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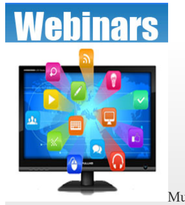

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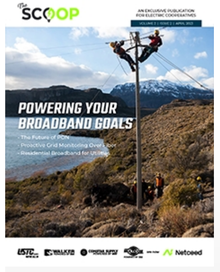

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- **MoCA – What is MoCA Technology?**

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- **How to "PULL" Fiber Optic Cable Correctly**
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Did You Know?

Why do we use dB (decibel)?
Hedy Lamarr was a Hollywood movie star known for her exotic good looks – and an inventor
GO GREEN! Fiber Optics is good for the environment
Both Detroit and Cleveland claim to be the home of the first traffic light
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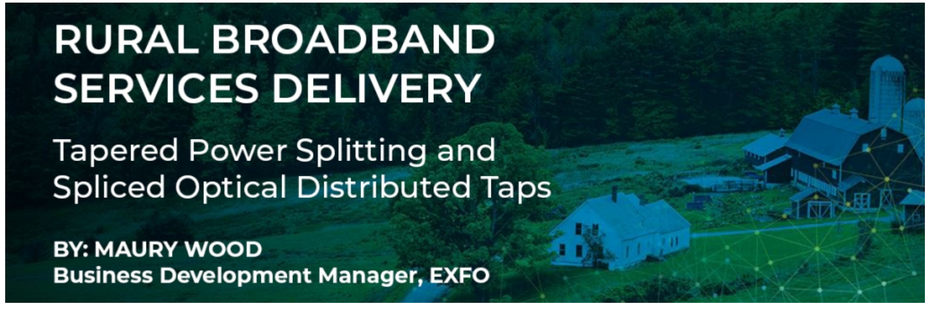
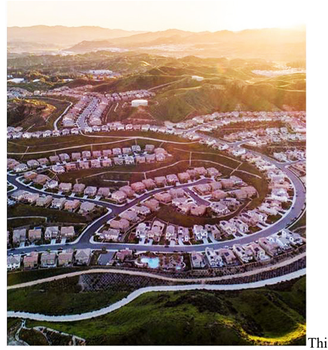
Did You Know that LEDs run brighter and more efficiently the colder it gets?
Did You Know that different types of fiber optic cable are used for different distances?
Did you know that the best fiber optic connector to use when transmitting video over fiber is the SC/APC connector
Do you know the difference between PE-39 and PE-84?
The Jacket Makes the Difference!
IMSA stands for International Municipal Signal Association and was started in 1896
There's a big difference between different types of indoor splitters
Are your fingers sore after installing "F" connectors on coax all day?
Sometimes 'F' connectors do not fit properly on coax cable – why?
The first cable TV systems were Community Antenna TV systems
By the way, do you know what ESPN stands for?
Since we're on acronyms, do you know what DOCSIS stands for?

Contractor Chronicles - Rural Broadband Services Delivery



When ISPs deploy fiber broadband service to rural areas, the biggest challenges they face are economic. Like any business, and in the absence of government regulations or mandates, ISPs will offer services first to those dwellings and businesses with the lowest total cost of deployment. (The resulting lower capital and operating costs yield higher returns.)

 This reality is in flux since broadband Internet access is increasingly recognized as a basic utility and an important public good. During the pandemic, skyrocketing needs for remote learning and remote work capability combined with fickle political fortunes to accelerate this shift in perspective. Political and industrial leaders in the US and abroad have even suggested broadband access be considered a fundamental human right.

Over the past several years, the US Federal Communications Commission (FCC) has shown impressive resolve to close the so-called digital divide separating urban and rural citizens. The Emergency Broadband Benefit Program (EBBP), the Connect America Fund (CAF) and the Rural Digital Opportunity Fund (RDOF) call to mind the massive push for electrification across the rural US, propelled by Franklin Roosevelt's New Deal. Subsidized broadband deployment to rural areas may soon benefit from the huge Biden administration infrastructure spending program.

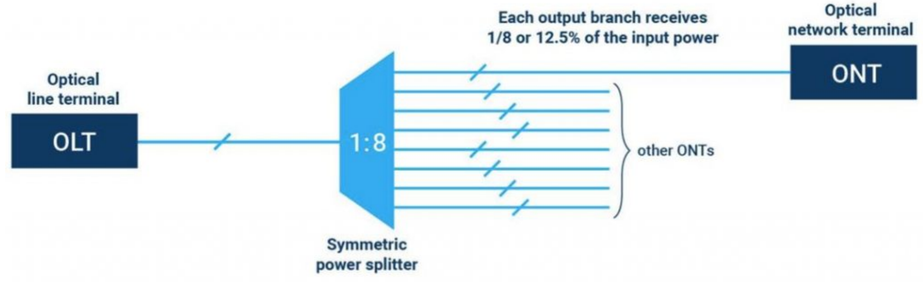
Fiber-to-the-home services in urban areas overwhelmingly utilize a passive point-to-multipoint downstream content distribution model, in which symmetric power splitters ensure all endpoints receive sufficient laser light energy and IP addresses filter that content to ensure accurate delivery of packets to their proper destination. Upstream packets also share a single channel, typically using time division multiple access methods. A key benefit of passive networks is that they avoid the need for optical repeaters and signal amplifiers to extend reach.

FTTH PON architecture has been wildly successful in serving the needs of urban (at least 1,000 people per square mile) and suburban residents (between 1,000 and 500 people per square mile), but not when deployed to rural areas (fewer than 500 people per square mile). Rural areas require longer, costlier f iber cable run lengths, and passive symmetric power splitting is not always optimal for signal distribution, particularly in sparsely populated remote villages.

Suppliers of outside plant optical components have innovated two approaches to adapt FTTH PON technology to rural applications: asymmetric unbalanced (or tapered) splitters and distributed taps.

Tapered Power Splitting

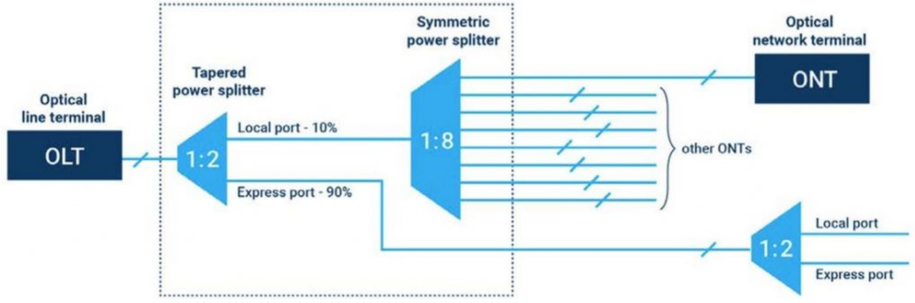
Symmetric splitters generally offer a "power of 2" number of power splits (typically 4, 8, 16, 32 or 64) where each output branch receives an equal (symmetric) share of the input power from the optical line terminal (OLT).



Symmetric splitters generally offer a "power of 2".

This equal allocation of light from the OLT among optical network terminals (ONTs) is appropriate in densely populated areas, as the distance of each dwelling or business from the centrally located symmetric splitter is roughly the same. However, in rural areas, subscribers are generally not clustered geographically. In these situations, asymmetric power splitting can help maximize reach.

Often tapered power splitters are 1:2, with one output branch being the lower insertion loss “express port” and the other output branch a higher insertion loss “local port” that connects directly to a subscriber ONT, or to a symmetric power splitter to serve a cluster of homes or businesses.



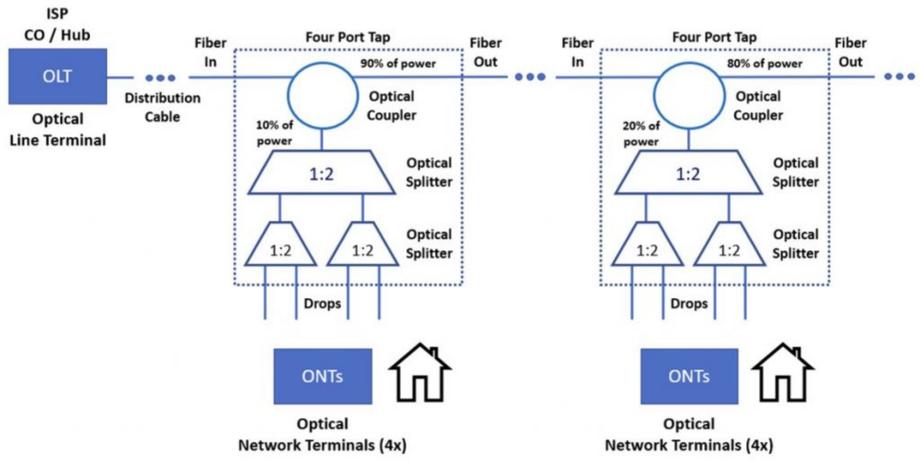
In this example, the local port receives 10% of the transmitted light from the OLT, while the express port receives 90% of the input power, preserving as much power as possible for the downstream tapered splitter to maximize reach out to more remote subscribers.

Tapered splitters are passive optical components and have several characteristics—insertion loss, reflective loss, polarization-dependent loss, and directivity—that network designers must bear in mind when determining overall PON system performance.

Spliced Optical Distributed Taps

One key to the cost savings associated with distributed taps, as claimed by their suppliers, relates to the reduced amount of fiber cabling (distribution and drop cables) required as compared with centralized symmetric power splitter network configurations. Passive distributed taps, as shown below, implement a linear or serial daisy-chain architecture that will be familiar to engineers and technicians with experience in hybrid fiber cable (HFC) topologies. While coaxial cable taps work in the electrical domain, and the distributed taps under discussion here work in the optical domain, the basic signal tapping theory of operation is similar. This functional similarity translates into lower training costs for network operators whose technicians are familiar with electrical coaxial components and technology.

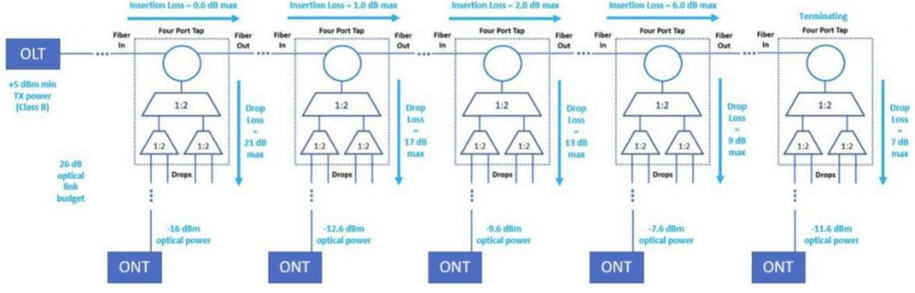
Distributed taps comprise optical couplers, which divert a portion of the input light power, and optical splitters, which equally split this diverted light into the drop outputs.



This example shows two cascaded 1:2 splitters to create four drop outputs. Note that the first tap extracts 10% of the light power, and the second tap extracts 20% of the remaining light power.

Another advantage of distributed taps is reduced splicing overhead, with only one fiber cut and two splices required to add each tap. The small physical size of tap terminals allows them to be mounted aerially, avoiding the need for equipment cabinets, mounting pads, labor costs and the associated local government approvals for this infrastructure.

Distributed taps have two important optical performance parameters that impact end-to-end optical loss budgeting. The first is the tap value or drop loss, and specifies the optical power extracted by the tap, between the input distribution fiber and the output drop fibers (the remaining optical power passes to the next tap in the PON). All the drop ports in each tap along the link (four in the example above) have the same drop loss. Taps closer to the optical line terminal (OLT) extract less optical power from the trunk than taps further from the OLT, in order to allow these PONs to have maximum reach; this is particularly important in dispersed rural areas. The second performance characteristic is tap insertion loss, the amount of light power (both typical and maximum) diverted from the input distribution fiber to the output distribution fiber. The final tap in the PON is the terminating tap, and it has no output fiber port, as all the light energy passes to the drop ports.



Here is a simplified illustration of the downstream path using typical loss values to help make these parameters clearer. Note that the attenuation of all connectors (below 0.75 dB for SC APC per IEC standards), fusion splices (below 0.3 dB per IEC standards), and the fiber itself (about 0.2 dB per km at 1490 nm) must be included in an actual engineering optical loss budget accounting.

A key takeaway here is the available range of tap values (drop losses) from their suppliers allows the network engineer to manage the optical link budget so that ONTs near and far from the OLT receive adequate transmit light signal power. This design methodology also manages the 1310 nm upstream signal power from the ONTs back to the OLT.

With distributed tap PON architecture, along with tapered splitter PON architecture, service providers have two options to deliver fiber broadband services to underserved rural areas cost effectively. EXFO's broad portfolio of fiber test tools, including PON power meters, optical fiber multimeters, inspection scopes, and OTDRs with iOLM, are perfectly suited to validate and maintain all types of passive optical networks.

This article was kindly contributed by Maury Wood, Business Development Manager, EXFO. We've brought together the distribution and manufacturing communities to publish ***"The Contractor Chronicles"***, a new publication focused on network contractors and operators. The inaugural issue includes the five things you need to know before installing cable or learn from some of our leading partners on service delivery, the FTTH ecosystem, fusion splicing, and power meters.

Contractor Chronicles - Top Tips: Investing in Fusion Splicing

In 1970, the innovation of optical fiber entered the telecommunications scene. Fusion splicing shortly followed as the most reliable means of permanently joining two optical fibers via electric arc. This technology creates a continuous optical path for signal transmission and provides the strongest connection with the lowest loss and reflectance of all fiber termination methods, with splices typically measuring less than 0.1dB of loss.

Fortunately, what was once an expensive and labor-intensive process with heavy, cumbersome equipment has significantly evolved. Several improvements in fusion splicing technologies now make it easier to invest in what has become an increasingly popular fiber termination method to meet today's increasing network demands.

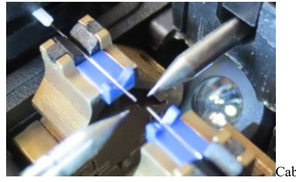
Consider the following tips:

1. Only Use Active Clad Alignment for Same-Era Fiber
Fiber consists of a central core, cladding that surrounds the core, and a protective coating. A singlemode fiber has a coating that typically measures 250 microns, a cladding of 125 microns, and a core of 8 microns. An active clad alignment splicer aligns the outer edges of the cladding by holding the fibers in a v-groove using electrodes as they move along an x- and y-axis, using cameras to assist with analyzing the alignment. Clad alignment is not recommended when splicing modern-day fiber with previous generations of fiber. Over time, fiber manufacturers have succeeded in improving fiber geometry, and the core concentricity will likely differ. When fiber cores are not the same concentricity, alignment can be off and the signal will not have an optimum path, resulting in a signal loss at the splice location, degrading or preventing transmission.

2. Achieve Greater Accuracy with Core Alignment
Instead of focusing on aligning the outer edges of the fiber's cladding, core alignment promotes light moving uninterrupted through the fiber core based on its properties. For example, because light moves differently through the core than the cladding, it glows brighter at the core. Core alignment solutions provide greater accuracy when splicing single fibers, especially when splicing two fibers that may not have the same core concentricity.

3. Choose a Mass Fusion Splicer for Ribbon Fiber
With increasing bandwidth demands, fiber counts have increased. To fit more fibers into a small footprint, manufacturers use ribbon fiber where 12 color-coded fibers are grouped together. A fiber cable can contain multiple tubes packed with ribbon fibers, arranged either flat and stacked or rolled, enabling fiber counts in a single cable to reach as high as 6912! Mass fusion splicers should be used for splicing ribbon fiber as they allow all 12 fibers to be fused simultaneously, significantly saving time and money. These splicers use clad alignment technology with multiple v-grooves to align all 12 fibers, but advancements in mass fusion splicing have increased accuracy closer to that of core alignment solutions.

4. Embrace the Variety of Applications
To meet bandwidth demands and high-speed application loss requirements, fusion splicing has significantly grown in popularity. The industry has catapulted away from simple cable-to-cable splicing long employed for restoration and repairs in outside plant single-mode applications to now encompass a diverse application portfolio across a multitude of environments.



Cable-to-pigtail splicing has become increasingly popular in inside-plant applications for repairs, adds, moves, or changes. Used with both single- and multimode fiber and either single or ribbon fiber, pigtail splicing has become the de facto choice for terminating incoming outside plant fiber to indoor fiber at the building entrance or demarcation point with splices typically residing in the rack- or wall-mounted enclosures. Depending on the type of fiber, core or active clad alignment solutions are both effective for pigtail splicing.

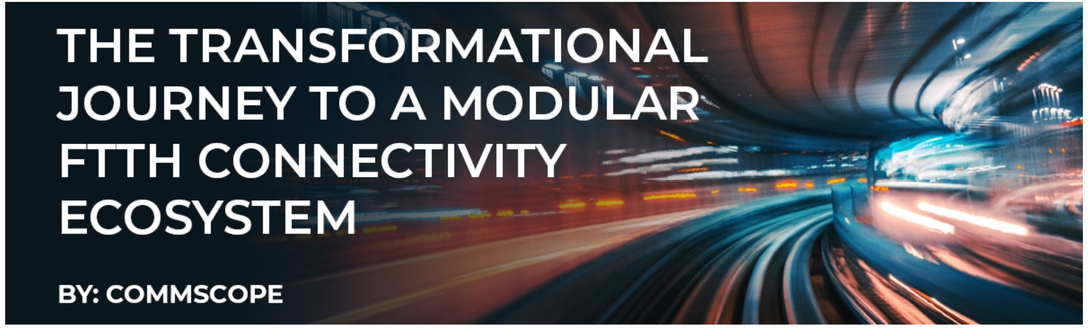
Also used in inside-plant applications, splice-on connectors have become increasingly popular for use with both singlemode and multimode fiber, and either single or ribbon fiber. They offer a reliable, low-loss method for easily terminating tight-buffered indoor fiber to single-fiber, duplex-fiber, or multi-fiber connectors.

5. Easily Justify Your Investment
Early fusion splicing equipment was expensive and cumbersome, costing anywhere from $12K to $40K and weighing an average of 30 pounds. Fusion splicing was also labor intensive, often requiring a team of two or three people to manually splice in a protected environment, qualify with an OTDR, and oversee the process.

Today's splicing equipment is far less expensive, ranging between $4K and $18K, depending on the application and features. They can be easily run by one employee, feature intuitive touchscreen interfaces, and are highly portable with splicers from Sumitomo Electric and UCL Swift weighing less than 5 pounds. Fusion splicers have also advanced to deliver a very close loss estimation during the splicing process and incorporate a pull test after the fibers are fused, eliminating the need for continuous testing during the splicing process. Per industry standards, it is however recommended to test the overall end-to-end loss of the link once splicing is complete. With its ability to support growing bandwidth demand and enable higher transmission speeds, the number of applications requiring fiber is on the rise. Manufacturers are working to make fiber optic cables easier to install, repair, and update. At the same time, the cost of electronics and splicing technologies continues to drop. Fusion splicing is now crucial for contractors to meet the network demands of today. Thankfully advancements in fusion splicing technology make justifying the investment easier than ever.

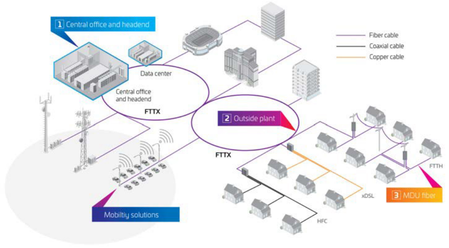
This article was kindly contributed by Corning Optical Communications and Cabling Installation & Maintenance. We've brought together the distribution and manufacturing communities to publish ***"The Contractor Chronicles"***, a new publication focused on network contractors and operators. The inaugural issue includes the five things you need to know before installing cable or learn from some of our leading partners on service delivery, the FTTH ecosystem, fusion splicing, and power meters.

Contractor Chronicles - Transformational Journey to a Modular FTTH



Service providers are accelerating the deployment of fiber-based network solutions that help them provide highly competitive connected experiences while preparing for a future of expanded capacity. But the fiber connectivity evolution has also resulted in several challenges for service providers. With fiber going deeper into the network, there is so much variation among enclosures and terminals that sourcing these critical connectivity devices, training technicians on their use, and deploying fiber quickly have become increasingly complex and difficult.

Fiber-to-the-home (FTTH) deployments, for example, rely on a seemingly infinite number of configuration permutations that account for variations among network segments and physical locations. Enclosures, terminals, closures, hubs, cabinets, and other connectivity devices must all be tailored for the fiber capacity, technologies, cable gauges, splice counts, connector types, mounting requirements, and environmental protection needs of their unique application.



FTTX Topography

The numbers are staggering. In its fiber connectivity portfolio, CommScope had approximately 2,500 different options for its hardened fiber terminals, including 206 types of fiber trays, 224 mounting brackets, and 155 closure domes or top covers. It's not atypical for large service providers to have tens of thousands of fiber SKUs in inventory. And satisfying each new application required a lengthy development time and added even more unique product variations to the portfolio. This rapidly expanding product set created a natural conflict between volume and variation that stifled CommScope's ability to meet customer needs quickly, created rigidity and complexity in its development processes, and made it difficult to scale production. These challenges presented the opportunity for a fresh approach and a better way to what's next in FTTH connectivity.

That's when CommScope embarked on a transformational journey, resulting in a multidisciplinary approach that is revolutionizing how CommScope brings its fiber connectivity products to market—from design to operations, ordering, and field installations. To begin this process, the company conducted a deep dive into customer needs, gathering input from over 25 global service providers and conducting multiple concept testing sessions including third-party installers to also understand how CommScope's products were not only being used—but pushed beyond their intended use. CommScope wanted to know how service providers were stretching components to their limits and adapting its connectivity products to solve problems.

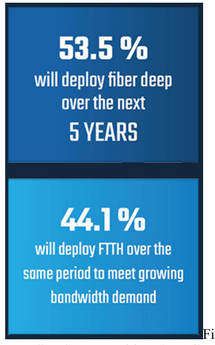
Internally, CommScope turned the development process into a company-wide, global initiative that involved employees from nearly every department: R&D, product management, field application engineering, operations, supply chain, sales, manufacturing, marketing, and customer service. This overhaul of design, production, and supply chain resulted in the creation of a modular end-to-end fiber connectivity ecosystem that CommScope calls NOVUX™. With it, CommScope has reduced components by at least 75 percent, while allowing for 50 times the configurations than are available today.

This paper details the key considerations that formed the creation of the industry's first modular FTTH ecosystem and reviews the path CommScope followed as it transformed its fiber connectivity portfolio around the principle of modularity—and redefined its company culture in the process.

INDUSTRY TRENDS AND CHALLENGES

Three principles emerged as the foundation for a new FTTH design approach: configurability, scalability, and simplicity. These values help guide CommScope's development while ensuring service providers can navigate current and future industry challenges and trends in an era of burgeoning demand for broadband capacity. The COVID-19 pandemic has heightened the urgency for the industry to deliver on broadband's potential and shined a spotlight on the hurdles preventing a clear path to fiber network rollouts.

Fiber Deeper in the Network



Fiber's march deeper into the network is undeniable. A November 2020 Cable Fiber Outlook Survey from Heavy Reading showed that 53.5 percent of respondents say they will deploy fiber deep over the next five years and 44.1 percent said they would deploy FTTH over the same period to meet the growing bandwidth demand. The magnitude of the investment required is demonstrated by findings from the Broadband Communities 2021 Fiber Trends report: fiber passes 53.8 million U.S. homes, but only connects 22.5 million. In Europe, fiber passes 182.6 million homes, connecting only 81.9 million, according to the FTTH Council Europe.

But as fiber goes deeper, the challenges increase. Diverse architectures (DAA, FTTX, FTTH, 5G and hybrids) and applications (residential, business, backhaul) require many connectivity product configurations, components, spares, and associated training and operational complexities— putting pressure on service providers' business cases and challenging equipment vendors to create more configurable solutions.

Shortage of Skilled Labor

Deploying fiber for FTTH requires a skilled labor force, but experienced technicians are difficult to find and expensive to train. The same Heavy Reading survey showed two of the top three challenges to installing FTTH are training staff and contractors. Currently, specialized technicians work in different parts of the network: trunk, feeder, and drop. The FTTH last mile is particularly complicated, with multiple variations that include spliced, connectorized, and hardened drops. With few technicians available and a trend toward a younger demographic, the opportunity to simplify fiber connectivity has never been greater

Rapid Technology Evolution

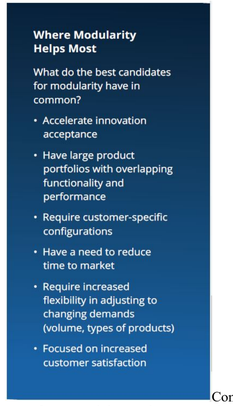
Any solution chosen and installed today must be prepared to address not only today's technologies, but also those of the future to come. Innovations are hitting the market more quickly than ever. Consider that since APON first entered the market around 2000, there have been over 20 new versions of PON released—essentially one new PON version per year. The older iterations are still in use, while new variations continue to be proposed. Fiber connectivity advancements such as rollable ribbon cables, multifiber connectivity, WDM, and fiber flex foils require that closures and terminals are designed to serve the present, as well as anticipate the future.

Changes in the Competitive Environment

The need to respond faster to market demand is increasingly important for service providers facing increased competition. This trend is expected to continue as service providers prioritize broadband investments and public funding for broadband increases.

This highly competitive environment is creating a sense of urgency for service providers who want to retain existing customers while attracting new ones. There is room for growth in both the U.S. and Europe. A recent study by USTelecom showed that 46% of areas in Europe have two or more competing facilities-based broadband providers. In the US, the areas in which subscribers benefit from competition between two or more broadband providers jump to 94%. For service providers, winning subscribers in these contested markets requires a network with the highest broadband capacity, fastest speed, and highest reliability. FTTH provides these advantages, assuming its deployment complexity can be mitigated so that a service provider can quickly respond to customer demands.

MODULAR DESIGN: A NEW BUT WELL-PROVEN METHOD



CommScope examined these trends and challenges and found a common thread in their solution: the ability to offer the most configurations for connectivity with the fewest components. The company first surveyed other industries to see how they accomplished this goal, and as a result, studied "platforming"—the standardization of components—as a potential solution. In the auto industry, for example, a manufacturer might use the same undercarriage or chassis for many models of cars. Here, platforming reduces the number of unique parts but also limits the potential for product variations. In broadband, platforming raises a similar issue since certain components that particular customers depend upon would need to be eliminated with this approach.

CommScope then examined the principle of modularity. The key to modularity is that interfaces are standardized. Therefore, components with these interfaces can be connected in any configuration that suits a service provider's technology and architectural requirements. This presents an elegant solution for product sets that must keep volume and variation in balance. Looking at FTTH through the lens of modular design, CommScope knew it would have to rethink and retool all its processes.

VISION OF A MODULAR FTTH ECOSYSTEM

Returning to the trends and challenges, let's review exactly how modularity can benefit an FTTH deployment.

Enable fiber deeper in the network

Using common building blocks with standardized interfaces reduces the number of modules needed to produce more connectivity configurations to address the many unique locations and applications associated with getting fiber deeper into the network.

Deploy fiber with less skilled labor

With a modular approach to fiber connectivity, installers only need to be trained one time on the installation and assembly process, which is common across the modular system. Regardless of the configuration, an installer encounters in the field, the installation process will be easy to recognize, making the work more efficient, while simplifying training and improving quality. Additionally, there is plug-and-play connectivity thanks to the interfaces but also because once a hardened technology module is tested in the factory, it is considered reliable in the field.

Keep up with rapid technology evolution

When technology changes occur, updated modules can be easily designed and produced to accommodate them. This reduces the need to replace products in the field or to redesign entire products to address a technological advancement while making it easier to upgrade the installed base to new technologies. In addition, tested modules and interfaces do not need to be retested when used in another configuration or network segment.

Address changes in competitive environments

The increased competition requires service providers to be agile and seize new opportunities. Since there is no "one size fits all" when it comes to fiber deployments, especially in brownfield and greenfield situations, service providers need the right products in the right volume, and with enough simplicity to deploy them quickly.

This article was kindly contributed by Commscope. We've brought together the distribution and manufacturing communities to publish ***"The Contractor Chronicles"***, a new publication focused on network contractors and operators. The inaugural issue includes the five things you need to know before installing cable or learn from some of our leading partners on service delivery, the FTTH ecosystem, fusion splicing, and power meters.

Contractor Chronicles – The Perils of Using a Broadband Power Meter in a Multi-service PON World

Test Challenge

For single-technology, single-wavelength PON deployments, the simple broadband power meter has been an excellent and sufficient tool for PON activation and troubleshooting. However, the existing PON fiber infrastructure can carry light power across many wavelengths simultaneously and— for all practical purposes—without interference. Based on this concept, new, next-generation PON technologies are being deployed on the same fiber plant as current-generation technologies but using independent wavelengths. Powerful new PON capabilities can thus be quickly rolled out to customers over the existing infrastructure by simply changing the equipment at the ends of the fiber.

However, the presence of multiple wavelengths on the same fiber or within the same PON infrastructure presents significant problems for those engaged with PON activation and troubleshooting and who are equipped with only broadband (unfiltered) optical power meters. There are two primary use cases where these problems will surface:

- In coexistent PON service structures where two PON services at different wavelengths are carried on the same fiber simultaneously, the use of a broadband power meter will result in erroneous and misleading power measurements as explained in more detail below.
- In parallel PON service structures where two services at different wavelengths exist in the same footprint, the network will be constructed such that a given fiber will carry either one service (wavelength) or the other but not both. In this use case, it is very easy to accidentally connect a customer to the wrong service through patching or provisioning errors. The use of a broadband power meter in this scenario runs the risk that power measured in the PON may seem good, but in reality, the wrong wavelength is being delivered. Unnecessary customer-premises equipment (CPE) swapping, long troubleshooting sessions, and needless escalations can result if you can't immediately identify the simple fact that the wrong wavelength is present at the customer premise.

Inside an Optical Power Meter

Optical power meters employ photodiodes that detect the number of photons striking the photodiode surface per unit of time and convert that photonic rate into a measured light power. The photodiodes in most broadband power meters can detect light energy across a broad spectrum of wavelengths, normally between 780 nm and 1650 nm. Power meters constructed in this way will measure photonic energy from any and all wavelengths of light within the photodiode's wavelength range and will produce a single power measurement proportional to the sum of all photons from all wavelengths per unit of time. (See Figure 1)

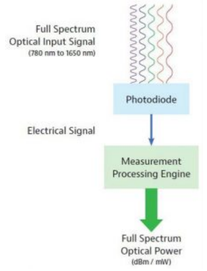


Fig.1. Power meters constructed in this way will measure photonic energy from any and all wavelengths of light within the photodiode's wavelength range and will produce a single powermeasurement proportional to the sum of all photons from all wavelengths per unit time.

As a specific example, if a broadband power meter is used to measure a PON with coexistent GPON (1490 nm) and XGSPON (1577 nm) services, the output of the broadband power meter will be the sum of the powers of both the GPON and XGS-PON wavelengths. The user will have no idea what the actual power and margin are for either of the two PON services on the link. Also important is the fact that even in networks that are intended to have a single service on the fiber at a time, a broadband power meter cannot tell you which service (wavelength) it is currently measuring. Errored provisioning and connection/patching will go undetected until the CPE fails to activate the service.

For these reasons, PON power meters designed for use in multi-service environments include optical filters in front of their internal photodiodes to ensure that only the power for a specific wavelength of interest is measured. In the case of PON power meters that are designed for GPON and XGS-PON (both coexistent and parallel networks), two filtered photodiodes are normally used. More specifically, the light from the measured fiber is split inside the power meter to two independent photodiodes, passing through two selective filters in front of those photodiodes. One filter is for GPON wavelength of 1490 nm, and the second filter is for XGS-PON, at 1577 nm. (See Figure 2)

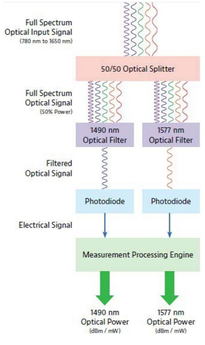


Fig. 2. One filter is for GPON wavelength of 1490nm, and the second filter is for XGS-PON, at 1577nm

PON power meters constructed as such can instantly and simultaneously measure the optical power for the filtered wavelengths accurately and independently, preventing the misleading measurements delivered by broadband power meters in a coexistent environment, and identifying the specific wavelengths associated with those power measurements for both coexistent and parallel PONs.

Consequences of Applying the Wrong Tool in a MultiService PON

As discussed above, when using a broadband power meter in a coexistent GPON / XGS-PON network, the measured power will appear artificially high when both GPON and XGS-PON signals are present on the fiber at the same time. This can have two types of impacts during service activation:

- Power measurement could look good, but the actual power of the individual GPON and XGSPON signals are too low to operate equipment, causing a false pass and driving:
  - Unnecessary CPE swap-outs
  - Troubleshooting complications, increasing the amount of time required to complete the installation
  - Needless escalations
- Power measurement could measure too high, causing a false failure and driving:
  - Unnecessary call-backs to the central office for incorrect requests for provisioning checks or changes
  - Extensive time spent troubleshooting a problem that does not exist
  - Unnecessary escalations and truck-rolls

In parallel, GPON / XGS-PON where network design intentionally routes either GPON or XGS-PON to the premise (but not both), using a broadband power meter could result in measuring good power at the end of the drop fiber without realizing that the wavelength associated with the power measurement is wrong. Something as simple as connecting to the wrong type of splitter in the splitter cabinet or connecting the drop fiber to the wrong drop terminal port can easily create such a scenario.

More recently, miss-provisioned optical line terminal (OLT) ports are an increasing cause for the wrong wavelength appearing at the end of a customer's drop. As PON OLT equipment has matured, there has been a natural migration from dedicated, single-service OLT ports to dual-function OLT ports (configurable as one service type or another), to multi-service OLT ports (providing simultaneous PON services and internal coexistence functions within the same OLT port).

Both provisioning and connection/patching errors will once again drive:

- Unnecessary CPE swap-outs
- Troubleshooting complications, increasing the amount of time required to complete the installation
- Unnecessary escalations and truck-rolls

Avoiding Cross-connection Issues

When a new customer signs up with a service provider they trigger several activities. The first steps include scheduling an installation date along with ordering the ONT and any other CPE. However, simply connecting any ONT to a live PON network does not ensure the activation of services. If that were the case anyone could purchase an ONU and connect it to get service for free.

The other step that happens is telling an OLT that it will be responsible for and approved to deliver services to a specific ONT device. This is referred to as provisioning the service, meaning that a specific OLT port is assigned to provide support (data) to a specific ONT serial number.

If you connect the ONT to the correct drop terminal port, which routes back to the OLT port where the service has been provisioned, then the service will turn up as it should. However, if you connect to the wrong drop terminal port and therefore an OLT port where the service has not been provisioned, the ONT may boot up but the service itself will not activate. This is because the OLT is expecting the ONT to appear or communicate on a different port, so it won't deliver service to that ONT. Wrong light, i.e., a downstream wavelength from an OLT port where the service was not provisioned, is a fairly common problem with FTTx deployments.

The drop terminal enclosure typically includes labeling to show which port is which, but in the real world it's all too easy for labels to be illegible, missing, or wrong, often because the distribution fiber routing has been altered by a previous tech. To ensure the right fiber cable is connected to the right OLT port and to enable easy handling of installation error tickets, it requires a device that identifies the type of OLT and the OLT-ID at any network location.

This device must be able to evaluate the PON-ID, a unique identifier that is standardized by ITU-T and is a frame in PLOAMd carrying PON-specific information, such as OLTID, ODN class, and the transmitted optical level from the OLT. If you can extract and read it, you can compare the provisioning information and state for certain whether the OLT port a customer is connected to is the right one or not.

Addressing the Challenge

Field technicians need to quickly and accurately:

- Confirm that there is sufficient power to operate a resilient PON service
- Confirm that the measured power is on the correct wavelength for the desired service
- Segment problems down to a specific portion of the fiber plant, avoiding unnecessary CPE or drop fiber replacements, and increasing the accuracy of escalation calls

Conclusion

Next-generation PONs deliver many business-critical advantages to providers compared to current PON technologies, including higher service-rate offerings, improved service-rate symmetry, increased split ratios, and the convergence of multiple applications into a single optical distribution network (ODN). As many providers transition from BPON, GPON, or EPON to next-generation technologies like XGS-PON or NG-PON2, a new test paradigm is required, as the potential for negative business impacts associated with continued use of broadband power meters in a multiservice PON environment is a real and immediate concern.

However, by deploying selective PON power meters and TruePON testers for activation and repair of multi-service PONs, providers will improve the efficiency of service activation and repair groups, and avoid the increased costs associated with longer installation and troubleshooting times and unnecessary escalations and truck rolls.

This article was kindly contributed by Scott Pettygrove and Nikki Kirschenmann of VIAVI Solutions. We've brought together the distribution and manufacturing communities to publish ***"The Contractor Chronicles"***, a new publication focused on network contractors and operators. The inaugural issue includes the five things you need to know before installing cable or learn from some of our leading partners on service delivery, the FTTH ecosystem, fusion splicing, and power meters.

Control the #1 Amenity Everyone Requires: High Speed Internet

Your Greatest Marketing Advantage: Ownership and Control of the High-Speed Internet into your single-family home developments, apartment/condo complexes, or office buildings results in the best services at the lowest costs for everyone.

Flex Your Muscle: Negotiate Your Own Contracts for the Best Services

Exclusivity arrangements between owners of single family home developments, apartment/condo complexes, or office buildings, and Internet Service Providers (ISPs), can be advantageous and lucrative for you – and enhance your property's desirability.

Single Family

The developer of **Single-family Home Developments** can hire an ISP on a short-term trial contract and negotiate:

- What services will be provided
- Duration of the trial contract
- Cost of the services

Apt / Condo

The **Apartment/Condo Complex** owner can hire an ISP on a short-term trial contract and negotiate:

- What services will be provided
- Duration of the trial contract
- Cost of the services

Office Bldg

Since the **Office Building** will be wired and provisioned with fiber optics, the tenants can determine the services they want:

- What services will be provided
- Duration of the trial contract
- Cost of the services

Connecting to the Internet on all of your devices including smart appliances, television, gaming, digital phone service, remote security monitoring, and any of the 'Internet of Things' – are all part of increasing the value and providing real solutions to your property.

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5 Reasons Why Owning your own Fiber Optic Broadband Network is a Profit-Making Investment that will Reward You – Now and in the Future:

1. **Provide More Value:** Unlike a pool, gym, or food court, the Internet is something every resident will use on a daily basis. You'll be providing value all day, every day. Future-proofing your property with fiber optic cabling goes beyond just keeping up with the latest lifestyle trends, you can increase value while providing real solutions.

2. **Differentiate Yourself:** When potential new owners or residents tour your property, they're keeping a mental list of everything you offer. Set yourself apart from similarly priced competitors with an amenity that they actually want – advanced technology. Including high-speed Internet access will allow you to bring in other tech-y wonders like smart thermostats, connected appliances, and WiFi-enabled doorbells. Small touches like these can really add up and just might make you the hottest place to live in your area.

3. **Boost Lease Retention at Offices & Apartments/Condos:** When it comes to lease renewals, you know better than anyone that long-term tenants are your golden ticket. They're a reliable and stable source of income for property owners and landlords. So while keeping units occupied should be a priority, keeping residents happy is also a must. Adding on new amenities and providing high-speed Internet broadband access will convince residents to be receptive to longer leases and increase the probability of renewing their lease.

4. **Private Home Developers:** Providing a fiber optic broadband network to each home results in an added feature that will facilitate a swifter sale. The homeowner or Home Owner's Association (HOA), can determine pricing, service, and duration of the contract, with providers of their choice.

5. MULTICOM **Design & Product Capability:** That's where Multicom comes in. Multicom is a stocking distributor and manufacturer, can design your network and provide all of the networking products to bring future proof high-speed Internet, HDTV, digital phone service, and Wifi to your single family home developments, apartments/condos, or office buildings. Multicom has the experience and expertise to successfully design and implement the fiber optic solution you need.

4 Reasons Why the Future is Now with the Benefits of a Fiber Optic Network:

1. **Increased Speed:** Times have changed, and more people are working and doing more things from home. Home is the new office for parents and students, family entertainment center, movie theater, gaming arcade, and dinner menu. Up and downloading any type of data needs to happen at the virtually unlimited speed of light – exactly what is transmitted over fiber optics.

2. **Future-proof Reliability:** Far more reliable than copper, fiber optic cable is impervious to wear or lightning strikes and is not weather-dependent. This keeps your 'Internet of Everything' up and running, full speed, all the time.

3. **Inherently Secure:** Fiber optic cables transmit light signals, making intercepting data transmission nearly impossible. This type of security allows for peace-of-mind up and down data transference.

4. **Cost:** Fiber optic broadband networks are becoming more and more competitive with copper, and costs continue to decrease as technology advances. Fiber optics, with its nearly unlimited capacity, has all of the benefits mentioned above, and is the future of broadband connectivity.

Download the Tri-fold: **Control the #1 Amenity Everyone Requires: High Speed Internet**

To learn more about the benefits of owning your own fiber optic broadband network, please contact Dominic at: dom@multicominc.com, or call 800-423-2594, and ask for Dom.

Copper vs. Fiber - Which to Choose?

When installing the network cable, which one do you prefer – copper cable or fiber optic cable? Let's break it down and make it simple…

Today we Make our Case for Fiber Optics

Both copper and what is essentially glass, or fiber optics, have their advantages and unique characteristics. Copper has already existed in many places and it is cheap in network devices connection. However, with the dramatic reduction of cost of optical deployment, the future-proof fiber optic cable shows more advantages over copper and has a better prospect in the future market.

We are presenting five reasons for the choice in fiber rather than copper cable from cost, bandwidth, transmission speed and distance, durability and security.

1. COST

A few years ago, the overall price of fiber cable was nearly twice that of copper, but now the price between fiber and copper has narrowed and fiber components and hardware have steadily decreased.

Let's start with the general premise that electrical power transmission over copper is cheaper than laser power transmission over fiber – because it has been up until this point – though this is changing fast. Most people overlook the cost of the wiring closet in copper networks – and they shouldn't. Let's not forget, a standard wiring closet includes the costs of conditioned UPS (Uninterruptible Power Source) power, data ground, HAVC (Hybrid Automatic Voltage Control) and floor space.

These integral costs generally exceed the extra cost of fiber equipment in a centralized fiber architecture, as well as take up significantly more working space (which is often limited). So, an all-fiber LAN (Local Area Network) is really more economical and space-efficient than a copper-based networking environment for new construction and major renovations.

Parameter	Fiber Optics	Copper
Bandwidth	60 Tbps and beyond	10 Gbps
Future-Proof	Evolving towards the desktop	CAT7 in development

Distance	12 Miles+ @ 10,000Mbps	300 Ft. @ 1,000Mbps
Noise	Immune	Susceptible to EM/RFI interference, crosstalk and voltage surges
Security	Nearly impossible to tap	Susceptible to tapping
Handling	Lightweight, thin diameter, strong pulling strength	Heavy, thicker diameter, strict pulling specifications
Lifecycle	30-50 Years	5 Years
Weight/1,000 ft.	4 Lbs.	39 Lbs.
Energy Consumed	2W per User	>10W per User

2. BANDWIDTH

Although copper is perfectly adequate for a voice signal, it has very limited bandwidth – while fiber provides standardized performance up to 10 Gbps and beyond.

Fiber links provide over 1,000 times as much bandwidth as copper and can travel more than 100 times further as well. A typical bandwidth-distance product for multi-mode fiber is 500 MHz/km, so a 500 meter cable can transmit 1 GHz. While twisted pair optimized for high data rates (Cat 6) can transmit 500 MHz over only 100 meters. In addition, the signal loss over 500 meters in fiber is negligible, but copper has very high loss at high frequencies.

3. TRANSMISSION SPEED AND DISTANCE

Fiber optic versus copper transmission can be viewed as the speed of photons versus the speed of electrons. Photons travel at the speed of light, whereas electrons used in copper travels at less than one percent of the speed of light. Although fiber optic cables do not reach the speed of light, they are only about 31% slower. So you can see that there is a huge inherent speed difference between fiber and copper. In addition, fiber does not have the 100 meter distance limitation which is inherent in unshielded twisted pair copper without a booster. Therefore, distance can range from 550 meters for 10 Gbps multi-mode and up to 40 kilometers for single-mode cable.

4. RELIABILITY

Fiber optic cable is much less susceptible to various environmental factors than copper cable. For example, copper will experience a great deal of degradation in quality over a distance of two kilometers, using fiber optic cable over the same distance can provide extremely reliable data transmission. What's more, fiber is also immune to several environmental factors such as temperature and electro-magnetic fluctuations – copper cannot say the same – you can deploy fiber cable next to industrial equipment without worry. Also, like the transatlantic cable connecting the U.S. with Europe and beyond, fiber can be submerged in water.

5. SECURITY

Since optical fiber does not transmit electricity, it does not radiate signals and cannot be tapped – copper does use electricity and is susceptible to be tapped, which can cause the entire system to fail. A broken or damaged optical fiber can be detected extremely quickly by using a number of monitoring techniques including monitoring the actual power transmission or the transmission of a pilot signal. On the other hand, copper cable carrying a current can short-out completely or even cause a fire if it is damaged, old or worn without such efficient monitoring techniques.

CONCLUSION – AND THE WINNER IS… ?

The advent of optical cable with its ever-reducing cost, increased bandwidth, extremely high speed and long transmission distance, excellent reliability and perfect security, has replaced copper in every aspect of network transmission and reception. Fiber optic cable has become one of the most popular mediums for both innovative cabling installations and upgrades, including backbone, horizontal, and even desktop applications. And with the steadily lowering cost and intrinsic improvements made seeminly daily in fiber optic connectivity, fiber construction will become more convenient and cost-effective. It's only a matter of time before fiber optics completely replaces copper cable in both long and short-haul networking.

CWDM vs. DWDM: Which Should You Use and When?

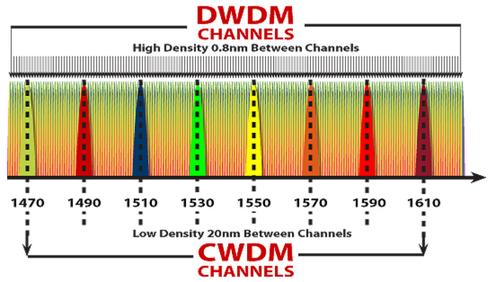
Do Not Bury More Cable! Learn how a CWDM or DWDM can save you effort, time, and most of all, a lot of Money!

It can be easy to run more channels of higher bandwidth traffic over THE SAME FIBER! CWDM and DWDM are both effective methods to solve the increasing bandwidth capacity needs and maximize the utilization of both new and existing fiber.

Simply put, the need to bury more fiber is eliminated – among a host of other advantages. Use what you have for a lot more! And there are many other considerations and options available that can save massive amounts of capital and monthly costs.

So what are CWDM and DWDMs? And which should you use when?

Coarse Wavelength Division Multiplexing (CWDM) and Dense Wavelength Division Multiplexing (DWDM) are the two primary technologies developed based on Wavelength Division Multiplexing (WDM), but with different wavelength patterns and applications.



DWDMs pack in the channels by using narrow channel spacing – all over a single new or existing fiber

Though both CWDMs and DWDMs are effective methods to solve increasing bandwidth capacity needs, they are designed to tackle different network challenges.

To best understand how to decide which of these two WDM technologies may be the best option when planning a network, it's best to have a basic understanding of how each technology works and what the differences are:

CWDM

- CWDM systems typically transport eight wavelengths with a channel spacing of 20nm in the spectrum grid from 1470nm to 1610nm – **on a single fiber**
- Lower total cost
- Lower complexity
- Lower power consumption
- Less complicated and lower cost lasers
- Can not be amplified
- Up to 80 km (~50 miles) reach

A CWDM system commonly supports eight wavelengths per fiber and is designed for short-range communications, using wide-range frequencies with wavelengths spread far apart (20nm).

Since CWDM is based on 20nm channel spacing in the 1470 to 1610nm spectrum, it is typically deployed on fiber spans up to 80km or less because optical amplifiers cannot be used with large spacing channels. This wide spacing of channels allows the use of moderately priced optics. However, the capacity of the links, as well as the distance supported, are less with CWDM than with DWDM. Generally, CWDM is used for lower cost, lower capacity (less than 10G), and shorter distance applications where cost is an important factor.

Note: In addition to the capability of supporting a greater number of wavelengths, CWDM and DWDM platforms are also capable of handling higher speed protocols as most optical transport equipment vendors today commonly support 100G or 200G per wavelength while emerging technologies are allowing for 400G and beyond.

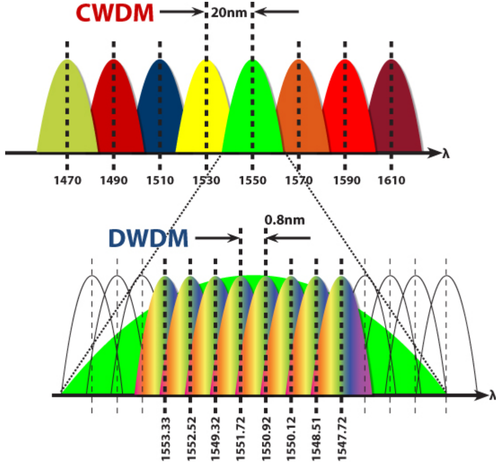
DWDM

- DWDM systems can carry 40, 80, 96, or up to 160 wavelengths by utilizing a much narrower spacing 0.8/0.4nm (100 GHz/50 GHz grid) – **on a single fiber**
- Wavelengths are typically from 1525nm to 1565nm (C-band), with some systems also capable of utilizing wavelengths from 1570nm to 1610nm (L-band)
- Longer reach – up to 120 km (~75 miles)
- Higher density and bandwidth
- More accurate temperature-controlled lasers
- Dense spacing allows for amplification

In DWDM systems, the number of multiplexed channels is much denser than CWDM because DWDM uses tighter wavelength spacing to fit more channels onto a single fiber. Instead of the 20nm channel spacing used in CWDM (equivalent to approximately 15 million GHz), DWDM systems utilize a variety of specified channel spacing from 12.5 GHz to 200 GHz in the C-Band and sometimes the L-band.

Today's DWDM systems typically support 96 channels spaced at 0.8nm apart within the 1550 nm C-Band spectrum (see graphic below). Because of this, **DWDM systems can transmit a huge quantity of data through a single fiber link** as they allow for many more wavelengths to be packed onto the same fiber.

DWDM is optimal for long-reach communications up to 120 km and beyond due to its ability to leverage optical amplifiers, which can cost-effectively amplify the entire 1550nm or C-band spectrum commonly used in DWDM applications. This overcomes long spans of attenuation or distance and when boosted by Erbium Doped-Fiber Amplifiers (**EDFAs**), DWDM systems have the capability to carry high amounts of data across long distances spanning up to hundreds or thousands of kilometers.



CWDMs utilize a channel spacing of 20nm, where a DWDMs utilize much denser spacing typically 0.8nm

CWDM or DWDM: Which should you use?

CWDM is a flexible technology that can be deployed to expand the capacity of a fiber network. It is a compact, cost-effective technology option when spectral efficiency or the need to span long distances under 80 km are not important requirements.

CWDM solutions, which typically utilize passive hardware components, are commonly deployed in point-to-point topology in enterprise networks and telecom access networks. For those reasons, CWDM is typically best suited for short-range applications that do not require services greater than 10Gb and in locations where not many channels are needed.

On the other hand, DWDM technology is the ideal solution for networks that require higher speeds, greater channel capacity, or for applications requiring the capability of utilizing amplifiers to transmit data across much longer distances. Though the hardware and electronics used in DWDM systems are not cheap, they are considerably more cost-effective than putting in new fiber.

As the need for capacity grows and service rates increase to 10G/40G/100G and 200G, the high re-occurring costs of leased lines to provide connectivity for these higher data rates are not scalable for organizations when compared to implementing and operating their own DWDM optical network.

Because of this, there is a growing demand to **increase network capacity by utilizing DWDM optical networking applications** to maximize the fiber connectivity between sites. Organizations are increasingly leveraging this technology as a scalable on-demand solution to keep up with their rising bandwidth demands.

Typically, DWDM systems utilize active hardware components and are often deployed as integrated hardware platforms such as ROADMs (Reconfigurable Optical Add-Drop Multiplexers), which provide enhanced operational capabilities and enable the creation of complex and scalable optical networks.

Because of its ability to handle so much data, DWDM is utilized by organizations spanning many industries as an integral part of their long-haul, core- or metropolitan-area fiber networks today. DWDM technologies are also used to interconnect data centers, such as ODCI (Optical Data Center Interconnect) platforms that provide ultra-high bandwidth links (400G and beyond) utilizing low-cost per bit hardware optimized for the data center environment.

Multicom stocks SFP/SFP+/XFPs for CWDM/DWDMs, and any type of network including GPON/XPON

Conclusion

We hope this article clarified the benefits, functionality, and advantages of CWDM and DWDMs. The main takeaway is that using the capabilities of CWDM and DWDMs, fiber optic cable is nearly limitless – that goes for existing cable as well as new deployments. Understanding this can save you time, effort, and most of all, a lot of money!

Multicom carries a wide variety of CWDM and DWDM components, as well as the **DZS O-Series** of environmentally hardened optical transport products that are optimized for high capacity and long-reach mobile backhaul scenarios.

Optical networking plays a key role in today's multi-layer networks and is used to extend the reach of traditional pluggable optics, interconnect data centers and tie sites together within a campus or business park across metropolitan regions, between cities, or for long-haul national connectivity. As a result, public sector organizations, utilities, healthcare providers, financial institutions, corporate enterprises, and data center operators are considering optical transport to be the solution of choice for their mission-critical networks.

With the massive growth of over-the-top applications, cloud computing, mobile devices, and the need for consumers and employees to have constant access to their data and applications, CWDM and DWDM optical networking solutions are rapidly being adopted by businesses as their bandwidth and distance requirements continue to grow. Thus, many organizations across industries are now operating their own optical transport networks to consolidate high rates of bandwidth and different traffic types across long distances.

Did You Know About - Jacket Types

Two of the most common characteristics seen when describing Ethernet cable is 'Plenum' and 'Riser'. It's important to distinguish the difference between the two because plenum cable can always replace riser cable, but riser cable cannot replace plenum cable in plenum spaces. Not knowing that simple fact can be the difference between life and death in case of a fire.

Here are some things to keep in mind:

• PLENUM (OFNP) – refers to a specific fire code rating of cables that are resistant to fire and do not emit toxic fumes or smoke when burned. Plenum-rated cables are primarily used in pathways for either heated, cooled or return airflows.
• RISER (OFNR) – is constructed of PVC and may emit toxic fµmes when burned and is to be run in non-plenum areas.

Did you know about fiber optic cladding?

You know that fiber cable is made of a transparent glass. But Did You Know that without the mirror-like cladding, the light within the fiber core would escape, making the the fiber cable useless.

Light passes through the cable, bouncing off the cladding until it reaches the other end of the fiber channel – this is called total internal reflection. Without the cladding, the light within the fiber would disperse and never make it to the destination.

Fiber specifications list the core and cladding diameters as a ratio. Multimode fiber is commonly 62.5/125 or 50/125 micron, single mode fiber is commonly 9/125 micron.

Did You Know that different types of fiber optic cable are used for different distances?

Multimode fibers have large cores, usually either 50µ or 62.5µ. They are able to carry more data than single mode fibers though they are best for shorter distances because of their higher attenuation levels.

Single Mode fibers have a small glass core, typically around 9µ. Single Mode fibers are used for high speed data transmission over long distances. They are less susceptible to attenuation than multimode fibers.

Did You Know that LEDs run brighter and more efficiently the colder it gets?

Compact fluorescence are known to operate poorly in colder climates and energy efficiency for other types of lighting decreases coinciding with the drop in temperature.

However, when the exterior temperature drops the cooling of the LEDs becomes ultra efficient resulting in increased brightness – making them perfect for outdoor applications like traffic signals and pedestrian countdown lamps.

Did you know that the best fiber optic connector to use when transmitting video over fiber is the SC/APC connector

Why? The SC/APC connector has no back reflection.

Digital Block Diagrams

The list of links below contain diagrams that illustrate the equipment necessary to provide HD and Digital TV service to your Private Cable Customers.

1 Satellite Delivery (Dish) of Standard and HDTV with Blonder Tongue Products

2 Satellite Delivery (Dish) of Standard and HDTV with Drake Products

3 Off-Air Delivery (8VSB) of HDTV with Blonder Tongue Products

4 Off-Air Delivery (8VSB) of HDTV with Drake Products

5 Off-Air Delivery (8VSB) of HDTV with Drake Products Using QAM

6 Off-Air Delivery (8VSB) of HDTV with Blonder Tongue Products to Analog Distribution

Our unique way to not only simplify the visualization of a system, but integrate the specific equipment necessary to build the system from end to end.

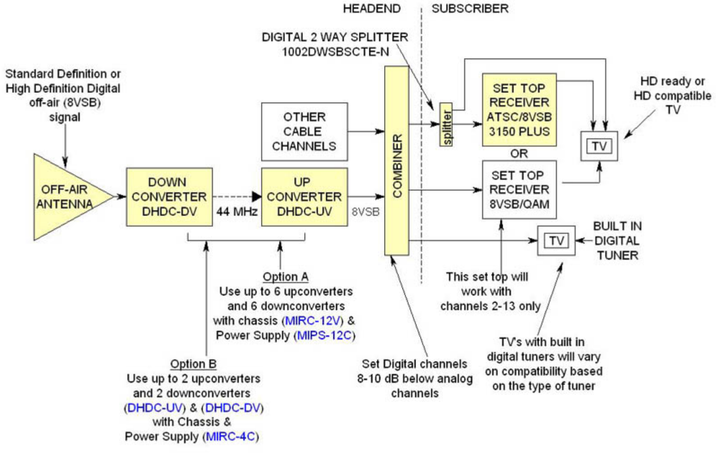
Even better, not only will we design a customized system for you, but we will lay it out with distribution and block diagrams, lay out the racks – and best of all, prepare a compete bill of materials.

Read more about our customized system design service!

Off-Air Delivery (8VSB) of HDTV with Blonder Tongue Products

MULTICOM, INC.
Multi Communication Systems & Products

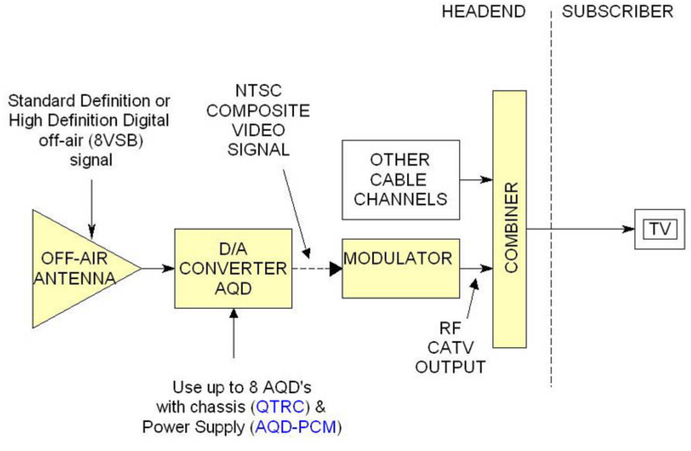
OFF-AIR DELIVERY (8VSB) OF HIGH DEFINITION TV
WITH **BLONDER TONGUE** PRODUCTS



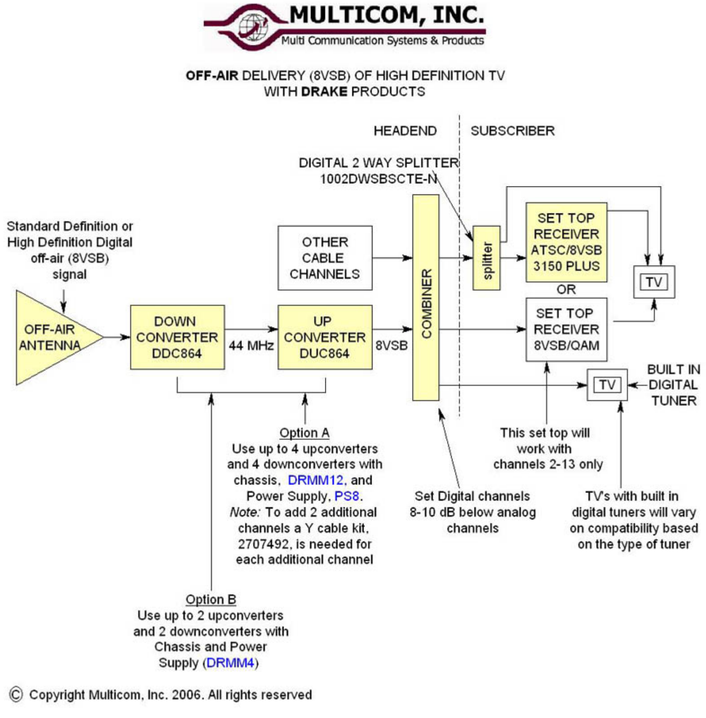
Off-Air Delivery (8VSB) of HDTV with Blonder Tongue Products to Analog Distribution

MULTICOM, INC.
Multi Communication Systems & Products

OFF-AIR DELIVERY (8VSB) OF HIGH DEFINITION TV
WITH **BLONDER TONGUE** PRODUCTS
TO **ANALOG** DISTRIBUTION



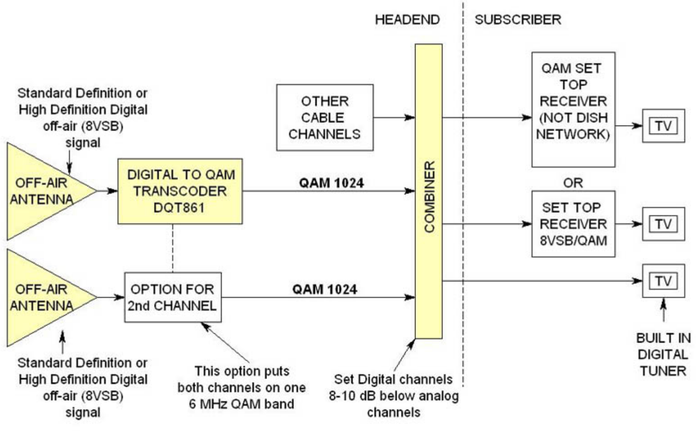
Off-Air Delivery (8VSB) of HDTV with Drake Products



Off-Air Delivery (8VSB) of HDTV with Drake Products Using QAM

MULTICOM, INC.
Multi Communication Systems & Products

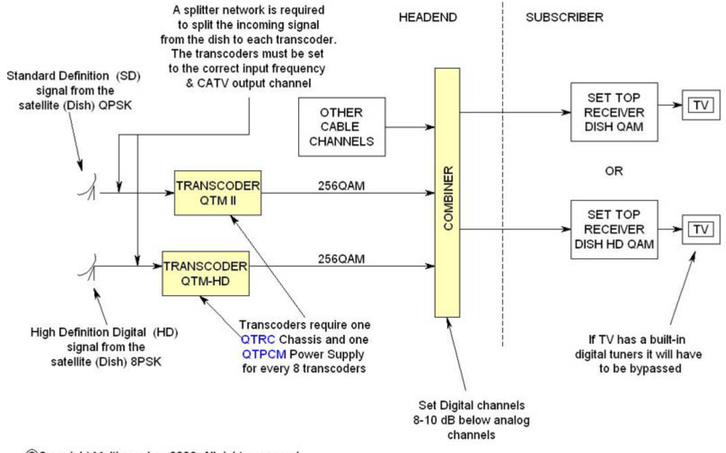
OFF-AIR DELIVERY (8VSB) OF HIGH DEFINITION TV
WITH **DRAKE** PRODUCTS USING **QAM**



Satellite Delivery (Dish) of Standard and HDTV with Blonder Tongue Products

MULTICOM, INC.
Multi Communication Systems & Products

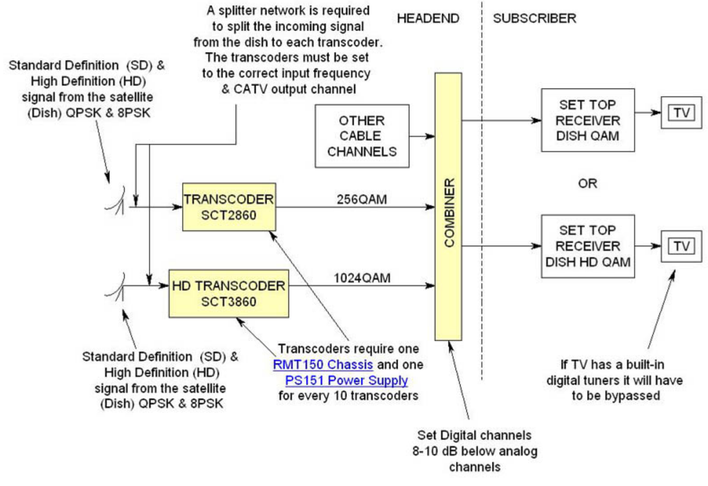
SATELLITE DELIVERY (DISH) OF STANDARD &
HIGH DEFINITION TV
WITH **BLONDER TONGUE** PRODUCTS



Satellite Delivery (Dish) of Standard and HDTV with Drake Products

MULTICOM, INC.
Multi Communication Systems & Products

SATELLITE DELIVERY (DISH) OF STANDARD & HIGH DEFINITION TV WITH **DRAKE** PRODUCTS



Do you know the difference between PE-39 and PE-84?

PE-39 is gel-filled and suitable for use in direct burial communication applications where protection against water and moisture entry is a critical requirement. PE-39 is recommended where rodent attack is possible.

PE-84 has an integrated messenger that is in a figure 8 construction that makes the cable self-supported in the air.

Do you know what DOCSIS stands for?

Data Over Cable Service Interface Specification (DOCSIS), is an international telecommunications standard that permits the addition of high-speed data transfer to an existing cable TV (CATV) system. It is employed by many cable television operators to provide Internet access over their existing hybrid fiber-coaxial (HFC) infrastructure.

DOCSIS 3.0

DOCSIS 3.0 is the next generation of DOCSIS (Data Over Cable Services Interface Specification), an international telecommunications standard that lets cable television operators add high-speed and telephony data to their current cable TV systems.

DOCSIS 3.0 for Cable Operators

In addition to its unprecedented speed advantages, DOCSIS 3.0 will enable operators to offer truly differentiated services such as IPTV and switched digital video along with IP content to the subscriber home. Its channel bonding capabilities will allow cable operators to compete against telecom service providers for important enterprise accounts by providing dedicated bandwidth to support services such as video conferencing and online training.
Other benefits include support for:

- User-defined interactive programming
- Time-shifted and place-shifted video, such as video-on-demand services
- Interactive online gaming
- Convergent media services, for example, allowing data to be viewed on a TV and video content to be viewed on a computer monitor
- 128-bit AES encryption
- IPv6

The table below provides a comparison of the speeds, channels, features, benefits and services offered by the various DOCSIS versions:

DOCSIS 1.x
(largely obsolete)43 Mbps Down
10 Mbps Up1 Down
1 Up43 Mbps Down
10 Mbps Up

Version	Speed per Channel	Number of Channels	Cap Internet Speed
Features	Benefits	Services	
Basic broadband connectivity for one or more devices in the home	Made interoperability of cable technology a reality and the standardization of cable modems possible	High-speed data on cable modems	

Modem	Speed per Channel	Number of Channels	Cap Internet Speed
DOCSIS 2.0	43 Mbps Down 31 Mbps Up	1 Down 1 Up	43 Mbps Down 10 Mbps Up
	Features	Benefits	Services
	Increased upstream reliability and throughput for symmetric services	Increased upstream throughput to 30 Mbps	Increased upstream throughput to 30 Mbps

Modem	Speed per Channel	Number of Channels	Cap Internet Speed
DOCSIS 3.0	43 Mbps Down 31 Mbps Up	4 or 8 Down 4 Up	172 or 344 Mbps Down 124 Mbps Up
	Features	Benefits	Services
	Channel bonding capabilities, support for	Allow cable operators to provide data rates	IPTV

Version	Speed per Channel	Number of Channels	Cap Internet Speed
	IPv6 and IPTV. Also, security and network management are greatly enhanced.	in the hundreds of megabits per second	

Modems

Modems are generally very simple devices, because of that most of them are basically the same. The biggest difference between modems is the standard that they support, which determines the Internet speed capacity, both for download and upload, that they are capable of delivering.

Currently, there are DOCSIS 1.x, DOCSIS 2.0, and DOCSIS 3.0 modems on the market. Both DOCSIS 1.x and DOCSIS 2.0 support only a single channel that has a download speed capacity of 43Mbps, and upload speed of 31Mbps – as shown on the chart above.

With DOCSIS 3.0 (which is backward-compatible with older standards), the speed capacity of a single channel remains 43Mbps down and 31Mbps up, but the modems are now capable of handling multiple channels at a time (channel bonding). A typical DOCSIS 3.0 modem generally offers four or eight channels for downloading, resulting in a speed cap of 172Mbps or 344Mbps, respectively. For uploading, they generally support four channels to offer a speed of up to 124Mbps. Relatively soon, there will be DOCSIS 3.0 modems that can handle even more channels.

Channel Bonding

Older version DOCSIS 2.0 modems can only utilize one downstream and one upstream channel at a time and it's forced to use the channel the cable company's headend tells it to use. Overloading that single channel can result in poor speeds – and there's nothing you can do about it.

Top-tier data plans offer eight downstream and four upstream QAM channels. If the channels are overloaded, a DOCSIS 3.0 cable modem can bond multiple channels together, using the capacity of each channel, to provide one big pipe and allow for maximum throughput. That way, even if only a little data can get through each channel, bonding them together will allow you to push that data through multiple pipes at one time and thus work around that congestion. Only DOCSIS 3.0 modems can do this.

Important: The maximum Internet speed you can achieve depends upon both the DOCSIS version of your equipment and the High Speed Internet package to which you subscribe.

Multicom distributes a wide variety of DOCSIS 3.0 Modems including:

CallCM820AArrisYes / 3.0-15 / +15 108-1002MHz5-42MHzDownload the FlyerDownload the Specs

DOCSIS Modems								
Order Option	Part # & Spec.	Man	DOCSIS Certified	dBmV In	dBmV Out	Downstream Freqency Range	Upstream Frequency Range	*Notes
View	SB-5101	Motorola	Yes / 2.0	-15 / +15	+8 / +58	88-860MHz	5-42MHz	1

Other DOCSIS 3.0 Modems

Vendor	Model	Product Name
Arris	CM820A	Touchstone Cable Modem CM820A
Arris	TG852G	Touchstone Telephony Wireless Gateway Modem TG852G
Arris	TG862G	Touchstone Telephony Wireless Gateway Modem TG862G
Arris	TM702G	Touchstone Telephony Modem TM702G
Arris	TM722G	Touchstone Telephony Modem TM722G
Arris	TM722G (Retail)	Retail Touchstone Telephony Modem TM722G
Arris	TM822G	Touchstone Telephony Modem TM822G
Arris	WBM760A	Touchstone Cable Modem WBM760A

Vendor	Model	Product Name
Cisco	DPC3000	Cisco DOCSIS 3.0 Cable Modem DPC3000
Cisco	DPC3008	Cisco DPC3008 DOCSIS 3.0 Cable Modem
Cisco	DPC3939	Cisco DOCSIS 3.0 Wireless Residential Voice Gateway
Cisco	DPC3939B	Cisco DOCSIS 3.0 Wireless Commercial Gateway
D-Link	DCM-301 (HW Rev E1)	D-Link DCM-301 DOCSIS 3.0 Cable Modem
Linksys	DPC3008 (Retail)	LinksysDPC3008 DOCSIS 3.0 Cable Modem
Motorola	SB6120	Motorola SURFboard SB6120 Cable Modem
Motorola	SB6120 (Retail)	Motorola SURFboard SB6120 Cable Modem
Motorola	SB6121	Motorola SURFboard SB6121 DOCSIS 3.0 Cable Modem
Motorola	SB6121 (Retail)	Motorola SURFboard SB6121 DOCSIS 3.0 Cable Modem
Motorola	SB6141 (Retail)	Motorola Surfboard SB6141 DOCSIS 3.0 Cable Modem
Motorola	SB6183	Motorola Surfboard SB6183 DOCSIS 3.0 Cable Modem
Motorola	SBG6580 (Retail)	SBG6580 DOCSIS 3.0 Wireless Cable Modem Gateway
Motorola	SBG6782AC (Retail)	SBG6782AC DOCSIS 3.0 Wireless Cable Modem Gateway
Netgear	C3000 (Retail)	Netgear N300 WiFi DOCSIS 3.0 Cable Modem Router
Netgear	C3700 (Retail)	Netgear N600 WiFi DOCSIS 3.0 Cable Modem Router
Netgear	C6300 (Retail)	Netgear AC1750 WiFi DOCSIS 3.0 Retail Cable Modem
Netgear	CG3000DCR	Netgear CG3000DCR DOCSIS 3.0 Commercial Cable Modem
Netgear	CG3000Dv2 N450	Netgear N450 WiFi DOCSIS 3.0 Cable Modem Router
Netgear	CM400 (Retail)	Netgear CM400 DOCSIS 3.0 Retail Cable Modem
Netgear	CMD31T (Retail)	Netgear DOCSIS 3.0 Cable Modem CMD31T
SMCNetworks	SMCD3G-CCR	SMC DOCSIS 3.0 Cable Modem and Router SMCD3G-CCR
SMCNetworks	SMCD3GNV	SMC DOCSIS 3.0 Wireless Gateway Cable Modem and Router
Technicolor	TC8305C	Technicolor Wireless Cable Gateway TC8305C
Ubee	DDM3513 (Retail)	Ubee (formerly Ambit) DOCSIS 3.0 Cable Modem
Ubee	DVM3203B	Ubee (formerly Ambit) DOCSIS 3.0 Telephony Modem
Ubee	U10C035	Ubee (formerly Ambit) DOCSIS 3.0 Cable Modem
ZoomTelephonics	5341 (Retail)	DOCSIS 3.0 Cable Modem 5341
ZoomTelephonics	5341J (Retail)	Retail DOCSIS 3.0 Cable Modem 5341J
ZoomTelephonics	5350 (Retail)	Model 5350 DOCSIS 3.0 Wireless-N Cable Modem Ro…
ZoomTelephonics	5352 (Retail)	Model 5352 DOCSIS 3.0 Wireless-N Cable Modem Ro…
ZoomTelephonics	5363 (Retail)	Model 5363 DOCSIS 3.0 Cable Modem/Router
ZyXEL	BRG-35503 (Retail)	ZyXEL BRG-35503 Cable Modem

4.3 billion Internet Protocol (IP) addresses seems like a lot, doesn't it?
But it's not nearly enough for the 7 billion people in the world.

Don't Fear the DEAD ZONE - Use an OTDR Launch Box!

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OTDR Launch Box

What's an OTDR Launch Box – and Why Do You Need One?

Optical Time Domain Reflectometer (OTDR) is a mandatory fiber optic testing tool which uses light backscattering technologies to analyze optical fiber performance. An OTDR can test the light loss and locate the breaks, splices and connectors in fiber optic network.

However, an OTDR has a ***"Dead Zone"*** which can affect the test results. To overcome the limitation of this OTDR dead zone, an OTDR Launch Box is used.

Basics of an OTDR Launch Box

The OTDR Launch Box has many other names – Dead Zone Box, **Pulse Suppressor**, Fiber Ring and Fiber Optic Launch Cable. How can an OTDR Launch Box minimize the effect of OTDR dead zone during fiber optic testing?

The dead zone of OTDR is caused by a number of factors including the high return level of reflection and the pulse width emitted from the OTDR – and might extend hundreds of yards from the OTDR. Because the dead zone is the initial length of fiber optic cable just after the OTDR, a length of 'Dummy Cable' is used to mitigate the dead zone distance. Thus, the receiver of the OTDR signal will have enough time to settle.

In short, the OTDR Launch Box, is actually a long spool of dummy optical fiber inserted between the fiber under test and OTDR, and can ensure that the OTDR dead zone happens in the OTDR launch box. In this way, the fiber optic link under test won't be largely affected by the OTDR dead zone.

Did you know that Multicom's **MUL-OTDR-1000** and **MUL-OTDR-1100** are the highest quality and best priced OTDRs on the market?

FBT vs. PLC Fiber Optic Splitters - What's The Difference?

PLC – Planar Lightwave Circuit Splitter

Advantages

- Suitable for multiple operating wavelengths (1260nm – 1650nm); unstinted.
- Equal splitter ratios for all branches.
- Compact configuration; smaller size; small occupation space.
- Good stability across all ratios.
- High quality; low failure rate.

Disadvantages

- Complicated production process.
- Costlier than the FBT splitter in the smaller ratios.

FBT – Fused Biconical Splitter

Advantages

- The product is well-known and is easy to produce, thus reducing cost of production.
- Splitter ratios can be customized.
- Can work on three different operating bands (850nm, 131 Onm, and 1550nm).

Disadvantages

- Restricted to its operating wavelength.
- Because of errors in equality insertion loss, the maximum insertion loss will vary depending on the split and increase substantially for those splits over 1:8.
- Because an exact equal ratio cannot be ensured, transmission distance can be affected.
- High temperature dependent loss (TDL). The operating temperature range is 23 °F- 167 ºF. Any changes in temperature can affect the insertion loss.
- The larger the split, the larger the encapsulation module.
- Susceptible to failure due to extreme temperatures or improper handling.

Parameters	FBT Splitter	PLC Splitter
Fabrication Method	Two or more pieces of optical fibers are bound together and put on a fused-taper fiber device. The fibers are then drawn out according to the output branch and ratio with one fiber being singled out as the input.	Consists of one optical chip and several optical arrays depending on the output ratio. The optical arrays are coupled on both ends of the chip.
Operating Wavelength	1310nm and lSSOnm (standard); 850nm (custom)	1260nm -1650nm (full wavelength)
Application	HFC (network of fiber and coaxial cable for CATV); All FTIH applications.	Same
Performance	Up to 1:8 – reliable. For larger splits reliability can become an issue.	Good for all splits. High level of reliability and stability.
Input/Output	One or two inputs with an output maximum of 32 fibers.	One or two inputs with an output maximum of 64 fibers.
Package	Steel Tube (used mainly in equipment); ABS Black Module (Conventional)	Same
Input/Output Cable	Bare optical fiber; 0.9mm, 2.0mm, and 3.0mm	Same
Part Number Example	FOSPLT-T-FBT-1/2-E-SM-SC/APC	FOSPLT-T-PLC-1/2-E-SM-SCI APC

Fiber Optic Connectors

An optical fiber connector terminates the end of an optical fiber, and enables quicker connection and disconnection than splicing. The connectors mechanically couple and align the cores of fibers so that light can pass. Connectors are available in APC (Angle Polished Connector) and UPC (Ultra Polished Connector) varieties.

Multicom stocks **Splice on Fiber Optic Connectors** that can be used with the Multicom **Fusion Splicer Kit**, as well as other compatible fusion splicers. Fusion-spliced, field-installable connectors are uniquely designed for ease of use and minimal loss. The factory pre-polished zirconia ferrule eliminates the need for polishing, adhesives, and crimping in the field, decreasing the potential for operator error.

Multicom stocks a wide variety of **Field-Installable Fiber Optic Connectors**. They feature:

- No epoxy, fiber polishing, special tools or fusion splicer required
- Quick and easy fiber termination in less than two minutes
- Durable components design for convenience and reusability
- Pre-installed fiber in ferrule for on-site assembly

SC Connectors

SC stands for Subscriber Connector. A general purpose push/pull style connector. SC has an advantage in keyed duplexibility to support send/receive channels. Mostly used for CATV applications.

FC Connectors

FC stands for Fixed Connection. It is fixed by way of a threaded barrel housing. FC connectors are typical in test environments and for singlemode applications. FC connectors were designed for use in high-vibration environments

ST Connectors

ST stands for Straight Tip. A quick release bayonet style connector with long ferrule. STs were predominant in the late 80s and early 90s. Common connector for mulitmode fibers

LC Connectors

LC stands for Lucent Connector. The LC is a small form-factor connector much like the SC connector but with a ferrule that is half the size. (duplex shown right)

Multicom stocks a wide variety of **Field-Installable Fiber Optic Connectors**

Details per Connector:

LC, SC, and ST Connectors			
Fiber Size/Type	Insertion Loss Typical/Maximum (dB)	Reflectance (dB)	Ferrule
62.5 µm MM	0.1/0.5	≤ -20	Zirconia
50 µm MM	0.1/0.5	≤ -20	Zirconia
50 µm LOMMF	0.1/0.5	≤ -26	Zirconia

LC Connectors:	
Parameter	Description
Intermateability	Connectors are FOCIS compliant with TIA/EIA 604-10A
Qualification	Passed EIA/TIA 568-B.3
Durability	0.2dB change, 500 rematings, FOTP-21
Tensile Strength	10 lb ≤ 0.2 dB change on jacked cable; 0.5 lb ≤ 0.2 dB change on 900µm cable; FOTP-6
Operating Temp.	-40° to +75°C, exceeding EIA/TIA 568-B.3

SC Connectors	
Parameter	Description
Intermateability	Connectors are FOCIS compliant with TIA/EIA 604-3
Qualification	Passed EIA/TIA 568-B.3
Durability	0.2dB change, 500 rematings, FOTP-21
Tensile Strength	10 lb ≤ 0.2 dB change on jacked cable; 0.5 lb ≤ 0.2 dB change on 900µm cable; FOTP-6
Operating Temp.	-40° to +75°C, exceeding EIA/TIA 568-B.3

ST Connectors	
Parameter	Description
Intermateability	Connectors are FOCIS compliant with TIA/EIA 604-2
Qualification	Passed EIA/TIA 568-B.3
Durability	0.2dB change, 500 rematings, FOTP-21
Tensile Strength	10 lb ≤ 0.2 dB change on jacked cable; 0.5 lb ≤ 0.2 dB change on 900µm cable; FOTP-6
Operating Temp.	-40° to +75°C, exceeding EIA/TIA 568-B.3

Multicom stocks a wide variety of **Field-Installable Fiber Optic Connectors**

Fiber Optic Glossary

Absorption

The portion of optical attenuation in which light signal is absorbed into the glass during transmission. This occurs during the conversion of optical power to heat and is caused by impurities in the fiber such as hydroxyl ions

A/B Switch

A device that accepts inputs (optical or electrical) from a primary path and a secondary path to provide automatic or manual switching in the event that the primary path signal is broken or otherwise disrupted. In optical A/B switches, optical signal power thresholds dictate whether the primary path is functioning and signals a switch to the secondary path until optical power is restored to the primary path

Adapter

An Adapter is a mechanical device designed to align fiber-optic connectors. It contains the split sleeve, also known as the interconnect sleeve, that holds the two ferrules together. Adapters can help mate or connect a variety of Fiber optic cables together. Fiber optic adapters are also known as mating sleeves, couplers, and mating adapters. A Fiber Optic Adapter Panel is a good example of this.

Attenuation

Loss of transmission power in both RF and light over distance traveled. Attenuation is measured in dB loss per length of cable. It is usually caused by absorption and scattering. In the example of light, attenuation can be mitigated or boosted by using an EDFA (short for erbium-doped fiber amplifier).

Attenuator

A passive device for reducing the amplitude of a signal without appreciably distorting the waveform. Multicom's Fiber Optic Attenuators fit in all standard panel interfaces including Adapter Panels.

Back Reflection

A term applied to any process in a cable plant that causes light to change directions in a fiber and return to the source. This most commonly occurs at a connector's interface where a glass-air interface causes a reflection. A good introduction to intricacies of fiber optic cable, cable designs and cable types is in the Multicom Fiber Optic Technical Resource Guide.

Bandwidth

The information carrying capacity of the system. In Analog systems, this is also the highest Frequency that can be carried. The range of signal frequencies that a fiber optic cable or equipment will transmit. As an example, a Multicom 1550 Transmitter takes 45-1000MHz RF input *bandwidth* and transmits that signal at 6 or 10dBm output power over the 1550nm *bandwidth*.

Buffer Coating

Plastic coating that protects the fiber from damage and moisture

Cable Plant

All the optical elements between a transmitter and a receiver

Cladding

Glass covering surrounding the core that acts as a mirror to reflect light back into the core

Core

Thin glass or plastic center of the fiber in which light is transmitted through. The larger the core, the more light that can pass through

EDFA

Short for Erbium-Doped Fiber Amplifier. EDFA is an optical repeater device that is used to boost the intensity of optical signals being carried through a fiber optic communications system. An optical fiber is doped with the rare earth element erbium so that the glass fiber can absorb light at one frequency and emit light at another frequency.

FTTx (Fiber To The X)

Most commonly covers FTTh (Fiber To The Home), FTTc (Fiber To The curb), FTTp (Fiber To The Premises), and FTTd (Fiber To The Desk) applications running from the central office or head-end to business, residential, or multi-unit dwellings.

- **FTTh** – Indicates fiber network connections running from the central office to a residence, or very small multi-unit dwelling.
- **FTTc** – Indicates fiber network connections to a network enclosure located at, or near, a property street/curb location, from which copper based networks generally connect to the end user
- **FTTp –** Is used for business, commercial, and institutional applications where fiber network connection(s) are distributed to a campus, set of structures, or high density building with a centrally located network operations center.
- **FTTd** – Indicates applications where a fiber optic connections are distributed from the central office to individual work stations or computers inside a structure, dwelling, or building.

FTTx applications require a wide range of products from multi-fiber trunk cables to standard simplex cable assemblies, and most everything in between. Multicom makes a number of products supporting FTTx requirements from central office all the way to the subscriber location.

Ferrule

A component (usually a rigid tube) used to align and protect the stripped end of a fiber

Fusion Splicer

An instrument that splices (joins) fibers by fusing or welding them together typically by electrical arc

GPON

Gigabit Passive Optical Network

Jumper Cable

a short single fiber cable with connectors on both ends used for interconnecting other cables or testing

Link

The entire span between two optical devices. Includes all cable, connections and splices

Loss Budget

The maximum amount of power that is allowed to be lost per optical link

Multimode

Type of fiber optic cable in which the diametral core is considerably larger than the wavelength of light traveling through it allowing for multiple modes of light to propagate. Two types used are 50/125µm and 62.5/125µm

Pigtail

A short optical fiber permanently attached to a source, detector, or other fiber optic device at one end and an optical connector at the other

Receiver

Converts optical signal into electrical signal

Return Loss

The ratio of the power launched into a cable and the power of light returned down the fiber. This measurement is expressed in positive decibel units (dB). A higher number is better. Return Loss = 10 log (incident power/returned power)

Scattering

A second cause of attenuation. Scattering occurs when light collides with individual atoms in the glass.

Singlemode

Type of fiber in which the diametral core allows for only one mode of light to propagate. One type used is 9/125µm

Splitter

Combines light signals and splits them out over single or multiple outputs

Tensile Strength

Stress at which a material breaks or permanently deforms

Total Internal Reflection

The reflection that occurs when light strikes an interface at an angle of incidence greater than the critical angle.

Transmitter

Converts electrical signals into optical and transmits the optical signals into the optical fiber

Wavelength

A means of measuring light color. Expressed in nanometers (nm).

Fiber Optic Technical Resource Guide

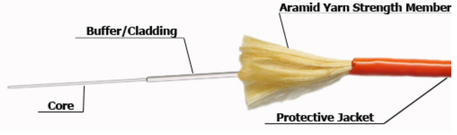
Fiber optics use light pulses rather than electrical signals to transport information.
Get more information from our Fiber Optic Glossary.

How Does it Work

Digitized information is “coded,” or placed on light pulses for transmission. That information travels along the glass fiber at the speed of light (186,000 miles/second). When it reaches its destination, a decoder converts the light information into a picture, audio or written form that we can understand.

Fiber Optic Cable

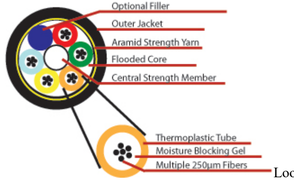
Fiber optic cables consist of the following components:



Core – Transparent plastic or glass through which light travels
Cladding – Glass covering surrounding the core that acts as a mirror to reflect light back into the core. This is called total internal reflection
Buffer coating – Coats and protects the fiber
Aramid yarn strength member – Reinforces the integrity of data transmission through the optical fibers in the cable
Protective outer jacket – Extruded PVC is typical

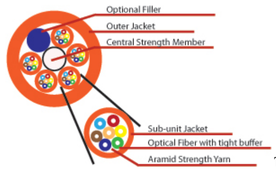
Fiber Cable Designs

There are two basic types of cable design. They are: Loose Tube (typically used for “OSP” outside plant installations) and Tight Buffered (typically used for inside installations).



Loose Tube fiber cable consists of:

- Multiple 250µm coated fibers
- One or more loose tubes holding those fibers
- Gel-fill to block moisture and protect movement of the fibers
- Central strength member
- Aramid yarn strength member
- Outer jacket



Tight Buffered fiber cable consists of:

- 900µm tight buffer around a 250µm fiber
- Central Strength member
- Aramid yarn strength member
- Outer jacket

Fiber Cable Types

There are two basic types of cable. Simplex and Duplex. Both types of cable come in: Singlemode and Multimode. Singlemode is for long distance cable runs and Multimode is for shorter cable runs.

Simplex Cable

Simplex fiber optic cable consists of a single fiber and is typically used in applications that only require one-way data transfer.
Example: An interstate trucking scale that sends the weight of the truck to a monitoring station, an oil line monitor that sends data about oil flow to a central location, or a radio station that broadcasts out to its listeners.

Duplex Cable

Duplex fiber optic cable consists of two fibers and is typically used for applications that require simultaneous, bi-directional data transfer.

Example: Workstations, fiber switches and servers, fiber modems, and similar hardware require duplex cable.

Fiber Optic Tools and Test Equipment

With every fiber install, special tools and equipment are required to complete the job.

Fiber Optic Splitters

A fiber optic splitter combines light signals and splits them out over single or multiple outputs. Multicom splitters are immune to electro-magnetic interference (EMI), consume no electrical power, and do not add noise to system design.

Multicom splitters can be fabricated in custom fiber lengths and with any type of connector.

Learn About GPON, HFC and RFoG Fiber Optic Distribution Systems

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Fiber Optic Testing Resources

Since their inception in the 1970s, fiber optic networks have continually evolved and expanded. The emergence of 5G and FTTH (Fiber to the Home), has highlighted the importance of robust fiber testing and monitoring. Multicom products and services offer unmatched technical experience, proficiency, reliability, and collaboration with integrators and cable operators for nearly 40 years. This has yielded the industry's premier fiber testing solutions.

What Is Fiber Optic Testing?

Fiber optics have emerged as the world's leading communication transport medium. The increasing diversity of fiber optic applications has highlighted the need for versatile, user-friendly testing solutions. Fiber optic testing encompasses the processes, tools, and standards used to test fiber optic components, fiber links, and deployed fiber networks. This includes comprehensive optical and mechanical transmission tests to verify the integrity of complete fiber network installations.

Why Do Fiber Networks Need to be Tested?

Despite the best intentions of highly trained technicians, the delicacy and scale of fiber optics can be unforgiving when it comes to contamination, micro-bending, and connector damage. **Dirty connections remain the number one cause of fiber network failures.** Testing the network comprehensively prior to turn-on allows any defects or damage to be detected and repaired proactively.

Fiber Optic Cable Testing Best Practices

Testing fiber optic networks is an essential part of fiber optic installation, as well as ongoing maintenance. Following some fundamental fiber testing best practices will lead to safer, more efficient, and more reliable fiber deployments and network activation.

- The importance of cleanliness in fiber installation and testing cannot be overstated. A **Fiber Optic Microscope** can be used as a fiber optic tester to verify the cleanliness of the core and connecting ferrules. Specialized cleaning materials are recommended for the proper cleaning of fiber optic connections. This same attention to cleanliness should be applied to reference cables and test equipment connections.
- When using a **Visual Fault Locator** (VFL), fiber tester for fault location, eye safety is extremely important. Since a VFL utilizes a high-intensity laser light source, neither the source nor the fiber core illuminated by the VFL should be viewed directly with the naked eye.
- The use of an **Optical Light Source** (OLS) and an **Optical Power Meter** (OPM), or a combination **Optical Power Meter and Visual Fault Locator** are considered good fiber test practices for ensuring that the optical power budget is within design specifications. A calibrated optical light source can be used in conjunction with an optical power meter to quantify the insertion loss of the link prior to turn-up.
- An **Optical Time Domain Reflectometer** (OTDR), is the recommended fiber optic test tool for detailed baselining and recording of fiber link 'characteristics'.
  - The purpose of an OTDR is to detect, find, and measure events at any location on a fiber link. Location information regarding localized loss and reflective events is generated, providing technicians with a pictorial and permanent record of the fiber's characteristics.
  - When using an OTDR, use **Launch Cables** to qualify the front-end and far-end connectors. A launch cable is connected between a tester and the fiber under test, and the receive cable is connected at the far end of the fiber link. It is important to note that the fiber used in the launch and receive cable should match the fiber being tested (type, core size, etc.)
- **Fusion Splicers** use a controlled electric arc to fuse optical fibers to one another. The goal is to fuse the two fibers together in such a way that light passing through the fibers is not scattered or reflected back by the splice, and that the splice and the region surrounding the splice are as strong as the original fiber creating a seamless, non-reflective connection from one length of fiber to another.
  - Multicom manufactures a variety of the highest quality core-alignment **Fusion Splicers** on the market today, at the best prices and with the best warranty available. Our Fusion Splicers are not simply the splicer itself, but an all-inclusive Fusion Splicer Kit that includes everything needed for fusion splicing in the field in a convenient carrying case.

See the new **Multicom Fiber Optic Tools & Test Equipment Matrix** for descriptions and product functionality

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See more **Multicom Tools and Test Equipment**

Fiber Optic Tools & Test Equipment Resource Page

For decades, fiber optics have been inspected and cleaned to ensure the proper passage of light. While this process is not new, it is growing in importance as our dependence on the capacity and other benefits of fiber optics surges.

Multicom manufactures and stocks only the highest-quality and most cost-effective products. Whether you're working in a local area network (LAN), a data center, or an office, we've got the tools you need to clean, cut, strip, splice, inspect, measure, and terminate your fiber optic cables.

Fusion Splicers

Fusion Splicers use a controlled electric arc to fuse optical fibers to one another. The goal is to fuse the two fibers together in such a way that light passing through the fibers is not scattered or reflected back by the splice, and that the splice and the region surrounding the splice are as strong as the original fiber. Creating a seamless, non-reflective connection from one length of fiber to another.

Multicom manufactures a variety of the highest quality core-alignment Fusion Splicers on the market today, at the best prices and with the best warranty available. Our Fusion Splicers are not simply the splicer itself, but an all-inclusive Fusion Splicer Kit that includes everything needed for fusion splicing in the field in a convenient carrying case.

- FAST 7 Second Splicing (optional)
- ULTRA-FAST 9 Second Heat Shrinking (optional)
- Drop/Impact, Dirt/Dust and Water Resistant
- Core-to-Core, State-of-the-Art Fiber Profile Alignment System (PAS)
- 2/3 Year USA Warranty – USA Service and Support
- Quick-change Rechargeable Lithium Battery
- German Design, USA & Japanese Technology

-

Fiber Optic Tools Matrix

Since their inception in the 1970s, fiber optic networks have continually evolved and expanded. The emergence of 5G and FTTH (Fiber to the Home), has highlighted the importance of robust fiber testing and monitoring. Multicom products and services offer unmatched technical experience, proficiency, reliability, and collaboration with integrators and cable operators for nearly 40 years. This has yielded the industry's premier fiber testing solutions.

Multicom Part#	Product	Quick Description of Use
Visual Fault Locator **MUL-VFL-10MW**		Visually check fiber cable/jumpers/connectors for breaks, bad assembly, problems (glow present in the area where none should be) **Use:** **Installation:** Assembling fiber optic Fast Connectors **Troubleshooting:** Testing optical Jumpers & Pigtails
Optical Light Source **MUL-OLS-100** for Singlemode **MUL-OLS-200** for Multi-mode **MUL-OLS-300** for Singlemode & Multi-mode		Provide a known level of calibrated laser input: 1310/1550nm. Also can use the modulated output for fiber cable tracing functions. **Use:** **Installation:** Tracing/Tracking fiber cable through a network, Certify installation work **Troubleshooting:** Testing Optical Jumpers/Pigtails

Optical Power Meter
MUL-OPM-100

Test the output level of laser on fiber to see if any loss and the amount differing from a calibrated input. Can use with OLS as the source. PON/GPON version is also available.

Use:

Installation: Certify installation work

Troubleshooting: Checking 1310/1550nm Transmitter output, Checking 1550nm EDFA output, Checking optical input level to micro-node, Testing Optical Jumpers/Pigtails

Handheld Video Fiber Inspection Microscope
MUL-FSCOPE-400

High-resolution detail of end-face scratches, defects and contamination. 400X magnification and integrated laser safety filters provide the most critical view of fiber end faces.

Use:

Installation: Assembling fiber optic Fast Connectors

Troubleshooting: Testing optical Jumpers & Pigtails

Video Inspection Microscope
MUL-FVSCOPE-400

Visually inspect with video the fiber end-face for dust, dirt, bad cleaves, etc. Electronically record the image for test/QA reports.
Use:
Installation: Assembling fiber optic Fast Connectors, Certify installation work
Troubleshooting: Testing optical Jumpers & Pigtails

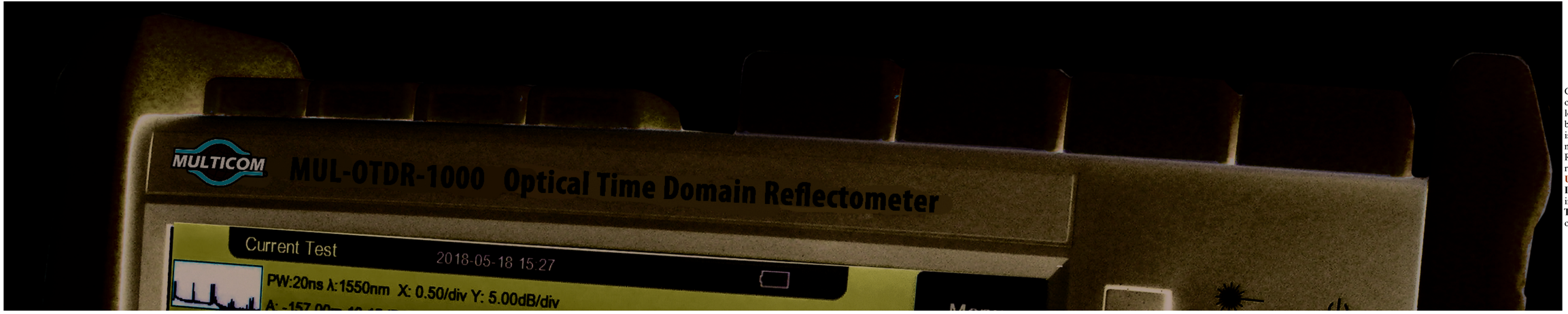
Optical Fiber Identifier with 10mW VFL
MUL-OFI-VFL

Trace/track fiber from its source through to its termination. Can be used with OLS as the source of the modulated signal to detect.
Use:
Installation: Tracing/Tracking fiber cable through a network
Troubleshooting:

Mini Optical Time Domain Reflectometer
MUL-OTDR-500

Comprehensive testing of optical networks, test for losses, connection quality, breaks, tight bends, or other issues. Suitable for shorter network runs (up to 40KM). Record and reporting of the results.
Use:
Installation: Certify installation work
Troubleshooting: Testing optical Jumpers & Pigtails

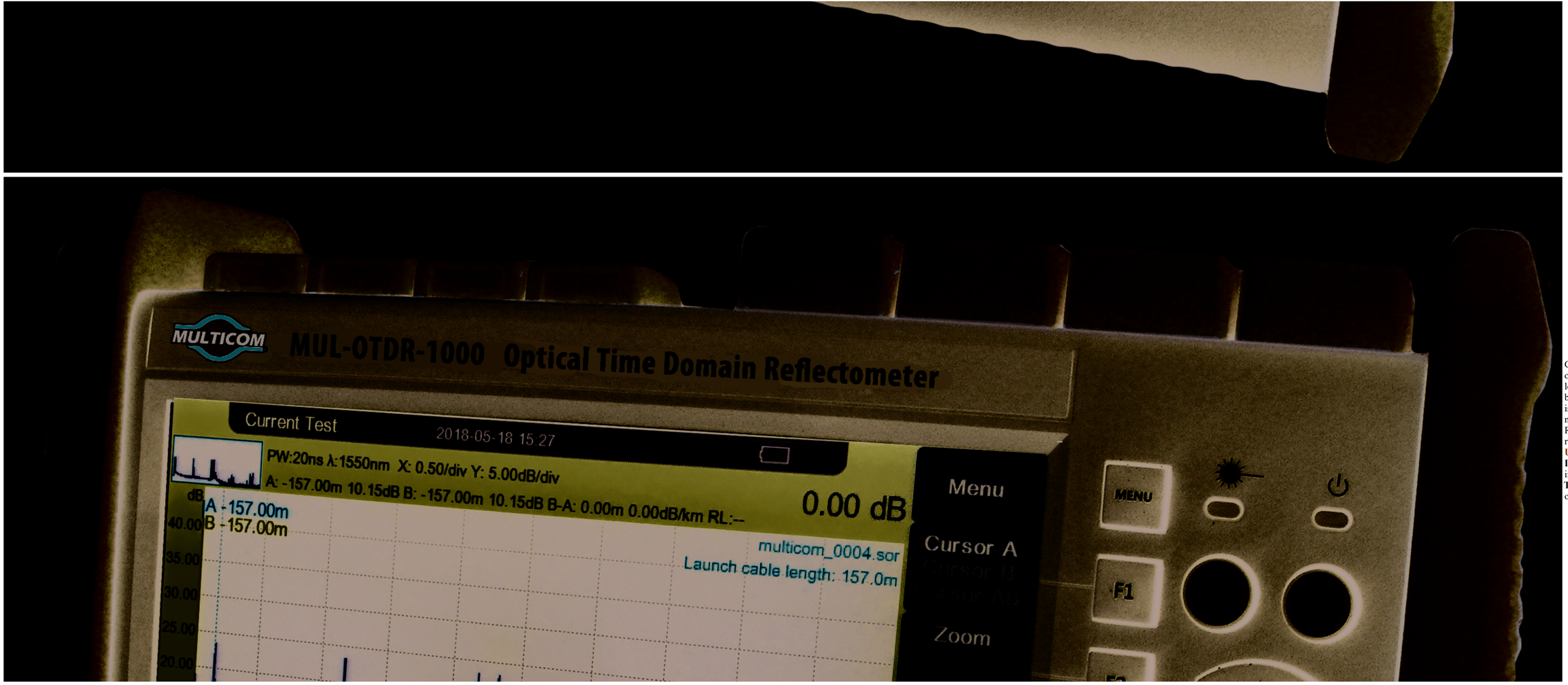
OTDR Optical Time Domain Reflectometer
MUL-OTDR-1000



Comprehensive testing of optical networks, test for losses, connection quality, breaks, tight bends, or other issues. Suitable for medium network runs (up to 128KM). Record and reporting of the results.
Use:
Installation: Certify installation work
Troubleshooting: Testing optical Jumpers & Pigtails


A -157.00m
B -157.00m
multicom_0004.sor
Launch cable length: 157.0m
0.00 dB
Menu
Cursor A
Zoom
Overlay
Trace
Next Page
Quit
MENU
F1
F2
F3
F4
F5
FILE
SETUP
ESC
ON/OFF
>2S

OTDR Optical Time Domain Reflectometer
MUL-OTDR-1100



Comprehensive testing of optical networks, test for losses, connection quality, breaks, tight bends, or other issues. Suitable for longer network runs (up to 250KM). Record and reporting of the results.

Use:

Installation: Certify installation work

Troubleshooting: Testing optical Jumpers & Pigtails


15.00
10.00
5.00
0.00
-0.2
0.3
0.8
1.3
1.8
2.3
2.8
3.3
3.8
4.3
km
No
Type
Distance km
Segment km
Loss dB
Loss dB
Slope dB/km
Reflect dB
Seg RL
Overlay
Trace
Next Page
Quit
F2
F3
F4
F5
ESC
FILE
SETUP
ON/OFF
>2S

PON Optical Power Meter with Visual Fault Locator
MUL-OPM-PON-VFL-300

3-in-1 PON Optical Power Meter provides outstanding functionality and durability with a broad power measurement range, wide variety of wavelengths, high precision, and high sensitivity.
Use:
Measures almost anything in a fiber optic network: The optical power in a PON network using the ONT & OLT ports, the optical power in a CATV and Telecom singlemode fiber system (including GPON/EPON), a IT/Data/LAN multi-mode fiber system, and more.

Fiber Optic Fusion Splicer
MUL-FSPLICE-300

With 6-Motors for enhanced focusing and auto-identification of the fiber type, the top-of-the-line MUL-FSPLICE-300 employs high-speed image processing and special core-to-core positioning technology allowing the fusion splicing to be completed in as little as a FAST 7 seconds and can heat shrink in as little as an ULTRA-FAST 9 seconds.
Use:
Uses an electric arc to fuse two pieces of optical fiber together so that light can pass through with minimal attenuation compared to other connection techniques. Fusion splicing helps to reduce loss in your network.

See more **Multicom Fiber Optic Tools & Test Equipment**
What Is Fiber Optic Testing? Why Do Fiber Networks Need to be Tested?
Read more in our **Fiber Optic Testing Resources**

Below is an easy to read Quick Guide to some of Multicom's Tools & Test Equipment, and their function:

		Installation			Troubleshooting			
Product	**Description**	**Assembling Fast Connectors**	**Tracing/ Tracking Fiber Cable Thru a Network**	**Certify Installation Work**	**Checking 1310/1550nm TX Output**	**Checking 1550nm EDFA Output**	**Checking Optical Input Level to Micro-Node**	**Testing Optical Jumpers/ Pigtails**
VFL - Visual Fault Locator **MUL-VFL-10MW**	Visually check fiber cable/jumpers/ connectors for breaks, bad assembly, problems (glow present in area where none should be)	√						√
OLS - Optical Light Source **MUL-OLS-100**	Provide a known level of calibrated laser input: 1310/1550nm. Also can use modulated output for fiber cable tracing functions.		√	√				√
OPM - Optical Power Meter **MUL-OPM-100**	Test the output level of laser on fiber to see if any loss and the amount differing from a calibrated input. Can use with OLS as source. PON/GPON version also available.			√	√	√	√	√
FSCOPE - Inspection Microscope **MUL-FSCOPE-400**	Visually inspect the fiber end-face for dust, dirt, bad cleaves, etc	√						√
FVSCOPE - Video Inspection Microscope **MUL-FVSCOPE-400**	Visually inspect with video the fiber end-face for dust, dirt, bad cleaves, etc. Electronically record the image for test/QA reports.	√		√				√
OFI - Optical Fiber Identifier **MUL-OFI-VFL**	Trace/track fiber from its source through to its termination. Can be used with OLS as the source of modulated signal to detect.		√					
OTDR - Optical Time Domain Reflectometer **MUL-OTDR-500**	Comprehensive testing of optical networks, test for losses, connection quality, breaks, tight bends, or other issues. Suitable for shorter network runs (up to 40KM). Record and reporting of the results.			√				√
OTDR - Optical Time Domain Reflectometer **MUL-OTDR-1000**	As above. Suitable for medium network runs (up to 128KM). Record and reporting of the results.			√				√
OTDR - Optical Time Domain Reflectometer **MUL-OTDR-1100**	As above. Suitable for longer network runs (up to 250KM). Record and reporting of the results.			√				√

Frequency Allocation Chart

Channel	Letter	Carrier (Mhz)	Channel	Letter	Carrier (Mhz)	Channel	Letter	Carrier (Mhz)
CH.160	T-7	7	CH.44	M-5	343.25	CH.105	M-61	679.25
CH.161	T-8	13	CH.45	M-6	349.25	CH.106	M-62	685.25
CH.162	T-9	19	CH.46	M-7	355.25	CH.107	M-63	691.25
CH.163	T-10	25	CH.47	M-8	361.25	CH.108	M-64	697.25
CH.164	T-11	31	CH.48	M-9	367.25	CH.109	M-65	703.25
CH.165	T-12	37	CH.49	M-10	373.25	CH.110	M-66	709.25
CH.166	T-13	43	CH.50	M-11	379.25	CH.111	M-67	715.25
CH.167	T-14	49	CH.51	M-12	385.25	CH.112	M-68	721.25
CH.2	CH.2	55.25	CH.52	M-13	391.25	CH.113	M-69	727.25
CH.3	CH.3	61.25	CH.53	M-14	397.25	CH.114	M-70	733.25
CH.4	CH.4	67.25	CH.54	M-15	403.25	CH.115	M-71	739.25
CH.1	A-8	73.25	CH.55	M-16	409.25	CH.116	M-72	745.25
CH.5	CH.5	77.25	CH.56	M-17	415.25	CH.117	M-73	751.25
CH.6	CH.6	83.25	CH.57	M-18	421.25	CH.118	M-74	757.25
CH.95	A-5	91.25	CH.58	M-19	427.25	CH.119	M-75	763.25

CH.96	A-4	97.25	CH.59	M-20	433.25	CH.120	M-76	769.25
CH.97	A-3	103.25	CH.60	M-21	439.25	CH.121	M-77	775.25
CH.98	A-2	109.25	CH.61	M-22	445.25	CH.122	M-78	781.25
CH.99	A-1	115.25	CH.62	M-23	451.25	CH.123	M-79	787.25
CH.14	CH.A	121.25	CH.63	M-24	457.25	CH.124	M-80	793.25
CH.15	CH.B	127.25	CH.64	M-25	463.25	CH.125	M-81	799.25
CH.16	CH.C	133.25	CH.65	M-26	469.25	CH.126	M-82	805.25
CH.17	CH.D	139.25	CH.66	M-27	475.25	CH.127	M-83	811.25
CH.18	CH.E	145.25	CH.67	M-28	481.25	CH.128	M-84	817.25
CH.19	CH.F	151.25	CH.68	M-29	487.25	CH.129	M-85	823.25
CH.20	CH.G	157.25	CH.69	M-30	493.25	CH.130	M-86	829.25
CH.21	CH.H	163.25	CH.70	M-31	499.25	CH.131	M-87	835.25
CH.22	CH.I	169.25	CH.71	M-32	505.25	CH.132	M-88	841.25
CH.7	CH.7	175.25	CH.72	M-33	511.25	CH.133	M-89	847.25
CH.8	CH.8	181.25	CH.73	M-34	517.25	CH.134	M-90	853.25
CH.9	CH.9	187.25	CH.74	M-35	523.25	CH.135	M-91	859.25
CH.10	CH.10	193.25	CH.75	M-36	529.25	CH.136	M-92	865.25
CH.11	CH.11	199.25	CH.76	M-37	535.25	CH.137	M-93	871.25
CH.12	CH.12	205.25	CH.77	M-38	541.25	CH.138	M-94	877.25
CH.13	CH.13	211.25	CH.78	M-39	547.25	CH.139	M-95	883.25
CH.23	CH.J	217.25	CH.79	M-40	553.25	CH.140	M-96	889.25
CH.24	CH.K	223.25	CH.80	M-41	559.25	CH.141	M-97	895.25
CH.25	CH.L	229.25	CH.81	M-42	565.25	CH.142	M-98	901.25
CH.26	CH.M	235.25	CH.82	M-43	571.25	CH.143	M-99	907.25
CH.27	CH.N	241.25	CH.83	M-44	577.25	CH.144	M-100	913.25
CH.28	CH.O	247.25	CH.84	M-45	583.25	CH.145	M-101	919.25
CH.29	CH.P	253.25	CH.85	M-46	589.25	CH.146	M-102	925.25
CH.30	CH.Q	259.25	CH.86	M-47	595.25	CH.147	M-103	931.25
CH.31	CH.R	265.25	CH.87	M-48	601.25	CH.148	M-104	937.25
CH.32	CH.S	271.25	CH.88	M-49	607.25	CH.149	M-105	943.25
CH.33	CH.T	277.25	CH.89	M-50	613.25	CH.150	M-106	949.25
CH.34	CH.U	283.25	CH.90	M-51	619.25	CH.151	M-107	955.25
CH.35	CH.V	289.25	CH.91	M-52	625.25	CH.152	M-108	961.25
CH.36	CH.W	295.25	CH.92	M-53	631.25	CH.153	M-109	967.25
CH.37	CH.X	301.25	CH.93	M-54	637.25	CH.154	M-110	973.25
CH.38	CH.Y	307.25	CH.94	M-55	643.25	CH.155	M-111	979.25
CH.39	CH.Z	313.25	CH.100	M-56	649.25	CH.156	M-112	985.25
CH.40	M-1	319.25	CH.101	M-57	655.25	CH.157	M-113	991.25
CH.41	M-2	325.25	CH.102	M-58	661.25	CH.158	M-114	997.25
CH.42	M-3	331.25	CH.103	M-59	667.25	CH.159	M-115	1,003.25
CH.43	M-4	337.25	CH.104	M-60	673.25			

FRP vs. Steel Strength Members in Fiber Optic Drop Cable

What is FRP?

FRP is a Fiberglass-Reinforced Plastic material that has the strength of steel at the fraction of the weight. FRP won’t corrode, rot, warp, attract insects, or rust, making it an ideal and long-lasting replacement for steel, wood and aluminum in a wide range of applications.

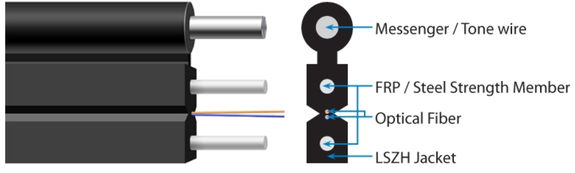
Because FRP is a composite material made up of fiberglass reinforcements and polymer resins, FRP can also stand for Fiberglass-Reinforced Polymer. The glass fiber provides the strength and stiffness, and the resin provides shape and protects the fibers.

FRP is a common reinforcement to provide strength and durability in fiber optic drop cable. However, you have a choice of strength members for optical cable, and steel is also a consideration.

Let's compare FRP with Steel as a strength reinforcement in fiber optic cable:

Parameter	FRP Composites	Steel
Corrosion, rot and and insect resistance	Resists a broad range of chemicals and is unaffected by moisture or immersion in water. Resists insect damage. Painting is only suggested when exposed to UV rays/direct sunlight.	Subject to oxidation and corrosion. Requires painting or galvanizing for many applications.
Strength	Has greater flexural strength and pound-for-pound is often stronger than steel and aluminum in the lengthwise direction.	Homogeneous material
Weight	Weighs 75% less than steel and 30% less than aluminum	Could require lifting equipment to move and place
Electrical conductivity	Nonconductive High dielectric capability	Conducts electricity Grounding potential
Thermal properties	Good insulator with low thermal conductivity	Conducts heat
Stiffness	Will not permanently deform under working load. Modulus of elasticity: 2.8 x 106 psi	Modulus of elasticity: 29 x 106 psi
Impact resistance	Will not permanently deform under impact. Glass mat in pultruded parts distributes impact load to prevent surface damage, even in subzero temperatures.	Can permanently deform under impact
Color	Color is molded within No painting required	Must be painted for color, may require repainting over time
Cost	Lower installation costs, less maintenance and longer product life allow for a lower lifecycle cost.	Lower initial material cost More expensive to maintain Much higher over time

Where does FRP Strength Members fit into Fiber Optic Drop Cable?



FRP reinforcement is not the messenger, but in a common configuration will straddle the optical cable within the jacket. In the case of Multicom fiber optic cable, we have constructed our cable in such a way that the optical fiber has the absolute least exposure and the FRP strength members are in a position to guard the hair-thin optical cables to keep them out of harm's way.

Multicom's MFFTX Fiber Optic Drop Cable is priced right and configurable to your specifications. With FRP strength members, messenger cable, LSZH jacket and 1 to 6 optical cables, it is perfect for indoor and outdoor applications. **Learn more about our Fiber Optic Drop Cable**

GO GREEN! Fiber Optics is good for the environment.

Considering that the electrical requirement to send an electrical signal over miles of wiring is typically dozens of times the amount of energy needed to send a brief flash of light over the same distance via fiber optical cabling.

Lower energy requirements means a lower carbon footprint and lower price of operation, which can be enjoyed by cable operators and their customers alike.

HDTV Over Coax

Digital Headend Products

It's the heart and soul of your operation. Day in, day out delivering quality video, voice and data to your customers. There's no bigger investment in your system than your headend electronics.

Think about what goes into a great headend: High-quality electronic equipment with state of the art design and engineering, equipment that you're proud to see on the headend rack:

- Sleek and stylish on the outside
- Powerful and reliable on the inside
- Versatile and practical all around
- Agile to meet your changing needs and able to reach your bandwidth requirements with capacity to grow

Multicom's Selection of Digital Headend Products Including a Wide Range of Clear QAM Products from the World's Most Renowned Manufacturers is Unsurpassed

Blonder Tongue Digital Headend Products

The Blonder Tongue Digital Collection offers a comprehensive series of products designed to multiplex, modulate, demodulate, process, and transcode signals in ASI, QAM, 8VSB, QPSK, and 8PSK formats.

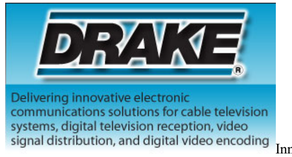
View Blonder Tongue Products

Pico Digital Digital Headend Products

Pico Digital is a worldwide leader in engineering, developing and manufacturing an extensive line of broadband network solutions, including headend electronics, systems equipment and installation components for the franchised cable, private cable and satellite television industries.

View Pico Macom/Pico Digital Products

Drake Digital Headend Products



Innovative Electronic Communications Solutions – R.L. Drake delivers innovative electronic communications solutions for cable television systems, digital television reception, video signal distribution, and ADA assistive listening services.

View Drake Products

ZeeVee Digital Headend Products

ZeeVee utilizes broadcast technologies which support data transmitting over coaxial cables. ZeeVee's products perform HD encoding and RF modulation for the different markets – from residential in home use to digital signage and cable operator companies. Now it is possible to use your existing cable network for sharing HD sources at any number of video displays or TVs.

View ZeeVee Products

Televes Digital Headend Products

Televes is a leading global company focused in the design, development and manufacture of equipment for distributing telecommunication services throughout the infrastructures of buildings and homes.

View Televes Products

Hedy Lamarr was a Hollywood Movie Star Known for her Exotic Good Looks – and an Inventor

Hedy Lamarr's most significant technological contribution was her co-invention, together with composer George Antheil, of an early technique for spread spectrum communications and frequency hopping. This paved the way for today's wireless communications and which, upon its invention in 1941, was deemed so vital to national defense that government officials would not allow publication of its details.

Today WiFi is everywhere and can be broadcasted and rebroadcasted almost endlessly – connecting data and telecommunication networks, Smart phones, computers, traffic signal devices, security systems – it is not unusual for entire cities to be under a single WiFi umbrella.

In celebration of the inventor and Hollywood star Hedy Lamarr's 101st birthday, Google put together this interesting video:

High Speed HDMI with Ethernet vs. High Speed HDMI

As high definition A/V technology continues to advance, the specification for HDMI equipment and cabling is continually updated to ensure reliability and maximum performance. Version 2.0 is the latest version of the HDMI specification, as issued by HDMI Licensing, LLC.

What you should know about HDMI 2.0:

Per the HDMI spec, only four HDMI cable types exist:

- Standard Speed
- Standard Speed with Ethernet
- High Speed (HS)
- High Speed with Ethernet (HS with Ethernet)

Keep in mind that installing a cable supporting HDMI 2.0 features does not give your existing devices with previous HDMI specifications the ability to experience 4K x 2K resolution, 3D, audio return or Ethernet. It's the A/V and Data equipment that has these features – the HDMI cable merely has the capability to support them.

Features that were added by the HDMI 2.0 specification:

HDMI 2.0 supports many new features to take your A/V entertainment to a new and exciting level. Below are just a few of the features we think are inportant:

- HDMI 2.0 systems can transfer data at up to 18Gbps, up from 10.2Gbps in HDMI 1.4
- 4K@50/60, (2160p) – this is four times the clarity of 1080p/60 video resolution
- Up to 32 audio channels for the total audio experience
- Up to 1536kHz audio sample frequency for the highest audio fidelity
- Simultaneous delivery of dual video streams to multiple users on the same screen
- Simultaneous delivery of multi-stream audio to multiple users (up to four)
- Support for the wide angle theater-size 21:9 video aspect ratio
- Dynamic synchronization of video and audio streams
- CEC extensions provide expanded command and control of consumer electronics devices through a single control point

Something else you might be interested in: On the Multicom Online Store you will find the best HDMI Cable on the market: HDMI 2.0, 4K Certified with Internet, 6 feet (1.8m) – for the unbelievable price of **$1.15** and **FREE Shipping!** **It's Here…**

HS HDMI with Ethernet

- **HDMI Ethernet Channel**
- Ultra HD 4K x 2K @ 50/60 (2160p)
- Up to 32 Audio Channels
- Deep Color and X.V. Color
- 18GHz Bandwidth
- Audio Return Channel
- 3D over HDMI
- Expanded Support for Color Spaces

HS HDMI

- Ultra HD 4K x 2K @ 50/60 (2160p)
- Up to 32 Audio Channels
- Deep Color and X.V. Color
- 18GHz Bandwidth
- Audio Return Channel
- 3D over HDMI
- Expanded Support for Color Spaces

Multicom stock a large supply of High Speed HDMI Cables, both with and without Ethernet:

High Speed HDMI Cables:
MUL-HDMI-1.3-1.5M-MA-MA-HS-30 – V1.3 High Speed HDMI Cable, 1.5 Meter
MUL-HDMI-1.3-1.8M-MA-MA-HS-30 – V 1.3 High Speed HDMI Cable, 1.8 Meter

High Speed HDMI Cables with Ethernet:
MUL-HDMI-2.0-1.5M-MA-MA-HS-30 – v2.0 High Speed HDMI Cable, 1.5 Meter, with Ethernet
MUL-HDMI-1.4-1.5M-MA-MA-HS-30SC-A – V1.4 High Speed HDMI 1.4 Cable Ver. A, with Ethernet

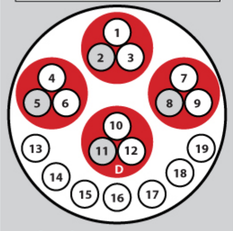
HDMI Cables come in a wide assortment of configurations. Give us a call at 800-423-3594 – if we don't have it in stock, we'll make it for you.

Below is a chart that shows the capabilities of each HDMI Cable version. Each HDMI Cable version includes all of it's sub-versions:

HDMI Cable Version	1	1.1	1.2	1.3	1.4	2.0
Transmission Bandwidth (Gbits/s)	4.95	4.95	4.95	10.2	10.2	18
sRGB	Yes	Yes	Yes	Yes	Yes	Yes
YCbCr 4:2:2/4:4:4	Yes	Yes	Yes	Yes	Yes	Yes
8 channel LPCM, 192 kHz, 24-bit audio capability	Yes	Yes	Yes	Yes	Yes	Yes
Blu-ray Disc and HD DVD video and audio at full resolution	Yes	Yes	Yes	Yes	Yes	Yes
Consumer Electronic Control (CEC)	Yes	Yes	Yes	Yes	Yes	Yes
DVD-Audio support	No	Yes	Yes	Yes	Yes	Yes
Super Audio CD (DSD) support	No	No	Yes	Yes	Yes	Yes
Deep color	No	No	No	Yes	Yes	Yes
xvYCC	No	No	No	Yes	Yes	Yes
Auto lip-sync	No	No	No	Yes	Yes	Yes
Dolby TrueHD bitstream capable	No	No	No	Yes	Yes	Yes
DTS-HD Master Audio bitstream capable	No	No	No	Yes	Yes	Yes
Updated list of CEC commands	No	No	No	Yes	Yes	Yes
3D over HDMI	No	No	No	No	Yes	Yes
Ethernet channel	No	No	No	No	Yes	Yes
Audio return channel (ARC)	No	No	No	No	Yes	Yes
4K resolution support at 30 fps	No	No	No	No	Yes	Yes
4K resolution support at 60 fps	No	No	No	No	No	Yes
YCbCr 4:2:0 support	No	No	No	No	No	Yes
32 channel audio support	No	No	No	No	No	Yes
1536 kHz audio support	No	No	No	No	No	Yes
4 audio streams support	No	No	No	No	No	Yes
2 video streams support	No	No	No	No	No	Yes
21:9 aspect ratio support	No	No	No	No	No	Yes

If you found this article interesting and informative – Go further, learn more:
4K Ultra HD vs. 1080p Full HD: What's the Difference?
Below is a wiring diagram that compares the individual pin-outs for Standard/High Speed HDMI Cables with an Ethernet Channel, and without an Ethernet Channel:

Standard / High Speed HDMI Cable
(No Ethernet)



Group A:
Pin 1: TMDS Data2 +
Pin 2: TMDS Data2 Shield (Drain)
Pin 3: TMDS Data2 -

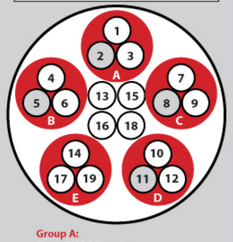
Group B:
Pin 4: TMDS Data1 +
Pin 5: TMDS Data1 Shield (Drain)
Pin 6: TMDS Data1 -

Group C:
Pin 7: TMDS Data0 +
Pin 8: TMDS Data0 Shield (Drain)
Pin 9: TMDS Data0 -

Group D:
Pin 10: TMDS Clock +
Pin 11: TMDS Clock Shield (Drain)
Pin 12: TMDS Clock -

Pin 13: CEC
Pin 14: Reserved for future use
Pin 15: SCL
Pin 16: SDA
Pin 17: DDC/CEC Ground
Pin 18: +5V Power
Pin 19: HPD (Hot Plug Detected)

Standard / High Speed HDMI Cable
With Ethernet



Group A:
Pin 1: TMDS Data2 +
Pin 2: TMDS Data2 Shield (Drain)
Pin 3: TMDS Data2 -

Group B:
Pin 4: TMDS Data1 +
Pin 5: TMDS Data1 Shield (Drain)
Pin 6: TMDS Data1 -

Group C:
Pin 7: TMDS Data0 +
Pin 8: TMDS Data0 Shield (Drain)
Pin 9: TMDS Data0 -

Group D:
Pin 10: TMDS Clock +
Pin 11: TMDS Clock Shield (Drain)
Pin 12: TMDS Clock -

Group E:
Pin 14: CEC
Pin 17: Utility/HEAC +
Pin 19: SCL

Pin 13: SDA
Pin 15: DDC/CEC/HEAC Shield
Pin 16: +5V Power
Pin 18: HPD (Hot Plug Detected)

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High Speed HDMI Cables with Ethernet:
MUL-HDMI-2.0-1.5M-MA-MA-HS-30 – v2.0 High Speed HDMI Cable, 1.5 Meter, with Ethernet
MUL-HDMI-1.4-1.5M-MA-MA-HS-30SC-A – V1.4 High Speed HDMI 1.4 Cable Ver. A, with Ethernet

HDMI Cables come in a wide assortment of configurations. Give us a call at 800-423-3594 – if we don't have it in stock, we'll make it for you.

How to "PULL" Fiber Optic Cable Correctly

Cable installers always talk about "pulling" fiber optic cable because that is how they install underground cable in conduit. In most cities, that is how the majority of cable is installed. A duct is available from point A to point B, a pull tape is blown in, a fiber optic cable is attached to it and the cable is pulled through the duct. Sounds simple, doesn't it.

Maybe not. Recent observations and conversations with more than a few people in the fiber optic business have indicated that the basic process is not well understood by some contractors. This crew I photographed near my home (below), were pulling fiber in a duct one block long. What they are currently doing is likely damaging cables, if not breaking fibers during the process, likely compromising the long-term reliability of the cable and fibers.

Outside plant (OSP) fiber optic cable is designed to be pulled into ducts during installation. Every cable has three specifications that the installer must understand before beginning the installation of the cable to prevent damage, maximum pull tension, bend radius, and crush loading.

These installers are pulling a cable larger than 1/2 inch diameter over a pulley about 5 inches in diameter when they should be using a pulley at least 20 inches in diameter (see red circle).

Pull tension is fairly obvious. The cable is designed to be pulled and the maximum pulling tension it can withstand is specified. For OSP cables, that is usually around 600 pounds of tension. To withstand this tension, the pull tape must be attached to the cable properly.

For all but the shortest runs, a swivel pulling eye is needed to prevent the cable from twisting when pulled. Pulling eyes can also be specified to limit pulling loads; when a maximum tension, like 600 pounds is reached, the swivel breaks. Then the cable must be pulled out and tried again, this time with some lubrication.

Long pulls are generally done with a powered capstan. A pulling wheel that monitors and limits tension to prevent exceeding the tension limit of the cable. If tension becomes high, lubrication is applied.

Bend radius is very important and more likely to be violated and more likely to damage the cable and the fibers in it. Bending the cable too tightly can be done by pulling the cable at the wrong angle out of a duct or across a pulley that is too small. Most fiber optic cables are specified with a minimum bend radius of 20 times the cable diameter when under tension during a pull or 10 times the cable's diameter when no longer under tension after installation.

With a typical fiber cable diameter around 1/2 inch (12mm), the minimum bend radius under tension is 10 inches. That means any pulleys or capstans being used to pull the cable has to be 20 inches diameter – it's bend radius, remember and the diameter of a round object is 2 times the radius.

These installers are pulling a cable larger than 1/2 inch diameter over a pulley about 5 inches in diameter when they should be using a pulley at least 20 inches in diameter (see red circle). As the cable is pulled over that small pulley, the fibers are being crushed and the cable structure itself may permanently be damaged.

There is only one way to prevent damage to fiber optic cable during installation. installers must be properly trained and certified.

Bend radius limits can also be violated easily when pulling the cable out of the conduit if the tension is applied at an angle as shown by the red dotted line above. Special hardware exists to provide a smooth radius for the cable or, if not available, one can often use plastic ducts to create a bend-radius limiter.

A problem we have encountered is the installers use hardware that is not intended for fiber optic installation. Rope and many other types of cable can withstand tighter bending than fiber, so the hardware is smaller and potentially deadly to fiber optic cable. That small pulley used above was probably intended for rope.

The final spec is crush loads. Copper power cables are much less susceptible to damage from crush loads than fiber cable. We've seen photos of crews installing fiber standing on the cable or even driving vehicles over it. That can be fatal to fiber.

Incidents like this can be very costly. There is only one way to prevent damage to fiber optic cable during installation. Installers must be properly trained and certified.

Thanks to Jim Hayes, President, FOA. Jim is a VDV writer and educator, and the President of The Fiber Optic Association.

IMSA stands for International Municipal Signal Association and was started in 1896

The IMSA is a Trade Association focused on the traffic industry.

Multicom carries a full range of IMSA traffic signal cables, specializing in DOT listed products.

Local Area Network (LAN)

A local area network (LAN) is a group of computers that are connected together in a localized area to communicate with one another and share resources such as printers. Data is sent in the form of packets and to regulate the transmission of the packets, different technologies can be used. The most widely used LAN technology is the Ethernet and it is specified in a standard called IEEE 802.3. (Other types of LAN networking technologies include token ring and FDDI.)

Ethernet uses a star topology in which the individual nodes (devices) are networked with one another via active networking equipment such as switches. The number of networked devices in a LAN can range from two to several thousand.

The physical transmission medium for a wired LAN involves cables, mainly twisted pair or fiber optics. A twisted pair cable consists of eight wires, forming four pairs of twisted copper wires and is used with RJ-45 plugs and sockets. The maximum cable length of a twisted pair is 100 m (328 ft.) while for fiber optic cable, the maximum length ranges from 10 km to 70 km, depending on the type of fiber. Depending on the type of twisted pair or fiber optic cables used, data rates today can range from 100 Mbit/s to 10,000 Mbit/s.

A rule of thumb is to always build a network with greater capacity than is currently required. To future-proof a network, it is a good idea to design a network such that only 30% of its capacity is used. Since more and more applications are running over networks today, higher and higher network performance is required. While network switches (discussed below) are easy to upgrade after a few years, cabling is normally much more difficult to replace.

MFH-2 Technical features, Block Diagrams, and Distribution

Foxcom’s NEW Compact MFH-2 Distribution System

- 2-5 L-Band (SAT-IF) Polarities
- 1 Cable TV/DTT/DAB
- (54-860MHz, 10-20 channels)
- Stand Alone Configuration
- High Output Power
- Low Power Consumption
- Small Footprint / Low Profile
- Plug and Play Deployment

Foxcom is pleased to announce a new addition to our current offering of products for FTTX applications: AL5T3 Compact Kits:

A single transmitter that can transport up to 5 L-band signals over a single fiber using CWDM technology anchors the compact kits. The transmitter is low profile and wall mountable, no racks or chassis required for head end build out. Models are available that can also transmit CATV and SMATV programming. The products were designed to provide an easy to order, space-saving, virtually plug and play installation along with the benefit of a significant cost reduction in cost per home. Foxcom is offering the Transmit Headend as a kit available in 8, 16 and 32 node configurations.

Each kit includes: Transmitter, CWDM, splitter, LGX-3 chassis and all of the necessary jumpers required to insure a working installation “out of the box”. The corresponding AL5R-3 receiver’s compact housing, is specifically designed for deployments where space is at a premium. The AL5R3’s small footprint, low power consumption and high output power can serve multiple homes from a single receiver. The AL5R3 receiver is Plug’n’Play without the need for any manual adjustments.

The Basic MFH-2 Platform Consists of

Transmitter

The AL5T3 compact series of transmitters are low profile and wall mountable providing a cost effective method of delivering transport for small and medium distribution systems where a traditional headend cannot be installed. The AL5T3 compact series of transmitters can be deployed in applications such as small and medium MDU’s,and other types of applications.

Receiver

The AL5R3 is housed in a compact housing specifically designed for deployments where space is at a premium. The AL5R3's small footprint, low power consumption and high output power can serve multiple homes from a single receiver, making it an ideal solution for both small and medium deployments. The AL5R3 is a "plug and play" product without the need for any manual adjustments making installations quick and easy.

See our Fiber Optic Products and Resources for more information about the products that Multicom can provide you with. From headEND-2-ENDuser, Multicom has 13,000 products from over 270 manufacturers – all under one roof.

MFH-2 Fiber Optic System Features

Foxcom's line of BsmarTV products affords the user all the benefits and features of utilizing fiber for signal distribution including:

- Extended distances from centralized headend; over 5+ kilometers
- Elimination of "Dish per Building" in Garden Style Complexes
- RFI, EMI and Lightning immunity
- Enhanced security and theft of service prevention

In addition, Fiber Optic Distribution Equipment offers advanced solutions such as:

- Multiple Orbital Locations – up to seven for the DIRECTV MFH2 Distribution Scheme
- Ka, Ku, and FSS Satellites reception
- Delivery of HD and Off-air content
- CATV/SMATV Options
- Return Path Capabilities; DOCSIS or Ethernet
- Automatic Gain Control (AGC)
- On-Board LNB Powering and Polarity Selection
- Compatibility with existing MFH1 deployments and Legacy Foxcom Equipment
- Choice of fiber architectures; dedicated or multiplexed

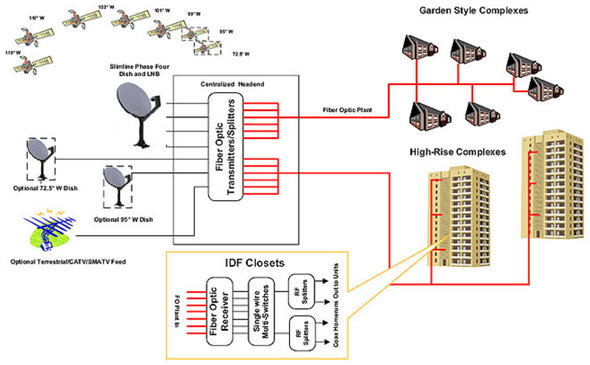
MFH-2 Background

Over the past several years and with plans for the future, DIRECTV has added and will bring online additional satellite capacity to distribute an extensive amount of new programming content to subscribers including video in high definition format and interactive options. In order to accomplish these goals, the RF distribution of the content has changed significantly both in technology as well the type of architecture deployments in the Multiple Dwelling Unit (MDU). Early MDU deployments were accomplished by the use of one or two "stacking" schemes over copper based coax cable to accomplish a "single-wire" solution.

Today's multi-polarity schemes and the widespread use of subscriber based Personal Video Recorders (PVR) have pushed the technology, primarily with regards to bandwidth and distance, beyond the practical use of these former legacy systems. Accordingly, new, cost effective systems are needed to allow for more efficient and intelligent use of bandwidth. MFH2 is an RF Distribution system that accomplishes just that. In brief, only the required amount of bandwidth and content is brought to the subscriber unit as needed as selected by the viewer. In addition, with MFH2 the traditional installed "home-run and splitter" architecture based on the use of industry standard, "off-the shelf" devices, can support the use of multiple tuners, either as set-top box, PVR or combination of both, with no additional customer required equipment. Most importantly, an MDU subscriber is afforded the same viewing experience, as well as the same consumer equipment, as a Direct-to Home (DTH) subscriber.

While the subscriber side of the system has been simplified, the transmission of seven or more satellites has actually increased the complexity of the MDU head-end in an effort to bring all this content out to the appropriately located "IDF" Closets within a High-Rise or Garden Style Multi Family Complex. In keeping with a growing trend, fiber optics is becoming the prime choice for such applications. Fiber allows for the use of enormous bandwidths and distances well of excess of those encountered in MDU applications. More recently, fiber and related equipment have become an extremely affordable choice when compared to the escalating material and deployment costs of copper based coax.

MFH-2 Basic Concept



In a typical MDU system, each of the 4 required stacks, and any optional satellite polarities and CATV/SMATV service, are converted into light and transmitted via fiber to each IDF closet within the building(s).

At the IDF closet, the fiber optic signal is converted back to RF for input into a cascade of “Single Wire Multi-switches” (SWM) for distribution to each individual unit.

The basic Fiber Distribution System consists of rack mounted fiber optic transmitters, fiber optic splitters and optional multiplexers, and wall mounted, multi-port Fiber Optic Receivers and associated racks, power supplies and accessories.

MoCA - What is MoCA Technology?

Multimedia over Coax Alliance **MoCA® – What does it stand for?**

Multimedia over Coax Alliance

What is MoCA technology?

MoCA technology is a protocol enabling the distribution of content over the existing in-home coaxial TV cabling. The primary job of MoCA technology is to guarantee delivery of packets to their destination.

What problem does MoCA technology solve and how does it make the home network better?

Multicom stocks 2,3 and 4-Way Moca Splitters

MoCA technology is used as an in-home backbone to guarantee wireless connectivity. As consumers bring more devices into the home all yearning for bandwidth a wire is required to guarantee the wireless network. Wi-Fi has improved dramatically over the years the stored and live content streaming, gaming, virtual reality and UHD format programming all strain even the most robust wireless network.

As a result of its high performance and reliability, and the support it provides for wireless networks, MoCA technology lowers the cost of managing the entire network, or total cost of ownership. This is important for both operators and consumers as guaranteeing the performance of the network and delivery of content reduces the need to continuously upgrade equipment and eliminates downtime from a non-performing network.

For operators, a well-performing network is especially important. Customer complaints means they are experiencing a non-functioning network and are not receiving services for which they have paid. The operator is then obligated to send a technician to fix the problem. The extra visits and associated time adds to the overall cost of network management. Integrating MoCA technology into the network reduces operational costs as delivery of services is guaranteed and additional repairs and customer complaints are eliminated.

For consumers, a well-functioning network also eliminates the downtime that accrues from inability to access the Internet.

What are some common applications?

There are numerous applications that benefit from MoCA technology. As the in-home backbone supporting wireless networking, operators and consumers have confidence to engage in numerous activities. These include multi-room DVR, HDTV and UHD video distribution, gaming and HD/UHD and live streaming and overall improvement of Internet access throughout the home.

What are some of the alternative technologies and mediums available for home networking?

Multicom stocks 2, 3 and 4-Way MoCA Splitters
Large houses, MDU environments, thick building materials, and the nature of the in-home wiring can all affect the performance and satisfaction level of a home network.

Wireless (Wi-Fi®) technology is a shared medium so the more devices on the network, the less bandwidth available. A wireless network may not reach every room in the home, will not go through walls, and is prone to interference with a neighbor's network.

Products using power line (HomePlug®) technology are easy to use and outlets are found in every room. Power line is also prone interference from everyday household appliances such as vacuum cleaners, microwave ovens and DECT phones. It is not an ideal medium for HD or ultra HD content distribution and it can be affected by condition and age of the wiring.

MoCA technology works over the existing coaxial cabling. Most houses and apartments worldwide have coax already installed. In addition, coax is immune to intrusions and interference. Thought coaxial outlets are not located in every room they can generally be found where homeowners are likely to watch TV. MoCA technology is the only standard that provides the performance and reliability essential for multiple streams of HD and ultra HD video reception and distribution.

When designing a home networking, products integrating both Wi-Fi and MoCA technology should be considered for maximum performance and satisfaction.

Does MoCA work with other standards organizations?

MoCA has been approved by DLNA for inclusion in their Interoperability Guidelines as a layer 2 protocol.

The technology is also part of the IEEE P1905.1 specification, branded as nVoy™ which creates an abstraction layer for discovery and identification of established transport protocols such as Wi-Fi, Ethernet and HomePlug.

Does MoCA technology work on any type of coax?

Yes. If you can receive a TV signal, you can get MoCA.

Does MoCA work with any network access technology?

Yes. MoCA technology works with any network access technology including fiber (GPON/EPON), DOCSIS, Ethernet and any other means including wireless used to provide broadband and programming to the home.

10. How fast can MoCA go?

MoCA 2.5 offers actual data rates of up to 2.5 Gbps. It is backward interoperable with MoCA 2.0 and MoCA 1.1. MoCA 2.0 is capable of up to 1 Gbps actual data rates.

Multicom stocks 2, 3 and 4-Way MoCA Splitters

Information for this article was provided by the Multimedia over Coax Alliance

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Multicom Videos

The Multicom Video Series is currently being updated and is unavailable.

Multicom, now **Netceed**, is dedicated to providing you with personal service in all aspects of purchasing and utilizing our products. We know that when you use our high-quality products as intended, they will perform exactly as you expect.

Multicom Catalogs – A complete and ever-growing overview of Multicom Products.

Home

Precision Multicom Products vs. 'Other'

Quality Makes a Difference –
Precision Multicom Products vs. 'Other' Products

The tough and rugged Multicom **MUL-FSPLICE-300 Fiber Optic Fusion Splicer** is drop/impact, dirt/dust, and water resistant – and comes with a 3 year warranty and quick-change rechargeable lithium battery.

The splicer employs high-speed image processing and special positioning technology allowing the fusion splicing to be completed in as little as FAST 7 seconds and can heat shrink in as little as an ULTRA-FAST 9 seconds. The splicer is compact in size, lightweight, and is ideal for working just about anywhere including harsh outdoor environments, and dark and remote worksites.

Specification	Multicom	'Other'	Multicom Quality Products	'Other' Product
German Engineering	**Yes**	No	**German engineering known for precision, quality, and reliability**	Engineered to meet a lower standard, planned obsolescence
State-of-the-Art Precision Motors	**Yes**	No	**Components made w/quality, high precision, long life bearings**	Shorter life bronze sintered bearings
High Resolution Optical system	**Yes**	No	**High precision, faster operations**	Lower resolution, low precision, higher loss, slower operation
Core vs. Clad Alignment	**Core**	Clad	**Highest precision Clad alignment, high-quality, low-loss splices**	Low precision Clad Align, higher price for Core
US/Japanese/Taiwan main components	**Yes**	No	**High quality internal components = Precision, Long Life**	Short life integrated circuits, heat sensitive
Ruggedized	**Yes**	No	**Drop/Impact, Dirt/Dust, & Water Resistant**	Low quality plastic, easy to crack or break
Auto-Calibration	**Yes**	No	**Automatically adjusts for temperture, altitude, humidity and number of fusion operations**	Manual calibration for changes in temperature/humidity/altitude higher loss splices
Splicing Speed **Heating Speed (seconds)**	**7 sec** **9 sec**	15 sec 30 sec	**Do more splices in less time! Make more money!**	Thumb twiddling is costing you money!
Warranty	**3 Year**	Maybe	**Multicom – No Risk Returns – most repairs/services are in your country!**	Send back to 'Other' country taking months to repair

- **FAST 7 Second Splicing** (optional)
- **ULTRA-FAST 9 Second Heat Shrinking** (optional)
- **3 Year Domestic, 2 Year International Warranty**
- **Quick-change Rechargeable Lithium Battery**
- **Drop/Impact, Dirt/Dust, and Water Resistant**
- State-of-the-art core-to-core fiber Profile Alignment System (PAS)
- Fully-automatic, semi-automatic, and manual operating modes
- See all of the additional features, below

See the MUL-FSPLICE-300 Product Details Compare More Quality Multicom Products

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Quality Makes a Difference –
MORE Precision Multicom Products vs. 'Other' Products

Fiber Optic Transmitter

Specification	Multicom	'Other'	Multicom Quality Products	'Other' Product
Ortel Lasers, Made in the USA	**Yes**	No	**High quality, long life**	Low cost, short life Chinese laser
Hot swap Power Supplies	**Redundant**	1	**Quick plugin modules, No downtime if one Power Supply fails**	Single, internal (not module), failure must replace entire transmitter
Integrated SNMP	**Yes**	No	**Remotely monitor, control/reconfigure, quickly resolve issues**	No SNMP/remote monitoring, no remote alerts,/alarms

See the Multicom Transmitters

EDFAs

Specification	Multicom	'Other'	Multicom Quality Products	'Other' Product
JDSU Lasers, Made in the USA	**Yes**	No	**High quality, long life**	
Redundant Hot swap Power Supplies	**Yes**	No	**Quick plugin modules, No downtime if one Power Supply fails**	Single, internal (not module), failure must replace entire EDFA
Integrated SNMP	**Yes**	No	**Remotely monitor, control/reconfigure, quickly resolve issues**	No SNMP/remote monitoring, no remote alerts,/alarms

See the Multicom EDFAs

Micro-Nodes

Specification	Multicom	'Other'	Multicom Quality Products	'Other' Product
AC Adapters	**Yes**	No	**UL and FCC certified, high quality, longest life**	Cheapest possible: about 1 year life, outages, unhappy operators and users

See the Multicom Micro-Nodes

4-Port Node

Specification	Multicom	'Other'	Multicom Quality Products	'Other' Product
GaAs hybrid Amplifiers, USA made	**Yes**	No	**Amps made by Anadigics – High quality, long life, stable reliable performance**	Low-quality output, shorter life, more service calls
Modular TX, RX, RF	**Yes**	No	**Easy the service, quick replacements, easy expansion, and upgrades**	1 piece assembly, failure affects entire node and all customers
FP-Isolator or optional DFB lasers	**Yes**	No	**Supports maximum bandwidth requirements, Easy upgrades**	FP laser, not as good for data and broadband networks

See the Multicom 4-Port Node

Fiber Optic Passives

Specification	Multicom	'Other'	Multicom Quality Products	'Other' Product
Corning Fiber in Cables	**Yes**	No	**Lowest loss, high-quality fiber**	Higher loss, degrade over life
Splitters: PLC – not FBT	**Yes**	No	**PLC – Highest quality, low loss, more rugged and reliable**	FBT – Provides a little lower cost but quality and performance issues

See the Multicom Fiber Optic Passives

Coax Cable – Trunk & Drop

Specification	Multicom	'Other'	Multicom Quality Products	'Other' Product
Extruded, Welded	**Yes**	No	**Both types are available according to customer preference**	
Virgin PVC Jacket	**Yes**	No	**Pure Virgin PVC for best performance and reliability**	Regrind and recycled PVC jacket – tears easy, bad stretching, UL susceptible
Pure Dense Foam PE Dielectric	**Yes**	No	**Manufacture of high quality, uniform dielectric ensures high-quality performance**	Low density, nonuniform dielectric – poor electric perfomance, nonSCTE
APA Bonded Shield	**Yes**	No	**Double side polymer shielding, bonded for best performance and reliability**	Single sided aluminum on polymer, not bonded

See the Multicom Coax Cable

Product Comparison: Select Multicom Video Encoders & Modulators

Multicom's constantly expanding line of high-quality Modulators and Encoders has been the primary focus of our engineering team lately. Whether it's one channel, eight channels, or more – we have the products necessary for your video, voice, data, and wireless needs.

Below is a comparison chart of four of Multicom's newest and most popular Modulators and Encoders (click the Part# below the image for product details)**:**

[table id=4 /]

Instead of having a rack full of fixed-channel modulators, you can now have the efficiency, economy, and redundancy of agile modulators. Agile modulators give the ability to change the output channel whenever needed – and Multicom's affordable agile modulators have come down to such a level that fixed-channel modulators can be a thing of the past.

Multicom HD Encoders and Modulators are perfect for multi-video distribution solutions in the commercial and institutional markets:

- Hotels
- Motels
- Sports bars

- Casinos

- Business and university campuses
- Digital signage

- Restaurants
- Hospitals
- Home Entertainment Systems

See more of the Multicom Line of Video Encoders & Modulators here…

RHW, RHW-2, USE-2 and RHH Building Wire - Explained

As mentioned in the article THHN vs. XHHW: What Is the Difference?, there are a lot of somewhat confusing abbreviations used on wires and cables. We broke down THHN and XHHW in that article, now let's tackle RHW, RHW-2, USE-2 and RHH building wire.

All electric wires and cables must be labeled appropriately by following the National Electric Code (NEC) guidelines. This way consumers know exactly what type of wire they are using.

RHW and RHW-2

R = Rubber Insulation

A rubber outer layer that is very important when it comes to copper cables, especially when those cables are utilized in possible hazardous environments. Like XHHW and XHHW-2, RHW-2 wires are insulated by cross-linked polyethylene (XLPE). Even though the "R" stands for rubber, it also incorporates other neoprene insulations that XLPE falls under.

H = Heat Resistance of 75° C

Cables must be able to withstand the elements. The insulation's length and width determine its heat resistance. The thinner the XPLE insulation, the less resistant it is to heat.

W = Water Resistance

Possibly the most important factor when considering the environment of your wire. The "W" means the cables can be submerged in water if needed. Even though the wire has a rubber outer layer and is acceptable for use in damp environments, the "W" designation is required for use in the presence of water and other liquids.

RHW and RHW-2 – The Difference:

RHW – RHW cable is a wire insulated by rubber or XLPE as mentioned above. RHW cable can withstand heat up to **75° C**, and is water resistant. It is acceptable to use RHW cables underground and in wet locations.

RHW-2 – Having the same inherent qualities as RHW, the NEC lists RHW-2 as having the ability to withstand heats of up to **90° C**. RHW-2 cable is suitable for direct burial in both wet or dry conditions.

USE-2

U = Underground
S = Service
E = Entrance

USE-2 cable stands for Underground Service Entrance cable. USE-2 cable can be used underground since it is able withstand pressure and is resistant to other elements such as sunlight (black only), oil and gas. USE-2 is a good choice for industrial applications where better insulation toughness and resistance to moisture and heat are desired. USE-2 can be used as RHW-2 or RHH cable at temperatures up to 90°C in wet or dry locations.

What does the "-2" stand for? It is a designation used for the 90° C temperature rating. In the past, there was a plain USE, but it is now generally considered obsolete and replaced by USE-2.

RHH

Very similar to RHW/RHW-2 cable. As mentioned above, the **R** stands for Rubber – but in this case the extra "H", or **HH** in RHH, stands for High Heat resistance of 90° C. The trade-off is that RHH cable does not possess the water resistance characteristic of RHW / RHW-2 cable.

Similarities: Both RHH and RHW / RHW-2 cable hold a 600 V rating. Both cables can be found in lighting, power systems and general wiring applications – depending on the location and environmental conditions.

Fortunately, at Multicom we stock many sizes of RHW-2 or RHH – Building Wire with a wide range of jacket colors, custom-cut to your order, or sold by the spool.

Also see: THHN vs. XHHW: What Is the Difference?

SFPs: B+ and C+ - What's the Difference?

Multicom stocks a wide variety of SFP Modules. See them here…

GPON stands for 'Gigabit Passive Optical Network'. GPON is one of the key technologies that are being used in fiber-based (FTTx) access networks, including fiber to the home (FTTH), fiber to the business (FTTB), fiber to the curb (FTTC), etc.

GPON systems contain two main active transmission components:

- Optical Line Termination (OLT)
- Optical Network Termination (ONT) or Optical Network Unit (ONU)

Modern OLTs and ONT/ONUs use compact fiber optic modules to achieve Triple-play GPON services. These modules are known as GPON SFP transceivers.

What Is a GPON SFP?


SFP stands for 'Small Form-factor Pluggable'. A GPON SFP is one type of Gigabit Optical Transceivers that are used in GPON system, which is compliant with ITU-T G.984.2 standard. It is a bidirectional module that has SC receptacle and works over simplex single-mode fiber optic cable.

A GPON SFP module transmits and receives signals of different wavelengths between the OLT at the 'Central Office' side and the ONT at the end users side. GPON SFPs utilize both the upstream data and downstream data by means of Optical Wavelength Division Multiplexing (WDM).

See the Multicom SFPs here…

GPON SFP: Class B+ vs. Class C+

GPON SFP transceivers are categorized into GPON OLT SFP and GPON ONT SFP or GPON ONU SFP depending on the devices they are used in. And there are **Class B+** GPON SFP and **Class C+** GPON SFP.

The major differences between them are the transmit power and the receive sensitivity. The table below lists the TX power and RX sensitivity of Class B+ GPON SFP and Class C+ GPON SFP:

SFP Module	B+	C+
Type	One fiber, Bi-directional Optical Module	
Operating Wavelength	TX: 1490nm RX: 1310nm	
Port Rate	TX: 2.49 Gbit/sec RX: 1.24 Gbit/sec	
Minimum Output Optical Power	**1.50 dBm**	**3.00 dBm**
Maximum Output Optical Power	**5.00 dBm**	**7.00 dBm**
Maximum Receiver Sensitivity	**-28 dBm**	**-32 dBm**
Optical Connector Type	SC/PC	
Optical Fiber Type	Singlemode	
Distance	20 KM	
Overload Optical Power	**-8 dBm**	**-12 dBm**
Extinction Ratio	8.2 dB	

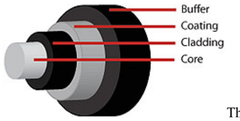
Benefits of Using GPON SFPs

Using a GPON SFP is considered a more convenient and cost-effective solution for the end customers. And it also reduces the devices that need to be provided by the Internet Service Provider (ISP). The SFP module has simplified the implementation of GPON services. It benefits both the service providers and the end users, making using GPON a cost-effective and efficient way of delivering high quality broadband services.

Multicom Stocks a wide variety of SFP Modules. See them here…

Single Mode SFP vs. Multi-Mode SFP

What Is The Difference Between a Singlemode SFP and Multi-mode SFP?



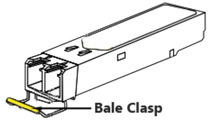
The Singlemode SFP and Multi-mode SFP mean the SFP transceivers will work on different types of optical fibers; as in a Singlemode SFP will work with Singlemode fiber only, and a Multi-mode SFP will work with Multi-mode fiber only.

So, what's the different between them? And what should we notice when using them?

Singlemode SFP

Singlemode fiber has much tighter tolerances for optics used. The core is smaller and the laser wavelength is narrower. This means that SMF has the capability to carry a higher bandwidth at much longer transmission distances. Singlemode SFPs work mainly in the 1310nm and 1550nm wavelengths and is mostly used in a long distances transmission environment reaching 2km, 10km, 40km, 60km, 80km and 120km.

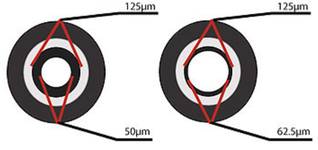
Singlemode SFP Color Coding



SFPs are identified by the color of the Bale Clasp. Though there is still a lack of total conformity; generally speaking, Singlemode SFPs use this color coding:

- Gray color coded bale clasp designates the 1470 nm SFP
- Violet color coded bale clasp designates the 1490 nm SFP
- Blue color coded bale clasp designates the 1510 nm SFP
- Green color coded bale clasp designates the 1530 nm SFP
- Yellow color coded bale clasp designates the 1550 nm SFP
- Orange color coded bale clasp designates the 1570 nm SFP
- Red color coded bale clasp designates the 1590 nm laser SFP
- Brown color coded bale clasp designates the 1610 nm SFP
- **The color of the compatible fiber optic patch cord or pigtail is yellow**

Multi-mode SFP



Multi-mode Fiber

Multi-mode fiber uses a much bigger core and usually uses a longer wavelength of light. Because of this, the optics used in Multi-mode have a higher capability to gather light from the laser. In practical terms, this means the optics are cheaper. The common Multi-mode SFPs work in 850nm wavelength and is only used for short distance transmission reaching 100m and 500m. Though it's not able to transport for long distance, it can transport many kinds of optical signals.

Multi-mode SFP Color Coding

As with Singlemode SFPs, Multi-Mode SFPs are identified by the color of the Bale Clasp:

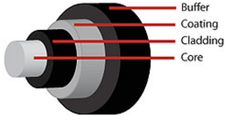
- Black color coded bale clasp designates a Multi-mode SFP
- **The color of the compatible fiber optic patch cord or pigtail is orange**

Tips

- Ensure that the SFPs in both ends of the fiber patch cord are of the same wavelength and consistent in color coding
- Avoid extreme bends or wind fiber optic cables as this will increase the attenuation of transmitted light
- If no SFP/XFP is in use in your host equipment, cover the empty port with a blank to protect the optical port
- In case you're wondering what SFP means: Small Form-factor Pluggable
- The terminology behind fiber optics can be tricky. Let Multicom help you Talk the Talk of Fiber Optics

Multicom's Fiber Optic Product Line and services also includes stocking and same day shipment of a large quantity and variety of custom-cut fiber optic cable (including loose tube, ADSS, Armored, etc), Corning fiber optics-based products and a wide selection of fiber optic transmitters, EDFA, receivers, nodes, accessories, splitters, jumpers, pigtails, and media converters designed to meet the demanding requirements of data, video, and voice networks.

Single Mode vs. Multi-Mode Fiber Optic Cable



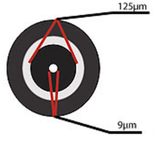
Let's Get Up to Speed…

Fiber Optics is sending signals down hair-thin strands of glass or plastic fiber. The light is "guided" down the center of the fiber called the "core". The core is surrounded by a optical material called the "cladding" that traps the light in the core using an optical technique called "total internal reflection."

The core and cladding are usually made of ultra-pure glass. The fiber is coated with a protective plastic covering called the "primary buffer coating" that protects it from moisture and other damage. More protection is provided by the "cable" which has the fibers and strength members inside an outer covering called a "jacket".

Multicom's Fiber Optic Product Line and services also includes stocking and same day shipment of a large quantity and variety of custom-cut fiber optic cable (including loose tube, ADSS, Armored, etc), and a wide selection of fiber optic Transmitters, EDFAs, Receivers, Nodes, accessories, splitters, jumpers, pigtails, and media converters designed to meet the demanding requirements of data, video, and voice networks. **We Use Only Corning Fiber in our Fiber Optic Cables.**

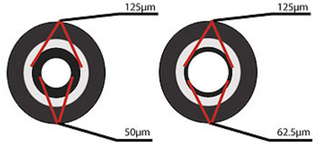
Single Mode Fiber Optic Cable



Single Mode fiber optic cable has a small diametral core that allows only one mode of light to propagate. Because of this, 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 further. This application is typically used in long distance, higher bandwidth runs by Telcos, CATV companies, and Colleges and Universities.

Left: Single Mode fiber is usually 9/125 in construction. This means that the core to cladding diameter ratio is 9 microns to 125 microns.

Multimode Fiber Optic Cable



Multimode fiber optic cable has a large diametral core that allows multiple modes of light to propagate. Because of this, the number of light reflections created as the light passes through the core increases, creating the ability for more data to pass through at a given time. Because of the high dispersion and attenuation rate with this type of fiber, the quality of the signal is reduced over long distances. This application is typically used for short distance, data and audio/video applications in LANs. RF broadband signals, such as what cable companies commonly use, cannot be transmitted over multimode fiber.

Above: Multimode fiber is usually 50/125 and 62.5/125 in construction. This means that the core to cladding diameter ratio is 50 microns to 125 microns and 62.5 microns to 125 microns.

What's Happening Inside The Multimode Fiber

Step-Index Multimode Fiber

Due to its large core, some of the light rays that make up the digital pulse may travel a direct route, whereas others zigzag as they bounce off the cladding. These alternate paths cause the different groups of light rays, referred to as modes, to arrive separately at the receiving point. The pulse, an aggregate of different modes, begins to spread out, losing its well-defined shape. The need to leave spacing between pulses to prevent overlapping limits the amount of information that can be sent. This type of fiber is best suited for transmission over short distances.

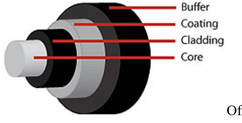
Graded-Index Multimode Fiber

Contains a core in which the refractive index diminishes gradually from the center axis out toward the cladding. The higher refractive index at the center makes the light rays moving down the axis advance more slowly than those near the cladding. Due to the graded index, light in the core curves helically rather than zigzag off the cladding, reducing its travel distance. The shortened path and the higher speed allow light at the periphery to arrive at a receiver at about the same time as the slow but straight rays in the core axis. The result: digital pulse suffers less dispersion. This type of fiber is best suited for local-area networks.

Single Mode vs. Multi-mode Fiber Optic Patch Cables

We have gone into detail about the differences between Singlemode and Multi-mode fiber optic cable in a previous article (here). But how about Singlemode and Multi-mode fiber optic patch cables – or jumper cables as they are often called?

Let's get down to the core of the matter:



Of course, it's the core of fiber cables that carries the light to transmit data – and the main difference between Singlemode and Multi-mode fiber patch cables is the size of their respective cores.

Singlemode cables have a core of 8 to 10 microns. In singlemode cables, light travels toward the center of the core in a single wavelength. This focusing of light allows the signal to travel over longer distances without a loss of signal quality than is possible with Multi-mode cabling. Most Singlemode cabling is color-coded yellow.

Multi-mode cables have a core of either 50 or 62.5 microns. In Multi-mode cables, the larger core gathers more light compared to Singlemode, and this light reflects off the core and allows more signals to be transmitted. Although more cost-effective than Singlemode, Multi-mode cabling does not maintain signal quality over long distances. Multimode cables are generally color-coded orange or aqua; the Aqua Fiber Patch Cables are for higher performance 10Gbps, 40Gbps, and 100Gbps Ethernet and fiber channel applications.

See all of the Multicom Singlemode and Multi-mode Fiber Optic Patch Cables
While you're at it, check out our Pigtails

Q: Which is better? A: It depends on your application:

Singlemode Fiber Patch Cables are the best choice for transmitting data over long distances. They are usually used for connections over large areas, such as college campuses and remote offices. They have a higher bandwidth than Multi-mode cables to deliver up to twice the throughput.

Multimode Fiber Patch Cables are a good choice for transmitting data and voice signals over shorter distances. They are typically used for data and audio/visual applications in local-area networks and connections within buildings or remote office in close proximity to one another.

Lesson:
Use Multi-mode to transmit data over short distances (LESS than ~500 meters, 1,600 feet, 1/3 of a mile)
Use Singlemode to transmit data over long distances (MORE than ~500 meters, 1,600 feet, 1/3 of a mile)

Multicom's Fiber Optic Product Line and services also include stocking and same day shipment of a large quantity and variety of custom-cut fiber optic cable (including loose tube, ADSS, Armored, etc), and a wide selection of fiber optic Transmitters, EDFAs, Receivers, Nodes, accessories, splitters, jumpers, pigtails, and media converters designed to meet the demanding requirements of data, video, and voice networks. **Multicom Uses Only Corning Fiber in our Fiber Optic Cables.**

Sometimes 'F' connectors do not fit properly on coax cable - why?

F connectors will fit correctly on coax cable if the proper connector for the specific drop cable and the right prep tools are used. See Multicom's comparison chart for matching coax cable with the proper connectors.
