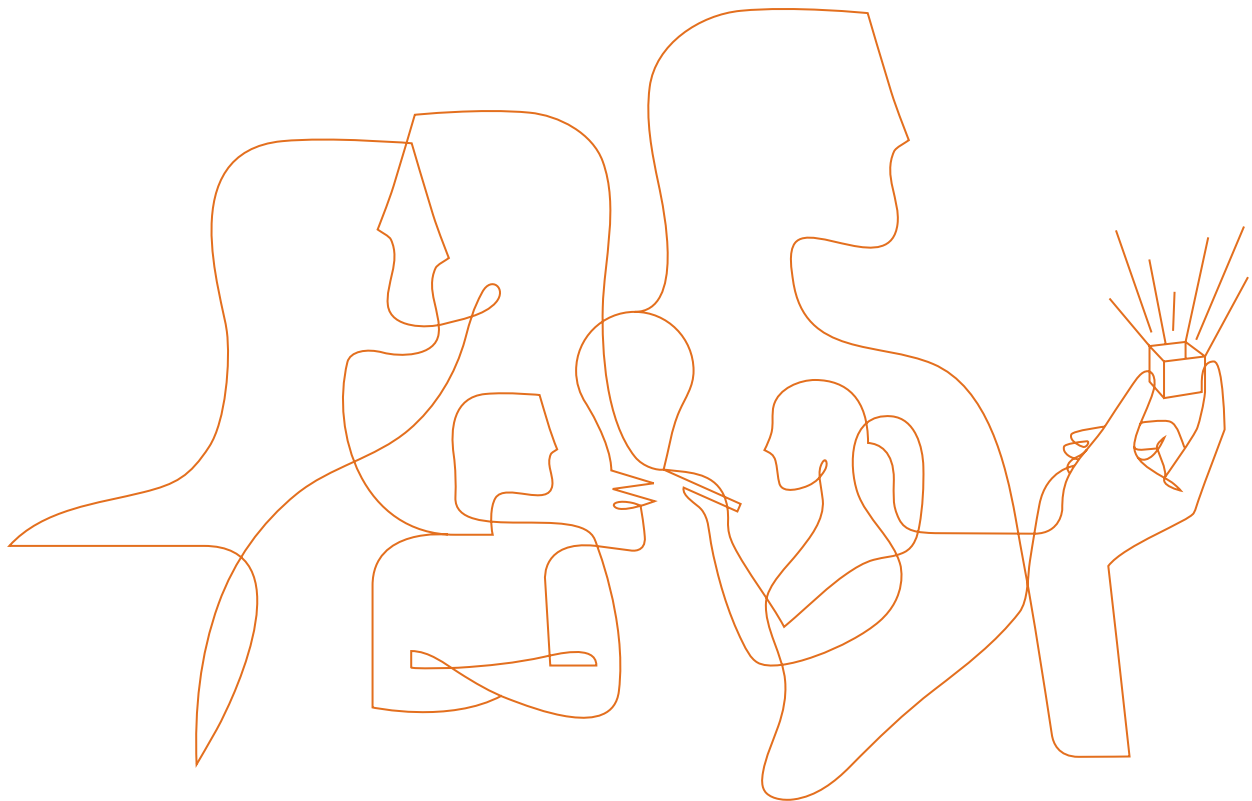


Practical Solutions for Long-Reach HDMI

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It's a Fact:

HDMI (High Definition Multimedia Interface) has become the digital interface of choice for manufacturers of high definition consumer electronics. This standardized interface represents a means for communicating multimedia content from any HDMI enabled source (such as a DVD player) to an HDMI enabled sink (such as a television). The latest HDMI 1.3 standard offers significant benefits over previous versions: namely increased link bandwidth up to 340MHz enabling greater color depth or 16-bit Deep Color, higher resolutions (greater than 1080p) and higher refresh rates (up to 120Hz).

But as most installers will attest, there are significant challenges to installing HDMI, especially over the longer distances typical in custom home or commercial installations. This is because HDMI was primarily designed as a short, point-to-point interconnect. It has generally proven unreliable over long distances due to losses in the high-speed video data lines – losses that are exacerbated at higher frequencies or data rates. This leads to increased signal jitter, making it difficult for a receiver to differentiate 1's from 0's in the digital signal. This can lead to pixel errors and visual artifacts.

However, all is not lost. As most installers are aware, there are several solutions available on the market today that help address long reach connectivity. But not all solutions are built equal. Each has its own unique set of benefits and drawbacks that installers have to weigh against their need for desired reach, performance, cost and ease of installation. This article discusses the most popular techniques in use today, as well as a new alternative designed specifically to meet the challenges of long-reach HDMI connectivity for professional installers.

Technique #1: Long reach HDMI cables

Long reach HDMI cables typically max out at 100 feet. This reach is achieved by making the cables thicker to reduce cable loss or by employing active electronics to combat the loss. Thick cables can be difficult to install as the weight of the cable and/or lack of flexibility might cause the HDMI connector to be pulled out, making for a poor connection. Depending on the vendor and performance offered, a 100 foot cable can cost anywhere from \$100 to \$500.

No discussion on HDMI cables would be complete without a note on cable performance. HDMI cables come in two performance flavors: Category 1, or Standard cables and Category 2, or High-Speed cables. Category 1 cables are tested at 75MHz or 720p / 1080i resolutions. Category 2 cables are tested at the full HDMI 1.3 rate of 340MHz, including 1080p. However, most long reach cables on the market today that claim 1080p performance are not Category 2 certified. This is because they cannot perform reliably at 340MHz and will not be compliant with future equipment that will take advantage of this increased bandwidth.

HDMI cables can be a very cost-effective, easy install if you are looking for something less than 100ft. However, in addition to the performance issues noted, long-reach HDMI cables tend to be thicker gauge, which can make them difficult to route, and they cannot be field terminated for custom lengths.

Gennum's ActiveConnect™ technology addresses the performance and cable thickness issues. It is the only actively powered solution that can be integrated into a cable (within the HDMI connector or a separate "bubble"), to enable HDMI 1.3 Category 2 performance over thin and long reach cables. End products from cable and HDMI extender manufacturers integrate ActiveConnect technology to ensure high performance and robust signal integrity.



Figure 1 HDMI cable with active electronics inline in the "bubble"

Technique #2: HDMI extenders or boosters

These extenders or boosters use active electronics to combat the loss in long reach HDMI cables. Similar to long reach HDMI cables, these solutions are mostly limited to distances of 100 feet at 1080p resolutions, but can be pretty cost-effective with prices in the \$50 to \$150 range. There are currently no Category 2 solutions on the market, although some vendors are offering extenders with performance up to 225 MHz or 1080p 12-bit Deep Color.



Figure 2 HDMI Extender

Technique #3: HDMI over Category 5 / Category 5e / Category 6 cables

Probably the most popular option among installers today, there are a plethora of manufacturers offering HDMI transmit/receive extenders over Cat 5/6 cabling. The transmitter converts HDMI for transmission over Cat 5/6, and is converted back to HDMI by the receiver at the display end. Typical reaches are 150 feet at 1080p resolutions. There are some solutions on the market that claim reaches of 450 feet and beyond at 1080p. However, these solutions are not all-digital and actually do a digital-to-analog conversion to get the reach. This not only defeats the purpose of installing HDMI, a digital interconnect, but also sacrifices video quality as it leads to data loss due to the analog conversion process.

The major benefits of using Cat5/6 are cost, as cables are cheap, and the ability to field terminate connections. Most extenders require dual runs of Cat 5/6 cable, although some manufacturers are now starting to offer solutions that require only a single cable. Assuming two runs of Cat cable, a 150 feet installation could be expected to cost \$500 - \$600, depending on the extender and cables. But buyers should beware, as not all HDMI extenders are built the same. Cat 5/6 is a very lossy medium, susceptible to skew and crosstalk. So not all marketing claims of reach match reality. Because of the cable medium, solutions are limited in distance (150 feet) and data rate (165MHz or 1080p 8-bit color). For longer distances, or higher data rates (for an all-digital link), installers need to look elsewhere. At the CEDIA Expo 2008, Genum expanded its ActiveConnect family with an all-digital solution for Cat 5 cable. It offers a reach of 250 feet at 1080p60, and also supports 1080p 12-bit Deep Color. End solutions based on this technology from major manufacturers are expected later this year.



Figure 3 CAT-x Extenders

Technique #4: HDMI over optical fiber

These solutions enable long reach HDMI over optical fiber. Due to the lower losses in optical links than copper, optical solutions can provide longer reach – up to 300 feet at 1080p resolutions. Optical solutions come in two flavors – as cables with active electronics needed to convert between electric and optical pulses built inline into the cable, or as discrete transmit/receive extenders similar to the Cat 5/6 extenders discussed above.

The inline cables are complete solutions offered in varying lengths from 35 feet up to 300 feet with support for 1080p resolutions. Typical costs are approximately \$900 for a 150ft solution and \$1800 to \$2000 for a 300ft solution. Most extender boxes require a 4-strand LC optical fibre cable for the HDMI data and clock, and a single Cat5 cable for transmitting HDCP. Typical costs are \$900 - \$1000 for 150 feet, and up to \$1500 for 300 feet at 1080p, depending on the extender and cables. The drawbacks of optical installations are higher costs and the inability to terminate optical fiber in the field.



Figure 4 Inline optical fiber cable

Technique #5: HDMI over coax

This relatively new technique consists of a transmitter / receiver pair that convert HDMI signals for transmission over RGBHV or RGBS cables. The benefits of this solution are long reach (up to 330 feet at 1080p resolutions), the ability to easily terminate connections in the field, and an easy upgrade path for existing RGBHV or RGBS cables in office or commercial installations. It also offers a performance benefit over existing Cat 5/6 and optical solutions as it is Category 2 certified. Cable costs are higher compared to Cat 5/6 solutions, although still significantly cheaper than optical solutions. Typical costs are expected to be \$700 for 150 feet, and \$1000 for 300 feet installations, depending on the extender and cables. This is a relatively new technique enabled by Gennum's ActiveConnect technology with offerings now (or soon to be) available from several manufacturers including Gefen, Tributaries, Liberty Wire and Cable, Ethereal and Canare.

So there are several options available to installers looking to run HDMI over extended distances. Each solution is unique in terms of reach, performance and ease of installation and offered at a range of price points. Installers will need to weigh these characteristics against their own requirements to select the best solution for their design. ActiveConnect™ technology offers yet another option to this marketplace for installers looking for long reach up to 300ft and high performance Category 2 solutions.



Figure 5 ActiveConnect for coax Reference Design