Electronic Design

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Video SerDes Tech Boosts Resolution Over a Longer, Single Wire

Sponsored by Texas Instruments: Achieve higher resolution and transfer uncompressed video, power, and more over one wire using V³Link serializers/deserializers.

The uncompressed transmission of video data, control signals and power is heating up—and it's not just with the promise of warmer weather. A wide range of applications, from endoscopy, a non-surgical procedure used to examine a person's digestive tract, to factory automation, require that high-bandwidth data be transferred over several meters worth of cable.

That presents a challenge, not just because of the signal loss introduced with such a transmission channel, but also due to the introduction of electromagnetic-interference (EMI) or electromagnetic-compatibility (EMC) considerations common to medical or industrial applications. Such external noise sources could interfere with the cable as data passes to its destination.

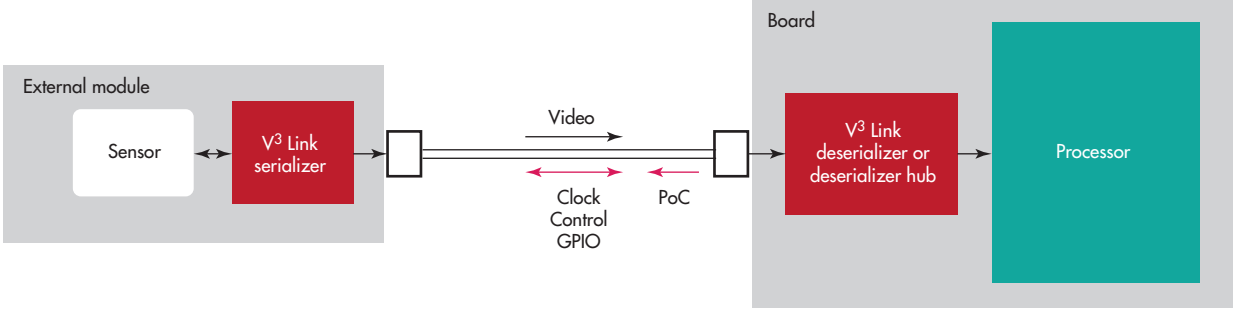
Fortunately, there's a significant reason why using a single wire over longer distances could soon become very mainstream: the V³Link high-speed bidirectional video serializer/deserializer (SerDes) technology.

Increasing the resolution of an imager in a system increases the amount of data it generates, data that must be transmitted, processed, and stored. Unfortunately, connecting an imager over a small-diameter wire or cable can add signal interference. Here, we'll discuss a modern solution to this problem: V³Link SerDes pairs, which can enhance resolution and reduce system size in high-speed video applications.

What is V³Link?

V³Link technology acts as a bridge between protocol-based data interfaces, which require multiple signaling conductors to transfer high-bandwidth data. Supported data-interface standards include HDMI, LVDS, MIPI CSI-2, and MIPI DSI. These standards, however, are designed to transfer video only over short distances, which may include PCB traces.

V³Link devices support various cable types. Applications typically utilize either coaxial or twisted-pair cables to carry information between serializer and deserializer. Coaxial cables tend to have lower insertion-loss characteristics when compared with twisted-pair cables due to their electromagnetic construction. Twisted-pair cables are typically more immune to the effects of electromagnetic interference. Most V³Link devices can support either coax or twisted-pair configurations to ensure flexibility in various applications.



This simplified diagram illustrates data serialization/deserialization and power transmission using V³Link devices.

V³Link transfer works by combining input data into packets or frames to be transmitted serially at high speed. Payload data makes up the majority of the frame. This is the high-bandwidth portion of the data, which could be comprised of video pixel information, audio data, or other data types including radar, LiDAR, and more.

Minimal Latency

Vision-based control systems such as industrial mobile robots require very low latency for real-time acquisition and video data analysis. Low latency also is needed to transfer the control information in the reverse direction to modify the camera position. The V³Link forward channel is used to send the serialized video, audio, or other data to an endpoint device with minimal latency.

By utilizing a proprietary echo-cancellation technique, V³Link SerDes allows for full duplex communication over one physical conductor. As high-speed data transfers from the serializer to the deserializer in the forward direction, low-speed data also is transferred back to the serializer simultaneously and without time multiplexing. The V³Link devices automatically establish this bidirectional channel by continuously cancelling out their own transmitting signals at each end of the link.

Using this simultaneous back-channel communication, I²C access and GPIO transfer can be enabled across in either forward or reverse directions. V³Link deserializers utilize multiple equalization techniques to recover high-frequency signal content and mitigate the effects of intersymbol interference (ISI), reflections, or external noise influence.

SerDes technology such as the V³Link TSER953 serializer and TDES960 and TDES954 deserializers work in tandem to transfer high-resolution video, control signals, and power simultaneously over a single thin wire. These devices help establish links between sensors and processors to aggregate clock, uncompressed video, control, power, and GPIO signals *(see figure)*.

In addition to facilitating the transfer of video data, control signals, and power over a single cable, V³Link devices include adaptive equalizer technology that can compensate for a loss of up to 21 dB at 2.1 GHz, enabling the use of very thin 28 to 32 American-wire-gauge (AWG) cables. The higher the AWG number, the thinner the cable and the higher the signal loss. The ability to transfer power and control signals on the same thin cable also minimizes the number of conductors.

At typical power dissipations of 250 mW on the sensor side, V³Link serializers consume very low power. As a result, the sensor and serializers can be integrated into very compact areas without the need for power and heat dissipation, which requires additional space.

Conclusion

V³Link is a high-speed bidirectional video SerDes technology that enables uncompressed transmission of video data, control signals, and power using a single wire. As a high-speed, uncompressed video-transport technology, V³Link aggregates video, clock, control, and peripheral data from cameras, radar, LiDAR, or time-of-flight sensors to an SoC over a single wire or cable up to 15 m. V³Link serializers and deserializers extend cable reach while maintaining image quality, reducing power consumption and improving system reliability.

Overall, vision-based designs can use V³Link devices to:

- Strengthen signal integrity.
- Extend cable reach up to 15 meters.
- Reduce system size, weight, and power.