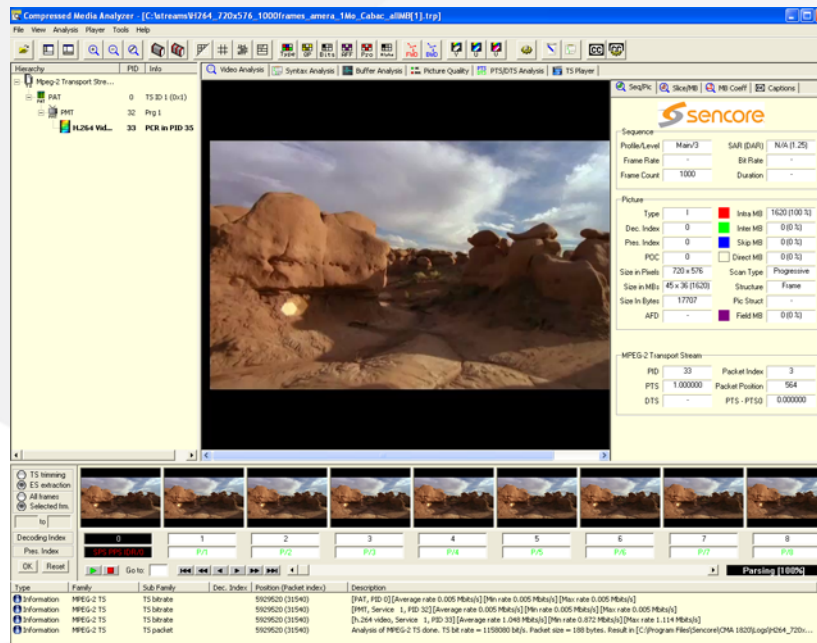




# CMA 1820

# Compressed Media Analyzer

## User Manual





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## Standard Documentation Set

The CMA 1820 Compressed Media Analyzer documentation set consists of

- A main User Manual that contains background information about the CMA 1820 Compressed Media Analyzer, and describes operating procedures. This manual can be used while learning about the CMA 1820, and for enhancing your basic knowledge of the product.
- A Media Extractor User Manual that details the features and use of the Media Extractor product.
- A Broadband Recorder User Manual that details the features and use of the Broadband Recorder product.
- A Standards Overview Quick Reference Guide that describes all standards managed by the CMA 1820 Compressed Media Analyzer.

## Software Version

This manual covers the functionality of the software version 05.00 and higher of the CMA 1820 Compressed Media Analyzer.

This manual continues to be relevant to subsequent software versions where the functionality of the equipment has not changed. When a new software version changes the functionality of the product, a new version of this manual is provided.

## About this Manual

This manual is written for operators of the CMA 1820 Compressed Media Analyzer.



This manual should be kept in a safe place for reference for the life time of the equipment. If passing the equipment to a third party, please ensure to pass all relevant documentation including this manual.

The manual is organized into the following chapters and appendices:

Table -1. Manual organization

Chapter/ Appendix	Title	Description
Chapter 1	'Overview'	Gives a general description of the equipment and its main features. It also identifies the controls, indicators and connectors on the equipment.
Chapter 2	'Installation and Startup'	Provides the procedures required for device installation and initial configuration.
Chapter 3	'Graphical User Interface'	Details how to use the Graphical User Interface to configure and supervise the equipment.
Chapter 4	'Frequently Asked Questions'	Helps you to solve some issues.
Appendix A	'Technical Specifications'	Gives information on signal processing and device specifications. It also provides standard compliance, declarations of conformity, and an ordering guide.
Appendix B	'Customer Services'	Indicates what you should do if you have a problem with equipment, whether you need to repair it, to return it or to dispose of it.
	'Glossary'	Includes uncommon or specialized terms within that manual with the definitions for those terms.

## Conventions Used in This Manual

### Warnings, Cautions and Notes

#### Heed Warnings

All warnings on the product and in the operating instructions should be adhered to. The manufacturer cannot be held responsible for injuries or damages where warnings and cautions have been ignored or taken lightly.

#### Read Instructions

All the safety and operating instructions should be read before this product is operated.

#### Follow Instructions

All operating and use instructions should be followed.

#### Terms in this Manual

Safety-related statements appear in this manual in the following form:



Warning statements identify conditions or practices that may result in personal injury or loss of life.



Caution statements identify conditions or practices that may result in damage to equipment or other property, or which may cause equipment crucial to your business environment to become temporarily non-operational.



Notes provides supplementary information. They are highlighted for emphasis, as in this example, and are placed immediately after the relevant text.

## Formatting

Naming conventions for the interface elements and Windows elements in this manual follow the Microsoft Manual of Style, Third Edition. Naming conventions for MPEG-2, ATSC, and DVB structures follow the conventions derived from the standards documents listed in [Appendix A 'Technical Specifications'](#). In addition, the following formatting conventions apply to this manual:

- **Pale blue** text refers to specific interface elements that you are instructed to select, click, or clear.

Example: “Select **Settings** from the **Configuration** menu.”

- **Blue** text refers to document names, sections, figures or tables.

Example: “Refer to **Section 'Warnings, Cautions and Notes'** on page 13 for more information.”

- **Mono-spaced text** can indicate the following:

- ❖ **Text you enter from a keyboard**

Example: “Enter administrator for your login and administrator for your password.”

- ❖ **Paths to components on your hard drive**

Example: “The MIB is at the following location: C:\MIB”.

## Notice

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# Chapter 1

## Overview

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### Introduction

This chapter gives a general description of the CMA 1820 Compressed Media Analyzer and its main features.

### Content of this Chapter

'Purpose' .....	page 16
'Functional Overview' .....	page 23

## Purpose

The Compressed Media Analyzer product is made up of three items:

- CMA 1820
- Media Extractor
- Broadband Recorder

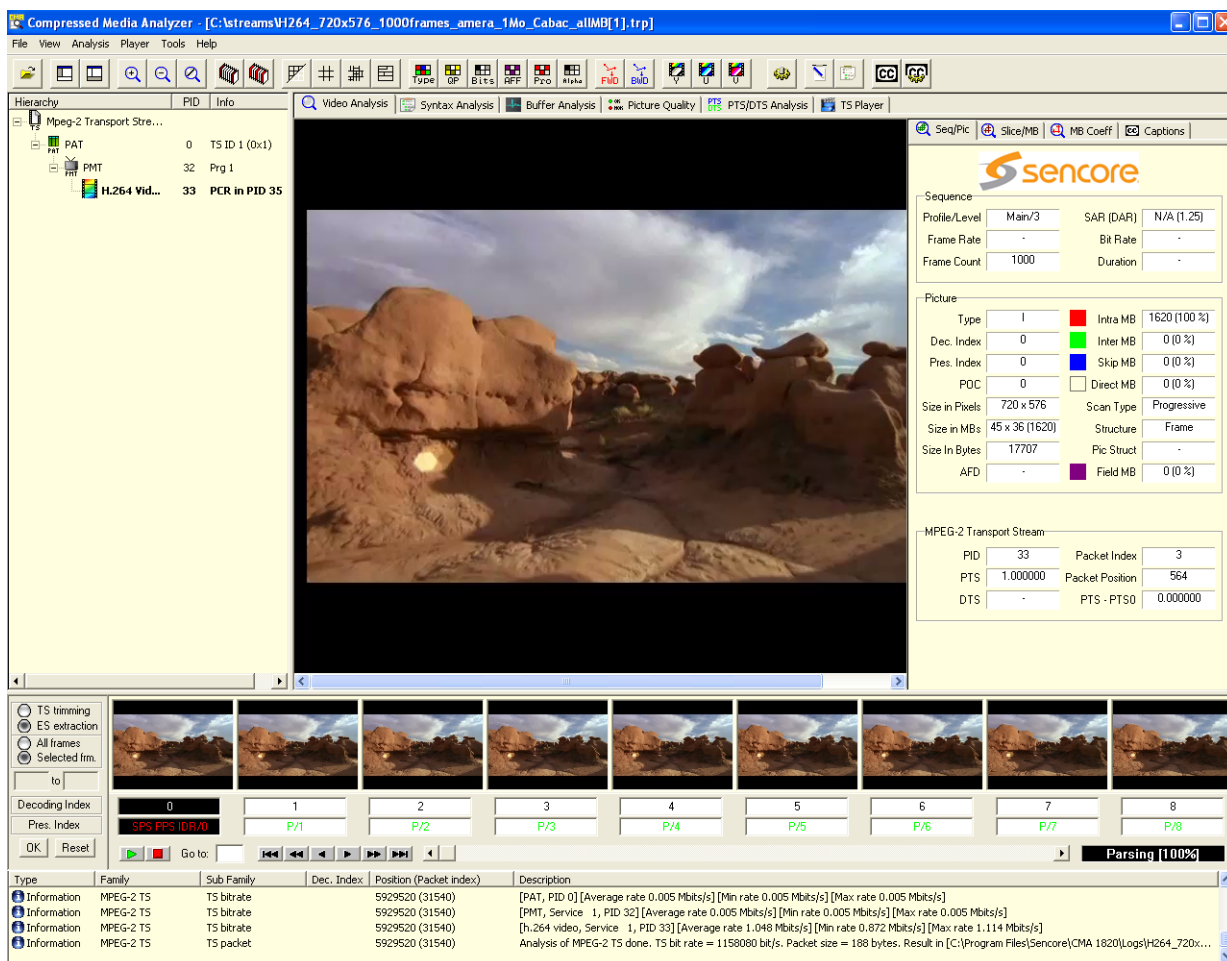
## Compressed Media Analyzer

Compressed Media Analyzer is a software-only, off-line analyzer. It is dedicated to the analysis of video encoded in H.264/AVC, H.265/HEVC, VC-1 and MPEG-2 video.

However, it can also analyze audio encoded in AAC, Dolby AC-3 and E-AC-3 or MPEG Audio. Streams may be in raw byte or encapsulated in various containers (MPEG-2 TS, TTS, ASF, MP4, MP4 fragmented, QuickTime, Adobe FLV, 3GP file format, MXF or HLS).



Figure 1-1. Compressed Media Analyzer Overview



Compressed Media Analyzer's main capabilities are listed hereafter.

## MPEG-2 TS Capabilities

- Hierarchical view
- TR 101 290 priority 1 and 2 (configuration available)
- Player: video (MPEG-2 or H.264/AVC) and audio (MPEG-1, AC3, AAC)
- Trimming: saving in an MPEG-2 TS or TTS with desired video picture range (for H.265/HEVC, H.264/AVC, VC-1 and MPEG-2)
- Dynamic buffer analysis: T-STD leak method model for TB, MB, EB buffers (for H.264/AVC and H.265/HEVC)
- PTS/DTS analysis: representation of access units and associated PTS/DTS, conformance analyses

## HLS Capabilities

- Master/ Media playlists hierarchical view, conformance analysis and display
- Audio/Video/Subtitles segment details
- Segment navigation and temporal cross-alignment checking
- Video (H.264/AVC and H.265/HEVC) and Audio (AAC, AC-3, E-AC-3) deep analysis
- WebVTT subtitles analysis and display

## H.264/AVC Capabilities

- Video decoding
- Macroblock (MB) details with partition grid, overlays for MB type, MB size in bits, MB quantization parameter (QP) and motion vectors, detailed characteristics with reference picture list content and Coded Block Pattern (CBP)
- Extraction of H.264/AVC raw byte with desired video picture range
- Detailed NAL syntax and conformance
- Dynamic buffer analysis: HRD model for CPB and DPB buffers
- Macroblock coefficients: decoded, pre-loop filtered, predicted, residual, dequantified, quantified

## H.265/HEVC Capabilities

- Video decoding
- Coding block (CB) details with partition grid, overlays for CB type, CB size in bits, CB quantization parameter (QP) and motion vectors, detailed characteristics with reference picture list content
- Slice, Tile and Coding Tree Block (CTB) details
- Extraction of H.265/HEVC raw byte with desired video picture range
- Detailed NAL syntax and conformance
- Dynamic buffer analysis: HRD model for CPB and DPB buffers

## VC-1 Capabilities

- Video decoding
- Macroblock (MB) details with partition grid, overlays for MB type, MB size in bits, MB quantization parameters (QP) and motion vectors, detailed characteristics with transform types and Coded Block Pattern (CBP)
- Extraction of VC-1 raw byte with desired video picture range

- Detailed syntax and conformance

### **MPEG-2 Capabilities**

- Video decoding
- Macroblock (MB) details with partition grid, overlays for MB type, MB size in bits, MB quantization parameter (QP) and motion vectors, detailed characteristics with prediction mode and Coded Block Pattern (CBP)
- Extraction of MPEG-2 Video raw byte with desired video picture range
- Detailed syntax and conformance
- Macroblock coefficients: decoded, predicted, residual, dequantified, quantified

### **Dolby AC-3 and E-AC-3 Capabilities**

- Accurate audio waveform from mono up to 5.1
- Playback & save (PCM or compressed format) in stereo mode of selected channels with desired audio frame range
- Main characteristics of audio stream
- Details on each frame (synchronization and bitstream information)
- Synchronization with associated video stream
- Audio Loudness Analysis
- Dialnorm presence and consistency with Program Loudness

### **MPEG Audio Capabilities**

- Accurate audio waveform in mono or stereo
- Playback & save (PCM or compressed format) in stereo mode of selected channels with desired audio frame range
- Main characteristics of audio stream
- Details on each frame (CRC)
- Synchronization with associated video stream
- Audio Loudness Analysis

### **AAC Capabilities**

- Accurate audio waveform in mono, stereo and 5.1
- Playback & save (PCM or compressed format) in stereo mode of selected channels with desired audio frame range
- Main characteristics of audio stream

- Details on each frame (complete frame header syntax)
- Synchronization with associated video stream
- Audio Loudness Analysis

### Picture Quality Capabilities (H.264/AVC Only)

- Artifacts analysis: blocking effect, noise and blur in a picture, jerkiness of the video
- Saturation analysis
- Detection of black and frozen sequences

### Closed Captions Capabilities

- CEA-608, CEA-708 and SCTE-20 formats supported simultaneously
- CC, text and XDS (Extended Data Service) supported in CEA-608 mode
- Decoding display
- Syntax interpretation
- Conformance analyses

Table 1-1. Video capabilities

	H.265/HEVC	H.264/AVC	VC-1	MPEG-2
Video analysis	X	X	X	X
Syntax analysis	X	X	X	X
Buffer analysis	X	X	–	–
Picture Quality analysis	–	X	–	–
PTS/DTS analysis	X	X	X	X
Audio/Video synchronization	X	X	–	X
TS player	–	X	–	X
Closed Captions	X <sup>a</sup>	X <sup>a</sup>	X <sup>a</sup>	X

<sup>a</sup> CEA-608 and CEA-708 only.

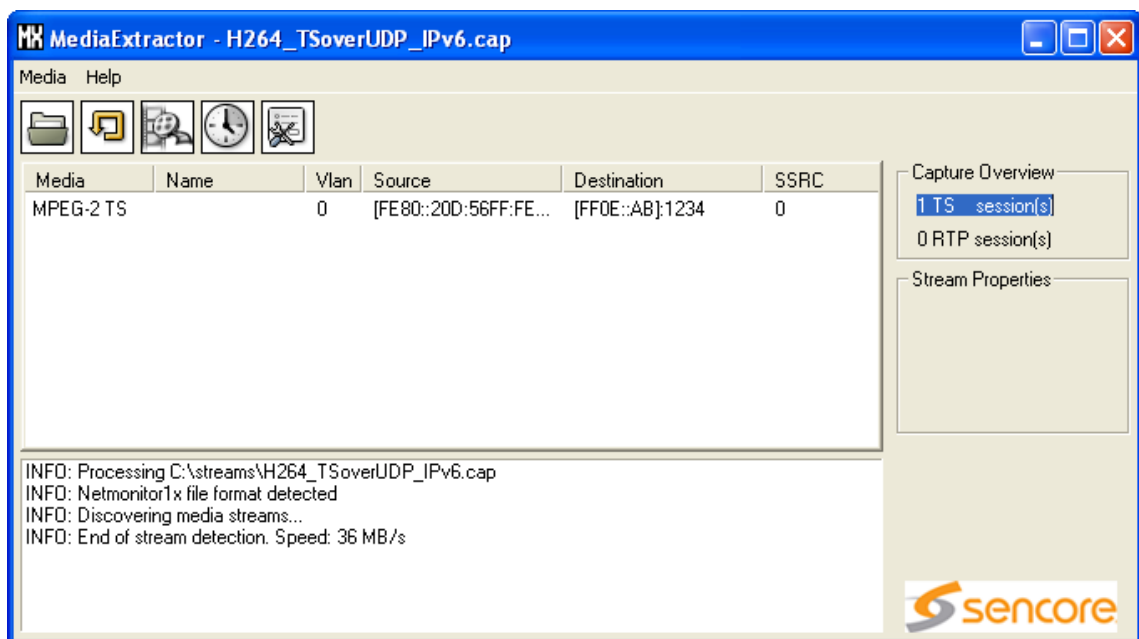


When the stream is carried over a TTS file, the buffer, PTS/DTS and TR 101 290 analyses are not available.

## Media Extractor

Media Extractor is a software-only tool that performs off-line stream extraction from network captured files.

Figure 1-2. Media Extractor



### Supported Network Capture File Formats

- TCPDump (also known as libpcap/ethereal file format)
- NetMonitor 1.x and 2.x
- Copper GES

### Supported IP Versions

- IPv4
- IPv6

### Stream Detection

- MPEG-2 TS in UDP
- RTP streams

### Stream and Timestamps Extraction

- MPEG-2 TS or TTS
- H.264/AVC payload in RTP

- AAC payload in RTP
- Raw payload in RTP

### **H.264/AVC in RTP Packetization Modes**

- Single NAL unit mode supported
- Non-Interleaved mode supported
- Interleaved mode disabled

### **Supported Session Protocols**

- Session Announcement Protocol (SAP)
- Real Time Streaming Protocol (RTSP)
- Session Initiation Protocol (SIP)
- SDP in a text file

### **Miscellaneous**

- Processing of files up to 2<sup>64</sup> bytes
- Big and little-Indian files supported
- Low CPU and memory footprint
- Multithreaded I/O
- Resilient to network errors (fragmentation, loss, corruption)

For further information, refer to the Media Extractor User Manual.

## **Broadband Recorder**

Broadband recorder is a software-only tool that is able to capture IP traffic.

For further information, refer to the Broadband Recorder User Manual.

## Functional Overview

### File Formats

#### Container Formats

- **MPEG-2 Transport Stream files.** An MPEG-2 TS or TTS file may contain one or several programs with audio and video Elementary Streams (ES).
- **MP4 and MP4 fragmented files,** i.e. file compliant with ISO/IEC 14496-14 and ISO/IEC 14496-15.
- **3GP files,** i.e. file compliant with 3GPP TS 26.244.
- **ASF files,** i.e. files compliant with Advanced System Format specification by Microsoft.
- **MOV files,** i.e. files compliant with Apple QuickTime files format.
- **FLV files,** i.e. files compliant with Adobe Flash video files format.
- **HLS files,** i.e. files compliant with Apple HTTP Live Streaming playlist format.
- **MXF files** complying with SMPTE 377M, 379M and other SMPTE MXF-related standards.

#### Video Formats

- **H.264/AVC raw byte files,** i.e. H.264/AVC Elementary Streams (ES) not encapsulated within a transport system such as MPEG-2 TS or IP/RTP. Default file extensions are .h264 and .264.
- **H.265/HEVC raw byte files,** i.e. H.265/HEVC Elementary Streams (ES) not encapsulated within a transport system such as MPEG-2 TS or IP/RTP. Default file extensions are .h265, .265 and .hevc.
- **VC-1 EBDU raw byte files,** i.e. VC-1 Elementary Streams (ES) encapsulated as described in Annex G from VC-1 standard. Default file extensions are .vc1 and .v9e.
- **Raw Compressed Video files (RCV),** i.e. VC-1 Elementary Streams (ES) encapsulated as described in Annex L from VC-1 standard. Default file extension is .rcv.
- **MPEG-2 Video raw byte files,** i.e. files conforming to ISO/IEC 13818-2 and not encapsulated within a transport system such as MPEG-2 TS or IP/RTP. Default file extension is .m2v.

## Audio Formats

- **AAC raw byte files**, i.e. AAC Elementary Streams (ES) not encapsulated within a transport system such as MPEG-2 TS. Default file extension is .aac.
- **Dolby AC-3 and E-AC-3 raw byte files**, i.e. Dolby AC-3 and E-AC-3 Elementary Streams (ES) not encapsulated within a transport system such as MPEG-2 TS. Default file extension is .ac3.
- **MPEG Audio**, i.e. MPEG-1 and MPEG-2 layers 1, 2, 3 audio Elementary Streams (ES). Default file extensions are .mp1, .mp2, .mp3 and .mpa.
- **AES-3** files are detected and displayed in the [Hierarchical](#) view but are not analyzed.

## Containers / Video, Audio, Data Combinations

The following combinations are available:

Table 1-2. Containers / Video , Audio, Data available combinations

	Containers					
	Raw Byte	MPEG-2 TS	MXF	MPE4/3GP	HLS	ASF
<b>Video</b>						
<b>MPEG-2</b>	X	X	X			
<b>AVC</b>	X	X	X	X	X	
<b>HEVC</b>	X	X		X	X	-
<b>VC-1</b>	X	X				X
<b>Audio</b>						
<b>PCM</b>			X			
<b>MPEG</b>	X	X	X		X	
<b>AAC/HE-AAC</b>	X	X		X	X	
<b>AC-3/E-AC-3</b>	X	X			X	
<b>Data</b>						
<b>Closed Captions</b>		X	X		X	
<b>Teletext</b>		X			X	
<b>DVB Subtitles</b>		X			X	
<b>SCTE-35</b>		X			X	
<b>VPS/WSS</b>		X			X	



## Unknown Extensions

Should you wish to open a file having an extension unknown to the Analyzer (e.g. a proprietary file format used within your company), the application lets you associate this extension with a file format it can handle. Select the file format to associate with the particular file extension and click [OK](#).

## Transport Stream Analysis

### TR 101-290 Conformance

The CMA 1820 performs analyses on the TS level when a TS file is opened. Conformance with TR 101 290 level 1 and 2 is tested, warning and error messages being displayed in the [Report](#) view.

These messages, as well as the whole TR 101 290 test, can be disabled from the [Settings](#) panel.

The CMA 1820 also displays the complete TS hierarchical structure in the [Hierarchical](#) view.

### PTS / DTS Conformance

The CMA 1820 performs on-demand analysis of time stamps associated with access units. The results may be seen in a dedicated view, conformance reports being logged to the [Report](#) view.

## HLS Analysis

### Playlist Analysis

The CMA 1820 performs analyses on the Master (if any) and Media playlist files when an HLS file is opened. Conformance with the standard is tested, warning and error messages being displayed in the [Report](#) View.

The structure of playlist files can be found in the [Hierarchical](#) View.

The CMA 1820 displays the structure of Audio, Video and Subtitle media and presents segment key frames as thumbnails. Useful information on Master, Media playlists and Segments can be found in the [Data](#) view.

The [Syntax](#) view shows the content of Master and Media playlist files.

## Video Analysis

H.265/HEVC, H.264/AVC, VC-1 and MPEG-2 videos may be found in raw byte, MPEG-2 TS, ASF, MP4, FLV, MOV or 3GP files.

### H.264/AVC Analysis

The CMA 1820 decodes pictures from the H.264/AVC Elementary Stream (ES) and displays useful information through picture overlaying or data boxes from the [Data](#) view. Key information on coding parameters is available at picture, slice and macroblock level.

The [Syntax](#) view describes the values and meanings of all syntax elements down to the slice header level.

The CMA 1820 also includes a Dynamic Buffer Analysis feature that tests conformance of a bitstream using the Hypothetical Reference Decoder model described in the H.264/AVC standard (for raw byte files) or the T-STD leak method model described in the MPEG-2 TS standard (for MPEG-2 TS files containing H.264/AVC Elementary Streams).

### H.265/HEVC Analysis

The CMA 1820 decodes pictures from the H.265/HEVC Elementary Stream (ES) and displays useful information through picture overlaying or data boxes from the [Data](#) view. Key information on coding parameters is available at picture, slice, tile and coding block level.

The [Syntax](#) view describes the values and meanings of all syntax elements down to the slice header level.

The CMA 1820 also includes a Dynamic Buffer Analysis feature that tests conformance of a bitstream using the Hypothetical Reference Decoder model described in the H.265/HEVC standard (for raw byte files) or the T-STD leak method model described in the MPEG-2 TS standard (for MPEG-2 TS files containing H.265/HEVC Elementary Streams).

### VC-1 Analysis

The CMA 1820 decodes pictures from the VC-1 Elementary Stream (ES) and displays useful information through picture overlaying or data boxes from the [Data](#) view. Key information on coding parameters is available at picture, slice and macroblock level.

The [Syntax](#) view describes the values and meanings of all syntax elements down to the slice header level.

## MPEG-2 Video Analysis

The CMA 1820 decodes pictures from the MPEG-2 Video Elementary Stream (ES) and displays useful information through picture overlaying or data boxes from the [Data](#) view. Key information on coding parameters is available at picture, slice and macroblock level.

The [Syntax](#) view describes the values and meanings of all syntax elements down to the slice header level.

## Picture Quality Analysis

Picture quality works only with H.264 compressed streams, independently of any file format.

The CMA 1820 deals with the following artifacts:

- Blocking effect in a picture
- Noise in a picture
- Blurriness of a picture
- Saturation of a picture
- Jerkiness of the video
- Black sequence
- Frozen sequence

The Analyzer computes the selected artifacts values for each frame and displays them in graphs. Except for black and frozen sequences which are only signaled in the [Report](#) view.

You can navigate through the results and easily compare them with the video shown in the [Thumbnail](#) view. Finally you can export all the results in a file.

## Closed Captions Analysis

CEA-608 and CEA-708 closed captions are supported on H.265/HEVC, H.264/AVC and MPEG-2 video streams.

CEA-608 closed captions carried over SCTE-20 are supported on MPEG-2 video streams.

The [Main](#) view is an interpreted view that emulates the internal behavior of a closed captions decoder by displaying, for each picture, the text and

commands that are received in order to generate the closed caption (e.g.: picture, pen, text, etc.).

A [Syntax](#) view is also available for troubleshooting and provides very detailed information on the closed caption, byte by byte.

## Audio Analysis

AAC, Dolby AC-3 and E-AC-3 and MPEG-Audio may be found in raw byte, MPEG-2 TS or any container supported by the Analyzer.

### AAC Analysis

The CMA 1820 decodes audio frames from the AAC Elementary Stream, and then displays the waveform together with useful information, including complete frame header syntax. It also lets you playback and save one or more channels in PCM or in compressed format.

### Dolby AC-3 and E-AC-3 Analysis

The CMA 1820 decodes audio frames from the Dolby AC-3 and E-AC-3 Elementary Stream, and then displays the waveform together with useful information. It also lets you playback and save one or more channels in PCM or in compressed format.

### MPEG Audio Analysis

The CMA 1820 decodes audio frames from the MPEG-Audio Elementary Stream, and then displays the waveform as well as useful information. It also lets you playback and save one or more channels in PCM or in compressed format.

### Audio Loudness Analysis

Audio loudness as defined in ITU-R BS.1770-3 is tested. Measurement Standards including EBU R128, ATSC A-85 and ARIB TR-B32 can be selected to configure the proper thresholds.

Final values of Program Loudness, Loudness Range and Max True Peak level, as well as Momentary and Short-term measures, are displayed in graphics and in the Data view.

## DVB Teletext and Subtitles Analysis

DVB teletext and subtitles are supported.

The **Main** view is an interpreted view that emulates the internal behavior of a teletext or subtitles decoder by displaying, for each picture, the text and commands that are received in order to generate the teletext or subtitles.

A **Syntax** view is also available for troubleshooting and provides very detailed information on the teletext or subtitles, byte by byte. VPS and WSS syntax is also displayed.

## WebVTT Analysis

When WebVTT subtitles are associated to video in an HLS Playlist file, they can be decoded and displayed in the CMA 1820.

The **Main** view is an interpreted view that emulates the internal behavior of a WebVTT decoder by displaying the subtitle text for each picture.

## SCTE-35 DPI Analysis

SCTE-35 DPI files are supported.

The **Main** view is an interpreted view that provides information on the avails and DPI commands.

A **Syntax** view is also available for troubleshooting and provides very detailed information on the SCTE-35 DPI data, byte by byte.

## Player Capabilities

The CMA 1820 features a built-in player that lets you play a video stream contained in an MPEG-2 TS.

### Supported Video Formats

- MPEG-2 video
- H.264/AVC

### Supported Audio Formats

- MPEG-1 audio
- MPEG-2 audio
- AC-3 and E-AC-3
- AAC over ADTS or LATM/LOAS



When using the built-in player, all analyses and on-picture display functions are unavailable.

ES coded in H.264/AVC, VC-1 or MPEG-2 video, whether these are contained in a TS or not, can also be played in "Raw Byte" mode, i.e. using the analysis module to decode and display the pictures.



When playing a video in Raw Byte mode, neither audio nor synchronization information is present.

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# Chapter 2

## Installation and Startup

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### Introduction

This chapter provides the procedures required for CMA 1820 Compressed Media Analyzer installation and initial configuration.

### Content of this Chapter

'Unpacking' .....	page 32
'Installing the Software' .....	page 33
'Starting the Application' .....	page 40

## Unpacking

Table 2-1 lists the accessories that are shipped. Use this list to ensure that your order is complete.

Table 2-1. List of accessories delivered

Quantity	Description
1	Compressed Media Analyzer Installation and Documentation CD-ROM.
1	The license password file is available on the CD-ROM in the <a href="#">Licensing</a> folder.
1	Rainbow Dongle, USB version



## Installing the Software

This section provides instructions for installing your software.

### Requirements

The analyzer shall be installed on a PC with the following characteristics:

- Operating System: Windows 10, Windows XP, Windows Vista, Windows Seven, Windows 8/8.1, Windows 2003 Server, Windows 2008 Server
- Architecture: 32 & 64 bits
- Processor: Intel Core2 @ 2GHz
- Available disk space: 300 Mbytes
- RAM: 3 Gbytes
- USB port
- CD-ROM drive

### Specific Requirements for Installation on a Laptop

It is possible to install the CMA 1820 on a laptop only if the laptop is not plugged on its desk.

Moreover, if you started your laptop on its desk and then removed it from the desk, you must reboot your system before launching the CMA 1820 (if not, a blue screen may occur).

### Prerequisites

Before you start, make sure that you have:

- The Software Protection key
- The license password file

(items supplied with your Compressed Media Analyzer product)

You will be prompted to install the Software Protection key on one USB port of your system and to enter the license password file after you have completed the Compressed Media Analyzer software installation.

Figure 2-1. USB software key



## Installation

To install the Compressed Media Analyzer software, perform the following steps:

1. Log on to your system as administrator.
2. Place the Compressed Media Analyzer Software CD into the CD-ROM drive.
3. Open the [Setup](#) folder and launch the `setup.exe` file.
4. Click [OK](#) to start software installation.

If DirectX 9.0 is not installed, a dialog is displayed and prompts for DirectX 9.0 installation. Once the installation is completed, DirectX setup reboots the machine.

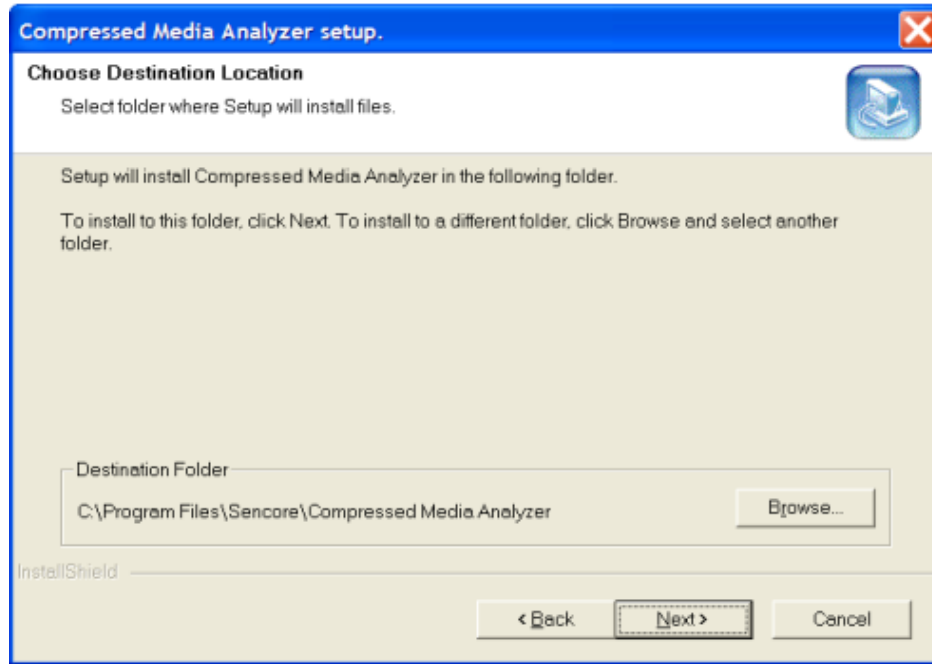
5. When the **Installation** window is displayed (after a few seconds), click **Next**.

Figure 2-2. Installation window



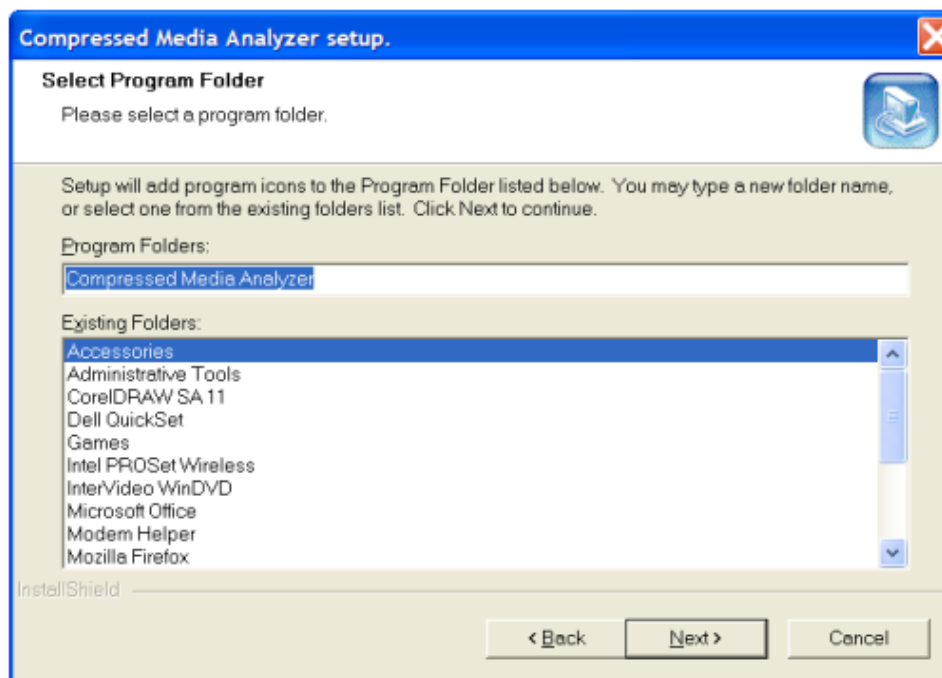
6. In the **Choose Destination Directory** window, click **Next** to accept the default destination drive (PROGRAM FILES\Sencore\CompressedMediaAnalyzer).

Figure 2-3. Choose Destination Directory



7. In the **Select Program Folder** window, click **Next** to accept the default folder name (CompressedMediaAnalyzer).

Figure 2-4. Select Program Folder



8. In the **Setup Type** window, click **Next** to accept the Stream library installation and to carry on the installation.

The Setup program begins to install the software and related files.

9. Click [Finish](#).

Figure 2-5. Setup complete window

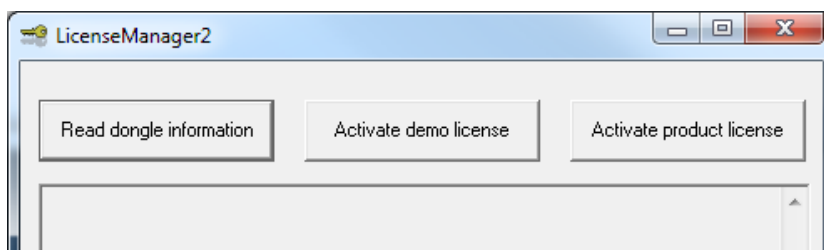


A Notepad window opens to display the `Readme` file.

10. Scan the text for important information, then select [Exit](#) from the [File](#) menu to close the window.

The [License Manager 2](#) window opens.

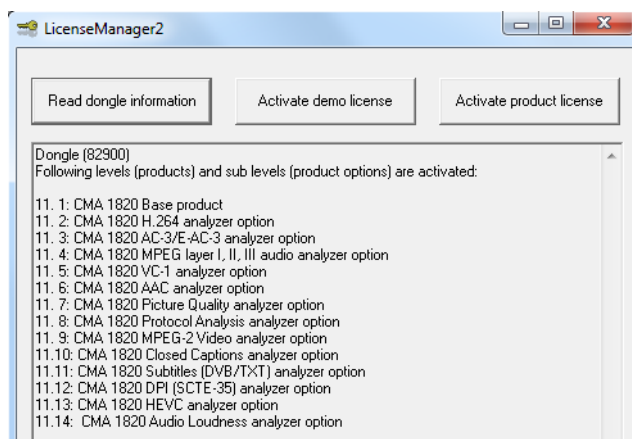
Figure 2-6. License Manager 2 window



11. Click the **Activate product license** button. A message box asks for the license password file. This file is located in the **Licensing** folder on the installation CD-ROM.

If the password file corresponds to the dongle, the list of activated options is displayed.

Figure 2-7. License Manager 2: list of activated options



12. Remove the Compressed Media Analyzer Software CD from the CD-ROM drive to complete the Setup.

## Starting the Application

To start the Compressed Media Analyzer, perform one of the following actions:

- From the [Start](#) menu, choose the [CompressedMediaAnalyzer](#) program group, then [CMA 1820](#).
- Double-click the [CMA 1820](#) icon from the desktop.
- From the inline command editor, enter the path to the `CMA1820.exe` file.

The main window of the application is displayed.

## Exiting the Application

To exit the application, perform one of the following actions:

- Choose [Exit](#) from the [File](#) menu.
- Use the Close window function.
- Use the `ALT + F4` keyboard shortcut.



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# Chapter 3

## Graphical User Interface

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### Introduction

This chapter explains how to use the Graphical User Interface to configure and supervise the CMA 1820 Compressed Media Analyzer.

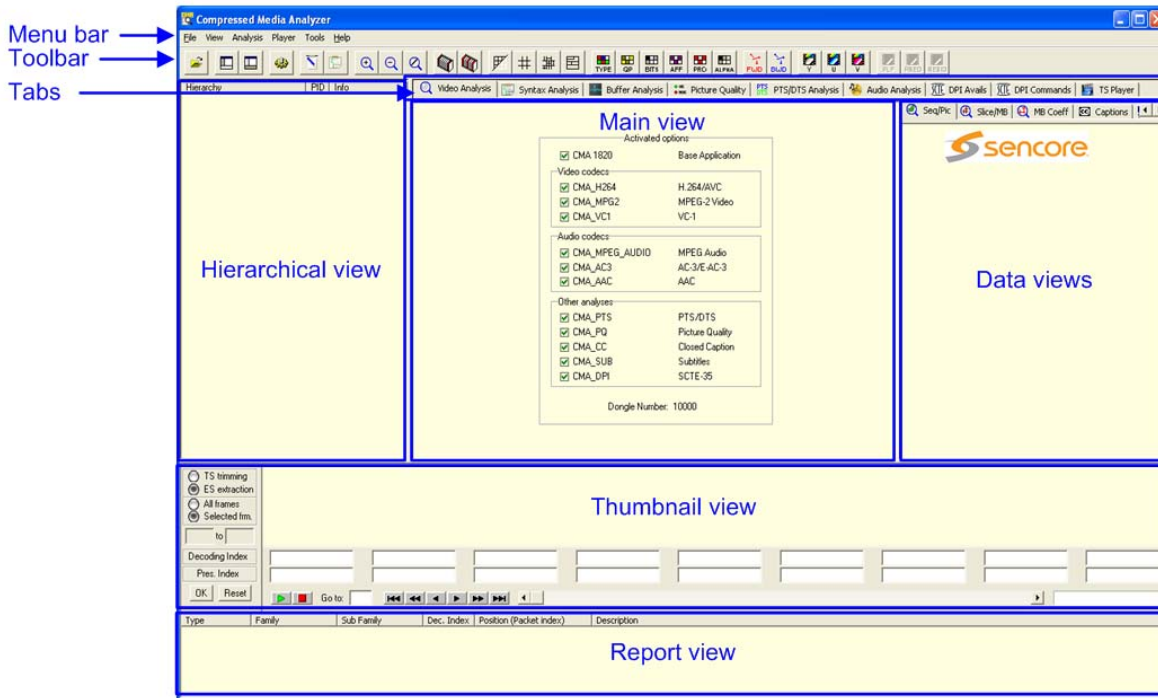
### Content of this Chapter

'GUI Overview' .....	page 42
'Basic Settings' .....	page 52
'Interface Description' .....	page 64

## GUI Overview

This section describes the general organization of the graphical user interface and its main components.

Figure 3-1. Graphical User Interface overview



The CMA 1820 GUI consists of:

- A **Menu bar** that gives access to the different menus of the application.
- A **Toolbar** that lets you customize the analysis information to be displayed.
- A **Hierarchical view** that displays the structure of the opened video file. It lets you select the stream to be analyzed.
- **Tab**s that let you choose the analysis you want to display in the **Main view**. Once a video file is opened, tabs are available according to the ES selected from the **Hierarchical view**.
- A central **Main view** that displays the current analysis, depending on the selected **Tab**.
- A **Thumbnail view** that lets you navigate through the video.
- A **Report view** that contains the list of error, warning and information messages.

Figure 3-1 shows the GUI as displayed when opening it for the first time, i.e. empty. Once you have opened a stream, all views are updated with the content of the stream and only the toolbar buttons available for the type of stream you opened are displayed.

A summary of the options available on your system is displayed in the [Main](#) view.

## Analysis Understanding Keys

### Color Codes

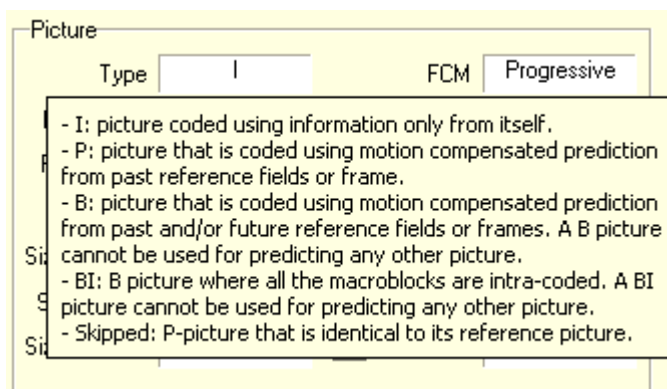
In the results of any analysis, the following color codes are always used:

- **green** = OK
- **orange** = warning
- **red** = error

### Tooltips

Every piece of information comes with a comprehensive tooltip, which is displayed when moving the mouse over a field, a LED, a toolbar button, a message in the [Report](#) view, etc.

Figure 3-2. Comprehensive tooltip display



## Short Presentation of the Views

### Hierarchical View

When you open a new video file, the [Hierarchical](#) view automatically displays the structure of the Transport Stream, Raw Byte, MP4, MOV or FLV file.



When a file contains audio or video elements that are not supported by the analyzer, these are indicated using the "Audio" or "Video" label, with no complementary information.

### Thumbnail View

When an H.264/AVC, VC-1 or MPEG-2 video Elementary Stream is selected from the [Hierarchical](#) view, it is automatically decoded and the [Thumbnail](#) view displays the first pictures in the first video sequence.



If the ES selected from the [Hierarchical](#) view is not in a supported format, the [Thumbnail](#) view is displayed empty.

The [Thumbnail](#) view provides basic information on the current 7 to 11 pictures (depending on the screen resolution) representing the current zone of interest in the video:

- Picture type
- Decoding index
- Presentation index

It also lets you access these pictures and navigate through the sequence via the navigation buttons and scroll bar.

It is possible to play and stop the video (only the video). In this case, data concerning the video - including overlay - is available in the [Main](#) view.

The [Thumbnail](#) view also contains trimming and extraction features. These both produce a new video file containing only the selected part of a video sequence. In the case of trimming, input and output have to be a TS or a TTS. Extraction can be performed on TS, TTS, MP4, MOV, FLV, 3GP, ASF or raw byte files. It always results in an H.264/AVC, MPEG-2 or VC-1 raw byte file.

## Main View

The tabs available in the [Main](#) view depend on the analyzed file type and content. [Table 3-1](#) provides the summary of the formats for which the tabs are available.

Table 3-1. Main view summary

	H.265/ HEVC	H.264/ AVC	VC-1	MPEG-2	AAC	AC-3/ E-AC-3	MPEG audio	SCTE-35 analysis	HLS
<b>Video Analysis</b>	X	X	X	X					
<b>Syntax Analysis</b>	X	X	X	X				X	
<b>Buffer Analysis</b>	X	X							
<b>Picture Quality</b>		X							
<b>PTS/DTS Analysis</b>	X	X	X	X	X	X	X		
<b>Audio Analysis</b>					X	X	X		
<b>Audio Loudness</b>					X	X	X		
<b>DPI Avails</b>								X	
<b>DPI Commands</b>								X	
<b>TS Player</b>		X		X	X	X	X		
<b>HLS Analysis</b>									X
<b>HLS Syntax</b>									X

All these tabs are briefly presented hereafter. They are fully described in [section 'Interface Description'](#).

### Video Analysis

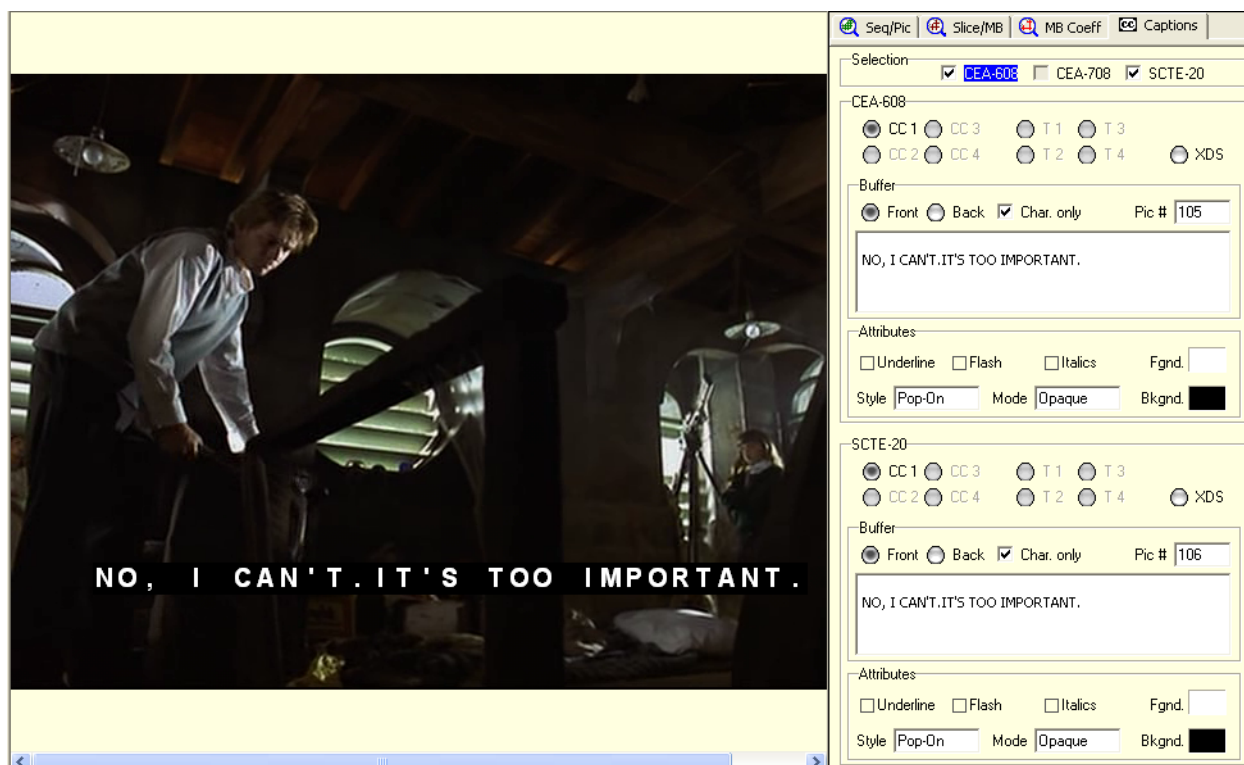
The [Video Analysis](#) tab displays the current picture with useful on-picture visualization functions.

Some data are displayed on the right part of the view, in complementary panels: the [Seq/Picture](#), [Slice/MB](#), [MB Coeff](#) and [VPS/WSS](#) tabs are

always available. The [Captions](#), [DVB Subtitles](#), and [DVB Teletext](#) tabs are available provided you bought the corresponding options.

- The [Seq/Picture](#) tab provides information and statistics on currently displayed picture.
- The [Slice/MB](#) tab lets you move the mouse over the picture so as to get information over a particular slice or macroblock.
- The [MB Coeff](#) tab provides information on the macroblocks coefficients. All types of coefficients are available only for H.264/AVC and MPEG-2 streams and if the option has been enabled in the settings.
- The [Captions](#) tab provides interpreted information on CEA-608, CEA-708 and SCTE-20 closed captions. This tab is available only if you purchased the Closed Captions product option.
- The [DVB Subtitles](#) tab represents the decoder's state at the picture display moment, regarding DVB subtitles. This tab is available only if you purchased the Subtitles (DVB/Teletext) product option.
- The [DVB Teletext](#) tab provides information on DVB teletext subtitles. This tab is available only if you purchased the Subtitles (DVB/Teletext) product option.
- The [VPS/WSS](#) tab provides position information on VPS and WSS data.

Figure 3-3. Captions tab and CC display on video



- The [WebVTT](#) tab provides information on WebVTT subtitles. This tab is available only if you purchased the OTT product option.

### Syntax Analysis

The [Syntax Analysis](#) tab displays the value and interpretation of every syntax element, down to and including slice headers.

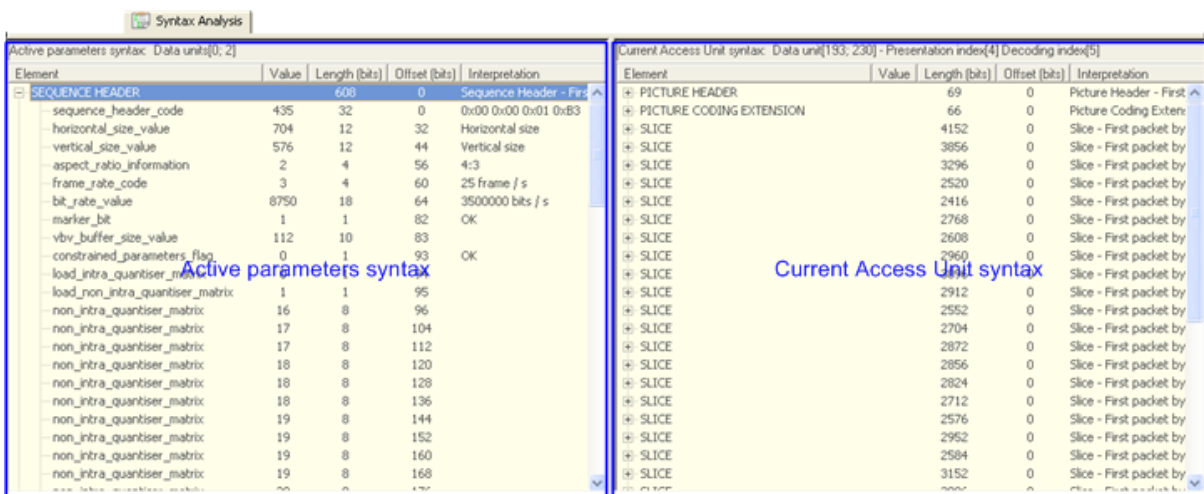
High-level syntax units are called:

- H.264/AVC and H.265/HEVC: Network Abstraction Layer (NAL) units
- VC-1: Bitstream Data Units (BDU)
- MPEG-2 Video: Data Units (DU)

Some of these contain parameters required by the decoder to operate properly, while other contain the coded video data.

The [Syntax Analysis](#) view is made up of two syntax trees that represent respectively the [active parameters syntax](#) (left) and the [current Access Unit syntax](#) (right). You can thus have a precise description of all video syntax elements.

Figure 3-4. Syntax Analysis view (MPEG-2)



The active parameters displayed in the left part of the view are:

- H.264/AVC: active Sequence Parameter Set (SPS) and Picture Parameter Set (PPS)
- H.265/HEVC: active Video Parameter Set (VPS), Sequence Parameter Set (SPS) and Picture Parameter Set (PPS)
- VC-1: Sequence Header (SH) and Entry-point Header (EH)
- MPEG-2 Video: Sequence Header (SH), optional sequence extensions and Group of pictures Header (GH)

In addition to this syntax description, stream conformance analysis is performed at two levels. First of all, a general stream structure analysis is performed to make sure that NAL units/BDU/DU are consistent and correctly ordered in the stream. Then, a syntax analysis is performed at the syntax element level to make sure that each value is correct.

Incorrect or improper values will be highlighted. The result of the conformance analysis can also be reached from the [Report](#) view and from a report file generated by the application.

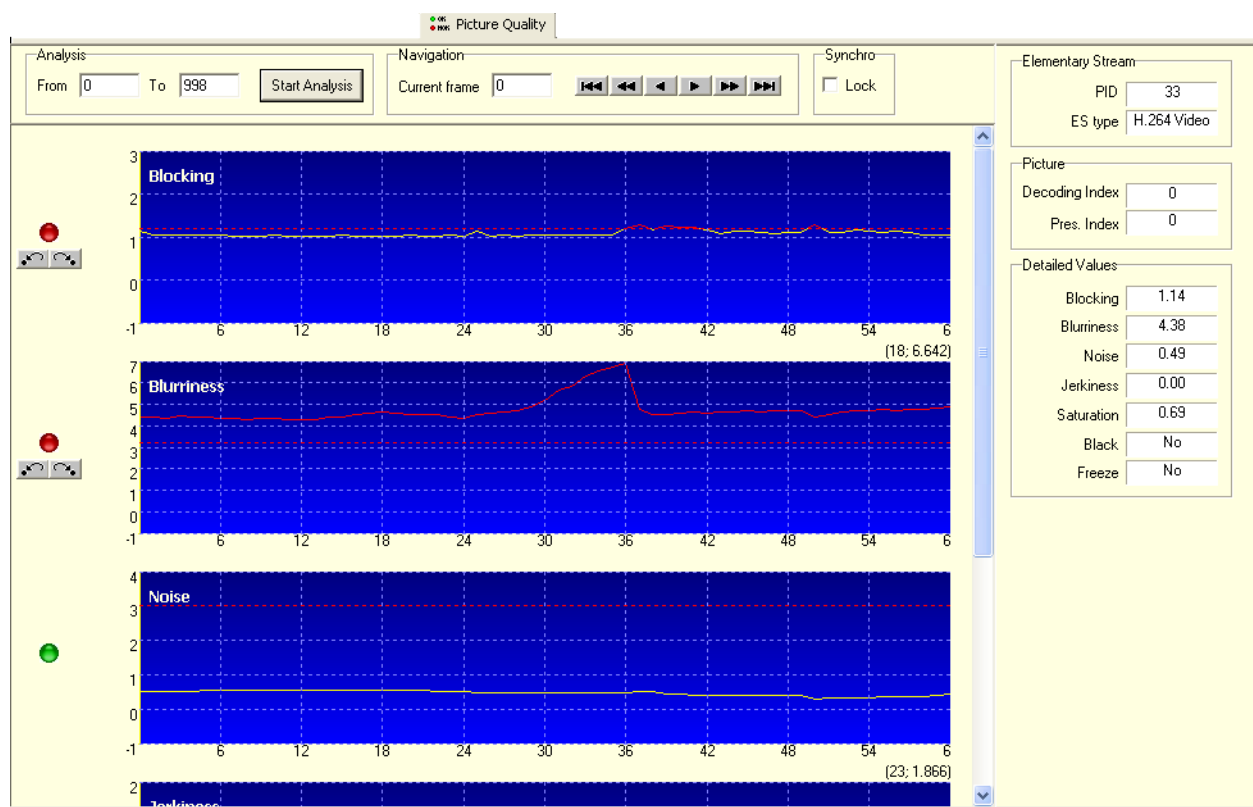
### Dynamic Buffer Analysis (H.264/AVC only)

The [H.264/AVC Dynamic Buffer Analysis](#) module lets you operate two models:

- [Hypothetical Reference Decoder \(HRD\)](#) model, to test conformance of H.264/AVC raw byte bitstreams
- [Transport Stream - System Target Decoder \(T-STD\)](#) leak method model to test conformance of H.264/AVC in an MPEG-2 TS bitstream

### Picture Quality Analysis (H.264/AVC only)

Figure 3-5. Picture quality analysis graphs



Unlike other analyses in the Analyzer, the picture quality analysis is not done automatically and not necessarily on the whole elementary stream.



The part of the video stream to analyze is given in the [Analysis](#) group box, and you may launch the analysis at will by clicking the [Start Analysis](#) button. The frame indexes in the [From](#), [To](#) and [Current](#) frame edits are presentation indexes which can be found in the [Thumbnail](#) view.

Each artifact selected in the [Settings](#) panel has its results displayed in a graph.

At the left of each graph is a led of color:

- **Red** if at least one frame value is greater than the threshold
- **Green** if all the values are lesser than the threshold

On the right part of the screen, there are detailed information about the current frame, its quality results and basic data that let you quickly identify the picture in other views of the Analyzer.

Black and frozen sequences do not produce a graph but a message in the [Report](#) view. Of course, the detailed view of the frame indicates if it belongs to one or another.

Therefore, there may be up to five graphs displayed in the view. There can be none if only black or frozen sequences detections are selected.

### **PTS/DTS Analysis**

This tab lets you perform a complete PTS/DTS analysis of a video or audio ES. If the stream contains errors, you can see the detail of the error and navigate in the stream. The tab also provides Access Units data.

### **Audio Analysis**

The audio waveform is displayed for each channel. You can play or save a single portion of audio signal. Additionally, main characteristics for the audio ES and details for each frame (header syntax for AAC, synchronization and bitstream information for AC-3 and E-AC-3 and CRC for MPEG) are available.

Provided analyses vary depending on the audio format being analyzed, e.g. for an MPEG audio format file, only two channels (i.e. left and right) may be analyzed.

### **Audio Loudness**

Loudness analysis parameters can be set in the [Settings](#) panel. Once defined, the analysis can be launched either on the entire file, or on a portion thereof.

Graphics showing the evolution of selected measurements are shown in the [Main](#) view. Numerical information can be found in the [Data](#) view along with the overall analysis status.

## DPI Avails

This tab is displayed when selecting an SCTE-35 DPI component from the [Hierarchical](#) view. It provides you with information on commercial breaks, called *avails*, present in the stream. Two levels of information are available: summary or avail detail.

## DPI Commands

This tab is displayed when selecting an SCTE-35 DPI component from the [Hierarchical](#) view. It lets you see the DPI commands with their type and time.

## TS Player

The [TS Player](#) module lets you play video streams contained in an MPEG-2 TS with a built-in player.

## HLS Analysis

The [HLS Analysis](#) tab displays playlist and segment information when an HLS file is opened in the CMA 1820.

The upper part of the view allows navigation in Segments, by segment index or by time. You can also open an HLS segment or an HLS media in a different CMA 1820, or save an HLS media as a single file.

The central part of the view shows the different Media Segments on a timeline. On top, LEDs indicating the status of the different analyses performed on Master, Media and Segment files can be found. The analyses can be enabled in the Settings.

In the center, a timeline for each Media signaled in the Master Playlist shows:

- the extent of time represented by the Media
- the currently selected segment with its starting and ending times
- the conformance status of the currently selected segment

On the left edge of each timeline, a LED indicating the analysis status of each Media regarding conformance analyses and a summary of Media characteristics.

On the right of each timeline, a thumbnail shows the first I frame of the selected Segment.

## **HLS Syntax**

The [Syntax Analysis](#) tab displays the content of Master (left) and Media (right) playlist files, for quick reference and navigation. Media playlist files can be selected in the [Hierarchical](#) view.

Lines containing syntax or conformance errors are highlighted in red.

## **Report View**

The [Report](#) view displays information, warning and error messages.

Messages are organized into families and sub-families.

## Basic Settings

This section contains step-by-step operating procedures that will introduce you to the capabilities and features of the CMA 1820.

The settings described in this section are the following:


- 'Opening a Video Elementary Stream'
- 'Analyzing an MPEG-2 Transport Stream'
- 'Navigating in a Video File'
- 'Analyzing a Video Sequence'
- 'Playing a Video with the Built-in Player'
- 'Playing a Video in Raw-Byte Mode'
- 'Performing Trimming or Extraction'
- 'Interpreting the Report View'
- 'Analyzing the Quality of Pictures'
- 'Checking the Time Stamps in a Transport Stream'
- 'Displaying Closed Captions, DVB Teletext or Subtitles Data'
- 'Viewing and Interpreting SCTE-35 DPI Data'
- 'Analyzing HLS Files'

For further detailed operating information on each module, refer to section 'Interface Description' on page 64.



The TS file that is used for the tutorial is located at the C:\Program Files\Sencore\AVC Analyzer\Streams path (if the installation directory has not been changed during setup).

## Opening a Video Elementary Stream

1. Click the  toolbar button.
2. Select the file to analyze. This can be either an H.264/AVC Raw Byte file or an MPEG-2 TS containing ES compressed in H.265/HEVC, H.264/AVC, MPEG-2 Video or VC-1 or in another compression format.
3. Click [Open](#).

In the case of an H.264/AVC, an MPEG-2 or a VC-1 Raw byte file (or an MPEG-2 TS or TTS containing only one H.265/HEVC, H.264/AVC, MPEG-2 or VC-1 ES), the ES is automatically parsed; the Analyzer performs decoding of the first pictures and displays them in the [Thumbnail](#) view.

If the ES selected from the [Hierarchical](#) view is not an H265/HEVC, an H.264/AVC, a VC-1 or an MPEG-2 ES, the stream can only be played using the built-in player.

## Analyzing an MPEG-2 Transport Stream

In the case of an MPEG-2 TS file, the Analyzer automatically performs a first analysis to test conformance of the stream with 'TR 101 290' on opening.







The results of this analysis are displayed in the [Report](#) view. The conformance points that are tested can be configured from the [Settings](#) panel.



## Navigating in a Video File

Once an H.265/HEVC, an H.264/AVC, a VC-1 or an MPEG-2 video file is opened, select the ES you wish to analyze from the [Hierarchical](#) view.

The ES is then parsed, decoded, and the [Thumbnail](#) view displays the first pictures in the stream. The first picture is also displayed in the [Main](#) view, located in the center.

To navigate in the sequence, you may perform one of the following actions:

- Drag the cursor on the scroll bar located in the lower part of the view to get to the desired part of the sequence.
- Click the [first picture](#)  and [last picture](#)  buttons to go to the start or to the end of the sequence.
- Click the [previous I picture](#)  and [next I picture](#)  buttons to navigate between I pictures.
- Click the [previous picture](#)  and [next picture](#)  buttons to navigate between pictures.
- Use the [go to](#) edit box and enter the presentation index of the desired picture.
- Click a thumbnail to display the corresponding picture in the [Main](#) view.

You can also use the Random access points or I pictures to reach quickly the start of a new video sequence within an H.264/AVC, a VC-1 or an MPEG-2 video stream. Click the  [RAP](#) button to enable the [RAP](#) mode and display only IDR pictures (for H.264/AVC or H.265/HEVC), entry-points (for VC-1). Click the  toolbar button to show only I pictures with closed GOP (for MPEG-2 Video) in the view.



**For H.264/AVC:** the decoder is able to decode a picture provided the SPS and PPS parameters referenced by the picture are present before the picture itself and if an I picture has been previously decoded.

**For H.265/HEVC:** the decoder is able to decode a picture provided the VPS, SPS and PPS parameters referenced by the picture are present before the picture itself and if an I picture has been previously decoded.

**For VC-1 Advanced profile:** the decoder is able to decode a picture provided the SH and EH parameters are present before the picture itself and if an I picture has been previously decoded.

**For MPEG-2 Video:** the decoder is able to decode a picture provided the Sequence Header and Sequence Extension are present before the picture itself and if an I picture has been previously decoded.

Should the decoder fail to process a picture, the [Main](#) view turns blank. In that case, simply try to go to the next I picture.

## Analyzing a Video Sequence

The CMA 1820 displays information in a graphical way thanks to overlays (see section '[Video Analysis View](#)' on page 88).


Use the [Data](#) view's tab to get additional information:

- Select a picture to display picture-level information in the [Seq/Picture](#) tab. The right column of the view displays statistics on prediction mode usage and TS-related information.
- Select the [Slice/MB](#) tab: slice and macroblock-level information are then displayed.
- Move the cursor over the picture: the data boxes display information on a given macroblock when the mouse pointer moves over it.
- Position the mouse pointer over a data box to reach information on its meaning.

## Playing a Video with the Built-in Player

Proceed as follows:


1. Choose the [TS Player](#) tab.

2. From the [Hierarchical](#) view, select the video ES you wish to play.
3. If there are several audio ES for the video ES, select the audio ES you wish to play.
4. Click the [Play](#) button  from the toolbar.

Once the file is being played, the Player's toolbar grants access to the most common player functions, such as [Pause](#), [Resume](#), [Full Screen](#) or [volume control](#) (see [Table 3-2](#) on page 64).


## Playing a Video in Raw-Byte Mode

This feature is only available with an H.265/HEVC, an H.264/AVC a VC-1 or an MPEG-2 ES. No audio is played in this mode. Since no transport layer is present, the stream is played at roughly 25 Frames Per Second (FPS), when possible. However, the use of on-picture display may slow down this rate.

1. Choose the [Video Analysis](#) tab.
2. Set the display functions (optional).
3. Click the [Play](#) button  from the [Thumbnail](#) view.



During play in Raw Byte mode, display settings cannot be altered. The main and navigation toolbars are disabled.

4. Press any key or click the [Stop](#) button  from the [Thumbnail](#) view to stop playing.

## Performing Trimming or Extraction

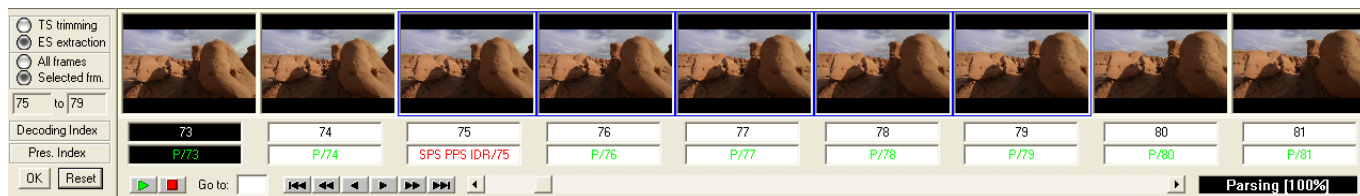
### Extracting Pictures

Let us suppose that you wish to extract pictures 76 to 79. Proceed as follows:

1. Right-click a thumbnail to select the first picture you wish to include in your sub sequence, e.g. picture 76. The selection automatically extends to the I picture preceding your selected, e.g. here picture 75 (a sequence shall start with an I picture so that it can be properly decoded in the future).

- Right-click another thumbnail to select the last picture in your sub sequence, e.g. picture 79.

Figure 3-6. Thumbnail view (pictures 75-79 selected)



On the left of the view, the two boxes indicate the number of the first and last pictures currently selected.



- Check the option you want to use: [TS Trimming](#) or [ES Extraction](#). For an explanation of the difference between trimming and extraction, see [section 'Edition'](#) on page 87.
- Click [OK](#) to perform the trimming or extraction operation.
- Name the resulting file.
- Click [OK](#).

## Extracting Video Sequences in RAP Mode or in I Pictures

If you need to select complete video sequences, you can enable the Random Access Point (RAP) mode: only RAP pictures are displayed, so that selected pictures correspond to the selection of complete picture ranges. RAP pictures are defined as:

- H.264/AVC: IDR pictures
- H.265/HEVC: IDR, CRA, BLA pictures
- VC-1: I pictures with an Entry-point Header
- MPEG-2 Video: I pictures with closed\_gop = TRUE

Similarly, the picture selection can be performed in I-only mode.

- Click the  toolbar button to enable the RAP mode in the [Thumbnail](#) view.
- Click the  toolbar button to enable the I mode in the [Thumbnail](#) view.

By right-clicking one thumbnail, you will then automatically select a video sequence. Right-click one or several thumbnails to select the video sequence you want to extract, as described in the procedure given in [section 'Extracting Pictures'](#).



## Interpreting the Report View

The [Report](#) view displays information and error messages.

Some messages may be related to TR 101 290 results. TR 101 290 is a DVB measurement standard defined to check the compliance of MPEG-2 TS at the transport level. Refer to *section 'Report View & Logs'* on page 82. For further information on the TR 101 290 standard, refer to the Standards Overview document.

Other messages may be related to dynamic buffer analysis or syntax conformance.









## Analyzing the Quality of Pictures

1. Once a file is opened, select the video ES you wish to analyze in the [Hierarchical](#) view.
2. Click the [Picture Quality Analysis](#) tab in the [Main](#) view.
3. Set the start and stop frames in the [From](#) and [To](#) fields in the [Analysis](#) area.
4. Click the [Start Analysis](#) button.

A progress bar shows the analysis advancement. You may interrupt the analysis any time by clicking the [Abort](#) button.

At the end of the analysis, the graphs are displayed. Several commands are available to navigate in the results.

To get to the results of one picture:

- Click the [first picture](#)  and [last picture](#)  buttons to go to the start or to the end of the sequence.
- Click the [previous page](#)  and [next page](#)  buttons to navigate to the next page in the graph (a page displays 61 pictures).
- Click the [previous picture](#)  and [next picture](#)  buttons to navigate between the pictures.
- Use the [go to](#) edit box and enter the presentation index of the desired picture.
- Click the [previous above threshold](#)  and [next above threshold](#)  buttons of an artifact to navigate only in the frames with a result above the threshold.

When the [Synchro Lock](#) box is checked, moving through the picture with the navigation button will set the current frame as current frame in the [Thumbnail](#) view too. Therefore you can have an insight of the picture

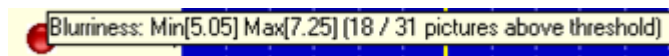
corresponding to the current results, and see it entirely in the [Video Analysis](#) view.



This synchronization is only effective in this way, changing the current picture in the [Thumbnail](#) view will have no effect on the [Picture analysis](#) view.

Each led features a tooltip that sums up the analysis results for that artifact. It tells the minimum and maximum values for the sequence, the number of picture above the threshold and the picture count in the sequence.

Figure 3-7. Tooltip on a LED summing up the results for an artifact



## Checking the Time Stamps in a Transport Stream

To check validity of the time stamps on a Transport Stream containing H.265/HEVC, H.264/AVC, MPEG-2 Video, AC3, AAC or MPEG audio:


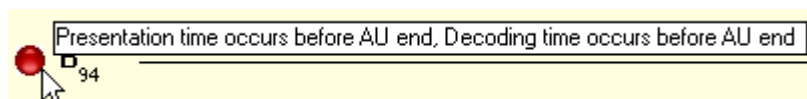
1. Click the [PTS/DTS Analysis](#) tab in the [Main](#) view.
2. Look at the LED on top of the view, in the [Error / Warning navigation](#) area. If it is green, the time stamps in your stream are correct. Else...
3. ...Click the [Go to next error](#) button  in the error navigation panel to display the first erroneous picture.
4. Move your mouse over the red LED to get a description of the error(s) on this picture.

Figure 3-8. Tooltip on a red LED indicates an error



PTS/DTS Analysis errors are mostly related to bad PES packetization or bad TS multiplexing.

## Displaying Closed Captions, DVB Teletext or Subtitles Data

The process to display closed captions, teletext or DVB subtitles data is very similar.

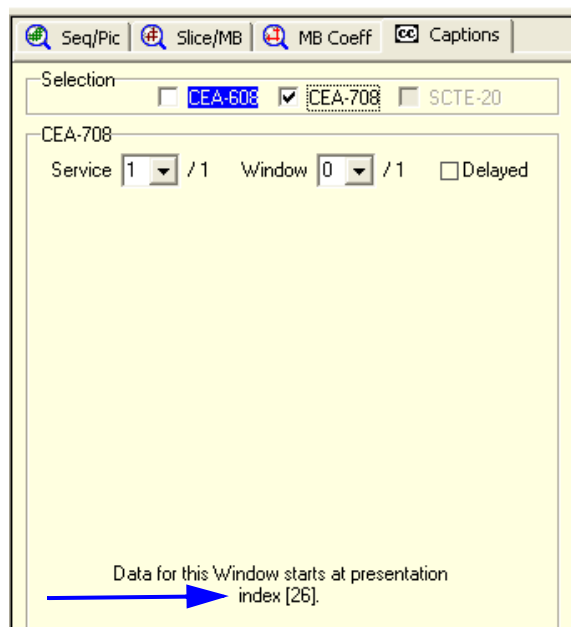
In all cases, we assume that the stream is opened and that the [Video Analysis](#) tab is selected.

### Displaying Closed Captions

If you have a stream that contains closed captions, proceed as follows to display them:

1. In the [Data](#) views on the right, select the [Captions](#) tab.  
Closed captions data are automatically detected and a message indicates which types are available.
2. Check the boxes corresponding to the CC types you wish to display.
3. Read the message indicating the first presentation index that shows closed captions data.

Figure 3-9. Reading the first presentation index showing closed captions data



4. In the [Thumbnail](#) view, key this presentation index in the [Go to](#) field and press [Enter](#).

You can see that data appear in the [Captions](#) tab. This does not mean that captions are actually displayed on the video.

- Use the **Thumbnail** view's buttons to navigate through the video and see captions evolution.

## Displaying DVB Teletext or Subtitles

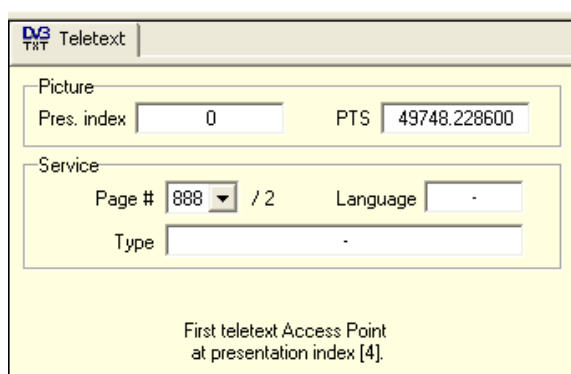
If you have a stream that contains DVB teletext or subtitles, proceed as follows to display them:

- From the **Hierarchical** view, select a **DVB Teletext**, **VBI Data** or a **DVB Subtitles** component.

The corresponding view is automatically displayed in the **Data** view on the right.

- Read the message indicating the first access point that shows teletext or subtitles data.

Figure 3-10. Reading the first access point showing teletext data



- In the **Thumbnail** view, key this access point in the **Go to** field and press **Enter**.

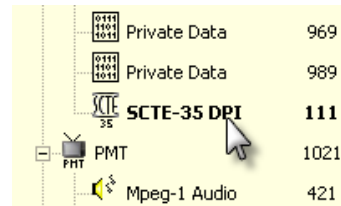
You can see that data appear in the **Teletext** or **Subtitles** tab. This does not mean that text is actually displayed on the video.

- Use the **Thumbnail** view's buttons to navigate through the video and see the teletext or subtitles evolution.

## Viewing and Interpreting SCTE-35 DPI Data

If you have a stream that contains SCTE-35 DPI data, to view and interpret the data, select an [SCTE-35 DPI](#) component from the [Hierarchical](#) view.

Figure 3-11. Selecting an SCTE-35 DPI component



The [DPI Avails](#) tab is automatically displayed, showing an overview of the avails (commercial breaks) present in the stream, and the [Data](#) view on the right displays avails-related data.

Figure 3-12. DPI Avails tab and Data view


To navigate through the avails, use the [Avail overview](#) time line or click the bars on the chart in the [Avails summary](#) tab.

To view details on an avail, select it and click the [Avails detail](#) tab. Additional data is provided in the [Data](#) view.

To obtain information on DPI commands, select the [DPI Commands](#) tab.

To view the syntax, select the [Syntax Analysis](#) tab.

To perform analyses on the avails, proceed as follows:

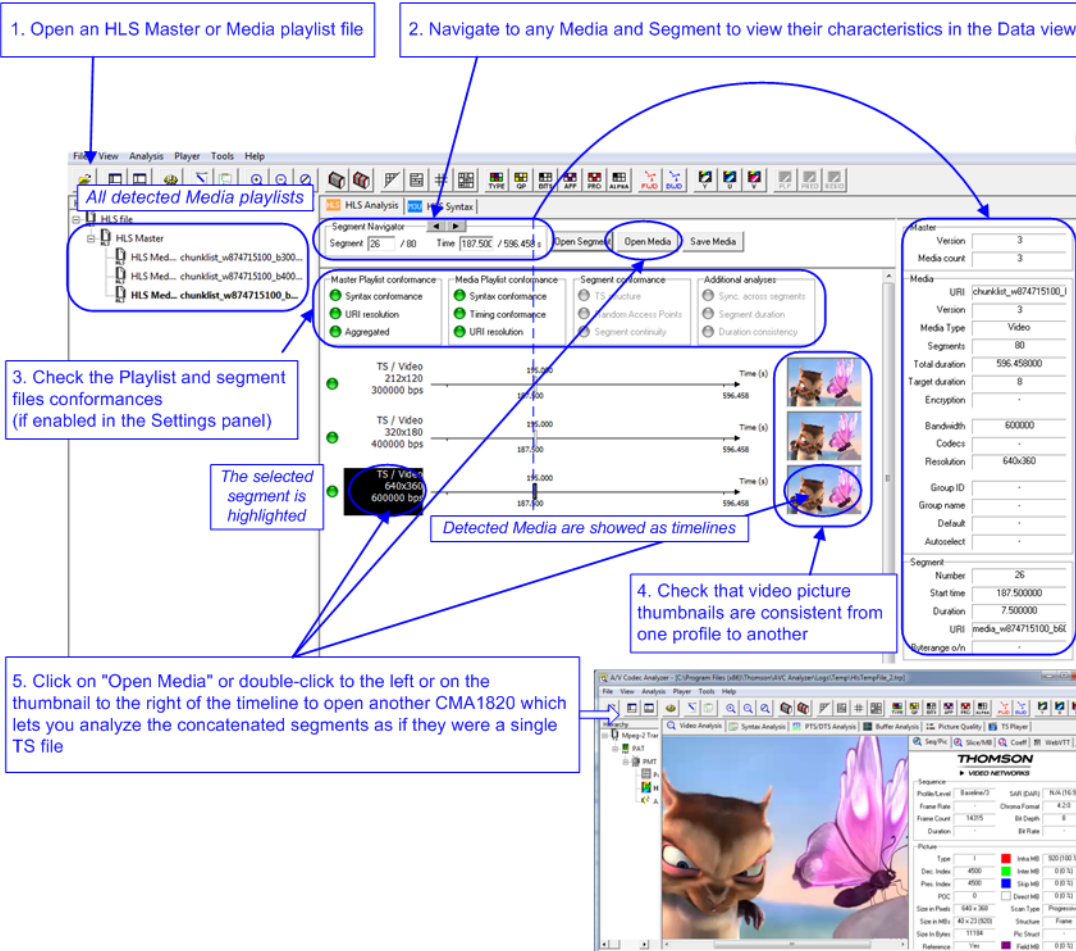
1. Click the  toolbar button.  
The SCTE-35 settings panel is displayed.
2. Perform your settings.
3. Click OK.
4. Reload the stream or, if the file is an MPTS, select a different component and then go back.

Analyses results are displayed in the frames in the center of the view.

## Analyzing HLS Files

HLS playlist files, whether they are Master or Media, can be opened for analysis. The playlist files are parsed, available segments are detected and analyzed in search of conformance issues.

Figure 3-13. Analyzing an HLS Playlist



The screenshot shows the CMA1820 software interface with several callouts explaining the analysis workflow:

1. Open an HLS Master or Media playlist file
2. Navigate to any Media and Segment to view their characteristics in the Data view
3. Check the Playlist and segment files conformances (if enabled in the Settings panel)
4. Check that video picture thumbnails are consistent from one profile to another
5. Click on "Open Media" or double-click to the left or on the thumbnail to the right of the timeline to open another CMA1820 which lets you analyze the concatenated segments as if they were a single TS file

The interface displays a tree view of detected media playlists, a central timeline with detected media segments, and a detailed data view for a selected segment. The data view includes conformance checks (Syntax, URI resolution, Aggregated) and additional analysis options (Sync across segments, Segment duration, Duration consistency). The timeline shows multiple segments with their respective TS/Video characteristics and bitrates.

1. Open an HLS Master or Media playlist file. The structure of the file is displayed in the [Hierarchical View](#), showing all detected Media playlists. The [HLS Analysis](#) view shows the different Media as timelines, with the selected segment highlighted on a time axis.
2. Check that the playlist and segment files are conformant thanks to the LEDs on top of the view. The analyses can be enabled or disabled in the [Settings](#) panel.
3. Navigate to any Media and Segment to view their characteristics in the [Data](#) view. The view is divided in 3 panels displaying Master, Media and Segment information. You can also check that video picture thumbnails are consistent from one profile to another.
4. Select the Media you want to analyze and click on "open Media". Alternatively, you can double click on the characteristics to the left or on the thumbnail to the right of the timeline. Another CMA 1820 opens which lets you analyze the concatenated segments, as if they were a single TS file.

## Interface Description

This section gives detailed information on the interface views, menu items or dialog boxes.

### Toolbar and Menus

The main toolbar is located below the [Main](#) view. It lets you display the desired information, depending on the activated view.

All the features available from the main toolbar can be reached from the Analyzer main menu as well.

The buttons and menu items available vary depending on the analysis that is being performed or on the format that is being analyzed.

[Table 3-2](#) details all menu items and corresponding toolbar buttons.

*Table 3-2. Main toolbar buttons & associated functions*










Menu	Button	Associated function
File   Open		Open a file.
File   Exit	-	Quit the CMA 1820 application.
View   Hide/Show Hierarchical view		Hide/Show the <a href="#">Hierarchical</a> view.
View   Hide/Show Report view		Hide/Show the <a href="#">Report</a> view.
View   Zoom in		Resize the picture. Zoom in can be x2 or x4 from normal size.
View   Zoom out		Resize the picture. Zoom out can reduce the picture by 50% from normal size.
View   Zoom normal size		Resize the picture to go back to normal size.
View   Display only Random Access Points pictures		Display only Random Access Points pictures in the <a href="#">Thumbnail</a> view.
View   Display only I pictures		Display only I pictures in the <a href="#">Thumbnail</a> view.
View   Change Grid Color		If the grids are not visible enough, the grid color will alternate between black and white.



Table 3-2. Main toolbar buttons &amp; associated functions


















Menu	Button	Associated function
Analysis   Display Tile		Display tiles (H.265/HEVC). No overlay means that the picture is made of a single tile.
Analysis   Display Slice Grid		Display slices. No overlay means that the picture is made of a single slice.
Analysis   Display MB/CTB Grid		Display macroblock grid and edges.
Analysis   Display MB Partition Grid		Display macroblock partitions grid, used for prediction (H.264/AVC and MPEG-2) or for transform (VC-1).
Analysis   Display CB Grid		Display Coding Blocks, used as a base for transform and prediction partitions (H.265/HEVC).
Analysis   Display PB Grid		Display Prediction Blocks, used for prediction (H.265/HEVC).
Analysis   Display TB Grid		Display Transform Blocks, used for transform (H.265/HEVC).
Analysis   Display MB Type Overlay		Macroblock type overlay. Display macroblock prediction types with a color code.
Analysis   Display MB QP Overlay		Display macroblock Quantization parameter overlay. For each macroblock, the darker the color, the lower the QP, the higher the size.
Analysis   Display MB Size Overlay		Display macroblock size overlay. For each macroblock, the darker the color, the higher the size.
Analysis   Display MB Frame/Field Overlay		Display Frame/Field overlay (H.264/AVC and MPEG-2). Indicates whether a macroblock pair is coded as frame or field.
Analysis   Display Custom Overlay		Display customizable overlay settings.
Modify Transparency of Overlay		When an overlay is active, set the overlay transparency.
Analysis   Display Forward L0 MVs		Display Forward motion vectors (MPEG-2 and VC-1) / L0 motion vectors (H.264/AVC and H.265/HEVC).
Analysis   Display Backward L1 MVs		Display Backward motion vectors (MPEG-2 and VC-1) / L1 motion vectors (H.264/AVC and H.265/HEVC).
Analysis   Hide/Show Y Component		Hide/Show the Y component.



Table 3-2. Main toolbar buttons &amp; associated functions

Menu	Button	Associated function
Analysis   Hide/Show Component	U 	Hide/Show the U component.
Analysis   Hide/Show Component	V 	Hide/Show the V component.
Player   Pause/Resume Sequence		Play/Pause the video stream (on <a href="#">TS Player</a> tab only).
Player   Stop Sequence		Stop the video stream (on <a href="#">TS Player</a> tab only).
Player   Decrease Sound Level		Decrease the volume (on <a href="#">TS Player</a> tab only).
Player   Increase Sound Level		Increase the volume (on <a href="#">TS Player</a> tab only).
Player   Set Full Screen Display		Full Screen Display (on <a href="#">TS Player</a> tab only).
Tools   Settings		Access the <a href="#">Settings</a> view.
Tools   Open Log files in Notepad		Open the Log files in Notepad.
Tools   Export view content to text file		Export the view's content to a text file.
Help   About Analyzer	–	Display contacts and product version information.
Help   User Guide	–	Display the User Guide PDF file.
–		Display pre-loop filter picture (only available on H.264 when the MB coefficients are displayed).
–		Display predicted picture (only available on H.264 or MPEG-2 videos when the MB coefficients are displayed).
–		Display residual picture (only available on H.264 or MPEG-2 videos when the MB coefficients are displayed).

## Display Customization

When using the CMA 1820, you may at any time want to focus on the [Main](#) view more than on secondary views.

E.g., once you have chosen the H.264/AVC, VC-1 or MPEG-2 Video ES to analyze, you need to see the pictures as precisely as possible, however, you do not need the [Hierarchical](#) view to be displayed anymore.

- Click the  [Show/Hide Hierarchical](#) view toolbar button to toggle the [Hierarchical](#) view on and off.
- Click the  [Show/Hide Report](#) view toolbar button to toggle the [Report](#) view on and off.

When analyzing a picture, you can zoom in and out to see the details more precisely.

Click the  [Zoom](#) buttons from the main toolbar to adapt the zoom level to your needs.

## MPEG-2 TS Analysis

Opening an MPEG-2 Transport Stream file automatically starts analyses for building a [Hierarchical](#) view and checking TR 101 290 conformance for level 1 and 2. The [Settings](#) panel lets you choose the points of conformance that will be tested, or disable completely the TR 101 290 analyses.

Additionally, **bit rates** are computed and a summary is available, listing average, min and max bit rates for each elementary stream.

Recognized file extensions for MPEG-2 TS are:

- .trp
- .ts
- .mpeg
- .mpg

## Hierarchical View

The [Hierarchical](#) view represents the MPEG-2 TS structure as a tree.

Three columns help in representing data:

- The [Hierarchy](#) column contains icons that represent the basic elements of the MPEG-2 structure. The top node of the tree is named Transport Stream. Immediately below is the Program Allocation Table (PAT) that references all the Program Map Tables (PMT), then the Elementary Streams (ES) such as H.264/AVC, VC-1 or MPEG-2 video.
- The [PID](#) column represents the Packet Identifier (PID) of the element.

- The **Info** column displays information such as the Transport Stream Identifier (TS ID) for the PAT or the program number for the PMT. For each video the PCR location is indicated: either the PCR is inside the video packet or it is inside an independent packet.

Figure 3-14. MPEG-2 TS structure with several programs

Hierarchy	PID	Info
Mpeg-2 Transport Stream		
PAT	0	TS ID 2 (0x2)
PMT	1284	Prg 517
Mpeg-2 Video	164	PCR inside
Mpeg-1 Audio	96	
PMT	1285	Prg 518
Mpeg-2 Video	165	PCR inside
Mpeg-1 Audio	100	
Dvb Teletext	35	
PMT	1283	Prg 516
Mpeg-2 Video	163	PCR inside
Mpeg-1 Audio	92	
PMT	1282	Prg 515
Mpeg-2 Video	162	PCR inside
Mpeg-1 Audio	88	
PMT	1286	Prg 519
Mpeg-1 Audio	104	
Mpeg-2 Video	166	PCR inside

Table 3-3. MPEG-2 TS structure elements












Icon	Element type
	Multiplex transport packets. This icon represents all (188 / 204 / 208-bytes) transport packets that makes up the stream.
	PAT (Program Association Table) sections. Always contained in PID 0 transport packets.
	CAT (Conditional Access Table) sections. The CAT table lets you associate one or more conditional access system with the Transport Stream.
	PMT (Program Map Table) sections.
	Video Elementary Stream: identified as video, if belonging to a supported type, the video will be analyzed. A green envelope indicates the stream contains a PCR.

Table 3-3. MPEG-2 TS structure elements

Icon	Element type
	Audio Elementary Stream: identified as audio, if belonging to a supported type, the audio will be analyzed. A green envelope indicates the stream contains a PCR.
	Private table.
	DVB subtitle.
	DVB teletext.
	SCTE-35 DPI component.
	VBI Data elementary Stream

## Report View

The **Report** view is divided into 6 columns. It displays messages indicating start and stop of MPEG-2 analysis, the bit rate and TR 101 290 results.

Figure 3-15. Report view

Type	Family	Sub Family	Dec. Index	Position (Packet Index)	Description
Error	Mpeg-2 Conforma...	Parsing	106	12965232 (68964)	Error appearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Error: if any vbv_delay field is
Information	Mpeg-2 Conforma...	Parsing	107	12997568 (69136)	Error disappearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Data unit index[4296].
Error	Mpeg-2 Conforma...	Parsing	123	15267104 (81208)	Error appearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Error: if any vbv_delay field is
Information	Mpeg-2 Conforma...	Parsing	124	15537636 (82647)	Error disappearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Data unit index[4979].
Error	Mpeg-2 Conforma...	Parsing	164	20254744 (107738)	Error appearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Error: if any vbv_delay field is
Information	Mpeg-2 Conforma...	Parsing	165	20459100 (108825)	Error disappearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Data unit index[6625].
Error	Mpeg-2 Conforma...	Parsing	300	36711136 (195272)	Error appearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Error: if any vbv_delay field is
Information	Mpeg-2 Conforma...	Parsing	301	36870372 (196119)	Error disappearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Data unit index[12083].
Error	Mpeg-2 Conforma...	Parsing	347	42450212 (225799)	Error appearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Error: if any vbv_delay field is
Information	Mpeg-2 Conforma...	Parsing	348	42498340 (226055)	Error disappearance for syntax element 'vbv_delay' of 'PICTURE HEADER'. Data unit index[13969].

Table 3-4. Report view columns

Column	Content
Type	Information, Warning or Error.
Family	MPEG-2 TS, H.264 NAL, H.264 VCL, H.264 DBA, H.264 Syntax, Audio, Internal, H.264 Conformance, Vc-1 Parsing, Vc-1 Decoding, Vc-1 Conformance, Picture Quality, Mpeg-2 Parsing, Mpeg-2 Decoding, Mpeg-2 Conformance, Closed Captions, DVB Subtitles, EBU Teletext, DPI, HEVC, HLS Conformance, MXF Conformance.

Table 3-4. Report view columns

Column	Content
Sub-family	TR 101 290-1, TR 101 290-2, Parsing, Trimming, Syntax, MPEG-2 section, TS packet, H.264 decoding, Missing parameter, Incorrect parameter, Information, Buffer error, NAL unit error, Profiles, Levels, DVB guidelines, MPEG-2 Sys Amd3, Output order, Decoding, PTS/DTS Analysis, Analysis, TS bitrate, Stream structure, DVB Subtitles and EBU Teletext.
Decoding Index	Decoding index of the erroneous image.
Position	Position of the first byte of the packet, i.e. position of synchronization byte 0x47.
Description	Message describing the event.


Table 3-5. TR 101 290 level 1 performed analyses

No.	Indicator	Precondition
1.1	TS sync loss	Loss of synchronization with consideration of hysteresis parameters: Consecutive packets for synchro found = 5, Consecutive packets for synchro loss = 3.
1.2	Sync byte	Sync_byte not equal to 0x47.
1.3 a(1)	PAT rate	Sections with table_id 0x00 do not occur at least every 0,5 s on PID 0x0000.
1.3 a(2)	PID 0x0 (PAT)	Section with table_id other than 0x00 found on PID 0x00
1.3 a(3)	PAT scrambling	Scrambling_control_field is not 00 for PID 0x0000
1.4	Continuity counter	Incorrect packet order: a packet occurs more than twice. Lost packet.
1.5 a(1)	PMT rate	Sections with table_id 0x02, (i.e. a PMT), do not occur at least every 0,5 s on each program_map_PID which is referred to in the PAT.
1.5 a(2)	PMT scrambling	Scrambling_control_field is not 00 for all packets containing information of sections with table_id 0x02 (i.e. a PMT) on each program_map_PID which is referred to in the PAT.
1.6	Absence of PID	Referred PID does not occur for a user-specified period (default period set to 5 s).

Table 3-6. TR 101 290 level 2 performed analyses

No.	Indicator	Precondition
2.1	Transport	Transport_error_indicator in the TS-Header is set to "1".
2.2	CRC	CRC error occurred in CAT, PAT, PMT, NIT, EIT, BAT, SDT or TOT table.
2.3 a	PCR repetition	Time interval between two consecutive PCR values more than 40 ms.
2.3 b	PCR discontinuity	The difference between two consecutive PCR values (PCR <sub>i+1</sub> - PCR <sub>i</sub> ) is outside the range of 0...100 ms without the discontinuity_indicator set.
2.4	PCR accuracy	PCR accuracy of selected program is not within ±500 ns.
2.5	PTS	PTS repetition period more than 700 ms.

The messages listed in the [Report](#) view are logged to a file. The location of this file is indicated in the last MPEG-2 TS report message.

All log files can be opened by clicking the  toolbar button. This button is disabled until all analyses have been completed.

## TR 101 290 Settings

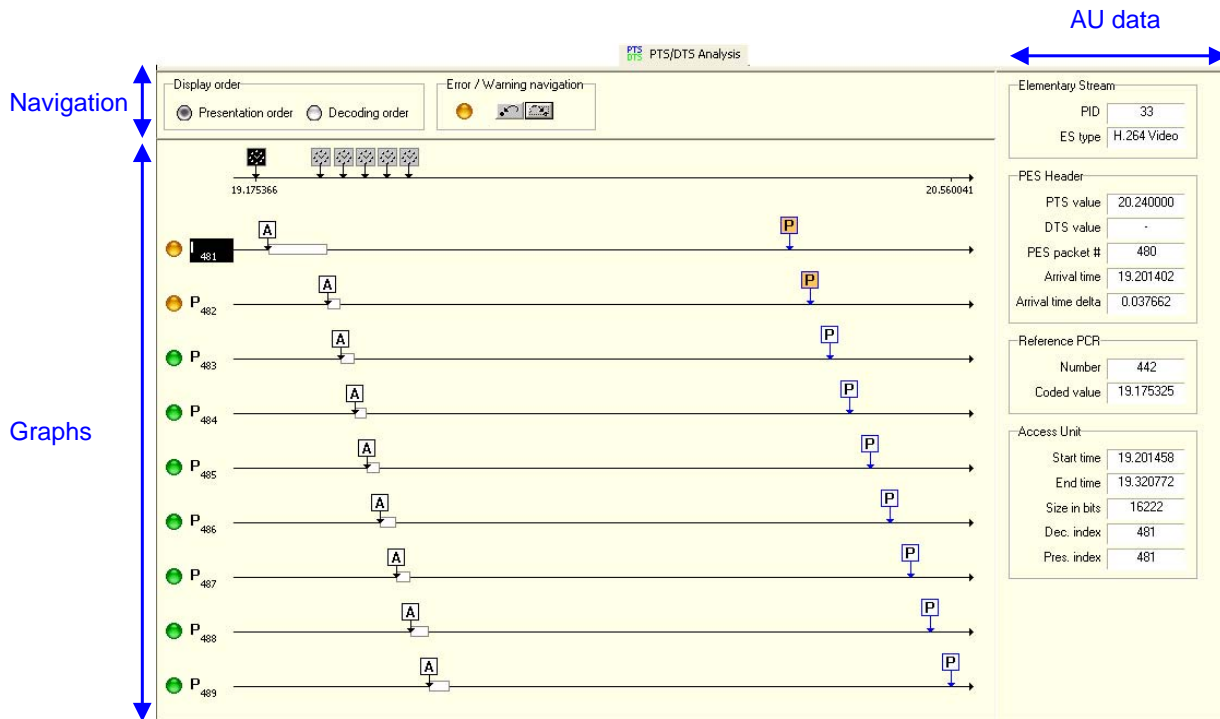
The [Settings](#) panel lets you enable or disable specific points in the TR 101 290 conformance test which is performed whenever an MPEG-2 Transport Stream is opened in the Analyzer. It also lets you specify different values when the test is based on a threshold.

All tests can be disabled at once via the [Perform TR 101 290 analyses](#) check box from the main [TR 101 290](#) panel. Disabling all or some of the TR 101 290 analyses can be performed even if the analyses are already started. However, once the MPEG-2 TS file is opened with TR 101 290 analyses disabled, enabling all TR 101 290 analyses will have no effect.

For more details on the [Settings](#) panel, refer to *section 'Settings Panel'* on page 216.

## PTS/DTS Analysis

Figure 3-16. PTS/DTS analysis



### Analysis Conditions

PTS/DTS analysis is run when you click the PTS/DTS Analysis tab in the interface.

It is performed on one Elementary Stream at a time. If you select a different elementary stream while on the PTS/DTS analysis view, a new analysis will be launched automatically on the ES you have just selected.

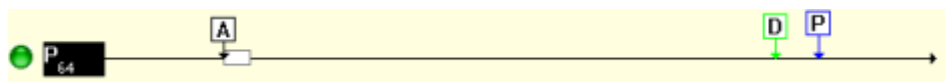
The analysis is real-time style, which means it is performed in one pass, without prior knowledge of the stream. That is why the first Access Units (AU) are not always analyzed: the analysis module needs to find a PAT, then a PMT, then SPS and PPS (in AVC video) in the stream before it can start analyzing the stream's content.

The progress of the analysis is indicated by a counter of analyzed AU. The analysis can be stopped by clicking the [Abort Analysis](#) button.



## Graphs

Figure 3-17. Graph for one access unit



The X-axis of the graphs is the stream time, i.e. the time computed from the PCR of the Transport Stream and set to 0 at the first computed byte of the stream.

For each access unit, a line represents the associated sequence of events:

- Arrival time of the PES header containing the associated PTS and/or DTS (labeled *A*)
- Arrival timing of the access unit, symbolized by a rectangle, extending from the time of arrival of the first byte pertaining to the AU to the arrival time of the last byte of this AU
- Value coded in the DTS field (labeled *D*), if this syntax element is present, representing the decoding time
- Value coded in the PTS field (labeled *P*), if this syntax element is present, representing the presentation time
- PCR arrived immediately before the PES header, highlighted on the top time-line

In addition, the following elements are also represented:

- Type and presentation index of the picture corresponding to the AU on the left of the line
- LED indicating the status of this AU regarding the PTS/DTS analysis

## Navigation in Video Elementary Streams

To navigate in video ES, use the navigation toolbar of the [Thumbnail](#) view. The access units displayed in the [PTS/DTS Analysis](#) tab correspond to the range of pictures visible in the [Thumbnail](#) view, with the picture selection being synchronized between the two views.

Figure 3-18. Navigation toolbar (Thumbnail view)



The access units can be displayed in [Presentation order](#), as in the [Thumbnail](#) view, or in [Decoding order](#). Use the radio buttons of the [Display order](#) area to change the order.

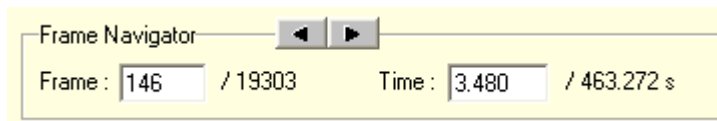
This has an impact on the number of AU represented because all AU visible in the [Thumbnail](#) view are represented, plus the ones that have a

decoding order between the lowest and the highest decoding orders represented in the [Thumbnail](#) view.

### Navigation in Audio Elementary Streams

To navigate in audio ES, use the navigation panel located on top of the tab. Click the arrows to go to the next/previous frame, or type the desired frame number or time in the corresponding box and pressing `Enter`.

Figure 3-19. Audio navigation panel



Since the audio frames are decoded in the same order as the presentation order (i.e. output), there is no such choice as in a video ES.

### Error Navigation and Interpretation

Errors are reported if the conditions listed below are not satisfied:

- The value of the DTS, if present, is greater than the arrival time of the last AU byte
- The value of the PTS, if present, is greater than the arrival time of the last AU byte
- If PTS and DTS values are present, the value of the PTS is greater than the value of the DTS
- For consecutive AU in decoding order, DTS values are increasing
- For consecutive AU in presentation order, PTS values are increasing
- If PTS and DTS values are present, the value of the DTS is not equal to the value of the PTS
- If a DTS field is present for an AU, a PTS field is present too
- Every audio AU has an associated PTS field (warning)
- Every video AU has an associated PTS field (warning)
- The difference between the PTS values of two consecutive audio AU is constant, i.e. the frame rate is constant (warning)
- The difference between the PTS values of two consecutive video AU is constant, i.e. the frame rate is constant (warning)

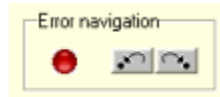
When an access unit does not fulfill all these conditions, an error appears on a condition. If the error is no longer present in a subsequent AU, it

disappears. Errors' appearance and disappearance are signaled in the [Report](#) view, and directly in the PTS/DTS analysis view.

Some of the analyses are indicated as warning-level because the characteristics they reveal are not necessarily errors. However, they can also indicate a problem in the stream.

The upper part of the view also features a LED with two arrow buttons. The LED indicates the analysis status. The arrow buttons will take you directly to the next/previous erroneous picture.

*Figure 3-20. Error navigation panel*



When a picture with a PTS/DTS error is visible in the graph part of the view, it is signaled by a red LED on the left of the AU line. Moving the mouse over the LED will display a tooltip of the error.

## Data Panel

Figure 3-21. PTS/DTS analysis data panel

Elementary Stream	
PID	220
ES type	MPEG-2 Video

PES Header	
PTS value	49748.788600
PTS time	0.898334
PTS interval	0.040000
DTS value	49748.668600
DTS time	0.778334
PES packet #	11
Arrival time	0.391355
Arrival time delta	-

Reference PCR	
Number	10
Coded value	49748.260378

Access Unit	
Start time	0.391520
End time	0.493104
Size in bits	56586
Dec. index	11
Pres. index	13

### Elementary Stream Data

- **PID**: PID of the analyzed ES.
- **ES type**: type of the analyzed ES.

### PES Header Data

- **PTS value**: value coded in the PTS field of the PES header, in seconds.
- **PTS time**: PTS value expressed in seconds from the beginning of the file.
- **PTS interval**: difference between the current PTS and the previous PTS.
- **DTS value**: value coded in the DTS field of the PES header, in seconds.
- **DTS time**: DTS value expressed in seconds from the beginning of the file.
- **PES packet #**: index of the PES packet in the stream.
- **Arrival time**: arrival time of the first byte of the PES packet.

- **Arrival time delta:** difference between the arrival time of this PES packet and the arrival time of the previous PES packet.


#### Reference PCR Data

- **Number:** index of PCR sample in the stream.
- **Coded value:** sample of the system clock coded in the PCR field, in seconds.

#### Access Unit Data

- **Start time:** arrival time of the first byte of the access unit.
- **End time:** arrival time of the last byte of the access unit.
- **Size in bits:** size of the AU in bits.
- **Dec. index:** decoding index of the AU.
- **Pres. index:** presentation index of the AU.

#### Log

You can save the results of the analysis to a text file by clicking the  toolbar button.

## HLS Analysis

Opening an HLS playlist file automatically starts analyses for building a **Hierarchical** view and checking playlist and Segment. The **Main** View displays the different Media as timelines, with the selected segment highlighted on a time axis.

### Hierarchical View

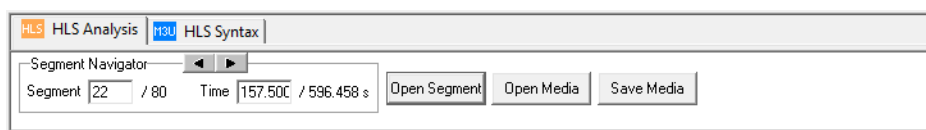
The **Hierarchical** view represents the MPEG-2 TS structure as a tree.

Two columns help in representing data:

- The **Hierarchy** column contains icons that represent the basic elements of the HLS structure. The top node of the tree is named HLS file. Immediately below is the Master Playlist (if any) and all Media Playlists referenced by the Master Playlist.
- The **URI** column displays the Uniform Resource Identifier (URI) of all Media Playlists referenced by the Master Playlist.

## HLS Analysis Tab

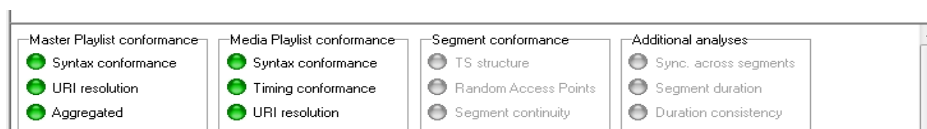
### Navigation



The upper part of the main view allows navigation in the segments of a Media, by segment index or by time. It also provides the following features:

- opening an HLS segment in a different CMA 1820
- opening an HLS Media in a different CMA 1820.
- saving an HLS segment as a single file.

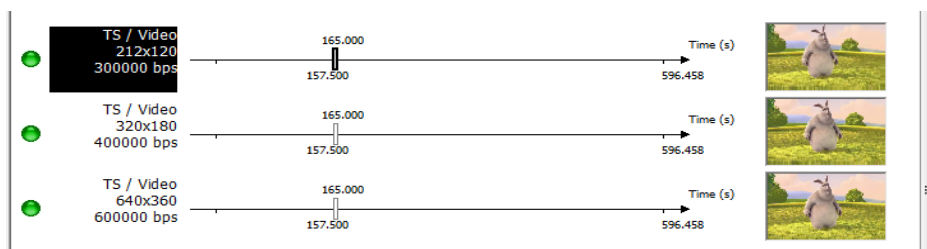
### Analysis Status



Below the navigation panel, you can find LEDs indicating the status of the different analyses performed on Master, Media and Segment files. The different analyses can be enabled in the [Settings](#).

For information on analyses, refer to section '[HLS Settings](#)' on page 225.

### Media and Segment Display



In the center, a timeline for each Media signaled in the Master Playlist shows:

- the extent of time represented by the Media
- the currently selected segment with its starting and ending times

The selection of a segment can be done directly by clicking on any portion of any timeline.

On the left of each timeline, the following items are displayed:

- a LED indicating the analysis status of each Media
- a box containing a summary of Media characteristics:
  - ❖ [Container](#) and [media type](#)
  - ❖ [Resolution](#) (for video)
  - ❖ [Language](#) (for audio)
  - ❖ [Bandwidth](#)
  - ❖ [Group name](#) if groups are used

Double-clicking the Media characteristics box opens the corresponding HLS Media in a different CMA 1820.

On the right of each timeline, a thumbnail shows the first I frame of the selected Segment. Double-clicking the thumbnail opens the corresponding HLS Media in a different CMA 1820.

## HLS Syntax Tab

Master Playlist:		Media Playlist:	
Line	Element	Line	Element
1	#EXTM3U	1	#EXTM3U
2	#EXT-X-VERSION:3	2	#EXT-X-VERSION:3
3	#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=300000,RESOLUTION=21	3	#EXT-X-TARGETDURATION:8
4	chunklist_w874715100_b300000.m3u8	4	#EXT-X-MEDIA-SEQUENCE:0
5	#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=400000,RESOLUTION=32	5	#EXTINF:7.5,
6	chunklist_w874715100_b400000.m3u8	6	media_w874715100_b300000_0.ts
7	#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=600000,RESOLUTION=64	7	#EXTINF:7.5,
8	chunklist_w874715100_b600000.m3u8	8	media_w874715100_b300000_1.ts
9		9	#EXTINF:7.5,
		10	media_w874715100_b300000_2.ts
		11	#EXTINF:7.5,
		12	media_w874715100_b300000_3.ts
		13	#EXTINF:7.5,
		14	media_w874715100_b300000_4.ts

The view is divided in 2 parts:

- The left part shows the syntax of the Master Playlist file.
- The right part shows the syntax of the Media Playlist files. The syntax trees can be expanded manually or by selecting a Media Playlist in the [Hierarchical View](#).

Lines containing syntax errors are highlighted in red. The corresponding error messages can be found in the [Report View](#).

## Data View

Master	
Version	3
Media count	3
Media	
URI	chunklist_w874715100_l
Version	3
Media Type	Video
Segments	80
Total duration	596.458000
Target duration	8
Encryption	-
Bandwidth	300000
Codecs	-
Resolution	212x120
Group ID	-
Group name	-
Default	-
Autoselect	-
Segment	
Number	22
Start time	157.500000
Duration	7.500000
URI	media_w874715100_b3l
Byterange o/n	-

The **Data** view is divided in 3 parts, displaying information on Master playlist, selected Media playlist and selected Segment.

### Master Playlist

- **Version**: Compatibility version of the Master playlist. It MUST appear in all Playlists containing tags or attributes that are not compatible with protocol version 1 to support interoperability with older clients.
- **Media count**: Number of Media playlist referenced in the Master playlist.

### Media Playlist

- **URI**: URI of the Media playlist, as it appears in the Master playlist.
- **Version**: Compatibility version of the Media playlist. It MUST appear in all Playlists containing tags or attributes that are not compatible with protocol version 1 to support interoperability with older clients.
- **Media type**: Type (*Audio*, *Video*, *Subtitles* or *Closed Captions*) of the Media.
- **Segments**: Number of segments described in the Media playlist.
- **Total duration**: Total duration of the selected Media, i.e. the sum of the duration of all segments.

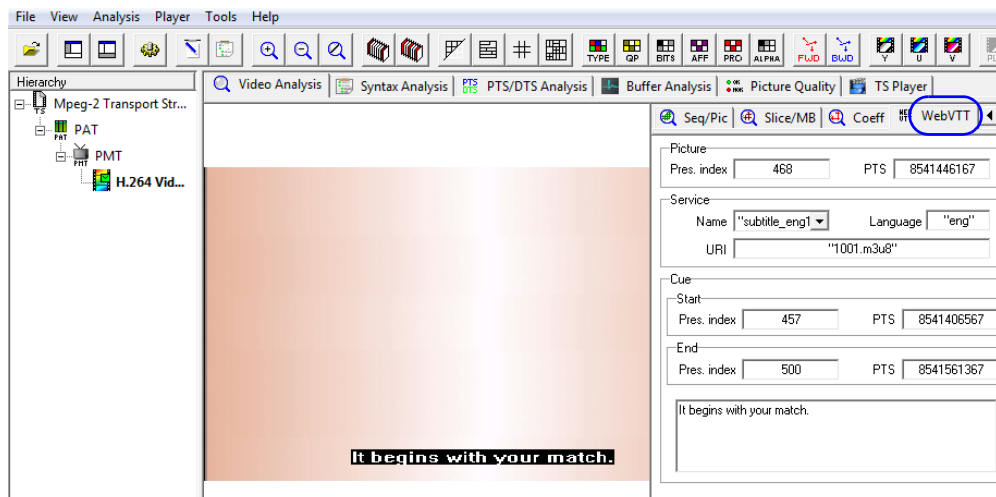


- **Target duration:** Target duration of the Media, i.e. the maximum segment duration.
- **Encryption:** Encryption method (*None*, *AES-128* or *Sample-AES*) for this Media.
- **Bandwidth:** Bandwidth attribute of the EXT-X-STREAM-INF tag.
- **Codecs:** Codecs attribute of the EXT-X-STREAM-INF tag.
- **Resolution:** Resolution attribute of the EXT-X-STREAM-INF tag.
- **Group ID:** Group-ID attribute of the EXT-STREAM-INF tag.
- **Group name:** Name attribute of the EXT-STREAM-INF tag.
- **Default:** Default attribute of the EXT-STREAM-INF tag.
- **Autoselect:** Autoselect attribute of the EXT-STREAM-INF tag.

### Segment

- **Number:** Index of the segment, starting at 1.
- **Start time:** Start time of the segment, in seconds.
- **Duration:** Duration of the segment specified in the EXT-INF tag.
- **URI:** URI of the segment, as it appears in the Media playlist.
- **Byterange o/n:** Segment byterange (offset / length). When present, indicates that the segment is a sub-range of the resource identified by its URI.

### WebVTT



## Picture

- **Pres index** value is the presentation index of the currently displayed picture.
- **PTS** value is the PTS of the currently displayed picture.

## Service

- **Name**: NAME attribute of the WebVTT media
- **Language**: LANGUAGE attribute of the WebVTT media
- **URI**: URI of the WebVTT media

## Cue

- **Pres index** value is the presentation index of the first / last picture associated to the currently displayed WebVTT Cue.

**PTS** value is the PTS of the first / last picture associated to the currently displayed WebVTT Cue.

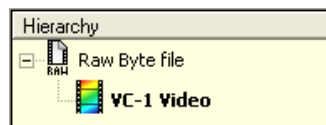
# Video Analysis

## Hierarchical View

The **Hierarchical** view's content varies depending on whether the opened file is an MPEG-2 TS, an mp4, an ASF or raw byte:

- In the case of a container file (MPEG-2 TS, HLS, MP4, MXF, FLV, MOV, ASF), the tree root is labeled according to the detected file format.
- In case of a raw byte file (H.264/AVC, H.265/HEVC, MPEG-2 or VC-1), the tree root is labeled *Raw Byte file*, as shown in [Figure 3-22](#).

Figure 3-22. Hierarchical view for a raw byte file



If there is a single video in the file, that video is automatically selected for parsing and decoding. In the case of multiple videos, the one that has been found first is selected. Click the desired video to select it.

## Report View & Logs

The **Report** view displays messages indicating start and stop of video parsing. Once parsing is done, a log file is generated.

That file lists all the NAL units present in the H.264/AVC or H.265/HEVC video, all the BDUs present in the VC-1 video and all DUs present in the MPEG-2 video. The location of that file is specified in the *parsing done* message. It should be in a **Log** directory, located at the installation path of the application: C:\Program Files\Sencore\CMA 1820\Logs by default.

### For H.264/AVC Files

The log file is made up of lines, each line representing a NAL unit. Two levels of information are available:

- General data: for all NAL units.
  - ❖ MPEG-2 TS file: NAL index, NAL type, packet position, position in packet, NAL length.
  - ❖ H.264/AVC raw byte file: NAL index, NAL type, NAL position, NAL length.
- Specific data: for SPS, PPS and slices.
  - ❖ Sequence Parameter Set (SPS): profile, level, SPS Id, picture width, picture height.
  - ❖ Picture Parameter Set (PPS): PPS Id, SPS Id, entropy coding (CABAC or CAVLC).
  - ❖ First slice in new picture: frame number, slice type, first MB in slice, PPS Id, field\_pic\_flag, bottom\_field\_flag, is SPS found, is PPS found, Picture Order Count (POC), presentation index, frame\_num.
  - ❖ Slice continuing a picture: frame number, slice type, first MB in slice, PPS Id, field\_pic\_flag, bottom\_field\_flag, is SPS found, is PPS found.

### For H.265/HEVC Files

The log file is made up of lines, each line representing a NAL unit. Two levels of information are available:

- General data: for all NAL units.
  - ❖ H.265/HEVC raw byte file: NAL index, NAL type, NAL position, NAL length.
  - ❖ MPEG-2 TS file: NAL index, NAL type, packet position, position in packet, NAL length.
- Specific data: for VPS, SPS, PPS and slices.
  - ❖ Video Parameter Set (VPS): VPS id, profile, tier, level, frame rate.
  - ❖ Sequence Parameter Set (SPS): SPS id, profile, tier, level, picture width, picture height, bit depth luma, bit depth chroma.

- ❖ Picture Parameter Set (PPS): PPS Id, tiles enabled.
- ❖ First slice in new picture: picture type, decoding index, presentation index, POC, PPS id.
- ❖ Slice continuing a picture: no information.

### For VC-1 Files

The log file is made up of lines, each line representing a BDU. Two levels of information are available:

- General data: for all BDUs.
  - ❖ MPEG-2 TS file: Packet position, Position in packet, BDU index, BDU type, BDU length, Emulation prevention count.
  - ❖ VC-1 raw byte file: BDU index, BDU type, BDU position, BDU length, Emulation prevention count.
- Specific data: for SH, EH, Frame Header and slices.
  - ❖ Sequence Header (SH): profile, level, picture width, picture height.
  - ❖ Entry-point Header (EH): closed entry, coded width, coded height.
  - ❖ Frame Header: decoding index, Ptype, FPtype.
  - ❖ Slice: slice address.

### For MPEG-2 Video Files

The log file is made up of lines, each line representing a Data unit (DU). Two levels of information are available:

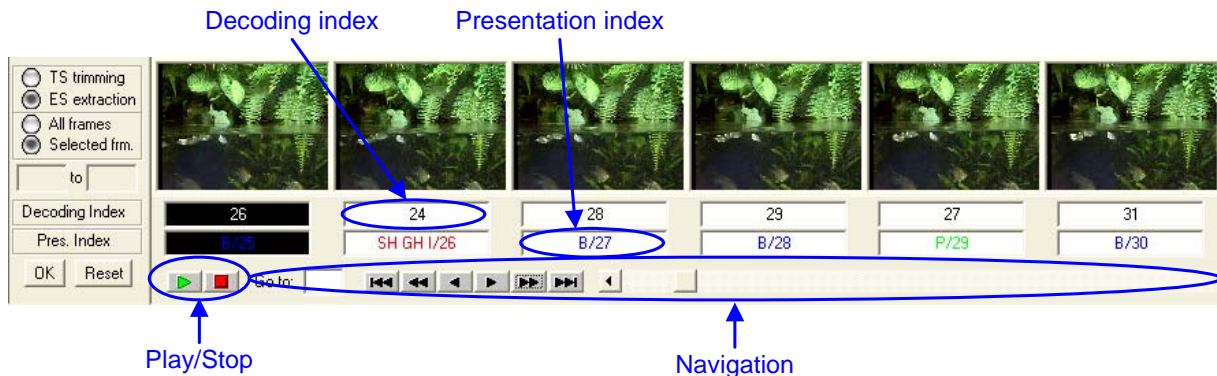
- General data: for all DUs.
  - ❖ MPEG-2 TS file: Packet position, Position in packet, DU index, DU type, DU length.
  - ❖ MPEG-2 Video Raw Byte file: DU index, DU type, DU length, DU position.
- Specific data: for SH, SE, GH, PH and slices.
  - ❖ Sequence Header (SH): picture width, picture height.
  - ❖ Sequence Extension (SE): profile, level.
  - ❖ GOP Header (GH): closed GOP, broken link.
  - ❖ Picture Header (PH): picture type, decoding index.
  - ❖ Slice: vertical position.

## Thumbnail View

The **Thumbnail** view is useful for navigating into the video as well as for editing. Once the video ES is selected (automatically or manually), the video parsing is done.

The thumbnails are decoded and data is available for each picture.

Figure 3-23. Thumbnail view











- **Decoding Index:** picture's decoding index.
- **Presentation Index:** picture's presentation index. It is preceded by the picture type:
  - ❖ H.264/AVC: I, P, B, IDR, SI, SP
  - ❖ H.265/HEVC: I, P, B, IDR, CRA, BLA
  - ❖ VC-1: I, P, B, BI, Sk
  - ❖ MPEG-2 Video: I, P, B
 and by optional parameters:
  - ❖ H.264/AVC: SPS, PPS
  - ❖ H.265/HEVC: VPS, SPS, PPS
  - ❖ VC-1: SH, EH
  - ❖ MPEG-2 Video: SH, GH

Text color is **red** for I/IDR/CRA/BLA/SI pictures, **green** for P/SP/Sk pictures and **blue** for B/BI pictures.

## Navigation

Table 3-7. Navigation buttons

Click	To
	Go to the sequence's start.
	Go to the previous I picture.
	Go to the previous picture.
	Go to the next picture.
	Go to the next I picture.
	Go to the sequence end.
	Go to the previous segment (HLS Video Media only).
	Go to the next segment (HLS Video Media only).

- **Go to:** enter presentation index.
- **Scroll bar:** click the arrows to go to the previous or next picture.
- Click to move by the number of displayed thumbnails. The **Thumbnail** view adapts to the screen size, from 7 thumbnails in 1024x768 or below to 11 thumbnails in 1600x1200 or above.
- **Play/Stop:** click to launch or stop the video-only playback. These buttons are enabled provided the **Video Analysis** tab is selected.
- Click a thumbnail to display the corresponding picture in the **Main** view. The default picture displayed in **Main** view is the first thumbnail.



Dragging the cursor of the navigation bar results in moving the zone of interest accordingly. When doing so, the Analyzer decodes the pictures back to I picture preceding the first picture displayed in the **Thumbnail** view.

This has two consequences:

- If the video ES has very sparse I pictures, navigating this way may take some time.
- The pictures represented may be predicted with reference to pictures located before the previous I picture and some decoding artifacts may appear.

## Edition

Two editing capabilities are available:

- **TS trimming** is the ability to cut an MPEG-2 TS or TTS file so that the selected Elementary Stream is properly cut. The result is an MPEG-2 TS file.
- **ES extraction** lets you extract the selected Elementary Stream portion (in case of an MPEG-2 TS, MP4 or MXF file) or to cut a raw byte file. The result is a raw byte file.

Those operations are possible at a picture level. The purpose is to **build a clean file** (MPEG-2 TS, H.264/AVC, H.265/HEVC, VC-1 or MPEG-2 Video). The selection always goes back to the previous I picture, so that the resulting file has a clean start and can be decoded correctly.

Necessary parameters are added at the beginning of the file, even when they are not part of the selection, to make sure a decoder is able to read the trimmed or extracted file. Required parameters are:

- H.264/AVC: SPS and PPS
- H.265/HEVC: VPS, SPS and PPS
- VC-1 Advanced profile: SH and EH (if present)
- MPEG-2 Video: SH, SE and GH (if present)

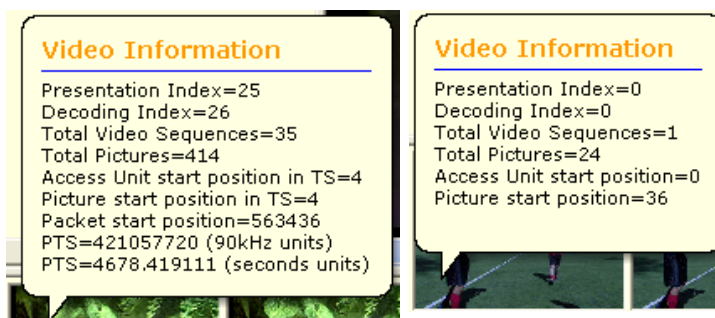
In the case of trimming, those added parameters are encapsulated in transport packets. Trimming also adds PAT and PMT before the video packets. Continuity counters are anyway adjusted to prevent the generation of transport errors.

## Tooltip

When the pointer of the mouse is located on a thumbnail, a tooltip is displayed. Depending on the file type, information on positions is different.

For an MPEG-2 TS, position of the packet and position in the packet are presented. Positions represent offset in bytes from the beginning of the file or from the beginning of the packet.

Figure 3-24. Tooltips for MPEG-2 TS and Raw Byte files



## Video Analysis View

The [Video Analysis](#) tab is part of the [Main](#) view. In addition to useful on-picture analysis features, it lets you play a video ES (either raw byte or contained in a TS).

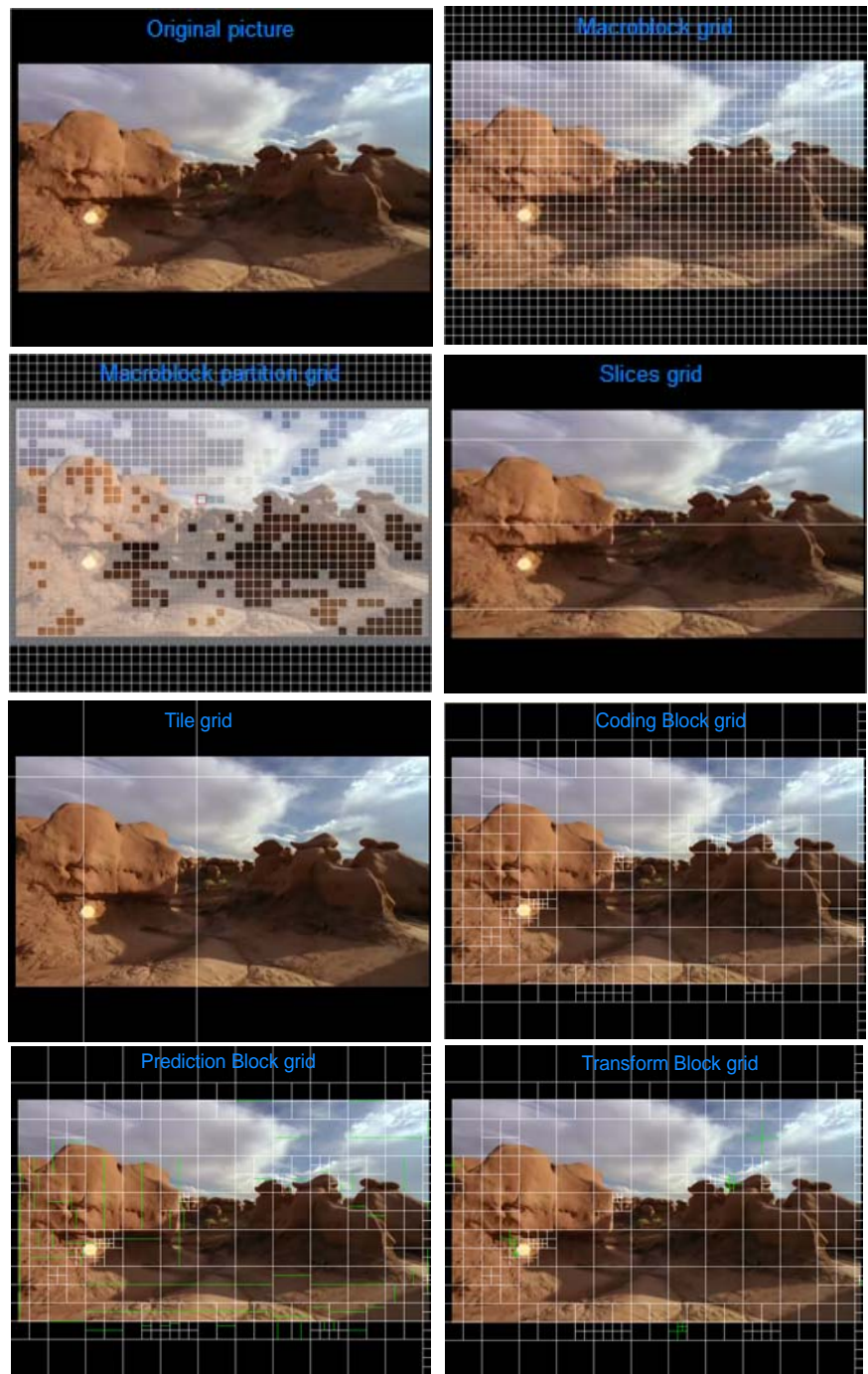
When an ES is opened, the [Main](#) view should always display a picture. If it does not, this may be because:

- The decoder has not had the time to decode the picture yet.
- The decoder has not been able to decode the picture because of a syntax or compliance problem.




A number of overlays can be applied to the original picture.


Figure 3-25. Video analysis overlays




### Tile Grid (H.265/HEVC only)

In H.265/HEVC, tiles are rectangular partitions of the picture composed of an entire number of Coding Tree Blocks. Click the  [Display Tiles](#) toolbar button to display the tiles on-picture.


### Slice Grid

A picture or tile in H.265/HEVC may be divided into slices, which may themselves contain any number of macroblocks or CTB. Click the  [Display Slices](#) toolbar button to display slice edges on-picture.


### Macroblock/Coding Tree Block Grid

The macroblock is the basic processing unit of a picture, or Coding Tree Block (CTB) in H.265/HEVC. Click the  [Display MB/CTB Grid](#) toolbar button to view macroblocks or Coding Tree Blocks directly on-picture.


### Macroblock Partition

During the prediction process, macroblocks may be divided into partitions, which are predicted separately. Click the  [Display MB Partition](#) toolbar button to display these partitions on-picture.


### Coding Block Grid (H.265/HEVC only)

The Coding Tree Block is split into luma and chroma Coding Blocks. Coding Blocks may be divided into Prediction Blocks during the prediction process and Transform Blocks during the transform process. Click the  [Display CB Grid](#) toolbar button to display the CB partitions on-picture.

### Prediction Block Grid (H.265/HEVC only)

In H.265/HEVC, Coding Blocks may be divided into partitions called Prediction Blocks during the prediction process. Click the  [Display PB Grid](#) toolbar button to display the PB partitions on-picture.

### Transform Block Grid (H.265/HEVC only)

In H.265/HEVC, Coding Blocks may be divided into partitions called Transform Blocks during the transform process. Click the  [Display TB Grid](#) toolbar button to display the TB partitions on-picture.

### Focus

The grids enable the macroblock focus, which displays a red square around the macroblock/coding tree block and coding block currently


selected. Information on the focused MB/CTB/CB is displayed in the [Slice/MB Data](#) or [Coding Details](#) view.

When you click the focused macroblock/CTB/CB, focus switches to lock mode. The focus is set on this macroblock/CTB/CB and remains there until the macroblock/CTB/CB is clicked again (which unlocks the focus) or another MB/CTB/CB is clicked (which locks the focus on this other MB/CTB/CB).

This is particularly useful when you wish to see how a particular macroblock/CTB/CB behaves throughout the sequence.


### Grid Color Customization

All grids are white by default.

Click the  [Toggle Grid Color](#) toolbar button to display those three grids in black instead.

### Macroblock/Coding Block Type Overlay

The Macroblock/CB prediction mode indicates how the macroblock was predicted.

Click the  [MB/CB Type Overlay](#) toolbar button to display macroblock types on-picture.

*Figure 3-26. Original picture with Macroblock/CB type overlay*

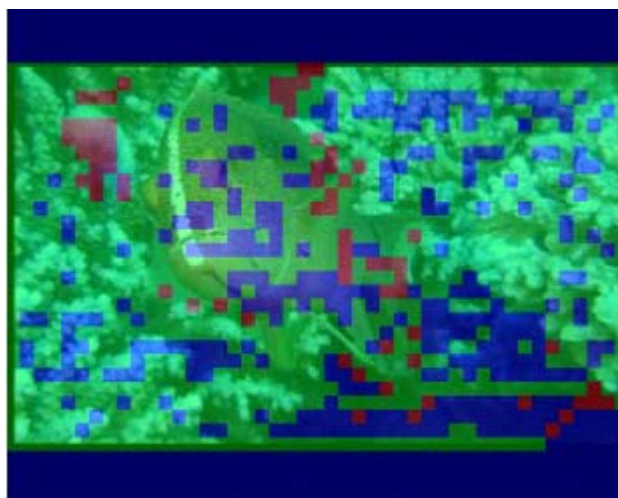


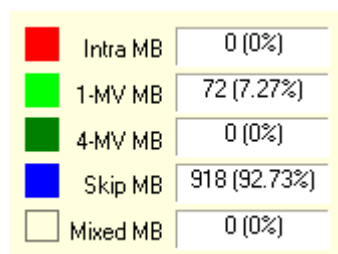
Table 3-8. Macroblock/CB types

MB/CB color	Type of file			
	MPEG-2 Video	VC-1	H.264/AVC	H.265/HEVC
Red	Intra-predicted	Intra-predicted (Intra MB)	Intra-predicted	Intra-predicted
Green or Light Green	Inter-predicted	1-MV MB	Inter-predicted	Inter-predicted
Dark Green	-	4-MV MB	-	-
Blue	Skipped	Skip MB	Skipped	Skipped
White	No Motion Compensation (No MC)	Mixed MB	Direct	Merge


For a complete description of these prediction modes, refer to the Standards Overview document.

Block types are listed in the [Seq/Picture](#) tab.

Figure 3-27. Macroblock types (VC-1)



### Macroblock/Coding Block Quantization Parameter Overlay

Click the  toolbar button to display the Quantization Parameter for each MB/CB.

The overlay display can be customized in the [Settings](#) panel (refer to [section 'Settings Panel'](#) on page 216). You can display the QP:

- In a range of yellow: the darker the MB/CB, the lower the QP, the bigger the size.
- Using a color palette.
- Using its value.

Figure 3-28. Original picture with MB/CB QP overlay



### Macroblock/Coding Block Size Overlay

MB/CB size is displayed in a range of gray. The darker the MB/CB, the higher the size.

Figure 3-29. Original picture with MB/CB size overlay



### Motion Vector Display

The motion vectors, i.e. the displacement used to reconstruct blocks from blocks of reference pictures, can be displayed on-picture.

The VC-1 and MPEG-2 video standards allow for bi-predicted blocks to be predicted using two directions:

- **Forward:** performed using a reference picture that is presented before the current picture.

- **Backward**: performed using a reference picture that is presented after the current picture.



The Analyzer lets you display vectors from the two directions, independently and using different colors, by clicking the  and  buttons.




Figure 3-30. Original picture with Motion vectors



In H.264/AVC and H.265/HEVC, the prediction mechanism is different: bi-predicted blocks are predicted from portion of pictures belonging to two reference picture lists called L0 and L1, containing pictures regardless of their prediction direction. Forward and Backward prediction are replaced by L0 and L1 in the motion vector overlay feature.

### Pre-loop filter, Predicted and Residual Picture

When the MB coefficients option is enabled in the [Settings](#) panel (see [section 'Settings Panel'](#) on page 216), and in H.264 or MPEG-2 videos, you can display the picture at different states of the decoding process:

- Click the  toolbar button to display the image as it is before the decoder's loop filter.
- Click the  toolbar button to display the predicted image.
- Click the  toolbar button to display the residual image.



The Pre-loop filter picture is the one that is the closest to the fully decoded picture, whereas the Residual picture is the least decoded (the most compressed).




### YUV Component Selection

Decoded pictures are made up of three distinct components:

- Y (luminance component)
- U (blue chroma component)
- V (red chroma component)

In order to reduce the amount of data required to represent a picture, and because the human visual system is less sensitive to chrominance than to luminance, U and V components can have:

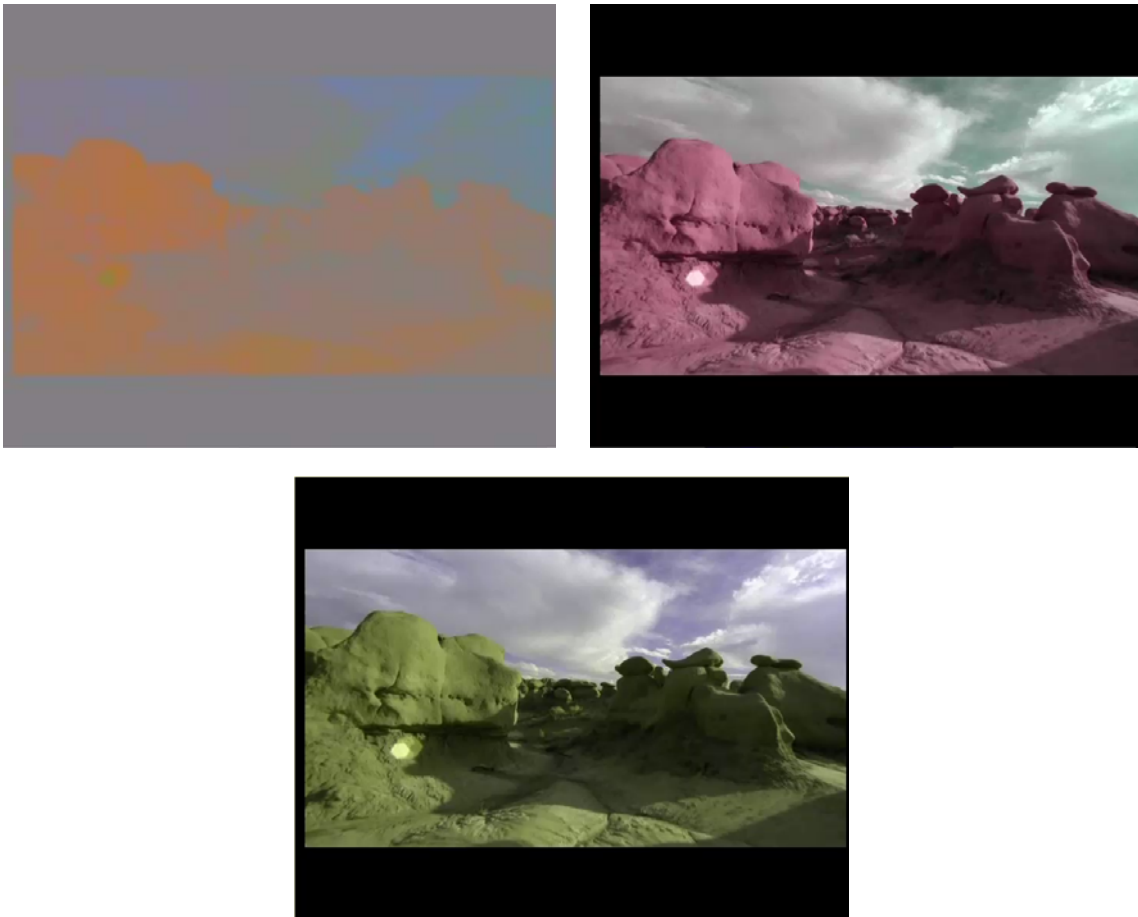
- Half the number of rows and columns of samples compared to luminance (4:2:0 format)
- The same number of rows and half the number of columns of samples compared to luminance (4:2:2 format)

You can display any combination of components using the  Hide/Show Y Component toolbar button and its chroma equivalents for U  and V  components: clicking a button removes the corresponding component from the picture.

To make visualization easier, the horizontal and vertical size of chrominance sample arrays are expanded to the size of luminance.

This feature can be used to detect an encoding error affecting only the luma or chroma components.

Figure 3-31. Picture without Y, U and V components (respectively)



When MB coefficients are enabled, the Y, U and V buttons also impact the MB coefficients' display.

### Zoom

The Analyzer features a 5-level zoom that lets you see small details more precisely or, on the contrary, fully display big pictures.

The zoom levels can be reached from the [Zoom](#) part of the main toolbar via the [Zoom In](#), [Zoom Out](#) and [Normal Size](#) buttons.

Figure 3-32. Zoom toolbar





The zoom uses no interpolation or extrapolation to stretch or shrink pictures, as this would result in a modification of the picture's characteristics.

### Elementary Stream Playback

Another useful feature of the [Main](#) view is the possibility to play a video ES directly, whether this is contained in a transport file or not. As the ES contains no timing data, the sequence is played at roughly 25 pictures per second up to 625 SD (720x576) resolution.

For the mentioned resolutions, the picture rate is the maximum achievable.

When playing the file in raw byte, the only available commands are starting and stopping the playback. ES playback is only possible if the [Video Analysis](#) tab is selected.

Click the [Start](#) button  in the [Thumbnail](#) view to launch the play.

Click the [Stop](#) button  in the [Thumbnail](#) view to resume the play.

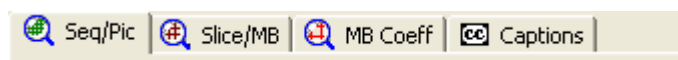
All display functions, including various grids, type overlay, component selection and zoom, can be activated before the playback but cannot be modified once it has started.

## Video Data View

The [Data](#) view is made up of four tabs, which sum up respectively:

- Sequence, Picture and transport characteristics (when present)
- Slice and Macroblock or Tile/Slice/CTB/CB characteristics
- Macroblocks coefficients
- Closed Captions characteristics (when present)


Figure 3-33. Data View tabs



The content of the [Seq/Pic](#) and [Slice/MB](#) or [Coding Details](#) tabs varies along with the type of file that is opened.

The [Data](#) view can also contain a [DVB Subtitles](#) or a [DVB Teletext](#) tab, if the corresponding ES is selected from the [Hierarchy](#) view.



You can export to a text file the exact content of all [Video data](#) tabs by clicking the  toolbar button.

## H.264/AVC Data

### Sequence and Picture Characteristics

The sequence and picture characteristics of the H.264/AVC video stream are summed up in the [Seq/Picture](#) tab. The sequence parameters are parameters that pertain to the whole stream (frame count for example), or to the Sequence Parameter Set, like the aspect ratio. SPS parameters may vary throughout the stream as they concern a video sequence, i.e. the portion of stream between two Random Access Points (typically IDR pictures).

Figure 3-34. Sequence and Picture Characteristics (H.264/AVC)

Sequence			
Profile/Level	Main/3	SAR (DAR)	N/A (1.25)
Frame Rate	-	Bit Rate	-
Frame Count	1000	Duration	-

Picture			
Type	I	<span style="color: red;">■</span> Intra MB	1620 (100 %)
Dec. Index	0	<span style="color: green;">■</span> Inter MB	0 (0 %)
Pres. Index	0	<span style="color: blue;">■</span> Skip MB	0 (0 %)
POC	0	<input type="checkbox"/> Direct MB	0 (0 %)
Size in Pixels	720 x 576	Scan Type	Progressive
Size in MBs	45 x 36 (1620)	Structure	Frame
Size In Bytes	17707	Pic Struct	-
AFD	-	<span style="color: purple;">■</span> Field MB	0 (0 %)

MPEG-2 Transport Stream			
PID	33	Packet Index	3
PTS	1.000000	Packet Position	564
DTS	-	PTS - PTS0	0.000000

### Sequence Data

#### ■ Profile/Level:

- ❖ **Profile:** subset of the syntax provided in the H.264/AVC standard. Possible values: Baseline, Main, Extended or High.

- ❖ **Level:** defined set of constraints on the values that may be taken by syntax elements and variables.
- **Frame rate:** in frames per second. Available only when VUI with `timing_info_present_flag = 1` is present in the SPS. The equation is  $\text{frame\_rate} = (\text{time\_scale} / \text{num\_units\_in\_tick}) / 2$ . See equation E-34 in the AVC standard.
- **Frame count:** number of video frames in the stream. A frame is either encoded as a frame or as two fields.
- **SAR (DAR):** Sample Aspect Ratio, as coded in the stream, and computed Display Aspect Ratio in brackets.
  - ❖ **Sample Aspect Ratio (SAR):** ratio between the horizontal distance between the columns and the vertical distance between the rows of the luma sample array in a frame. In other words, it is the "shape" of a luma sample. Sample aspect ratio is expressed as  $h:v$ , where  $h$  is horizontal width and  $v$  is vertical height (in arbitrary units of spatial distance).
  - ❖ **Display Aspect Ratio (DAR):** intended ratio between the horizontal and vertical dimensions of the displayed image. Common values are 4:3 (1.33) and 16:9 (1.77). When SAR is different from square sample (1:1), the display aspect ratio is modified by the SAR and  $\text{DAR} = \text{SAR} * (\text{horizontal\_size}/\text{vertical\_size})$ .
- **Bit rate:** bit rate in bit/s, based on total frame size and frame rate.
- **Duration:** duration of the video in seconds.

#### Picture Data

- **Type**
  - ❖ I: picture containing only I slices.
  - ❖ P: picture containing I and P slices.
  - ❖ B: picture containing I, P and B slices.
  - ❖ SI: "switching picture" containing SI-slices only.
  - ❖ SP: "switching picture" containing SP-slices only.
- **Dec. index:** index of the picture in decoding order.
- **Pres. index:** index of the picture in presentation order.
- **POC:** the Picture Order Count defines the decoding order of fields between two IDR pictures.
- **Size in Pixels:** picture's width and height in pixels.
- **Size in MBs:** picture's width, height and total number in macroblocks, i.e. blocks of 16x16 pixels.
- **Size in Bytes:** coded picture's size.

- **AFD:** Active Format Description. Optional information contained in the stream that indicates to the decoder how to display the video, e.g. how to display a 4/3 video on a 16/9 screen.
- **Intra MB:** number and percentage of macroblocks predicted using the Intra (i.e. spatial) prediction mode.
- **Inter MB:** number and percentage of macroblocks predicted using the Inter (i.e. temporal) prediction mode.
- **Skip MB:** number and percentage of macroblocks predicted using the Skip mode. For skipped MBs, no differential motion vector, reference index or residual data is present in the bitstream. Skipped MBs are found in B and P slices.
- **Direct MB:** number and percentage of macroblocks predicted using the Direct mode. For Direct MBs, no motion vector differences or reference indices are present in the bitstream.
- **Scan Type:**
  - ❖ **Progressive:** the two fields of a picture were captured at the same time instant.
  - ❖ **Interlaced:** the two fields of a picture were captured at different time instants.
  - ❖ **MBAFF:** pictures contain a mix of field-coded and frame-coded macroblocks.
- **Structure:**
  - ❖ **Top Field:** made up of the even-numbered rows of a frame.
  - ❖ **Bottom Field:** made up of the odd-numbered rows of a frame.
  - ❖ **Frame:** made up of a top and a bottom field.
- **Pic Structure:** indicates whether the picture should be displayed as a frame or as one or more fields.
- **Field MB:** number and percentage of macroblocks coded using the Field mode. In MacroBlock Adaptive Frame/Field mode (MBAFF), a vertical macroblock pair may be encoded as Frame macroblocks or Field macroblocks.

### Slice/Macroblock Characteristics

Click the [Slice/MB](#) tab to reach the Slices' and Macroblocks' characteristics.

Figure 3-35. Slice/MB tab (H.264/AVC)

Slice		Macroblock	
Type	I	Number	174 (39,3)
Number	0	Pred. Mode	Intra 16x16
Entropy Coding	CABAC	Size In Bits	0
QP	26	QP (Y; U; V)	26; 26; 26

CBP Luma / Chroma			Prediction Lists		List L0
Y	Cb/Cr				
0	0	0			
0	0				

Motion Vectors / Intra Prediction Modes				List L1
Vertical (Mode 0)				

### Slice Data

#### ■ Type:

- ❖ I: slice decoded using prediction only from decoded samples within the same slice (intra prediction).
- ❖ P: slice decoded using intra prediction or prediction from decoded samples within previously decoded reference pictures (inter prediction), using at most 1 motion vector and reference index to predict the sample values of each block.
- ❖ B: slice decoded using intra prediction or inter prediction from decoded samples within previously-decoded reference pictures, using at most 2 motion vectors and reference indices to predict the sample values of each block.
- ❖ SI: specially-coded slice that enables efficient switching between video streams. SI slices are designed to support switching between completely different coded sequences.
- ❖ SP: specially-coded slice that enables efficient switching between video streams. SP-slices are designed to support switching between similar coded sequences,

#### ■ Number: slice number in the picture.

- **Entropy Coding:**
  - ❖ **CABAC:** Context-Adaptive Binary Arithmetic Coding.
  - ❖ **CAVLC:** Context-Adaptive Variable Length Coding.
- **Slice QP:** Quantization Parameter at slice level. This parameter can be modified at macroblock level.

#### Macroblock Data

- **Number:** absolute index, row & column of focused MB in current picture.
- **Pred. Mode:** prediction mode (Inter, Intra, Skip, Direct or I-PCM) and partition size used to predict the focused MB.
- **Size In Bits:** coded MB size in bits.
- **QP:** Quantization Parameter at macroblock level.

#### CPB Luma / Chroma Data

- **CPB Luma / Chroma:** Coded Block Pattern Luma: Indicates which of the 4 Luma 8x8 blocks contain coded coefficients.
  - ❖ 0 indicates that there are no non-zero AC transform coefficient levels in the luma component of the 8x8 block.
  - ❖ 1 indicates that at least one AC transform coefficient is non-zero.
  - ❖ **Coded Block Pattern Chroma:** Indicates if the 2 chroma 8x8 blocks contain coded coefficients.
  - ❖ 0 indicates that all chroma levels are equal to zero.
  - ❖ 1 indicates one or more DC coefficients are non-zero, all AC coefficients being equal to zero.
  - ❖ 2 indicates zero or more DC coefficients are non-zero and one or more AC coefficients are non-zero.

#### Prediction Lists

- **Prediction lists:** reference picture list used to predict the different 8x8 blocks of the current MB, with index in the list and, in parenthesis, corresponding picture number.
- **List L0:** the current partition is predicted using List 0 reference pictures. Allowed in P-slices and B-slices.
- **List L1:** the current partition is predicted using List 1 reference pictures. Allowed in B-slices only.

## Motion Vectors / Intra Prediction Modes

- **Motion vectors:** motion vectors for each 4x4 block in an Inter-predicted MB, in units of quarter pixels. If the partition is bigger than 4x4, the motion vector is located in the top-left-most 4x4 block of the partition. L0 motion vectors are on the first line, L1 motion vectors are on the second line.
- **Intra prediction modes:** Intra 4x4, Intra 8x8 prediction modes or Intra 16x16 mode in an Intra-predicted MB. For each bloc, the interpretation of the mode and the value of the mode are indicated, e.g. *Vertical (Mode 0)*.

## H.265/HEVC Data

### Sequence and Picture Characteristics

The sequence and picture characteristics of the H.265/HEVC video stream are summed up in the [Seq/Picture](#) tab. The sequence parameters are parameters that pertain to the whole stream (frame count for example), or to the Sequence Parameter Set, like the aspect ratio. SPS parameters may vary throughout the stream as they concern a video sequence, i.e. the portion of stream between two Random Access Points (typically IDR pictures).

Figure 3-36. Sequence and Picture Characteristics (H.265/HEVC)

Sequence			
Profile/Level	Main/6	SAR (DAR)	-
Tier	High	Chroma Format	4:2:0
Frame Rate	-	Bit Depth Y/C	8/8
Frame Count	490	CTB Size	64 x 64
Duration	-	Bit Rate	-

Picture			
Type	P	<span style="color: red;">■</span> Intra pels	0.51 %
Dec. Index	4	<span style="color: green;">■</span> Inter pels	22.47 %
Pres. Index	4	<span style="color: blue;">■</span> Skip pels	77.02 %
PDC	4	<input type="checkbox"/> Merge pels	0 %
Size in Pixels	720 x 576	Scan Type	-
Size in CTBs	12 x 9 (108)	Pic Struct	-
Size In Tiles	1 x 3	Tiles enabled	Yes
Size In Bytes	402	Time Code	-
Reference	Yes	AFD	-

Sequence Data

- Profile/Level:
  - ❖ **Profile**: a subset of algorithmic features provided in the H.265/HEVC standard. Possible value: Main, Main 10 and Main Still
  - ❖ **Level**: a set of limits on the values that may be taken by syntax elements and variables.
- **Tier**: the tier, in association with the level, defines the limits on the values that may be taken by syntax elements. Possible values: Main and High.
- **Frame Rate**: in frames per second. Available only when VUI with `vui_timing_info_present_flag = 1` is present in the SPS.
- **Frame Count**: number of video frames in the stream. A frame is either encoded as a frame or as two fields.
- **Duration**: duration of the video in seconds.
- **SAR (DAR)**: Sample Aspect Ratio, as coded in the stream, and computed Display Aspect Ratio in brackets.
  - ❖ **Sample Aspect Ratio (SAR)**: ratio between the horizontal distance between the columns and the vertical distance between the rows of the luma sample array in a frame. In other words, it is the "shape" of a luma sample. Sample aspect ratio is expressed as  $h:v$ , where  $h$  is horizontal width and  $v$  is vertical height (in arbitrary units of spatial distance).
  - ❖ **Display Aspect Ratio (DAR)**: intended ratio between the horizontal and vertical dimensions of the displayed image. Common values are 4:3 (1.33) and 16:9 (1.77). When SAR is different from square sample (1:1), the display aspect ratio is modified by the SAR and  $DAR = SAR * (horizontal\_size/vertical\_size)$ .
- **Chroma Format**: Sampling structure of the chroma components.
- **Bit Depth Y/C**: Number of bits used for the representation of each of the samples in the luma and chroma components.
- **CTB Size**: Width and height of each Coding Tree Block in units of pixels.
- **Bit Rate**: bit rate in bit/s, based on total frame size and frame rate.

Picture Data

- **Type**
  - ❖ I: picture containing only I slices.
  - ❖ P: picture containing I and P slices.
  - ❖ B: picture containing I, P and B slices.



- **Dec. index:** index of the Access Unit in the stream in decoding order.
- **Pres. index:** index of the Access Unit in the stream in presentation order.
- **POC:** the Picture Order Count defines the output order of the picture in the coded video sequence.
- **Size in Pixels:** picture's width and height in pixels.
- **Size in CTBs:** picture's width and height in Coding Tree Blocks.
- **Size in Tiles:** picture's width and height in Tiles.
- **Size in Bytes:** coded picture's size in bytes.
- **Reference:** indicates whether the picture is used as reference for other pictures.
- **Intra pels:** percentage of pixels predicted using Intra (i.e. spatial) prediction mode.
- **Inter pels:** percentage of pixels predicted using Inter (i.e. temporal) prediction mode.
- **Skip pels:** percentage of pixels predicted using Skip mode. For skipped CTBs, no motion vector differences, reference indices or residual data are present in the bitstream.
- **Merge pels:** percentage of pixels predicted using Merge prediction mode.
- **Scan Type:**
  - ❖ **Progressive:** the two fields of a picture were captured at the same time instant.
  - ❖ **Interlaced:** the two fields of a picture were captured at different time instants.
- **Pic Structure:** indicates whether the picture should be displayed as a frame or as one or more fields (the syntax element `pic_struct` is optional and, when present, located in the Picture Timing SEI message associated with a picture).
- **Tiles enabled:** if true, specifies that there can be more than one tile in the picture.
- **Time Code:** coded time used for synchronization, associated with each picture and expressed in hours:minutes:seconds:pictures.
- **AFD:** Active Format Description. The AFD describes the portion of the coded video frame that is 'of interest'. The format descriptions are informative in nature and are provided to assist receiver systems in optimizing their presentation of video.

## Coding Details

Click the [Coding Details](#) tab to reach the characteristics of slices, tiles, Coding Tree Blocks and Coding Blocks.

Figure 3-37. Coding Details tab (H.265/HEVC)

Tile			
Index	2	Size in CTBs	12 x 3
Size In Bits	175	Size in pixels	768 x 192
Slice			
Index	6	QP	27
Type	P	SAD enabled	Yes
Size In Bits	168	DF enabled	Yes
CTB			
Index	75	Size In Bits	8
CB			
Index	0	Size in pixels	64 x 64
Pred. mode	Inter	Size In Bits	6
QP	27		

### Tile Data

- **Index:** Index of the tile in tile scan order.
- **Size in Bits:** Size of the tile in bits.
- **Size in CTBs:** Width and height of the tile in Coding Tree Blocks.
- **Size in Pixels:** Width and height of the tile in pixels.

### Slice Data

- **Index:** Index of the slice in the picture.
- **Type:**
  - ❖ I: slice decoded using prediction only from decoded samples within the same slice (intra prediction).
  - ❖ P: slice decoded using intra prediction or prediction from decoded samples within previously decoded reference pictures (inter prediction), using at most 1 motion vector and reference index to predict the sample values of each block.
  - ❖ B: slice decoded using intra prediction or inter prediction from decoded samples within previously-decoded reference pictures, using at most 2 motion vectors and reference indices to predict the sample values of each block.
- **Size in Bits:** size of the slice in bits.
- **QP:** Quantization Parameter variable used by the decoding process to scale the transform coefficient levels. The bigger the QP, the worse the quality.

- **SAO enabled:** If true, specifies that the Sampling Adaptive Offset is enabled for the current slice.
- **DF enabled:** If true, specifies that the Deblocking Filter is enabled for the current slice.

#### CTB Data

- **Index:** Index of the CTB in the current picture.
- **Size In Bits:** size of the CTB in bits.

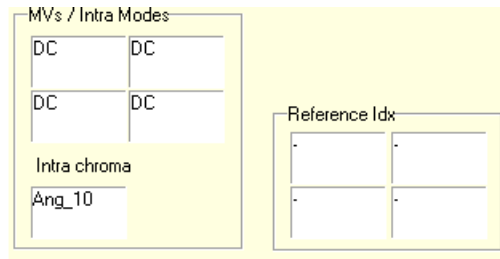
#### CB Data

- **Index:** index of the CB in the CTB.
- **Pred mode:** Prediction mode used for the Coding Block.
- **QP:** Quantization Parameter: see Slice QP for definition. The QP can be adjusted at CB-level, in particular for rate-control purpose.
- **Size in pixels:** width and height of the Coding Block, in pixels.
- **Size In Bits:** size of the Coding Block, in bits.

The content of the bottom part of the view contains either Prediction information or Transform information. Radio buttons can be used to select the information to display.

#### Prediction Data

Figure 3-38. Coding Details tab (H.265/HEVC) - Prediction area



#### **MVs/intra Modes:**

- Motion vectors for each prediction block in an inter-predicted CB, in units of quarter of pixels. L0 motion vectors are on the first line, L1 motion vectors are on the second line.
- Intra prediction modes for luma in an intra-predicted CB.

**Intra chroma:** Intra prediction modes for chroma in an intra-predicted CB.

**Reference Idx:** stands for 'reference picture list: list index'

## Transform Data

Figure 3-39. Coding Details tab (H.265/HEVC) - Transform area

Block selection

Y    Cb  Cr

Coded Block Flags

0	-	-	-	0	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
1	-	-	-	0	-	-	-
-	-	-	-	-	-	-	-

This view shows the luma or chroma Coded Block Flags (CBF) for the current Coding Block.

Luma and chroma CBF can be selected with the "block selection"

If the coding block is 32 x 32 or smaller, all luma CBF can be seen at once.

If the coding block is 64 x 64, the desired luma 32 x 32 block can be selected with the "block selection".

## VC-1 Data

### Sequence and Picture Characteristics

The sequence and picture characteristics of the VC-1 video stream are summed up in the [Seq/Picture](#) tab. Depending on the file type, MPEG-2 TS data may not be filled.

Figure 3-40. Sequence and Picture Characteristics (VC-1)

Sequence

Profile/Level	Main/Low	SAR (DAR)	N/A (4:3)
Frame Rate	-	Bit Rate	1315728
Frame Count	24	Duration	1.000

Picture

Type	I	FCM	Progressive
Dec. Index	0	Structure	Frame
Pres. Index	0	Intra MB	300 (100 %)
QP	3	1-MV MB	0 (0 %)
Size in Pixels	320 x 240	4-MV MB	0 (0 %)
Size in MBs	20 x 15 (300)	Skip MB	0 (0 %)
Size in Bytes	21126	Mixed MB	0 (0 %)

### Sequence Data

- Profile/Level:
  - ❖ **Profile**: a subset of the syntax provided in the VC-1 standard. Possible values for VC-1 files: Simple, Main or Advanced.
  - ❖ **Level**: a defined set of constraints on the values that may be taken by syntax elements and variables.
- **Frame rate**: in frames per second. In Advanced profile, this value is available only if FRAMERATE\_FLAG = 1 in the sequence-level syntax. In Simple and Main profile, value of FRAMERATE in the sequence-layer data structure.
- **Frame count**: number of video frames in the stream. A frame is either encoded as a frame or as two fields.
- **SAR (DAR)**: Sample Aspect Ratio, as coded in the stream, and computed Display Aspect Ratio in brackets.
  - ❖ **Sample Aspect Ratio (SAR)**: ratio between the horizontal distance between the columns and the vertical distance between the rows of the luma sample array in a frame. In other words, it is the "shape" of a luma sample. Sample aspect ratio is expressed as  $h:v$ , where  $h$  is horizontal width and  $v$  is vertical height (in arbitrary units of spatial distance).
  - ❖ **Display Aspect Ratio (DAR)**: intended ratio between the horizontal and vertical dimensions of the displayed image. Common values are 4:3 (1.33) and 16:9 (1.77). When SAR is different from square sample (1:1), the display aspect ratio is modified by the SAR and  $DAR = SAR * (horizontal\_size/vertical\_size)$ .
- **Bit rate**: bit rate in bit/s, based on total frame size and frame rate.
- **Duration**: duration of the video, in seconds.

### Picture Data

- Type:
  - ❖ I: picture coded using information from itself.
  - ❖ P: picture coded using motion compensation prediction from past reference fields or frames.
  - ❖ B: picture coded using motion compensation prediction from past and / or future fields or frames. A B picture cannot be used for predicting any other picture.
  - ❖ BI: B picture where all the macroblocks are intra-coded. A BI picture cannot be used for predicting any other picture.
  - ❖ Skipped: P picture that is identical to its reference picture.
- **Dec. index**: index of the picture in decoding order.

- **Pres. index:** index of the picture in presentation order.
- **QP:** Quantization Parameter, variable used by the decoding process to scale the transform coefficient levels. The bigger the QP, the worse the quality.
- **Size in Pixels:** picture's width and height in pixels.
- **Size in MBs:** picture's width, height and total number in macroblocks, i.e. blocks of 16x16 pixels.
- **Size in Bytes:** coded picture's size.
- **FCM:** Frame Coding Mode. Indicates whether the frame is coded as Progressive, Field interlace or Frame interlace.
  - ❖ **Progressive:** the two fields of a frame were captured at the same time instant.
  - ❖ **Interlaced:** the two fields of a frame were captured at different time instants.
- **Structure:**
  - ❖ **Top Field:** made up of the even-numbered rows of a frame.
  - ❖ **Bottom Field:** made up of the odd-numbered rows of a frame.
  - ❖ **Frame:** made up of a top and a bottom field.
- **Intra MB:** number and percentage of macroblocks predicted using Intra (i.e. spatial) prediction mode.
- **I-MV MB:** number and percentage of macroblocks predicted using the Inter (i.e. temporal) prediction mode with 1 motion vector per macroblock.
- **4-MV MB:** number and percentage of macroblocks predicted using the Inter (i.e. temporal) prediction mode with 4 motion vectors per macroblock.
- **Skip MB:** number and percentage of macroblocks predicted using the Skip mode. For skipped MBs, no differential motion vector, reference index or residual data is present in the bitstream. Skipped MBs are found in B and P slices.
- **Mixed MB:** number and percentage of macroblocks predicted using a mix of temporal and spatial modes. Mixed MBs are found in B and P frames.

### Slice/Macroblock Characteristics

Click the [Slice/MB](#) tab to reach the Slices' and Macroblocks' characteristics.

Figure 3-41. Slice/MB tab (VC-1)

The screenshot shows a software interface with several panels for configuring video parameters:

- Slice Panel:**
  - Number: 0
  - Row Address: 0
  - Size In Bits: 168960
- Macroblock Panel:**
  - Number: 169 [9,8]
  - Pred. Mode: Intra
  - Pred. Dir: -
  - Size In Bits: 1097
  - QP: 0
  - MV Mode: -
- CBP Luma / Chroma Panel:**
  - Y: [1] [1]
  - Cb: [1] [1]
  - Cr: [1] [1]
- Transform Type Panel:**
  - 8x8: [ ] [ ]
  - [ ] [ ] [ ] [ ]
- Motion Vectors Panel:**
  - [ ] [ ]
  - [ ] [ ]

#### Slice Data

- **Number:** slice number in the picture.
- **Row Address:** number of the first row of this slice.
- **Size in Bits:** slice size in bits.

#### Macroblock Data

- **Number:** absolute index, row and column of focused MB in current picture.
- **Pred. Mode:** prediction mode (Intra, Inter 1-MV, Inter 4-MV, or Mixed) for the focused MB.
- **Pred. Dir:** prediction direction (Forward, Backward, Bi-Directional, Direct or Interpolated).
- **Size In Bits:** coded MB size in bits.
- **MV Mode:** unit used to express motion vectors. Can be  $\frac{1}{4}$  pixel,  $\frac{1}{2}$  pixel,  $\frac{1}{2}$  pixel bilinear or Mixed PY;
- **QP:** the Quantization Parameter can be adjusted at macroblock-level, in particular for rate-control purposes.

CPB Luma / Chroma Data

- **CPB Luma / Chroma**: Coded Block Pattern Luma: Indicates the presence or absence of residual information in blocks within a macroblock.

Transform Type

- **Transform Type**: indicates which transformation is used for each 8x8 Luma block.

Motion Vectors

- **Motion Vectors**: motion vectors for each 8x8 block in an Inter-predicted MB, in units of quarter pixels or half pixels depending on the mode.

**MPEG-2 Video Data****Sequence and Picture Characteristics**Sequence data

- **Profile / Level**:
  - ❖ **Profile**: defined subset of the syntax described in the MPEG-2 Video standard. Possible values are Simple, Main, SNR, Spatial, High, 4:2:2 and Multi-view.
  - ❖ **Level**: defined set of constraints on the values which may be taken by the parameters of the MPEG-2 Video standard within a particular profile. Possible values are Low, Main, High and High1440.
- **Frame rate**: in frames per second. May be derived from frame\_rate\_value (sequence header) or frame\_rate\_extension\_n and frame\_rate\_extension\_d (sequence extension).
- **Frame count**: number of video frames in the stream. A frame is either encoded as a frame or as two fields.
- **Display Aspect Ratio**: ratio between the horizontal size and the vertical size of the displayed picture. Common values in television are 4:3 and 16:9.
- **Bit rate**: average bit rate in bit/s, based on bit\_rate\_value (sequence header) and bit\_rate\_extension (sequence extension).
- **Duration**: duration of the video in seconds, based on the frame rate.

Group Of Pictures (GOP) data

- **Closed GOP**:
  - ❖ when set to "TRUE", specifies that all pictures located in this GOP (i.e. all pictures between consecutive I pictures) have been coded without reference to pictures not belonging to this GOP.



- ❖ when set to "FALSE", this constraint does not apply and the first consecutive B-pictures following the I-picture may be corrupted.
- **Broken link**: when set to "TRUE", indicates that the first consecutive B-pictures following the I-picture may be corrupted because of stream editing (they may reference pictures that are no longer present in the bitstream).

#### Picture data

- **Picture type**:
  - ❖ **I picture**: coded using information from itself.
  - ❖ **P picture**: coded using motion compensation prediction from past reference fields or frames.
  - ❖ **B picture**: coded using motion compensation prediction from past and / or future fields or frames.
- **Dec. index**: index of the picture in decoding order.
- **Pres. index**: index of the picture in presentation order.
- **Temporal reference**: integer incremented by one modulo 1024 when pictures are examined in display order. After a GOP header, the temporal reference is reset to 0.
- **Size in pixels**: picture's width and height in pixels.
- **Size in MBs**: picture's width, height and total number in macroblocks, i.e. blocks of 16x16 pixels.
- **Size in bytes**: coded picture's size.
- **AFD**: Active Format Description. Optional information contained in the stream that indicates to the decoder how to display the video, e.g. how to display a 4/3 video on a 16/9 screen.
- **Intra MB**: number and percentage of macroblocks predicted using Intra (i.e. spatial) prediction modes (Intra and Intra Quant).
- **Inter MB**: number and percentage of macroblocks predicted using Inter (i.e. temporal) prediction modes.
- **Skip MB**: number and percentage of macroblocks predicted using Skip mode. For skipped MBs, no differential motion vector and residual data are present in the bitstream.
- **No MC MB**: percentage of macroblocks predicted using " No MC " modes. For " No MC " MBs, no differential motion vector is present in the bitstream.
- **Scan Type**:
  - ❖ **Progressive**: the two fields of a picture were captured at the same time instant.

- ❖ **Interlaced**: the two fields of a picture were captured at different time instants.
- **Structure**:
  - ❖ **Top Field**: made up of the even-numbered rows of a frame.
  - ❖ **Bottom Field**: made up of the odd-numbered rows of a frame.
  - ❖ **Frame**: made up of a top and a bottom field.
- **Time code**: coded time used for synchronization, associated to each picture and expressed in hours:minutes:seconds:pictures.
- **SMPTE 328 TC**: time code contained in the picture user data and conforming to SMPTE 328 syntax.

#### **Slice/Macroblock Characteristics**

##### Slice data

- **Index**: index of the slice in the picture.
- **Row number**: number of the row of macroblocks.
- **Size in bytes**: slice's size, in bytes.
- **Q scale**: quantization scale of the slice specifying the "strength" of data compression. The bigger the Q scale, the higher the compression, the worse the quality.

##### Macroblock data

- **Number**: absolute index, row and column of the focused MB in the current picture.
- **MB mode**: type of the macroblock. Possible values are {Intra; Intra, Quant; MC, Coded; No MC, Coded; MC, Not Coded; MC, Coded, Quant; No MC, Coded, Quant; Interp, Not Coded; Interp, Coded; Bwd, NotCoded; Bwd, Coded; Fwd, Not Coded; Fwd, Coded; Interp, Coded, Quant; Fwd, Coded Quant; Bwd, Coded Quant}.
- **Size in bits**: coded MB's size, in bits.
- **Q scale**: quantization step at MB level. It is either inferred from slice Q scale or modified directly at MB level.
- **Prediction mode**: can take the following values:
  - ❖ **Frame**: predictions are formed from one or more previously decoded frames.
  - ❖ **Field**: predictions are formed from one or more previously decoded fields.
  - ❖ **16x8**: two motion vectors are used for each MB used in field pictures only.
  - ❖ **Dual Prime**: one MV is encoded together with a small differential MV.

- **Coded Block Pattern luma/chroma:** indicates which of the 4 8x8 luma blocks and 8x8 chroma blocks contain coded coefficients. For one macroblock, there are 1 (4:2:0), 2 (4:2:2) or 4 (4:4:4) block(s) of each chroma component.
- **Motion vectors:** vectors used in the motion compensation process. There can be up to 4 vectors for one MB, as MV can be forward/backward and top/bottom.

### MPEG-2 Transport Stream Data

Figure 3-42. Video transport characteristics (MPEG-2 TS file)

MPEG-2 Transport Stream			
PID	481	Packet Index	6
PTS	0.700000	Packet Position	1128
DTS	0.540000	PTS - PTS0	0.160000

- **PID:** packet identifier in an MPEG-2 TS.
- **PTS:** Presentation Time Stamp: defines decoder output order in an MPEG-2 TS.
- **DTS:** Decoding Time Stamp: defines decoder input order in an MPEG-2 TS.
- **Packet index:** number of packets where the first data for this frame is located.
- **Packet Position:** position of the first byte of the packet of the frame in the MPEG-2 TS.
- **PTS - PTS0:** difference in seconds, between actual PTS and first PTS of the Elementary Stream.

### HLS Segment Data / EBP Data

Figure 3-43. HLS segment characteristics (HLS Video Media only)

HLS segment			
Index	1	Start time	0.000000
1st picture	0	Duration	2.000000
URI	20150326T085718-01-51424120.ts		

- **Index:** index of the segment, starting at 1.
- **1st picture:** first presentation index of the current segment, starting at 0.
- **Start time:** start time of the segment (not available for EBP).

- **Duration:** duration of the segment specified in the EXT-INF tag (not available for EBP).
- **URI:** URI of the segment, as it appears in the Media playlist (not available for EBP).

### MP4/QuickTime/FLV File Data

Figure 3-44. Video transport characteristics (MP4/QuickTime/FLV file)

MP4 / 3GP File Format			
Track ID	3	Position in file	59628
Timestamp	0.250250	Sample ID	7

- **Track ID:** track identifier in an MP4, QuickTime, FLV or 3GP file.
- **Timestamp:** presentation time of the picture, in seconds.
- **Position in file:** position of the picture in the file, in bytes.
- **Sample ID:** identifier of the sample (video picture or audio frame) in the file.

### ASF Data

Figure 3-45. Video transport characteristics (ASF file)

ASF File Format			
Stream ID	2	Position in file	470131
Timestamp	3.583000	Object number	15

- **Stream ID:** identifier of the stream in the ASF file.
- **Timestamp:** presentation time of the picture, in seconds.
- **Position in file:** position of the picture in the ASF file, in bytes.
- **Object number:** identifier of the Media Object (video picture or audio frame) in the ASF file.

## MXF Data

Figure 3-46. Video transport characteristics (MXF file)

MXF File Format			
Track ID	256	Sample Index	9
PTS	0.300000	Sample Position	1620503
DTS	0.266000	PTS - PTS0	0.300000

- **Track ID:** track identifier in an MXF file.
- **PTS:** Presentation Time of the picture, in seconds.
- **DTS:** Decoding Time of the picture, in seconds.
- **Sample Index:** identifier of the sample in the file.
- **Sample Position:** position of the sample in the file, in bytes.
- **PTS - PTS0:** difference between actual PTS and first PTS of the stream, on seconds.

## Macroblocks Coefficients (H.264/AVC and MPEG-2 Only)

Click the **MB Coeff** tab to access information on macroblocks coefficients.

Figure 3-47. MB Coeff tab

MB Coeff

**Coeff. selection**

Decoded

Pre-Loop Filt.

Predicted

Residual

Dequant.

Quant.

**Block selection**

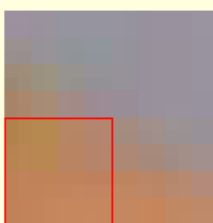
Y

U

Cb

Cr

MB



[ Enable coefficients selection in settings ]

137	140	141	141	142	142	142	142
137	140	141	141	142	141	141	142
138	141	141	141	141	141	141	142
139	141	141	141	141	141	141	142
140	142	141	141	141	141	141	141
140	142	142	143	143	144	144	144
141	142	143	144	145	145	145	145
141	142	143	144	145	145	146	145

By default, only the [Decoded](#) coefficients are available. To see all types of coefficients, you first need to enable an option: click the [Settings](#) button, choose [Video Analyses](#) and check the [MB coefficients](#) box. The video will be automatically reloaded to take this change into account.



This option uses a lot of memory.

The information displayed in the [MB Coeff](#) tab depends on the position of the mouse's pointer on the picture. To see the coefficients information better, it is recommended to display the grid and to select one macroblock on the grid.

This tab is composed of three areas:

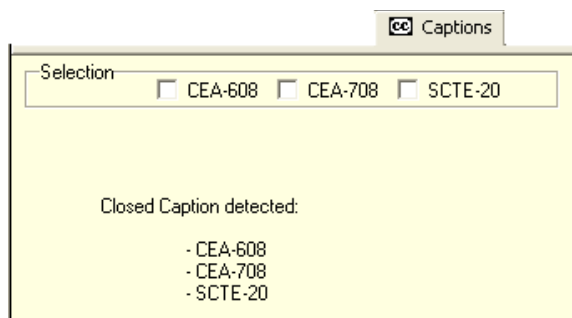
- The [Coeff selection](#) area lets you select the type of coefficient you wish to display. The [Decoded](#) type corresponds to the picture as it comes out the decoder. All other types correspond to different states of the picture while being decoded. The lower the coefficient type in the list, the more compressed the picture will be.
- The [Block selection](#) area lets you select one chrominance or luminance block of the macroblock (4:2:0 for H.264 videos, 4:2:0 or 4:2:2 for MPEG-2 videos). The absolute index corresponding to the selection is displayed in the right part of the tab with a preview of the block.
- The lowest part of the tab contains the coefficients themselves.

## Closed Captions

Click the [Captions](#) tab to access information about closed captions.

The CMA 1820 automatically detects the closed caption formats present in the stream and displays the list in the [Captions](#) tab. You can display simultaneously information on up to two formats. Use the [Selection](#) check boxes to make your choice.

Figure 3-48. Closed captions formats choice



The format used for display is highlighted in blue in the [Captions](#) tab. You can choose the format you want to use for display in the [Settings](#) dialog (see section '[Closed Captions Settings](#)' on page 222).

Figure 3-49. Captions tab

The screenshot shows the 'Captions' dialog box with the following settings:

- Selection:**  CEA-608,  CEA-708,  SCTE-20
- CEA-608:**
  - Radio buttons: CC 1 (selected), CC 2, CC 3, CC 4, T 1, T 2, T 3, T 4, XDS
  - Buffer:**  Front,  Back,  Char. only, Pic # 105
  - Text area: NO, I CAN'T. IT'S TOO IMPORTANT.
  - Attributes:**  Underline,  Flash,  Italics, Fgnd. (white)
  - Style: Pop-On, Mode: Opaque, Bkgnd. (black)
- SCTE-20:**
  - Radio buttons: CC 1 (selected), CC 2, CC 3, CC 4, T 1, T 2, T 3, T 4, XDS
  - Buffer:**  Front,  Back,  Char. only, Pic # 106
  - Text area: NO, I CAN'T. IT'S TOO IMPORTANT.
  - Attributes:**  Underline,  Flash,  Italics, Fgnd. (white)
  - Style: Pop-On, Mode: Opaque, Bkgnd. (black)

#### CEA-608 and SCTE-20

The radio buttons contain the list of possible closed caption types. Those that are not available in the stream are greyed and disabled. Click one active button to display its characteristics. For more information on closed caption types, refer to the *Closed Captions Standards* section in the Standards Overview document.

Fields presented below apply to the CC type.

#### Buffer area

There are three closed captions display styles:

- **Pop-on:** received text is kept in memory in the back buffer and then displayed (front buffer).

- **Paint-on:** received text is immediately displayed.
- **Roll-up:** received text is displayed on 2, 3 or 4 lines and rolls-up.

The back buffer contains the closed captions that have just been received. The front buffer contains the closed captions that are currently displayed on the stream. According to the closed captions style, there may be a difference of content between the front and the back buffers. Click one radio button to display the corresponding buffer's content.

The **Char only** option is enabled by default. It allows displaying only the closed captions text. If disabled, other information on closed captions is displayed, such as commands.

The **Pic #** field indicates the number of the last picture where a closed caption started to be displayed (access point).

#### Attributes area

This area provides the following information on the closed captions:

- **Underline:** if checked, it means that the closed caption is underlined.
- **Flash:** if checked, the closed caption is flashing.
- **Italics:** if checked, the closed caption is in italics.
- **Fgnd.:** indicates the foreground color.
- **Bkgnd.:** indicates the background color.
- **Style:** indicates the closed caption style (pop-on, paint-on or roll-up).
- **Mode:** indicates the closed caption opacity or transparency.



The attributes correspond to the closed captions that are being received. There might be a gap with what is being displayed on the stream.

#### **CEA-708**

- **Service:** select a service in the drop-down list. A service usually corresponds to a language (e.g. Service 1: English, service 2: Spanish). There can be up to 64 services.
- **Window:** select a window in the drop-down list. A window is an area of the image where it is possible to display some text. A window can be visible or hidden.
- **Delayed:** if checked, there is a delay on the service.

#### Buffer area

- **Defined:** if checked, the window is defined.
- **Visible:** if checked, the window is visible.




- The **Char only** option is enabled by default. It allows displaying only the closed captions text. If disabled, other information on closed captions is displayed, such as commands.
- The **Pic #** field indicates the number of the last picture where a closed caption started to be displayed (access point).

### Attributes area

This area provides information on the window's definition, the window's attributes, the pen's attributes and on the delay (Sync.). Click one radio button to display the corresponding information.

### Export

Click the  **Export view content to text file** toolbar button to open the services files of selected closed captions, e.g. CEA-608 CC1 and CEA-708 Service 1.

### DVB Subtitles Tab



To display this tab, you must first select the DVB Subtitles elementary stream from the **Hierarchy** view, if present in the stream.

The **DVB Subtitles** tab represents the decoder's state at the picture display moment.

Once the video is parsed, the **DVB Subtitles** tab indicates the presentation index where the first subtitle access point can be found. Enter this presentation index in the **Go to** field, in the navigation bar, and press **Enter**.

Subtitles are automatically displayed on the video, in the **Main** view.

Figure 3-50. DVB Subtitles tab

On the left of the tab, a tree represents the page structure. The page corresponds to what is displayed on screen. It can contain several regions, that can itself contain objects.

The Segment timing area displays the Presentation Time Stamp of the PES packet containing the displayed segment.

Parameters displayed at the right of the tree depend on the selection in the tree. For each element, the version number is indicated.

- **Page:** the panel displays information on the page composition segment:
  - ❖ **State:** this field has three possible values: acquisition point (the page is refreshed), normal case (the page is simply updated) or mode change (a new page is displayed). This is the access point used by the decoder.
  - ❖ **Page time-out:** maximum number of seconds during which the page is to be displayed.

The panel also indicates the next presentation index of a picture where a subtitle access point can be found.

- **Region:** the panel displays information on the region composition segment, such as the identifier or the size of the region.

- **Object:** the panel displays information on the object definition segment, such as the identifier of the object, the method of coding (pixels or strings of characters), the type of object, its position in the region.

The **Graphical object** area indicates the size of the object, in pixels, and its top field / bottom field length, as well as a preview of the object. Indeed, subtitles are compressed images and not text.

- **CLUT:** the panel displays information on the Color Look-Up Table, such as luminance, chrominance and transparency values. The CLUT represents the color palette used to display the subtitles.

### DVB Teletext Tab



To display this tab, you must first select a DVB Teletext or VBI Data elementary stream from the [Hierarchy](#) view, if present in the stream.

Once the video is parsed, the **DVB Teletext** tab indicates the presentation index where the first subtitle access point can be found. Enter this presentation index in the **Go to** field, in the navigation bar, and press **Enter**.

This tab only takes into account the teletext subtitles, and not other teletext data.

Teletext is automatically displayed in a grid on the video, in the **Main** view. Contrarily to subtitles, teletext are not images but bytes.

Figure 3-51. DVB Teletext tab

The tab's structure is basically the same as for DVB Subtitles:

- The Picture area displays information on the currently selected picture.
- The Service area provides information the services detected in the PMT. It indicates the page number (i.e. the identifier of the service), the language of the subtitle and the type of teletext.
- The Page area displays information on the page itself: set of characters used for teletext, subcode and national option sub-set.  
The panel also indicates the presentation index of the first picture associated to the next page header.
- The Control Bits area lists the control bits contained in the page header.
- The Enhancement Packets area indicates the types of non-displayable packets found since the last page header.
- The Data Bytes area provides a simulation of the teletext display. Uncheck the **Characters only** box if you wish to see the detailed syntax of the teletext (elements and corresponding values). By default, only the characters, i.e. the text of the teletext, are displayed.

## VPS/WSS Tab



To display this tab, you must first select a DVB Teletext or VBI Data elementary stream from the [Hierarchy](#) view, if present in the stream.

Once the video is parsed, the [VPS/WSS](#) tab indicates the presentation index where the previous (if any) and next VPS/WSS data can be found. Enter this presentation index in the [Go to](#) field, in the navigation bar, and press [Enter](#).

The tab also indicates the presence of VPS/WSS data on the currently selected picture.

Figure 3-52. VPS/WSS tab

The screenshot shows the VPS/WSS tab interface. At the top, there is a tab labeled 'VPS/WSS'. Below it, there are two main sections: 'VPS' and 'WSS'. Each section has a checkbox labeled 'Present on current picture' which is checked. Under each section, there are two rows: 'Previous' and 'Next'. Each row contains two input fields: 'Pres. index' and 'PTS'. For both VPS and WSS, the 'Pres. index' is 224 and the 'PTS' is 53310.758111. Below the 'Next' row in each section, there is a link that says 'See syntax view for VPS/WSS details'.

The [Pres index](#) value is the presentation index of the previous/next picture associated to VPS/WSS data.

The [PTS](#) value is the PTS of the previous/next VPS/WSS data.

## DPI Analysis

When selecting an SCTE-35 DPI component from the [Hierarchical](#) view, the DPI parsing is automatically started at the end of the video parsing, and the [Main](#) view then displays the DPI dedicated view.

This view is composed of three tabs:

- The [DPI Avails](#) tab provides you with information on commercial breaks, called *avails*, present in the stream,

- The [DPI Commands](#) tab lets you see the commands with their type and time,

These tabs both feature a data view on the right.

- The [Syntax Analysis](#) tab displays the data syntax. To learn more on this view, refer to section '[Syntax and Conformance](#)' on page 134.



When there are several commands in the stream, when opening the [Syntax](#) view from the [Avail summary](#) tab, all commands are displayed. When opening the [Syntax](#) view from the [Avail detail](#) tab or the [DPI commands](#) tab, only the selected command is displayed.

## DPI Avails Tab

The [DPI Avails](#) tab contains two parts:

- On the top of the view, the [Avail Overview](#) area displays the avails defined in the stream on a time line. The beginning and end of the stream file are indicated by brackets.
- Under this time line, the view is divided into two parts and you can display avail information either as a summary or in a detailed view:
  - ❖ The [Avail summary](#) tab contains a chart with indication of the avails position in the stream and their duration (in seconds).
  - ❖ The [Avail detail](#) tab contains three time lines on which you can see the position of `splice_out` and `splice_in` commands and of the selected avail, with their corresponding time.

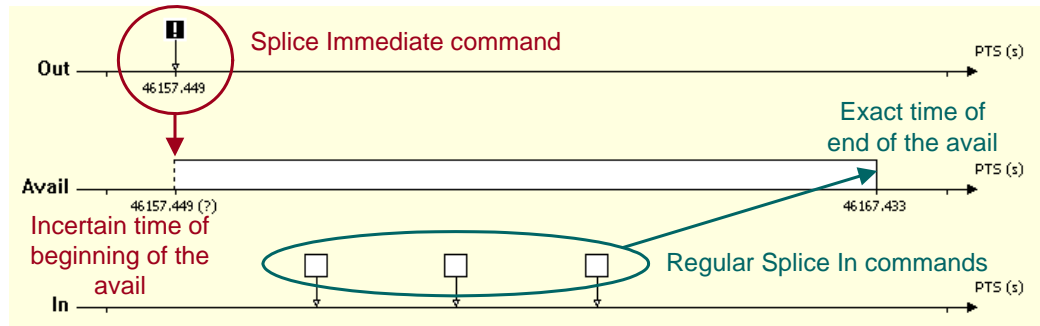
Time line values are provided in PTS value interpreted in seconds.

### Main Principles

**Avails materialization:** avails are materialized as lozenges on the time line in the [Avail Overview](#) area, and as bars in the [Avail summary](#) and [Avail detail](#) tabs.

If the beginning or the end of an avail results from a `splice_immediate` command, it is represented by a dotted line, because it is not possible to know the exact time the command will be executed.

Figure 3-53. Avails materialization (Avail detail tab)



**Navigation:** you can click the avails either from the overview or from the chart to obtain information from the data view, on the right.

When selecting an avail from the time line, the same avail is also selected on the [Avail Summary](#) chart, and inversely.

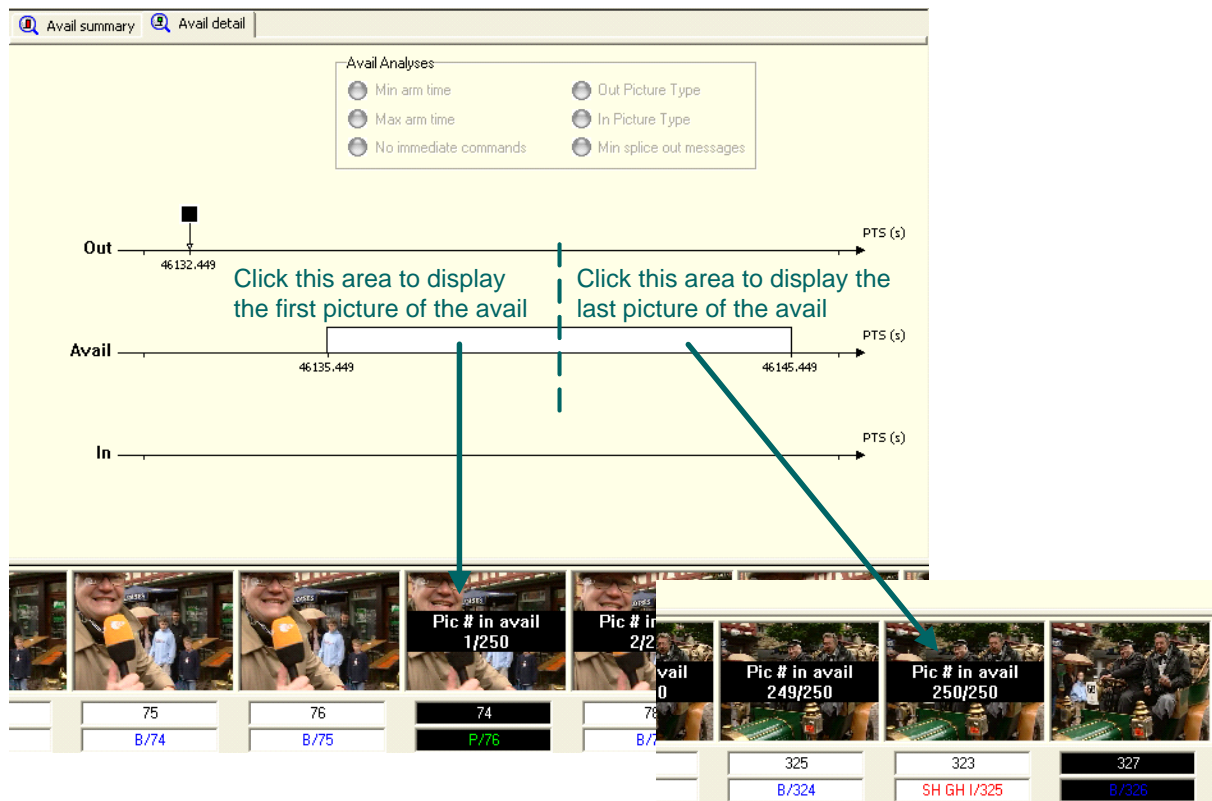
The [Thumbnail](#) view is also positioned according to the avail selected centered on the first picture of the avail. This is possible only if the PTS of the beginning of the avail corresponds to a stream picture. All pictures affected by an avail are tagged with label indicating the position of the picture in the avail.

Figure 3-54. Thumbnail view with avail tag



From the [Avail detail](#) tab, you can double-click the first half of the avail to position the [Thumbnail](#) view on the first picture of the avail, and double-click the second half of the avail to position the [Thumbnail](#) view on the last picture of the avail.

Figure 3-55. Navigation in the Thumbnail view from a avail

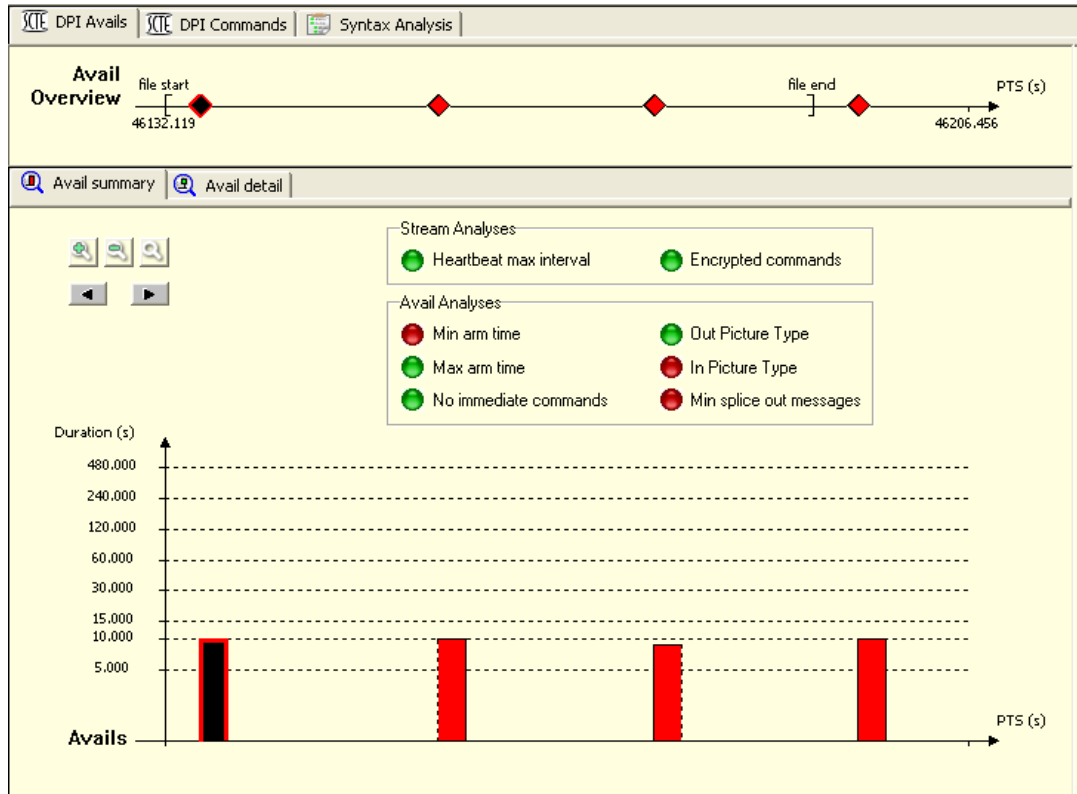


**Analyses:** you can set analyses to be performed on the stream and on the avails. The summary of the analyses results is displayed in the [Avail summary](#) tab (at stream and avail levels), and in the [Avail detail](#) tab (at avail level).

When analyses are configured, the lozenges and bars that materialize the avails are colored if there are errors on the avails, as well as the squares that materialize commands if errors relate to the commands.



Figure 3-56. Analyses on Avail summary view



For information on analyses, refer to section 'SCTE-35 Settings' on page 224.

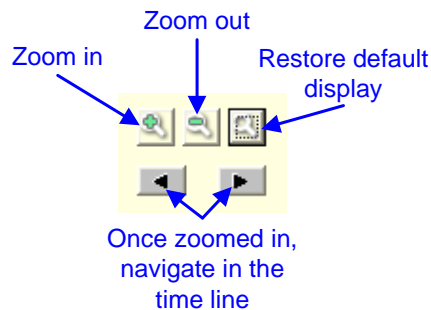


Once you have configured analyses, they are not performed automatically. To do so, you need to reload the stream or, if the file is an MPTS, to select a different component and then go back.

**Zoom feature:** in the [Avail summary](#) tab, zoom buttons are available.

Once zoomed in, the [Avail overview](#) time line, on the top of the view, lets you see the portion of the stream that is displayed. You can then navigate from a portion to another using the arrow buttons.

Figure 3-57. Zoom feature



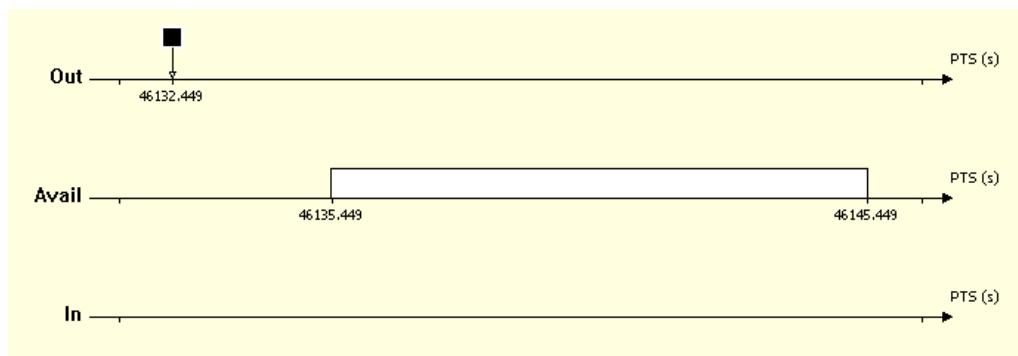
### Avail Detail Tab

The [Avail detail](#) tab displays detailed information on the avail selected from the [Avail summary](#) tab.

It contains three time lines:

- On the first one, you can see the position of splice\_out commands, i.e. commands that result in the interruption of the video and the beginning of the avail.
- On the second one, the avail is represented with its start and end times.
- On the last one, you can see the position of splice\_in commands, i.e. commands that result in the end of the avail and the return to the video.

Figure 3-58. Avail detail tab



Commands are materialized by squares. Splice\_immediate commands are tagged with an exclamation point.

When clicking a command, its time is displayed: this corresponds to the moment when the command is received (not the time it is executed).

If there is no splice\_in command and no duration specified in the splice\_out command, the avail is ended at the end of the default break duration specified in the [Settings](#) panel.

### DPI Commands Tab

The [DPI Commands](#) tab contains two parts:

- On the top of the view, the [Command Overview](#) area displays the commands present in the stream on a time line.
- The lower part of the view displays several time lines, one for each type of command.

**Commands materialization:** Like in the [Avail detail](#) tab, commands are materialized by squares and splice\_immediate commands are tagged with an exclamation point.

When clicking a command, its time is displayed: this corresponds to the moment when the command is received (not the time it is executed).

**Navigation:** you can click the arrows under each type of command to navigate from one command to another on the time line.

**Zoom feature:** zoom buttons are available. Refer to [Figure 3-57](#) above to learn how to use these buttons.

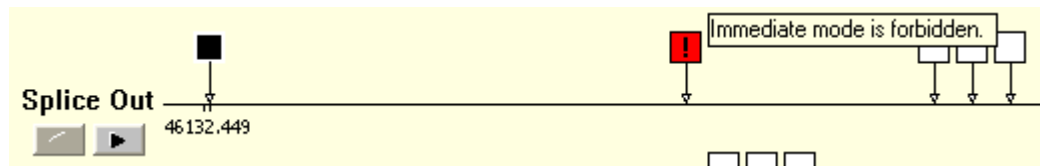
Once zoomed in, the [Command Overview](#) time line, on the top of the view, lets you see the portion of the stream that is displayed. You can then navigate from a portion to another using the arrow buttons.

**Analyses:** you can set analyses to be performed on avails, some of which can be related to commands.

When analyses are configured, the squares that materialize the commands are colored if there are errors related to the commands. A tooltip indicates information on the error when positioning the mouse cursor on the command.

Example: if you checked the [No immediate commands](#) box from the [Settings](#) panel, immediate commands will be displayed in red.

Figure 3-59. DPI Commands tab - Immediate command not allowed



For information on analyses, refer to section '[SCTE-35 Settings](#)' on page 224.



Once you have configured analyses, they are not performed automatically. To do so, you need to reload the stream or, if the file is an MPTS, to select a different component and then go back.

## Data View

The content of the [Data](#) view on the right depends on the tab selected in the [Main](#) view:

- When the [Avail summary](#) tab is selected, Stream and Avail data are available.
- When the [Avail detail](#) tab is selected, Avail and Splice command data are available.



When the [Avail summary](#) tab is selected, the Avail data area varies along with the avail selected from the tab, whereas when the [Avail detail](#) tab is selected, the Avail data area is static since the view is already focused on one specific avail.

The Splice event IDs provided for the [Avail summary](#) tab among the Avail data area are not provided again in this area for the [Avail detail](#) tab since these IDs are indicated in the Splice command data area.

- When the [DPI Commands](#) tab is selected, Command and Splice command data are available.



The Splice command data area is similar both in the [Avail detail](#) and in the [DPI commands](#) tabs.

### Stream

- [Avail count](#): number of avails found in the entire stream.
- [Cue stream type](#): value of the cue\_stream\_type field found in the PMT descriptor, if any.

### Avail

- [Number / expected](#): identifier of the avail within the program / expected number of avails in the current program.
- [Splice mode](#): the mode of splicing can be:
  - ❖ *Program*: all PIDs of the service are spliced at the same time.
  - ❖ *Component*: PIDs can be sliced at different times and some PIDs may not be spliced.
- [Splice event IDs](#):
  - ❖ [Splice out program ID](#): unique program ID for the splice out event associated with the avail.
  - ❖ [Splice out event ID](#): event ID for the splice out event associated with the avail.
  - ❖ [Splice in program ID](#): unique program ID for the splice in event associated with the avail.
  - ❖ [Splice in event ID](#): event ID for the splice in event associated with the avail.
- [Out picture and In picture](#):
  - ❖ [Splice immediate](#): the box is checked if the command is a splice immediate command.
  - ❖ [PTS](#): PTS associated with the first picture after the break starts (for Out picture) or ends (for In picture).

- ❖ **Pres. index / type:** presentation index and coding type associated with the first picture after the break starts (for Out picture) or end (for In picture).
- **Avail length:**
  - ❖ **Pictures:** duration of the break, in pictures.
  - ❖ **Duration:** duration of the break, in seconds.

#### Splice Command

- **Unique program ID:** unique identifier of the program that contains the splice command.
- **Event ID:** identifier of the event that comprises the splice command.
- **SCTE-67 source/ID:** SCTE-67 interpretation of the event ID value for the currently selected avail. This interpretation partitions the ID into 2 parts: a source indication and an ID.
- **Program:** mode of splicing. This box is checked if the splice mode is program (all PIDs of the service are spliced at the same time) and unchecked if it is component (PIDs can be sliced at different times and some PIDs may not be spliced).
- **Immed.:** this box is checked if the selected command is a splice immediate command.
- **Duration:** this box is checked if a duration is specified for the selected command.
- **Command time:** time at which the selected command is received, reconstructed from the PCR clock, in seconds.
- **Splice time:** PTS indicated in the splice\_time field or absolute UTC time (in the case of a schedule) for the selected command, if any, in seconds.
- **PTS adjustment:** value of the pts\_adjustment field for the selected command, in seconds.
- **Duration:** duration indicated in the break\_duration field for the selected command, if any, in seconds.
- **Arm time:** time that separates the command from its execution (splice\_time) for the selected command, if any, in seconds.

#### Command

- **Descriptor:** this box is checked if the selected command is followed by an SCTE-35 descriptor.
- **Command time:** time at which the selected command is received, reconstructed from the PCR clock, in seconds.
- **Type:** type of the selected command (i.e. value of the splice\_command\_type field in the Splice Info Table).

- **Total**: total number of commands of the same type in the stream (e.g. total number of splice out commands or of time signal commands).



For this value, splice out and splice in commands are considered as two distinct types, although they are both splice insert commands.

- **Index**: index of the selected command among commands of the same type.

### Export

Click the **Export view content to text file** toolbar button to export the view content:

- If the **Avail summary** tab is selected: interpreted data on avails.
- If the **Avail detail** tab is selected: interpreted data on the selected avail and its related DPI commands.
- If the **DPI Commands** tab is selected: all data on DPI commands.

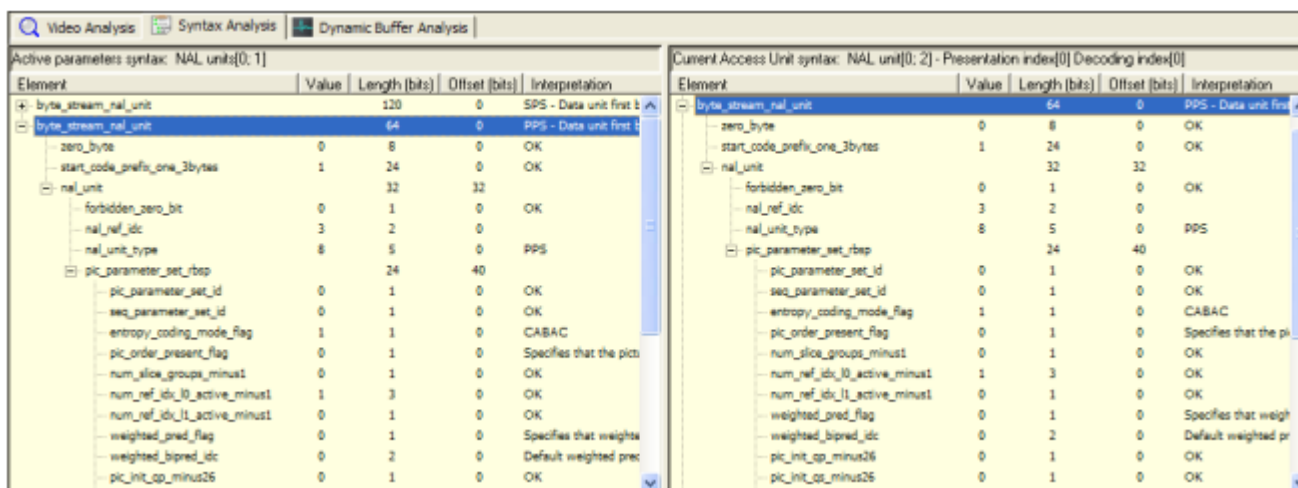
## Syntax and Conformance

### Overview

The **Syntax Analysis** tab is part of the **Main** view.

The information displayed varies depending on the type of file.

Figure 3-60. H.264/AVC Syntax view



The view is split into two parts:


- **Active parameters syntax**:
  - ❖ H.264/AVC: active SPS & PPS for current access unit.

- ❖ H.265/HEVC: active VPS, SPS & PPS for current access unit.
  - ❖ VC-1: active SH and EH (for the Advanced profile) and the SEQUENCE LAYER METADATA (for Simple & Main profiles).
  - ❖ MPEG-2 Video: active, SH, SE, GH and optional extensions.
- **Current Access Unit syntax:**
    - ❖ H.264/AVC: syntax of NAL units that constitute the current access unit, including SPS & PPS, if present.
    - ❖ H.265/HEVC: syntax of NAL units that constitute the current access unit, including VPS, SPS & PPS, if present.
    - ❖ VC-1: syntax of the BDUs that constitute the current access unit, including SH and EH (for Advanced profile) or SEQUENCE LAYER METADATA (for Simple and Main profiles), if present.
    - ❖ MPEG-2 Video: syntax of Data units that constitute the current Access Unit, including SH, SE, GH and optional extensions.

The [Syntax Analysis](#) view is also available for SCTE-35 DPI components.

A tree with 5 columns represents the NAL unit syntax (H.264/AVC or H.265/HEVC), the BDU syntax (VC-1) or the DU syntax (MPEG-2 Video):

- **Element name:** as described in the standards, a tooltip is associated with each element to detail its purpose.
- **Value:** decoded value of syntax element.
- **Length:** number of bits used to encode the value of the syntax element. A tooltip is associated with the length of the NAL unit, the BDU or the DU, to display the length in bytes.
- **Offset:** number of bits from the beginning of the NAL unit, the BDU or the DU.
- **Interpretation:** depending on the element:
  - ❖ NAL unit / BDU / DU name and position if beginning of a NAL unit / BDU / DU.
  - ❖ Syntax element interpretation: profile main, level 2.2...
  - ❖ OK if no error.
  - ❖ Nothing if it is not tested.
  - ❖ Erroneous syntax element is in red, as the NAL unit / BDU / DU itself.

Click the  [Export view content to text file](#) toolbar button to save the syntax description to a file. This button is enabled provided the [Syntax Analysis](#) tab is selected.

If closed captions are present, USER DATA (MPEG-2 and VC-1) or SEI - user\_data\_registered\_itu\_t\_t35 (H.264/AVC) syntax is interpreted. Therefore, it is possible to investigate CEA-608 and CEA-708 data.

Figure 3-61. Syntax log file

```

----- Active parameters syntax: -----
-----
SEQUENCE HEADER Sequence Header
-----
sequence_header_code = 435      0x00 0x00 0x01 0xB3
horizontal_size_value = 1920    Horizontal size
vertical_size_value   = 1088    Vertical size
aspect_ratio_inform  = 3       16:9
frame_rate_code      = 4       30 000 = 1001 (29.97...) frame / s
bit_rate_value       = 37475    14990000 bits / s
marker_bit           = 1       OK
vbv_buffer_size_value = 457
constrained_parameters_flag = 0   OK
load_intra_quantiser_matrix = 1
intra_quantiser_matrix = 8
intra_quantiser_matrix = 16
intra_quantiser_matrix = 16
intra_quantiser_matrix = 43
intra_quantiser_matrix = 16
intra_quantiser_matrix = 43
intra_quantiser_matrix = 70
intra_quantiser_matrix = 70
intra_quantiser_matrix = 70
intra_quantiser_matrix = 70
intra_quantiser_matrix = 70
intra_quantiser_matrix = 70
intra_quantiser_matrix = 106
intra_quantiser_matrix = 88
intra_quantiser_matrix = 106
intra_quantiser_matrix = 115

```

## H.264/AVC Conformance

### General Conformance

General conformance is performed during the parsing of the H.264/AVC video stream. Errors are logged in the [Report](#) view and saved in the report file, but are not displayed in the [Syntax](#) tree.

According to the NAL unit order defined by the H.264/AVC standard, the following constraints are tested:

### NAL Unit Order

- **SPS must precede PPS or SEI Buffering Period** that reference it. PPS must precede coded slice or coded slice data partition A NAL units that refer to it.
- **Values of POC** for the coded pictures in consecutive AU in decoding order containing non-reference pictures shall be non-decreasing.
- **If any SEI NAL unit is present**, it shall precede the primary coded picture.
- **Buffering period SEI message** shall be the first SEI message payload of the first SEI NAL unit in the AU.



- **Primary coded picture** shall precede the corresponding redundant coded pictures.
- **Redundant coded pictures** shall be ordered in ascending order of the value of `redundant_pic_cnt`.
- **If an end of sequence NAL unit is present**, it shall follow the primary coded picture and all redundant coded pictures (if any).
- **If an end of stream NAL unit is present**, it shall be the last NAL unit.
- **NAL units** having `nal_unit_type` equal to 0, 12, or in the range of 19 to 31, inclusive, shall not precede the first VCL NAL unit of the primary coded picture.
- **If ASO not allowed**, the order of coded slice of an IDR picture NAL units shall be in the order of increasing macroblock address for the first macroblock of each coded slice of an IDR picture NAL unit.

### Profiles Checking

According to the profiles restrictions defined in Annex A of the H.264/AVC standard, the following constraints are tested:

- **Baseline Profile**
  - ❖ Only I and P slice types may be present.
  - ❖ NAL unit streams shall not contain `nal_unit_type` values in the range of 2 to 4, inclusive.
  - ❖ Sequence parameter sets shall have `frame_mbs_only_flag` equal to 1.
  - ❖ Picture parameter sets shall have `weighted_pred_flag` equal to 0.
  - ❖ Picture parameter sets shall have `weighted_bipred_idc` equal to 0.
  - ❖ Picture parameter sets shall have `entropy_coding_mode_flag` equal to 0.
  - ❖ Picture parameter sets shall have `num_slice_groups_minus1` in the range of 0 to 7, inclusive.
  - ❖ Syntax element `transform_8x8_mode_flag` shall not be present in picture parameter sets.
  - ❖ Syntax element `pic_scaling_matrix_present_flag` shall not be present in picture parameter sets.
  - ❖ Syntax element `second_chroma_qp_index_offset` shall not be present in picture parameter sets.
- **Main Profile**
  - ❖ Only I, P and B slice types may be present.

- ❖ NAL unit streams shall not contain `nal_unit_type` values in the range of 2 to 4, inclusive.
- ❖ Picture parameter sets shall have `num_slice_groups_minus1` equal to 0 only.
- ❖ Picture parameter sets shall have `redundant_pic_cnt_present_flag` equal to 0 only.
- ❖ Syntax elements `transform_8x8_mode_flag` shall not be present in picture parameter sets.
- ❖ Syntax elements `pic_scaling_matrix_present_flag` shall not be present in picture parameter sets.
- ❖ Syntax elements `second_chroma_qp_index_offset` shall not be present in picture parameter sets.
- Extended Profile
  - ❖ Sequence parameter sets shall have `direct_8x8_inference_flag` equal to 1.
  - ❖ Picture parameter sets shall have `entropy_coding_mode_flag` equal to 0.
  - ❖ Picture parameter sets shall have `num_slice_groups_minus1` in the range of 0 to 7, inclusive.
  - ❖ Syntax elements `transform_8x8_mode_flag` shall not be present in picture parameter sets.
  - ❖ Syntax elements `pic_scaling_matrix_present_flag` shall not be present in picture parameter sets.
  - ❖ Syntax elements `second_chroma_qp_index_offset` shall not be present in picture parameter sets.
- High Profile
  - ❖ Only I, P and B slice types may be present.
  - ❖ NAL unit streams shall not contain `nal_unit_type` values in the range of 2 to 4, inclusive.
  - ❖ Picture parameter sets shall have `num_slice_groups_minus1` equal to 0 only.
  - ❖ Picture parameter sets shall have `redundant_pic_cnt_present_flag` equal to 0 only.
  - ❖ Sequence parameter sets shall have `chroma_format_idc` in the range of 0 to 1 inclusive.
  - ❖ Sequence parameter sets shall have `bit_depth_luma_minus8` equal to 0 only.
  - ❖ Sequence parameter sets shall have `bit_depth_chroma_minus8` equal to 0 only.

- ❖ Sequence parameter sets shall have `qprime_y_zero_transform_bypass_flag` equal to 0 only.

### Levels Checking

According to levels restrictions defined in Annex A of the H.264/AVC standard, the following constraints are tested:

- $\text{PicWidthInMbs} * \text{FrameHeightInMbs} \leq \text{MaxFS}$
- $\text{PicWidthInMbs} \leq \text{Sqrt}(\text{MaxFS} * 8)$
- $\text{FrameHeightInMbs} \leq \text{Sqrt}(\text{MaxFS} * 8)$
- Depending on the profile, `direct_8x8_inference_flag` shall equal 1
- Depending on the profile, `frame_mbs_only_flag` shall equal 1

### MPEG2-sys Amd3

According to restrictions defined in MPEG2-sys Amd3 standard, the following constraints are tested:

- Access Unit Delimiter shall be used at the beginning of an AU.
- Access Unit Delimiter start code shall be 0x00000001 (a zero\_byte is added).

If VUI `hrd_parameters()` is present and `low_delay_hrd_flag=1`, then `timing_info_present_flag=1`.

### DVB Guidelines

According to DVB guidelines, the following constraints are tested:

- Between two H.264/AVC RAPs, the content of a PPS with a particular `pic_parameter_set_id` shall not change.
- Time interval between two changes in pairs of `pic_width_in_mbs_minus1` and `pic_height_in_map_units_minus1` shall be greater than or equal to one second.
- It is recommended to specify the chrominance locations using the syntax elements `chroma_sample_loc_type_top_field=1` and `chroma_sample_loc_type_bottom_field=1` in the VUI.
- Maximum time interval between two H.264/AVC RAPs shall be less than or equal to 5 seconds.
- A transport packet carrying a H.264/AVC RAP shall have an adaptation field and a PES packet start, `payload_unit_start_indicator=1`, `adaptation_field_control=1`, `random_access_indicator=1`, `elementary_stream_priority_indicator=1`.
- SDTV constraint0: `profile_idc = 77` or `100`.
- SDTV constraint1: `constraint_set_0_flag = 0`.

- SDTV constraint2: constraint\_set1\_flag = 1 (profile\_idc = 77) or = 0 (profile\_idc = 100).
- SDTV constraint3: constraint\_set\_2\_flag = 0.
- SDTV constraint4: constraint\_set\_3\_flag = 0 (profile\_idc = 100).
- SDTV constraint5: gaps\_in\_frame\_num\_value\_allowed\_flag = 0 (gaps not allowed).
- SDTV constraint6: vui\_parameters\_present\_flag = 1.
- SDTV constraint7: level\_idc = 30.
- SDTV constraint8: aspect ratio shall be either 4:3 or 16:9.
- SDTV constraint9: frame rate = {25; 24000/1001; 24; 30000/1001; 30}.
- SDTV recommendations0: VUI colour\_primaries = 5 (25 Hz) or 6 (30Hz).
- SDTV recommendations1: VUI transfer\_characteristics = 5 (25 Hz) or 6 (30Hz).
- SDTV recommendations2: VUI matrix\_coefficients = 5 (25 Hz) or 6 (30Hz).
- HDTV constraint0: profile\_idc = 100.
- HDTV constraint1: constraint\_set\_0\_flag = 0.
- HDTV constraint2: constraint\_set\_1\_flag = 0.
- HDTV constraint3: constraint\_set\_2\_flag = 0.
- HDTV constraint4: constraint\_set\_3\_flag = 0.
- HDTV constraint5: gaps\_in\_frame\_num\_value\_allowed\_flag = 0 (gaps not allowed).
- HDTV constraint6: vui\_parameters\_present\_flag = 1.
- HDTV constraint7: level\_idc = 30; 31; 32 or 40.
- HDTV constraint8: aspect ratio shall be either 16:9.
- HDTV constraint9: frame rate = {25; 50; 24000/1001; 24; 30000/1001; 30; 60000/1001; 60}.
- HDTV recommendations0: VUI colour\_primaries = 1.
- HDTV recommendations1: VUI transfer\_characteristics = 1.
- HDTV recommendations2: VUI matrix\_coefficients = 1.

#### Syntax Element Conformance

Syntax element conformance is performed during the parsing of the H.264/AVC video stream. Errors are logged in the [Report](#) view and saved to the report file. The [Syntax](#) view provides a clear access to NAL Units syntax, with errors highlighted in red.

Depending on the syntax element, one of the following processing operations is performed:

- No conformance done (most flags)
- Compare syntax value to a single value
- Is syntax value inside a range
- Is syntax value part of N possible values
- Value depends on other values

#### **Output Order Conformance**

Output order conformance is tested only on H.264/AVC Raw byte files and H.264/AVC Elementary Streams contained in MPEG-2 TS files. This conformance test is based on two syntax elements: Presentation Time Stamp, or PTS, is contained in PES packet headers of MPEG-2 TS, hence tested only in the case of an MPEG-2 TS file. Picture Order Count or POC, is part of the Elementary Stream.

The following criteria are tested:

- POC shall be equal to 0 if picture is an IDR.
- POC increment for the picture following a frame in presentation order shall be equal to 2.
- POC increment for the picture following a field in presentation order shall be equal to 1.
- PTS value shall increase with increasing picture position in presentation order.
- PTS gap between consecutive pictures in presentation order should not exceed a threshold defined by preceding PTS differences.

#### **H.265/HEVC Conformance**

##### **General Conformance**

##### Profiles Checking

According to the profiles, the following constraints are tested:

- Main Profile
  - ❖ SPSs shall have chroma\_format\_idc equal to 1 only.
  - ❖ SPSs shall have bit\_depth\_luma\_minus8 equal to 0 only.
  - ❖ SPSs shall have bit\_depth\_chroma\_minus8 equal to 0 only.
  - ❖ CtbLog2SizeY shall be in the range of 4 to 6, inclusive.
  - ❖ When a PPS has tiles\_enabled\_flag is equal to 1, it shall have entropy\_coding\_sync\_enabled\_flag equal to 0.

- ❖ When a PPS has `tiles_enabled_flag` is equal to 1, `ColumnWidthInLumaSamples[ i ]` shall be greater than or equal to 256 for all values of `i` in the range of 0 to `num_tile_columns_minus1`, inclusive, and `RowHeightInLumaSamples[ j ]` shall be greater than or equal to 64 for all values of `j` in the range of 0 to `num_tile_rows_minus1`, inclusive.
- Main 10 Profile
  - ❖ SPSs shall have `chroma_format_idc` equal to 1 only.
  - ❖ SPSs shall have `bit_depth_luma_minus8` in the range of 0 to 2, inclusive.
  - ❖ SPSs shall have `bit_depth_chroma_minus8` in the range of 0 to 2, inclusive.
  - ❖ `CtbLog2SizeY` shall be in the range of 4 to 6, inclusive.
  - ❖ When a PPS has `tiles_enabled_flag` is equal to 1, it shall have `entropy_coding_sync_enabled_flag` equal to 0.
  - ❖ When a PPS has `tiles_enabled_flag` is equal to 1, `ColumnWidthInLumaSamples[ i ]` shall be greater than or equal to 256 for all values of `i` in the range of 0 to `num_tile_columns_minus1`, inclusive, and `RowHeightInLumaSamples[ j ]` shall be greater than or equal to 64 for all values of `j` in the range of 0 to `num_tile_rows_minus1`, inclusive.
- Main Still Profile
  - ❖ SPSs shall have `chroma_format_idc` equal to 1 only.
  - ❖ SPSs shall have `bit_depth_luma_minus8` equal to 0 only.
  - ❖ SPSs shall have `bit_depth_chroma_minus8` equal to 0 only.
  - ❖ SPSs shall have `sps_max_dec_pic_buffering_minus1[ sps_max_sub_layers_minus1 ]` equal to 0 only.
  - ❖ `CtbLog2SizeY` shall be in the range of 4 to 6, inclusive.
  - ❖ When a PPS has `tiles_enabled_flag` is equal to 1, it shall have `entropy_coding_sync_enabled_flag` equal to 0.
  - ❖ When a PPS has `tiles_enabled_flag` is equal to 1, `ColumnWidthInLumaSamples[ i ]` shall be greater than or equal to 256 for all values of `i` in the range of 0 to `num_tile_columns_minus1`, inclusive, and `RowHeightInLumaSamples[ j ]` shall be greater than or equal to 64 for all values of `j` in the range of 0 to `num_tile_rows_minus1`, inclusive.

### Levels Checking

According to levels restrictions defined in Annex A of the H.265/HEVC standard, the following constraints are tested:

- PicSizeInSamplesY shall be less than or equal to MaxLumaPs, where MaxLumaPs is specified in Table A.1.
- The value of pic\_width\_in\_luma\_samples shall be less than or equal to  $\text{Sqrt}(\text{MaxLumaPs} * 8)$ .
- The value of pic\_height\_in\_luma\_samples shall be less than or equal to  $\text{Sqrt}(\text{MaxLumaPs} * 8)$ .
- The value of sps\_max\_dec\_pic\_buffering\_minus1[ HighestTid ] + 1 shall be less than or equal to MaxDpbSize, which is derived as follows:

if( PicSizeInSamplesY <= ( MaxLumaPs >> 2 ) )

MaxDpbSize = Min( 4 \* maxDpbPicBuf, 16 )

else if( PicSizeInSamplesY <= ( MaxLumaPs >> 1 ) )

MaxDpbSize = Min( 2 \* maxDpbPicBuf, 16 ) (A-2)

else if( PicSizeInSamplesY <= ( ( 3 \* MaxLumaPs ) >> 2 ) )

MaxDpbSize = Min( ( 4 \* maxDpbPicBuf ) / 3, 16 )

else

MaxDpbSize = maxDpbPicBuf

where MaxLumaPs is specified in Table A.1 and maxDpbPicBuf is equal to 6.

- For level 5 and higher levels, the value of CtbSizeY shall be equal to 32 or 64.
- The value of NumPocTotalCurr shall be less than or equal to 8.
- The value of num\_tile\_columns\_minus1 shall be less than MaxTileCols and num\_tile\_rows\_minus1 shall be less than MaxTileRows, where MaxTileCols and MaxTileRows are specified in Table A.1.

### **Syntax Element Conformance**

Syntax element conformance is performed during the parsing of the H.265/HEVC video stream. Errors are logged in the [Report](#) view and saved to the report file. The [Syntax](#) view provides a clear access to NAL Units syntax, with errors highlighted in red.

Depending on the syntax element, one of the following processing operations is performed:

- No conformance done (most flags),
- Compare syntax value to a single value,
- Is syntax value inside a range,
- Is syntax value part of N possible values,
- Value depends on other values.



## VC-1 Conformance

### General Conformance

General conformance is performed during the parsing of the VC-1 video stream. Errors are logged in the [Report](#) view and saved in the report file, but may not be displayed in the syntax tree.

Categories of errors are listed in [Table 3-9](#):

*Table 3-9. VC-1 conformance error categories*

Error category	Errors pertaining to the category
Internal Error	PARSER CONTEXT IS NULL ADVANCED PROFILE NOT MANAGED FOR RCV FILES
Stream Error	START CODE ERROR RCV STREAM DOES NOT START WITH SEQUENCE HEADER ENCAPSULATION ERROR ENCOUNTERED RCV STREAM CAN NOT END WITH SEQUENCE HEADER RCV STREAM CAN NOT END WITH ENTRY POINT HEADER NON-ZERO IN PADDING BYTES OR MISS ENCAPSULATION IN DATA INCOMPLETE FRAME DATA FORBIDDEN START CODE INVALID BDU ORDER RCV FRAME SIZE INDICATES POSITION BEYOND END OF STREAM BDU IS AT WRONG POSITION THERE ARE SUPERFLUOUS BYTES IN STREAM NO DATA FOLLOWS START CODE ONLY ONE BYTE FOLLOWS START CODE RESERVED START CODE LAST BYTE OF USER DATA SHOULD BE 0x80

Table 3-9. VC-1 conformance error categories

Error category	Errors pertaining to the category
Sequence Error	ADVANCED PROFILE SEQUENCE IS MISSING PTYPE UNDEFINED ADVANCED PROFILE REQUIRED SEQUENCE LAYER IS MISSING PROFILE UNDEFINED SIMPLE OR MAIN PROFILE REQUIRED SPMP SEQUENCE IS MISSING INCOMPLETE SEQUENCE HEADER FIRST FRAME OF SPMP MUST BE I FRAME NO B FRAMES IF MAXBFRAMES NULL MBF EXCEED BOUND OF SIMPLE PROFILE MBS EXCEED BOUND OF SIMPLE PROFILE MBF EXCEED BOUND OF MAIN PROFILE MBS EXCEED BOUND OF MAIN PROFILE MBF EXCEED BOUND OF ADVANCED PROFILE MBS EXCEED BOUND OF ADVANCED PROFILE RMAX EXCEED BOUND OF ADVANCED PROFILE BMAX EXCEED BOUND OF ADVANCED PROFILE RATES SHALL BE ORDERED FROM SMALLEST TO LARGEST BUFFER SIZE SHALL BE ORDERED FROM SMALLEST TO LARGEST THIS BDU SHOULD NOT FOLLOW SEQUENCE HEADER THIS BDU SHOULD NOT FOLLOW END OF SEQUENCE THIS BDU SHOULD NOT FOLLOW ENTRY POINT
Entry Point Error	ENTRY POINT IS MISSING RELATED SEQUENCE HEADER IS MISSING RELATED SEQUENCE HEADER IS INVALID ENTRY POINT SHALL BE PRESENT ONLY IN AP IMMEDIATE DUPLICATE OF ENTRY POINT FIRST FRAME OF ENTRY POINT IS NOT VALID ADJACENT ENTRY POINTS ERROR CLOSED ENTRY SHALL BE 0 IF PI FRAME

Table 3-9. VC-1 conformance error categories

Error category	Errors pertaining to the category
Picture Error	FIELD PRESENCE REQUIRES INTERLACE FIELD INTERLACE MUST PRECEDE FCM UNDEFINED NO SKIPPED FRAME IF MAXBFRAMES CODING TYPE DIFFERENCE BETWEEN B FRAME AND ITS BACKWARD REFERENCE FRAME MVRANGE OF B FRAME SHOULD NOT BE LESS THAN OF SUBSEQUENT ANCHOR P PICTURE RESPIC IN P FRAMES SHOULD BE THE SAME TO THE CLOSEST I FRAME TFF P FIELD REFERENCE FRAME ERROR TFF B FIELD FORWARD REFERENCE FRAME ERROR B ANCHOR FRAMES SHALL HAVE SAME RESPIC
Frame Error	INVALID ADVANCED PROFILE SEQUENCE INVALID ENTRY POINT INVALID SPMP SEQUENCE FIELD START CODE SHALL APPEAR IN INTERLACE FIELD FRAME PS PRESENT SHALL BE 1 FRAME HEIGHT SHALL BE MULTIPLE OF 4 IN INTERLACED FRAME
Frame Layer Error	INVALID RCV FRAMESIZE KEY EQUAL TO 1 FRAME SHOULD BE INTRA KEY EQUAL TO 0 FRAME SHOULD NOT BE INTRA
User data error	INVALID SLICE USER DATA INVALID FIELD USER DATA INVALID FRAME USER DATA INVALID ENTRY POINT USER DATA INVALID SEQUENCE USER DATA

#### Syntax Element Conformance

Syntax element conformance is performed during the parsing of VC-1 video stream. Errors are logged in the [Report](#) view and saved to the report file. The [Syntax](#) view provides a clear access to BDU syntax, with errors highlighted in red.

Depending on the syntax element, one of the following processing operations is performed:

- No conformance done (most flags)
- Compare syntax value to a single value
- Is syntax value inside a range
- Is syntax value part of N possible values
- Value depends on other values

## MPEG-2 Video Conformance

MPEG-2 Video streams go through multiple conformance tests. These tests can be classified in three groups:

- General conformance deals mainly with stream structure, verifying that Data Units are present and in the right order in the bitstream.
- Profile/level conformance checks that parameters affected by the use of a profile or level respect the constraints given in the standard.
- Syntax conformance examines syntax elements that are constrained by the standard and checks that their values are correct.

### General Conformance

**Table 3-10** summarizes the conformance tests performed by the analyzer.

*Table 3-10. Stream structure*

Syntax structure	13818-2 section(s)	Description
sequence header	6.1.1.6	In repeat sequence headers all of the data elements with the permitted exception of those defining the quantization matrices (load_intra_quantiser_matrix, load_non_intra_quantiser_matrix and optionally intra_quantiser_matrix and non_intra_quantiser_matrix) shall have the same values as in the first sequence header.
sequence extension	6.3.1	If the first sequence_header() of a sequence is followed by a sequence_extension() then all subsequent occurrences of sequence_header() shall also be immediately followed by a sequence_extension().
	6.3.1	sequence_extension() shall only occur immediately following a sequence_header().
	6.3.1	sequence_extension() shall not immediately precede a sequence_end_code.

Table 3-10. Stream structure

<b>Syntax structure</b>	<b>13818-2 section(s)</b>	<b>Description</b>
	6.1.1.6	Sequence header shall be followed by a sequence extension to conform to 13818-2.
	6.1.1.6	All of the data elements in the sequence_extension() that follows a repeat sequence_header() shall have the same values as in the first sequence_extension().
sequence display extension	6.1.1.6	If a sequence_display_extension() occurs after the first sequence_header() all subsequent sequence headers shall be followed by sequence_display_extension() in which all data elements are the same as in the first sequence_display_extension(). Conversely if no sequence_display_extension() occurs between the first sequence_header() and the first picture_header() then sequence_display_extension() shall not occur in the bitstream.
sequence scalable extension	6.1.1.6	If a sequence_scalable_extension() occurs after the first sequence_header() all subsequent sequence headers shall be followed by sequence_scalable_extension() in which all data elements are the same as in the first sequence_scalable_extension(). Conversely if no sequence_scalable_extension() occurs between the first sequence_header() and the first picture_header() then sequence_scalable_extension() shall not occur in the bitstream.
group of pictures header	of 6.1.1.7 / 6.3.1	The first coded frame following a group of pictures header shall be a coded I-frame.
	6.1.1	If both a repeat sequence header and a group of pictures header immediately precede a particular picture, the group of pictures header shall follow the repeat sequence header.
picture header	6.1.1.6 / 6.1.1.11	In the coded bitstream, a repeat sequence header may precede either an I-picture or a P-picture but not a B-picture.
picture header picture coding extension	6.1.1.4.1 /	The first and second field of a frame coded as two fields pictures shall have the same picture_coding_type, except when the first coded field is an I-picture.

Table 3-10. Stream structure

Syntax structure	13818-2 section(s)	Description
	6.1.1.4.1	When the first field of a frame coded as two field pictures is an I picture, the second field may be either an I-picture or a P-picture
	6.1.1.6	In the case that an interlaced frame is coded as two separate field pictures a repeat sequence header shall not precede the second of these two field pictures.
picture coding extension	6.3.1	If sequence_extension() occurs in the bitstream then each picture_header() shall be followed immediately by a picture_coding_extension().
	6.3.1	picture_coding_extension() shall only occur immediately following a picture_header().
	6.3.10	The first encoded field of a frame may be a top-field or a bottom field, and the next field must be of opposite parity.
	6.3.12	A picture_display_extension() shall not occur unless a sequence_display_extension() followed the previous sequence_header().

#### Profile/Level Conformance

According to the profiles restrictions defined in section 8 of the 13818-2 standard, the following constraints are tested:

- Syntactic constraints (table 8-5)
- Value of chroma\_format
- Value of picture\_coding\_type
- Maximum number of bits for a macroblock (table 8-6)
- Maximum sampling density (table 8-11)
- Maximum luma sample rate (table 8-12)
- Maximum bit rate (table 8-13)
- Maximum VBV buffer size (table 8-14)

**Syntax Conformance**

**Table 3-11** summarizes the conformance tests performed by the analyzer.

*Table 3-11. MPEG-2 video syntax conformance*

<b>Syntax structure</b>	<b>Syntax element</b>	<b>Description</b>	<b>Depends on</b>
sequence header	horizontal_size	shall not be 0.	
	vertical_size	shall not be 0.	
	aspect_ratio_information	The value '0000' is forbidden.	
	frame_rate_code	The value '0000' is forbidden.	
	bit_rate	The value 0 is forbidden.	
	constrained_parameters_flag	Shall have the value '0'.	
user data	user_data	In the series of consecutive user_data bytes there shall not be a string of 23 or more consecutive zero bits.	
sequence extension	frame_rate_extension_n	Shall be zero when an entry exists for the frame rate in table 6-4.	frame_rate_code
	frame_rate_extension_d	Shall be zero when an entry exists for the frame rate in table 6-4.	frame_rate_code
	progressive_sequence	When set to '1' the coded video sequence contains only progressive frame-pictures.	picture_structure, progressive_frame
sequence display extension	colour primaries	The value 0 is forbidden.	
	transfer_characteristics	The value 0 is forbidden.	
	matrix_coefficients	The value 0 is forbidden.	
sequence scalable extension	horizontal_subsampling_factor_m	The value 0 is forbidden.	

Table 3-11. MPEG-2 video syntax conformance

Syntax structure	Syntax element	Description	Depends on
	horizontal_subsampling_factor_n	The value 0 is forbidden.	
	vertical_subsampling_factor_m	The value 0 is forbidden.	
	vertical_subsampling_factor_n	The value 0 is forbidden.	
picture header	temporal_reference	When a frame is coded as two field pictures, the temporal_reference associated with each coded picture shall be the same.	picture_structure
	picture_coding_type	The value 000 is forbidden.	
	vbv_delay	If any vbv_delay field in a sequence is coded with hexadecimal FFFF then all of them shall be coded with this value.	
	full_pel_forward_vector	Shall have the value 0.	
	forward_f_code	Shall have the value 111.	
	full_pel_backward_vector	Shall have the value 0.	
	backward_f_code	Shall have the value 111.	
picture coding extension	f_code[s][t]	The value 0 is forbidden. In I pictures with concealment_motion_vectors at 0, f_code[s][t] shall take the value '1111'. In I and P-pictures, f_code[1][t] is not used and shall take the value '1111'	picture_coding_type
	picture_structure	Shall be set to '11' if progressive_frame is set to 1.	progressive_frame
	top_field_first	Shall have the value '0' in a field picture. Shall be set to '0' if repeat_first_field is set to 0.	picture_structure, repeat_first_field



Table 3-11. MPEG-2 video syntax conformance

Syntax structure	Syntax element	Description	Depends on
	frame_pred_frame_dct	In a field picture it shall be '0'. frame_pred_frame_dct shall be '1' if progressive_frame is '1'.	picture_structure, progressive_frame
	repeat_first_field	Shall be 0 if progressive_sequence is equal to 0 and progressive_frame is equal to 0.	progressive_sequence, progressive_frame
	chroma_420_type	Shall be the same as progressive_frame if chroma_format is "4:2:0". Else shall be 0.	progressive_sequence, progressive_frame
quant matrix extension	intra_quantiser_matrix	The value 0 is forbidden. The first value shall always be 8.	
	non_intra_quantiser_matrix	The value 0 is forbidden.	
	load_chroma_intra_quantiser_matrix	If chroma_format is "4:2:0" this flag shall take the value '0'.	chroma_format
	chroma_intra_quantiser_matrix	The value 0 is forbidden. The first value shall always be 8.	
	load_chroma_non_intra_quantiser_matrix	If chroma_format is "4:2:0" this flag shall take the value '0'.	chroma_format
	chroma_non_intra_quantiser_matrix	The value 0 is forbidden.	
copyright extension	copyright_identifier	Shall be 0 when copyright_flag is set to '0'.	copyright_flag
	copyright_number	Shall be zero when copyright_identifier is equal to '0' or when copyright_flag is set to '0'.	copyright_identifier, copyright_flag
slice	priority_breakpoint	Shall take the value zero in partition 1.	
	quantiser_scale_code	The value 0 is forbidden.	
	reserved_bits	Shall have the value 0.	

Table 3-11. MPEG-2 video syntax conformance

Syntax structure	Syntax element	Description	Depends on
	extra_bit_slice	Shall be set to 0.	

### Closed Captions Conformance

When a video is selected for analysis, CC is parsed and conformance analysis is performed. Results of this analysis are available in the report view, like any other analysis.

#### CEA-608 Conformance Analyses

- Parity bit error checking.
- Each two-byte control code whose first character is in the range of 10h to 1Fh should be transmitted twice in successive frames.
- Control codes (non-printing characters) with values 01h to 0Fh have no valid purpose on line 21, field 1.
- The cursor can never move beyond the 32nd column. This limitation should also hold true for Tab Offset commands.
- CC: The captioning service provider is expected to precede each Background Attribute Code with a standard space.
- CC: The captioning service provider shall precede each Foreground Attribute Code with a standard space.
- CC: When selecting black as the foreground color, the caption service provider shall select a background color other than black.
- CC: Standard characters shall precede corresponding extended characters. For example, to include a lower-case "u" with umlaut/diaeresis in the captioning, the caption provider shall send a standard "u" followed by the Extended Character "ü".
- CC: Proper order of data recommendation:
  - ❖ Roll-up style, precede each new row of text with these three codes:
    - RU2 or RU3 or RU4 (to set roll-up style and depth)
    - CR (to roll the display up one row)
    - PAC (to set the indent and base row)
    - EDM (optionally, may be sent at any moment)
  - ❖ Paint-on style, each continuous transmission should be coded as follows:
    - RDC (to select paint-on style)
    - PAC (to set row, indent, attributes)

- text (characters to be painted onto this row)
- PAC (to relocate the cursor and/or set attributes)
- Text or DER
- If there is to be a pause in the data transmission, each new burst of data should be preceded by RDC
- EDM (optionally, may be sent at any moment)
- ❖ Pop-on style, each discrete caption should be coded as follows:
  - RCL (to select pop-on style)
  - ENM (optionally, to clear the memory for new data)
  - PAC (to set row, indent, attributes)
  - Text (characters to be displayed on this row)
  - PAC (to set position, attributes for next element)
  - Text, etc.
  - EDM (optionally, to erase the currently displayed caption, if any)
  - EOC (to display the caption just received)
- Text: in text mode, characters outside the range 20h to 7Eh shall not be used for purposes of Section 7, and shall be discarded.
- Text: each row of text contains a maximum of 32 characters.
- XDS: the Start and Continue control characters shall always be followed by the Type character. The type character identifies the unique packet. This character is always in the range of 01h to 7Fh
- XDS: each complete packet shall have no more than 32 Informational characters.
- XDS: when resuming a packet, the Type code used with the Continue code shall be identical to the Type code used with the Start code.
- XDS: check range for second, minute, hour, day, date, month is correct.

#### **CEA-CEB-10A Conformance Analyses**

For ease of inserting and retrieving the NTSC closed captions, NTSC Line 21, Field 1 and Field 2 captions must always be placed in the User Data stream before any DTVCC caption data.

#### **CEA-708 Conformance Analysis**

To allow for simple extraction and insertion of these packets without the need to fully parse their contents, the first byte-pair of each DTVCC Caption Channel Packet shall be marked using the `cc_type = 11` syntax flag (i.e., DTVCC Caption Channel Packet Start). The remaining byte-pairs

of the DTVCC packet shall be marked with the `cc_type = 10` flag (i.e., DTVCC Caption Channel Packet Data).

For video sequences with `progressive_sequence == 0` for pictures with `top_field_first == 0`, `cc_type 00` shall precede `cc_type 01`.

For video sequences with `progressive_sequence == 0` for pictures with `top_field_first == 1`, `cc_type 01` shall precede `cc_type 00`.

For `picture_structure` of Top Field, `cc_type 00` shall not be present.

For `picture_structure` of Bottom Field, `cc_type 01` shall not be present.

Following values shall be respected:

Table 3-12. CEA-708 conformance analysis values

frame_rate_value	picture_structure	progressive_frame	repeat_first_field	top_field_first	cc_count	NTSC_cc_data_bytes	DTV_cc_data_bytes
60 or 59.94	11	1	0	0	10	2	18
60 or 59.94	11	1	1	0	20	4	36
60 or 59.94	11	1	1	1	30	6	54
30 or 29.97	01 or 10	0	0	0	10	2	18
30 or 29.97	11	x	0	x	20	4	36
30 or 29.97 (note)	11	1	1	x	30	6	54
24 or 23.97	11	1	0 (required)	0 (required)	25	4 or 6	44 or 46

(x = may be 0 or 1)

Note: for frequencies with `frame_rate_value = 30` or `29.97`, `progressive_frame == 1` and `repeat_first_field == 1` implies progressive frequency == 0.

## DVB Subtitles and Teletext Conformance

### DVB Subtitles Conformance

Table 3-13. DVB subtitles conformance

Error	Description
PtsError	Each PES header shall carry a PTS, associated with all the subtitle data contained within this PES packet.
	All of the segments of a single display set shall be carried in one (or more) PES packets that have the same PTS value.
	The PTSs of subsequent displays shall differ by more than one video frame.
	DVB Subtitles and video PTS are not in the same range.
PesError	In the PES data field, data_identifier must be set to 0x20.
	In the PES data field, subtitle_stream_id must be set to 0x00.
PageIdError	The page id value of a segment containing data for a subtitle service shall be equal either to the value of the composition_page_id or to the ancillary_page_id provided in the subtitle descriptor.
	All segments signaled by the composition page id value shall be delivered before any segment signaled by the ancillary page id value.
	The page_id of each page_composition_segment shall be equal to the composition_page_id value provided by the subtitling descriptor.
EpochError	All the regions to be used in an epoch shall be introduced by the Region Composition Segments (RCSs) in the display set that accompanies the PCS with page state of 'mode change' (i.e. the first display set of the epoch).
	All of the CLUT entries to be used during the epoch shall be introduced in this first display set. Subsequent segments can modify the values held in the pixel buffer and composition buffer but may not alter the quantity of memory required.
DisplayDefinitionSegmentError	A single subtitle stream shall not convey both a subtitle service that includes a display_definition_segment and one that does not; in this case the subtitle services must be carried in separate streams and on separate PIDs.
PageCompositionSegmentError	Page compositions are not shared by multiple subtitle services; consequently, the page id of each page composition segment shall be equal to the composition_page_id value.
	The ancillary page id value shall not signal page composition segments.

Table 3-13. DVB subtitles conformance

Error	Description
RegionCompositionSegmentError	<p>The ancillary page id value shall not signal region composition segments.</p> <hr/> <p>The vertical position of the regions shall be defined so that regions do not share any horizontal scan lines on the screen. A region therefore monopolizes any part of the scan lines that it occupies; two regions cannot be presented horizontally next to each other.</p> <hr/> <p>A complete set of Region Composition Segments (RCS) shall be present in the display set that follows a PCS with page state of 'mode change' or 'acquisition point' as this is the process that introduces regions and allocates memory for them.</p> <hr/> <p>Once introduced the memory 'foot print' of a region shall remain fixed for the remainder of the epoch. Therefore the following attributes of the region shall not change within an epoch: width; height; depth; region_level_of_compatibility; CLUT_id.</p> <hr/> <p>The value of the region_n-bit_pixel_code shall not change in RCS where the region_fill_flag is not set.</p> <hr/> <p>Regions shall be listed in the page_composition_segment in the order of ascending region_vertical_address field values.</p> <hr/> <p>The region composition contains a list of objects; the listed objects shall be positioned in such a way that they do not overlap.</p> <hr/> <p>The pixel buffer shall never overflow and is defined by (region_width x region_height x region_depth). Maximum is 80 kbytes (320 kbytes for decoders capable of dealing with streams that include a display definition segment).</p> <hr/> <p>region_width shall be in range [1 to 720] if no DDS.</p> <hr/> <p>region_width shall be in range [1 to (display_width +1)] if DDS.</p> <hr/> <p>The sum of region_width and region_horizontal_address shall not exceed 720.</p> <hr/> <p>region_height shall be in range [1 to 576] if no DDS.</p> <hr/> <p>region_height shall be in range [1 to (display_height +1)] if DDS.</p> <hr/> <p>The sum of region_height and region_vertical_address shall not exceed 576.</p> <hr/> <p>object_horizontal_position shall be in the range between 0 and region_width - 1.</p>

Table 3-13. DVB subtitles conformance

Error	Description
RegionCompositionSegmentError (continued)	object_vertical_position shall be in the range between 0 and region_height - 1.
ClutDefinitionSegmentError	Only one N-bit/entry_CLUT_flag shall be set to 1 per CLUT_entry_id and its associated Y-, Cr-, Cb- and T-values.
	Stuff bits shall be set to 0.
ObjectDataSegmentError	Top Field length error: pixel count different from field resolution.
	Bottom Field length error: pixel count different from field resolution.
EndOfDisplaySetSegmentError	The last segment of a display set shall be followed by an 'end_of-display-set segment', which signals that no more subtitling data associated to a certain PTS is needed for that service before decoding can start.
	The end_of_display_set_segment shall be inserted into the stream immediately after the last object_data_segment for each display set.

**Teletext Conformance**

Table 3-14. EBU teletext conformance

<b>Error</b>	<b>Description</b>
PES packet: PTS presence in VBI	A VBI PES packet shall always carry a PTS.
PES packet: data_unit_id consistency	The PES packet signalization ("data_unit_id") is not consistent with the descriptor found in the PMT.
packet 27 and 28 order	The transmission of a page header packet shall be followed by the transmission of any packets with Y = 27 and Y = 28, in that order.
packet 26 order	In the case of pages intended for direct display, packets with Y = 26 shall be transmitted before any packets with Y = 1 to Y = 25.
packet 26 designation code order	Packets with Y = 26 shall be transmitted in ascending order of designation code.
serial transmission	Any packets in the range X/1 to X/28 transmitted between two successive page headers shall have the same magazine address as the first page header.
control bit C6 consistency	<p>The teletext_type field (descriptor) indicates subtitle but Control Bit C6 ("Subtitle") is not set in the page header. The page will be ignored.</p> <p>The data_unit_id field (PES packet) indicates subtitle but Control Bit C6 ("Subtitle") is not set in the page header. The page will be ignored.</p> <p>The data_unit_id field (PES packet) does not indicates subtitle but Control Bit C6 ("Subtitle") is set in the page header. The page will be ignored.</p>
control bit C11 shall not change	The setting of Control Bit C11 ("Magazine Serial") shall be the same for all page headers in the service.
Double Width position	Double Width must not be inserted in either of the last two columns positions of any display row, nor immediately preceding the edge of a boxed area.
Double Size position	Double Size must not be inserted in either of the last two columns positions of any display row, nor immediately preceding the edge of a boxed area.
Repetition of Start Box attribute	Protection against false operation is provided by double transmission of Start Box control characters, with the action taking place between them.



**SCTE-35 Conformance**

Table 3-15. SCTE-35 conformance

<b>Error</b>	<b>Severity</b>	<b>Message</b>	<b>Description</b>
In Point too early	error	In Point time is located before the break starts	The time of the In Splice Event is smaller than the time of the corresponding Out Splice Event.
In Point too late	error	In Point time is located after the break ends	The time of the In Splice Event is greater than the time computed from the duration field of the corresponding Out Splice Event.
Cancel too early	warning	Cancel command on unknown event ID	A cancel command has been issued with a splice_event_id that is yet unknown.
Cancel too late	error	Cancel command received after the specified splice time	A cancel command received after the break has started (or ended) is ignored.
Bad PTS adjustment	warning	PTS adjustment should be the same for all messages	The value of the PTS_adjustment field is not the same in all SCTE 35 messages.
Unknown duration	warning	Avail has no indicated duration and no In point, cannot compute end time	No duration is specified in the Out Event messages, no In point is found and the setting "default duration" is disabled. The analyzer cannot compute a duration for this avail.
Bad splice time	error	Command is received after the indicated splice time	The PTS indicated in the splice_time field is smaller than the arrival time of the command. The command cannot be executed on time.

## Dynamic Buffer Analysis View (H.264/AVC and H.265/HEVC)

The Dynamic Buffer Analyzer performs video buffer analyses on H.264/AVC or H.265/HEVC Raw Byte streams and H.264/AVC or H.265/HEVC streams carried over MPEG-2 TS. These analyses use the buffer models described in the corresponding standards to simulate the decoding and presentation of a bitstream through a decoder and display device.

The Dynamic Buffer Analyzer can be used to test the conformance of a bitstream. The associated view helps in understanding the buffer analysis process and locating error causes.

This section explains how to operate the Dynamic Buffer Analyzer and how to interpret curves and error messages when analyzing an H.264/AVC or H.265/HEVC stream. It is **strongly recommended** to be familiar with the concepts of *buffer analysis*, *Hypothetical Reference Decoder* (HRD) and *System Target Decoder* (T-STD). These concepts are described in the Standards Overview document.

### Using the Dynamic Buffer Analyzer View on an MPEG-2 TS File

The operation of the T-STD focuses rather on transport and multiplexing-related issues and does not perform the same video-level analyses as the Hypothetical Reference Decoder (HRD) defined in the H.264/AVC or H.265/HEVC standard. It is recommended to test a bitstream in its Raw Byte form as well to ensure full conformance to the H.264/AVC or H.265/HEVC standard.

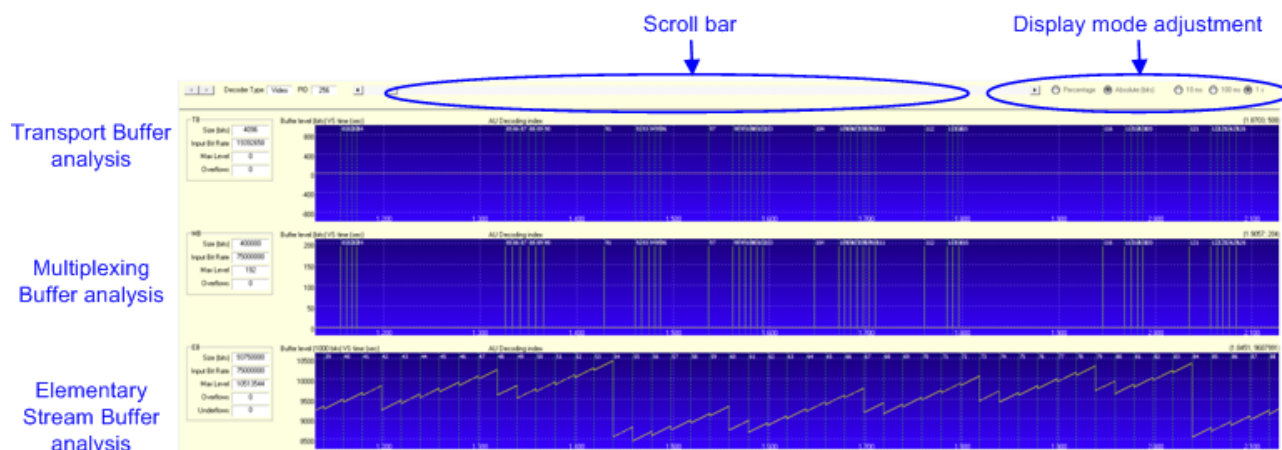
#### Overview

To perform dynamic buffer analysis, open a Transport Stream file, select an Elementary Stream (if there are several H.264/AVC or H.265/HEVC ES in the TS) and click the [Buffer Analysis](#) tab to start the analysis.

The results are automatically displayed in the [Report](#) and [Buffer Analysis](#) views when the analysis is over.

The [Buffer](#) view for an H.264/AVC or H.265/HEVC stream carried over an MPEG-2 TS is shown in [Figure 3-62](#).

Figure 3-62. Buffer Analysis view of an H.264/AVC or H.265/HEVC over MPEG-2 TS file.



- **Scroll Bar:** scrolls all three graphs simultaneously to reach the previous and next time windows.
- **Display mode adjustment:**
  - ❖ **Percentage/absolute:** switches all three graphs from percentage display (the graphs show percentage of buffer occupancy VS time) to absolute display (the graphs show the number of bits VS time).
  - ❖ **10 ms/100 ms/1 s:** zoom buttons that modify the time window to display 10 ms, 100 ms or 1 s of the curves.
- **TB:** shows the main figures about the Transport Buffer (TB).
- **MB:** shows the main figures about the Multiplexing Buffer (MB).
- **EB:** shows the main figures about the Elementary Stream Buffer (EB).
- **Graphs:** show the buffer's level throughout the analysis period. If the Y scale is not adapted, in particular if the buffer's level on the graph is very low, right-click the graph to switch the Y axis to auto-scale. In this mode, the scale will be adjusted automatically so that the curve fills the graph completely. For curve interpretation, see section '[Graph Interpretation](#)' on page 164.

### Limitations

The Dynamic Buffer Analysis makes the following assumptions in the case of an MPEG-2 TS:

- The analysis is performed using the leak method, the HRD management is not used even if the appropriate descriptor is present with the HRD management flag set to "1",
- The DPB present in the T-STD model is not represented. However, PTS and decoding order consistency are tested.

### Graph Interpretation

The Dynamic Buffer Analysis view is made up of three graphs, representing the occupancy in bits of three buffers amongst the buffers that compose the HRD model (TB, MB and EB), as against the elapsed time in seconds. The graphs can be scrolled using the scroll bar located at the top of the view. When this bar is scrolled, all three graphs scroll so that the TB, MB and EB curves always correspond to the same time window.

The analysis starts after a PAT, PMT and SPS have been found in that order. The origin of all graphs is the same and equals the time of arrival in the TB of the first packet of the first analyzed Access Unit. This time is reported in the message announcing the start of the buffer analysis. All timings used in the graphs are relative to this time.

In addition to the buffer occupancy, the graphs also display useful information:

- The **red** dotted line on each graph marks the total size of the buffer. If the buffer level exceeds this threshold, the curve turns red, which means this buffer is undergoing an overflow.
- **Green** dotted lines are picture input or output times. On the TB and MB graphs, they represent the arrival time of PES packets, which generally correspond to Access Units. On the EB graph, they mark the time at which a picture is removed from EB and decoded.
- **Integers** near the green dotted lines refer to the decoding order of the Access Unit (of the first AU in the PES packet for TB and MB graphs).

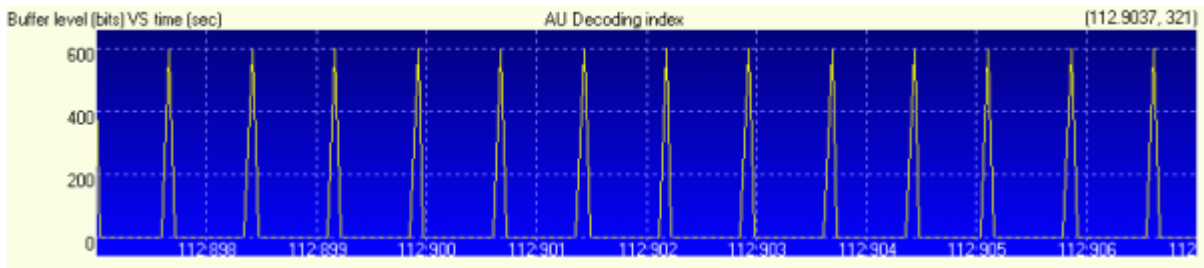


The Zoom feature is particularly helpful when analyzing an MPEG-2 TS. As this analysis is performed on a TS packet level, some variations in the curves are too small to be distinguished with a large-scale setting.

### Transport Buffer

The Transport Buffer (TB) represents the first level of an Integrated Receiver Decoder (IRD). All TS packets, including duplicate packets, enter the TB at the transport rate. Bytes that are part of the PES packet or its contents are delivered to the MB at the MB input rate; other bytes are discarded. If the output rate of the TB (equal to the input rate of the MB) is greater than or equal to its input rate, the level remains always 0. When the input rate is greater, the curve shows TS packets entering and exiting the TB as shown in [Figure 3-63](#).

Figure 3-63. TB graph example



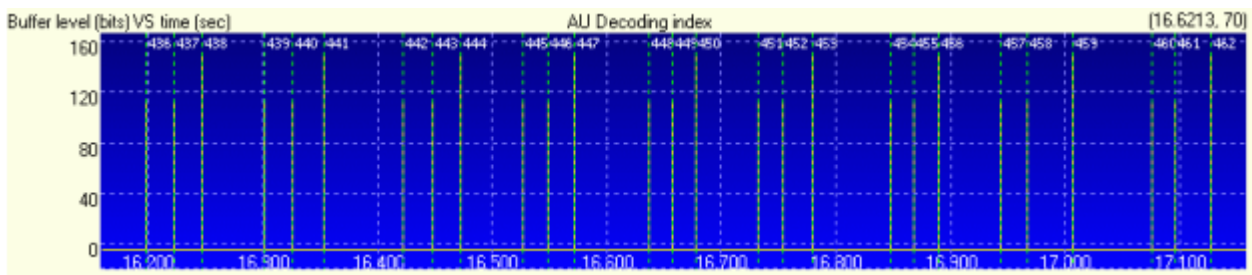
The size of the TB is fixed at 512 bytes. As this is very small, this buffer may be prone to overflow if the TS rate is not adapted.

### Multiplexing Buffer

The leak method operates as follows: if there is PES payload data in the MB and the EB is not full, this payload is transferred from the MB to the EB at a rate equal to the EB's input rate. If the EB is full, data are not removed from the MB. PES headers are discarded when the first byte of the payload following the corresponding header is delivered to the EB.

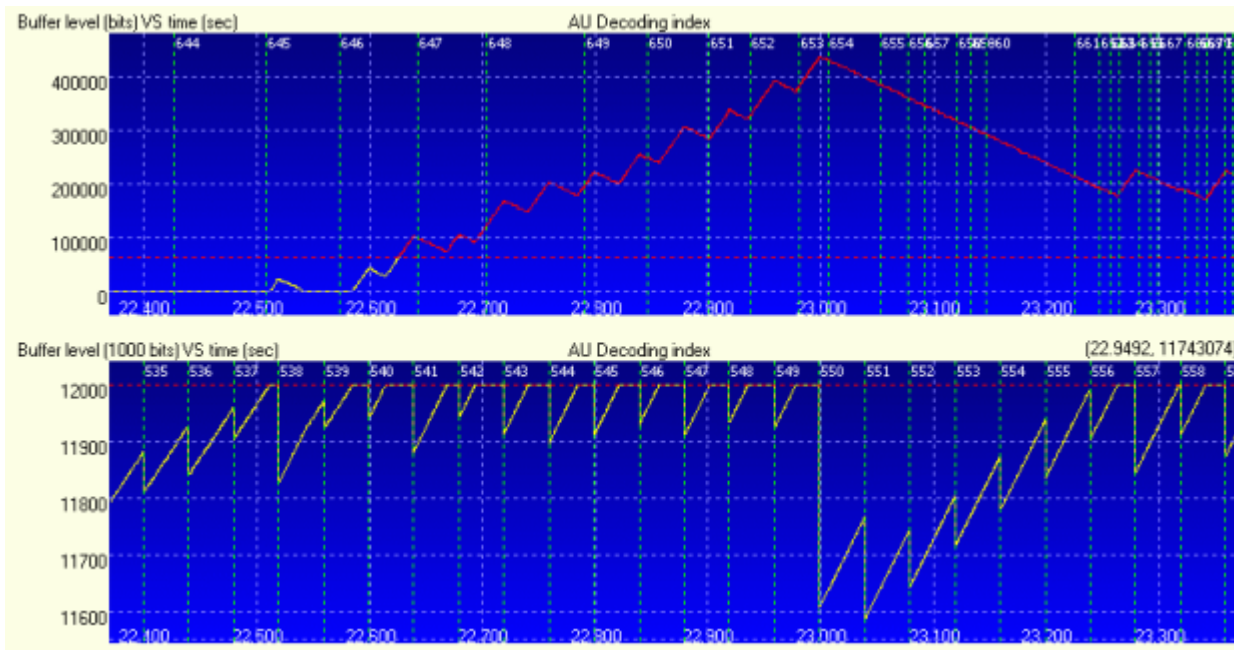
Due to this latest rule and to the fact that the MB's output rate is always equal to or greater than its input rate, the MB's curve has a distinctive shape: it remains at 0 except for PES headers that enter the buffer at the input rate and are discarded soon after.

Figure 3-64. MB graph example



The MB's behavior when the EB is full: PES bytes are no longer transferred to the EB and are stored in the MB until a picture is decoded, hence freeing room in the EB. When this happens, the MB keeps delivering PES payload bytes to the EB until the MB is empty or until the EB becomes full again.

Figure 3-65. Illustration of the leak method on MB (top) and EB (bottom)



### Elementary Stream Buffer

The EB's role is similar to the role of the Coded Picture Buffer (CPB) in the HRD.

The EB is designed to store coded pictures before they are decoded. Its purpose is to ensure that the decoder never runs out of material, i.e. an Access Unit must be complete in EB at the time it is to be decoded. As it represents an amount of memory in a real system, it must also be set at the lowest possible capacity. Because pictures have variable sizes, the EB must store pictures for some time before the decoder starts removing them for decoding.

In the leak method, Access Unit bytes enter the EB as soon as they are available in the MB. An AU is removed from the EB at the time indicated by the Decoding Time Stamp (DTS).

### Understanding DBA Messages

There are four categories of messages related to the DBA:

- Information messages inform you on the sequence of DBA events. These events are mainly analysis start & end.
- Missing parameter messages warn you about the absence of a parameter, which may cause the analysis to generate erroneous results.
- Incorrect parameter messages inform you on bitstream conformance errors.

- Buffer error messages report buffer overflow as well as underflow appearance and disappearance.



DBA error messages shall be considered in their order of appearance, since an error often triggers multiple different errors.

### Information Messages

Information messages give the following information:

- **Analysis start:** method used (always leak method), starting time (representing the arrival time of the first analyzed TS packet), index of first analyzed AU, frame rate, fixed frame rate flag, low delay flag.
- **Analysis end:** number of AUs analyzed.
- **New SPS activated:** index of the first AU concerned, frame rate, fixed frame rate flag, low delay flag.
- **Analysis impossible:** no Random Access Point (IDR picture or Recovery Point) has been found in the stream. The analysis cannot be initiated if the RAP is missing.

### Missing Parameter Messages

The following parameters can be reported as missing:

- **VUI parameters and timing info:** when no AVC timing and HRD descriptor is included in the PMT, a VUI message with timing info should be present in the SPS for every IDR picture and every picture associated with a Recovery Point SEI message.

**Solution:** reform the bitstream with VUI parameters and timing info.

- **Presentation Time Stamp:** this time stamp found in the PES header is a sample of the System Time Clock (STC) and represents the presentation time of the first AU associated with the PES packet. If absent, decoding and presentation time cannot be computed.

**Solution:** reform the bitstream with PTS values in PES headers.

### Incorrect Parameter Messages

Incorrect parameter messages are displayed when a conformance condition is not fulfilled or when a parameter has an incorrect value.

Incorrect parameter messages belong to 2 categories:

- **PTS out of range:** the Presentation Time Stamp is a sample of the System Time Clock (STC), which is sampled at the encoder side and reconstructed at the decoder side using PCR values. This error occurs when the value indicated by the PTS is more or less than 60 seconds later than the arrival time deduced from the STC, or when the DTS is more or less than 10 seconds later than the arrival time. This last value is a normative constraint.



**Solution:** recompute the PTS and, if necessary, DTS values to match the constraints.

- **Incorrect DTS:** Decoding Time Stamps (DTS) are the equivalent of PTS except that they indicate the decoding time of AUs. These values are optional even when the PTS are present. In this case the decoding time is considered to be equal to the presentation time. This error occurs when the decoding time indicated in DTS values or inferred equal to the PTS value does not match the order of arrival of AUs.

**Solution:** include correct DTS values when necessary, i.e. when the decoding time is different from the presentation time.

### Buffer Error Messages

Buffer error messages indicate overflows and underflows in the buffers.

The following situations may occur:

- **TB overflow**

**Solution:** since the TB size is fixed, the solution may be to insert stuffing bytes in the TS to prevent too many TS packets from arriving in a row in the TB.

- **MB overflow**

**Solution:** in leak method, MB should not store bytes except for PES headers, unless the EB is full. The solution may be to prevent the EB from getting full.

- **EB overflow:** in leak method, cannot happen, since any excess bytes will be stored in the MB until there is enough room in the EB.

## Using the Dynamic Buffer Analyzer View on a Raw Byte File

### Overview

To perform dynamic buffer analysis, open a Raw Byte file and click the [Buffer Analysis](#) tab to start the analysis.

The results are automatically displayed in the [Report](#) and [Buffer Analysis](#) views when the analysis is over.

The [Buffer](#) view for an H.264/AVC or H.265/HEVC Raw Byte file is shown in [Figure 3-66](#).



Figure 3-66. Buffer Analysis view of an H.264/AVC or H.265/HEVC Raw Byte file



- **Leaky Bucket selection:** the HRD buffer model operates with several Leaky Buckets, i.e. several sets of parameters {CPB size, CPB bit rate, CBR flag}. Each Leaky Bucket corresponds to different settings, hence different curves. This zone lets you select the Leaky Bucket and displays its index and its type (NAL or VCL).
- **Scroll Bar:** scrolls both graphs simultaneously to reach the previous and next time windows.
- **Display mode adjustment:**
  - ❖ **Percentage/absolute:** switches all three graphs from percentage display (the graphs show percentage of buffer occupancy VS time) to absolute display (the graphs show the number of bits VS time).
  - ❖ **10 ms/100 ms/1 s:** zoom buttons that modify the time window to display 10 ms, 100 ms or 1 s of the curves.
- **CPB:** shows the main figures about the Coded Picture Buffer (CPB). The size of the CPB can be modified directly in the edit box. This does not trigger a new analysis but the threshold is modified accordingly on the CPB graph.
- **DPB:** shows the main figures about the Decoded Picture Buffer (DPB).
- **Graphs:** show the buffer's level throughout the analysis period. If the Y scale is not adapted, in particular if the buffer's level on the graph is very low, right-click the graph to switch the Y axis to auto-scale. In this mode, the scale will be adjusted automatically so that the curve fills the graph completely. For curve interpretation, see section '[Graph Interpretation](#)' on page 170.

### Limitations (H.264/AVC)

The Dynamic Buffer Analysis makes the following assumptions:

- DPB reference frame management is made using "sliding window" process described in section 8.2.5.3 of the H.264/AVC Standard regardless of the value of the `adaptive_ref_pic_marking_mode_flag` parameter found in the slice header. Only `memory_management_control_operation` equal to 5 is considered.
- In DPB reference frame management, gaps in `frame_num` and "non-existing" frames are ignored.

### Graph Interpretation

The [Dynamic Buffer Analysis](#) view is made up of two graphs, representing the occupancy in bits of the two buffers amongst the buffers that compose the HRD model (CPB and DPB), as against the elapsed time in seconds. The graphs can be scrolled using the scroll bar located at the top of the view. When this bar is scrolled, both graphs scroll so that the CPB and DPB curves always correspond to the same time window.

In addition to the buffer occupancy, the graphs also display useful information:

- The **red** dotted line on each graph marks the total the size of the buffer. If the buffer level exceeds this threshold, the curve turns red, which means this buffer is undergoing an overflow.
- **Green** dotted lines are picture output times. On the CPB graph, they mark the time at which a picture is removed from the CPB and decoded. On the DPB graph, they mark the time at which a picture is presented (this does not necessarily mean that this picture is removed from the DPB at that time).
- **Integers** near the green dotted lines refer to the decoding order of the picture. When preceded by a letter (for DPB), they indicate the type and presentation order of presented picture.

### Coded Picture Buffer

The CPB is designed to store coded pictures before these are decoded. Its purpose is to ensure that the decoder never runs out of material, i.e. an Access Unit must be complete in the CPB at the time it is to be decoded. As it represents an amount of memory in a real system, it must also be set at the lowest possible capacity. Since pictures have variable sizes, the CPB must store pictures for some time before the decoder starts removing them for decoding.

An Access Unit starts entering the CPB at its initial arrival time and data bits flow into the CPB until the AU's final arrival time is reached. The duration of the AU input is equal to the number of bits in this AU divided by the input bit rate of the CPB. The AU is removed at its CPB removal

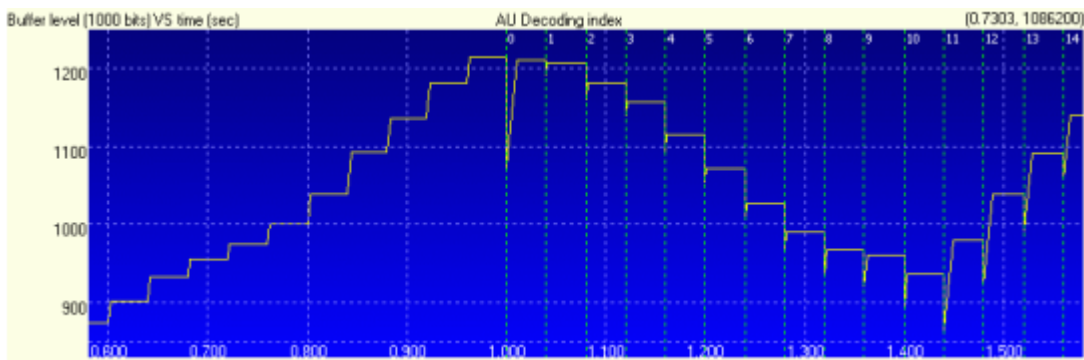
time. The first AU is removed at a time equal to `initial_cpb_removal_delay`.

Other CPB parameters are the bit rate at which data bits enter the buffer and the CBR flag, which indicates (if true) that an AU starts entering the CPB as soon as the previous AU's final arrival time is reached.

The CPB goes through three main phases:

- The buffer starts filling at time = 0 seconds with bits from the first analyzed AU, which is always the first AU associated with a Buffering Period SEI message. The CPB is filled at its peak bit rate, which is displayed in the CPB panel. In the first phase, the CPB keeps filling with data from Access Units until the `initial_cpb_removal_delay` is out.
- The second phase starts at time = `initial_cpb_removal_delay`. At this time, the first AU is removed from the CPB and decoded. From then on, Access Units are removed and decoded periodically as new AU bits keep entering the CPB. This phase ends when the last AU has finished entering the CPB. Next figure shows the transition between the first and the second phase of the CPB curve.
- In the third phase, the AUs are still removed periodically from the CPB but there are no more Access Units on input. Once the last AU is removed, the CPB level should remain at 0 until the end of the analysis.

Figure 3-67. CPB graph example



### Decoded Picture Buffer

The role of the DPB is to store a decoded picture before presentation if any of the following conditions is true:

- Its display time is later than its CPB removal time.
- It is used as a reference for the prediction of future pictures.

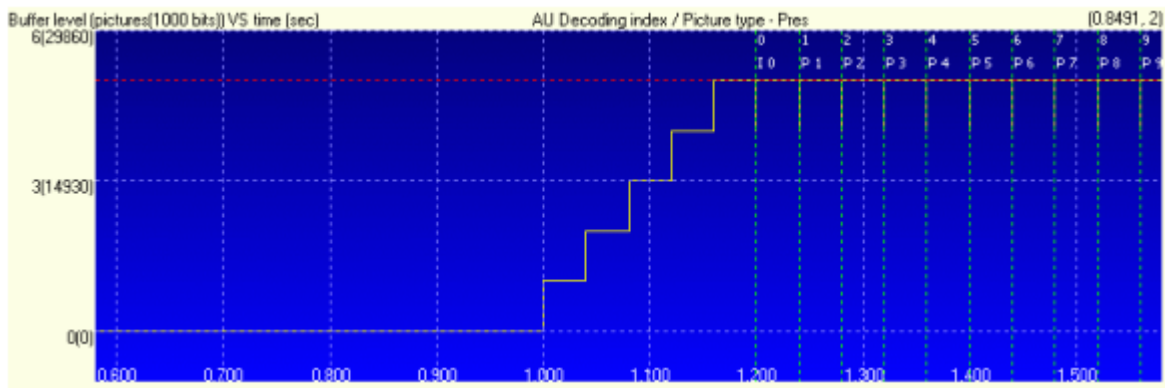
The default behavior of the DPB when a picture is decoded is as follows:

- If the current picture is an IDR picture, all reference pictures in the DPB are marked as "unused for reference".

- If the current picture is a non-IDR reference picture, the "sliding window" process is executed, which means that the picture is stored in the DPB and the picture with the lowest presentation order is output from the DPB if necessary (i.e. if the buffer has reached its maximum capacity of reference pictures).
- Every picture, which is not used as reference and has already been presented, is removed from the DPB.

Figure 3-68 shows the DPB as pictures start being decoded, at the same time window as the CPB on Figure 3-67. Pictures that leave the CPB are decoded and instantly put in the DPB until it is full. After that, a picture is removed every time a new picture is decoded.

Figure 3-68. DPB graph example



### Understanding DBA Messages

For information on the categories and on information messages, please refer to section '[Understanding DBA Messages](#)' on page 166.

### Missing parameter messages

Table 3-17 lists the parameter that can be reported as missing.

Table 3-16. Missing parameter messages

Missing parameter message	Solution
VUI parameters: contained in the SPS, these parameters contain timing information that is useful to perform the analysis. If missing, these parameters are set to default values of frame rate and Leaky bucket parameters.	Reform the bitstream with VUI parameters in the SPS.

Table 3-16. Missing parameter messages

Missing parameter message	Solution
<b>HRD parameters:</b> can belong to NAL or VCL category. Part of the VUI, these parameters contain Leaky Bucket information, i.e. mainly CPB size and bit rate. The main cause of this error is that only one of the two types of parameters (NAL and VCL) is defined. The DBA compensates the absence of HRD parameters by using default values.	Reform the bitstream with HRD parameters.
<b>Buffering Period SEI:</b> this SEI message shall be present for every IDR picture and for every picture associated with a Recovery Point SEI message. If there is no Buffering Period SEI in the stream, the Analyzer will start the analysis at the first IDR picture or Recovery Point, and apply default timing values.	Reform the bitstream with Buffering Period SEI messages for every IDR picture and for every picture associated with a Recovery Point SEI message.
<b>Picture Timing SEI:</b> this SEI message shall be associated with every picture (including pictures that already have an associated Buffering Period SEI message). Otherwise, default timing parameters are computed.	Reform the bitstream with Picture Timing SEI messages for every picture (frame or field).

### Incorrect Parameter Messages

Incorrect parameter messages appear when a conformance condition is not fulfilled. Conformance conditions can be found in Annexes A and C of the H.264/AVC or H.265/HEVC Standard.

Table 3-17 lists the Incorrect parameter messages categories.

Table 3-17. Incorrect parameter message categories

Incorrect parameter messages	Solution
<b>Initial arrival time consistency:</b> refers to equations C-14, C-15 and C-16 of the H.264/AVC Standard or equations C-18, C-19 and C-20 of the H.265/HEVC Standard. This error occurs when an Access Unit (AU) associated with a Buffering Period SEI message has an initial arrival time inferior to the final arrival time of the previous AU. This error usually happens when the input bit rate cannot keep up with the data rate.	Increasing the CPB bit rate (which can be made by modifying the appropriate HRD parameters in the SPS or increasing the bitstream Level) will usually solve the problem. This error can also be a consequence of bad timing values in the Buffering Period or Picture Timing SEI messages.

Table 3-17. Incorrect parameter message categories

Incorrect parameter messages	Solution
<p><b>CPB removal time:</b> also called CPB underflow. Refers to the "CPB underflow and overflow prevention" paragraph in section C.6 of the Standard. This error occurs when the CPB removal time of an AU is inferior to its final arrival time, i.e. all of the AU's bits are not present in the CPB at the time the AU is supposed to be removed. The AU cannot be removed until all of its bits are in the CPB, hence causing a lateness delay that can lead to inconstant frame rate on output. This error usually happens when the input bit rate cannot keep up with the data rate.</p>	<p>Increasing the CPB bit rate (see previous error) will usually solve the problem.</p>
<p><b>Inconstant frame rate:</b> occurs when the <code>fixed_frame_rate_flag</code> is equal to 1 (indicating a constant DPB output rate) and the actual computed output rate is not constant. This can be a consequence of the errors described above or, if not triggered by another error, a consequence of erroneous timing values in the Picture Timing SEI message associated with the picture or erroneous Picture order count (POC).</p>	<p>Check that the POC is correctly incremented and reset to 0 at every IDR picture. Also check Picture Timing SEI parameter <code>dpb_output_delay</code>, if present.</p>
<p><b>Maximum CPB removal rate:</b> refers to condition A.3.1.a of the H.264/AVC Standard or equations A.4.2.a of the H.265/HEVC Standard. This error occurs when the difference between two consecutive removal times of AU from the CPB is too low for the max macroblock processing rate computed from table A-1.</p>	<p>Increasing the Level parameter will also increase the max macroblock processing rate.</p>
<p><b>Maximum DPB output rate:</b> refers to condition A.3.1.b of the H.264/AVC Standard or equations A.4.2.b of the H.265/HEVC Standard. This error occurs when the difference between two consecutive output times of pictures from the DPB is too low for the max macroblock processing rate computed from table A-1.</p>	<p>Increasing the Level parameter will also increase the max macroblock processing rate.</p>

Table 3-17. Incorrect parameter message categories

Incorrect parameter messages	Solution
<p><b>Maximum DPB size:</b> refers to condition A.3.1.h of the H.264/AVC Standard or equations A.4.2.h of the H.265/HEVC Standard. This error occurs when the DPB size indicated in the bitstream (max_dec_frame_buffering in the VUI) is greater than the limit based on the level (computed from table A-1). Note that the DPB size cannot exceed 16 decoded frames (or 32 decoded fields).</p>	<p>Increasing the bitstream Level or setting max_dec_frame_buffering to a bigger value will solve the problem.</p>
<p><b>Maximum CPB size:</b> refers to conditions A.3.1.i and A.3.1.j of the H.264/AVC Standard or equations A.4.2.e and A.4.2.f of the H.265/HEVC Standard. This error occurs when the CPB size indicated in the bitstream (cpb_size_value_minus1 and cpb_size_scale in the HRD parameters of the VUI) is greater than the limit based on the level (computed from table A-1).</p>	<p>Increasing the bitstream Level or setting cpb_size_value_minus1 and cpb_size_scale to a correct value will solve the problem.</p>
<p><b>Maximum CPB bit rate:</b> refers to conditions A.3.1.i and A.3.1.j of the H.264/AVC Standard or equations A.4.2.e and A.4.2.f of the H.265/HEVC Standard. This error occurs when the CPB bit rate indicated in the bitstream (bit_rate_value_minus1 and bit_rate_scale in the HRD parameters of the VUI) is greater than the limit based on the level (computed from table A-1).</p>	<p>Increasing the bitstream Level or setting bit_rate_value_minus1 and bit_rate_scale to a correct value will solve the problem.</p>
<p><b>Maximum number of slices:</b> refers to conditions A.3.2.a and A.3.2.b of the H.264/AVC Standard or equations A.4.2.c and A.4.2.d of the H.265/HEVC Standard. This error occurs when the number of slices in a picture is too high for the max slice rate computed from table A-3.</p>	<p>Increasing the Level parameter will increase the max slice rate.</p>
<p><b>Maximum number of bytes in AU:</b> refers to conditions A.3.1.c and A.3.1.d of the H.264/AVC Standard or equations A.4.2.g and A.4.2.h of the H.265/HEVC Standard. This error occurs when the number of bytes in the AU is too high for the minimum compression ratio computed from table A-1.</p>	<p>Increasing the Level parameter will increase the minimum compression ratio.</p>



## Buffer Error Messages

Buffer error messages indicate overflows and underflows in the buffers.

[Table 3-18](#) lists the buffer error messages that may occur.

*Table 3-18. Buffer error messages*

Buffer error message	Solution
CPB overflow	Increasing the size of CPB will solve the problem. If this error occurs during the first filling phase, check that the initial removal delay is not too long.
CPB underflow	Increasing the CPB bit rate (which can be made by modifying the appropriate HRD parameters in the SPS or increasing the bitstream Level) will usually solve the problem.
DPB overflow	DPB parameters may be set to incorrect values, or default values may be too small. In this case, increasing the level may prevent this error. This error can also be caused by erroneous <code>dpb_output_delay</code> values or incorrect POC.

## Export

Click the  [Export view content to text file](#) toolbar button to open the analysis result in a file.

## Audio Analysis

The [Audio Analysis](#) tab is part of the [Main](#) view. This tab is available provided the opened file contains at least one AAC, Dolby AC-3 and E-AC-3 or MPEG audio stream.

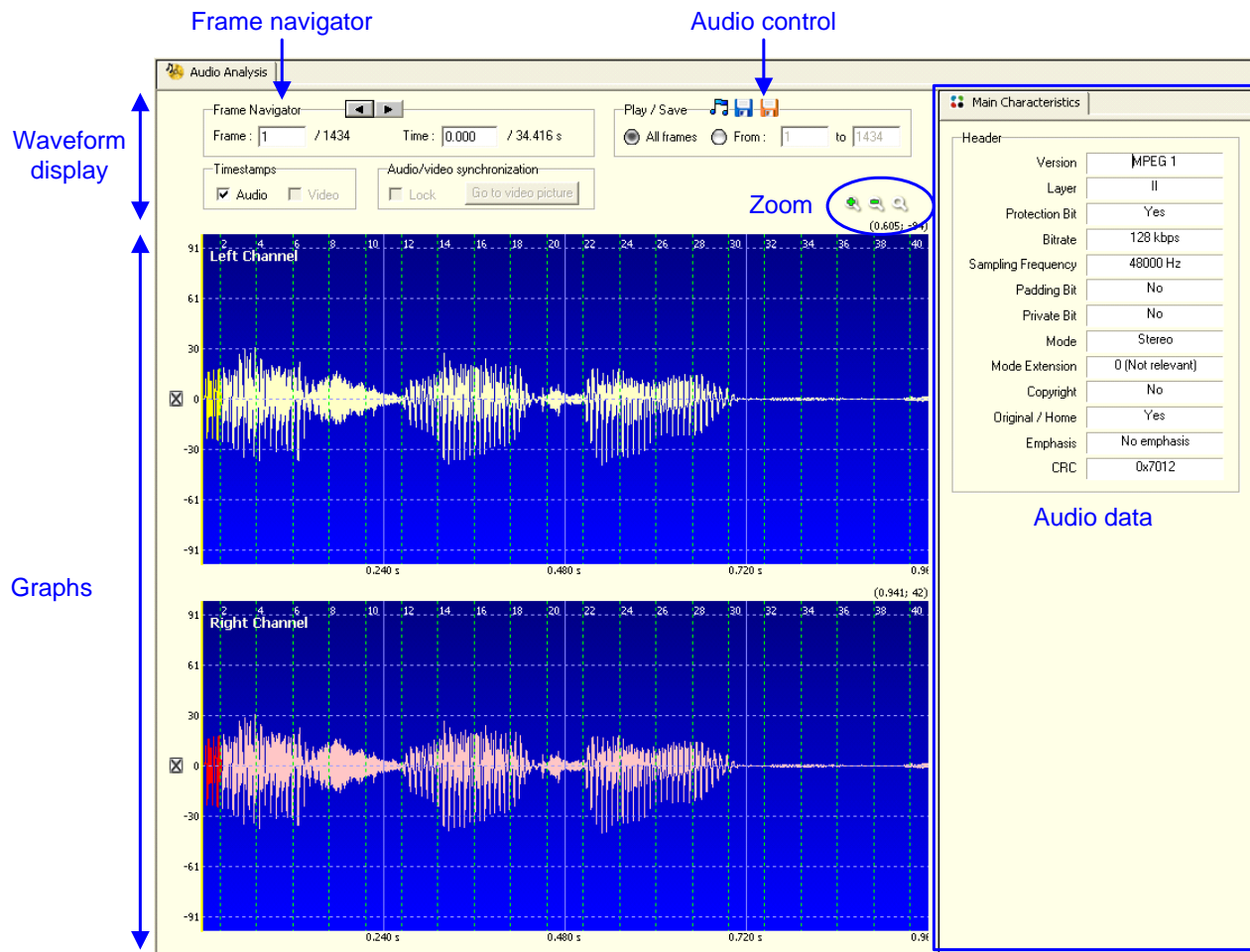
The view varies along with the type of audio stream opened.

The [Audio Analysis](#) view is split into two parts:

- Waveform display, with frame navigator, audio control for playback and save, and controls for video synchronization.
- Audio data, with main characteristics and details.



Figure 3-69. Audio Analysis view




## Waveform Display

### Waveforms

- **AC-3 and E-AC-3:** depending on the number of channels, 1 to 6 waveforms may be represented. Channels may be: Left, Center, Right, Surround, Left Surround, Right Surround, Low Frequency Effects (LFE).
- **MPEG:** depending on the number of channels, 1 or 2 waveforms may be represented. Mode may be mono or stereo.
- **AAC:** depending on the number of channels, 1 to 6 waveforms may be represented. Channels may be: Center, Left, Right, Left Surround, Right Surround, Low Frequency Effects (LFE).

## Graph Zoom

Time axis may be adjusted using the  **Zoom in / Zoom out / Zoom** reset buttons.

Click in the graph and drag the mouse onto the right to manually zoom in.

Right-click to adjust the level axis (auto scale).

## Frame Navigator





You can navigate through the audio stream using the frame navigator panel.

The navigator also lets you specify the time to jump to. In this case the selected frame is updated accordingly.

While navigating through frames, a vertical bar representing the beginning of the audio frame is shifting on the graph. The portion of waveform corresponding to the selected audio frame is also highlighted.

## Audio Control

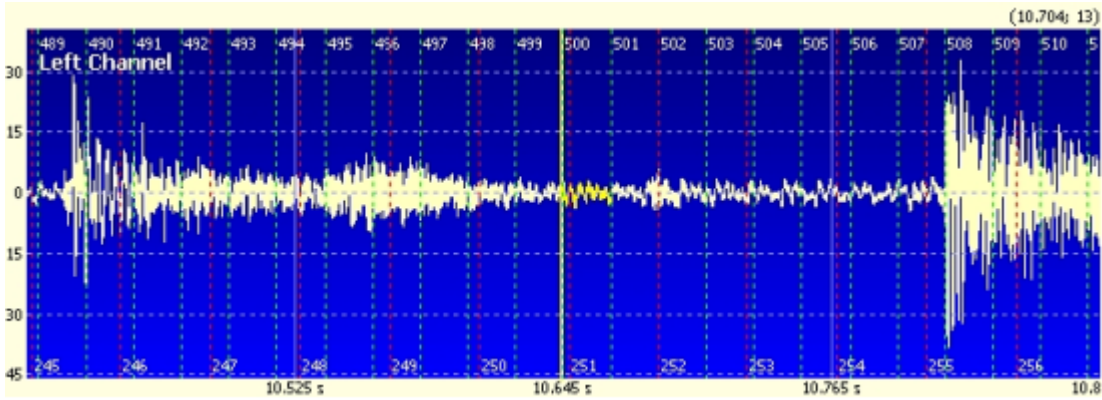
The **Play / Save** controls let you play or save the entire audio stream or a part of it.

- **Selection:** select the desired channels to be played or saved using the  button selection next to each graph.
- **Play:** select the desired channels and click the  icon. A progress bar is displayed during audio playback.
- **Save:**
  - ❖ as a PCM (uncompressed) WAV file: select the desired channels and click the  icon. A progress bar is displayed during audio saving. The WAV file is saved in the directory you have defined.
  - ❖ as a compressed file: select the desired channels and click the  icon. The format of the produced file is the original stream format, i.e. AC-3/E-AC-3, MPEG audio or AAC Raw Byte file.
- **Timestamps:** displaying audio timestamps is possible on every audio file. It will show the presentation time of audio frames on the waveform. Displaying video timestamps is possible only in a transport file, since a video stream needs to be associated to the analyzed audio stream. Furthermore, the video stream needs to be of a supported format, i.e. MPEG-2, H.264/AVC or VC-1.  
Check the Audio and/or Video boxes of the Timestamps area to enable the timestamps display.

Audio timestamps are displayed in green and associated to a frame number located in the upper part of the graph.

Video timestamps (based on PTS in MPEG-2 TS files and on presentation timestamps in MP4, MOV and FLV files) are displayed in red and associated to a picture presentation index located in the lower part of the graph.

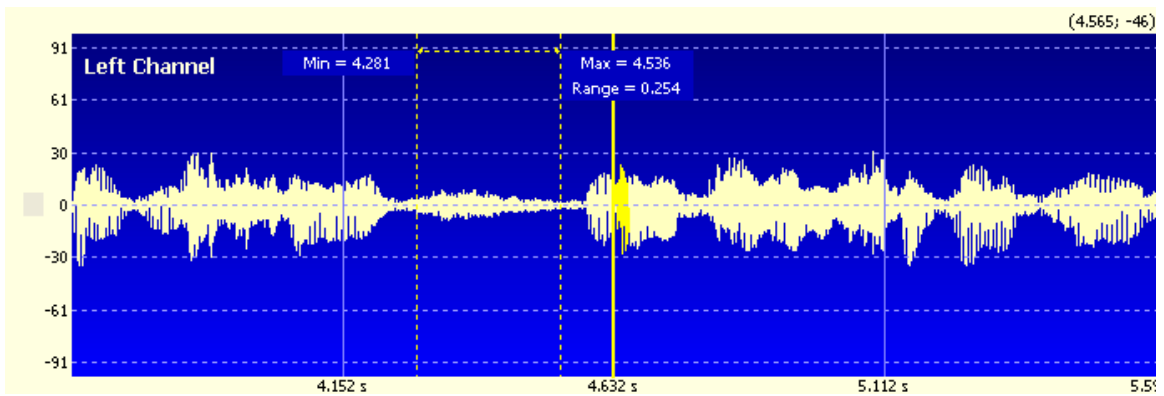
Figure 3-70. Waveform with audio and video timestamps



### Basic Audio Video Synchronization

In order to help measuring the time interval between a picture and an audio frame, you can click anywhere on a graph and drag the mouse to another point of the graph. The interval between the two points will be computed and displayed on the graph. For example, in Figure 3-71, you can see the two yellow dotted lines that identify the minimum and maximum values. The range between the two values is indicated below the maximum value. Values are in milliseconds.

Figure 3-71. Range computation in audio analysis



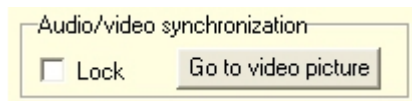
## Synchronizing Audio View with Video

The main purpose of audio/video synchronization is to let you see the connection between audio frames and video pictures, based on presentation times.

This feature is available only if an MPEG-2 TS or MP4/MOV/FLV/3GP file is open in the Analyzer. Furthermore, the audio stream to synchronize must be associated to a video stream of a supported format (H.264/AVC or VC-1).

To enable the synchronized mode, check the [Lock](#) box.

Figure 3-72. Audio/video synchronization controls

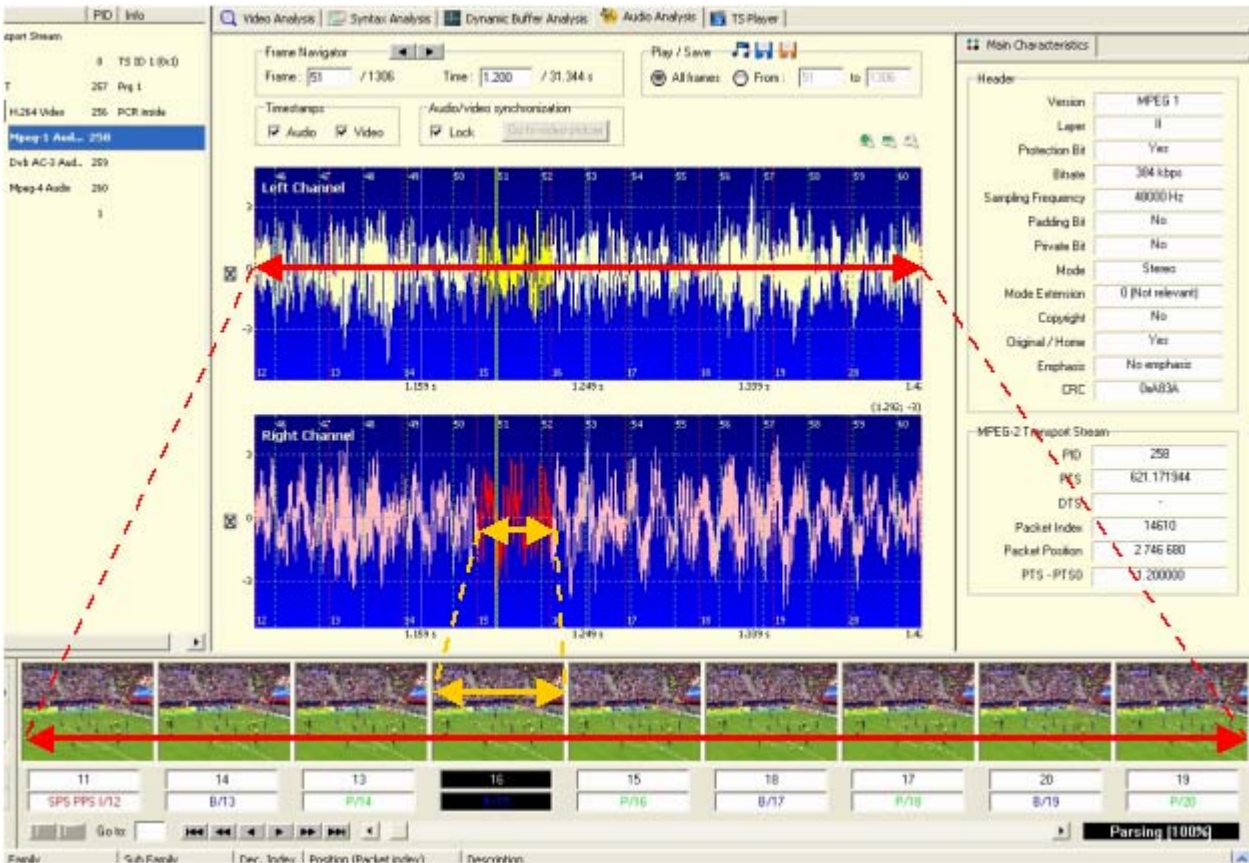


The [Go to video picture](#) button takes the video to the picture corresponding (presentation time-wise) to the selected audio frame.

In synchronized mode, the following rules apply:

- The waveform displays the audio frames corresponding to the pictures that appear in the [Thumbnail](#) view.
- Navigation can be achieved with the video navigation controls located in the [Thumbnail](#) view.
- The highlight on the waveform represents the duration of the selected video picture.
- Audio navigation is constrained to graph boundaries.
- The zoom feature is not available.

Figure 3-73. Audio/video synchronization



## Audio Data

Audio data are split into two tabs: [Main Characteristics](#) and [Details](#).

The content of these tabs vary along with the type of audio stream opened.

### AC-3 and E-AC-3 Audio Data

#### AC-3 and E-AC-3 Main Characteristics

Figure 3-74. Audio main characteristics (Dolby AC-3)

Main Char.		Details	
Frame			
AC-3 Version		Alternate AC-3	
Sampling Rate		48 kHz	
Type of Service		Complete Main (CM)	
Audio Coding Mode		3/2	
Bitrate		384 kbps	
LFE Channel		Yes	
Copyright		Yes	
Original bit stream		Yes	
CRC2		0x2845	
MPEG-2 Transport Stream			
PID		330	
PTS		11601.001433	
DTS		-	
Packet Index		359	
Packet Position		73236	
PTS - PTS0		0.000000	

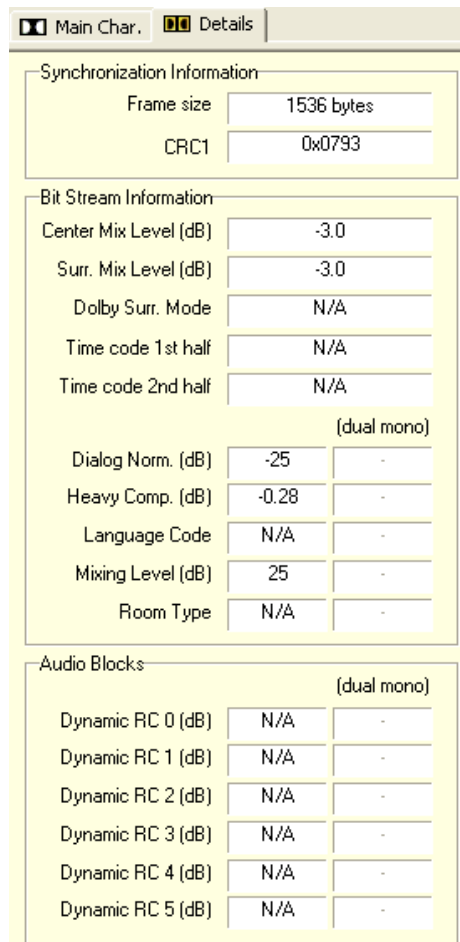
- **AC-3 Version:** bitstream identification, indicates the AC-3 syntax version used.
- **Sampling Rate:** sampling frequency of the audio bitstream.
- **Type of Service:** bitstream mode, indicates the type of service that the bitstream conveys.
- **Audio Coding Mode:** main service channels that are in use.
- **Bitrate:** rate of the audio bitstream.
- **LFE Channel:** indicates whether a Low Frequency Effect channel (sub woofer) is present or not.
- **Copyright:** indicates if the audio bitstream is indicated as protected by copyright.

- **Original bit stream:** indicates whether the bitstream is an original or a copy of another stream.
- **CRC2:** Cyclic Redundancy Check applied to the entire frame.

**AC-3 Details**

Details for each audio frame are summed up in the left panel. Depending on audio coding mode, second independent channel may not be filled (it is used only in 1 + 1 audio coding mode).

Figure 3-75. Audio details (Dolby AC-3)



- **Frame size:** number of bytes that make up the frame.
- **CRC1:** Cyclic Redundancy Check applied to the first 5/8th of the frame.
- **Center Mix Level:** in 3/x coding mode only, indicates the nominal down mix level of the center channel with respect to the left and right channels.
- **Surround Mix Level:** when surround channels are in use, indicates the nominal down mix level of the surround channels.



- **Dolby Surr. Mode:** when operating in two-channel mode, indicates whether the program has been encoded in Dolby Surround or not.
- **Time code 1st half:** first half of the time code. The Time Code is the sum of the first half and the second half.
- **Time code 2nd half:** second half of the time code. The Time Code is the sum of the first half and the second half.
- **Dialogue Norm. (dB):** indicates how far the average dialogue level is below digital 100 percent.
- **Heavy Comp (dB):** gain that may be used to scale the reproduced audio level in order to reproduce a very narrow dynamic range, with an assured upper limit of instantaneous peak reproduced signal level in the monophonic downmix.
- **Language Code:** reserved value.
- **Mixing Level (dB):** absolute acoustic sound pressure level of an individual channel during the final audio mixing session.
- **Room Type:** type and calibration of the mixing room used for the final audio mixing session.
- **Language Code:** reserved value.
- **Mixing Level:** absolute acoustic sound pressure level of an individual channel during the final audio mixing session.
- **Room Type:** type and calibration of the mixing room used for the final audio mixing session.
- **Dynamic Range Control:** for each block of audio a dynamic range control value may be included in the bitstream. The decoder, by default, shall use this value to alter the magnitude of the coefficient.



**E-AC-3 Detailed Data**

E-AC-3 detailed data is provided on three panels named [1](#), [2](#) and [3](#).

**Panel no.1**

Figure 3-76. Audio Details (E-AC-3, panel #1)

BSI - common	
Stream Type	0
Sub Stream Id	0
Frame Size	255
Reduced Sample Rate	-
Nb of Audio Block	6
(dual mono)	
Dialog Norm. (dB)	21
Heavy Comp. (dB)	-0.28
Custom Channel	-
Converter Sync. Flag	-
Block Id	-
Frame Size Code	-
Additional BSI Length	-

- **Stream Type:** the stream type can be:
  - ❖ Type 0: the frames comprise an independent stream or substream. The program may be decoded independently of any other substreams that might exist in the bitstream.
  - ❖ Type 1: the frames comprise a dependent substream. The program must be decoded in conjunction with the independent substream with which it is associated.
  - ❖ Type 2: the frames comprise an independent stream or substream that was previously coded in AC-3. Type 2 streams must be independently decodable, and may not have any dependent streams associated with them.
  - ❖ Type 3: Reserved.
- **Sub Stream Id:** substream identification parameter. This parameter can be used, in conjunction with additional bitstream metadata, to enable carriage of a single program of more than 5.1 channels, multiple programs of up to 5.1 channels, or a mixture of programs with up to 5.1 channels and programs with greater than 5.1 channels.
- **Frame size:** this field indicates a value one less than the overall size of the coded frame in 16-bit words. That is, this field may assume a value ranging from 0 to 2047, and these values correspond to frame sizes ranging from 1 to 2048.

- **Reduced Sample Rate:** the value can be: 24 kHz, 22.05 kHz, 16 kHz or *reserved*.
- **No. of Audio Blocks:** number of audio blocks per synchronization frame.
- **Dialog Norm.:** this value indicates how far the average dialogue level is below digital 100 percent. Valid values are comprised between -1 dB and -31dB. This value affects the sound reproduction level.
- **Heavy Comp.:** encoder-generated gain word. This element allows the program provider (or broadcaster) to implement a large dynamic range reduction (heavy compression) in a way which assures that a monophonic downmix will not exceed a certain peak level.
- **Custom Channel:** if this bit is a 0, the channel map for a dependent substream is defined by the audio coding mode and LFE on parameters. If this bit is a 1, the following 16 bits define the custom channel map for this dependent substream. Only dependent substreams can have a custom channel map.
- **Converted Sync. Flag:** converted synchronization flag. This bit is used for synchronization by a device that converts an Enhanced AC-3 bitstream to an AC-3 bitstream.
- **Block Id:** if the stream type is a Type 2 stream, this bit is set to 1 to indicate that the first block in this Enhanced AC-3 frame was the first block in the original standard AC-3 frame.
- **Frame Size Code:** this code is used along with the sample rate code to determine the number of (2-byte) words before the next synchronization word.
- **Additional BSI Length:** Additional bitstream Information Length. This 6-bit code, if present, indicates the length in bytes of additional bitstream information. The valid range of *addbsil* is [0–63], indicating [1–64] additional bytes, respectively.

#### Panel no.2

- **Downmix Mode:** type of stereo downmix preferred by the mastering engineer. This information may be used by the AC-3 decoder to automatically configure the type of stereo downmix, but may also be overridden or ignored. The value can be: *Not indicated, Lt/Rt downmix preferred, Lo/Ro downmix preferred* or *Reserved*.
- **LR Cent. Mix Level:** nominal down mix level of the center channel with respect to the left and right channels in an Lt/Rt downmix, in decibels.
- **LoRo Cent. Mix Level:** nominal down mix level of the center channel with respect to the left and right channels in an Lo/Ro downmix, in decibels.
- **LR Sur. Mix Level:** nominal down mix level of the surround channels with respect to the left and right channels in an Lt/Rt downmix, in decibels.

- **LoRo Sur. Mix Level:** nominal down mix level of the surround channels with respect to the left and right channels in an Lo/Ro downmix, in decibels.
- **LFE Mix Level Code:** level at which the LFE data is mixed into the Left and Right channels during downmixing, in decibels.
- **Program Scale Factor:** scale factor that should be applied to the program during decoding, in decibels.
- **Ext. Program Scale Factor:** scale factor that should be applied to the external program (i.e., the program that is not carried in this bitstream) during mixing.
- **Mix Control Type:** mode and parameter field lengths for program mixing.
- **Mixing Par. Data Len.:** Length of Mixing Parameter Data Field. This is the mixing data field size for the most flexible mode.
- **Pan Information:** this value defines how a single channel is reproduced in a two dimensional sound field.
- **Mix Conf Info AB n:** block mixing configuration information.

### Panel no.3

- **Dolby Mode:**
  - ❖ **Surround:** this field indicates whether or not the program has been encoded in Dolby Surround.
  - ❖ **Headphone:** this field indicates whether or not the program has been Dolby Headphone-encoded.
  - ❖ **Surround EX:** this field indicates whether or not the program has been encoded in Dolby Surround EX.
- **Mixing Level:** absolute acoustic sound pressure level of an individual channel during the final audio mixing session, in decibels.
- **Room Type:** type and calibration of the mixing room used for the final audio mixing session.
- **A/D Converter Type:** type of A/D converter technology used to capture the PCM audio. This type can be *Standard* or *HDCD*.
- **Source Sample Rate:** if this bit is a 1, the source material was sampled at twice the sampling frequency rate.
- **Audio Blocks:**
  - ❖ **Dynamic RC n:** encoder-generated gain word applied to scale the reproduced audio. This element allows the program provider to implement subjectively pleasing dynamic range reduction for most of the intended audience, while allowing individual members of the audience the option to experience more (or all) of the original dynamic range.

## MPEG Audio Data

Figure 3-77. Audio main characteristics (MPEG Audio)

Main Characteristics	
Header	
Version	MPEG 1
Layer	II
Protection Bit	Yes
Bitrate	128 kbps
Sampling Frequency	48000 Hz
Padding Bit	No
Private Bit	No
Mode	Stereo
Mode Extension	0 (Not relevant)
Copyright	No
Original / Home	Yes
Emphasis	No emphasis
CRC	0x7012

- **Version:** ID of algorithm used.
- **Layer:** layer used.
- **Protection bit:** indicates whether redundancy has been added in the bitstream to facilitate error detection and concealment.
- **Bitrate:** rate of audio bitstream.
- **Sampling Frequency:** sampling frequency of audio bitstream.
- **Padding Bit:** indicates if the frame contains an additional slot to adjust the mean bitrate to the sampling frequency.
- **Private Bit:** indicates whether private bit is used or not.
- **Mode:** audio mode used. Possible values are Single Channel, Dual Channel, Stereo and Joint Stereo.
- **Mode Extension:** used in joint stereo mode only. Indicates which sub bands are in intensity stereo (in Layer I and II) or which type of joint stereo coding method is applied (in Layer III).
- **Copyright:** indicates whether the audio bitstream is indicated as protected by copyright or not.
- **Original / Home:** indicates if the bitstream is an original one or a copy of another stream.
- **Emphasis:** indicates the type of de-emphasis that shall be used.
- **CRC:** Cyclic Redundancy Check, used for optional error detection within the encoded bitstream.

## AAC Audio Data

The CMA 1820 is able to detect the presence of SBR and PS data, i.e. it can recognize HE-AAC and HE-AAC v2 stream. It can recognize them, if they are explicitly declared in the header (in AudioSpecificConfig for LOAS/AudioSyncStream), and even in case of implicit signaling (the data are present but not declared in any header).

But it is able to decode only SBR data. PS stream will be decoded and played but the PS data will be ignored, in that case the channel(s) with PS data will be rendered as mono.

### AAC Main Characteristics

The main characteristics are summed up in this panel. Depending on the file type, the tab may contain frame data and MPEG-2 TS data.

Figure 3-78. Audio main characteristics (AAC)

Frame	
AAC Version	Mpeg 2
ES Type	ADTS
Profile	LC profile
Extension	None
Sampling Rate	48000 Hz
Bitrate	384 kbps
Channel Configuration	stereo (L,R)
LFE Channel	No

- **AAC Version:** Indicates whether the AAC follows the MPEG 2 or 4 standard.
- **ES Type:** The layer encapsulating the AAC data (ADTS, LOAS, etc.).
- **Profile:** The object type in MPEG4 or the profile in MPEG2.
- **Extension:** Extension to the object type such as SBR and PS.
- **Sampling Rate:** Sampling frequency of the audio bitstream used for the output. Depending on the presence of the SBR extension, this value might be different from those declared in the detailed view, because the SBR tool operates at twice the sampling frequency of the AAC stream.
- **Bitrate:** Rate of the audio bitstream.
- **Channel Configuration:** Which audio channels are used.
- **LFE Channel:** Indicates if a Low Frequency Effect channel (sub woofer) is present.

## AAC Details

The CMA 1820 supports two types of encapsulation layer for AAC streams: ADTS and LOAS/AudioSyncStream.

The detailed views display a tree showing the whole AAC frame header syntax. It shows the value actually coded in the bitstream followed by its meaning when appropriate.

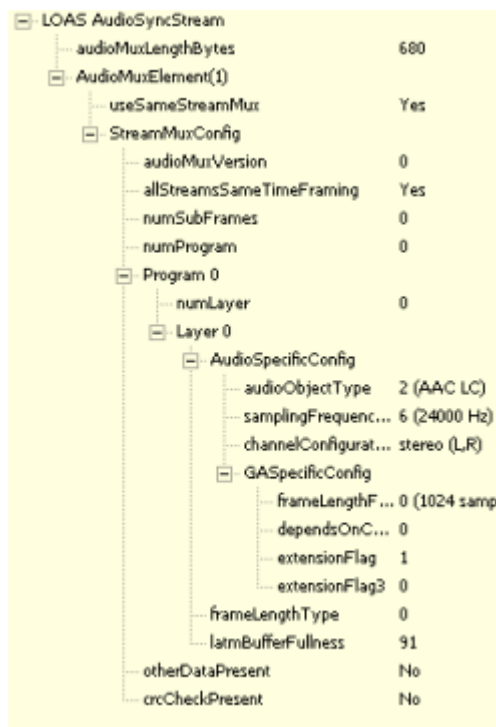
Figure 3-79. Audio detailed characteristics ADTS

Field	Value
ADTS Header	
ID	1 (Mpeg 2)
Layer	0
Protection absent	No
Profile	1 (LC profile)
Sampling frequency ind...	3 (48000 Hz)
Private bit	0
Channel Configuration	stereo (L,R)
Original / Copy	No
Home	No
Copyright ID bit	0
Copyright ID start	No
Frame length	1024 bytes
Buffer fullness	64 words
Nb of raw data block	0
CRC check	0xD6AB

- **ID**: Indicates whether the AAC follows the MPEG 2 or 4 standard.
- **Layer**: must be 0.
- **Protection absent**: indicates whether the frame is no protected with a CRC. Yes (1) means no protection, no (0) means a CRC follows the header.
- **Profile**: Which profile is used, Main (0), LC(1), SSR(2), LTP(3). LTP is used only in MPEG4 (ID = 0).
- **Sampling frequency index**: sampling frequency of audio bitstream.
- **Private bit**: bit for private use.
- **Channel configuration**: audio channels used. If this value equals 0, the channel configuration is not specified in the header and must be given by a program\_config\_element or must be known by the application.
- **Original / Copy**: if this bit equals '0' there is no copyright on the coded bitstream, '1' means copyright.
- **Home**: this bit equals '0' if the bitstream is a copy, '1' if it is an original.
- **Copyright ID bit**: on of the bits of the 72-bit copyright identification field. The bits of this field are transmitted frame by frame.
- **Copyright ID start**: indicates whether the Copyright ID bit of this frame is the first bit of the copyright identification field.

- **Frame length:** length of this frame in bytes, including headers and error\_check.
- **Buffer fullness:** number of 32 words remaining in the encoder buffer after encoding the first raw\_data\_block in the frame. A value of hexadecimal 7FF signals that the bitstream is a variable rate bitstream. In this case, buffer fullness is not applicable.
- **Nb of raw data block:** number of raw\_data\_block in the frame minus 1. 0 means one raw\_data\_block.
- **CRC check:** 16 bits CRC generated for the frame according to the standards ISO/IEC 13818-7 or ISO/IEC 14496-3.

Figure 3-80. Audio detailed characteristics LOAS/AudioSyncStream



This document does not fully describe the LOAS/AudioSyncStream header, because it is not its purpose. Instead, it gives a description of the elements most commonly encountered. For elements not described here or for more detail, please refer to ISO/IEC 14496-3:2005.

#### LOAS / LATM header elements:

- **audioMuxLengthBytes:** A 13-bit data element indicating the byte length of the subsequent AudioMuxElement with byte alignment.
- **useSameStreamMux:** A flag indicating whether the multiplexing configuration in the previous frame is applied in the current frame.

- **audioMuxVersion**: A 1 bit data element to signal the used multiplex syntax. If audioMuxVersion is 1, a new 1 bit data element is shown. It's called audioMuxVersionA and must be 0.
- **allStreamSameTimeFraming**: A data element indicating whether all payloads, which are multiplexed in this frame, share a common time base.
- **numSubFrames**: A data element indicating how many subframes are multiplexed (numSubFrames+1). If more than one subframe is multiplexed, they share a common StreamMuxConfig. The minimum value is 0 indicating 1 subframe.
- **numProgram**: A data element indicating how many programs are multiplexed (numProgram+1). The minimum value is 0 indicating 1 program.
- **numLayer**: A data element indicating how many scalable layers are multiplexed (numLayer+1). The minimum value is 0 indicating 1 layer.
- **useSameConfig**: A data element indicating that no AudioSpecificConfig is transmitted but that the AudioSpecificConfig most recently transmitted shall be applied. Not shown for layer 0 of program 0, because in this case the AudioSpecificConfig must be present. If useSameConfig is 1, the corresponding AudioSpecificConfig is displayed, even if not really present in the stream.
- **frameLengthType**: A data element indicating the frame length type of the payload. 0 means a payload with variable frame length. The payload length in bytes is directly specified with 8-bit codes in PayloadLengthInfo (after the header in the frame). 1 means a payload with fixed frame length. The payload length in bits is specified with frameLength in StreamMuxConfig.
- **LatmBufferFullness**: data element indicating the state of the bit reservoir in the course of encoding the first access unit of a particular program and layer in an AudioMuxElement. A value of hexadecimal FF signals that the particular program and layer is of variable rate. In this case, buffer fullness is not applicable.
- **otherDataPresent**: A flag indicating the presence of the other data than audio payloads.
- **crcCheckPresent**: A data element indicating the presence of CRC check bits for the StreamMuxConfig data functions.
- **crcCheckSum**: CRC error detection data. This CRC uses the generation polynomial CRC8, as defined in the standard and covers the entire StreamMuxConfig up to but excluding the crcCheckPresent bit.

AudioSpecificConfig elements:

- **audioObjectType**: The object type of the stream.



- **extensionAudioObjectType**: This data element extends the range of audio object types.
- **samplingFrequencyIndex**: Sampling frequency of audio bitstream.
- **extensionsamplingFrequencyIndex**: The output sampling frequency of the extension tool corresponding to the extensionAudioObjectType.
- **channelConfiguration**: Which audio channels are used. If this value equals 0, the channel configuration is not specified in the AudioSpecificConfig and must be given by a program\_config\_element in the GASpecificConfig element.
- **sbrPresentFlag**: a flag signaling the presence of SBR data. 0 means SBR is not present, 1 means SBR is present, -1 means SBR is implicit, that is the SBR data might be present in the stream, but their presence isn't announced beforehand.
- **psPresentFlag**: a flag signaling the presence of PS data. 0 means PS is not present, 1 means PS is present, -1 means PS is implicit, that is the PS data might be present in the stream, but their presence isn't announced beforehand.
- **frameLengthFlag**: Length of the frame (0 for 1024 samples or 1 for 960 samples).
- **DependsOnCoreCoder**: Signals that a core coder has been used in an underlying base layer of a scalable AAC configuration. Should be 0 here.
- **extensionFlag**: Shall be '0' for audio object types 1, 2, 3, 4, 6, 7. Shall be '1' for audio object types 17, 19, 20, 21, 22, 23 (with error resilience).
- **extensionFlag3**: Extension flag for the future use. Shall be '0'.

## PCM Data

Figure 3-81. Audio characteristics (PCM data)

Frame	
Sampling Rate	48000 Hz
Number of channels	2
Bits per sample	16
Samples per frame	1920

- **Sampling rate**: Sampling frequency of the audio bitstream.
- **Number of channels**: number of channels of the audio bitstream.
- **Bits per sample**: number of bits used to code a sample.
- **Samples per frame**: number of samples that compose one audio frame.

## MPEG-2 Transport Stream Data

Figure 3-82. Audio transport characteristics (MPEG-2 TS file)

MPEG-2 Transport Stream	
PID	258
PTS	632.259944
DTS	-
Packet Index	147312
Packet Position	27 694 656
PTS - PTS0	12.288000

- **PID**: packet identifier in an MPEG-2 TS.
- **PTS**: Presentation Time Stamp: defines decoder output order in an MPEG-2 TS.
- **DTS**: Decoding Time Stamp: defines decoder input order in an MPEG-2 TS.
- **Packet index**: number of the packets where the first data for this frame is located.
- **Packet Position**: position of the first byte of the packet of the frame in the MPEG-2 TS.
- **PTS - PTS0**: difference in seconds, between actual PTS and first PTS of the Elementary Stream.

## MP4/QuickTime/FLV File Data

Figure 3-83. Audio transport characteristics (MP4/QuickTime/FLV file)

MP4 / 3GP File Format	
Track ID	4
Timestamp	0.213333
Position in file	58 975
Sample ID	11

- **Track ID**: track identifier in an MP4, QuickTime, FLV or 3GP file.
- **Timestamp**: presentation time of the picture, in seconds.
- **Position in file**: position of the picture in the file, in bytes.
- **Sample ID**: identifier of the sample (video picture or audio frame) in the file.

## General Conformance

General conformance is performed during the parsing of the audio stream. Errors are logged in the [Report](#) view and saved in the report file. For each of the supported audio type, the CMA 1820 checks if the headers of the audio frames respect the standards.

### Audio MPEG Conformance

The CMA 1820 verifies that the header fields have allowed values:

- [Layer](#) must not be 0, reserved value.
- [Sampling frequency index](#) must not be 3, reserved value.
- [Bitrate index](#) must not be 15, forbidden value.
- [Emphasis index](#) must not be 2, reserved value.

For streams with error protection, the Analyzer computes the [CRC](#) of the frame and compares it with the one in the header.

### AC-3 and E-AC-3 Conformance

The CMA 1820 verifies that the synchronization information and the bitstream information have allowed values:

- [Sampling frequency code](#) (fscod) must not be 3, reserved value.
- [Frame size](#) and [bitrate code](#) (frmsizecod) must not be equal to or greater than 38, undefined values.
- The [bitstream identification](#) should be 8. Referred as AC-3 version in the AC-3 main view. This is a warning only.
- [Center mix level](#) (if present) must not be 3, reserved value.
- [Surround mix level](#) (if present) must not be 3, reserved value.
- [Dolby surround mode](#) (if present) must not be 3, reserved value.
- [Dialogue normalization](#) must be in the range [1, 31]. 0 is a reserved value and values greater than 31 are undefined.
- [Room type](#) must not be 3, reserved value.

Moreover, the CMA 1820 computes the 2 CRC of the frame and compare them with the one in the synchronization information and the one at the end of the frame.

### AAC Conformance

For [ADTS](#) frame, the CMA 1820 verifies that the header fields have allowed values:

- [Layer](#) must not be 0, reserved value.

- For MPEG-2 AAC, the `profile` must not be 3, reserved value.
- `Sampling frequency index` must be in the range [0, 11] for MPEG-2 ACC, and in [0, 12] for MPEG-4 AAC. Other values, up to 15, are reserved.

For `LOAS/AudioSyncStream` frame, the CMA 1820 verifies that the header fields are present and have allowed values:

- The first frame must not have `useSameStreamMux` equal to 1.
- If the first frame has its `useSameStreamMux` equal to 1, thus its `StreamMuxConfig` is not defined, for all the following frames having that same value, the `StreamMuxConfig` will not be defined either.
- `audioMuxVersionA` must be 0.
- `numProgram` should be 0, the Analyzer doesn't support other values.
- `numLayer` should be 0, the Analyzer doesn't support other values.
- `frameLengthType` must be 0 or 1. 2 is a reserved value and values above are not used with AAC.
- `audioObjectType` should be 2, because LC is the only object type supported by the decoder. But before, the Analyzer check the object type is related to AAC and send an appropriate error message if not.
- `samplingFrequencyIndex` must not be 13 or 14, reserved values.
- `channelConfiguration` must be in the range [0, 7], 8 to 15 are reserved values.

### Common Errors

Synchronization problems are common to all the audio formats. The Analyzer displays an information message when it loses it, indicating where the synchronization element should have been in the file. It sends a message when it finds the synchronization again.

It might happen that the decoder can't decode one particular frame in the stream, in this case the frame is replaced by an empty frame of the same duration, it's visible on the waveform and it produce a blank when playing the stream. If the decoder can't decode 20 frames successively, it aborts decoding. In this case an error message is displayed.

Replacing not decodable frames with blank ones allows keeping the synchronization with the video. But in case of audio synchronization loss, many audio frames might be skipped, thus video and audio are likely to be not synchronized after the first loss.

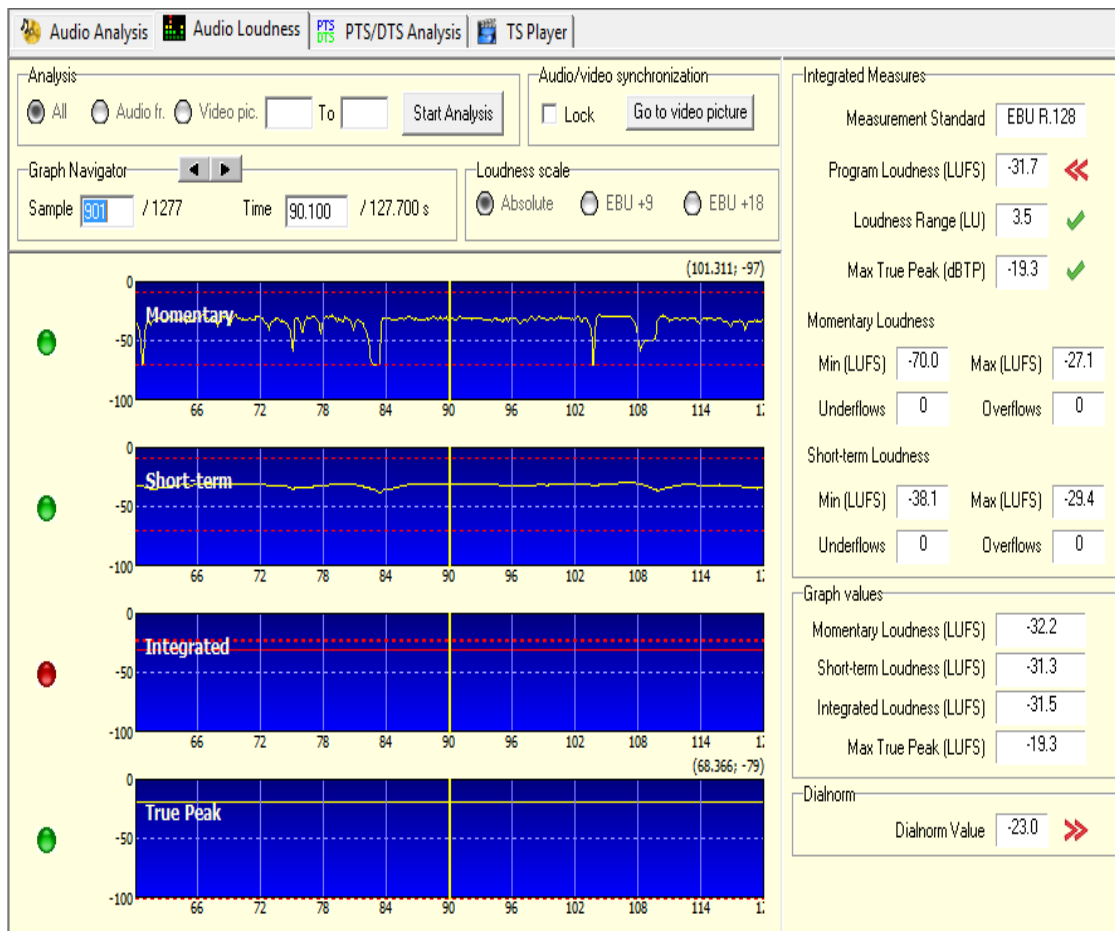
## Audio Loudness

The **Audio Loudness** tab is part of the **Main** view. This tab is available provided the opened file contains at least one AAC, Dolby AC-3 and E-AC-3 or MPEG audio stream.

The **Audio Loudness** view is split into two parts:

- Graph display, with analysis control, graph navigator, loudness scale selection, and controls for video synchronization.
- Loudness data, with integrated measures, graph values and dialnorm.

Figure 3-84. Audio Loudness view



For a complete explanation of audio loudness metering and interpretation, refer to the corresponding section in the Standards Overview document.

## Graph Display

### Analysis Configuration

The loudness analysis can be run thanks to the [Analysis](#) area. You can define the portion of the file which will be analyzed:

- **All**: if you want to analyze all the audio frames of the selected stream.
- **Audio fr.**: lets you set a first and last audio frame index to define a portion of the audio stream to analyze.
- **Video pic.**: lets you set a first and last video picture index to define a portion of the video stream corresponding to the audio to analyze. This is very useful to compute the loudness of a program contained within a bigger stream, by identifying its boundaries on the video.

Once the range to analyze has been defined, click [Start Analysis](#) to run the loudness analysis.

### Graphs

Once the analysis is finished, the graphs are displayed in the view. The number of graphs displayed depends on the configured settings (see section '[Loudness Analysis](#)' on page 220). Momentary, Short-term, Integrated Loudness and True Peak can be represented in this view.

The graphs all share the same time scale on X axis. They can be navigated with the [Graph Navigator](#) tools.



The Program Loudness is the final value of the Integrated Loudness computed on a program.

### Graph Navigator

You can navigate through the graph samples using the [Graph Navigator](#) panel.

The navigator also lets you specify the time to jump to. In this case, the selected loudness sample is updated accordingly.

While navigating through loudness samples, a vertical bar representing the beginning of the sample is shifting on the graph.

### Loudness Scale

The EBU has defined two scales to display the loudness of a program.

- **EBU +9** scale, which ought to be suitable for most programs
- **EBU +18** scale, which may be needed for programs with a wide Loudness Range (LRA)

These two scale are displayed in EBU mode, meaning that 0 equals -23 LUFS/LKFS.

Alternatively, an absolute scale in LUFS/LKFS is also provided.

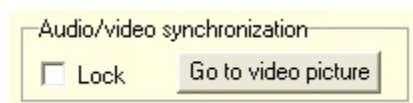
### Synchronizing Audio View with Video

The main purpose of audio/video synchronization is to let you see the connection between loudness samples and video pictures, based on presentation times.

This feature is available only if an MPEG-2 TS file is open in the Analyzer. Furthermore, the audio stream to synchronize must be associated to a video stream of a supported format (H.265/HEVC, H.264/AVC, MPEG-2 or VC-1).

To enable the synchronized mode, check the [Lock](#) box.

Figure 3-85. Audio/video synchronization controls



The [Go to video picture](#) button takes the video to the picture corresponding (presentation time-wise) to the selected loudness sample. It is not available when the synchronized mode is active.

In synchronized mode, the following rules apply:

- The waveform displays the loudness samples corresponding to the pictures that appear in the [Thumbnail](#) view.
- Navigation can be achieved with the video navigation controls located in the [Thumbnail](#) view.
- Loudness sample navigation is constrained to graph boundaries.

### Loudness Data




The units depend on the [Measurement Standard](#) defined in the [Settings](#) (see section '[Loudness Analysis](#)' on page 220).

#### Integrated Measures

This area provides the [Measurement Standard](#) that was used for the analysis and the three important values of loudness metering:

- [Program Loudness](#): The Program Loudness value is the Integrated Loudness over the duration of the program.

- **Loudness Range:** The Loudness Range describes the distribution of loudness within a program.
- **Max True Peak:** The Max True Peak is the maximum (positive or negative) value of the audio signal waveform of the program in the continuous time domain.

Each of these values has a status icon indicating whether the value is lower , higher  or within the specified limits .

Below, the results of Momentary and Short-Term loudness are displayed.

- **Momentary Loudness Min:** The minimum value of the Momentary Loudness.
- **Momentary Loudness Max:** The maximum value of the Momentary Loudness.
- **Momentary Loudness Underflows:** The number of samples below the Momentary Loudness minimum threshold defined in the [Settings](#) panel.
- **Momentary Loudness Overflows:** The number of samples above the Momentary Loudness maximum threshold defined in the [Settings](#) panel.
- **Short-term Loudness Min:** The minimum value of the Short-term Loudness.
- **Short-term Loudness Max:** The maximum value of the Short-term Loudness.
- **Short-term Loudness Underflows:** The number of samples below the Short-term Loudness minimum threshold defined in the [Settings](#) panel.
- **Short-term Loudness Overflows:** The number of samples above the Short-term Loudness maximum threshold defined in the [Settings](#) panel.

#### Graph Values

This area provides the values corresponding to the loudness sample selected in the graph view:

- **Momentary Loudness:** The value of the Momentary Loudness for the currently selected loudness sample.
- **Short-term Loudness:** The value of the Short-term Loudness for the currently selected loudness sample.
- **Integrated Loudness:** The value of the Integrated Loudness for the currently selected loudness sample.
- **Max True Peak:** The value of the true Max True Peak level for the currently selected loudness sample.



**Dialnorm (AC-3 and E-AC3 only)**

This area contains the dialnorm value and a status icon indicating whether the value is lower, higher or within the specified limits. If the dialnorm value is not constant throughout the analysis, the displayed value is the last value found in the analyzed stream. In this case, the status icon will indicate that the value is incorrect.

- **Dialnorm Value:** The value of the last dialnorm field within the program.

## Picture Quality Analysis

### Overview

Picture quality has many possible meanings; this is why multiple criteria are tested in the CMA 1820:

- **Blocking:** this artifact is defined as the discontinuities found at the boundaries of adjacent blocks in the reconstructed frame.
- **Blurriness:** defined as a loss of spatial detail in some areas of the picture.
- **Jerkiness:** defined as the perception of originally continuous motion as a sequence of distinct snapshots.
- **Noise:** random variation in the spatial or temporal dimension, which appears in videos and images as a result of processes linked to transmission and generation techniques.
- **Saturation:** tests the luma and chroma values of each pixel, considering it saturated if they are not within specific boundaries.

For each of these criteria, a plot is drawn, indicating the level for each picture. Error navigation makes it easy to navigate between frames that are above threshold.

In addition, two others criteria are analyzed but not represented as a plot:

- **Freeze frames:** if a range of consecutive frames are similar, they are considered as frozen.
- **Black frames:** if a range of consecutive frames are black, the Analyzer detects it.

## Algorithms Description

### Overview

This section describes a set of metrics for measuring the quality of digital video.

Quality metrics measure the typical artifacts introduced by MPEG-2 and H.264 video compression and transport of digital video.

Quality metrics take into account the image content and frame data of the video resulting from the given coding and transmission conditions.

The metrics can be divided into spatial and temporal metrics. Spatial metrics such as blockiness, which perform their measurements on a frame-by-frame basis, return a result for each frame measured.

Temporal metrics such as jerkiness look at two or more consecutive frames simultaneously to obtain a measurement.

### **Non-referenced Video Assessment**

The measurement tools can be divided into relative metrics (full-reference, FR) and absolute metrics (non-reference, NR). FR metrics compare a compressed or otherwise processed video directly with the original, whereas NR metrics analyze any video without the need for a reference, using only the data contained in the clip under test.

For the NR metrics, the metrics are based on *a priori* artifacts: the MPEG-2 and H.264 compression artifacts.

Such metrics enable the measurement of streaming video quality at any point in the content production and delivery chain. They are particularly useful for monitoring quality variations due to network problems, as well as for applications where service level agreements and quality control are required.

Another possible application is characterization of several encoders with the same input.

Our NR metrics are blockiness, bluriness, noisiness and jerkiness. These metrics are objective metrics (depending only of the frame pixels) unlike MOS (Mean Opinion Score), which depends on the subjective results of a panel of persons within predefined screen type, distance to the screen, luminosity in the room, etc.

Moreover, the blockiness/bluriness/noisiness algorithms are only spatial algorithms (no temporal filtering is applied on the results). If black strides are present in the frames, these are not taken into account into the measurements.

### **Perceptual Metrics**

#### **Blockiness**

Blockiness is a perceptual measure of the block structure that is common to all DCT-based image compression techniques. The DCT is typically performed on 8x8 blocks in the frame, and the coefficients in each block are quantized separately, leading to artificial horizontal and vertical

borders between these blocks. Blockiness can also be caused by transmission errors, which often affect entire blocks in the video.

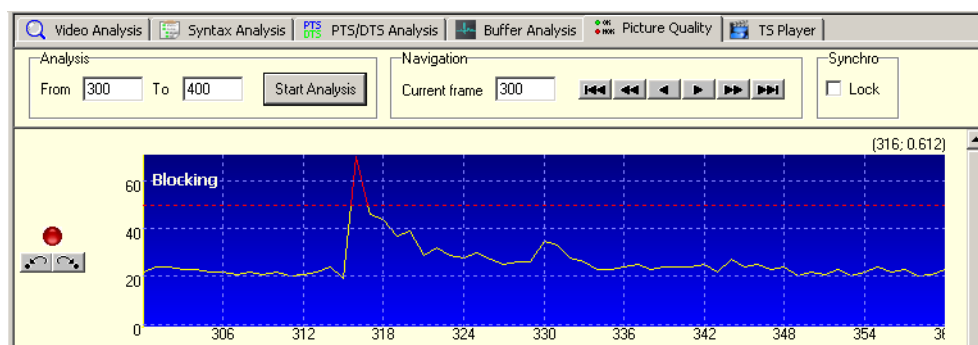
Blocking effect is defined as the discontinuities found at the boundaries of adjacent blocks in a reconstructed frame since it is a common practice to measure and reduce the blocking effect by only taking into account the pixels at the block boundaries.

The cause of the blocking effect with respect to block-based coding is intuitively obvious. In brief, due to the isolated nature in which individual blocks are coded, the level and characteristics of the coding error introduced into a block may differ from one block to another. This, in consequence, manifests as discontinuities between the boundaries of adjacent blocks: the blocking effect.

Figure 3-86. Blocking effect on pictures



Figure 3-87. Blocking effect measurement



### Blockiness Measurement Description

In different spatial domain blocking artifact measurements, the discontinuity is first extracted along the block boundary, usually on the luminance component of the color space, and the block size is chosen

according to the block transform size. Human Vision System (HVS) properties are also exploited to improve the perceptual performance. Luminance masking and spatial masking effects are the mainly considered HVS factors affecting the blocking visibility and subjective feeling. For the luminance masking, the blocking artifact in extreme bright as well as extreme dark areas is less visible compared to luminance values between 70 and 90 (in 8 bit gray scale image, obtained through HVS analysis and large training set). For the spatial masking, the blocking artifact will be suppressed to some extent in spatial highly textured areas.

The discontinuity along the block boundary can be modeled as an abrupt change of luminance<sup>1 2</sup> as well as the luminance slope<sup>3</sup>. The masking factors are mainly considered as the weighting coefficients when the image blockiness is obtained as weighted sum of the local discontinuity along the block boundary.

In our measurement, GBIM (Generalized Block-edge impairment metric)<sup>2</sup> is adopted as the blocking metric. This metric uses the differences between pixel values at the block boundaries. The pixel differences are weighted by a weighting matrix whose values depend on spatial characteristics of the image. Simply, more weights are given to those boundaries that are more visible. The luminance masking effect is used in determining weights. The noise in extreme bright as well as extreme dark areas is less visible compared to luminance values between 70 and 90 (in 8bit gray scale image).

#### Remarks / Limitations

- A blockiness value lower than 75% can be considered as acceptable quality.
- The block metric may be erroneous in picture with original abrupt luminance change at block boundary not caused by black stripes.
- The results may be erroneous with 3/2 pull down streams.

#### **Blur Artifact Measurement**

##### Artifact Description

Blurring manifests as a loss of spatial detail, spatial activity regions of pictures, such as in roughly textured areas or around object edges.

Increased blurriness can be caused by coarser quantization, edge-attenuating filters, or overlapped block motion compensation (OBMC). In the images with blurriness, the edges are not so sharp as in the original image and degradation of the structure information can also be perceived.

<sup>1</sup> R. W. Chan et al. A psycho-visually-based image quality evaluator for JPEG images. Proc. IEEE ICSP, 2000.

<sup>2</sup> H. R. Wu et al. A generalized block-edge impairment metric for video coding. IEEE Sig. Proc. Let., Nov. 1997.

<sup>3</sup> Shigenobu Minami and Avidesh Zakhor. An Optimization Approach for Removing Blocking Effects in Transform Coding. IEEE CSVT, vol.5, no.2, April, 1995.

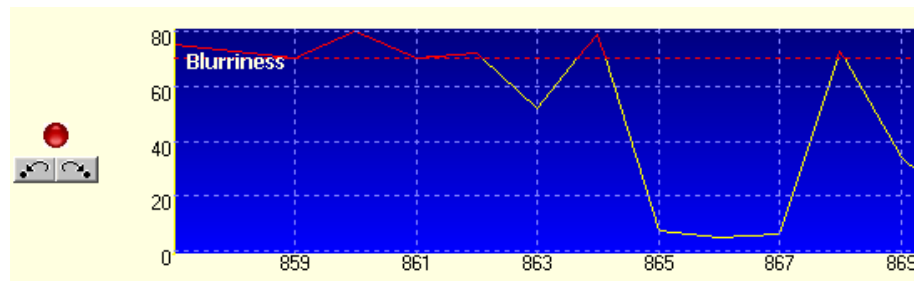
Obviously, the perceived blurring is highly dependent on content, spatial resolution, and contrast.

The blurriness is directly observed in the spatial domain as the image sharpness degradation and the structure information loss. Thus edge spreading detection can be proposed as a blurriness measurement. Furthermore, directly measuring the sharpness can also give an inverse version of blurriness. Image sharpness is the informal, subjective evaluation of the clarity of detail and contours of an image. Objectively, it can be measured by the characteristics of the edges in the spatial domain and high frequencies in the transform domain.

Figure 3-88. Blurriness on pictures



Figure 3-89. Blurriness measurement



### Artifact Measure Detailed Description

The blur metric adopted is based on the analysis of the spread of the edges in an image<sup>1</sup>.

The adopted blurring metric assumes no knowledge of the original image, and does not make any assumptions on the type of content or the

<sup>1</sup> Pina Marziliano, Frederic Dufaux, Stefan Winkler and Touradj Ebrahimi. A no-reference perceptual blur metric. Proceedings of the International Conference on Image Processing, vol. 3, pp. 57--60, Rochester, NY, September 22-25, 2002.

blurring process. The output is an objective measure which correlates with the perception of blur. This blurring measurement is defined in the spatial domain. As blur is perceptually apparent along edges or in textured areas, the adopted algorithm is based on the smoothing effect of blur on edges, and consequently attempts to measure the spread of the edges.

An edge detector (e.g. Sobel filter) is first applied in order to find edges in the image. Then image edge spreading is measured as the average edge width in the blurred image. In scanning each row of the image, for pixels corresponding to an edge location, the start and end positions of the edge are defined as the local extreme locations closest to the edge. The edge width is then given by the difference between the end and start positions, and identified as the local blur measure for this edge location. Finally, the global blur measure for the whole image is obtained by averaging the local blur values over all edge locations.

#### Remarks / Limitations

- A bluriness value lower than 75% can be considered as acceptable quality.
- The blur metric also detects the original video blur (not only the blur added by compression) so important bluriness value is not always an error: it can be an artistic choice or due to an important motion.
- The results might be erroneous during fade in/out.
- The results may be erroneous with 3/2 pull down streams.

#### **De-noising Level Measurement**

##### Artifact Description

Noise is a random variation in the spatial or temporal dimension that appears in videos and images as a result of random processes linked to transmission and generation techniques. It is most noticeable in smooth regions or regions with smooth transitions. It gives the subjective impression that the image is not clean, or that something unintended is superimposed on the image.

The subjective feeling introduced by noise is dependent not only on the noise intensity, but also on the noise spatial location, region size with noise, interaction with color component and other kinds of artifacts.

In some cases, small amount of high-frequency noise added to the naturalness of textures (in contrast with a plastic or synthetic appearance) have been found to increase perceptual quality.

In video compression context, de-noising algorithms are often used to simplify the signal before or during the encoding/transcoding process. Furthermore, a coarser quantization can amplify this de-noised subjective feeling on the images. In these cases, the natural noise tends to disappear and to be replaced by smooth regions. The adopted



de-noising metric is based on this fact and can be assimilated with the picture definition. The more the de-noising metric is important, the worst the frame definition is.

Figure 3-90. Examples of de-noised pictures



#### Artifact Measure Detailed Description

It can be seen that the typical noise measurement is closely related to the noise removal problem. Obviously if the image with noise can be well filtered to give a noise-free version of the original image, the noise measurement can be immediately obtained.

In our implementation, the de-noising level measurement benefits from both the typical noise measurement problem and the noise removal algorithms. As mentioned above, suppressing the block variation introduced by image content, such as strong edges and texture, is important for the robustness of the de-noising level measurement. In the proposed de-noising level metric, bilateral filter which plays an important role in the noise removal problem is exploited in the noise measurement algorithms to improve the robust performance.

For the strong edges in the original image, the intensity variation in the corresponding blocks in the residual image could largely be reduced by applying bilateral filter<sup>1</sup> to the original image. For the high textured

<sup>1</sup> C. Tomasi and R. Manduchi. Bilateral filtering for gray and color images. in Proc. of IEEE Int. Conf. on Computer Vision, Jan. 1998, pp. 836-846.

detail, especially some texture pattern with moderate stochasticity, the introduced intensity variation in the corresponding blocks in the residual image maybe could not be efficiently reduced by bilateral filter. On the other side, the highly textured detail could suppress the perceptual degradation caused by noise, which is called *masking effect* in HVS<sup>1</sup>. In a comprehensive framework for de-noising level measurement, special actions maybe should be taken for the textured area. The simplest way is just not to consider the intensity variation in such areas for the final de-noising level measurement fusion from different blocks.

The de-noising level metric mainly takes the following steps:

1. The input noisy image is pre-processed by bilateral filter to obtain the residual image without strong edges.
2. The residual image is divided into small 8x8 blocks, and then the intensity variations is calculated for each of the 9-overlapping 3x3 sub-blocks inside each block. An estimation of the block noise variance was obtained by averaging the 4 smallest sub-block variances.
3. Different weights are allocated to highly textured regions and other regions in the final fusion process to obtain the de-noising level measurement for the image.

#### Remarks / Limitations

- A de-noising level value lower than 75% can be considered as acceptable quality.
- The noise metric may be erroneous with picture with a lot of homogeneous areas of the same luminosity.
- The results may be erroneous with 3/2 pull down streams.

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<sup>1</sup> X. K. Yang, W. S. Lin, Z. K. Lu, et al. Just noticeable distortion profile with nonlinear additivity model for perceptual masking in color images. Proc. ICASSP, vol. 3, Apr. 2003, pp. 609-612.



## Measures Interpretation Guidelines

Values provided in [Table 3-19](#) are guidelines to interpret the data resulting from picture quality analyses.

Table 3-19. Measures interpretation guidelines

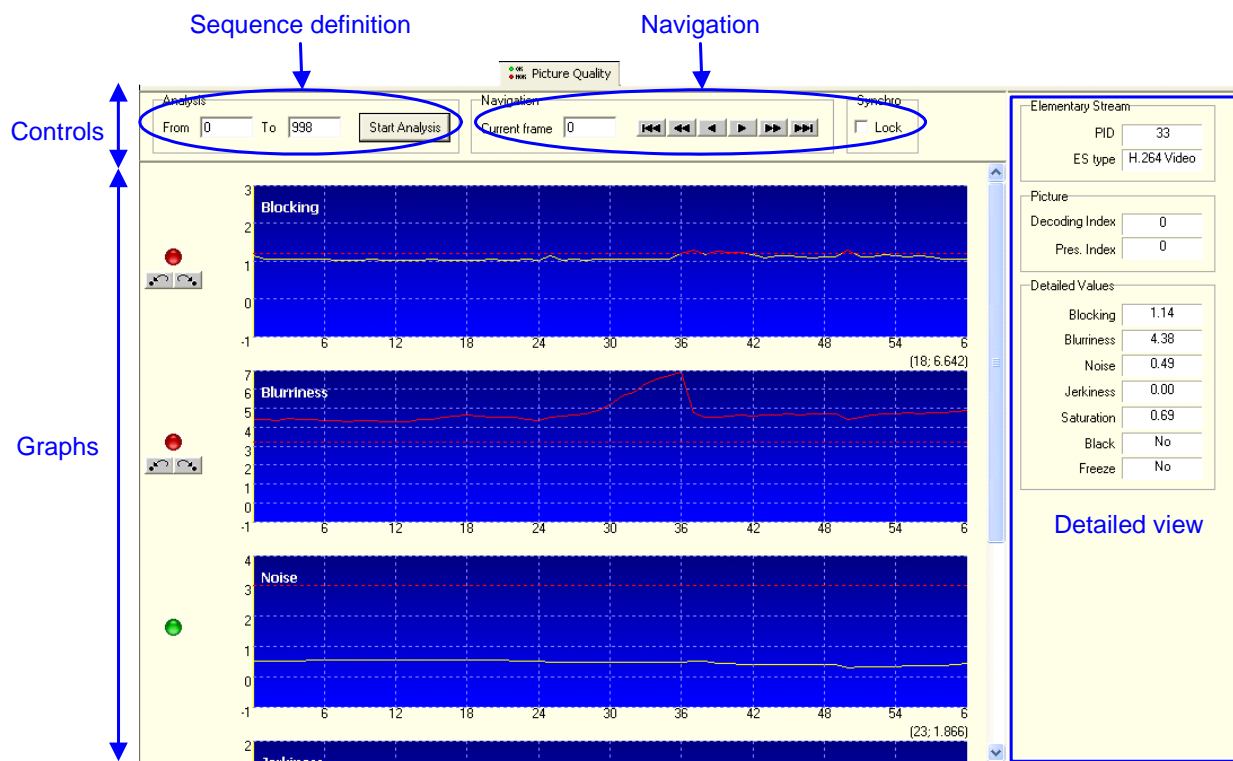
	Measurement interval	Description	Good quality metric
Blockiness	[0 - 100]	The larger the metric for < 75 blockiness is, the worst the video quality will be.	
Blurriness		The larger the metric for < 75 blurriness is, the worst the video quality will be.	
Noise		The larger the metric for noise < 75 is, the worst the video quality will be.	
Jerkiness		-	< 20

If, for a picture, blockiness, blurriness and noise metrics are all equal to 75, video quality is considered as bad.

## Picture Quality Analysis Tab

The [Picture Quality Analysis](#) tab is part of the [Main](#) view. This tab is available provided the opened file contains at least one H.264/AVC video stream.

Figure 3-91. Picture Quality analysis tab



The **Picture Quality Analysis** view is split into three parts:

- The control area lets you define the video sequence to analyze and navigate through the results.
- The graph shows a visual representation of the analysis results (one graph per analyzed artifact).
- The detailed view shows detailed information on the current picture.

## Sequence Definition

Enter the presentation indexes in the **From** and **To** fields to define the sequence to analyze.

For each new elementary stream selection in the **Hierarchical** view, the first time the **Picture Quality** tab is accessed, the 2 edit boxes are filled with default values. **From** contains the presentation index of the first decodable picture, **To** contains the presentation index of the last known picture at that time. It's not necessarily the last picture of the stream, if the file parsing is in progress. If these values are unknown when accessing the tab, the edits are left blank. They will be set when known by the Analyzer, only you did not already do it.

## Results Display

Results of the analysis are displayed in a graph, one for each artifact selected in the [Settings](#) panel, except for the black and frozen sequences analysis which are not represented in a graph.

The X-axis is the picture presentation indexes, the Y-axis is the values of the artifact (a real number). The yellow vertical line is the current frame selected with the control part of the view.

The horizontal red dotted line is the threshold defined in the [Settings](#) panel. Parts of the graph under the threshold are drawn in yellow, parts above in red.

One graph can display at most 61 pictures on the X-axis. For analyzed range greater the view will scroll automatically, the current frame will be in the middle of the graph when possible.

Right-click in the graph to restrain the Y-axis scale to the minimum and maximum values. In this mode the threshold line may not be visible. Right-click again to revert to normal. The Y scale is from 0 to a little more than the maximum between the maximum value and the threshold.

## Navigation

Use the arrow buttons of the [Navigation](#) panel to go to the next/previous frame, next/previous page or the first/last frame, or type the desired frame number in the corresponding box and press enter.

A page is the maximum number of pictures that can be displayed in a graph (61 pictures). Navigation page by page allows for a quick scrolling in the graph without displaying the same result twice.

Check the [Lock](#) box to synchronize the [Thumbnail](#) view with this one. This synchronization is one-way only, navigation in this view cannot be done using the panel in the [Thumbnail](#) view.

On the left of each graph, a red LED indicates that at least one of the analysis results is above the threshold. Such frames can be quickly retrieved by using these buttons.

*Figure 3-92. Too high picture quality results navigation panel*



When the [Lock](#) box is not checked and a control in a control part has the focus, shortcuts are available to navigate through the results: you may use the plus and minus key of the numpad. Press the + key to increase

the current frame by one; click the – key to decrease it by one. Click the `Ctrl` key at the same time to increment and decrement by one page.

## Detailed View

The detailed view shows detailed information for the current picture, grouped in tree categories.

The [Elementary Stream](#) area is a remainder of the elementary stream analyzed. It indicates its PID in case of a TS or MP4/MOV/FLV file and its type which is currently limited to H.264/AVC. For files with more than one video stream, if the selected video stream in the [Hierarchical](#) view is different from the last analyzed one, the background of the PID field becomes blue.

The [Picture](#) area contains presentation and decoding indexes. They are the same as those displayed in the [Thumbnail](#) view.

The [Detailed Values](#) area contains the values found for each analyzed artifact for the picture. An hyphen is indicated for not analyzed artifacts.

Black and freeze values are not numerical, they can have one of the following values:

- *No*: the current picture does not belong to a sequence.
- *Yes*: the current picture belongs to a sequence.
- *Yes, is first*: the current picture is the first of a sequence.
- *Yes, is last*: the current picture is the last of a sequence.

## Analysis Errors

If an error occurs during the quality analysis process, a message appears in the [Report](#) view. When browsing the results, the decoding and presentation edits tell it. Since there are no results for this frame, the edits of the detailed views contain a hyphen.

For a picture in error, in the graphs the values are set to 0.

## Advanced Quality Settings

The [Settings](#) panel lets you define the parameters used in different quality algorithms, the jerkiness, saturation and black sequence analysis.

For the jerkiness, you may set the window span, by default it is 3. For jerkiness computing, the CMA 1820 uses images before and after the current picture. The window span is the total number of frames used in the computation, it's 2 times the number of frames on each side (before and after) plus the current frame. Therefore it must be an odd number. For example, a window span of 3 means one frame on each side of the

current one, a window span of 7 means 3 frames on each side. The Analyzer accept only values lesser than 11, if you set a bigger one, it will be ignored.

For the saturation analysis, you may set the boundaries for the Y and chroma components. Each pixel having one of its component outside the corresponding boundaries will be considered saturated, thus increase the global saturation value for the picture. The default values are not chosen haphazardly, they correspond to the default boundary values defined in the H.264 standard for Y, U and V. But in fact the standard defines 2 sets of boundary values, one between 16 and 235, 240 (the default one) and the other between 0 and 255. Since each component is 8-bits coded, computing the saturation with the second set will lead to a saturation value of 0 for each frame. But, for streams where components are coded using the [0-255] boundaries, computing the saturation with the first set has no meaning, those streams cannot saturate.



To find which boundary set a stream use, go to the Syntax view for a frame containing SPS information. Expand the tree to see the `vui_parameters` node and look for the `video_signal_type_present_flag`. If it's set to 1 look for the `video_full_range_flag`. If `video_signal_type_present_flag` is 0 then `video_full_range_flag` is 0 too.  
If `video_full_range_flag` is 0 the boundaries are Y [16, 235] and U,V [16, 240],  
Else boundaries are [0, 255] for each component.

For black sequence analysis, you may set the maximum Y value to be considered as black. In this case it's meaningful to know which are the boundaries for the Y coding (see explanations in the previous paragraph). The default value (30) is intended to be used in the [16, 235] boundaries. In general, values lesser than 16 are meant to be used in [0, 255] and values above in [16, 235].

Black detection can't focus only on the luminance, it must use the chrominance components as well. The Analyzer uses an interval around the component values. Each one of these intervals has the same length, determined by the value given in the settings. It's the distance between the given value and the minimum possible value (0 or 16 depending on the stream). It's recommended not to set values greater than 16 units above the minimum value, that is for [0-255] the maximum value will be 15, and for [0, 235] you should not set a value greater than 31.

## TS Player

The [TS Player](#) tab is part of the [Main](#) view. It is available only if the opened file is an MPEG- 2 TS. From the [Hierarchical](#) view, you can start the playback of any video stream present in the TS, provided it is encoded in one of the following formats:

- MPEG-1
- MPEG-2
- H.264/AVC (4:2:0, 8 bits only)

The player also playbacks audio streams. Supported audio formats are:

- MPEG-1 audio
- MPEG-2 audio
- AAC
- AC3

Since a program stream may contain several audio streams, the default audio stream played is the first associated audio. To play a video with another audio stream, first select the audio stream from the [Hierarchical](#) view.


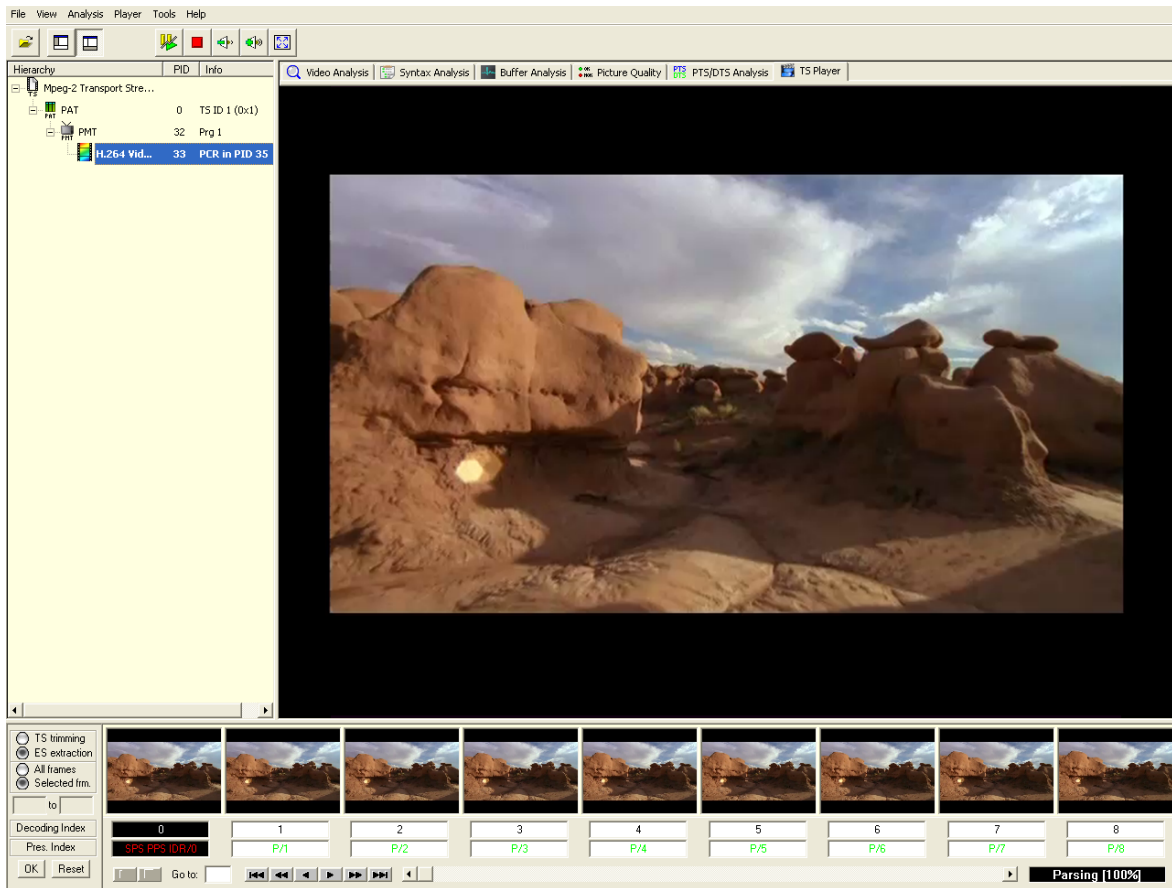

Simply click the  [Play](#) toolbar button to launch the playback immediately.

Figure 3-93. TS Player view



## Settings Panel

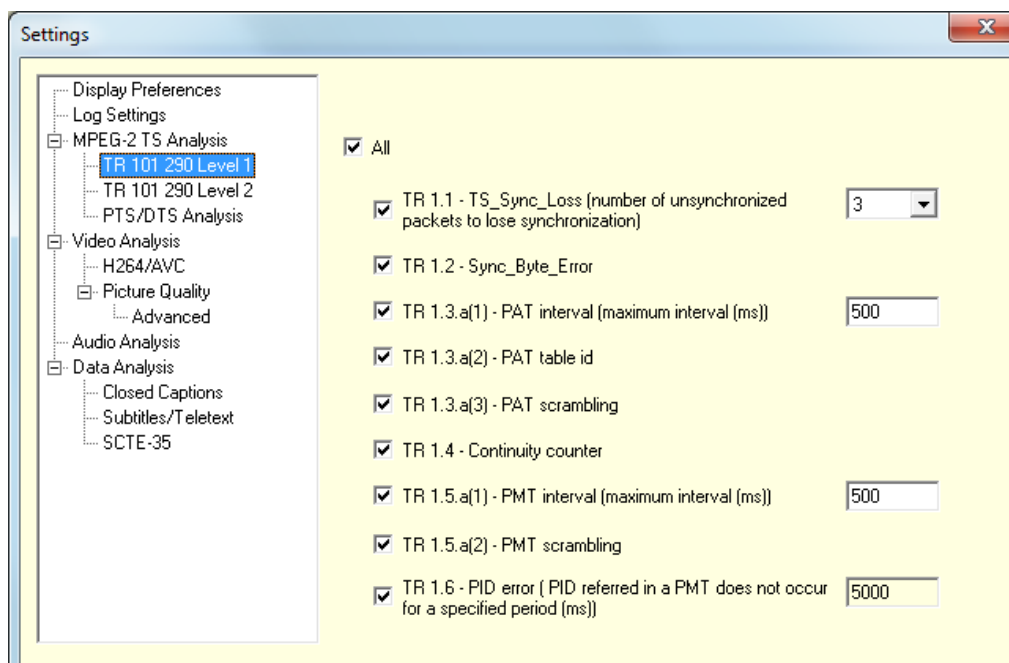
To reach the [Settings](#) panel, click the  toolbar button.

The [Settings](#) panel opens on the view that corresponds to the current analysis in the main view.

The [Settings](#) panel lets you enable or disable specific points in the conformance tests that are performed whenever a stream is opened in the Analyzer.

In all the views of this dialog, the [All](#) check box lets you check or uncheck all of the underlying options.

Figure 3-94. Settings panel (TR 101 290 level 1 view)



## Display Preferences Settings

[Display Preferences](#) settings let you set a number of display parameters:

- [Video frame rate for playback](#): choose whether you want to be asked to enter a frame rate when playing back a stream either when the frame rate information is not present in the stream, always or never.
- [QP overlay](#): choose the type of Quantization Parameter overlay you want to display:
  - ❖ [Absolute QP](#): QP values are represented using a color palette.
  - ❖ [Relative QP](#): QP values are represented using yellow shades.
  - ❖ [QP value](#): QP values are displayed as such on the picture.



- **Expand field pictures to frame size:** when the video is composed of fields instead of full frames, you can choose to display these fields at the same size as a frame.
- **Expand pictures to display aspect ratio** (available only for Closed Captions analysis, DVB subtitles and EBU teletext): check this box to display the video at its real display aspect ratio instead of the format it has been encoded.
- **Display syntax elements values in hexadecimal:** check this box to display the syntax values in hexadecimal instead of decimal. This has repercussions in the [Syntax Analysis](#) tab as well as in the PID number in the tree when playing an MPEG-2 stream.

## Log Settings

Log settings let you personalize the way log files are generated.

- **Specify log file path:** if you want to modify the default location for saving log file, check the box and browse to select the new directory.
- **When reopening a file:** you can select the behavior of the analyzer when a file is opened multiple times. Either overwrite the previous log files with the new ones, or create a folder with a different name to store the new files.
- **Exported file format:** for some analysis results, the result can be exported either in text format or in Comma-Separated Values (CSV).
- **Number of errors reported before muting:** if you want to modify the number of errors of a particular type that are reported before the system mutes subsequent errors of this type, check the box and specify a higher value.



On Windows 8/8.1 systems, if the software is installed in the "Program Files" folder, the system may forbid the creation of log files in the installation folder. The "specify log file path" setting allows you to define a different path, so that log files will be available.

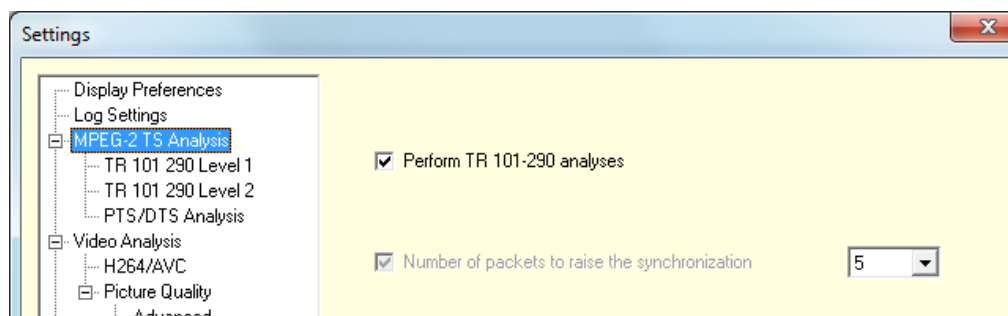
## MPEG-2 TS Analysis Settings

- **Standard :** when set to " DVB " this setting interprets the Service Description Table (SDT) to display the service name in the Hierarchic View.
- **Analyze packets with transport\_error\_indicator = 1:** When disabled, this option ignores all packets with transport\_error\_indicator = 1. When enabled, all packets are analyzed, which allows more flexible analysis but can cause analysis errors.

## TR 101 290 Settings

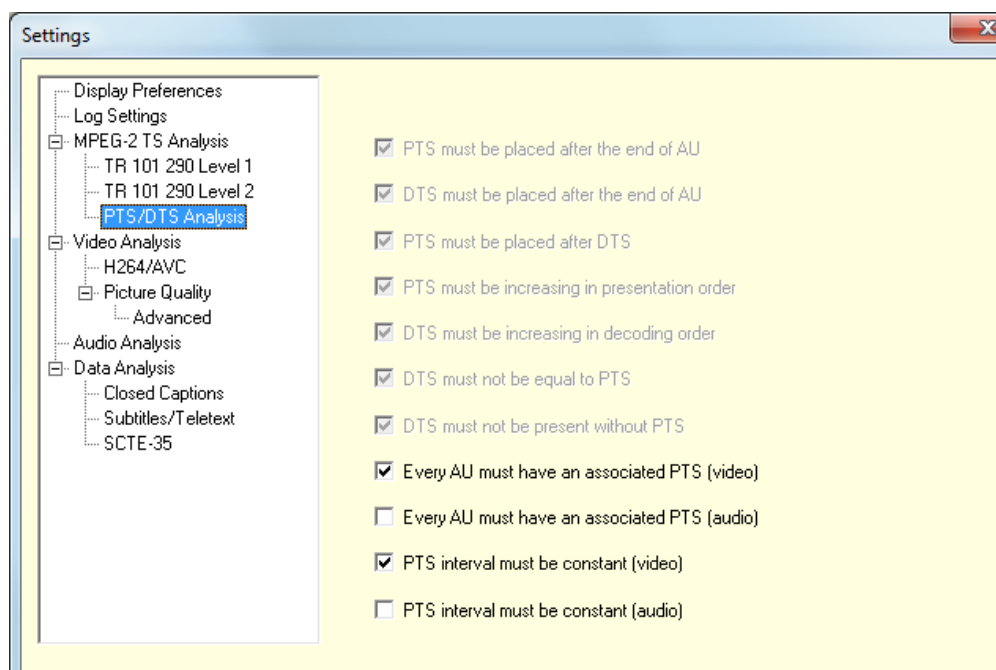
For MPEG-2 Transport Streams, conformance to TR 101 290 is tested. When the test is based on a threshold, it also lets you specify different values. All tests can be disabled simultaneously by unchecking the [Perform TR 101 290 analyses](#) box from the main [MPEG-2 TS Analysis](#) panel.

Figure 3-95. Disabling all TR 101 290 tests simultaneously



## PTS/DTS Analysis Settings

Figure 3-96. PTS/DTS analysis settings



Some PTS/DTS analyses are mandatory and are therefore always performed (enabled and grayed). These are conformance rules and will appear as errors in the PTS/DTS analysis view.

Other PTS/DTS analyses are optional. You may enable or disable them as needed. They will appear as warnings in the PTS/DTS analysis view.

## Video Analysis Settings

**Video Analysis** settings let you enable the macroblock coefficients display.

You can also set the number of GOPs decoded when jumping forward or backward in the stream.

### H.264/AVC Settings

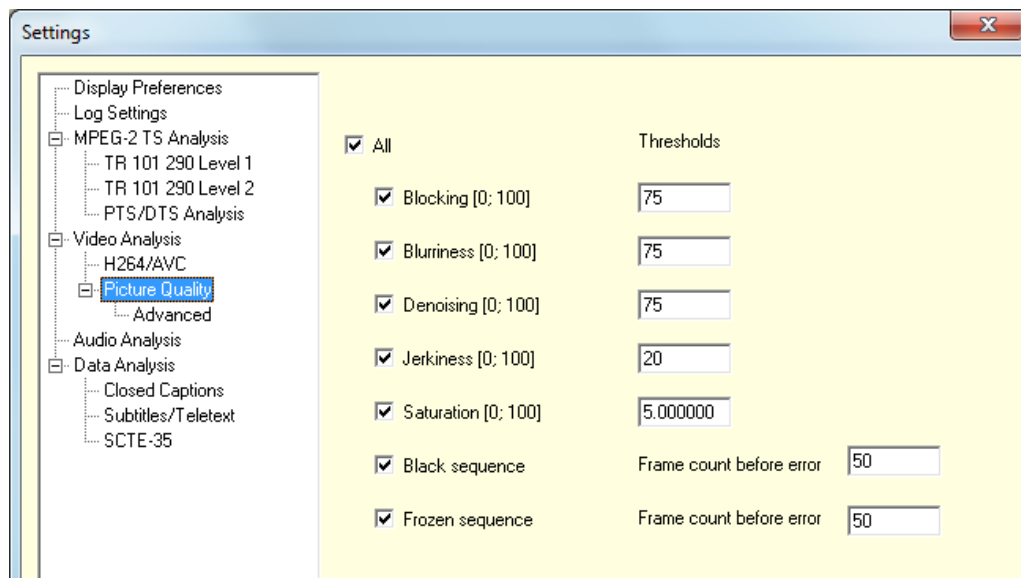
For H.264/AVC streams, you can enable or disable conformance tests.

### Picture Quality Settings

**Picture Quality** settings let you select the analyses to perform: check a box to enable the corresponding analysis.

- **Thresholds:** you can set a threshold for the five first analyses. Enter the threshold value in the field. When an analysis is enabled, the corresponding graph may be obtained. The threshold will be shown on the graph by a red horizontal dotted line. Results above this threshold will be considered as of bad quality and displayed in red too.
- **Black sequence** and **Frozen sequence** detection: you can set the minimum number of successive pictures to be black or frozen before the CMA 1820 considers this as a black or frozen sequence.

Figure 3-97. Selection of Picture Quality analysis



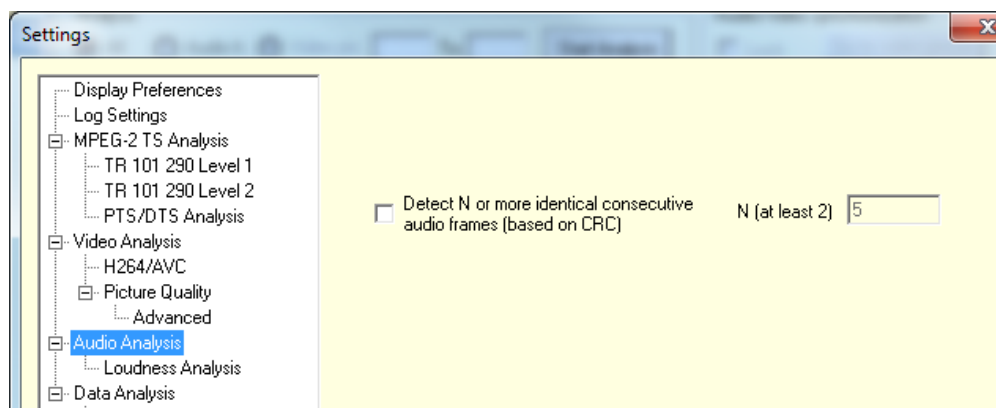
[Advanced settings](#) lets you set parameters for some detections algorithms. These are explained in *section 'Advanced Quality Settings'* on page 212.



Change of advanced settings values are reserved for very specific cases.

## Audio Analysis Settings

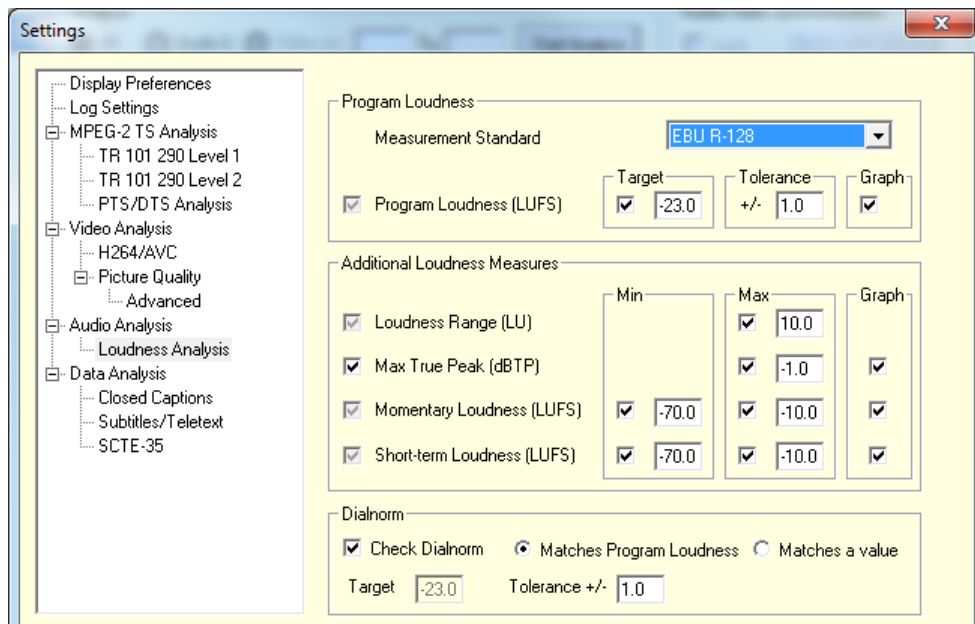
Figure 3-98. Audio analysis settings



[Audio Analysis](#) settings let you set the number of identical consecutive audio frames after which an alarm should be raised. Check the box and set the value in the field.

## Loudness Analysis

Figure 3-99. Loudness analysis settings



In the **Program Loudness** area, choose the measurement standard that you want to use. This will set the **Program Loudness Target** and **Tolerance** accordingly. The values of **Program Loudness Target** and **Tolerance** can also be set manually, but this will result in the measurement standard to be set to "Custom values". The display of the graph can also be disabled.

In the **Additional Loudness Measures** area, you can set thresholds on the other measures.

- A maximum value can be set for **Loudness Range** and **Max True Peak**.
- A minimum, a maximum value, or both can be set for **Momentary Loudness** and **Short-term Loudness**.

The computation of the **Max True Peak** values can be disabled to save time. The display of all graphs can also be disabled.



The computation of **Program Loudness**, **Loudness Range**, **Momentary Loudness** and **Short-term Loudness** cannot be disabled.

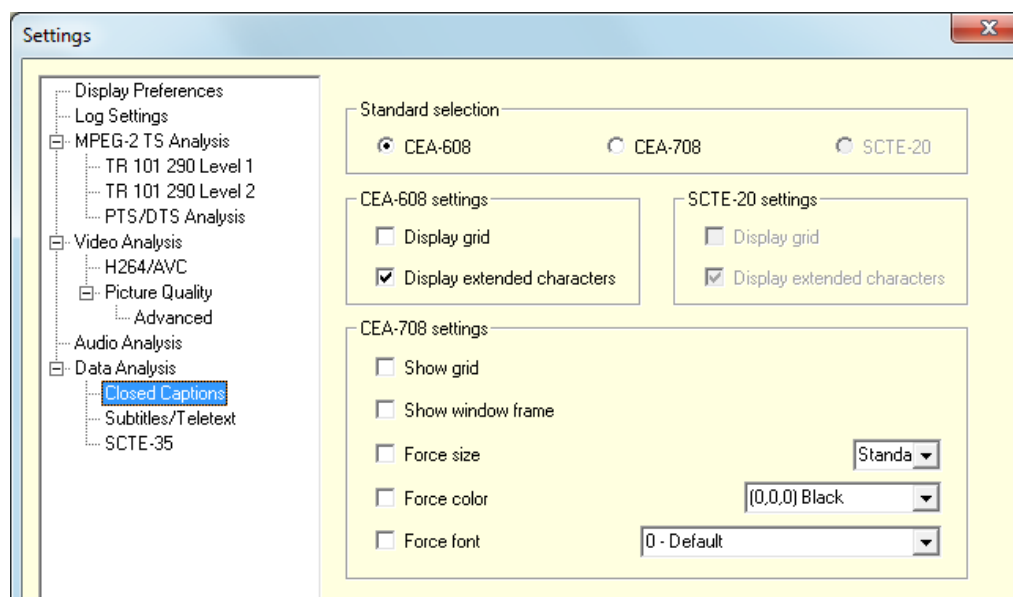
The **Dialnorm** area defines the configuration for the analysis of the **Dialnorm** field contained in AC-3 and E-AC-3 metadata. The check can be globally disabled, and if enabled, can check either:

- that the **Dialnorm** field value matches the Program Loudness (recommended in some environments)
- that the **Dialnorm** field value matches a target value, with a tolerance.

## Data Analysis

### Closed Captions Settings

Figure 3-100. Closed captions settings



In the **Standard selection** area, choose the format that you want to display on the video.

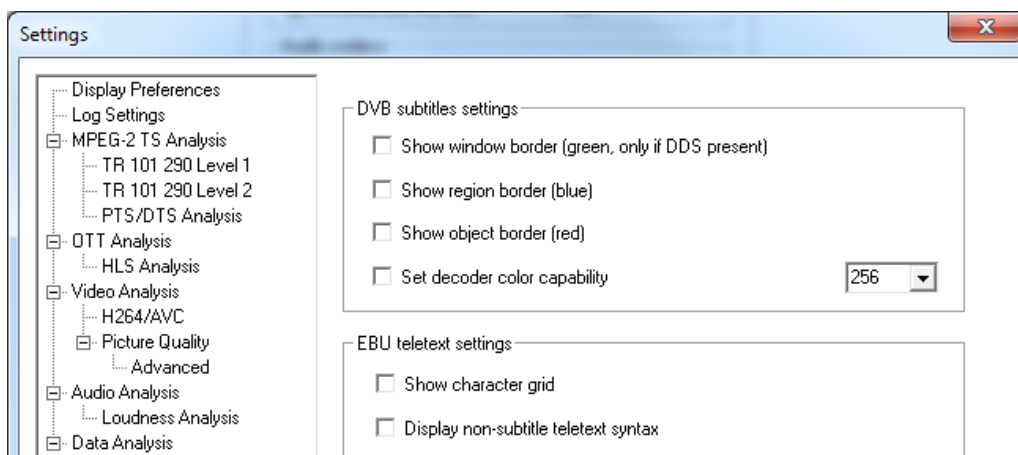
A dedicated area is available for each closed caption standard. Set the options for each of them.



Some areas might be grayed if the corresponding format does not exist in the stream.

## Subtitles and Teletext Settings

Figure 3-101. Subtitles and teletext settings



This panel is divided into two areas, one for DVB subtitles and the other for EBU teletext.

### DVB Subtitles Settings

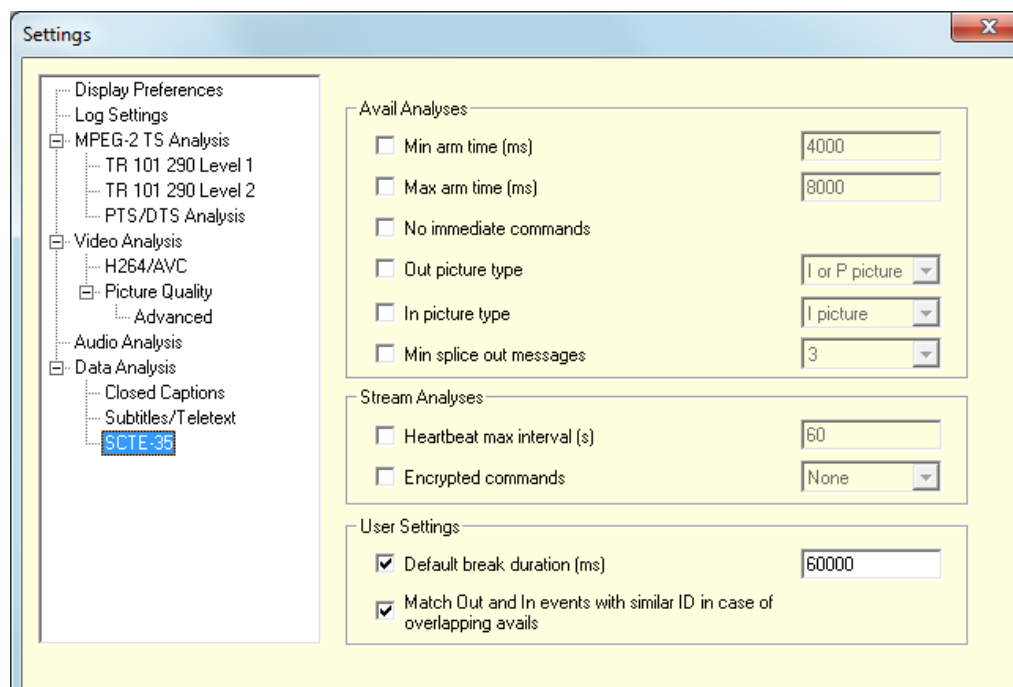
- **Show window border:** in High Definition videos, it is necessary to define a virtual window in which the subtitles will be displayed. The subtitles coordinates will apply in this virtual window. Check the box to display the window's borders on the video.
- **Show region border:** check this box to display the regions' borders in the page, on the video.
- **Show object border:** check this box to display the objects' borders in the regions, on the video.
- **Set decoder color capacity:** each decoder has its own color capacity. Check this box if you wish to simulate the display with a given number of colors, and choose a mode from the drop-down list.

### EBU Teletext Settings

- **Show character grid:** check this box if you wish to display the grid (i.e. lines and columns) in which EBU teletext will be displayed on the video.

## SCTE-35 Settings

Figure 3-102. SCTE-35 settings



This panel is divided into three areas, one for analyses at avail level, one for analyses at stream level, and the last one for particular settings.

### Avail Analyses

- **Min arm time:** minimum time that should separate a command's reception from its execution, in milliseconds. Check this box to raise alarms if a command's arm time is lower than the value defined in the field.
- **Max arm time:** maximum time that should separate a command's reception from its execution, in milliseconds. Check this box to raise alarms if a command's arm time exceeds the value defined in the field.
- **No immediate commands:** check this box to raise alarms if splice immediate commands are present.
- **Out picture type:** check this box to raise alarms if the Out picture (the first picture of the avail) is not of the type defined from the drop-down list.
- **In picture type:** check this box to raise alarms if the In picture (the first picture back in the stream, after the end of the avail) is not of the type defined from the drop-down list.
- **Min splice out messages:** check this box to raise alarms if the number of splice out commands is inferior to the number defined from the drop-down list.



### Stream Analyses

- **Heartbeat max interval:** check this box to raise alarms if the time between two heart-bit messages (splice null commands) exceeds the value defined in the field, in seconds.
- **Encrypted commands:** check this box to perform an analysis on encrypted commands. You can check that:
  - ❖ all commands are encrypted,
  - ❖ at least insert commands are encrypted,
  - ❖ no command is encrypted.

An alarm is raised if commands encryption does not respect this rule.

### User Settings

- **Default break duration:** check this box to specify a default duration for avails, in milliseconds. An avail is broken after the defined duration if no duration is specified in the splice out command AND no splice in command is received.
- **Match Out and In events with similar ID in case of overlapping avails:** the SCTE-35 standard does not require Out and In events of a same avail to have the same ID. As a result, if avails overlap, it can be tricky to identify the correspondence between Out and In events. Check this box to match Out and In events that have the same splice\_event ID in case of overlapping avails. If this box is unchecked, Out and In events will not be considered as belonging to the same event even if they have the same event ID.

## HLS Settings

HLS Analysis lets you enable different analyses on HLS playlist files and MPEG-2 TS segments.

### Master Playlist Conformance

These analyses cannot be disabled and thus do not appear in the [Settings](#) panel. However, the corresponding conformance status is represented in the [HLS Analysis](#) view.

- **Syntax conformance:** fails if the Master Playlist does not respect the HLS syntax as described in the standard.
- **URI resolution:** fails when a Media Playlist URI specified in the Master Playlist cannot be resolved, i.e. if no file can be opened at this URI.
- **Aggregated:** the status of this analysis represents the conformance status of all Media Playlist files referenced in the Master Playlist. It allows a quick view of the overall conformance.

### Media Playlist Conformance

- **Syntax conformance:** check this box to raise alarms if the Media Playlist does not respect the HLS syntax as described in the standard.
- **Timing conformance:** check this box to raise alarms if the maximum duration indicated in the Media Playlist (with the "EXT-X-TARGETDURATION" tag) is exceeded by the declared duration (in the "EXTINF" tag) of any contained Segment.
- **URI resolution:** check this box to raise alarms when a Segment URI specified in the Media Playlist cannot be resolved, i.e. if no file can be opened at this URI.

### Segment Conformance

- **TS structure:** check this box to raise alarms if the Segment does not respect the constraints on MPEG-2 TS Segments:
  - ❖ The Segment must contain a single MPEG-2 Program
  - ❖ A PAT and a PMT should be found at the start of the Segment, before any picture start.
- **Random Access Points:**
  - ❖ The 1st analysis fails if a Segment does not contain at least one I frame
  - ❖ The 2nd analysis fails if the I frame is not the first frame in the Segment
- **Segment continuity:** check this box to raise alarms if a Segment is not in the continuity of the previous one in terms of Timestamps and Continuity Counters. Does not apply if a discontinuity is signaled.

### Additional analyses

- **Synchronization** across segments: check this box to raise alarms if the starting time of Segments belonging to the same time window is not identical. This test is performed on segments of a similar type (Audio, Video or Subtitles).
- **Segment duration:** allows definition of a minimum and/or maximum Segment duration, in units of milliseconds. The respect of a constant Segment duration throughout the Media can also be verified.
- **Duration consistency:** check this box to raise alarms if the duration specified in the Media Playlist (in the "EXTINF" tag) is not the duration found in the actual segment in terms of Timestamps. The duration is rounded to the nearest integer.

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# Chapter 4

## Frequently Asked Questions

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### Introduction

If you face any problem with the product, read this section. It can help you to solve your issues.

### Content of this Chapter

'I installed the CMA 1820 on my laptop and I get errors. Why?'  
page 228

'There is an error message because the log files cannot be created, what can I do ?' ..... page 228

## **I installed the CMA 1820 on my laptop and I get errors. Why?**

When installing the CMA 1820 software on a laptop, the laptop must not be plugged on its desk. If it is, the CMA 1820 may not work when the laptop is no longer on its desk.

When starting your laptop on its desk, you must not remove it from its desk to use the CMA 1820 software. If you do, reboot your laptop before launching the CMA 1820 (or a blue screen may occur).

## **There is an error message because the log files cannot be created, what can I do ?**

On Windows 8/8.1 systems (or if you are not the administrator of the machine running A/V Codec Analyzer), if the software is installed in the "Program Files" folder, the system may forbid the creation of log files in the installation folder. The "specify log file path" setting allows you to define a different path, so that log files will be available.

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# Appendix **A**

## Technical Specifications

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### Introduction

This chapter gives information on standard compliance, and provides an ordering guide.

### Content of this Chapter

'Specifications' .....	page 230
'Standard Compliance' .....	page 233
'Ordering Guide' .....	page 236

## Specifications

The decoders that are embedded in the Compressed Media Analyzer feature the following characteristics.

### H.264/AVC

#### Profiles

H.264/AVC supported profiles at all levels (max resolution: 3840 x 2160):

- Baseline
- Main
- Extended
- High
- High 10
- High 4:2:2
- High 4:4:4

#### Decoding Tools

H.264/AVC supported decoding tools:

- All chroma formats
- All bit depth
- I slices
- P slices
- B slices
- CAVLC
- CABAC
- Interlaced: PAFF, MBAFF and field mode
- Weighted prediction
- Redundant slices
- IPCM

Unsupported decoding tools:

- SP and SI slices
- Data partitioning

- Slice groups



If a file containing FMO (Flexible Macroblock Order) is opened, it is not decoded.

- ASO

If the stream features Data partitioning or ASO, the Analyzer will not be able to open it. In case of SP or SI slices, only these slices will not be decoded.

## H.265/HEVC

### Profiles

H.265/HEVC supported profiles at all levels (max resolution: 4096 x 2160):

- Main
- Main 10
- Main still
- Format Range Extension profiles

## VC-1

VC-1 supported profiles at all levels (maximum resolution: 1920 x 1080):

- Simple
- Main
- Advanced

## MPEG-2 Video

### Profiles

Mpeg-2 Video profiles supported at all levels (maximum resolution: 1920x1080):

- Simple
- Main
- High
- 4:2:2

Unsupported profiles:

- SNR
- Spatial
- Multi-view

## Coding Tools

Unsupported coding tools:

- Scalability

If the stream features scalability, Data Unit belonging to a layer different from the base layer will be identified and reported in the [Syntax](#) view, but will not be decoded.

## MPEG Audio

MPEG-1 audio and MPEG-2 audio supported layers (one or two channels):

- Layer I
- Layer II
- Layer III

## AC-3 and E-AC-3

AC-3 and E-AC-3 supported channels:

- All channels supported, up to 5.1

## AAC

Supported AAC elements:

- Stream type: ADTS, LOAS/LATM
- Object type: Main, LTP, LC, ER LC, SBR, PS
- Channels: mono, stereo and 5.1

Unsupported AAC elements:

- Stream type: ADIF
- Object type: SSR, ER LD

In case of unsupported object type, the Analyzer will open the file and read some characteristics, but it will not decode it.



## Standard Compliance

Table A-1. Standard compliance

Standards	Title
<b>ISO/IEC 13818-1</b>	Information technology - Generic coding of moving pictures and associated audio information: Systems. July 2014
<b>TR 101 290</b>	Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems. Edition 1.2.1, May 2001
<b>ITU/T H.264</b>	Advanced video coding for generic audiovisual services. February 2014
<b>ITU/T H.265</b>	Infrastructure of audiovisual services - Coding of moving video High Efficiency Video Coding October 2014
<b>ETSI TS 101 154 DVB implementation guidelines</b>	DVB; Implementation guidelines for the use of Video and Audio coding in Broadcasting Applications based on MPEG-2 Transport Stream version 1.7.1, June 2005
<b>ISO/IEC 14496-14</b>	ISO base media file format (MP4 and MP4 fragmented). October 2008
<b>FLV</b>	Adobe Video File Format specification V9 <sup>a</sup> . April 2008
<b>HLS</b>	HTTP Live Streaming draft-pantos-http-live-streaming-14, October 2014
<b>MOV</b>	Apple QuickTime File Format specification <sup>a</sup> . September 2007
<b>ISO/IEC 14496-15</b>	Advanced Video Coding (AVC) file format. First edition, April 2004
<b>3GPP TS 26.244</b>	3rd Generation Partnership Project Transparent end-to-end packet switched streaming service (PSS); 3GPP file format (GP) Version 6.2.0, December 2004
<b>Coding of audio-visual objects: Audio ISO/IEC 14496-3</b>	MPEG-4 Audio, ISO/IEC December 2001
<b>Coding of audio-visual objects: Audio ISO/IEC 14496-3 Amd-1: bandwidth extension</b>	MPEG-4 Audio Amd-1, ISO/IEC December 2003

Table A-1. Standard compliance

<b>Standards</b>	<b>Title</b>
<b>Coding of audio-visual objects: Audio ISO/IEC 14496-3 Amd-4</b>	MPEG-4 Audio Amd-4, ISO/IEC December 2004
<b>ATSC AC-3</b>	ATSC Digital Audio Compression Standard (AC-3, E-AC-3) Revision B Document A/52B, 14 June 2005
<b>ISO/IEC 13818-2</b>	Generic coding of moving pictures and associated audio information: Video. February 2000
<b>CEA-608-D</b>	Line 21 Data Services. May 2007
<b>CEA-708-C</b>	Digital Television (DTV) Closed Captioning. July 2006
<b>ANSI/SCTE 20</b>	Methods for carriage of closed captions and non-real time sampled video. 2004
<b>ETSI EN 300 743</b>	DVB Subtitling systems Version 1.3.1, November 2001
<b>ETSI EN 300 468</b>	Specification for Service Information (SI) in DVB systems. Version 1.8.1, July 2008
<b>ETSI EN 300 706</b>	Enhanced Teletext Specification. Version 1.2.1, April 2004
<b>ETSI EN 300 472</b>	Specification for conveying ITU-R System B Teletext in DVB bitstreams. Version 1.3.1, May 2003.
<b>ETSI EN 301 775</b>	Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams. Version 1.2.1, May 2003
<b>SCTE-35</b>	Digital Program Insertion Cueing Message for Cable. 2013
<b>SCTE-67</b>	Interpretation for SCTE 35. 2006
<b>ETSI EN 300 231</b>	Television systems; Specification of the domestic video Programme Delivery Control system (PDC). Version 1.3.1, April 2004
<b>ETSI EN 300 294</b>	Television systems; 625-line television Wide Screen Signalling (WSS). Version 1.4.1, April 2004
<b>ITU-R BS.1770-3</b>	Algorithms to measure audio programme loudness and true-peak audio level. August 2012
<b>EBU R 128</b>	Loudness normalisation and permitted maximum level of audio signals. August 2011
<b>EBU TECH 3341</b>	Loudness Metering: 'EBU Mode' metering to supplement loudness normalisation in accordance with EBU R 128. August 2011

Table A-1. Standard compliance

<b>Standards</b>	<b>Title</b>
<b>EBU TECH 3342</b>	Loudness Range: A measure to supplement loudness normalisation in accordance with EBU R 128. August 2011
<b>WebVTT</b>	Web Video Text Tracks Format, Draft Community Group Report 22, March 2015
<b>MXF File Format</b>	Material Exchange Format (MXF) File Format Specification - May 2009
<b>MXF Generic Container</b>	Material Exchange Format (MXF) MXF Generic Container - September 2004
<b>EBP Comcast</b>	Encoder Boundary Point Specification - Comcast EBP I01 - January 2012
<b>EBP CableLabs</b>	Encoder Boundary Point Specification - OC-SP-EBP-I01 - January 2013

## Ordering Guide

The CMA 1820 is made up of cumulative options, activated with the license manager.



The list of activated options is displayed in the [About](#) box ([Help](#) menu) and in the [Main](#) view when no file is opened.

## Base Product

Table A-2. CMA 1820 base product reference

Commercial reference	Description
CMA 1820	CMA 1820 Compressed Media Analyzer Base. This license includes Broadband Recorder, Media Extractor, TS parser, player and TR101290.

## Video Codecs Options

Table A-3. CMA 1820 video codecs options

Commercial reference	Description
CMA_HEVC	CMA 1820 License. This option enables HEVC/H265 Video Analysis. It includes HEVC/H265 analysis, compliance, decoding and trimming.
CMA_H264	CMA 1820 License. This option enables H264/AVC Video Analysis. It includes MPEG-4 analysis, compliance, decoding and trimming.
CMA_MPG2	CMA 1820 License. This option enables MPEG-2 Video Analysis. It includes MPEG-2 video analysis, compliance, decoding and trimming.
CMA_VC1	CMA 1820 License. This option enables VC-1 Video Analysis. It includes VC-1 analysis, compliance, decoding and trimming.

## Audio Codecs Options

Table A-4. CMA 1820 audio codecs options

Commercial reference	Description
CMA_MPEG_AUDIO	CMA 1820 License. This option enables MPEG layer I, II, III Audio Analysis. It includes analysis, parsing, decoding, waveform display and extraction.
CMA_AC3	CMA 1820 License. This option enables Dolby® AC3 and Dolby® Digital Plus Audio Analysis. It includes analysis, parsing, decoding, waveform display and extraction.
CMA_AAC	CMA 1820 License. This option enables AAC Audio Analysis. It includes analysis, parsing, decoding, waveform display and extraction.

## Options for Other Analyses

Table A-5. CMA 1820 options for other analyses

Commercial reference	Description
CMA_OTT	CMA 1820 License. This option enables WebTV/Over-the-top content analysis. HTTP Live Streaming format and WebVTT subtitles supported. It requires at least one video analysis option.
CMA_LOUDNESS	CMA 1820 License. This option enables audio loudness, loudness range and max true peak level analyses. It requires at least one audio analysis option.
CMA_PTS	CMA 1820 License. This option enables PTS/DTS Analysis on MPEG-2 TS.
CMA_SUB	CMA 1820 License. This option enables DVB and EBU Teletext subtitles analysis and display. It requires at least one video analysis option.
CMA_CC	CMA 1820 License. This option enables closed captions analysis and display (CEA-608 and CEA-708). It requires at least one video analysis option.
CMA_DPI	CMA 1820 License. This option enables Digital Program Insertion analysis (SCTE 35 cue tones). It requires at least one video analysis option.

*Table A-5. CMA 1820 options for other analyses*

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CMA_PQ	CMA 1820 License. This option enables Picture Quality Analysis on MPEG-4 video. It includes Blockiness, Bluriness, Jerkiness, and Noise, Saturation measurements, Black and Freeze frames detection.
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## Appendix **B**

# Customer Services

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## Repackaging for Shipment



We strongly recommend you to use the original box and packaging when returning your system. Sencore cannot honor the instrument's warranties if the system arrives at the service center damaged and it was not shipped in its original carton or in a replacement carton (and its supporting packaging material) purchased from Sencore. If you lose your original packaging material, contact your Sencore representative to obtain replacement packaging.

The system is shipped in cartons designed to protect the instrument. Should you ship the instrument, use these cartons, spacer pads, protective bag and instrument support inserts to provide adequate protection. If an instrument is to be shipped to the Sencore service center, please request a **Return Materials Authorization (RMA)** number from your Sencore representative. Please enclose in the box the following information:

- RMA number
- Owner's name and address
- Serial number
- Description of the problem(s) encountered and/or service required

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<b>AAC</b>	Advanced Audio Coding
<b>ABR</b>	Adaptive Bit Rate
<b>AC transform coefficient</b>	Any transform coefficient that is not the top-left coefficient of the transformed block (called DC).
<b>ADIF</b>	Audio Data Interchange Format
<b>ADTS</b>	Audio Data Transport Stream
<b>Arithmetic coding</b>	A category of coding schemes that take symbols as input and produce a floating-point number as the output.
<b>ASF</b>	Advanced System Format
<b>ASO</b>	Arbitrary Slice Order
<b>ATSC</b>	Advanced Television Systems Committee
<b>AU</b>	Access Unit A set of NAL units always containing a primary coded picture. In addition, it may also contain other optional NAL units.
<b>Avail</b>	Time space provided to cable operators by cable programming services during a program for use by the CATV operator; the time is usually sold to local advertisers or used for channel self promotion.
<b>AVC</b>	Advanced Video Coding
<b>B slice</b>	A slice decoded using Intra prediction and Inter prediction using at most two reference pictures.
<b>BDU</b>	Bitstream Data Unit A unit of the compressed data which may be parsed (i.e. syntax decoded) independently of other information at the same hierarchical level. A BDU could be, for example, a sequence header, an entry-point header, a coded picture or a slice. An Encapsulation Mechanism (EM) is described to prevent emulation of the start code prefix in the bitstream. The compressed data before encapsulation is called Raw Bitstream Decodable Unit (RBDU), while Encapsulated BDU (EBDU) refers to the data after encapsulation.
<b>Block</b>	An MxN array of samples or transform coefficients.
<b>CABAC</b>	Context-based Adaptive Binary Arithmetic Coding One of the two entropy-coding schemes defined in AVC.

<b>CAT</b>	Conditional Access Table
<b>CAVLC</b>	Context-based Adaptive Variable-Length Coding One of the two entropy-coding schemes defined in AVC.
<b>CB/CU (Coding Block / Coding Unit)</b>	In H.265/HEVC, the coding block is the leaf node of the partitioning of CTB in a recursive quadtree. The size of the CTB is the largest supported size for a CB. The term "block" usually refers to an array of luma or chroma samples, whereas the term "unit" refers to the ensemble formed by a luma block and the two corresponding chroma blocks.
<b>CBF (Coding Block Flag)</b>	In H.265/HEVC, a flag associated to each Transform Block which, when equal to 1, specifies that the TB contains one or more transform coefficient levels not equal to 0.
<b>CTB/CTU (Coding Tree Block / Coding Tree Unit)</b>	In H.265/HEVC, the Coding Tree Block is the basic partitioning of the coding layer. The size LxL of a luma CTB can be chosen as L = 16, 32, or 64 samples, with the larger sizes typically enabling better compression. The term "block" usually refers to an array of luma or chroma samples, whereas the term "unit" refers to the ensemble formed by a luma block and the two corresponding chroma blocks.
<b>CBP</b>	Coded Block Pattern. A variable indicating the pattern of the coded block, i.e which of the six 8x8 partitions of a macroblock contain non-zero transform coefficient levels.
<b>CBPCY</b>	Coded Block Pattern of Color-difference and Luma blocks
<b>CC</b>	Closed Caption
<b>CEA</b>	Consumer Electronics Association
<b>Chroma</b>	One of the two color components of a video signal. The symbols used for the components are U and V. In AVC, each of these two components is half the dimension of the luma component.
<b>Closed GOP</b>	A closed GOP uses no referenced pictures from the previous GOP at the current GOP boundary. For example the GOP is closed when it starts with an I-frame and subsequent B-frames do not rely on I or P-frames of previous GOP. See 'GOP'.
<b>CLUT</b>	Color Look-Up Table
<b>Compression layer</b>	The compression layer is the compressed elementary stream and associated metadata that describes the elementary stream. Usually this layer is organized into variable length packets with headers and payloads of data, in which case the bitstream is called a packetized elementary stream, or PES. See the appropriate MPEG-2, DVB, or ATSC standards for more information. See also ' <a href="#">System layer</a> '.
<b>CPB</b>	Coded Picture Buffer
<b>CPU</b>	Central Processing Unit.
<b>CRC</b>	Cyclic Redundancy Check

<b>DBA</b>	Dynamic Buffer Analysis
<b>DC transform coefficient</b>	Top-left coefficient of the transformed block.
<b>DCT</b>	Discrete Cosine Transform
<b>Direct prediction</b>	An inter prediction mode for which no motion vector is transmitted.
<b>DPB</b>	Decoded Picture Buffer
<b>DPI</b>	Digital Program Insertion
<b>DTS</b>	Decoding Time Stamp A field that may be present in a PES packet header that indicates the time that an access unit is decoded in the system target decoder.
<b>DVB</b>	Digital Video Broadcasting The Digital Video Broadcasting Project (DVB) is an industry-led consortium of around 250 broadcasters, manufacturers, network operators, software developers, regulatory bodies and others in over 35 countries committed to designing open technical standards for the global delivery of digital television and data services. Services using DVB standards are available on every continent with more than 500 million DVB receivers deployed.
<b>EBDU</b>	Encapsulated BDU VC-1 terminology. See <a href="#">'BDU'</a> .
<b>EBP</b>	Encoder Boundary Point. It is a signaling mechanism that can provide a hinting mechanism for taking continuous streams conditioned for adaptive streaming and creating discrete chunks of decodable content with boundaries in one component stream in the multiplex (Fragment) or across the multiplex (Segment).
<b>EBU</b>	European Broadcasting Union
<b>EH</b>	Entry-point Header
<b>ES</b>	Elementary Stream One of the coded video, audio or other bitstreams in PES packets. One ES is carried in a sequence of PES packets.
<b>ES extraction</b>	The process of creating an Elementary Stream containing only a part of a video sequence.
<b>ETSI</b>	European Telecommunication Standards Institute
<b>FCM</b>	Frame Coding Mode The syntax element which indicates whether the frame is coded in progressive mode, interlace-field mode, or interlace-frame mode.
<b>FH</b>	Frame Header
<b>Field</b>	An assembly of alternate rows of a frame. A frame is made up of two fields, a top field containing even rows and a bottom field containing odd rows.
<b>FMO</b>	Flexible Macroblock Order Coding feature authorizing the use of slice groups.

<b>Frame</b>	A frame contains lines of spatial information of a video signal. For progressive video, these lines contain samples starting from one time instant and continuing through successive lines to the bottom of the frame. For interlaced video a frame consists of two fields, a top field and a bottom field. One of these fields will commence one field later than the other.
<b>GOP</b>	Group Of Pictures MPEG-2 term. A GOP is the set of frames contained between two consecutive key frames. A key frame can be an I frame, or an 'IDR' frame.
<b>GUI</b>	Graphical User Interface It is a type of user interface that allows users to interact with electronic devices with images rather than text commands. A GUI represents the information and actions available to a user through graphical icons and visual indicators such as secondary notation, as opposed to text-based interfaces, typed command labels or text navigation.
<b>HD</b>	High Definition.
<b>HDTV</b>	High Definition Television.
<b>HE-AAC</b>	High Efficiency Advanced Audio Coding
<b>HEVC</b>	High-Efficiency Video Coding
<b>HLS</b>	HTTP Live Streaming is a media streaming communications protocol implemented by Apple. It is an Adaptive Bit Rate (ABR) format which works by breaking an overall stream into a sequence of smaller streams called Media Segments, typically lasting between 1 and 10 seconds. As the stream is played, the client may select from a number of different alternate stream containing the same material encoded at a variety of data rates, allowing the session to adapt to the available data rate.
<b>HRD</b>	Hypothetical Reference Decoder
<b>I slice</b>	A slice that is decoded using only Intra prediction.
<b>IDR</b>	Instantaneous Decoding Refresh A coded picture containing only slices with I slice types (no B and no P), that causes the decoding process to mark all reference pictures as "unused for reference" immediately after decoding the IDR picture. After the decoding of an IDR picture all following coded pictures in decoding order can be decoded without inter prediction from any picture decoded prior to the IDR picture. The first picture of each coded video sequence is an IDR picture.
<b>Inter prediction</b>	A prediction derived from decoded samples of reference pictures other than the current picture.
<b>Intra prediction</b>	A prediction derived from the decoded samples of the same decoded slice.
<b>Intra Coded Modulation (I-PCM)</b>	<b>Pulse</b> A particular kind of Intra encoding in which the encoder transmits the values of the image samples directly, without prediction or transformation.

<b>IRD</b>	Integrated Receiver Decoder. The IRD is the official name for the satellite receiver, which has a built-in decoder for unscrambling subscription channels. It is also known as Set-Top Box for the cable.
<b>ISO</b>	International Standards Organization.
<b>ITU</b>	International Telecommunications Union
<b>ITU-R</b>	International Telecommunications Union - Radio. Formerly CCIR. Deals with the standardization of wireless communication.
<b>ITU-T</b>	International Telecommunications Union - Telecommunications. Formerly CCITT. Produces global telecommunication standards, and defines tariff and accounting principles.
<b>LATM</b>	Low-overhead MPEG-4 Audio Transport Multiplex
<b>LC</b>	Low Complexity
<b>Level</b>	Each level specifies a set of limits on the values that may be taken by syntax elements. For any given profile, levels generally correspond to decoder processing load and memory capability. Levels range from 1 to 5. Intermediate levels with non-integer values are also defined.
<b>List 0 (List 1) prediction</b>	Inter prediction of the content of a slice using a reference index pointing into reference picture list 0 (list 1).
<b>LOAS</b>	Low Overhead Audio Stream
<b>Loudness</b>	Defined by the International Telecommunication Union in ITU-R BS.1770, loudness measures how "loud" a program is on average.
<b>Loudness Range (LRA)</b>	The Loudness Range (LRA) measures loudness variation within a program (range between quiet and loud sounds).
<b>Luma</b>	The monochrome component of a picture. The symbol for the luma component is Y.
<b>Macroblock</b>	A macroblock is made up of a 16x16 array of luma samples and two 8x8 arrays of Chroma samples.
<b>Macroblock pair</b>	A pair of vertically contiguous macroblocks in a frame that is coupled for use in macroblock-adaptive frame-field (MBAFF) decoding.
<b>Macroblock-Adaptive Frame/Field</b>	A coding feature lets the encoder consider macroblocks in pairs in which some may be coded as two frame macroblocks and others as two field macroblocks.
<b>MB</b>	Macroblock
<b>MBAFF</b>	Macroblock-Adaptive Frame/Field
<b>Media Segment</b>	A portion of a multimedia presentation, as described in the HLS standard.
<b>Motion vector</b>	A two-dimensional vector used for inter prediction that provides an offset from the coordinates in the decoded picture to the coordinates in a reference picture.

<b>MP4</b>	File format standardized in ISO/IEC 14496-14, based on ISO Base Media File Format (14496-12).
<b>MPEG</b>	Moving Picture Experts Group
<b>MPTS</b>	Multiple Programs Transport Stream
<b>MV</b>	Motion Vector
<b>MXF</b>	Material Exchange Format.
<b>NAL</b>	Network Adaptation Layer A layer specifying the transport-specific features of the AVC standard.
<b>NALU</b>	Network Adaptation Layer Unit A syntax structure containing the coded video data for transmission or storage.
<b>NIT</b>	Network Information Table
<b>OTT</b>	Over-the-Top Television
<b>P slice</b>	A slice decoded using only Intra prediction and Inter prediction using at most one reference picture.
<b>Packet</b>	- In networks, a unit of data transmitted over a packet-switching network. A packet consists of a header followed by a number of contiguous bytes from an elementary data stream. - In transport streams, a packet is a small, fixed-size data quantum.
<b>PAT</b>	Program Associated Table Table indicating which programs exist in a transport Stream. PAT points to PMT.
<b>PCR</b>	Program Clock Reference The sample of the encoder clock count that is sent in the program header to synchronize the decoder clock.
<b>PES</b>	Packetized Elementary Stream Data structure used to carry Elementary Stream data. It consists of a PES packet header followed by a PES packet payload.
<b>Picture Parameter Set</b>	A set of parameters to be applied to one or more coded pictures. Contains a reference to an associated Sequence Parameter Set.
<b>Picture-Adaptive Frame/Field</b>	A coding feature lets the encoder choose between encoding an interlaced picture as a single frame or as two separate fields.
<b>PID</b>	Packet Identifier A 13-bit code in the packet header. All packets belonging to the same ES have the same PID. PID 0 indicates a packet that contains a PAT.
<b>Playlist</b>	Type of files defined in the HLS standard for communication between client and server. HLS describes two types of playlist files: Media Playlist, describing the Media Segments and Master Playlist, describing the global characteristics and identifying Media Playlists.

<b>PMT</b>	Program Map Table Tables in the PAT that point to the video, audio and data content of each program.
<b>POC</b>	Picture Order Count
<b>PPS</b>	Picture Parameter Set
<b>PB / PU (Prediction Block / Prediction Unit)</b>	In H.265/HEVC, the prediction block is the leaf node of the partitioning of CB, used in the prediction process. Depending on the basic prediction type decision, the luma and chroma CBs can then be further split in size and predicted from luma and chroma prediction blocks (PBs). H.265/HEVC supports variable PB sizes from 64x64 down to 4x4 samples. The term "block" usually refers to an array of luma or chroma samples, whereas the term "unit" refers to the ensemble formed by a luma block and the two corresponding chroma blocks.
<b>Prediction process</b>	The use of a combination of previously decoded samples to provide an estimate of the sample value currently being encoded or decoded.
<b>Profile</b>	Three profiles are defined in AVC: Baseline, Main and Extended. Each profile specifies a subset of algorithmic features and limits that shall be supported by all decoders conforming to that profile.
<b>PS</b>	Parametric Stereo (in HE-AAC v2)
<b>PS</b>	Program Stream A bitstream containing compressed video, audio and timing information.
<b>PSI</b>	Program Specific Information
<b>PTS</b>	Presentation Time Stamp Part of a PES packet header that indicates the time that a presentation unit is presented in the system target decoder.
<b>QOS</b>	Quality of Service
<b>QP</b>	Quantization Parameter A variable used in the quantization for the scaling of transform coefficients levels.
<b>RAP</b>	Random-Access Point A random access point in the bitstream is defined by the following guarantee: If decoding begins at this point, all frames needed for display after this point will have no decoding dependency on any data preceding this point, and are also present in the decoding sequence after this point. A random access point is also called an entry-point.
<b>RBDU</b>	Raw Bitstream Decodable Unit VC-1 terminology. See 'BDU'.
<b>RCV</b>	Raw Compressed Video
<b>RDBU</b>	Raw BDU
<b>Reference picture list</b>	A list of indexes that are assigned to reference pictures. All Inter prediction used for P and SP slices uses reference picture list 0. In B slices list 0 and list 1 are used for Inter prediction.

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<b>Residual data</b>	The difference between a prediction of a sample and its decoded value.
<b>RTP</b>	Real Time Transport Protocol. This Protocol defines a standardized packet format for delivering audio and video over IP networks.
<b>SBR</b>	Spectral Band Replication (in HE-AAC)
<b>SC</b>	Start Code
<b>SCTE</b>	Society of Cable and Telecommunications Engineers
<b>SD</b>	Standard Definition.
<b>SDTV</b>	Simple Definition Television.
<b>Segment</b>	See 'Media Segment'.
<b>SEI</b>	Supplemental Enhancement Information
<b>Sequence Parameter Set</b>	A set of parameters to be applied to a complete video sequence.
<b>SH</b>	Sequence Header
<b>SI slice</b>	A specially-coded kind of I slice designed to switch efficiently between two completely different sequences.
<b>Skip prediction</b>	An inter prediction mode for which no motion vector or residual data is transmitted.
<b>Slice</b>	An integer number of macroblocks ordered consecutively within a picture (or within a slice group if Flexible Macroblock Order is active).
<b>Slice group</b>	A subset of the macroblocks of the picture when Flexible Macroblock Order is active.
<b>SMPTE</b>	Society of Motion Picture and Television Engineers. A Standards Organization devoted to advancing theory and application in motion imaging, including film, television, video, computer imaging, and telecommunications.
<b>SP slice</b>	A specially-coded kind of P slice designed to switch efficiently between two similar coded sequences without the increased bit penalty of I slices.
<b>Splicing</b>	Splicing represents the quality of the video and audio at the transition between two segments when they are played one after the other.
<b>SPS</b>	Sequence Parameter Set
<b>SPS</b>	Service Provisioning System
<b>SPTS</b>	Single Program Transport Stream
<b>Sub-macroblock</b>	One quarter of the samples of a macroblock, i.e. an 8x8 luma block and two 4x4 chroma blocks of which one corner is located at a corner of a macroblock.



<b>System layer</b>	<p>The system layer is the transport stream with program data and associated metadata that describes the composition and organization of the transport stream. MPEG-2 system layer information includes synchronization bytes, PID numbers, scrambling information, and other indicators, including the start of the transport packet payload. Transport packets can be PES packet, a PSI table, or other private data. ATSC and DVB transport streams are MPEG-2 compatible because the required ATSC and DVB system layer data are MPEG-2 private data structures.</p> <p>See the appropriate MPEG-2, DVB, or ATSC standards for more information.</p>
<b>Tier</b>	<p>In the design of H.265/HEVC, it was determined that some applications existed that had requirements that differed only in terms of maximum bit rate and CPB capacities. To resolve this issue, two tiers were specified for some levels - a "Main" tier for most applications and a "High" tier for use in the most demanding applications.</p>
<b>Tile</b>	<p>In H.265/HEVC, tiles are rectangular, independently-decodable regions of a picture that are encoded with some shared header information. The main purpose of tiles is to increase the capability for parallel processing rather than provide error resilience.</p>
<b>TB/TU (Transform Block / Transform Unit)</b>	<p>In H.265/HEVC, the transform block is the leaf node of the partitioning of CB, used in the transform process. The CB residual may be identical to the TB or may be further split into smaller TBs. The term "block" usually refers to an array of luma or chroma samples, whereas the term "unit" refers to the ensemble formed by a luma block and the two corresponding chroma blocks.</p>
<b>Trimming</b>	<p>The process of creating a Transport Stream containing only a part of a video sequence.</p>
<b>True Peak Level (TPL)</b>	<p>Defined by the International Telecommunication Union in ITU-R BS.1770, the true peak level indicates the maximum value of the audio signal waveform.</p>
<b>TS</b>	<p>Transport Stream. A multiplex of several Elementary Stream that are contained in packets.</p>
<b>UDP</b>	<p>User Data Protocol. A connectionless protocol, like TCP, that runs on top of IP networks. Unlike TCP/IP, UDP/IP provides very few error recovery services, offering instead a direct way to send and receive datagrams over an IP network without acknowledgment for guaranteed delivery.</p>
<b>URI</b>	<p>Uniform Resource Identifier (URI) used in HLS Playlist files to reference Media Playlist and Segments.</p>
<b>UTC</b>	<p>Coordinated Universal Time. UTC is the time standard by which the world regulates clocks and time. In casual use, UTC corresponds to Greenwich Mean Time (or GMT).</p>
<b>VBI</b>	<p>Vertical Blanking Information</p>
<b>VBV</b>	<p>Video Buffering Verifier</p>

<b>VCL</b>	Video Coding Layer A layer specifying the coding-specific features of the AVC standard.
<b>Video sequence</b>	A set of consecutive coded pictures starting with an IDR picture.
<b>VPS (Video Parameter Set)</b>	In H.265/HEVC, a set of parameters, including the dependencies between temporal sub-layers, to be applied to a complete video sequence.
<b>VLC</b>	Variable-Length Coding A category of coding schemes designed to produce short codewords for frequently occurring symbols.
<b>VPS</b>	Video Programme System
<b>VUI</b>	Video Usability Information
<b>WebVTT</b>	Web Video Text Tracks is a W3C standard for displaying timed text. It is supported in HLS playlist files.
<b>WSS</b>	Wide Screen Signalling
<b>XDS</b>	Extended Data Service

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