Fiber Optics for Wireless

Foundational

This four-day instructor-led course provides the foundation needed to understand fiber optic applications and challenges in FTTA and small cell network applications. This course examines how fiber works and the fundamentals of different fibers, cables, connectors, and other hardware used in fiber optic communication networks. After learning the basics and nuances of fiber within wireless networks, attendees will build skills and best practices in hands-on labs for cable preparation, OTDR operation, and optical loss testing.

Audience: Installers, design engineers, project managers, field engineers, or anyone who is managing or installing fiber for a FTTA/cell site

Prerequisite: Fiber Foundations is recommended, but not required.

Credentialing

ETA® International Fiber to Any Antenna (FTAA)

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.

"The instructor showed ample knowledge not only in the field of fiber optics but in all industries that may use it."

—James Stephens, Schlumberger

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

Light Brigade®

Fiber Optics for Wireless

Detailed Course Outline

Light Brigade®
FIBER OPTIC TRAINING

This four-day instructor-led course provides the foundation needed to understand fiber optic applications and challenges in FTTA and small cell network applications. This course examines how fiber works and the fundamentals of different fibers, cables, connectors, and other hardware used in fiber optic communication networks. After learning the basics and nuances of fiber within wireless networks, attendees will build skills and best practices in hands-on labs for cable preparation, OTDR operation, and optical loss testing.

Prerequisites: None. Entry level.

Certifications and Credits: ETA Fiber to Any Antenna (FTAA) Certification
Light Brigade Digital Credentialing

Classroom Lecture

Introduction to Wireless
- Wired technology
- Wireless technology
- Wired/wireless synergies
- Mobile network demands
- Fiber to wireless deployments
- Bandwidth versus coverage

Optical Communications Basics
- Basic signal communication
- Digital communications
- The binary system
- What is an optical fiber?
- Primary fiber coatings
- Secondary fiber coatings
- Optical fiber color coding
- Basic units of measure in fiber optics
- Advantages of fiber optics
- Standards and codes
- Standards committees

Fiber Optic Transmission Theory
- The electromagnetic spectrum
- Fiber optic transmitters
- Fiber optic receivers
- Fiber optic loss
- The dBm scale
- Optical power loss
- Attenuation
- Lightwave transmission
- Refraction
- Total internal reflection
- Numerical aperture
- Optical reflection
- Optical dispersion
- Fiber tolerances
- Bandwidth

Optical Fibers
- The physical plant
- A fiber comparison
- What is a mode?
- Multimode fiber types and specifications
- Single-mode fiber types and specifications

Optical Cable
- Cable designs
- Cable materials and structure
- Indoor optical cable ratings
- Ammonium octamolybdate (AOM)
- Distribution cables
- Breakout cables
- Tight buffered cable specifications
- Interlocking armor cable
- Standard cable cordage
- Standard cordage color coding
- Indoor/outdoor cables

835 N Central Avenue Ste. D-132
Kent WA 98032

1 (206) 575-0404
1 (800) 451-7128

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- Loose tube outside plant cables
- Stranded cables
- Unitube/central tube cables
- Ribbon cables
- Ultra high density fiber cables
- Microduct cables
- Aerial fiber optic cables
- Drop cables
- Optical cable specifications
- Binder color code charts
- Composite and hybrid cables
- Power for wireless networks
- Cable termination
- Cable elements

Fiber Optic Connectors

- FOCIS
- IEC 61754
- Connector components and roles
- What to look for in a connector
- Causes of excess loss
- Connector types
- Subscriber connector (SC)
- BFOC/2.5 (ST)
- LC connector
- Multifiber push-on connectors
- Older connector styles
- Legacy connector styles
- Small form factor evolution
- Emerging connectors
- Drop cable terminations
- Hardened fiber optic connectors
- Termination techniques
- Attenuators
- Launch boxes and optical terminators

Connector Endfaces

- Endface geometry
- Fiber optic connector inspection
- Contaminated or damaged?
- Clean connectors matter!
- Fiber optic connector inspection
- Dust dimensions
- Connector inspection criteria
- Fiber optic endface inspection
- Reflection issues
- Fiber optic connector polishes
- Fiber profile vs. Reflection

Splicing

- Connectors vs. Splices
- Why do we need to splice?
- Splicing considerations
- Fiber cleaving
- Common fiber optic cleavers
- Cleave defects
- Cleave angle
- Cleaved ribbon fibers
- Fusion splicing
- Ribbon splicing technology
- Mechanical splicing
- Pigtail splicing and splice-on connectors
- Protecting the splice

Fiber & Cable Management

- Fiber management
- Rack space
- Cable management
- Patch panels
- Splice panels
- Optical entrance enclosures
- Fiber distribution units
- Splice closures
- Splice trays
- Fanout and breakout kits
- Buildings and campuses
- Wall-mounted premises panels
- Fiber raceway systems
- Work area outlets
- Fiber to the building installations
- OSP fiber and cable management
- FTTx cable management products
- OSP cable management overview
- Fiber distribution hubs
- Fiber access terminals
- Multiport service terminals
- Fiber transition terminals
- Cabling scenarios
- Vaults and handholes
- Panel and closure considerations

Installation

- Optical cable installation
- Cable handling
- General guidelines
- Standards, regulations, and codes
- Air blown fiber
- Topologies
- Cable trays and duct benefits
- Cable installation products

OSP Installation

- Underground installation techniques
- Proper route planning & engineering
- Cable trenching
- Direct buried
- Plowing
- Directional boring
- Equipment requirements
- Conduit and duct installation
- Microducts for fiber optic cables
- Cable pulling methods
- Tension monitoring
- High air speed blown
- Aerial installation and placement
- Utility applications of fiber optics
- Mid-span (express) entries
- Slack storage methods
- Cable storage
- Sequential markings
- Fiber installation inspection report

Test Equipment

- Optical loss test equipment
- Optical time domain reflectometers
- Fiber identifiers
- Visual tracers
- Visual inspection
- Optical talk sets
- Optical dispersion testers
- Chromatic dispersion
- Polarization mode dispersion
- Testing documentation

Optical Testing

- Fiber optic testing
- ANSI/TIA-568 testing terminology
- Test methods
- Multimode launch conditions
- Optical loss testing with a mandrel
- Mode suppressor loop
- Measurement quality jumpers (MQJ)
- Reference testing methods
- Insertion loss method
- Loopback IL testing
- “Not to exceed” attenuation reports
- Testing input and output power
- OTDR deadzone
- OTDR signatures
- Gainers on OTDR traces
- Fiber roll-off
- Testing fiber optic splitters
- Key points to understanding IOR
- IOR accuracy settings
- Optical dispersion
- Important documentation

Loss Budgets

- Loss budget basics
- Safety margin
- Multimode system budgets
- Multimode wavelength optimization
- Multimode fiber size compatibility
- “Not to exceed” chart for multimode spans
- Single-mode wavelength optimization
- Single-mode system budgets
- “Not to exceed” chart for single-mode spans
- 5G using FTTx PON networks
- Point to multipoint system budgets
- P2MP system budgets

Fiber to the Macrocell

- Fiber to the Antenna
- Macrocell components
- Fiber to the tower architecture
- Common public radio interface
- Impact on installation and testing
- Installing hybrid cable to tower top
- Sectors

- Shifting color codes
- Installation considerations
- Loopback testing
- Loopback devices
- Before connecting

Fiber to the Microcell

- The migration to 5G
- Microcells
- Path to 5G via microcells
- 5G radio spectrum
- Point to multipoint 5G
- Optical splitters
- Latency
- Optical splitter types
- WDMs and bidi devices

Distributed Antenna Systems

- What is DAS?
- Early DAS
- DAS versus microcells
- In-building DAS (i-DAS)
- Passive DAS
- Active optical DAS
- Hybrid DAS
- In-building coverage
- o-DAS
- Impact on the fiber technician
- Connectors and enclosures

Safety Best Practices

- Fiber optic safety concerns
- Visual safety using fiber optic sources
- Wavelength and the eye
- Laser classifications
- Working with lasers
- Safety eyewear
- Working with optical fibers
- Personal protective equipment
- Chemicals
- Safety data sheets (SDS)
- The work area
- Installation practices
- Cable installation safety
- Aerial safety
- RF safety

Hands-on Skills Learning

Splicing and Cable Preparation

- Fusion and pigtail splicing
- Fiber handling and cleaving
- Loose tube cable preparation
- Breakout and distribution cable preparation
- Patch panel and splice closure preparation
- Mid-entry practices

OTDR Operation

- Acceptance testing
- Reflection testing
- Span testing and splice loss
- Emergency restoration
- Troubleshooting

Optical Loss Testing with FTTA Simulator

- Measuring transmit and receive power
- Performing end-to-end and link loss measurements
- Documentation
- Troubleshooting with optical loss test sets, visual fault finders, and fiber identifiers
- Connector inspection and cleaning
  - Visual inspection of fiber end faces based on quality control criteria
  - Identifying contamination
  - Cleaning connector end faces

Class Review and Q&A