Fiber Optics for Data Centers

Foundational

This four-day course has been developed with two days of classroom learning and two days of hands-on skills labs, review, and certification testing. The course covers the fundamentals of fiber optic communication, installation techniques, testing, and maintenance, with a focus on practical applications and industry best practices. Participants will engage in hands-on exercises to ensure they are prepared to address the challenges and opportunities presented in modern data centers.

The labs provide the practical understanding and skills required to properly install and maintain fiber optic networks in data center environments. Students will learn how to splice, connectorize, test, and troubleshoot optical fiber networks to increase efficiency, reliability, and on-the-job safety as well as reduce costs and downtime. Following the lab sessions, those who have chosen to pursue ETA certification will complete their ETA certification testing.

Audience: IT professionals, data center managers, network engineers, and technicians who are responsible for the design, implementation, and maintenance of fiber optic systems in data centers

Prerequisite: Fiber Foundations is recommended, but not required.

Credentialing

ETA® International Fiber Optic Technician–Inside Plant (FOT-ISP)
Valid for four years.

Light Brigade Digital Badge
Complete this course and receive a Credly digital badge.

Click or scan for detailed course information and upcoming training locations.

For training, tools, or equipment:
1 (206) 575-0404 • 1 (800) 451-7128 • lightbrigade.com

Light Brigade®

Fiber Optics for Data Centers

Detailed Course Outline

Light Brigade®
FIBER OPTIC TRAINING

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Audience: IT professionals, data center managers, network engineers, and technicians who are responsible for the design, implementation, and maintenance of fiber optic systems in data centers.

Prerequisites: None. Entry level. Fiber Foundations (online) is recommended but not required.

Certifications and Credits: ETA Fiber Optic Technician–Inside Plant (FOT-ISP) Certification
Light Brigade Digital Credentialing

Classroom Lecture

Introduction to Fiber

- Fiber versus copper
- Advantages and benefits of fiber optics
- Fiber versus UTP
- Digital communications
- Media selection & bandwidth comparison
- The telecommunications revolution
- High-speed transmission rates
- Application areas of optical fiber
- Storage and data centers
- Network topologies

Fiber Optics Transmission Theory

- Basic signal communication
- The binary system
- What is an optical fiber?
- Primary fiber coatings and color coding
- Basic units of measure in fiber optics
- Total internal reflection
- Numerical aperture
- Refraction
- Optical reflection
- Fiber profile vs. reflection
- Reflection issues
- What is a mode?
- The electromagnetic spectrum
- Lightwave transmission
- Transmitters and receivers
- The dB and dBm scales
- Typical data center power levels
- Transceivers
- Fiber optic attenuation/loss
- Bandwidth
- Optical dispersion
- Fiber tolerances

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Standards and Codes

- Standards committees and bodies
- Common fiber optic standards
- Data center tier classifications
- The five nines
- Building codes
- National Electrical Code
- Indoor optical cable ratings
- National Electrical Safety Code
- ANSI/TIA standards
- System standards bodies

Safety Best Practices

- OSHA
- Fiber optic safety concerns
- Visual safety using magnification
- Laser safety
- Safety eyewear
- Working with optical fibers
- Chemical safety
- Safe cable handling
- Installation safety

Optical Fibers

- Optical fiber manufacturing
- The physical plant
- Multimode fiber types
- Multimode fiber specifications
- Single-mode fiber types
- Single-mode fiber specifications
- Mode field diameter
- Dispersion in single-mode fibers
- Lanes and speeds

Optical Cables

- Cable designs
- Cable materials and structure
- Low smoke zero halogen
- Distribution cables
- Breakout cables
- Interlocking armor cable
- Standard cable cordage
- Fiber coating and buffer color codes
- Indoor/outdoor cables
- Loose tube outside plant cables
- Stranded cables
- Unitube / central tube cables
- Ribbon cables
- Ultra high density fiber cables
- Microduct cables
- Sample optical cable specifications
- Composite and hybrid cables
- NEC specific requirements
- Cable termination

Connectors

- Connector standards
- Main connector components
- Single-fiber vs. multifiber connectors
- Typical connector roles
- What to look for in a connector
- Causes of excess loss
- Connector types
- Subscriber connectors
- BFOC/2.5 (ST) connectors
- LC connectors
- Multifiber push-on connectors
- Older and legacy connector styles
- Small form factor evolution
- Emerging connectors
- Hardened fiber optic connectors
- Termination techniques

Connector Endfaces

- Endface geometry
- Fiber optic connector inspection
- Clean connectors matter!
- The impacts of contamination
- Cleaning MPO connectors
- Fiber optic connector polishes

Fiber Management Products

- Fiber versus cable management
- Data center cabling
- ANSI/TIA-942 standard
- Wall-mounted premises panels
- Patch panels
- Cable trays and ducts
- Fiber raceway systems
- Patch and splice modules

- Splice panels
- Splice trays
- Optical distribution frames
- Underfloor and overhead
- Optical cable entrance facility
- Fiber distribution units
- Cable management
- Rack layout and sizing
- Labeling and administration

Topologies and Connectivity

- Modern data center architecture
- Server rack cable routing
- Top of rack switching
- End of row switching
- Backbones, links, and channels
- MPO connectors and adapter
- Trunk/patch cord polarity
- FOCIS-19 smaller format connectivity
- USFF/VSFF connectors
- Use of AOC/DAC cables
- Serial and parallel transmission
- Current and future network speeds
- Transceiver types and parameters

Splicing

- Connectors vs. splices
- Splicing specific considerations
- Fusion splicing
- Why do we need to splice?
- Anatomy of a fusion splicer
- Splicer cleanliness
- Choose the correct settings
- Perform regular arc tests
- Splice errors
- Cleanliness – strip tools
- Fiber cleaving
- Ribbon splicing
- Splicing operations
- Pitch conversion options
- Ribbonizing
- Pigtail splicing and splice-on connectors
- Termination techniques
- Protecting the splice

Installation

- Buildings and campuses
- Firestopping
- NEC article 770
- Fiber installation inspection reports
- Cable pre-pull planning
- Cable placement
- Short indoor runs
- Cable pulling
- Tension monitoring
- Sequential markings
- Installation errors

Test Equipment

- Optical loss test sets
- Optical time domain reflectometers
- Fiber identifiers
- Visual tracers
- Visual inspection
- Optical talk sets

Optical Testing

- Tests defined in standards
- ANSI/TIA test methods
- Certification test sets
- Testing terminology
- Measurement quality jumpers
- Launch conditions
- Encircled flux
- Mode suppressor loops
- One-jumper references
- MPO testing
- OTDR testing
- OTDR dead zones
- Index of refraction accuracy
- OTDR event signatures
- Optical dispersion testing
- Visual lasers for troubleshooting
- Simplex/duplex vs. MPO testing
- MPO link testing
- Polarity checks
- Identifying front and back connectors
- What to test in an AOC/DAC
- Cable test use cases

- Breakout cable testing
- Testing documentation
- Troubleshooting

Loss Budgeting

- Elements of system design
- Typical span distances
- Fiber optic receivers
- Link loss budget calculations
- Link vs. channel loss
- The need for lower attenuation

Twisted Pair Copper

- Copper cable
- Twisted pair cabling
- Category copper cable
- ANSI/TIA-568
- Termination types
- Insulation displacement
- Termination tooling
- Grounding and bonding
- Copper cable management
- Testing
- Wiremap
- Length
- Propagation delay and delay skew
- Insertion and return loss
- Crosstalk
- Patch cords

Wrap-up and Review

Hands-on Skills Learning

Review of Lab Safety Practices

Cable Preparation for Termination

- Identify fiber optic cable and jacket types.
- Prepare cable for installation into a fiber panel.
- Prepare a fanout kit.

Testing

- Inspect and identify connector contamination.
- Clean connector endfaces using wet and dry cleaning methods.
- Clean connectors using commercially available fiber optic cleaning products.
- Identify damaged connectors.
- Use an optical loss test set to observe the effects of a macrobend and microbend on a fiber.
- Learn proper test reference methods.
- Measure optical loss for various data center connector types and polarity schemes.
- Use a fiber identifier to detect active fibers.
- Test copper twisted pair assemblies to industry requirements.

Splicing and OTDRs

- Clean the test port and all connectors of an OTDR.
- Modify typical OTDR settings to obtain a clear interpretable trace.
- Recognize and interpret events depicted by an OTDR.
- Use an OTDR to test and identify events in a span.
- Use a launch box to identify events close to the OTDR.
- Strip and cleave an optical fiber.
- Modify typical splicer settings to obtain a high-quality splice.
- Perform arc calibration on a fusion splicer.
- Create fusion splices on various fiber types.

Connectors

- Prepare and install a mechanical splice-on connector.
- Prepare and install a fuse-on connector.
- Inspect and clean fiber connector endfaces.
- Use a visual fault locator to identify nearby bends and breaks.
- Prepare and terminate shielded and unshielded copper twisted pair cable using different tool methods.