APPLICATION NOTE

LOOP-IN-PATH PROCESSING

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Addressing signal processing requirements utilizing Loop-in-Path processing can avoid undesirable compromises and maintain a native signal throughout a routing switcher. In doing so, signal processing becomes a true manageable path device with better processing quality and higher operational flexibility. In this manner the ultra-reliability and signal integrity of any broadcast infrastructure is preserved.

INTRODUCTION

Many examples of using existing technologies to address signal management requirements within broadcast infrastructures have led users to accept compromised products and solutions. This guide details various technologies and implementations that are used to achieve an uncompromised workflow.

Due to the expanding diversity of signal types and formats, the steadily increasing demand to support more signal paths than ever before, and the requirement for centralized switching to easily share more content, there will be a dramatic change in the technology needed for broadcast infrastructures. To address this change, some manufacturers have implemented existing technologies which have produced compromised products.

Grass Valley® has a long history of developing products using a forward-looking approach in order to satisfy customer requirements for both today and tomorrow. Only premiere quality products and solutions have been offered, and this will continue as it is essential to the Grass Valley business philosophy.

Grass Valley has been focused on developing efficient broadcast infrastructure solutions able to cope with any signal type, data rate, or number of signal paths, as well as being as signal agnostic as possible. An agnostic signal approach for routing switchers, is a major concern, especially within many broadcast infrastructures in order to preserve the true native signal and quality, and specifically for content re-use anytime and anywhere, as well as for monitoring and diagnostics.

The increasing demand for signal processing and management of the signal path is a result of the diversity of signal types, multiplexing, and data rates used within broadcast infrastructures. This demand can be addressed with hybrid router solutions, in which the routing switcher is using built-in signal processing. When hybrid router solutions are implemented the routing switcher itself becomes multiformat supportive.

Apart from a hybrid router solution, there are other methods to accomplish a more efficient and less compromised solution known as Loop-in-Path processing in which the signal processing functions become an efficiently manageable resource within any broadcast infrastructure.

COMPARISON BETWEEN BUILT-IN VERSUS LOOP-IN-PATH

It is clear that hybrid router solutions are attracting substantial interest as they can represent an all-in-one approach with lower costs and easy operation. But that does not necessarily mean that the hybrid router adequately addresses all path-switching and signal-processing requirements efficiently.

In a hybrid router, signal processing is logically placed on each respective routing switcher input and on each respective routing switcher output—it is always part of the signal path whether it is used or not. This restricts the use of signal processing to only those inputs and outputs. This is not really an efficient method considering how many times these functions are used for a specific signal path.

In the case of the signal processing function being a de-embedder and embedder, the signal path will experience a best-case path delay of a few video lines—in other words, the routing switcher is now a delay line for the associated video lines. There is also now a lip-sync issue introduced, which requires compensation somewhere within the signal path. Obviously all of this can be corrected using a frame synchronizer within the signal path, but that now introduces a one frame total delay.

These days, routing switchers have to cope with higher data rates and there is an increased risk of potential crosstalk, especially for those architectures using long trace runs, interconnects, and mismatched impedances—all effecting signal performance. In the case of a hybrid router using embedders and de-embedders, this crosstalk risk is further increased as video and audio signals are running within the same chassis and on the same boards over traces in proximity to each other. Further degradation results from the use of alternative connectors to achieve greater densities. The overall result is that the signal performance can no longer be truly native due to all the impacts experienced in the chain.

This processing will also increase the risk of signal path failures due to the additional active components required, which are now always part of the signal path.

The additional power consumption and resulting heat that is being generated within a single, dense chassis must be also considered. The requirement for additional cooling may shorten the product life cycle and the long-term reliability.

What really needs to be accomplished?

The requirements for de-embedding and embedding are now fully understood, and the claim that this need is significantly large does not match reality.

There will be some sources which will need to be de-embedded because the audio channels are in the wrong order, but this is the exception. There might be a need to de-embed audio into a particular audio infrastructure, but this not always the case. If a source requires permanent signal processing, why does it need to be part of the routing switcher since this does not provide much flexibility?

In large-scale infrastructures, only a few selectable sources will require signal processing functions. The main advantage to managing signal processing within a switching system is the flexibility and efficient use of available switching and signal management resources across the entire signal infrastructure. All signal management functions need to be truly assignable resources for any signal path as they are needed. There is a penalty in wasted power consumption for unused or inefficiently used hardware resources.

Loop-in-Path processing allows the use of any signal management function across any input as well as any output, at any moment in time. The only consideration needed is how many processing paths are required any single moment in time. The efficient use of Loop-in-Path processing can be fully managed and automated using tie-line management, which is a standard function of many routing switcher control solutions.

Today, Loop-in-Path processing can be graphically visualized using our new approach towards broadcast infrastructure system control called CommandCenter™.

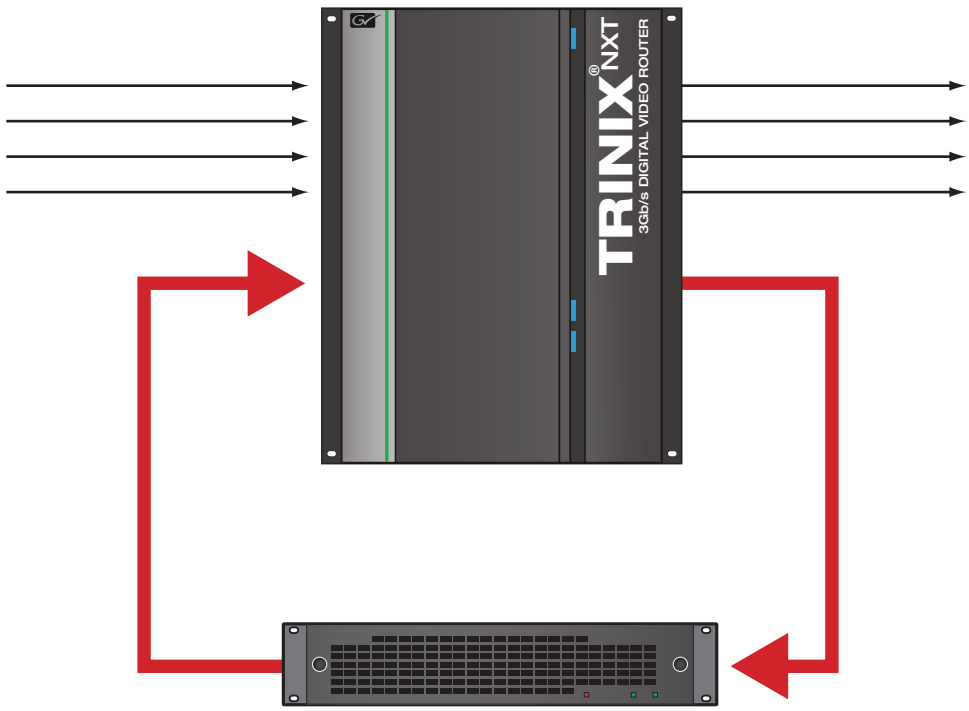

Figure 1 – *Loop-in-Path processing applied to video processing for up/down/crossconversion.*

BENEFITS OF LOOP-IN-PATH PROCESSING

Available in the high-end Trinix® NXT routing switcher platform from Grass Valley are unique technologies including CleanFlow™ architecture supporting native signal performance, and EvenFlow™ architecture supporting a long life cycle.

Minimizing components as part of the signal path within a routing switcher significantly improves its overall performance. The signal agnostic approach to switch the native signal without any impact throughout the routing switcher is a primary philosophy. There is a minor signal latency of a few nanoseconds and there is true native signal performance throughout the routing switcher.

There are many good reasons to exclude permanent signal processing from each signal path and from the switching infrastructure. The use of built-in signal processing as part of the routing switcher results in a higher granularity of failure and a higher risk of signal path loss. Because lowering the cost per signal path is the main objective, built-in processing is in many cases a compromise on quality and performance. On top of this, any kind of built-in processing is influencing the signal transparency as it requires additional impedance conversion, introduces potential cross talk issues, and adds path delays as explained earlier.

That is why it is compelling to address signal processing requirements utilizing Loop-in-Path processing to avoid undesirable compromises. In doing so, signal processing becomes a true manageable path device with better processing quality and higher operational flexibility. In this manner the ultra-reliability and signal integrity of any broadcast infrastructure is preserved.

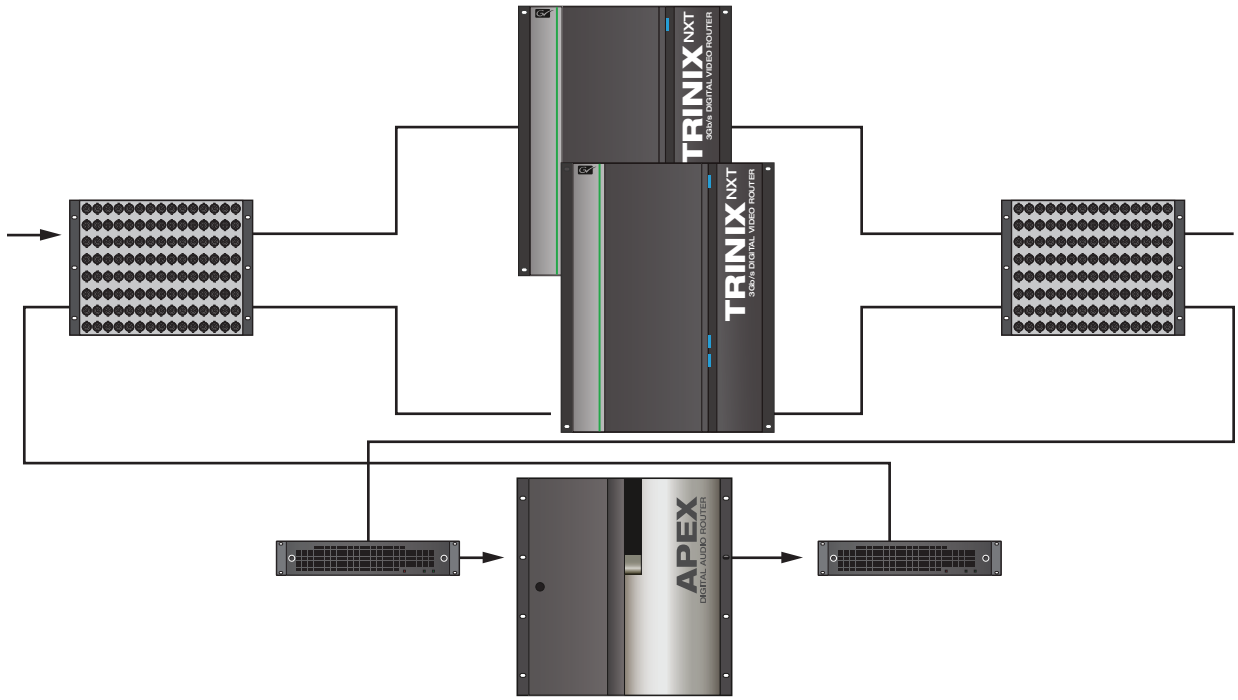

Figure 2 – *Loop-in-Path processing applied to audio processing and switching based on a fully protected router solution.*

BENEFITS OF LOOP-IN-PATH PROCESSING (CONT.)

It is inherently the nature of broadcast infrastructures to support all switching, processing, and monitoring requirements. It should also provide a deep and wide integration with many external devices helping to complete an overall broadcast infrastructure solution. There are very efficient external signal processing devices (all-in-one types) available that perform de-embedding, line/frame sync, multichannel audio swapping, AES/MADI inputs/outputs, lip-sync correction, as well as embedding.

Upcoming introductions of revolutionary high-speed interconnections will further enhance the efficient use of signal management devices. Grass Valley will lead such initiatives as a next logical step within its broadcast infrastructure product and solution portfolio.

Thanks to the use of more common protocols and interfaces, hardware devices as well as software tools can be quickly and easily integrated. The common use of universal application layers and accessible APIs permits a variety of choices for switching control, device diagnostics, processing control, signal management, and other required applications such as multilayer tally, SNMP monitoring, and diagnostics to complete and support all kinds of broadcast infrastructure workflows.

These additional tasks can be performed with the introduction of a forward-thinking approach towards broadcast infrastructure system control, CommandCenter.

CommandCenter offers a comprehensive feature set and extensive functionality. In modern broadcast infrastructures, control solutions need to do more than just have control of signal paths and processing functions, they must also effectively manage broadcast workflows across multiple devices and instances. With this approach, Loop-in-Path processing is not only efficient, but it is now a simplified operational task within a variety of workflows.

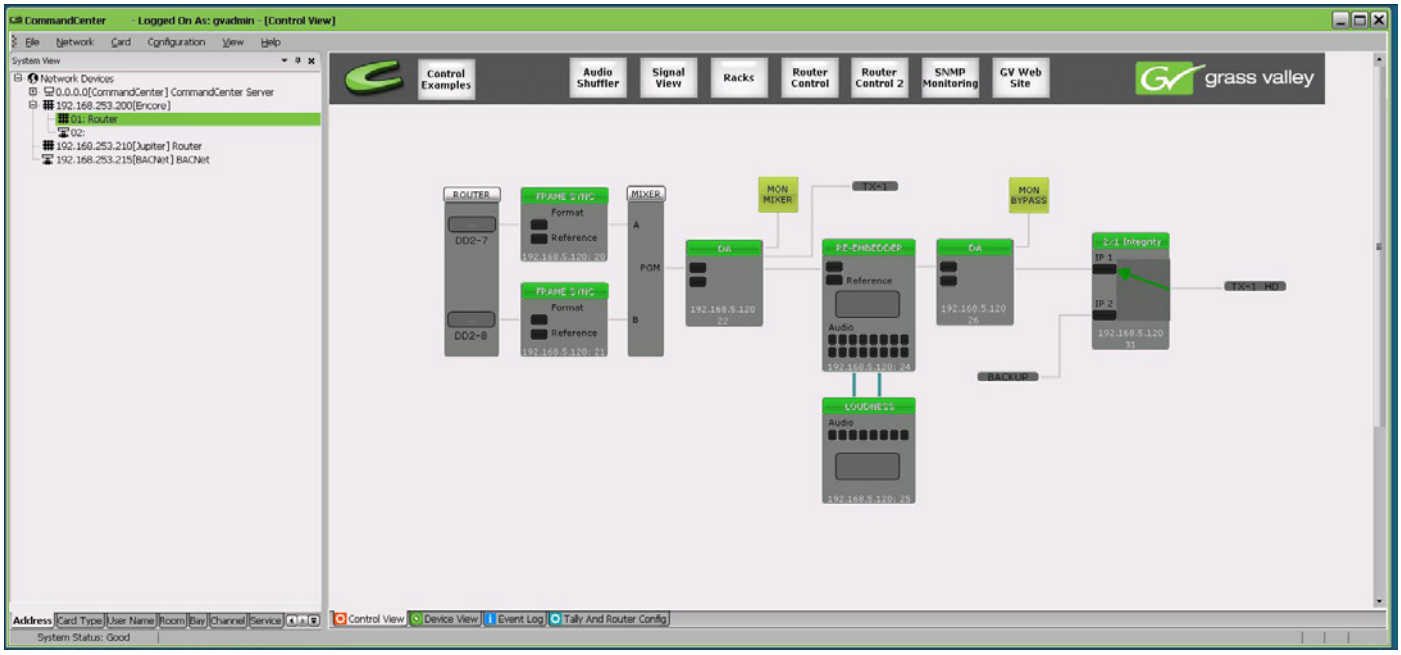

Figure 3 – *Graphical presentation of all devices related to a specific signal path within a broadcast infrastructure solution.*

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Grass Valley is changing the way live television is made and delivered. Recognized with 18 Emmy® awards for technology innovation, Grass Valley's product portfolio—from image acquisition to playout—offers a complete end-to-end workflow of flexible, forward thinking solutions which enable broadcasters and content owners to build multiscreen, multiplatform futures. By simplifying and enhancing the way content is produced and distributed, Grass Valley gives customers the freedom they need to be creative in the studio, the field, and the newsroom. Merging optimizations of IT technologies with best-in-breed media systems, Grass Valley's next generation solutions deliver higher quality and greater efficiencies. Customers include world-leading broadcasters, teleproduction facilities, service providers, government, religious, educational, corporate, and independent video professionals. Grass Valley is headquartered in Hillsboro, OR, and maintains local presence across the globe with offices throughout North and Latin America, Europe, the Middle East, and Asia-Pacific regions.

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