Electronic Design

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Going the Distance with High-Res Video

Sponsored by Texas Instruments: What's the most efficient way to transmit uncompressed high-definition video over long distances? ICs developed using high-speed video serializer/deserializer technology offer an easy-to-implement solution.

Here's a trend you may have missed: the increased use of high-resolution video in a wide variety of applications. This isn't your run-of-the-mill video, but real 1080p 2.3MP 60 frames/s (fps) as well as 4MP 30 fps. These video resolutions provide the fine detail often needed to justify the use of video.

And such enhanced video offers an extra set of eyes that often provide valuable information to make the application worthwhile. Tiny high-resolution sensors now can be integrated into a variety of specialty products, giving them increased capabilities and, in some cases, permitting operations not possible before.

However, the adoption of high-res capability also has created some design challenges. One of the most difficult is the transport of the video from one place to another over some distance. That challenge is now met with some special integrated circuits described in this article.

High-Res Applications

Today, traditional products like machine vision are able to "see" better than ever before. The fine detail now can identify more defects or other conditions in inspection processes. Robots also benefit from the improved vision, such as detecting obstacles. Medical imaging, surgical robotics, and patient monitoring become more effective with the improved detail.

Other applications that can benefit are surveillance systems used in security installations. Not to mention industrial, factory or automotive applications like radar or LiDAR. Furthermore, high-res video cameras are fast becoming the key sensor in modern automobiles to improve advanced driver-assistance systems (ADAS) and self-driving vehicles.

A positive development is the availability of artificial-intelligence (AI) software and hardware that can be used to analyze and interpret the massive amount of data generated by a high-res sensor. Machine learning and specialty processors provide the increased accuracy and sensitivity in identifying patterns and detecting obstacles or abnormal conditions.

One of the major problems encountered in addressing these applications is the need for a transport medium that maintains the raw high-resolution data, which in turn delivers the end usefulness. Existing cables and interfaces simply don't have that capability.

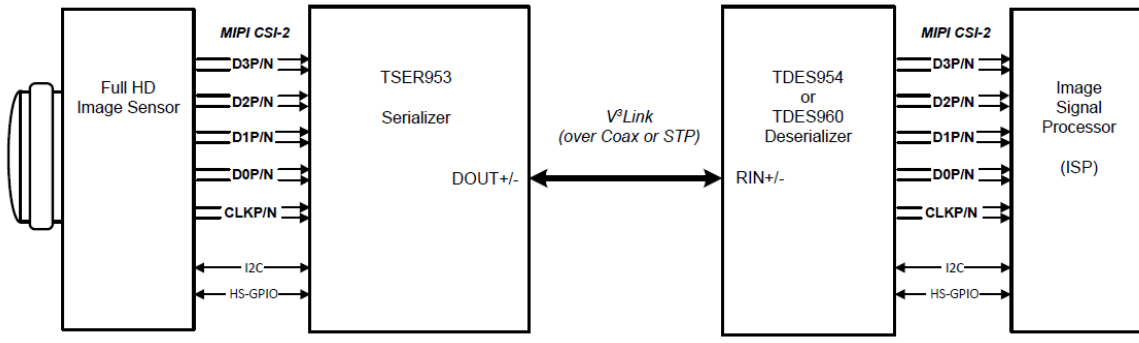
A New Solution

Texas Instruments now offers its V^{3}Link devices that facilitate high-res data transport. V^{3}Link is high-speed video serializer/deserializer technology that permits the transmission of high-res uncompressed video over distance on a single thin cable. In addition, it offers the ability to carry control signals and dc power over the same cable.

The cable may be coax, 100-Ω shielded, or unshielded twisted pair over a distance of several meters. Wires as thin as AWG 32 can be used to provide cable flexibility and light weight.

High-resolution sensors typically produce a parallel binary output compatible with available standards like MIPI-CSI-2. The idea is to serialize that data for transmission, which is the function of the TI TSER953 V^{3}Link serializer. It supports inputs from sensor interfaces like the MIPI-CSI-2, MIPI-DSI, LVDS, and HDMI; serializes the data; and formats it into packets for transmission at 4.13 Gb/s. The packets incorporate a 16-bit CRC for error detection. An adaptive equalizer is integrated to mitigate the cable losses.

A key feature of the V^{3}Link ICs is the full-duplex capability on the single cable. Data transmission takes place over a forward channel at the 4.13-Gb/s rate. A back channel is provided to carry dc as well as control signals from I^{2}C, SPI, or GPIOs to/from the host processor for the application. The GPIOs often are used for camera synchronization, diagnostics, and control. The serializer and deserializer can be



A typical application illustrates the simplicity of the 4.13-Gb/s uncompressed video imaging system thanks to these new ICs,

programmed through the host with this feature. The back-channel data rate is 50 Mb/s.

The TSER53 operates with a 1.8-V supply with typical power consumption of about 250 mW. It's housed in a 5- × 5-mm VQFN package, making it small enough to fit inside a probe or other miniature camera module. The device is compliant to IEC-61000-4-2 for electrostatic discharge (ESD).

The V^{3}Link product line also includes two deserializers, the TDES954 and TDES960. Both are fully compatible with the TSER953 serializer and operate at the 4.13-Gb/s rate over the chosen cable. Output interfaces are the MIPI-DPHY or CSI-2. The TDES954 is able to aggregate one or two serial sensor inputs, while the TDES960 deserializer is a hub that can accommodate four V^{3}Link serial inputs and provides two MIPI CSI-2 outputs.

Applying the TSER953

The *figure* shows a typical application. The camera module has a MIPI CSI-2 interface that connects directly to the TSER953. All of the formatting and serialization is handled by the TSER953. The deserializer translates the output to MIPI CSI-2 format for the image processor. Maximum range depends on the type of cable, but it can be many meters long, which is sufficient for most applications.

These unique devices make it possible to incorporate high-res video into products heretofore not possible. With the continued increase of HD video, the need for these ICs will help speed up and simplify the design of new products.