

FIBER OPTIC OVERVIEW

Thursday, December 10, 2015



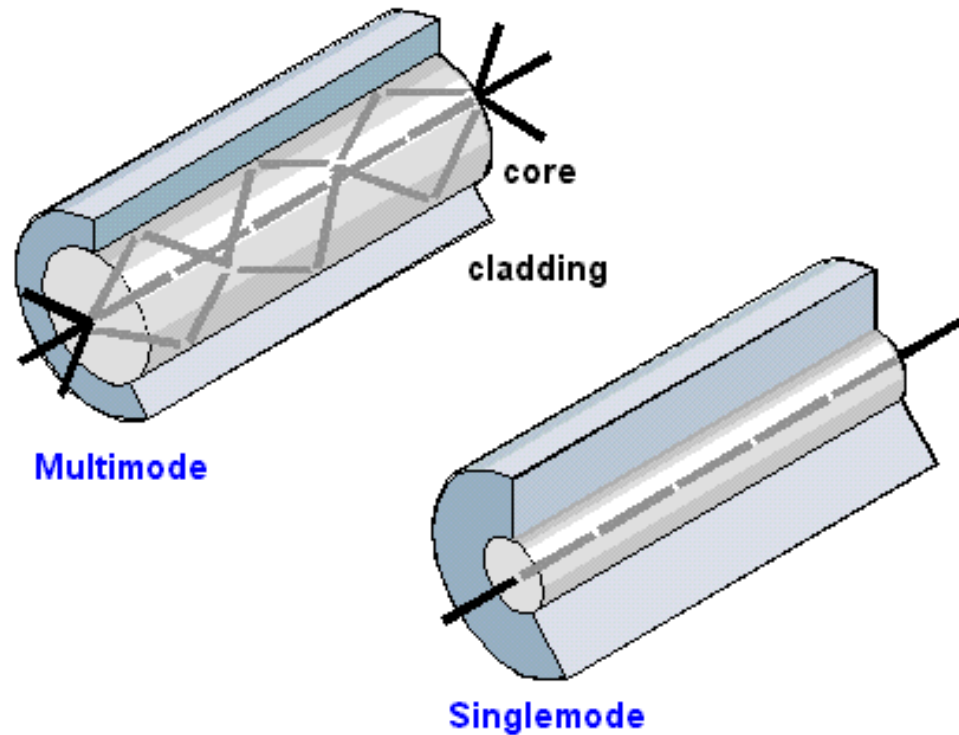
Fiber Optic 101 – Training Manual

FIBER OPTIC OVERVIEW PURPOSE

- To increase our sales team's general knowledge base on fiber optic products.
- To provide insight on each fiber optic product and how it functions within the fiber optic system.
- To assist our sales team in selling fiber optic cables and cross-selling all ancillary products associated with fiber optic systems.

WHAT IS FIBER OPTIC CABLE?

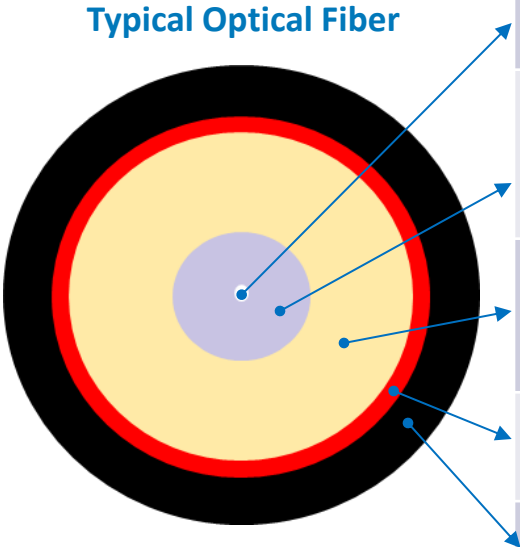
- Fiber Optics refers to the technology of transmitting light signals down hair-thin strands of highly transparent optical fibers.
- These optical fibers are usually glass but in some cases made out of special blends of plastic.



TYPICAL FIBER OPTIC FEATURES

- The typical optical fiber cable consist of a core, cladding, and various coatings. Coatings can include: buffers, strength members and a cable jacket, depending on the type of fiber optic cable.

Product Attribute	Purpose of Product Attribute
Core	The fiber core is made of silica glass and is the central part of the fiber optic cable that carries the light signal. The fiber is hair-thin in size and the diameter is typically between 8 um for single mode fiber, and 250 um for multimode fiber.
Cladding	Is designed to keep the light that may leak from the core confined to the fiber. This material is also made of glass, and is the layer that surrounds the fiber core. Together, they form a single solid fiber of glass that is used for the light transmission. The diameter of cladding is typically 125 um.
Primary Coating or "Buffer"	After the cladding, there is the primary coating that is also known as the primary buffer. This layer provides protection to the fiber core and cladding.
Strength Members	This layer contains layers of aramid yarn (better known as Kevlar). This layer is added to the fiber optic cable to prevent the breakage of the fiber glass during installation.
Cable Jacket	The last layer is the cable jacket, which is comprised of different materials depending on the choice of the end user and the application in use. This layer serves as mechanical protection to the fiber core and cladding inside.



The diagram, titled 'Typical Optical Fiber', shows a cross-section of a fiber optic cable. It consists of several concentric layers. At the center is a small purple circle representing the core. Surrounding it is a red ring representing the cladding. The next layer is a yellow ring representing the primary coating or buffer. This is followed by a black ring representing the strength members. The outermost layer is a thick black ring representing the cable jacket. Blue arrows point from each of these layers to the corresponding row in the table on the right.

HOW DOES FIBER OPTICS WORK?

- **Fiber Optic Transmitter:**

- Takes information and turns it into a pulsing light wave that can be sent along a fiber optic cable.
- A lens is then used to send the light into a fiber optic cable.

- **Fiber Optic Cable:**

- The core of a fiber optic cable is made of a very clear glass tube that transmits light. This glass core is surrounded by a coating called cladding.
- The light bounces off of the mirrors on the cladding and is directed back into the fiber optic core to continue its journey along the cable.



HOW DOES FIBER OPTICS WORK? (cont.)

- ***Optical Receiver:***

- The receiver essentially performs the opposite function of the transmitter found at the beginning of the system.
- Optical receivers receive the light signal from the fiber optic cable and turn it back into information that can be translated
- Receivers can include wireless antennas, data center equipment, televisions, computers and in the future.....game consoles.



ADVANTAGES OF FIBER OPTIC CABLE

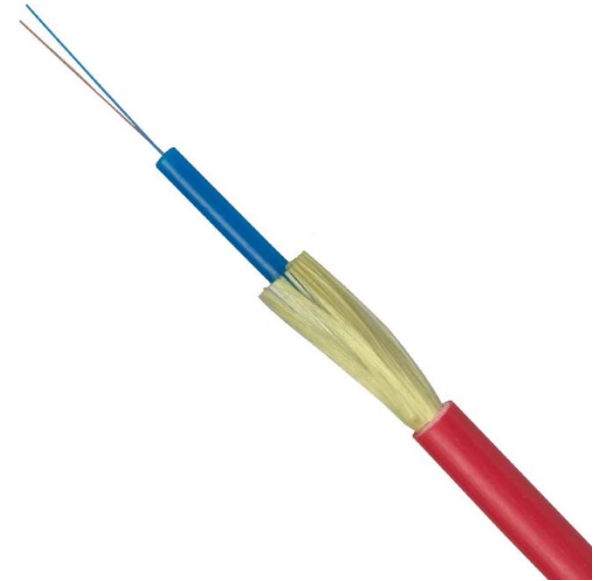
- Most cost effective means of transporting information.
- Can transport more information longer distances in less time than any other communications medium.
- The bandwidth and distance capability of fiber means that fewer cables and repeaters are needed.
- Uses less power and requires less maintenance than copper.
- Is unaffected by the interference of electromagnetic radiation (this makes it possible to transmit information and data with less noise and errors)
- Is lighter than copper wires which makes it popular for aircraft and automotive applications.



BENEFITS OF FIBER OPTIC CABLE

Quality Transmission

- Unlike copper cabling, optical fiber is immune to “electrical noise” (Electromagnetic Interference or EMI).
- Industrial and military environments use fiber optics for clear, secure and time-critical data transmissions .
- Industries with loud production lines and heavy machinery have turned to fiber optics for their internal communications



BENEFITS OF FIBER OPTIC CABLE

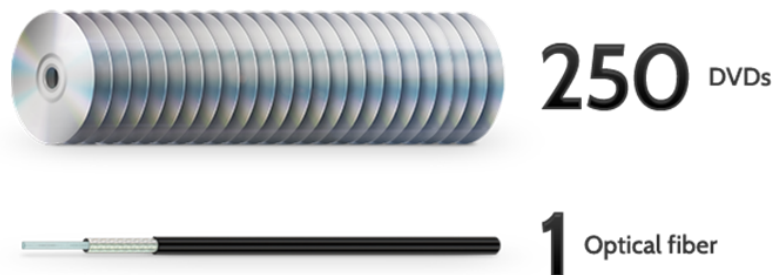
Rugged Durability

- Optical fiber may be made of glass, but inch for inch it's stronger than steel and more durable than copper.
- Optical fiber is strength tested at a minimum of 100,000 pounds per square inch to ensure its mechanical robustness.
- There is no “theoretical lifetime” for optical fiber. The fiber optic cables manufactured and installed 40 years ago are still in use today.
- By carrying light instead of electricity, fiber optic cables are safe from lightning strikes or electrical faults.

FIBER SCALABILITY AND SPEED vs. COPPER CABLES

Today's Fiber Optic cable speeds are only limited by the speeds of the terminals at either end of the optical connection (optical transmitter and optical receiver).

A single modern optical fiber can carry 10Tb/s (10 trillion bits of information per second) over a kilometer i.e., **enough information to fill 250 DVDs every second.**



To Transmit the same amount of information by electrical means, you would need almost **400,000 standard twisted copper wire pairs**, that's 880 tons of copper.

FIBER OPTIC CABLE FACTS

Fiber Is Fast

- In 2011, NEC laboratories reached a data-sending rate of 101.7 terabytes per second through 165 kilometers of fiber.
- **Equivalent: three seamless months of HD video in a single second!**

Fiber Bends

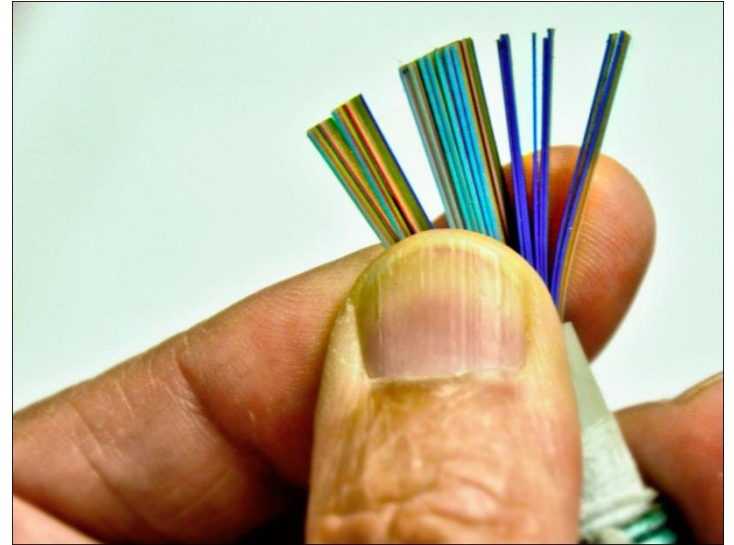
- Current single mode and multimode optical fiber is flexible enough to bend around tight corners without sacrificing performance.



FIBER OPTIC CABLE FACTS

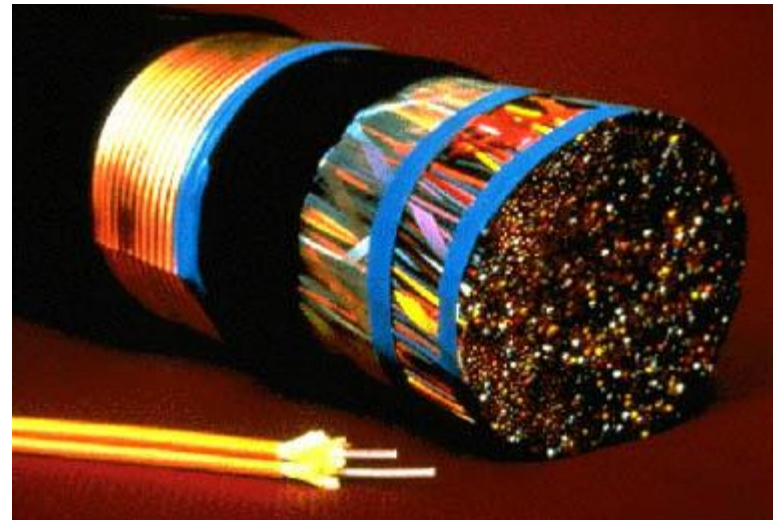
Fiber Is Light And Easy To Handle

- An optical fiber is only 250 μm diameter -
- the size of a human hair.



Fiber's Capacity Blows Copper Away

- A single fiber is capable of transmitting 250 million phone conversations every second.
- One mile of fiber weighs about 1/4th of a pound whereas **copper cable with the same information-carrying capacity would weigh 33 tons.**



FIBER OPTIC CABLE FACTS (continued)

Fiber Brings Us Together

- Nearly two billion people are instantaneously and simultaneously accessing the Internet, thanks to optical fiber.

Fiber Means Business

- Banks, brokerage firms and other businesses have been able to significantly cut costs and add services due to optical fiber.



FIBER OPTIC CABLE FACTS (continued)

Fiber Is Green

- Businesses interested in internationally recognized Leadership in Energy and Environmental Design (LEED) certification are choosing optical fiber cabling systems to create more cost-efficient, environmentally friendly data centers.



Fiber Is More Secure

- An attempt to tap into a fiber cable can cause the glass to break, likely triggering maintenance and/or surveillance alarms.



FIBER OPTIC CABLE FACTS (continued)

Fiber Is Cost-Effective

- Traditional copper cable requires repeaters to amplify signals every mile, **whereas optical fiber systems need repeaters every 60 miles or more.**
- This cost advantage was one of the key drivers in the installation of undersea cables that now connect every continent except Antarctica.

Fiber Keeps Getting Better

- Today, fiber is 100 times better with signal loss of just 0.17 db/kilometer.



USES OF FIBER OPTIC CABLE



Public Carrier Networks

- 4G
- LTE
- WiMax
- Backhaul
- Base Station Infrastructure
- Rural Broadband



Indoor Networks

- DAS Networks
- WLAN
- WiFi Hotspot Coverage
- Enhanced Cellular Coverage
- SOHO Networking
- Unified Communications



Outdoor Networks

- Mesh
- Point-to-Point
- Point-to-Multipoint
- Backhaul

FIBER OPTIC CABLE CONSTRUCTION



BASIC TYPES OF FIBER – SINGLE-MODE vs. MULTI-MODE FIBER

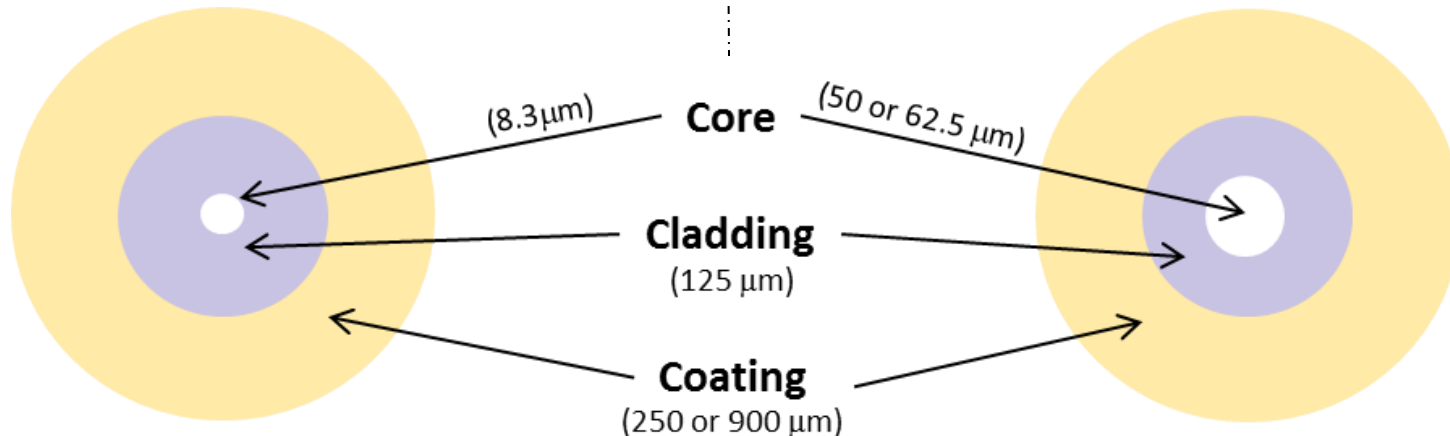
- The Term “MODE” indicates a single stream of photons (a ray of light) that travels in a straight line unless acted upon by the environment.

SINGLE-MODE

Single-mode Fiber has a narrow core (approximately 8.3 μm) and only supports one ray/mode.

MULTI-MODE

Multi-mode Fiber has a broader core (50-60 μm) and supports many rays/modes.



SINGLE-MODE OPTICAL FIBER

Single-mode fiber has a small core ($8\mu\text{m}$) that supports one mode (or pathway of light). With only a single wavelength of light passing through its core, Single-mode realigns the light toward the center of the core instead of simply bouncing it off the edge of the core as with multi mode.

Recommended for:

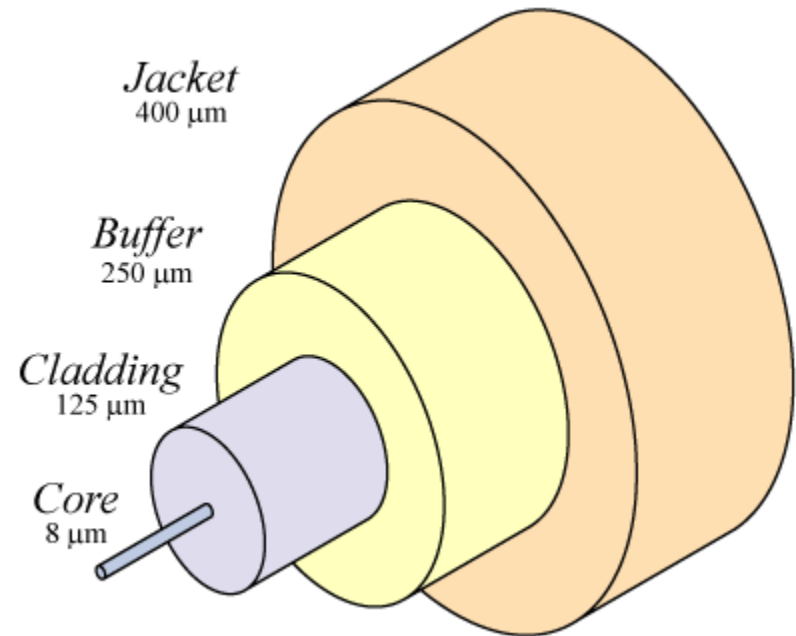
- Systems that require very high data rates
- Telecom Backhauls
- Connections between telecom switching offices.
- FTTC, FTTA, and FTTH Applications
- CATV

Advantages:

- Much greater bandwidth capacity
- Used for longer distances
- Very Low-Attenuation
- Very Low Dispersion

Disadvantages:

- More expensive to operate (usually requires advanced laser equipment).



MULTI-MODE OPTICAL FIBER

Multi mode fiber has a larger core (50 μm and 62.5 μm) can support multiple modes (or pathways of light). With multiple wavelengths of light passing through its core, light signals bounce off the mirrored cladding as it travels through the cable.

Recommended for:

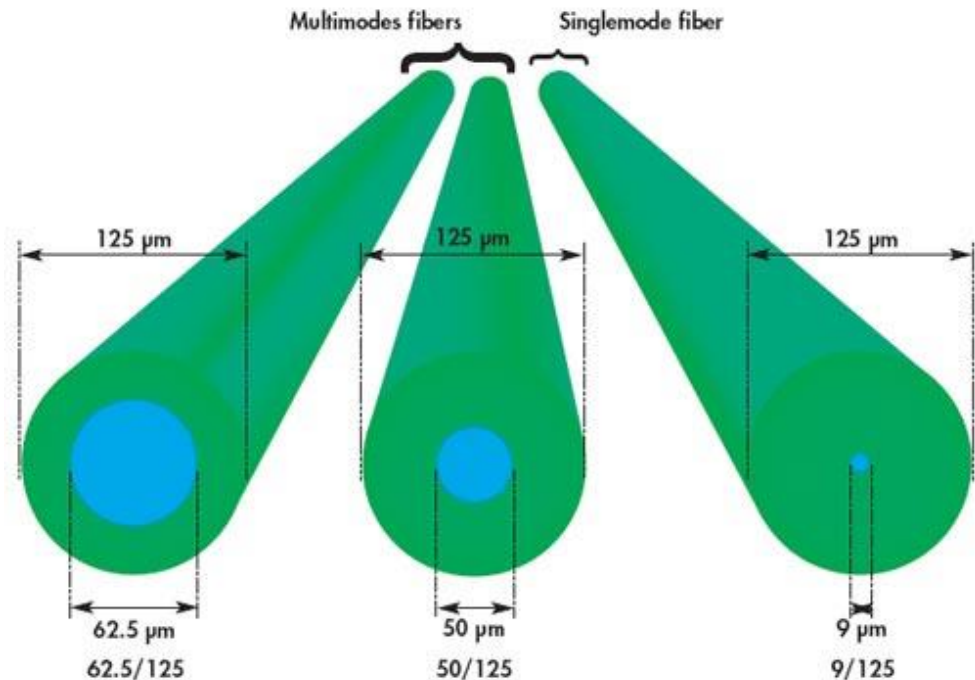
- Distributed antennae systems (DAS)
- In-Building systems
- Data Centers
- Plant/Manufacturing environments

Advantages:

- Less expensive than single-mode
- Utilizes less expensive sources
- Utilizes less expensive connectors
- Lower cost of installation

Disadvantages:

- Higher attenuation than single-mode
- Higher signal dispersion than single mode
- Effective up to 550 meters.



MULTIMODE FIBER - 50 μm vs. 62.5 μm CABLE

- 50-micron cable features three times the bandwidth of standard 62.5-micron cable, particularly at 850 nm.
- 50-micron fiber features a smaller core, which is the light-carrying portion of the fiber,
- 50-micron cable is recommended for premise applications: backbone, horizontal, and intra-building connections, and should be considered especially for any new construction and installations.
- Both types can use either LED or laser light sources.
- The 850-nm wavelength is becoming more important as lasers are being used more frequently as a light source.
- Other differences are distance and speed. 50-micron cable provides longer link lengths and/or higher speeds in the 850-nm wavelength.

MULTIMODE FIBER - OM STANDARDS

Transmission Standards	100 Mb Ethernet	1 Gb (1000 Mb) Ethernet	10 Gb Ethernet	40 Gb Ethernet	100 Gb Ethernet
OM1 (62.5/125)	Up to 2000 meters	275 meters	33 meters	Not Supported	Not Supported
OM2 (50/125)	Up to 2000 meters	550 meters	82 meters	Not Supported	Not Supported
OM3 (50/125)	Up to 2000 meters	550 meters	300 meters	100 meters	100 meters
OM4 (50/125)	Up to 2000 meters	1000 meters	550 meters	150 meters	150 meters

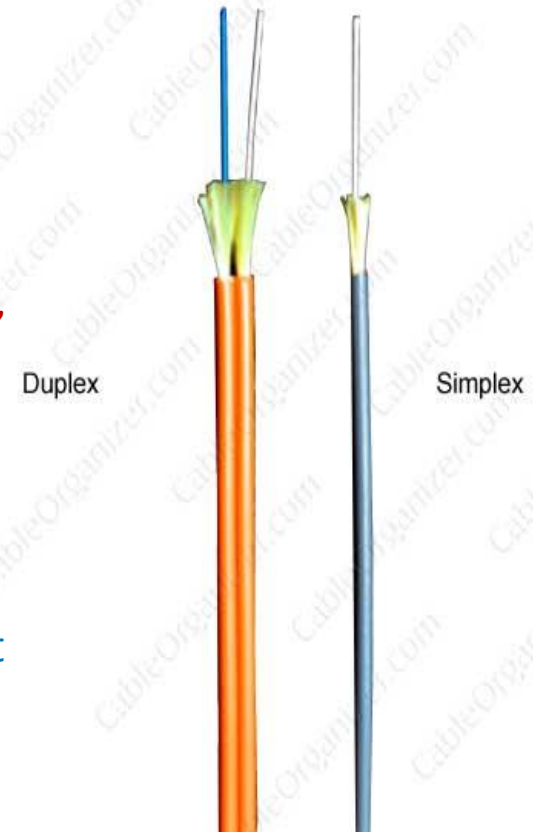
SIMPLEX VS. DUPLEX FIBER OPTIC CABLE

DUPLEX CABLE

- Consists of two fibers, usually in a zipcord (side-by-side) style.
- Used for applications that require simultaneous, bi-directional data transfer.
- Workstations, fiber switches and servers, fiber modems, and similar hardware require duplex cable.
- Is available in single-mode and multi-mode.

SIMPLEX CABLE

- Consists of a single fiber, and is used in applications that only require one-way data transfer.
- Is available in single-mode and multi-mode.



FIBER OPTIC CABLE TYPES & FIBER OPTIC CABLE RATINGS



DISTRIBUTION CABLE

Application: **Indoors (plenum & riser)**

Recommendation: **High Flexibility for Backbone and Horizontal Applications**

- Popular indoor cable, because of it's small size and light weight construction.
- It contains several tight-buffered fibers bundled under the same jacket with Kevlar strength members and ***sometimes*** a fiberglass rod for reinforcement.
- Cables are small in size, and used for short, dry conduit runs, riser and plenum applications.



Fibers	Modes	Application	Indoor Ratings
2-144	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

INTERLOCKED ARMOR DISTRIBUTION CABLE

Application: **Outdoor/Indoor**

Recommendation: **For Rugged Adverse Environments**

- Can be used for direct burial applications
- Has superior protection and durability
- It contains several tight-buffered fibers bundled under the same jacket.
- Can be constructed with Kevlar strength members and *sometimes* a fiberglass rod for reinforcement.



Fibers	Modes	Application	Ratings
2-144	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

INTERCONNECT CABLE

Application: **Indoor Applications**
Recommendation: **For Open Office Environments**

- Best for indoor business and office environments
- Used for small and very flexible for confined spaces.
- Capability for simplex and duplex styles.
- Zip cord construction is common with these types of cables.



Fibers	Modes	Application	Ratings
2	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

BREAKOUT STYLE CABLE

Application: **Indoor/Outdoor Applications**

Recommendation: **For Harsh environment applications**

- Can have direct termination **without** junction boxes , patch panels or other hardware.
- Made of several simplex cables bundled together inside a common jacket.
- Fibers are individually reinforced
- Perfect for industrial applications where a strong and rugged design is needed.



Fibers	Modes	Application	Ratings
2-144	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

TACTICAL CABLE

Application: **Outdoor Applications**
Recommendation: **Direct burial applications**

- Construction is small and lightweight
- Ideal for repeated deployment and retrieval cycles
- Simplex and duplex styles
- Has superior crush resistance
- Perfect for industrial applications where a strong and rugged design is needed.



Fibers	Modes	Application	Ratings
2-144	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

LOOSE TUBE/CENTRAL TUBE CABLE

Application: **Outdoor (mostly for outside plant trunks)**

Recommendation: **Direct burial applications**

- Cables provide a small, high fiber count cable.
- Cables can be made with the loose tubes filled with gel or water absorbent powder to prevent harm to the fibers from water.
- Can be used in conduits, strung overhead or buried directly into the ground.
- Cables can be made with the loose tubes filled with gel or water absorbent powder to prevent harm to the fibers from water.



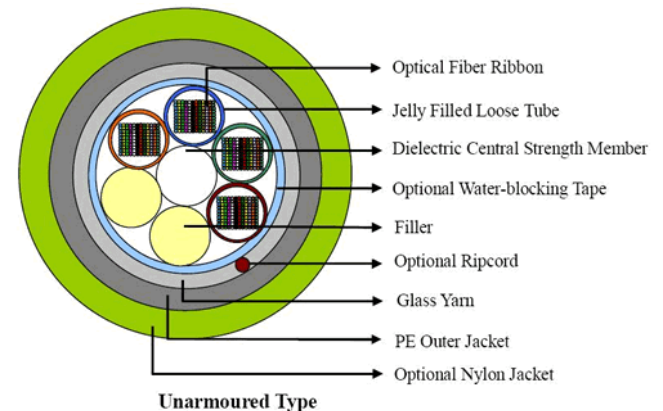
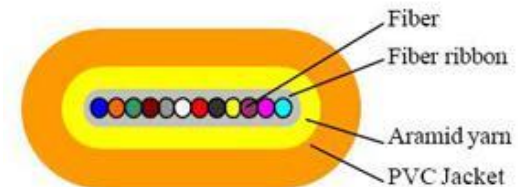
Fibers	Modes	Application	Ratings
2-24	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

RIBBON CABLE

Application: **Indoors**

Recommendation: **Switch Offices , telecom rooms & NOC centers**

- Ideal for use in telecommunications and industrial applications .
- Ideal where easy termination and high fiber density is required.
- Low profile and durability
- Applications include central-office switches, parallel computing clusters, LAN's, remote testing, and under-carpet cabling.



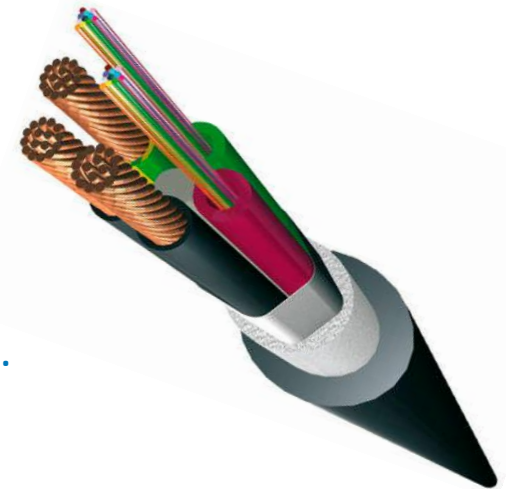
Fibers	Modes	Application	Ratings
12-288	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

HYBRID FIBER/POWER CABLES

Application: **DAS, FTTA, FTTCS**

Recommendation: **Switch Offices , telecom rooms & NOC centers**

- For use in applications where fiber and power are needed to relay optical signals and power active equipment.
- Can be used for both indoor and outdoor applications.
- Can come in a variety of different outer jackets.
- Can be manufactured in both armored and non-armored.



Fibers	Modes	Application	AWG	Ratings
12-288	OM1, OM2, OM3, OM4 & OS2	Indoor & Outdoor	Dependent on Application	Riser (OFNR), Plenum (OFNP), Low Smoke/Zero Halogen (LSZH)

FIBER OPTIC CABLE RATINGS

PLENUM RATED CABLE:

- Complies with NFPA-262 and UL-910.
- Only cable allowed in spaces defined as air plenums such as raised flooring systems and air handling ducts.
- Plenum cables must self extinguish and not reignite.
- Produce less smoke than traditional PVC cables.

RISER RATED CABLE:

- Complies with UL-1666.
- For use in vertical tray applications such as cable runs between floors through cable risers or in elevator shafts.
- Spaces cannot be used for environmental air.
- Cables must self extinguish and must also prevent the flame from traveling up the cable in a vertical burn test.

FIBER OPTIC CABLE RATINGS

LOW SMOKE ZERO HALOGEN (LSZH) RATED CABLE:

- Used in shipboard applications and computer networking rooms where toxic or acidic smoke and fumes can injure people and/or equipment.
- Low smoke means the cable does not produce the heavy black soot and smoke common with PVC cables.
- Cables will self extinguish but cannot pass UL-910 or UL-1666 for a plenum or riser rating.

ARMORED CABLES:

- Include an outer armor layer for mechanical protection and to prevent damage.
- Can be installed in ducts or aerially, or directly buried underground.
- Is surrounded by a polyethylene jacket.
- Armored cable can be used for rodent protection in direct burial if required.

DETERMINING FIBER STRAND COUNTS

- Fiber optic cable is manufactured with anywhere from 1 to 288 strands in a single jacket.
- Strands counts include (1, 2, 4, 6, 12, 24, 48, 72, 96, 144, and 288, 432, 576 up to 1076).
- Number of strands is dependent on your equipment requirements.
- How much you want to account for redundancy.
- How much you want to account for expansion.

CONNECTORS, PATCH CORDS AND FIBER MANAGEMENT



FIBER OPTIC CONNECTOR POLISHES



FIBER OPTIC CONNECTOR TYPES



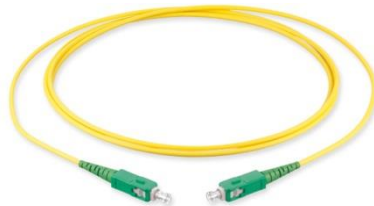
FIBER CABLE PATCH CORDS

- Fiber optic patch cords are used for **non-permanent connections** between patch panel, transmission equipment, etc. Pre-assembled fiber cables allow for the implementation of plug & play solutions.
- Cable assemblies can have any combination of connectors (SC/SC; SC/LC; SC APC/LC; etc.)
- Cable assemblies are used to be disconnected occasionally for testing or rerouting.

SIMPLEX



SC to SC



SC APC to SC APC



LC to LC

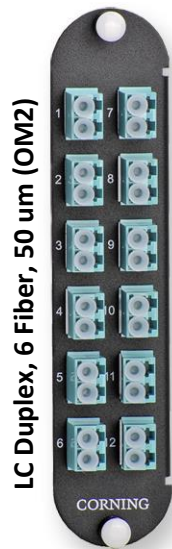
DUPLEX



LC Duplex to LC Duplex

CABLE CCHE PATCH PANELS – FIBER MANAGEMENT

- These panels are used with field-installable connectors or in applications where the pre-connectorised cables are routed directly from the equipment to the piece of inter-connect hardware. Patch panels are an efficient way to securely mate two or more connectors.
- Patch panels are available with a variety of industry-standard adapter types. In most applications, the housing panels are designed for applications where specified labeling and connector identification are required.
- These housings can come in 6, 12, 16 and 24 fiber CCHE panels



PATCH PANEL CONNECTOR HOUSINGS– FIBER MANAGEMENT

- Wall-mountable connector enclosures provide interconnect or cross-connect capabilities.
- These units can be used in telecommunication rooms and are available in different capacities:
 - 2 CCHE panels
 - 4 CCHE panels
 - 6 CCHE panels
 - 12 CCHE panels
- Optional accessories include jumper storage guide kit, and cable strain relief kits.



SPLICE TRAYS – FIBER MANAGEMENT

- Splice trays are suited to protect and manage fiber splices in the field, at transition points, and at end-of-splice locations.
- Can be used with either indoor or outdoor enclosures.
- Offers physical protection for fiber optic splices (or permanent fusions) of fiber optic cables.
- Splice trays are engineered for use with both loose tube and tight buffered optical cable design.



- Fusion splicing, a method of optical fiber termination, is the process of permanently fusing or welding two fibers together, usually by an electric arc.

INDOOR/OUTDOOR FIBER ENCLOSURES – FIBER MANAGEMENT

- Fibers cabinets are for intuitive and efficient cable routing and splitter storage.
- Fiber cabinets make splitter parking and cable toning simple,.
- These enclosures provide customers more flexibility and deployment options.
- Cabinet design allows for quick subscriber turn-up and error-free long-term maintenance as the cabinet is loaded to capacity.



MULTIPOINT TERMINAL SOLUTION – FIBER MANAGEMENT

- Are used for remote terminal fiber-to-the-antenna applications
- Is used in conjunction with fiber optic patch cords (also called cable assemblies or jumpers) to create the link between the remote radio unit and a tower-top consolidation.
- These enclosures provide customers more flexibility and deployment options.
- Cabinet design allows for quick subscriber turn-up and error-free long-term maintenance as the cabinet is loaded to capacity.



WHY DO WE NEED FIBER OPTICS?



ENTERPRISE CONNECTIVITY MARKET DRIVERS

Growth in data consumption is occurring across all access types



Fixed/Wired Access

24% CAGR

In data consumption
through 2015



Fixed/WiFi Access

39% CAGR

Access



Bandwidth



Mobile Access

92% CAGR

Growth in wired & wireless data access required an underlying IT infrastructure to service the demand.

ENTERPRISE CONNECTIVITY MARKET DRIVERS

Growth in data consumption is occurring across all access types



By 2016, Middle East
Africa IP traffic will
grow at

57% CAGR



Asia Pacific data
consumption will reach

**41.1 exabytes
per month**

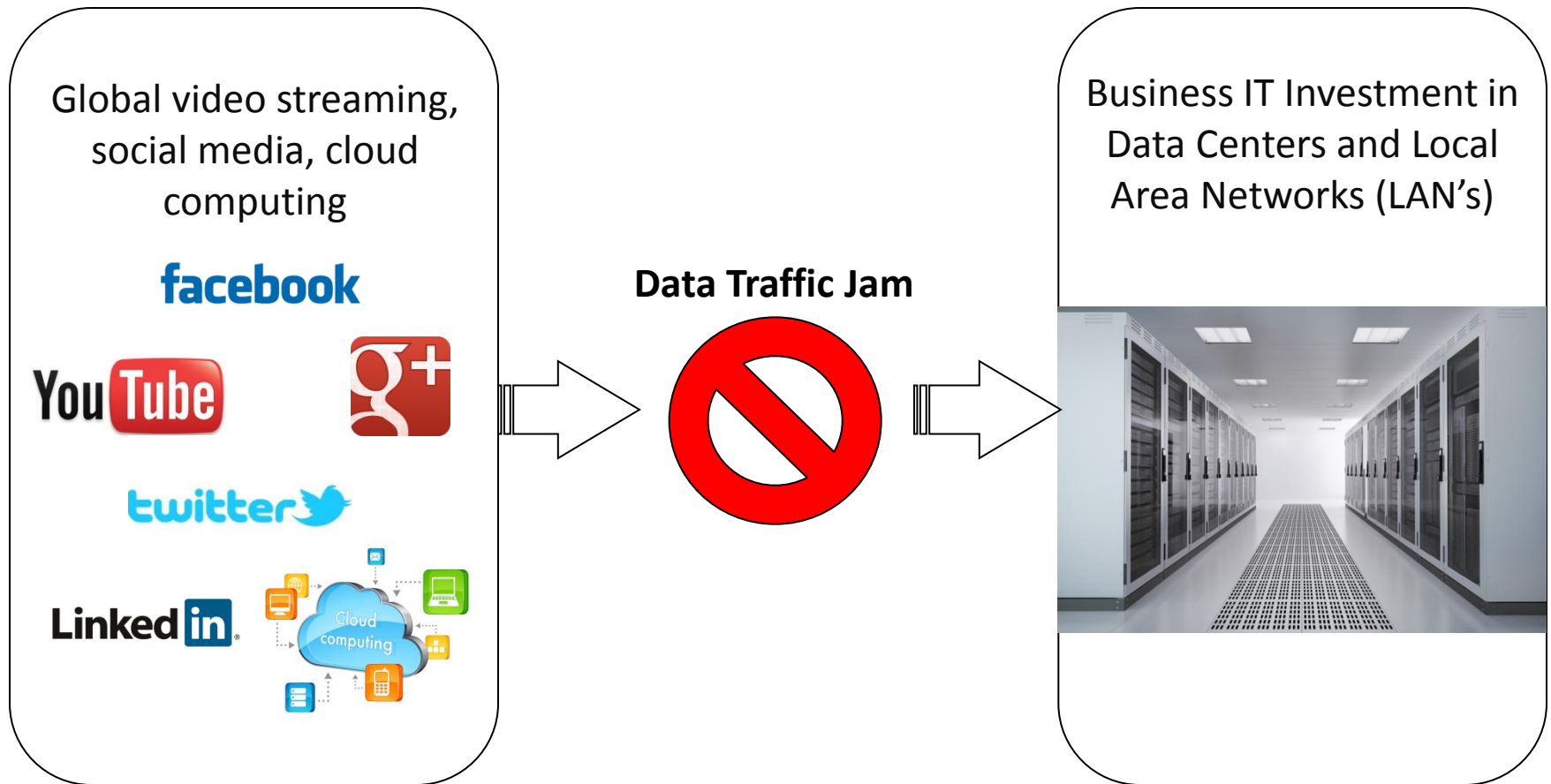


Latin America IP
traffic will grow at

49% CAGR

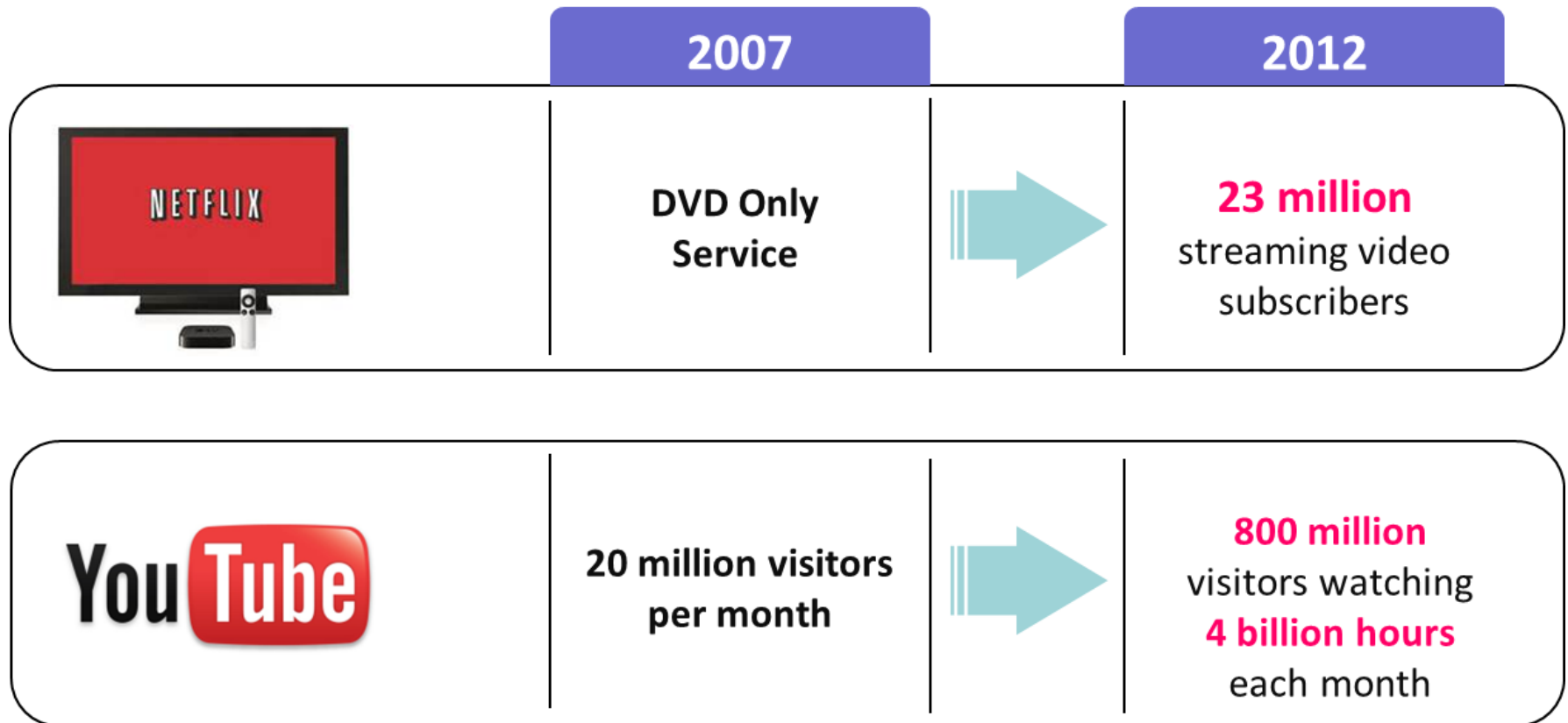
Growth in wired & wireless data access required an underlying IT infrastructure to service the demand.

ENTERPRISE CONNECTIVITY MARKET DRIVERS



Accelerating growth in global data consumption drives investment in the IT infrastructure.

ENTERPRISE CONNECTIVITY MARKET DRIVERS



Customers demand reliable transmission of data intensive streaming video, which requires high bandwidth and high performance IT infrastructure.

UNDERSTANDING THE FIBER APPLICATION

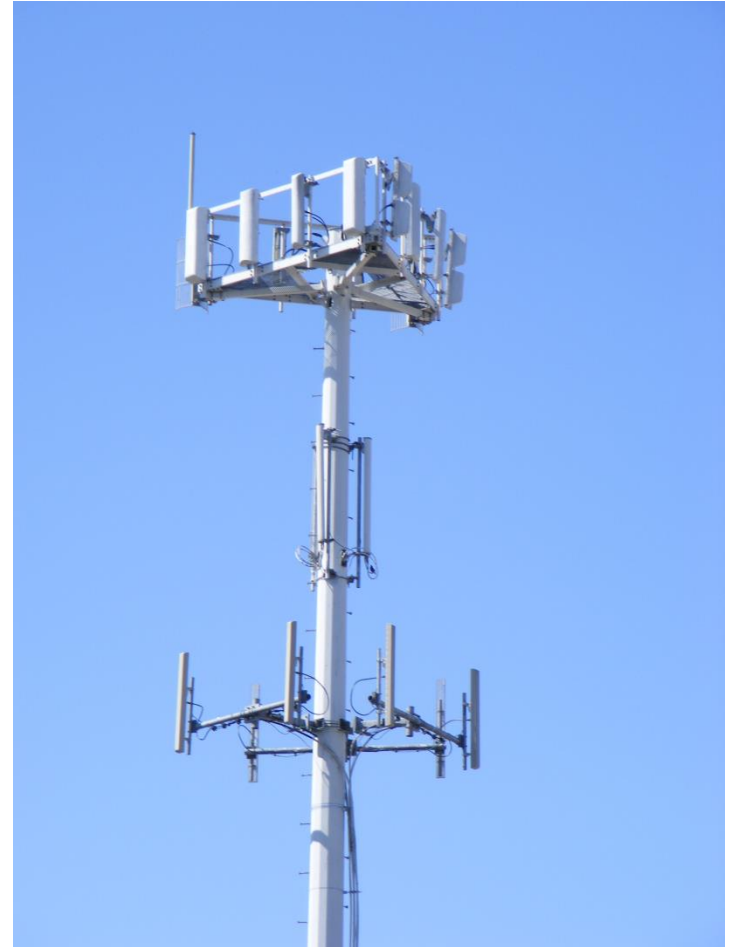


FIBER-TO-THE-ANTENNA (FTTA)

- Fiber-to-the-Antenna (FTTA)
- Fiber-to-the-Cell Site (FTTCS)

Examples of Fiber Products Included in this Application

- 1 MF2 or MF4 Multiport Terminal
- 2 Remote Radio Distribution Terminal
- 3 Sealed Remote Radio Distribution Terminal
- 4 Remote Radio Fiber Optic Cable Assembly
- 5 Module Rack-Mount Solution
- 6 Closet Connector Housings



indoor DISTRIBUTED ANTENNA SYSTEMS (iDAS)

- Airports
- Hotels
- Medical Centers
- Grocery Stores
- Military Bases
- Public Utilities
- Warehouses
- Storage Facilities
- Libraries
- Retail Chains
- SMB Enterprises
- Property Management

Examples of Fiber Products Included in this Application

- 1 Riser or Plenum Fiber Optic Cables
- 2 Composite Cables (Fiber & Power)
- 3 Armored or Non-Armored Cables
- 4 CCH Connector Panels
- 5 PCH Connector Housings
- 6 Fiber Optic Patch Cords



outdoor/indoor DISTRIBUTED ANTENNA SYSTEMS (oDAS/iDAS)

- Sports Arenas
- Campus Environments
- Amphitheaters
- Outdoor Storage Facilities
- Recreational Facilities/Parks
- “Downtown” City Venues

Examples of Fiber Products Included in this Application

- 1 Gel-Filled or Gel-Free Cable
- 2 Loose Tube or Unitized Cable
- 3 Plenum or Riser Cable
- 4 Armored or Non-Armored Cables
- 5 CCH Connector Panels
- 6 PCH Connector Housings
- 7 Fiber Optic Patch Cords

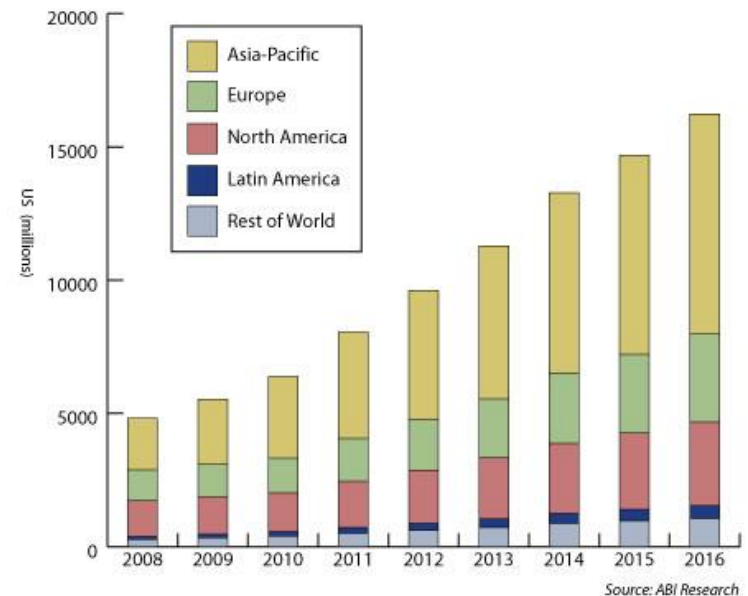


DAS: A GROWING MARKET SEGMENT

- Worldwide DAS revenues will reach \$16.23B by 2016
- Worldwide in-building systems CAGR is 20.9% (2008-2016)
- In North America, DAS revenues will reach \$3.137B by 2016
- Majority of DAS will be LTE and MIMO Systems
- DAS, Picocells and Femtocells
- Top purchasing factors will be:
 - Multi-Band/Service Capabilities
 - Scalability
 - Upgradeability
 - Reliability

Summarized from *ABI 2011 In-Building Wireless Systems Report*

In-Building Wireless Deployments Overview, Revenue by Region
World Markets, Forecast: 2008 - 2016



DAS: WHY IS IT A GROWING MARKET SEGMENT?

- Line of sight issues
- Dense tree cover
- Metro downtown / neighboring buildings
- Dense construction materials (i.e.: Glass, steel, block and bricks)
- Suburban & rural areas
- Dense interior wall and furniture schemes
- Underground structures such as basements and military bases
- LEED Guidelines for new “Green” building constructions



- (Since 9/11, more strict building codes have called for laminated glass, stronger steel supports, encased elevators, thicker concrete in stairwells etc. These all block RF signals from entering buildings).



DATA CENTER APPLICATIONS

DATA CENTER CLASSIFICATIONS

- **ENTERPRISE** : privately owned by private corporate, institutional or government entities.

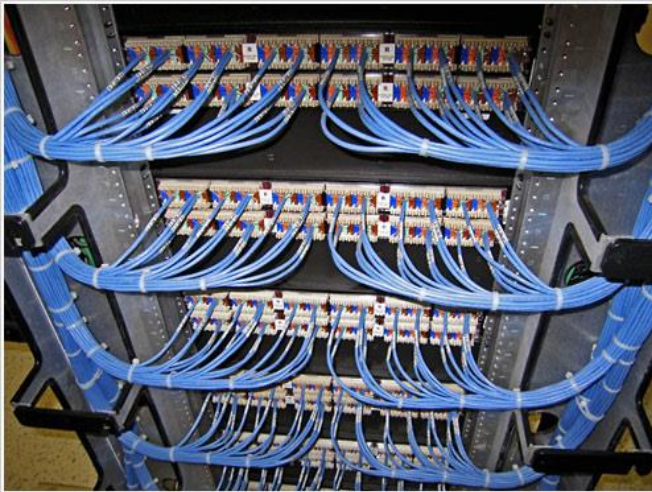
- Google
- Amazon
- Facebook
- Twitter
- Tech Startups
- Educational Institutions
- Research Institutions
- Hospitals/Healthcare
- Criminal Justice Systems
- Financial Institutions
- Local Government
- State Government
- Federal Government
- Defense Contractors
- Foreign Governments

- **CO-LOCATION** “co-lo” (owned and operated by telcos or unregulated competitive service providers). The data center equipment and space are available for rental to retail customers. These are “managed services”.

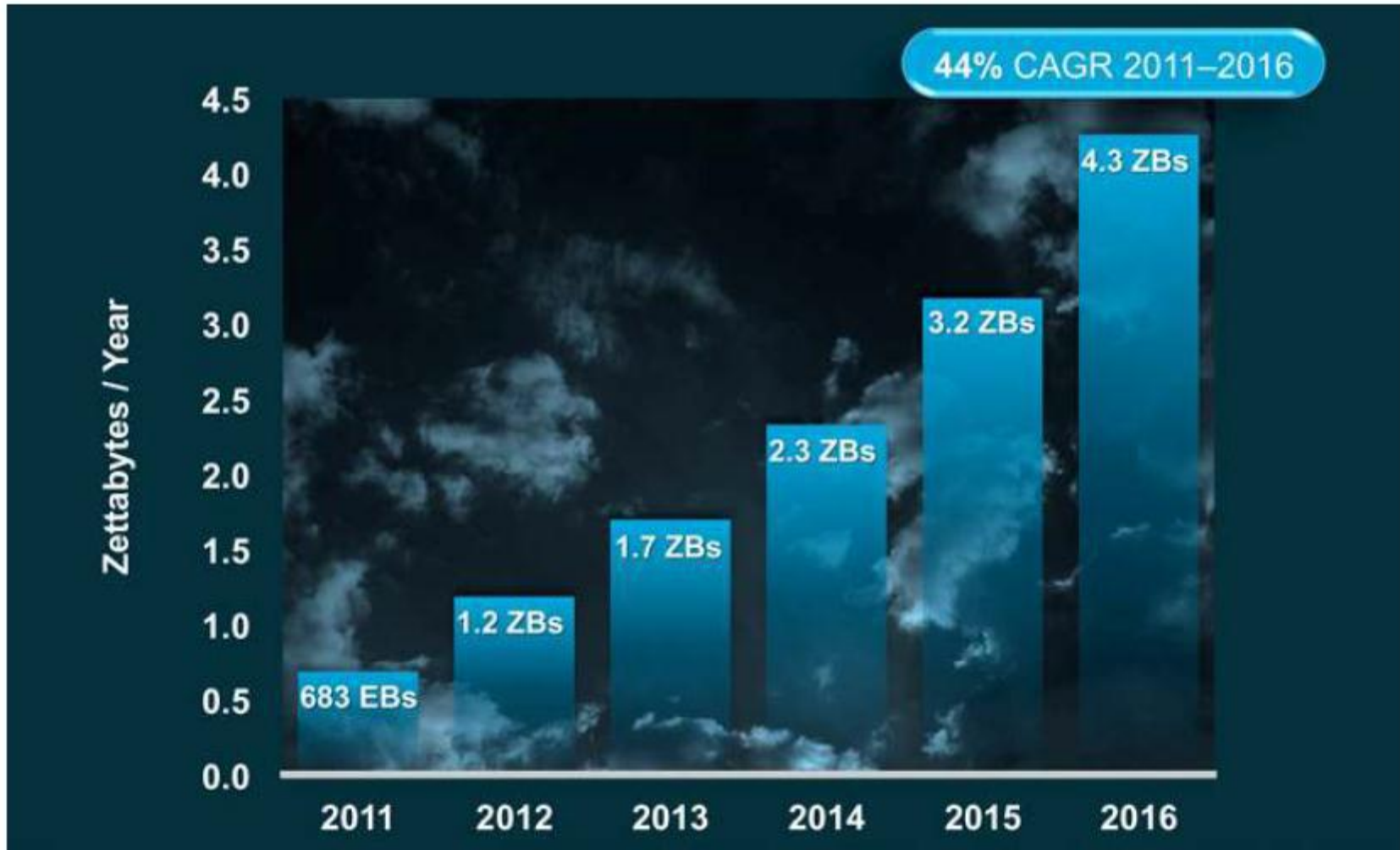
- Google
- Rackspace
- GoDaddy.com
- C7 Data Centers
- Colocation America
- Verizon “terremark”
- AT&T Datacenters
- Databank
- BurstNet
- PhoenixNAP
- Qualitytech
- INTERNAP
- telX
- Vantage Data Centers
- Intelligent Control (io)

MOST COMMON DATA CENTER SERVICES

- Internet Access
- Application & Web Hosting
- Content Distribution
- File Storage & Backup
- Web Hosting
- Database Management
- Fail-Safe Power
- HVAC Controls
- Security Configurations
- High-Performing Cabling Infrastructures



DATA CENTER TRENDS



WHAT IN THE WORLD IS A ZETTABYTE?

Name	Power	Number	SI symbol	SI prefix
One	0	1	-	uni
Ten	1	10	da	deca
Hundred	2	100	h	hecto
Thousand	3	1,000	k	kilo
Million	6	1,000,000	M	mega
Billion (Milliard)	9	1,000,000,000	G	giga
Trillion (Billion)	12	1,000,000,000,000	T	tera
Quadrillion	15	1,000,000,000,000,000	P	peta
Quintillion	18	1,000,000,000,000,000,000	E	exa
Sextillion	21	1,000,000,000,000,000,000,000	Z	zetta
Septillion	24	1,000,000,000,000,000,000,000,000	Y	yotta

DATA CENTER PRODUCTS (EXAMPLES)

Data Center Housings



PN: EDGE-01U-SP
SKU: 575860



PN: EDGE-04U

Multimode & Single Mode Patch Cords “Jumpers”



MTP Trunk Harnesses Single Mode & Multimode



DATA CENTER PRODUCTS (EXAMPLES)

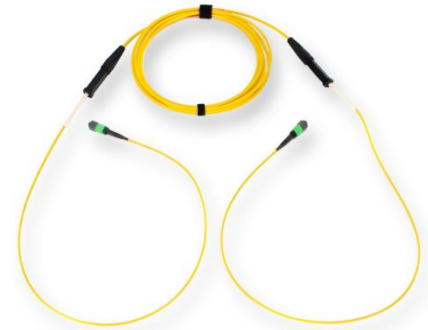
Modules Single Mode & Multi Mode



MTP Adapter Panels



Multimode & Single Mode Extender Trunks



Fiber Optics – Cables, Connectors & Hardware



CORNING

COMMSCOPE®

CABLES UNLIMITED

Optimum FiberOptics

Fiber Optic Product Questions?

contact

Jonathan Simpson

**Sr. Product Manager, Fiber Optics
Base Station Infrastructure Team
Extension: 1018**

