

Ministry of Education

Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools

Version 4.0

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REFERENCED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARDS

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

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS ISO 717.1:2004	Acoustics – Rating of sound insulation in buildings and of building elements-airborne sound insulation
AS/NZS 1367:2007	Coaxial cable and optical fibre systems or the RF distribution of analog and digital television and sound signals in single and multiple dwelling installations
AS/NZS 1768:2007	Lightning protection
AS/NZS 2107:2000	Acoustics – Recommended design sound levels and reverberation times for building interiors
AS/NZS 3000:2007 including Amendment 3	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3080:2013	Telecommunications installations – Generic cabling for customer premises.
AS/NZS 3084:2003	Telecommunications installations – Telecommunications pathways and spaces for commercial buildings
AS/NZS 3085.1:2004	Telecommunications installations – Basic requirements
AS/NZS 4296:1995	Cabling trunking systems
AS/NZS 61000.6.3:2012	Electromagnetic compatibility (EMC) - Part 6.3: Generic standards - Emission standard for residential, commercial and light-industrial environments
AS/NZS CISPR 22:2009	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
AS/NZS ISO/IEC 14763.3:2012	Telecommunications installations – Implementation and operation of customer premises cabling - Part 3: Testing of optical fibre cabling

AS/NZS IEC
61935.1:2012 Specification for the testing of balanced and coaxial
information technology cabling – Part 1: Installed balanced
cabling as specified in ISO/IEC 11801 and related
standards

AUSTRALIAN STANDARDS

AS 3996:2006 Access covers and grates

AS ISO 140.4:2006 Acoustics – Measurement of sound insulation in buildings
and of building elements - Field measurements of airborne
sound insulation between rooms

AS/CA S008:2010 Requirements for customer cabling products

AS/CA S009:2013 Installation requirements for customer cabling (Wiring
Rules)

OTHER PUBLICATIONS

 Compliance document for New Zealand Building Code –
Clause C Protection from Fire (including amendments 2
and 3)

New Zealand Building Code Compliance document for New Zealand Building Code –
Clause E2 External Moisture (Third edition, including
amendment 6)

 Compliance document for New Zealand Building Code –
Clause G9 Electricity (including amendment 6)

Building Industry
Consulting Service
International, Inc
(BICSI) Telecommunications Distribution Methods Manual
(TDMM), 13th Edition

Building Industry
Consulting Service
International, Inc
(BICSI) Network Design Reference Manual (NDRM), 6th Edition

ADDITIONAL MATERIAL

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

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS 2967:2010	Optical fibre communication cabling systems safety
AS/NZS ISO/IEC 24702:2007	Telecommunications installations – Generic cabling – Industrial premises
AS/NZS IEC 61935.2:2006	Testing of balanced communication cabling in accordance with ISO/IEC 11801 – Patch cords and work area cords
AS/NZS 60079.10.1:2009	Explosive atmospheres – Classification of areas – Explosive gas atmospheres

INTERNATIONAL STANDARDS

ISO/IEC 11801 Ed. 2.2 en(2011)	Information technology – Generic cabling for customer premises
IEC 60268-16 Ed. 4.0 en_d(2011)	Sound system equipment – Part 16: Objective rating of speech intelligibility by speech transmission index

OTHER PUBLICATIONS

Building Industry Consulting Service International, Inc (BICSI)	Outside Plant Design Reference Manual (OSPDRM), 5th Edition
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WEBSITES

<http://www.legislation.govt.nz/>
www.minedu.govt.nz/
<http://www.telepermit.co.nz/PtcSpecs.html>

LATEST REVISIONS

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

FOREWORD

The educational environment provides one of the most challenging frameworks for the operation of comprehensive structured information and communication technology (ICT) infrastructure solutions. It has exceptionally high requirements for reliability, fault-tolerance and service availability that exceed many other similar sized operating environments.

Educational providers are frequently at the leading edge of the technology and application lifecycle with teaching systems often involving new and innovative applications, extensive use of graphical content, monitoring, and reviewing functions. They are also much more likely to involve the use of complementary technologies including wireless and cabled monitoring systems, audio-visual applications, presentation applications, multi-media content, metering and control requirements and collaborative developments than their commercial or government counterparts.

The modern school infrastructure must address not only the standard applications of telephony and data connectivity, but must also support the unique requirements of heavy burst-oriented network traffic requirements over relatively shorter periods associated with educational systems, extensive use of multi-media technologies, and both wired and wireless networking.

The goal of this Ministry of Education document, *Information and Communications Technology (ICT) Cabling Infrastructure: Policy and Standards for Schools v4.0* is to provide a reference document for cost effective design and construction of telecommunications distribution infrastructure for all facilities in New Zealand Schools. It has been prepared to outline the minimum standards required to ensure consistency and compatibility of all new and existing Ministry of Education schools Structured Cabling Systems (SCS) and network infrastructure systems.

This document provides the technical standards and guidelines which are to be followed for the design and technical performance of any ICT telecommunications infrastructure in facilities owned by Ministry of Education schools is installed, maintained, certified and managed. It is updated regularly as Standards, school requirements and Ministry policy change. Prior to using this document the user should confirm that they have the latest version. The latest version of the document may be obtained from www.minedu.govt.nz/

Purpose

The document shall be used by schools and other organisations which participate in the design, installation, and operation of information and communications technology infrastructure and cabling systems for New Zealand schools. The document addresses information technology infrastructure in new schools, and is to be applied to existing schools planning significant installations, upgrades, and modifications to existing infrastructure.

This document provides guidance on minimum technical standards in the following areas:

- a) Technical requirements for cabling systems
- b) Product selection
- c) Design, installation and testing
- d) Labelling, administration and documentation.

Document sponsor

This document has been developed and is controlled by the Ministry of Education. All queries, errors, omissions or suggestions are to be directed to:

The Director, Technology in Schools
Education Infrastructure Services
45-47 Pipitea St
PO Box 1666
Wellington 6140

Acknowledgements

The Ministry of Education acknowledges with thanks the assistance and contribution of a number of organisations and parties in the preparation of this document. In particular the assistance of the following parties is acknowledged:

Information Communications Technology Directorate	Department of Education and Training, Government of Western Australia	Connector Systems Ltd (Molex)
Torque IP	Telco Technology Services	3M
J A Russell Ltd (Hubbell)	TE Connectivity	Leviton
Schneider Electric (NZ) Ltd	Aurecon	

Outcome statement

By using this document, designers and installers will successfully meet the Ministry of Education minimum standards for the safety, design, installation and support of structured cabling systems and information and communications technology environments that New Zealand schools manage and operate.

1. USING THIS DOCUMENT

1.1 Interpretation of this document

1.1.1 Interpretation

For the purposes of this document, the word 'shall' refers to requirements that are mandatory, while the word 'should' refers to practices that are advised or recommended.

1.1.2 Scope of this document

This document addresses the following areas:

- a) Structured Cabling System (SCS) comprised of balanced copper cabling and optical fibre for use in New Zealand schools
- b) Cable pathways and equipment spaces including equipment rooms, telecommunications distribution spaces and equipment mounting
- c) Cabling for wireless networking systems.

1.1.3 Criteria for use

All school Information and Communications Technology (ICT) installation and upgrade work shall be in accordance with this document.

It is a requirement of the Ministry that all schools, designers and installers of networks for schools shall use this document, in order to allow the school to fully participate in the e-learning environment and protect the investment in SCS.

In addition to this document, the designer and installer should refer to other sources for detailed design and installation guidance, such as relevant mandatory legislation, publications outlined in this document, and manufacturer installation guidelines.

1.2 Application of this document

1.2.1 Regulations, codes, and Standards

All cabling system works are to be carried out in accordance with the regulations, codes, and Standards listed at the beginning of this document.

Where New Zealand and international Standards are referenced in this document the application of the Standard shall be, unless specifically stated elsewhere to the contrary, to the latest edition and amendments available on the date 30 calendar days prior to the issue of any request, quote, tender or proposal.

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

1.2.2 Regulatory requirements and Codes of Practice – cabling

Other than for compliance with the Electrical Regulations and relevant New Zealand Codes of Practice, there are no regulatory requirements for telecommunications cabling components, design practices, or installation practices in New Zealand.

The Telecommunications ACT 1987 gives Telecom and any other Network Operators the right to refuse connection or to disconnect unsatisfactory cabling and components from their network.

For cabling connected to the national telecommunication network, compliance with Telecom PTC specifications is a contractual requirement.

1.2.3 Installation specific standards and requirements

The designer and installer shall conform to all the requirements of this Standard.

Designer and installer note:

Where a school has site specific standards and requirements, for example product type or labelling schemes, and it is a) cost efficient; and b) does not have a material impact on the technical aspects of meeting this Standard, then these shall be followed if written agreement from the school and the Ministry is received.

1.2.4 Variation from this document

Compliance to the requirements of this document may, under some circumstances, not be practical, or cost effective, or an alternative solution may exist that better suits the conditions on site.

The designer and installer are advised that, in the event that compliance to this document cannot be met, before undertaking the non-compliant works the designer or installer is to obtain written approval for a variation from:

The Director, Technology in Schools
Education Infrastructure Service
45-47 Pipitea St
PO Box 1666
Wellington 6140

1.2.5 Conflicts

If a conflict exists between the Standards or with the Scope of Works then the installer shall notify the Project Manager or their representative of any conflicts and seek clarification prior to continuation.

In general the order of precedence shall be:

- a) Statutory Codes and Regulations
- b) The Ministry of Education publication *ICT Cabling Infrastructure: Policy and Standards for Schools* (this document)
- c) Standards and specifications within the tender or contract
- d) Referenced New Zealand and International Standards

In situations where tender specific Standards, specifications, or both, exceed Ministry requirements, these shall take precedence.

Where reference is made to any other Standard or specification, the latest published editions of any such specification shall apply.

Conflicts in requirements or requests for variation from published documents that are identified by Schools, consultants, designers, tenderers, or installers shall be notified in writing to:

The Director, Technology in Schools
Education Infrastructure Service
45-47 Pipitea St
PO Box 1666
Wellington 6140

Written confirmation from the Ministry is to be received before resolution.

1.3 Definitions and abbreviations

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

1.3.1 Definitions

Term	Definition
As-built	Final set of drawings produced at the completion of a construction project, including all changes made to the original construction drawings
Building backbone cabling	Cable that connects the building distributor to a floor distributor
Campus	A school, and includes the buildings and grounds in which a cabling system is installed
Campus backbone cabling	Cable that connects the campus distributor to the building distributor(s)
Campus distributor	Distributor from which the campus backbone cabling starts
Category 5 (Cat 5)	For the purposes of this document, cabling components which provide a permanent link that, when tested, do not meet AS/NZS 3080 Class D performance
Category 5e (Cat 5e)	For the purposes of this document, cabling components which provide a permanent link that, when tested, meet AS/NZS 3080 Class D performance
Category 6 (Cat 6)	A definition of cabling components which provide AS/NZS 3080 Class E performance

Term	Definition
Catenary wire	A wire supported at two points kept under mechanical tension to provide a support to which cabling may be fastened.
Channel	End-to-end transmission path connecting two pieces of application specific equipment (includes patch leads and work areas cables)
Clear working spaces	A ventilated working space allowing quick unrestricted egress or escape in the event of emergency
Consolidation Point	Connection point in the horizontal cabling subsystem between a floor distributor and a telecommunications outlet
Designer	A person who plans the look, or workings, or both, of something prior to it being made, by preparing drawings or plans
Distributor	The term used for a collection of components (such as patch panels, patch cords) used to connect cables
Enclosure	A housing for accommodation of equipment and cabling that includes mounting rails and protective panels
Equipment footprints	The vertical and horizontal planes occupied by a piece of equipment in normal operation
Horizontal cabling	Cable connecting the floor distributor to the telecommunications outlets
Installer	A person that places or fixes equipment or machinery in position ready for use. The party(s) responsible for the supply, installation, testing and warranty of cabling systems
Manufacturer	A person or company that makes cabling goods for sale
Practicable	Able to be done or put into practice successfully
Permanent link	Transmission path between the telecommunications outlet and the floor distributor
Single vendor system	A system provided by a single vendor to help reduce operational, configuration, and management complexity
Site	See Campus
Structured Cabling System	A set of cabling and connectivity products that are constructed according to standardised rules to facilitate integration of voice, data, video, and other signals
Suitably qualified person	A person with the professional qualifications and experience in the industry to undertake the design and supervision of the works
Velcro™	A proprietary form of Hook & Loop fastener/cable tie

1.3.2 Abbreviations

AFFL	Above Finished Floor Level	MCB	Miniature Circuit Breaker
BD	Building Distributor	MUTO	Multi User Telecommunications Outlet
BER	Bit Error Rate	ODF	Optical Distribution Frame
CAD	Computer Aided Design	OFCS	Optical Fibre Communication Systems
CD	Campus Distributor	PE	Polyethylene
CES	Communications Earth System	RCBO	Residual Current Breaker (with overcurrent protection)
CoC	Certificate of Compliance	RCD	Residual Current Device (No overcurrent protection)
CP	Consolidation Point	RJ45	Registered Jack Number 45
DB	Electrical Distribution Board	RU	Rack Unit
EMC	Electromagnetic Compatibility	RUPO	Restricted Use Power Outlet
ESC	Electrical Safety Certificate	SCS	Structured Cabling System
FD	Floor Distributor	SFF	Small Form Factor
FOBOT	Fibre Optic Break Out Termination	SMOF	Single Mode Optical Fibre
F/UTP	Foil wrapped Unshielded Twisted Pair	SPA	School Property Advisor
GbE	Gigabit (per second) Ethernet	SPD	Surge Protection Device
GPO	General Purpose Electrical Outlet	TO	Telecommunications Outlet
ICT	Information and Communications Technology	TR	Telecommunications Room
IDC	Insulation Displacement Connection	TRC	Telecommunications Reference Conductor
IP	Internet Protocol	UPS	Uninterruptible Power Supply
LAN	Local Area Network	uPVC	Unplasticised polyvinyl chloride
LC	A small form factor optical fibre connector type	UTP	Unshielded Twisted Pair
MAC	Moves Adds Changes	UV	Ultraviolet
MATV	Master Antenna television	WA	Work Area
MCB	Miniature Circuit Breaker	WAP	Wireless Access Point
MMOF	Multimode Optical Fibre	WLAN	Wireless Local Area Network

2. STRUCTURED CABLING SYSTEMS: OVERVIEW

2.1 ICT cabling background

The Information and Communications Technology (ICT) cabling 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.

Cabling systems range in size from small and simple, linking just a few nodes, to large and complex, linking several buildings with tens of thousands of nodes.

The cabling system provides the physical link between active network equipment such as routers and switches, and the terminal equipment such as computers and telephones. Structured cabling systems (SCS) are typically comprised of unshielded twisted pair (UTP) copper cable and optical fibre cable.

To facilitate the day-to-day operations of a normal school environment, a 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.

As data throughput and transmission speeds continue to grow, greater demands are being placed on the UTP and optical fibre cabling plant. Gigabit Ethernet, and other high bandwidth services, use “parallel transmission schemes” to transmit signals simultaneously over multiple copper pairs instead of one pair. Delivery of these new services requires increased performance from cabling plant.

2.2 Structured Cabling System (SCS)

An SCS is a set of cabling and connectivity products that are constructed according to standardised rules to facilitate integration of voice, data, video, and other signals. Use of such a system provides benefits in terms of rationalisation 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.

Cabling equipment manufacturers offer a minimum link performance warranty of 20 years if the installation uses approved components that are installed by an installer certified or accredited by the manufacturer.

In the case of work undertaken to change or expand an existing cabling installation the following requirements shall be applied¹:

- a) The new equipment shall be specified to ensure all existing warranties and system performance are maintained or enhanced.
- b) The new equipment should be matched as closely as possible to the existing equipment unless a more up to date and cost effective solution is available or such matching would conflict with occupational health and safety requirements or mandatory standards.
- c) The number of differing types of equipment installed throughout a site should be kept to a minimum.

In the case of cabling for new buildings added to a school, the cabling system shall comply with the requirements of this document unless such compliance would create compatibility or performance issues.

2.3 General design requirements

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

For this reason it is important that the cabling system is designed to be flexible and scalable, to ensure longevity and accommodate future increased bandwidth requirements. This is particularly important where cabling is installed underground or in other locations where upgrades to plant can be expensive and disruptive.

¹ This applies specifically to existing buildings and does not apply to new buildings on the same site

3. GENERAL CONDITIONS

3.1 Ministry ICT Cabling requirements

All works that include either new or upgraded ICT cabling shall:

- a) Be installed to comply with this Standard
- b) Have a minimum twenty (20) year performance warranty
- c) Have a minimum two (2) year installation warranty
- d) Be installed by a Ministry approved ICT contractor
- e) Be installed using a Ministry approved manufacturers product
- f) Have all relevant documentation submitted to the school and the Ministry.

3.2 Cabling system works

The scope of work for the provision of ICT cabling systems in schools typically includes supply, installation, testing, commissioning, labelling and documentation.

Installation shall only be carried out by ICT SCS installers who hold current accreditation from the manufacturer of the cabling and connecting hardware as qualified to perform the cabling work relevant to the performance standard of the particular cabling system.

3.3 Standards and references

All works shall be carried out in accordance with the regulations, codes, and Standards referred to in the appropriate section of this document and the associated Scope of Works. In addition, all works involving product and equipment shall be carried out in accordance with the manufacturer's product guidelines, instruction sheets and specifications. See 1.2 for more information.

In all cases where Standards, documents and publications are referenced, the latest additions and amendments available at the time of release of the Scope of Works shall be used. Where reference is made to any other standard or specification, the latest published editions of any such specification shall apply. If a conflict exists between the standards or with the Scope of Works, the installer shall notify the Ministry of Education or its representatives of any conflicts and seek clarification prior to continuation.

It is the installer's responsibility to obtain the latest editions of and familiarise themselves with these documents and publications.

3.4 Security clearance and Police vetting

The Education Act requires that every installer, employee of an installer, or subcontractor engaged by an installer who has, or is likely to have, unsupervised access to students at the school or children during normal school hours or service opening hours must be Police vetted.

Normal school hours are defined as the hours that the school is open for instruction.

Police vetting shall be obtained before a person who is required to be vetted has, or is likely to have, unsupervised access to students or children.

Once successfully vetted, the installer or employee of an installer will be cleared for employment for 12 months, upon which time an application must be resubmitted.

Many schools will also wish to induct visitors onto the site using the normal business practice of signing visitors into the school when they arrive and signing them out as they leave. Information typically required from visitors is:

Name
Company name
Purpose of visit
Time in and Time out

Installers working at schools should wear an identification tag while in the school grounds, but at all times shall carry personal identification – for example, a driver's license – and present it on request.

3.5 Occupational Health and Safety (OSH)

The installer shall comply with all Acts and Regulations, Approved Codes of Practice, all relevant Standards, WorkSafe New Zealand (previously Department of Labour) Guidelines, Occupational Health and Safety requirements, accepted codes of practice, manufacturer's instructions and any temporary rules and restrictions that may be in force at the time.

The installer shall also comply with the school and Ministry of Education Health and Safety policy, guidelines and rules when engaged in work on Ministry of Education sites and equipment, and shall conform to all site specific requirements including safety requirements. Prior to the commencement of any design or construction work on school property involving access to grounds or buildings the installer shall ensure they have received:

- a) A copy of the school safety plan, including the location of school safety and first-aid equipment
- b) A school vehicle access plan including safe access and parking for contractor and delivery vehicles.

The installer shall ensure that all its personnel working on Ministry of Education sites or working on Ministry of Education networks have undertaken appropriate training and have a recognised site safety accreditation for both the site and work to be undertaken.

No open pits, holes, trenches, or access areas, are to be left unattended at any time. All are to be clearly marked and secured in accordance with OSH regulations and all ground or structural disturbances are to be secured and/or removed at the end of each day's work in accordance with OSH regulations.

3.6 Advice

The installer shall advise the school and gain approval before undertaking any work that may or will result in voice, data, security or other ICT network service disruption or network downtime to existing network infrastructure. Any work that may result in network down time will require scheduling with school representatives.

3.7 Site conditions

The installer shall familiarise themselves with the site conditions prior to undertaking or providing quote or estimate prices for any work. Specific conditions to be observed include school and Ministry of Education site access and entry requirements, Ministry of Education OSH requirements, qualification and identification of personnel and onsite legacy equipment and configurations.

Installers are required to undertake all necessary investigations to fully inform themselves of the site conditions and other factors that could impact the cost and execution of works.

This includes but is not restricted to:

- a) Hazards that may be present at the school (such as asbestos)
- b) Heritage registration of buildings
- c) Environmental conditions including special precautions for the protection of flora and fauna
- d) Local site conditions including weather hazards and cultural significance
- e) Easements
- f) Safety of students and staff with respect to pit covers and location
- g) Existing and projected underground services, note that site maps may not be complete or available

3.8 Contractual obligations

The installer shall complete all works in a manner consistent with the Ministry of Education objectives and requirements, and consistent with the detail contained in this specification and the Scope of Works for any work to be undertaken and detailed drawings and specification documentation that accompanies the Scope of Works. The installer shall also conform to all regulatory requirements applicable to the work being undertaken.

3.9 Installer qualification

The installer's lead installer, site manager or site foreman shall have attended and passed the Ministry of Education ICT Cabling Standards training course and hold a valid certification from this course. All works need to have oversight by a person holding this certification. The size of the installation will determine the necessary time that this person shall be onsite during SCS construction and certification.

The installer's personnel undertaking any installation or remedial work on a Ministry site or facility ICT system are required to be trained by the manufacturer or its representatives on the product, system or components being installed. All workmanship shall be compliant with regulatory requirements and with manufacturer's requirements and specifications.

The installer shall ensure that all its personnel undertaking any prescribed work or work requiring a licence or accreditation are fully trained and accredited for the work being undertaken.

3.10 Existing sites floor plans

For existing buildings, floor plans shall be provided by the Ministry or its representative for mark up by the installer. The installer shall mark up the drawings to reflect locations, numbering, and so on, and return them to the Ministry or its representative. Any identified additions or deletions to the plans will be required to be supplied to scale.

3.11 Design by the installer

When the installer is required by the Scope of Works to develop the design shown on the contract drawings and detailed in the Scope of Works into fully detailed final design, the installer shall coordinate with the Ministry of Education or its representatives, and with other contractors to prepare design documents for construction purposes.

The installer shall submit the design and documents to the school or its representatives for approval before work is undertaken.

3.12 Electrical installation works

The installation of all electrical products and equipment shall be installed to the manufacturer's guidelines to the correct and relevant regulations and Standards by a registered electrician. See ELECTRICAL for more information.

It is important to note regulatory requirements regarding the installation of 10mA RCD (Residual Current Device) protection in schools.

3.13 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 in EQUIPMENT SPACES should be considered.

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

3.14 Contract drawings

When contract drawings are diagrammatic or indicative only, they are not intended for construction purposes. In conjunction with the design requirements described in this specification, the contract drawings are used to show the general layout of the system and to describe the performance requirements.

The quantity and specification of the equipment shown in diagrammatic contract drawings and the associated schedules are typically the minimum requirements only.

3.15 Fit for purpose

The installer must provide all equipment that is required for a complete and working installation to attain the specified performance.

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 in the original packaging except where pre-installation commissioning, run-up and configuration may require equipment to be worked on off-site.

All minor materials and fittings or any work which is necessary for the satisfactory installation and operation 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 document, the installation specification, or shown on construction drawings.

3.16 Final design approval

The design and proposals for all work shall be reviewed and approved by a person with a recognised industry certification with a minimum of 3-years relevant ICT experience prior to final signoff by the Ministry of Education or its representatives.

3.17 Computer Aided Design (CAD) drawings

All drawings shall comply with the requirements using recognised symbols and graphics as identified in AS/NZS 3085.1 and be in Revit, AutoCAD RL2004 (or later version) .dwg with attribute blocks. All drawings will be to a scale that will be legible and easy to follow when reproduced on A3 paper. Drawings shall be supplied uncompressed and unprotected.

3.18 Shop drawings

Shop drawings shall be provided to the Ministry or its representative for written approval prior to commencement of site works. As a minimum the shop drawings shall provide the following:

- a) System type, manufacturer and warranty details
- b) Proposed site, building and floor location of all distributors and ICT cabinets
- c) Proposed IDC frame and ICT cabinet layouts showing dimensioned location of all new and existing cabling
- d) Proposed site pathway plan showing locations for all pit, pipe, cable tray and catenary systems
- e) Floor plans showing proposed location and numbering of all telecommunications rooms, pathways and outlets
- f) Any proposed changes to the electrical systems and switchboards.

All shop drawings shall be provided and scaled to present the information within the drawing in a clear and easily viewable layout in .pdf, and either Revit, or AutoCAD format. That is, a drawing with a high density of TO's shall be presented in a scale

that allows for all information on each TO to be read easily without the need to zoom in on the electronic version of the drawing.

3.19 Time elapsed

Due to the time elapsing between the release of new build tender specifications and the installation and construction works for the communications systems, it is anticipated that some of the equipment proposed will be superseded by later models by construction time.

The installer is to review products and confirm the models of all equipment and products proposed with the engineer one month prior to the procurement and installation of the equipment including but not restricted to all Structured Cabling System components that is, Multimedia system.

3.20 Construction documentation

Installation shall be in accordance with approved construction drawings.

Construction documentation will typically include:

- a) Scaled 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. Drawings will be to a reasonable accuracy, see Figure C1 of AS/NZS 3085.1
- b) Schematic diagrams detailing the quantity and types of cables linking distributors, see Figure C2 of AS/NZS 3085.1
- c) Equipment room layouts
- d) Physical enclosure layouts, see Figure C3 and C4 of AS/NZS 3085.1
- e) Schematic diagram detailing patch panel layout and port numbering
- f) Physical layout drawings of data and power outlet positions and identification numbers
- g) Equipment lists detailing the equipment (type/make/model) to be installed including racks, enclosures, patch panels, and outlets. Floor layout with all TOs labelled
- h) Identification of cable pathway routes and labelling
- i) Rack or cabinet layout at commissioning.

For all new works, floor plans with telecommunications outlet locations and numbering shall be provided to the school and its representatives and agents in .pdf, and either Revit, or AutoCAD format.

3.21 Coordination with other services

The installer shall be responsible for coordination with Ministry of Education personnel and representatives and with other works and trades including civil, building, electrical, mechanical and security where cabling work is dependent upon or carried out in conjunction with these works.

This includes but is not restricted to:

- a) Use of site and facilities
- b) Closure or restriction of access to site and facilities
- c) Scheduling of works and resources
- d) Segregation of services
- e) Site reinstatement.

3.22 Out of hours work

Periodically, installers will be engaged to work at Ministry schools and facilities out of normal school hours. If required by the school, the installer shall arrange for school representatives to be present at all times when installers are engaged on the school site and facilities.

3.23 Testing

See TESTING AND CERTIFICATION for more information.

3.24 Site reinstatement

For works undertaken as a refit or extension to existing installations, including all connections to existing site backbones and installation and patching at existing backbone distribution areas, all sites shall be reinstated to their original condition to the satisfaction of the Ministry of Education staff or their representatives. This shall be carried out as soon as practicable after works have been completed.

Site reinstatement shall be considered part of the installation and shall include the removal of all packaging materials and waste, the painting and plastering of wall surfaces damaged during installation, and the reinstatement to original condition of any ground surfaces damaged during earth works.

3.25 Cleaning

The installer shall maintain a clean working environment minimising disruption to the school staff and students, and remove all packaging materials, off-cuts and materials left over from the installation of its product and leave the area clean on completion of all works.

3.26 Removal of redundant materials

When refit, renovation, variation or Moves/Adds/Changes (MAC) work is required, the installer shall identify and remove any SCS cabling and cabling materials made redundant as a result of the work being undertaken.

Cabling that is unused may be left in place if it is determined that it may be used at a later stage, or if removal of the cable may damage other services, or where removal

is prohibitive. Written approval from the school or its representatives shall be obtained prior to the decision to retain any redundant cable can be made.

Cabling left in place shall be tagged and labelled for future use and as-built documentation updated to show retained cabling and associated pathways.

3.27 Practical completion

The stage in the execution of the works under the contract where the Contract Works are complete.

3.28 Audits and inspections

Audits and installations may be initiated by the Ministry of Education or its representatives from time to time to confirm compliance with Ministry standards, the specifications, and construction drawings.

These audits and inspections will include, but not be limited to, written reviews of:

- a) Compliance with the Ministry of Education publication *ICT Cabling Infrastructure: Policy and Standards for Schools* (this document)
- b) Installation practices to current regulatory requirements
- c) Installation techniques and OSH guidelines, for the safety of site users and installation staff
- d) Test results
- e) Site reinstatement
 - i. All work completed is to the former condition and the school representative's satisfaction
 - ii. All work completed as soon as practicable after the works are complete
- f) Required project documentation and warranties.

3.29 As-built drawings

These drawings shall include the following information:

- a) Site and building or floor location plans showing the location and size of pathways and the cables installed, cable routes, pit locations and enclosure and distributor locations
- b) Schematic diagrams detailing the quantity and types of cables linking distributors
- c) Equipment room layouts
- d) Physical enclosure layouts
- e) Schematics of patch panel layout and port numbering.
- f) Physical layout drawings detailing outlet positions (TOs, GPOs, and RUPOs) and identification numbers
- g) When included with the scope of works, the locations and circuit identification of all power socket outlets (GPOs and RUPOs)
- h) Description of the patching system and the labelling system used
- i) Equipment lists detailing the installed equipment (type/make/model) including racks, enclosures, patch panels, and outlets
- j) Test reports detailing procedures, equipment configuration, and test results (in the test equipment native format) for both balanced copper and optical fibre cable.

As-built drawings shall be provided to the SCS Manufacturer for warranty application purposes.

3.30 Warranties

Warranties, Certificate of Compliance, Defect Periods and Guarantees shall be required as part of the Scope of Works for installation, maintenance and refit of facilities.

Warranty periods shall commence at practical completion or, if not concurrent with practical completion, at acceptance of installation.

The project will not be considered completed until all warranty documentation has been received by the Ministry of Education or its representative, and the school.

Two types of warranties apply to Structured Communications System installations:

- a) Installation Warranty (Defect Liability Period)
- b) Manufacturer's Warranty.

3.30.1 Installation Warranty

The cabling system installer shall provide a Defect Liability Period warranty on its own work and workmanship for a minimum period of two (2) years. This includes any remedial work done to bring existing cabling up to the required Standard.

3.30.2 Manufacturer's Warranty

A manufacturer's system performance warranty with a minimum of a twenty (20) year validity period is a mandatory requirement.

In the event that the manufacturer's requirements contradict those within this document, the installer is to bring those contradictions to the attention of the Ministry immediately.

Retained cabling which has passed testing (Cat 5e and Cat 6 cables) and has been installed to the required standards is not required to be covered under the new warranty (but may be if negotiated with the manufacturer).

Any additional cabling at the warranted premises must not compromise the existing warranty. All modifications and additions to already warranted SCS must be tested and warranted by the manufacturer. An updated warranty and system certification shall be provided at the completion of any additions.

3.31 Records and retention

All records, warranties, test results in RAW format, guarantees and drawings relating to installation and maintenance work undertaken by the installer shall be maintained by the installer for a minimum period of one (1) year after the end of the warranty or guarantee period.

Copies of all warranties, test results in RAW format, guarantees and other records relating to installation or maintenance and upgrade work are to be provided to the Ministry of Education or its representative within two weeks of practical completion.

3.32 Intellectual property

All submissions, drawings, schematics, policies and procedures related to the Ministry of Education network and its premises are the property of the Ministry of Education.

3.33 Confidentiality

All drawings, specifications and other information, samples, models, patterns, and the like supplied by either the Ministry of Education, or by the designer or installer are regarded as confidential.

The designer or installer shall not disclose any such information to a third party without the written consent of the Ministry.

3.34 Training

The installer shall provide operator training and operational manuals as required for Ministry of Education personnel. Training shall be carried out not later than one week after and not earlier than 4 hours before practical completion.

4. DESIGN CRITERIA

4.1 Criteria for use

See 1.1.3. The designer and installer should refer to sources and publications outlined at the beginning of this document for general design guidance.

4.2 Associated systems and components

The following systems and peripheral components should be considered in conjunction with the design and implementation of the cabling system:

- a) False floor in server/communications rooms to facilitate cable routing to floor mounted racks and cabinets
- b) Temperature control by forced ventilation or air conditioning in server and communications rooms
- c) Alternatives to fire sprinklers in server and communications rooms
- d) Smoke detection in server and communications rooms
- e) UPS system capacity requirements, accommodation, battery maintenance and life span
- f) Wireless access points
- g) IP telephone systems
- h) Video conferencing
- i) IP cameras using existing switching (not on separate security network)
- j) Network for Learning (N4L) terminations and associated equipment.

4.3 Design exclusions

4.3.1 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 installer shall be limited to the following:

- a) Provision of communications earth system (CES) where specified as part of the works
- b) 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 shall be completed by a registered electrician.

4.3.2 Existing cabling

There is no requirement to modify existing cabling and related systems 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, or to bring the installation up to the required Standard.

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 as part of an upgrade or redevelopment, or if cabling performance is inadequate for new communications facilities.

Any existing Class D or Class E cabling that is deemed to be retained by the school or project manager shall be tested to the appropriate class performance specification. If the link fails it shall be either:

- a) Replaced
- b) Brought up to specification
- c) Removed from service if no longer required.

4.3.3 Other cabling or systems

Related cabling or systems that are outside the scope of these Standards include:

- a) Network equipment, such as servers and switches, that are connected to the SCS
- b) Master Antenna Television (MATV) cabling and equipment
- c) Security systems
- d) Wireless LAN equipment
- e) Radio based carrier interface
- f) Patch by exception balance cable termination systems

4.4 Applications and cabling performance

The Ministry's minimum standard for new horizontal cabling installations is based on using Cat 6 cabling components to provide a Class E infrastructure performance which is guaranteed to transport Gigabit Ethernet (GbE) and allow for emerging technologies as they develop.

The Ministry's minimum standard for new backbone cabling installations is based on using OM3 optical fibre cable or short lengths of Cat 6 UTP (up to 37m channel length). IEEE standards have been ratified for 10 Gigabit Ethernet (10GbE) on OM3 optical fibre and it is likely that backbone infrastructure will be required to support 10GbE transmission in the foreseeable future.

School cabling systems shall be constructed to conform to AS/NZS 3080:

Telecommunications installations – Generic cabling for commercial premises.

AS/NZS 3080 specifies six performance classes (A, B, C, D, E and F) for balanced cabling channels. Only Class D and 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 D is specified to 100 MHz while Class E is specified to 250 MHz.

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

The maximum channel length is 100 metres for both Class D and Class E.

The cable and components used within balanced cabling systems are classified according to category. Category 5 components provide Class D performance while Cat 6 components provide Class E performance.

AS/NZS 3080 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 in this case signifies multimode while the S signifies single-mode. OM1 is 50 or 62.5/125 μ m (200/500MHz) and OM2 is 50 or 62.5/125 μ m (500/500MHz) while OM3 is 50/125 μ m (1500/500MHz) laser optimized optical fibre cable.

4.5 Category 6 (Cat 6) UTP cable and connecting hardware

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

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

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

Cat 6 backbone balanced cabling shall be generally terminated with modular 8-pin (RJ45) outlets using the T568A arrangement. However, insulation displacement (IDC) punch-down blocks may be used to terminate outdoor balanced cables used within the voice backbone.

4.6 Cabling lengths

The following table is taken from AS/NZS 3080, and may also be reproduced with permission granted by Standards New Zealand under licence 001075.

Maximum cable lengths specified for optical fibre are as follows:

Network Application	Wavelength	50/125 μ m	62.5/125 μ m	9/125 μ m
100BASE-FX	1,300nm	2,000m	2,000m	2,000m
1000BASE-SX	850nm	550m	275m	N/A
1000BASE-LX	1,300nm	550m	550m	5,000m ²
10GBASE-SR	850nm	300m	33m	N/A
10GBASE-LX4	1,300/1,310nm	300m	300m	10,000m
10GBASE-LR/LW	1,310nm	N/A	N/A	10,000m
10GBASE-ER/EW	1,550nm	N/A	N/A	40,000m

Table 1: Optical fibre channel lengths

4.7 Cabling system architecture

The conceptual arrangement of a generic cabling system is illustrated below:

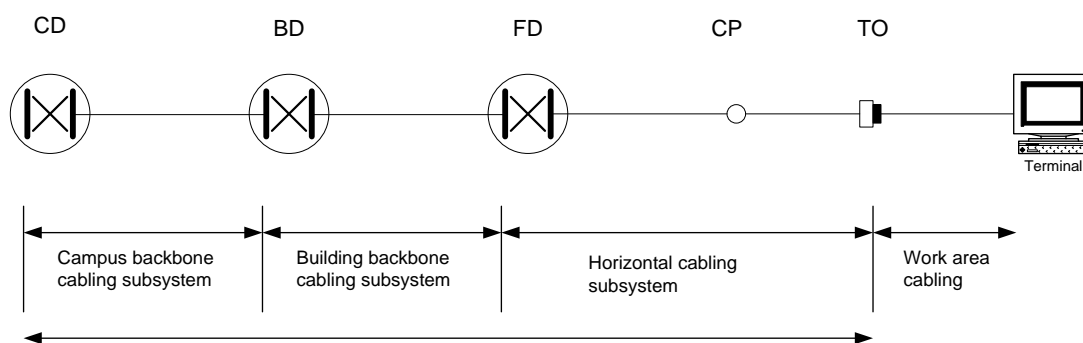


Figure 1: Structure of generic cabling

The distributors (**C**ampus **D**istributer, **B**uilding **D**istributer and **F**loor **D**istributer) 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.

² In accordance with IEEE 802.3

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

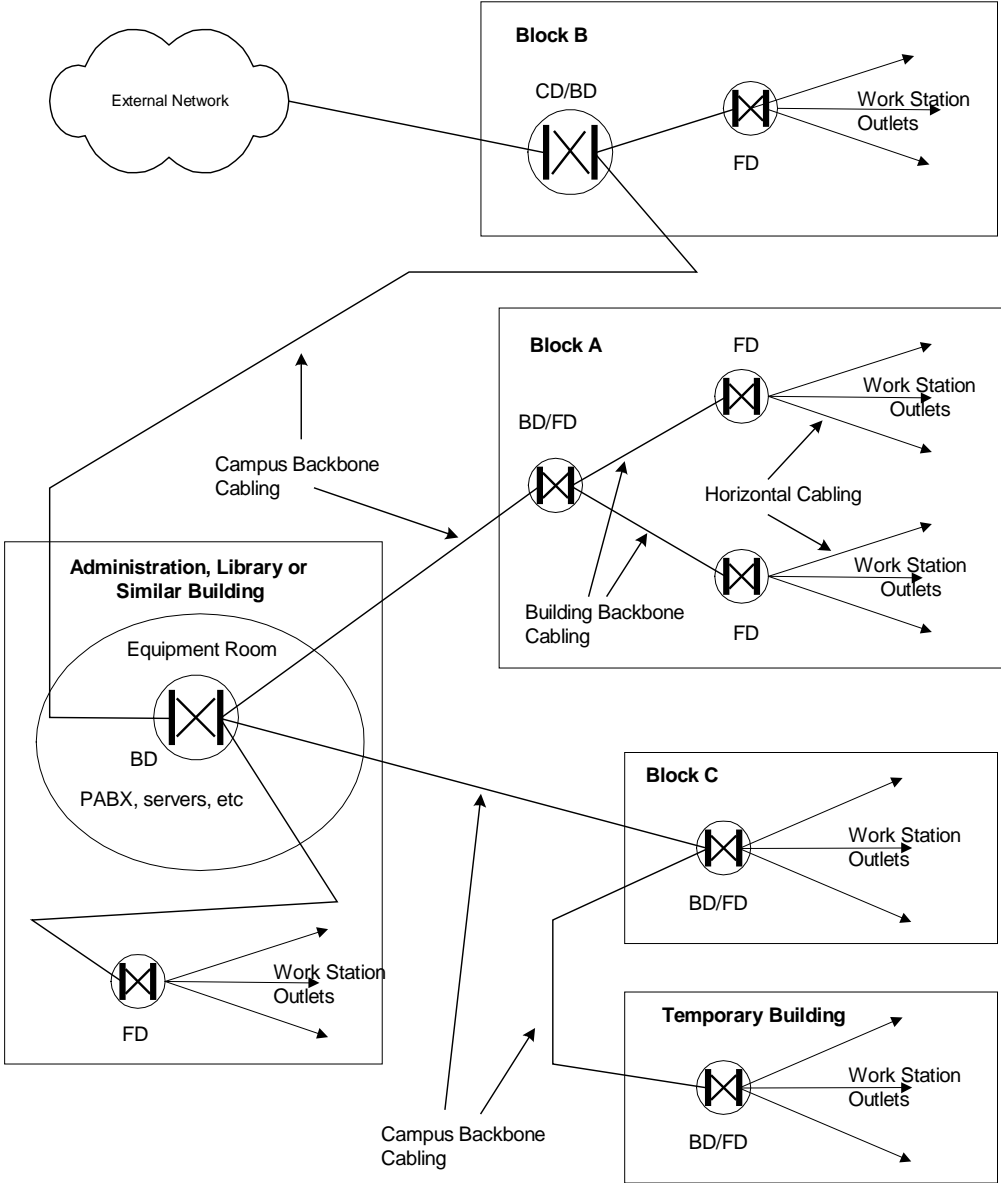


Figure 2: Conceptual cabling layout

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

4.8 Aesthetic design

In all cases the SCS shall be designed and installed in a manner that is suitable for the building and not in conflict with the environment at the particular school.

4.8.1 Heritage buildings

Many schools contain buildings that have significant historical or cultural significance. Modification on work within these buildings may be difficult and the amount and nature of any refurbishment may be subject to specific controls and restrictions. Designers and installers are required to ensure that in the proposed construction activities do not compromise the restrictions imposed in these buildings.

See APPENDIX A – HERITAGE SITES for more information.

4.8.2 Exposed cabling

The designer is expected to minimise the use of exposed conduit and capping and overhead connections. Where possible all cabling and cable pathways, including pits and external conduits, should be placed as unobtrusively as possible so as to be hidden from view and not attract attention. It is expected that where service pathways are provided in a school campus (walkway cavities are a perfect example), they will be used to distribute ICT Cabling Infrastructure around that campus – If for any reason this may not be practicable, then written agreement from **BOTH** the School's authorised representative and the School SPA will be needed.

When it is not possible to completely hide the cable pathways including overhead, conduits and capping, installers shall use materials and products that are the least obtrusive to view.

4.9 Single vendor solutions

4.9.1 New works

4.9.1.1 Systems

All new cabling systems and work items within a specific building shall be a single-vendor system comprising both copper and fibre optic networking products and incorporating both the connectors, cables and mounting trays and panels. The Ministry of Education has reviewed and approved manufacturer's products for use on its sites and facilities. All new works must utilise products from the approved vendor list provided in APPENDIX B – APPROVED ICT CONTRACTORS LIST.

4.9.1.2 Warranty

The cabling solution is to be supported with a single vendor's warranty for a period of not less than 20 years. A "mix-and-match", or "back-to-back" warranty structure using cabling and connector products and warranties from multiple vendors will not be accepted. The product exceptions to this are limited to (subject to these exceptions not conflicting with the manufacturer's warranty):

- a) Cabinets and cable pathway products
- b) Cat 3/Voice-grade telecommunications cable only
- c) Patch cables and cable assemblies
- d) Fibre optic break out trays and unloaded patch-panels, consolidation points and mounting hardware

4.9.2 Moves, adds and changes

When moves, adds, and changes (MACs) are being undertaken on existing installations, and where a warranty is already in place for the existing installed system, MACs shall be consistent with the installed product and shall not, where possible, void an existing warranty. Where applicable the warranty for the existing system shall be extended to include the new works.

4.9.3 Existing infrastructure requiring maintenance

If an existing Cat 6 link fails the Class E performance test as per AS/NZS 3080, and is not covered by current warranty it can be tested to Class D. If tested at Class D with a pass it can be retained, but marked on the as-built drawings, TO and horizontal distributor records accordingly. If it fails Class D performance tests, re-terminate the cable and test again. If it still fails the cable shall be replaced.

4.10 Dimensioning

The network requirements and configuration in any given area or classroom is to be determined and confirmed by the school. Sufficient TOs and accompanying RUPOs shall be installed in all areas to meet the Ministry design guidelines as per the specific scope documents and tender documents.

4.11 Salt spray and corrosive environments

Particular care shall be taken for installations in coastal regions to minimise the 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 spray ingress. See NZS 3604 for additional information.

4.12 Chemical corrosion

4.12.1 Equipment rooms

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

4.12.2 Storage areas

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.

4.12.3 Wet areas

Computer and networking equipment should not be installed in wet areas or rooms containing hot water cylinders, cleaner's equipment, sinks or basins.

If installation in a wet area is unavoidable, then approval must be received in writing from the Ministry and the school prior to commencement of installation.

4.13 Noise

Equipment enclosure locations shall be selected such that noise levels in work areas arising from the enclosed equipment, when combined with other sources of work area noise, shall be maintained within the limits specified by AS/NZS 2107 *Acoustics – Recommended design sound levels and reverberation times for building interiors*.

Recommended design sound levels for different areas of occupancy in buildings are given in Table 1 of AS/NZS 2107, from which the following design details are extracted and may also be reproduced with permission granted by Standards New Zealand under licence 001075.

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

Table 2: Acceptable sound levels

Further information on acoustics can be found in NZS 6801, NZS 6802, AS ISO 140.4, and AS/NZS ISO 717.1.

4.14 Legacy systems

The cabling system design shall consider the interface requirements of legacy equipment in existing installations. If any discrepancies are noted they should be highlighted in writing to the school or its representative.

4.14.1 Retention of legacy backbone cabling

It is recommended that existing Cat 6 cables installed as backbone be replaced with OM3 fibre. See 6.2.5.2 for more information.

Installer note:

If the backbone is 37 metres or less, Cat 6 cabling can be retained if it would be more cost efficient.

4.14.2 Retention of legacy horizontal cabling

A decision should be made by the on-site auditor and installer if existing cabling infrastructure could be retained, and then this decision shall be documented and supplied to the Ministry or its representative and the school.

The following is a guide to assist in this decision:

- a) Only Cat 6 and Cat 5e cables should be retained
- b) For a good existing standard of installation then channel performance testing shall be carried out along with all other channel performance testing required at the completion of the installation
- c) There is no requirement for existing cabling to be warranted retrospectively but some may already have an existing warranty
- d) Retained cabling should be integrated into the new installation as best as possible, labelled consistently but clearly identified as being excluded from the new warranty
- e) Poor quality installations not meeting this Standard should be removed or modified to meet this Standard
- f) For poor installation, where tests are failed then cabling should be removed
- g) If no additional TOs and power outlets are required in an area (or block) then the existing cabling shall be tested to the appropriate link class and retained if testing is passed. The labelling of the existing TO's must be consistent with the rest of the site
- h) The system designer will need to make an economic decision as to whether to replace the old system or retain it.

Any remaining legacy cabling, for example not properly secured and laying on the ground, that is being retained shall be rectified.

4.14.3 Cable removal

All cabling that does not meet the required Standard should be removed from site prior to any new installation where practical.

Consideration should be given to service continuity and ensuring a minimal service disruption period during installation. This includes associated pathways and the repair of any building structures as a result of the removal.

4.14.4 Cable management systems

Existing cable management in an enclosure can be retained and used for new cabling in conjunction with new installations providing this does not compromise the manufacturer's warranty.

4.15 Fire rating

All penetrations made through fire rated walls must maintain fire ratings where wiring goes through fire rated elements. This includes (but is not limited to):

- a) All penetrations, vertical and horizontal must be sealed utilising a system or product, or both, that adheres to all requirements of the relevant specific building design, Standard, Ministry, Local Authority, and New Zealand Building Code regulations

- b) All materials utilised for the sealing of the necessary fire rated risers and walls must be suitable for the purpose and comply with any Fire Safety Feature Reports that are issued and with all Local Authority regulations
- c) Where fire rated walls are penetrated a suitable fire rated sleeve shall be utilised to reticulate the Telecommunications cabling through the opening and protrude at least 100mm either side of the penetration
- d) Vertical Risers and penetrations shall be sealed horizontally and utilise an easily removable solution that allows for future expansion and meets with necessary regulations
- e) Photographic evidence shall be collected for each completed fire rated penetration. This shall include a time and date stamp, and form part of the completed handover documentation supplied to the Ministry of Education or its representative
- f) If the installer identifies non-compliant firewall penetrations made by other trades or installers they shall notify the school or its representatives of the non-compliance immediately in writing.

4.16 Electrical installation works

ICT and networking installations may require electrical work to be carried out to complete the installation or programme of works. When electrical installation work is required as part of a network system upgrade the following shall apply:

- a) All electrical work shall be carried out by a registered electrician in accordance with the Electricity (Safety) Regulations and Compliance document for New Zealand Building Code – Clause G9 Electricity
- b) A special note should be taken for AS/NZS 3000 requiring the installation of 10mA RCD (Residual Current Device) protection for newly installed GPOs in some situations where Years 1 to 8 are in attendance. Guidance on compliance options for schools is provided in ELECTRICAL
- c) A Certificate of Compliance (CoC) and Electrical Safety Certificate (ESC) shall be issued for all electrical work undertaken. Electrical testing results shall be recorded on the CoC.
- d) Photographic evidence shall be collected for each completed installation. This shall include a time and date stamp, and form part of the completed handover documentation supplied to the Ministry of Education or its representative.
- e) If the installer identifies non-compliant electrical installation made by other trades or installers they shall notify the school or its representatives of the non-compliance immediately in writing.

4.17 Electromagnetic compatibility

There are presently no EMC regulations covering cabling installations and systems. However, the following cabling installation practices are recommended to limit the risk of interference to other services and the risk of interference from unwanted external emissions.

For unscreened cabling, the EMC performance of the installed cabling is controlled by its 'balance'. Balance is a measure of the control exercised over the physical relationship of individual conductors inside the cable or connecting hardware and is,

therefore, a critical parameter during the manufacture of the high performance cables and connecting hardware used in generic cabling.

It is necessary to utilise installation methods that maintain the original balance of the cabling components:

- a) Transmission equipment shall meet the requirements of AS/NZS CISPR 22
- b) Complete systems shall meet the requirements of AS/NZS 61000.6.3.

To facilitate satisfactory EMC performance of the overall SCS the design of cable routes and pathways shall take due consideration of requirements detailed in AS/NZS 3080 and AS/NZS 3084.

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.

5. PATHWAYS AND SPACES

5.1 General requirements

5.1.1 Fixings

Fixings shall be entirely suitable for the situation in which they will be used:

- a) Where fixings are to be used externally or exposed to the weather stainless steel shall be used. Plain and cadmium plated steel is not acceptable
- b) Where fixings are used internally, cadmium plated steel is acceptable.

All fixings, fastenings and supports shall be of adequate strength and size and arranged to avoid mechanical failure under normal conditions prevailing in schools.

Cables shall be held firmly by the securing device without undue pressure being exerted on the cable sheaths.

Cable ties used externally shall be UV resistant. The use of plastic cable ties shall not be permitted even for temporary fastening or support of cables during the construction phase.

All cables shall be tied to catenaries and any other pathway or cabling loom using Velcro™ ties.

Cables shall not be secured to beams or any other structure by pin clips, staples, stapled cable ties or stapled Velcro™ ties. Where pathways are required, catenary wires, trays or trunking shall be provided. When transitioning from a tray or catenary wire less than two (2) metres from the outlet location, the use of one stapled Velcro™ tie for support is permissible.

5.1.2 Internal catenaries and above-cable trays

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

- a) A main cable route shall be chosen such that the cable path is accessible and conforms to the segregation requirements
- b) Horizontal cabling and backbone cabling shall be installed on separate catenary wires
- c) The catenary wire shall be anchored at a maximum of 3m spans. Turnbuckles and steel eyelets shall be used to tighten the catenaries so that there is no more than 150 mm sag between catenary supports when fully loaded
- d) A maximum of 24 x 4 pair UTP cables may be tied to a single catenary. All cables will be secured at regular intervals of approximately 300mm using Velcro™ ties
- e) Any cable leaving the wire shall not have an unsupported length greater than one (1) metre before its next fixing, access, or dropping down a wall
- f) Data and telephone services shall not be supported on catenary wires that are used for electrical services
- g) Catenary wires shall be run square and true with no deviations to avoid other services. They shall be run parallel to the major axis of the building
- h) Any cable runs under buildings shall use catenary wires or trays. Where cables transition from underground ducts to catenary wires the duct exit point shall be

- plugged or sealed using some form of removable material. Rodent resistant polyester insulation wool may be used for this. Expanding foam is not permitted
- i) Cables installed under decks shall be installed in a conduit to protect the cable from the environmental elements
 - j) Cables supported on catenary wires shall have a minimum ground clearance of 500mm where possible for serviceability and to reduce potential rodent damage. For all instances where 500mm clearance cannot be maintained from the natural ground level it shall be protected by a conduit, or external UTP cable may be used
 - k) When vertical drops of cable exceed two (2) metres, catenary wire shall not be used as the means of support. The installer is to use tray or chain with appropriate fixings to prevent cable from slipping.

5.1.3 Penetrations

Fire rated elements and structural members shall not be penetrated without approval from the building architect and relevant Fire Authority, and the New Zealand Building Code Compliance Clause C Protection from Fire shall be complied with.

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 both sides of the opening and provide holes for the cables only. All holes shall be fire-stopped with a proprietary product that exceeds the fire resistance of the materials being filled and is installed to the manufacturer's specifications.

Ducts that pass through walls, roofs, or floors shall be sealed to the manufacturer's specification with an industry-standard duct sealing device to prevent the ingress of water.

Where the cabling exits an external underground conduit and enters the structure, the penetration shall comply with the New Zealand Building Code Clause E2 External Moisture. Mechanical flashings shall be used to weather proof all external penetrations to the structure, with the use of sealant deemed a secondary means of weatherproofing.

Any low level flashing used to protect a building penetration shall be constructed to ensure that the top surface is angled at approx 20 degrees. For low level building penetrations, the underground duct shall terminate in an appropriate weather proof enclosure of minimum L300mm x W200mm x D150mm. Cabling transitioning through the rear of the enclosure shall pass through a section of 50mm conduit inclined at a downwards angle of approx 10 degrees.

All flashing shall be manufactured from stainless or hot dip galvanised steel, and designed to meet the New Zealand Building Code Clause E2. Other materials may be used, with written approval for these from the school and the Ministry to be received prior to installation. Flashing shall aesthetically match the building as far as practicable (colour to be determined on site prior to ordering and installation).

The installer shall ensure all installed flashings avoid health and safety issues, for example sharp edges, or pathway and access obstruction.

5.1.4 Metal pathways

All metal pathways shall be bonded as per AS/NZS 3000.

5.2 Inter-building pathways

5.2.1 General

Inter-building pathways shall be constructed to accommodate the cabling between buildings. Inter-building pathways may consist of underground, overhead, and aerial pathways.

5.2.2 Cost

Due to the cost and intrusion of creating inter-building pathways installers are advised to confirm the requirements of other trades and where possible co-exist in pathway or trenches to minimise cost.

5.2.3 Specifications

Underground pathways are preferred wherever practicable however above ground routes may be necessary in some circumstances. As detailed in 5.4.1:

- a) The pathway shall be fully covered and the cabling shall be installed within protective conduit or ducting for the entire external section of the cable route
- b) Externally rated cabling shall be used in all inter-building pathways.

5.2.4 Crawl space

Open and unsecured crawl space under elevated buildings must be considered an external environment and proper consideration shall be given to the choice of components used in this space. Cable pathways in this area shall be protected as per 5.7.4.

5.2.5 External pathways

All external pathways including junction boxes, ducting, trunking and conduits entering a building shall be protected against damage or vandalism for their entire length to a minimum height of 2.0m above the ground.

Protection shall be in the form of a robust metal flashing of minimum 1mm thickness. The flashing shall be constructed of either stainless or hot dip galvanised steel. Other materials may be used, with written approval for these from the school and the Ministry to be received prior to installation.

If the duct or conduit then continues up under the eave of the building, then it shall be protected all the way to ensure aesthetics are maintained and that it blends into the existing building structure.

Where the new duct to be protected is directly adjacent existing plastic cable ducts following the same path, these ducts shall also be covered within the flashing.

5.2.6 Damage resistance

All inter-building pathways that can be prone to vandalism or damage shall be protected against identified risks.

5.2.7 Manufacturer's approval

All ICT cabling pathway components shall be approved by the SCS manufacturer as suitable and approved within the warranty requirements of the vendor's system.

5.3 Underground pathways

5.3.1 General design

Underground pathways shall be designed and constructed in accordance with AS/NZS 3084. Where underground pathways enter into the interior of the building they shall be rodent proofed and sealed from the ingress of water to meet New Zealand Building Code Clause E2 External Moisture.

5.3.2 Trenches

Trenches for communication cabling shall be constructed to provide a minimum depth of 450mm cover between the natural ground surface and the top surface of the communications conduit.

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.

Conduit may be installed by directional drilling providing the minimum cover to the natural ground surface can be maintained.

A suitable warning marker tape shall be installed directly above conduit installed in a trench, at the appropriate level, for the entire length of the trench prior to backfilling to deter possible mechanical damage to data pathways by diggers.

Backfilling shall be performed with due care to avoid distortion of the cable inspection pits and the conduit shall be supported firmly and evenly on all sides. Suitable fine grit material shall be used to surround pits and conduit prior to backfilling trenches.

All trenches must be backfilled with fine grit up to the duct level and original excavated material removed from site or disposed of in accordance with the school's requirements.

5.3.2.1 *Fill ratios*

Fill ratios shall be approved by the designer, but shall not exceed 50% fill-rate on first installation, and 80% on subsequent MAC works, without the written authorisation of the Ministry or its representatives.

5.3.3 Conduit

For all conduits the following requirements shall be followed:

- a) A minimum diameter of 50mm for all newly installed conduits unless where otherwise specified or approved in writing by the Ministry or its representatives
- b) Conduits and accessories should be UV stabilised and white, green or grey UPVC or PE
- c) Conduits shall be installed in areas where there is a requirement for added protection and/or to aid the ease of installation for any Telecommunications cabling
- d) If conduits are installed in exposed areas then they shall be installed on parallel paths and change direction utilising appropriate bends and accessories required to form a right angle
- e) Draw wires shall be installed in conduits that have spare capacity and also in conduits not currently in use. A minimum of 500mm of draw wire shall extrude from each conduit end and be fixed so as not to become unusable.

Underground conduits should be sized to accommodate backbone cables such that the conduit is not greater than 50% occupied at the time of installation. In addition:

- f) The conduit shall extend into the pit for a distance of approximately 50mm through a close fitting hole.
- g) All conduits and accessories shall be suitably manufactured and coloured for telecommunication cabling use
- h) Sweeping bends shall be used to allow for cable bending radii
- i) The minimum size of conduit shall be 50mm and it is strongly recommended that a spare 50mm diameter, PVC, communications conduit be installed along the complete route of the underground inter-building pathway system for future installations. A single 100mm conduit may be considered an acceptable, and perhaps better, alternative to two 50mm conduits
- j) All conduit used on site shall be UV stabilised. All conduits shall be installed with a draw wire consisting of a 1mm conduit wire, a 3mm nylon cord, or a 12mm nylon ribbon
- k) Conduits shall be sized to ensure the haul tension of the cable is not exceeded under installation.

5.3.3.1 *Underground conduit building access*

Underground conduit shall either:

- a) Continue up and be fixed to the outside wall of the building to enter the ceiling space through the eave, or
- b) Finish above ground level and the cable(s) fastened to a vertical perforated cable tray fixed to the outside wall of the building.

The cable tray shall be continuous from the conduit top to an access hole at ceiling space level. The access hole shall be sealed with a moisture and fire retardant material as per 5.1.3. The perforated tray, access hole, and cable(s) shall be protected by a steel top hat section.

Both conduit and top hat sections shall be painted to match other building fixtures such as down pipes.

Where underground cable enters a building, access shall be fit for purpose, comply with New Zealand Building Code Clause E2 External Moisture, and be protected from damage.

5.3.3.2 *Flexible conduit*

Flexible conduit is not recommended, however if this is required to achieve a smooth directional change the following conditions shall be met:

- a) The flexible conduit must be UV stabilised and of PVC construction
- b) The flexible conduit must be painted grey or to match the colour of the solid conduit sections
- c) The paint used must be UV resistant.
- d) Flexible conduit sections shall not exceed 0.5m in length.

5.3.4 Pits

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

- a) At distances not exceeding 50m along underground cable pathways
- b) Where a significant change of direction to the route occurs.

The minimum pit dimensions shall be 450mm x 450mm x 600mm deep. All lids must be lockable (not screwed down) and of solid construction.

Communications pits shall be of robust construction and suited to the conditions where they are installed.

Pits shall have the following accessories:

- c) Secured and correctly rated (lockable) Pedestrian covers
- d) Secured and correctly rated (lockable) Trafficable covers where applicable
- e) Gaskets and seals (T-Dux or equivalent).

Pits shall have non slip surfaces and should not be placed in or near designated play areas. Pits and pit covers shall be rated for their environment in accordance with AS 3996.

Particular care must be taken when pits are in common walking areas or vehicle access roads. Where pits are installed in areas having traffic (this includes grass and field areas maintained by a grounds keeper using a tractor or similar), the correct approved strengthening ring for the pit lip shall be used. Pit lids shall have non-slip surfaces and be correctly rated for the expected exposure to heavy vehicles.

5.4 Overhead pathways

5.4.1 Overhead support systems

Overhead pathways may be considered where buildings are linked by covered walkways or gantries. For all fixed conduit pathways, the conduit shall not be greater than 50% occupied at the time of installation.

5.4.1.1 *Use of existing service ducts*

Existing service ducts housed in walkways that run between classrooms, that are designed for the purpose of routing services around the school unobtrusively, shall be used where they are present and when there is enough spare space.

Catenary wire may be used where service duct is enclosed. Externally rated cabling shall be used, and it shall be supported by catenaries installed in accordance with AS/NZS 3084.

5.4.1.2 *No existing service ducts*

Backbone and horizontal cabling may be installed within conduit of 50mm minimum diameter provided that the pathway is fully covered. The cabling shall be installed within protective conduit or ducting for the entire external section of the cable route. Externally rated cabling shall be utilised.

All external pathways including junction boxes, ducting, trunking and conduits entering a building shall be protected against damage or vandalism for their entire length to a minimum height of 2.0m.

Installer note:

If the duct or conduit then continues up under the eave of the building, then it shall be protected all the way to ensure aesthetics are maintained and that it blends into the existing building structure.

Conduits or ducts installed under covered walkways shall be positioned to prevent anyone from swinging on them.

Installer note:

When multiple ducts or conduits are installed under covered walkways or within a building, an accessible and aesthetically pleasing boxing shall be installed around them and painted to blend the pathway into the surroundings.

Stainless steel full saddles and stainless steel screws shall be used for direct fixing of conduit and pathways to an external structure where applicable. Full saddles and fixings shall be spaced at no more than 1m apart.

5.4.2 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 AS/NZS 3084, and the following:

- a) Aerial pathways shall be selected to avoid crossing power lines
- b) Where aerial pathways are indicated on the site plans, the SCS installer shall install UV resistant, PVC-coated, flexible metal conduit between buildings. In this instance the length of conduit may be greater than 1m
- c) The conduit shall be sized such that fill at the time of installation does not exceed 50% rated capacity
- d) The catenary wires shall be terminated and sized to support the load of the conduit with 80% fill of cables under extreme weather conditions
- e) Catenary wires shall be PVC coated galvanized steel and in no circumstances shall be less than 3.4mm diameter. Catenary wire shall be fixed to the buildings using eyelets and turnbuckles and bonded to the protective earth as required
- f) The conduit shall be tied to the catenary with stainless steel cable ties.

5.5 Tunnels

This Standard does not address the requirements for tunnels. In the event that tunnels are available or are required, the design and appropriate specifications shall be prepared by suitably qualified persons.

5.6 Intra-building pathways

Intra-building pathways shall be constructed to accommodate the cabling within a building or blocks.

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

All ICT cabling pathway components shall be approved by the SCS manufacturer as suitable and approved within the warranty requirements of the vendor's system.

See 5.3.2.1 for fill ratios.

5.7 Horizontal cabling pathway components

All ICT cabling pathway components shall be approved by the SCS manufacturer as suitable and approved within the warranty requirements of the vendor's system.

See 5.3.2.1 for fill ratios.

5.7.1 Horizontal cabling supports

Horizontal ICT cabling shall be supported by an approved method – for example, cable tray, catenary wire – from the cabinet to within one (1) metre horizontally of the vertical channels used to deliver the ICT cables to their telecommunications outlets.

In addition:

- a) No more than 24 cables of any type shall be tied to a catenary wire
- b) Cables shall be tied to catenary wires at 300mm intervals using a hook and loop tape (minimum of 12mm wide tape)
- c) Cables installed on cable trays shall be loosely laid and secured not more than every 1.5m using hook and loop tape
- d) Catenary wire shall be supported at a minimum of every 3m.

5.7.2 Cable trays

Cable trays shall be perforated galvanised mild steel sheet.

Minimum steel thickness for cable tray shall be:

- a) 1.0mm for trays up to 150mm wide; and
- b) 1.2mm for trays up to 300mm wide.

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

Where cable trays transition from a horizontal to vertical positioning, an appropriate solution to avoid cable crimping shall be installed at the point of transition.

Where the cable tray is used as an earthing medium, electrical continuity shall be maintained along its full length.

5.7.3 Cable trunking

Trunking is used primarily to provide a pathway and expansion for TOs and GPOs/RUPOs. Outlets are to be installed externally to the trunking flush to the wall (where access into the wall is available). If outlets are to be installed directly into trunking due to mounting on a concrete or block wall, the trunking is to be installed 750mm above the floor where possible to allow desks to fit under it.

When new trunking is required to provide a pathway for new TOs or GPOs/RUPOs, any existing services that utilise this pathway and existing pathways shall be removed – for example, neatcaps or conduit.

Where twin compartment trunking is utilised for mounting data and power outlets, the top compartment shall be used for GPOs/RUPOs and these are not to be installed directly above a TO.

All metal and plastic trunking must support the required bend radius for Cat 6 and any fibre cable installed to ensure all products maintain their warranty and comply with AS/NZS 4296. All trunking bends, tees and elbows that are installed onsite shall be pre-fabricated by the manufacturer or be a factory manufactured part.

Compliant plastic trunking must be paint absorbent, with a minimum UV stabilisation warranty of 10 years. Unless an alternative colour is stipulated by the school, the colour of the trunking will be white or similar.

5.7.3.1 *Surface mounted trunking*

Surface mounted trunking shall be installed where alternative methods for concealment of cables are not possible. Twin compartment trunking shall be used to segregate power and data cabling. No exposed conduit or duct is to be used within buildings for feeding TO's or GPOs/RUPOs.

Surface mounted trunking and ducting shall follow the natural vertical and horizontal lines of the room structure. It is preferable to install vertical trunking where possible in a corner if it is close to the outlet location or in a location to make it look as aesthetically pleasing as possible while maintaining expandability and flexibility.

The fixing of surface mount trunking directly to the ceiling or other horizontal surface (lid facing down) should be avoided. Where this is necessary, Velcro™ ties shall be screwed within the trunking at maximum of 2 metre spacing to ensure that cables are retained when lids are removed. Alternatively, solid cross sections placed to hold the cable in place may be used.

5.7.3.2 *Fixings*

Ducting shall be screw-fixed to walls using suitable fixings (for example cavity fasteners for cavity walls and masonry anchors for concrete walls) at approximately 1m intervals when run vertically and approximately 600mm intervals when run horizontally. Fixings shall not cause undue distortion to the ducting when tightened.

5.7.4 Under floor cabling

Backbone and distribution cabling may be installed under floors when access permits.

For all under floor cabling the following requirements are to be adhered to:

- a) Cables must be suitable for the environment in which they are installed
- b) Exposed standard distribution cables may be used when the under-floor space is dry and not subject to spray or splashes. Cables should be installed clear of access and vent points
- c) External grade cables (gel-filled or water-block) and rodent resistant cables should be considered when the cables are at risk. Alternatively, sealed conduits may be used to protect cables from damage by water or rodents
- d) A minimum separation of 500mm shall be observed between fibre optic cabling and ground level. Where this cannot be achieved cabling shall be installed within plastic conduit of 50mm diameter
- e) Where practical all internally rated copper cable shall maintain a minimum distance of 500mm from finished ground level, externally rated cabling may be used for cabling positioned between 200mm and 500mm from ground level
- f) Any cabling installed within 200mm of ground level shall be provided with additional mechanical protection, that is, installed within 50mm plastic conduit maintaining the minimum bend radius and expansion requirements

- g) In all cases the manufacturer shall be consulted to ensure the installation meets the specifications and requirements for warranty.

Installer note:

It is preferred that cabling be concealed by installation in ceiling, floor or wall cavities. However, it may be necessary to surface mount cabling within ducting where no cavity exists or where concealment would prove to be inordinately expensive, disruptive or impracticable. Two-compartment duct shall be used to segregate power and data cabling.

All ducting shall be run in an inconspicuous manner. Excess cabling shall not be stored in the ducting.

*Where cable is run in a false (suspended) ceiling it shall be suspended from fixed non-movable structural features, purpose installed flat cable trays, or from catenary wires. Fixed, non-movable features **exclude** water pipes, sprinkler systems and trunked electrical power.*

Cables shall not be laid on ceilings or ceiling tiles or attached to any suspended ceiling support structures.

Plastic capping should not be used in new installations and low profile ducting should be considered where cable numbers are low. Capping may:

- a) Be used at 2m above finished floor height*
- b) Be used for no more than two cables; and*
- c) Be retained if 2m above finished floor height and no change is required.*

All capping shall be UV rated.

6. CABLING

6.1 General

All cabling shall be installed in full accordance with the manufacturer's recommendations. Cables shall be installed so that:

- a) Maximum permitted hauling tension is not exceeded
- b) Minimum bending radius of the cable is not exceeded
- c) Maximum permitted crush rating is not exceeded.

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

Equipment and patch panels shall be laid out to minimise patch cord length. Patch cords shall follow clear paths to avoid patch field obstruction.

6.1.1 Balanced Cable Termination

An RJ45 system shall be 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 the T568A arrangement in accordance with AS/NZS 3080.

The connecting hardware shall be installed to the manufacturer specification and to preserve wire twists as close as possible to the point of mechanical termination to minimise signal impairment. The amount of untwisting in a pair shall be no greater than 13mm for Category 5 cable and no greater than 6mm for Category 6 cable.

To preserve the electrical characteristics of the balanced cable, the outer insulation of the cable shall not be stripped back more than recommended by the manufacturer for the purposes of termination.

6.1.2 Optical fibre cable termination

Multimode optical fibre cores shall be fusion spliced with LC terminated pig-tails.

Single mode optical fibre terminations shall be achieved by splicing pigtails to optical fibre cores using the manufacturer's approved splicing techniques.

The cables shall terminate in fully enclosed 1-RU 12 port (24 fibre) or 24 port (48 fibre) LC duplex patch panels in the communications cabinets.

All fibre cores specified shall be terminated at each end and presented at the patch panel. The number of points at which through patching of backbone fibre occurs should be kept to one (1).

Fusion spliced connection of inbound and outbound fibre cores at a communications cabinet shall not be permitted, except in cases where through patching must occur more than once due to geographical or distance constraints.

All unoccupied fibre ports shall have rubber plugs fitted to prevent the entry of dust.

6.2 Backbone

6.2.1 Backbone cabling

Backbone cabling includes both campus and building backbone cabling subsystems. The backbone cabling generally provides interconnection between active network equipment that may be within the same building or in separate buildings.

All new campus and building backbone cabling shall be optical fibre. Any exception shall be approved in writing by the Ministry or its representative. See 6.2.5.2 for more information.

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

Cabling requirements for voice communications depend on the technology used for voice switching. Internet Protocol (IP) Telephony systems transport voice signals as data over the common optical fibre backbone cabling. For the older (TDM) telephone systems dedicated balanced cabling will be required in the backbone.

Installer note:

Where backbone cables are run through ducting, sufficient slack of at least one loop must be retained in all inspection pits. All backbone cabling shall be labelled within pits using standard labelling conventions for the site.

6.2.2 Fibre optic backbone cables

The increased bandwidth required by schools has resulted in optical fibre communication systems being implemented in a wide variety of environments to which both cabling practitioners and others might have access.

The following specifications shall be followed:

- a) All fibre optic network design shall be based on the performance and distance restrictions identified in AS/NZS 3080. The link-loss budget of the fibre link must meet the performance limitations of this Standard
- b) All pig-tails shall be colour matched to the fibre cable
- c) All fibre optic connections shall comprise fusion spliced pig-tails. Mechanical splices and field termination are not acceptable
- d) A minimum of multimode OM3 fibre shall be used for distances less than 300m in all new fibre backbone cabling installations
- e) Multimode optical fibre cabling used within backbone cabling subsystems shall be 50/125 μm OM3 cable and comply with AS/NZS 3080
- f) Optical fibre connecting hardware used within backbone cabling subsystems shall comply with AS/NZS 3080

- g) A minimum of single-mode OS1 for distances exceeding 300m in all new fibre backbone cabling installations
- h) OS1 optical fibre cables used within backbone cabling subsystems shall comply with AS/NZS 3080
- i) OS1 optical fibre connecting hardware used within backbone cabling subsystems shall comply with AS/NZS 3080
- j) All the fibre cores at both ends of each optical fibre cable run shall be terminated using LC-duplex type fibre connectors. Unused cores shall not be left un-terminated
- k) All fibre cables will be presented in appropriate sealed fibre trays or distributors with compression glands for protection from rodent damage
- l) All fibre fusion spliced terminations shall be presented on an approved splice cassette, firmly fixed within the fibre tray
- m) Fibre optic backbone cables shall be run from the Campus Distributor (CD) to each Building Distributor (BD) or Floor Distributor (FD). These cables may traverse, where installed, Optical Distribution Frames (ODF's) assuming that link loss budgets are adhered to
- n) Fibre Optic Break Out Termination (FOBOT) patch panels shall be rack mountable, hinged or sliding, with eye safe front (including laser warning symbol) and integrated patch cord management
- o) All fibre optic backbone cables shall have a crossover as per AS/NZS 3080. The crossover shall be implemented at the down-stream end of the link (farthest end from the CD)
- p) Each optical fibre cable shall be installed with 5m spare length in the communications enclosure at the respective distributors. The spare cable shall be stored so that it does not interfere with the opening of cabinets, FOBOTS, or servicing of equipment within the cabinet
- q) Optical fibre bending radius shall not be less than 10 times the cable diameter (not less than 30mm) or as specified by the cabling manufacturer whichever is greater under no load conditions and 20 times the cable diameter or as specified by the cabling manufacturer whichever is greater under load, that is, when being pulled through conduits and the like.

Refer to APPENDIX C – CABLING WORK PRACTICES for more information.

6.2.3 Cable running or termination operations

The following precautions shall be taken in these operations:

- a) Care shall be taken not to breach the cable's protective sheath.
- b) Cables shall not be forced through openings that are too narrow or have sharp or rough edges.
- c) Cables shall not be bent more than the manufacturer's recommended minimum bend radius.
- d) All building entry and cable pathway entry points shall be suitably sealed against water ingress in a manner aligned with the New Zealand Building Code Document E2, with drip loops provided on cables where necessary.

6.2.4 Use of gel-filled cables

As there are no regulations or legislation that covers the use of gel-filled cables in New Zealand, the Ministry will not be restricted by a set distance for the entry of gel filled cables (copper or fibre) inside a building.

Termination of gel filled cables into telecommunications cabinets shall be directed by the recommendations and warranty requirements of the system manufacturer.

6.2.5 Campus and building subsystems

For the purposes of the application of single vendor system warranties, all aspects of the campus backbone shall be considered part of the SCS and shall be included within warranties. The OSP campus network should be from the same vendor or manufacturer as the building systems vendor.

6.2.5.1 Installation

Cables shall be:

- a) Rated for the environment in which they are installed
- b) Certified by the manufacturer for the environment in which they are installed.
External cables should be gel-filled water-resistant cables
- c) Installed in a manner that does not expose them to the elements and that protects them from risk of damage or vandalism. Refer to 5.3 for more information on conduit sizing, fill rates and installation.

6.2.5.2 Channel length

Fibre optic cables should be used in all instances. In instances where Cat 6 UTP is installed as a backbone link, a maximum channel length of thirty seven (37) metres shall not be exceeded. An exception to this distance is only applicable where detailed within sections of this document, and approved in writing by the Ministry or its representative.

UTP backbone cable lengths shall not be less than fifteen metres (15m) unless permitted by the SCS manufacturer and a passing test is achieved.

6.2.6 Fibre optic terminations

Fibre optic cable shall be terminated with LC UPC type fibre connectors.

6.2.7 Fibre optic patch cords

Fibre optic 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 matched to the AS/NZS 3080 optical fibre cable type 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.

Patch cords shall employ the following colour scheme:

- a) Orange for OM1 62.5/125µm (expansion or upgrades only)

- b) Aqua for OM3 50/125µm
- c) Yellow for OS1 (single mode)
- d) Yellow and orange or grey for mode conditioning patch cords (yellow for SMOF element, orange or grey for MMOF element).

Mixing of optical fibre patch cords and cabling, for example 50/125µm cabling with 62.5/125µm patch cords and vice versa, shall be avoided.

6.2.8 Cabling within enclosures

All cables shall terminate at the patch panels in the communications enclosures with an excess length of five (5) metres for optical fibre and not less than half (0.5) metres for other cables neatly placed out of sight prior to terminating.

Excess cable shall not be stored in “coils” but shall be formed into a “loop back” generally contained at one side of the cabinet up against a wall. Any excess length cabling must be properly supported.

Cables terminating at the enclosures shall be neatly loomed within the enclosure, utilising the cable management system specified in 7.6.

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.

6.2.9 Spare capacity

A coil of cable (both fibre and copper) of at least 1m shall be left in each pit to allow for future expansion or maintenance purposes. All cables left coiled in the pits must be identified using water proof labels indicating the cabinets or points between which the backbone link is installed.

At the distribution and work area ends of the horizontal cabling installation, provision should be allowed to house a certain amount of spare cable, for the requirement of re-termination or reconfiguration of the local cables.

These spare cable capacity provisions are:

- a) Building distribution – half (0.5) metres
- b) Floor distribution – half (0.5) metres
- c) Work area (ceiling/floor) – one (1) metre
- d) Outlet (false wall) - three hundred (300) mm

These spare cables should be stored in such a way as not to cause or induce any interference into the infrastructure, and so that it does not interfere with the opening of cabinets or servicing of equipment within the cabinet.

6.2.10 Copper (voice) building subsystem

Gel filled copper backbone cables shall not be used in internal building risers

Internal grade Category 3 (Voice) can be terminated on either IDC modules or rack mounted patch panels as required.

6.2.11 Labelling convention

The installer shall follow the labelling convention in use by the school. When this convention is inadequate or has conflicts, an alternative shall be provided. There is no requirement to re-label existing outlets.

Refer to APPENDIX D – LABELLING CONVENTION for labelling convention and requirements.

6.3 Horizontal cabling

Horizontal cabling extends from the Floor Distributor (FD) to the Work Area (WA). The horizontal cabling subsystem includes all cables, telecommunication outlets, patch and jumper cords and may include Multi User Telecommunication Outlets (MUTO's) and Consolidation Points (CPs).

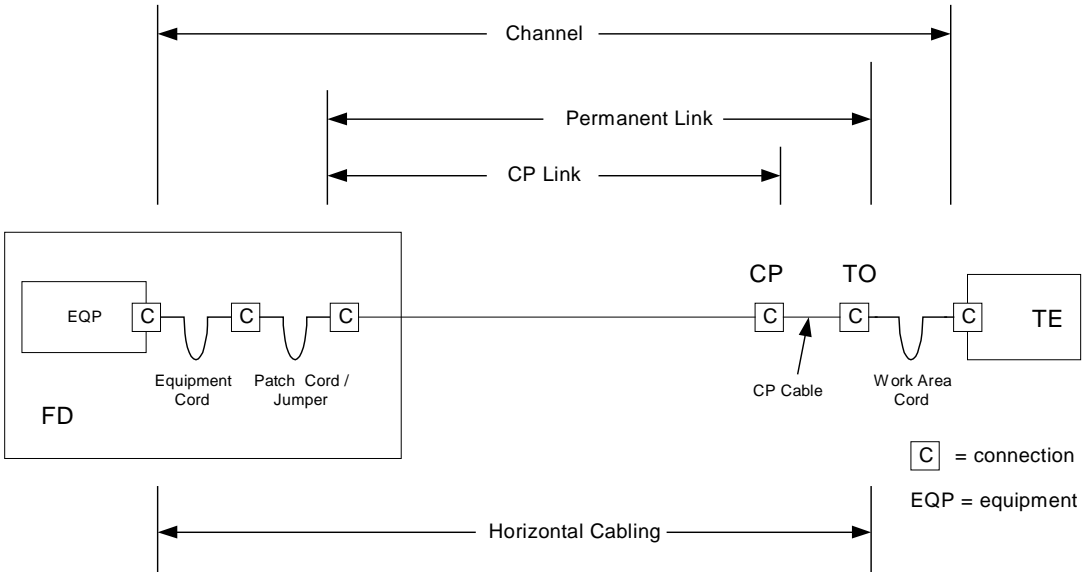


Figure 3: Horizontal cabling channel

New horizontal cabling installed shall be at a minimum Cat 6 4-pair 100ohm UTP balanced cable.

New UTP cable lengths shall not be less than fifteen (15) metres unless permitted by the SCS manufacturer and a passing test is achieved.

If extending existing cabling then patch panel to the CP shall be a minimum of fifteen (15) metres and CP to TO shall be a minimum of five (5) metres unless permitted by the SCS manufacturer and a passing test is achieved.

The maximum channel length is one hundred (100) metres for both Class D and Class E. Exception to this is only applicable where directly referenced in sections of this document or specific Ministry scoping documents.

6.3.1 Cable selection

All horizontal cable types shall comply with the relevant standards and shall be rated to equal the connecting hardware unless otherwise specified.

6.3.2 Telecommunication Outlets

Each telecommunication outlet (TO) shall incorporate a modular RJ45 socket designed for IDC termination and compliant with AS/NZS 3080.

Telecommunication outlets shall be equipped with unshuttered face plates. Where the TO is positioned on existing trunking, 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 should match power outlets in appearance and manufacture.

6.3.3 Balanced twisted pair cabling

The performance of balanced twisted pair cabling, in this standard, is referred to in terms of either its “Category” or “Class” and these terms are interchangeable. Irrespective of the term used the connecting plugs and sockets shall be an 8-way modular design.

The Ministry’s minimum standard for all new horizontal cabling is Cat 6 cable and connector components, installed and tested for Class-E performance.

6.3.3.1 Outdoor cabling

In the event that balanced cabling is used externally the cable shall meet the following requirements:

- a) For underground routes the cables shall be rated by the manufacturer for external use, moisture resistant, and placed in a conduit
- b) For aerial and overhead routes the cables shall be rated by the manufacturer for external use, moisture resistant, UV rated, and placed in a conduit
- c) The appropriate rated cable must be used for the outdoor application such that it will be warranted by the manufacturer for a period of not less than 20 years
- d) When gel filled cables are used, care must be taken to follow the manufacturer’s instructions with regard to termination on a patch panel.

Refer to AS/CA S008 and AS/CA S009 for more information.

6.3.4 Wiring sequence

All distribution frames, patch panels, telecommunications outlets shall be wired using the T568A pair assignments.

6.3.5 Untwist

The amount of untwisting in a pair shall be no greater than 13mm for Cat 5e cable and no greater than 6mm for Cat 6 cable.

6.3.6 Bend radius

For Cat 5e and Cat 6 cable, a bend radius of at least 25mm (4x the cable diameter) should be provided for hand cable placement. Installation bend radius must be at least 50mm.

6.3.7 Copper Terminations

The means of terminating balanced copper cabling shall be the modular 8-pin sockets (commonly known as RJ45) and plugs using the T568A arrangement.

The method of termination at the RJ45 sockets will be by Insulation Displacement Connection (IDC). RJ45 sockets will be fitted to 24-port 19" rack mount patch panels at the FD and to flush plates, selected to match other electrical fittings in style and colour, at the TO.

6.3.8 Existing cabling

There is no requirement to modify existing cabling and related systems that was 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 or to bring the installation up to the required Standard.

Any existing cabling being retained as part of a new installation that is not properly secured (for example, laying on the ground) shall be rectified – that is, supported to comply as much as possible with requirements pertaining to cable support detailed within this document.

6.3.9 Segregation

Cat 6 4-pair UTP cables shall be kept in separate bundles from the multi-pair voice or fibre cable.

6.3.10 Balanced cabling patch and work area cords

6.3.10.1 General

Patch cords and work area cords shall be:

- a) Constructed of an 8 wire, stranded Cat 6 cable terminated with RJ45 plug at both ends and complying with AS/NZ 3080
- b) Factory assembled, terminated and certified
- c) Fitted with moulded boots unless snagless patch cords are used.

Pin assignments and colour codes shall conform to the T568A arrangement in accordance with AS/NZS 3080.

6.3.10.2 Cat 6 UTP Work area cords

Work area cord lengths shall not exceed five (5) metres.

6.3.10.3 *Cat 6 UTP patch cords*

In no circumstances shall patch cord lengths exceed the distances set out in table 22 of AS/NZS 3080.

6.3.10.4 *Cord colour scheme*

There is no mandated colour scheme for patch and work area cords but a colour scheme which positively and uniquely identifies each application is a useful management aid. The following colour scheme shall be used in school installations:

- a) Grey for general work areas cords
- b) White for work area cords providing WAP connections and Power over Ethernet
- c) Blue for general patching
- d) Yellow for up-link connections
- e) Red for critical connection, for example file servers.

6.3.11 Transportable classrooms

Schools in New Zealand may utilise education transportable classrooms (also known as modular or relocatable classrooms), delivered to the site as a standalone unit or a cluster of units to provide a learning studio.

Unless it is the point of entry into the building, all cabling located underneath transportable classrooms shall not protrude below the floor joists to prevent cable damage if the building is relocated.

6.3.11.1 *Cabling - New transportable installations*

Consolidation points should not be used in new transportable installations, but in specific cases may be appropriate to provide ease of integration into a school network.

6.3.11.2 *Cabling - Current transportable installations*

Where existing cabling in current transportable classrooms is appropriate to reuse, consolidation points should be considered to meet the requirements of AS/NZS 3080. A consolidation point may be installed into an existing transportable classroom to maintain existing cable warranties.

Installation of the consolidation point should be made with consideration to allow future upgrade to a data cabinet. In all instances a consolidation point solution shall be approved in writing by the Ministry or its representatives.

7. EQUIPMENT SPACES

7.1 Equipment rooms

The Ministry recognises the following styles of equipment and plant rooms within its network and makes specific minimum performance and design requirements of each style of room.

- a) Entrance facility (EF)
- b) Equipment Room (ER)
- c) Telecommunications Rooms (TR)

7.2 Equipment room design

The designer shall:

- a) Be responsible to inform the architect and electrical engineer of these requirements and to do this early in the schematic design phase of the project; and
- b) Where these design requirements cannot be met, the designer shall advise Ministry and develop an alternative set of requirements for approval.

7.3 Entrance facility

An entrance point to a building or facility for both fibre optic and copper cabling, and the space made for cable transition (from external to internal grade cable) is referred to as an Entrance Facility (EF).

Most Ministry of Education schools do not utilise an EF. If they do, then the cable entry shall be constructed to ensure that water ingress and damage will not occur to Ministry property.

In addition:

- a) The EF shall not be used as a patching environment, cable types transition from external to internal in the EF by jointing or splicing
- b) External installers and facilities personnel are likely to need access to the EF therefore an EF shall not be collocated within an ER or TR which are secure environments.

7.3.1 Sizing

AS/NZS 3084 provides generic sizing information for commercial facilities. These sizing's may not be suitable for schools, therefore supporting documentation supporting a decision to deviate from AS/NZS 3084 shall be provided by the designer to the Ministry for approval.

In general:

- a) The TR shall be sized to match the functionality and size of the location
- b) The TR shall not be shared with electrical installations other than those necessary for telecommunications.

7.4 Equipment and telecommunications rooms

The telecommunications rooms are building distributors (BD) and floor distributors (FD) whose primary purpose is house equipment and the distribution of SCS cables, and shall generally be considered as telecommunications rooms.

The final size of the ER/TR shall be determined after developing the ER/TR design that accounts for all equipment footprints and incorporates all the defined clear working spaces.

The following process shall be followed:

- a) No clear working space requirements shall be eliminated or reduced. ER/TR layouts with inadequate clear working space for equipment are not acceptable
- b) Use the ER/TR “base size” from the above calculation including the required clear working spaces for all systems designated for the TR
- c) If the ER/TR door swings inward rather than outward, do not use the wall space behind the door swing for mounting panels, or equipment
- d) If additional space is required to achieve a compliant layout, adjust the length or width of the ER/TR, and if necessary, expand the number of square metres accordingly
- e) The TR shall have a minimum height from floor to ceiling of 2.4 metres without obstructions. A minimum headroom access of three hundred (300) mm shall be maintained above cable raceways.

The final size of the TR shall not be calculated until an acceptable equipment layout is developed based on the criteria listed above.

7.4.1 Location

Horizontal cable lengths have the potential to exceed ninety (90) metres between the patch panel and the telecommunications outlet in the work area, including the service slack requirements at both ends of the cable as identified in other sections of this document.

7.4.2 Security

In general, it should be necessary to pass at least two points of restriction to access equipment and server rooms. This can be generally achieved by using lockable doors to rooms housing equipment enclosures, and providing lockable equipment enclosures. Open racks in lockable equipment rooms accessible from staff-only areas may also be acceptable.

Where schools already have burglar alarms installed, server rooms shall be secured by electronic security systems (access control, intrusion detection alarms).

The TR shall have lockable doors as a minimum.

7.4.3 Lighting

The TR average lighting level measured at one (1) metre AFFL between cabinets should be 500 lux in the horizontal plane and 200 lux in the vertical plane. Light fittings shall be mounted at least 2.4 metres AFFL, unless otherwise specified.

7.4.4 Power supply

Core cabinets with total UPS input load of greater than 1.0kW should be provided with a 16A and 10A dual RUPO, each on a dedicated feed and supplied via individual 20Amp MCB's respectively.

The 16A MCB RUPO should be used to supply any Server UPS's.

The 10A RUPO supplying switching UPS's which feed the cabinet power distributors.

Small core cabinets with total input (UPS or not) less than 1.0kW require a 10Amp dual RUPO on a dedicated feed with 16A MCB. This feeds the enclosure power distributor.

The power outlet shall be located on the wall placed low down inside the enclosure, approx 150-200mm from the bottom edge of the cabinet.

For free standing enclosures, the power outlets shall be located on the wall either:

- a) 300mm above the floor behind the free standing enclosure; or
- b) 300mm above the floor inside the cabinet footprint.

7.5 Air conditioning and temperature control

Equipment in the ICT rooms and cupboards will generate heat. The heat created in this environment will, unless moderated, cause the air temperature to rise.

Servers and associated equipment operate reliably only within certain temperature and humidity ranges and may fail if operated outside of these specified ranges. The vendor may decline to honour the warranty if it can be established that the equipment was operated outside its specified environmental range.

Each equipment space shall be evaluated in regards to potential heat output and environmentally conditioned accordingly.

Advice should be sought from a suitably qualified person, but, as a guide, room temperature should be maintained between ten (10) and twenty eight (28) degrees Celsius.

Air conditioning units shall not be placed directly above a cabinet.

See APPENDIX F – AIR CONDITIONING AND TEMPERATURE CONTROL for more information.

7.6 Enclosures and racks

Communication enclosures are used to house and restrict access to cabling, active network components and other communications hardware. Enclosures may be free-standing or wall-mounted, and are designed for 19" equipment mounting.

Cabinets mounted side-on close to a wall (to conceal and contain vertical cable entry from above or below) shall not be secured to that wall.

Enclosures and racks shall not be placed next to windows or areas subject to direct sunlight (UV). In situations where this is unavoidable, the window shall be tinted, covered or blanked off.

All newly installed cabinets shall be no more than 60% loaded at time of first installation and provide a minimum of 0.9m clearance front and rear for adequate access.

7.6.1 Cable management

Racks shall be supplied with cable management panels to facilitate the support and organisation of patch cords between patch panels. For each 2RU of equipment in the rack there shall be a corresponding 1RU cable management panel which is deep enough to support 48 patch cords.

Rear cable support systems are also required to offer strain relief for cables entering the rear of the rack and patch panels.

7.6.2 Balanced cabling patch panels

Patch panels for balanced cabling shall be 24-way or 48-way modular socket (RJ45) with a port density of 24 ports per 1RU.

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

New cable management shall be from the same manufacturer providing the performance warranty.

7.6.3 Optical fibre patch panels

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

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

Patch panels shall be rack mountable, hinged or sliding, with eye safe front (including laser warning symbol) and integrated patch cord management. All new fibres installed shall be terminated within this enclosure using manufacturer-approved fusion splice pigtailed with LC connectors to maintain warranty (unless specified on the network upgrade design).

Terminated fibres shall be connected to LC connectors through couplers mounted on the faceplate of the optical fibre termination panels.

Hardware shall minimise potential eye hazards from optical sources.

7.6.4 Seismic bracing

All enclosures and racks shall be seismically braced to current New Zealand standards, refer to NZS 4219 for more information. Floor loading needs to be investigated to ensure cabinet integrity and safety.

Free standing cabinets shall be seismically braced and securely fixed to the floor. For wooden floors M12 threaded rod with flat washers on either side shall be used. For concrete floors M12 Dynabolts shall be used.

Floors must be able to sustain the maximum loading of a cabinet estimated to be 1000kg/m².

7.6.5 Free standing cabinets

To avoid thermal cross-contamination between multiple free standing cabinets bayed together, the internal cabinet panels should be left fitted with bushed cable entry holes provided top and bottom to allow cable reticulation between cabinets.

Free standing cabinets shall be provided with a 16 Amp and a 10 Amp dual RUPO each on a dedicated feed supplied via individual 20Amp MCB's respectively. The 16A MCB RUPO should be used to supply any Server UPS's. The 10Amp RUPO supplying switching UPS's which feed the cabinet power distributors. Surge protection is highly recommended.

The cabinets shall have the following as minimum requirements:

- a) Thirty seven (37) to forty five (45) rack units (RU) high
- b) Minimum six hundred (600) mm wide, to provide space for vertical cable management and up to one thousand (1000) mm deep to allow for possible future mounting of nine hundred (900) mm deep servers or UPS's
- c) Front rails located one hundred and fifty (150) mm from the front of the cabinet
- d) Provide an earth bonding terminal
- e) Fully lockable, including fully removable side panels
- f) Baying kit
- g) Perforated doors
- h) Top of cabinet cabling access - for cable chimneys and so on.
- i) RU labelling – front and rear
- j) Two full length cable trays for cable management
- k) A facility for levelling adjustment
- l) Power rail providing not less than five (5) outlets for 24RU enclosures and not less than 9 outlets for 37RU, 42RU or 45RU enclosures
- m) A minimum depth of 800mm.

7.6.6 Wall mounted enclosures

Wall mounted enclosures should be located to avoid injury and follow relevant Standards and OSH requirements.

Wall mounted cabinets should be provided with a 10 Amp dual RUPO on a dedicated feed supplied via a single 20 Amp MCB respectively.

Top of the enclosure should be no higher than two thousand (2000) mm AFFL and the bottom of the enclosure a minimum of five hundred (500) mm AFFL. If this requirement is unable to be met, then written approval from the school and the Ministry for an alternative installation shall be obtained prior to installation.

Designer and Installer note:

The servicing of cabinets that are installed outside the AFFL measurements outlined above may have future financial implications to the school, due to more stringent OSH requirements for working at heights.

Cabinets may only be mounted above a maximum vertical footprint of two metres when:

- a) This is required to mitigate a potential OSH hazard, for example the risk of staff or students being injured on the cabinet bottom edge or corners.
- b) Physical constraints such as permanently fixed building elements or services at otherwise suitable locations prevent the mounting of the cabinet beneath the two metre limit.

In cases where the top edge of the cabinet will exceed the upper maximum footprint of two metres, the following shall be carried out:

- c) A visible laminated sign of no less than A4 size, is to be fitted to the front bottom of the cabinet door. The sign shall state that access to the cabinet must be achieved using an appropriate sized ladder. For transparent cabinet doors, fix the label to the inside of the door to prevent removal.
- d) Where possible, plastic or rubber corner protectors must be fitted to minimise the risk of head injury.
- e) The cabinet must be documented within the school's OSH register indicating the cabinet identification, cabinet location and that an appropriately sized ladder must be used by suitable qualified personnel to access and service the cabinet.
- f) Striped hazard tape may also be considered for the bottom edge of the cabinet where this can be applied in a permanent neat manner.

In addition the wall mounted enclosures shall:

- g) Be twelve (12) RU minimum and twenty four (24) RU high maximum. When more space is required a floor mounted cabinet is preferred
- h) Include a swing frame which shall be a minimum of one hundred (100) mm deep and rear mounted to the cabinet
- i) Measure six hundred (600) mm wide by six hundred (600) mm deep, including the swing frame
- j) Provide an earth bonding terminal
- k) Be installed on a suitably sized AC grade plywood backboard which is attached to a minimum of two wall studs top and bottom
- l) Be vented top and bottom to allow for airflow

- m) Have a perforated door to allow for airflow
- n) Be fully lockable
- o) Have front rails set back at least one hundred (100) millimetre's from the open door
- p) Have a power rail providing not less than five (5) outlets.

7.6.7 Open frame racks

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 be:

- a) Mechanically secure and supported at the base and top
- b) Provided as 38RU or 45RU.

Open frame racks shall be fitted with:

- c) Horizontal and vertical cable tidy panels or loops, or both
- d) A vertical cable tray
- e) A power rail providing not less than five (5) outlets.

Open frame racks shall not be used to support heavy equipment – free-standing (4-post) enclosures shall be used for such equipment.

Open frame racks shall only be used in communications rooms where access is restricted by a locked door.

7.6.8 Enclosure maximum equipment load

Equipment enclosures shall be constructed to support the maximum equipment loads as follows:

- a) 12RU Cabinet Wall Mount – 30kg
- b) 18RU Cabinet Wall Mount – 45kg
- c) 24RU Cabinet Wall Mount – 46kg.

Consideration shall be given to load bearing capacity of the floor when selecting or specifying floor mounted enclosures. See 7.6.4.

Installer note:

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 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:

- a) *Provided with sufficient clearance for installation and maintenance activity*
- b) *Installed plumb and square without twists in the frames or variations in level between adjacent racks*
- c) *Be bonded to the protective earth system*

The vertical footprint for wall mount enclosures shall not extend above 2m or below 0.5m from the floor. Wall mount locations shall be selected to avoid risk of injury by walking past or rising from beneath the enclosure.

Enclosures shall not be mounted on wheels or be moveable to allow for access.

Equipment mounting rails at the front of the enclosure shall be set back so that doors may be closed without contacting equipment or connectors or distorting cable bends to ensure the minimum cable bend radius is maintained.

Enclosure cable entry

Cabling entering from the floor or ceiling space to 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 enclosure.

In the case of raised floors the vertical cable support system shall extend below the raised floor level.

In the case of above ceiling pathways the vertical cable system shall extend above the ceiling level.

The vertical cable system shall have a metal construction, colour and finish similar to the enclosure or interior building door. The vertical cable system includes two cable trays (power and data/voice).

8. WORK AREAS (WA)

8.1 Telecommunication outlets (TO)

TO's should be mounted at the same height and manner (vertically or horizontally) as existing outlets. If there are none, in office and administration areas they shall be mounted at 100mm above the desk or 300mm AFFL and, unless otherwise specified, mounted vertically.

The installer is responsible for informing the Ministry or its representative in writing (prior to completing any work) of any TO's scheduled for installation which do not have at least one GPO/RUPO installed near or scheduled for mounting adjacent to or within one (1) metre of the new outlet.

8.1.1 Positioning telecommunication outlets

Where workbenches are fixed to the wall, outlets may be installed above bench height. Where workbenches are positioned along a wall or benches have data distributed internally, a minimum of 800mm separation shall be maintained between the data outlets.

It is recommended that a dual TO should be installed top left or right of the whiteboard. This is to support installation of WAPs and projectors.

Terminal outlets shall be flush mounted wherever practicable. Mounting boxes, similar in style and colour to the flush plate, shall be used where flush mounting of communications outlets is not practicable.

Outlets shall be located to avoid being obscured and work area cords being damaged by furniture and office equipment, and feet.

The GPOs/RUPOs shall not be mounted in such a way that extension cords, multi boxes or power leads are required to cross access ways.

TOs and GPOs/RUPOs shall be mounted as close as possible to the areas requiring service.

All cable pairs at the telecommunication outlets and at the distribution panels shall be terminated.

8.2 Floor boxes

It is recommended that floor boxes should not be installed in schools.

If floor boxes are to be installed, they shall be constructed from durable material capable of withstanding a 150kg load and have approximate dimensions: 245 mm square with a minimum depth sufficient to fit a standard TO or GPO/RUPO wall plate and to maintain the bend radius and performance requirements for a Cat 6 cabling installation.

The mounting of the floor box shall be such that it is flush with the floor and does not present a hazard to any user. A floor box with a carpet insert shall be used to allow the floor box to blend into the surroundings.

Each floor box shall be able to accommodate a minimum of four GPOs/RUPOs and maximum of four TOs. To prevent debris or foreign objects from damaging the outlets or presenting a hazard to the user, the mounting of GPOs/RUPOs and TOs shall be such that they are not facing directly upwards.

The entry and exit of power and communications cables to and from the floor box shall be provisioned via separate entry and exit points with sufficient capacity to allow four work area patch cords and four power cords, with sufficient protection to prevent damage. The floor box entry holes through which horizontal data and power cabling is passed shall be bushed to prevent cables being damaged on metal edges.

Each new floor box shall be fed with a minimum of two 40 mm conduits when installed in a concrete slab. In order to ensure that circuits can be repaired, replaced and upgraded in future:

- a) There shall be no hard 90 degree corners used and all changes in direction will be made using sweeping bends
- b) No conduit shall be more than 50 % full at completion of project.

Earthing of floor boxes shall be carried out in accordance with the requirements of AS/NZS 3000.

8.3 Flush mounted faceplates

All TO's shall be flush mounted, where possible utilising the wall cavity. The TO shall be located so that, after removing the faceplate, a user can disconnect and replace the work area cable assembly.

The TO mounting support shall be suitably fire rated and protected if required, the slack or spare cable should be located at the next convenient access point.

The work-area cable shall be installed in a suitable location, to ensure it can be easily replaced.

8.4 Radiators

TOs and telecommunication trunking shall not be installed within 100mm of radiators in any direction.

9. *EARTHING AND TRANSIENT PROTECTION*

9.1 Earthing

A Telecommunications Reference Conductor (TRC) system performs a functional role only and shall not be used for protective earthing purposes. A TRC system is not generally required unless otherwise specified by design.

All equipment racks and cabinets, cable trays, and metal duct systems shall be earthed in accordance with AS/NZS 3000 to the building protective earth system.

Earth wires shall be used for the general earthing of metal structures (communications racks, catenary, cable tray, frames, and so on).

Connection to catenaries shall be by way of a brass or copper line tap.

Connections to cable tray or metal structures shall be via a suitably sized terminal lug, and serrated star washer, ensuring that any paint is scraped back to bare metal.

No more than 3 earth wires shall connect into any one (1) earth bar connection point.

Solder shall not be used as the primary connection method for earth connections.

9.2 Transient protection

Where available, applicable, and cost effective, transient protection equipment should be provided for protection of equipment connected to balanced copper outdoor cables where such equipment can be provided without compromising transmission performance.

9.3 Communications Earth System (CES)

A Communications Earth System (CES) performs a functional role and shall be compliant with the requirements in AS/NZS 3000.

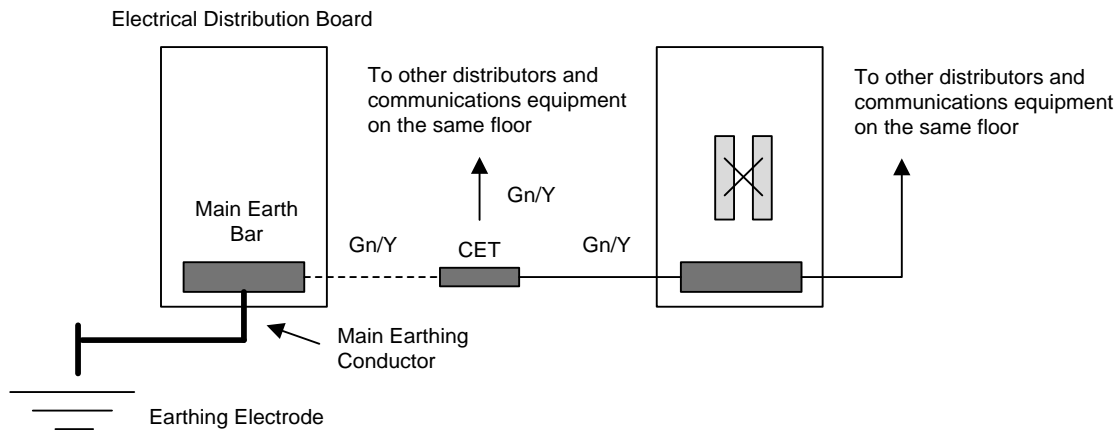


Figure 4: Communications earth system (CES)

A CES shall have a maximum earth resistance of 1Ω measured between the Communications Earth Terminal (CET) and any point on the system. The connection of the CES at the electrical distribution board (DB) shall be completed by a registered electrician.

All communications racks, cabinets, enclosures, catenary wires, cable tray, metallic IDC frames and so on shall be earthed as per AS/NZS 3000. The conductive resistance from any exposed metal element of the cabinet to the CET shall be less than 1Ω .

The main earthing conductor from the CET shall be terminated at the earth bar of the DB or main switch board. This work shall be completed by a registered electrician. The earth wire used for this connection shall be green/yellow, minimum size 6mm^2 , provided that the resistance does not exceed 0.5Ω .

The CES shall be tested in accordance with AS/NZS 3000. The installer shall provide a test certificate demonstrating the measured earth resistance from each rack to the CES which complies with the requirements of AS/NZS 3000.

10. ELECTRICAL

10.1 Electrical installation

The installation of all electrical products and equipment shall be installed to the manufacturer's guidelines to the correct and relevant regulations and Standards by a registered electrician.

10.2 Electrical segregation

Cable pathways and cable shall be installed to achieve a minimum 50mm physical separation between communications cabling and low voltage services as per AS/NZS 3000. Where this cannot be achieved, a durable plastic or earthed metal barrier shall be provided to achieve physical separation.

Where specific manufacturer requirements require greater separation than required by AS/NZS 3000, the greater distance shall be observed.

10.3 Guidance for installation of 10mA RCD protection in schools

RCD's are to be installed in accordance with the requirements of AS/NZS 3000.

10.3.1 Types of schools covered by 10mA RCD requirements

For avoidance of doubt the Ministry has interpreted the requirement to include:

Any rooms and areas that is normally accessible by pupils up to and including the educational age of year 8.

The regulation therefore does not apply to secondary schools, excepting for areas normally designated to accommodate year 8 or below pupils, as in some composite schools where areas are regularly shared.

10.3.2 Areas in schools that require 10mA RCD protection

Based on the standard and relating this to a typical school construction, the following areas would be considered as "areas normally accessible by children":

- a) Classrooms and areas where it is intended to teach children
- b) Workrooms where children are allowed to work
- c) Technology classrooms (except ICT suites)
- d) Music rooms

10.4 Communications overvoltage or surge protection

Users and equipment shall be protected from communication system overvoltage that may exist between the operational environment and the communications facilities in that environment. Examples of overvoltage may include the following:

- a) Contact with (alternating current) mains power through customer equipment failure or cabling faults
- b) Surge currents and induced voltages through power system faults or lightning
- c) Power feeding.

10.4.1 Surge protection devices (SPD) – Carrier or Voice grade services

Over voltage (lightning) protection modules shall be fitted to all IDC 10 pair modules and frames directly connected to the lead-in cable, on the customer's side of the network boundary, or other external copper cabling (for example, Inter-building tie cabling connections) that have or will have carrier or telephony present.

Refer to AS/NZS 1768 for further information and guidelines

11. WIRELESS ACCESS POINTS

11.1 Wireless LAN (WLAN) location

The design and installation of WLAN access points will generally be carried out by the school's ICT systems provider and is not considered to be a part of the Structured Cabling System.

The SCS installer will be responsible for the installation of the SCS required to support the Access Points.

A site survey will be undertaken by the ICT systems provider to determine the optimum mounting locations for the wireless access points.

All wireless systems shall be selected and installed to Ministry requirements.

11.2 Access points

The TO's that connect to the Wireless Access Points (WAP's) should be fixed to structural members of the building where possible, alternatively the use of manufacturer approved mounting fixtures can be used subject to approval.

The TO shall be permanently and clearly identified and labelled. It shall be installed in a readily accessible location.

Final placement of the WAP shall be achieved by the use of patch-cables. Patch-cables shall not be longer than 5m.

When a WAP is fitted on a ceiling tile, the TO may be installed above the ceiling tile as long as it can be readily accessed to allow the patch cables to be fitted.

12. TESTING AND CERTIFICATION

12.1 Testing, certification, and documentation

The installer shall provide test records for all cabling links installed under the Scope of Works using test equipment accepted and approved by the manufacturer of the single vendor solution as part of their performance warranty programme.

12.1.1 Permanent Link

The permanent link is the transmission path of an installed cabling subsystem including the connecting hardware at the ends of the installed cable.

In the horizontal cabling subsystem, the permanent link consists of the telecommunications outlet, the horizontal cable, an optional CP and the termination of the horizontal cable at the floor distributor. The permanent link includes the connections at the ends of the installed cabling.

12.1.2 Channel

The channel is the transmission path between equipment such as a LAN switch and the terminal equipment.

A typical channel would consist of the horizontal subsystem together with work area and equipment cords. For longer reach services the channel would be formed by the connection of two or more subsystems (including work area and equipment cords).

The performance of the channel excludes the connections at the application-specific equipment.

12.1.3 Horizontal cabling

For a new installation, the permanent link shall be a direct run, free of bridges, taps and splices.

12.1.4 Backbone cabling

For a new installation, the backbone cable shall be a direct run, free of bridges, taps and splices.

12.2 Copper

All links shall be tested using a Level-III (up to Class-E) or Level-IV (Class-E_A) cable test device. The tests shall include the full set of tests required to confirm performance to AS/NZS IEC 61935.1 and AS/NZS 3080 Permanent Link specification.

The tester shall:

- a) Have a certification of calibration current to within the tester manufacturer's specification
- b) Be running the latest version of the manufacturer's firmware.

Marginal Pass results (*PASS) are not acceptable in new installations and shall be rectified to ensure a clear Pass result.

Marginal Pass results (*PASS) are acceptable in existing installations.

Marginal Fail results (*FAIL) are not acceptable. Links with a Marginal Fail shall be rectified to ensure a clear Pass result.

Test results shall:

- a) Be downloaded to a database using the utility provided by the cable tester manufacturer
- b) Be supplied in the native format of the tester (for example, in .data, .fact, .low, .mdb format) and are to be provided on CDROM with a copy of the tester manufacturers software to read the file.

Frequency sweep test results and plot data shall be provided.

Text files and hard-copy of test results are not acceptable

12.3 Fibre

All terminated links shall be tested using a Power Source/Light Meter. An optical time-domain reflectometer may only be used as an additional test.

The tests shall include the full set of tests required to confirm performance to AS/NZS ISO/IEC 14763.3 and AS/NZS 3080 specification.

In addition:

- a) The tester shall have a certification of calibration current to within the tester manufacturer's specification
- b) Multimode fibre shall be testing using the 1 test cord reference method. Testing shall be undertaken in both directions at 850nm and 1300nm
- c) Single-mode fibre shall be tested using the 1 test cord reference method. Testing shall be undertaken in both directions at 1310nm and 1500nm
- d) Cable length shall be verified either by using an OTDR or it may be directly determined from the cable metre marking.

12.4 Warranty certification

Warranties and certification are a requirement for all new installations and for all MAC's in existing installations.

The project works are not considered complete until all warranty documentation is provided.

In all cases, manufacturer warranty certificates shall be accompanied by documentation that clearly defines which cabling components, backbone connections and TOs are covered by the warranty provided.

TOs and shall be referenced on a per cabinet basis detailing the number warranted e.g. AG1 001 - AG1 075.

For backbone links the two cabinets shall be referenced between which the link(s) is installed e.g. AG1 - BG1 BF 01-06.

The accredited installer shall be responsible for ensuring:

- a) The manufacturer provides a warranty covering all system components, system performance and labour for a period of not less than twenty (20) years
- b) The original certificate confirming warranty and an electronic copy is forwarded to the Ministry and their representatives. Hard copies of all warranties are required
- c) Electronic copies of test results and certificates required by the Ministry or its representatives are stored for future reference.

Electronic records shall:

- d) Be provided on WORM (Write-Once/Read-Many) CD/DVD media
- e) Include scanned copies of all warranties.

Electronic records shall not be provided on USB stick, flash-cards or other types of removable read/write media.

APPENDIX A – HERITAGE SITES

(Informative)

A1. General

Many older sites have objects such as buildings or trees that may have a heritage status, or be deemed as protected by a local or regional council.

Information is often not easy to find and can be located in different places depending on the local or regional council. In addition to the heritage status and council designation the site may also be recognised as an archaeological site or one of significant Maori heritage.

Often schools and SPAs are not aware themselves of heritage status of some of their buildings. If a building is suspected of heritage status the following information can be used to determine the any details

A2. Historical Sites

Historic sites are registered in the New Zealand Historic Places Trust (NZHPT). The NZHPT has a regulatory role regarding protected historic places, archaeological sites and sites of importance to Maori and may prosecute under the Historic Places Act 1993

There is likely to be historic significance if the school was built pre-1930s. The auditor will need to search the Historic Trust's register located at <http://www.historic.org.nz/theregister>.

It's useful to search the suburb or town to ensure that all historic places in the area are captured. Care needs to be taken when dealing with suspected historic places. Confirmation from the school or SPA is not sufficient and if heritage significance is suspected, confirmation in writing from the NZHPT must be received.

A3. Archaeological Sites

An archaeological site is defined in the Historic Places Act 1993 as any place associated with pre-1900 human activity. Any works that may affect an archaeological site must have written authority from the NZHPT before work begins.

Archaeological sites may be listed in the NZHPT register or, in a council district plan, or council database. If in doubt, contact the NZHPT at archaeologist@historic.org.nz AND the relevant council.

References to archaeological sites can be found at:
<http://www.historic.org.nz/protectingourheritage/archaeology/digitallibrary.aspx>

Within this page there is a catalogue (in Excel format) of reports that have been completed. There are many schools listed in this index including some new schools recently built. The relevant report can then be requested at no cost³.

A4. Maori Heritage

Māori heritage can be divided into the physical/tangible, natural and intangible. The NZHPT employs specialist Pouārahi (Māori Heritage Advisors) and other staff based in its offices in Kerikeri, Auckland, Tauranga, Christchurch and Wellington.

If the site (or locations within the site) is suspected as of Maori Heritage then contact the NZHPT for advice on proceeding further. This may be necessary around a Marae (particularly if it is a very old site), or if old carvings are present, and so on.

A5. Council Designation

The NZHPT does not manage all historic places and many of them are managed by the local or regional council.

Councils have responsibilities under various pieces of legislation for heritage management and protection, notably the Resource Management Act, Historic Places Act, Building Act and Local Government Act.

Sites may be protected under a council designation and each council and region has a difference database and method of accessing that database. Some councils only have these listed in their district plan and other councils may not have digital records or a searchable database.

³ This is only the list of reports; it is not necessarily the complete list of archaeological sites.

APPENDIX B – APPROVED ICT CONTRATORS LIST

(Normative)

B1. Approved ICT contractors list

The Ministry, schools, and their agents (such as project managers or designers) shall select suppliers from the Ministry's Approved ICT Contractors List for the following categories of ICT services and products:

- a) Structured cabling installation services
- b) Structured cabling product supply
- c) Wireless integration services.

This requirement is to be followed whether the ICT work is undertaken by any Ministry programme of work, or independently by a school.

Over time, the list is intended to be extended to include other types of ICT contractor.

The list of approved ICT contractors can be found at <http://www.minedu.govt.nz/>.

APPENDIX C – CABLING WORK PRACTICES

(Normative)

C1. General safe work practices and responsibilities

The installer shall ensure that all persons working on any Ministry school or facility that is under their control are protected from risk created by residual materials and workmanship associated with any construction works, including ensuring all areas are cleaned after fibre optic work to ensure no sharps or splinters of fibre remain, and the removal of all sharp and hazardous edges from fittings.

C2. Work areas

Work areas for terminating copper and fibre optic cables, and splicing optical fibre cables shall:

- a) Have adequate lighting and ventilation
- b) Be kept free of debris and other contaminants
- c) Ensure optical fibre off-cuts are removed from site and disposed of in an appropriate manner
- d) Ensure sharps and syringes used as part of optical fibre cabling are disposed of in an appropriate sharps container and removed from site
- e) Ensure a medical waste or clinical waste container will meet the requirements of a sharps container.

In addition:

- f) Sharps containers shall be disposed of by direct burial or incineration
- g) Sharps containers shall not be disposed of via domestic and standard industrial collection services
- h) Sharps containers shall be disposed of off-site separately from other site waste
- i) Chemical waste shall be removed from site and disposed of in an appropriate manner
- j) Washing of hands both before entering and after leaving the work area shall be required for all persons working on the site
- k) Food or beverages shall not be consumed or brought into the work area.

C3. Fibre Optic - General Health and Safety

The handling, installation, testing and operation of OFCS involve inherent risks that require safety precautions to be taken.

Silicate optical fibre is very thin and is usually made of pure glass. The process of scoring or cleaving this type of material results in small glass shards that is difficult to see and avoid if left lying around the work area.

Accidentally brushing a hand across a workbench can cause tiny shards to penetrate the skin and potentially migrate further into the body. These sharp particles can cause direct damage to the body and can also cause infections to set in.

If the glass enters the eye, damage to eyesight, including blindness, can occur. Unlike wood splinters, these glass splinters will not degrade inside your skin.

The signals transmitted over optical fibre commonly comprise high intensity infra-red light that is not visible to the human eye and can cause permanent tissue and eye damage when exposed to the human body.

For all medical emergencies related to optical fibre installation and operation, immediate medical attention shall be sought. As a minimum the following emergency equipment shall be available on site or within a mobile work space when work involving fibre optic cable termination or splicing is being undertaken:

- a) Eye wash
- b) Tweezers
- c) Magnifying device
- d) First aid kit.

C4. Fusion splicing

All fibre optic cables shall be fusion spliced.

Fusion splicing is an effective method of joining optical fibres. However, it entails the melting of glass by electric arcing, which occurs at temperatures exceeding 1700°C. The following precautions shall be observed:

- a) The use of fusion splicing in hazardous areas as defined in AS/NZS 2430.3.1 shall not be permitted without ensuring full compliance to all relevant standards and OSH requirements on site. Hazardous areas as defined in AS/NZS 2430.3.1 are all areas containing flammable gases or flammable liquids that may give off vapours and areas prone to potentially explosive dust clouds
- b) Gloves, or barrier cream, or both, shall be used
- c) Material safety data sheets (MSDS) shall be provided for all optical fibre materials involved and cable manufacturers' warning and recommendations shall be observed.

APPENDIX D – LABELLING CONVENTION

(Normative)

D1. Approved cabling systems products

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

Labels may be computer generated by the Brother labelling system or equivalent industrial standard (for example Dymo Industrial Labellers using vinyl tape). Use of felt tipped pen and the like is not acceptable for outlet front cover plates and the fronts of patch panels.

All horizontal cable ends at the rear of patch panels and behind TOs shall be labelled with permanent marker.

All fibre optic and copper backbone links shall be labelled on the cable using a permanent marker; the label shall clearly indicate the two cabinets or points between which the backbone link is installed. The label shall be applied as close as possible to the fibre tray or panel on which it terminates.

The method of designation shall be in accordance with AS/NZS 3085.1 and as described below.

For example, a backbone link between cabinet AG1 and BG1 when standing at cabinet AG1 shall be labelled: AG1-BG1. The same link when standing at cabinet BG1 shall be labelled: BG1-AG1.

All retained cabling shall be labelled in a consistent manner to the new installation.

D2. Enclosures

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

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

The labels shall be 100mm x 50mm, self-adhesive multi-layered laminate engraved with 15mm upper case lettering. The labels shall be located on the front centre of each rack or enclosure, near the top.

D3. Patch panels

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

- a) Horizontal ports shall be sequentially numbered using three digits. Sequences shall start at 001 for each enclosure
- b) Backbone balanced modular 8-pin ports shall be sequentially numbered using the letter B followed by two digits. Sequences shall start at B01 for each enclosure.
- c) Backbone optical fibre ports shall be sequentially numbered using the letter F followed by two digits. Sequences shall start at F01 for each enclosure.
- d) For all fibre optic and copper backbone links, a clearly visible label shall be applied to indicate the two cabinets or points between which the backbone link is installed. For fibre trays the label shall be placed on the front face of the tray.

For example a 6 core fibre backbone link between cabinet AG1 and BG1 when standing at cabinet AG1 shall be labelled: AG1-BG1 BF01-06. The same link when standing at cabinet BG1 shall be labelled: BG1-AG1 BF01-06.

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 top left of the respective vertical.

Ports shall be designated as Xmno where X indicates the vertical and mno indicates the pair number.

D4. Horizontal cabling

The horizontal wiring shall be labelled with the enclosure and patch panel port identifiers as specified above. For example A12-073 could signify horizontal port 73 from enclosure 2 on level 1 of the Administration building

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.

D5. Labelling of outlets

Each telecommunications outlet shall be labelled with the unique enclosure and patch panel port identifier. For example, the outlet designated A12-073 would be connected to patch socket 073 in cabinet A12.

The label shall be clearly visible and securely mounted with the identical label provided on the back plate using permanent marker pen.

D6. Underground ducts

All underground ducts at the point of entering or exiting a building are to be labelled "Warning: Underground Communications Duct" with an arrow pointing down.

The labels shall be 100mm x 50mm, Self-adhesive multi-layered laminate engraved with 10mm upper case lettering. They may also be riveted in place to offer additional mechanical bonding.

The labels shall be located on the front centre of each flashing, shroud or enclosure, approximately 300mm above the natural ground level.

D7. Restricted use general power outlets

RUPOs and DB's associated with the TO installation shall be labelled using an industrial grade labeller with vinyl tape face plates. Faceplates must be labelled at the front and on the back plate using permanent marker pen.

For newly installed power circuits: All RUPO's of the circuit shall be marked with the applicable circuit identification.

For new RUPO's looped off existing power circuits: All RUPO's and GPO's of the circuit, both new and existing, shall be marked with the applicable circuit identification.

All new RUPOs installed shall be labelled '**ICT use only - No RCD protection**' with the applicable circuit identification. Note that there will be a maximum of 6 x dual RUPO's per circuit.

All existing RUPO's that are paired with a new TO need not be labelled "**For ICT use only - No RCD protection**" but are retained as GPOs.

As-built drawings must have circuits marked on them, including the phase, circuit and distribution board they are fed from and an indication that it is RCD protected (if applicable). For example DB7-R17-RCD (Distribution Board 7, Red Phase, Circuit/Breaker 17, RCD Protected).

APPENDIX E – RECOMMENDED TYPICAL CLASSROOM LAYOUT FOR TELECOMMUNICATIONS OUTLETS

(Informative)

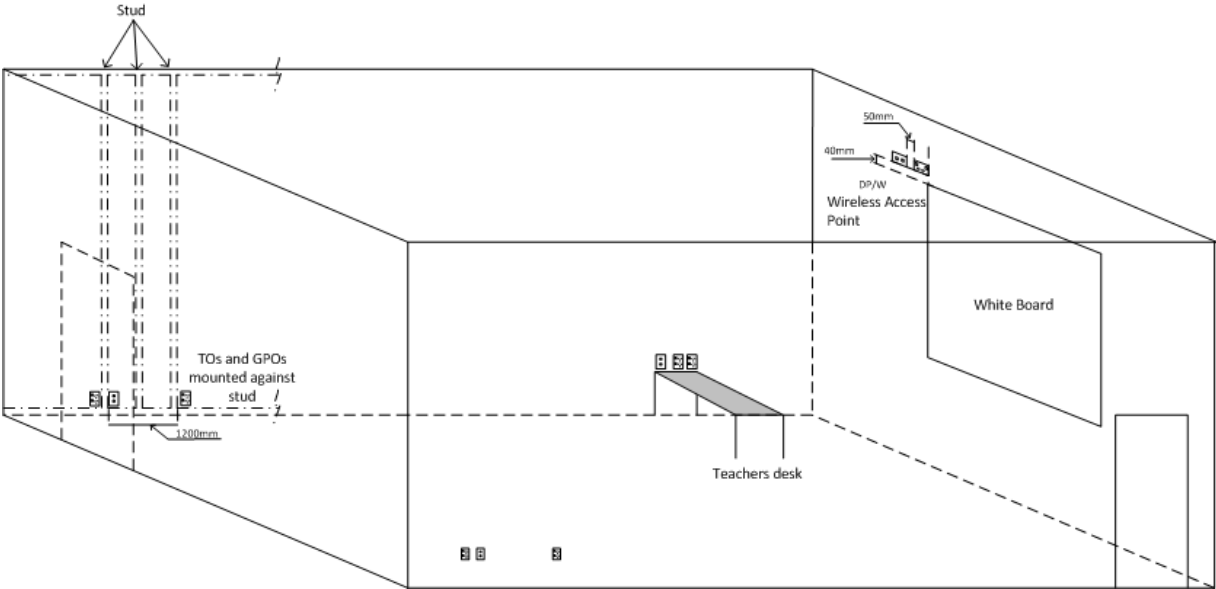


Figure E1: Typical full classroom layout

APPENDIX F – AIR CONDITIONING AND TEMPERATURE CONTROL

(Informative)

Computer and networking equipment is designed to operate within a fairly narrow temperature range. To ensure reliable operation and the longest possible life from components the temperature must be kept within the range specified by the manufacturer.

For new schools and schools undergoing extensive renovation the consulting engineers engaged on the project will be able to advise on the need for air conditioning to control the temperature in server rooms. For existing schools building a computer network and establishing a server room for the first time, and schools expanding an existing computer network, professional advice on the need for air conditioning might not be so readily available. The following may provide some guidance.

Servers and other electrical and electronic equipment in the server room generate heat. The heat created in the room, unless extracted, causes the air temperature to rise. Servers and associated equipment operate reliably only within certain temperature and humidity ranges and may fail if operated outside these specified ranges. Furthermore, the vendor may decline to honour the warranty if it can be established that the equipment was operated outside its specified environmental range.

General recommendations suggest that the temperature should not go below 10°C or above 28°C. In larger server rooms (more than 2 free standing cabinets) the air temperature must be controlled by air conditioning and professional advice shall be sought. Although this seems a wide range these are the extremes and it is far more common to aim at maintaining the room temperature around 20-21°C. To do this reliably, dual redundant air conditioning units are essential.

For a small school the operating and maintenance costs for an air conditioning unit may prove difficult to sustain and it may be possible to control the temperature of small server rooms by a simple, thermostatically controlled extractor fan.

Servers are typically specified to work in temperatures up to about 35°C but a margin for local hot spots must be allowed and 28°C is a maximum safe air temperature at the extractor fan. Cold temperatures are unlikely to cause problems in New Zealand if a thermostatic fan switch is used.

In principle it is easy to calculate the amount of cooling necessary for a server room by simply adding up the heat input and installing an appliance that can remove that much heat. In practice it is rather more complicated.

Assuming good insulation, limited windows and doors, or an internal building space, solar heat input to the server room may be ignored. Small server rooms will typically include the following heat generating equipment:

Equipment	Heat in Watts
Server	400
Ethernet switch x 2	100
UPS	100
Lighting (only when door is open)	
Total heat input	600

Given the specific heat capacity of air (1.2kJ/m³.°K) it can be shown that for each kW of heat to be extracted, 50m³ of air must be pumped through the room per minute per 1°C temperature rise between inlet and exhaust air.

For example, to remove 600W of energy, using air at an ambient temperature of 20°C and permitting the room temperature to rise to 28°C maximum, would require a fan to pump 3.75m³ (say 4m³) of air per minute. This is equivalent to a complete air change in a 2mx2mx2.4m server room every 2.5 minutes.

Volume of air $m^3 = 0.05 \times W \div ^\circ C$ where W is heat in Watts and °C is air temperature rise.

This simple calculation ignores impedance to air flow and assumes minimal pressure drop between air inlet and extractor fan. A 250mm wall fan venting directly to outside can pump between 8-12m³ per minute providing there is unrestricted airflow into the room.

The problem with forced ventilation becomes immediately obvious when higher ambient temperatures are encountered. At 26°C ambient air temperature, not uncommon in some regions, the amount of air to be pumped increases to 15m³ per minute.

The typical layout for a small server room might place an air inlet grill, of at least 1.5 times the fan area, low down on the door and the extractor fan high on opposite wall.

In summary, the choice of extractor fan is important and if high ambient temperatures are common in summer or room heat loads are likely to exceed 1kW, professional advice on air conditioning should be sought.

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