grass valley

APPLICATION NOTE

K2 Advantages with QOS, Bandwidth, and File Compatibility in File-based Workflows

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File-based Workflows – this is what users want today and this is what all suppliers say they offer. But what does it mean?

This application note will explain what a file-based workflow is and more importantly explain what features you need to make a good file-based workflow. The K2 Platform (K2, K2 Summit™ and K2 Solo™) was designed from the ground up for file-based operation and still offers features today which are not available with other vendors.

What is a File-based Workflow?

A file-based workflow (Fig 1) is one in which the entire workflow is in the compressed domain. Video is encoded as early as possible, sometimes even in the camera, and that content remains compressed until it is played out to air—at which time it is decoded back to baseband (SDI/HD-SDI) and sent out. Ingest, editing, metadata management, archive, browse, media asset management, and playout management are all performed using compressed files.

FILE-BASED WORKFLOW IN BROADCAST

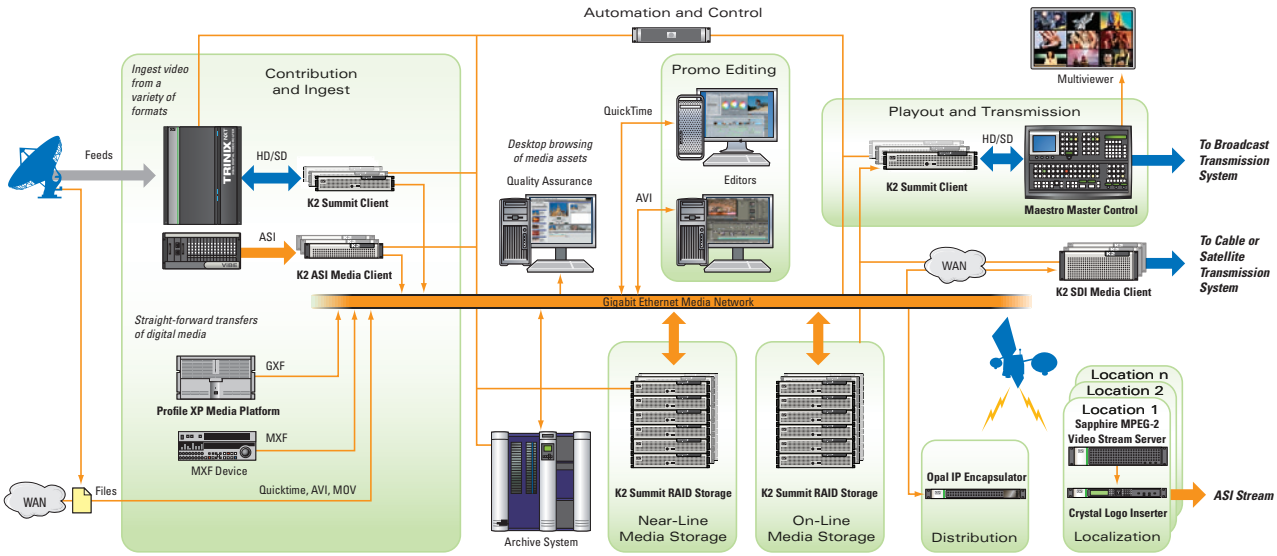

Figure 1 – *In a file-based workflow, video is compressed to a file on ingest (left side) and only goes back to baseband video when played out (right side).*

What Makes a Good File-based Workflow?

To have an effective and productive file-based workflow, you need an infrastructure with the following attributes:

1. Support for a **wide variety of industry-standard formats** – both compression formats and file wrappers

2. **Large amounts of bandwidth** to move the data around and the ability to scale as needed

3. Ability to manage that bandwidth with **Quality of Service (QOS)** so bandwidth is always available where it is needed most

Industry Standard Formats

When talking about "files" it is easy to get confused between compression formats and file wrappers. The compression format and the wrapper are totally independent of each other. Your system needs to be compatible with both.

Compression is the way the video is reduced in size from 270 Mb/s for SD and 1.5 Gb/s for HD to a manageable 8 Mb/s to 100 Mb/s of data. Standard compression formats today are MPEG-2, DVCPRO, AVC-Intra, and others. Once compressed into smaller amounts of data, it then needs to be stored in a wrapper so it can be moved from one device to another. Standard wrappers today are MXF, GXF, .AVI, and .MOV (QuickTime). For example, you can have MXF files with DVCPRO or MPEG-2 or an MPEG-2 file can be wrapped as MXF or GXF. For this discussion, it is not important to understand all the compression formats or wrappers, just to understand the concept and the importance of this in selecting an infrastructure for your workflow.

K2 supports MPEG-2, DVCPRO, and AVC-Intra compression formats and MXF, GXF, .AVI, and .MOV file wrappers. *This makes K2 a solid choice as the foundation for your infrastructure. Without this flexibility of formats, you would have to spend a lot of time and money in transcoding to other formats or rewrapping into the wrappers supported.*

Large Amounts of Bandwidth

The second critical feature is "bandwidth." There are two important questions to ask: how much is there and how easy is it to add more—because your need for bandwidth always increases over time.

What is Bandwidth and Where Does it Come From?

Bandwidth is easy to talk about but hard to define. It's important to understand that all bandwidth comes from the disk storage system (Figure 2). If you determine you need 500 MB/s of bandwidth, then the storage system must be able to **reliably** read or write 500 MB/s of data to or from the disks, including when a RAID disk is being rebuilt. Plus the infrastructure must be able to move 500 MB/s of data. Both the storage system and the network need to be designed to meet this specification under all conditions—else you have a poorly designed infrastructure that will eventually end up dropping frames when playing to air. Black in the middle of a commercial can cost a station hundreds of thousands of dollars.

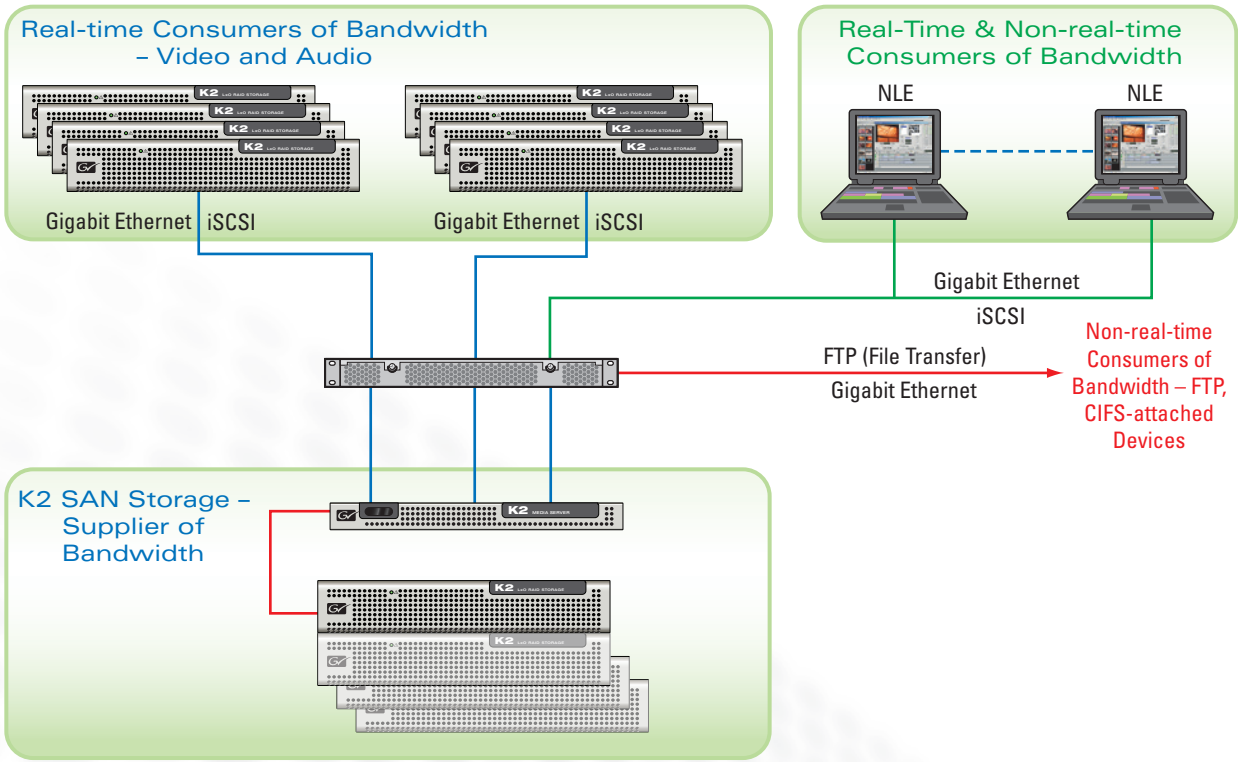

Figure 2 – *All bandwidth comes from the K2 SAN storage system. Bandwidth is classified as real-time and non-real-time use. Quality of Service (QOS) manages bandwidth so it is always available where needed and enables efficient use of all system bandwidth.*

What Makes a Good File-based Workflow? (cont.)

Your workflow efficiency improves with bandwidth because your users spend less time waiting for data. As your needs grow, your infrastructure needs the ability to grow with more bandwidth. *K2's modular architecture can easily scale for more storage and more bandwidth. K2 systems are running today with over 2,500 MB/s (20,000 Mb/s) of bandwidth.*

Obviously more bandwidth is better but bandwidth is not free so it's critical that you have the ability to control bandwidth—that is hard to do. Some designs compensate for this by just putting in more bandwidth than is needed—a costly approach. Others can allocate XXX amount of bandwidth for video and YYY amount for file transfers—but these are fixed and if there is unused video bandwidth it cannot be used for file transfers and vice-versa.

K2 solves this problem with Quality of Service to control all the bandwidth.

Controlling Bandwidth with Quality of Service (QOS)

Having built an infrastructure with the required bandwidth and support for the compression and file types needed is generally where people stop their analysis and where trouble can start. If you cannot control that bandwidth to make sure it gets used for the highest priority tasks, then your workflow will fail. Not all users have the same priority need for bandwidth and a first come, first serve model can be disastrous. For example (Figure 3), if you have 10 editors on a pool of storage with 200 MB/s of bandwidth, then you would expect each editor to have 20 MB/s of bandwidth. But one editor may log in first and fire up an edit with 10 layers of DVCPRO 100 and use up all 100 MB of bandwidth so the other four editors will have totally unacceptable performance to get their job done.

Or you may start to transfer lots of files to archive and suddenly when you go to play a commercial, there is inadequate bandwidth to play the spot without black frames. Note a black frame is where the playout server did not get data in time to play and thus plays black—it is almost always related to a stall due to inadequate bandwidth.

K2 Quality of Service – QOS

K2 is unique in how it solves this problem. K2's built-in QOS lets you classify bandwidth users as "real-time" and "non-real-time" (Figure 2). It can limit a device (user) to a specific amount of bandwidth. A video device playing to air is defined as a real-time user and a file transfer device is defined as non-real-time user. Editors fall in between; they are real-time up to a defined limit and then the rest is non-real-time.

Dynamic allocation of bandwidth enables all devices to use available bandwidth by allocating unused real-time bandwidth to non-real-time users (Figure 4).

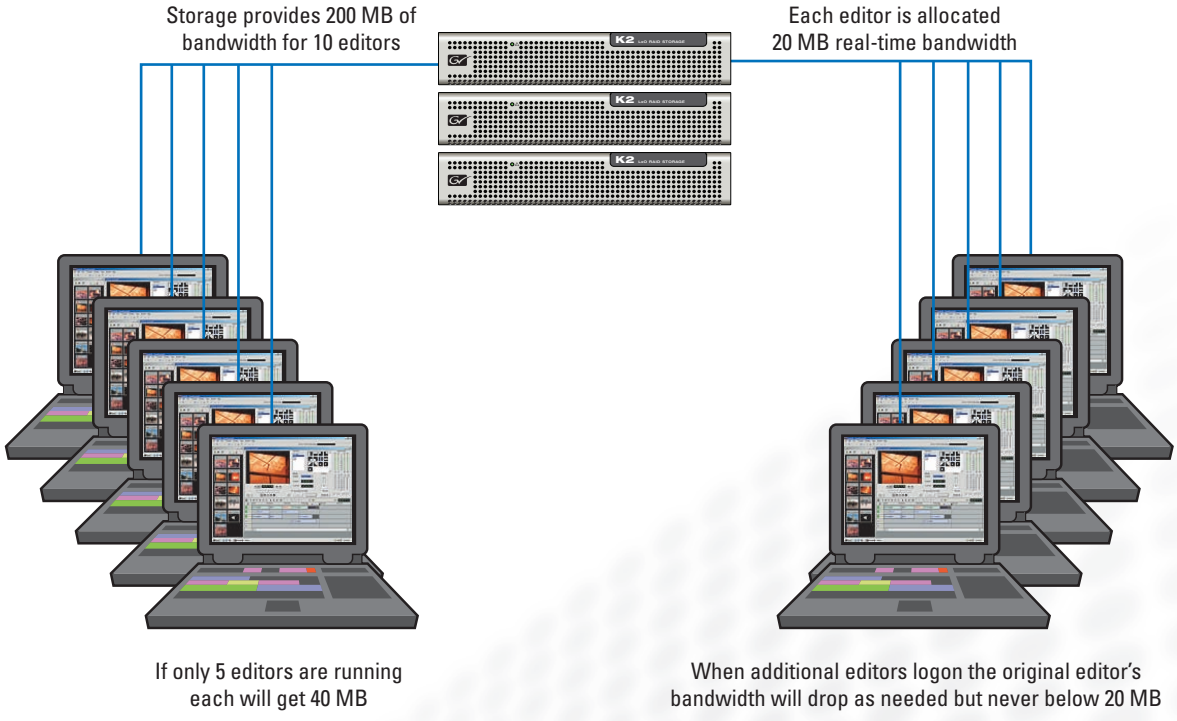

Figure 3 – *In a shared editing environment, editing bandwidth is provided on a equal basis so all editors are guaranteed adequate bandwidth to do their job.*

NLE Example of Shared Bandwidth

Most editing storage platforms on the market today have no concept of allocating bandwidth—most have a first come, first serve model resulting in some users having inadequate performance. With K2 storage all of the system bandwidth is available to the editors that are running. As more editors log on, they get their share of bandwidth and each editor is guaranteed an equal amount of bandwidth.

K2 Production Storage Example with QOS Bandwidth Allocation

The benefits of K2 QOS are:

- Bandwidth is always prioritized for recording and playing (real-time) so a frame of data is never missed
- Unused real-time bandwidth can dynamically be allocated to non-real-time users
- Non-real-time users can never take bandwidth from a real-time user, ensuring playout is never impacted
- One NLE user cannot take more than their fair share of bandwidth such that other users cannot do their job

Summary

Bandwidth management is fundamental to the efficient operation of a workflow that consists of both real-time and non-real-time devices or users. It enables a more cost-efficient design by maximizing the use of all system bandwidth. The alternative is to increase the cost of the system by putting in more bandwidth than is really needed.

K2's storage architecture enables easy scaling for more bandwidth as needs grow. This means a design can start with the current requirements and grow without penalty—again optimizing the cost for the initial system installation.

The result is a cost optimized system without tradeoffs.

K2 PRODUCTION STORAGE EXAMPLE WITH QOS BANDWIDTH ALLOCATION

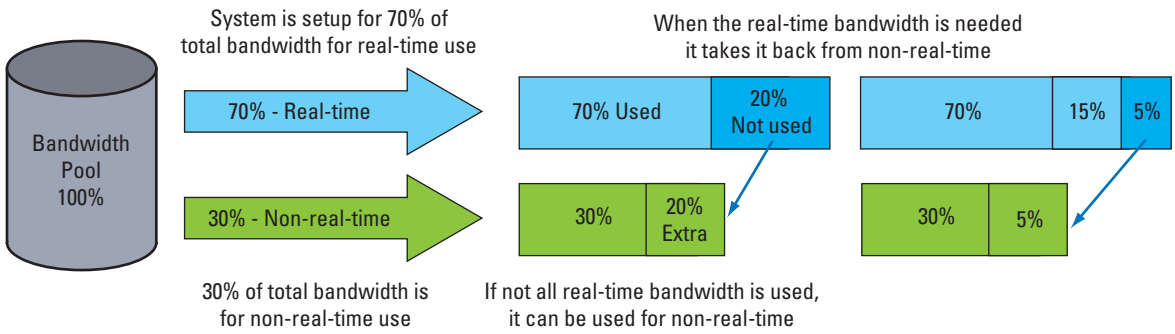

Figure 4 – *K2 QOS can dynamically allocate unused bandwidth from the real-time pool to be used for non-real-time use. Bandwidth will dynamically be allocated back to real-time when needed so real-time devices are never starved for bandwidth. Most systems on the market allocate bandwidth for one use or the other and cannot use bandwidth that is not being used by the other side.*

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