



Parabola Explorer User Guide

Version 4.0

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1 Introduction

Parabola Explorer is a Windows application for use by engineers needing to visualise, check and analyse HEVC bitstreams.

This software is intended for applications including purchasing HEVC equipment, interoperability testing, service quality assessment, codec research and development.

Designed to be naturally intuitive, Parabola Explorer is also eminently suitable for training, demonstration and presentation.

2 System requirements

Parabola Explorer requires a PC with Windows 7, 8 or 10. Installation on a virtual machine or hypervisor is not supported.

For good performance on UHD bitstreams a machine with at least 16GB RAM and 4 CPU cores is recommended. At HD and lower resolutions at typical bitrates, an ordinary laptop should suffice for most use cases.

Parabola Explorer does not require any temporary disk storage space during use.

3 Installation and licensing

The same installer and installation process are used for Essential, Pro and trial editions. Trials are managed via trial extension codes. Paid licenses are delivered using license keys. Please contact Parabola to request a trial extension or to purchase a license.

Parabola Explorer validates the authenticity of license keys upon activation and periodically thereafter. For this to work, Parabola Explorer requires a network connection and the software will issue a warning if it is unable to get online.

A paid license may be moved from one PC to another. Install Parabola Explorer on both machines and use the wizard from menu item **About > License Activation** to deactivate on one machine and to activate on another.

4 Quick start

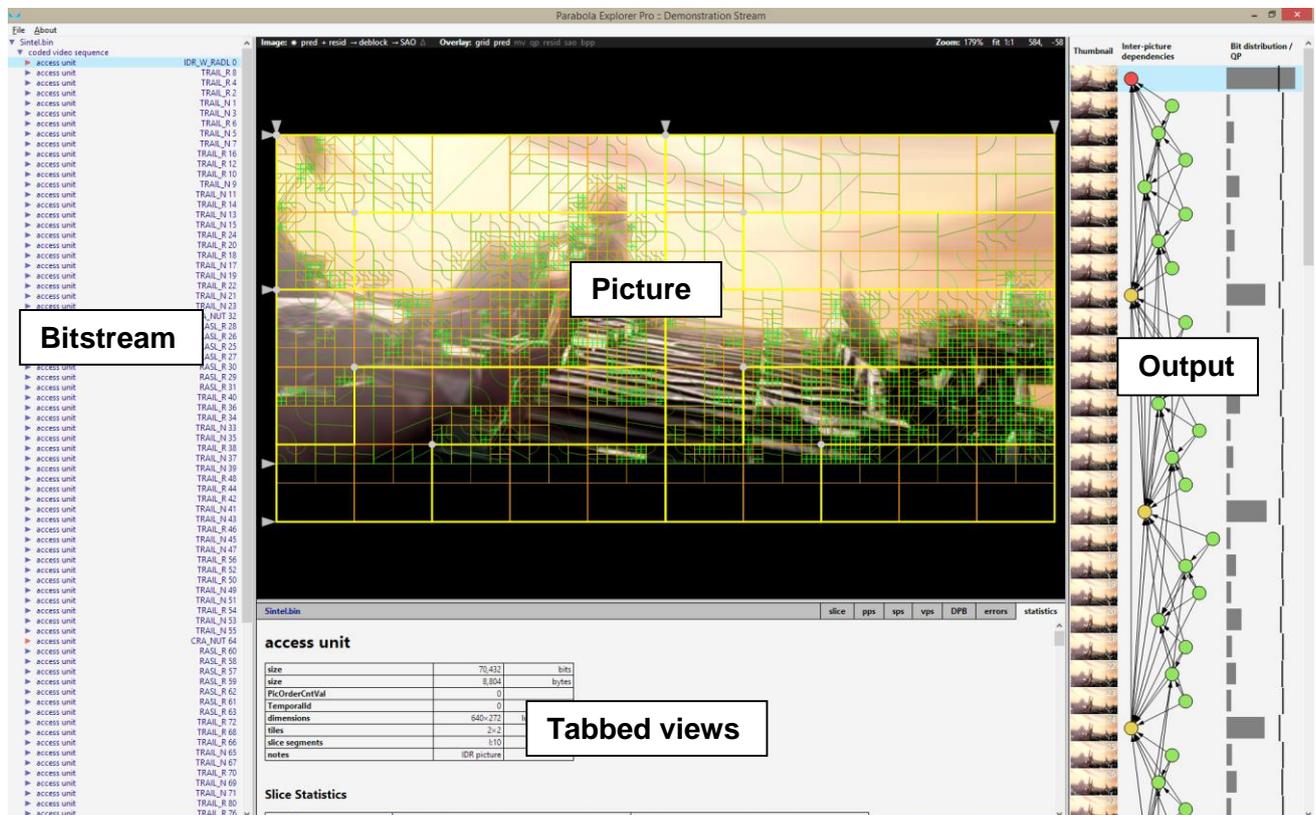
Parabola Explorer's user interface is designed to be as lightweight and as intuitive as possible, making good use of contextual hinting such as tooltips.

Confident users will be able to operate the software without reading the user guide and the following tips should help them to make the most of the tool:

- Use **File > Open** to open a local bitstream file
- Use left and right cursor keys to step forwards and backwards through output pictures
- Use mouse scroll wheel or laptop scroll gesture to zoom picture. Drag to pan.
- If an 8-bit planar YUV file named "ref.yuv" is present in the same folder as the bitstream file, Parabola Explorer will use it as reference for its picture-difference display.

5 Main window

Parabola Explorer is a stand-alone Windows application that runs in a single window. Its display is divided into five panes. These panes may be resized by dragging the dividers.



Parabola Explorer GUI Overview

6 Window Menus

6.1 File

The file menu contains sub items **Open**, **Close**, **Recent Files** that allow the user to open local HEVC bitstream files for analysis.

Locate in Folder opens Windows Explorer at the location of the current file.

[Pro only] Print Statistics Report prints the current contents of the statistics tab. Depending on operating system and other third party software, the report can be printed to PDF and/or XPS file for distribution as a file.

If the user has no HEVC bitstream files, the **Demonstration Stream** facility allows the tool to operate using short sample bitstream that is integrated into the software.

6.2 About

Sub menu items here are:

- **About Parabola Explorer** displays software version, edition and license information.
- **Credits / Attribution** provides acknowledgements of third-party contributors to Parabola Explorer
- **User Guide** displays this document
- **Online Support** launches a browser to Parabola's online support portal
- **License Activation** starts a wizard that allows the user to perform software license management tasks including activation, deactivation and trial extension.

7 Bitstream pane

This pane shows the syntactic constructs of the loaded bitstream as a tree with expandable nodes.

Elements shown in this pane are always in bitstream order with no omissions. Clicking the triangular expander icons toggles expansion of child constructs. In this view, child constructs are syntactic structures that are contained within the parent.

A user may select any construct here. When selected, the construct's row is highlighted in a light blue colour in the tree view. The information in the other panes is refreshed accordingly

Information in the bitstream pane is split over two columns. The left column gives the name of each context using identical nomenclature to the text of the HEVC standard. The right column contains the value of the construct or, where appropriate, other important information pertaining to the construct.

Different coloured text is used to represent different types of bitstream data. A dark blue colour is used to represent NAL bitstream constructs. RBSP constructs are shown in purple. CABAC constructs are black and SEI green.

8 Output pane

This display is tabular with each row representing a single decoded picture. Rows are shown in display order. The pane is divided into three columns showing:

- A thumbnail image of the output picture with some metadata
- The node of inter-picture dependency graph
- A multifunctional chart showing the size, in bits of the picture's access unit and the initial luminance Qp value of the picture

9 Picture pane

The picture pane shows the decoded picture corresponding to the active syntactic construct.

To move to the subsequent picture in display order, press the right cursor key (→). To move to the previous picture in display order, press the left cursor key (←). Pictures are cached internally such

after their first display, stepping backwards and forwards through a small set of pictures becomes more fluent.

The display here may be panned or zoomed. A number of controls at the top of this pane allow the user to control exactly what is shown.

9.1 Image

Image: * pred + resid → deblock → SAO Δ

These controls allow the user to display predicted, reconstructed or filtered image. In this way, the user may see how each encoded picture is built up.

A brightness control is provided. By clicking the sun (☀) icon, the picture may be dimmed in steps of 25% (100%, 75%, 50%, 25% and 0% brightness).

The delta (Δ) control enables a mode where image differences is shown. When enabled, the difference between decoded output picture and a reference are shown. For this to operate correctly an I420 or planar YUV file “ref.yuv” of 8-bit samples needs to be present in the same folder as the loaded bitstream.

9.2 Overlay

Overlay: bpp qp pred resid sao grid

These controls toggle various overlays upon the output video. Multiple overlays can be enabled simultaneously should this be helpful to show more information.

9.2.1 Picture Structure (grid)

An overlay showing the picture structure including tile boundaries, slices, CTU and CU boundaries. The overlay is navigable by clicking. Clicking on an element here selects the corresponding syntax construct.

9.2.2 Prediction (pred)

An overlay showing intra and inter prediction mode, intra prediction direction and motion-vector differential. Intra, L0, L1, BI and PCM blocks are distinguished with different colour rectangles. Intra prediction direction is shown with a straight line, distinctive curved symbols depict DC and planar modes. Tooltips provide more information. Prediction units may be clicked to navigate to the corresponding prediction_unit() in bitstream view.

9.2.3 Motion vectors (mv)

This overlay depicts motion vectors on a per-PU basis. L0 and L1 vectors are shown in different colours. The vectors are show actual size and more details are provided by tooltips.

9.2.4 Bits per pixel (bpp)

An overlay showing spatial bit usage distribution. Different colours are used to distinguish bits used for residual coding. The mapping of bits-per-pixel value to colour is consistent between pictures and indeed between video sequences to enable comparison. Tooltips provide numeric information and the figure provided here is equal to bit count divided by luminance sample count.

9.2.5 Quantisation (qp)

An overlay showing **QpY** distribution. A consistent mapping of **QpY** to colour is used for every picture to enable comparison. Tooltips provide more information.

9.2.6 Residual (resid)

An overlay showing the presence and location of **residual_coding()** elements. These are depicted as shapes centred on the square region concerned. This representation allows Parabola Explorer to show every permutation of residual encoding whilst allowing tooltips to provide more information.

Ordinarily, **residual_coding()** elements are shown as circles. The following shapes are used to indicate specific coding modes:

- square - cu_transquant_bypass_flag = 1
- diamond - transform_skip_flag[[][]] = 1

Clicking on any shape representing **residual_coding()** will load an additional overlay showing coefficients and scan order. To close this additional overlay, select any other syntax construct.

9.2.7 Deblock (dblk)

An overlay showing edges to be deblocked. Edges are shown if they are boundary strength of edges to be deblocked. Also shown is asymmetric deblocking: if one side of an edge has deblocking disabled (for example PCM blocks) then the edge is depicted accordingly. Tooltips show boundary strength.

9.2.8 SAO (sao)

An overlay showing SAO modes in use. Tooltips are displayed upon mouse-hover to provide further information.

9.3 Zoom/pan control

Zoom: 100% fit 1:1 253, 121

Here the current zoom ratio and cursor “x, y” location in units of luminance samples from top-left origin are shown. There are two controls that the user may click to adjust the zoom:

- The **‘fit’** control resizes the video picture to fill the available pane size.
- The **‘1:1’** control resets zoom to actual size.

To zoom the displayed picture, move the cursor over the picture pane and use the mouse scroll wheel or laptop scroll gesture.

To pan, use mouse left button to drag the picture within its pane.

10 Tabbed views

Here the user clicks tabs to select between the following displays.

10.1 Hex / binary bitstream dump

When the currently selected bitstream construct is not CABAC-coded, the relevant bitstream / bytestream is shown here in both binary and hexadecimal form. The offset from the start of

bitstream file, from beginning of RBSP data or beginning of SEI is shown in the left-most column. Bits corresponding to the currently selected construct are highlighted.

10.2 CABAC state

When a CABAC bitstream construct is selected, CABAC state is available in this tabbed view. Radio buttons allow the user to see either state before or state after decoding the selected syntax construct. Global information such as arithmetic range and value are shown.

The current state of all active context state variables are displayed. In the “after” display, orange borders indicate CABAC variables used during selected bitstream construct. Tooltips provide additional information.

10.3 Headers

The syntax elements of the following headers are shown in their respective tabs when the corresponding header is active:

- Slice segment header
- Video parameter set
- Sequence parameter set
- Picture parameter set

10.4 DPB (Decoded Picture Buffer)

This tab shows the pictures stored in the DPB at the time the currently selected syntax construct is parsed. Where applicable, one or both reference pictures lists are displayed here also.

Weighed reference pictures are shown with weighting applied using an approximation. Weighing parameters are shown in tooltip displays.

When the mouse pointer passes over a reference picture in the DPB or RPS, that picture is highlighted in the picture and bitstream views. If the prediction overlay is active, those parts of the picture that do not reference the hovered reference picture are dimmed.

10.5 Errors

[Pro only] This tab lists any HEVC standard violations detected within the currently selected element. To see all bitstream violations, first select the bitstream file itself in tree view.

Conformance violations are reported either as errors or warnings:

- Errors: if a bitstream contains errors, it is not a conforming HEVC v1 bitstream.
- Warnings: if a bitstream contains warnings, it is not a conforming HEVC v1 bitstream. However, the HEVC standard requires that conforming decoders must be able to handle such violations.

If a bitstream contains only warnings then it should play back as expected on any conforming HEVC v1 decoder. If a bitstream contains errors, there are may be issues with playback on any HEVC decoder, or subset of decoders.

The “clause” column contains the paragraph number where the violated requirement may be found. This aids rapid understanding of any bitstream faults.

On a modern PC, the current version of Parabola Explorer can scan bitstream for errors at a rate of approximately 1.5Mbit/s. This means it will take approximately 1 minute per 11MB of bitstream for the error report to render. For much faster analysis, consider command-line tool Parabola Verifier.

10.6 Statistics

This tab contains information about the currently selected bitstream construct. Information such as construct size (both in bits and in bytes) is always present. For CABAC constructs, size is displayed with fractional-bit precision. Other information is specific to the particular construct.

[Pro only] Extended data and statistics appropriate to the currently selected construct are available to users of the Pro edition. These include statistics about distribution of mode decisions made by the encoder, bit usage, merge mode usage and motion vector extents.

The user may print the currently displayed statistics, on paper, or to a PDF / XPS file, depending on the installed printer drivers.

On a modern PC, the current version of Parabola Explorer can analyse bitstream statistics at a rate of approximately 1Mbit/s. This means it will take approximately 1 minute per 7.5MB of bitstream for the statistics report to render.

11 HEVC standard

Parabola Explorer uses identical nomenclature to the HEVC standard text. The text of HEVC version 1 is available free for download via the ITU website:

<http://www.itu.int/rec/T-REC-H.265-201304-1>