

FTTH Training Programme and Certification for Telecommunications Service Technicians

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Document Authorities

Document Details	Name
Author(s)	Michael Hansen
Contributors	Bernard Lee
	Victoria Ong Siow Fern
	Michael Chee

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1. Introduction

1.1.1. Objectives of Manual

The objectives of this Manual are to provide a consistent training guideline for Service Technicians who are involved with the service provisioning and fault fixing of Fibre to The Home services.

1.1.2. Intended Audience

FTTH Service Provider: Managers, Service Technicians, Field Managers and Training Providers.

1.2. Related Reference Material

Although the following documents provide related reference material, they may or may not be referenced directly in this document:

Document Title
FTTH Council APAC Request, Assessment, Endorsement, and Certification process for FTTH Training Programmes
FTTH Council EU Training Handbook
FTTH Council FTTH Standards Handbook

1.3. Glossary of Terms Used

The following list describes some of the terms used in this document:

Term	Description
ABF	Air Blown Fibre
ABFAT	Air Blown Fibre Access Terminal
FAT	Fibre Access Terminal
FTTH	Fibre to the Home
FFP	Fibre Flexibility Point
GPON	Gigabit Passive Optical Networking
H-ONT	Home Optical Network Terminal
ITU	International Telecommunications Union
NOA	National Qualifications Authority
OFDF	Optical Fibre Distribution Frame
RGW	Residential Gateway
T & M	Test and Measurement
xPON	x Passive Optical Networking

2. FTTH Training Programme

2.1. Purpose

This Outline defines the Learning Outcomes that Service Technicians need to achieve in order to gain the Skills and Certification required for carrying out the following activities on their national FTTH Network:

- Basic FTTH Testing and Measurement
- FTTH Service Provisioning & Commissioning
- FTTH Service Fault Troubleshooting and Fault Fixing
- Basic Business Process Workflows and Records Management for FTTH Provisioning and Fault Fixing

These Learning Outcomes are intended to bring existing copper provisioning Service Technicians and new Trainee Service Technicians up to the required skill level to support basic activities for FTTH Service Provisioning and Fault Fixing on an individual FTTH Customer circuit.

Optical Health and Safety considerations for the Customer and the Service Technician are a particular area of focus for this Training and Certification activity.

2.2. Prerequisites

It is assumed that the Service Technicians undertaking this FTTH Training Programme and Certification will hold a relevant National Telecommunications Qualification, or be undertaking a course of study to achieve this.

The National Telecommunications Qualification provides basic knowledge and skills for effectively and safely working on Telecommunications Networks.

This basic knowledge and skills are a prerequisite for undertaking this FTTH Training Programme and Certification.

People not holding a relevant National Telecommunications Qualification may undertake the Learning Modules described in this Training Programme in order to gain a general appreciation of FTTH knowledge and skill areas.

However, it is unlikely that they will be able to gain the full Certification.

2.3. Scope

The scope of activity is defined as covering Service Provisioning and Fault Fixing activities for an individual FTTH Customer circuit from the GPON port in the Central Office or FFP through to the H-ONT and / or RGW at the End Customer's premises.

The scope of activity does not include Network Design, Build, Testing, Commissioning or Complex Fault Troubleshooting and Fault Fixing activity on Communal Fibre Infrastructure on the Fixed Fibre Network. Training and Certification for these areas are managed separately.

Provisioning issues or Faults proved into the Communal Fibre Infrastructure will be referred to the appropriate group for resolution.

The scope of activity includes Service Provisioning and Fault Fixing of an individual FTTH Customer circuit at an individual dwelling or multi dwelling unit.

It is assumed that:

- The individual dwelling will have communal infrastructure existing from the Central Office and / or FFP to the property boundary.

- The individual multi dwelling unit will have communal infrastructure existing to the external wall.
 - The scope of activity does not include Network Design, Build, Testing, Commissioning or Complex Fault Troubleshooting and Fault Fixing activity on Communal Fibre Infrastructure within an MDU. Training and Certification for these areas are managed separately.
 - Provisioning issues or Faults proved into the Communal Fibre Infrastructure will be referred to the appropriate group for resolution.
-

3. Training and Certification

Service Technicians shall successfully undertake and complete learning, assessment, and certification for all modules prior to gaining overall Programme Certification.

Programme Certification will be valid for three years. Service Technicians shall undertake refresher training on a three-yearly basis in order to maintain Programme Certification.

3.1. Categories

Each Module is allocated one of the following three categories:

Fundamental: Learn knowledge and practical skills via lecture and practical demonstration. Apply knowledge and practical skills in a classroom/laboratory environment.

Intermediate: Practical application and assessment of knowledge and skills in a production (live) network environment.

Advanced: Practical application of knowledge and skills:

- In a production (live) network environment, and;
 - In a design and job management environment, and;
 - In advanced troubleshooting and fault fixing activities
-

3.3. Fundamental Modules

- Comprising** : Learning & Written Assessment
- Objectives** : Learn knowledge and practical skills via lecture and practical demonstration
: Apply knowledge and practical skills in a classroom/laboratory environment.
- Prerequisite** : None
- Recommended Duration** : 3~5 days

Learning Outcomes:

- FTTH Architecture and Network Overview
- Residential and Business Fibre Services
- Understand the technical requirements to design, build & operate a FTTH infrastructure from end-to-end.
- Acquire basic skill in installation design, installation & maintenance work for FTTH infrastructure.

Teaching Methodology:

- Lecture room & Demonstration

Course Structure

Topic	Sub Topics	Key Subjects	Skillsets to be developed
Fundamental of Fiber Optics	<ul style="list-style-type: none"> • Introduction of optical fiber technology and operational principles • Optical Fiber construction for various ITU-T compliant optical fibre and their key features • Optical Fiber cable construction for various installation environments and safety 	<ul style="list-style-type: none"> • History of optical fibre • Fibre fabrication techniques • Optical fibre construction • Light propagation • Optical fibre characteristics, including but not limited to: attenuation, return loss, reflection loss, scattering, absorption, mode field diameter. 	<ul style="list-style-type: none"> • Identify different fiber characteristics scenario (Bending, mode field diameter attenuation & optical return loss) • Recognition of fiber type (G652 & G657) and connector types • Recognition of fiber cable type (Blown and Conventional for Underground & Aerial applications)

	<ul style="list-style-type: none"> requirements Optical Fiber connectivity methods available in the market and their selection criteria Optical Fiber characteristics: The Do's and Don'ts when handling fibre Optical Fiber cleanliness: The No: 1 enemy for FTTH networks 	<ul style="list-style-type: none"> Optical fibre mechanical and environmental attributes Fibre optic technologies, including fixed fibre and air blown fibre Optical safety, standards and practices Modes of propagation, and multiplexing used in Fibre Optics Basic Power loss Budgets (relationship of dB/dBm to power) Cables and connectors used in provisioning: cable types, connector types, standards, construction, colour coding (including bend insensitive fibre) Network hygiene, fibre connector cleaning and inspection requirements, requirement to inspect before connection, acceptable inspection practice (safety when inspecting), inspecting and testing with a fibre inspection probe and automated Software. Common tools and practices for testing and measurement Service commissioning 	<ul style="list-style-type: none"> Fiber connector end face inspection and cleaning with proper tools All health and safety procedures followed (e.g. laser eye safety & fiber handling) Successful fusion splices within the acceptable loss budget of 0.05dB/splice. Successful assembly of field instable connector within the acceptable loss budget of 0.3dB/connector
Introduction to FTTH	<ul style="list-style-type: none"> Why Deploy FTTH and what are the advantages over xDSL & Wireless technologies? FTTH Fiber Components commonly found and what are their key functions & features? FTTH Network Architecture & Design approaches and considerations FTTH Network Installation phases 	<ul style="list-style-type: none"> Evolution of FTTH (History & advantages compared to conventional access network) Definition of different Fttx network FTTH Market Analysis and Update FTTH Architecture and Network Overview (Passive) FTTH Architecture and Network Overview (Active) Basic FTTH Component and Installation FTTH network design principles FTTH component standards including IEC, ITU, GR as applicable to National environment. 	<ul style="list-style-type: none"> Design a typical FTTH network Recognition of FTTH network component Installation on Fiber closure, splitter, termination box & Drop panel box

		<ul style="list-style-type: none"> Passive optical network Standards including GPON & EPON as applicable to National environment 	
Introduction to FTTH Testing	<ul style="list-style-type: none"> FTTH Test & Measurement Equipment and how are they different from conventional ones The importance of Insertion Loss & Optical Return Loss Testing FTTH Testing Phases and its respective methodologies FTTH Troubleshooting: Who are the usual suspects PON OTDR Specification & Test Method 	<ul style="list-style-type: none"> Typical FTTH Test & Measurement Tools Insertion Loss Testing (IL) Optical Return Loss Testing (ORL) OTDR Specification and test method FTTH Budget Loss Calculation FTTH Testing Phase (Deployment, service activation & monitoring phase) FTTH typical network fault FTTH Troubleshooting method Report & Documentation 	<ul style="list-style-type: none"> Testing of insertion loss on PON simulation network Testing of Optical return loss on PON simulation network Exhibit proper OTDR configuration (Pulse width, IOR, Resolution & Duration) Exhibit troubleshooting skill on typical FTTH network fault (High IL, No signal, Bad ORL & bending scenario) End to End FTTH network budget loss calculation

3.3.1. FTTH Training Modules

Module 1 Fibre Fundamentals

Module 2 FTTX Installation

Module 2 FTTX Installation – Endorsement for Air Blown Fibre

Module 2 FTTX Installation – Endorsement for Fault Finding and Damage Rectification

Module 3 Core Networks

Module 4 Structured Cabling

Module 1 Fibre Fundamentals

A.1.1. Fibre Basics, Connector Cleaning, Inspection and Testing

Learning Outcomes:

- History of optical fibre
- Fibre fabrication techniques
- Optical fibre construction
- Light propagation
- Optical fibre characteristics, including but not limited to: attenuation, return loss, reflection loss, scattering, absorption, refractive index
- Optical fibre mechanical and environmental attributes
- Fibre optic technologies, including fixed fibre and air blown fibre
- Optical safety, standards and practices
- Modes of propagation, and multiplexing used in Fibre Optics
- Basic Power loss Budgets (relationship of dB/dBm to power)
- Cables and connectors used in provisioning: cable types, connector types, standards, construction, colour coding (including bend insensitive fibre)
- Network hygiene, fibre connector cleaning and inspection requirements, requirement to inspect before connection, acceptable inspection practice (safety when inspecting), inspecting and testing with a fibre inspection probe and automated Software.
- Common tools and practices for testing and measurement
- Service commissioning
- Basic fault finding

Skills:

- Recognition of Fibre types by sight
- Recognition of Connectors on sight
- Cleaning fibres with acceptable tools
- Performing automated testing of fibre terminations
- Select connector by sight for a given situation
- Perform inspection of fibre before connection
- Clean fibre terminations & re-inspect before connection.
- Perform simple power measurements
- Compare measurements with expected levels.

A.1.2. Mechanical Splicing

Learning Outcomes

Knowledge:

- Key aspects of Mechanical Splicing including methodology and Health & Safety.
- Factors affecting splice quality
- Preparation of cables for splicing
- Risks to health during splicing, Hazard minimisation/Use of PPE
- Performing the splice
- Protecting the splice

Skills:

- Follow safe work practices
- Use stripping tools to prepare a cable for splicing
- Manage hazards and fibre off-cuts
- Perform cleaving of fibre
- Mechanical connectors
- Use of mechanical splice tool
- Abilities:
- Prepare a cable for splicing in a controlled condition
- Perform a pigtail splice in a controlled condition
- Evaluate quality of the resultant splice
- Protect the resultant splice.

Practical Assessment and Accreditation

- 10 Successful mechanical splices within the acceptable loss budget of 0.1dB
- All health and safety procedures followed
- Fibre handling skills exhibited

A.1.3. Fusion Splicing (Cladding Alignment)

Learning Outcomes

Knowledge:

- Key aspects of Fusion Splicing including methodology and Health & Safety.
- Factors affecting splice quality
- Preparation of cables for splicing
- Risks to health during splicing, Hazard minimisation/Use of PPE
- Performing the splice
- Protecting the splice

Skills:

- Follow safe work practices
- Use stripping tools to prepare a cable for splicing
- Manage hazards and fibre off-cuts

- Perform cleaving of fibre
- Operate the Fusion Splicer

Abilities:

- Prepare a cable for splicing in a controlled condition
- Perform a pigtail splice in a controlled condition
- Evaluate quality of the resultant splice
- Protect the resultant splice.

Practical Assessment and Accreditation

- 10 Successful fusion splices within the acceptable loss budget of 0.1dB
- All health and safety procedures followed
- Fibre handling skills exhibited

Module 2 – FTTX Installation

A.2.1. Industrial FTTH Standards

Learning Outcomes:

- Understand FTH Standards including IEC, ITU, GR as applicable to the local National environment.

A.2.2. Safety at Heights and Aerial Installations

Learning Outcomes: To be defined by local Operator based on local conditions.

- Worksite health and safety
- Safety at heights
- Working in proximity to power cables
- Traffic management
- Certification requirements
- Installation of fibre aerial feeds using local products and practices.

A.2.3. FAT and Cabinet End Tasks and Configuration

Learning Outcomes:

- Site Safety
- Procedures and timelines for Work Orders
- Preparation of cables for splicing
- Use and care of equipment
- Hygiene of open FAT
- Power meter testing
- Optical splitters
- Fibre trays & records
- FIP testing
- Fibre lead-in at FAT including fusion splice
- Cabinet configuration
- Records systems management

Skills:

- Extract information from a Work Order
- Prepare for an installation
- Use network components

Practical Assessment and Accreditation:

- Perform splicing required at the FAT
 - Perform cabinet configuration to specified requirements
 - Perform commissioning tests.
 - Complete records and documentation
-
-

Module 2 – FTTX Installation (Endorsement for Air Blown Fibre)

A.2.4. Air Blown Fibre Blowing

Learning Outcomes:

- ABF duct products and types used in FTTH networks
- Hygiene of open FAT and ABFAT (Fixed Fibre Only)
- Fibre blowing (Microcable and Enhanced Performance Fibre Unit (EPFU))
- Tube cleaning systems and duct verification methods
- Use of compressor equipment
- ABF fibre blowing
- Tool management
- Tool maintenance, problem solving.

Practical Assessment and Accreditation

- 6 x Boundary connections
- 6 x Straight joints
- 6 x Boundary drop joints
- Blow fibre in a controlled environment

Module 2 – FTTX Installation (Endorsement for Fault Finding and Damage Rectification)

A.2.5. Fixed Fibre Fault Finding and Damage Rectification

Learning Outcomes

Knowledge:

- An understanding and identification of key points of quality
- An understanding of Fixed Network Fibre products including handling limits such as bend radius etc.
- Fundamental concepts of Fixed Fibre
- Fault finding methodology, boundary joints, straight joints, branch joints, boundary connections, ETP terminations, fault repairs, for fixed fibre then fault repairs may need a separate section and be closely related to OTDR use.

Practical Assessment and Accreditation

- 5 x Boundary connections
 - 5 x Straight joints
-

A.2.6. Air Blown Fibre Fault Finding and Damage Rectification

Knowledge:

- An understanding and identification of key points of quality
- An understanding of Air Blown Fibre products including handling limits such as bend radius etc.

- Fundamental concepts of fibre blowing
- Fault finding methodology, boundary joints, straight joints, branch joints, boundary connections, ETP terminations, fault repairs, fibre blowing.

Practical Assessment and Accreditation

- 6 x Boundary connections
- 6 x Straight joints
- 6 x Boundary drop joints

Module 3 - Core Networks

A.3.1. xPON Subrack / Module

Learning Outcomes:

- Layer 2 Network Topology: Star, Mesh, CFAN etc.
- Layer 2 Network Standards and Protocols
- TDM, MPLS, GPON, SIP, IP, Ethernet, TR-069, ATA, ENNI / UNI, CVLAN/SVLAN, VLAN tagging
- Service descriptions as used in the network (OVC, CVC etc)
- Technologies and Skills for xPON Subrack / Module: network placement
- Power & earthing
- Alarms
- Cabling
- Card layout
- Card changing
- Commissioning
- Configuration
- Testing & measurement
- Troubleshooting & end to end fault finding methodology
- Health and Safety
- Isolation and ESD practices

A.3.2. Core Alignment Fusion Splicing

Learning Outcomes

Knowledge:

- Key aspects of Fusion Splicing including methodology and Health & Safety.
- Factors affecting splice quality
- Preparation of cables for splicing
- Risks to health during splicing, Hazard minimisation/Use of PPE
- Performing the splice
- Protecting the splice

Skills:

- Follow safe work practices
- Use stripping tools to prepare a cable for splicing
- Manage hazards and fibre off-cuts
- Perform cleaving of fibre
- Operate the core alignment Fusion Splicer

Abilities:

- Prepare a cable for splicing in a controlled condition
- Perform a pigtail splice in a controlled condition
- Evaluate quality of the resultant splice
- Protect the resultant splice.
- Manage Spliced fibre to avoid macrobends

Practical Assessment and Accreditation

- 10 Successful fusion splices within the acceptable loss budget of 0.05dB or less
- All health and safety procedures followed
- Fibre handling skills exhibited

Module 4 – Structured Cabling

A.4.1. Structured Cabling for Local Network Environment

Learning Outcomes

- Cat5 & Cat6 Structured Cabling standards and practices in individual premises and MDU's.
- Health and safety
- Demonstrate knowledge of telecommunication fundamentals relevant to structured cabling.
- Demonstrate knowledge of electrical protection of structured cabling.
- Demonstrate knowledge of fireproofing.
- Understand local building regulations relating to building penetrations and reinstatement.
- Demonstrate an understanding and application of key structured cable standards.
- Demonstrate knowledge of National Premises Wiring Code of Practice and the reasoning behind these standards.
- Demonstrate ability to produce a structured cabling design for a customer's premises based on the relevant standards, documentation and customer requirements.
- Demonstrate ability to generate an accurate Bill of Materials (BOM) for the designed installation and apply relevant costing and pricing to the design.
- Demonstrate ability to plan and prepare for installation of structured cabling systems.
- Demonstrate ability to install structured cabling systems to the appropriate standards.
- Demonstrate ability to acceptance test structured cabling systems to qualification level.
- Demonstrate ability to hand over structured cabling system to customer / end-user.
- Demonstrate ability to Fault find and repair structured cabling systems.

3.4. Intermediate Modules

Comprising : Learning & Practical Assessment

Objectives : Learn knowledge and practical skills via hands-on lab
: Apply knowledge and practical skills

Prerequisite : Fundamental

Recommended Duration : 3~5 days

Learning Outcomes:

- Understand the technical requirements to design, build & operate a FTTH infrastructure from end-to-end.

- Acquire basic skill in installation design, installation & maintenance work for FTTH infrastructure.

Teaching Methodology:

- Focus Group Demonstration & Practical Assessment of Fundamental Modules.

3.5. Advance Module: Practical Application - *Advanced*

Comprising

- Participate as a team member in six 'live' FTTH Service Provisioning requests.
- Observe and learn from experienced staff, and apply knowledge and practical skills under supervision of Field Manager.
- Troubleshoot and repair six individual FTTH Service faults.

Objectives

- This activity to be carried out following successful completion of Labs.
- Activity and assessment is to be carried out under the direct supervision of an accredited Field Manager.
- The scope of activity is defined as covering from the xPON port in the Central Office through to the ONT and / or RGW at the End Customer's premises. It includes all elements of the FTTH circuit including all Access Network FFP's, pits, joints, enclosures, cabinets and pillars.
- The scope of activity includes a single FTTH Customer Service connection at an individual dwelling or multi dwelling unit.

Prerequisite : Intermediate

Recommended Duration : 5~6 days

Learning Outcomes:

- Live network experience

Teaching Methodology:

- Live network installation, testing and troubleshooting
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3.6. Three Yearly Assessment, Refresher Training and Re-Certification - *Advanced*

Provider: Approved Private Training Establishment

Comprising: Field Activity, Learning & Assessment

Audience: Service Technicians & Field Managers
