Version *.9*

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1   PURPOSE OF THIS DOCUMENT

1.1   Purpose of this technical specifications document

This document provides an overview of the Cambria FTC encoder and its functionality, differentiates the available versions, identifies key features, provides performance benchmarks, and details the minimum system requirements and available licensing options.

2   OVERVIEW OF FUNCTIONALITY

Cambria FTC is a Windows-based video on demand (VOD) file transcoding engine that imports and exports widely used professional digital video formats, including H.264, MPEG-2, DNxHD and HEVC, and adaptive bitrate formats like HTTP Live Streaming (HLS) and DASH.

2.1   Key features

Here is an overview of features.

2.1.1   General Features

2.1.1.1   Exceptional Video Quality

Uses high-quality codecs such as x264, NTT-AT H.264, NTT-ATT HEVC, x265, Pegasys MPEG-2, and Avid DNxHD. Deploys superior motion adaptive deinterlacer, smart frame rate converter, video resolution scaler, with automatic scaling mode for optimal output quality. Also includes 10-bit support for most video formats and filters, with lossless video and audio pass-through where available.

2.1.1.2   Superior Transcoding Speed

Faster-than-real-time encoding speed for H.264; Video and audio pass-through support while trimming or changing container; Optimized deinterlacer, frame rate converter, video resolution scaler for faster processing time. Growing source file support – transcode while source is copying or being moved.

2.1.1.3   Flexible Workflow Solution

Automatic target setting based on source file settings, such as same as source for resolution, frame rate, and interlacing aspect ratio. Change encoding settings based on source file properties. Separate out multiple audio tracks from video. REST API and watch folder support.

2.1.2   Engine Features

2.1.2.1   Deinterlacing, Scaling, Frame Rate Conversion

Cambria FTC performs high-quality, multiframe, motion-adaptive deinterlacing. It can adjust playback speed with audio pitch correction when necessary, as in 24p to 50i conversion. Its content-adaptive frame conversion minimizes stuttering, and an automatic scaling algorithm helps produce optimal visual quality.

2.1.2.2   Future-proof Engine

Cambria FTC already supports 8K, 12-bit, and HDR. It also supports 64-bit processing for major codecs.

2.1.2.3   Video/Audio Rewrapping and Pass-through

Change containers and trim without re-encoding; pass-through AC-3 audio while preserving metadata; or normalize audio without touching the video.

2.1.2.4 Automatic Target Setting

Cambria FTC can automatically set target settings based on properties of the source file, such as automatically preserving the resolution, frame rate, interlacing, and aspect ratio of the original.

2.1.2.5 Timecode Support

Segment sources based on embedded timecode.

2.1.2.6 Handles Audio and Captions

The Multitrack Engine handles each audio and metadata track as its own entity. Normalize each audio track separately and add multiple closed caption files for different languages.

2.1.2.7 Source-adaptive Bitrate Ladder

Automatically adjust the bitrate ladder used for DASH, HLS, or Smooth Streaming based on the encoding complexity of the source video.

2.1.3 Workflow Features

2.1.3.1 Scriptable Workflows

Cambria FTC helps create intelligent workflows by supporting scripts that automatically set transcoding options (for encoding, filters, etc.) based on the properties of the source. Example workflows:

- Encode to same resolution as the source, and adjust bitrate based on resolution.
- Encode to same frame rate as the source, or exactly half the frame rate if greater than 30 fps.
- Don't encode to any MPEG DASH resolution greater than source resolution.
- Pass through audio if source contains AC-3 data. Otherwise, encode source to AC-3.
- Burn in subtitle text file to matching source files by same base file names.

2.1.3.2 Watch Folder

The Cambria Watch Folder automates batch transcoding jobs. Define your presets for a Watch Folder and simply drop a file on it to start converting automatically. The Watch Folder also supports post-conversion tasks such as FTP/network retrieval and notification via email.

2.1.3.3 Multi-file Workflows

Watch Folders can be configured to look for a group of files, for example, an MP4, XML, and PNG file with the same base filename. Using a workflow script, you could combine these assets automatically. Two examples:

- Transcode an MP4 file adding a PNG overlay, use the XML file to define in/out source timecode, and transform other attributes into output metadata XML.
- Specify groups and scripts to combine video with additional languages in separate WAV files and closed caption files.

2.1.3.4 Source Analysis and Preset Creation

Inspect the properties of a video file and generate an encoding preset. Resolution, codecs, bitrate, and other information such as Transport Stream PIDs and repeat rates are set to generate a file matching the analysis report.

2.1.3.5 Growing File Support

When using certain video formats, Watch Folders can begin transcoding while the source file is being written or captured to disk.

2.1.3.6   Modern REST API

Transcoding jobs and resources can be easily controlled through an API. Cambria FTC's REST architecture is similar to popular APIs such as Facebook or Twitter and is familiar to developers.

2.1.3.7   Urgent Job

Label a time-sensitive job in the queue as urgent, and each Cambria FTC workstation will open an extra slot for transcoding. Urgent jobs run at a higher priority for processing power, effectively pulling CPU resources away from other operations without the need to manually pause and later resume other jobs.

2.1.4   Video and Audio Filters

2.1.4.1   Audio Normalizer

Cambria FTC includes an audio normalizer for EBU R128 compliance.

2.1.4.2 Black Frame/Color Bar Removal Filter

Allows users to automatically remove black frames and color bars during transcoding.

2.1.4.3 Third-party Plug-in Filter

Cambria FTC allows third-party software makers to integrate plug-ins with a simple SDK. Plug-ins only process the video frames; decoding, encoding, and muxing is done by Cambria FTC. The WPF user interface for plug-ins makes them look and feel like a native software function.

2.1.4.4 EZTitle Subtitles Plug-in

The EZTitle plug-in works seamlessly within Cambria FTC. Burn in or embed closed captions in EIA608, EIA708, DVB, or teletext format. Embed multiple languages as separate caption tracks as well.

2.1.4.5 Audio Speed Adjustment

Speed up video playback while preserving audio pitch to squeeze in more commercials.

2.1.4.6 Property Changer

Users can overwrite the aspect ratio, frame mode, and frame rate of source files.

2.1.4.7 Black Segment Remover

Automatically removes the black segment included in a source file while transcoding.

2.1.4.8 Color Bars Remover

Automatically removes color bars included in source file while transcoding.

2.1.4.9 Other Filters

Colors Control, Color Range Adjustment, 601/709 Correction, Denoiser, Temporal, Logo, Text Burn-in, Teletext Burn-in, DVB Subtitle Burn-in, XML ttilter, DVD Subtitle Burn-in, Subtitle Burn-in, Closed Caption Burn-in, SST, Timecode Burn-in, Timecode Overwrite, DVD Makers, Volume Adjustment, Audio Surround to Stereo, Audio Compressor, Audio Delay

3   MINIMUM SYSTEM REQUIREMENTS

3.1   Operating System

Windows 7 SP1 (64 bit), Windows 10 (64 bit), Windows Server 2012 R2, Windows Server 2016. Cambria FTC can be run on standalone computers, and virtual machines and cloud instances running the required operating system.

3.1.1   Windows Update May Be Required

Note that File Convert and Cluster installation requires addition system files included in recent Windows Update. If you encounter issues during installation, please conduct "Windows Update", reboot, and try again.

3.2   Processor

Intel 2.8GHz (Quad-Core) or faster.

3.3   System Memory (RAM)

8GB or more (4K/8K encoding requires more memory 32GB suggested).

3.4   Video Card

Video card must supports Direct3D acceleration.

4   OPERATIONAL MODES AND LICENSING MODELS

This section describes how Cambria FTC can operate and the licensing models.

4.1   Operational Modes

4.1.1   Standalone operation

Customers can purchase and deploy licenses individually on any supported platforms.

4.1.2   Cluster operation

Cambria Cluster is an application that allows management of other Cambria File Converters with a single manager client. You can encode many jobs simultaneously by leveraging all available machines with Cambria File Convert installed. Job distribution and synchronization are handled automatically by the manager. The Cluster is also highly expandable and client machines can be added or removed at any time without affecting other existing client machines. Here is a diagram of Cambria Cluster Manager at the head of a group of File Convert machines:
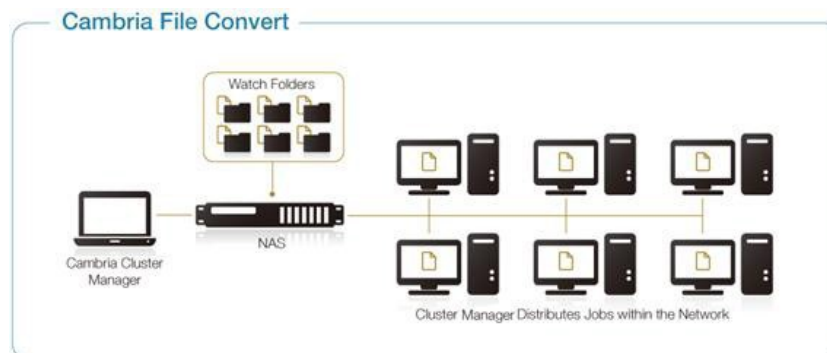
Please download the document entitled Cluster Info & Troubleshooting for more information regarding how to acquire and install Cambria Cluster.

4.2   Licensing Models

Cambria is purchased on a per-license basis. Each license enables Cambria to run on one computer at a time. Customers can license a single machine via a software license, can deploy Cambria on multiple machines individually via a hardware dongle, or can deploy Cambria over multiple computers via a floating license. Please download the document Managing Floating Licenses to learn more about deploying and using floating licenses.

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5   SUPPORTED FORMATS

5.1   Input Formats

Cambria supports the following input formats. Asterisks indicate formats supported only in optional export packages identified below.

Input Format	Container	Video Codec	Audio Codec
Flash Video	F4V	H.264	MPEG-2 AAC Linear PCM
Generic MP4	MP4	H.264	MPEG-2 AAC Linear PCM Dolby Digital* Dolby Digital Plus*
		HEVC	MPEG-2 AAC Linear PCM Dolby Digital* Dolby Digital Plus*
		MPEG-2	MPEG-2 AAC Linear PCM Dolby Digital* Dolby Digital Plus*
Generic TS	MPEG-2 TS	H.264	MPEG-2 AAC MPEG-1 Layer-2 AES3 Linear PCM Dolby Digital* Dolby Digital Plus*
		MPEG-2	MPEG-2 AAC MPEG-1 Layer-2 AES3 Linear PCM Dolby Digital* Dolby Digital Plus*
		HEVC	MPEG-2 AAC MPEG-1 Layer-2 AES3 Linear PCM Dolby Digital* Dolby Digital Plus*
Generic PS	MPEG-2 PS	MPEG-2	MPEG-2 AAC MPEG-1 Layer-2
	MPEG-1 PS	MPEG-1	MPEG-2 AAC MPEG-1 Layer-2
DVD	VOD	MPEG-2	Linear PCM
HDV	MPEG-2 TS	MPEG-2	MPEG-1 Layer 2
Capella Intermediate	INTERIM	Uncompressed	Linear PCM
		H.264	Linear PCM
Panasonic P2	MXF	DVCPRO, DVCPRO 50, DVCPRO HD	Linear PCM Dolby E*
		AVCI 50, AVCI 100	Linear PCM Dolby E*
		IEC DV25	Linear PCM Dolby E*
MOV	MOV	DVCPRO, DVCPRO 50, DVCPRO HD	Linear PCM, AAC Dolby Digital* Dolby Digital Plus*
		Uncompressed	Linear PCM, AAC Dolby Digital*

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			Dolby Digital Plus*
		Uncompressed QT (in32 codec)	
		DV25	Linear PCM, AAC Dolby Digital* Dolby Digital Plus*
		ProRes 422	Linear PCM, AAC Dolby Digital* Dolby Digital Plus*
		ProRes 4444 XQ	Linear PCM, AAC Dolby Digital* Dolby Digital Plus*
		HEVC	Linear PCM, AAC Dolby Digital* Dolby Digital Plus*
		DNxHD / DNxHR	Linear PCM, AAC Dolby Digital* Dolby Digital Plus*
Sony XDCAM	MXF	DVCAM (DV25)	Linear PCM Dolby E*
		IMX (MPEG-2)	Linear PCM Dolby E*
		MPEG-2 HD	Linear PCM Dolby E*
AVCHD	MPEG-2 TS	H.264	Linear PCM
AVI	AVI	Grass Valley HQ	Linear PCM
		Microsoft DV	Linear PCM
		Uncompressed	Linear PCM
Windows Media	WMV	Windows Media Video	Windows Media Audio
Sony XDCAM-EX	MP4	MPEG-2	Linear PCM
MKV	MKV	H.264	MPEG-2 AAC
RealMedia Variable Bitrate	RMVB	RealVideo	RealAudio
Sony XAVC	MXF	XAVC H.264 Intra/Long GOP	Linear PCM Dolby E*
Avid DNxHD / DNxHR	MXF, MOV	DNxHD / DNxHR	Linear PCM Dolby E*
JPEG2000	MP4, MOV, MXF	JPEG2000	MPEG-2 AAC Linear PCM Dolby E*
IMF	MXF	JPEG2000	MPEG-2 AAC Linear PCM Dolby E*
Input Format	**Image Format**		
Still Image	DPX, TIFF, TGA, BMP, JPG 12bit 8K TIFF		

5.2   Output Formats

Cambria supports the following output formats. Asterisks indicate formats supported only in optional export packages identified below.

Output Format	Container	Video Codec	Audio Codec
Generic TS	MPEG-2 TS	H.264 (x264) (incl. 4K) HEVC* (incl. 4K/8K, HDR) MPEG-1 MPEG-2 Passthrough	AAC MPEG Dolby Digital* Dolby DigitalPlus* AES3/PCM ALS* Passthrough
Generic PS	MPEG-2 PS	MPEG-2 Passthrough	MPEG Passthrough Linear PCM
	MPEG-1 PS	MPEG-1	MPEG Passthrough
Elementary Streams	Elementary Streams	H.264 (x264) (incl. 4K) HEVC* (incl. 4K/8K, HDR) DVCPROHD DV JPEG2000 MPEG-2 IMX MPEG-2 MPEG-1 Uncompressed Vdeo AVC-Intra Passthrough	AAC MPEG Dolby Digital* Dolby Digital Plus* Dolby E* Passthrough PCM
Generic MP4	MP4	H.264 (x264) (incl. 4K) HEVC* (incl. 4K/8K, HDR) MPEG-2 IMX MPEG-2 XDCAM HD MPEG-2 Passthrough DNxHD* / DNxHR* (220x, 220, 145, 36)	AAC Dolby Digital* Dolby Digital Plus* Passthrough PCM ALS*
Flash Video	F4V	H.264 (x264) (incl. 4K) Passthrough	AAC Passthrough PCM
MOV	MOV	H.264 (x264) (incl. 4K) HEVC* (incl. 4K/8K, HDR) DVCPRO HD DV MPEG-2 IMX MPEG-2 MPEG-2 – XDCAM HD Uncompressed Video ProRES DNxHD* / DNxHR* (220x, 220, 145, 36) Passthrough	AAC MPEG PCM
Windows Media	WMV	Windows Media Video	Windows Media Audio
Canopus HQ AVI*1	AVI	Canopus HQ	PCM
ProRES	MOV	ProRES	AAC, MPEG, PCM
Mosaic	MP4	H.264 (x264)	-
Analysis	-	-	-
WAV	-	-	PCM
Output Format	Image Format		
Still Image	TIFF, PNG, BMP, JPG		

5.3   Optional Export Packages

5.3.1   Broadcast Export Package (**x264 4:2:2 10bit license)

Output Format	Container	Video Codec	Audio Codec
Sony XDCAM	MXF	XDCAM DVCAM MPEG-2 IMX MPEG-2 HD (4:2:0, 4:2:2) Passthrough	PCM Dolby E*
Sony XAVC	MXF	AVC-Intra Requires x264 and x264 10bit license*	PCM Dolby E*
Avid DNxHD / DNxHR	MP4, MOV, MXF	DNxHD / DNxHR (220x, 220, 145, 36)	PCM Dolby E*
JPEG2000	MXF, ES	JPEG2000	PCM Dolby E*

5.3.2   Streaming Output Package

Output Format	Container	Video Codec	Audio Codec
HLS	Multiple MPEG-2 TS	H.264 (x264) HEVC	AAC
MPEG-DASH	Multiple MP4	H.264 (x264), HEVC	Multiple audio streams
Microsoft Smooth Streaming	Multiple MP4	H.264 (x264), HEVC	Multiple audio streams

6   PERFORMANCE BENCHMARKS

This section details performance benchmarks.

6.1   Benchmark Machine

CPU: 2x Intel Xeon CPU E5-2640 v3 @ 2.60GHz
Memory: 64 GB RAM
Operating System: Windows Server 2012 R2
System Drive: Samsung SSD 850 EVO 500GB
Capella File Convert Version: v3.4

6.2   H.264 SPEED VS. QUALITY

These tests benchmark performance when encoding to a range of quality and performance settings. The source video is MPEG-2 TS 1080p30.

Target Codec	CPU Utilization	Encoding Speed
H.264 1080p 30 (Fast Setting)	72%	4.74x RT
H.264 1080p 30 (Balanced Setting)	62%	3.51x RT
H.264 1080p 30 (High Quality Setting)	64%	3.18x RT

6.3   Basic

These tests benchmark performance for a range of general transcoding applications. The source video is MPEG-2 TS 1080p30.

Target Codec	CPU Utilization	Encoding Speed
MP4 H.264 1080p30 *	64%	3.18x RT
Flash Video H.264 FLV 1080p30 *	64%	3.18x RT
QuickTime H.264 MOV 1080p30 *	64%	3.18x RT
MPEG-2 PS 1080p30	42%	4.74x RT
ProRes MOV 1080p30	66%	4.25x RT

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6.4   Broadcast

These tests benchmark performance when encoding to a range of broadcast-related formats. The source video is MPEG-2 TS 1080p29.97.

Target Codec	CPU Utilization	Encoding Speed
Sony XDCAM HD MXF 1080i29.97	40%	4.10x RT
Sony XAVC AVC-Intra 100 MXF 1080i29.97	31%	1.47x RT
Avid DNxHD 220 MXF 1080i29.97	26%	4.84x RT

6.5   Streaming

These tests benchmark performance when encoding to a range of broadcast-related formats. The source video is MPEG-2 TS 1080p30.

Target Codec	CPU Utilization	Encoding Speed
HLS Streaming H.264 (1080/720/480/240)	95%	2.03x RT
MPEG-DASH, H.264 (1080/720/480/240)	95%	2.02x RT
Microsoft Smooth Streaming (1080/720/480/240)	95%	2.03x RT

6.6   HEVC

These tests benchmark performance when encoding to HEVC output. The source video is ProRes 422 2160p30.

Target Codec	CPU Utilization	Encoding Speed
HEVC TS 1080p30	42%	.56x RT
HEVC TS 4Kp30	68%	.25x RT

6.7   Passthrough Video and Audio

These tests benchmark performance when passing through video and audio. The source video is Source is MPEG-2 TS 1080p30 (H.264).

Target Codec	CPU Utilization	Encoding Speed
MP4 H.264 1080p30	4%	30.25x RT

6.8   Passthrough Video / Normalize Audio

These tests benchmark performance when passing through video and normalizing audio. The source video is ProRes 1080p30.

Target Codec	CPU Utilization	Encoding Speed
ProRes MOV 1080p30	4%	21.85x RT

6.9   Benchmarking Notes

- Sources and Targets read and written to the same hard drive (Samsung SSD 850 EVO 500GB)
- *Broadcast Targets tested with interlaced 29.97fps sources

- CPU Utilization is the measure of the approximate CPU load during a single transcoding job. Cambria File Convert can run multiple transcoding jobs concurrently. Multiple jobs that have lower CPU Utilization can be run concurrently to improve overall transcoding throughput.
- Encoding speed is measured as a factor of real-time (RT). Example: A measurement of 3.00x RT means that the transcoding job will process 3x faster than real-time, a 30-minute source will take 10 minutes to finish encoding to the target.