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Extending the Reach of UHD (4K) Video Delivery

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As UHD (4K) video becomes more popular, there's an ever-greater need to extend the length of cables transporting 4K. This is particularly true in the commercial and broadcast video fields, where it's necessary to interconnect UHD equipment like video monitors, switches, routers, format converters, processors, distribution amplifiers, and others. Cable lengths vary, but can extend up to 100 meters. Now, standard interfaces such as the serial digital interface (SDI) are available to handle this job—even 10 Gigabit Ethernet is an option.

What Exactly is UHD (4K)?

UHD stands for ultra-high definition, the term for high-resolution TV sets and video monitors. The 4K moniker refers to the pixel count, which in this case means four times the pixel count of Full HD, also known as 1080p. The 4K standard has a resolution of 3840 × 2160 or 3640 pixels per 2160 horizontal lines.

There's also an even higher-resolution version of UHD—8K—with a pixel count of 7680 × 4320. It's not widely used, simply because there's very little 8K content available for viewing. However, 4K content is now available from sources like Amazon, Netflix, and YouTube, with more UHD content in the works. Furthermore, 4K TV sets are readily available today.

Serial Digital Interface

HDMI or High Definition Multimedia Interface has been the interface of choice for transporting HD video. All TV sets and disk players and other consumer boxes have HDMI ports. But for professional and commercial video work, the Serial Digital Interface (SDI) is the preferred transport medium.

[is a standard of the Society of Motion Picture and Television Engineers (SMPTE). There are multiple versions ɜt, based on different data rates from 143 Mb/s to 24 Gb/s and a variety of video formats. SDI is used to transmit uncompressed and unencrypted video, digital audio, and time codes over a simplex (one-way) link. The transmission medium is 75-Ω coax with BNC connectors. Coding is non-return to zero, inverted (NRZI).

The protocol supports data packets of 10 or 20 bits. Error correction is performed using cyclic redundancy checking (CRC). Popular versions of SDI support data rates of 3, 6, and 12 Gb/s. A key issue, though, concerns cable-length limitations. For 3-Gb/s versions or slower, maximum length is usually limited to 100 meters. The goal has been to achieve 12 Gb/s at up to 100 meters.

10 Gigabit Ethernet

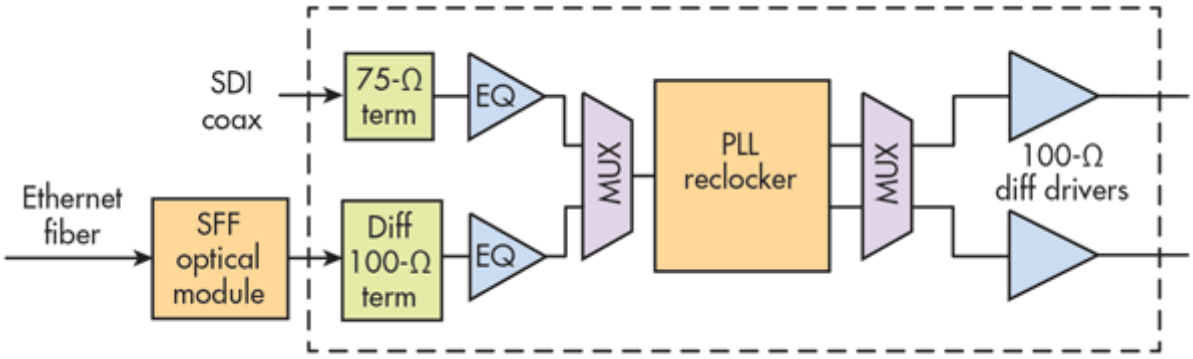
One well-entrenched networking technology that has shown promise for video transport is 10 Gigabit Ethernet (10GE). Available 10GE hardware and software make it a sensible choice for low cost and convenience, as well as compatibility with existing enterprise networks. And it's scalable to data rates of 40 and 100 Gb/s.

The technology comes in a variety of formats with both copper and fiber media. Fiber is generally preferred, as the reach is longer and reliability higher, but it's more expensive than copper. Copper versions use CAT 6a or CAT 7 twisted-pair cable. Reach maximums are 100 meters for copper; however, some fiber versions have a reach of up to 80 km.

The Ethernet protocol defines a standard frame with a data field up to 1500 bytes. For video transport, a growing trend is to use the Internet Protocol (IP) encapsulated in an Ethernet frame.

Designing for the Long Haul

Transmitting digital signals over long reaches of cable causes them to be severely attenuated and distorted, plus they're susceptible to jitter. Attenuation develops from the loss characteristics of any transmission line. Distortion also occurs as the result of line characteristics, such as the cable inductance and capacitance of coax. Jitter is the timing noise that's common at very high clock and data rates.



Designing transmitting and receiving circuits requires special circuits to correct for these limitations. Amplification overcomes attenuation, while an equalizer at the receiver can correct the distortion based on cable length. Jitter can be corrected by reclocking the data stream. Special integrated circuits are available, making it unnecessary to design them yourself.

One example is Texas Instruments' LMH1219, which provides all of the circuits needed to support both SDI and Ethernet interfaces *(see figure)*. The top input provides 75-Ω coax termination and an adaptive cable equalizer (EQ). The lower input gives 100-Ω termination for a small-form-factor (SFF) optical module for Ethernet and an adaptive printed-circuit-board (PCB) trace equalizer. Both inputs drive a multiplexer that selects the input to be

d. The selected signal is then reclocked to minimize jitter using a phase-locked-loop (PLL) reclocking circuit with on-chip loop filter. The output multiplexer selects the desired 100-Ω differential driver.

The LMH1219 supports both SMPTE SDI and Ethernet at rates up to 11.88 Gb/s. A coax cable reach of 75 meters is possible at 11.88 Gb/s (12G) for 4Kp60 UHD, while a reach of 120 meters is achievable at 5.94 Gb/s (6G UHD) and 200 meters at 2.97 Gb/s (3G UHD). By providing compatibility with both SDI and Ethernet, the LMH1219 helps your product meet the needs of the market. A variety of other driver, equalizer, and reclocker circuits, as well as evaluation modules, are also available to meet specific needs.

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