



# Fiber Optics for Wireless

Detailed Course Outline

This four-day course examines how fiber works and the different fibers, cables, connectors, and other hardware used in fiber optic communication networks with a focus on FTAA and small cell applications. After learning the basics and the nuances of fiber within wireless networks, attendees will build skills and best practices in hands-on labs for fiber splicing, cable preparation, OTDRs, and optical loss testing.

**Prerequisites:** None. Entry level.

**Certifications and Credits:** ETA Fiber to Any Antenna (FTAA) Certification  
Light Brigade Certificate of Completion

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## Classroom Lecture

### Introduction to Wireless

- Wired technology
- Wireless technology
- Wired/wireless synergies
- Coverage versus capacity

### Communications Basics

- Digital communications
- What is an optical fiber?
- Fiber coatings
- Optical fiber color coding
- Basic units of measure in fiber optics
- Advantages and disadvantages
- Standards committees

### Fiber Optic Transmission Theory

- The electromagnetic spectrum
- Fiber optic transmitters
- Fiber optic receivers
- Optical power
- The dBm scale
- Loss and attenuation
- Refraction
- Total internal reflection
- Numerical aperture
- Optical reflection
- Optical dispersion
- Fiber tolerances
- Bandwidth

### Optical Fibers

- The physical plant
- Fiber comparison
- What is a mode?
- Multimode fiber characteristics
- Multimode optical fiber types
- Application supported distance
- Single-mode fiber characteristics
- Mode field diameter
- Single-mode optical fiber types
- Dispersion in single-mode fibers

### Cable

- Cable materials and structure
- Indoor optical cables
- Distribution cables
- Armored cable
- Breakout cables
- Fiber optic cable cordage
- Indoor/outdoor cables
- Loose tube outside plant cables
- Ribbon cables
- Microduct cables
- Aerial fiber optic cables
- FTTx drop cables
- Typical optical cable specifications
- Fiber and buffer color codes
- Composite and hybrid cables
- Cable interconnection options

## Connectors

- Main connector components
- Connector types
- What to look for in a connector
- Typical connector roles
- Subscriber connector (SC)
- BFOC/2.5 (ST)
- LC connector
- Multifiber connectors
- Older connector styles
- Termination techniques
- Fiber optic connector inspection
- Cleaning methods
- Single-mode field connectorization issues
- Attenuators
- Terminators

## Splicing

- Why do we need to splice?
- The splicing sequence
- Splicing considerations
- Fiber cleaving
- Common fiber optic cleavers
- Fusion splicing
- Ribbon splicing
- Mechanical splicing
- Pigtail splicing
- Protecting a splice

## Fiber and Cable Management

- Fiber management scenarios
- Rack and wall mount patch panels
- Splice panels
- Optical entrance enclosures
- Fiber distribution units
- Splice closures
- Splice trays
- Fanout and breakout kits
- Fiber raceway systems
- Work area media outlets
- Fiber to the building installations
- OSP fiber and cable slack management
- FTTx cable management products
- Fiber distribution hubs
- Fiber access terminals
- Multipoint service terminals
- Fiber transition terminals
- Vaults and handholes
- Panel and closure considerations

## Installation

- Cable handling
- Guidelines for fiber optic cable installation
- Standards, regulations, and codes
- Air blown fiber
- Cabling buildings
- Cable trays and cable duct benefits
- Cable installation products

## OSP Installation

- Underground installation techniques
- Proper route planning and engineering
- Conduit and duct installation
- Cable pulling methods
- Tension monitoring
- Air blown fiber
- Aerial installation
- Utility applications of fiber optics
- Mid-span (express) entries
- Storage methods and products
- Sequential markings

## Test Equipment

- Optical loss test sets
- Optical time-domain reflectometers (OTDRs)\*
- Key considerations for OTDRs
- Fiber identifiers
- Visual tracers
- Visual inspection
- Optical talk sets
- Optical dispersion testers
- Testing documentation

## Optical Testing

- TIA-568 testing terminology
- Test methods
- Multimode launch conditions
- Optical loss testing with encircled flux or mandrel
- Reference test methods
- Insertion loss method
- "Not to exceed" charts
- Testing transmitter and receiver power
- OTDR deadzone
- OTDR signatures
- Gainers on OTDR traces
- Fiber roll-off
- Testing through fiber optic splitters
- Key points to understanding IOR
- Documentation

## Communication System Basics

- Fiber optic transmitters
- Laser light sources
- Light sources in multimode systems
- Laser and LED spectral width
- Reflection concerns
- Fiber optic receivers
- Typical span distances
- Repeaters, regenerators, and amplifiers
- Basic components for optical transmission
- Optical splitters
- WDMs and bidi devices
- CWDM and DWDM

## Loss Budgets

- Design options for fiber optic networks
- Safety margins
- Multimode system budgets
- 10/40/100 Gigabit networks
- Single-mode system budgets
- Loss budgets for FTTx networks (point-to-multipoint)

## Macrocell

- Fiber to the tower architectures
- Tower installation and testing
- Installing hybrid cable to tower top
- Tower top connector inspection
- Sectors
- Shifting color codes
- Loopback testing
- Loopback devices

## Microcell

- The migration to 5G
- Path to 5G via microcells
- 5G radio spectrum

## Distributed antenna systems (DAS)

- What is DAS?
- Early DAS
- DAS versus microcells
- In-building DAS
- Passive DAS
- Active optical DAS
- Hybrid DAS
- In-building coverage and placements
- Outdoor DAS (o-DAS)

- o-DAS in venues
- o-DAS smart cities

## Safety

- Fiber optic safety best practices
- Visual safety using fiber optic sources
- Wavelengths 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
- Aerial safety issues
- RF safety

## Wrap-up and Review

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## Hands-on Skills Learning

### Fiber Splicing (120 minutes)

- Fusion / mechanical / pigtail
- Fiber handling and cleaving

### Cable Preparation (180 minutes)

- Loose tube cable preparation
- Breakout and distribution cable preparation
- Patch panel and splice closure preparation
- Mid-entry practices

### OTDR Operation (120 minutes)

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

### Optical Loss Testing (180 minutes)

- Link loss measurement
- Transmit and receive power
- Visual inspection and cleaning
- Variable and fixed attenuators

### Class Review Q&A (120 minutes)