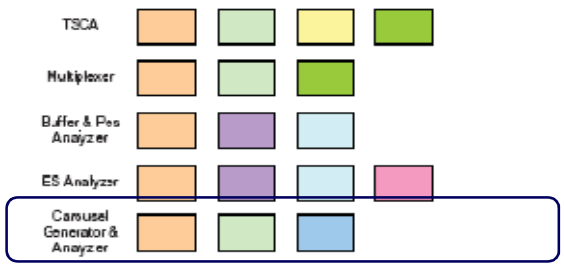


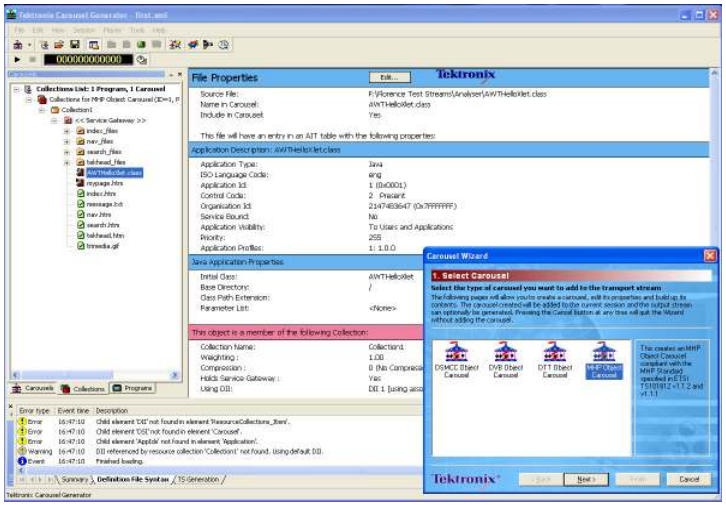


Carousel Generator

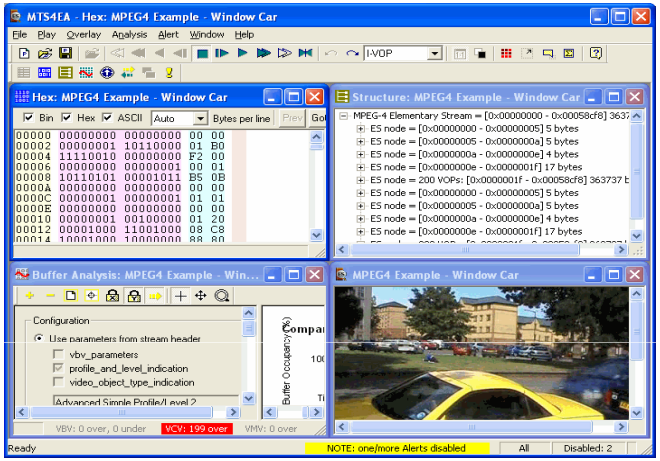
- Creates object carousel contents within an output Transport Stream.
- Useful in test situations where the effects of varying parameters, such as individual repetition intervals, may be quickly ascertained.
- Creates object carousels conforming to the MPEG-2, DVB, DTT (MHEG-5) or MHP standards.







Elementary Stream Analyzer



MTS4EA / MTS4CC

Compressed Video Analyzer

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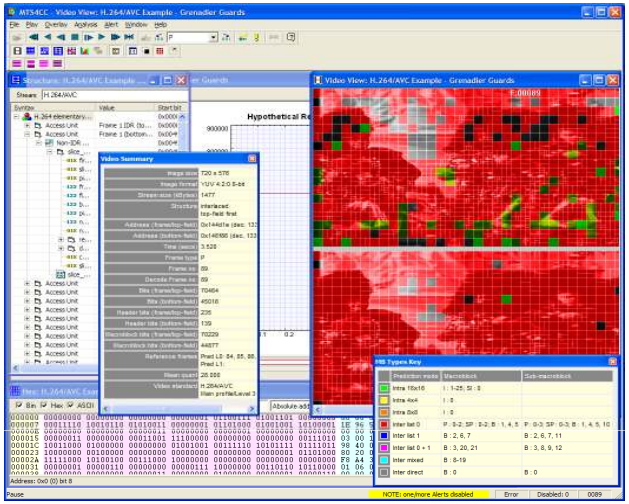
MTS4CC Overview

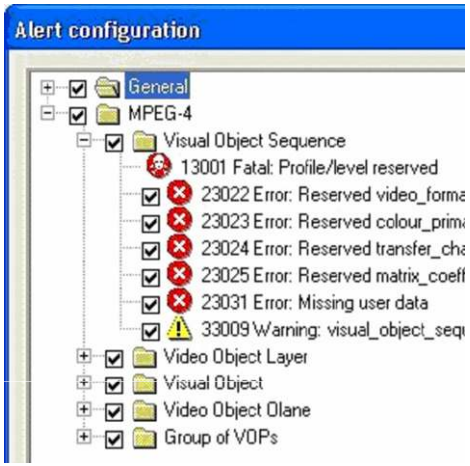
- Supports Next Generation and legacy Codecs
  - VC-1, H.264/AVC (incl. *FREXt*), MPEG-2, MPEG-4, H.263, H.263
  - TS, PS, ASF, MP4 and 3GPP Files
- Simultaneously display and check encoded video streams (dependant on PC performance)
- Frame-by-Frame decode
- MB overlays including encoder statistics
- Batch mode for automated testing
- Audio decode and waveform display
- ES extraction from TS

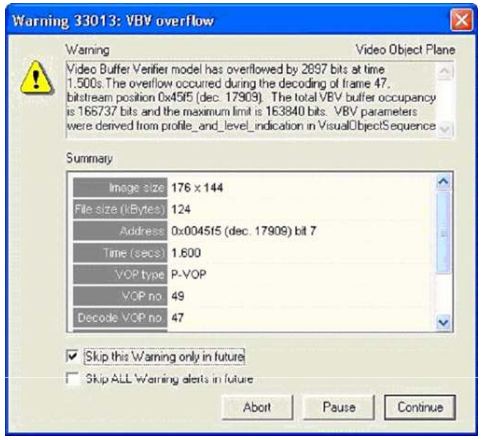


Standalone PC Based Software

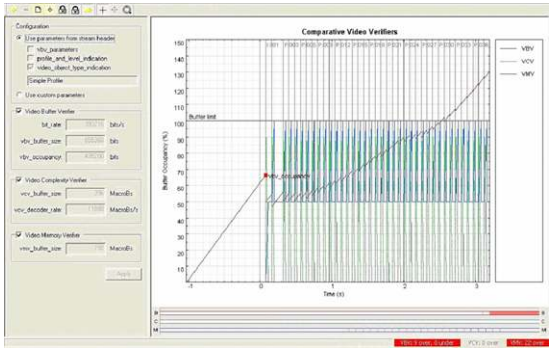
MTS4CC Capabilities

- Comprehensive Error Notification and Alerts

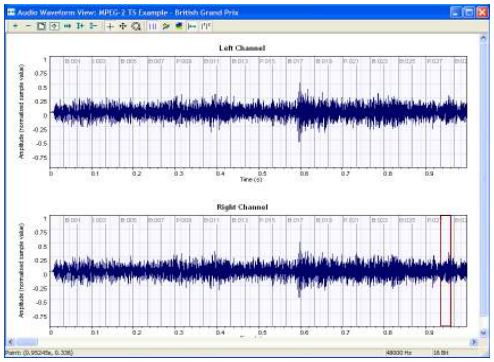




- Buffer Analysis



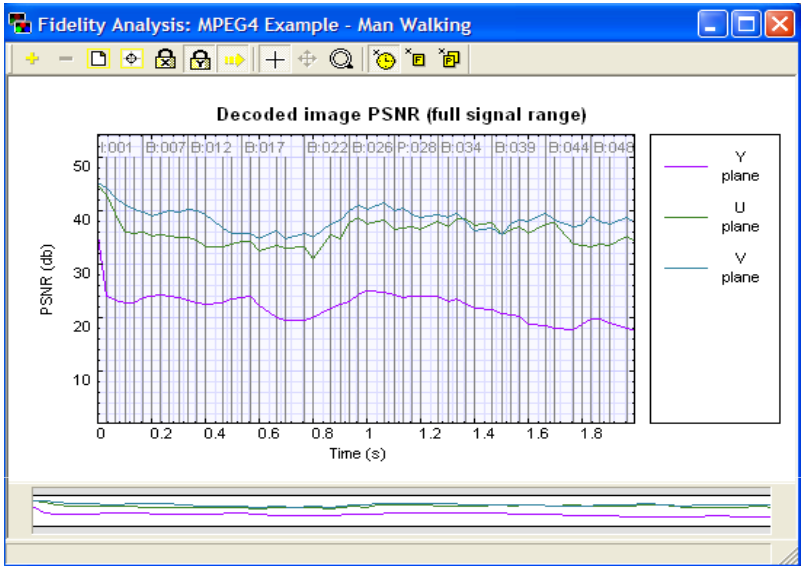
- Video & Audio decode & playout
  - Audio waveform displays video frame markers

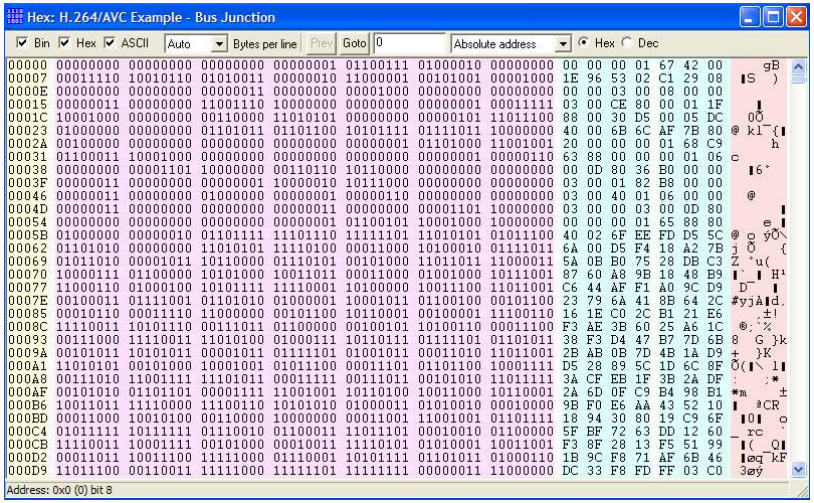


- Selectable video overlays with color key.
  - Number of Bits and Quantizer values

MTS4CC Capabilities

- Batch / command line mode to allow automated testing
- Fidelity Analysis (option)
  - PSNR Measurements
  - Visual Differencing
- Hex View
- Extract Elementary Streams directly from MPEG2 Transport Stream
- Can analyse up to 1 ExaByte (10^{18} B) video file





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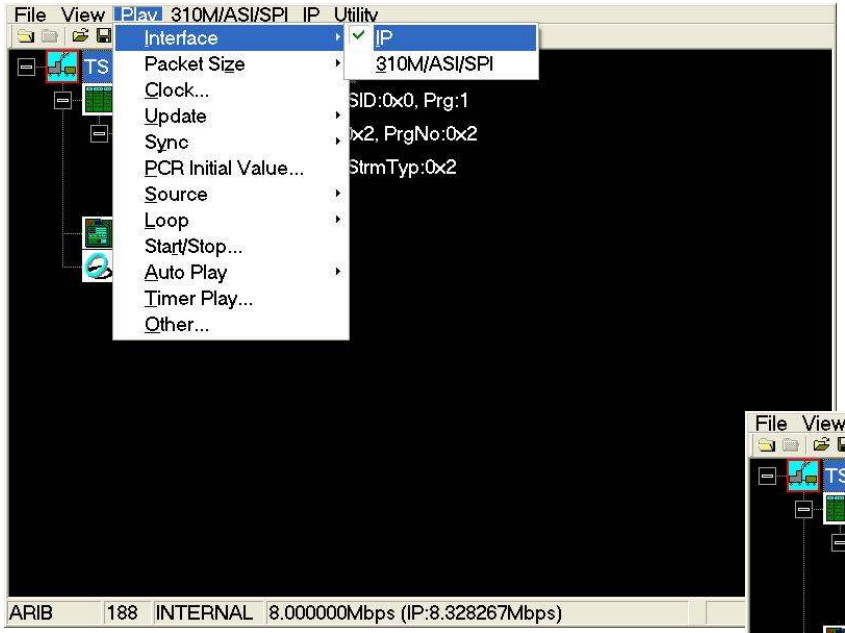
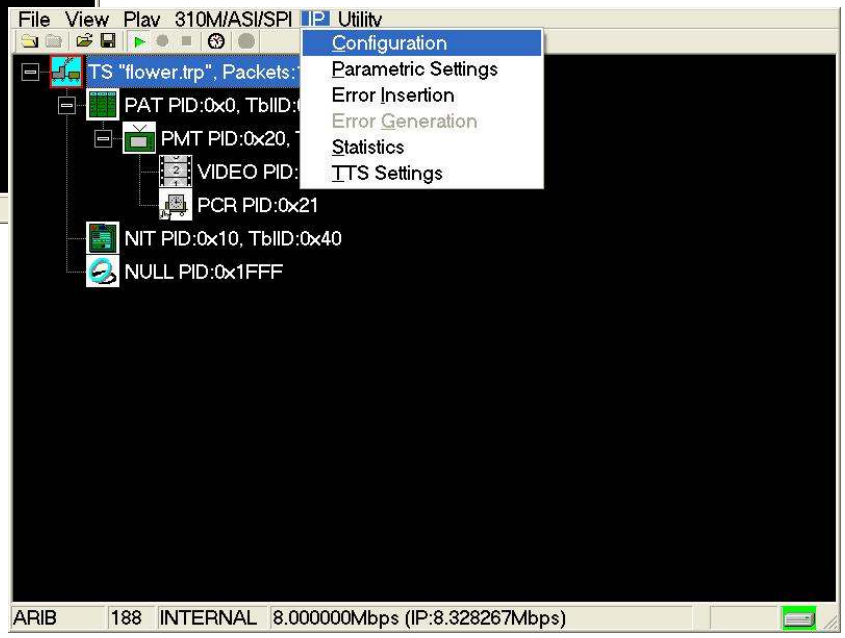
MTS4CC Supported Standards

Standard	History / application	Body
▶ H.264/AVC	New video standard; best compression Mandated for new DVD standard, incl FRExt	ITU plus MPEG
▶ SMPTE VC-1	New video standard, derived from WMV-9.	SMPTE
▶ H.263	2nd generation; video conferencing plus in 3GPP MANDATORY FOR MOBILE APPLICATIONS	ITU
▶ MPEG-2	DVD standard Main and 4:2:2 Profile	MPEG
▶ MPEG-4	Applications in mobile and Internet Simple Profile and Advanced Simple Profile	MPEG

DTV MPEG/ RF Signal Generation w/ IP Generation MTX100B/ RTX130B/ RTX100B

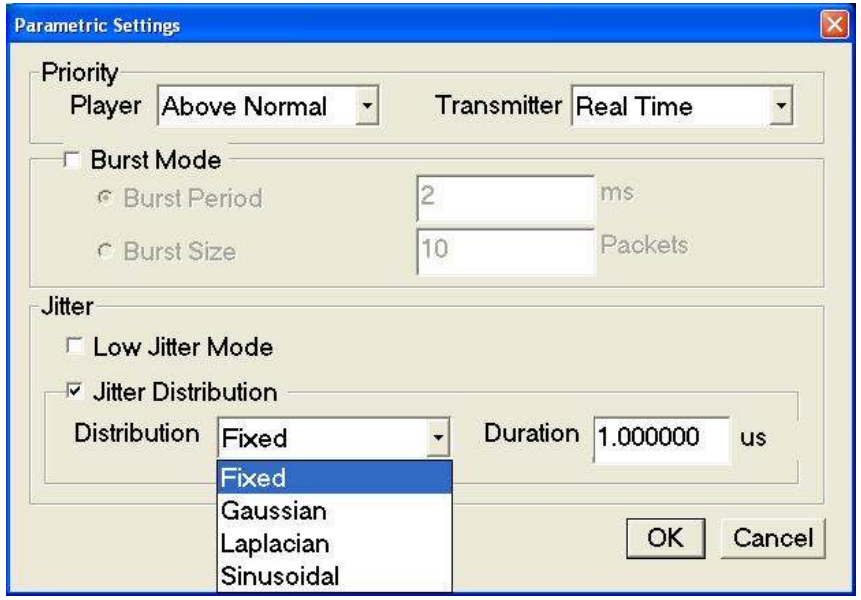


Interface :
ASI (TS) / SPI(TS) /
Ethernet port (IP/RTP/UDP)



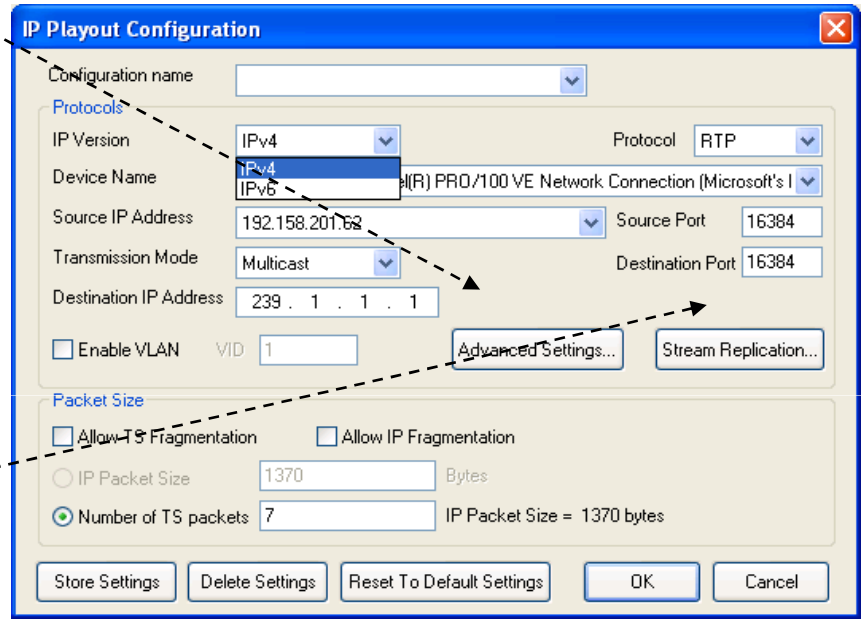
Stress Test Features

- Parametric Playout Capabilities
  - Error Insertion Capability (Packet Drops, Checksum Errors, Sequence Errors and Jitter)
  - Burst mode (both timing and packet number based)
  - Manual error generation capabilities
- ***"Stress Test, not Load Test"***
- Simultaneous Play/Rec can be used
  - Adjust priority
  - Non-deterministic timing



Advanced Playout Features

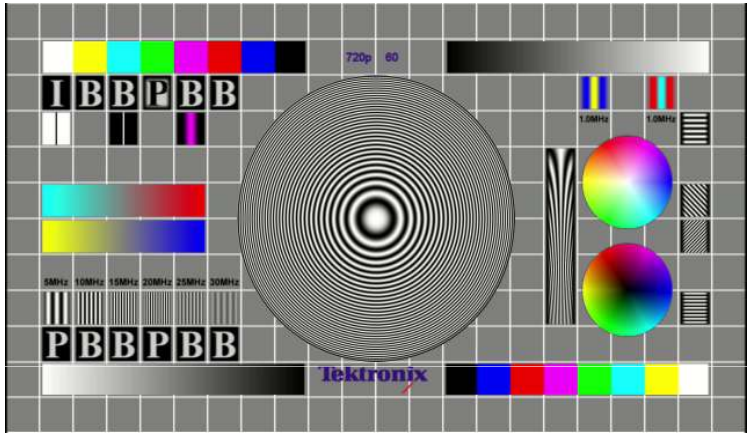
- Advanced Mode
  - Protocol header customization capabilities for source and destination ports and addresses,
  - Advanced mode for setting MAC address, transport checksum, network checksum
  - user editing of any packet header field parameters



- Session replication to simultaneously encapsulate and play a TS over many IP sessions

Tclips : New Suite of Test Streams

- >300 Video Test Streams
- >50 Audio Test Streams
- Source of repeatable test patterns
- Playout streams to test decoders
- Use as source material for creating new streams with software Mux
- Not just a stream player
- ***"Stream Creation and Generation Toolkit"***



- TG700, VM700 and PQA Test Patterns
- Motion and Static
- Encoded as H.264 and MPEG-2
- SD and HD
  - 480
  - 576
  - 720
  - 1080
- DVB and ATSC Service Information included

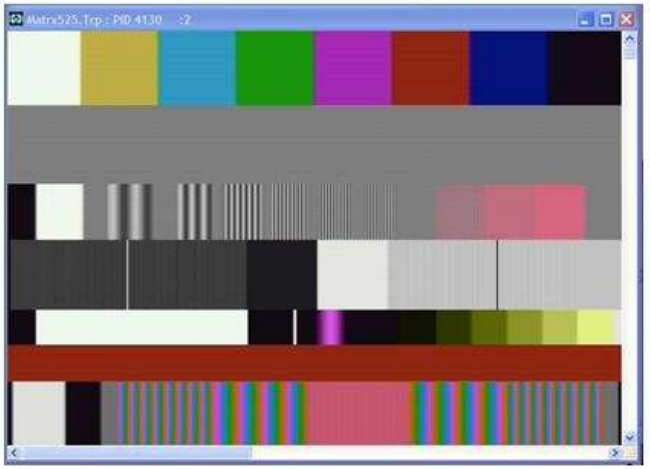
POA200-300 folder

- 2 Video Test Streams, multiple scenes (15 per stream)
- With SI/PSI and Audio Tones

- Use for PQA300 PQR tests at the analog or SDI output of the decoder.

TSG130A-131A-VM700 Matrix folder

- 2 Video Test Streams
- With SI/PSI and Audio Tones

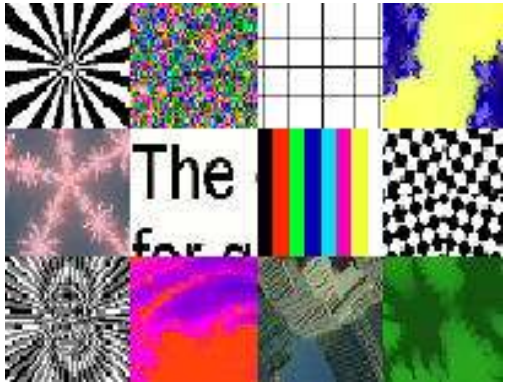


- Use with VM700T Auto mode for more complete analog test coverage of decoder.
- Use as source material for creating new streams with software Mux

Vclips

- Series of Video clips for test, optimisation and demonstration of video compression. Supplied by Vqual
- Encoder series – YUV clips for encoder testing, includes difficult to encode sequences for 'stressing' encoders.
- Decoder series – MPEG 4 and H264 clips for decoder testing, includes functional tests and error tests. Syntax switching to test for decoder tolerance of bitstream errors.

QCIF-CIF-D1-720p-1080i



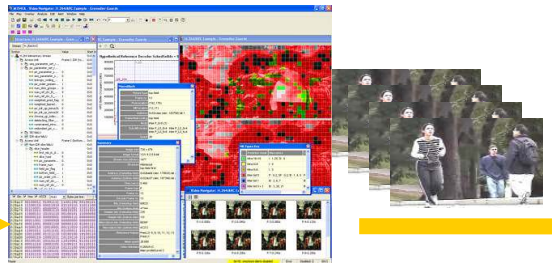
Picture Quality Analyzer PQA500

- The successor of PQA300
  - Support the all measurement capability, PQR/PSNR
  - Expands the application area
    - Multi resolution, Multi rate
    - Variety of viewing situation
- New Extended HVS model algorithm for the predictive DMOS
  - High correlation with PQR numbers on the same setting
  - New 8 patents in the algorithm
- Provide the Engineering tool
  - New Summary Viewing Displays
  - Less limitation on the video sequences
  - Supports easy regression testing.
- Running on latest HW platform

PQA Measurement Application – STB Testing

Reference
YUV File
(Vclips)

MTS4CC
Software
(Extract MPEG Video
To YUV file)



LCD Monitor

MPEG
Encoded
File

Reference
Video

PQA500

RF
O/P

(Set-Top-Box)
D.U.T

I/O
Interface
Conversion
To SDI

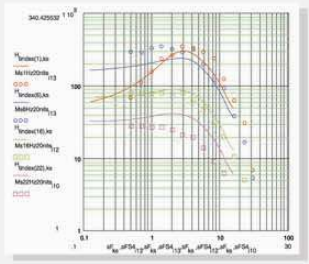
Test
Capture
SDI Video

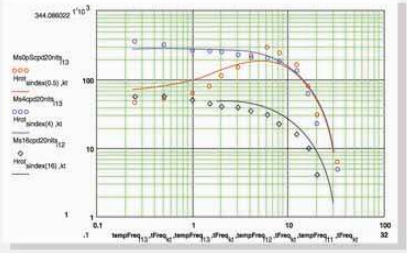
MTX100B (MPEG Player)
RTX130B (ATSC/QAM)
RTX100B (ISDB)

Adaptor
HDMI -> SDI
Analog CVBS/YPbPr -> SDI

Playout Server or Tapedeck stimulating Device under Test

PQA500





Device Under Test

Input Card

Display Model

View Model

Human Vision/ Perceptual Model

Cognitive Attention Model

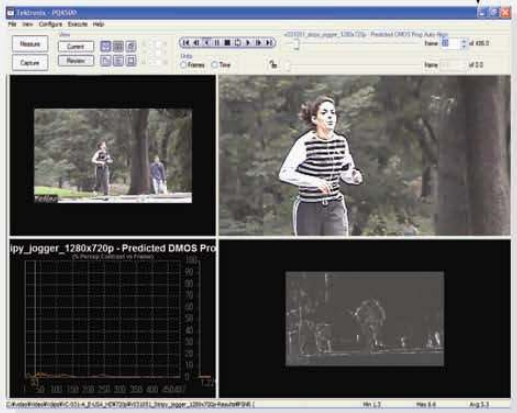
Task Based Summary

PSNR map

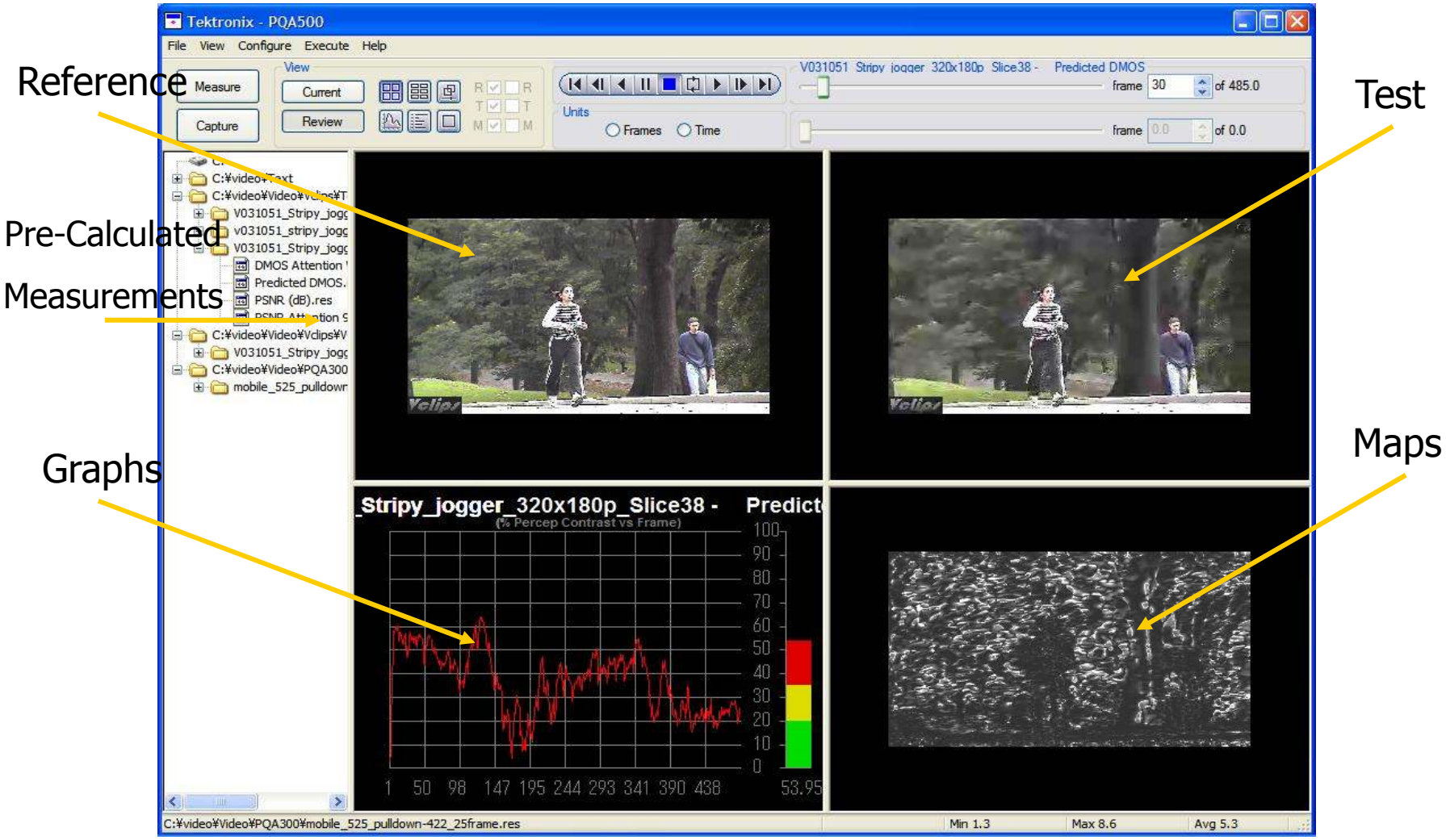
Perceptual Difference Map

Perceptual Contrast map

Attention map



User Interface



Measurements Types

- Double- Ended
  - Require both a Reference and Test sequence of the video material
  - DMOS
  - PQR
  - PSNR

Reference

Test

- Single – Ended
  - Require a test sequence of the video material
  - Attention Model
  - DC Blockiness

Picture Quality Measurement – Picture Quality

Measure A

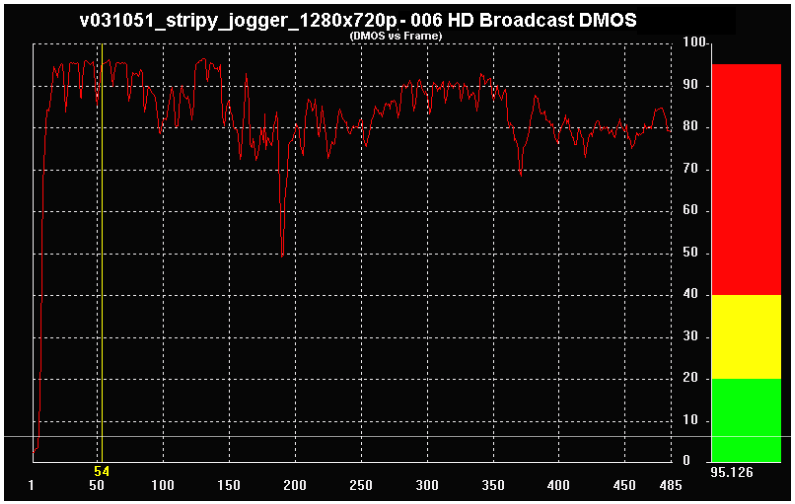
Measure B

Measure C

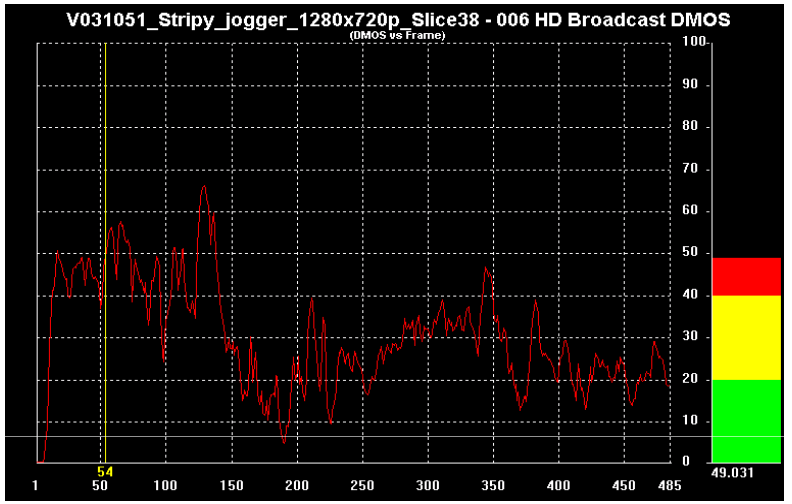
Measure D

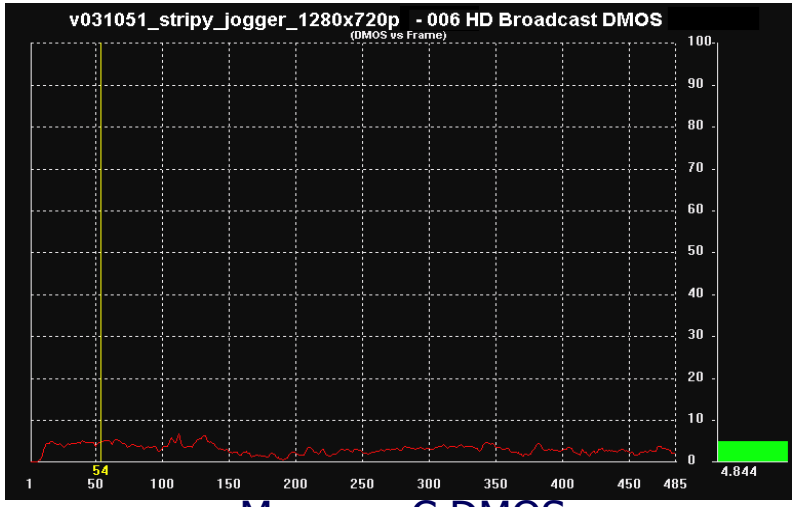
Picture Quality Measurement - Graph Results DMOS

Measure A DMOS

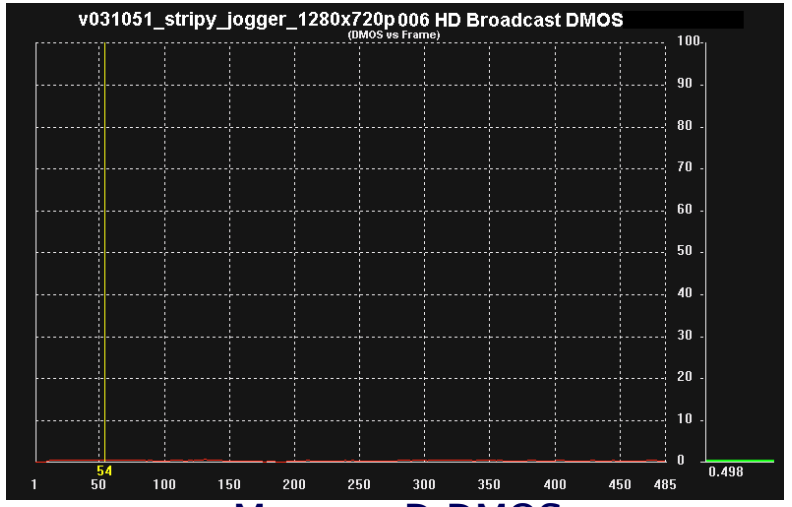


Measure B DMOS





Measure C DMOS



Measure D DMOS

Picture Quality Measurement – Broadcast Lab

- Broadcast Material converted to various video formats

HD Broadcast

1920x1080
or
1280x720

HD to SD
Down Conversion

720x576
or
720x486

SD Broadcast

Down Conversion
&
MPEG
Conversion

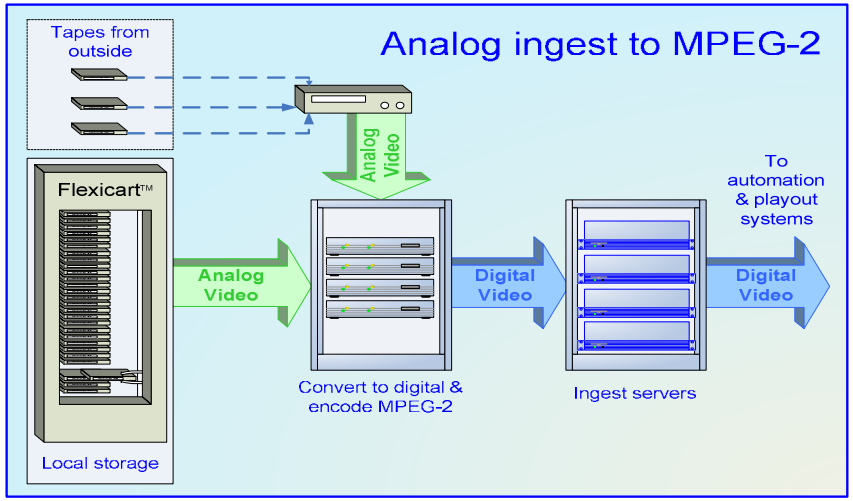
320x180

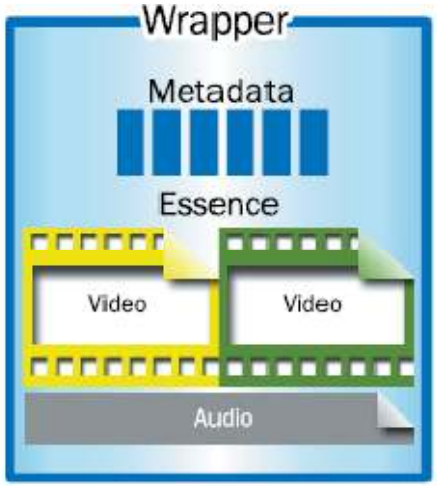
Mobile
Phone
Broadcast

- Broadcast Applications
  - Up / Down Conversion
    - HD to SD & SD to HD
  - MPEG Codec Evaluation
    - Suitable Bit Rate
  - Mobile Broadcast Analysis

Technical Challenges for Content Verify

- Ingest and Playout are in transition
  - Analogue to Compressed Digital
- Methods of storing video are changing
  - Tape to File based stored on Server
- Many different new formats
  - Terrestial, Satellite, Cable, VoD, IPTV
  - QCIF, CIF,SD, HD,
  - MPEG-2, MPEG-4, H.264/AVC, VC-1
  - Different bitrates, GOP, Audio etc





- There has been no off-the-shelf way to rapidly test stored compressed file-based media content

File Based video Quality Control

- File Based Video QC Application Challenges
  - Traditional video T&M only checks baseband (luma/chroma/signal) levels in analog and digital video streams
  - File-based video is different. It must be checked for
    - ***Correct Encoding Syntax*** – at digital level, audio/video must be encoded without errors, so it plays out correctly at the Customer's STB / playout device
    - ***Correct Parameters*** – audio/video bitrates, GOP structure, Color-space, Color depth, Frame size, Frame rate, Aspect ratio, Quantization levels
    - ***Correct Baseband and Quality levels*** - analog parameters for Signal levels, Luma, Chroma, Gamut and Quality levels of Black frames, Blockiness, Loss of audio, Audio clipping, Video/Audio playtime

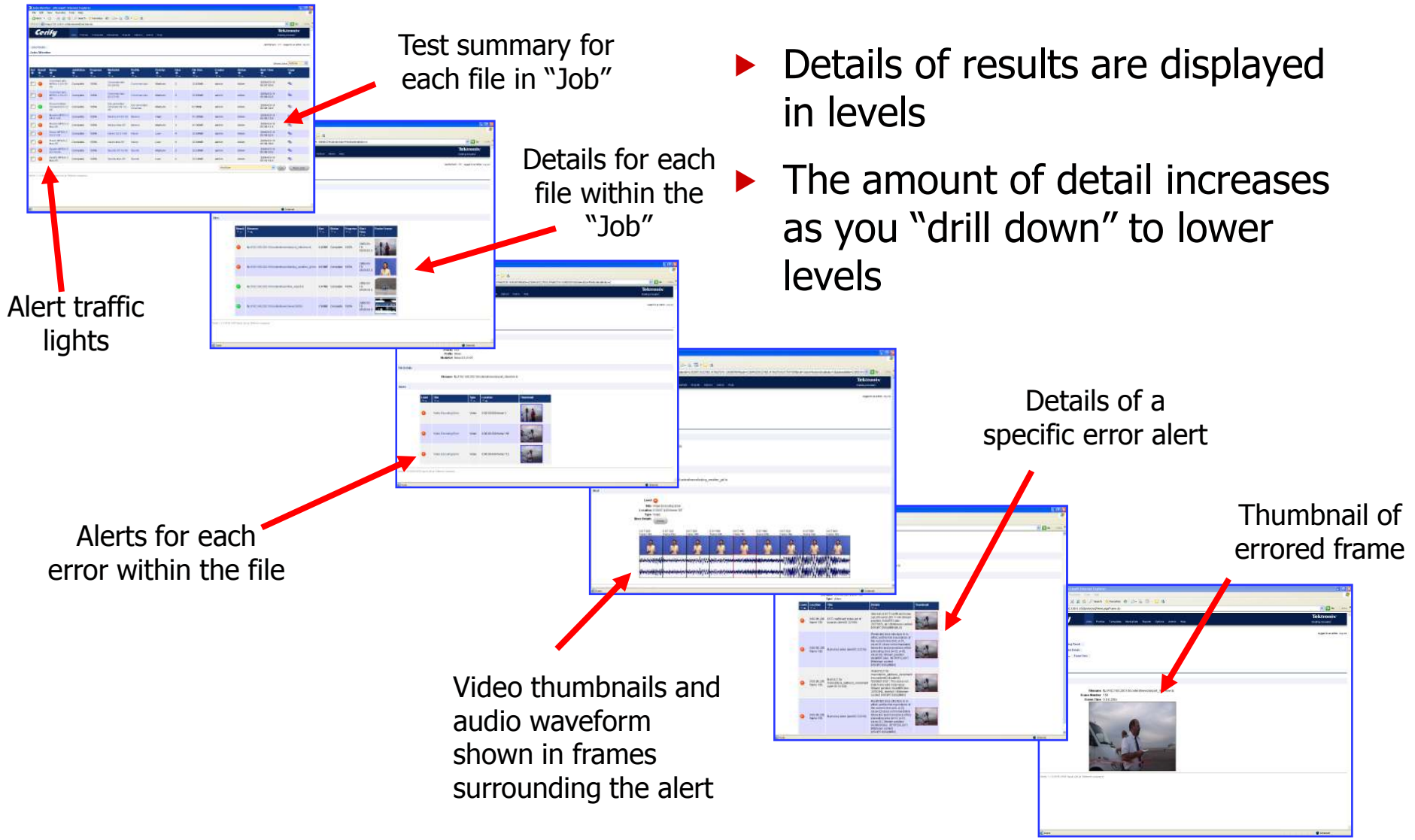
Product Portfolio

- CerifyLite
  - For post production / content suppliers
  - Software only, PC standalone test
  - Manual operation
  - Single user

- Cerify CYC200, CYS200, CYM200
  - For Broadcasters (Terrestrial, Sat, Cable, VoD, IPTV etc)
  - Integrates into workflow
  - Automatic operation
  - Includes site install, integration & user training
  - 1, 3 or 5 years hardware & software support options

- **Automated verification of compressed digital media**
  - All formats: QCIF, CIF, D1, SD, 720p, 1080i/p, etc
  - Wrappers: MPEG TS/ PS, MXF, GXF, MP4, MOV, ASF, 3GPP
  - Video: MPEG-2, IMX, D10, MPEG-4, H.264, H.263, VC-1/WMV, DV25
  - Audio: MPEG-1/2, AAC, HE AAC, PCM, WMA, AC3, Dolby-E

See and Solve Test Results

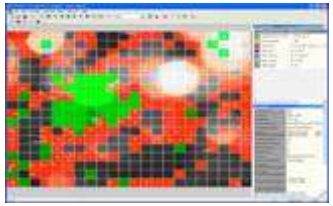


- Details of results are displayed in levels
- The amount of detail increases as you "drill down" to lower levels

Tektronix Compressed Digital Video Product Portfolio

Solving today's digital video delivery and quality challenges

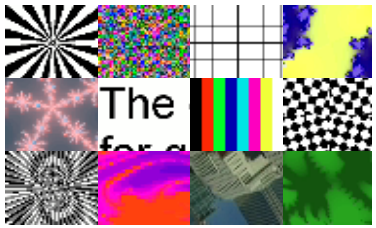
MPEG Test Systems & Software
MTS415/430/400P/4SA



Next Generation Compressed
Video ES Analysis
MTS4EA/MTS4CC

Analysis

MPEG Generators
MTX100B/RTX100B/RTX130B



Test Streams
Vclips/Tclips

Generation

MPEG Monitors
MTM400A

File-Based
Video Content Analysis
Cerify™
CerifyLite

Operations

Demonstrations & Q&A

- Questions ?