White Paper

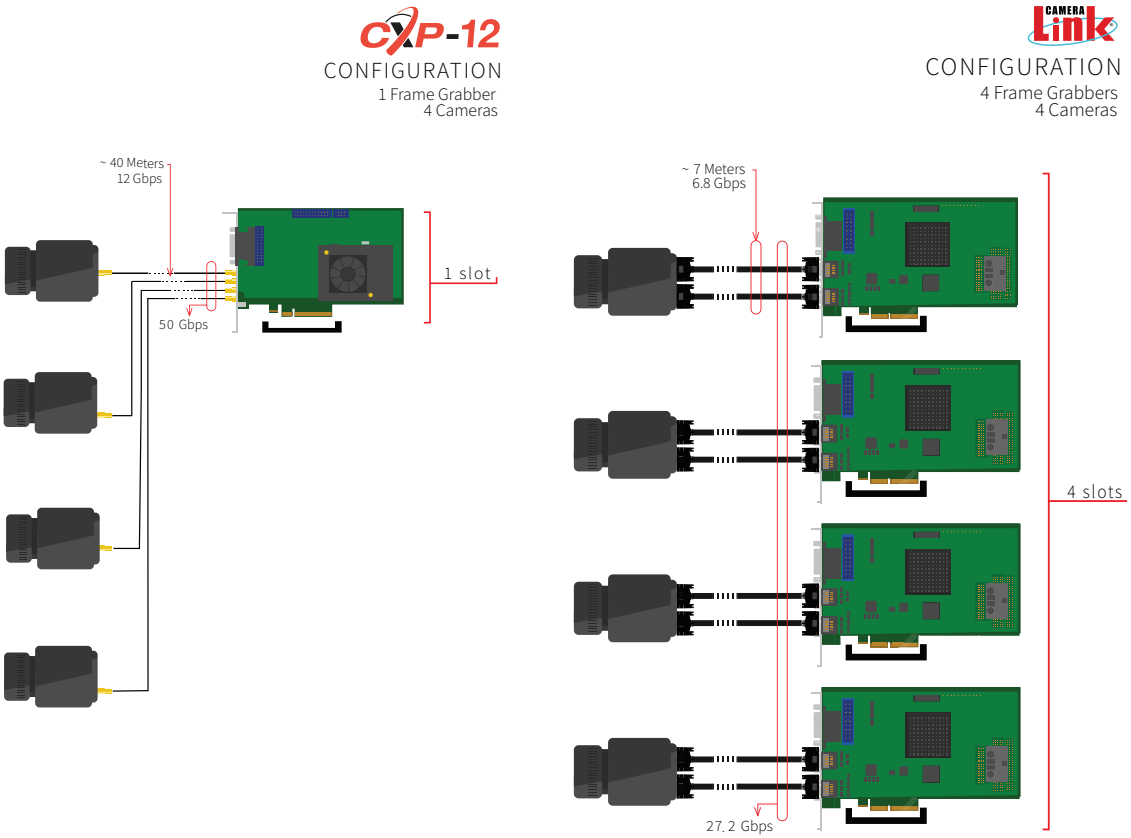
CoaXPress 2.0

Extended bandwidth and more…

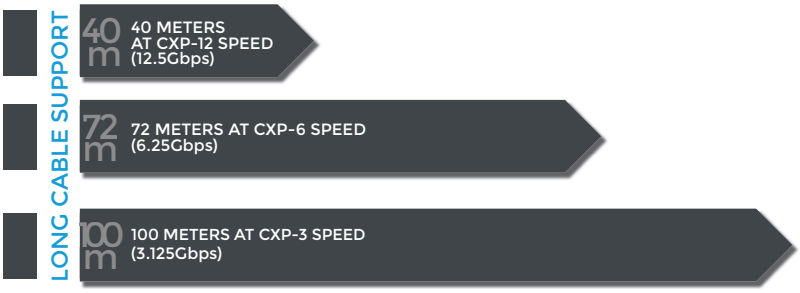
The success of CoaXPress as a high-end machine vision standard has been driven by its reliability, simplicity in terms of cable and connectors, extended cable lengths, and other industry-required features such as very low jitter triggers, camera control, and power over cable. The CoaXPress Standard Version 2.0 brings a rich new set of features while remaining backwards compatible to CoaXPress 1.1.1. This is an overview of these new features along with example use cases.

Extended bandwidth and higher trigger rates

A CoaXPress 2.0 link with four CXP-12 connections can support a maximum data transfer rate of 50 Gbps, or 5 GByte/s. This is sufficient, for example, to operate a 10-bit 12-megapixel area-scan sensor at more than 300 images/s, or an 8-bit 16k line-scan sensor at 300 thousand lines/s. A single connector CoaXPress CXP-10 camera delivers greater bandwidth over a single cable than a Camera Link Extended Full 80-bit configuration, which delivers 6.8 Gbps (0.85 GBytes/s) over two cables. A four-connection CXP-12 frame grabber delivers in a single slot more bandwidth than four Camera Link Full frame grabbers.

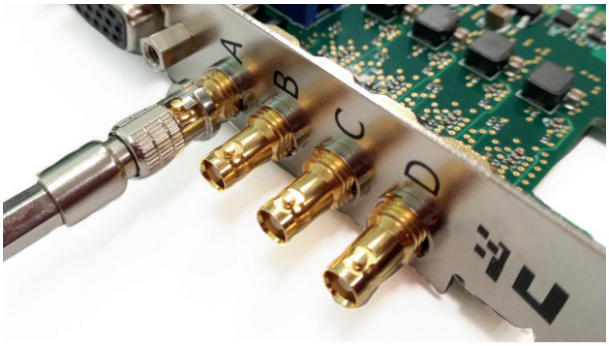


In addition, CoaXPress 2.0 also increases the up-connection bitrate, from host to device, from 20.83 Mbps to 41.6 Mbps for CXP-10 and CXP-12, enabling a host to send trigger messages to a camera at rates of almost 600 kHz in single trigger message mode or almost 300 kHz in dual trigger message mode (rising/falling edges). Cable length is another important aspect related to CoaXPress 2.0 extended bitrates. Due to the efforts expended on cable drivers and equalizer to make CXP-10 and CXP-12 possible, the cable lengths for lower bitrates were significantly improved (CXP-1, CXP-2, CXP-3, CXP-5, and CXP-6).



Support for Micro-BNC connectors

Driven by the extended bitrates, CoaXPress 2.0 includes support for Micro-BNC (also known as HD-BNC™) connectors. This connector is a de-facto standard, originated by Amphenol® and designed to handle transfer rates up to 12 Gbps. It is widely used in the world of broadcast for 12G-SDI links and features unmatched mechanical stability, compact size (similar to DIN 1.0/2.3), and suitable electrical properties.



Unified Time Stamping

CoaXPress 2.0 introduces the Unified Time Stamping, which allows reporting events coming from Devices, Hosts, and software into a unified time reference. The basis of the Unified Time Stamping is that Host and Device maintain an internal and independent free-running time clock. Both Host and Device will timestamp internal events with their respective time clock ("t-dev" for Device events and "t-host" for Host events). The Device periodically sends a time synchronization message to the Host, allowing it to keep track of the relationship between t-dev and t-host. Based on this relationship, the Host can translate any timestamp expressed in t-dev to a timestamp expressed in t-host.

Event channel

The Event channel is a new communication path introduced in CoaXPress 2.0 that provides the Device a mechanism to asynchronously send messages and status updates to a Host. All Event messages are timestamped using the Unified Time Stamping mechanism. Through this new channel, the Device can precisely inform the application when specific internal events occur, for instance, the start of exposure or input/output signal states.

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Error reporting

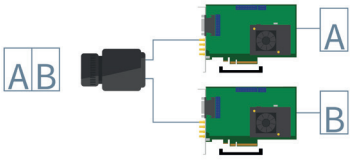
CoaXPress 2.0 introduces a series of counters to give users a clear view of the link quality during operation. These counters are incremented whenever a link-related problem occurs, for example: Link loss, wrong 8b/10b symbols detected, CRC errors, and differences between duplicated characters (used in some CXP messages for robustness). The application can read or reset these counters via GenApi.

Control Packet Tag

CoaXPress 2.0 also introduces a tag field into control packets in order to improve the robustness of the control channel. The tag field is a free running number, incremented for each new command issued by the Host. The Device (camera) must send an acknowledgment message along with the tag received in the corresponding command packet. With this rule, the Host and the Device can consistently recover from error conditions, for example, in case of a lost acknowledgment message. In this particular case, after a given time-out, the Host will resend the command while keeping the same tag. The Device will be able to verify if this command was already executed based on the received tag.

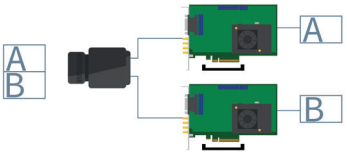
Data Sharing

CoaXPress 2.0 defines rules for data sharing, where a Device simultaneously streams data to more than one Host. A Device capable of data sharing must have more than one link and each link, called sub-Device, must be a standard CoaXPress link. This means that from the Host point of view, each link from a data sharing Device can be treated as a regular Device. CoaXPress 2.0 also defines a number of sharing modes for image streams as follows:



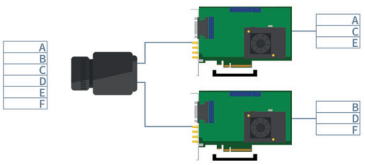
1) Vertical Striping

The image is split into 'v' vertical columns, typically where 'v' is the number of sub-Devices.



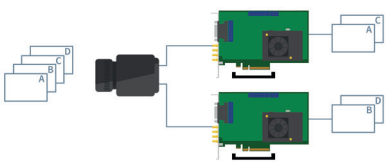
2) Horizontal Striping

The image is split into 'h' horizontal rows, typically where 'h' is the number of sub-Devices.



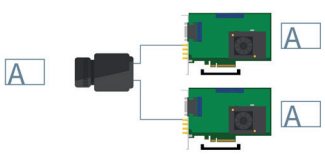
3) Line Interleaving

A number of consecutive lines are sent to each sub-Device in turn.



4) Frame Interleaving

Alternate frames are sent to each sub-Device in turn.



5) Image Duplication

The full frame is sent to all sub-Devices.

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Other improvements/features in CoaXPress 2.0

The CoaXPress 2.0 standard includes also several clarifications on mecanical, electrical and protocol levels, making it easier to implement and more reliable.

Conclusion

Since it was approved as an official standard in 2011, CoaXPress vision interface standard has achieved significant adoption in the machine vision and video monitoring industries by machine builders and system integrators worldwide. CoaXPress 2.0, the latest evolution of the standard, provides a major step forward by delivering the bandwidth to support the next generation of high resolution, high frame rate cameras in delivering a new generation of applications that provide clearer images in less time, making it possible to achieve higher levels of productivity, quality, security and understanding of the real world than ever before.

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