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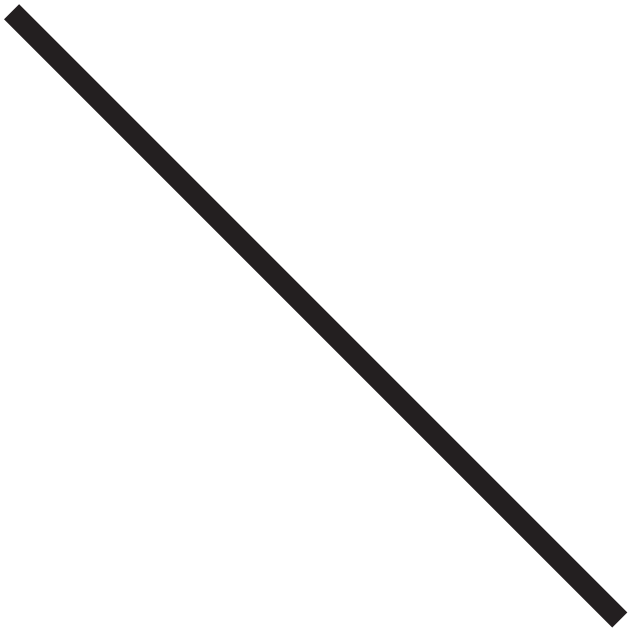
Fiber Optics in Live Production



Essential Guide

GUIDES

Essential Guide to Fiber Optics in Live Production

The use of fiber in live production has grown each year to the point that a fiber infrastructure is a normal sight on every live event production around the world.

By Michael Grotticelli

There was a time when the use of fiber optic cable struck fear in hearts of live production crews because it was difficult to work with and there was a certain black magic associated with distributing optical signals that had to be done right in order for multiple paths of video and audio to cleanly pass through tiny strands of glass.

Today, the technology has advanced to include military-grade tactical cable and fiber/copper hybrid cabling that is much more robust to work with. Along with better equipment, there is a better understanding across the industry of how to deploy fiber cable and hardware with the least amount of effort and on-site field problems.

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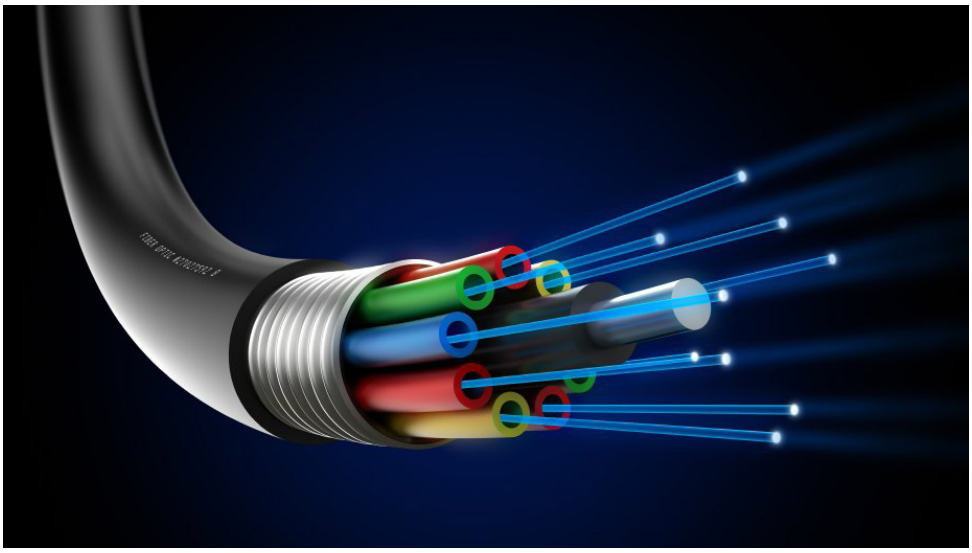


Single-mode fiber optic cable has a small core that allows only one mode of light to propagate.

The industry has migrated from copper-based solutions to fiber optic cable over the last 10 years. Over that time period, fiber usage has grown each year to the point that a fiber infrastructure is a normal sight on every live event production around the world. Fiber optic cable offers added benefits, from its reduced weight and size, virtually unlimited bandwidth capacity, and the increased distance uncompressed signals can travel. The ease of deploying, using, and wrapping fiber cable and hardware on a show cannot be overstated.

There are two types of fiber cable technologies: single mode and multi-mode. Multi-mode fiber optic cable has a large core that allows multiple modes of light to propagate. As a result, the number of light reflections created as the light passes through the core increases, enabling more data to pass through at a given time. With the high dispersion and attenuation rate with this type of fiber, the quality of the signal is reduced over long distances; therefore, multi-mode cable is typically used for short distance runs, and is more popular in the IT world than in live event broadcast.

Single mode fiber optic cable has a small core that allows only one mode of light to propagate. Consequently, the number of light reflections created as the light passes through the core decreases, lowering attenuation and creating the ability for the signal to travel faster and farther. Single-mode was designed for sending higher bandwidth signals across longer distances; and in some cases, distances can reach many kilometers.

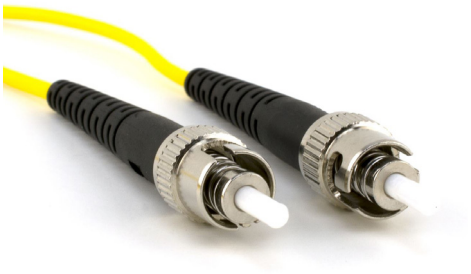
For all intents and purposes, the worldwide live production industry has settled on using single mode fiber with Straight Tip (ST) connectors. Most fiber hardware manufacturers who support the live event market build hardware to support single mode fiber because it provides a more reliable signal over long distances. It has also allowed the industry to "standardize," allowing easier integration of equipment from multiple manufacturers.

SMPTE Hybrid And Tactical Cable

When high-definition cameras became available, the industry realized that copper cables could not carry these HD signals as far as prior technologies. Even the largest diameter cable had its limitations. Many sports venues, and other large facilities, needed to reach longer distances. SMPTE then introduced the 311M standard to meet that requirement. Designed for high-definition (HD) cameras, these composite cables contain fiber and copper cables in one jacket, and enable the manufacturer an easy way to carry power, date, video, and audio signals.

Newly emerging higher-resolution formats like 4K and 8K require more bandwidth, and fiber optic cabling answered that demand. Much like when the industry moved to HD, signals could not travel more than 275-300 feet without a repeater. Connectivity needed at a standard live event could be 1,000 feet or more to be able to connect the mobile unit to the venue and to the announce booth. Today, both SMPTE Hybrid and tactical fiber are used to move a wide range of signals, including cameras, audio and video, communications, and data.

Depending on the facility the event is being held in, SMPTE Hybrid cable will often be used as the cabling for cameras since it provides all the connectivity and power required for the camera. Fiber-capable cameras come with this interface built into the camera and CCU, making this task as easy as connecting Triax cable. For some venues where the facility is not wired with SMPTE cable, or the camera count is larger than what the facility can support, tactical cable is used with hardware devices to adapt the SMPTE connector to tactical cable, to then insert power close to the camera. Camera manufacturers have standardized on a single connector to make this possible.



Single-mode fiber-optic patch cable with Straight Tip (ST) connectors.

SMPTE Hybrid and tactical fiber are used to move a wide range of signals, including cameras, audio and video, communications, and data.

For live events, redundancy is also taken into consideration. In the world of live sports and entertainment television when the stakes are high, there are no second chances to get it right.

The most commonly used "military-grade" tactical (also known as TAC-XX, with the "XX" noting the number of strands in the jacket) fiber cable has a durable Kevlar jacket or sheath surrounding the glass fibers that many claim will not break, even if run over by a truck. This cable is used between trucks, for point-to-point links to individual cameras, and for sending signals to and from the announcer's booth high above the stadium or venue floor.

A less costly "construction-grade" fiber cable is often used for more permanent or less dangerous situations. Usually, in newer stadiums or arenas, there is a layer of permanent fiber infrastructure that is installed inside and around the venue for mobile production companies to easily attach their temporary tactical fiber to, then disconnect when production strikes.

How Much Fiber Do You Need?

Unlike the old days, single mode fiber has become very inexpensive, so crews will often take out more cable than they need on a job. The key is to figure out how many strands you will need for your production, and then add another 50 percent to be safe. This allows preparation for "oh by the ways," which plague many live events to make sure all the connectivity needed can be provided.

Most experts agree that you must first determine what locations will be used, what signals will be needed at each location, and where those signals will come from (video, audio, intercom, data, etc.). All of these variables need to be taken into consideration when laying out a fiber-cabling plan.

To reduce the number of strands required to move a set of signals, there are a number of fiber transmission products on the market that offer seamless multiplexing and Coarse Wavelength Division Multiplexing (CWDM) technology to allow users to combine and send dozens of audio, video and other sources over one single mode fiber cable.

For live events, redundancy is also taken into consideration. What paths are the most important? Which cables do those signals run on? What hardware drives those signals? Program and backup feeds will be fed on separate cables through separately powered hardware to ensure full redundancy. In the world of live sports and entertainment television when the stakes are high, there are no second chances to get it right.

One caveat: While single mode fiber is rated for all types of harsh weather conditions, users still have to look out for how it is deployed, ensure the connectors are clean, and test the lines to ensure a strong light path. Field scopes and line testers are used on every job for quality assurance. Typically, the fiber will be laid around the venue, and then a team of fiber experts will run light through the line to ensure a clean path. Special light meters are also used to ensure all the strands are passing light at the proper levels. Fiber cables are also tested in the vendor's engineering facilities before and after each project. Once the main infrastructure is tested and

Military-grade tactical fiber cabling is most commonly used for longer runs in the field and in the studio.
Image courtesy of Bexel Global Broadcast Services

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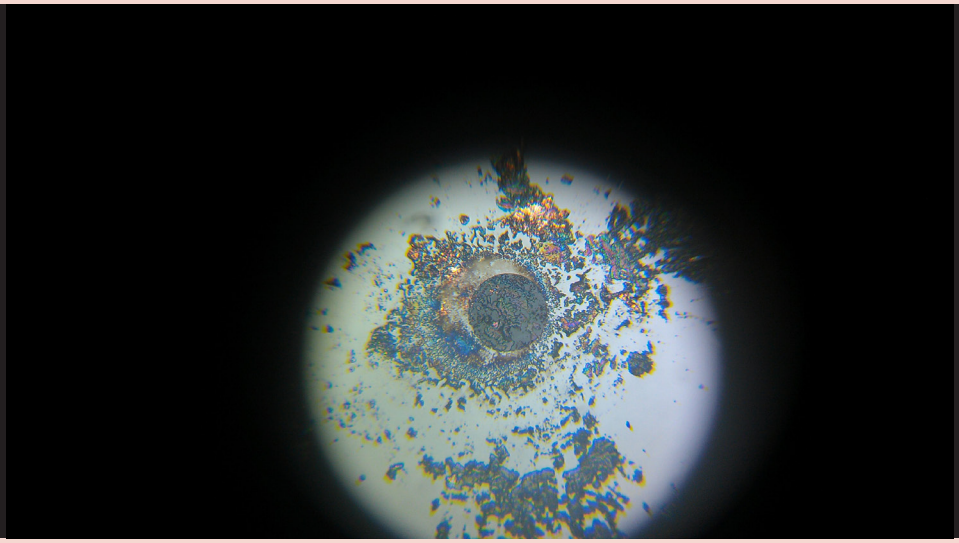
Keeping It Clean



Under a scope, dirt is evident inside this fiber cable connector. The center dark circle should be clear of any dirt particles (but still dark) while the surrounding ceramic encasement around it should be clear white, allowing light to pass through unimpeded.

Among the biggest culprit of bad fiber signal propagation is a dirty fiber connector. When the connectors are dirty, it reduces the intensity of the light passing through the cable, adversely affecting the signal transport and your production.

Small particles of dirt can block the light that passes through a fiber cable and cause the fiber hardware to perform poorly or stop working all together. Sometimes the entire signal is lost since it cannot pass through the specs of dirt. Other times, the distance a signal can travel is seriously affected.

Dirt becomes a problem when connectors are left uncapped, or they are subject to adverse conditions like dirt, mud and rain. If the light is completely blocked, then no signal can pass through the cable. If it is partially blocked, the distance a signal can travel over that single mode cable can be significantly limited.

To combat the problem, those working with fiber have a hand-held fiber microscope to view the connection under magnification and see the amount of dirt present. (Warning: This should be done while the fiber is not energized, or no light is passing through). Most fiber experts recommend that users check their connections before and after every project, especially if the connectors have not been capped. The cable should be clear white, with no trace of specs of dirt. If dirt is present, there are a number of connector cleaning solutions (sprays and wipes) available to address this. Simply spray the connector and wipe it clean with a dust-free cloth or specially made, pre-moistened fiber connector wipes.

Dedicate someone in your facility to clean cable connections on a regular basis

The next time you are out in the field, or in the studio, and your fiber product is not working like it should, inspect the cables for dirt and clean the connections before hooking up your equipment. As a rule of thumb, if you are not using a fiber cable, make sure it is capped on both ends. Dedicate someone in your facility to clean cable connections on a regular basis. Every type of fiber connector comes with a cap, so it should be used at all times, when not connected to a piece of equipment.

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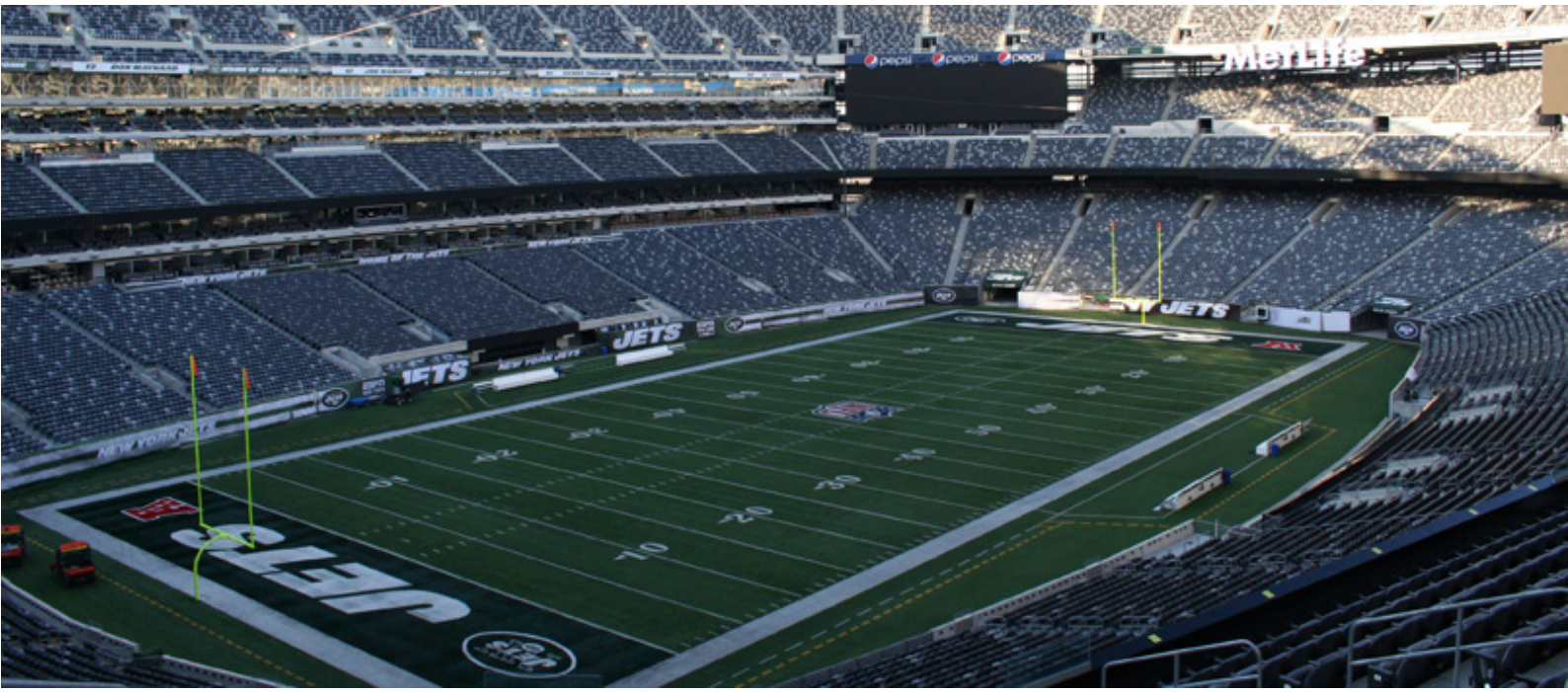
Field scopes and line testers are used on every job for quality assurance in the field. Fiber connections should also be tested before and after every project in the tech lab.
Image courtesy of Bexel Global Broadcast Solutions

confirmed, cameras and other equipment are hung on the fiber network and each signal tested again. When it comes to each connection, cleanliness is the most important piece of the puzzle. While in the days of triax, a camera connector could be left out in the rain and mud and still function; fiber is not the same. The caps on the connector are there to keep dust out. Dust is the enemy of every fiber connector.

The Future Is Fiber

In the world of live production, what has become clear is the advantages of optical signal distribution are no longer a luxury, but a necessity. With the advances in fiber technology, cable and hardware are inexpensive and easier to deploy, making this technology available to a wider range of production types. Most new sport venues are pre-cabling the facility with fiber cable during the construction process as a future-proof way to ensure they can distribute all types of signals, to a myriad of locations, with ease.

As the need increases to move more, larger signals, fiber optics is the best signal distribution method solution for live production projects. It connects camera positions, announcer booth, field-level audio, and everywhere that broadcast signals need to be sent and received. Those professionals who were raised on triax and coax cable, having to load and unload the weighty coils on pallets, probably appreciate the advent of fiber in live production more than most.



Most new stadiums are being wired with fiber to create the most flexible infrastructure for all types of applications and source distribution.

Fiber Networking

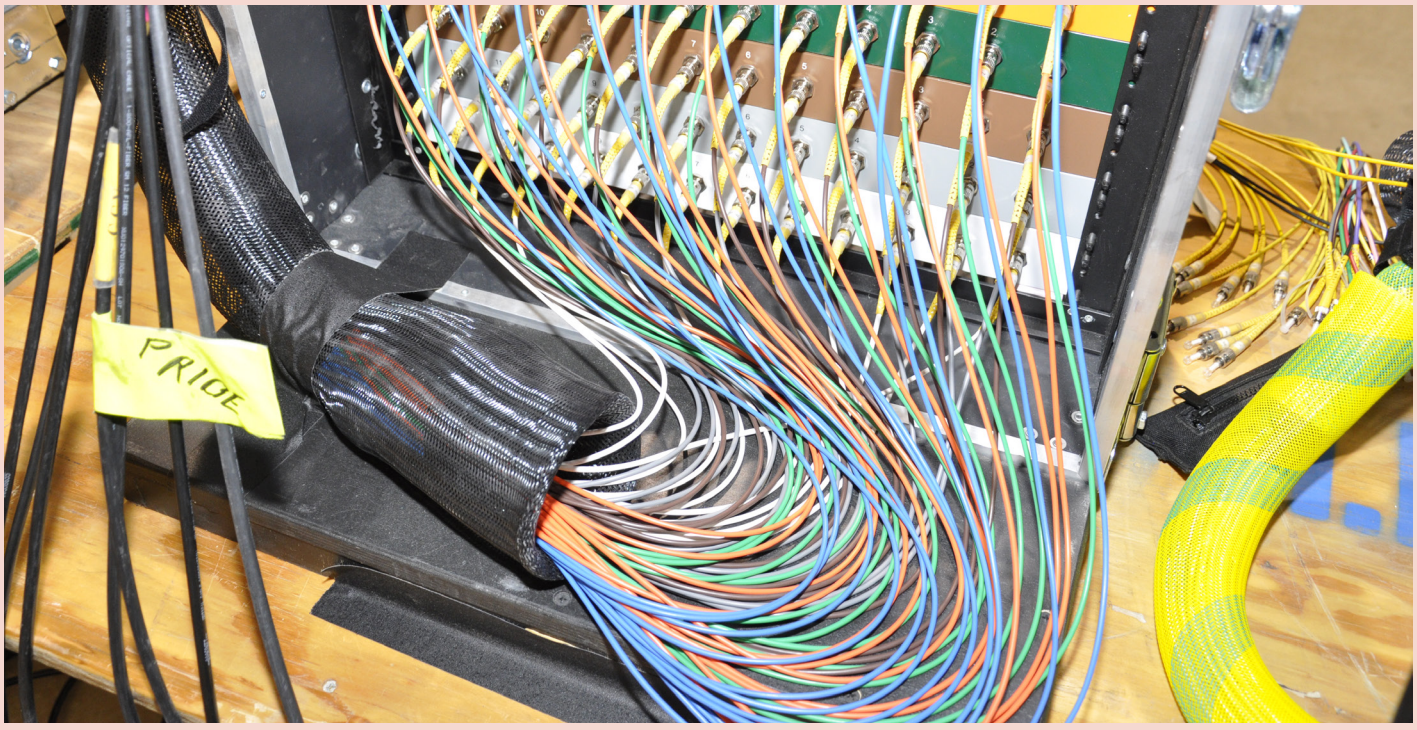
During a mobile production, single mode fiber is used to connect companion trucks together and allow them to share resources. For example, a pre-game (host) sports production truck could be located at a different location at the stadium than the main game day truck, so they will often share fiber feeds from specific cameras on the field or other sources. Many fiber paths are deployed between the mobile units to accomplish this kind of connectivity.

In major entertainment events, a fiber network is deployed around a venue and the truck compound specifically to allow multiple production companies to work together and often share feeds.

New advances in networking technology have led to a number of production companies installing permanent fiber runs to the most desired spots. This also includes building fiber networks or rings around a truck compound or a field of play (e.g., a golf course) to connect the trucks on-site, hang a variety of production equipment, and have it available for a single operator, or multiple operators, from a centralized control location.

Some production companies are using an optical router or data switches controlled by special router control software that allows them to send signals bi-directionally to any end-point. They represent a real-time uncompressed optical networking topology that can interconnect multiple (and disparately located) pieces of equipment or staging locations for managing, controlling and distributing all types of uncompressed signals from one centralized location. These signals can be delivered to an on-site production crew, and to those located literally anywhere in the world (via an IP connection).

With such centralized control over a network of fiber cables, crews can paint and control multiple cameras prior to an outdoor shoot from a single remote control panel over the fiber-optic network. Users save cost and set-up time, while having the ability to remotely control and change the parameters of any piece of equipment tied to a fiber network. It is like sitting in the cockpit and having all of the features and capabilities at your fingertips, via a tactile push-button controller or a software-based graphic user interface. Either way, the configuration flexibility and device control are all in the hands of a single operator.



A fiber network is deployed around a venue and the truck compound specifically to allow multiple production companies to work together and often share feeds. *Image courtesy of Bexel Global Broadcast Solutions*

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