



K2 Media Platform: Media Formats and Interchange

Mohit Tendolkar and Karel Rasovsky

April 2014



The range of media file formats available can be confusing. What are the differences between them? What is the application space intended for each format? What are the strengths of each format?

This application note takes a closer look at file formats in context of media handling in K2 systems, including a practical review of K2 media interchange capabilities.

Introduction

The ongoing digital transformation of media production and services to viewers means the ways of moving content — video and audio — are evolving rapidly. Not only is there growing reliance on content management platforms, workflow engines and automation, but also the preparation and packaging of material for distribution to a variety of digital media platforms. Besides the need to carry metadata, robust and flexible file interchange is needed to accommodate diverse media applications, collaborative workflows and streaming for real-time operations.

The Grass Valley, a Belden Brand, K2 media platform is a comprehensive media server and storage system with embedded user applications and system tools. Teamed with the GV STRATUS nonlinear

media production tools and the K2 Dyno Replay Controller, K2 offers an ideal solution for live events such as sports and concerts, studio production, news and any application that requires quick access to recorded media. As such, K2 must seamlessly work with various file formats and applications encountered in digital media production.

Media Interchange

The Grass Valley K2 system records and plays clips, internally represented as a collection of discrete track files for video, audio, timecode and ancillary data, combined with XML edit decision list (EDL). This K2 internal representation is known as K2 CMF (Common Movie Format), providing a common asset model for proxy, edit constructs, transitions, playlists and metadata.

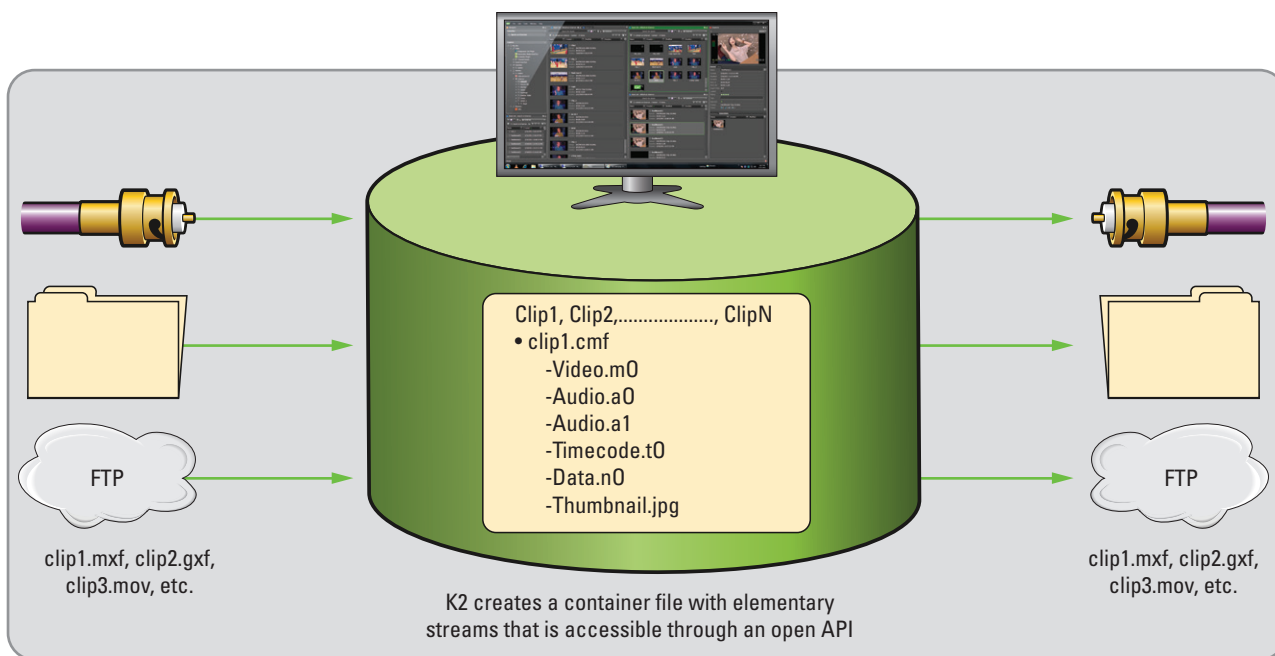


Figure 1 - K2 CMF Internal File Representation.

Introduction (Cont.)

The K2 media platform has to be able to send and receive clips with other systems for archival, transcoding, editing and so on — we refer to this as clip or media interchange. The K2 terminology for the different types of file moves follows these conventions:

- Exporting a clip represented as K2 CMF in another multimedia file format
- Importing a clip represented in another multimedia format as a K2 CMF clip
- Exporting a clip from one system and importing it into another system “transfers” the clip
- On the K2 user interface, each of the above operations is referred to as a “clip transfer”

Transfer Capabilities

As a robust media platform, K2 incorporates a rich set of transfer capabilities essential to implementing diverse, fast digital media workflows. These include:

- Transfer of clips while channels are recording or playing
- Transfer or export of growing clips (files being recorded/imported)
- Play/transfer of clips while they are being imported
- Simultaneous import and export of a clip
- Transfer of advanced clip types: sub-clips, sequences and playlists. Exporting a sub-clip generates a file that represents only that

portion of the original clip. Sequences/playlists exported in non-GXF formats get flattened, meaning that multiple cuts are joined together to represent a single cut in the exported file.

Note that flattening is not supported for material with cuts in different codec formats and cuts with inter-frame encoded video.

- Partial exports (exporting a portion of the entire clip)
- Simultaneous transfers, subject to resource limitations as per the site-specific system configuration. The default is four simultaneous transfers on the K2 system with local storage, and 10 clips on the K2 system with shared storage.
- Several transfer requests can be queued up.

Transfer Mechanisms

On K2 systems, generic file transfers can take place to/from local drives available to K2 (e.g., external hard drives, USB drives, or portable NAS), or to/from Windows network shares.

The K2 media platform can also act as an FTP server to complete tuned FTP network transfers of large files. FTP transfers in the K2 environment are exclusive to formats that do not require random access during import and/or export. When an FTP network transfer is invoked, the FTP server exposes standard FTP operations on K2 clips, such as clip listings, renaming or deletes. The standard FTP command “get” represents a clip export, and FTP “put” represents a clip import.

K2 & Media File Formats

It is important to keep in mind that while the K2 is only working in its own internal K2 CMF format, the framework supports and works with many different industry formats. To optimally meet the needs of diverse applications encountered in digital media production, the Interchange Engine of the K2 system is designed with extensive file export and import capabilities. The supported file formats include:

- Mainstream industry-standard file formats: GXF, MXF, MOV, MPEG streams, MP4
- QuickTime 32 graphics files
- Miscellaneous production assistance file formats

When we talk about media file formats, we refer to a well-defined layout of audio-visual content and metadata in a file. Any file format defines:

- Header information about audio-visual data in the file
- Arrangement and constraints on the audio-visual data in the file
- Timing used to synchronize between audio-visual data in the file
- Optional application helpers such as transfer hints, random access indices

The following defines these formats and how they are used within the context of GV STRATUS/K2 environment and workflows. The most relevant formats are: GXF, MXF, QuickTime, MPEG streaming and MP4.

General eXchange Format (GXF)

Originally developed by Grass Valley Group and later standardized by SMPTE, GXF is a file exchange format for the transfer of simple and compound clips between media storage systems. The format supports all flavors of Grass Valley application-specific content, including:

- Open-ended clips (e.g., clips being recorded)
- Highlights (portions of a master clip)
- Content with extra/unseen material (such as guard bands)
- Slow-motion content
- Programs with optional placeholders for later material insertion
- Playlists with control options (e.g., effects, looping sections, GPI triggers)
- Ganged, stereoscopic 3D and key-fill compositions

GXF remains the de facto standard media interchange format, consistently implemented across the Grass Valley product portfolio. As such, it preserves and allows moving of content across all generations of Grass Valley product platforms, including Grass Valley media servers, editors and other products. GXF has also been adopted as a popular mezzanine format in many TV production houses around the world.

K2 & Media File Formats (Cont.)

Material eXchange Format (MXF)

Standardized by SMPTE, MXF is a generic file transfer format which supports a number of different streams of coded essence, encoded with a variety of codecs, together with a metadata wrapper which describes the material contained within the MXF file. As a compression-agnostic scheme, MXF-based transport of files is independent of content, not dictating the use of specific manufacturer's equipment, therefore enabling interoperability of content between various applications used in the digital media processing chain.

The MXF OP1a variant has been broadly adopted by the broadcast industry, and is also supported by Grass Valley K2 and GV STRATUS platforms. The GV STRATUS/K2 implementation also includes support for some of the industry-leading vendor specific MXF OP1a variants, such as Sony IMX (SMPTE ST 386) or Sony XDCAM HD (SMPTE RDD 9). Beyond MXF OP1a, the K2/GV STRATUS environment also supports non-MXF OP1a file format interchange. Specifically, Panasonic P2 format support facilitates end-to-end native acquisition and editing workflows (e.g., with Avid editors). Support for AWMA AS 02 facilitates workflows specializing in content mastering and versioning.

MPEG-2 Program/Transport Streams

MPEG-2 (MP2) is a legacy established delivery and playback scheme, describing video/audio data compression methods. The GV STRATUS/K2 environment uses MP2 for FTP and file import only. It is also used by K2 media servers to harvest legacy content from discontin-

ued products, and consumer/professional content in formats such as DVD movies and AVC-HD.

QuickTime

QuickTime is an extensible multimedia framework developed by Apple Inc., capable of handling various formats of digital video, picture, sound, panoramic images and interactivity. QuickTime functionality in GV STRATUS/K2 environment is mostly limited to handling interface with Apple Final Cut Pro editing applications. This includes file interchange for simple clips (single cuts) in Apple production workflows, and reference files (EDL) generated for K2 CMF clips.

MPEG-4

The ISO-ratified MPEG-4 (MP4) is a digital multimedia format of choice for today's media processing needs — widely used to store video and audio. Like most modern container formats, it also allows for streaming over the Internet.

The GV STRATUS/K2 environment supports MP4-based file import of H.264 encoded content when interacting with NLE systems such as Adobe Premiere and Apple Final Cut Pro, with camera equipment (Sony, Panasonic) and with modern video appliances such as PlayStations. The MP4 container format also facilitates GV STRATUS/K2 proxy streaming workflows, whereby media material is recorded, encoded and played as MP4 files. The persistent proxy generation and interchange throughout the GV STRATUS/K2 environment facilitates efficient, economic workflows and proxy streaming to the desktop.

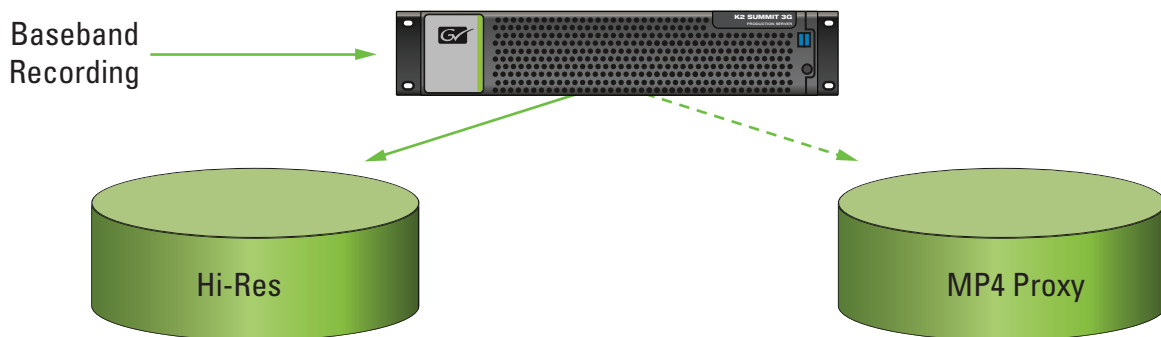


Figure 2 - Persistent Proxy Generation in K2 System.

Miscellaneous Production Assist Formats

Beyond GXF, MXF, QuickTime, MPEG streams and MP4, there are other media formats supported in the GV STRATUS/K2 environment:

- XML import
- Audio import
- Ancillary data import

Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. This set of open standards is quickly gaining popularity as it was developed for simplicity and

usability over the Internet. Taking advantage of XML's virtues, the GV STRATUS/K2 framework facilitates XML file import for K2 CMF-like folders, enabling rapid creation of content from elementary audio and video files.

The K2 system also supports audio file imports as PCM audio from WAVE, AIFF, SND and AU files. This is typically used for adding audio tracks to existing compositions or creating audio-only content.

To aid in adding or merging of ancillary data such as captions and AFD to existing clips, the K2 platform facilitates file import of K2 defined ancillary data files containing ANC or VBI data.

File Transfer Provisions

K2 Connectivity

To move and store media files in a shared production environment, K2 framework incorporates industry-standard interconnects for networking and media storage. All K2 servers/clients come with USB connectors to use various storage devices for file import and export. K2 clients and servers are equipped with Gigabit Ethernet ports, with the latest servers also supporting 10 Gigabit Ethernet connectivity. These connections can be used for standard networking, and/or connecting to storage arrays such as NAS configured as a mapped network drive.

K2 systems support both FTP and CIFS protocols for interchange of files. Therefore connectivity with common IT devices such as PCs, servers, storage arrays and archives require no special hardware or software.

Transfer Methods in K2 Platforms

To accommodate diverse media production needs, the K2 file interchange can happen in different ways.

As a modern, reconfigurable framework for nonlinear media production, the K2 environment facilitates a diversity of media file transfer modes. These include:

- Manually import, export or move content via user interface on K2, GV STRATUS, K2 Dyno, or other K2-compatible peripheral devices
- Move/transfer content using automation protocols such as VDCP, AMP
- Automated FTP transfers via content management systems, such as GV STRATUS
- Watch-folder based automated file imports/exports
 - HotBin import: Files imported from a preconfigured file folder on local or remote file system
 - Specialized HotBin imports for clip formats where clip is represented as a collection of files
 - HotBin export: Clips in a preconfigured clip bin exported to a known file folder

Summary

As a flexible and extensible nonlinear production platform, K2 offers exceptional interoperability of content between various file formats and applications used in the nonlinear media production chain. K2 is the only media server platform that supports end-to-end SD/HD workflows in DVCPRO, MPEG-2, AVC-Intra, H.264/AVCHD and DNx-HD formats. When coupled with GV STRATUS, the unified K2/GV

STRATUS environment supports an unmatched diversity of media transfer workflows, while offering powerful tools for nonlinear media production. To media enterprise, this means efficient integration of production workflows, improved operational efficiency and enhanced creative productivity.

References

- K2 Media Platform System Guide
- Import and Export of Files in K2 Media Platform