Department of **Education**

Data Communication Cabling

Standards and Specifications

Version 4.2

Information & Communications Technology Directorate

March 2010

Document Information

DOCUMENT SPONSOR

Chief Information Officer

DOCUMENT REVIEW AND VALIDITY

Authorisation shall be – Director Infrastructure and Telecommunications

Technical Liaison shall be – Infrastructure Coordinator

The document shall be reviewed on a 6-monthly basis and shall be valid for a period of three years from the date of Version 4.1.

INFORMATION & COMMUNICATIONS TECHNOLOGY DIRECTORATE

DOCUMENT TITLE

DATA COMMUNICATIONS CABLING STANDARDS AND SPECIFICATIONS

VER	*ISSUE DATE*	*DESCRIPTION*	*PREP BY*	*CHK'D BY*	*AUTH. BY*	*REASON FOR REVISION*
2.A	05/11/03	Issued for Review	BF	RN		Initial release.
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2.1	17/02/04	Issued for Use	BF	RN		Incorporate Quality Review changes
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4.1	09/09/2009	Issued for use	GL	Panel	GL	Minor updates
4.2	11/03/2010	Issued for use	TM	Panel	TM	Minor updates

Changes between Versions

The key changes between this version of the specifications and the previous are:

General
Updated document version to 4.2 throughout and review date to March 2010.
Updated Department of Education and Training to Department of Education.
Updated DET to DoE throughout.
Updated logo.
Updated references to the Department of Training to the Department of Training and Workforce Development throughout.
Updated Manager Infrastructure and Telecommunications to Director Infrastructure and Telecommunications throughout.
Standardised terminology to Patch Cord and Work Area Cord throughout.
Updated AS/NZS 3080 to AS/NZS 3080:2003 throughout.
Updated AS 3080 to AS/NZS 3080:2003 throughout.
Updated Z.A.2 to ZA.2 throughout.

Document Information
Updated version history table.

Changes Between Versions
Updated changes between versions history.

Table of Contents
Updated the table of contents.

1 Introduction
Updated the Internet link to:
"http://www.det.wa.edu.au/education/ict/purchasing/docs/Data_Communication_Cabling_Standards_and_Specifications_Ver_4.2.pdf ".

2.1 Definitions
Added:
Fly-lead – see work area cord.

Equipment cord – cord connecting equipment to a distributor.

Patch cord – cable, cable unit or cable element with connector(s) used to establish connections on a patch panel.

Work area cord – cord connecting the telecommunications outlet to the terminal equipment – also known as a fly-lead.

9.4 Enclosures and Racks
Ensured power rails were localised to this section.

9.4.3 Wall Mounted Sub-Enclosures (Cabinets)
Updated the third dot point from four (4) outlet power rail to six (6) outlets:

- 1 RU power rail providing not less than six (6) outlets for 9RU, 12 RU or 18 RU enclosures

9.4.6 Cable Management
Added the following to the first paragraph:
A 1RU cable management panel shall be installed below any additional 1RU patch panel, which can then be utilised with a second 1RU patch panel.

14 Labelling
14.1 General
Re-order the opening sentence to reflect the order of the accompanying sections and removed reference to Dymo and Brother printing devices. Changed from:

"All telecommunication outlets, patch panels, enclosures, cables and conduits shall be systematically and permanently labelled.

Labels may be computer generated such as the Brother Labelling system or equivalent, with the exception of telecommunications outlets. Use of Dymo label, felt tipped pen and the like shall not be acceptable. Telecommunications outlets will be labelled with computer generated, or similar system and placed behind a clear, tamper resistant cover."

To:

All enclosures, patch panels, horizontal UTP wiring, backbone cabling and telecommunication outlets shall be systematically and permanently labelled.

The method of designation shall be in general in accordance with AS/NZS 3085 and as described below.

14.2 Enclosures

Bulletised appropriate sentences.

14.6 Labelling of Outlets

Renamed heading to: Labelling of Telecommunications Outlets.

Reworded section from:
Each telecommunications outlet is to be labelled with a Unique Point Identification.

The outlet labelling shall be equivalent to the designation of the horizontal cabling designation by which it is connected to the floor distributor.

For example the outlet connected to the cable described in 14.4 would be designated A12-73.

Relabelling of any existing Category 5 cabling shall use the Clipsal 30PID.

To:
Each telecommunications outlet is to be labelled with a Unique Point Identification. Telecommunications outlets will be labelled with a computer generated, or similar system and placed behind a clear, tamper resistant cover.

The outlet labelling shall be equivalent to the designation of the horizontal cabling designation by which it is connected to the floor distributor.

For example the outlet connected to the cable described in 14.4 would be designated A12-73.

Relabelling of any existing Category 5 cabling shall be with a computer generated, or similar system and placed behind a clear, tamper resistant cover.

Table of Contents

1 Introduction

This document outlines the Data Communication Cabling Specifications, Guidelines and Standards that are applicable to the environment of the Department of Education (DoE) of Western Australia.

This document is updated regularly as standards change. Prior to using this document please confirm that it is the latest version, which may be obtained at: http://www.det.wa.edu.au/education/ict/purchasing/docs/Data_Communication_Cabling_Standards_and_Specifications_Ver_4.2.pdf or: http://www.det.wa.edu.au/education/ict/purchasing/.

1.1 Purpose

This document has been prepared for use by the Department of Education (DoE) personnel and for other organisations or parties that participate in provision and implementation of data communication cabling products and systems for the Department.

It provides guidance in the following areas:

- Technical requirements for cabling systems
- Product selection and dimensioning guidance
- Design, installation and testing requirements
- Cabling administration and documentation

1.2 Scope

This document addresses the following areas:

- Cabling systems comprised of balanced copper cabling and optical fibre cabling for use in Departmental schools, colleges and office facilities
- Cable pathways and equipment spaces including equipment rooms

Guidelines are provided for capital works, upgrades and minor works.

1.3 Related Information

Specific cabling requirements, particularly for capital works and major upgrades, will normally be set out in contract documents relevant to the particular works.

Additional guidance in relation to cabling and related matters for capital works is provided at the following location:

Primary and Secondary schools: http://www.dhw.wa.gov.au/psb/main.cfm

1.4 Special Conditions

For the duration of the Cabling contract with Siemon, all products to be used in Department schools will be deemed to be manufactured by Siemon (see Appendix 2) unless a specific exemption is applied. All installation work shall be carried out by Siemon Certified installers, as per installation requirements.

Information in relation to Siemon can be found on their website at: http://www.siemon.com.au/au/.

1.5 Questions and Clarifications

Adherence to the standards and specifications within this document is mandatory. Exemptions may only be sought in accordance with section 3.4

Any questions or clarifications related to data communications or the contents of this document should be directed to:

- ICT Customer Service Centre
    - Phone: 08 9264 5555 or 1800 012 828
    - Email: customer.service.centre@det.wa.edu.au

2 Definitions and Abbreviations

2.1 Definitions

Alien crosstalk (ATX) – is electromagnetic noise that can occur in a cable that runs alongside one or more other signal-carrying cables.

Building backbone cabling – cable that connects the building distributor to a floor distributor.

Cabinet – see Enclosure.

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 5 (Cat 5) – a performance standard for cable and equipment in AS/NZS 3080:2003.

Category 5e – any reference to Category 5e shall be interpreted as Category 5.

Category 6 (Cat 6) – a performance standard for cable and equipment in AS/NZS 3080:2003.

Certified Installer – is used within this document to indicate the party(s) responsible for the supply, installation, testing and warranty of cabling systems.

Channel – end-to-end transmission path connecting two pieces of application specific equipment.

Communications earth system – a system of earthing using common elements to provide earthing facilities for electrical and communications equipment within premises.

Consolidation Point – connection point in the horizontal cabling subsystem between a floor distributor and a telecommunications outlet.

Department – in this document Department shall mean the Western Australian Department of Education.

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 cord – cord connecting equipment to a distributor.

Fly-lead – see work area cord

Horizontal cabling – cable connecting the floor distributor to the telecommunications outlets.

Learning Space – an area used by one or more students as a pseudo classroom.

Main Distribution Frame – a distributor that provides, or is intended to provide, an electrical termination point for a carrier's lead-in cabling.

Patch cord – cable, cable unit or cable element with connector(s) used to establish connections on a patch panel.

Permanent link – transmission path between the telecommunications outlet and the floor distributor.

Rack – see Enclosure.

Registered Jack 45 – in the USA RJ45 is the Universal Service Ordering Code (USOC) for circuit configuration 45 (neither T568A nor T568B) for an 8-position modular connector. In this document RJ45 shall mean a modular 8-pin connector wired according to T568A configuration in accordance with AS/NZS 3080:2003 ZA.2.

Site – means a facility such as a school or college and includes the buildings and grounds in which a cabling system would be installed.

Structured cabling system – set of cabling and connectivity products that are constructed according to standardized rules to facilitate integration of voice, data, video, and other signals.

Tenderer – means the entity requested to provide a quotation for the supply, installation, testing and warranty of cabling systems.

Work area cord – cord connecting the telecommunications outlet to the terminal equipment – also known as a fly-lead.

2.2 Acronyms and Abbreviations

10GbE	10 Gigabit Ethernet
ACMA	Australian Communications and Media Authority
BD	Building Distributor
BCA	Building Code of Australia
CAD	Computer Aided Design
CD	Campus Distributor
CES	Communications Earth System
CP	Consolidation Point
DoE	Department of Education (Western Australia)
DEO	District Education Office
DHW	Department of Housing and Works (Western Australia)
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EPR	Earth Potential Rise
FD	Floor Distributor
FEP	Fluorinated Ethylene Propylene
FOBOT	Fibre Optic Break Out Tray
GbE	Gigabit Ethernet
GPO	General Power Outlet
ICT	Information and Communication Technology
IDC	Insulation Displacement Connection
IP	Internet Protocol
LAN	Local Area Network
LASER	Light Amplification by Stimulated Emission of Radiation
LC	A small form factor optical fibre connector

LED	Light Emitting Diode
MDF	Main Distribution Frame
MMOF	Multi-mode Optical Fibre
MT-RJ	A small form factor optical fibre connector
MUTO	Multi-user Telecommunications Outlet
PoE	Power over Ethernet
PSE	Power Sourcing Equipment
RFI	Radio Frequency Interference
RJ45	Registered Jack 45 (USOC reference)
RU	Rack Units (1RU = 44.5mm)
SCS	Structured Cabling System
SFF	Small Form Factor (connector)
SFP	Small Form factor Plug
SMOF	Single-mode Optical Fibre
STP	Shielded Twisted Pair
TFEE	Telecommunications Functional Earth Electrode
TE	Terminal Equipment
TO	Telecommunications Outlet
TRC	Telecommunications Reference Conductor
UPS	Uninterruptible Power Supply
USOC	Universal Service Ordering Code
UTP	Unshielded Twisted Pair
UV	Ultraviolet
VoIP	Voice over Internet Protocol
VLAN	Virtual Local Area Network
WAN	Wide Area Network
WLAN	Wireless Local Area Network

3 Reference Documents

Cabling system works shall be carried out in accordance with the Regulations, Codes and Standards listed below.

Where Australian and International Standards are referenced in this document the application of the Standard shall be, unless specifically stated to the contrary, the latest edition and amendments available on the date 30 calendar days prior to the issue of any request for a quote, tender or proposal, within which this specification is included.

Where specifications or standards or any other references referred to in this document refer in turn to other specifications, standards or documents whether whole or in part, those consequential references shall apply to this specification as if they were completely contained in their entirety in the original reference.

AS/ACIF S009 defines mandatory work practices. Australian Standards are advisory unless incorporated in legislation or agreed by contract.

3.1 Statutory Codes and Regulations

The work covered by the Specification shall comply with the requirement of the following Acts and legislation:

- Western Australian Environmental Protection Act 1986
- Western Australian Occupational Safety and Health Act 1984
- Western Australian Occupational Safety and Health Legislation Amendment Act 1995
- Western Australian Occupational Safety and Health Legislation Amendment Act 2002
- Western Australian Electricity (Licensing) Regulations 1991
- ACMA Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard 2003 and Amendment Standard 2007 (No. 1)

3.2 Australian and International Standards

The work covered by the Specification shall comply with the following Australian Standards, Specifications and Technical Bulletins.

Standard/Specification or Technical Bulletin Number	Description
ARPANSA Radiation Protection Series Publication No. 3	Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz
AS/NZS CISPR 22	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
AS 1269	Occupational noise management
AS 1485	Safety and health in workrooms of educational institutions
AS 2107	Acoustics – Recommended design sound levels and reverberation times for building interiors
AS/NZS 2211.2	Laser safety – Safety of optical fibre communications systems
AS 2834	Computer accommodation

Standard/Specification or Technical Bulletin Number	Description
AS/NZS 3000:2007	Electrical installations (known as the Australian / New Zealand Wiring Rules)
AS/NZS 3080:2003	Telecommunications Installations – Integrated Telecommunications Cabling Systems for Commercial Premises
AS/NZS 3084:2003	Telecommunications Installations – Telecommunications Pathways and Spaces for Commercial Buildings.
AS/NZS 3085.1:2004	Telecommunications Installations – Administration of Communication Cabling System - Part 1: Basic Requirements
AS/NZS 4117	Surge protection devices for telecommunication applications
AS/NZS 4251.1	Electromagnetic compatibility (EMC) – Generic emission standard Part 1: Residential, commercial and light industry
AS/NZS IEC 61935.1:2006	Testing of balanced communication cabling in accordance with ISO/IEC 11801 – installed cabling
AS/NZS IEC 61935.2:2006	Testing of balanced communication cabling in accordance with ISO/IEC 11801 – Patch cords and work area cords
IEC 60297-3-100 Ed. 1.0 (Bilingual 2008)	Dimensions of mechanical structures of the 482.6mm (19in) series
IEEE 802.3	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications
IEEE 802.3af	Power over Ethernet standard. Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications--Amendment Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
TIA-942	Telecommunications Infrastructure Standard for Data Centres

3.3 ACA/ACIF Technical Standards and Codes

The work covered by the Specification shall comply with the following AS/ACIF Standards.

Standard/Specification or Technical Bulletin Number	Description
AS/ACIF S008:2006	Requirements for authorised cabling products
AS/ACIF S009:2006	Installation requirements for customer cabling (Wiring Rules)

3.4 Departmental Standards and Specifications

Cabling system works shall be carried out in accordance with the Departmental standards and specifications identified in tender or contract documents.

In the event of conflict between Departmental standard or specification and other regulations, codes or standards the order of precedence shall be:

i) Statutory Codes and Regulations

ii) Mandatory Codes and Standards (e.g. AS/ACIF S009)

iii) Departmental Standards or Specifications within the tender or contract

iv) Siemon installation practises and standards

v) This Specification

vi) Referenced Australian and International Standards

In the event of a conflict between the DOE documentation and DHW, or any other government agency documentation, this document carries precedence unless there is a written approval for an exemption. All respective DOE and DHW documents are to make reference to this specification only unless they include a current written approval for an exemption. Conflicts in requirements that are identified by DOE personnel, Consultants, Tenderers, Certified Installers or Contractors shall be notified to the ICT Directorate.

Where, for purposes of design or installation, the standards and specifications detailed in this document do not offer the most appropriate solution, an exemption must be sought from the ICT Directorate. Exemptions may only be granted by the ICT Director Infrastructure and Telecommunications or a duly appointed delegate. Requests for exemptions must be in writing and any subsequent approval or rejection must also be in writing. No variation from the standards and specifications detailed in this document is allowable without formal exemption. Notification of approval for any exemption must include notification of the potential for product and application warranties becoming void.

4 General Conditions

4.1 Cabling System Works

The scope of work for provision of cabling systems for the Department shall include supply, installation, testing, commissioning, labelling and documentation. Warranty provisions shall include on-site repair for a period of one year following completion of commissioning with a minimum defects liability period of 15 years. A defects liability period of 20 years is preferred.

Installation shall be carried out by a communications cabling system installer that is accredited by the manufacturer of the cabling and connecting hardware as qualified to perform the cabling work relevant to the performance standard of the various elements of the particular cabling system.

In addition, all installation works shall be 100% site supervised by personnel currently registered with the ACMA or ACMA authorised registrar as holding a cabling provider Open License together with additional accreditation indicating completion of endorsed courses in the areas of testing, commissioning, installation and correct work practices relevant to the performance standards of the various elements of the particular cabling system.

4.2 New Equipment

All cable and equipment shall be new and selected to ensure satisfactory operation under the environmental conditions present at the site.

Cables and equipment shall be delivered to site in its original packaging.

4.3 Minor Materials, Fittings and Consumables

All materials and fittings or any work which is obviously necessary for the satisfactory and efficient functioning of the installation or which is generally provided in accordance with accepted trade practices shall be provided or carried out as part of the works even though such material or work may not be explicitly mentioned in this specification or shown on the drawings.

4.4 Statutory Clearance for Access to Sites

All personnel undertaking works at Departmental sites must demonstrate they have been cleared by the National Criminal Record History Check (NCRHC) and must also comply with the Working with Children (Criminal Record Checking) Act 2004. NCRHC clearances for all personnel shall be requested through the Departments ICT Customer Service Centre (refer sub section 1.5) to the Policy and Screening officer or individually via the relevant school where forms are available. All personnel should refer to the web site at http://www.det.wa.edu.au/screening/detcms/portal/ for guidance about “child related work” and the process for Working with Children Checks that might be required.

4.5 Electrical Installation Works

All electrical power system upgrading work is to be undertaken by qualified Electricians in accordance with the relevant Australian Standards (AS/NZS 3000).

4.6 Site Conditions

The Tenderer shall undertake the necessary investigations to fully inform itself of the site conditions and other factors that could impact execution of the works. This shall include but not be limited to the following:

- Hazards that may be present at the site (such as asbestos and the like)
- Heritage registration of buildings
- Environmental conditions including special precautions for protection of flora and fauna
- Local site conditions including weather factors

Prior to submitting quotations, the Tenderer shall determine (in writing) with the Principal the presence at the Site of any hazardous conditions or materials such as asbestos and the like. If there is any doubt regarding hazardous conditions or materials the Tenderer shall confirm the Site conditions with the relevant Area Representative from the Department of Housing and Works (DHW).

Furthermore, the Tenderer shall verify whether any of the buildings or other structures at the Site have been included on the Heritage register. Details of such registration can be verified using the Heritage Council database accessible from http://www.heritage.wa.gov.au/. If a site is registered with the National Trust, prior approval is required from the Heritage Council prior to any works commencing.

If existing work is not up to standard, then the ICT Directorate needs to be advised as soon as possible.

In addition, everything that worked prior to any works commencing, functions as it did on completion of those works. i.e. network connectivity for existing services must be maintained.

4.7 Site Inspections

Dimensions shall be checked on site. No claims will be allowed for errors due to scaling of drawings.

The Department recommends that the Tenderer inspect the site prior to pricing to become familiar with the access, site conditions, and the existing installations.

Ignorance of the existing conditions or installation will not be accepted as justification for variation claims.

4.8 Equipment Locations

Equipment and cable pathways shall be installed in accordance with approved drawings and plans.

When deciding on a suitable location for equipment all factors as stated in section 7.1 of this document in relation to Health and Safety should be considered.

Additions or modifications to installed plant shall not be made without the written approval of the Principal or the ICT Directorate. Such additions or modifications shall be detailed on drawings and plans.

4.9 Site Reinstatement

All sites shall be reinstated to their former condition, to the satisfaction of the site's representative. Site reinstatement must occur as soon as practicable after the works have been completed.

4.10 Coordination with Other Works

Where the cabling system works is dependent upon or carried out in conjunction with other works at site such as building, electrical or mechanical works and the like the cabling system provider shall coordinate cabling activities with other works with respect to:

- Use of the site and access facilities
- Scheduling of the works and site construction resources and utilities
- Maintaining mandatory segregation of services
- Reinstatement

4.11 Clarification or Questions on This Document

Refer to sub section 1.5 for contact details for any questions or clarifications in relation to this document.

5 Department Structured Cabling System

5.1 General

Departmental cabling systems are generally intended to serve for a long period of time. It is likely that transmission system requirements will change during the life of the cabling system.

For this reason it is important to plan the cabling system to provide flexibility and to accommodate increased bandwidth requirements as far as possible. This is particularly important where cabling is installed underground or in other locations where upgrades to plant can be expensive and disruptive.

There are many factors to be considered in the design of cabling systems. It is suggested that professional opinion, or assistance, should be sought for design of cabling systems. This support may be obtained from the ICT Directorate, or from external organisations such as consultants, contractors or systems/network integrators.

5.1.1 Background

The structured cabling communications system plays a critical role in telecommunications systems, providing the physical link between sources and destinations of information. Data, voice, video and control signals are transmitted over this infrastructure linking devices across the hall, throughout a building or across several buildings.

The cabling system may be quite small and simple, linking just a few nodes, or it may be massive, linking several buildings with tens of thousands of nodes, or a system somewhere in between.

Essentially the structured cabling communications system is the physical link between active network equipment such as routers, switches, and terminal equipment such as network interface cards and telephones. Usually a structured cabling system (SCS) is comprised of unshielded twisted pair (UTP) cable or optical fibre cable or a combination of both.

To facilitate the day-to-day operations of a normal office environment, the cabling system must enable the user to make additions, moves and changes, wherever and whenever necessary. Furthermore, the SCS must also be flexible and provide the capability to carry a wide variety of applications - from high-speed local area network (LAN) applications to voice and low speed data.

Prior to this document the specification for the Data Communication Cabling within the Department was for Class D (Cat 5) UTP-based cabling system utilising optical fibre backbones where necessary.

As data throughput and transmission speeds have continued to grow, greater demands are being placed on the UTP and optical fibre cabling plant. Network applications such as Gigabit Ethernet and 10 Gigabit Ethernet use “parallel transmission schemes” where signals are transmitted simultaneously over multiple copper pairs instead of one pair.

Applications such as Gigabit Ethernet and 10 Gigabit Ethernet require increased performance from cabling plant. As a consequence, a number of existing “Category 5”[1] compliant cabling systems will fail to support these new applications.

Delivery of these new services requires increased performance from cabling plant.

[1] Category 5 performance has changed between editions of AS/NZS 3080:2003. Category 5 performance in the 2003 edition has been previously known as Category 5e. The earlier Category 5 used in association with Category 5e was not specified to support Gigabit Ethernet.

Other factors to be considered in relation to cabling system design and performance include:

- Convergence between data and voice applications including IP Telephony
- Video delivery using the Internet Protocol (IP)
- Use of Wireless LAN technology

5.1.2 Structured Cabling System Description

A Structured Cabling System (SCS) is a set of cabling and connectivity products that are constructed according to standardized rules to facilitate integration of voice, data, video, and other signals. Use of such a system provides benefits in terms of rationalization of infrastructure costs and facilitating predictable performance.

For the purpose of this document a SCS is defined as the cabling, connecting hardware, terminations, patch cords and work area cords. Equipment enclosures and associated pathways and spaces are considered as ancillary items.

The cabling, connecting hardware, termination and interconnecting cords comprising the SCS shall be a single matched solution from a manufacturer approved by the Department. The two major advantages to this approach are:

- **Manufacturers Warranty.** Cabling equipment manufacturers offer an automatic warranty of 15 to 20 years if the installation is a "Single Brand Solution" that is installed by a certified or accredited installer, rather than the 1 to 5 years available for a cabling system constructed from mixed brand products.
- **Performance Improvements**. Independent testing has revealed that mixing cabling products from a number of manufacturers can have significant impact upon the performance of the cabling system thereby limiting the useful life of the installation.

In the case of cabling works undertaken to expand or upgrade existing cabling plant at existing buildings the following requirements shall be applied: [2]

- The new cabling products shall be specified to ensure all warranties and system performance are maintained.

In the case of cabling works undertaken for new buildings added to a Site the cabling system shall comply with the requirements of this document except where such compliance would create compatibility or performance issues. Such issues shall be brought to the attention of the ICT Directorate prior to authorization of any works.

5.2 Applications and Cabling Performance

The current Departmental standard for new cabling installations is based on providing Gigabit Ethernet (GbE) over the backbone with 1000BASE-T to the desktop.

IEEE standards have already been ratified for 10 Gigabit Ethernet (10GbE) and it is likely that cabling infrastructure will be required to support 10 Gigabit transmission on the Fibre Backbone i.e. OM3 or OS1 and maintain support for Gigabit Ethernet to the desktop in the foreseeable future.

Departmental cabling system shall be constructed to conform to AS/NZS 3080:2003 – Telecommunications installations – Generic cabling for commercial premises.

[2] This applies specifically to existing buildings and does not apply to new buildings on the same site.

AS/NZS 3080:2003 specifies six performance classes (A, B, C, D, E and F) for balanced cabling channels. Only Class E performance is considered in this document.

Balanced cable channel performance is classified according to the maximum frequency at which performance is specified. Class E is specified to 250 MHz.

Gigabit Ethernet (1000BASE-T) is supported by Class E (Class E system will support all Class D applications).

The maximum channel length is 100m for Class E.

The cable and components used within balanced cabling systems are classified according to Category. Category 6 components provide Class E performance.

AS/NZS 3080:2003 defines three operating ranges for optical fibre transmission using four types of optical fibre cable.

Operating ranges are specified for 300m (OF-300), 500m (OF-500) and 2,000m (OF-2000). These distances are the minimum distances over which supported applications shall operate.

The defined optical fibre types are OM1, OM2, OM3 and OS1. The M is this case signifies multi-mode while the S signifies single-mode. OM1 and OM2 may be 50/125μm or 62.5/125μm while OM3 is confined to 50/125μm cable. **Only OM3 and OS1 are to be used unless specifically exempted**.

Any Power Sourcing Equipment (PSE) must be 802.3af compliant. e.g. Switches, Power Injectors. For Gigabit Ethernet, PSE may only be of the "Endspan" type.

5.3 Cabling System Architecture

The conceptual arrangement of a generic cabling system (from AS/NZS 3080:2003) is illustrated in Figure 1 below:

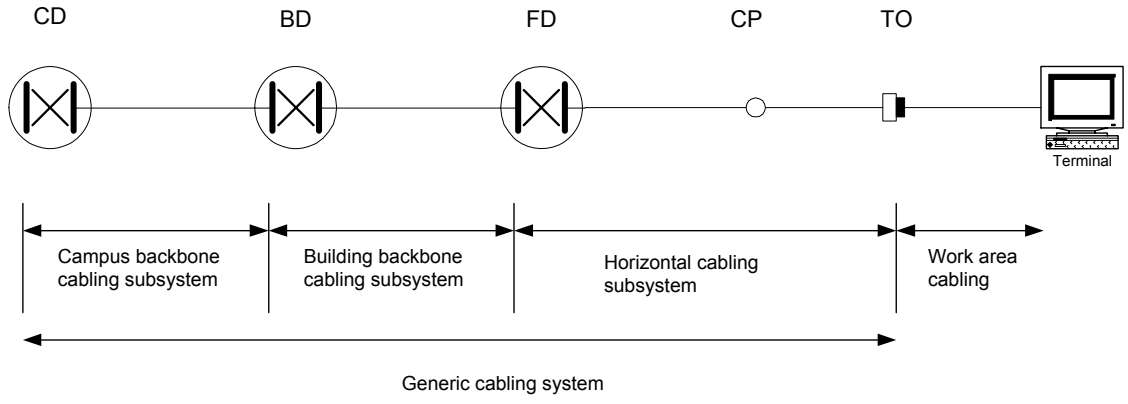

Figure 1 Generic Cabling System

The distributors provide the means to construct different cabling system topologies such as bus, star and ring, or a combination of these. Furthermore, the distributor functions may be combined, and the consolidation point may or may not be included in the cabling between the Telecommunications Outlet (TO) and the distributor.

The Structured Cabling System within Department facilities will often combine the Building Distributor (BD) and Floor Distributor (FD) functions. A conceptual layout that could be typically applied at a Departmental facility is illustrated below in Figure 2.

The lead-in cable providing the interface to carrier services will normally be located at the building that is closest to the carrier infrastructure.

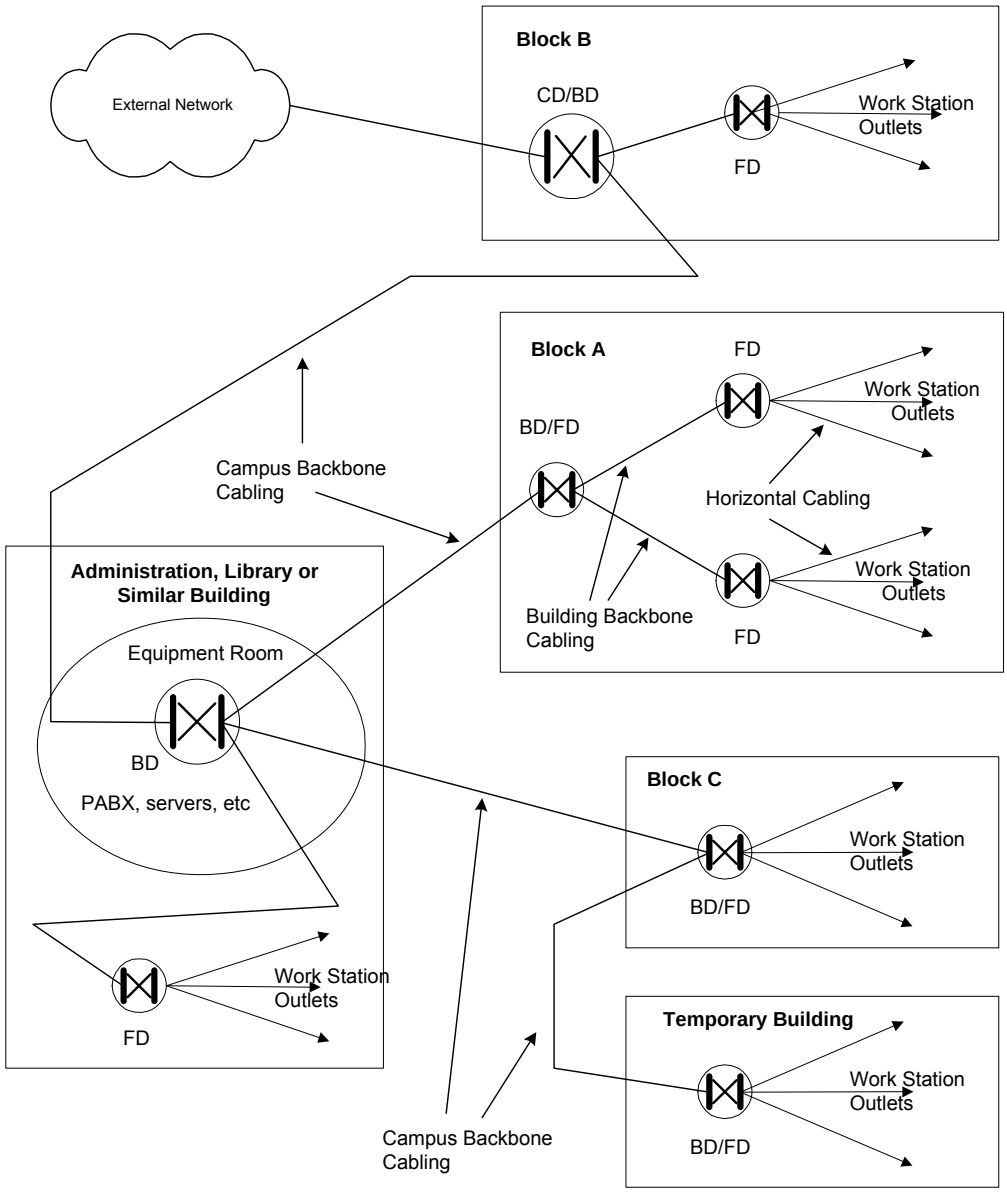

Figure 2 Conceptual DOE Layout

The major components of the SCS are described in the following sections.

5.3.1 Backbone Cabling

Backbone cabling includes both campus and building backbone cabling subsystems.

Campus backbone cabling runs between buildings. Building backbone cabling runs within buildings and provides the interconnection between the floor distributors and building distributors, or in some cases between a campus distributor and building / floor distributors.

The backbone cabling generally provides interconnection between active network equipment that may be within the same building or in separate buildings.

Campus backbone data communications cabling shall typically be optical fibre.

In some unusual cases balanced copper cabling may be used for campus backbone cabling. This may be where the path is very short and the risk of damage due to voltage transients is very low (e.g. between closely spaced temporary buildings). Use of balanced copper cabling for campus backbone cabling shall be approved by the ICT Directorate on a case by case basis.

Building backbone data cabling shall generally be optical fibre. However, copper cable may be used for building backbone in certain circumstances subject to ICT Directorate approval. Balanced copper building backbone cabling shall be multiple 4-pair UTP for Category 6.

Cabling for voice communications will vary according to the technology used for voice switching. For example, Internet Protocol (IP) Telephony systems voice signals will be transported along with data communication over common backbone cabling.

For conventional telephone systems the most practical solution will generally be to utilise balanced cabling in the backbone. In the majority of cases where optical fibre cabling is used for data communications dedicated balanced cabling will be required in the backbone to support conventional voice communications.

5.3.2 Horizontal Cabling

The horizontal cabling subsystem extends from the telecommunications outlet (TO) to the associated distributor. It includes consolidation points (CP) that may be in the path and distributor patch cords but does not include work area cords between the terminal equipment and the TO.

The horizontal cabling shall be a star topology connecting each workplace telecommunications outlet to a patch point at a distributor as shown below.

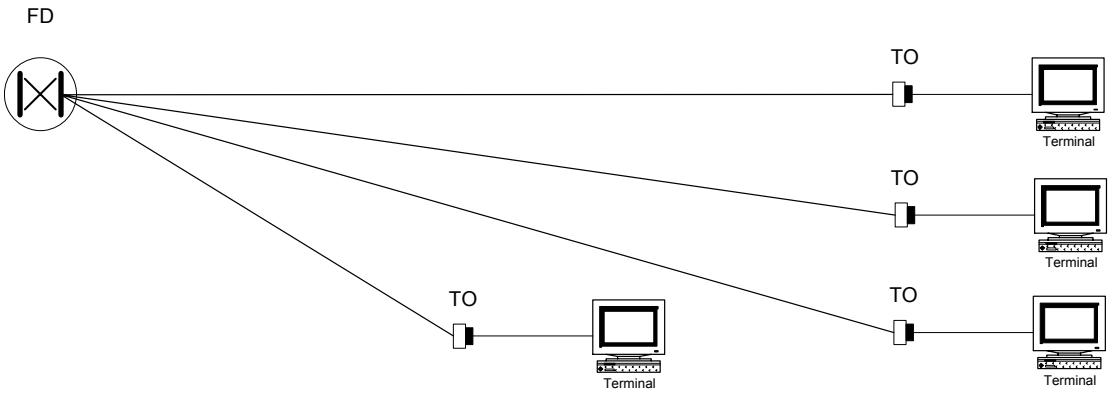

Figure 3 Horizontal Cabling

Horizontal cabling shall be Category 6 (Class E) 4-pair 100 ohm UTP balanced cable.

Existing 150 mm by 50 mm three channel cabling duct is to be used wherever possible.

5.3.2.1 Twisted-Pair Cabling

All qualified cables shall surpass the most severe category 6 requirements provided in the Industry Standards by meeting or exceeding the performance listed below for all specified frequencies (except where noted):

Parameter	UTP Cable Performance				
	100 MHz	200 MHz	250 MHz	350 MHz*	550 MHz*
Insertion Loss (dB)	19.6	28.7	32.6	36.1	51.3
NEXT Loss (dB)	47.3	42.8	41.3	40.1	36.2
PSNEXT Loss (dB)	45.3	40.8	39.3	38.1	34.2
ACR (dB)	27.7	14.1	8.8	4.0	-15.1
PSACR (dB)	25.7	12.1	6.8	2.0	-17.1
ELFEXT (dB)	30.8	24.8	22.8	21.3	16.0
PSELFEXT (dB)	28.8	22.8	20.8	19.3	14.0
Return Loss (dB)	22.5	21.0	20.5	20.1	18.8
Propagation Delay (ns)	517.6	516.5	516.3	516.1	515.5
Delay Skew (ns)	≤ 35	≤ 35	≤ 35	≤ 35	≤ 35

* Performance for frequencies beyond TIA and ISO requirements are for information only

5.3.2.2 Horizontal Cabling Variations

The preferred horizontal cabling arrangement is a continuous 4-pair UTP cable between the TO and the distributor as shown in Figure 3. However two variations to this arrangement may be permitted for changes to existing installation – these being the use of consolidation points (CP) and multi-user telecommunications outlets (MUTO):

CP and MUTO arrangements are primarily intended to reduce the effort associated with rearrangements occurring in open-office style environments. The CP or MUTO is installed within close proximity to a cluster of TOs as shown in Figure 4 below. In the event of rearrangement the cabling between the distributor and the CP / MUTO can be retained.

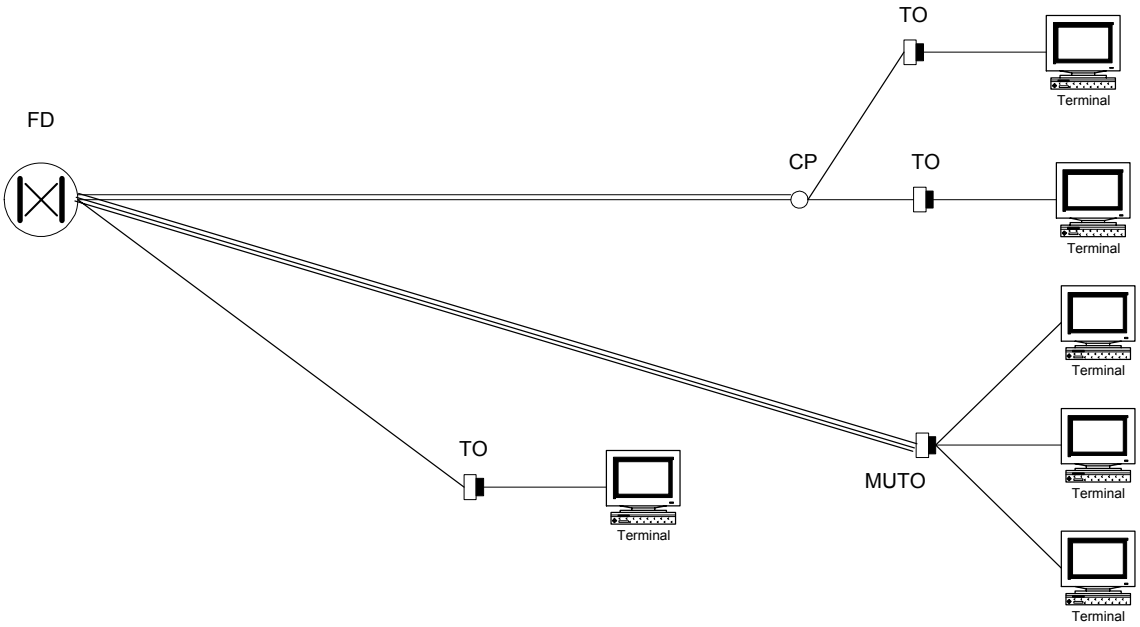

Figure 4 CP and MUTO Arrangement

Consolidation points are used with solid copper UTP and generally constructed using insulation displacement punch-down termination blocks or RJ45 type outlets.

Multi-user telecommunications outlets provide a number of RJ45 outlets and are designed to accommodate the flexible work area cords.

CP and MUTO arrangements shall not be used in new installations. ICT Directorate approval shall be obtained for the introduction of CP and MUTO within existing cabling systems.

5.3.2.3 Wireless LAN Interfaces

Use of wireless technology for data communications is increasing. A number of standards have been developed to extend the LAN using wireless.

Wireless LAN (WLAN) equipment conforming to the IEEE 802.11 standards is widely deployed. Guidelines for utilisation of Wireless LAN (WLAN) infrastructure are provided in SOE Standards document Wireless LANs in Schools v1.9. Distribution of this document is restricted – the ICT Directorate should be approached for guidance regarding deployment of WLAN equipment.

WLANs provide an alternative to a wired LAN architecture but are usually deployed in conjunction with cabling infrastructure. The WLAN equipment is not considered to form part of the cabling system. However, horizontal cabling may be used to interconnect wireless access points to the network infrastructure and this aspect is briefly discussed below.

Placement of outlets used to interface with WLAN access points should consider the following:

- A wireless access point should be placed at between 2.0 and 2.5 metres from the floor for reasons of accessibility, and to match up with the next point below.
- The WLAN antennas should be located at elevated positions. e.g. at or near to ceiling height (not greater than 2.5 metres) for reasons of coverage and to minimise potential for exposure to radiation.
- Multiple access points may be required to service larger or unusually shaped rooms. Outlet spacing needs to be designed with due consideration of coverage and interference.
- Outlets shall not be located near to microwave ovens or other sources of interference.
- Data outlets for access points must be internal to buildings with provision for external antennas (where required) in secure positions with a low risk of vandalism.

For 100 Base T networks, preference is given to the use of PoE Midspan PSE, e.g. power injectors (see 5.2) at the patch panel to provide power for wireless access points. For 1000 Base T networks, only PoE Endspan PSE may be used.

5.3.3 Copper Terminations

The general method for termination of copper cabling shall be modular 8-pin sockets (commonly known as RJ45) and plugs using the AS/NZS 3080:2003-T568A standard.

Interface connectors at the FD and TO shall be modular 8-pin sockets (RJ45). Horizontal balanced cables shall be terminated with corresponding modular 8-pin jacks.

Insulation Displacement Connection (IDC) punch-down blocks fitted to 19” rack mount frames may be used for termination of outdoor (external) and multipair copper cables.

Patch by exception systems are an alternative to RJ45 patching that is permitted by AS/NZS 3080:2003. A common arrangement is using IDC blocks with semi-permanent

connections established using jumpers. The jumpered connections may be interrupted by patch cords. Patch by exception systems provide higher density than patch panels and are suited to systems where wiring changes are infrequent. Patch by exception systems are not described in this document but may be used within Departmental cabling systems and may only be used with prior approval.

5.3.4 Optical Fibre Terminations

Optical fibre cable shall be terminated with LC type fibre connectors. Where an exemption is provided for the use of OM1 instead of OM3, SC terminations are to be used on the OM1 fibre and FOBOT.

Network equipment that uses Small Form Factor (SFF) or Small Form factor Pluggable (SFP) optical connectors shall be interfaced to the LC connectors at the patch panel using optical patch cords to provide adaptation between LC and the particular SFF or SFP connector.

With a range of pre-existing Fibre termination at a given site, consideration must be given to the provision of LC to SC and LC to ST patch cords. A similar consideration is necessary when installing OM1 Fibre, to provide SC to SC or SC to LC patch cords as necessary.

5.3.5 Carrier Interface

The carrier service interface varies according to location and function. For example:

- Metropolitan sites and a large number of regional sites are provided with a 10 Megabit per second (10 Mbit/s) Government Wideband IP (GWIP) service from the site to Central Office. The connection between the Telstra switch / Managed Optical Media Converter and the site's Departmental Router is via an Ethernet connection.
- Where GWIP is not available, sites are provided with a Government Business IP (GBIP) service or Telstra Private IP (TPIP) frame relay equivalent service operating via 512Kbit/s, 1 or 2 Mbit/s from the site to Central Office. The connection to the site's Departmental Router is via an X21 Serial Connection.
- Remote locations are provided with a Remote Data satellite service operating via 128Kbit/s download, bursting up to 1024Kbit/s (4.864Mbit/s capacity) from the satellite hub to the school, and 32Kbit/s upload, bursting up to 128Kbit/s (1.2Mbit/s capacity) from the school to the satellite hub, shared across 37 sites (with an overall capacity of 6Mbit/s Ethernet backhaul from the satellite hub to Central Office). The connection between the satellite equipment and the site's Departmental Router is via an Ethernet connection.

5.4 Cable Alternatives

Cable specifications are included in section 10.

5.4.1 Optical fibre

Single-mode optical fibre (SMOF) has been commonly used in long haul optical fibre routes or in high bandwidth applications. Multi-mode optical fibre (MMOF) conforming to IEC 60793-2-10 type A1b (62.5/125μm) has been widely deployed in Australia within campus and building cabling system backbones. MMOF conforming to IEC 60793-2-10 type A1a (50/125μm) is popular in Europe and Japan.

Two GbE transmission systems are specified by the IEEE for optical fibre depending on the transceiver (light source) that is used. One option is known as 1000BASE-SX (850nm - short wavelength laser) and the other is 1000BASE-LX (1,310nm - long wavelength laser). GbE interface modules are also available at 1,550nm for use with single-mode optical fibre cable.

A range limit of 275m applies for 1000BASE-SX over 62.5/125µm OM1 multi-mode optical fibre, while a range limit of 550m applies to 1000BASE-LX over 62.5/125µm OM1 multi-mode optical fibre.

10GbE operation using 850nm (10GBASE-S) is defined by the IEEE for 50/125µm OM3 MMOF and for 62.5/125µm OM1 MMOF. Operating range in this case is restricted to 33m for 62.5/125µm OM1, 82m for 50/125µm OM2 cable and 300m for OM3 (laser optimized) cable.

The only system recognized within AS/NZS 3080:2003 for 10 GbE using 62.5/125µm MMOF (10GBASE-LX4) utilises four carriers operating with wavelengths near to 1,310nm to achieve a 300m maximum operating range.

Optical fibre cable for Departmental cabling systems shall be constructed using OS1 SMOF or OM3 MMOF in accordance with section 5.5.

5.4.2 Balanced Copper

Balanced cabling subsystems shall be constructed using Category 6 balanced unshielded twisted pair (UTP) cable.

Shielded twisted pair (STP) cabling is intended for use in environments subject to high levels of electromagnetic interference or where low levels of electromagnetic radiation are required. ICT Directorate approval shall be obtained for use of STP cabling.

5.4.3 Maximum Cabling Channels Lengths

Maximum channel lengths specified by AS/NZS 3080:2003 (Table 1 Clause 5.7.1) are:

- 100m total for the horizontal cabling channel
- 2000m total for the campus backbone + building backbone + horizontal cabling channel

The length of the components of the horizontal cabling channel shall not exceed the distance set out in Clause 7.2.2.2 and Table 21 of AS/NZS 3080:2003 considering the appropriate length de-rating for maximum ambient temperatures above 20^0 C except that the length of work area cords shall not exceed 5 m.

The length of the components of the backbone (balanced) cabling channel shall not exceed the distance set out in Clause 7.2.3.2 and Table 22 of AS/NZS 3080:2003 considering the appropriate length de-rating for maximum ambient temperatures above 20^0 C.

Maximum channel lengths specified for optical fibre cable[3,4] are specified in Table 1 below.

[3] Channel lengths for multi-mode cable for 100BASE-FX, 10000BASE-SX and 1000BASE-LX are from Table F.4 of AS/NZS 3080:2003.
[4] Channel lengths for 10GBASE-X are from IEEE 802.3ae

Network Application	Wavelength	62.5/125μm (OM1)	50/125μm (OM3)	9/125μm
100BASE-FX	1,310nm	2,000m	2,000m	2,000m
1000BASE-SX	850nm	275m	550m	N/A
1000BASE-LX	1,310nm	550m	550m	5,000m[5]
10 GBASE-S	850nm	33m	300m	N/A
10 GBASE-LX4	1269.0 - 1,355.9nm	N/A[6]	N/A[7]	10,000m
10 GBASE-L	1,310nm	N/A	N/A	10,000m
10 GBASE-E	1,550nm	N/A	N/A	40,000m

Table 1 Optical fibre channel lengths

Operation at distances greater than those shown in the table is possible, but such distances are not defined by the relevant standards. For example, Gigabit Ethernet operation can be achieved over 70 km distances using higher power lasers and avalanche photodiode receivers while operation can be extended to 100 km using dispersion shifted fibre or higher power lasers used for coarse wavelength division multiplexing (CWDM) systems.

5.5 Cable Utilisation Guidelines

5.5.1 Introduction

The optimum cable arrangement will depend on the circumstances of the particular installation. Factors that need to be considered in determining the composition of the SCS include:

- Distances between distributors and outlets
- Compatibility with existing cabling and equipment
- The equipment that will use the cabling system and constraints that such equipment may introduce with regard to supported interface modules.
- Environmental factors such as salt atmosphere and prevalence of lightning

Guidelines for utilisation of the various cabling alternatives with respect to distance and locations are included in the following subsections.

5.5.2 General Cable Utilisation Guidelines

External (outdoor) cable routes shall utilise optical fibre cable due to:

[5] In accordance with IEEE 802.3

[6] 10GBASE-LX4 is not defined for 62.5/125μm OM1 cable or 50/125μm OM3. However, for 50/125μm OM2 or 62.5/125μm OM2 cable with Modal bandwidth of 500 MHz/km the maximum distance is 300m.

- Increased bandwidth and resultant ability to support higher transmission rate application
- Improved protection against damage due to voltage transients, electrical noise and lightning

ICT Directorate approval must be obtained for the use of copper cable for external cable routes as detailed in section 3.4. Any approved installation of external UTP must have isolators (transient protection) installed at each end of the external runs - refer to 7.5.1, unless specifically exempted.

Copper cable will not be considered for any external cable in lightning prone districts if there is more than 3m between buildings. For all other approved exemptions to use external UTP, the maximum distance between buildings is 10m.

For all cable route lengths of 275m or less, Multi-mode optical fibre (MMOF) of type OM3 will be used. Where the length of the cable route exceeds 275m, Single-mode optical fibre (SMOF) of type OS1 will be used. Other types of optical fibre will not be used without an exemption as detailed in 3.4.

Underground pathways are preferred for external cable routes. However, above ground routes may be used, subject to ICT Directorate approval, provided that:

- The pathway is fully covered and the cabling is installed within protective conduit or ducting for the entire external section of the cable route
- And for balanced cabling:
  - The distance between distributor connection points does not exceed 15m
  - The building earths of the buildings at which the cable route terminates are bonded together
  - Transient protection is provided at each termination point of the cable

External cabling routes using catenary wire for support shall only be used in circumstances where alternative underground or aboveground pathways are impractical. ICT Directorate approval shall be required for external catenary wire cable pathways.

Category 6 cabling and components shall be used for the indoor and outdoor components of balanced cabling subsystems of all new installations i.e. at new schools.

Upgrade and expansion works to sites with existing Category 5 or earlier cabling shall be Category 6. Upgrade and expansion works to sites with existing Category 6 cabling shall be Category 6.

Factory terminated optical fibre cables in specific lengths have been available for a number of years. These may be appropriate as a low cost alternative to terminating cores on site under certain circumstances. ICT Directorate is to be consulted before any installation is carried out.

5.5.3 Cable Utilisation versus Location / Distance

Guidelines for cabling selection for campus backbone, building backbone and horizontal cabling are included below.

- **Campus backbone cabling (external inter-building inclusive of all transportable and demountable buildings):**
  - OS1 6-core minimum for all channel lengths greater than 275m
  - OM3 6-core minimum for all channel lengths 275m or less

- In new capital works 12-core OM3 and/or OS1 may be specified in design considerations
- Any transportable or demountable building (except for a Pre-Primary) is to be considered to be of a temporary nature and is to be linked back to the nearest permanent building unless ICT deem it to be more cost effective to go back to the core.
- Any transportable building considered to be the first pre-primary transportable building, is to be linked back to the network core. Any additional pre-primary buildings can be linked to this pre-primary building or to the nearest permanent building.

- **Building backbone cabling (internal intra-building):**
  - OS1 6-core minimum (12-core preferred) for all channel lengths greater than 275m
  - OM3 6-core minimum (12-core preferred) for all channel lengths less than 275m
  - Category 6A 4-pair UTP cables such as the Siemon Z-MAX, where approved for use, will be of a maximum cable route length of 90m
- **Horizontal cabling:**
  - Category 6 for all new capital works, i.e. not upgrades to existing facilities
  - The maximum allowable cable length for Category 6 is 90m.
  - The minimum UTP run for Category 6 is 15m, this is related to network equipment limitations and not structured cabling.

5.6 Location/Program Specific Requirements

5.6.1 Capital Works Programs

Cabling systems for capital works shall utilise Category 6 (Class E) balanced cabling.

5.6.2 Expansion and Upgrade to Existing Facilities

Upgrade or expansion works are to maintain uniformity with this standard (i.e. Cat 6 or OM3). Any variation must be justified to and approved by the ICT Directorate.

5.6.3 Transportable Buildings

Temporary buildings shall be fitted with not less than seven (7) telecommunications outlets per learning space. Preference is for nine (9) telecommunications outlets. All new temporary building placements are to have nine (9) telecommunications outlets. In all cases, one telecommunications outlet is to be left free for voice related use.

Temporary transportable buildings are generally transported in two sections. In this case the cabling system distribution and outlets shall be contained within one section wherever practicable.

It is intended that the store room would be generally used as the equipment room. In this case cabling shall be within the same section as the store room.

The equipment room shall be provided with access security and adequate ventilation to maintain suitable operating conditions for equipment. Equipment room doors shall be fitted with a lock and as a minimum shall allow a vent in the door.

5.7 Capacity and Dimensioning

5.7.1 General Dimensioning Requirements

General dimensioning requirements are as below:

- The maximum number of outlets at primary schools shall be equal to the expected number of students and teachers and administrative staff. For schools with secondary students the maximum shall be 120 percent of the expected number of students and teachers and administrative staff unless there is specific ICT approval.
- Every learning space should have at least eight (8) telecommunications outlets (TO). Consideration needs to be given to the location of TO in relation to existing infrastructure such as general power outlets (GPO) so as not to create any potential occupational, health and safety issues. For each TO there will be, as a minimum, one adjacent GPO. If the learning space is to include standard voice services, a minimum of one (1) additional telecommunications outlet is to be installed and left free for voice services only.
- Backbone cabling links used for voice applications shall have not less than 25% more pairs than the associated horizontal cabling and telecommunications outlets.
- Balanced cabling work area cords shall be provided on the following basis:
    - The total number of work area cords shall equal 1.2 x number of outlets
    - Work area cord lengths shall be 2.0m and 3.0m, or the closest standard lengths supplied by the vendor (e.g. 2.1m and 3.1m) with each length supplied in equal quantities.
- Balanced cabling patch cords shall be provided on the following basis:
    - The total number of patch cords per distributor shall equal 1.1 x number of sockets
    - 80% of the patch cords shall be 1.0m
    - 20% of the patch cords shall be 1.5m
- Optical fibre patch cords shall be provided on the following basis:
    - The total number of optical fibre patch cords shall equal one each end of an active pair. Pricing options are to be provided for LC-LC, LC-SC, LC-ST, LC-SFF, ST-SFF and dependent on pre-existing infrastructure and prior approval from the Department for an exemption from using OM3.
    - Optical fibre patch cords shall be provided as standard manufactured items of standard length and shall be as short as is practicable to minimise excess cable management requirements. Longer patch cords will be required where network equipment is not installed in the same enclosure as the optical fibre termination / distribution panel.
    - Optical fibre patch cords will not necessarily be provided at the time of installing the optical fibre, as the client may not know what the exact

active equipment type will be. Many new switches are available with only the SFF type of connectors so the type of each patch cord may not be determined until the active equipment is known.

5.7.2 General and District Offices

Unless otherwise specified the minimum distribution of data outlets for offices shall be as specified below:

- Provide dual telecommunications outlets cabled to the appropriate floor distributor for:
  - Individual closed offices
  - Conference rooms, meeting rooms and the like
  - Each workstation area
  - Each printer, fax or other network connected device
  - For every 15m^2 of open office space

5.7.3 Schools

Unless otherwise specified the minimum distribution of data outlets for schools shall be in accordance with Table 2 below, with one (1) additional point per area for all Capital Works to allow for a phone connection.

Room definition	Min No of Ports	Description
Standard classroom	8	Standard learning area with no high density computing device requirements
Specialist classroom	24	Higher density computing devices required such as Art, Design & Technology, Computer or business studies
Library/Resource Centre	22	
Art/music/cooking	4	Special purpose learning areas for non ICT
Manual arts	4	Specialist manual arts learning areas
Collegiate work areas	1 per staff plus 3 extra	Staff or collegiate work areas are used by teaching staff for preparation and administration. The distribution of data outlets should be 1 per workstation, plus an allowance for printers and phones.
Registrars work area	4	Includes computer, printer, phone and fax
Administration work area	1 per staff plus 2 extra	Every administration work area (includes library, reception, Principal, Deputy, etc). Work area is defined as the workstation for a single person and includes phone.

Table 2 School outlet requirement

Note: Areas that are used for computing equipment that are not outlined in the above table shall have MUTO outlets installed at no closer than 800mm separation.

5.7.4 TAFE Colleges

Unless otherwise specified the minimum distribution of data outlets for TAFE colleges shall be in accordance with Table 3 below, with one (1) additional point per area for Capital Works to allow for a phone connection.

Room definition	Min No of Ports	Description
Standard classroom	21	Standard learning area
Specialist classroom	25	Higher density computing devices required such as Art, Design & Technology, Computer or business studies
Library	20	Research, library search and general use
Student Resource room	6	Additional learning area located close to workshops
Collegiate work area	1 per staff plus 3 extra	Lecturer work areas are used by lecturing staff for preparation and administration. The distribution of data outlets should be 1 per workstation, plus an allowance for printers and phones.
Administration work area	1 per staff plus 2 extra	Every administration work area (includes library, reception etc). Work area is defined as the workstation for a single person and includes phone.

Table 3 College outlet requirements

Note: Areas that are used for computing equipment that are not outlined in the above table shall have MUTO outlets installed at no closer than 800mm separation.

5.7.5 Data Centres

Such is the nature of Data Centres that this specification is to apply only in relation to horizontal and backbone cabling. Data Centre equipment rooms/facilities and infrastructure design will be specified independently to meet the unique requirements of the centre. Designers should use the TIA-942 Telecommunications Infrastructure Standard for Data Centres.

5.8 Mandated Equipment and Services

Tenderers and cabling system Installers shall confirm with the Department the existence of any panel contracts or similar that may be in place that place constraints on the provision of services or materials.

6 Exclusions

6.1 Building and Electrical Earths

Building earth systems and electrical earth systems shall be provided as part of the building works.

Earthing and related works by the cabling system certified installer shall be limited to the following:

- Provision of communications earth system (CES) where specified as part of the works.
- Provision of telecommunications reference conductor earthing system (TRC) where specified as part of the works.
- Bonding of the cabling system equipment, enclosures, components, pathways and the like to the relevant earthing system including provision of earth bars, cabling and connections as required.

6.2 Existing Cabling

This document does not require the modification of existing cabling and related systems installed and completed prior to the commencement of any new works, except where necessary to achieve a successful merger of old cabling with new works on the same site.

Cabling that has been provided in accordance with earlier standards will generally be retained in service unless there is sufficient justification for replacement of the cabling such as recabling of the premises as part of an upgrade or redevelopment or if cabling performance is inadequate in relation to provision of new communications facilities.

6.3 Other Cabling or Systems

Related cabling or systems that are outside the scope of this document include:

- Network equipment (servers, switches and the like) that are connected to the SCS
- Master Antenna Television (MATV) cabling and equipment
- Wireless LAN equipment
- Patch by exception balance cable termination systems
- Radio based carrier interface

7 System Design

7.1 Health and Safety

Optical fibre systems shall meet the requirements of AS/NZS 2211 - Laser safety – Safety of optical fibre communications systems. Connectors that are not in use shall have dust covers fitted to protect against potential laser exposure and dust ingress.

Warning labels shall also be affixed advising not to look directly into the fibre connectors.

Wall mounted enclosures shall be located to avoid injury to persons. Requirements are specified in section 11.3.1.

Telecommunications outlets shall be located so as to provide ready access without the need for excessive bending or stretching.

The layout and location of the cabling system and pathways shall ensure that equipment, access facilities or metallic components shall not be placed in a location where the earth potential rise (EPR) may exceed 430 V ac under power system fault conditions in accordance with Clause 5.1.4 of AS/ACIF S009.

7.1.1 Acoustic Noise

For the purpose of design tasks associated with acoustic noise, particularly attenuation of noise, it shall be assumed that noise levels originating from a telecommunications closet shall be maintained within the limits specified by the National Standard for Occupational Noise - NOHSC:1007(2000):

- The national standard for exposure to noise in the occupational environment is an eight-hour equivalent continuous A-weighted sound pressure level, $L_{Aeq,8h}$, of 85dB(A). For peak noise, the national standard is a C-weighted peak sound pressure level, $L_{C,peak}$, of 140dB(C).

The exposure to noise is taken to be that measured at the employee's ear position without taking into account any protection that may be afforded by personal hearing protectors.

Equipment enclosure locations shall be selected such that noise levels in work areas arising from servers and the like, when combined with other sources of work area noise, shall be maintained within the limits specified by AS/NZS 2107. Recommended design sound levels are indicated in Table 1 of AS/NZS 2107, from which the following design details are extracted.

Type of Occupancy / Activity	Design sound Level (L_{Aeq} dBA)		Reverberation Time (s)
	Satisfactory	Maximum	
Art / Craft Studio	40	45	0.6 – 0.8
Computer Room – Teaching	40	45	0.4 – 0.6
Duplicating Rooms / Stores	45	50	0.6 – 0.8
Library – General Area	40	50	0.4 – 0.6
Library – Reading Area	40	45	0.4 – 0.6
Teaching Areas – Primary	35	45	0.4 – 0.5
Teaching Areas – Secondary	35	45	0.5 – 0.6

In general this should be achieved by installing the equipment enclosure within a room that is segregated from work areas and that provides suitable attenuation of the noise transmission path between the equipment and the listeners.

7.1.2 Electromagnetic Radiation

The cabling systems specified within this document are passive and therefore will not radiate unless connected to active equipment.

Electromagnetic radiation needs to be considered in relation to compatibility with other equipment and potential harmful effects.

Electromagnetic compatibility aspects are addressed in section 7.7.

The regulatory requirements in relation to human exposure to electromagnetic radiation (EMR) are undergoing review by the ACMA and other bodies. The methodology and planned implementation is outlined in the ACMA's EMR framework.

The Australian Standard for human exposure to electromagnetic radiation (AS 2772.2) expired in April, 1999 but remained the basis for ACMA human exposure standards introduced in 1999 and 2001. In 2002, ARPANSA published the Radiation Protection Standard for Maximum Exposure to Radiofrequency Fields - 3 kHz to 300 GHz (2002).

The ARPANSA Standard forms the basis for:

- ACMA Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard 2003, which commenced on 1 March, 2003 and imposes electromagnetic radiation (EMR) performance requirements on mobile and portable transmitters with integral antennas intended to be used in close proximity to the human body.
- ACMA Radiocommunications Licence Conditions (Apparatus Licence) Determination 2003 that imposes conditions on transmitters operating under apparatus license conditions.

While human radiation exposure standards and legislation are not relevant to the passive cabling system components the cabling system layout shall be developed with due consideration of outlets that are designated for interfacing with wireless LAN or other radio equipment. These outlets should be located such that antennas are installed with sufficient physical separation to satisfy human exposure criteria.

7.2 Equipment Rooms

Equipment rooms shall meet the requirements of section 8.2 and shall be designed with due consideration of the following:

- AS/NZS 3084 Clause 6 and Appendix ZB.
- Room for future expansion
- Safety – equipment layout shall not restrict escape routes
- Acoustic noise requirements identified in section 7.1.1
- Suitable access to equipment for installation and maintenance
- Provision of space for carrier entry when required
- Access to/from the equipment room to external parking for the transport of equipment

- Equipment enclosures shall not be installed in positions where exposure to moisture is likely. For example, enclosures should not be installed under air conditioning vents.

7.3 Spare Capacity

The cabling system at the time of installation shall be dimensioned to provide spare capacity as detailed below:

- Equipment rooms shall allow for installation of an increase in the number of enclosures by 25% or 1 enclosure/rack, whichever is the greater. For example, equipment rooms with 1 to 4 enclosures shall allow space for a further enclosure. An equipment room with 5 enclosures shall provide space for a further two enclosures.
- Enclosure and racks shall not be more than 60% occupied.
- Pathways shall provide spare capacity IAW section 9 requirements.
- Cable trays shall provide spare capacity IAW section 9 requirements.
- Conduits shall not be filled to more than the listed capacity in section 9.
- Balanced cabling backbone capacity (CD/BD – BD/FD) for voice communications shall have not less than 50% spare capacity relative to the number of pairs allocated to voice services between the FD and connected TOs.
- Balanced cabling backbone capacity (CD/BD – BD/FD) for data communications shall have not less than two unused 4-pair UTP cables or the equivalent multipair capacity.

7.4 Legacy System Compatibility

Cabling system design shall consider the interface requirements of legacy equipment.

7.5 Environmental Factors

The equipment comprising the cabling system shall be suitable for the environmental conditions at the particular site.

The cabling system layout, including equipment room and distributor locations, shall consider cabling and network equipment environmental performance specifications and manufacturers recommendations.

7.5.1 Lightning Protection

Special consideration shall be given to earthing practices in areas prone to lightning activity.

Transient protection shall be provided for equipment connected to outdoor copper cabling.

Transient protection for cabling shall be compatible with the earthing system provided at the facility. Particular care needs to be taken where separate buildings earths may not be bonded.

7.5.2 Salt

Particular care shall be taken for installations in coastal regions or near to salt pans / lakes to minimise exposure of equipment to salt.

Equipment enclosures and distributors shall not be installed in open areas.

Equipment room vents shall be fitted with filters to minimise salt ingress.

7.5.3 Chemical Corrosion

Equipment rooms and distributors shall not be located near to corrosive atmospheric or environmental conditions.

Storage areas for cleaning solvents and other chemical products shall not be used to house cabling equipment and shall not be adjacent to equipment rooms or equipment room vents.

7.5.4 Heat

Equipment room design, including HVAC and venting, shall consider the heat load of active equipment likely to be fitted to enclosures.

Enclosures shall be equipped with vented panels to facilitate air flow for cooling of active equipment. Where necessary, ventilation trays or racks shall be installed in the enclosure.

If further increased air flow is required, door vents and / or ceiling extraction fans should be used.

N.B. Side panels and doors should not be removed to improve ventilation; instead external environmental factors should be improved. e.g. consider air-conditioning.

7.6 Reliability

Floor mount boxes accommodating telecommunications outlets shall not be used in areas where water ingress is possible.

Floor mounted telecommunications outlets shall not face upward.

7.7 Electromagnetic Compatibility

To address the problem of electromagnetic interference (EMI) the ACA and other regulators have established a framework to introduce technical limits for the electromagnetic compatibility (EMC) of devices and communications standards. This framework is known as the EMC framework.

Passive components including cables and connectors are presently excluded from the EMC framework.

In general, it is required that manufacturers of transmission equipment take full account of the contribution of the cabling to the overall EMC of the transmission system. In this case it is necessary to ensure that the performance of the installed cabling channel is within the limits specified by the transmission equipment.

Transmission equipment shall meet the requirements of AS/NZS CISPR 22.

Complete systems are required to meet AS 4251.1.

To facilitate satisfactory EMC performance of the overall SCS the design of cable routes and pathways shall take due consideration of the recommendation included in AS/NZS 3080:2003 ZA.1.3.3 and AS/NZS 3080:2003 ZA.3.2.

7.8 Security

In general, it shall be necessary to pass at least two points of restriction to access equipment from outside the building. This shall generally be achieved using locked doors at the equipment room, communications cupboards/closets and equipment enclosures.

Pits and external plant shall be placed as unobtrusively as is practicable so as not to attract attention.

External cabling installed in overhead pathways shall be installed within protective conduits or ducts.

8 Equipment Rooms and Service Entry

8.1 Carrier Service Entrance

The service entrance for carrier services will generally be located within the building that is closest to the carrier infrastructure.

Carrier service entry facilities should be planned in consultation with the carrier.

The facility shall be easily accessible to the carrier.

A shelf shall be included in carrier cabinets to cater for network terminating units associated with carrier services.

8.2 Core Equipment Rooms

This document does not require the modification of existing facilities to establish core equipment rooms as described below. In the case of existing facilities the following requirements can be considered as desirable features for an equipment room.

The core equipment room shall be used to accommodate the major items of communications equipment such as routers, switches and servers and shall be the central point of the cabling system. Note that the interface to carrier services may not be located in the Core Equipment Room.

Core equipment rooms shall meet the following requirements:

a) The minimum useable area of core equipment rooms shall not be less than $15m^2$ with a minimum width of 3 metres for Primary Schools and $20m^2$ for District High Schools, Middle Schools and Senior High Schools that have in excess of 750 students.

b) The clear height (i.e. without obstructions) shall not be less than 2.4m.

c) The doors to the equipment room shall open inwards, be lockable from the outside, but egress shall not require a key or tool. The door height shall be a minimum of 2040 mm. The door width shall be a minimum of 820 mm.

d) The room shall house only telecommunications equipment or related compatible equipment.

e) The equipment room shall include an earth link that is bonded to the building electrical earth system in accordance with AS/ACIF S009.

f) Equipment rooms shall not be located near to sources of electromagnetic interference (EMI) or radio-frequency interference (RFI) such as radio transmitters, electric motors, transformers or arc welding equipment. Location shall be selected in accordance with AS/NZS 3084 ZB2.3.2.4 to meet the requirements of AS 2834.

g) Ready access to the equipment room for authorized personnel shall be available on a 24 hour, 7 days a week basis.

h) In some cases the carrier entry may be to the core equipment room. In these cases the room will be required to accommodate the building distributor (building MDF) cable frames.

i) Suitable pathways shall be provided to the building pathway(s), campus pathways and the carrier entrance facility (if separate to the campus pathways).

j) Floor loading shall meet the requirements of AS/NZS 3084 ZB2.3.2.2.

k) No water pipes, water sprinklers, high voltage or power supply cables shall be installed within the equipment room.

l) Equipment rooms shall have there own closed system Aircon, this should be a PAC unit that regulates temperature and humidity within the room. No other air should be permitted into the room.

m) No air ducts, except for ducts that provide service to the equipment room, shall be installed or routed through the equipment room.

n) There shall be no openings in the room except for the door, the ventilation/air-conditioning ducts and cabling ducts. All windows, if any, must be shut and sealed. If necessary, window coverings and security grilles should be provided. Penetrations, openings and doors must adhere to suitable fire resistance levels where applicable.

o) The room shall not be located where it is exposed to vibration due to vehicles or machinery.

p) Sufficient lighting shall be provided in the room in accordance with AS/NZS 3084 ZB2.3.4.8.

q) A dedicated electrical power supply should be provided to the room. The power supply shall be connected to an essential supply generator if provided, and through a recommended power filtration system.

r) Electrical power shall be distributed via a dedicated single-phase residual current device (RCD) circuit with a minimum current rating of 15 A.

s) The temperature and humidity shall be controlled to provide an operating range for the room between 18°C and 24°C with 29% to 57% humidity as per AS/NZS 3084 ZB2.3.4.6.2.

t) If the core equipment room can be secured, the preference is to utilise 4-post racks.

8.3 Communications Closets / Cupboards

Communications Closets and Cupboards are to be strategically located to restrict UTP cable runs to less than 90 metres and to minimise the number of cupboards/rooms required and are not to be used for core equipment. Locations shall be selected to meet equipment room environmental and access requirements as far as is practicable.

In buildings where communications closets/cupboards are provided, the doors shall be lockable and accessible only from internal to the building.

Closets and cupboards shall be sealed from the roof space and located in cool dry areas of the building. Vents shall be provided in doors to provide an air flow that is clean and dry. Closets or cupboards shall not be located under gutters, water pipes and the like under any circumstances.

Four post floor mounted racks with a minimum depth of 600mm are recommended for installation in a closet/cupboard to allow installation of heavy equipment such as uninterruptible power supplies (UPS). The minimum depth between the vertical rails shall be 450mm. The standard width between mounting rails shall be 19 inches. The recommended clearance forward of the front vertical rail is 200mm.

Open type Lab Racks may be considered and accepted by the Department where thought to be beneficial.

The minimum internal dimensions of communications closets and cupboards is determined as follows:

- Where the closet is in place of a core equipment room then the minimum is 1200 mm deep and 1800 mm wide.
- Other non-core closets may be as small as 900 mm deep and 1000 mm wide."

The positioning of equipment within the communications closet or cupboard is to conform to the layout described in appendix 3.

9 Cable Pathways and Enclosures

Installation requirements for cable pathways and enclosures are included in section 11.

9.1 General Pathway Requirements

9.1.1 Pathway Route

Cable pathways shall be selected and designed to:

a) Maintain minimum segregation from other services as mandated by AS/ACIF S009 and AS 3000 in accordance with AS/NZS 3080:2003 ZA.3.1.

b) Minimise interference in accordance with AS/NZS 3080:2003 ZA3.2.

9.1.2 Bend Control Accessories

Where bend control accessories are used to assist with cabling installation they are not to be removed after the bend installation has been completed, i.e. all bend control accessories are to remain in-situ.

9.1.3 Replacement Draw-string

Where existing in-situ drawstrings are utilised, they should be replaced with appropriate cord (see 9.3.1.2) as a part of the pull. If the pathway is full, an additional pathway should be installed adjacent to the existing one. If lubricant is required, only products designated for that purpose should be used.

9.2 Intra-Building Pathways

9.2.1 Vertical Risers

Specification for vertical risers within buildings is beyond the scope of this specification. Requirements for vertical risers shall be addressed within building specifications.

9.2.2 Cable Tray

Cable trays shall be perforated sheet mild galvanised steel.

Minimum steel thickness for cable tray shall be:

- 1.0mm for trays up to 150mm wide; and
- 1.2mm for trays over 150mm wide.

Trays shall have folded edges with minimum height of 20mm.

Electrical continuity shall be maintained along the full length of cable trays.

9.2.3 Ducting and Conduits

For all non-exposed pathways, conduit is preferred. For exposed, internal vertical use conduit may be used. For exposed, external use where the pathway is visible below the roof/ceiling line, ducting should be used.

Ducting when used shall be tamper-resistant, single compartment, rectangular section, metal body. Clip-in covers shall not be used for exposed or accessible ducting. Horizontal ducting in office/class areas will be skirting style metal dual channel with screw on covers.

Ducting and conduit shall be selected to be aesthetically matched to the building as far as practicable and compliant with AS/ACIF S009 (colour to be determined on site prior to ordering) and sized to suit the number of cables.

Ducts and conduits shall have a minimum of 50% spare capacity after completion of works.

9.2.4 Internal Catenary

Catenary wires used for support of internal cablings shall be installed within ceiling spaces.

The maximum bundle size of cables supported by a catenary wire shall be 24 4-pair cables for Category 6.

The catenary wires shall be terminated, sized and supported to support the potential load of attached cables while meeting the maximum sag requirements of AS/NZS 3084 ZB3.5.3.1.

9.2.5 Pathway Fill Ratio

The following pathway fill ratios shall be applied:

- In a false ceiling environment, a minimum of 75 mm shall be observed between the cable supports and the false ceiling.
- Continuous conduit runs installed by the certified installer should not exceed 30.5 m or contain more than two (2) 90 degree bends without utilizing appropriately sized pull boxes.
- All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
- The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a geometric shape of the cables.
- Maximum conduit pathway capacity shall not exceed a 40% fill. However, perimeter and furniture fill is limited to 60% fill for move and changes.
- Horizontal distribution cables shall not be exposed in the work area or other locations with public access.

9.3 Inter-Building Pathways

Inter-building pathways shall be constructed to accommodate the cabling between buildings.

Underground pathways are preferred wherever practicable and the following shall apply:

- The backbone subsystem shall include cable installed between buildings via underground, tunnel, direct-buried, aerial or any combination of these from the main cross-connect to an intermediate cross-connect in a multi-building campus.
- Unless otherwise recommended by the manufacturer, all fibre cables will be run in innerduct.
- Fibres will be terminated in the telecommunications rooms using SC, or LC (OM3) connectors in wall mounted interconnect centres or rack mounted panels equipped with sufficient ports, slack storage space and splice trays if required to terminate and secure all fibres.

- In an underground system, adequate underground conduit space shall be available and accessible at each building. The conduits shall not exceed a fill factor of 40%.
- All underground systems shall be designed to prevent water runoff from entering the building.
- The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each satellite building telecommunications room. All Inter-building cables shall be installed to the applicable codes and regulations.
- Optical fibre shall be run for all Inter-building backbone segments, and as a recommendation, at least one balanced twisted-pair cable should be run for each Inter-building backbone segment.
- Backbone pathways shall be installed or selected such that the minimum bend radius and pulling tension of backbone cables is kept within cable manufacturer specifications both during and after installation.

9.3.1 Underground Pathways

Underground pathways shall be designed and constructed in accordance with AS/NZS 3084 Clause 8 and ZB5, however, pit provision and spacing shall be in accordance with section 9.3.1.3.

9.3.1.1 Trenches

Trenches for communication cabling shall be constructed to provide the depth of cover and segregation specified in Clause 5.5.3 of AS/ACIF S009. Depth of cover in this case means the distance between the natural ground surface and the top surface of the communications conduit. In general the depth of cover required shall be:

- 450mm under public footway or roadway
- 300mm in other areas except where soil conditions preclude a trench depth to provide 300mm cover in which case the depth of cover shall be in accordance with AS/ACIF S009 Clause 5.5.3.5.2

9.3.1.2 Conduits

The existing underground conduit system shall be utilised where possible and practical, without degrading the performance of the installation.

Underground conduits that are newly installed shall be sized to accommodate backbone cables such that conduit fill at the time of installation does not exceed 40% of rated conduit capacity.

Conduits and accessories shall be white UPVC and shall conform to AS/ACIF S008 Clause 5.3.2 as outlined below:

Outdoor conduit/pipe shall meet the following minimum classifications in accordance with Clause 5 of AS/NZS 2053.

- Clause 5.1. Any classification (PVC to be used in this application)
- Clause 5.2. Threadable or non-threadable (non-threadable)
- Clause 5.3. Medium mechanical stresses (‘medium duty’)
- Clause 5.4. Rigid

- Clause 5.6. Flame propagating or non-flame propagating — the conduit/pipe should be marked 'HF' or 'Halogen Free', if applicable
- Clause 5.8.1. Rated to IP66
- Clause 5.8.2. Rated to IP66
- Clause 5.8.3.1. Medium protection outside/inside
- Clause 5.8.4. Medium protection against solar radiation
- Clause 5.8.5. Non-hygroscopic

Sweeping bends shall be used to allow for cable bending radii and shall also be white communications type PVC.

The Department strongly recommends that a spare 100mm diameter, PVC, white communications conduit shall be installed along the complete route of the underground inter-building pathway system for future installations.

All conduits shall be installed with nylon draw cord, 3mm for conduits up to 63mm and 8mm for conduits over, i.e. 100mm.

Any section of conduit that may be exposed to direct sunlight shall be UV stabilised i.e. painted.

Conduits and accessories shall be provided in 50mm, 63mm or 100mm sizes.

9.3.1.3 Pits

Pits shall be installed at suitable locations to facilitate installation and maintenance of cabling including:

- Building entrances
- At distances not exceeding 50m along underground cable pathways
- Where a significant change of direction to the route occurs
- At road crossings or culverts

The minimum pit dimensions shall be 605mm x 300mm x 700mm deep. Pits shall be of PVC manufacture and shall be provided with all required accessories including:

- Concrete covers and support bars for covers as required
- Covers to be permanently and appropriately labelled
- Cable support bars
- Bushes (PVC) for conduit entry
- Gaskets and seals

Where pits are installed in areas having traffic the correct approved strengthening ring for the pit lip shall be used.

Shared service pits with other services (e.g. gas, power, water) shall not be used except under the limited circumstances described in AS/ACIF S009 and with the express permission of the ICT Directorate.

9.3.1.4 Tunnels

This document does not address requirements for tunnels. In the event that tunnel pathways are required, suitably qualified personnel shall prepare design and appropriate specifications.

9.3.2 Overhead Pathways

Overhead pathways may be used where building are linked by covered walkways or gantries. ICT Directorate approval shall be obtained for the use of overhead pathways.

Overhead pathways shall be constructed of cable tray or cable ladder. Spare capacity of 60% shall be provided.

Cables shall be installed within protective enclosures such as metal conduits or ducts for the length of the pathway.

9.3.3 Aerial Pathways

In cases where underground or overhead pathways are not practicable aerial pathways utilising catenary suspension systems may be employed.

Aerial pathways shall meet the requirements of Clause 19.5 of AS/ACIF S009 and the following:

- Aerial pathways shall be selected to avoid crossing power lines.
- Where aerial pathways are indicated on the site plans, the certified installer shall install PVC corrugated flexible conduit between the respective buildings. The conduit shall be sized as to allow for only 40% fill.
- The bearer or catenary wires shall be terminated and sized to support the load of the conduit with 100% fill of cables under extreme weather conditions.
- Catenary wires shall not be less than 4.0mm diameter.
- Catenary wire shall be fixed to the buildings using eyelets and turnbuckles. The conduit shall be tied to the catenary with stainless steel cable ties.
- The conduit shall be PVC corrugated flexible conduit.

9.4 Enclosures / Racks

Communication enclosures are used to house and restrict access to hubs, cabling, all active LAN components and other communications hardware. Enclosures may be free standing or wall mounted.

Enclosures and racks shall be designed for 19” equipment mounting.

Open frame racks may be used for fully passive applications where only patch panels and distributors are mounted, or for light-weight active equipment such as switches. Open frame racks shall only be used in communications rooms where access is restricted by a locked door.

9.4.1 General

Cabinets and wall frames shall comply with the relevant requirements of IEC-60297.

The enclosure(s) within the core equipment room containing core switching equipment shall provide 42 rack units (42 RU) equipment mounting space.

All enclosures at a site shall be fitted with keyed alike doors.

Enclosures shall provide facilities for ventilation in the form of vented panels or the like.

Metal surfaces of the enclosure and accessories shall be powder coated, painted or otherwise protected against corrosion. Grey finish is preferred. Bare metal surfaces shall not be accepted.

Enclosures and open frame racks shall be bonded to the protective earth system or communications earth system (CES) using a minimum 2.5mm^2 green/yellow conductor. Enclosures and open frame racks shall not be bonded to the Telecommunications Reference Conductor (TRC) if provided.

Sufficient cable management brackets are to be supplied and installed in the cabinet or wall frame.

Front mounting rails shall be positioned to allow a 100mm minimum clearance to the front edge of the cabinet frame to make room for fibre to bend and to allow the cabinet door to close.

9.4.2 Free Standing Core Enclosures (Cabinets)

Free standing enclosures shall be provided as 42 RU.

Enclosures shall be a minimum 1000mm deep when used as the core enclosure, or 600mm when used as other than a core enclosure. This measurement does not refer to the closet or cupboard or recess or room where the enclosure will be installed.

Freestanding enclosures shall be fitted with:

- Front and rear 19” mounting rails
- Horizontal and vertical cable tidy panels and/or loops
- Vertical cable tray or cable management troughs fitted to both sides of the enclosure
- A minimum of two supporting shelves
- Dual power rail providing not less than 10 outlets
- Removable side panels
- Keyed, lockable, smoked or clear glass front door
- Keyed, lockable, steel rear door or removable panel in cases where insufficient clearance is available to accommodate a door
- Levelling adjustment

9.4.3 Wall Mount Sub-Enclosures (Cabinets)

Wall mounting enclosures shall be of swing frame design where possible to facilitate rear access. However, swing frame enclosures shall only be used where adequate structural support is available for mounting.

Wall mounting enclosures shall be provided as 9RU, 12 RU or 18 RU.

Enclosures shall be with a minimum internal depth of 550 or 600mm (i.e. excluding door). Enclosures shall have no sharp edges or protrusions that could cause injury to persons.

Wall mounting enclosures shall be fitted with:

- Front 19” mounting rails
- Horizontal and vertical cable tidy panels and/or loops

- 1 RU power rail providing not less than six (6) outlets for 9RU, 12 RU or 18 RU enclosures
- Keyed, lockable, smoked or clear glass or polycarbonate front door
- Earth bar

9.4.4 Open Frame Racks

Open frame racks can be either two or four-post and shall be mechanically secure and supported at the base and top.

Open frame racks shall be provided as 42 RU minimum.

Racks shall be fitted with:

- Horizontal and vertical cable tidy panels and/or loops
- Vertical cable tray fitted to both sides of the rack
- 1RU Power rail providing not less than six (6) outlets for instances where the rack is intended to accommodate active equipment
- Levelling adjustment
- Earth bar (running from top to bottom of rack)

2-post open frame racks shall not be used to support heavy equipment. 4-post open frame racks shall be used for heavy equipment or for housing the core equipment (refer 8.3).

Where the four post floor mounted rack is designated as the core rack, there must be a minimum of 610mm between the front and rear vertical mounting rails.

9.4.5 Enclosure Power

As a minimum, two 15 ampere power outlets on a dedicated circuit shall be provided for the core enclosure(s) at each site.

A single 15 ampere power outlet on a dedicated circuit shall be provided for all other enclosures.

The preferred location of power outlets for new enclosures is on the wall inside the enclosure near the bottom edge. If however, an existing power outlet on a dedicated circuit is located outside and adjacent to the enclosure it may be used provided the hole in the enclosure for the power cord is protected with a grommet.

For freestanding enclosures the power outlets shall be mounted 300mm above the floor.

9.4.6 Cable management

Racks shall be supplied with cable management panels to facilitate the support and organising of patch cords between patch panels. For each 2 RU of patch panel or equipment in the rack there shall be a corresponding 1 RU cable management panel. A 1RU cable management panel shall be installed below any additional 1RU patch panel, which can then be utilised with a second 1RU patch panel.

A rear cable support system is also required to offer strain relief for cables entering the rear of the rack.

9.4.7 Enclosure Maximum Equipment Load

Equipment enclosures shall be constructed to support the maximum equipment loads as detailed below.

a) 9RU & 12 RU Cabinet Wall Mount – 30 kg

b) 18 RU Cabinet Wall Mount – 45 kg

9.4.7.1 Floor Mounted Enclosures

Consideration shall be given to load bearing capacity of the floor when selecting or specifying floor mounted enclosures.

10 Cabling System Technical Requirements

10.1 General

Cabling and components shall be selected to meet cabling system performance requirements with due consideration to compatibility and performance variation due to temperature.

Category 6 cable and components shall be independently verified for compliance with the Category 6 performance specifications of AS/NZS 3080:2003 by UL, ETL or other approved independent NATA laboratory verification system.

The cabling system certified installer shall warrant that products will operate to the standards and specifications claimed by the manufacturer and that the product is free from any defects in materials or workmanship.

The Manufacturer shall make technical and user documentation on the product available to the Department.

Installation practices to be applied for cabling systems are described in 11.

10.2 Overall System Transmission Performance

The transmission performance of cabling system is defined between specific interfaces. Channels may be described according to the transmission medium (optical fibre or balanced cabling) or location (campus, building or horizontal). Examples are shown in Figure 5 and Figure 6 below.

The performance of a channel is specified at and between connections to active equipment. A channel is comprised only of passive components.

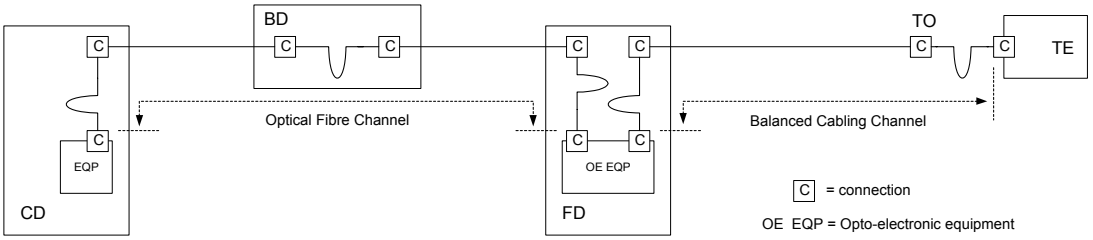

Figure 5 Optical backbone channel

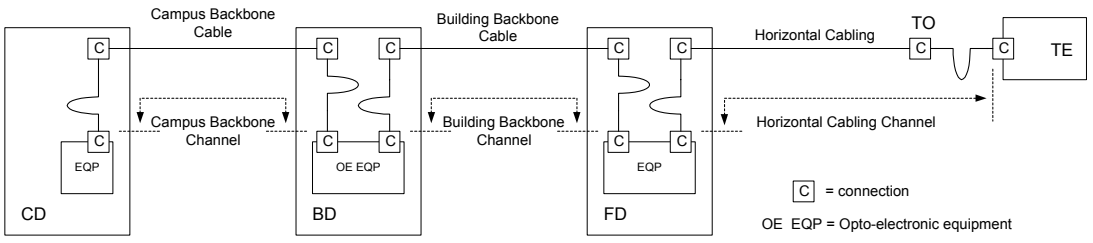

Figure 6 Optical and balanced backbone channel

AS/NZS 3080:2003 specifies six performance classes (A, B, C, D, E and F) for balanced cabling channels and three performance classes (OF-300, OF-500 and OF-2000) for optical fibre cable. Balanced cable performance is classified according to the maximum frequency at which performance is specified while optical fibre cable performance is classified according to the minimum distance over which applications can be reliably supported.

Only Class E balanced cabling performance is considered in this specification.

Only OM3 and OS1 optical fibre cable performance is considered in this specification.

Optical fibre channels (campus and building backbone) shall meet the performance requirements of Clause 8, Clause 9 and Clause 10 of AS/NZS 3080:2003.

Balanced cabling channels (building backbone and horizontal) shall meet the performance requirements of Clause 6, Clause 9 and Clause 10 of AS/NZS 3080:2003.

10.2.1 Horizontal Cabling Transmission Performance

Performance of the channel containing the horizontal cabling is defined between the equipment outlet at the Floor Distributor (FD) and the Terminal Equipment (TE) as shown in Figure 7 below. This channel will be referred to as the horizontal cabling channel. The horizontal channel will utilise balanced cabling for Departmental cabling systems.

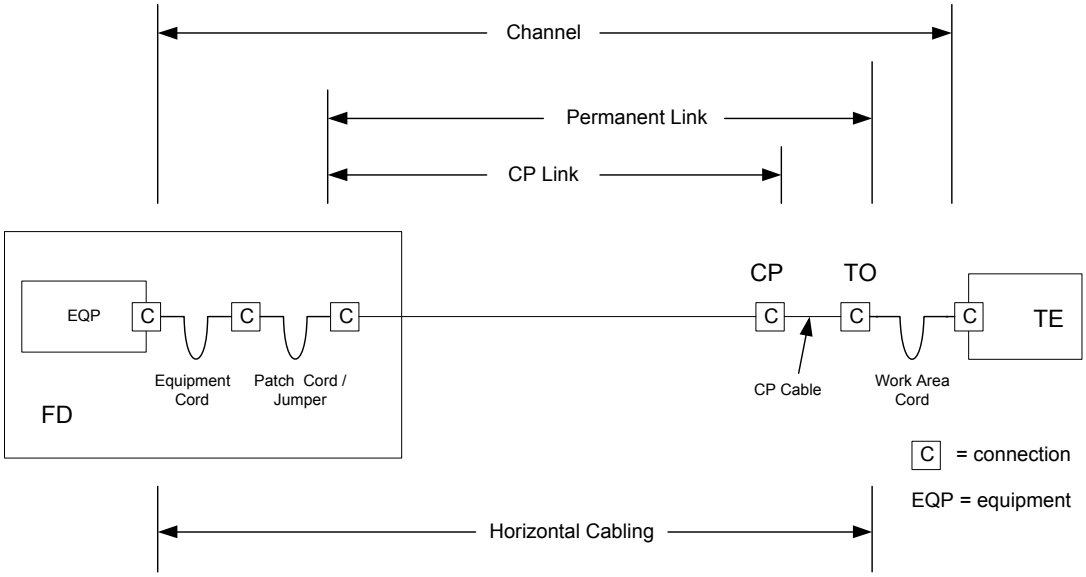

Figure 7 Horizontal Cabling Channel

The horizontal cabling channel includes cable sections, connecting hardware, work area cords, equipment cords and patch cords. The connections at the active equipment at the FD and TE are not included within the channel.

Category 6 installations shall comply with the requirements for Class E channel performance as specified in Clause 6 of AS/NZS 3080:2003. Performance of the permanent link and CP link elements of the channel shall comply with the requirements of Annex A of AS/NZS 3080:2003.

The length of the components of the horizontal cabling channel shall not exceed the distance set out in Clause 7.2.2.2 and Table 21 of AS/NZS 3080:2003 considering the

appropriate length de-rating for maximum ambient temperatures above 20^0 C except that the length of work area cords shall not exceed 5m.

The permanent link or CP link and CP cable shall be a direct run, free of bridges, taps and splices.

10.2.2 Backbone Cabling Transmission Performance

Performance of the channel containing the backbone cabling is defined between the equipment outlet at the Floor Distributor (FD) / Building Distributor (BD) and the equipment outlet at the Building Distributor (BD) / Campus Distributor (CD). This channel will be referred to as the balanced cabling backbone channel.

Category 6 installations shall comply with the requirements for Class E channel performance as specified in Clause 6 of AS/NZS 3080:2003. Performance of the backbone permanent link shall comply with the requirements of Annex A of AS/NZS 3080:2003.

The length of the components of the backbone (balanced) cabling channel shall not exceed the distance set out in Clause 7.2.3.2 and Table 22 of AS/NZS 3080:2003 considering the appropriate length de-rating for maximum ambient temperatures above 20^0 C.

The backbone cable shall be a direct run, free of bridges, taps and splices.

10.3 Balanced Cabling

This section applies to Category 6 cabling in horizontal and backbone applications.

10.3.1 General

Balanced cabling shall meet the requirements of AS/ACIF S008 and shall meet or exceed the performance requirement of AS/NZS 3080:2003 for the relevant performance Class.

Cable of the same manufacturer type shall be employed throughout the entire installation.

Certification shall be provided by the installer that the balanced cabling system meets the specified Class E performance levels.

Plenum-rated cables shall use 100% FEP (fluorinated ethylene propylene) for the insulation except where it is proven that the cable constructed with alternate materials meets or exceeds the electrical performance of FEP.

10.3.2 Outdoor Cabling

Optical fibre cabling shall be generally used for campus backbone cabling. However, in the event that balanced cabling is used externally the cable shall meet the following requirements:

a) For underground routes the cables shall be moisture resistant in accordance with AS/ACIF S008.

b) For aerial and overhead routes the cables shall be UV rated.

c) Termite resistant sacrificial sheath and jacket shall be utilised in areas prone to termites.

d) Transient protection equipment shall be provided for protection of equipment connected to the cables where such equipment can be provided without compromising transmission performance.

10.3.3 Category 6 UTP Cable and Connecting Hardware

Category 6 cables used within horizontal or backbone cabling subsystems, or as work area cords, shall comply with Clause 9 of AS/NZS 3080:2003. In the event that multiple signals share a cable the additional performance requirements of Clause 9.3 of AS/NZS 3080:2003 shall be met.

Category 6 connecting hardware used within horizontal or backbone cabling subsystems shall comply with Clause 10 of AS/NZS 3080:2003.

Category 6 horizontal cabling shall be terminated with modular 8-pin (RJ45) outlets using the T568A arrangement.

Category 6 backbone balanced cabling shall be generally terminated with modular 8-pin (RJ45) outlets using the T568A arrangement.

10.4 Optical Fibre Cabling

10.4.1 General

Optical fibre cabling shall meet the requirements of AS/ACIF S008 and shall meet or exceed the performance requirement of AS/NZS 3080:2003 Clause 9.4 for the relevant performance class.

Cable jackets shall incorporate clearly legible identification marking distance intervals not exceeding one metre to indicate cable manufacturer, date of manufacture, batch number, cable type and capacity and length marker.

Optical fibre cables shall terminate at fibre patch panels located at distributors. Each cable shall be continuous from one patch panel to the destination patch panel without intermediate joins or connections. The cable strength member shall be securely fastened at the termination enclosure.

Optical fibre cable shall be terminated with LC type fibre connectors. Equipment that uses Small Form Factor (SFF) optical connectors shall be interfaced to the LC connectors at the patch panel using optical patch cords to provide adaptation between LC and the particular SFF connector.

While equipment mounted optical connectors are outside the scope of this document it should be noted that the only SFF connectors presently acceptable to the ICT Directorate are LC style.

10.4.2 Outdoor Cabling (Multi-Mode or Single-Mode Optical Fibre Cable)

For all outdoor fibre cable, non-metallic loose buffer tube construction suitable for drawing through underground conduits is required.

Where loose buffer is used each buffer tube shall be filled with a non-hygroscopic electrically non-conductive and fungus resistant homogenous gel.

The cable core shall be filled with a suitable compound to prevent the ingress of water and/or other solutions and impurities.

Cables shall be capable of long-term water immersion without degradation of performance.

Termite resistant sacrificial sheath and jacket shall be utilised in areas prone to termites.

10.4.3 Indoor Cabling (Multi-Mode or Single-Mode Optical Fibre Cable)

Optical fibre cables for indoor cabling shall be non-metallic indoor tight-buffer fibre optic cable for riser applications.

Cable materials shall be flame retardant producing low levels of smoke and shall be halogen free.

10.4.4 Multi-Mode Optical Fibre Cabling and Connecting Hardware

Multi-mode optical fibre cabling used within backbone cabling subsystems shall be 50/125 μm OM3 cable that are compliant with Clause 9 of AS/NZS 3080:2003.

OM3 optical fibre connecting hardware used within backbone cabling subsystems shall comply with Clause 10 of AS/NZS 3080:2003.

All the fibre cores at both ends of each optical fibre cable run shall be terminated using LC type fibre connectors conforming to the requirements of AS/NZS 3080:2003 and IEC 60874.

10.4.5 Single-Mode Optical Fibre Cabling and Connecting Hardware

OS1 optical fibre cables used within backbone cabling subsystems shall comply with Clause 9 of AS/NZS 3080:2003.

OS1 optical fibre connecting hardware used within backbone cabling subsystems shall comply with Clause 10 of AS/NZS 3080:2003.

All the fibre cores at both ends of each optical fibre cable run shall be terminated using LC type fibre connectors conforming to the requirements of AS/NZS 3080:2003 and IEC 60874.

10.5 Distributors and Patch Panels

10.5.1 General

Distributors and patch panels shall be designed for 19” rack mounting in accordance with IEC-60297.

10.5.2 Insulation Displacement Punch-down Termination Blocks

Insulation displacement (IDC) punch-down termination blocks may be used for termination of outdoor or multipair copper voice cabling.

The IDC termination blocks shall be matched to the AS/NZS 3080:2003 performance Class E of the cabling system and compatible to the conductor type (solid or stranded) of the cabling.

Termination blocks shall be disconnection module style to allow test cords to isolate the cabling system for testing purposes.

10.5.3 Balanced Cabling Patch Panels

Patch panels for balanced cabling shall be 1RU 24-way modular socket (RJ45).

The connecting hardware of the patch panels shall be rated to the AS/NZS 3080:2003 performance Category 6 of the cabling system.

10.5.4 Optical Fibre Patch Panels

Optical fibre termination equipment shall provide cross-connect, interconnect or splicing capabilities.

Optical fibre patch panels shall be combination type 1 RU 12 or 24 port fitted with duplex LC couplers (adaptors) and cover plate. Patch panels shall be equipped with cable management facilities including splice trays.

10.5.5 Power over Ethernet

For ad hoc powered Ethernet requirements preference is given to the use of inline power injectors rather than powered patch panels or powered switches. This arrangement consumes less power, generates less heat, and is less costly for small numbers of PoE devices.

10.6 Telecommunication Outlets

Each telecommunication outlet (TO) shall incorporate two or more modular RJ45 sockets designed for IDC termination and compliant to AS/ACIF S008.

The RJ45 sockets shall be matched to the AS/NZS 3080:2003 performance Category 6 of the cabling system.

Telecommunication outlets shall be equipped with unshuttered face plates. Where the TO is positioned on existing duct modular type mounting enclosures shall be used. Blanking plugs shall be fitted where the apertures of the mounting enclosure is not filled with a RJ45 jack.

Faceplates shall match power outlets in appearance and manufacture.

10.7 Balanced Cabling Patch Cords and Work Area Cords

This section is applicable for new sites with any variations to be approved by the Director Infrastructure and Telecommunications or delegate.

Existing sites should conform to a documented standard, which should be recorded in the CMDB.

10.7.1 General

Patch cords and work area cords shall be constructed of an 8 wire, stranded Category 6 cable terminated with RJ45 connectors at both ends complying with Clause 13 of AS/NZ 3080.

Patch cords and work area cords shall be from the same manufacturer as the horizontal cable and matched to the AS/NZS 3080:2003 performance Category 6 of the cabling system in which they are used.

Pin assignments and colour codes shall conform to the “T568A” arrangement in accordance with AS/NZS 3080:2003 ZA.2.

All patch cords and work area cords are to be factory assembled, terminated and certified.

Patch cords and work area cords shall be fitted with moulded boots.

10.7.2 Cat 6 UTP Work Area Cords

Work area cord lengths shall be in accordance with section 10.2.1. All work area cords shall conform to the colour code schemes outlined in 10.7.3.

10.7.3 Cat 6 UTP Patch Cords

Patch cord lengths shall be generally provided in accordance with 5.7.1. In no circumstances shall patch cord lengths exceed the distance set out in Clause 7.2.3.2 and Table 22 of AS/NZS 3080:2003.

10.7.3.1 Fixed Installation (no VLAN)

Patch cords for fixed installations and physically separated local networks shall employ the following colour scheme:

Work Area	Patch Cord Colour
Student/Curriculum	Blue
Admin	Green
Servers, wireless access points and routers	Red
Voice - Phone	White
Switch - Switch	Yellow crossover

Table 5.1 No VLAN patch cord colour requirement

Note: All work area cords to be blue.

10.7.3.2 VLAN (Static / Dynamic)

Patch cords for installations using static or dynamic VLAN networks shall employ the following colour scheme:

Work Area	Patch Cord Colour
Student/Curriculum	Blue
Admin	Green
Managed Devices	Red
Voice - Phone	White
Switch - Switch	Yellow crossover

Table 5.2 VLAN patch cord colour requirement

Note: All work area cords to be blue.

10.7.3.3 Central Office and DEOs

Patch cords for installations at Central Office or DEOs shall employ the following colour scheme:

Work Area	Patch Cord Colour
Student/Curriculum & Admin	Blue
Voice - Phone	White
Switch - Switch	Yellow crossover

Table 5.3 Central Office & DEO Office patch cord colour requirement

10.7.3.4 Department of Training and Workforce Development (TAFE)

For TAFE sites, the expectation is that cabling will conform to the previous Enterasys cabling standard as per below:

Work Area	Patch Cord Colour
Student	Green
Admin	Blue
WAN - Admin	Purple
WAN - Student	Pink
Server - Admin	Red
Server - Student	Orange
Phone	Black
Switch - Switch	Yellow
Special VLANs	White
Photocopier Monitor	Grey

Table 4.4 TAFE patch cord colour requirement

10.7.4 Cat 6 UTP Crossover Cables

All crossover cables shall have all 4 pairs crossed over in accordance with the following diagram:

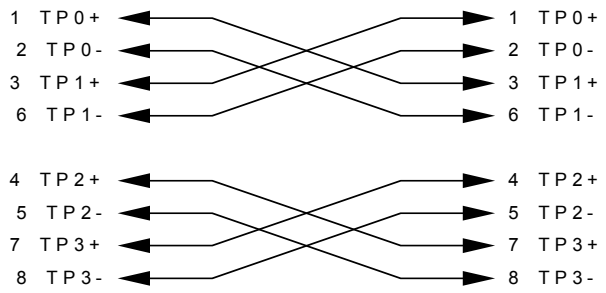

Figure 8 Crossover cable

10.8 Optical Fibre Patch Cords

10.8.1 Optic Fibre Patch Cords

Optical fibre patch cords shall be 50/125μm OM3 or OS1 according to the application.

Optical fibre patch cords shall be provided as duplex LC to LC except where used to interface equipment using Small Form Factor (SFF) connectors to optical patch panels.

Patch cords shall be from the same manufacturer as the backbone cable and matched to the to the AS/NZS 3080:2003 optical fibre cable type (OM3 or OS1) of the cabling system in which they are used.

Patch cords shall be provided in standard pre-manufactured lengths (e.g. 1m, 2m, etc) sufficient to interconnect the optical fibre termination unit and switch/router hardware while minimizing the need to manage excess cable. Refer 5.7.1

Patch cords shall employ the following colour scheme:

- Orange for 62.5/125μm (where 62.5/125μm is used as an approved exemption)
- Aqua for 50/125μm OM3
- Yellow for OS1 (single mode)
- Yellow and aqua for mode conditioning patch cords (yellow for SMOF element, aqua for MMOF element)

Mixing of multi-mode patch cables and optical fibre cabling (e.g. 50/125μm cabling with 62.5/125μm patch cables and vice versa) is not possible without some form of media conversion (e.g. via switch fibre modules). Any such mixing shall require ICT Directorate approval and will only be approved in exceptional circumstances.

11 Cabling System Installation Practice

11.1 General

11.1.1 Safety

Cabling system installation shall be performed in a safe manner.

Personnel undertaking installation works shall be equipped with appropriate personal protection equipment, tools and mechanical aids.

Appropriate barriers and warning signs shall be used to restrict access and draw attention to potential hazards such as open trenches and the like.

11.1.2 Qualifications of Certified Installer

The Structured Cabling System is to be installed only by organisations that are accredited by the manufacturer of the cabling system components and by properly qualified personnel as specified in Section 17.

11.1.3 Manufacturers Recommendations

All equipment and cabling shall be installed in full accordance with manufacturers recommendations and instructions.

11.1.4 Cable Lengths

Cable lengths shall be kept to a minimum by taking the most direct and practical route.

11.1.5 Segregation

Cable pathways and cable installation shall be installed to achieve suitable segregation between communications cabling and other services.

Segregations shall comply with AS/ACIF S009 as an absolute minimum. However, additional segregation shall be provided where practicable in accordance with AS/NZS 3080:2003 ZA.3.

11.1.6 Concealment

All cables shall be concealed except where nominated otherwise, and shall be run in neat lines.

11.1.7 Earthing Protection

All metallic conduit, boxes and enclosures shall be permanently and effectively grounded in accordance with the relevant West Australian electrical codes.

Provision regarding earthing protection of cabling systems shall comply with Australian Standards, including AS 3000, AS/ACIF S009 and AS/NZS 3080:2003.

11.2 Cable Support Systems and Pathways

11.2.1 General

Cable support systems and pathways shall meet the requirements of AS/ACIF S009 and AS/NZS 3084.

11.2.2 Horizontal Pathways

No fixed cabling is to be visible to the eye within the workplace. Acceptable locations for cabling are in roof, floor or wall spaces or in conduits, cable trays or ducting.

Where cable is run through a false (suspended) ceiling it shall be supported by means of purpose installed flat cable trays or suspended by one or more catenary cables from fixed non-movable structural features. Fixed, non-movable features exclude water pipes, sprinkler systems and trunked electrical power. Approved cable fasteners shall be used at intervals that comply with AS/NZS 3084 (ZB4.2.1.3) and with the manufacturer's specified spacing and be of the Velcro fastening type.

In areas visible to the eye within the workplace, where ducting needs to be used, it shall be aluminium channel duct with a depth of at least 50 mm to provide adequate cable bend radius. Architects shall be requested to specify the inclusion of horizontal 150 mm by 50 mm three channel cabling duct, fed vertically from the roof space at least every 2.4 metres starting approximately 1.2 metres from the first corner. The vertical feed shall preferably be in 32 mm conduits installed in the cavity and the architect shall make provision for those conduits to be installed through steel lintels that obscure access in a cavity wall. Alternatively, the vertical 32 mm conduits may be chased (channelled) into internal non face brick walls. Where there is face brick with no access to a cavity, metal ducting matching the appearance and carrying capacity of the horizontal channel duct shall be used for the vertical feed and firmly fixed to the wall.

Excess cabling shall not be stored in the duct or cabinets but shall be fixed in an "S" bend loom within the ceiling or floor space immediately above or below the termination.

Any circumstance where horizontal cabling is planned to be installed outside building spaces shall be specified and submitted, with a description of the alternative, for ICT Directorate consideration. Installation shall only proceed with ICT Directorate approval.

11.2.3 Backbone Pathways

Inter-building pathways may consist of underground, buried and aerial pathways.

In multi-storey installations, cabling between floors must be routed via an approved communications cabling riser or duct.

Where cable is run in an exposed area, it shall be enclosed in PVC duct or conduit. External grade cable shall be used in accordance with AS/ACIF S009.

11.2.4 Cable Trays

Cable trays shall be installed in accordance with AS/NZS 3084 ZB3.3.6.

11.2.5 Ducting / Trunking

Surface mounted ducting shall be installed where an alternative method for concealment of cables is not possible.

Ducting shall be screw fixed to walls using suitable fixings e.g. (cavity fasteners for cavity walls and masonry anchors for concrete slabs, columns and the like) at approximately 1.0 metre intervals when run vertically and approximately 600mm intervals when run horizontally. Fixings shall be of a type that do not cause undue distortion to the ducting when tightened.

11.2.6 Fasteners / Fixings / Ties

Generally fixings shall be of a type suitable to the situation in which they will be used. Where fixings are to be used externally or exposed to the weather stainless steel or brass is preferred, plain steel will not be accepted. Where fixings are used internally, cadmium plated is acceptable. All fixings, fastenings and supports shall be of adequate strength and size and arranged to ensure the installation against mechanical failure under normal conditions of use and wear and tear.

Where “ezydrive” or “nail in” type concrete fasteners are used these shall be the removable screw exit type, so as to avoid damage to wall and surrounds when removed.

Cable bundling shall be tightened by hand without using tools and shall be tightened just sufficiently to hold cables together and to fix cables to supports. Care shall be taken to avoid tight twisting of the cable, tearing of the outer jacket, cutting or wearing through due to abrasion of the cable.

Only hook and loop cable ties e.g. Velcro style, are to be used. Nylon/zip style cable ties are not to be used. All cable ties shall be a minimum of 10mm width with suitable length to allow adequate security of the tie. Cable ties used externally shall be UV resistant.

11.2.7 Internal Catenaries and Above-cable Trays

Internal cabling supported by catenaries or above-cable trays shall be installed in accordance with AS/NZS 3084 ZB3.5.3.1 and the following.

Generally, a main cable route shall be chosen such that the cable path is accessible and conforms to the segregation requirements of AS/ACIF S009.

The catenary wire shall be anchored at a maximum of 5.0 metre spans. Turnbuckles and steel eyelets shall be used to tighten the catenaries.

A maximum of 24 x 4 pair UTP cables shall be tied to a single catenary. Cables shall generally leave the main cable route at 90 degrees to the final termination point.

11.2.8 Trenching

Trenches shall be constructed such that installed conduits shall maintain a minimum longitudinal grade of 1 in 150 at all times. A longitudinal grade of 1 in 100 is preferred where practicable in accordance with AS 3084 ZB5.2.2.6.

The conduit shall be supported firmly and evenly on all sides using suitable fines prior to commencement of backfill.

Backfilling shall be performed with due care to avoid compaction or distortion of the pit.

11.2.9 Underground Conduits

Conduits shall be laid into a trench at the depth specified in section 9.3.1.1.

The conduit shall extend into the pit for a distance of approximately 50mm.

A suitable bush (PVC) shall be used for conduit entry. The conduit shall be glued in place within the bush while the bush shall be glued to the pit and sealed.

11.2.10 Pits

Conduits shall generally enter pits on the vertical centre-line of the pit end with a minimum clearance of 50mm to the bottom of the pit.

Pits shall be located such that conduit entries shall be achieved using a straight section wherever practicable.

Pits shall be installed such that the pit covers are substantially flush with the ground level.

Pit locations shall be selected to be unobtrusive to reduce the potential for opportunistic vandalism or sabotage.

11.2.11 External Catenaries / Conduits

External cabling supported by catenaries shall be installed in accordance with AS/ACIF S009 and the following.

Cabling shall be installed within PVC corrugated flexible conduit that shall be sized in accordance with section 9.3.3.

Outdoor cabling shall be used in all cases irrespective of cable enclosure within conduit.

11.2.12 Penetrations

Fire rated elements and structural members are not to be penetrated without prior approval from the Building Architect and relevant Fire Authority.

Where ladders or trays pass through ceilings, walls and floors provide neat, close fitting apertures. At openings through fire rated elements, terminate the ladders or trays either side of the opening and provide fire stopped holes for the cables only. Firestopping shall comply with the Building Code of Australia (BCA).

11.2.13 Building Access

Access from the underground conduit bends, adjacent to the building, to the ceiling space of the buildings where the conduit run cannot be continued, shall be achieved by installing a 100mm perforated cable tray.

The cable tray shall be reverse mounted from the conduit top at ground level, to an access hole at ceiling space level. The access hole at ceiling level shall be filled with a moisture and fire retardant material. The perforated tray and cabling shall be protected by a 150mm x 150mm steel top-hat section, painted to match other building fixtures such as down pipes and the like.

11.3 Enclosures / Cabinets

All enclosures whether floor or wall mounted shall be installed and mechanically supported to accommodate the load of the enclosure combined with the equipment load specified in section 9.4.7.

11.3.1 Enclosure Installation

Communication enclosures shall be located to achieve maximum operator convenience. The space available for a communications cabinet is to be verified on site. The cabling system Certified Installer shall ensure that racks are arranged to permit installation of other equipment and enclosures with adequate access spaces for inspection, wire termination and patch field alterations.

Enclosures shall be provided with sufficient clearance for installation and maintenance activity. Minimum clearances for wall mounted and free standing enclosures are indicated in Figure 9 below.

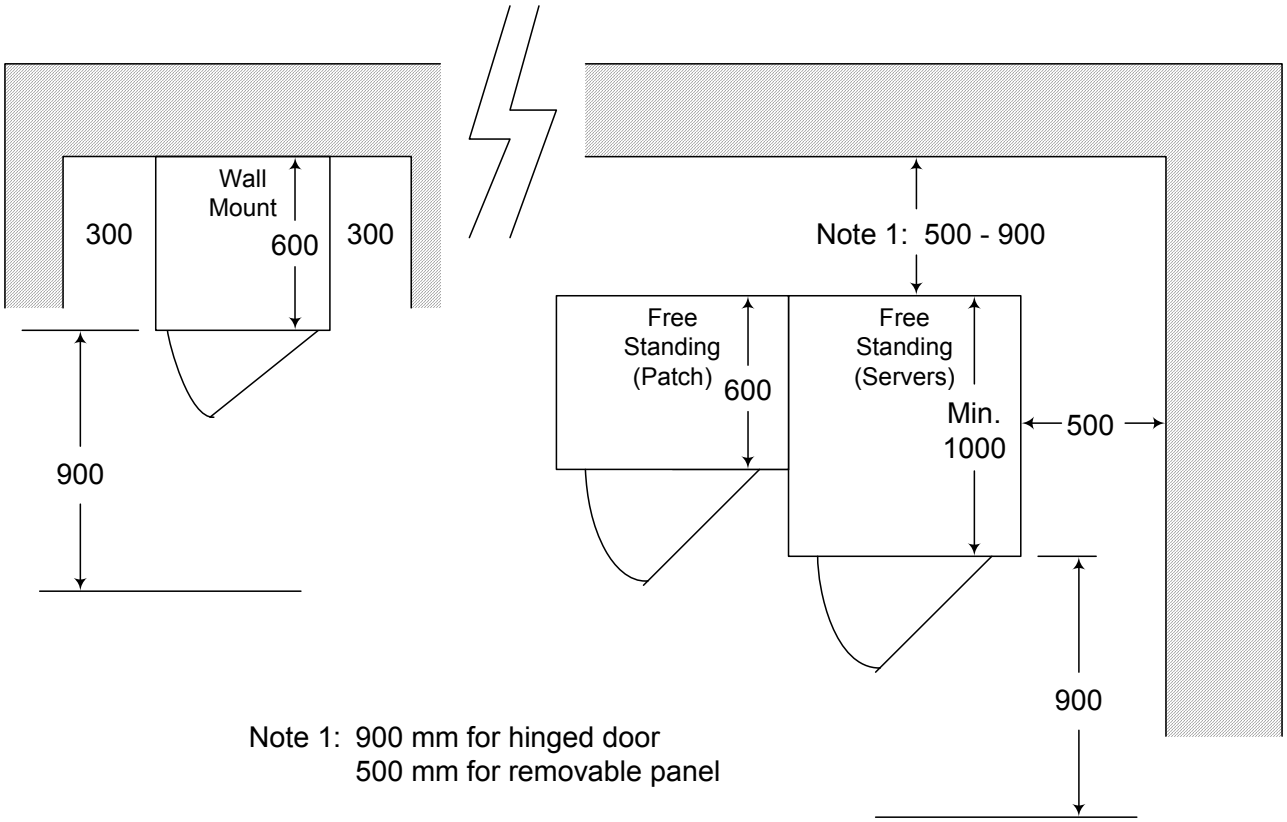

Figure 9: Enclosure Minimum Clearance

The vertical footprint for wall mount enclosures shall not extend beyond 2.4 metres nor lower than 0.5m. Wall mount locations shall be selected such that there is no risk of injury through striking arising from walking past or rising from beneath the enclosure.

Enclosures shall be installed plumb and square without twists in the frames or variations in level between adjacent racks.

Enclosures shall be bonded to the protective earth system,

Equipment mounting rails at the front of the enclosure shall be set back such that doors may be closed without contacting equipment or connectors or distorting cable bends.

11.3.2 Enclosure Cable Entry

Cabling entering from the ceiling space to the enclosures shall be supported and concealed by a vertical cable support system.

The vertical cable support system shall extend from the backbone/horizontal cable pathway to the base of the enclosure. In the case of raised floors the vertical cable support system shall extend below the raised floor. In the case of above ceiling pathways the vertical cable system shall extend above the ceiling.

The vertical cable system shall have the same metal construction, colour and finish as the communications rack and be complete with two vertical cable trays (power and data/voice).

11.3.3 Cabling Within Enclosures

All cables shall terminate at the patch panels in the communications enclosures with 5m of optical fibre cable and 2m of other cables neatly placed out of sight prior to terminating.

Cables terminating at the enclosures shall be neatly loomed within the enclosure, utilising the cable management system specified in section 9.4. Cables shall be loomed between the space on the outside of the mounting rails and the removable door. Cables loomed inside wall mounted cabinets shall be loomed in groups of a maximum of 12, to allow enough space for mounting active network equipment.

11.4 Cable Installation

11.4.1 General

All cabling shall be installed in full accordance with the manufacturer's recommendations.

Cables shall be installed with due skill and care such that:

- maximum permitted hauling tension is not exceeded
- minimum bending radius of the cable is not exceeded
- maximum permitted crush rating is not exceeded

Cable bundles shall not obstruct the installation and removal of equipment within equipment enclosures.

Wiring frames shall be wired such that jumper connect wires follow clear paths between sections and are not obstructing patch fields, and that lengths of jumper connect wires are minimised.

Equipment and patch cords shall be laid out such that patch cords follow clear paths and do not obstruct patch fields.

11.4.2 Precautions During Installation of Cables

Precautions shall be observed not to have excessive lengths of "parallel cables" due to alien cross-talk. Cables need to be randomly laid, loosely bundled.

Precautions shall be observed to eliminate cable stress caused by tension in suspended cable runs and tightly strapped bundles.

Care shall be taken not to distort the twists by excessive pulling or bending of cables.

Cable bundles shall not rub on or be unduly compressed against or by any cable tray, building or enclosure penetrations, equipment racking, or other cable support. Grommets or similar forms of protection shall be provided where cables pass metallic or other rigid edges.

Adequate support shall be provided for vertically installed cabling ensuring that the weight of cables is sufficiently supported.

Category 6 cables shall be fixed to cable trays and catenary wires by loose bundling methods as referred to in 11.2.6.

Cables fixed to catenary wires or above-cable trays shall be supported at intervals according to AS/NZS 3084 Table ZB6. Cables that are supported by below-cable trays shall be tied at intervals not exceeding 1200mm. At no point shall the cabling rest on the topside of the false ceiling or light fittings or any other services.

Where cabling is run in cavity walls, surface mounted ducting and similar enclosures, cables shall be installed in areas free from protrusion of screws and similar fasteners.

11.4.3 Balanced Cabling Installation

The cable interconnecting distributors or between a telecommunication outlet and a horizontal distribution panel or patch panel shall be one continuous length with no intermediate joins, splices or taps. Mid-run joints of cables are not permitted except for the use of consolidation points as outlined in section 5.3.2.2.

The maximum length of the various elements of the balanced cabling shall be in accordance with section 5.4.3. ICT Directorate approval shall be sought for installation that does not comply with the specified maximum lengths and approval to proceed obtained in writing prior to commencing installation.

Where two or more cables share a pathway the cables shall be tied together approximately every 1.2 metres to create a trunk effect.

When installing and terminating backbone cable runs, sufficient slack with minimum length of one (1) metre shall be provided at a suitable location in the cable pathway. The preferred location is within the ceiling space or under raised floors.

All horizontal cabling shall be terminated within 2 metres of the intended location of the terminal equipment.

A loop of cable shall be left in the cable trunking on the approach to each telecommunication outlet to facilitate re-termination of the cable in the future, should this be required. The preferred minimum length of this loop is one (1) metre, but the final determination as to the required length shall be made by the site representative.

Balanced copper cable bending radius shall not be less that eight (8) times the cable diameter under no load conditions and 16 times the cable diameter under load, i.e. when being pulled through conduits, or as specified by the cabling manufacturer which ever is greater. Cables shall be anchored immediately before the start and after the finish of the bend. Refer section 9.1.2 on the use of bend control accessories.

To preserve the electrical characteristics of the balanced cable, the outer insulation of the cable shall not be stripped back unnecessarily, and shall be left intact up to a point as close as possible to where the individual pairs are terminated to the IDC connector.

Sufficient cable slack shall be provided at telecommunications outlets to allow removal of faceplates and associated the RJ45 socket for servicing.

11.4.4 Optical Fibre Cabling

Optical fibre cable interconnecting distributors shall be one continuous length with no splices or joins except for pigtails used to terminate single mode optical fibre cores.

The maximum length of optical fibre cable shall be in accordance with section 5.4.3.

The cable shall be handfed into conduits and cable trays.

Each optical fibre cable shall be installed with one (1) metre of spare length in the communications enclosure at the respective distributors.

Optical fibre bending radius shall not be less than 10 times the cable diameter or as specified by the cabling manufacturer which ever is greater under no load conditions and 20 times the cable diameter or as specified by the cabling manufacturer which ever is greater under load, i.e. when being pulled through conduits and the like.

11.5 Terminations

11.5.1 Balanced Cable Termination

An RJ45 system shall be generally utilised at both the main communications centre and all remote cabinet locations.

Cable termination onto a horizontal distribution panel or patch panel should be undertaken in a manner permitting additional cables to be terminated without unduly disturbing previously installed cables.

Cabling termination to information outlets, patch cords, work area cords and patch panels is to be in accordance with the “T568A” arrangement in accordance with AS/NZS 3080:2003 ZA.2.

The connecting hardware shall be installed to provide minimal signal impairment by preserving wire twists as close as possible to the point of mechanical termination, as manufactures specifications.

The amount of untwisting in a pair as a result of termination to connecting hardware shall be no greater than 10mm for Category 6 cable, and less than this if possible.

11.5.2 Optical Fibre Cable Termination

Optical fibre cabling shall be terminated with type LC fibre connectors (refer 10.4.4 and 10.4.5).

OM3 optical fibre cores shall be either direct terminated by the use of LC multimode ceramic tipped connectors or spliced with LC terminated pig-tails.

Single mode optical fibre terminations shall be achieved by fusion splicing pigtails to optical fibre cores.

The cables shall terminate in fully enclosed 1 RU 12 port or 24 port LC duplex patch panels in the communications cabinets. All fibre cores specified shall be terminated at each end.

Sufficient duplex LC couplers shall be inserted into the patch panel as there are terminated fibres.

11.5.3 Telecommunication Outlets

Outlets shall be installed above bench height in teaching areas. The minimum outlet height above the floor in all cases shall be 450mm.

Where workbenches are positioned along a wall or benches have data distributed internally, a minimum of 800mm separation shall be maintained between wall or face plates housing the data outlets.

As a classroom standard, 2 data outlets shall be placed at the front, or teacher’s/instructor’s desk area, of a classroom, the remainder shall be distributed along appropriate walls at the discretion of the school/college. In the case of capital works, locations will be defined by the architect.

Outlet connectors are to be flush mounted wherever practicable. Flush plates shall be mounted on skirting duct or floor boxes as required.

Mounting blocks, white in colour, shall be used where flush mounting of communications outlets is not practicable. All surface mount boxes are to be securely mounted on the skirting or wall adjacent to each required user connection point or as specified in the provided work plans.

Where possible the outlet shall be oriented to avoid contact of the work area cord with furniture, equipment or feet.

All telecommunication outlets shall have all cable pairs fully terminated and connected back to the distribution node.

Sufficient bend radius (1:8) shall be provided to avoid damage to the outlet or work area cords. Outlets shall be located to avoid being obscured by furniture and office equipment.

Unless indicated otherwise, outlets shall be located near to power outlets.

Balanced cables shall be terminated at the TO using the “T568A” pin assignments and colour codes in accordance with AS/NZS 3080:2003 ZA.2.

Outlets designated for use by WLAN access point shall be located to meet the requirement identified in section 5.3.2.3.

12 Earthing and Transient Protection

12.1 Earthing

All equipment racks, cable tray systems and the like shall be earthed in accordance with AS3000 to the building protective earth system.

Earthing practices shall comply with the requirements of AS/ACIF S009.

Catenary wires used for cabling support shall be bonded to building protective earth system.

12.2 Transient Protection

Transient protection equipment shall be provided for protection of equipment connected to balanced copper outdoor cables where such equipment can be provided without compromising transmission performance.

13 Inspection, Testing and Commissioning

13.1 General

The cabling system Certified Installer shall supply all labour, materials and equipment required for fully commissioning and testing the installation.

Testing shall be performed at the channel level wherever practicable. A generic 5m work area cord shall be used in testing horizontal channels. Performance testing at other than channel level shall not be accepted without ICT Directorate approval.

Testing shall only be performed using calibrated test and simulation equipment as listed below.

13.1.1 Test Equipment Criteria

- All balanced twisted-pair field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.
- Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters
- Test settings selected from options provided in the field testers shall be compatible with the installed cable under test.

Copper Testing

- All category 6 field-testing shall be performed with an approved level III balanced twisted-pair field test device.
- All installed category 6 channels shall perform equal to or better than the minimum requirements as specified by the table below:

Parameter	Performance @ 100MHz	Performance @ 200MHz	Performance @ 250MHz
Insertion Loss	20.3 dB	29.7 dB	33.7 dB
NEXT Loss	42.1 dB	37.5 dB	36.1 dB
PS NEXT Loss	40.6 dB	36.1 dB	34.6 dB
ACR	21.8 dB	7.8 dB	2.4 dB
PS ACR	20.3 dB	6.4 dB	0.9 dB
ELFEXT	23.9 dB	17.9 dB	15.9 dB
PS ELFEXT	20.9 dB	14.9 dB	12.9 dB
Return Loss	14.0 dB	11.0 dB	10.0 dB
Propagation Delay	528 ns	527 ns	526 ns
Delay Skew	40 ns	40	40 ns

- Category 3, balanced twisted-pair horizontal and backbone cables, whose length does not exceed 90 m for the basic link, and 100 m for the channel shall be 100 percent tested according to ANSI/TIA/EIA-568-B.1. Test parameters include wire map plus ScTP shield continuity (when present), insertion loss, length and NEXT loss (pair-to-pair). NEXT testing shall be done in both directions.
- All balanced twisted-pair backbone cables exceeding 90 m or 100 m shall be 100% tested for continuity if applications assurance is not required.

- Category 6 balanced twisted-pair horizontal and backbone cables, whose length does not exceed 90 m for the basic link, and 100 m for the channel shall be 100 percent tested according to ANSI/TIA/EIA-568-B.1. Test parameters include wire map plus ScTP shield continuity (when present), length, NEXT loss (pair-to-pair), NEXT loss (power sum), ELFEXT loss (pair-to-pair), ELFEXT loss (power sum), return loss, insertion loss, propagation delay, and delay skew.

The test results, for all cables, connectors and outlets shall be fully documented and tabulated, identifying each cable and each outlet or interface port by its label. Testing shall not proceed until all labelling and documentation is complete so that the test results accurately reflect the actual cables and connectors. All test results shall be included in the manuals, they shall include tests for each of the cable types.

The cabling system Certified Installer shall provide all necessary specification and compliance reports of the cables and connecting hardware used in the communications installation, and include such information in the manuals.

13.2 Inspection

The Department may inspect the works from time to time to confirm accuracy and quality and that the cabling system installation conforms to specifications and construction drawings.

13.3 Balanced Cabling and Connecting Hardware

Test personnel and the test methodology shall comply with the requirements of AS/NZS 3087.1 and AS/NZS 3087.2.

The acceptance testing and certification report section for balanced cabling shall include the test results for each outlet. The report shall include as a minimum the following details and tests results for each outlet:

- Cable and outlet/port identification
- Test equipment and test configuration details
- Wire map testing
- Cable length
- Cabling performance parameters as specified in AS/NZS 3080:2003
- Date and time of testing
- Name and signature of testing engineer

The cabling system Certified Installer shall fully test the cabling system for wire map (including pin assignment and colour coding), cable length and performance of all cable pairs.

The cable system shall be tested in accordance with Standards Australia HB27 and certified to Class E Channel performance in accordance with Clause 6 of AS/NZS 3080:2003.

Any cable run not meeting the required performance standards shall be replaced at the expense of the cabling system Certified Installer.

The equipment manufacturer shall provide certification in writing indicating full compliance of the balanced cabling connecting hardware (telecommunication outlets and patch panels) with the relevant performance Category 6 of the cabling system. Certification shall include test results as recorded by the appropriate test laboratory.

The cabling system Certified Installer shall certify the performance of each channel (horizontal and backbone) to Class E (all frequencies up to and including 250 MHz) for all pairs as detailed in the Standards Australia HB27. The overall responsibility for achieving and demonstrating this performance objective shall remain with the cabling system certified installer.

13.4 Optic Fibre Backbone Cabling and Related Hardware

The acceptance testing and certification report for optical fibre cables shall include as a minimum:

- Cable identification
- Test equipment and test configuration details including equipment settings
- Length of fibre segment in metres
- Loss over fibre segment in dB
- Date and time of testing
- Name and signature of testing engineer

13.4.1 Fibre Optic Testing

13.4.1.1 Horizontal Fibre Testing

- Fibre horizontal cables shall be 100% tested for insertion loss and length.
- Insertion loss shall be tested at 850 nm or 1300 nm for 50/125μm and 62.5/125μm multimode cabling in at least one direction using the Method B (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-14A.
- Length shall be tested using an OTDR, optical length test measurement device or sequential cable measurement markings.
- The horizontal link performance guarantee is to support 10GB Ethernet.

13.4.1.2 Backbone Fibre Testing

- Fibre horizontal cables shall be 100% tested for insertion loss and length.
- Insertion loss shall be tested at 850 nm and 1300 nm for 50/125μm and 62.5/125μm multimode cabling in at least one direction using the Method B (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-14A.
- Insertion loss shall be tested at 1310 and 1550 for single-mode cabling in at least one direction using the Method A.1 (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-7.
- Length shall be tested using an OTDR, optical length test measurement device or sequential cable measurement markings.
- The backbone link performance guarantee is to support 10GB Ethernet.

14 Labelling

14.1 General

All enclosures, patch panels, horizontal UTP wiring, backbone cabling and telecommunication outlets shall be systematically and permanently labelled.

The method of designation shall be in general in accordance with AS/NZS 3085 and as described below.

14.2 Enclosures

Each enclosure shall be labelled with a three character designation that is unique for the site:

- The first character shall be alphabetic and signify the building (e.g. A for Administration, F for Block F, etc).
- The second character shall be alphanumeric and signify the level within the building (e.g. 1 for Level 1, G for Ground, B for Basement, etc).
- The third character shall be a sequential numeral (1, 2, 3, etc) signifying the particular enclosure on the respective level. For example F24 would signify the fourth enclosure on Level 2 of Block F.

The door to the cabinet location shall have an engraved label 100mm x 50mm. The labels shall be self-adhesive multi-layered laminate engraved with 15mm upper case black lettering on a white background. The labels shall be located on the front centre of each rack, near the top.

14.3 Patch Panels

Patch panel ports within the enclosure shall be designated as follows:

- Horizontal ports shall be sequentially numbered, starting at 1 for each enclosure.
- Backbone balanced modular 8-pin ports shall be sequentially numbered using the letter B followed by the required number of digits. Sequences shall start at B1 …. B999 for each enclosure.
- Backbone optical fibre ports shall be sequentially numbered using the letter F followed by two digits. Sequences shall start at F1 for each enclosure.

Backbone IDC blocks (where used) shall be designated according to the particular installed configuration. Generally the blocks will be arranged in a number of verticals with pair numbering commencing at the bottom left of the respective vertical. Ports shall be designated as XY where X indicates the vertical Y indicates the pair number.

14.4 Horizontal UTP wiring

The horizontal wiring shall be labelled with the enclosure and patch panel port identifiers as specified above. Labels shall be attached to the cable at both the rear of the telecommunications outlet and the rear of the patch panel by using the computer generated cable label. The size and length of the marking system carriers shall be sized to suit the cable size and the text required for proper identification.

For example A12-73 could signify horizontal port 73 from enclosure 2 on level 1 of Block A.

14.5 Backbone Cabling

Labelling conventions for backbone cabling shall have the general format:

AAA/BBB/XX-ab/mno where:

- AAA is the designation of the enclosure with lower alphabetic ranking.
- BBB is the designation of the enclosure with higher alphabetic ranking.
- XX is the cable type (M3 = OM3, S1 = OS1, C6 = Category 6).
- ab is the number of cores or conductors (in this case a 4-pair Category 6 cable would include 8 conductors and ab would equal 08).
- mno is a numeric sequential identifier indicating the backbone cable number and is incremented independently of the other elements of the cable designation.

Each cable shall be labelled at the rear of each patch panel.

For example AG1/L13/S1-12/013 would be backbone cable number 13 that is an OS1 cable with 12 cores running between Enclosure 1 in Block A Ground Floor and Enclosure 3 on Level 1 of Block L. B12/F11/M3-6, S1-6/101 could be backbone cable number 101 that is a composite OM3/OS1 cable (6 cores of each) running between Enclosure 2 on Level 1 of Block B and Enclosure 1 on Level 1 of Block F.

In the case of optical fibre cables each fibre core shall be labelled with a fibre number behind the patch panel adjacent to the connector. The fibre number is a numeric sequence number of the fibre within the cable sheath determined by the colour coding system used by the manufacturer. When it is necessary to signify a particular fibre core the number can be appended to the cable designation. In a similar fashion the pair/leg of balanced cable can be appended to the cable designation. For example, AG1/L13/S1-12/013/5 would signify core number 5 of cable AG1/L13/S1-12/013.

14.6 Labelling of Telecommunications Outlets

Each telecommunications outlet is to be labelled with a Unique Point Identification. Telecommunications outlets will be labelled with a computer generated, or similar system and placed behind a clear, tamper resistant cover.

The outlet labelling shall be equivalent to the designation of the horizontal cabling designation by which it is connected to the floor distributor.

For example the outlet connected to the cable described in 14.4 would be designated A12-73.

Relabelling of any existing Category 5 cabling shall be with a computer generated, or similar system and placed behind a clear, tamper resistant cover.

15 Administration and Documentation

15.1 General

Records shall be provided in electronic and hard-copy formats.

15.2 Construction Documentation

Installation shall be in accordance with approved construction drawings and data. Construction documentation shall include:

- Where viable, scale site and building/floor location plans showing the location and size of pathways and the cables to be installed therein, cable routes, pit locations and enclosure/distributor locations. Scale drawings shall be to a reasonable accuracy in the event that CAD drawings of the site are not available. (See Figure C1 of AS/NZS 3085).
- Schematic diagrams detailing the quantity and types of cables linking distributors. (See Figure C2 of AS/NZS 3085).
- Equipment room layouts.
- Physical enclosure layouts. (See Figure C3 and C4 of AS/NZS 3085).
- Schematic diagram detailing patch panel layout and port numbering.
- Physical layout drawings detailing outlet positions and identification numbers
- Equipment lists detailing (type/make/model) the equipment to be installed including enclosures, patch panels, outlets and the like
- Test methods for balanced copper cable
- Test methods for optical fibre cable

15.3 Handover Documentation

One bound copies of the following documentation shall be supplied at the completion of the project:

- As-constructed scale site and building/floor location plans showing the location and size of pathways and the cables installed therein, cable routes, pit locations and enclosure/distributor locations. Scale drawings shall be to a reasonable accuracy in the event that CAD drawings of the site are not available. (See Figure C1 of AS/NZS 3085.1).
- As-constructed schematic diagrams detailing the quantity and types of cables linking distributors. (See Figure C2 of AS/NZS 3085.1).
- As-constructed equipment room layouts.
- As-constructed physical enclosure layouts. (See Figure C3 and C4 of AS/NZS 3085.1).
- As-constructed schematic diagrams detailing patch panel layout and port numbering.
- As-constructed physical layout drawings detailing outlet positions and identification numbers.

- Cabling infrastructure patching records. (See Appendix D and Appendix E of AS/NZS 3085).
- Equipment lists detailing (type/make/model) the installed equipment including enclosures, patch panels, outlets and the like.
- Test reports detailing procedures, equipment configuration and test results for balanced copper cable.
- Test reports detailing procedures, equipment configuration and test results for optical fibre cable.
- Certificate of Compliance to AS/NZS 3080:2003 performance as specified for the particular cabling system.
- Certificate of Compliance to AS3000 regulations.
- 20 Year Warranty documentation.
- Certified Installer details.
- Photographs of cabinets with the door open and closed.

16 Warranty

16.1 General

Two types of warranties apply to Data Communication Cabling Installations:

- Installation Warranty
- Manufacturers Warranty
- Application Warranty

16.2 Installation Warranty

The cabling system cabling system Certified Installer shall warranty its own work and workmanship for a minimum period of 12 months.

16.3 Manufacturers Warranty

The Departmental standard for a manufacturers warranty is a minimum of 15-years parts and labour with 20-years preferred.

The cabling system Certified Installer shall provide the client with a minimum 15-year manufacturer's product warranty and Applications Assurance on the complete cabling installation and minimum 15-year applications assurance warranty. The application warranty shall apply to any protocol sanctioned for use with cable plant including connecting hardware now for a minimum 15-year time period. The cabling system Certified Installer shall provide a clear statement of the warranty to the above effect.

Any additional cabling at the warranted premises must not compromise the existing warranty. Additional cabling shall be installed and tested by a certified and accredited cabling system Certified Installer. An updated warranty and system certification shall be provided at the completion of any additions.

16.4 Application Warranty

Manufacturers are to supply a warranty to support application and cable performance as per section 5.2.

16.5 System Certification

The installed SCS must be certified and carry a minimum 15-year installation warranty (20-year preferred) by the equipment manufacturer to guarantee that it will meet the Product and Application requirements of this document. One system certification shall cover all components of the structured cabling system.

Where the SCS is in addition to existing data communication cabling, the extent of the warranty and any exclusions shall be documented and agreed upon by the site representative.

17 Contractor Qualifications

17.1 General Qualifications

A cabling system Certified Installer approved by the communications hardware manufacturer shall install the communications component of all works completed in accordance with this specification. This is to enable the hardware manufacturer to provide a 15-Year (20-Year preferred) System Infrastructure and Application Warranty.

Cabling is to be installed by communication cabling specialist organisations / personnel that are:

- Qualified to undertake cabling installation conforming to Australian Standard AS/NZS 3080:2003 (Telecommunications Installation/Cabling Installation);
- Authorised by one or more product manufacturers at a level that provides a minimum of 15 year (20 year preferred) warranty on products post installation, fully sponsored and covered by the manufacturer;
- Hold a current Open Registration with an ACA authorised Registrar; and
- Have a proven minimum of five (5) years previous experience in the installation of integrated communications cabling systems to the performance standards of the particular cabling system being installed.

The cabling system Certified Installer (and sub-contractor if applicable) must have a manufacturer's certification to install and maintain the selected cabling system prior to commencing work on the installation of that cabling.

The cabling system Certified Installer must provide documentation detailing their level of certification.

17.2 Insurance

- The cabling system Certified Installer shall provide insurance certificates as specified in the terms of the specific Contract.

17.3 Cabling System Certified Installer Selection Criteria

When calling for Tenders or requesting quotations the School should invite cabling system Certified Installer who can provide the following information:

17.3.1 Company Details

- Company overview
- Last year financial statement

17.3.2 Qualifications and References

- References of 15/20 year warranted sites (3)
- Copy of warranty certification statements from the manufacturer
- Customer reference letters with contact details

17.3.3 Personnel Details and Qualifications

- Current Company staff details

- Full-time staff & responsibilities
- Part-time cabling system Certified Installers & responsibilities
- Training
- ACA cabling registration details or Austel General Premises licence numbers or
- Base cablers licence numbers
  - Aerial cabling endorsement
  - Category 5 endorsement
  - Category 6 endorsement
  - Optical fibre endorsement
- Industry specific training
- Company 15/20 Year warranted SCS solutions
- Vendor Certificates

17.3.4 Testing and Commissioning

- Type, make and model of testing equipment provided
- Level IIe and Level III copper cable scanner
- Class D & E testing capabilities
- Optical fibre launch loss method
- Optical fibre OTDR method

18 Appendix 1

18.1 List of standard exemptions

Presented below is a list of items that have been deemed to be standard exemptions. Note however, that approval is still required from the DOE ICT Directorate prior to any works commencing.

18.1.1 Install Cat 5 (Cat 5e) instead of Cat 6 UTP for horizontal cabling

This will be commonplace for some years to come as sites expand on existing Cat 5 installations. An exemption for this purpose will only be approved where one or more of the following exists:

- the installation is only temporary;
- the required of TOs expansion small in number and there is sufficient spare capacity in the existing Cat 5 patch panels;
- the site is subject to LAEP activities;
- the site will undergo capital works in the near future and the extent is yet to be confirmed.

18.1.2 Use of UTP (Cat 6 or Cat 5) between buildings

External use of UTP is not a preferred option, but may be approved under very strict criteria. Generally the buildings will need to be close together (no more than 5m) and/or transient protection devices must be installed at each end of each UTP cable.

18.1.3 Install OM1 fibre instead of OM3

In sites where there is an existing large scale installation of OM1 fibre, an exemption may be approved where there is potential for cross connection of OM1 to OM3 to occur. This can sometimes be overcome by using the fibre interfaces on a Cisco switch as an OM1/OM3 media converter instead of installing new OM1.

18.1.4 Optical fibre link to transportable building connects to nearest fixed building and not network core

The desire is to have all transportable buildings connected to the existing network core, however this is not always possible. The number of such buildings can be very high and the existing infrastructure may not be readily upgradeable to accommodate this. This is reviewed on a case by case basis and the most widely accepted variation is to have the new transportable connected to the nearest fixed building and a mini core switch installed in that building to accommodate this, unless the transportable is located near to the core.

19 Appendix 2

19.1 Siemon Parts Catalogue

RACKS AND CABINETS	1.1	9RU 600mm deep wall mount (comms only)	MFB or B&R	0235704 or AR9U600
	1.2	12RU 600mm deep wall mount (comms only)	B&R/SIEMON	BRQ-Q115931/1
	1.3	18RU 600mm deep wall mount (comms only)	B&R/SIEMON	BRQ-Q115931/2
	1.4	27RU 1000mm deep floor mount (server and comms)	MFB or RT (30RU)	0600015 or RCKCC3001-L
	1.5	Min 42RU 1000mm deep floor mount (server & comms)	B&R/SIEMON	BRQ-Q115931/3
	1.6	Full height 4 post rack, min 610mm between front & rear mounting rails (server & comms)	B&R/SIEMON	BRQ-Q115931/4
	1.7	Full height 2 post rack (comms only)	MFB, B&R or RT	0226101, AL45U or RCKOF4501
PATCH PANEL	1.8	24 way Cat 6 Patch Panel per each	SIEMON	HD6-24
	1.9	Angled (offset) LC Fibre termination unit per each	SIEMON	FCP3 and RIC-F-LC12-01
LC	1.16	A pair of LC Fibre Connectors	SIEMON	2 x FC1-LC-MM-J80
UTP OUTLETS	1.17	Single outlet	SIEMON	1 x MX6-F02 & MX-HFP-01-02
	1.18	Double outlet	SIEMON	2 x MX6-F02 & MX-HFP-02-02
	1.19	Triple outlet	SIEMON	3 x MX6-F02 & MX-HFP-03-02
	1.20	Quad outlet	SIEMON	4 x MX6-F02 & MX-HFP-04-02
OSP FIBRE	2.1	OM1 - 6 core Outside Plant Fibre per metre	SIEMON	9F8LD4-6B1
	2.2	OM3 - 6 core Outside Plant Fibre per metre	SIEMON	9F5LD4-6B1.00
	2.3	OS1 - 6 core Outside Plant Fibre per metre	SIEMON	9F8LD4-6B1
CAT 6	2.4	Cat 6 UTP per metre	SIEMON	9C6X4-E3
OM3 RISER FIBRE	2.5	2 core Riser Fibre per metre	SIEMON	9F5LB1-2F
	2.6	4 core Riser Fibre per metre	SIEMON	9F5LB1-4A
	2.7	6 core Riser Fibre per metre	SIEMON	9F5LB1-6B
	2.8	12 core Riser Fibre per metre	SIEMON	9F5LB1-12D
OS1 RISER FIBRE	2.9	2 core Riser Fibre	SIEMON	9F8LB1-2F
	2.10	4 core Riser Fibre	SIEMON	9F8LB1-4A
	2.11	6 core Riser Fibre	SIEMON	9F8LB1-6B
OS1 PATCH	2.16	2m per each	SIEMON	J2-LCLCP-02
	2.17	(Non standard) 5m	SIEMON	J2-LCLCP-05
OM3 PATCH	2.18	2m per each	SIEMON	FJ2-LCLC5L-02AQ
	2.19	Non standard 5m per each	SIEMON	FJ2-LCLC5L-05AQ

20 Appendix 3

20.1 Standard Communications Cabinet Layout

FOBOT	
Cable Management	
Patch Panel	
Patch Panel	
Cable Management	
Patch Panel	
Patch Panel	
Cable Management	
Core Switch	
1U space	If available
Edge Switch	
Edge Switch	
Cable Management	
Router	
1U space	If available
Telstra Switch or Optical Media Converter	
Telephone Patch Panel	
1U space	REQUIRED
Rack Mount Server	
1U space	REQUIRED
Rack Mount Server	
1U space	REQUIRED
UPS min 2U	

Not to scale. Not every cabinet will have all this equipment.