Application Note

Low Latency Products: Better Performance

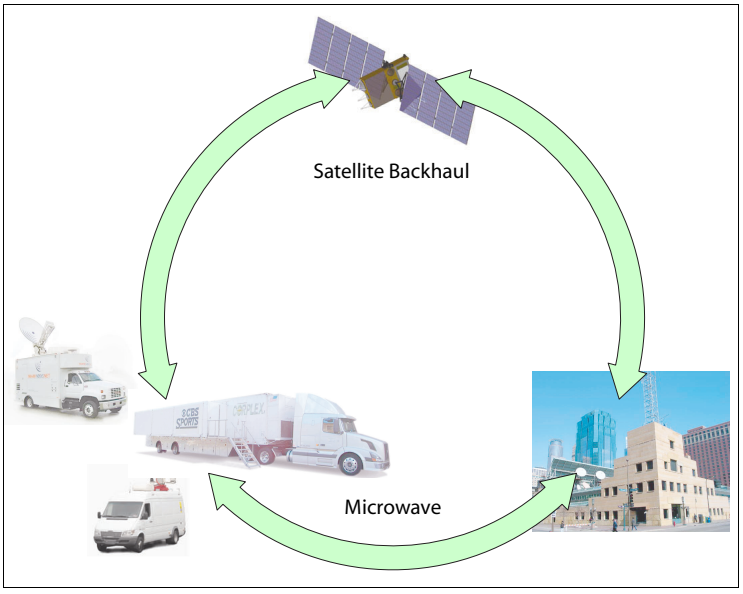
Introduction

Miranda's low-latency products offer a better solution.

In the context of this document, *latency* means the amount of time it takes a signal to propagate through a product or a transmission chain. Latency equates to *delay* in the signal path. In virtually all broadcast and most post-production applications, it is desirable to keep overall system latency as low as possible. To achieve this requires careful product selection and system design. Delay times are additive. The overall latency for a signal path is the sum of all of the individual product latencies.

Many would argue that a worse issue is variable latency — where a particular product's path length changes depending upon operating mode. Downstream devices can react badly when they detect a radical change in input timing, often resulting in picture disturbances.

Applications for which low latency is critical include news backhaul feeds, live news coverage (e.g., from a helicopter or ENG truck), transmission of live programming from a venue site back to the broadcasting center, interactive video etc. High latency values create a disconnect between viewer and content, or cause unnatural dialog between participants. "State-of-the-art" today means latency values in the half-second range — but it is expensive. Ideally, overall system latency can be kept below two seconds, and typically in the 750–1000 ms range.



Certain parts of the signal chain introduce latency values that are not correctable. Examples are satellite uplink and downlink or IP streaming. In these cases, selecting products that introduce minimal additional latency into the signal path can help mitigate the effects of other systemic issues.

At the module level, reducing latency usually means a reduced feature count or lower image quality. Improving module performance or offering additional features means that the signal remains in the module's processing circuitry longer, so low-latency designs typically must make compromises. Digital signal processing (DSP), has been universally adopted as the design tool of choice. Processing signals in the digital domain has led to better performance because complex processing algorithms are more economically implemented in code. However the transition to digital signal processing has only made the latency situation worse.

Synapse Products

Synapse processing modules address these issues by providing applications-oriented modules. Synapse modules are often multi-function, combining many common processing functions on a single card. The

internal Synapse bus can dramatically lower module count in some applications by sharing input signals across modules.

Consider up- and down-conversion for instance. Synapse offers a range of modules, a few of which are listed here:

- The HSU10 that provide low latency while creating high-quality output images.
- The HSU20 that trades off some additional processing time for improved performance.
- The HSU30 and HSU40 that use advanced algorithms for the utmost in image quality when the application demands it.

Figure 1 shows transmission and I/O feeds for a remote truck application that uses Synapse modules:

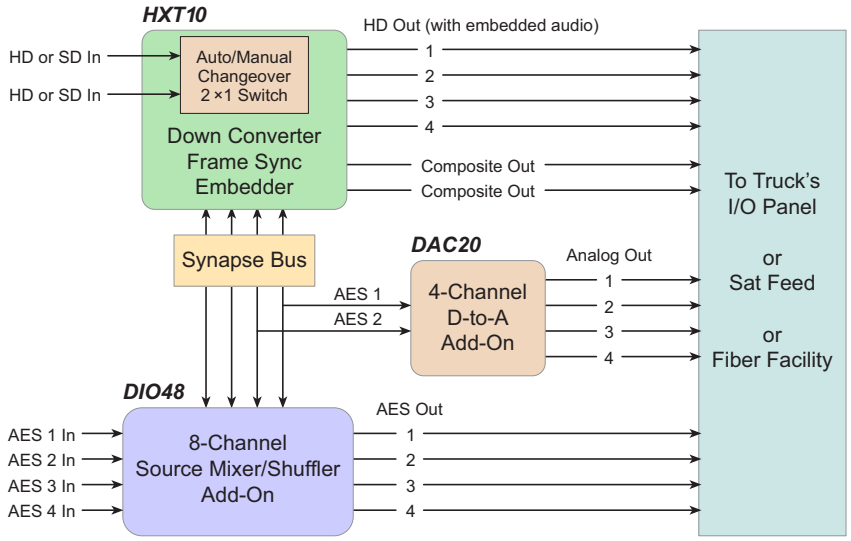


Figure 1. Remote Truck Application

Many signal-processing functions are available in the Synapse TWINS series, where two of a particular function are combined onto a single module. Besides the obvious density this provides, these modules work with very low overall latency. With Synapse products, you can choose the solution that is optimal for your particular situation.

The HSU10 is the ideal up-converter for ENG backhaul. It provides useful features such as built-in frame sync and embedded audio processing yet maintains a very low latency interval. Other modules such as the 2HS10 dual down-converter provide exceptional SD output image quality and all the features needed in a typical HD or down-converted SD simulcast application yet manages to keep module latency comparable to what would be found on the HD half of the signal chain. Another multi-function building block, the HXT10/HXT20 (see Figure 1) combines an HD frame synchronizer, down-converter and SD frame synchronizer with complete audio management to create simultaneous HD and SD output streams from a single HD input.

This module provides yet another backhaul approach and demonstrates the application solutions that the Synapse family provides.

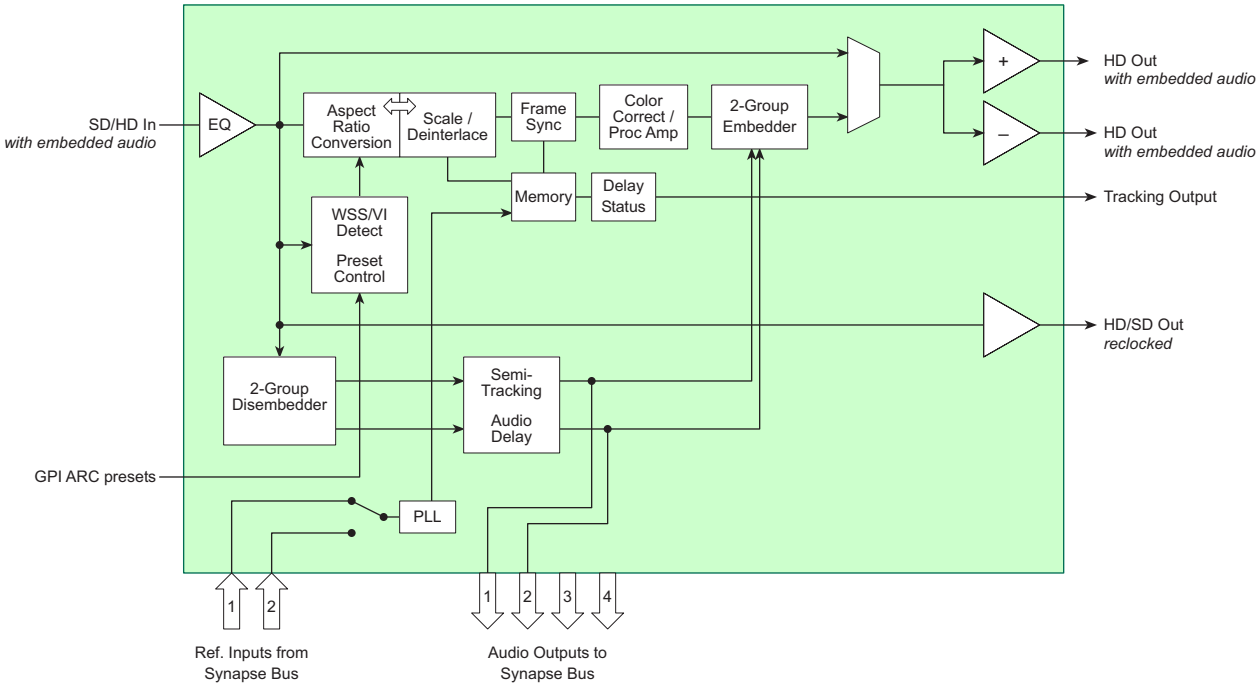


Figure 2. HSU10 HD Up-Converter with Color Corrector

Miranda's NVISION series routing systems, by design, do not add appreciable latency to a system. Typical input-to-output delays are measured in pixels. However, a trend has emerged where routers are incorporating processing circuits internally — for example, video outputs that provide down-conversion or built-in DSP for audio manipulation. Without careful engineering, adding these functions to a router can dramatically increase its overall path length. All NVISION series routing products provide the lowest possible path length for any set of functions, and maintain that value across all outputs regardless of mode.

Miranda believes some processing functions are best implemented outside the routing core, at least until technology matures enough that a sensible implementation can be made. Down-conversion is one example: current processing technology is power-hungry and demands too much user intervention (e.g., aspect ratio settings and audio control) to make a "one-size-fits-all" solution truly useful. Installing Synapse TWINS 2HS10 modules downstream of the router allows 36 down-converters to fit in 4RU of space and, unlike a router-embedded solution, the 2HS10 modules provide an HD pass-through so there is no loss of router outputs. In fact, an Miranda's NV8288 router and a few Synapse SFR18 4RU frames filled with 2HS10 modules offer better down-conversion performance, higher density, a smaller rack footprint, and lower latency than competitive products!

If you examines the signal chain as a whole, a few options are open for consideration. Obviously, the desired processing function will dictate the required equipment. For example, an ENG truck backhaul feed requires a certain set of processing functions. Implementing these functions with as few discrete modules as possible

can reduce latency through the entire chain. Comparing specifications will allow product choices that provide minimum delay.

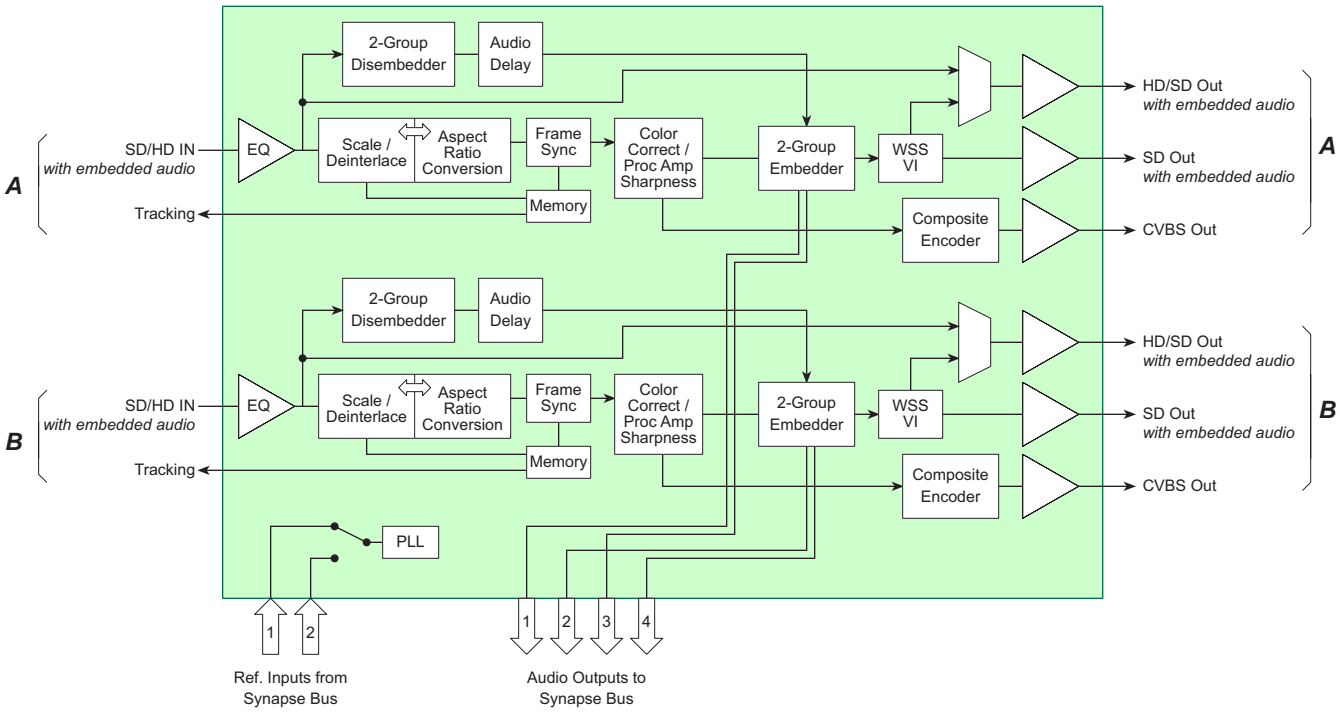


Figure 3. 2HS10 Dual-Channel High-End HD to SD/Composite Down-Converter

The former NVISION's NV2020-HD is an H.264 real-time video encoder that accepts an HD input with up to 8 channels of embedded audio (in either AES or other encoded and compressed formats). It creates a high-quality encoded output signal that can be configured over a wide range of low bit rates, while simultaneously providing an output for IP streaming applications. It offers one of the lowest input-to-output latencies of any of the encoder products currently on the market. This makes it ideal for backhaul applications, both for live programming as well as ENG and news feeds.

Figure 4. NV2020-HD

The NV2020-HD has a dedicated DVB/ASI output that is intended for backhaul use. High-quality HD video with bit rates down to 6 MB/s are attainable. Superior pictures can be made available over standard RF links used for ENG and remote use from trucks, broadcast helicopters, etc. The performance "sweet spot" is about 8 MB/s which is ideal for QAM transmission systems. The audio payload is user-configurable, supporting up to 8 channels of embedded AES or Dolby-encoded multi-channel material, or a mix of both.

The NV2020-HD also provides an IP output that is optimized for streaming applications and that can be used simultaneously with the ASI output when needed. High-quality HD video and multi-channel audio can

easily be streamed onto virtually any network, and the NV2020-HD's low encoding latency helps compensate for the often long delays encountered on a switched network.

Combining products such as the NV2020-HD and the 2HS10 creates a low-latency HD/SD backhaul solution for ENG use. The NV2020-HD performs the compression and the HD pass-through output of the decoder feeds into the 2HS10 where is it down-converted to SD. Because the 2HS10 is a TWINS module, one of its channels can be the primary station feed and the other channel can be a clean-feed output. If you must transport much audio, a pair of DIO48 cards will add extensive audio processing and management functions and the internal Synapse bus makes it all a simple plug-and-play operation.

Because many stations still use network pass-through and up-conversion of local content for their primary HD signal, the Synapse line of up-converters and audio processors is an excellent choice. The Synapse HSU10 and HSU20 provide low-latency up-conversion and can be paired with a Dolby encoder such as the DBE08 to provide a simple and cost-effective solution. The low latency of this package means less offset between the SD and HD feeds from the station.

Conclusion

Miranda provides application-oriented solutions to help you improve the performance of your facility and can help solve challenging technical projects. Contact your Miranda sales representative or give Miranda a call for information on applications covered in this note or on any of the products Miranda offers.