The Most Reliable Networks Require Category 6A Cable

Author: Ron Tellas
Technology and Applications Manager

Table of Contents

Overview

Times are changing: And nowhere is that more evident than in the world of enterprise networks. Data rates continue to climb and more devices than ever are connected to LANs.

Did you know?

Internet-connected things will ***outnumber humans 4-to-1*** by 2020

An estimated ***127 new devices connect*** to the internet ***every second***

IoT-connected devices stand at around ***26 billion*** as of 2019, with forecasts suggesting that this number will ***nearly double*** by 2023

What began as a single network to support voice and data has expanded into a network that still supports these systems, but also wireless access points, access control systems, video surveillance, digital signage, LED lighting, nurse call systems and much more.

Many of these systems call for longer reach (the devices will be up to 100 m away from a switch), higher Power over Ethernet (PoE) levels of up to 100W and 100% uptime and connectivity for data collection and sharing.

This means that your layer 0 (cabling and connectivity infrastructure) must be able to manage multiple systems that all require more bandwidth and less latency.

Applications once considered "emerging" are now becoming commonplace. They too demand higher performance, more bandwidth, faster speeds and low latency. For these reasons, industry standards that previously recommended Category 6A cabling only for data centers now recommend it for most LAN installations as well.

Because bandwidth-intensive applications require LAN speeds beyond 1000 Mb/s, and backbone speeds in data centers are migrating to 40 and 100 Gb/s speeds, your cabling system needs to keep up – or you risk it becoming a productivity and revenue bottleneck.

Factors Driving the Need for Category 6A Cabling

In the past, Category 6A cabling systems could be thought of as “nice to have” – not a necessity to doing business. But, as we mentioned earlier, times are changing. There are many factors impacting the type of cable that should be used today to build a network infrastructure.

Next-Generation Wi-Fi

Along with IEEE 802.11ac Wave 2, the IEEE 802.11ax (Wi-Fi 6) wireless standard, scheduled for release in 2020, will bring many new benefits to users, such as:

- Faster, more stable connections in high-density environments
- Extended device battery life
- Support for more devices at one time
- Simultaneous communication with multiple devices
- Data rate increases
- Faster, easier device connections with modular plug terminated link (MPTL) topology (direct connect)

IEEE 802.11ax is set to alleviate the frustration associated with network overuse. It will offer improved speed capabilities, along with the ability for many people to be on a network at the same time with higher speed and fewer connectivity problems. It’s predicted that these high-speed initiatives will require at least 20G.

The goal of this new standard is to improve average throughput per user by a factor of at least four in dense environments as compared to IEEE 802.11ac, the current standard. IEEE 802.11ax is engineered for our new connected world, where upload and download traffic are becoming equivalent. Cabling standards address this future need by recommending two runs of Category 6A cabling during installation of wireless access points (see TIA’s TSB-162-A).

With the increase in wireless signals traveling through the air, it is important to ensure that your cabling is immune to this external noise. The best way to make a cabling immune to external noise is through the cabling balance, measured as TCL and ELTCTL. Having lower TCL and ELTCTL values means the cable is better balanced and less susceptible to external noise.

The best (and possibly only) viable solution to support higher-speed 802.11ax is Category 6A cabling.

In-Building Cellular Networks

Cellular signals travel over the air from cell towers to cellular devices quite well. Take this cellular device indoors, however, and the signal is severely attenuated as it propagates through building materials, such as glass, wood and cement. Add to this the many reflections that occur from angled walls and metal, and the cellular device will lose signal and drop connectivity to the network. The remedy to this issue is to offload the signal onto an in-building cellular network. This in-building cellular network takes the form of a distributed antenna system (DAS) or WiFi system. Both may use category cabling.

Today’s 4G LTE systems are capable of delivering up to 100 Mb/s of data. The improvements to LTE will bring higher data rates with LTE Advanced, capable of up to 300 Mb/s, and LTE Advanced Pro, bringing gigabit speeds. In fact, LTE Advanced Pro will satisfy the 5G enhanced mobile broadband initiative (eMBB) and will likely become part of the 5G standard.

With the data speeds that are predicted in the near future, it only makes sense to invest in cabling designed for higher data rates. Category 6A will allow current 4G networks to be ready for these higher data rates.

The best (and possibly only) viable solution when using category cabling with an in-building cellular network is Category 6A cabling.

Increased Data Sharing & Transferring

The need to quickly transfer larger files, such as medical imaging, high-definition streaming video, high-end graphics and surveillance video, tasks Category 5e and Category 6 networks running 100BASE-TX and 1000BASE-T.

For example, in a healthcare environment, a set of medical images for a single patient totaling 9,000 MB takes about a minute to download over a 1,000 Mb/s network, but only seven seconds over a 10 Gb/s network. In an emergency situation, that time difference is critical.

The best (and possibly only) viable solution to support sharing and transferring of large files is Category 6A cabling.

100W PoE

Just a few years ago, devices that required PoE connections were low-wattage devices like VoIP phones, wall clocks, access control systems and lighting controls. Today, however, devices like IP cameras, digital signage, videoconferencing systems and wireless access points require higher power levels.

Without PoE, smart buildings would be more expensive to design and build. Case in point: Instead of several different, standalone networks with their own wiring, connectors and pathways, single IP networks are being used. Before PoE, systems that were connected to IP networks required separate data and power, as well as proximity to electrical outlets. With PoE, one single cable provides data and power.

IEEE 802.3bt – the 100W PoE standard – was ratified and approved as a new standard in September 2018. It takes advantage of all four pairs in a 4-pair cable, spreading current flow out among them. Power is transmitted along with data and is compatible with data rates of up to 10GBASE-T. It can also deliver higher power levels to devices with a smaller temperature rise inside a cable bundle, avoiding poor transmission performance.

The best (and possibly only) viable solution to support 100W PoE is Category 6A cabling.

AV Signal Transmission

With the increased demand for high-quality digital content, the AV world has adopted the use of IP or IP-like systems to transmit AV signals and provide power to display devices. Technologies such as HDBaseT, SDVoE, Dante AV, AVB (Audio Video Bridging) and others have large bandwidth requirements that can only be handled with Category 6A cabling.

It is possible to use lower levels of category cabling to transmit AV signals by introducing compression to the digital signal to reduce bandwidth requirements. The drawback to compressing the AV signal, however, is the negative effect on image quality. As more compression is introduced, the likelihood of the received image having defects, artifacts or other distortions increases. To guarantee AV image quality, less (or zero) compression is applied, requiring more bandwidth.

Higher data speeds are also susceptible to external noise, referred to as alien crosstalk. This phenomenon did not exist when lower category cables were designed to support gigabit speeds.

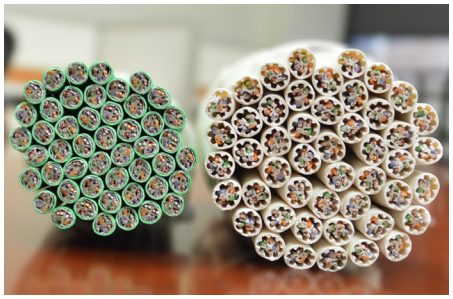
The best (and possibly only) viable solution to support AV signal transmission is Belden 4K UHD Media Cable or Category 6A cabling.

What Has Changed About Category 6A?

Early implementations of Category 6A cable were relatively expensive due to installation practices, field testing and power consumption. But many of the limitations holding people back from installing Category 6A cable are now gone.

Physical Characteristics

The first Category 6A cables were up to 50% larger than Category 6 predecessors because of their material: more twists in the copper pairs, larger splines separating the pairs and thicker outer jackets. This presented problems in terms of installation and handling.



Today, newer small-diameter Category 6A cables, like Belden 10GXS, and now 10GXW, which is equivalent to Category 6 in terms of size, eliminate added diameter and weight, as well as impact how many cables can fit into a cable tray or conduit.

Financial Considerations

Previously, installers had to budget more time and money to test for new parameters, including alien attenuation crosstalk ratio far-end (AACRF), alien near-end crosstalk (ANEXT) and power sum alien crosstalk parameters (PSAACRF and PSANEXT).

Today, however, many Category 6A cost obstacles like these have been offset or eliminated thanks to manufacturing advancements and improvements in 10GBASE-T physical layer device (PHY) design.

Dramatic improvements to 10GBASE-T active equipment have also decreased cost and power consumption per port (1.5W to 3W per port vs. 12W per port for first-generation 10GBASE-T PHYs).

How to Choose the Right Category 6A Cable

Now that you've discovered all the reasons why Category 6A cabling is likely necessary for your next project, there are a few tips to keep in mind when searching for the right system. Look for Category 6A cables that offer …

Lighter Weight and Smaller Diameter

While many Category 6A options still remain significantly larger and heavier in order to control noise and crosstalk at higher frequencies, high-performance Category 6A cables are designed to offer the same level of noise and crosstalk control at a diameter that's only about 15% larger than Category 6. Smaller-diameter cables also save space in conduit and cable trays (helpful in retrofit applications) and allow more airflow within racks.

Smaller Bend Radius

High-performance, small-diameter Category 6A cables are easier to route and install. They also make installation in smaller, tighter spaces (inside wall cavities, for example) faster and simpler. The smaller the bend radius, the easier the cable is to route and install.

Power Delivery without Heat Buildup

In a conventionally designed Category 6A cable, the spline and jacket surrounding each copper pair create an insulated compartment prone to overheating when delivering PoE. Newer thermal-dissipation designs distribute heat around the circumference of the cable instead, eliminating hotspots.

Some Category 6A cables have enough insertion loss margin to handle the extra heat generated from tightly packed cables without impacting performance. (This doesn't apply to all Category 6A cables, however. Even though many promise a 100 m solution, some cables may become an 85 m solution if the temperature increase is too high.)

High-performance cables are also capable of delivering up to 100W PoE while keeping thermal rise within acceptable limits. With IEEE 802.3bt now approved, paying attention to cable temperature rise will be even more important.

Full 100 m Channel Length

As mentioned above, some small-diameter Category 6A cables may not be able to support the full 100 m distance per channel and need to be derated to less than full length.

When higher power levels are being carried on data cabling, for example, derating the cable may be necessary. When you derate a cable, you don't get the full performance benefits – such as reach – that it offers. The cable must be operated at less than its rated maximum capability to avoid performance issues.

A cable that can handle the full 100 m not only provides an extra margin of performance, but also supports full-length LAN channels and a wider range of data center configurations, including top-of-rack, end-of-row and middle-of-row.

LP Certification

Cables with UL's Limited Power (LP) certification don't exceed jacketing temperature ratings under certain conditions and have been evaluated to carry the marked current "under reasonable worst-case installation scenarios without exceeding the temperature rating of the cable." This is achieved by manufacturing the cable with insulating and jacketing material that can handle higher temperatures.

Most applications don't require LP cable, but there are situations where it may be called for:

- Power-supplying equipment is capable of power over 60W
- Power-supplying equipment higher than PoE Type 3 is being used

An important note: Regardless of the LP certification, if higher temperatures are introduced into the cable, its reach is negatively impacted due to higher insertion loss at elevated temperatures. As a result, the cable may not reach its full 100 m distance. LP certification does not change this fact.

Category 6A Cables Offering Full Reach and Power Delivery

When can a channel fulfill its 100 m reach under higher temperatures without derating? Only when the manufacturer designs and manufactures it to do so.

To prove this theory, Belden conducted a series of performance tests. Belden cables, along with a handful of other well-known cables, were placed in an environmental chamber to measure cable temperature change and insertion loss.

Temperature and insertion-loss changes were recorded; then, the data was combined with insertion-loss levels of connectors and patch cords to determine the maximum length that a typical channel could reach while maintaining channel insertion loss compliance.

Belden used a full 100 m channel with 10 m of patch cords and an initial permanent link length of 90 m. During these tests, we assumed that the connectors and patch cords were used at room temperature with the same insertion-loss levels. Permanent links were assumed to be at 60 degrees C (aligning with TSB-184-A, where the ambient temperature is 45 degrees C and temperature rise is 15 degrees C due to PoE current and cable bundling).

The result? Belden's 10GXS Category 6A Cable offers 8% insertion loss margin. This extra margin ensures that your channel will still reach 100 m under maximum PoE load – even when bundled and faced with higher cable temperatures.

In comparison, most other Category 6A cables had an insertion loss margin of 3% – not high enough to allow you to obtain the full 100 m reach. This is an important point to keep in mind when choosing a Category 6A cable.

The Skinny on 28 AWG Patch Cords

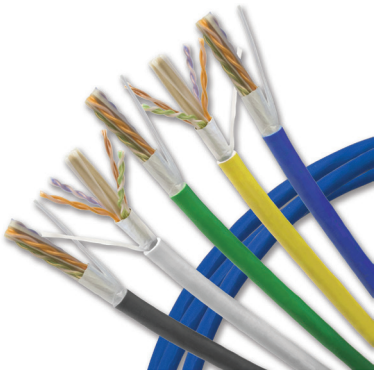
Skinnier patch cords (like 28 AWG patch cords) help save space. Compared to 24 AWG patch cords, they are more than 50% smaller in diameter. They help reduce pathway congestion, generate room for equipment and make high-density, bulk patching easier.

Originally designed for use in data centers, ANSI/TIA-568.2-D approves 28 AWG patch cords for use in networks as well because of the space savings they offer. This is good news for high-density applications where congestion, airflow and sharp bend radius are important considerations. Their narrow diameter allows them to be used in places where 22 AWG to 26 AWG may be difficult or impossible to deploy.

They can also be used to support power delivery per TSB-184-A-1, an addendum to TSB-184-A: 28 AWG in bundles of up to 12 can be used for PoE applications up to 30W.

Belden's 10GXW: The Industry's Smallest-Diameter Category 6A Cable

An increasing number of applications such as wireless access points require Category 6A cabling performance. Installers need a cable that is lightweight and easy to route through plenum spaces. Belden listened to changing market demands and developed a cable optimized for growing smart building applications, including in-building wireless.



Now, in addition to Category 6A 10GXS Cables, there's a new Category 6A option specifically for smart building applications. Belden's 10GXW Cables allow you to easily upgrade to Category 6A performance levels for smart building applications like in-building wireless. They offer the smallest Category 6A cable diameter on the market, which also makes the cable light and easier to deploy.

10GXW utilizes EquiBlock™ technology to achieve uniform heat flow dissipation and enables a consistent, 0.250-inch diameter. The cable also has outstanding cable balance with superior TCL and ELTCTL, which provides superior noise immunity performance. Noise immunity is critical with the close proximity of the multi-gigabit speeds traveling throughout a smart building. Without this superior noise immunity, data signals may not reach end devices, causing network reliability issues in the form of slower speeds and downtime. When paired with the REVConnect® Connectivity System, 10GXW supports the easiest-to-deploy end-to-end smart building infrastructure system that can connect any end device.

To learn more, call **1.800.BELDEN.1** (1.800.235.3361) or visit **www.belden.com/10gx-cable**

© Copyright 2019, Belden Inc.