

Data and voice cabling standard

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1.2	October 2007	DCIS	Updated standards for optic fibre cabling and category 6A class EA UTP and category 6A class EA F/UTP. Added category 7 specifications.
1.3	November 2009	DCIS	Minor change to standards for comms room specification including cooling requirements. Minor changes to overview page to highlight that Cat 7 cabling standard is to be used for all NTG greenfield sites.
1.4	July 2012	DCIS	Complete review of the entire document to include the latest Australian standards, update requirements and correct minor omissions.
2.0	February 2013	DCIS	Updated department names and changed version from 1.x to 2.x as July 2012 was a major update. Minor grammar corrections throughout document. Updated cabinet height to 2.2m. Clarified power rail requirements for equipment cabinets.
3.0	January 2016	DCIS	Review to highlight category 6A class EA cabling standard as the initial standard for NTG installations .Update to include current trends. Included underground cabling, UPS, communication room labelling, and communication cabinets. Expanded the standard to include design requirements. Distributed to agencies for comment.

Change history			
3.1	March 2016	DCIS	Revised the document based on agency comments on v 3.0.
4.0	April 2016	DCIS	Approved by ICT Leadership Group.
4.1	May 2016	DCIS	Minor editorial changes
4.2	15 September 2016	DCIS	Document name change, and minor editing to reflect name change.
4.3	28 November 2016	DCIS	Updates to labelling, minimum size of wall mounted communications cabinets, securing of communication cabinets to floors, and communications room flooring.
5.0	19 June 2018	DCIS	Cat 6A F/UTP as minimum standard. Updates to fly leads and patch leads distribution, wall mounted cabinet specifications and layout. Including some minor editorial changes.
5.1	28 August 2019	DCIS	Editorial changes. Standards update. Review labelling. New section added for wall mounts. New section added for workstations. Section 3.4 Entrance Facility deleted. Cat 7 Section incorporated in main specification. Not published.
5.2	27may 2020	DCIS	Changed cabling standard from Cat 6A F/UTP to Cat 6A U/FTP.

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1 Introduction

Important: It is essential that the Department of Corporate and Information Services (DCIS) Information and Communication Technology (ICT) Project Management Office be engaged at the earliest opportunity by design staff, when considering projects that involve network infrastructure, particularly ICT cabling. Specialist advice and direction will be provided with regard to the appropriate infrastructure, in the design and construction phases of the project, to ensure that the standards are adhered to, and that the project is delivered in accordance with the recommended standards and procedures.

The Australian and international standards that apply to this document are listed in the clause entitled **Standards**, and will be enforced. This document is a supplement to those standards.

All design documentation on Greenfield sites (new buildings), and significant renovations, must be presented to the DCIS ICT Project Management Office for review prior to going to tender.

It should be noted that some Northern Territory Government (NTG) agencies may have specific requirements related to some sites including remote sites. It is recommended that contractors engage NTG agency ICT staff or the assigned NTG Project Manager prior to commencing work.

1.1 Overview

The following table displays the NTG accepted cable categories and the recognised bandwidth for each of those categories.

Bandwidth	Category	Class
1mHz to 500mHz	Category 6A	Class EA
1mHz to 1000mHz	Category 7A	Class FA

Category 5e class D, category 6 class E, category 6A UTP, and category 7 class F, have been **discontinued** for use by the NTG, and are not to be used on any NTG structured cabling projects unless otherwise approved the DCIS ICT Project Management Office.

The Northern Territory Government minimum standard is category 6A class EA U/FTP and category 7A class FA. for use on selected high bandwidth sites.

Primarily, and dependent upon direction from the DCIS ICT Project Management Office, cabling installed for the NTG should be as follows:

Category 6A class EA U/FTP – Category 6A Class EA U/FTP shall be the minimum NTG cabling standard. Unshielded Foiled Twisted Pair (U/FTP) reduces Electromagnetic Interference (EMI), and has a greater ability to dissipate heat generated by PoE and PoE plus (PoE+).

Minimum manufacturer's warranty is 20 years.

The DCIS ICT Project Management Office may consider approving the use of Category 6A Class EA F/UTP as an option to Category 6A Class EA U/FTP, only after reviewing a written application detailing the circumstances for the substitution.

Category 7A class FA (S/FTP) – optional for Greenfield installations or upgrades to existing legacy sites.

Category 7A class FA is a fully screened and shielded cable, and is capable of frequencies of up to, and beyond, 1200mHz making it uniquely able to support all channels of CATV at 862mHz

Category 7A class FA is currently rated for 10 Gbps data transmission, because of the extremely high frequency possible with this class of cable, it is expected that the data transmission rates will increase over time with hardware advancement. An interim 40 Gbps standard has been proposed.

Another feature of the category 7A class FA cabling system is the ability to use and manage individual pairs of the cable for different applications. Typically one category 7A class FA 100mHz workstation outlet is equivalent to two category 6A class EA 100mHz workstation outlets.

Additionally, due to the unique ability of category 7A class FA to carry up to four circuits over one cable, the overall cost benefit between category 6A class EA and category 7A class FA may be in the order of 20%.

Category 7A class FA S/FTP cabling is best terminated using a TERA style connector which makes use of shared pair technology allowing the cable to maximise use of all four pairs in the cable. TERA style patch leads will be required to enable cross patching to Ethernet switch ports and workstations network interface cards.

- **Laser optimised (OM3) laser optimised multimode optical fibre (MMOF)** – For upgrades to legacy sites.

OM3 laser optimised multimode optical fibre is capable of supporting 10 Gbps up to a distance of **300m** and has a bandwidth rating of 2000mHz

- **Laser optimised (OM4) multi- mode optical fibre (MMOF)** – For all new installations and upgrades to legacy sites.

OM4 laser optimised multi-mode optical fibre is capable of supporting 10 Gbps up to a distance of **550m** and is best suited in core backbone applications.

- **Single-mode (OS2) optical fibre (SMOF)** – For Greenfield installations and upgrades to legacy sites.

OS2 is capable of supporting 10 Gbps up to a distance of 80 kms and is best suited for services a great distance apart.

Existing OM1 and OM2 multi-mode fibre is capable of 100mbps to 1 Gbps. OM1 and OM2 optical fibre is not to be used for new NTG installations or upgrades.

Wireless networking should be considered where possible. Refer to the wireless networking section in this document.

2 Standard

This document describes the standards and practices to be followed in the supply, installation, documentation and testing of data and voice cabling technology used to support the data and voice communications services currently in use within the NTG.

2.1 Introduction

2.1.1 General approach

Note: For the purpose of this document, where an Australian, an Australian/New Zealand, or International standard is referred to, the intention is that the latest addendum or edition, of that standard be used, i.e. **AS/NZS 11801.1:2019** will be referred to as AS/NZS 11801 in this document.

It will be the responsibility of those responding to tenders, to ensure they are referencing the latest versions of the relevant Standards.

Greenfield sites are defined as buildings, sites or floors where the NTG has no existing presence with respect to communications infrastructure (cabling, LAN or WAN).

This specification covers the standard cabling requirements for the NTG Local Area Networks (and other services) utilising category 6A class EA and 7A shielded twisted pair, and multi-mode optical fibre cables.

Category 7A class FA may be selected for specific infrastructure upgrades and Greenfield installations. All category 7A class FA cabling installations for the NTG must conform to AS/NZS 11801.

Primarily, and dependent upon direction from the DCIS ICT Project Management Office, cabling installed for the NTG should be as follows:

- **Category 6A class EA U/FTP** – The minimum standard to be used. RJ45 connectors are used with category 6A class EA U/FTP.
- **Category 7A class FA (S/FTP)** – **optional** for Greenfield installations, or upgrades at specified sites which may have particular requirements. TERA style shared pair technology connectors are used with category 7A class FA S/FTP. The ICT Project Management Office will advise when category 7A class FA is to be utilised.
- **OM3 multimode optical fibre (-MMOF)** – For upgrades at specified sites. LC connectors are used for OM3 fibre terminations.
- **OM4 multi- mode optical fibre (MMOF)** – For Greenfield installations or upgrades at specified sites. LC connectors are used for OM4 fibre terminations.
- **Single- mode optical fibre (SMOF)** – For Greenfield installations or upgrades at very specific sites where distance is a factor. LC connectors are used for OS2 fibre terminations.

In all cases, installation of category 6A class EA U/FTP, category 7A class FA S/FTP multi-mode, and single-mode optical fibre, shall meet or exceed the national and international standards applicable to each type.

Structured cabling installations carried out for the NTG will be subject to rigorous quality assurance inspections in order to ensure that correct installation practises are maintained at all times.

2.1.2 Supported systems

The cabling system shall support:

- analogue and digital voice applications
- data
- local area networks (LAN)
- PoE and PoE plus.
- video and low voltage devices for building controls
- management of the common cabling platform.

The systems that shall be supported include, but are not limited to:

- **Data processing** – Mainframe access, client-server, enterprise server, messaging systems and electronic mail, common document utilisation, client database, etc.
- **Data communications** – ISDN, Ethernet (10 Base-T, 100 Base-T, 1000 Base-T, 1000 Base-TX and 10 GBase-T).
- **Voice applications** – Voice over IP (VoIP) applications are used throughout NTG.
- **Video** – Analogue video, digital video and video conferencing. Additionally CATV can be carried over category 7A class FA.
- **Building services** – Heating ventilation and air conditioning (HVAC) monitoring and control, low voltage devices (equipment sensors, etc.), wall clocks, security, energy monitoring and control, lighting, motion sensors, public address, modular wall systems and paging systems.

2.1.3 Site requirements

Each site may have specific individual requirements that may require a customised solution, however in most cases the layout of structured cabling within NTG owned or leased buildings will conform to a general standard.

The DCIS ICT Project Management Office is able to provide advice on site specific solutions.

Typically, horizontal cabling to the desktop will be either category 6A class EA or category 7A class FA, and the vertical backbone cabling for Greenfield sites will be OM4 multi-mode optic fibre.

Given approval by the DCIS ICT Project Management Office, existing category 3 voice cabling may be re-used where suitable, however where a building is being renovated or upgraded, voice services will be provided by the specified data cable.

Each floor will have a floor distributor (communications room), with an equipment cabinet with patch panels for horizontal and vertical cabling. On floors where there are only a small number of users, a wall or floor mount cabinet may suffice as a floor distributor after written application for approval from the DCIS ICT Project Management Office has been given. Please note that there are minimum size requirements for all cabinets – refer to section titled '[communications cabinets](#)'.

The horizontal cabling topology shall be in the form of a star, with the centre of the star being the floor distributor. For the larger sites multiple star configurations may be interconnected in a tree of stars or meshed network.

Single floor distributor are to be centrally located in a floor to ensure that cable runs are as short as possible. This is to ensure that future increases in network speeds are not impacted by cable runs close to the existing 90m standard. Where this is not possible two or more floor distributors should be considered.

Unless otherwise specified by the DCIS ICT Project Management Office, category 6A class EA cable terminations will use RJ45 connectors, and category 7A class FA terminations will be TERA style connectors. Sequencing shall conform to the EIA/TIA 568A standard.

Catenary cable, and wire mesh support systems, will be used to support cabling in the ceiling space.

Cabling will not be supported by the use of ceiling hangers, or be allowed to rest on the suspended ceilings. Specific details of catenary and tray system requirements are included in the horizontal cabling section of this document.

2.1.4 Contractor requirements

The cabling contractor must:

- possess the applicable open cabling registration under the Australian Communications and Media Authority (ACMA)
- follow telecommunication cabling provider rules (CPRs)
- comply with the Australian standard AS/CA S009 – Installation requirements for customer cabling (wiring rules).

It is mandatory for the cabling contractor to be a cable manufacturer's certified installer for that type of cabling they are installing, and to be part of the cable manufacturer's ongoing training program.

Evidence of manufacturer's certification is to be provided before commencement of any cabling work.

The manufacturer's warranty is to be provided at the completion of works.

The NTG has a Panel Contract for one off, and minor cabling work. The NTG Data and Voice Cabling Standard must be observed when doing Panel Contract work.

The cabling contractor must ensure that a minimum of 50% of the installation staff on site at any time throughout the installation must be certified by the specified cabling manufacturer. Cabling contractor must comply at all times with all the relevant standards and in particular the applicable technical standards.

The cabling contractor shall:

- provide all cabling materials and services for the installation of the cabling system, including ducting (where required)
- site and fix the equipment cabinet in its final position
- be responsible for the provision of patch panels and wiring management components to be installed in the cabinets.

All installed cabling systems shall be fully certified, and warranted for a minimum of 20 years by the termination equipment, and cable manufacturers. The cabling contractor must be part of the manufacturer's installers certification program to achieve the warranty. This warranty should at least include parts and labour.

On completion of the installation, the contractor shall supply the following:

- cable and optical fibre test results in soft copy
- patch panel continuity test results
- marked up floor plans showing outlet numbers and locations, floor distributors, and risers
- consolidation point plans and specifications (if applicable)
- manufacturer's warranty certification
- certification that the cabling installation meets, or exceeds, the minimum specified standard.

2.1.5 Required installer training

The installer shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice, and imaging network systems.

The installer shall at a minimum possess the following:

- personnel trained and certified in the design of the manufacturer's cabling system
- personnel trained and certified to install the manufacturer's cabling system
- the designer and installer shall show proof of current certification to the design and installation of the manufacturer's cabling system
- provide references detailing past successful completion of the type(s) of installations provided in this specification
- personnel trained and certified in cat 6A U/FTP and 7A S/FTP termination and testing techniques
- personnel must have experience in the use of approved testing equipment
- personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.

2.1.6 NTG Project Manager

With most projects, an NTG Project Manager will be assigned to the project. That person will be the contractor's point of contact and all queries relating to the construction and fit out should be directed to that person.

2.1.7 ICT Project Manager

An ICT Project Manager will be assigned to the project and all queries relating to this specification should be directed to that person through the NTG Project Manager.

2.1.8 Technical contact

All technical queries relating to this specification should be directed to the DCIS ICT project Management Office through the NTG Project Manager.

2.1.9 Site inspection

Site inspections should be arranged by contacting the NTG Project Manager or their nominated representative.

2.2 General requirements

2.2.1 General

The cabling system to be installed shall consist of horizontal cabling between telecommunication outlets in the work area and a patch panel mounted in a floor distributor. If there is more than one floor distributor, optical fibre will be used to connect the floor distributors.

All outlets and patch panels will be numbered, labelled and documented.

The horizontal cabling system will be terminated in the patch panel and the appropriate patch leads will be used to connect horizontal data services to active equipment or voice ties.

In the case of analogue voice facilities where category 6A class EA, or category 7A class FA, is used to provide horizontal connectivity, the patch cables will be used to connect horizontal cabling to voice ties terminated in the patch panels.

2.2.2 Campus or Inter-building pathways

A campus, or inter-building, network is defined as is a network of multiple interconnected local area networks (LAN) in a limited geographical area that are connected to a corporate, or government LAN via a single gateway, called a Campus Distributor.

On a campus, such as a university, hospital or police complex, the main building distributor that houses the core may also be the campus network distributor. Additional buildings shall be connected to the campus core building via a minimum of 12 core OS2 Single Mode Optical Fibre SMOF.

Campus / inter-building pathways must conform to the following:

- pits and underground conduit system is preferred, with pits to be placed at the entry point of each building
- underground conduit to be a minimum of 50mm
- a draw wire is to be installed in all conduits
- provide for 100% expansion.

Campus / inter-building backbone must conform to the following:

- Be minimum 12 core OS2 Single Mode Optical Fibre (SMOF).
- Be a single segment continuous without joins or splices.
- Be terminated at both ends with LC type connectors in a FOBOT at the top of the communications cabinet in each building.
- Do not loop through one building to another (daisy chain). Each building in the campus must have an individual connection to the Campus Distributor.

2.2.3 Building distributors and floor distributors

Buildings where NTG staff reside, that require ICT infrastructure, will have a dedicated building distributor (building core), or in the case of a multilevel site, a minimum of one (1) floor distributor on each floor in addition to the building distributor.

In a campus environment the entry point Building Distributor will also become the Campus Distributor.

Building and floor distributors (excepting major PABX installations) may house one or more communications cabinets. The cabinet is the transition point between the backbone and horizontal distribution pathways. It houses active equipment, cable termination and associated cross connection cabling.

Typically, small sites with less than 10 staff may only have a dedicated communications area with a floor mounted equipment cabinet. It is the NTG preference that all cabinets be floor mounted where possible. If it is intended to install a wall mounted cabinet then the agency ICT staff, or appointed NTG Project Manager, should be consulted. Note there are minimum size requirements for all cabinets – refer to section titled '[communications cabinets](#)'.

Subject to maximum cabling distance limits, medium sized sites with less than 50 staff will have at least one (1) dedicated building distributor (Core room), where all structured cabling, LAN and WAN equipment and telephony infrastructure is to be located.

Large sites with greater than 50 staff, may have a requirement for multiple floor distributors, depending on the physical site characteristics e.g. multiple floors or buildings or horizontal distances greater than 90m within a building.

Where possible, in multi-story buildings, building distributors (Core room) shall incorporate solid walls from the floor, to the underside of the floor above, and be left open without the use of false or hanging ceilings.

Every effort should be made to limit dust and fibre pollution when moving ceiling tiles in single level buildings where there is no solid level cover above the building distributor.

Floor distributor locations and characteristics are subject to a number of constraints:

2.2.3.1 Location

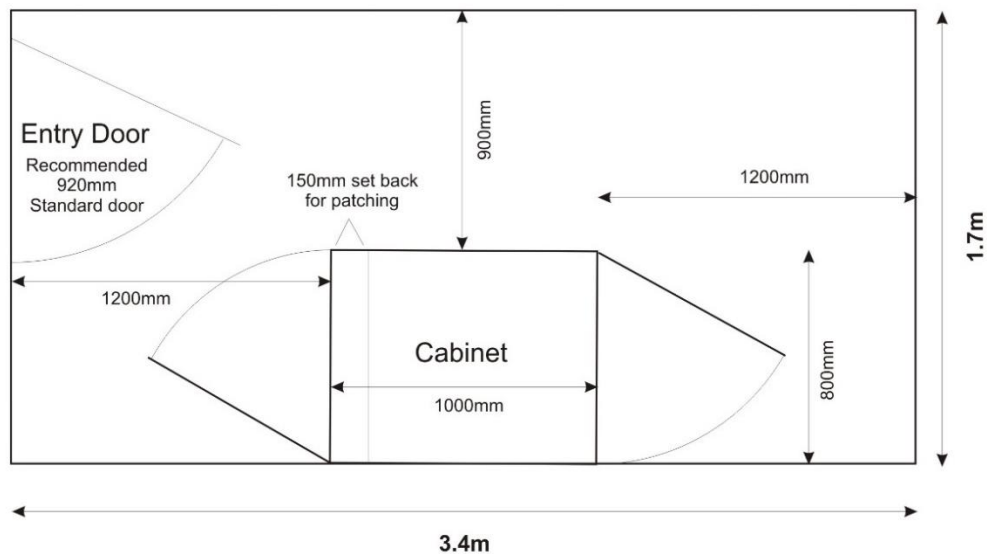
- There must be a cabinet location within 90m fixed cable length of all current and potential network outlets.
- The cabinet must be convenient for connection to the building backbone cabling i.e. adjacent or very near to a vertical riser.
- It must be accessible by trolley and provide reasonable space within or outside the area to unload and manoeuvre equipment.
- It must be accessible by NTG service provider, contractor and NTG ICT staff 24 hours per day, seven days per week, and be positioned directly off a common area, e.g. corridor.
- Cabinets, once installed, cannot be moved without consideration given to re-cabling the entire area (floor or even building). The location must be in an area not subject to any planned reconstruction.

2.2.3.2 Prohibited locations

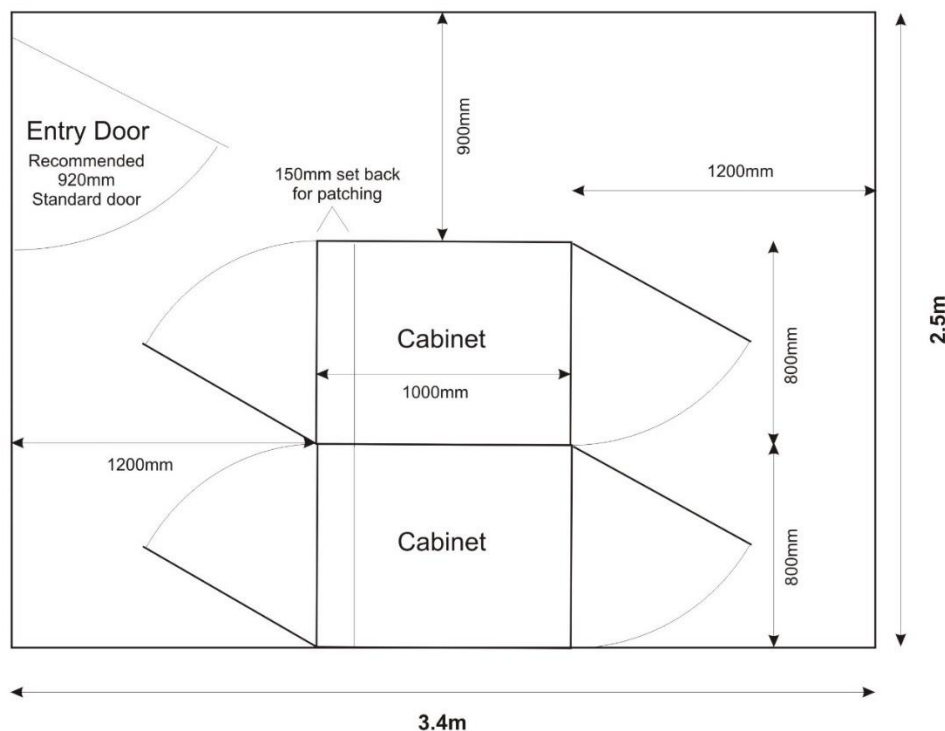
- In ablution or toilet facilities, boiler, plant, machine rooms, or in areas subject to corrosive fumes or fluids, or excessive Electro Magnetic Interference (EMI).
- In fire escape stairways.
- Near automatic sprinklers, unless cabinet is protected from water.
- In any area that is subject to flooding.
- Within a cupboard containing a fire hose reel.
- In a cupboard with no ventilation.

2.2.3.3 Size and inclusions

- Building and floor distribution rooms will be sized by method of calculation.
- There shall be 1.2m clear space to the front and rear of the cabinet and 900mm clear space on each side in a single cabinet situation.
- Where multiple cabinets are installed they may be placed side by side but must maintain the same clearances front and rear and to the outside of the nesting as for a single cabinet above.
- Written approval to install a cabinet with one side adjacent to a wall must be made to the DCIS ICT Project Management Office, or agency ICT staff. This application must include a proposed room layout.



Example of a single cabinet layout



Example of multiple cabinet layout

- The space should not be shared with electrical installations such as high voltage distribution boards unless there is a minimum of 1m separation, and comply with AS3000. Only electrical installations that provide power to the cabinet will be allowed. Any other unrelated service (e.g. plumbing) shall require written application to the DCIS ICT Project Manager for approval.
- Adequate separation between power and data cabling should be maintained at all times.
- Unless otherwise approved, a dedicated 15 amp power outlet with threaded collar at the socket is to be provided, mounted externally adjacent to each cabinet, and suspended from the ceiling on a pendant mount. In the case of a wall mounted cabinet a dual 10 amp power outlet is to be installed on the wall alongside the cabinet.
- Floor walls and ceilings should be finished to eliminate dust.
- The floor must be level.
- All penetrations are to be sealed as per fire regulations. Provide documentation to certify all penetrations comply.
- Provision should be considered for a security camera to be installed in the room; this will include data cabling to the designated location.
- Pouring concrete around cables is not suitable as the water content may damage the cables and will void the cabling warranty. Cabling passing through concrete must be run through conduit cast in the concrete. Provide conduit of sufficient internal diameter to allow for 50% additional cabling to be run through the conduit.
- Lighting adequate to enable detailed work within the cabinet. A ceiling lighting switched is required within the room, plus emergency lighting in the event of building power failure.
- Building distributors require 24 x 7 air-conditioning, and in some cases floor distributors may also require 24 x 7 air conditioning. It is recommended that contractors consult with NTG ICT staff or the ICT Project Manager to determine requirements.
- If a separate air conditioning system is required then this needs to be provided with a dedicated power circuit. In some situations it may be necessary to protect and support the air conditioning system by UPS.
- Building distributor and floor distributor rooms must have anti-static flooring, not carpeted, and ideally have an aspirated smoke detector system installed. All walls / roof are to be sealed with paint or other sealant type substance that minimises cement or concrete dust being introduced to the room.
- Where building distributor and floor distributors have windows that are in direct sunlight these windows are to be blacked out.
- Security access control to the room.
- A fire management system shall be incorporated into the Building Distributor, and should have an automatic fire detection and fire alarm system that complies to current NT fire regulations. Sprinklers are not to be located directly above the communications cabinets. A portable carbon dioxide, or a halogenated agent type, fire extinguisher shall be provided to protect electronic equipment. A sign shall be located adjacent to the extinguisher and shall plainly indicate the type of fire for which it is intended.
- An access door sized to ensure equipment installation, 920 mm is recommended.
- Each building distributor and floor distributor must have a dedicated building earth cable installed in the room on an appropriately sized earth bar. All earthing conductors used shall have green / yellow insulation, and comply with the requirements of Australian standards – AS/CA S009.

Building distributor and floor distributor sizing is dependent on:

- the size of the site, or the number of staff at the site
- quantity of structured cabling
- quantity of cabinets to be installed
- quantity of ICT equipment to be installed and
- any agency specific ICT equipment e.g. BAS Servers to be installed.

Refer to AS/NZS 3084 for guidelines on sizing.

2.2.3.4 General

Communication cabinets are to be floor mounted unless otherwise approved by the ICT Project Management Office.

Cabinets must conform to the following:

- supplied by a recognised, reputable manufacturer with in-house warranty
- a minimum of 45 RU 1000mm in depth and 800mm in width, unless otherwise directed, to ensure NTG equipment can be installed correctly
- a 150mm minimum clearance between the face of the patch panels and the inside of the closed door
- where a smaller size communications cabinet has been approved, a minimum depth between the rails of 600mm is required, and is in addition to the clearance of 150mm from the face of the patch panels to the inside of the closed door
- secured to the floor to prevent tipping (i.e. bolted to floor), unless otherwise approved by the ICT Project Management Office
- supplied so that the front and back of the cabinet shall have vented, lockable doors, and provision for fans. Written application for wire mesh doors front and rear can be made to the ICT Project Management Office for approval.
- fitted with side panels attached to any accessible side. It is recommended that if two cabinets are joined the internal side panels are to be left off. Any side against a wall is not required to have a panel attached as long as that cabinet is fixed.
- effectively earthed as per AS/CA S009
- a minimum of a 10 way 15 amp 240V rated power rail will be fitted internally including an isolating switch on the incoming supply, and a terminal block for connection of the supply conductors. Unless otherwise approved, the power rail will connect to the incoming supply through a soft wired captive plug/socket arrangement at the top of the cabinet enabling isolation of the equipment cabinet in the event the cabinet has to be removed or relocated. Unless otherwise directed, lacing bars or a trough must be provided to support and dress where the cables will be fitted.
- a forced air ventilation unit must be supplied with the cabinet.

Horizontal cable management is to be the “bolt in” style, not “press in”.

- fixed to the floor. Written application for approval to install a cabinet on castors to enable the cabinet to be moved may be made to the ICT Project Management Office. If permission is granted, sufficient cable slack shall be provided to allow the cabinet to move out a maximum

of 1.2m. The castor wheels shall be capable of supporting 100 kg weight in addition to the weight of the cabinet. Once the cabinet is in place it shall be fixed to the floor or wall to provide cabinet stability.

- Pre-assembled. In the case where cabinets are delivered in flat pack form, the contractor shall assemble them in accordance with the manufacturer instructions.
- Grommets, bushing, or edging strip are to be fixed in cut outs in the cabinet to protect cabling from sharp edges.

2.2.3.5 Wall mount cabinets

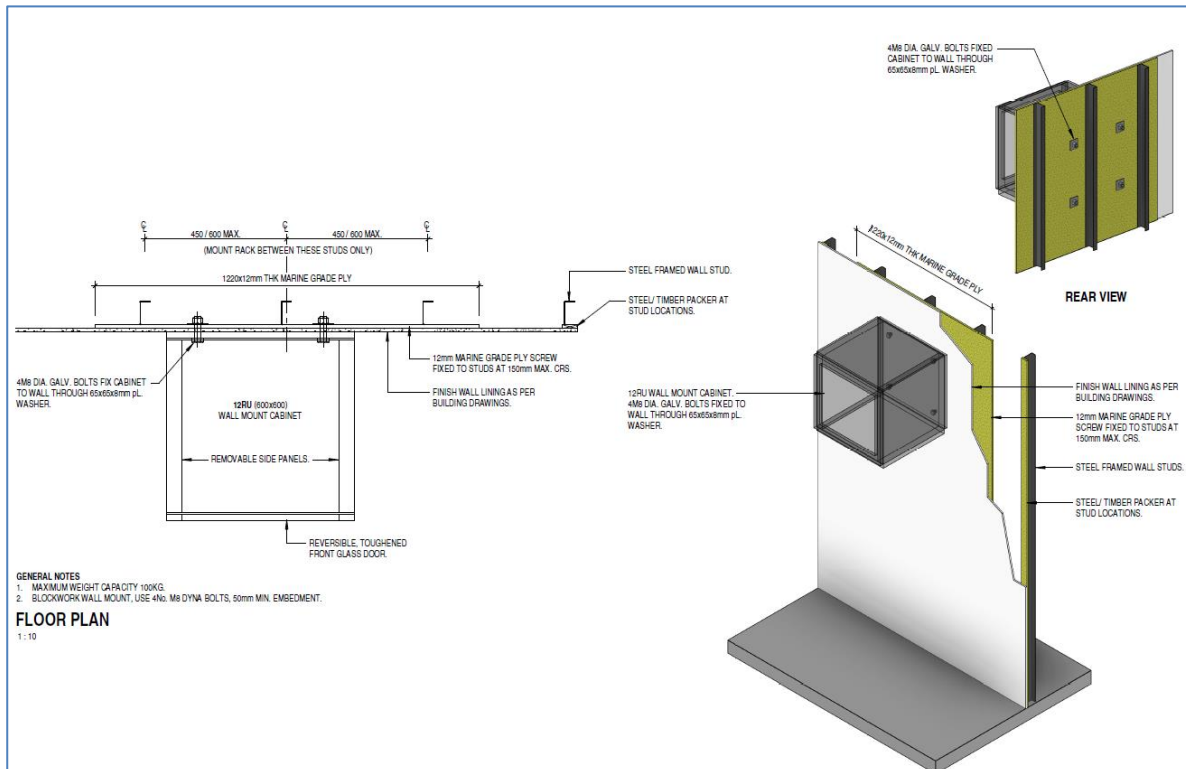
Unless otherwise specified, approval must be sought from NTG ICT staff or the ICT Project Manager to install a wall mount communications cabinet.

Wall mount cabinets shall comply with the following requirements:

- ideally be located in utility, store, or equipment room
- be hinged to allow access to the rear of the patch panels
- have a 150mm recessed patch panel for exiting patch lead protection
- allow access to the fibre splice trays from the front of the cabinet
- horizontal cable management is to be the “bolt in” style, not “press in”.
- 10 amp power outlet is to be installed on the wall alongside the cabinet.
- have a lockable door with a tinted glass or acrylic panel
- be mounted at a minimum of 150mm below the ceiling
- be fitted with industry standard earth
- grommets, bushing, or edging strip is to be fixed in cut-outs in the cabinet to protect cabling from sharp edges.

Where there is no other option but to place a wall mount communications cabinet in an open area where staff traffic is unavoidable, then the base of the cabinet shall be a minimum of 2,000mm above floor level.

Wall mounted cabinets require a dual 10 amp power outlet installed on the wall alongside the cabinet.



Example of a single wall mount cabinet installation

2.2.3.6 Keys

The contractor shall provide all necessary keys for supplied cabinets and patch panels and any other lockable devices, cabinets or equipment.

2.2.4 Labelling of building and floor distribution rooms

Unless otherwise instructed, building and floor distribution rooms will be labelled accordingly.



- **where G** is the location (G defining the ground floor in this case: options are B for basement, G for ground, 1 for first floor, 2 for second floor, 3 for third floor, and so on) and
- **A** being the first floor distributor on that floor (options are A for the first, B for the second, C for the third, and so on for the rest of the floor: A being the closest floor distributor to the front door and **Z** being the furthest away from the front door).
- **In a campus situation, a building ID or code can preface the distribution room label, i.e. 100DCX-GA, or Bld 06-GA, where the prefix to – GA is the building ID or code.**

Examples of floor distributor room labelling

1B where 1 is the first floor, and B is the second floor distributor on that floor.

6A where 6 is the sixth floor, and A is the first floor distributor on that floor.

2.2.5 Labelling of communication cabinets

Unless otherwise instructed, communication cabinets will include the distribution room label and a number; i.e.:

GA1 GA1

- where **GA** is the communication rooms unique identifier and
- **1** is the cabinet number (cabinet numbers start at one and run for as many consecutive numbers as there are cabinets; cabinets are numbered consecutively, **one** being closest to the entrance, and **999** being the furthest away from the entrance).

Examples of communication cabinet labelling

1B3 where **3** is the third cabinet in room 1B.

2A1 where **1** is the first cabinet in room 2A.

In a design where there will only ever be one cabinet in the floor distributor then the communications cabinet in that floor distributor may be GA, 1B, 4A, or whatever the case may be.

Cabinet labelling must be clear and legible and fitted at the top of the rack on both the frame and the door. Usually this would be black letters on white backing or vice versa. Sizing is not prescriptive and can vary depending on the cabinet type so long as it is very easy to read from up to 3m away.

GA

The corresponding wall outlet labels will be labelled accordingly.

2.2.6 Labelling of wall outlets

Unless otherwise instructed, wall outlets will include the communications cabinet unique identifier and the wall outlet number. I.e.:

GA1-001

- where **GA1** is the cabinet identifier and GA1-001
- **-001** is the wall outlet (wall outlet numbers start at -001 and run for as many consecutive numbers as there are wall outlets on that floor; wall outlets are numbered where **-001** is closest to the floor distributor and **-999** being the furthest away from the floor distributor).

Examples of wall outlet labelling

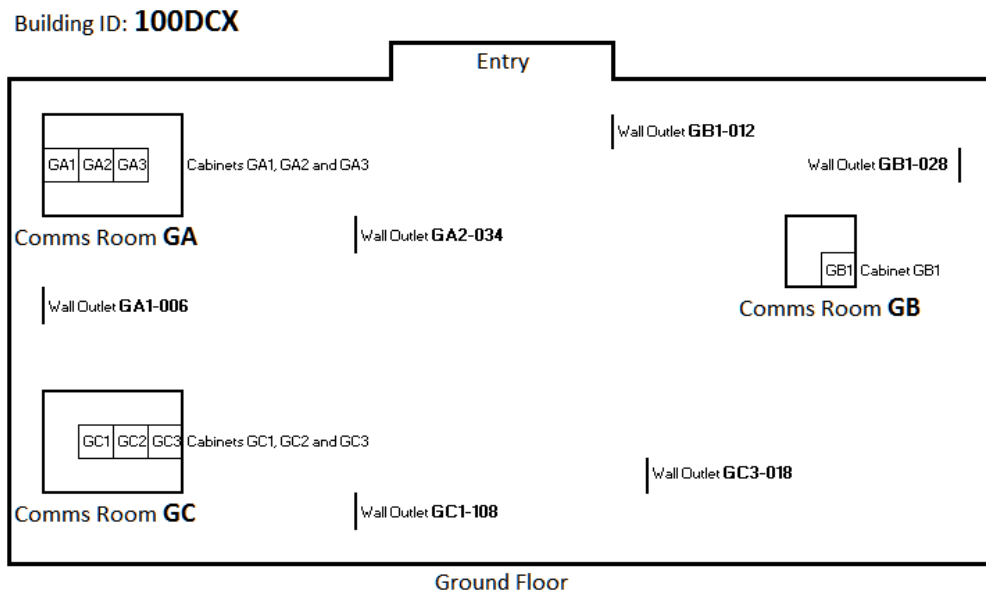
GA2-028 where **GA2** is the cabinet where that outlet is terminated and **-028** is the patch panel port number in cabinet GA2.

GA2-028

2C2-125 identifies **Level 2** floor distributor C cabinet number **2**, and wall outlet **-125**.

2C2-125

Each work area data communications outlet plate shall be labelled using consecutive numbers.



Example of floor distributor, cabinet, and wall outlet labelling.

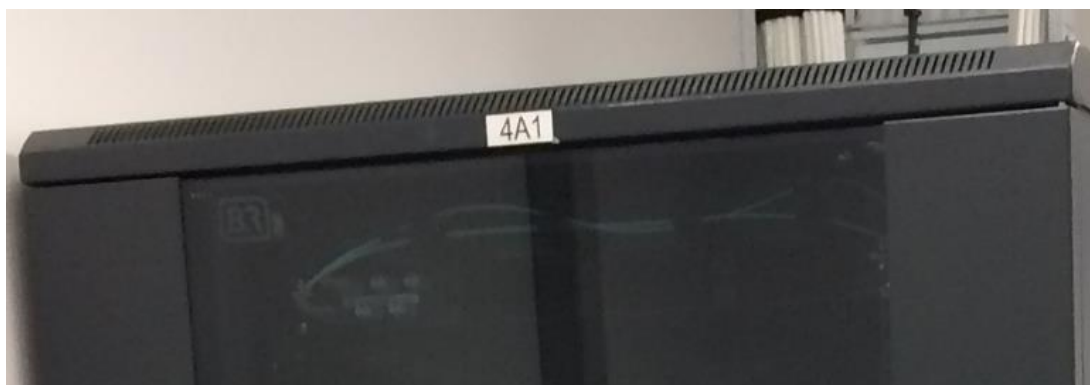
The designated order of multiple outlets on a single faceplate shall be from left to right and then from top to bottom. Materials used for data communications outlet labels shall be durable or protected from damage.

Designations shall be printed and not easily erased or altered. It shall be possible to change faceplate designations by replacing the label.

2.2.7 Acceptable methods of labelling

Acceptable methods of labelling include:

- printed plastic tape labels inserted into a recess in the faceplate intended for the purpose and fitted with a clear plastic cover. The mounted wall plate behind the face plate shall have the data outlet ID marked in indelible pen.
- machine printed, self-adhesive labels adhered directly to the surface of the faceplate or cabinet e.g. Traffolyte ®. This is the most suitable for communications cabinet labelling and have provided a photo as follows showing example of cabinet labelling:



- lettering moulded, or heat embossed in the faceplate (for outlet designations only).

2.2.8 Unacceptable methods of labelling

Unacceptable methods of labelling include:

- numbered plastic caps inserted over the flush plate fixing screws
- embossed, self-adhesive plastic tape systems (such as Dymo ®)
- press-in plastic number "dots" inserted into the flush plate with a single "dot" bearing all numerals of the faceplate number
- handwritten labels of any kind, including the use of paint pens
- paper labels adhered directly to the surface of the faceplate
- paper labels fitted in a recess without a durable protective cover.

2.2.9 Labelling patch panels

All positions on patch panels shall be labelled with the same designations as the corresponding wall outlets.

Patch Panel numbering shall commence with the lowest numbered port appearing at the top left and proceed left to right, and then top to bottom.

Backbone cable numbering shall be designated according to the numbering scheme specified in the Contract documents. The order of appearance of backbone cables on the patch panel shall commence with the lowest numbered cable appearing at the top left and proceed left to right, and then top to bottom.

2.2.10 Labelling optical fibre

2.2.10.1 Campus backbone optical fibre labelling

Campus backbones distribute the network between buildings housed within the campus, and are typically Single Mode Optical Fibre SMOF, terminated with LC connections in an approved FOBOT at the top of the communications cabinet.

Unless otherwise instructed, campus backbones will be labelled

1 - 24 SMOF CN34 - GA1 to CN6 - GB3

Campus building No.6 FOBOT label

1 - 24 SMOF CN6 - GB3 to CN34 - GA1

Campus building No.34 FOBOT label

Where:

1 – 24 indicates the number of fibre cores in the backbone

SMOF identifies the optical fibre type. SMOF – Single Mode Optical Fibre

CN6 identifies the Campus Core building that distributes the network. The building identifier can be any combination of characters that uniquely identify each campus building.

GB3 is the building distributor room number (**GB**) and cabinet number (**3**) in the Core building

CN34 identifies the building that is being connected to the Campus Core. The building identifier can be any combination of characters that uniquely identify each campus building.

GA1 is the building distributor room number (**GA**) and cabinet number (**1**)

2.2.10.2 Building backbone optical fibre labelling

Building backbone optical fibre networks provide the link from the Building Distributor to each of the Floor Distributors in a multi-story building.

The Building Distributor is the Core of the building network and usually located on the ground floor, unless circumstances such as flooding or multiple tenants dictate an alternative location.

Unless otherwise instructed, building backbones will be labelled

1 - 12 MMOF 4A1 to GA1

Building distributor FOBOT label

1 - 12 MMOF GA1 to 4A1

Level 4 floor FOBOT label

Where:

1 – 12 indicates the number of fibre cores in the vertical backbone

MMOF identifies the optical fibre type. MMOF – Multi Mode Optical Fibre and SMOF – Single Mode Optical Fibre

GA1 is the building distributor room number (**GA**) and cabinet number (**1**)

4A1 is the floor distributor room number (**4A**) and cabinet number (**1**)

2.2.10.3 Floor distributor backbone labelling

Floor distributor backbones are optical fibre links between two floor distributors on the same floor.

Unless otherwise instructed, floor distributor backbones will be labelled

1 - 12 MMOF 4C1 to 4A1

Floor distributor 4A FOBOT label

1 - 12 MMOF 4A1 to 4C1

Floor distributor 4C FOBOT label

Where:

1 – 12 indicates the number of fibre cores in the horizontal backbone

MMOF identifies the optical fibre type. MMOF – Multi Mode Optical Fibre

4A1 is the floor distributor room number (**4A**) and cabinet number (**1**)

4C1 is the second floor distributor room number (**4C**) and cabinet number (**1**)

2.2.11 Uninterrupted power supply (UPS)

Unless a Building UPS is installed to supply protected power to the floor distributors as part of the construction phase, Uninterrupted Power Supplies will be provided for NTG active equipment and installation will be arranged by the ICT Project Manager at the time equipment is being installed and commissioned.

The DCIS ICT Project Management Office should be included in all discussions regarding the sizing and distribution of Building UPS.

2.3 Installation

2.3.1 Site survey

Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Approval from the NTG appointed project manager must be sought to remove any obstructions.

2.3.2 Horizontal cable routing

Consolidation points are not permitted with category 7A class FA cabling.

All horizontal cable routing shall conform to the following:

- all horizontal cables, regardless of media type, shall not exceed 90m from the telecommunications outlets in the work area to the horizontal cross connect
- the combined length of jumpers, or patch cords and equipment cables in the telecommunications room and the work area should not exceed 10m
- horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation
- in open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports (these supports shall be spaced no more than 1.5m apart)
- each run of balanced twisted-pair cable between the horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall not contain splices
- in a false ceiling environment, a minimum of 75mm shall be observed between the cable supports and the false ceiling
- continuous conduit runs installed by the contractor should not exceed 30.5m or contain more than two 90 degree bends without utilising appropriately sized pull boxes
- all horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes
- the number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a geometric shape of the cables
- maximum conduit pathway capacity shall not exceed a 40% fill; however, perimeter and furniture fill is limited to 60% fill to allow for move and changes
- horizontal distribution cables shall not be exposed in the work area or other locations with public access.

2.3.3 Pulling tension

The maximum cable pulling tensions shall not exceed 110N.

2.3.4 Bend radius

The maximum cable bend radii shall not exceed manufacturer's specifications.

2.3.5 Slack

In the work area, a minimum of 300mm should be left for balanced twisted-pair cables, while one metre is left for fibre cables.

In telecommunications rooms a minimum of three metres of slack should be left for all cable types. This slack must be neatly managed on trays or other support types.

2.3.6 Grounding

All grounding/earthing and bonding shall be done to applicable standards

2.3.7 Horizontal cabling

Each work area data communications outlet shall be cabled directly to the patch panel without any intermediate termination or jointing (unless the ICT Project Manager approves the use of consolidation points).

Bridges, taps and splices are not to be used.

All installed horizontal cable shall conform to the latest edition of AS/NZS 11801.

Existing cable requiring re-termination should be terminated using RJ45, or TERA style connector's dependant on the cabling category installed.

A vertical duct shall be supplied and installed to carry cables from the ceiling space to the equipment cabinet, where required for neat appearance and mechanical protection of the cables. This duct shall have sufficient capacity for a 50% future increase in the number of cables.

All horizontal cabling runs shall be provided with not less than 600mm of slack at each end. Where cabling is run in ceilings, the slack shall be left in a loop on the catenary or cable tray directly above the drop points. Where cabling is run within stud walls, the slack shall be left in the cavity directly behind the faceplate. In all other cases, direction shall be obtained from the nominated ICT Project Manager.

Cable bends shall maintain the minimum bend radius specified by the manufacturer. Deformation of the cables (e.g. pinching at points of support, when changing direction to pass through wall plates, etc.) shall be carefully avoided.

Only hook and loop ties, such as Velcro® brand, are to be used to bundle cables or support hanging cable runs. Insulation tape and plastic **cable ties are not permitted** for cable bundling or cable support.

Where cable deformation is found to have occurred, it will be the contractor's responsibility to replace affected cabling. Penetration through fire rated walls, ceilings or floors shall be stopped, or filled, using approved materials so as to maintain the existing fire rating. Installed cables shall not be under tension.

2.3.8 Vertical cabling installation practices

Where cabling is required to be installed vertically, it shall be installed on Cable Trays and secured every 300mm using hook and loop fastening ties, such as Velcro® brand ties. Take due care to not over tighten ties and place undue strain on the cabling infrastructure.

Where network cabling and power cabling run parallel they must maintain a segregation of at least 300mm, and 450mm in the case of high voltage power cables, and only cross at right angles using adequate separation such as a conduit sleeve.

2.3.9 Work area telecommunication outlets and faceplates

Unless otherwise stated, each work area shall be provided with:

- a white faceplate
- RJ-45, or TERA style, female connector dependant on the nominated cable category
- the connector shall be designed so that the incorrect insertion of a plug is not possible.

Unless otherwise specified all outlet plates shall be mounted horizontally.

Wherever possible, faceplates shall be flush mounted on walls or skirting duct.

Faceplates mounted in walls shall be fitted with a protective cover to prevent ingress of dust unless the design of the outlets renders this unnecessary.

Where faceplates cannot be flush mounted, the contractor shall supply and install suitable mounting blocks. Mounting blocks shall be of the same colour as the faceplates.

Faceplates shall be mounted at the same vertical height from the floor as adjacent or nearest power outlets, or where these are not present, at the height specified by the ICT Project Manager.

Where faceplates are specified to be floor or service pole mounted, the contractor shall supply and install a suitable mounting box. Floor mounting boxes shall be fixed securely to the floor. The type of mounting box proposed for use shall be submitted to the ICT Project Manager for approval prior to the commencement of work

2.3.10 Patch panel

Recognised good quality 24 port patch panels are to be provided. Where more than 24 ports are required, a number of 24 port modules shall be used.

Patch panels shall comply with the relevant standard for category 6A class EA and 7A installations. The terminations of the patch panels shall be suitable for terminating category 6A class EA and 7A cables. Patch panel categories should not be mixed unless otherwise approved by agency ICT staff, or NTG Project Manager.

Cable management shall comply with the **physical cable management** clause within this document.

The cabling shall connect directly to the patch panel using insulation displacement techniques.

2.3.11 Desktop workstations

All new desktop workstations shall have suitable gaps, or holes, to allow power and data cables to easily pass through the workstation. Custom made desktop workstations shall have a minimum of one 50 mm dia hole cut through the workstation per occupant, to provide access for power and data cabling.

Provide a minimum of four power GPO's for each workstation occupant.

All desktop workstations shall have suitable cable management incorporated to provide a pathway for cabling that protects from being kicked, or interfering with workstation occupants.

All monitor arms shall incorporate a removable mount that can be screwed to the rear of the monitor and clip easily onto the monitor arm.

Dual monitor stands shall be individually adjustable for height and aspect.

2.3.12 Backbone cabling

Backbone optical fibre networks provide the link between each building in a campus, and the Building Distributors to each of the Floor Distributors in a multi-story building, and shall comply with the following:

- on greenfield sites all backbone optical fibre shall be OM4 MMOF within the building and OS2 SMOF between buildings in a campus
- unless otherwise specified be a minimum of 12 core OM4 MMOF shall be employed for building backbones
- be a direct uninterrupted link form the campus network centre to each Building Distributor, and from the Building Distributor to a single Floor Distributor. Daisy chain backbone connections will not be accepted.

Larger sites may require multiple 12 core optical fibre backbone links.

Backbone cabling includes:

- horizontal connections between communications cabinets on the same floor
- vertical cabling between Floor Distributors and Building Distributors
- in a campus environment, cabling between each Building Distributor and the Campus Distributor, or campus network centre
- be labelled in accordance with this standard.

2.3.13 Optical fibre

Optical fibre backbone cables shall be installed to meet the following minimum requirements:

- all optical fibre cables shall conform to AS/NZS 11801 and shall be either OM3 or OM4 multi-mode, graded-index optical fibre
- all optical fibre cable shall meet the minimum transmission performance specified in AS/NZS 11801
- optical fibre cables shall be of a construction suitable for building riser applications. Slotted core cables, for instance, are not acceptable.

OM3 and OM4 optical fibre cables shall be clearly marked as such to distinguish them from other cables and have suitable sheath identification.

All optical fibre cables shall be protected from breakage or stress through suitable protective ducting or enclosures permanently anchored in position, as required. The protection level provided shall comply with AS/NZS 3013.

For major building installations, one building distributor shall be nominated as the main fibre patch panel for the building. The network fibre backbones shall originate from this location to each additional fibre backbone node. Unless otherwise specified, all fibre optical cables being installed to provide a network backbone shall contain a minimum of six cores, with 12 core fibre being recommended.

All fibre cores shall be terminated. All termination enclosures shall be mounted in non-movable cabinets or securely fixed on structural walls within the building.

Within the building riser, the cable shall be attached to a cable tray anchored in position, and the cable shall be supported at points no greater than 300mm apart. The fibre backbone can be mounted

in the same cable tray as the copper cabling, but **not** in the same bundle. The fibre must be mounted separately.

For installations other than within major buildings, the location of all optical fibre network nodes shall be specifically indicated on the site plans.

2.4 Terminations

2.4.1 Horizontal cabling

The contractor shall be responsible for the termination of the horizontal cable on the work area, data communications outlets, and patch panels. Cable termination, pin assignments, pair allocation and colour coding shall conform to AS/NZS 11801, configuration T568A.

The location and configuration of the equipment cabinet, and the locations of the wall outlets required for the installation, will be identified in the project documentation.

Cabinets are not to be installed by the contractor without the approval of the ICT Project Manager.

The tools utilised for terminating cables shall be of a type approved by the manufacturer for the connectors used.

The cable twist rate shall be maintained as close as practical to the termination points on the wall outlets and the patch panel.

2.4.2 Optical fibre

All optical fibre circuits shall use the inter-connect methodology for the establishment of circuits. The connectors of equipment fly leads shall be connected directly to the connectors of the backbone cable.

The performance of optical fibre circuit connections shall be in accordance with AS/NZS 11801.

All cables shall be neatly butted and stripped to ensure that fibres and jacketing are undamaged.

All optical fibres shall be either fusion spliced on to optical fibre pigtails, which have been factory pre-terminated with type LC connectors, or terminated directly on site to type LC connectors. The connectors shall have ceramic ferrule connectors with a PC pre-radius ferrule installed by epoxying the connector onto the fibre end. (Crimp on type connectors are specifically **not** allowed).

These connectors shall sustain a minimum of 500 mating cycles as per AS/NZS 11801.

Where the contractor elects to use “on site” termination, the contractor shall provide test results that prove the quality of the termination is as good as if it were made in the factory.

All connectors shall be supplied with protective caps fitted. The contractor must take steps during the installation to ensure that dust does not enter optic fibre cabling.

2.4.2.1 Optical fibre termination enclosures

Termination enclosures shall be of all metal construction with a fully enclosed compartment to house the cable entry, splice trays and bare fibre. This compartment shall be accessible via a screwed or clipped panel.

Optic fibre enclosures must be designed to anchor all optical fibre cables in place to prevent movement and resulting potential degradation of performance or damage to cables or terminations.

LC connectors are used for all optical fibre terminations.

Note: Where there is active NTG Network equipment to be installed in this enclosure, please refer to section titled 'Communication cabinets' for minimum cabinet size requirements.

2.4.3 Patch leads

2.4.3.1 Optical fibre

Patch leads shall be provided for interconnection between the fibre optic patch panel and the active equipment located in the equipment cabinet. Each patch cable shall be:

- 600mm, 1,200mm or 2,000mm of a single pair
- fitted with LC type connectors at each end.

All optical fibre patch leads must be tested by the manufacturer to AS/NZS 11801.

Typically backbone optical fibre cables will be OM4 multi-mode or OS2 single mode unless otherwise specified by the ICT Project Manager.

2.4.3.2 Fly leads and patch leads

Fly Leads shall be provided for interconnection between the wall outlets and user equipment. Patch leads shall be provided for interconnection between the patch panel and the active equipment. Each lead shall be:

Category 6A class EA U/FTP – Cabling contractor to provide 100% of all leads. That is 100% patch leads and 100% fly leads. I.e. if the project requires 50 data outlets, then 50 patch leads and 50 fly leads are required.

Slim line Category 6A U/FTP patch leads will be provided by the contractor.

Category 7A class FA – Cabling contractor to provide 100% of leads. That is 100% patch leads and 100% fly leads. I.e. if the project requires 50 data outlets, then 50 patch leads and 50 fly leads are required.

- constructed of stranded conductors
- fitted with RJ-45, or TERA connectors as required by the cabling standard
- terminated with the pin assignments, pair allocation and colour coding specified in AS 11801, configuration T568A
- tested by the manufacturer to the relevant standard.

The following is a guide to the lengths of required for patch and fly leads:

Length	Patch Leads	Fly leads
0.5m	20%	–
1.0m	35%	–
1.5m	45%	–
2.0m	–	55%
3.0m	–	40%
5.0m	–	5%
–	100%	100%

If contractor assembled leads are to be used, the tools and procedures used to fit the connectors to the cable shall be approved by the manufacturers.

2.4.4 Integrated rear cable management

The patch panels shall provide integrated rear cable management for guiding cable to the IDC block. This management facility shall provide cable bend radius guides to ensure minimum cable bend radius criteria (>four times cable diameter) is not exceeded during installation; and hook and loop fastening tape, such as Velcro® brand, to secure incoming cables without over-compressing the cables, which could compromise the cable performance.

2.4.5 Physical cable management

A one RU horizontal cable manager is recommended below each patch panel and adequate vertical cable management, incorporating fingers and spools is essential.

The cable management panels should be mounted on the patching facility between every two rows of connection ports. In this way, patch leads from every patch panel port are directed to the cable management panels above or below the outlet so that at no time, even when fully populated, outlets are obscured by patch leads. Such a layout ensures the patching facility, when cable management is properly utilised, does not go out of control and can be efficiently utilised for adds, moves and changes over the life of the cabling system.

To facilitate effective patching during the life of the cabling system, the cabinet shall be laid out for minimal clutter and the shortest reasonable route for patch cords.

In a single cabinet installation, the patch panels terminating the horizontal cabling should be centrally located in the cabinet. Active equipment such as LAN switches, if accommodated in the cabinet, should be mounted above the horizontal cable patch panels. In the case where there are more than 144 outlets switches may be mounted above and below the patch panel. Fibre patch panels should be mounted above the active equipment.

Where analogue voice service cabling is routed to the IDF, the patch panels terminating these cables should be installed below the horizontal cabling patch panels. Where multiple cabinets are to be utilised the same layout principle should be adopted horizontally.

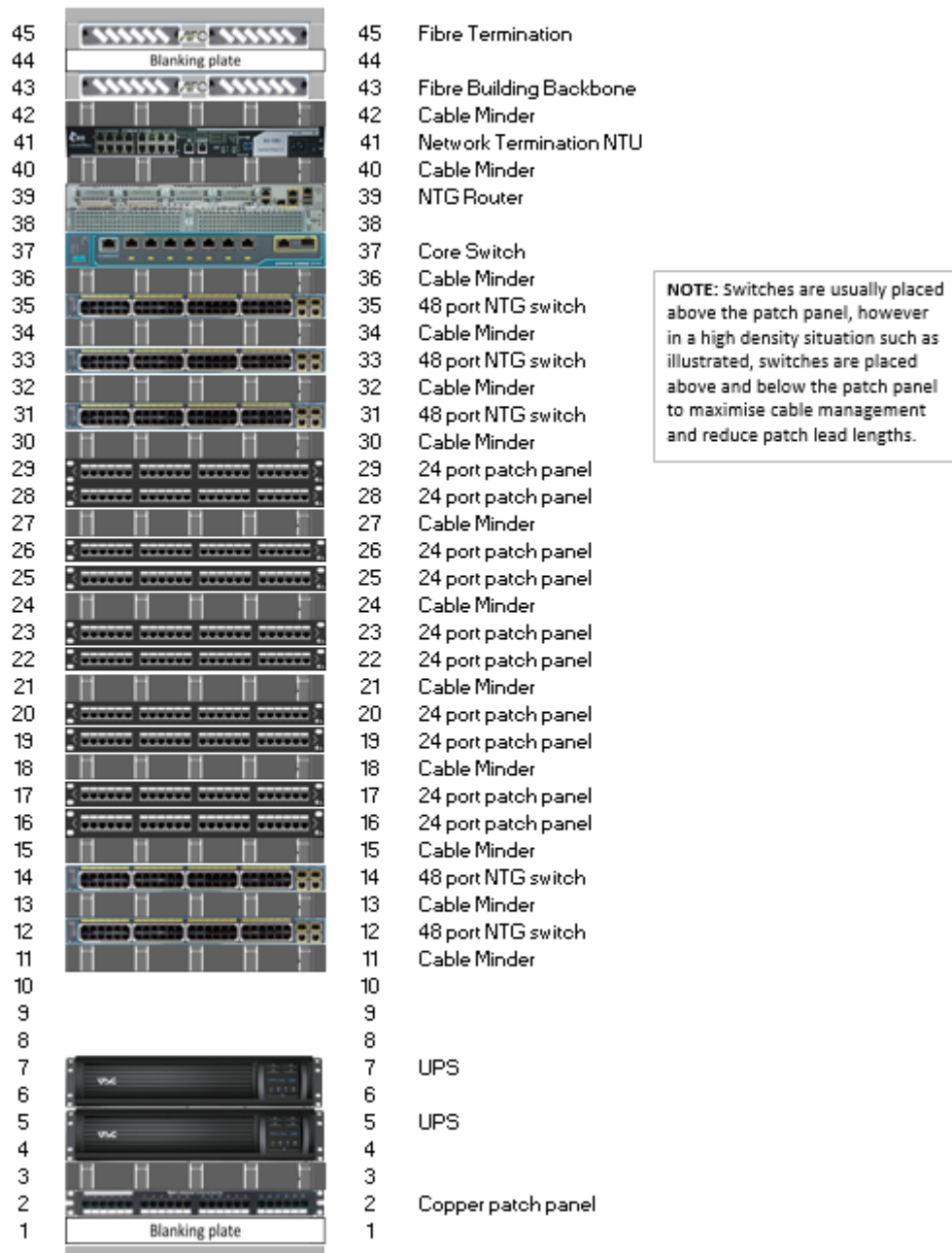
2.4.6 Cabling topology

The topology of the horizontal sub-system is star connected with each cable being a maximum of 90m. Where a horizontal cabling cannot be established within the 90m limitation, a second floor distributor shall be established to install a second horizontal sub-system to meet the specification. The location of a second or subsequent floor distributor shall be to the ICT Project Manager's approval.













2.4.7 Equipment cabinet layout

The contractor shall install the cabinets in the position indicated by the project documentation. The contractor shall install the patch panels, shelves and data cabling in the cabinets.

Unless otherwise specified, the layout of all cabinets shall normally conform to the following typical examples:



Example of 45RU Floor Standing Cabinet Layout

12		12	Fibre Termination
11		11	Cable Minder
10		10	NTU
9		9	NTG Router
8		8	NTG Router
7		7	Cable Minder
6		6	48 port NTG switch small form
5		5	Cable Minder
4		4	24 port patch panel
3		3	24 port patch panel
2		2	Cable Minder
1		1	ups small form

Example of 12RU Wall Mounted Cabinet Layout

Typically, the horizontal patch panels should be located midway down the cabinet depending upon the space requirements for optic fibre terminations and active equipment. Cable management should be provided for each 24 port patch panel.

All installed cabinets shall be earthed.

2.4.8 Ducting, cable trays and service poles

2.4.8.1 Work area

Wherever practical, cables shall be run in existing wall, ceiling or floor voids.

In certain circumstances, ducting or conduit may be required to provide an acceptable appearance and to provide mechanical protection of horizontal cabling. Typical examples include:

- to carry workstation cabling around skirtings to the work area data communications outlets where these outlets are required to be mounted on solid external and internal walls
- to carry workstation cabling from the ceiling space to skirting ducts in room corners and adjacent to door frames where practical to minimise the length of cabling runs
- to carry workstation cabling from the ceiling space to the work area data communications outlets on columns and where skirting duct runs would be impractical
- to carry workstation cabling from the ceiling to the top of partition walls.

Vertical ducting runs shall have a physical separation barrier when next to conduits carrying mains power. Their colour shall be compatible with the background wall or column colour. The duct shall be surface mounted.

All ducting shall be of sufficient cross section to carry the number of cables required, plus at least two additional cables to allow for future changes, including those installations where only one cable is required.

Service poles may be required to provide network facilities in an open office environment. The contractor shall provide a minimum of two channel segregated service poles.

All cabling to be installed in external cavity walls shall be installed in conduit.

2.4.8.2 Ceiling space

All new cabling in ceiling spaces shall be installed in accordance with AS/NZS 3084 and AS/CA S009.

2.4.8.3 Catenary cable support system

Where wire mesh cable tray supports for cabling are not available, catenary cables shall be installed. All catenary cables shall be 2.5mm PVC coated, multi strand steel cable fixed to the building structure at a maximum of 3m intervals. Fixings should be at irregular intervals to prevent performance degradation due to in-phase noise build up. The cable should be securely fixed to the building structure using M8 x 25mm Dyna ® bolts or similar. M6 x 25mm Dyna ® bolts shall be used for the secondary support fixings.

Cables shall be secured to the catenary support system using Velcro ® style tie wraps at a maximum of 300mm centres. Insulation tape may be used to facilitate installation of the bundles, however permanent fixing must be completed using Velcro ® style tie wraps.

Cable shall be in a maximum of 24 cables per bundle. Each catenary shall support a maximum of 48 cables, i.e. two bundles of 24 cables.

Each bundle of cables shall be individually supported from the catenary cable using Velcro ® style ties wraps.

2.4.9 Building riser

Cabling contractors are responsible for the correct replacement of fire retardant material when work in risers is completed.

Contractors must provide written certification to the NT Government Property Management branch that appropriate material was installed as per manufacturer's specifications. Contractors must be accredited installers in order to complete this work or must arrange for a suitably qualified installer to complete the installation and provide the necessary certification. Failure to provide the required certification may have implications concerning liability in the case of fire or other emergency situations.

Cabling contractors are responsible for ensuring that building risers are maintained in a tidy and clean state during installation, and any refuse material is disposed of in an appropriate manner.

All cabling installed into risers is to be fixed to wire mesh cable trays at a minimum of 300mm centres by Velcro ® style ties, with appropriate separation from AC power as per AS/CA S009.

2.5 Installation of underground fibre

2.5.1 High level design

A high level design, including the proposed route, for the network extension will be provided by the ICT Project Management Office.

2.5.2 Supply and installation of conduit

All conduit used in the installation shall comply with the following:

- use 50mm poly pipe class 9 PE communications conduit, unless otherwise directed
- external building entry conduits will consist of a 32mm GI conduit and comply with AS2053.2
- all conduits must enter the end of a pit only
- no conduit is to be installed at the base of a pit

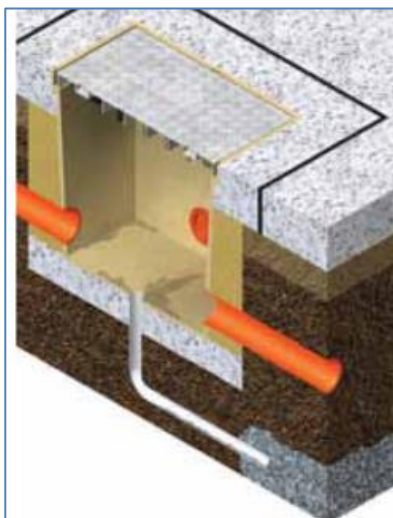
- large sweeping bends are to be used for change of direction, for 50mm conduit a minimum radius of 800mm is required
- smaller bends may only to be used on building entry, for 50mm conduit a minimum radius of 300mm is required
- a draw wire is to be installed in all conduits.

2.5.3 Supply and installation of pits

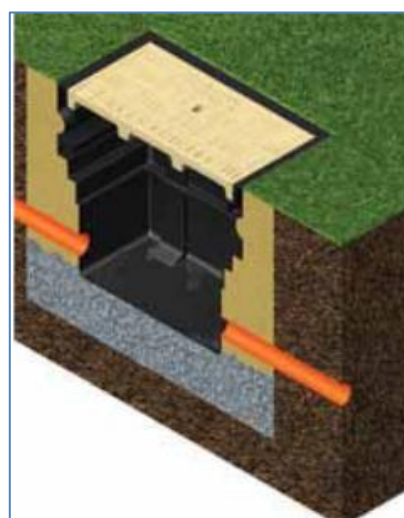
The contractor shall ensure that:

- P5 or P6 rectangular communications pits are used
- all pits must be fitted with NTG approved locking lids
- pits must not be installed more than 250m apart
- the location of pits will comply with the approved high-level design
- pits must be installed level
- pits inside fence boundaries are to be finished to the NTG Project Manager's requirements
- pits outside fence boundaries are to be finished to Local Government requirements
- carrier approval is obtained where a carrier service is being provided externally
- pits are to be installed on common property boundaries where practical
- pits are not to be installed in locations where driveways, or vehicle parking areas may be constructed at a later date
- a concrete surround is to be installed in accordance with the manufacturers specifications and as follows:
 - P5 and P6 Pit surround – 150mm concrete surround on the length and width
 - the base will be 150mm concrete in areas with vehicle traffic, and 150mm compacted grave in foot traffic areas.

See example in picture below. An expansion joint is to be installed if the pit is placed in a concrete slab: 50mm x 50mm x 3mm wire mesh shall be used to reinforce the concrete surround.



Example a of pit surround



Example B of pit surround

2.5.4 Backfill and reinstatement of excavation

2.5.4.1 Bedding material

Bedding material only shall be used around conduit.

Conduit ends, including bends at each pillar location and elsewhere, shall be securely supported in position during placement and compaction of bedding material.

All conduits shall be separated by compacted bedding material and spacers used to maintain separation between conduits shall be removed prior to bedding material compaction.

Bedding material shall be placed in layers not exceeding 100mm, packed under and around the sides to avoid the formation of air pockets beneath pipes or collars, and finished at a level of 50mm minimum above conduits.

2.5.4.2 Backfilling generally

Backfilling is to be completed as soon as practicable after the installation and audit of conduits in trenches.

Polymeric cable protection cover shall be installed where required. Orange caution tape to advise "Warning Communication Cable Below" shall be installed where shown on the applicable drawing and backfilling continued.

Trenches in areas other than footpaths and roads e.g. private property, shall be backfilled in loose layers not exceeding 250mm and compacted to achieve 95% of standard maximum dry density obtained in accordance with AS1289 5.5.1.

In areas such as roadways and access tracks 98% of standard maximum dry density is required. Rock, sharp objects or any other material that could damage conduit is not permitted in backfill within 200mm of the conduit.

2.5.5 Reinstatement of surfaces

Permanent reinstatement of surfaces shall be carried out as soon as practical after backfilling, the surface level and finish shall match as near as possible the surface prior to excavation, and be to the satisfaction of the NTG Project Manager.

Additionally the reinstatement of concrete driveways and slabs shall include the drilling and doweling of adjoining concrete surfaces where practical during the reinstatement work.

2.5.6 Care of optical fibre cable

Optical fibre cable shall be protected from damage at all stages of handling and installation.

In particular excessive bending or crushing shall be avoided. Cable ends shall be suitably sealed to prevent the ingress of water. Cables shall be handled using only suitable equipment and in such a manner as to prevent deformation or damage.

Conductors shall be protected from immersion in water or contamination with foreign materials.

Vehicles shall not be driven over optical fibres on the ground.

Factors that can cause possible fibre damage, if they are excessive, are as follows:

- tension
- twisting

- bending
- crushing
- vibration.

2.5.7 Pre-installation testing

2.5.7.1 Procedure

The attenuation of all optical fibres shall be checked at the time of delivery by the contractor.

Attenuation data will be compared with that included on the certified test reports supplied from the manufacturer.

After completion of this test, the contractor shall seal the cable against water or dust entry.

This practice will be observed after each subsequent test, and prior to splicing.

Plastic caps shall be fitted using adhesive plastic tape to seal the ends.

2.5.7.2 Splicing and termination

The contractor shall carry out the fibre terminations by fusion splicing methods such that the signal attenuation at each joint is as per the specifications outlined in AS/NZS 11801.

The average loss for all joints in any one fibre from substation to substation shall not exceed 0.12 dB.

The fibre shall be arranged in the termination boxes with loops contained within trays in an orderly and consistent identifiable pattern with sufficient slack to allow re-jointing without resorting to extra optical fibre cable.

The contractor shall be responsible for sealing the termination boxes such that they are watertight.

The boxes and coiled fibre cable shall be structurally secured in a neat and tidy manner. Materials used for securing the fibre cable and the terminal boxes shall be durable to give the required maintenance free design life of 50 years.

2.5.7.3 Post installation testing

The attenuation of all fibres shall be checked by the contractor after installation of the optical fibre cable and splicing of the fibres.

The contractor shall be responsible for all work and materials required to remedy any fibre defects that occurred during installation or for the remaking of joints that do not meet specification requirements.

2.5.8 'As Constructed' drawings

Prior to the issue of a completion notice the contractor will supply 'As Constructed' drawings for the civil works which will include;

- actual placement of the conduit infrastructure
- distance of infrastructure between pits
- actual placement of the pit
- type/size of pit

- pit number/Labels
- bore logs.

All 'As Constructed' drawings must be returned to the NTG Project Manager within 10 days of practical completion, and registered with NTLIS for inclusion in dial before you dig (Call 1100 or www.1100.com.au).

2.6 Testing

Testing of all newly installed cable channels shall be performed prior to system cutover.

2.6.1 Horizontal cabling

All cables shall be tested for Ethernet operation by the contractor according to a formal test plan and as per AS/NZS IEC 61935. The test plan shall be submitted to the ICT Project Manager for approval prior to the commencement of testing and must confirm the operation of the cabling installation.

A complete set of test results shall be provided to the ICT Project Manager as part of the documentation.

Test results must be provided prior to the installation of active equipment

Data cable testing shall comply with the following:

- All field-testing shall be performed with an approved balanced twisted-pair field test device.
- All installed channels shall perform equal to or better than the minimum requirements as specified by the manufacturer.
- All balanced twisted-pair horizontal and backbone cables will not exceed 90m for the basic link, and 100m for the channel shall be 100% tested according to the current Standards. Test parameters include wire map plus ScTP shield continuity (when present), length, NEXT loss (pair-to-pair), NEXT loss (power sum), ELFEXT loss (pair-to-pair), ELFEXT loss (power sum), return loss, insertion loss, propagation delay and delay skew.

2.6.2 Backbone optical fibre

The following shall be the minimum testing requirements for the backbone optical fibre cabling:

- 100% of optical fibre shall be tested for loss and uniformity of transmission characteristics using a recording optical TDR (time domain reflector). The measurement method shall be in accordance with AS/NZS ISO/IEC 14763.3. The test shall be performed from each end unless an additional tail fibre is used such that both ends of entire fibre length under test is observable in the OTDR display. A copy of the test results shall be included with the documentation, including the instrument measurement scale factors etc.
- Connector loss should be measured for optical fibre fly leads.
- Acceptable loss measurements are as defined in AS/NZS 11801.

The test methods to be employed for optical fibre cable testing should comply with the relevant standard for optical fibre testing.

2.6.3 Test equipment criteria

Test equipment shall comply with the following:

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

2.6.4 Documentation

The NTG will provide to the contractor copies of the primary site plan(s) at the time of an order for installation, alteration, or additions to the data network.

Upon completion of the work at each site the following documentation shall provide to the NTG Project Manager and the ICT Project Manager:

- an updated site plan showing the physical location and designation of each cable route, cable ducts and cable trays, marked up on the supplied drawing(s)
- one copy of these drawings shall be provided to the project supervisor, and a second copy shall be left in a suitable holder mounted in the appropriate data communications closet or floor distributor.
- cable run list of backbone cable from start to end location
- copies of all test results
- update any local service records as required
- completed forms necessary to meet the regulations pertaining to power installation in the Northern Territory
- documentation of all cabling components used, including manufacturer's part number
- any manuals supplied with the installed equipment and
- any keys or codes for any lockable device.

2.7 Warranty

2.7.1 System warranty

A minimum of a 20 year warranty for all structured cabling system shall be provided for an end-to-end channel model installation which covers applications assurance, cable, connecting hardware and the labour cost for the repair or replacement thereof.

2.7.2 Applications supported

Existing and future applications supported for a channel model warranty include those approved by the Institute of electronic and Electrical Engineers (IEEE), the asynchronous transfer mode (ATM) Forum, the American National Standards Institute (ANSI) or the International Organization of Standards (ISO) that specify compatibility with the cable referenced herein.

2.8 Standards

The requirements of the following standards shall be met.

2.8.1 Australian/New Zealand standards

Cabling materials and practice shall comply with the requirements of the latest edition or amendment of the following Australian standards.

Standard number	Standard title
AS/NZS 3000	Electrical installations Australian/NZ wiring rules.
AS/NZS 11801	Information technology - Generic cabling for customer premises General requirements (ISO/IEC 11801-1:2017, MOD)
AS/NZS 3013	Electrical installations – classification of fire and mechanical performance of wiring systems.
AS/NZS 3084	Telecommunications installations – Telecommunications pathways and spaces for commercial buildings.
AS/NZS 3085.1	Telecommunications Installations – Administration of communications Cabling Systems.
AS/NZS IEC 61935.1	Testing of balanced communications cabling in accordance with ISO/IEC 11801- Installed cabling.
AS/NZS IEC 61935.2	Testing of balanced communications cabling in accordance with ISO/IEC 11801- Patch cords and work area.
AS/NZS IEC 61935.2	Telecommunications installations – Advanced testing for optical fibre cabling.
AS/NZS 60950	Safety of information technology equipment.
AS/NZS 4117	Surge protective devices for telecommunications applications.
AS/CA S003	Customer switching, multiplexing and ancillary equipment for connection to a telecommunications Network.
AS/CA S008	Requirements for authorised cabling products.
AS/CA S009	Installation requirements for customer cabling (wiring rules).

2.8.2 ACMA Technical standards

Standard number	Standard title
ACA TS001-1997	Safety requirements for customer equipment (expires 1 July 2004).
ACA TS002-1998	Telecommunications technical standard (customer equipment and customer cabling).
ACMA – CPR	Cabling provider rules (latest edition).

2.8.3 International standards

Standard number	Standard title
IEEE 802.3	Carrier sense, multiple access with collision detection (CSMA/CD) access method and physical layer specifications (latest edition).
ISO/IEC 11801	Information technology – Generic cabling for customer premises.

3 Additional cabling system installation and test specifications

3.1 Separation from electrical supply

Any AC voltage over 42.4 volts AC (peak) and any DC voltage over 60 volts is considered to be hazardous. Safe extra low voltages (SELV) and telecommunications network voltages (TNV) are not considered hazardous.

High voltage (HV) power is considered extremely hazardous.

Ensure separation of all data communications cables and fittings from low voltage cables by a continuous solid barrier or 100mm spacing. This segregation is to be fully maintained at all times, especially at entry or exit points, crossovers, junctions and all accessories and fittings. Where a continuous barrier is employed, it shall be either durable insulating material or metal. If it is metal, the barrier shall be bonded to the building protective earthing system.

Data communications cable is to be physically separated from HV cables by a minimum distance of 450mm. Avoid long parallel runs of data communications cables and other higher voltage cables.

3.2 Quality and performance expectations

The installation phase of the project is the culmination of the planning and design phases, and as such it is important that the installer to have documented work practices and quality assurance procedures to include the total range of works within the project.

Connection of equipment to a public telecommunications network shall be completed by personnel complying with local telecommunications carrier licensing requirements.

During the installation activities, records must be kept of all items installed, including reference to cable pathways used, final location, identity of cables and equipment. The presentation of all of these records will provide the "as constructed" basis for all future reference to the installation.

The cabling shall be installed in accordance with manufacturer's installation instructions. The **manufacturer's certified installer** will ensure that the manufacturer's specifications for the cables meet the transmission characteristics detailed in this document and/or the relevant Australian standards.

All installed cables, termination boxes, distribution panels and wall outlets shall be marked and numbered in accordance with the relevant standards to the naming convention provided by the client. This marking and numbering shall be used during the creation of all installation records and documentation.

The testing and certification of installed cabling, interconnection hardware and patch leads shall comply with the relevant standards.

In particular the following tests should be carried out and the results documented and maintained to form part of the "As Constructed" documentation:

- test all of the copper cable installation for termination and twisted pair integrity, including continuity, polarity, pin-assignment and colour codes
- perform visual inspections to ensure that each pair of wires remain twisted as close as possible to the termination point, to maintain the impedance and minimise attenuation losses

- test the cabling installed for:
 - alien cross-talk (ANEXT)
 - near end cross-talk (NEXT)
 - PowerSum near end cross-talk (PSNEXT)
 - equal level far end cross-talk (ELFEXT)
 - PowerSum equal level far end cross-talk (PSELFEXT)
 - insertion loss
 - return loss
 - delay and
 - delay skew.

To ensure the installed cable complies with category 6A class EA, or category 7A class FA channel performance criteria, matching patch cords from the same manufacturer must be used.

An allocation of time should be allowed for the consulting engineer or the client's representative to witness the certification process and to perform some sample tests of the installed cabling system. The amount of time is outlined in the scope of works, however there should be at least to (2) Witness Points;

- once cabling has commenced and prior to ceiling tiles being installed,
- at completion of the cabling, and before testing and building finalisation work.

The documentation required at the completion of the installation phases shall contain all of the following information, together with any other information the installer has acquired during the installation:

- “as constructed” documentation, showing total cabling and connection installed, utilising floor space plans and cable record sheets. This documentation must show all cables and outlets incorporating the full numbering and marking convention supplied
- cabling test results and certification information, identified by cable, connection and numbering convention, necessary for all cables.

The installers shall provide a full statement of "workmanship warranty" applicable to the total installation, and shall state their agreement to investigate and restore any failed part of the installation when requested to do so by the client.

During the period of the project, all aspects of the installation will be monitored for progress and completion in accordance with the project plans provided by the client.

A representative of the client will be appointed to perform the tasks of project management. This individual will liaise at all times with the installers and will be responsible for the acceptance of the installation at the time of completion.

The process of acceptance will have occurred when the installer has produced the full documentation package, and when the ICT Project Manager is satisfied that all of the works have been completed and all required information has been provided.

The installer should recognise the importance of notification to the NTG appointed Project Manager of any problem or item of disruption to the installation schedule. Every effort must be made to keep within the timetables provided by the client.

All components of the cabling system should be sourced from one manufacturer to ensure minimal impedance mismatch and best possible return loss performance and to guarantee the performance from end-to-end.

The cabling system should operate without introducing or being affected by electromagnetic radiation from other sources. Maintaining segregation from other services or screening (metal conduit) are the only methods to achieve acceptable immunity.

U/FTP systems must be provided with appropriate U/FTP patch leads. **UTP patch leads are not to be used on U/FTP systems.**

3.3 Ancillary considerations

Upon completion of final engineering drawings, the contractor will provide to the ICT Project Manager:

- the building and floor distribution diagrams including cable routing, position of all components and apparatus and detail of the cabinet layout and labelling plan
- all horizontal cable routes will be detailed on a plan to the general contractor and an approved labelling plan for all work areas
- all cable trays, conduit and catenary installation plans.

3.4 Certification

The entire cabling system components and installation shall be covered by warranties provided the manufacturer and the installer. Certification shall provide a minimum 20 year product warranty, system warranty, and application assurance on applications for the passive element of the cabling system.

The system warranty shall commit the manufacturer to ensure that any standards sanctioned application introduced over the installed cabling system will function normally, over a period of a minimum of 20 years from the date of certification. If any problems are experienced during the introduction of such applications, the manufacturer shall provide the necessary support for the cabling system for the application to be activated at no cost to the user.

The product warranty shall commit the manufacturer to rectify any passive cabling component that may fail during a 20 year period from the commissioning of the cabling system, and the installer to rectify any installation errors for the same time period.

The installer shall demonstrate their certified installer status and submit a copy of their certification document, identifying the individual(s) commissioned to provide the certification of the installation.

The installation shall comprise of components in the data stream from only one manufacturer to ensure optimal end-to-end electrical and mechanical integrity.

The entire installation shall be 100% tested, with all results documented before acceptance of the installation is granted.

Every circuit should be tested end-to-end including all patch leads and fly leads and the results documented in accordance with the labelling convention supplied by the client.

Allowance must be made for the ICT Project Manager to be present at the certification process and complete spot checks.

All documentation on the certification process is to be presented in both hard copy and on compact disc and included in the "As Constructed" documentation to the ICT Project Manager.

4 Requirements for wireless networking

4.1 General

It may be a requirement of the project to install wireless access points (WAPs). The ICT Project Manager will arrange for the supply and commissioning of the WAPs.

WAPs are powered by power over Ethernet (PoE). A dedicated mains power outlet is not required at WAP locations.

4.1.1 Wireless survey

The ICT Project Manager will commission a wireless survey when the building site is at the stage where all the internal walls are constructed and prior to painting. This survey will determine the installation location for the WAP.

4.1.2 WAP hardware installation

The ICT Project Manager will provide the contractor with WAP mounting brackets which the contractor shall install at the locations identified by the wireless survey.

When installing the WAP brackets the contractor's cabling installer shall:

- unless otherwise specified, each WAP location install have a single category 6A class EA, or category 7A class FA, block mounted data outlet in the ceiling at the identified location. Data outlet labelling will be in accordance with the requirements of this document; in some cases dual outlets may be required and it is recommended that contractors engage agency ICT staff or ICT Project Manager in order to determine requirements.

A label should be placed on the ceiling grid adjacent to the WAP, and on the mounting block in the ceiling, clearly identifying the data outlet.

- the data outlet(s) shall be installed on the underside of the ceiling slab above suspended ceiling and in a location that is easily accessible from below using step ladders
- a 3m category 6A class EA, or category 7A class FA, fly-lead shall be plugged into the data outlet and left suspended above the ceiling grid; this fly-lead will be labelled at both ends (within 50mm) of the data jack with the data outlet number it is connected to – the label must be attached in such a way that it is secure and fully visible
- the WAP mounting brackets shall be fitted onto the underside of a suspended ceiling tile grid as directed by the ICT Project Manager
- the contractor shall locate the free end of 3m fly-lead and route it to the WAP bracket and then through the edge of the ceiling tile to a distance of no more than 300mm.

Notwithstanding the above, if a data outlet is approved for installation on the ceiling tile frame, then the shortest fly lead to suit the application may be used. The ICT Project Manager may give approval and advice on fly lead length.

The NTG will install the WAP to the brackets and connect the fly-lead to the WAP.

5 Requirements for closed circuit television (CCTV)

5.1 General

Server rooms may require internal monitoring by CCTV. The contract documentation will identify if a camera is required. The ICT Project Manager can also provide input.

5.1.1 CCTV hardware installation

The CCTV location will be nominated by the ICT Project Manager.

The CCTV camera will require a single category 6A class EA, or category 7A class FA, block mounted data outlet provided by the contractor.

NTG will utilise the services of a CCTV sub-contractor for the installation and commissioning of the camera.

CCTV cameras are powered by power over Ethernet (PoE). A dedicated mains power outlet is not required at CCTV locations.

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