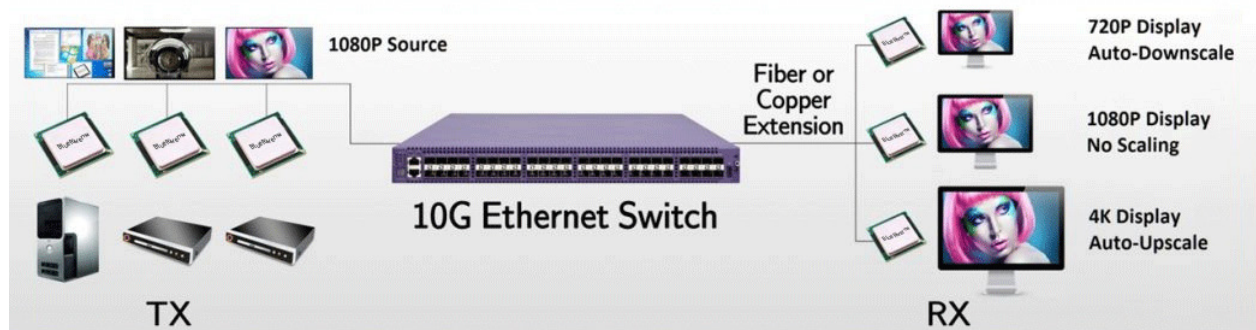# BlueRiver AV Processor

BlueRiver™ AV Processor is a fully in-line engine for high-fidelity processing of uncompressed audio and video signals. Available on BlueRiver NT2000 chipsets, BlueRiver AV Processor integrates numerous functions into a single, in-line, zero-frame latency signal processing subsystem. These functions include broadcast-quality scaling, visually «indistinguishable» light compression, multi-source video compositing, video splitting, color-space conversion, frame-rate conversion, audio embedding/de-embedding, audio down-mixing, and audio re-sampling. BlueRiver AV Processor is fully embedded into and tightly coupled with the BlueRiver chipset's signal extension and switching capabilities delivering the world's first and only single-chip solution for end-to-end signal distribution and processing.

Broadcast Quality Scaling

Optimized for video, graphics and text quality, BlueRiver AV Processor supports both up-scaling and downscaling for resolutions up to true 4K/60/4:4:4. This broadcast-quality scaling engine is architected with fully programmable horizontal and vertical taps and includes pre- and post-processing algorithms to reduce ringing and aliasing artifacts while preserving the sharpness of edges. The scaling engine operates in line with the other functional blocks of the chipset such as HDMI encoding/decoding, AES 128-bit encryption, extension (10G streaming), light compression (if and when needed) and only adds 16-lines of latency to the video transmission (or just ~30us of latency at 4K/60Hz). A wide variety of formats including RGB and YUV (444/422/420) are supported along with 8-, 10- and 12-bit color depths.

Support for in-line scaling lets BlueRiver excel in common Pro AV applications:

Display-adaptive scaling in 1×n signal distribution – When a source is being transmitted to multiple displays of varying resolutions, the scaling engine in each receiver can automatically upscale or downscale the source to the native resolution of the attached display if and when needed, ensuring that each display receives the source in its optimal image quality. Without this capability, the source would have to be set to the resolution of the lowest resolution display forcing all higher resolutions display to always show a lower quality upscaled image.

True seamless switching in n×m signal distribution – In a matrix-switching environment, switching a display from one source to another typically results in a black screen, frozen frames or other artifacts. With BlueRiver AV Processor's scaling capability integrated into an AV-over-IP platform, truly seamless switching can be achieved where the switching delay is only 1-2 frames and without artifacts, irrespective of the resolution of the switched source.

Multi-view, PIP, and PAP – The scaling capability works with the multi-source video compositing capabilities of BlueRiver AV Processor to deliver multi-view, picture-in-picture (PIP) and picture-and-picture capabilities (PAP) within the AV signal distribution system, without the need for additional equipment.

Video wall processing – When used with the video-splitting and bezel correction capabilities of BlueRiver AV Processor, the scaling capability also enables full video wall processing without the need for additional equipment.

Pixel Perfect Light Compression

BlueRiver chipsets transmit uncompressed, pixel-for-pixel video signals extended over long distances and switched through IP switches with zero-frame latency. In very few cases, it may be desirable to apply light compression to enable a video resolution to be transmitted across a limited bandwidth network or to enable longer distance transmission for the same resolution. For such cases, a unique new compression algorithm was developed with a compression ratio of just 1.4:1 to enable pixel-perfect image quality. When enabled, this ultra-low compression ratio results in mathematically lossless compression for most content and visually indistinguishable image quality for the remaining cases. What's more, the compression codec functions in-line with the rest of the various AV processing and adds only 7-lines on latency (<15us for 4K/60Hz).

Multi-Source Video Compositing

BlueRiver AV Processor's multi-source video compositing capability allows each BlueRiver receiver to combine multiple video sources onto a single display enabling a variety of applications such as multi-view, PIP and PAP. This multi-source video compositing capability is tightly coupled with the scaling capability which is used to scale the resolution of each source to the target window on the display canvas. This 4K/60-capable compositing function can tolerate a large number of asynchronous inputs and can render without tearing or other visual artifacts. Multiple pre-sets are available and layouts can be updated in real time.
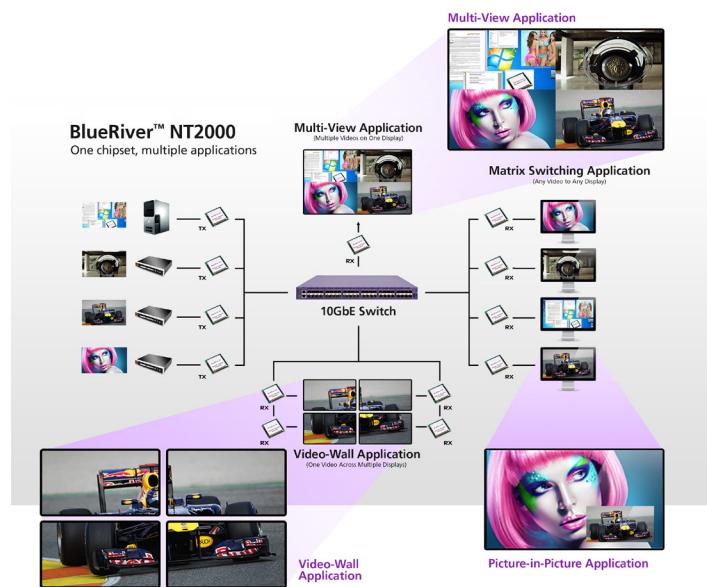
Video Splitting and Bezel Correction

BlueRiver AV Processor's multi-source video compositing capability also allows each BlueRiver receiver to automatically split an incoming video and render only a portion of the image as part of a video wall. Configurable bezel-correction support compensates for the thickness of the bezel to virtually hide the pixels that need to be obscured by the display bezel. Combined with the scaling capability, bezel-correction support delivers video walls of any size and eliminates the need for additional equipment.

Colorspace Conversion

Pro AV applications often require the flexibility to support many types of input formats (e.g. RGB, YUV 4:2:0, YUV 4:2:2). Mismatches between the format being output by the source and the formats supported by the display are common, resulting in interoperability issues. BlueRiver AV Processor integrates an in-line, color-space converter which automatically converts between mismatching color spaces on the source and the display. For example, content sourced as YUV can be converted to RGB for easy compatibility with DVI displays. Perhaps more importantly in a 4K world, it means full capability for chroma subsampling conversion. For example, content at 4K60 4:4:4 can be down sampled to 4K60 4:2:0 for supporting first-generation 4K60 displays.

Frame-rate Conversion

Interoperability of resolutions and color spaces is incomplete without the ability to convert frame rates as mismatches in resolutions and color spaces are also often accompanied by a mismatch in frame rates. The BlueRiver AV Processor includes full arbitrary frame-rate conversion, enabling true cross conversion from any resolution and frame rate to another. For example, 4K30 can be scaled down to 1080p60 and 1080p24 can be scaled up to 4K60. Content sourced at 59.97 Hz can be used along with 60 Hz content without any special considerations. Other AV processing capabilities of BlueRiver AV Processor, such as scaling and true seamless switching, also benefit from frame-rate conversion – a monitor will never have to re-sync during an input switch, regardless of the associated resolution or refresh rate.

Highly-flexible Audio Capabilities

Professional AV applications often have audio requirements as complex as their video requirements, and BlueRiver AV Processor delivers on all of them.

Sample rate conversion - To support seamless switching, or simply to match the capabilities of a low-cost audio system, BlueRiver AV Processor can convert the sample rate of any PCM stream (stereo or multi-channel) to any other.

Stereo down-mixing - A large matrix video system may include destinations with varying audio capabilities. A home theater is built for high-resolution multi-channel audio, but the small television in the kitchen may only accept stereo audio. By enabling each endpoint to down mix multi-channel PCM to stereo PCM (in combination with sample-rate conversion), compatibility with any audio destination can be guaranteed.

Audio embedding and de-embedding - Sometimes even the audio processing built into BlueRiver AV Processor is not enough, such as when the AV switching system needs to be integrated with a full-blown audio DSP for mixing program audio and sound reinforcement. To enable this, BlueRiver AV Processor allows audio to be extracted from an HDMI feed and output via I2S to other on-board modules, such as DSPs, DACs, or popular networked audio modules and gear. After processing, this audio can be re-embedded with video, and sent via HDMI stream or a BlueRiver AV-network feed. Analog audio may also be embedded by connecting an ADC to the I2S input port on BlueRiver AV Processor.

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