

Real4K™ HDMI Video: Uncompressed & Uncompromised



The 4K Revolution is Here. And it Changes Everything.

The 4K revolution brings big challenges, but also great opportunities for those who are prepared to embrace the change. One of the biggest challenges and biggest opportunities is the transition from copper interconnects to optical interconnects. Not everyone is ready to make the transition, but those who are will deliver better solutions to their customers and have a competitive edge over those who are stuck in the past.

4K video with HDR is driving the future of AV toward fiber because it needs the full 18 Gbps pipe, and copper cables, even well-constructed ones, only support this up to ~20ft. Why is this becoming such a problem now? With the proliferation of 4K HDR video, the bandwidth is moving beyond the 10 Gbps capabilities of category copper cable solutions with video over IP or HDBaseT. This means that system integrators are looking to solutions that can support these bandwidths to keep up with 4K HDR video and dynamic HDR, including Dolby Vision and HLG. Fiber not only provides the bandwidth, but also eliminates some of the issues that category cables have with electromagnetic interference and ground loops. Fiber is now making the transition from just Datacom to products specifically designed for AV, making installations easy, clean and simple.

Real4K Extenders For Any Installation

Whatever the application, if your interconnect doesn't support 18 Gbps, the viewing experience is compromised even if you have the best content players and displays. So when you simply want the best HDMI video, Real4K delivers...no compromising, no compression, no worries.

Integrate Real4K solutions with matrix switches to provide a complete solution that can run in parallel with your network solutions without adding to the bandwidth needs. The single fiber cable provides full bandwidth, HDMI video plus IR control, so there is no need to compromise your AV installations.

EMI issues are a thing of the past with fiber, reducing installation time and cost. Fiber is immune to EMI, so it can be run alongside category network cable, power or any other noisy environment without being affected. No more chasing ground loops or worrying about alien crosstalk... just a simple, fast installation.



Uncompressed and Uncompromised

WHAT IS REAL 4K?

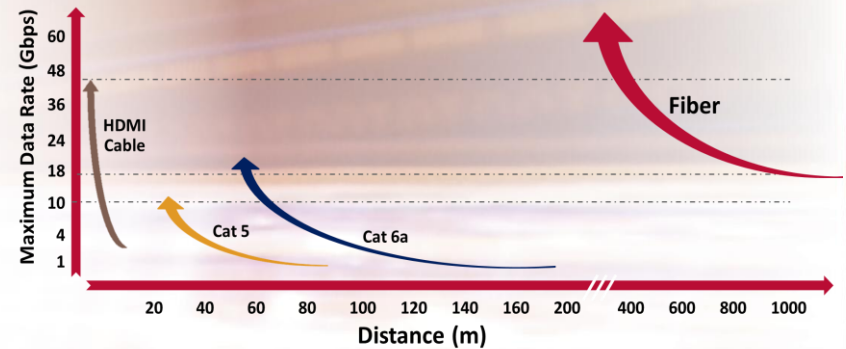
The 4K video experience is more than just resolution - there are higher frame rates to eliminate motion artifacts, expanded color depth for realism, and high dynamic range (HDR) 10-bit color which enhances contrast to incredible levels. Real 4K offers the best video experience available today, but it requires more than 10 Gbps for the video and control bandwidth, and that presents a challenge for video over IP, including SDVoE, and HDBaseT. Unfortunately for consumers, many solutions available on the market today can't support the full 18 Gbps, so instead, they compromise with compression.

Does compression really matter? Since streaming applications use compression, one could argue that this entire discussion on compression doesn't matter since the content was already compressed and therefore compromised just by downloading it. Well, that's not an accurate comparison because the downloadable streaming content uses high efficiency codecs and the compression/decompression is done by a system that has vast time, computational resources, and power available. The compression of real-time video, such as when sending that HDMI video from your player to your display, becomes much more challenging when there are limits on latency and power consumption. The spatial and quantization compression methods used for real-time delivery often lead to visual artifacts. So compression is a very good solution for delivery of content, but a poor solution for a real-time video link.

Is it really 4K? Many solutions use compression so they can send the data over a 10G Ethernet or HDBaseT link or even a 1G Ethernet network. Compression wasn't much of an issue until HDR came along because the bandwidths still fit within the 10G limit supported by HDBaseT, SDVoE, Video over IP and SFP+ modules, but that's changing as more and more HDR content becomes available, and compression is resulting in compromises that are readily visible, such as banding and blocking artifacts, as visually-lossless compression isn't necessarily an option any more. System integrators need a better solution today for 4K HDR video at 18 Gbps and soon for HDMI 2.1 data rates at 24 Gbps, 32 Gbps, and 48 Gbps. Fiber has plenty of bandwidth plus it eliminates issues with electromagnetic interference and ground loops. There is no need to compromise. If it's not 18 Gbps, it's not real 4K.



Fiber Distance at 18G is 100X HDMI Cable and 10X Cat6a



Smart Installers Know to Read the Fine Print

Some products in the market today claim to support 18 Gbps yet they use compression between the transmitter and receiver, so while you will get 18 Gbps output, there is still compression and data is still lost! Be sure to look for solutions that do not use compression to get the best picture and ensure seamless interoperability.

INSTALLING FIBER? IT'S BECOMING STANDARD PRACTICE

Fiber should be pulled for every new AV installation – it's gotten cheap, it's much more rugged than it used to be, and it can be field terminated faster than Cat6 cable. There used to be a time when fiber was fragile and field termination was nearly impossible with the polishing and epoxies needed, but those days are long gone. Fiber termination in the field can use simple no-polish, no-epoxy connectors that can be terminated in under a minute, fiber cables have been developed to have bend-insensitive fiber and include Kevlar strength members so it can be pulled around corners and up through the ceiling with little risk of damage, and with the proliferation of fiber, the cost has gone down dramatically so that it is nearly the same cost per foot as high-end category copper cable. For rugged applications, there is even steel-armored fiber that provides an incredibly tough cable.

And the best part, this same fiber stays in the wall in the future! Unlike copper category cable, where the cable construction changes from generation to generation so new cable needs to be pulled, fiber is already being used in datacenters for 100 Gbps and even 400 Gbps links, so fiber cable is future-proof. The fiber that supports 4K today can simply connect to 8K or even 10K products in the future.

FIELD TERMINATION IS FAST AND EASY

Fiber termination in the field is new to the AV market, but thanks to developments by fiber companies, such as Cleerline, fiber is safer and easier than ever to use. Fiber termination kits are available from a number of different vendors and each offer their own connectors to use with their kit. There are just a few simple steps to fiber termination:

1. Prepare fiber connector and laser light indicator
2. Strip jacketing and buffer
3. Cleave fiber
4. Insert fiber into connector
5. Clamp connector and attach to fiber cable

Pro Tip: It's okay to mix and match fibers and connectors

Fiber from any vendor can be terminated with connectors from any other vendor, so you don't need to worry about having a lot of different termination kits or making sure a certain fiber is installed. Cleerline fiber has a buffer that can be stripped using a fingernail whereas standard fiber will require you to use the three-hole tool in your kit.



WHICH TYPE OF FIBER TO USE?

There are a number of terms out there for fiber cables that can make it confusing to know what to buy and install. Here's a quick overview:

Multimode or Singlemode?

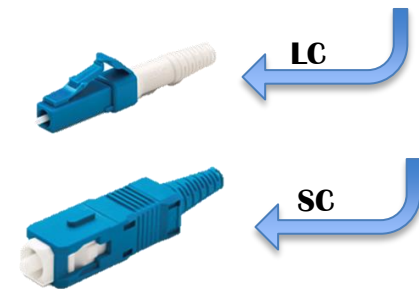
Singlemode fiber has a tiny core that only allows one mode to travel along it, so it can support distances of many km, but the optical components tend to be more expensive. The fiber types are OS1 and OS2, with OS2 supporting longer distances. The components and fiber must match, so if you have a singlemode transceiver, you need to use singlemode fiber. If your application is less than 1000m, Inneos recommends using multimode fiber and components.

Multimode fiber has a larger core for the light to travel along, so it is easier to field terminate and has cheaper components. Multimode fiber comes in rates of OM1, OM2, OM3, OM4 and OM5, and generally the higher the OM-number, the longer the distance. The table below shows the generally distance for video links vs OM fiber rating, so you can choose what is needed for the link while still keeping thing future-proof.

Video Rate per Channel	Fiber Type	OM2	OM3			OM4		
	Fiber BW (Mhz.km)	500	1250	2000	2750	3000	4000	6000
1080p 12bit color (2.25 Gbps)	Max. Distance (m)	520	1260	1940	2210	2270	2430	2580
4k 30hz 4:4:4 (3.0 Gbps)		320	800	1230	1610	1730	1890	2030
4k 60hz 4:4:4 (5.97 Gbps)		150	380	580	760	820	1000	1220
8K Full Rate (12.0 Gbps)		50	125	200	250	290	365	500

SC or LC Connectors?

SC and LC connectors are both commonly used for field termination and both are available with no-polish, no-epoxy quick-connect field terminations. SC connectors are the larger of the two, and therefore some people find it somewhat easier to field terminate, just because the parts are easier to hold – Inneos adapters and extenders all use SC connectors. LC connectors are smaller and are more commonly found in Datacom applications; therefore you will often see LC connectors if your AV equipment uses a 10 Gbps SFP+ module for the optical link.



WHAT TO CONNECT TO THE FIBER?

There are many options for systems to connect to your installed fiber, including AV extenders and video adapters, which are like baluns for fiber. Optical video extenders are the easiest solution to use because you simply terminate with industry-standard connectors and plug in the source and display ends.

Inneos' Real4K Optical Extenders require just one SC-terminated multimode fiber to support the full 18 Gbps HDMI 2.0b, including support for all CEC, HDCP, and EDID, as well as Audio Return Channel (ARC) and bi-directional IR control because we use a WaveStacker™ technology that allows us to simultaneously transmit and receive on one fiber using different colors of light so they don't interfere with each other.

Real4K™ - All the Performance you Need in One Tiny Extender

- **Uncompressed 18 Gbps HDMI Video with CEC, ARC and IR Support**
 - HDMI 2.0b 18 Gbps (4K/60Hz 4:4:4, 4k/60 HDR) up to 1000 meters
 - Includes support for all HDR: HDR10, Dolby Vision and HLG
 - HDMI content is simply passed from source to display... no signal processing involved
- Variable HDMI copper lengths up to 10 ft
- Single, industry-standard field-terminable fiber
- Standard SC fiber connectors



COMPLETE THE DESIGN WITH FIBER ACCESSORIES

- Keystone wall plates with fiber inserts provide clean, easy designs and installations
- InvisiCable – the fiber disappears in plain sight for those times when you just can't hide the cable



Real4K Extender Features and Benefits

- Supports both HDMI 2.0x and HDMI 1.x signals
- Transmits superior HDMI video up to 1000m (3300 ft)
- Supports both HDCP 2.2 and HDCP 1.4 content protection
- All video transport, content protection and maintenance operation transmitted over a single fiber
- Integrated safety feature turns off lasers when an open fiber is detected
- Uses industry-standard fiber and SC connectors
- TAA Compliant for government suppliers
- Made in the USA

FIBER TO THE RESCUE

Reducing Costs and Increasing Profits

It may be difficult to believe, but fiber technologies have improved to the point that fiber systems can actually reduce costs and increase profits for installers and integrators if they are using pre-installed fiber cable and terminating in the field. Fiber systems can be installed quickly and there will be fewer call-backs for troubleshooting due to EMI and interoperability issues. These factors lead to lower installation and set up costs, so the overall cost is reduced and, best of all, the profits are higher:

- Fiber cable technology has improved so that it is as rugged as category cable to pull
- Field termination can be done in only minutes
- Fiber doesn't have active ends that can be damaged during installation like AOCs
- Fiber is immune to EMI, so it can be run next to power, radio, Cat6, etc. without any problems
 - No crosstalk issues
 - No ground loops
- Fiber links do not need to use compression, so all HDR and audio formats are transmitted natively, eliminating problems caused by compression algorithms
- Fiber stays in the wall for upgrades to 8K, so you just need to swap out the extenders connected to the fiber

Secure Links for the Most Demanding Applications

For those projects where security is key, fiber is a perfect option because it is extremely difficult to hack into the data from a fiber cable without disrupting the link, so the Real4K Optical Extenders offer a safe, secure video link. Plus they are TAA compliant for government suppliers.

Made in the USA

Quality is key, and with Inneos' US-based engineering and manufacturing, there is no need to worry. We perform extensive performance and interoperability testing to make sure we work with what's on the market, and we maintain high quality standards on our production line. If you do have a question, we have local, same time zone technical support to help. Just call us at (925) 494-3062.

Where to use Active Optical Cables?

Installers and integrators have been pulling these through walls to get the video quality, distance, and EMI benefits of optical video links because there wasn't any other choice.

However, pulling AOCs is an expensive, cumbersome process. The ends are difficult to pull around corners and tight bends, often resulting in broken cables during installation, which then required that the AOC be pulled back out and a new AOC be pulled because they can't be re-terminated or repaired in the field. Oh, and if the AOC is accidentally put it in backward, the whole thing has to be pulled out and re-pulled the correct direction since there is a specific 'source' and 'display' end. All this leads to increases in both material and labor cost for in-wall installations.

AOCs are a great solution when the cable is run within one room because they are easy and cheap, but if you need to run cabling through walls, then it's much easier to run fiber in the structured wiring at the beginning and just connect up the AV equipment when it is time for final installation.