INTUS SMARTCITIES CUTI DIVISION

FTTH Deployment & Management Training

A 4-Week Comprehensive Engineering & Technician Management Curriculum

Target Audience: Engineering & Technician Students

Focus: Deployment Management & Function Mastery

Format: 4-Week Intensive Course Outline

Course Overview & Educational Philosophy

This 4-week intensive curriculum is designed for engineering and technician students in partnership with the INTUS Smartcities CUTI Division. The primary objective is not to mold students into hyperspecialized tactical operators in every single sub-discipline, but to provide a comprehensive, holistic understanding of the **entire Fiber-to-the-Home (FTTH) deployment lifecycle**. Students will master the operational necessity, cross-functional dependencies, and managerial touchpoints required to successfully oversee modern broadband infrastructure projects.

> **Core Pedagogical Goal:** Bridge the gap between theoretical optical engineering and field-level execution, ensuring future project managers understand the complex interplay between logical network architecture, civil works, permits, and ongoing operations.

WEEK 1

Week 1: Theoretical Foundations, IP Network Design & OSP Network Design

1.1 Fiber Optics Physics & XGSPON Architecture

- **Light Propagation & TIR:** Fundamentals of Total Internal Reflection $n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$, core/cladding refractive index differentials, and single-mode vs. multi-mode structures.
- **Standards & Attenuation:** Deep dive into ITU-T G.652 (standard OSP) and ITU-T G.657 (bend-insensitive) fiber, alongside attenuation mechanics, macrobending limits, and logarithmic decibel scaling (dB / dBm).
- **XGSPON Principles:** Architecture of 10-Gigabit Symmetrical Passive Optical Networks, optical power budgeting, split ratios (1x32 cascade layouts), and oversubscription traffic modeling.

1.2 IP Network Design Overview

- **End-to-End Logical Architecture:** Tracing data flow from the residential Optical Network Terminal (ONT) through the Optical Line Terminal (OLT), aggregation switches, and core routers to the Internet Exchange.
- **Core Requirements & Configuration:** VLAN segmentation strategies, IP subnetting, QoS (Quality of Service) policies for voice/video/data, and separating management traffic from subscriber data payloads.

1.3 Outside Plant (OSP) Network Design & Layout

- **Physical Infrastructure Topology:** Mapping out the path from the Central Office/POP to the Fiber Distribution Hub (FDH) cabinet, splice closures (FOSC), Multiport Terminals (MPTs), and subscriber drop layers.
- **Subsurface & Aerial Planning:** Placement criteria for multi-duct conduit systems, micro-ducts, ground-level pull boxes, handholes, pedestals, and pole-attachment engineering.

1.4 GIS Tools & Design Locates

- **Geospatial Data Capture:** Utilizing Geographic Information Systems (GIS) to create digital twins of physical plant assets, splicing records, and duct routes.
- **Design-Stage Locates:** Integrating preliminary utility maps into GIS platforms during the engineering phase to identify potential utility conflicts before field operations begin.

WEEK 2

Week 2: POP/Telecom Closet, Middle Mile, Permitting & Municipal Compliance

2.1 POP/Telecom Closet & Middle Mile Transport

- **POP Facilities Design:** Engineering requirements for Point of Presence (POP) shelters and technical closets, including AC/DC power plants, HVAC environmental controls, structural grounding, and OLT chassis placement.
- **Middle Mile Transport Links:** Connecting local aggregation hubs to regional Internet Exchanges (IX) via high-capacity fiber routes or high-frequency licensed/unlicensed microwave radio links.

2.2 Municipal & Environmental Permitting

- **Regulatory Frameworks:** Identifying local, county, and state municipal requirements for right-of-way (ROW) access, encroachment permits, and highway crossing authorizations.
- **Environmental Compliance:** Managing federal and state environmental reviews (such as NEPA/NHPA) for rural builds crossing wetlands, protected habitats, or historic districts.
- **Engineering Drawings for Permitting:** Specialized drawing sets mandated by municipalities showing bore profiles, traffic control plans, pavement restoration details, and setback boundaries.

2.3 Utility Locating & One-Call Systems

- **The 811 Ecosystem:** Understanding the government-mandated "Call Before You Dig" ticket lifecycle, legal mandates, and cross-utility clearance protocols.
- **Dedicated Locating:** Implementing private, dedicated pre-construction locating teams to sweep proposed routes, verify utility depths, and prevent catastrophic strikes and project delays.

WEEK 3

Week 3: Construction Methodologies (IFCs), Splicing & Asset Management

3.1 Construction Methodologies & IFC Drawings

- **Issued for Construction (IFC) Drawings:** Interpreting blueprint specifications, stationing markers, boring paths, and detail callouts that govern field execution.
- **Trenching & Micro-Trenching:** Open-cut pavement mechanics, standard depth compliance (minimum 1.0-meter bury depth for distribution), and restorative paving standards.
- **Horizontal Directional Drilling (HDD):** Physics of directional boring, drill entry/exit pit planning, tracking beacon calibration, mud/polymer fluid management, and vacuum excavation (hydrovac) potholing for cross-utility clearance.

3.2 Overview of Splicing & Optical Validation

- **Preparation & Cable Management:** Outdoor moisture-blocked jacket stripping, buffer tube management, ring-cutting, and environmental sealing inside dome enclosures.
- **Fusion Splicing Standards:** Core-alignment fusion splicing techniques targeting strict insertion loss thresholds ($\leq 0.05\ dB$ per splice).
- **Testing & Diagnostics:** Using Optical Power Meters (OPM) and Optical Time-Domain Reflectometers (OTDR) at 1310/1550/1577 nm wavelengths to validate link budgets and isolate faults.

3.3 Asset Management & As-Built Documentation

- **Inventory & Material Tracking:** Managing Bills of Materials (BOM), reel tracking, cabinet serial numbers, and hardware deployment logs.
- **As-Built Conversion:** Transitioning from design drawings to verified As-Built GIS records, capturing actual depth deviations, splice point coordinates, and slack loop locations.

WEEK 4

Week 4: Network Operations, Monitoring & Capstone Project Management

4.1 Network Operations Center (NOC) & Monitoring

- **24/7 Network Oversight:** Understanding the role of the NOC in monitoring overall network health, active equipment alarms, and traffic congestion metrics.
- **GIS-Based Alarm Visualization:** Leveraging GIS dashboards tied directly to network management systems to instantly visualize fault locations geographically, drastically reducing Mean Time to Repair (MTTR).

4.2 Quality of Experience (QoE) & Maintenance Scheduling

- **Performance Metrics:** Monitoring latency, packet loss, optical signal levels (Rx optical power at the ONT), and Wi-Fi performance to ensure subscriber satisfaction.
- **Predictive Maintenance:** Transitioning from reactive break-fix operations to proactive maintenance schedules based on telemetry trends and threshold alerts.

4.3 Capstone Deployment Management Project

- **Project Lifecycle Synthesis:** Students synthesize all four weeks into a comprehensive management portfolio, reviewing a simulated regional FTTH rollout plan from initial feasibility through construction, permitting, splicing, and live NOC operation.