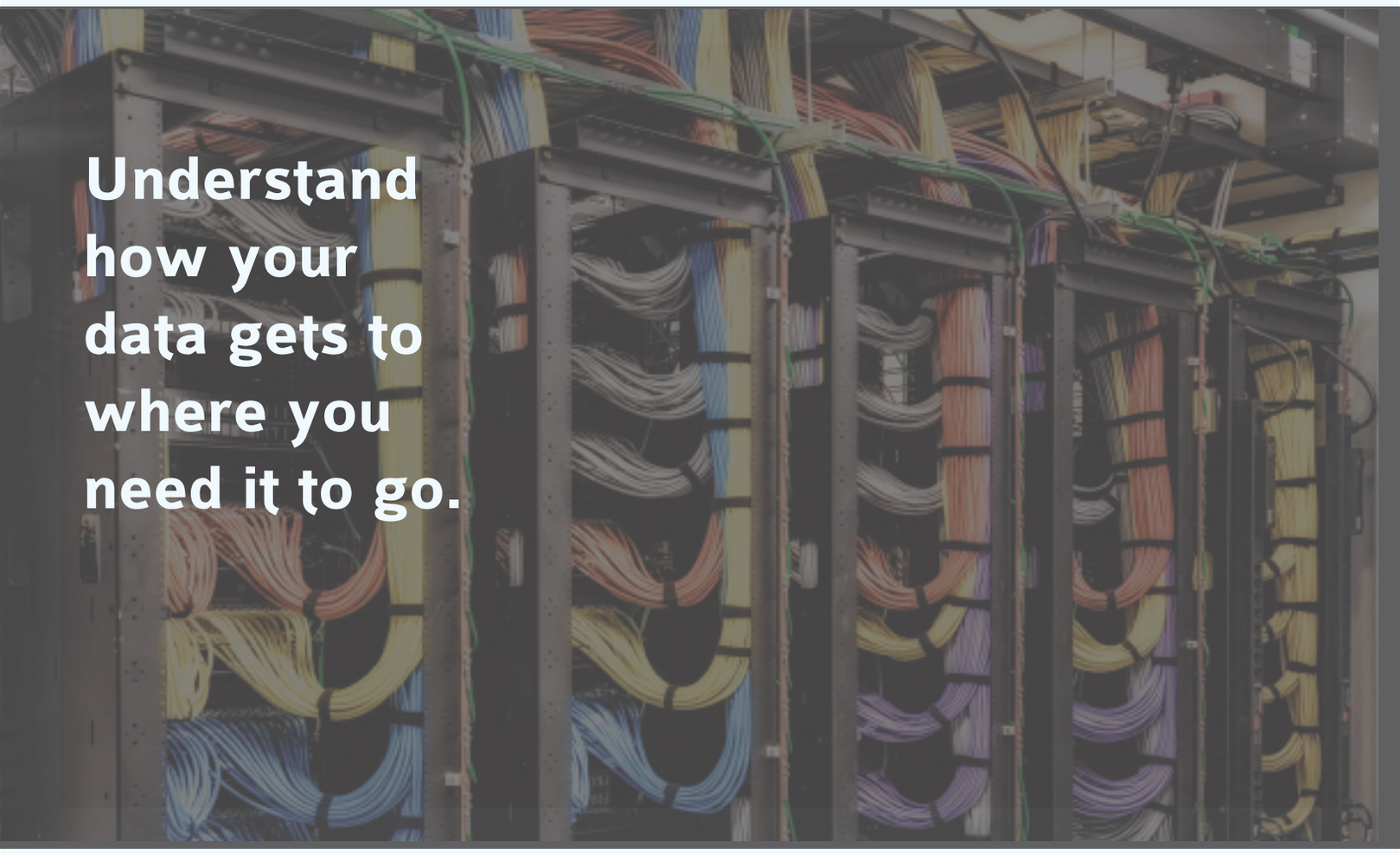
BCI INTEGRATED SOLUTIONS
a Midwest Alarm company

Structured Cabling

a guide by BCI Integrated Solutions



> Ever wondered how we get your signal to cut through the noise?
> You don't have to anymore.

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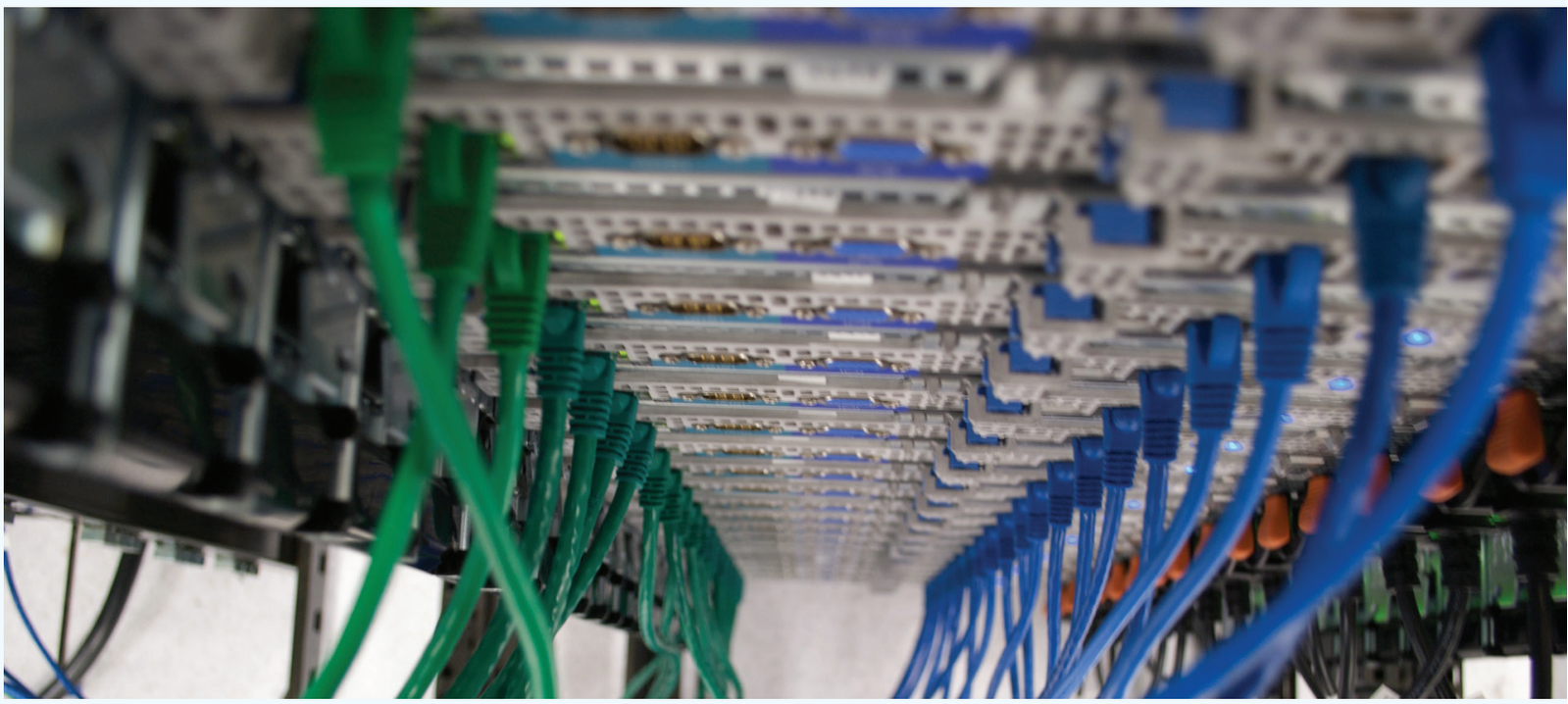
Cabling is king

Structured cabling and data networks have come a long way from the electromagnet and telegraph of the 19th century. A series of inventions including the telephone, radio, television, and computer have built upon the foundations of electricity discovered by some of the greatest minds in human history.

Today, we have a profound understanding of what it takes to achieve the clarity and reliability you demand from your communications technology at home and in the workplace. As more markets find ways to leverage a strong network into opportunities for business growth, getting the right information to where it needs to be is more important than ever.

History



> Data is a precious thing and will last longer than the systems themselves.
> Tim Berners-Lee, inventor of the World Wide Web

Cables of two centuries ago were (and usually still are, unless you have special requirements) unshielded, insulated wire made from readily available materials like copper. One of the first commercial applications of copper wiring was the telegraph. The telegraph made use of technology like the electrical relay and electromagnet preceding it.

Telegrams for communication stayed prominent into the 20th century to connect the world via underwater cables. Over time, telephones gained ground for more local connections, and by the 21st century usurped telegraph technology entirely. But the vehicle for both technologies remained the same, and copper is still an exceptionally popular choice for cabling.

Recently, the introduction of new technologies like streaming and Voice over IP (VoIP) have required cabling solutions to marshal more and more capacity for change. Instead of copper, some signals are sent today using optical fiber. Optical fiber is more expensive to install, and requires a greater understanding than copper wiring, but it can pay for itself by creating opportunities to cut other costs, ensure better connections, and future-proof your structured cabling system.

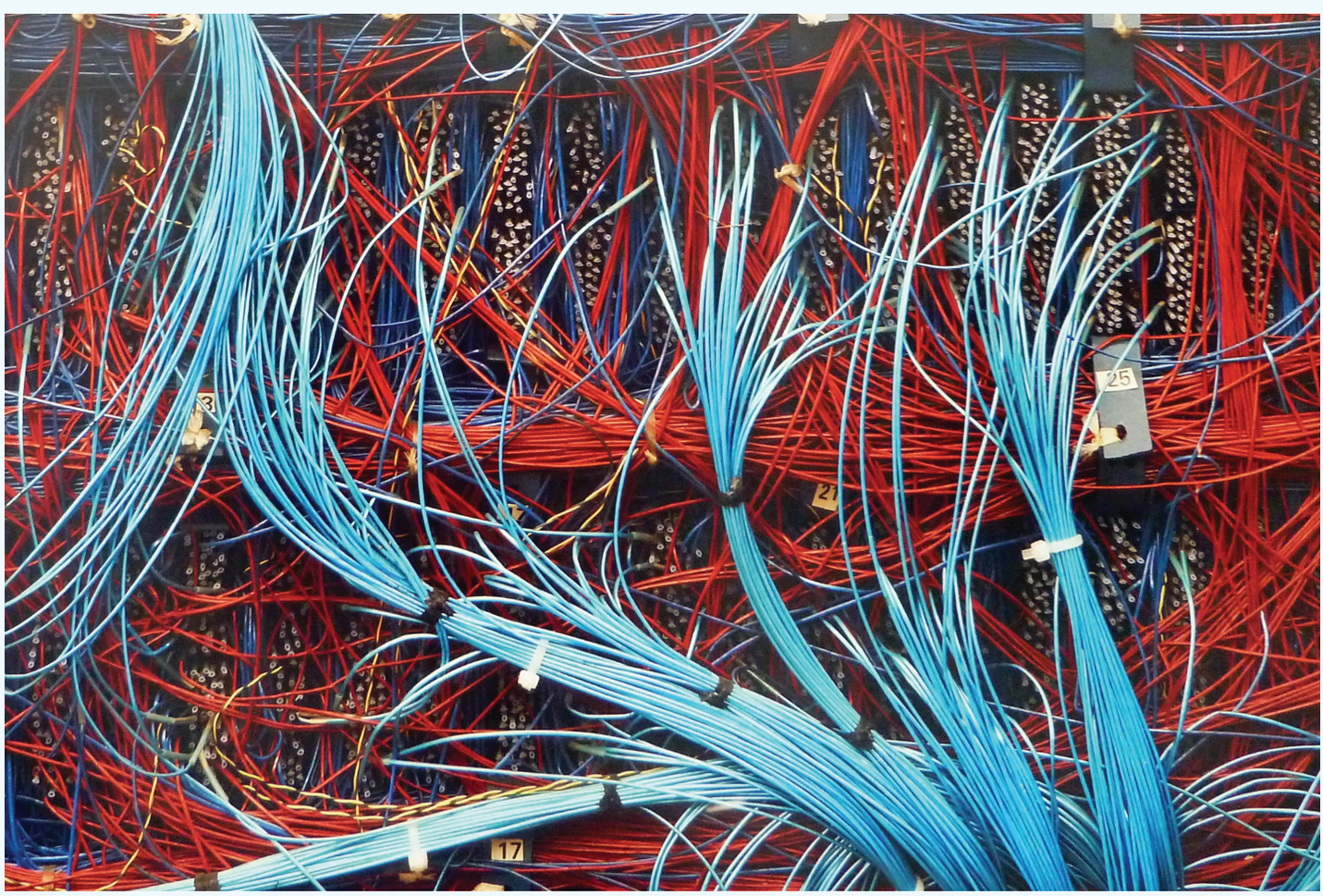
Accommodating new convergent technologies is an everyday challenge for system integrators and network cabling companies. Whether you have an analog system or a top-of-the-line optical fiber network, it's important to understand the science behind the tech.

Wait... how does all this work?

Cabling sends data packets across its length by cycling electricity in a series of 0s and 1s to produce a response or transmit a signal. The number of times the cable can switch between 0 and 1 is generally measured in Megahertz, equal to one million hertz. But the most powerful network cabling today can handle thousands of Gigahertz per second, and those numbers are only growing.

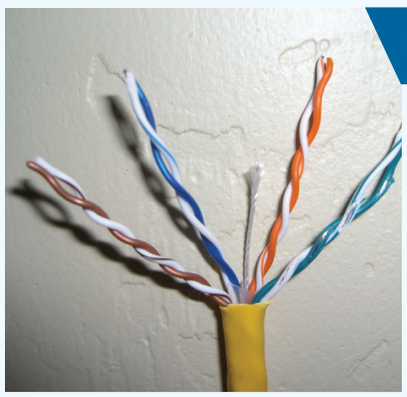
Standard twisted pair cables are typical network connectors, widely available today for your own Ethernet connection or network. Your home may connect to the grid with optical fiber or copper wiring depending on your internet service provider's offerings and their last-mile policy. Optical fiber, unlike copper twisted pair cables, is largely future-proof because the optical fiber infrastructure can last indefinitely. It only needs to have its electronics upgraded.

Optical fiber produces infrared wavelengths anywhere from 650 to around 1600 nanometers, depending on the grade. Copper wiring produces microwaves, which have a lower wavelength and frequency than infrared waves. This means they cycle less quickly than fiber, resulting in less data sent. Optical fiber is quickly becoming the preferred cabling method for its comparatively faster speeds and longer lifespan, but it's still more costly than copper wiring. Both kinds of cabling have a lot of life to them and will be common for years to come.



Now that you know a little bit about the history of structured cabling and data networks and how they work, let's take a closer look at some of the technology that makes today's systems so powerful.

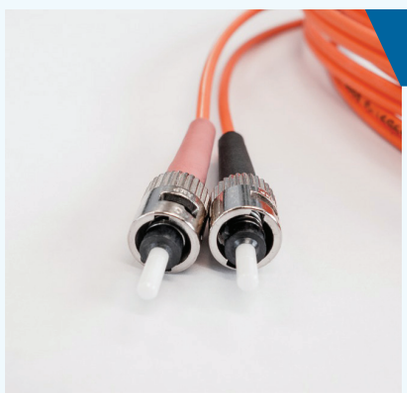
Modern cabling types



Category 6, or Cat 6, is a popular cabling standard offering performance up to 250 MHz at a distance of 55 meters or 180 feet. A successful Cat 6 installation may need to make use of shielding, and must ground on both ends, which can contribute to interference. Cat 6 are typical patch or crossover cords connecting different devices to the same network. Cat 6 cabling is widely available and relatively inexpensive, serving as the baseline for adequate system performance today.

Category 6A doubles the capacity of Cat 6, offering 500 MHz at 100 meters distance, or around 328 feet. The improved cabling offers greater performance than its predecessor, and is also widely available, but more expensive.

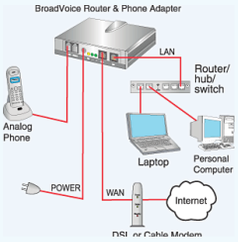
Cat 6A is a strong technology used for access control, building automation, audiovisual systems, and more, and favored for many new installations.



Optical fiber differs from Category cables because of how quickly it can send data. Instead of transmitting through electrical impulses, it sends pulses of light modulated to carry information. Optical fiber can handle cycles anywhere from 500 MHz to 4700 MHz, equivalent to anywhere from 10 MBit/s to 10 Gbit/s of data over up to 600 meters or 2000 feet.

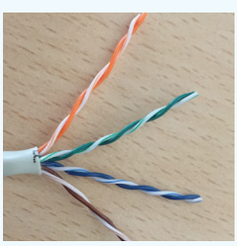
Optical fiber allows data to travel significantly faster than Ethernet cables, though not as fast as the speed of light itself. It's the preferred form of cabling across long distance, or if your connection needs a lot of power.

Other common data network terms



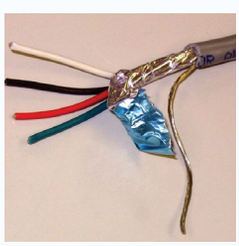
Voice over Internet Protocol, or VoIP, offers a phone connection over the internet. This allows more direct multimedia delivery than having to send packets of data because it allows two users to dial into the same domain to communicate instead of establishing a direct telephonic connection. By eliminating the need to route traffic, VoIP provides better ease of access and coordination. iMessage, one of Apple's most popular features, is a VoIP service offering near-instantaneous syncing to iPhones, iPads, and Macs. The connection can be bidirectional and maintained, adding cool features like read receipts and enhanced sharing.

Single-mode and multi-mode are different kinds of optical fiber. Depending on your signal strength and distance needs, you may want to use one type over another. Optical fiber is measured using categories OM1, OM2, OM3, OM4, OM5, OS1, and OS2. Different categories denote different wavelengths, different cable width, and sometimes different emission method. Some optical fibers use LED, some use VCSEL, and others use EEL. You may prefer a specific style depending on your distance or strength needs.



Twisted pair cabling, invented by Alexander Graham Bell, reduces external electromagnetic interference and radiation and cuts down on "crosstalk" between pairs or different cables. Because there is less of a gap between twisted pairs than straight pairs, interference has a much tougher time passing through the pair.

Cabling comes shielded or unshielded, referred to as STP or UTP respectively. Shielding builds on the twisted pair model by creating a barrier between electromagnetic interference and the copper cabling. Depending on the system you're trying to set up, you may opt for little to no shielding, or you may need significant shielding to prevent electromagnetic interference (EMI). UTP cables are frequently used in the home, for security cameras, and at short and medium length. In areas of high EMI or data transmission needs, STP may be a better option.



Who sets the standards for building data networks and structured cabling?

BICSI, the Business Industry Consulting Service International, works with the Telecommunications Industry Association, the International Organization for Standardization, and other authorities to ensure cabling compatibility across the globe. BICSI approves structured cabling specifications related to design, wavelength, capacity, shielding, and many other variables.

Credentials are also managed by BICSI. Certified professionals get one of four titles offered by the organization: Registered Communications Distribution Designer (RCDD), Data Center Design Consultant (DCDC), Outside Plant Designer (OSP), or Registered Telecommunications Program Manager (RTPM).

BICSI and its affiliates are responsible for improving the technology you use every day, and the knowledge of the designers and technicians who bring those systems to life.

What do we try to improve about cabling?

The technology behind data/network cabling and communications grows with user needs. Stronger cabling offers a greater capacity to handle "change," or cycles between 0 and 1. The binary combinations translate into system actions on the user end. Better cabling or fiber gets those combinations where they need to go, stronger and faster.

You've already learned that copper cabling and optical fiber transmit data through different wavelengths, and vary their frequency and amplitude depending on the cabling used. But what is it those cables are sending? Depending on how the signal is modulated, the 1s and 0s mentioned above "combine" into instructions for the computer to display, and for us to understand. For instance, the word "love" is 01101100 01101111 01110110 01100101. This plays out hundreds of thousands of times per second until the computer successfully displays the text, image, or other data expected.

Another thing we try to improve about cabling is its protection from the environment. Wiring an office or hospital is much different than a stadium or outdoor restaurant. Moisture, heat, light, wind, and other variables affect how long cabling can last. Better protection technology means stronger cable.

New faces in structured cabling

Category 8, or Cat 8 cabling, features speeds of up to 2000 MHz, terminating at maximum distances of about 120 feet. Cat 8 but focuses on accommodating shorter distances in places like data centers. So, if you work in an office, your data center may upgrade to Cat 8 cabling, but you won't be getting a Cat 8 ethernet connection.

Cat 8 cable comes shielded and requires proper grounding and installation. Its use as a patch for high-speed connection from server to server and rack to rack means placing extra emphasis on a successful installation. Cat 8 offers an affordable alternative to optical fiber for the many systems that still rely on quality copper cabling.

Distributed Antennae Systems (DAS), also commonly referred to as cell signal boosters, amplify primarily cellular signals in areas that would otherwise not receive them. Signals are sent from cell sites and repeater stations to bring coverage to your phone, but some modern circumstances make that more difficult. Buildings made from "thick" material like concrete or built many stories high get reduced signal because of interference. DAS can be either "active" or "passive" depending on your needs. Active systems pass signal from antennas (usually on the roof) through fiber cables, while passive systems "leak" signal throughout a building.

A great example is the recent upgrades to the New York City Subway, which recently installed DAS in many of their subway stations to bring cellular signal underground. DAS are very popular in high rises, hotels, hospitals, concrete buildings, and other areas with high interference.

Cat 8 cables, cell boosters, and other technology boosting signal in hard to reach places or the speed of data transmission will see increasing demand as cellphones and internet access become even more ubiquitous and necessary to conduct business.

What to expect from the future

There are all kinds of improvements being made to communications and data networking infrastructure. As we gain a better understanding of how to manipulate the modulation of light and electricity into data, we improve the speed, quality, and availability of that data.

Data and network cabling is a constantly growing field, and in all likelihood there will one day be a Category 9, new standards for optical fiber, thinner cables transmitting data more effectively, and many more innovations. Remember, we're after more Megahertz, longer transmission lengths, and less electromagnetic interference.

Convergence also offers a series of opportunities like the expansion of IPTV, or delivering TV over the internet instead of with cabling from your television service provider. Improvements to other tech like digital broadcasting, geolocation services, and much more are on the horizon.

One of the most sought-after improvements to data transmission and networking is wireless data transfers. What if, instead of using optical fiber or copper, you could send data directly through the air instead? You've probably seen some of the limitations in action. Hooking an ethernet cord up to your modem or router results in a faster connection than a wireless signal can send.

The gap between the two decreases as we make improvements to the technology behind it, but it's unlikely it's eliminated entirely. Optical fiber is the closest we can get to transmitting data at the speed of light, because it literally is the concentrated transmission of light without a vacuum. Changing that would require a meteoric shift in scientific understanding.

But stranger things have happened. The future promises sweeping improvements in every mode of information transportation.

Would you like to join us for lunch?

We'd love to talk to you about your next big structured cabling project over an office meeting, lunch-and-learn, or visit to your site for analysis. We also offer a variety of other solutions including audiovisual, security, and communications systems, plus fire alarm and life safety technology. Contact us to schedule a meeting and take a big step forward.

Thank you!

We hope you learned everything you want to know about data and network cabling, a fascinating and integral component of low voltage systems. Without great cabling, you can't have great data transmission, and without great data transmission, your network could suffer.

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