

COMMERCIAL AV AT THE SPEED OF LIGHT

The Business Case for
Fiber-Optic Cabling

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New advances in high-bandwidth, high-speed fiber-optic cabling have made it easier to train skilled technicians, and the cabling terminates faster than Category cabling and is 200 times stronger than traditional fiber—all of which means this improved cabling is a must for IT, AV, and commercial building stakeholders who are seeking to meet their rapidly growing networking needs.

By Steven Castle

Executive Summary: The Future Is Now

The future is now for fiber-optic cabling in commercial buildings

If you haven't considered installing fiber-optic cabling at your organization because it's expensive, fragile, and requires excessive training and tooling—think again. Technology advances have drastically decreased prices and have created stronger fiber with 10,000 times the bend longevity and up to 200 times the durability of traditional fiber. Coated glass has made it easier and faster to terminate than any Category cable. Field technicians can be trained to terminate SSF™ fiber with less than 30 minutes of training and meet Fiber Optic Association (FOA) standards. The bottom line: The business case for installing fiber-optic cabling is finally here.



No longer is fiber-optic cabling something to put off for the future. In 2017, an estimated 280 million kilometers of fiber-optic cabling will be sold around the world. That's approaching a trillion feet of fiber (about 919 billion feet). Fiber optics are now the de facto standard for connecting the world—and not just through undersea cables and fiber-to-the-curb and fiber-to-premises services, but also inside commercial buildings, where networks need to be as robust as and nimbler than exterior wiring to move around our vast amounts of data, voice, and video with reliability and ease.

A fiber-optic cabling installation not only future-proofs your network infrastructure, but it also harnesses the performance and capabilities of today's best technologies—resulting in faster and more robust business operations that lead to greater financial opportunities.

With proven manufacturing innovations, fiber-optic cabling is now as easy and as safe to terminate as Category cabling—and termination no longer requires the costly training that has hindered adoption. Wiring a building with fiber-optic cabling can now be considered a best business practice to provide the fastest, highest bandwidth, and most cost-effective networking for now and the future. Today's best fiber optics provide businesses—from commercial building owners to their tenants and from building consultants to IT/AV professionals—the ability to move forward and prosper—at the speed of light.

The business case for fiber-optic cabling continues to grow. IT and AV managers, commercial building owners, and consultants all need to send AV and other data over IP quickly, efficiently, and without tasking otherwise busy networks. The same is true for entertainment facilities, office environments, distribution centers, warehouses, manufacturing facilities, multiple dwelling units (MDUs), health facilities, hotels, and many other commercial buildings.

The network speeds and bandwidth required to handle today's streaming media, data, telephony, security/surveillance needs, and billions of connected devices already task the limits of traditional copper wiring infrastructures like Category 6 and 6a Ethernet cabling.

The bandwidth crunch will only worsen with the rise of streaming video, Internet of Things (IoT) connectivity, and the rapid adoption of Ultra-high-definition (UHD) 4K video and the expected arrival of its successor, 8K video.

Video is now the predominant mode of traffic on the Internet—it represented an estimated 73 percent of all net traffic last year and is set to grow to 82 percent by 2021, according to a recent [report](#) from Cisco. And bandwidth-hungry UHD 4K video is set to become the new HD standard.

The only cabling infrastructure that can address the ever-increasing high-speed, high-bandwidth needs for today and for tomorrow is fiber-optic cabling, which contains glass strands that transmit data in light—at the speed of light and with virtually unlimited bandwidth.

Fiber-optic cabling is no longer for the future. It is for now.

The New Currency

The first to execute enjoys a clear advantage

The scene is the same the world over. Computers turn on, desktops light up, and a bevy of portable devices seek wireless connections. Video, data, and voice flood the networks of offices, industrial complexes, warehouses, retail outlets, residential buildings, hospitals, and hotels. Information is the new currency, and those who keep the flow of information up to speed enjoy a clear advantage.

Yet most commercial buildings today are equipped with an aging infrastructure of structured wiring, including copper-based Category Ethernet cabling. Higher-rated cables, such as Category 6 and 6a, provide Gigabit networking and bandwidths of up to 10Gps (gigabits per second). Yet no matter how advanced Category cabling becomes at transmitting video, voice, and data, it will always be limited by its copper core.

The new HDMI 2.1 standard required for transmitting high-definition video will have the capacity of up to 48Gps—enough to handle Ultra-high-definition uncompressed 4K and 8K video. Uncompressed 4K video can take up to 18Gps, and 8K will require 48Gps. The demands on our networking infrastructures grow by the day, and in some cases by the hour.

"We're at the intersection of the changeover from copper to light," says Rick Sant, Cleerline Technology Group's principal. "Today's [electronics] are able to transmit 4K, and we're seeing all of this convergence. Everything we're seeing in our lives is about speed. We want the higher-resolution TV and more data going down the network."

Category cabling sends UHD 4K video signals via compression, however, and not as pristine, uncompressed video. "You see the difference on a display between compressed 4K and uncompressed," Sant says.

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Ultra-high-definition (UHD) 4K will turn into 8K within a few years. Think that's a bold a prediction? The 2020 Tokyo Olympics will be broadcast in 8K, and Japan's NHK network expects to be broadcasting in 8K by 2018. The 10G networks common today with Category 6 cabling will become 40G, Sant says, "and there's some discussion of going straight from 10G to 100G. We are at the tipping point for this changeover from copper to fiber."

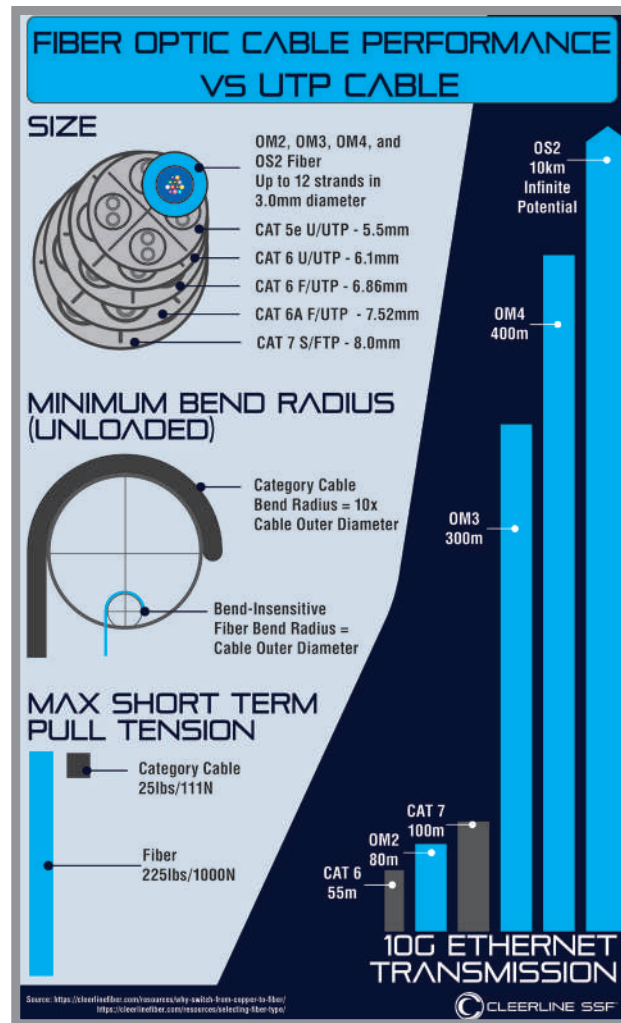
As if high-bandwidth video isn't enough, there's also the highly publicized Internet of Things, which according to experts should really be called the Internet of Everything, as it encompasses not just personal devices but also sensors for a slew of applications from environmental control to security to lighting and energy management. Some 20 billion devices will be connected to the Internet by 2020, according to research firm [Gartner Inc.](#) This figure is up from the 8.4 billion in use today. In his keynote address at the recent [AV/IT Technology Leadership Summit](#), Mike Walker, a research director at Gartner, suggested that figure might be closer to 30 billion IoT devices. Add to that the staggering number of Internet addresses available on the newer IPv6 Internet protocol, and you can see where all of this is going.

It is going on your network.

The implications for commercial building networks are enormous. And that's not even taking into account bandwidth-hungry emerging technologies such as virtual reality (VR). No matter how you feel about VR, it's set to become a reality that network systems the world over will have to accommodate.

The data/bandwidth crunch inside a building, therefore, becomes very real, very quickly. Traditional network concerns for email, data, security, and VoIP telephony seem quaint by comparison.

[Advantage Electric](#), a full-service, low- and high-voltage integrator in Las Vegas, works with several casinos where the high speed and bandwidths of fiber-optic cabling have become



necessary for their networks. Advantage sees fiber branching into other markets as well. “We do a fair share of office buildings, and we see a rise in pulling fiber to all the rooms,” says low-voltage director and senior on-site technician Evan Zucker.

Many commercial building tenants in Asia won't consider anything less than a fiber-optic-equipped building, just as home buyers in the United States check cell signals and high-speed network availability in prospective neighborhoods. If you consider data networking to be like a big pipe, our information too often flows at a trickle compared to how quickly it could flow.

“Everything connects to the network in the world of IoT, and we need a much more robust network,” says Robert D'Addario, president and managing director of Cleerline Technology Group. He's not just talking about the exterior network to the building. “We need a stable, internal network exponentially larger in bandwidth to what's outside a building.”

“The biggest thing is the distance,” says Zucker. “You have to have less than 330 feet to run Category 6. For many commercial buildings, a fiber-optic infrastructure solves the issue of moving data and video long distances.”

For AV, the new HDMI 2.1 specification may be capable of handling up to 48Gps, but the HDMI cable itself is limited in the distance it can carry that signal. Fiber-optic cabling, however, is not limited.

“Speed is hampered by distance,” Sant says. “The capacity of one piece of glass can transmit so much data. Everyone is starting to realize we can't avoid this any longer.”

Fiber-Optic Game Changers

How fiber's weaknesses were addressed and turned into clear advantages

Some IT directors and commercial building consultants are reluctant to change their business models to include fiber-optic cabling. They're comfortable doing what they know with Category cabling, and they want any infrastructure they put in to be bulletproof. In addition, many IT personnel feel hampered by having to call certified technicians to perform new fiber terminations and connections.

The previous drawbacks of working with fiber-optic cabling have been resolved by advanced manufacturing techniques that make the high-speed cable highly durable, bendable, and easy and safe to work with. And while unshielded Category cabling is susceptible to interference from other signals, fiber-optic cabling is not.

Not all fiber-optic cabling is the same. Cleerline Technology Group sought a way to make its product stronger than any other cabling and created a cable that is durable, strong, safe, and easy to terminate.

The demands on our networking infrastructures grow by the day, and in some cases by the hour.

Cleerline's SSF™—Stronger, Safer, and Faster—cable can be bent to a 2.2mm radius, which would be a death crimp for any Category cabling (most of which can be bent only from about 60mm to 90mm). Other fiber-optic cabling is also susceptible to fractures when bent to extremes.

The Cleerline SSF™ fiber with up to 10,000 times the bend longevity and 3 to 4 times the pull strength over traditional fiber shatters the belief that fiber-optic cable is too fragile.

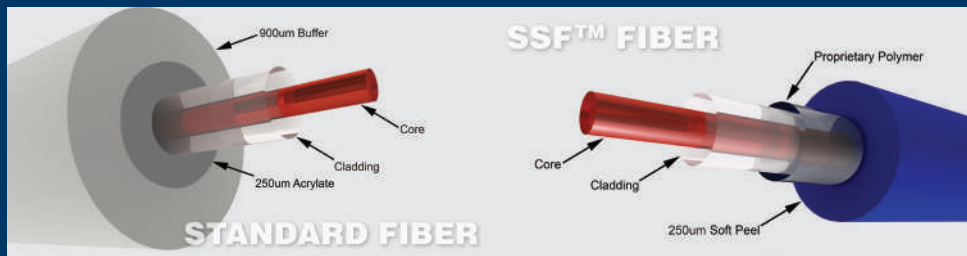
Tests of pull-tension, repeat bending, and elongation found that Cleerline's fiber-optic cabling is 200 times more durable under duress. It can withstand 225 pounds short term and 120 pounds of sustained tension, versus Category 6's 25 pounds. In another stress test that submerged glass fibers in water heated to 90 degrees Celsius, typical 125-micron glass broke within 100 to 1,000 seconds, while Cleerline's SSF™ fiber lasted 10,000 to 100,000 seconds.

Traditional fiber-optic cabling can be difficult to work with, as the cabling must be precisely cleaved, exposing strands of glass that can puncture human tissue. The special polymer coating on the SSF™ also ensures safety from glass punctures, and the cable can be cleaved and terminated in the field in seconds by any technician who has watched a short YouTube video, which saves up to 80 percent in labor costs, according to the company.

Sant says the polymer coating is like the coating on a car windshield or smartphone, which helps to prevent one small chip from causing a crack. The SSF™ fiber is much more durable than other fibers, so the glass strands don't fracture as easily.

In one test, union technicians who had been using a leading rival fiber-optic cabling were able to cleave and connect 33 percent to 150 percent faster using Cleerline's SSF™ cabling for the

The Cleerline SSF™ fiber with up to 10,000 times the bend longevity and 3 to 4 times the pull strength over traditional fiber shatters the belief that fiber-optic cable is too fragile.



Standard Fiber vs. Cleerline SSF™ Fiber

Stronger: 10,000 times the bend longevity and up to 200 times the durability allow technicians to treat Cleerline's SSF™ fiber-optic cables like standard Category cable with no fear of failure.

Safer: The Cleerline fiber, with its smaller glass-cladding layer, is more bendable and forgiving. The 125um coated GGP will not puncture the skin.

Faster: Skilled technicians can terminate SSF™ more quickly, since fewer preparations and precautions are required. Overall, SSF™ is simpler to handle. It also takes less time to train new technicians to get up to speed making quality connections.

FIBER OPTIC CABLE PERFORMANCE vs. UTP CABLE						
Cable Type	Size	Minimum Bend Radius Loaded / Unloaded	Short Term Pull Tension MAX	Approximate Termination Time	Shielding/RF-EMI Resistance	Maximum Data Rates
Category 5e U/UTP	5.5mm	112mm/56mm	25 Lbs / 111 N	2 min.	4 x Twisted Pair, No Shielding	1G Ethernet 100m
Category 5e F/UTP	6.35mm	128mm/64mm	25 Lbs / 111 N	5 min.	4 x Twisted Pair, Foil Overall Shield	1G Ethernet 100m
Category 6 U/UTP	6.1mm	122mm/61mm	25 Lbs / 111 N	2 min.	4 x Twisted Pair, No Shielding	10G Ethernet 55m
Category 6 F/UTP	6.86mm	138mm/69mm	25 Lbs / 111 N	5 min.	4 x Twisted Pair, Foil Overall Shield	10G Ethernet 55m
Category 6A F/UTP	7.52mm	152mm/76mm	25 Lbs / 111 N	5 min.	4 x Twisted Pair, Foil Overall Shield	10G Ethernet 100m
Category 7 S/FTP	8.0mm	160mm/80mm	25 Lbs / 111 N	3 min.	4 x Twisted Pair, Foil Shielded	40G Ethernet 30m
OM2 Fiber	2 x 3mm or 1-12 strands in 3mm	Cable OD if greater than 2.2mm*	225 Lbs / 1000 N	<1 min.	Not Applicable - Light Transmission	10G/150m - 40G/30m
OM3 Fiber	2 x 3mm or 1-12 strands in 3mm	Cable OD if greater than 2.2mm*	225 Lbs / 1000 N	<1 min.	Not Applicable - Light Transmission	10G/300m - 40G/100m
OM4 Fiber	2 x 3mm or 1-12 strands in 3mm	Cable OD if greater than 2.2mm*	225 Lbs / 1000 N	<1 min.	Not Applicable - Light Transmission	10G/450m - 40G/100m
OS2 Fiber	2 x 3mm or 1-12 strands in 3mm	Cable OD if greater than 2.2mm*	225 Lbs / 1000 N	<1 min.	Not Applicable - Light Transmission	Current 100G Ethernet 10km, Potential Bandwidth Infinite
*refers to Bend-Insensitive Fiber, such as Cleerline SSF™						

first time. Once cut, the outer part of Cleerline's SSF™ glass fiber can be stripped by a finger or fingernail to the desired length, and the technicians in the test quickly learned the technique.

"The biggest selling point is no formal training, as it is just as easy as Category copper termination, if not easier," says D'Addario.

D'Addario points to a fiber-optic solution in one of his company's own buildings, which was installed by Com-Bell Systems of Long Island. D'Addario's own technicians did the terminations to 130 desktops. "The IT staff was thrilled to be able to install fiber for the first time and internalize this needed upgrade," he says.

Enterprises such as hotels can also benefit from having on-staff technicians perform the terminations, safely pull fiber-optic cabling, and make the connections. In D'Addario's case, the fiber went to the workspaces and then to patch cables such as Cat 6 to desktops. In other cases, he recommends just getting the fiber in the building.

Don't forget the potential for digital signage. Advantage Electric, for one, is pulling fiber to video displays for directional signage in casinos and hotels. While they're presently transmitting only on Full HD 1080p video, they're set up for the transition to 4K and beyond.

In some casinos, Advantage Electric is consolidating disparate network operations in numerous locations to one room, served by fiber optics between data switches, and then using Category 6 cabling to connect to each location, such as slot machines. Cleerline is also being installed in financial service markets like Fortune 500 financial companies and even stock markets.

The company has fielded calls from installers such as one who, high atop the auditorium on a catwalk at an NBA arena, was terminating SSF™ fiber for the first time. While Cleerline doesn't recommend terminating fiber for the first time

in an unusual environment, the company representatives are always available and willing to talk newcomers through the necessary steps.

For those still skittish about switching to fiber, Sant points to universal SFP (small form-factor pluggable) ports on network switches in use today. SFPs convert fiber-optic light to digital data, and they can be bought in 1Gbps to 10Gbps or 25Gbps units, says Sant. The connections are simple as well. (See sidebar.) Baluns are also available for sending full uncompressed 4K video.

There's No Comparison

	Cat 6a	Cleerline SSF™
Max data rate	10 Gps	40Gps/potentially infinite with single-mode
Pull strength	25 lbs.	225 lbs.
Min. Bend radius	56-160 mm	2.2 mm

Source: Cleerline Technology Group

Fiber Optics 101

Selecting fiber-optic cabling isn't rocket science. It's actually quite simple. There are two different kinds of fiber-optic cabling: single-mode and multimode. Single-mode is generally required for all long distance applications over 400 to 500m. Multimode is generally utilized within a structure or typically at distances under 400m. Single-mode cabling uses a smaller core for faster speeds at longer distances.

The number of strands in a fiber-optic cable depends on how much bandwidth you will need and how you want to separate the signals. You often need at least two strands to connect many of the devices that communicate via fiber.

"Multimode is generally rated as OM2, OM3, and OM4. Application of Multimode fibers are typically within a building or home or used for connecting structures at limited distances.

Simply put, choosing the right fiber optic cabling is based on your application needs.

Grade	10Gps	40Gps
OM2	260ft/82m	Not Supported
OM3	1000ft/300m	330ft/100m
OM4	1300ft/400m	500ft/150m

Cleerline recommends using either multimode or single-mode fibers appropriate to installation requirements and running multiple strands to each location.



Courtesy: The Mob Museum Building / Jeff Green



Courtesy: The Mob Museum Building / Jeff Green



Courtesy: The Mob Museum Building / Jeff Green



Courtesy: The Mob Museum Mob 101 / Jeff Green

From Good to Great

How fiber-optic infrastructure opens pathways to new business opportunities

One might not think [The Mob Museum](#) in Las Vegas would have much need for fiber-optic cabling, but the historic downtown building houses one of the best museums in the country, according to TripAdvisor reviews.

"We didn't think we had a lot of reason to have fiber in a museum, but we have several hundred people here on Wi-Fi every day," says Director of Technology Ryan Markus.

The Museum is also undergoing a renovation that will include a speakeasy bar with its own distillery, to show how organized crime grew by running booze during Prohibition; a crime lab that will show how police examine evidence like fingerprints; use-of-force simulator to engage guests in an intensive training experience based on the training law enforcement officers receive; as well as expanded retail and dining space.

The Museum started using fiber-optic cabling from Cleerline a year ago, running it between data switches, interconnected with modules from 1G to 10G, and along a trunk line from the basement to the third floor.

"We want to send our video signals by fiber-optic baluns," Markus says. "Costs are coming into the affordable area, and we really like how it pulls, the distance over which we can use it and

that there's none of the interference that you can get with long runs of Category cabling."

Not having to pay \$100 a pop for outside people to come in to do fiber terminations was also a big draw. Markus' team of technicians quickly trained to do the terminations on their own.

The Mob Museum is a non-profit, so it must watch its costs, Markus said. It's not doing 4K video yet, but will as equipment costs for that technology come down, and Markus looks forward to how that will add to the immersive visitor experience in the use-of-force simulators and other areas.

"Our job is to provide the best possible experience for our guests," he says. "But we have to constantly be learning new technologies and do a lot of that work ourselves."

The Museum already offers video streaming and live broadcasts, and will look to produce those as well as some oral archives in 4K.

Markus also uses the fiber network for the Alcorn McBride ride-control software, control, and BrightSign digital signage that is used through the Museum. "Most everything is now being done with TCP/IP, so most of that stuff we can reliably control [over the fiber network]."

Tools and Connectors

Cleavers are generally used in the field to score and break the fiber-optic cabling at the proper angle, and dispose of the discarded glass safely. Handheld devices can be used as well, but they may not be as accurate. Some cleavers may need to be adjusted slightly to cleave Cleerline's specially coated SSF™ cabling.

Connectors are where the fiber meets electronics. It's important to choose the right connector, which will vary depending on what you're connecting to and the connections available.

The two most common connectors in the U.S. are LC and SC connectors. LC connectors are most commonly used for network-related devices and have a smaller form factor than SC connectors. SC and LC connectors account for the vast majority of connectors. ST connectors are falling out of favor.



Cleerline recommends using either multimode or single-mode fibers appropriate to installation requirements and running multiple strands to each location. Many AV electronic equipment manufacturers have standardized on multimode OM3.

Category cabling is run along the trunk in case it is needed.

"Integrators requiring long-distance runs may be using some type of fiber already," adds D'Addario. "With Cleerline's fiber, you can have low-level tech do the bulk of the work and have a senior tech check it."

"There's a significant cost savings in using fiber over the long term," D'Addario says.

For integration companies, moving into fiber also makes sense to get an edge on the competition, especially when vying for commercial jobs. "It's helped us because we were one of the first doing it," Zucker says of Advantage Electric.

Whether an integration firm or an internal technology team at an organization such as The Mob Museum, the long-term cost savings, future-proofing, highest bandwidths and network speeds available today, along with durability, bendability and safety make advance fiber optics like Cleerline's SSF™ cabling a logical choice for any commercial building project or upgrade. ■

Best Practices for Fiber-Optic Cabling

"Treat it like Category cable," Cleerline's Rick Sant advises. "Many of the same practices you use for Category copper can be followed for management of cabling in a rack and wall box and in the use of premade patch cords, just like Category cabling."

You should also put fiber in place, even if you're not connecting it right away. Then it's there, and your building is future-proof.

One of the most important things to learn is how to troubleshoot fiber, especially old fiber systems, says Evan Zucker of Advantage Electric in Las Vegas. He trains his technicians in the field in what to look for.

"Make sure you lock the fiber into the connector, and don't place fiber where it can be hit by a door opening", advises Ryan Markus, director of technology for the Mob Museum in Las Vegas.



Check out the series of fiber-optic instructional videos by Cleerline.



ABOUT THE AUTHOR

Steven Castle has been writing about emerging technologies for 25 years. He is an award-winning writer, editor, and storyteller who also specializes in the luxury market, high-performance home systems, green technology, and healthy building. His website is www.stevencastle.com.