
# University of Otago

# Building Technologies – Standards Suite

## CHAPTER 4: IT INFRASTRUCTURE – PASSIVE OPTICAL LAN STANDARD

# DOCUMENT CONTROL

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# BUILDING TECHNOLOGIES STANDARDS SUITE INDEX

This document is only one chapter of the University of Otago Building Technologies Standards Suite.

The Building Technologies Standards Suite consists of the following chapters (chapter highlighted refers to this document):




## Acknowledgements

The University of Otago, New Zealand, acknowledges with thanks the assistance and contribution of a number of organisations, institutions, statutory bodies, and individuals in the preparation of these Standards. In particular, the assistance of the following parties is acknowledged:

Torque IP, CommScope and University of Otago IT Staff

# Contents

# 1 DOCUMENT PURPOSE

This document is CHAPTER 4: IT INFRASTRUCTURE – PASSIVE OPTICAL LAN STANDARD and forms part of the University of Otago Building technologies Standards Suite.

The Building Technologies Standards Suite covers the following Information and Communication Systems. Each system is presented as a separate chapter:

- Chapter 1 – Introduction to Building Technologies Standards Suite
- Chapter 2 - Cabling Infrastructure Pathways Standard
- Chapter 3 - IT Infrastructure – Generic Cabling Systems Standard
- Chapter 4 - IT Infrastructure – Passive Optical LAN Cabling Standard
- Chapter 5 - Electronic Safety and Security (ESS) Systems Standard
- Chapter 6 - Closed Circuit Television (CCTV) System Standard
- Chapter 7 - Audio Visual (AV) Cabling Standard
- Chapter 8 – Labelling Standard

Its purpose is to provide design consultants and contractors with the guidance to be followed when designing, installing, maintaining, or performing changes to a University of Otago Passive Optical LAN system.

# 2 USING THIS DOCUMENT

This document shall be read in conjunction with all other chapters in the BUILDING TECHNOLOGIES STANDARDS SUITE that carry other relevant information regarding the installation of a Passive Optical LAN solution, including but not limited to Pathways, Equipment rooms, Cabinets, Security, AV, CCTV and documentation requirements.

Design consultants, contractors and University staff shall refer to CHAPTER 1: INTRODUCTION TO BUILDING TECHNOLOGY STANDARDS for an overview of the standards suite requirements.

# 3 REFERENCED DOCUMENTS

Reference is made in this document to the following:

## 3.1. NEW ZEALAND STANDARDS

| | |
|---|---|
| NZS 3604:2011 | Timber framed buildings |
| NZS 4219:2009 | Seismic performance of engineering systems |
| NZS 6801:2008 | Acoustics - Measurement of environmental sound |
| NZS 6802:2008 | Acoustics - Environmental noise |

## 3.2. JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

| | |
|---|---|
| AS/NZS ISO 717.1:2004 | Acoustics – Rating of sound insulation in buildings and of building elements-airborne sound insulation |
| AS/NZS 2107: 2016 | Acoustics – Recommended design sound levels and reverberation times for building interiors |
| AS/NZS 1367:2016 | Coaxial cable and optical fibre systems or the RF distribution of analogue and digital television and sound signals in single and multiple dwelling installations |
| AS/NZS 1768:2007 | Lightning protection |
| AS/NZS 2107:2016 | Acoustics – Recommended design sound levels and reverberation times for building interiors |
| AS/NZS 3000:2007 | Electrical installations (known as the Australian/New Zealand Wiring Rules). The cited version of AS/NZS 3000 as per the Electrical (Safety) Regulations 2010. |
| AS/NZS 1680 | Interior and workplace lighting |
| AS/NZS 11801-1:2019 | Information technology — Generic cabling for customer premises — Part 1: General requirements |
| AS/NZS 3084:2013 | Telecommunications installations – Telecommunications pathways and spaces for commercial buildings |
| AS/NZS 3085.1:2004 | Telecommunications installations – Basic requirements |
| AS/NZS 4296:1995 | Cabling trunking systems |

| | |
|---|---|
| AS/NZS 61000.6.3:2012 | Electromagnetic compatibility (EMC) - Part 6.3: Generic standards - Emission standard for residential, commercial and light-industrial environments |
| AS/NZS CISPR 22:2009 | Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement |
| AS/NZS 14763.2:2017 | Telecommunications installations – Implementation and operation of customer premises cabling - Part 2: Planning & Installation |
| AS/NZS 14763.3:2017 | Telecommunications installations – Implementation and operation of customer premises cabling - Part 3: Testing of optical fibre cabling |
| AS/NZS IEC 61935.1:2012 | Specification for the testing of balanced and coaxial information technology cabling – Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards |

## 3.3. AUSTRALIAN STANDARDS

| | |
|---|---|
| AS 3996:2019 | Access covers and grates |
| AS 11801.2:2019 | Information technology — Generic cabling for customer premises — Part 2: Office premises |
| AS 11801.3:2019 | Information technology — Generic cabling for customer premises — Part 3: Industrial premises |
| AS 11801.4:2019 | Information technology — Generic cabling for customer premises — Part 4: Single Tenant Homes |
| AS 11801.5:2019 | Information technology — Generic cabling for customer premises — Part 5: Data Centres |
| AS 11801.6:2019 | Information technology — Generic cabling for customer premises — Part 6: Distributed building services |
| AS ISO 140.4:2006 | Acoustics – Measurement of sound insulation in buildings and of building elements - Field measurements of airborne sound insulation between rooms |
| AS/CA S008:2020 | Requirements for customer cabling products |

| | |
|---|---|
| AS/CA S009:2020 | Installation requirements for customer cabling (Wiring Rules) |

## 3.4. OTHER PUBLICATIONS

| | |
|---|---|
| New Zealand Building Code | Compliance document for New Zealand Building Code – Clause C Protection from Fire (including amendments 2 and 3)<br><br>Compliance document for New Zealand Building Code – Clause E2 External Moisture (including all amendments)<br><br>Compliance document for New Zealand Building Code – Clause G9 Electricity (including amendment 6) |
| ITU G.984 | Gigabit PON (Asynchronous 2.5/1.25 Gbps) |
| ITU G.987 | XG-PON (Asynchronous 10/2.5 Gbps) |
| ITU G9807 | XGS-PON (Synchronous 10/10 Gbps) |
| ITU G.989 | NG-PON2 (Synchronous 40/40 Gbps) |
| Building Industry Consulting Service International, Inc (BICSI) | Telecommunications Distribution Methods Manual (TDMM), 14th Edition |
| Otago University Campus Passive Fire Guide | Volume 1 – General<br>Volume 2 – Product Selection<br>Volume 3 – Basic Solutions |

## 3.5. ADDITIONAL MATERIAL

The following publications and websites are not referenced in this document but provide additional guidance for designers and contractors.

## 3.6. JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

| | |
|---|---|
| AS/NZS 2967:2014 | Optical fibre communication cabling systems safety |
| AS/NZS 60079.10.1:2009 | Explosive atmospheres – Classification of areas – Explosive gas atmospheres |
| AS/NZS 2967:2014 | Optical fibre communication cabling systems safety |

## 3.7. INTERNATIONAL STANDARDS

| | |
|---|---|
| ISO/IEC 11801-2:2017 | Information Technology – Generic cabling for customer premises – Part 2: Office premises |
| ISO/IEC 11801-3:2017 | Information Technology – Generic cabling for customer premises – Part 3: Industrial premises |
| ISO/IEC 11801-4:2017 | Information Technology – Generic cabling for customer premises – Part 4: Single Tenant Homes |
| ISO/IEC 11801-5:2017 | Information Technology – Generic cabling for customer premises – Part 5: Data Centres |
| ISO/IEC 11801-6:2017 | Information Technology – Generic cabling for customer premises – Part 6: Distributed Building Services |
| ISO/IEC 11801-3:2017 | Information Technology – Generic cabling for customer premises – Part 3: Industrial premises |

## 3.8. OTHER PUBLICATIONS

| | |
|---|---|
| Building Industry Consulting Service International, Inc. (BICSI) | Outside Plant Design Reference Manual (OSPDRM), 6th Edition |

## 3.9. WEBSITES

http://www.legislation.govt.nz/

http://www.otago.ac.nz

http://www.telepermit.co.nz/PtcSpecs.html

## 3.10. LATEST REVISIONS

The users of this document shall ensure that their copies of the above-mentioned New Zealand Standards and the New Zealand Building Code are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on http://www.standards.co.nz.

# 4 DEFINITIONS AND ABBREVIATIONS

For the purposes of this document the following definitions and abbreviations shall apply.

## 4.1. Definitions

| Term | Definition |
|---|---|
| Application Specific Cabling | System manufacturers design |
| As-built | Final set of drawings produced at the completion of a construction project, including all changes made to the original construction drawings |
| Building backbone cabling | Cable that connects the building distributor to a floor distributor |
| Campus | An area or site which contains a number of university buildings, and includes the grounds in which a cabling system is installed |
| Campus backbone cabling | Cable that connects the campus distributor to the building distributor(s) |
| Campus distributor | Distributor from which the campus backbone cabling starts |
| Category 6 (Cat 6) | A definition of cabling components which provide AS/NZS 11801-1 Class E performance |
| Category 6A (Cat 6A) | A definition of cabling components which provide AS/NZS 11801-1 Class EA performance |
| Catenary wire | A wire supported at two points kept under mechanical tension to provide a support to which cabling may be fastened. |
| Channel | End-to-end transmission path connecting two pieces of application specific equipment (includes patch leads and work areas cables) |
| Clear working spaces | A ventilated working space allowing quick unrestricted egress or escape in the event of emergency |
| Consolidation Point | Connection point in the horizontal cabling subsystem between a floor distributor and a telecommunications outlet |

| Term | Definition |
|---|---|
| Contractor | Where the term “Contractor” is used within this document it shall be interpreted as the “Communications Contractor”. |
| Designer | A person who plans the look, or workings, or both, of something prior to it being made, by preparing drawings or plans |
| Distributor | The term used for a collection of components (such as patch panels, patch cords) used to connect cables |
| Enclosure | A housing for accommodation of equipment and cabling that includes mounting rails and protective panels |
| Equipment footprints | The vertical and horizontal planes occupied by a piece of equipment in normal operation |
| Generic cabling system | Structured telecommunications cabling system, capable of supporting a wide range of standardized applications. Standards based design |
| Horizontal cabling | Cable connecting the floor distributor to the terminal equipment outlets |
| Installer | A person that places or fixes equipment or machinery in position ready for use. The party(s) responsible for the supply, installation, testing and warranty of cabling systems |
| Integrator | A person that places or fixes active IT equipment e.g. network switching, Wireless Access Points, servers, desktop computers etc. in position and configures, programs them ready for use. The party(s) responsible for the supply, installation, testing and warranty of active equipment systems |
| Manufacturer | A person or company that makes cabling goods for sale |
| Passive Optical LAN | An alternative method of networking and cabling a building or campus, utilising single mode fibre instead of traditional copper cabling systems, with network switching hardware. The Passive Optical LAN uses carrier grade equipment, comprising of an OLT headend and ONT nodes to transmit voice, video and data up to 20Km. |

| Term | Definition |
|---|---|
| Power Over SCS or GCS cabling | Power over structured telecommunications cabling (application specific cabling) or power over generic cabling (non-application specific cabling), |
| Permanent link | Transmission path between the telecommunications outlet and the floor distributor |
| Service Distributor (SD) | Equivalent to distributor 1 in ISO/IEC 11801-1 |
| Service Outlet (SO) | Equivalent to a TE Outlet in ISO/IEC 11801-1 |
| Site | See **Campus** |
| Structured Cabling System | Specific cabling solution designed with a set of cabling and connectivity products that are constructed (engineered) according to standardised rules to facilitate specific connectivity requirements e.g. Nurse Call (Staff Assist). Legacy design. |
| Suitably qualified person | A person with the professional qualifications and experience in the industry to undertake the design and supervision of the works |
| Terminal Equipment Outlet (TEO) | Fixed connecting device which provides and interface to the terminal equipment. N.B. The term telecommunications outlet is used in some other parts of the ISO/IEC 11801 series, while the term terminal equipment outlet is used within AS/NZS 11801-1 and this document. |
| Velcro™ | A proprietary form of Hook & Loop fastener/cable tie |
| | |

## 4.2. Abbreviations

| | | | |
|---|---|---|---|
| AFFL | Above Finished Floor Level | ODF | Optical Distribution Frame |
| AV | Audio Visual | OFCS | Optical Fibre Communication Systems |
| BD | Building Distributor | OLT | Optical Line Terminal |
| BoM | Bill of Materials | ONT | Optical Network Terminal |
| BUDI | Building Distribution | OSP | Outside Plant |
| BTSS | Building Technology Standards Suite | OTDR | Optical Time Domain Reflectometer |
| CAD | Computer Aided Design | PABX | Private Automatic Branch Exchange |
| CD | Campus Distributor | PCC | Passive Optical LAN Command Centre |
| CES | Communications Earth System | PDU | Power Distribution Unit |
| CoC | Certificate of Compliance | PHD | Primary Home Distributor |
| CP | Consolidation Point | PE | Polyethylene |
| DB | Electrical Distribution Board | PL | Permanent Link |
| EMC | Electromagnetic Compatibility | PLC | Planar Lightwave Circuit (Type of POL Splitter) |
| ES1 | Energy Source Class I | PoE | Power over Ethernet |
| ES2 | Energy Source Class II | POL | Passive Optical LAN |
| ES3 | Energy Source Class III | PON | Passive Optical Network |
| ESC | Electrical Safety Certificate | RCBO | Residual Current Breaker (with overcurrent protection) |
| ETP | External Termination Point | RCD | Residual Current Device (No overcurrent protection) |
| FDH | Fibre Distribution Hub | RDT | Rapid Deployment Terminal |
| FFP | Fibre Face Plate | RFI | Radio Frequency Interference |
| FOBOT | Fibre Optic Break Out Termination | RJ45 | Registered Jack Number 45 |

| | | | |
|---|---|---|---|
| F/UTP | Overall screened cable with unscreened twisted pairs (often referred to as FTP) | RMA | Return to Manufacturer Authorisation |
| GbE | Gigabit (per second) Ethernet | RU | Rack Unit |
| GPO | General Purpose Electrical Outlet | SC | Subscriber Connector |
| GCS | Generic Cabling System | SC/A | Subscriber Connector / Angled |
| IT | Information and Communications Technology | SCS | Structured Cabling System |
| IDC | Insulation Displacement Connection | SCP | Service Concentration Point |
| IP | Internet Protocol | SD | Services Distributor |
| LAN | Local Area Network | S/FTP | Overall braid screened cable with foil screened twisted pairs (often referred to as STP or PiMF) |
| LC | A small form factor optical fibre connector type (Lucent Connector) | SFF | Small Form Factor |
| LC/A | Lucent Connector / Angled | SMOF | Single Mode Optical Fibre |
| LSPM | Light Source and Power Meter | SO | Service Outlet |
| LSZH | Low Smoke Zero Halogen | SPD | Surge Protection Device |
| MAC | Moves Adds Changes | TAC | Technical Assistance Centre |
| MATV | Master Antenna Television | TEO | Terminal Equipment Outlet |
| MCB | Miniature Circuit Breaker | TO | Telecommunications Outlet |
| MER | Main Equipment Room | TR | Telecommunications Room |
| m | Metre | TRC | Telecommunications Reference Conductor |
| mm | Millimetre | UoO | University of Otago |
| MCB | Miniature Circuit Breaker | UPS | Uninterruptible Power Supply |
| MPO | Multi-fibre Push On | uPVC | Unplasticised polyvinyl chloride |
| MPTL | Modular Plug Termination Link | UTP | Unshielded Twisted Pair |

| | | | |
|---|---|---|---|
| MUTO | Multi User Telecommunications Outlet | UV | Ultraviolet |
| | | WA | Work Area |
| | | WAP | Wireless Access Point |
| | | WLAN | Wireless Local Area Network |
| | | | |

# 5 CABLING SYSTEMS: OVERVIEW

## 5.1. Passive Optical LAN

The Communications Contractor and designer shall comply with this chapter of the standard and shall adhere to other related sections requirements for the supply and installation of Passive Optical LAN (POL) Systems.

## 5.2. General

This Passive Optical LAN (POL) chapter provides specific extents of design, standards, installation practices, product specifications and documentation aspects of a POL cabling system only. Active components are mentioned within this standard only, but specific integration and hardware requirements are the responsibility of the University IT Infrastructure Team.

The standard has been written to ensure that a cost-effective solution is provided without compromising any standards or safety issues, and that the design has been completed in consultation with Otago University requirements.

## 5.3. Extent of work covered by this standard

This standard covers the supply, delivery, installation, commissioning, testing, placing into service, maintenance of said services, and includes the following principal items:

Provide a standards-compliant Passive Optical LAN cabling system as detailed within this standard.

Provide POL cabling between OLT and ONT locations as per the standards requirements.

## 5.4. Passive Optical Specification of Criteria

Two levels of criteria are specified, mandatory and highly desirable within this standard.

a) The mandatory requirements are described by the word “must” and “shall”; whilst highly desirable are described by the words “should”, “may” or “desirable”.
b) Mandatory requirements must be adhered to under all circumstances and shall not be changed.
c) Highly desirable requirements are the desired ways of design, implementation and documentation that may be changed depending on individual circumstances.
d) All parties shall adhere to this standards document.

## 5.5. POL Design Scope

This standard covers the design of physical cabling topology related to providing network connectivity to services such as, but not limited to:

i. LAN
ii. Wi-Fi – general across the site
iii. IP Telephony
iv. IPTV (where required)
v. MATV (where required)
vi. BMS – including security/ CCTV, lighting control, service monitoring etc. (where required)

The cabling topology shall use passive optical components from CommScope using single-mode OS2 G657.A1 or G657.A2 grade glass with bend insensitivity, using passive optical splitters to provide a point-to-multi-point arrangement.

A basic Passive Optical LAN topology is provided in Figure 5-1:

Active equipment (OLT and ONTs) for the transportation of network services shall be supplied and installed by the University IT Infrastructure Team.

Mounting and fixing options for ONTs are covered within this standard. The cabling infrastructure shall provide the transmission pathway for all areas of the client network.

The communications (POL) contractor shall be responsible for mounting and patching the ONTs and OLT Cards supplied by the University IT Infrastructure Team.

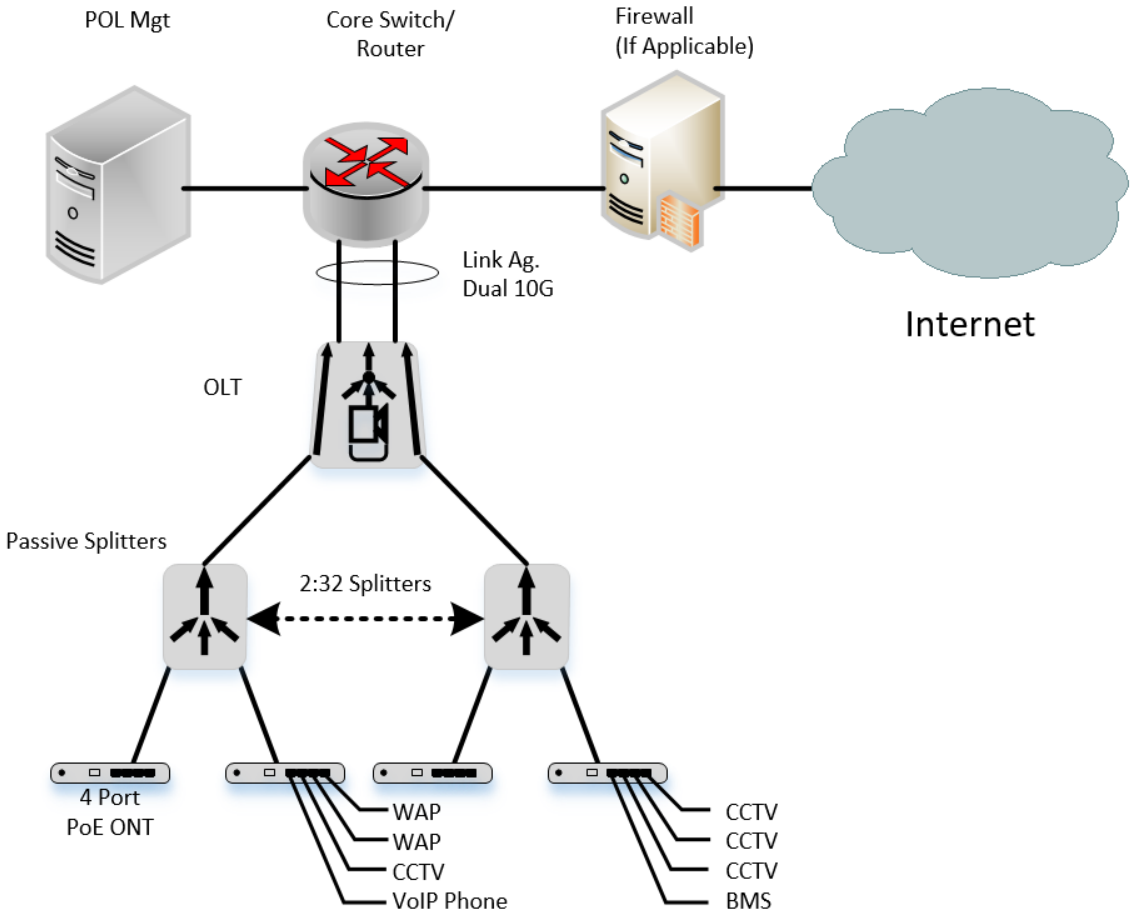
## 5.6. POL Specification

When a Passive Optical LAN (POL) network infrastructure has been specified as a part of the design to support voice, data, Wi-Fi, security and other network services, it shall comply with the following:

- THE POL PASSIVE INFRASTRUCTURE SHALL BE COMMSCOPE
- THE POL ACTIVE EQUIPMENT SHALL BE NOKIA

The POL passive infrastructure must be provided with a minimum twenty-five-year performance warranty for parts and labour.

## 5.7. University of Otago typical network structure – POL




## 5.8. POL Installation Requirements

All the work carried out shall be implemented in strict compliance with this standard and CommScope's requirements.

## 5.9. POL Nominated Contractors

Only nominated contractors, with prequalified relevant experience, shall be selected by the University of Otago to tender for any work that requires compliance with this standard. The nominated contractors must be a CommScope Certified Partner Company that carries a current certification.

## 5.10. POL Contractor Certification

Contractors shall have current CommScope Netconnect certification. Current CommScope partners can be confirmed on the global partner locator:

https://www.commscope.com/locator/wizard.aspx?p=net

Contractors shall include their current certificate of CommScope Partnership at time of any tender submission.

## 5.11. Manufacturer Warranty

A CommScope performance warranty for the passive optical LAN passive infrastructure (both copper and fibre) at project completion shall be provided. The performance warranty shall be valid for no less than 25 years and provide assurance from workmanship or product defects over the 25-year period.

The warranty shall be issued directly to the University of Otago.

It is a requirement of this standard that CommScope site inspection reports shall be provided to the University of Otago and the consultant at regular intervals of any installation process.

## 5.12. POL Cabling Practice

All cables shall be run and installed in a professional manner and in accordance with AS/CA S009. The recommendations in AS/NZS 11801.1 shall also be followed.

The contractor shall plan the cabling system and routing to ensure adequate segregation from services, ensure system integrity and performance, ensure that it does not present problems of maintenance or access, and ensure there is no conflict with the operation and maintenance of other systems.

Fibre cables shall not be touching any other services cabling.

The designer and contactor shall refer to Chapter 2: Pathways for all cable trays, catenaries and ductwork required to complete the installation.

All work shall be installed and comply with CommScope's installation practices. These practices shall be made available upon request.

All optical fibres shall be installed in the following manner:

a) Cable raceways shall not be filled greater than the maximum fill rate as per CommScope pathway calculator.
b) Cables shall be installed in continuous lengths from origin to destination (no splices) unless specifically addressed in this document.
c) Where cable splices are allowed, they shall be in accessible locations and housed in an enclosure intended and suitable for the purpose e.g. indoor/Outdoor rating.
d) One 12 core OS2 distribution fibre cable shall support a bend radius of 25mm under no-load conditions. One, 12 core fibre cable is intended to be pulled through horizontal pathways during installation and shall support a bend radius of 50mm under a pull load of 222 N (50 lb/f).
e) If a catenary system is used to support cable bundles, all distribution and horizontal cables shall be supported by Velcro™ at a maximum of 500mm intervals – at no point shall cable(s) rest on acoustic ceiling grids, mechanical ventilation ducts or panels.
f) Cable shall not be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware.
g) The cabling system and active hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
h) Cables shall not be attached to ceiling grid or lighting support wires.
i) Cable drops from ceiling space to desk areas, shall be supported via cable droppers or protective flexible conduit. The dropper solution shall be approved in writing by the University of Otago IT Head of IT Infrastructure.
j) Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the University.
k) The cable identification label shall be applied to the cable behind the fibre faceplate and on a section of cable that can be accessed by removing the cover plate. Both fibre patch cord and face plate shall be labelled
l) Cables shall be neatly bundled and dressed to their respective rapid fibre terminals (RDTs) and fibre face plates (FFP).
m) Each fibre distribution cable or patch cord shall be clearly labelled on the cable jacket behind the fibre connector at each end of the cable at a location that can be viewed without removing the bundle support ties.
n) Cable labels shall not be obscured from view.
o) Fibre slack shall be neatly coiled within the RDT enclosures or in rack-mount fibre management enclosure.
p) No slack loops shall be allowed external to the fibre enclosure(s).
q) Each fibre connector or patch cord shall be cleaned prior to project completion. Dust caps shall then be installed on the connectors and couplers at all times, unless physically connected.

## 5.13. POL System Structure

A passive optical LAN (POL) system is comprised of seven key components. These are listed below:

a) Optical line terminal (OLT)
b) Fibre termination panels located in the main equipment room (MER) from which OLT ports will be patched to, for distribution.
c) Fibre distribution hub (FDH)
d) Building Distributor (BUDI)
e) Rapid fibre distribution terminal (RDT)
f) Fibre face plate (FFP)
g) Optical network terminal (ONT)
h) Copper cabling at network end points (this may include an MPTL connection).

There are only two active components within the link – the OLT and ONT. These are covered in POL Active Equipment and shall be supplied by the University IT Infrastructure Team.

### 5.13.1. Optical Line Termination (OLT)

This device serves as the endpoint of a passive optical network. It shall multiplex the subscriber channels into the single core optical fibre cable. It shall also provide the network management system/ maintenance functions for the POL system.

The OLT shall be rack mounted, with suitable integrated fibre patch cord management incorporated into the OLT bracket.

Figure 5-2 OLT Capacity shall be specified by the University IT Department

### 5.13.2. Fibre Terminations in MER

The Main Equipment Room (MER) shall encapsulate active equipment supplied and managed by others. The MER shall house the OLT, power rectifier, UPS system and other headend active equipment and shall be installed into the cabinet as per the relevant section of Chapter 3: GCS of this standards suite.

OLT Ports shall be replicated in a 1RU MPO fibre tray, installed in the same cabinet and shall have the following:

a) All future patching of OLT ports shall be done via the fibre tray to avoid regular patching contact with the OLT.
b) The fibre tray shall utilise 12 fibre single-mode MPO cassettes with SC/A connector format.
c) Single-mode OS2 MPO trunk or patch cable will then connect to either a wall based FDH or rack mounted FDH utilising GPX trays.
d) Specific number of fibres shall be detailed in any design packages.
e) Unused ports of a fibre tray shall be covered with blank covers or shuttered couplers to prevent contamination from dust and debris.
f) Single-mode OS2 patch cords from OLT to fibre tray to be SC-SC/A simplex format.

### 5.13.3. POL Fibre Distribution Hub

A passive element that does not require any power (or active electronics), the hub houses the optical splitters which provide passive splitting of the optical signal and combining the optical signal between OLT and ONT.

The fibre hub shall have the following:

a) The preference if for splitters to be CommScope OCM6 or OCM2 style and include pre-connectorised LC/A input and output tails.
b) Split ratio shall be 2:32.
c) Splitter tails shall be the appropriate length for the style of enclosure being installed – 61cm for a CommScope BUDI box or 180cm for iFFP wall frame.
d) Each FDH is designed for pre-connectorised distribution cabling with MPO connectors for quick “plug-and-play” connection to the RDT’s in the building environment.
e) Cable glass shall be of G.657 reduced bend radius OS2 grade.
f) FDH enclosures shall be wall based to utilise less rack space and provide dedicated cable support and fibre management when there is limited space to mount the equipment within a cabinet, otherwise GPX trays are permitted to be used as the FDH with a cabinet.
g) Space shall be allowed within the FDH for a minimum 20% future growth.

Figure 5-3 Rack Mount GPX FDH

Figure 5-4 Wall Mount GPX FDH

### 5.13.1. POL Wavelength Combiners

POL Wavelength combiners are not required by the University of Otago Infrastructure team as they shall utilise Nokia FWLT-C line cards, which are a Multi PON line card providing 16 GPON/XGS/MPM PON ports, so no need for downstream physical Wave Combiners.

These line cards provide GPON (2.5Gbps/1.25Gbps) and XGS PON (10Gbps/10Gbps) on a single PON port to permit the University IT Infrastructure Team to deploy both GPON and XGS PON ONTs on all splitter ports depending on application and local connectivity requirements.

### 5.13.2. POL Building Distributor (BUDI)

The CommScope BUDI can house 3x 2:32 LC/A splitters. The BUDI also has an area for the installation and maintenance of backbone connectivity or local patching within the enclosure.

The backbone couplers permit up to 36 Duplex LC/A connectors to be mounted within the enclosure or Simplex SC/A couplers for provisioning of directly connected ONTs to the BUDI.

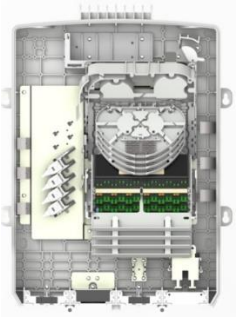


Figure 5-5 BUDI PON FDH

Space shall be allowed within the BUDi for a minimum of 20% future growth.

It is permissible to utilise BUDIs in a floor distribution role if:

1) greater than 3x 2:32 splitters are needed for the building distribution and
2) there are limited backbone pathways to riser cupboards that could house a BUDI.

### 5.13.3. POL Rapid Fibre Distribution Terminal (RDT)

The RDT is another passive element that does not require power. The RDT distributes the single optical fibre cable connections from the FDH or BUDI to ONT directly or via an FFP, when required.

Each RDT shall come with a minimum of 30 metres of pre-connectorised cabling plus a terminated MPO connector for easy "plug-and-play" connection to the FDH. Cable glass shall be of G.657 reduced bend radius OS2 Single Mode.

The RDT shall provide 12 SC/A ports. Lengths are available between 30 and 300 metres, in 30 metre increments. The RDT can store up to 30 metres of fibre slack within the enclosure so network design shall ensure that there is at least 15 metres of spare fibre within the RDT after installation. If required, the University will be able to relocate services as the RDT can be moved to a different location without re-cabling.

Figure 5-6 12F RDT

### 5.13.4. Optical Network Terminal and Mounting

The ONT connects stationary Ethernet devices and systems to the Optical LAN network, providing network services at distances of up to 20km from the Main Communication Room.

ONTs shall either be 4, 8 or 12ports and be either Power over Ethernet (PoE) or non-PoE capable, depending upon the University requirements.

The communications contractor shall be responsible for mounting all ONTs as per this standard and shall refer to later sections within this standard for "ceiling void considerations" and "MPTL" connections.

As a rule, the University requires all ONTs to be mounted as close as practically possible to the end point device requiring connectivity.

The table below provides mounting location options and descriptions that shall be followed:

| Description | Permitted Mounting Location | Mounting option reference |
|---|---|---|
| Ceiling mounted WAP requiring PoE in a general office area, lecture hall, gymnasium, open space etc. | Within ceiling cavity, tile or grid system shall be marked with labelling scheme to indicate position of ONT for ease of servicing | Figure 5-7, Figure 5-8 and Figure 5-9 |
| Ceiling mounted CCTV requiring PoE in a general office area, lecture hall, gymnasium, open space etc. | Within ceiling cavity, Tile or grid system shall be marked with labelling scheme to indicate position of ONT for ease of servicing | Figure 5-10, Figure 5-11 and Figure 5-12 |
| | | |

Table 1 ONT mounting requirements schedule

Permission to deviate from the mounting requirement shall be requested and approved by the University Head of IT Infrastructure.

Figure 5-13: 4-Port ONT

The communications contractor shall liaise with the electrical contractor and shall ensure the ONT has power outlets mounted within 750mm maximum from the ONT. This will allow

the power lead from the ONT plug pack to reach the ONT, when the ONT is being locally powered.

The communications contractor shall liaise with the University regarding any special conditions required for the selected Nokia ONTs to be installed in a ceiling cavity e.g. ceiling cavity temperature shall not exceed 40 degrees Celsius. If that temperature is to be exceeded, a hardened version with higher operating temperatures is required.

## 5.14. POL Internal Pathways

Overhead ceiling mounted basket or cable tray solutions may be used to carry cables within the communications rooms depending on the overall building construction. Cable basket/tray/catenary shall be installed to provide supported cable routes from the communications room to the building entrance facility and for patch ways to each FDH, BUDI or RDT, depending on network architecture as listed in the design. Refer to Chapter 2: Pathways for further detail.

The following specific POL pathway requirements shall apply:

a) The POL fibre is permitted to share the electrical tray and shall occupy 100mm on the opposite side of the tray to the electrical cable. It shall be the responsibility of the communications contractor to coordinate this requirement onsite with the electrical contractor and the IT Design consultant to coordinate with the Electrical Engineer during the design phase.
b) Catenary wires shall not be installed directly below beams that may be used to support HVAC or other equipment, they shall be offset by a minimum of 300mm, however 750mm is preferred.
c) The offset installation of catenary wires shall be utilised to prevent damage to POL cabling/components by other trades at the time of installation.
d) Trays may be shared for power and PON services, but fibre cables must be protected and labelled within flexible conduit where this occurs. Refer to chapter 2: pathways for requirements.
e) For any required copper network cabling, cable tray sizing shall conform to AS/NZS 14763.2, and the CommScope installation specifications.
f) No whale bone type tray shall be accepted.
g) Any pathway shall not exceed 50% capacity from installation completion.

## 5.15. POL Ceiling Void Considerations

Planning of overhead cable trays must be coordinated with all parties involved in the planning, design and implementation of the building works. Lighting, HVAC and sprinkler systems must not be impeded by tray work.

The communications contractor shall be responsible for the installation and mounting of any ONTs in the ceiling void if indicated on the associated drawings/design as per Figure 5-14. If a cable tray is not available the alternative method of mounting detailed in Figure 5-14-8 shall be implemented.

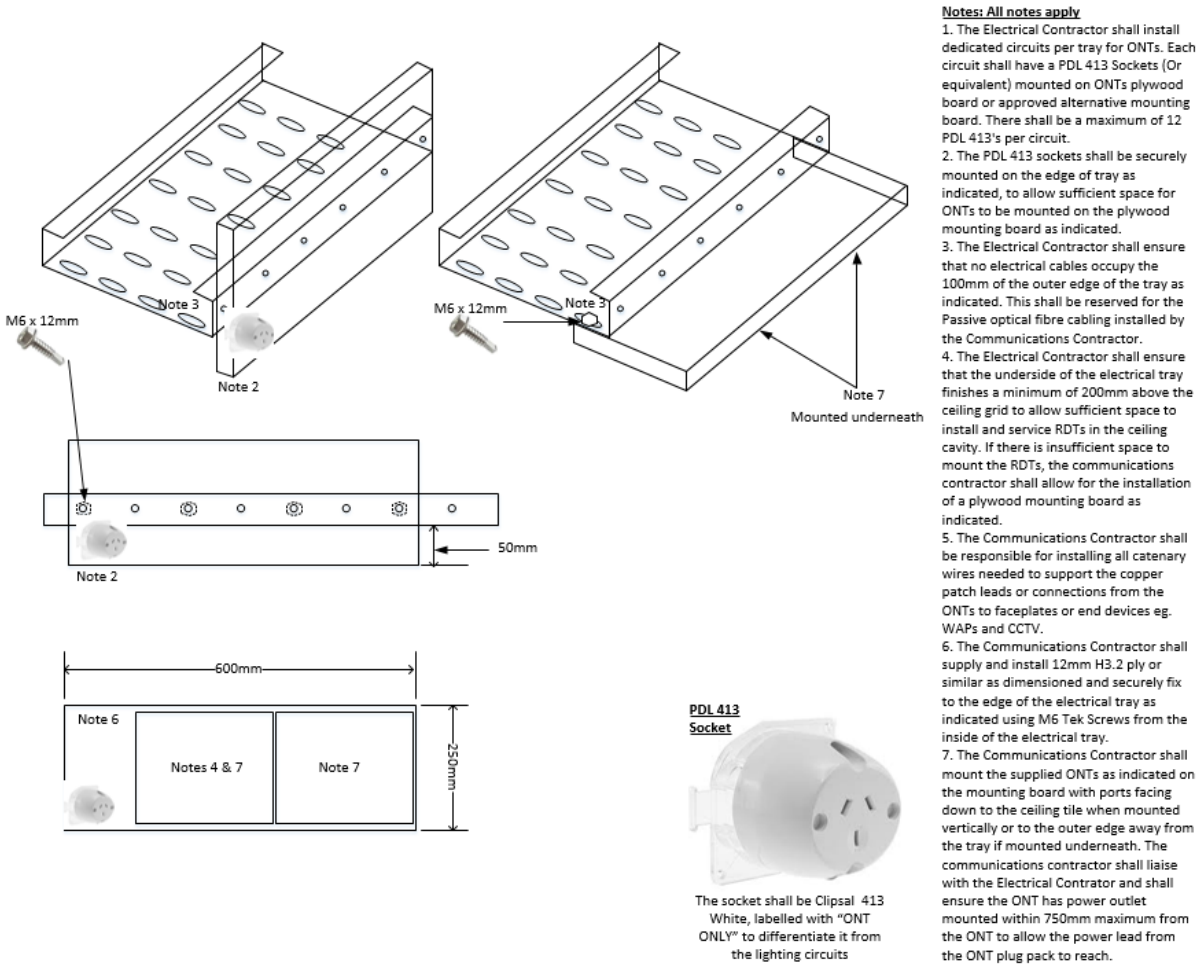



Figure 5-14 : Mounting details for ONTs

All notes detailed on the diagram above shall apply.

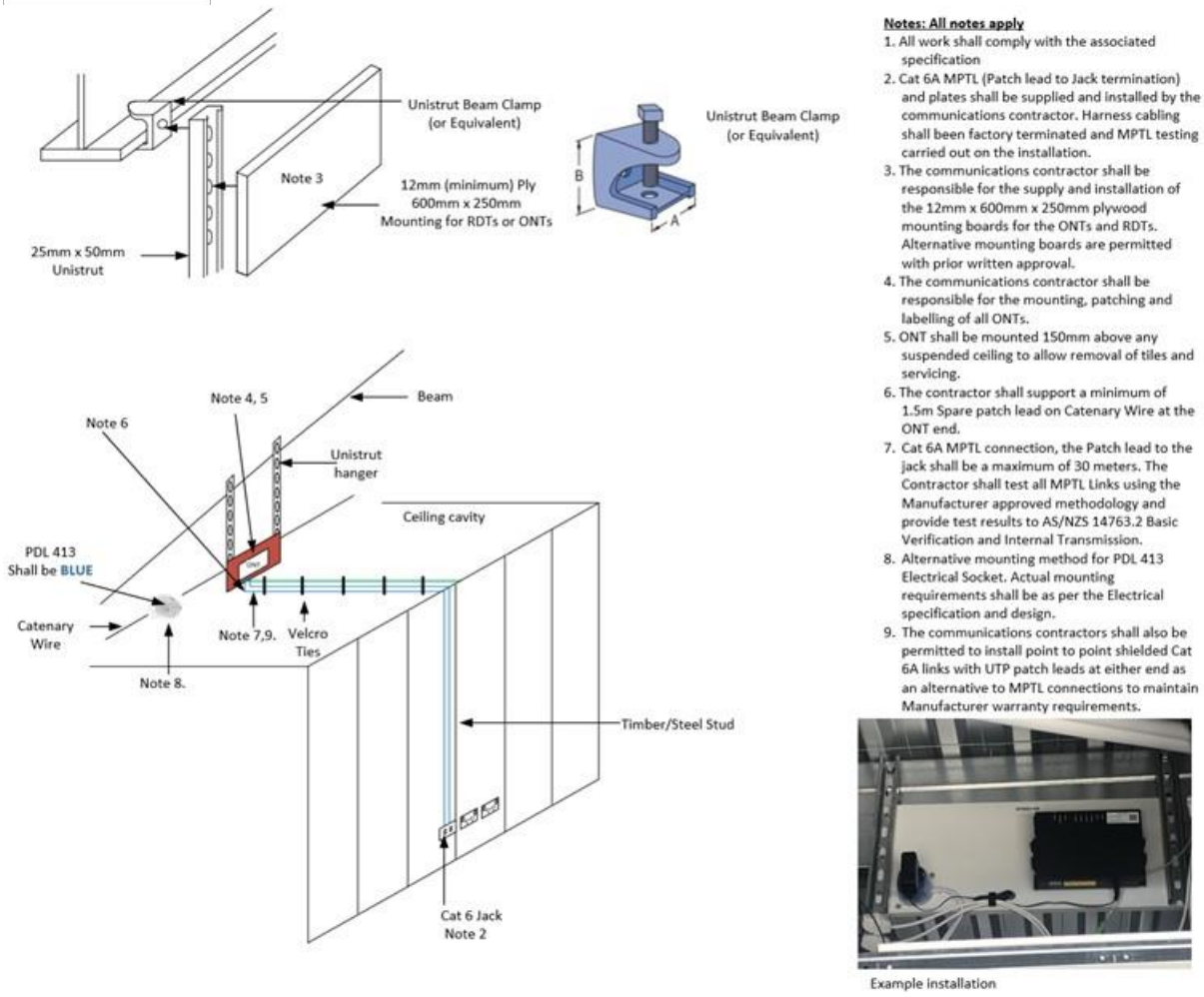



Figure 5-15 : Mounting details for ONTs

All notes detailed on the diagram above shall apply.

## 5.16. POL Fibre Distribution

The fibre distribution listed is for the purposes of data, video and voice connectivity.

Cabling shall extend from the MER located on Level "X" (the communication contractor shall refer to the design for the location of "X"), where the FDH or BUDI shall house all passive splitters and distribute fibres to the RDT locations as per design.

a) 12 port RDTs shall distribute the fibre single fibre armoured drop cables to each FFP location.
b) The ONT shall then be patched to the FFP with an additional armoured patch cable, as per design. Figure 5-16 shows this topology.

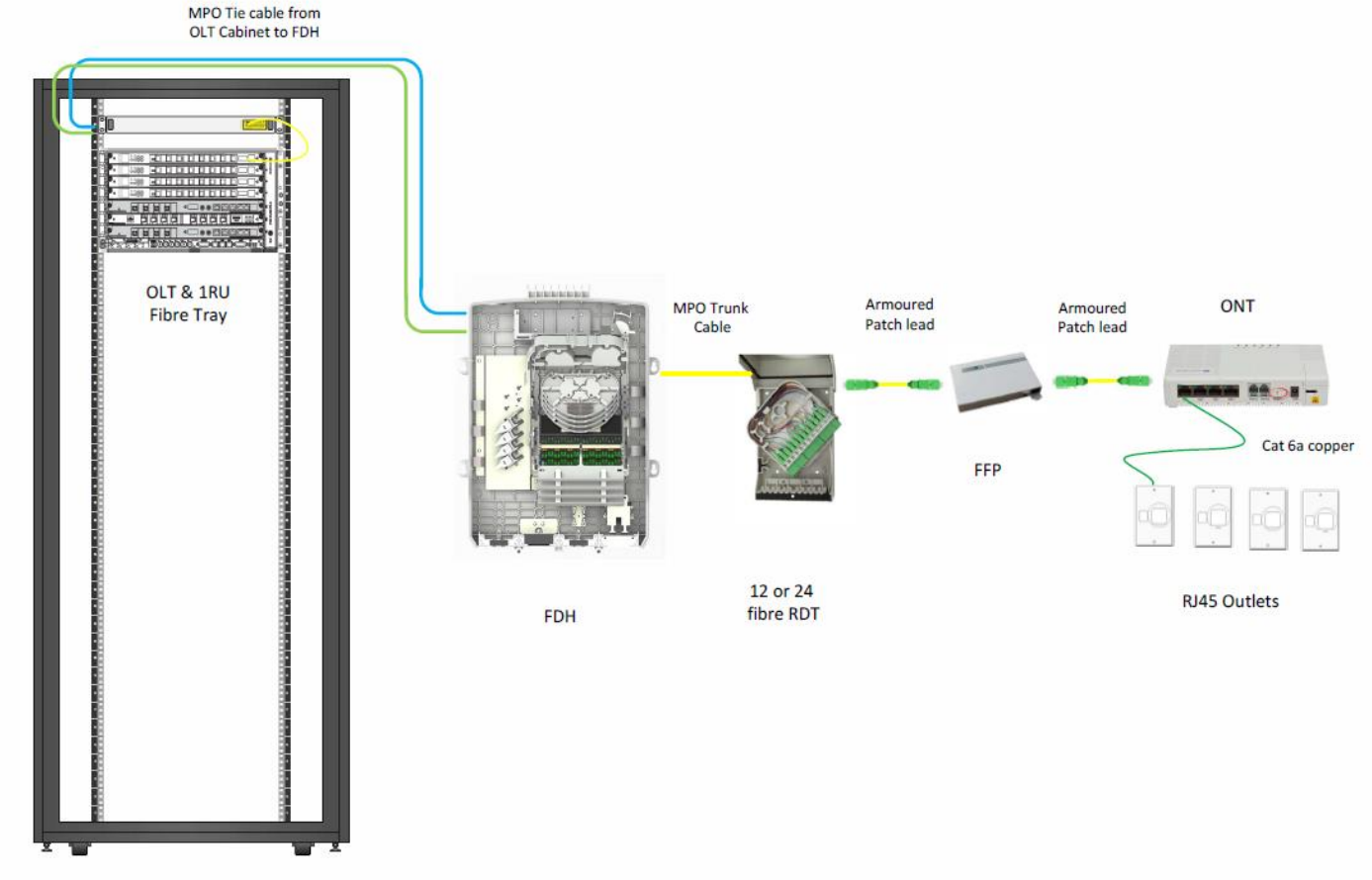



Figure 5-17 POL Fibre Distribution

c) Ports from the OLT shall be patched to a rack mounted 1RU fibre panel within the same cabinet as the OLT.
d) This fibre panel shall connect to either a wall mounted FDH or BUDI in the building that this is servicing.
e) Diverse pathways may be utilised in the backbone to support the 2:32 splitters and provide additional levels of resiliency, to be confirmed with the University Head of IT Infrastructure.
f) The FDH/BUDI contains the splitter modules and connectivity for connection via MPO cables to the RDT terminals, which are to be located as per design. From each RDT, a single armoured fibre drop lead shall be run to an FFP, and then further to the ONT.
g) Copper connections to the end device may be via direct Cat $6_A$ UTP patch cords or via Cat $6_A$ shielded cabling, as per design. These shall be white in colour.
h) OLT ports shall be SC format.
i) 1RU fibre trays shall be SC/A format.
j) Splitter input and output tails shall be LC/A (for high density).
k) RDT and FFP format to be SC/A.

## 5.17. POL Cabling Elements

Copper cabling is required within a PON installation for providing connectivity from the ONT to the end device. All copper cabling shall be CommScope Cat6$_A$, to best support bandwidth and PoE requirements in the future.

Copper cabling may either be in the form of factory terminated RJ45 patch cords, patched direct from ONT into end device, or via a traditional permanent link cable with two RJ45 outlets or via an MPTL connection from the ONT. Refer to design for specific requirements. Fibre Cabling shall be as per Figure 5-18.

### 5.17.1. POL Patch Cords

SM Fibre patch cords within the MER shall be 1.8mm LSZH simplex leads, of the required connector type. SM fibre patch cords from RDT to FFP, and FFP to ONT shall be white simplex SC/A armoured leads with LSZH cladding and available in lengths between 1 and 60 metres.

### 5.17.2. POL MPTL Horizontal Cabling

Where copper cabling is required from ceiling mounted ONTs to either wireless access points (WAPs) or CCTV cameras, these shall be via patch cords directly connected to a PoE ONT port. The patch cords shall be permanently labelled each end with the ONT # and port number on the ONT using the following designation; ONT:1:1 refers to the 1st ONT on the network and port 1 on the ONT.

Cabling from a ceiling mounted ONT to an MPTL outlet indicated on the design (and that can be reached using a 30m patch cord), shall use the installation method detailed in Figure 5-19. Should the cable run from the ONT exceed 30m then the communications contractor shall install a standard Cat 6$_A$ RJ45 jack in the face plate and run Cat 6$_A$ shielded cable back to the ONT location and support the cabling on a catenary wire as per the requirements of this specification.

The Cat 6$_A$ cabling at the ONT end shall be terminated using a Modular Plug Link Termination (MPTL) connector from CommScope to terminate the Cat 6$_A$ into the ONT port.

All testing of MPTL links shall be as per AS/NZS 14763.2 Basic Verification and Internal transmission. The testing methodology shall comply with the manufacturer's requirements to achieve a minimum 25-year warranty.

Refer to Chapter 3: GCS for additional MPTL requirements and testing.

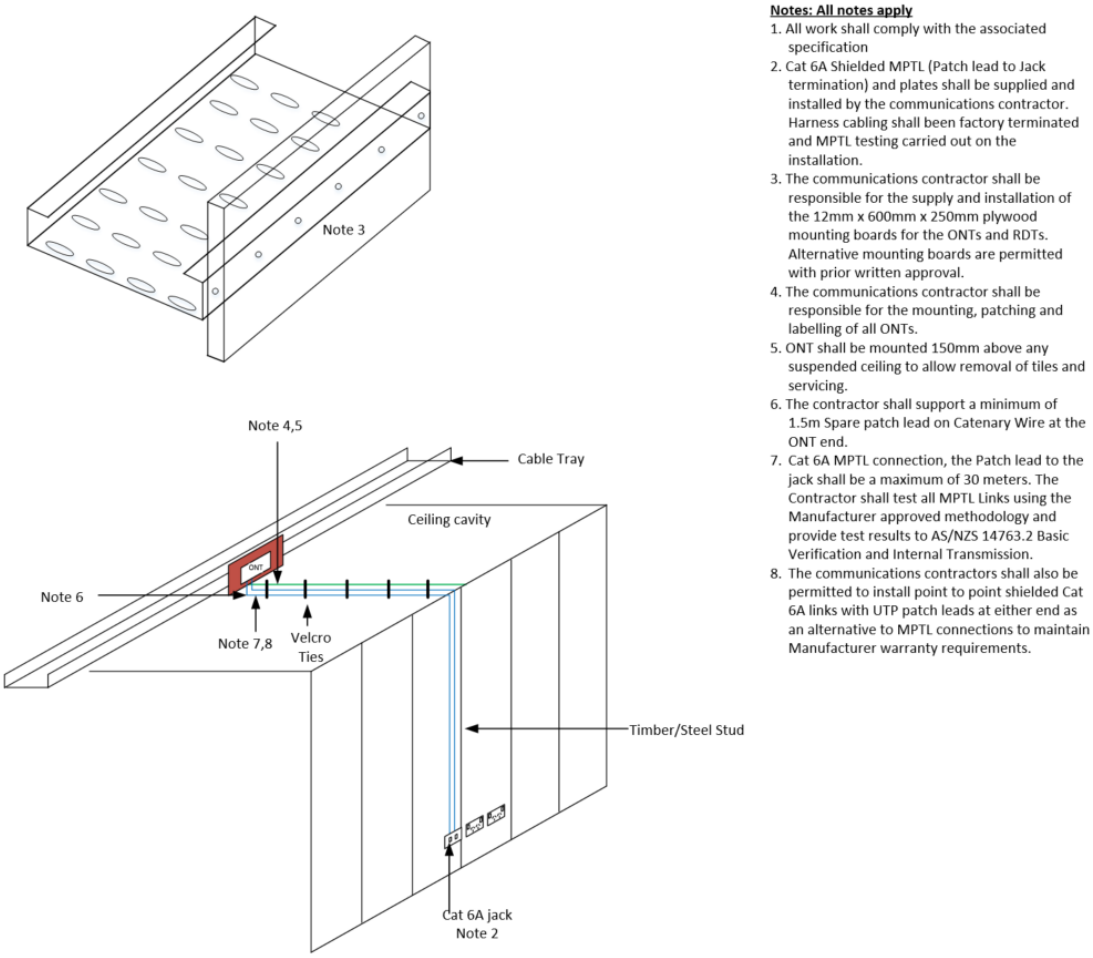



Figure 5-20 MPTL installation

### 5.17.3. POL Inter-building Fibre Backbone Cabling

The University utilises a blown fibre solution for inter-building backbone cabling. Refer to UoO Campus Fibre backbone cabling requirements in Chapter 3: GCS of the standards suite for these requirements.

### 5.17.4. POL Fibre Distribution Cabling (Zone)

Distribution fibre cabling (also referred to as "Zone Cabling" reticulated as per Figure 5-21 .

The design shall utilise pre-terminated MPO 12 port RDT enclosures, with 3.2mm LSZH SM OS2 G.657 compliant fibre cable.

### 5.17.5. POL Fibre Horizontal Cabling

Horizontal fibre cabling reticulated from the RDT shall be white armoured SC/A patch leads and shall also comply with the following:

a) RDTs are permitted to directly connect to an ONT mounted in the ceiling cavity
b) Adjacent to an RDT or
c) In an enclosed service riser or
d) location not directly visible to end users.
e) All other locations shall terminate on a fibre face plate.

### 5.17.6. POL Face Plates (FFP)

Fibre outlets shall be presented in either CommScope FFP or Surface Mount keystone style enclosures and shall comply with the following:

a) FFP or Surface mount adaptors shall either have a shutter or dust plug connected at all times.
b) FFPs shall be compatible with existing electrical sockets or new sockets installed.
c) 100% of fibre ports MUST be cleaned after installation and just prior to connection to any active equipment of fibre patching.

### 5.17.7. Splitter Design Requirements

#### 5.15.7.1 Splitters

All splitters used within the network shall be Planar Lightwave Circuit (PLC) and suitable for both indoor and outdoor applications.

The system designer shall engineer the solution utilising a 2:32 split ratio and any deviation from this shall be agreed in writing with the University of Otago Head of IT Infrastructure.

Both rack mount LC/A connectorised splitters and splitters with LC/A tails shall be permitted to be used.

#### 5.15.7.2 Centralised Splitter Deployment

The University's preference is to utilise a fibre rich design with a centralised building distribution point, for management of all fibre and splitters.

This centralised building distribution point will inter-connect to the campus backbone blown fibre solution, terminate in the campus 325 Data Centre and then connect to the OLT within the 325 Data Centre.

#### 5.15.7.3 Cascaded Splitter Deployment

Cascaded Splitter solutions maybe utilised with prior written approval from the University of Otago Head of IT Infrastructure in the following situations where a fibre-rich centralized design would be difficult or costly;

a) heritage buildings where pathways are limited.
b) existing buildings where pathways are limited.
c) Where power survivability is required and a cascaded design fits the brief.
d) In light pole-mounted CCTV and WAP deployments, where a number of poles in a line have cameras and/or WAPs mounted on them

### 5.17.8. Zone Cabling

The University has a preference to use a zone based cabling approach, where all designs shall employ the use of 12 port RDT to provide a focal point for all cabling within an area (zone) to emanate from.

This will provide ease of maintenance, expansion, management and long-term flexibility of the POL solution.

Each zone shall not utilise more than 10 of the available RDT's ports on day one.

### 5.17.9. Power Survivability

The following section covers what level of power survivability (resiliency or reliability) is required.

This is often application specific and depends on whether there are any "Life Safety Systems" being run on an ONT.

#### 5.15.9.1 Local Battery Backup

This option shall be utilised if the University requires an ONT to remain powered on and delivering PoE to an end device for up to a maximum of 4 hours, when the ONT is not fed by a critical supply from a generator.

The length of hold up time, number of devices supported by the battery and when this option shall be utilised is covered by the University of Otago IT Infrastructure Team.

Applications may include Personal Emergency Response Systems (PERS), also known as Nurse Call Systems or CCTV cameras that require temporary battery backup in the event of a power failure and other devices or applications as the detailed below;

| Description | Application | Holdup Time |
|---|---|---|
| Medical School Training Lab | PERS | 2 hours |
| Chemical Storage Facility | CCTV | 4 Hours |
| Safety Camera for Carpark | CCTV | 4 Hours |

Table 2 Backup battery requirement schedule

### 5.15.9.2 Remote DC Power

This option shall be utilised if the University requires an ONT to remain powered on and delivering PoE to an end device in the event of power failure and the UPS centrally feeding these critical circuits is supplied from a generator.

The length of hold up time from the central UPS, number of devices supported by the UPS battery and when this option shall be utilised is covered by the University of Otago IT Infrastructure Team.

Applications may include Personal Emergency Response Systems (PERS) that must be maintained beyond 4 hours, also known as Nurse Call Systems or CCTV cameras that require to be held up 100% of time in the event of a power failure and other devices or applications as the detailed below;

| Description | Application | Holdup Time |
|---|---|---|
| Medical School Ward | PERS | Sufficient to allow generator power to come online (2 hours minimum) |
| Drug Dispensary | CCTV | Sufficient to allow generator power to come online (2 hours minimum) |
| Safety Camera | CCTV | Sufficient to allow generator power to come online (2 hours minimum) |

Table 3 Backup battery requirement schedule

## 5.18. POL Labelling Schema

### 5.18.1. POL Cable Labels

All fibre and copper cabling shall be permanently labelled at both ends including feeder cables, distribution cables, splitters, breakout cables or any fibre or copper patch leads installed.

The permanent labelling system for labelling all cables shall be a Brady self-laminating marker or equivalent as per Figure 5-22 below.

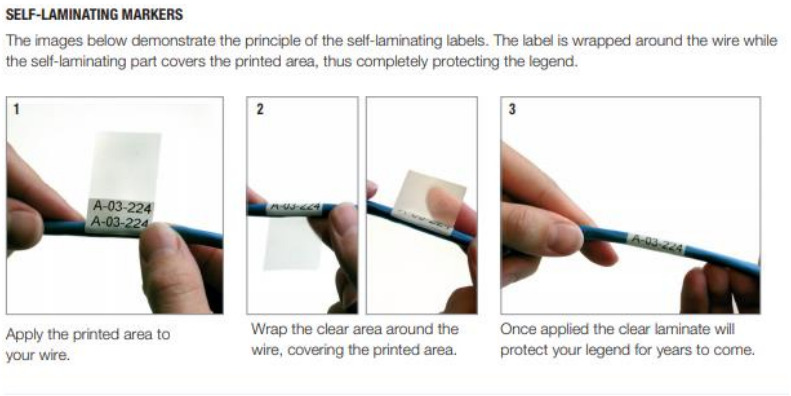



Figure 5-22 : POL Cable Labelling

### 5.18.2. POL Labelling Convention

The designer and contractor shall refer to Chapter 8: Labelling of the building technologies standards suite for labelling requirements.

## 5.19. POL Active Equipment

Active equipment for the brief is defined as two components – the OLT and the ONT.

Services integration shall be carried out by the selected network integrator or the University IT Infrastructure Team, along with PON service templates for IP services distributed by the PON.

The manufacturer of active equipment, supplied and supported via suitably qualified systems integrator shall be *Nokia*.

The supply and installation of the OLT power supply (with SNMP module included) shall be covered by the University of Otago IT Infrastructure Team.

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## 5.20. POL Support and Training Requirements

The communications contractor shall as part of their solution comply with the following:

a) Provide training to the client's IT support team to ensure they can carry out fibre patch lead cleaning and replacement.
b) Patching and management of fibre splitters.
c) Patching and management of RDTs
d) Patching and management of BUDIs

## 5.21. POL Fibre Optic Testing

Testing is required for 100% of installed fibre and copper products, excluding fibre patch cords from ONT to 1RU fibre panel, FFP to ONT and factory terminated copper RJ45 patch cords

a) Channel performance shall not be an accepted criteria for any fibre optic installations.
b) All permanent links are to be installed and tested at the completion of the installation to the requirements or the Quality Plans detailed in the Appendix of this specification.
c) 100% of the single-mode optical fibre links must be tested for attenuation (power loss):
    i. Light Source and Power Meter (LSPM); and
    ii. Optical Time Domain Reflectometer (OTDR)

The following sets out the protocol for PON testing:

### 5.21.1. Feeder Cable

Test the Feeder Cable and both its end connectors (shown as section A) with;

a) LSPM at two wavelengths (1310 & 1550 nm for single-mode) and in both directions using the 1-Test-Cord Method of Reference Setting, measuring the insertion loss of this link, and
b) OTDR testing on section A is optional using compliant launch and tail cords, measuring component ORL, any events along the cable, and providing an initial signature trace.

Note: This OTDR testing can also be used to validate insertion loss.

The tests shall meet the performance limits in AS/NZS ISO/IEC 14763.3 and AS/NZS 11801.1.

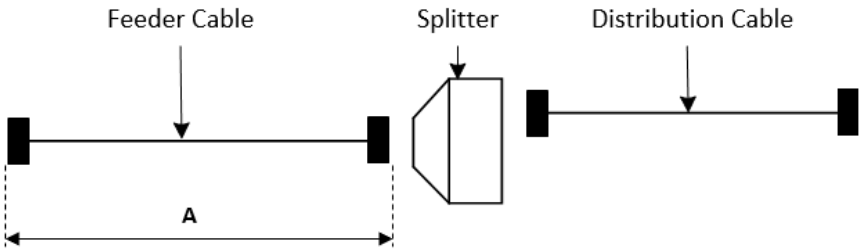


Figure 5-23 PON System – Section A

### 5.21.2. Distribution Cable

Test the Distribution Cable and both its end connectors (shown as section B) with;

a) LSPM at two wavelengths (1310 & 1550 nm for single-mode) and in both directions using the 1-Test-Cord Method of Reference Setting, measuring the insertion loss of this link.
b) OTDR testing on section B is optional using compliant launch and tail cords, measuring component ORL, any events along the cable, and providing an initial signature trace.

Note: this OTDR testing can also be used to validate insertion loss

The tests shall meet the performance limits as specified in AS/NZS 14763.3 and AS/NZS 11801.1.

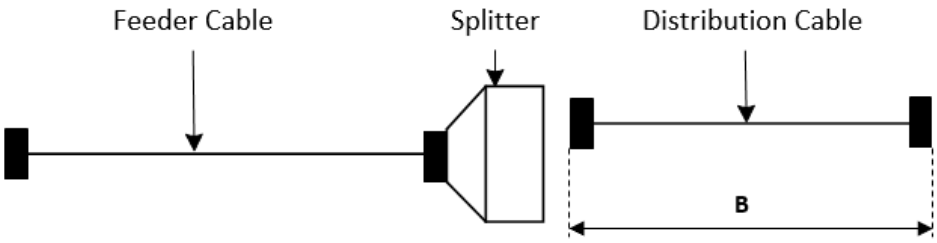


Figure 5-24 PON System – Section B

### 5.21.3. PON Cabling

The PON cabling includes the Feeder Cable, the Splitter and the Distribution Cable. Test the PON cabling and both its end connectors (shown as section C) with;

a) LSPM at two wavelengths (1310 & 1550 nm for single-mode) and in both directions using the 1-Test-Cord Method of Reference Setting, measuring the insertion loss of this link, and
b) OTDR testing on section C is optional. If undertaken, shall be at two wavelengths (1310 & 1550 nm) and in one direction only from the last connector on the end of the distributor cable, back to the first connector on the feeder cable using compliant launch and tail cords, measuring component ORL, any events including the splitter along the cable, and providing an initial signature trace.

Note 1: OTDR loop-back testing of two fibres at once is not acceptable.

Note 2: OTDR testing from the distribution cable end does not adequately characterise the return loss of the connection of the feeder cable to the splitter.

The tests shall meet the performance limits in AS/NZS 14763.3 and ASNZS 11801.1 plus an allowance for a splitter as set out in Splitter Loss Allowance below

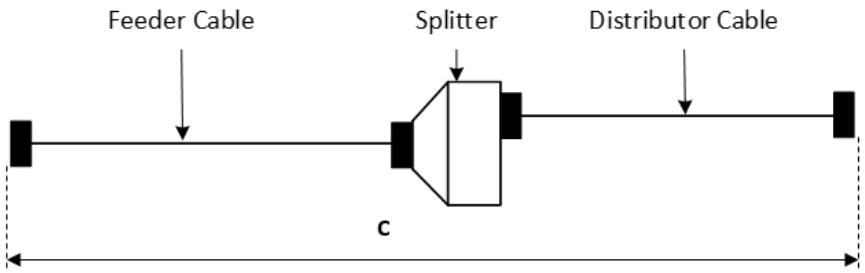


Figure 5-25 PON System – Section C

| Splitter | Insertion Loss (dB) |
|---|---|
| 1 x 2 | 4 dB |
| 1 x 4 | 7.5 dB |
| 1 x 8 | 11 dB |
| 2 x 8 | 11.5 dB |
| 1 x 16 | 14.5 dB |
| 2 x 16 | 15.1 dB |
| 1 x 32 | 18 dB |
| 2 x 32 | 18.7 dB |

Table 4 Splitter Loss Allowance Table

Note 1: Losses are based on an even split at 23 °C

Note 2: Splitter losses based upon spectral bands 1260 nm to 1360 nm and 1480 nm to 1660 nm

Ensure Reference Grade leads have been used and qualification of these has been saved as part of fibre optic test results.

Summary files in electronic format are not acceptable.

All test results must be provided in native format.

## 5.22. Telecommunication Spaces and Distributors

Data cabinets must be selected from the Otago University Approved Products List. Appendix H of Chapter 3: GCS

## 5.23. Telecommunications Rooms

The designer and contractor shall refer to Chapter 3: GCS of the building technologies standards suite for Telecommunications Room requirements.

END