UCT Structured Cabling System Guidelines and Specifications for External Contractors

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Document Control

Version Control

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1	10 February 2013	Creation of document	Bruce Fielies	Bruce Fielies
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Overview

The installation of ICT infrastructure in buildings can be divided into a number of discrete but interrelated components. This document seeks to explain those components, clarify ICTS's role in each of them, and define the university's standards and expectations. Detailed specifications for contractors are included as separate sections of this document.

Background

The university's current data network has evolved over a number of years and stretches across a number of geographically discrete sites – such as the Upper, Middle and Lower Campuses, Medical School and the Graduate School of Business – as well as to a number of student residences (both on and off campus).

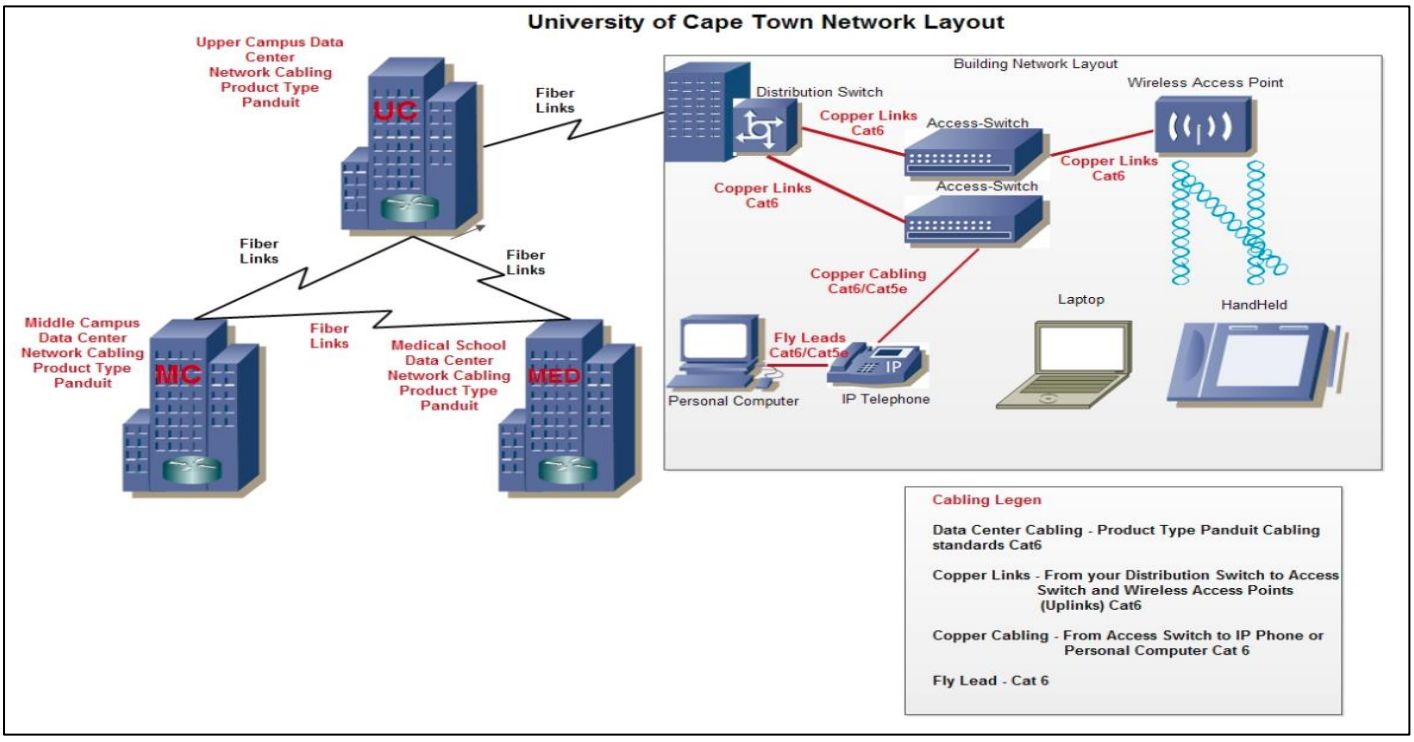
ICTS engages with daily operational requests that include minor and major operational network cabling installations. Among these are projects that include building renovations and maintenance to the Campus network structured cabling infrastructure.

The current network is a mix of IEC/ISO 11801 (2002) Class D, Class E, Class EA 50/125 and 62.5/125 micron multi-mode and 9 or 10/125 micron single-mode mixed plant fibre optic cabling wired in a centralised or de-centralised star topology – depending on the location.

Periodically, the network infrastructure and supporting hardware and environment is extensively re-fitted in order to deliver the services needed by UCT's leading research and teaching units.

As a general guideline, the network provides multiple gigabit fibre opticcapability, redundant services for the backbone sub-component and Gigabit to multi-Gigabit capable Structured Cabling System (SCS).

A great emphasis is placed on reliable SCS operation over the full life-span of the system as well as future expansion capability in terms of route capacity and SCS-supported applications (1Gbps, 10Gbps and future 40/100Gbps).



ICT components of a building renovations project

In any building renovation project, the ICT requirements can be roughly divided into five separate components – three of which are within the scope of the project work, and two of which will be completed by ICTS once the building is complete and has been handed over to the university. General considerations for all components are given in **Section D.**

Interior civil works

Interior civil works include all cable pathways, trays, ducts, conduits, etc. required to get structured data cabling from each point in each room of the building back to a central location within that building. As the requirement for such cable pathways is intricately linked to the installation of the interior cabling, these two aspects are contained in a single requirements document.

Additionally, these works include the establishment of a centrally-located Network Distribution Centre – a small room set aside to house the communications equipment required by the building. In order to house the required equipment and ensure ease of future maintenance and growth, this room has specific requirements with regard to layout, accessibility, electrical power, etc. Detailed specifications of this requirement are given in **Section B.**

Interior cable works

Interior cable works include the installation, termination, labelling, and certification of all structured data cables within the building. This work also includes the installation of Telecommunication Outlets (TO) and in-rack cable looms to provide a complete, certified, end-to-end SCS ready for immediate connection to the university's network switches and other infrastructure.

Due to the limitations imposed by SCS, the interior cable work is intricately linked to the civil works required to support such cables. As a result, combined specifications for the two requirements are given in **Section A**.

Exterior civil works

Exterior civil works are those excavations, road works, paving, underground sleeves, manholes, maintenance holes, etc. that are required to interconnect the Network Distribution Centre established by the new project – to the university's existing fibre optic cable reticulation system. These works should establish two independent cable-ready routes – one to each of the existing network distribution centres serving the area in which the building is located.

The design of these routes needs to consider UCT's overarching network design, the requirements for network redundancy and resiliency, the re-use of existing routes, and the potential for re-use of any new routes established by the project. As such, we expect that these route designs will be done in consultation with ICTS project staff. Detailed specifications of this requirement are given in **Section C**.

Exterior cable works

Exterior cable works cover the installation of the necessary fibre optic cables required to connect the newly-established network distribution centre to UCT's existing network.

Due to SCS-imposed limitations, the exterior cable work is intricately linked to the civil works required to support such cables. As a result, combined specifications for the two requirements are given in **Section A.**

This work is typically undertaken by the installer during the project implementation phase. The project needs to make appropriate budgetary provision for this work (see **Section E**).

Connection to the university's network

The final stage in connecting a building to the university's data network involves the installation of network switches, uninterruptable power supplies, and other communications equipment into the newly-established network distribution centre. Like the exterior cable work, this work is typically undertaken by the installer and ICTS during the project lifecycle. The project needs to make appropriate budgetary provision for this work (see **Section E**).

ICTS becomes the ultimate custodian of all interior structured communications cabling and the associated infrastructure: by university mandate, ICTS must ensure that any installation conforms to the university's internal standards, and is responsible for connecting any new or renovated building to the university's existing data network. Additionally, once a project is handed over, ICTS becomes responsible for the long-term maintenance of any such installation.

To ensure that it is in a position to meet these ongoing obligations, ICTS has certain expectations as regards its involvement in any major building project. Ultimately, ICTS represents the university as the "client" in such a project, but it is a knowledgeable client that can bring a wealth of ICT experience and expertise to the table.

As a representative of the client, at the very least, ICTS expects to be involved in three major areas of any project:

1. **The requirements establishment and initial specification phase:** This will help the building's eventual occupants to understand their ICT requirements. It will also bring in the broader university ICT perspective.

2. **The approval of final design before implementation:** This will ensure that all requirements are adequately catered for, that any necessary compromises are acceptable, and that ICTS specifications will be met.

3. **The final commissioning and hand-over phase:** This will ensure that work has been completed to an adequate standard and that all the design requirements and specifications have been met.

However, the exact nature of ICTS's involvement will differ in each of these components.

Table 1 below summarises ICTS's expectations of involvement at each stage of the project lifecycle for each component.

Table 1: Summary of ICTS's involvement

Project Phases	ICT Components: Interior Civil Works	Interior Cable Works	Exterior Civil Works	Exterior Cable Work	Connect to the network	Voice
Requirements Establishment	In conjunction with the PM and client	In conjunction with the new occupant of the building	In conjunction with the PM and client	In conjunction with the PM and client	In conjunction with the PM and client	In conjunction with the PM and client
Budget Preparation	ICTS to be consulted	In conjunction with the PM and client	ICTS to be consulted	In conjunction with the PM and client	In conjunction with the PM and client	In conjunction with the PM and client
Design & Planning	ICTS to be consulted	In conjunction with the PM and client	Establish the intersection with existing systems	Handled by the project in consultation with ICTS	Handled by ICTS and cabling contractor	Handled by ICTS and cabling contractor
Final Design Approval	Sign off	Sign off	Sign off	UCT Network Blueprint	UCT Network Blueprint	UCT Network Blueprint
Contractor Selection	ICTS to be consulted	Pre-approved list	ICTS to be consulted	Pre-approved list	Pre-approved list	Pre-approved list
Construction & Implementation	ICTS to be consulted	In conjunction with the PM and client	ICTS to be consulted	Handled by the project in consultation with ICTS	Handled by ICTS and cabling contractor	Handled by ICTS and cabling contractor
Commissioning & Handover	Sign off	Sign off	Sign off	Sign off	Sign off	Sign off

In this table, the green entries indicate where ICTS needs to be involved, while the white entries indicate where ICTS is not directly involved, but should still be consulted. The last two columns are included in the table for completeness, and to draw attention to the budgetary implications of these components. See **Section E** for details.

Section A: Structured Cabling System Standards for UCT

1. Design considerations

1.1 Cable routes and network distribution centre locations should be planned such that no cable length shall exceed 90 metres when measured for permanent link and 90m+10m for channel as specified in the applicable standards.

1.2 By preference, cable routes should pass at ceiling height in a suspended ceiling or similar. Cable routes should not pass underground or outside the main structure of the building except with the prior approval of ICTS.

1.3 In multi-story installations, cabling between floors must be routed via a cabling riser or duct.

1.4 Where cable routes pass between floors or through designate fire control walls, the design needs to include provision for suitable fire stop material. Such material needs to be removable and replaceable in order to facilitate future work.

1.5 Cable routes should have a capacity that is greater than or equal to the aggregate of their branches (i.e. where two equal sized routes join, the feeder route must have at least double the capacity of each branch route).

1.6 The capacity of a particular cable route is to be measured at the narrowest point along that route. This makes it important to pay attention to the capacity of wall crossings, etc.

1.7 UCT prefers the use of CommScope Netconnect (KRONE) or Panduit products, including patch panels and brush panels, for the management and termination of the cables in a Network cabinet or Panduit NetFrames as shown in **Figures 1 to 3** below. This means that:

- 1.7.1 Every network socket (work area outlet) should be connected to a single port on a patch panel within the network cabinet. No network socket should be connected directly into the network equipment.
- 1.7.2 Switch ports will be directly connected to the patch panel by means of 1 metre patch leads. The patch leads should connect to the switch ports then enter and exit through a brush panel, before connecting to a patch panel (as shown in **Figures 1 and 2** below).
- 1.7.3 If a Panduit NetFrame is used, no brush panels are needed – since the NetFrame comes with horizontal side cable managers (as shown in **Figure 3** below).
- 1.7.4 All patch panels and switches should be labelled appropriately.
- 1.7.5 Only 24 or 48 port patch panels should be used.
- 1.7.6 A maximum of 24 patch leads should enter and exit a single brush panel.

1.8 Special consideration needs to be given when data cables need to be installed into fixed furniture. Designs for such cabling must be discussed with ICTS.

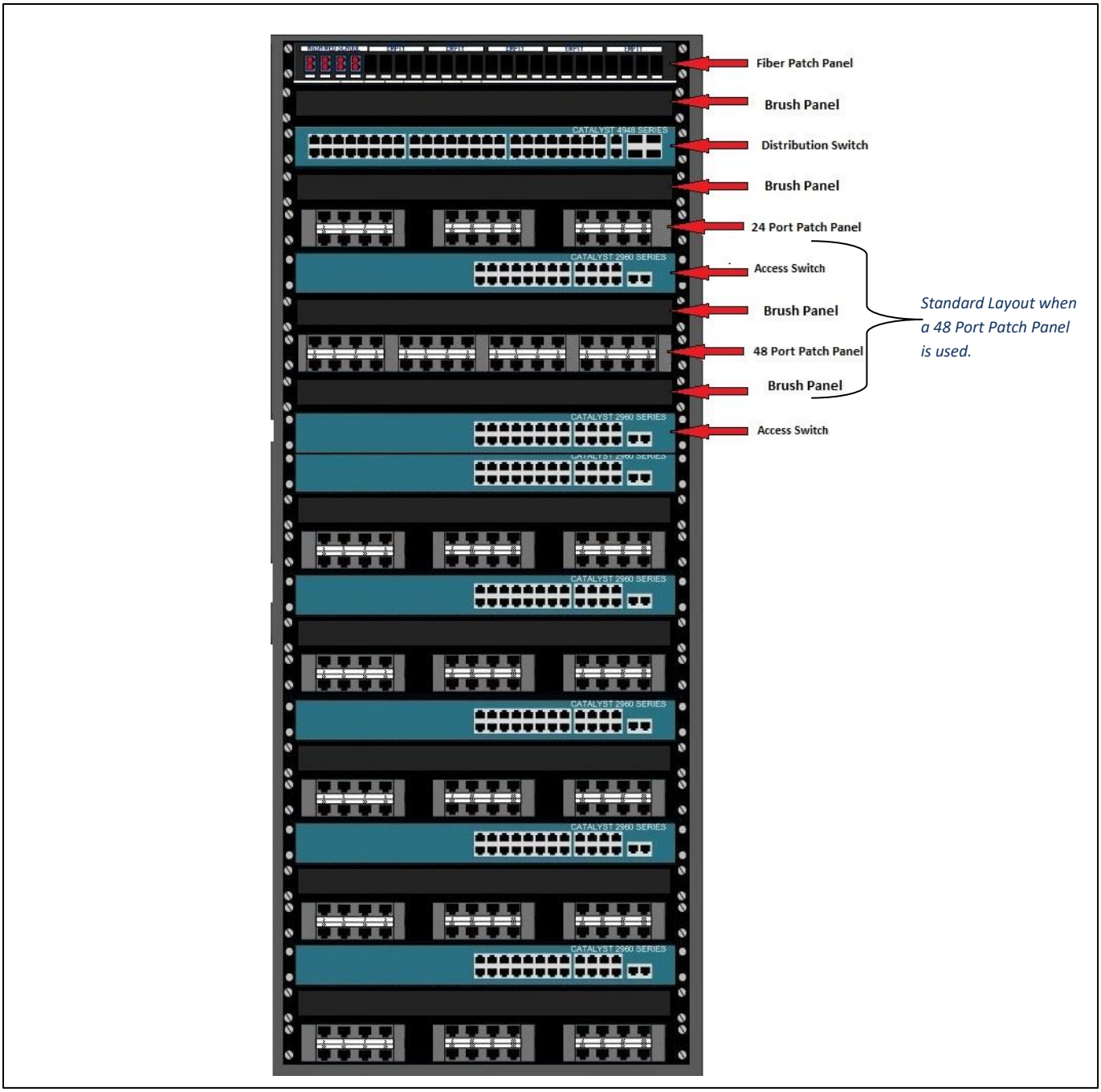


Figure 1: 25U Network Cabinet layout

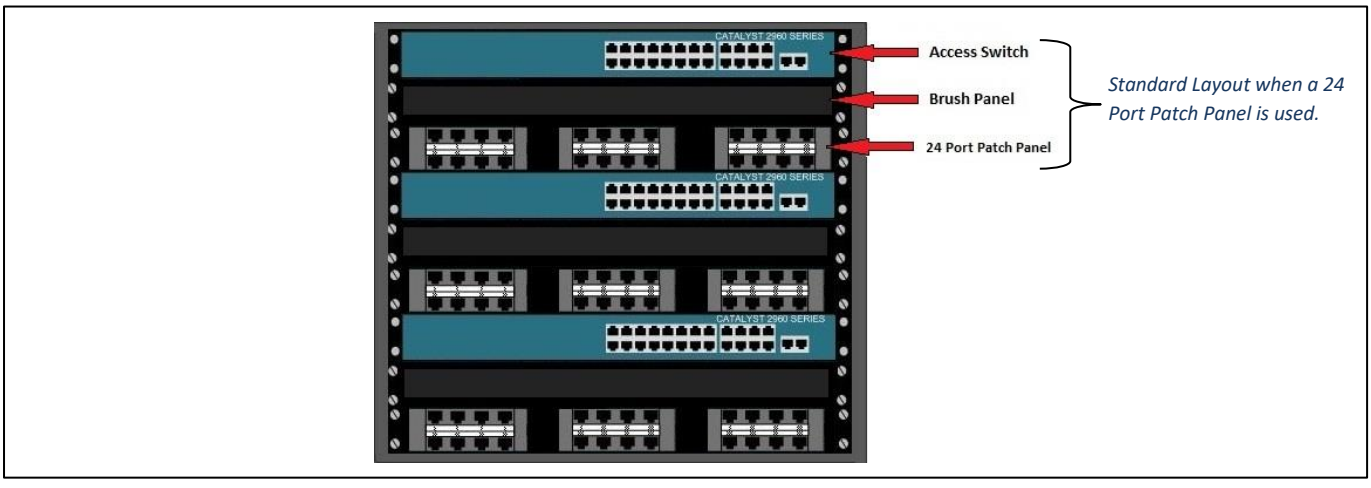


Figure 2: 9U Network Cabinet layout

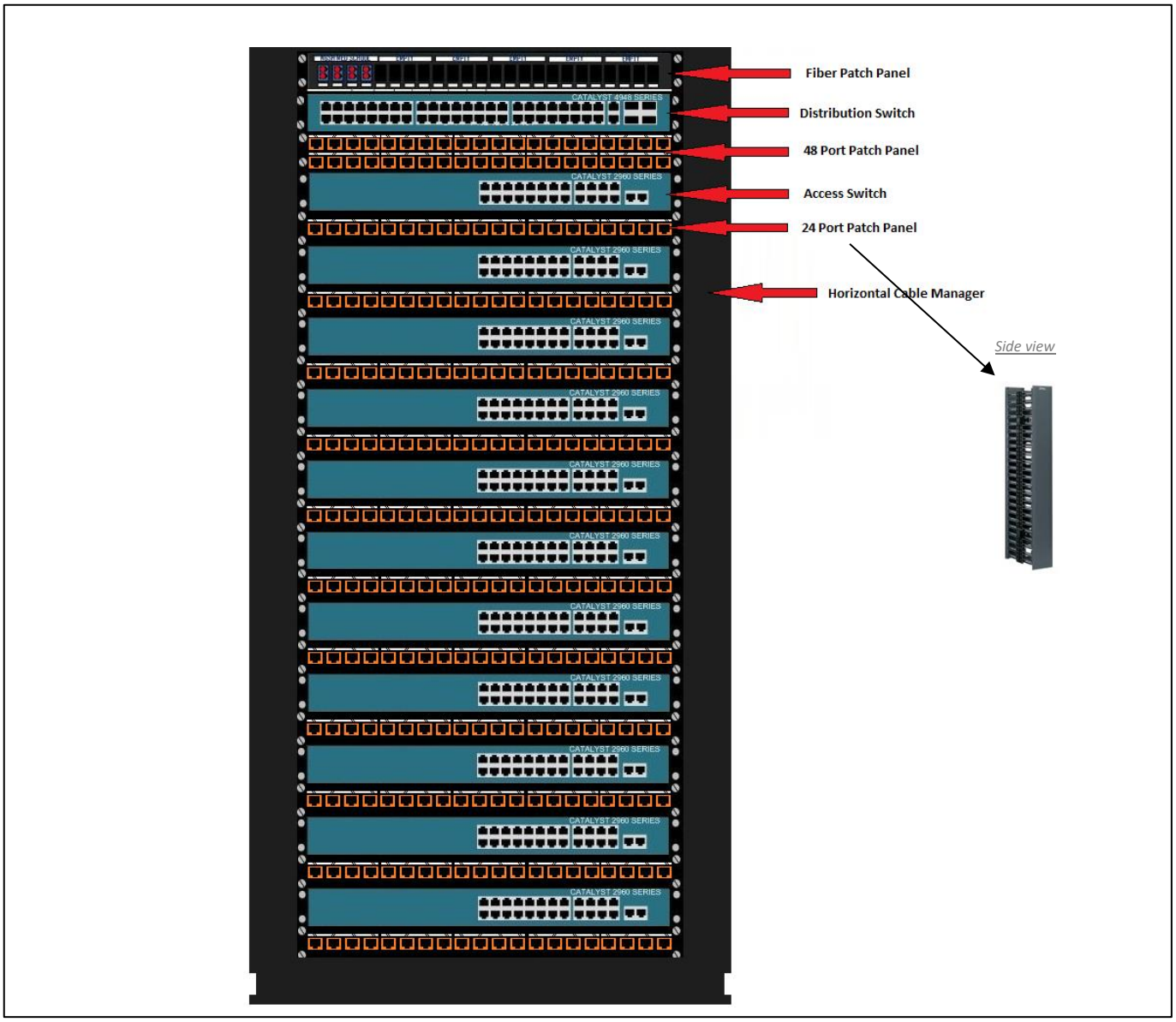


Figure 3: Panduit NetFrame layout

2. Installation considerations

2.1. The installer is expected to provide all cable, telecommunications outlet, patch panels, system tails, ducting and other infrastructure necessary to complete the full end-to-end connection between the telecommunications outlet in a room and the network switch in a telecommunications enclosure located in the network distribution centre.

2.2. The installer is expected to supply a network cabinet with the following minimum specification:

- 2.2.1 42U (h) x 800 mm (w) x 1000 mm (d).
- 2.2.2 Front and back mounting rails (industry standard with squared holes to accommodate cage nut assemblies).
- 2.2.3 2 x 10 way metal power duct (with a minimum of 10A CB protection each).
- 2.2.4 Perforated front and rear doors.
- 2.2.5 Brush cable entry at the bottom of the cabinet.
- 2.2.6 304mm Cable tray for cable routing of cable looms.

2.3. The installer will also be expected to install network switches procured by the project and configured by ICTS.

2.4. Every installation shall consist of:

- 2.4.1 Patch panel.

2.4.2 Solid twisted pair cable (of the construction and category specified).

2.4.3 Telecommunications outlet (flush mounted with all the required face plates, adapters and all other items needed to properly install the TO in the environment it is located). Surface mounted outlets will only be accepted with written approval from ICTS.

2.4.4 3m patch cord – of the same category specified (for connection at the user side, unless a different length is specified).

2.4.5 1m patch cord – of the same category specified (for connection at the user side, unless a different length is specified).

2.5. Installers must take care that no undue stress is placed on the cable while installing.

2.6. Termination at both ends will be in line with manufacturer recommendation and industry standards and the untwist of cable pair shall be 0 mm for Category 6 and Category 6A/Class E and Class EA installations.

2.7. Cable sheath shall remain intact for the entire length of cable installed and the cable sheath at the terminations will be kept to a minimum. No cable sheath removal will be allowed away from the termination ends.

2.8. All cables shall be protected where it crosses sharp metal edges, entry into telecommunication enclosures, passing through power skirting and any other area where possible cable damage could occur.

2.9. Only components of the same manufacturer and of the same category/class shall be used for any installation and addition to existing installations.

3. Hand-over considerations

3.1. On hand-over, ICTS expects the following to be made available:

3.1.1 Detailed test results for all cables, tested with Fluke DSP or DTX or DSX cable analyser or other approved Level III or higher cable test equipment. These are to be supplied in electronic format.

3.1.2 Proof of calibration for the cable analyser used.

3.1.3 Photos to be supplied with all installations upon sign-off.

3.1.4 Network Checklist sign-off sheet.

3.1.5 Manufacturer system and product warranty of no less than 25 years.

3.1.6 Complete layout drawings of the installation including: floor plans, telecommunications enclosure location, cable routes, and telecommunications outlet location.

3.1.7 Keys for any supplied telecommunications enclosure.

3.2. Random acceptance testing shall be performed using ICTS's own cable analyser. These results will be compared with the corresponding scan certificates provided. Any variances outside the margin of error shall be grounds for withholding acceptance until the problem is rectified.

4. General provisions & specifications

4.1. Materials & handling

4.1.1 All materials must be new, complete, in good condition, and unused. Materials are to be visually inspected for damage on-site and before use.

4.1.2 All installations must use CommScope Netconnect (KRONE) or Panduit-approved components, and must conform to ANSI/TIA/EIA-568-C Category 6A / ISO 11801 Class EA (Category 6/A Class EA should be used in all new installations).

4.1.3 Additionally, all installations must conform to the vendors' instructions, best practices, and standards for the product(s) used.

4.1.4 Cable must not be pulled under excessive load, and all cable must be free of kinks, snags, and twists during and after installation. Wherever possible cable should be placed in pathways rather than

pulled under tension. Balanced twisted-pair cable slack between 200 mm and 300 mm should be stored at or in close proximity to (within 6m) telecommunication outlet locations.

4.1.5 Cable bends must have a minimum radius of 8x the outer diameter when installing and 4x the outer diameter after installation. Conduit and ducting should have a bend radius of no less than 6 x the diameter of the largest cable.

4.1.6 Cable must not be installed in areas exposed to direct sunlight or temperatures that might exceed the manufacturer's specifications.

4.1.7 No network cable should be normally visible except within the building network distribution centre.

4.2 Copper Materials Specification

4.2.1 Cable

4.2.1.1 Panduit & CommScope Netconnect (KRONE) Cabling solutions.

4.2.1.2 Exceeds requirements of ANSI/TIA-568-C.2 Category 6A, IEEE 802.3an-2006, and ISO 11801 Class EA channel standards.

4.2.1.3 Exceeds requirements of ANSI/TIA-568-C.2 Category 6A and IEC 61156-5 Category 6A component standards.

4.2.1.4 Certified channel performance in a 4-connector configuration up to 100 meters and exceeds the requirements of ISO 11801 Class EA standards swept up to 500 MHz for supporting 10GBASE-T transmission over twisted-pair cabling systems as part of the Panduit® TX6A™ 10Gig™ UTP Copper Cabling System. Certified component performance up to 100 meters and exceeds the IEC 61156-5 Category 6A standards for supporting 10GBASE-T transmission over twisted-pair cabling systems.

4.2.1.5 Category 6A, low smoke zero halogen (LSZH), 4-pair, UTP copper cable. Copper conductors are 23 AWG with HDPE insulation. Conductors are twisted in pairs, separated by an integrated pair divider, surrounded by a matrix tape and protected by a low smoke zero halogen (LSZH) jacket.

4.2.1.6 Meets IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE applications.

4.2.1.7 Cable design suppresses alien crosstalk with enhanced internal electrical performance.

4.2.1.8 Round cable design with reduced cable diameter enables improved cable bundling and optimises fill capacity.

4.2.1.9 Flame rating: HDPE (LSZH-1): IEC 60332-1, 60754-2, 61034-2.

4.2.1.10 Cable diameter: (7.6mm) nominal.

4.2.1.11 Installation temperature range: 32°F to 140°F (0°C to 60°C).

4.2.1.12 Operating temperature range: -4°F to 167°F (-20°C to 75°C).

4.2.1.13 Installation tension: 25 lbf (110 N) maximum.

4.2.1.14 All testing and headroom shall be based on 48-port/1RU panels.

4.2.1.15 European Source is preferred .

4.2.1.16 Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable scrap.

4.2.2 Module

4.2.2.1 Exceeds channel requirements of ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA standards for supporting 10GBASE-T transmission over twisted pair cabling systems in a 4-connector configuration up to 100 meters at swept frequencies 1 to 500 MHz.

4.2.2.2 Exceeds component requirements of ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA standards at swept frequencies 1 to 500 MHz Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.

4.2.2.3 Each jack is 100% tested to ensure NEXT and RL performance and is individually serialized for traceability.

4.2.2.4 Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module.

4.2.2.5 Meets ANSI/TIA-1096-A contacts plated with 50 micro inches of gold for superior performance.

4.2.2.6 Meets IEC 60603-7 and IEC 60512-99-001.

4.2.2.7 UL 1863 (Use as communications circuit accessory) UL 2043 (Suitable for use in air-handling spaces).
4.2.2.8 PoE compliance: Rated for 2500 cycles with IEEE 802.3af / 802.3at and proposed 802.3bt type 3 and type 4.
4.2.2.9 Operation Temperature range: -10°C to 65°C (14°F to 149°F).
4.2.2.10 Tool less Module.
4.2.2.11 Can be re-terminated up to twenty times.
4.2.2.12 Blue termination cap designates Category 6A performance and provides positive strain relief; helps control cable bend radius and securely retains wires.
4.2.2.13 Terminate 4-pair, 22 – 26 AWG, 100 ohm, solid or stranded twisted pair cable.
4.2.2.14 Universal termination cap is color-coded for T568A and T568B wiring schemes.
4.2.2.15 Accept 6 and 8-position modular plugs without damage.
4.2.2.16 Can be clearly identified with optional labels and icons.
4.2.2.17 Optional Dust cap keeps out dust and debris while not in use.
4.2.2.18 RoHS Compliant.

4.2.3 Patch Panel

4.2.3.1 Angled patch panel If cabinet design allowed – which eliminates the need for horizontal cable managers by letting patch cords to be routed directly into vertical cable managers. Otherwise use Flat Patch Panel.
4.2.3.2 24 or 48 ports in 1U with labels.
4.2.3.3 Allow labelling scheme and port identification to be visible at all times.
4.2.3.4 Allow front access to installed modules for easy moves, adds and changes.
4.2.3.5 Accept 8-position, 8-wire universal module for UTP, Fibre optic, and audio/video, which snap in and out for easy moves, adds, and changes.
4.2.3.6 Mount to standard EIA 19" racks or 23" racks with optional extender brackets.
4.2.3.7 RoHS Compliant.

4.2.4 Patch Cord

4.2.4.1 Exceed requirements of ANSI/TIA-568-C.2 Category 6A, IEEE 802.3an-2006, and ISO 11801 Class EA channel standards.
4.2.4.2 Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.
4.2.4.3 Certified channel performance in a 4-connector up to 100 meters.
4.2.4.4 Meets IEC 60603-7.
4.2.4.5 Each patch cord is 100% performance tested and wired to T568B.
4.2.4.6 Constructed of 26 AWG stranded copper cable and Modular Plugs for superior performance.
4.2.4.7 Plug meets all applicable ANSI/TIA-968-A requirements contacts plated with compliance: 50 micro inches of gold for superior performance and exceeds IEC 60603-7 specifications.
4.2.4.8 Operating temperature: 14°F to 140°F (-10°C to 60°C).
4.2.4.9 Slender strain relief boot provides easy access in high density applications.
4.2.4.10 Plug uses an integral pair manager to optimise performance and consistency by reducing untwisting of conductors within the plug.
4.2.4.11 Plug performance in centre of TIA/EIA component range, ensuring interoperability and 10GBASE-T Ethernet channel performance.
4.2.4.12 Labels on patch cords provide identification of performance level, length, and quality control number.
4.2.4.13 Cable diameter: 0.240 in. (6.1mm) nominal.
4.2.4.14 Tangle-free latch prevents snags and provides easy release, saving time on frequent moves, adds, and changes.

4.2.4.15 RoHS Compliant.
4.2.4.16 Rated to 2500 mating cycles.
4.2.4.17 UL 1863 approved.

4.2.5 Category 6A UTP Field Term RJ45 Plug

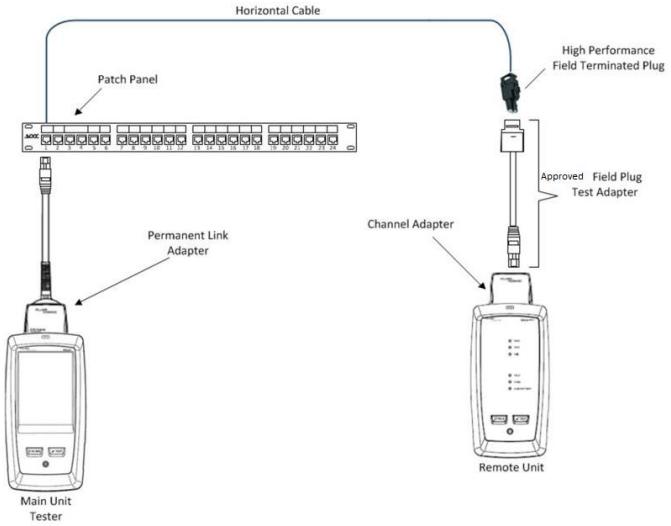
The simple-to-attach Field-Term Plug is ideal for connecting the increasing number of network-powered devices requiring a plug connection to the network and where field attachment of the plug to UTP cable is desired.

4.2.5.1 Typical applications include:

4.2.5.1.1 Wireless access points (WAPs)
4.2.5.1.2 Power over Ethernet (PoE) LED lighting
4.2.5.1.3 IP security cameras and motion sensors
4.2.5.1.4 Building access control points
4.2.5.1.5 Network-attached Audio/Video equipment
4.2.5.1.6 Other PoE or HDBASE-T powered network devices

4.2.5.1.7 Standards include:

4.2.5.1.7.1 Exceeds ANSI/TIA 568-C.2 Category 6A and ISO 11801 Class EA Channel performance requirements with up to two field term plugs in channel. Meets or exceeds proposed TIA Modular Plug Terminated Link requirements with up to two field term plugs in link.
4.2.5.1.7.2 Compatible with 4-pair, 22–26 AWG solid or stranded unshielded twisted pair cable with conductor insulation diameters of 0.060 in. maximum and overall cable O.D. 0.200 in. to 0.330 in.
4.2.5.1.7.3 Meets ANSI/TIA-1096-A (formerly FCC Part 68).
4.2.5.1.7.4 IEC 60603-7, IEC 60529 (IP 20).
4.2.5.1.7.5 Supports IEEE 802.3af / 802.3at (PoE/PoE+) and proposed 802.3bt type 3 and type 4 (PoE++) applications.
4.2.5.1.7.6 Rated to 2500 mating cycles.
4.2.5.1.7.7 UL 1863 (Use as communications circuit accessory) UL 2043 (Suitable for use in air-handling spaces).
4.2.5.1.7.8 Operating temperature: -10°C to 65°C (14°F to 149°F).
4.2.5.1.7.9 Cable with Direct Attach field plug must get a 25 years performance warranty.
4.2.5.1.7.10 Cable testing must follow below testing setup procedure using approved Field plug test adapter.



4.2.6 Fibre Materials Specification

4.2.6.1 Single Mode Fibre Indoor/Outdoor Cable

4.2.6.1.1 Cable

4.2.6.1.1.1 Optical fibres meet or exceed numerous standards for optical fibre (Categories A, B, C and D).

4.2.6.1.1.2 EN 50173, IEC 60793-1, ISO/IEC 24072 and TIA-492CAAA. Recommended OS2 SM G.657.A1.

4.2.6.1.1.3 CST or HDD for outdoor long distance (corrugated steel tape or heavy-duty duct).

4.2.6.1.1.4 Used within buildings and outdoor environments for transitional aerial and duct applications, and in entrance facilities that require low smoke zero halogen (LSZH) rated cable.

4.2.6.1.1.5 Eliminates the need for building entrance transition point.

4.2.6.1.1.6 All-dielectric cable construction requires no grounding or bonding.

4.2.6.1.1.7 Dry water-blocking technology allows rapid cable preparation and termination for lower termination costs and time (no messy gel required).

4.2.6.1.1.8 Low smoke zero halogen (LSZH) rated jacket meets IEC 60332-1, IEC 61034, and IEC 60754-2 for standards compliant safety.

4.2.6.1.1.9 (2, 4, 6, 8, 12, 24, 36, 48 & 72) Core SM Fibre Optic.

4.2.6.1.1.10 Sheath markings provide positive identification, quality traceability, and length verification.

4.2.6.1.1.11 RoHS-compliant.

4.2.6.1.1.12 250µm buffer coating protects fibres during handling and allows for ease of stripping.

4.2.6.1.1.13 Core Diameter: 8.2µm typical.

4.2.6.1.1.14 Cladding Diameter: 125µm ± 0.7µm.

4.2.6.1.1.15 Cladding Non-Circularity: ≤ 1%.

4.2.6.1.1.16 Core-Cladding Concentricity: ≤ 0.5µm.

4.2.6.1.1.17 Coating Diameter: 242µm ± 7µm.

4.2.6.1.1.18 Coating-Cladding Concentricity: ≤ 12µm.

4.2.6.1.1.19 Attenuation: 1310nm: ≤ 0.39dB/km , 1310 – 1625nm: ≤ 0.34dB/km and 1550nm: ≤ 0.25dB/km.

4.2.6.1.1.20 Numerical Aperture: 0.14 typical.

4.2.6.1.1.21 Operating Temperature Range: -60° C to +85° C.

4.2.6.1.1.22 Temperature Dependence (-60° C to +85° C): ≤ 0.05dB/km.

4.2.6.1.1.23 Temperature-Humidity Cycling (-10° C to +85° C, up to 98% RH): ≤ 0.05dB/km.

4.2.6.1.1.24 Water Immersion (23° C ± 2° C): ≤ 0.05dB/km.

4.2.6.1.1.25 Heat Aging (85° C ± 2° C): ≤ 0.05dB/km.

4.2.6.2 Connector

4.2.6.2.1 Pigtails connectors.

4.2.6.2.2 Pass all TIA/EIA-568-C.3 performance requirements.

4.2.6.2.3 100% factory-inspected end face geometry in compliance with Telcordia GR-326-CORE, Issue 3.

4.2.6.2.4 Typical insertion loss per connection: 0.25dB.

4.2.6.2.5 UPC polished (55dB minimum return loss).

4.2.6.2.6 Factory-terminated and 100% tested for insertion loss and return loss.

4.2.6.2.7 Insertion loss and return loss data recorded for every singlemode patch cord.

4.2.6.2.8 Lifetime traceability of test data to a quality control number on each patch cord.

4.2.6.2.9 Highest quality flame-retardant fibre optic cable with tight-buffered coating on each optical fibre.

Note: Field Pre-Polished Connecter termination is permitted if meets acceptable insertion loss and approved by UCT.

4.2.6.3 Fibre Enclosure

4.2.6.3.1 Integral mounting flange for installation in 19" wide EIA-310 racks.

4.2.6.3.2 Holds Fibre adaptors panels.

4.2.6.3.3 Suitable for all pre-terminated, field terminated, or field-splice applications.

4.2.6.3.4 Up to four cassettes or FAPs per rack unit for maximum patch field density.

4.2.6.3.5 Slide-out, tilt-down drawer provides full front access to all fibres and cables.

4.2.6.3.6 Integral bend radius control and cable management for fibre optic patch cords.

4.2.6.3.7 Multiple trunk cable entry locations.

4.2.6.3.8 Include fibre optic cable routing kit (grommets, cable ties, spools, strain relief bracket, and ID/caution labels) for various cable management solutions.

4.2.6.4 Fibre adaptors panels

4.2.6.4.1 Fibre adapter panels contain TIA/EIA-604 FOCIS-compliant or compatible simplex or duplex fibre optic adapters.

4.2.6.4.2 Meet TIA/EIA-568-C.3 requirements.

4.2.6.4.3 Meet MPO: TIA/EIA-604 FOCIS-5 compliant, LC: TIA/EIA-604 FOCIS-10 compatible, SC: TIA/EIA-604 FOCIS-3-compliant.

4.2.6.4.4 Follow the TIA/EIA-568-C.3 suggested colour identification scheme.

4.2.6.4.5 Split sleeve material: Zirconia ceramic.

4.2.6.4.6 Supports UPC connector.

4.2.6.5 Patch Cord

4.2.6.5.1 Pass all TIA/EIA-568-C.3 performance requirements.

4.2.6.5.2 100% factory-inspected end face geometry in compliance with Telcordia GR-326-CORE, Issue 3.

4.2.6.5.3 Typical insertion loss per connection: 0.35dB.

4.2.6.5.4 UPC polished (55dB minimum return loss).

4.2.6.5.5 Factory-terminated and 100% tested for insertion loss and return loss.

4.2.6.5.6 Insertion loss and return loss data recorded for every singlemode patch cord.

4.2.6.5.7 Lifetime traceability of test data to a quality control number on each patch cord.

4.2.6.5.8 Highest quality flame-retardant fibre optic cable with tight-buffered coating on each optical fibre.

4.2.7 Multimode Fibre Indoor/Outdoor Cable

4.2.7.1 Cable

4.2.7.1.1 OM4 exceed TIA-492AAAB, TIA-492AAAC, TIA-492AAAD and IEC 60793-2-10 and Telcordia GR-20-CORE specifications.
4.2.7.1.2 Used within buildings and outdoor environments for transitional aerial and duct applications, and in entrance facilities that require low smoke zero halogen (LSZH) rated cable.
4.2.7.1.3 Eliminates the need for building entrance transition point.
4.2.7.1.4 All-dielectric cable construction requires no grounding or bonding.
4.2.7.1.5 Dry water-blocking technology allows rapid cable preparation and termination for lower termination costs and time (no messy gel required).
4.2.7.1.6 Low smoke zero halogen (LSZH) rated jacket meets IEC 60332-1, IEC 61034, and IEC 60754-2 for standards-compliant safety.
4.2.7.1.7 (2, 4, 6, 8, 12, 24, 36, 48 & 72) Core MM Fibre Optic.
4.2.7.1.8 Sheath markings provide positive identification, quality traceability, and length verification.
4.2.7.1.9 RoHS Compliant.
4.2.7.1.10 250µm buffer coating protects fibres during handling and allows for ease of stripping.
4.2.7.1.11 Cable shall support network transmission speeds up to 10 Gb/s for link lengths up to 300 metres with an 850nm source per IEEE 802.3ae 10 GbE Standard; backward-compatible for use with all 50/125µm system requirements.
4.2.7.1.12 Core Diameter: 50.0µm ± 2.5µm.
4.2.7.1.13 Core Non-Circularity: ≤ 5%.
4.2.7.1.14 Cladding Diameter: 125µm ± 1µm.
4.2.7.1.15 Cladding Non-Circularity: < 1%.
4.2.7.1.16 Core-Cladding Concentricity: ≤ 1.5µm.
4.2.7.1.17 Coating Diameter: 245µm ± 10µm.
4.2.7.1.18 Coating-Cladding Concentricity: < 10µm.
4.2.7.1.19 Attenuation: 850nm: ≤ 3dB/km, 1300nm: ≤ 1dB/km.
4.2.7.1.20 Temperature Dependence - 850nm (-60° C to +85° C): ≤ 0.10dB/km.
4.2.7.1.21 Temperature Dependence - 1300nm (-60° C to +85° C): ≤ 0.10dB/km.
4.2.7.1.22 Temperature-Humidity Cycling - 850nm (-10° C to +85° C, >90% RH): ≤ 0.20dB/km.
4.2.7.1.23 Temperature-Humidity Cycling - 1300nm (-10° C to +85° C, >90% RH): ≤ 0.20dB/km.

4.2.7.2 Connector

4.2.7.2.1 Pigtails connectors.
4.2.7.2.2 Pass all TIA/EIA-568-C.3 performance requirements.
4.2.7.2.3 Insertion loss per connection: 0.25dB maximum.
4.2.7.2.4 PC polished (26dB minimum return loss).
4.2.7.2.5 Backward-compatible for use with all 50/125µm system requirements.
4.2.7.2.6 Factory terminated and 100% tested for insertion loss.
4.2.7.2.7 Insertion loss data recorded for every multimode patch cord.
4.2.7.2.8 Lifetime traceability of test data to a Q.C. number on each patch cord.
4.2.7.2.9 Highest quality flame-retardant fibre optic cable with tight-buffered coating on each optical fibre.

4.2.7.3 Fibre Enclosure

4.2.7.3.1 Integral mounting flange for installation in 19" wide EIA-310 racks.
4.2.7.3.2 Holds fibre adaptors panels.

4.2.7.3.3 Suitable for all pre-terminated, field terminated, or field-splice applications.
4.2.7.3.4 Up to four cassettes or FAPs per rack unit for maximum patch field density.
4.2.7.3.5 Slide-out, tilt-down drawer provides full front access to all fibres and cables.
4.2.7.3.6 Integral bend radius control and cable management for fibre optic patch cords.
4.2.7.3.7 Multiple trunk cable entry locations.
4.2.7.3.8 Include fibre optic cable routing kit (grommets, cable ties, spools, strain relief bracket, and ID/caution labels) for various cable management solutions.

4.2.7.4 Fibre adaptors panels

4.2.7.4.1 Fibre adapter panels contain TIA/EIA-604 FOCIS compliant or compatible simplex or duplex fibre optic adapters.
4.2.7.4.2 Meet TIA/EIA-568-C.3 requirements.
4.2.7.4.3 Meet MPO: TIA/EIA-604 FOCIS-5 compliant, LC: TIA/EIA-604 FOCIS-10 compatible, SC: TIA/EIA-604 FOCIS-3 compliant.
4.2.7.4.4 Follow the TIA/EIA-568-C.3 suggested color identification scheme.
4.2.7.4.5 Split sleeve material: Zirconia ceramic.
4.2.7.4.6 Supports PC connector.

4.2.7.5 Patch Cord

4.2.7.5.1 Pass all TIA/EIA-568-B.3 performance requirements.
4.2.7.5.2 100% factory-inspected end face geometry in compliance with Telcordia GR-326-CORE, Issue 3.
4.2.7.5.3 Insertion loss per connection: 0.25dB maximum.
4.2.7.5.4 PC polished (26dB minimum return loss).
4.2.7.5.5 Backward-compatible for use with all 50/125µm system requirements.
4.2.7.5.6 Factory-terminated and 100% tested for insertion loss and return loss.
4.2.7.5.7 Insertion loss and return loss data recorded for every singlemode patch cord.
4.2.7.5.8 Lifetime traceability of test data to a Q.C. number on each patch cord.
4.2.7.5.9 Highest quality flame-retardant fibre optic cable with tight-buffered coating on each optical fibre.

4.3 Support and ducting

4.3.1 All cables must be installed either into approved ducting or conduit, or supported by means of an overhead cable tray – especially in our Distribution Room.
4.3.2 No cable should be glued, tacked or otherwise affixed to any part of the building, fittings, fixings or furniture.
4.3.3 No cable should be placed directly on top of suspended ceiling tiles. Neither cable nor support structures should be secured to any fixture or structure belonging to an unrelated function (e.g. other conduit, air-conditioning drain pipe, false ceiling hangers, etc.). All cable routing and supporting hardware must be fixed to the building structure only.
4.3.4 All metallic support structures shall be grounded according to national electrical regulations.
4.3.5 All ducting and conduit must be permanently affixed by means of screws or bolts at intervals of no more than 1 metre. The maximum number of screws or bolts must be used.
4.3.6 No ducting or conduit may be filled beyond 50% of its designed capacity at the initial installation, allowing for 25% future growth. All ducting covers must be securely replaced.
4.3.7 No network cables should be installed in ducting or conduit used or intended for other purposes. No power or other cabling may be installed in ducting intended for network cabling without prior approval from ICTS.

4.3.8 Where cable is to run in cable trays, bundles of cables are to be secured by means of velcro or fasteners at intervals of no more than 1 metre. Cables must be securely fastened but still permit some cable movement if tugged upon with reasonable force. Cable bunches should not contain more than 24 cables.

4.3.9 All exposed vertical spans to be supported at intervals of no more than 30cm.

4.3.10 Cable ties shall not be used to support cables. Cables must be protected from sharp edges at all times.

4.4 Shielding & interference protection

4.4.1 All network cables to be separated from electrical or radio frequency cables by a distance of not less than 100 mm or as prescribed in the international standards under minimum separation distances. Common ducting must have a physical barrier separating network and power cables.

4.4.2 Network cable must not run in parallel to unshielded power cables for more than 0.5 metres unless there is a physical, grounded metallic barrier separating them.

4.4.3 At no point may a network cable cross the path of a power cable, radio-frequency cable or fluorescent light except at an angle of 90 degrees (i.e. perpendicular).

4.4.4 Copper cabling should only be used to interconnect locations that share the same electrical ground (i.e. a common earth mat or earth spike).

4.4.5 Where data cabling is used to supply power for a low-voltage system, the maximum number of cables placed in a bundle should not exceed 24 in a controlled environment with ambient temperatures not exceeding 35°C, and not exceeding 0.5 A per conductor. For systems using over 0.5 A per conductor, but not exceeding 1 A per conductor, the maximum bundle size should be 12 cables.

4.5 Labelling & certification

4.5.1 All new cables must be scanned after installation with a Fluke DTX or DSX CableAnalyzer™ Series (or approved equivalent level III or higher) cable analyser and meet the requirements appropriate to the class of cable used (class D, E & EA). Tests should be for permanent link certification.

4.5.2 All cabling to be labelled at both ends according to a pre-agreed scheme. All system tails, patch panel ports, network sockets should be clearly labelled by means of an appropriately-secured printed label.

4.5.3 All network cables shall be labelled on the front of patch panels and wall outlets. At the back of the patch panels and wall outlets, all cables shall be labelled by permanent printed labels corresponding to the label in front. (Oval grip or similar labels should be used.)

4.5.4 All labelling shall conform to the ANSI/EIA/TIA-606 and ISO 11801 standards.

4.5.5 Label eg: Cabinet/Patch Panel/Data Point

A / PP1 / D01

Section B: Distribution Room Requirements for a Network Data Centre Design at UCT

1. Design considerations

When planning a room for a network centre, a network cabinet is required. The network cabinets are of a certain size and require clearance around them to allow technicians to work on them. These factors influence the acceptable sizes and shapes of rooms for a network centre. A cable basket tray runs over the network cabinet to support network cables.

2. Network cabinet

A standard Network cabinet is 800 mm wide, 1000 mm deep and 2m high. The cabinet requires a minimum of 600 mm clearance on all sides; except for the front, where the door requires a 1m clearance to be able to open and allow equipment to be installed (see **Figure 2**).

If the building contains in excess of 312 network sockets, an additional cabinet will be required (each 42U cabinet can support infrastructure for up to 312 sockets).

Cabinet Size	Telecommunication Outlet Capacity
6U	48
9U	72
12U	96
15U	120
25U	192
42U	312

Figure2

Wall mount cabinet (Dual Section)

Type	Dimensions (mm)			Weight (kg)
	Width	Depth	Height	
6U	600	400 + 200 | 500+100	368	19
9U	600	400 + 200 | 500+100	501	25
12U	600	400 + 200 | 500+100	635	30
15U	600	400 + 200 | 500+100	769	32

2.1.1 42U Cabinet Specification

2.1.1.1 Cabinets shall consist of a welded and assembled steel frame construction available in 800 mm (31.5") widths, 1000 mm (39.4") depths, and 42 RU heights.

2.1.1.2 Cabinets shall include curved perforated front single hinge doors with 69% air flow rate and split rear perforated doors.

2.1.1.3 The cabinet shall have two horizontal locking side panels on each side.

2.1.1.4 The cabinet shall have fully adjustable front and rear equipment rails.

2.1.1.5 The 800 mm wide cabinet shall come with provisions for front or rear cable management fingers.

2.1.1.6 Vertical Finger cable manager.

2.1.1.7 The 800 mm wide cabinets shall have vertical blanking panel with (4) 1 RU vertical pass throughs and cover plates as option if installed in Cold or Hot Containment.

2.1.1.8 The top of cabinet includes brush cable entry points to prevent air leakage.

2.1.1.9 Cabinets shall have optional bottom panels with brush cable entry points and cover plates for effective air sealing.

2.1.1.10 Cabinet shall have two full height PDU/cable management brackets – one on each side.

2.1.1.11 The entire cabinet shall be fully electrically bonded, including equipment rails, doors, and side panels.
2.1.1.12 The cabinet comes equipped with the necessary brackets and hardware to gang adjoining cabinets.
2.1.1.13 Cabinets shall have 1,360kg (3,000 lbs.) static load rating and 500kg (1,100 lbs.) rolling load rating.
2.1.1.14 Steel with durable black powder coat finish.
2.1.1.15 EIA-310-E.
2.1.1.16 TIA/EIA-942.

2.1.2 Panduit NetFrame

2.1.2.1 A standard Panduit Rack is 823mm wide, 432mm deep, and 2m high. The cabinet requires a minimum of 600 mm clearance on all sides.
2.1.2.2 If the building contains in excess of 504 network sockets, an additional cabinet will be required (each 45U cabinet can support infrastructure for up to 504 sockets). (See Figure 3).

Cabinet Size	Telecommunication Outlet Capacity
25U	264
45U	504

3. Copper Cable baskets Specification

A cable basket must run at a height of approximately 2.25m above the floor over the middle of the top of the cabinet. This will support cables running between the cabinet.

The cable basket must be extended to all cable ingress points in the room. For cable ingress points below 2.25m, the cable basket must be extended down the wall to the ingress point. This will support cables running from the frame to all network points within the building, and the fibre optic cables which connect the building to the campus network.

Standard requirements for cable baskets are given in **Section A, 4.3**.

3.1 Copper Cable Basket Specification

3.1.1 The overhead cable tray routing system shall consist of pathway sections, splice connectors, sidewalls, waterfalls, mounting brackets, and accessories designed to route and manage copper cables.
3.1.2 The pathway sections shall be provided in widths: 12" (305 mm)
3.1.3 Sidewalls shall include 4" (102 mm) heights that can be hand installed at any location along pathway sections.
3.1.4 Waterfalls and intersection bend radius parts shall provide 3" (76 mm) bend radius protection.
3.1.5 Trapeze, cantilever, and wall mount, shall be provided to support the system.
3.1.6 Pre-galvanized steel wire and galvanized cold rolled steel prior to paint ABS (Sidewall Waterfall).
3.1.7 All components shall be painted black.
3.1.8 Standard finish is black powder coat.
3.1.9 Two different methods of installation: ceiling hanged & cabinets rested.
3.1.10 All Overhead Cable Tray Routing System components are RoHS-compliant.
3.1.11 UL Classified for their suitability for use as Equipment Grounding Conductor in accordance with Sections 392.3(C) and 392.7(B) of the NEC (pending) Metal Cable Tray in accordance with CAN/CSA-C22.2 No.126.1-02 (pending) NEMA VE 1-2002 and ANSI/NFPA 70, “National Electric Code” (NEC) corrosion-resistant per ASTM A653/A653M-08 and A641/A641M-09.

3.1.12 EN61537:2007 Cable Tray Systems and Cable Ladder Systems for Cable Management (pending).
3.1.13 This system provides a bolted mechanical bond between system components eliminating the need for bonding jumpers between Path way sections.

4. Fibre Cable Raceway Specification

4.1 6" x 4" (150 mm x 100 mm).
4.2 Material: Rigid uPVC (Channel), ABS (Fittings).
4.3 Flammability: 94V-0.
4.4 Cable protection: A minimum 2" bend radius maintained throughout all fittings prevents excessive bends in fibre optic cabling.
4.5 Multiple spill-out options provide versatility to mate to various equipment and rack configurations.
4.6 Compliant with the applicable tests in Telcordia GR-63-CORE Network Equipment Building Systems (NEBS) Level 3.
4.7 Snap-on, hinged channel covers and split fitting covers allow easy access to cables without fully removing covers, thereby reducing time required to make moves, adds, and changes.
4.8 Compliance with stringent industry standards including UL 2024A and NEBS GR-63 (ensures that system features and functions will withstand regular use and perform over the lifetime of the installation).
4.9 Solid, maintenance-free, non-metallic channel and fitting construction will last the life of the system.

5. Electrical

5.1 A single SANS 1239 (IEC 60309) 2P+E 16A-6h CEE industrial outlet (with on/off switch) is required to power the network equipment. This outlet must be powered from a dedicated circuit breaker – not on earth leakage. The outlet should be located near the cabinet so that a power cable can be run into the cabinet.
5.2 Two SANS 164-1 16A standard socket outlets are required to power network test equipment.
5.3 If a sub-distribution-board is to be located within the network centre, it should be assumed that access to it will be unavailable after hours, and thus shouldn't power other areas of the building that might be occupied outside of working hours.

6. Other design considerations

6.1.1 Where the network distribution centre is located on the ground floor, consideration must be given to the location of the door relevant to down pipes, storm water drains, etc. to avoid the possibility of flooding during severe weather.
6.1.2 Careful consideration must be given to the proximity of water and sewage pipes, wet walls, storage tanks, fire suppression systems, or other systems containing or capable of producing water (e.g. air-conditioners). Should such systems be located in a position where failure might result in flooding, adequate precautions should be taken to ensure water cannot enter the network centre (e.g. drip trays with appropriately sized waste outlets).
6.1.3 Where cabling is to pass through walls, floors, or ceilings, suitable fire stop material must be provided. Such material must be removable and replaceable in order to facilitate future work.

7. Additional requirements for distribution centres

7.1 A network distribution centre contains a high proportion of fibre optic cable, originating from outside the building. To facilitate the easy ingress of this cable, a network distribution centre should have a small (200 × 200 mm) trench connecting the exterior cable ingress and the Enclosure (see **Figures 7 and 8** for details). Such a trench can be facilitated by raising the floor level in the room.
7.2 Where possible (given cable length restrictions of the internal building cabling), an external door with security gate instead of internal door. Alternatively, arrangements must be made for ICTS staff to have unrestricted 24×7×365 access from outside the building to the network centre.

7.3 All electrical loads in a network distribution centre should be fed from a dedicated sub distribution-board, located inside the network distribution centre. No other loads should be fed from this distribution board.

7.4 As all network distribution centres differ depending on the exact requirements of the sector they serve, there may be other requirements not articulated here. The design of such centres should be done in consultation with ICTS staff.

8. Copper & Fibre Requirement for Data Centre

8.1. Copper Cabling System

Because all network distribution centres differ depending on the exact requirements of the sector they serve, there may be other requirements not articulated here. The design of such centres should be done in consultation with ICTS staff.

8.1.1 Cable

8.1.1.1 As all network distribution centres differ depending on the exact requirements of the sector they serve, there may be other requirements not articulated here. The design of such centres should be done in consultation with ICTS staff.

8.1.1.2 Exceeds requirements of ANSI/TIA-568-C.2 Category 6A, IEEE 802.3an-2006, and ISO 11801 Class EA channel standards.

8.1.1.3 Exceeds requirements of ANSI/TIA-568-C.2 Category 6A and IEC 61156-5 Category 6A component standards.

8.1.1.4 Certified channel performance in a 4-connector configuration up to 100 meters and exceeds the requirements of ISO 11801 Class EA standards swept up to 650 MHz for supporting 10GBASE-T transmission over twisted-pair cabling systems as part of the Panduit® TX6A™ 10Gig™ UTP Copper Cabling System. Certified component performance up to 100 meters and exceeds the IEC 61156-5 Category 6A standards for supporting 10GBASE-T transmission over twisted-pair cabling systems.

8.1.1.5 Category 6A, low smoke zero halogen (LSZH), 4-pair, UTP copper cable. Copper conductors are 23 AWG with HDPE insulation. Conductors are twisted in pairs, separated by an integrated pair divider, surrounded by a matrix tape and protected by a low smoke zero halogen (LSZH) jacket.

8.1.1.6 Meets IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE applications.

8.1.1.7 Cable design suppresses alien crosstalk with enhanced internal electrical performance.

8.1.1.8 Round cable design with reduced cable diameter enables improved cable bundling and optimises fill capacity.

8.1.1.9 Flame rating: HDPE (LSZH-1): IEC 60332-1, 60754-2, 61034-2.

8.1.1.10 Cable diameter: (7.6mm) nominal.

8.1.1.11 Installation temperature range: 32°F to 140°F (0°C to 60°C).

8.1.1.12 Operating temperature range: -4°F to 167°F (-20°C to 75°C).

8.1.1.13 Installation tension: 25 lbf (110 N) maximum.

8.1.1.14 All testing and headroom shall be based on 48-port/1RU panels.

8.1.1.15 European Source is preferred.

8.1.1.16 Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable scrap.

8.1.2 Module

8.1.2.1 Exceeds channel requirements of ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA standards for supporting 10GBASE-T transmission over twisted pair cabling systems in a 4-connector configuration up to 100 meters sat swept frequencies 1 to 500 MHz.

8.1.2.2 Exceeds component requirements of ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA standards at swept frequencies 1 to 500 MHz Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.

8.1.2.2.1 Each jack is 100% tested to ensure NEXT and RL performance and is individually serialised for traceability.
8.1.2.2.2 Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module.
8.1.2.2.3 Meets ANSI/TIA-1096-A contacts plated with 50 micro-inches of gold for superior performance.
8.1.2.2.4 Meets IEC 60603-7 and IEC 60512-99-001.
8.1.2.2.5 UL 1863 (Use as communications circuit accessory) UL 2043 (Suitable for use in air-handling spaces).
8.1.2.2.6 PoE compliance: Rated for 2500 cycles with IEEE 802.3af / 802.3at and proposed 802.3bt type 3 and type 4.
8.1.2.2.7 Operation Temperature range: -10°C to 65°C (14°F to 149°F).
8.1.2.2.8 Tool-less Module.
8.1.2.2.9 Can be re-terminated up to twenty times.
8.1.2.2.10 Blue termination cap designates Category 6A performance and provides positive strain relief; helps control cable bend radius and securely retains wires.
8.1.2.2.11 Terminate 4-pair, 22 – 26 AWG, 100 ohm, solid or stranded twisted pair cable.
8.1.2.2.12 Universal termination cap is color-coded for T568A and T568B wiring schemes.
8.1.2.2.13 Accept 6 and 8-position modular plugs without damage.
8.1.2.2.14 Can be clearly identified with optional labels and icons.
8.1.2.2.15 Optional Dust cap keeps out dust and debris while not in use.
8.1.2.2.16 RoHS-compliant.

8.1.3 Patch Panel

8.1.3.1.1 Angled patch panel If network cabinet design allows, which eliminates the need for horizontal cable managers by letting patch cords to be routed directly into vertical cable managers. Otherwise, use Flat Patch Panel.
8.1.3.1.2 Flat patch panel at Server Cabinet.
8.1.3.1.3 24 or 48 ports in 1U with labels.
8.1.3.1.4 Allow labelling scheme and port identification to be visible at all times.
8.1.3.1.5 Allow front access to installed modules for easy moves, adds and changes.
8.1.3.1.6 Accept 8-position, 8-wire universal module for UTP, Fibre optic, and audio/video, which snaps in and out for easy moves, adds, and changes.
8.1.3.1.7 Mount to standard EIA 19" racks or 23" racks with optional extender brackets.
8.1.3.1.8 RoHS-compliant.

8.1.4 Patch Cord

8.1.4.1.1 Exceed requirements of ANSI/TIA-568-C.2 Category 6A, IEEE 802.3an-2006, and ISO 11801 Class EA channel standards.
8.1.4.1.2 Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.
8.1.4.1.3 Certified channel performance in a 4-connector up to 100 meters.
8.1.4.1.4 Meets IEC 60603-7.
8.1.4.1.5 Each patch cord is 100% performance tested and wired to T568B.
8.1.4.1.6 Constructed of 26 AWG stranded copper cable and Modular Plugs for superior performance.
8.1.4.1.7 Plug meets all applicable ANSI/TIA-968-A requirements contacts plated with compliance: 50 micro-inches of gold for superior performance and exceeds IEC 60603-7 specifications
8.1.4.1.8 Operating temperature: 14°F to 140°F (-10°C to 60°C).
8.1.4.1.9 Slender strain relief boot provides easy access in high density applications.
8.1.4.1.10 Plug uses an integral pair manager to optimise performance and consistency by reducing untwisting of conductors within the plug.
8.1.4.1.11 Plug performance in centre of TIA/EIA component range, ensuring interoperability and 10GBASE-T Ethernet channel performance.

8.1.4.1.12 Labels on patch cords provide identification of performance level, length, and quality control number.
8.1.4.1.13 Cable diameter: 0.240 in. (6.1mm) nominal.
8.1.4.1.14 Tangle-free latch prevents snags and provides easy release, saving time on frequent moves, adds, and changes.
8.1.4.1.15 RoHS-compliant.
8.1.4.1.16 Rated to 2500 mating cycles.
8.1.4.1.17 UL 1863 approved.

8.2 Fibre pre-terminated solution

8.2.1 Pre-terminated Fibre Cabling Systems:

8.2.1.1.1 Cable type: 3.0 mm indoor.
8.2.1.1.2 Cable outside diameter (OD): 3.0 mm.
8.2.1.1.3 Minimum bend radius: 30 mm.
8.2.1.1.4 Cable retention strength: 50N.
8.2.1.1.5 Cable flex: 100 cycles at 4.9N.
8.2.1.1.6 Cable twist: 10 cycles at 15N.
8.2.1.1.7 Enable Gender and Polarity change on field.
8.2.1.1.8 Gender reversible durability for Multimode: 50 cycles.
8.2.1.1.9 Polarity reversible durability for Multimode: 50 cycles.
8.2.1.1.10 Connector durability: 500 mating cycles.
8.2.1.1.11 Maximum cable attenuation: Singlemode: 1.0dB/km at 1310/1550nm,Multimode: 3.5dB/km at 850nm,1.5dB/km at 1300nm.
8.2.1.1.12 Maximum MPO connector insertion loss (Mated MPO): Singlemode: 0.75dB,Multimode: 0.5dB.
8.2.1.1.13 Minimum connector return loss: Singlemode: 55dB.
8.2.1.1.14 Multimode: OM3 26dB, OM4 26dB.
8.2.1.1.15 MPO-MPO , 12 Fibre ribbon Interconnect OM4 and OS1/OS2 Singlemode.
8.2.1.1.16 LSZH rated jacket.
8.2.1.1.17 Meets or exceeds ISO/IEC 11801, TIA/EIA-568-C.3, TIA-604-5 (FOCIS-5), FOCIS-5, TIA/EIA-568-C.1, TIA-492AAAB, TIA-492AAAC, TIA-492AAAD and IEC 60793-2-10.
8.2.1.1.18 RoHS-compliant.
8.2.1.1.19 Factory-terminated and 100% tested for insertion loss.
8.2.1.1.20 Lifetime traceability of test data to a Q.C. number on each cable assembly.

8.2.2 FIBRE CASSETTES

8.2.2.1.1 Connectivity meets or exceeds TIA/EIA-568-C.3 performance requirements.
8.2.2.1.2 Supports IEEE 802.3ae (10 Gigabit Ethernet) and ANSI T11.2 (Fibre Channel) channel and link specifications.
8.2.2.1.3 MTP connector exceeds TIA/EIA-455-21A: 500 mating cycles (singlemode & multimode).
8.2.2.1.4 100% tested.
8.2.2.1.5 Insertion loss per channel: 0.75dB max (per cassette, MPO + LC).
8.2.2.1.6 Return loss per channel: >26dB Multimode & Singlemode.
8.2.2.1.7 OM4 Multimode and OS1/OS2 Single mode.
8.2.2.1.8 LC Duplex cassette capacity: 24 Fibre, 12 Duplex.
8.2.2.1.9 Front Connectivity LC Duplex, SC Duplex or SC Simplex adapters Multimode with PC Polish Singlemode with UPC Polish.
8.2.2.1.10 Split sleeve material: Zirconia.
8.2.2.1.11 Rear Connectivity: Multimode: MPO adapter with male ferrules (pins) and UPC polish.
8.2.2.1.12 Singlemode: MPO adapter with male ferrules (pins) and APC polish.

8.2.3 PATCH CORDS

8.2.3.1.1 Meets or exceeds ISO/IEC 11801, TIA-568-C.3, TIA-604-10 (FOCIS-10).
8.2.3.1.2 Insertion loss per connection: Multimode: 0.25dB Max.
8.2.3.1.3 Singlemode: 0.35dB Max.
8.2.3.1.4 Connector Return Loss: Multimode: 26dB min (OM3 and OM4).
8.2.3.1.5 Singlemode: 55dB min (OS1/OS2).
8.2.3.1.6 OM4 Multimode and OS1/OS2 Single mode.
8.2.3.1.7 LC Duplex Fibre Optic Patch Cords.
8.2.3.1.8 Factory terminated and 100% tested for insertion loss.
8.2.3.1.9 Cable outside diameter (OD): 1.6mm duplex.
8.2.3.1.10 Bend Radius (min) Short-Term: 16mm.
8.2.3.1.11 Bend Radius (min) Long-Term: 32mm.
8.2.3.1.12 Connector cable retention: 50N (4.24lb) @ 0° 19.4N (4.4lb)@ 90°.
8.2.3.1.13 Connector durability: 500 cycles.
8.2.3.1.14 Operating and installation temperature: -10°C to 60°C.
8.2.3.1.15 Lifetime traceability of test data to a Q.C. number on each patch cord.
8.2.3.1.16 Cable Jacket Rating: Low Smoke Zero Halogen (LSZH) per: IEC 60332-1-2, IEC 60332-3-24, IEC 60754-1, IEC 60754-2, IEC 61034-2.
8.2.3.1.17 Insertion loss data recorded for every multimode patch cord.
8.2.3.1.18 Highest quality flame-retardant fibre optic cable with tight-buffered coating on each optical Fibre.

8.2.4 FIBRE ENCLOSURE:

8.2.4.1.1 Dimensions: 1.72"H x 17.6"W x 16.8"D (43.8mm x 447mm x 426.5mm), 1 RU or 3.47"H x 17.6"W x 16.8"D (88.2mm x 447mm x 426.5mm), 2 RU.
8.2.4.1.2 Mounting: Integral mounting flange for installation in 19" wide EIA-310 racks.
8.2.4.1.3 Slide-out, tilt-down drawer.
8.2.4.1.4 Hinged, swing down front door.
8.2.4.1.5 TIA-606-A compatible labelling.
8.2.4.1.6 Weight <13 lb.

8.3 Installation considerations

8.3.1 The cable baskets may not contain electrical cables.
8.3.2 All circuit breakers should be clearly labelled.
8.3.3 Light fittings should not be located directly above the cabinet or cable baskets.
8.3.4 Air-conditioners should not be located directly above the cabinet or cable baskets.
8.3.5 Provision must be made for the installation of fire-stop material on all cable ingresses.

8.4 Handover considerations

8.4.1 On handover, ICTS expects the following to be made available:
8.4.1.1 All keys for the network centre door.
8.4.1.2 The remote (if any) for the air conditioner.
8.4.2 The electrical contractor is expected to make known the location of all circuit breakers supplying the network centre, and may be asked to demonstrate that the circuit provided for the cabinet is dedicated and in line with the specifications.

8.5 General provisions & specifications

8.5.1 A room for a network centre must:

8.5.1.1.1 Be of a standard height, not less than 2.4m.
8.5.1.1.2 Have a level floor.

8.5.1.1.3 Be reasonably dust-free. Walls and ceiling must be painted, and floors covered with linoleum or equivalent. In dusty environments, weather strip may be needed to seal to the door and exclude drafts.

8.5.1.1.4 Not have a suspended ceiling and be without obstructions.

8.5.1.1.5 Have a single entrance door, preferably opening outwards. The door must have a reasonably secure lock (3-lever, cylinder night latch, etc.) suitable for exterior use.

8.5.1.1.6 Not have any windows or other openings except the door and cable ducts.

8.5.1.1.7 For buildings with more than 144 network sockets, have an air-conditioner to compensate for the additional heat load of the network equipment and maintain an ambient room temperature within the range 15–30°C (nominally 25°C).

8.5.1.1.8 Be located such that every network socket can be reached by cable no longer than 90m.

8.5.1.1.9 Must not house any equipment other than that required by ICTS.

8.5.1.1.10 Must provide a means to earth the cabinet that is bonded to the building electrical earth system.

8.5.1.1.11 Must not contain water pipes, water sprinklers, high voltage or power supply cables, air ducts or any other services.

8.5.1.1.12 Have sufficient lighting.

8.5.1.1.13 In buildings which have a fire panel, a smoke detector must be located in the network centre.

8.5.1.1.14 Be equipped with a dedicated Telecommunications earth bar linked directly to the Building Main Earth Terminal via a copper cable with a conductor size of no less than 25 square mm.

8.6 Concessions for smaller buildings

8.6.1 In smaller buildings or remote Telecommunications Enclosure (those that will never have more than 120 Telecommunications Outlet), a full network distribution centre is not required. Instead, the following concessions can be made to accommodate the network equipment in a smaller network closet:

8.6.1.1 Instead of the cabinet referred to in **2** above, a wall-mounted equipment cabinet may be used. A smaller equipment cabinet is 600 mm wide, 700 mm deep and 9U (400 mm) high.

8.6.1.2 The cabinet must be mounted such that its top is at a height of not less than 1.5 m and not more than 1.8m above the floor.

8.6.1.3 Instead of the overhead cable baskets referred to in **3.1** above, wall-mounted baskets may be used to route work area (building) cabling to the network cabinet. However the provisions of **Section A** still apply in their entirety.

8.6.1.4 The three electrical sockets referred to in **5.1** above may be replaced by two SANS 164-1 16A sockets (maybe one double outlet) mounted just below and to one side of the equipment cabinet. All other electrical provisions remain.

8.6.1.5 The minimum clearances referred to in **2** and **3** above, as well as the roof height, referred to in **8.5** can be varied, provided the minimum dimensions set out in **8.9** below are met.

8.6.2 The corresponding minimum interior (finished) dimensions of a network closet are 900 mm wide by 900 mm deep. However, a closet of 1.4m × 1.0m is preferred since the minimum dimensions do not allow the back panel of the equipment cabinet to be properly opened. The minimum height is 1.9 m or 0.2 m above the top of the equipment cabinet – whichever is higher.

8.6.3 If such constrained dimensions are used, the door of the network closet must be outwards opening and should have a suitable vent panel to ensure adequate ventilation.

8.7 Standardised Cable Colour Patch Leads to be used in Distribution Room

Colour code	Description
GREY	NORMAL DATA POINTS
RED	BACKBONE UPLINKS
ORANGE	WIRELESS ACCESS POINT DEVICES
YELLOW	MANAGEMENT
GREEN	PDU
BLUE	SERVER

8.8 Labeling Policy for the network point

The naming convention used is summarised as follows:

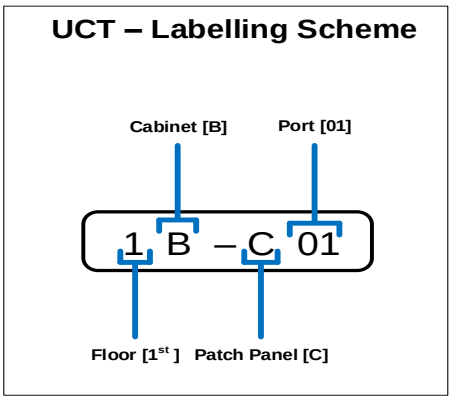
An alphanumeric naming standard has been adopted.

The identifier is Fourteen (06) characters long.

The naming standard makes use of predetermined codes.

- [1] - Floor
- [B] - Cabinet in the floor
- [C] - Patch panel inside the cabinet
- [01] - Port number in the patch panel

E.g.



8.8.1 Policy Details

8.8.2 The first character [1] indicates the floor level in the building, combined with an alphabetic letter [B] representing the number of cabinets on the particular floor.

8.8.3 The third alphabetic letter [C] indicates the number of patch panels inside the cabinet combined with two numerical characters indicating the port numbers.

8.9 Sample floor layouts

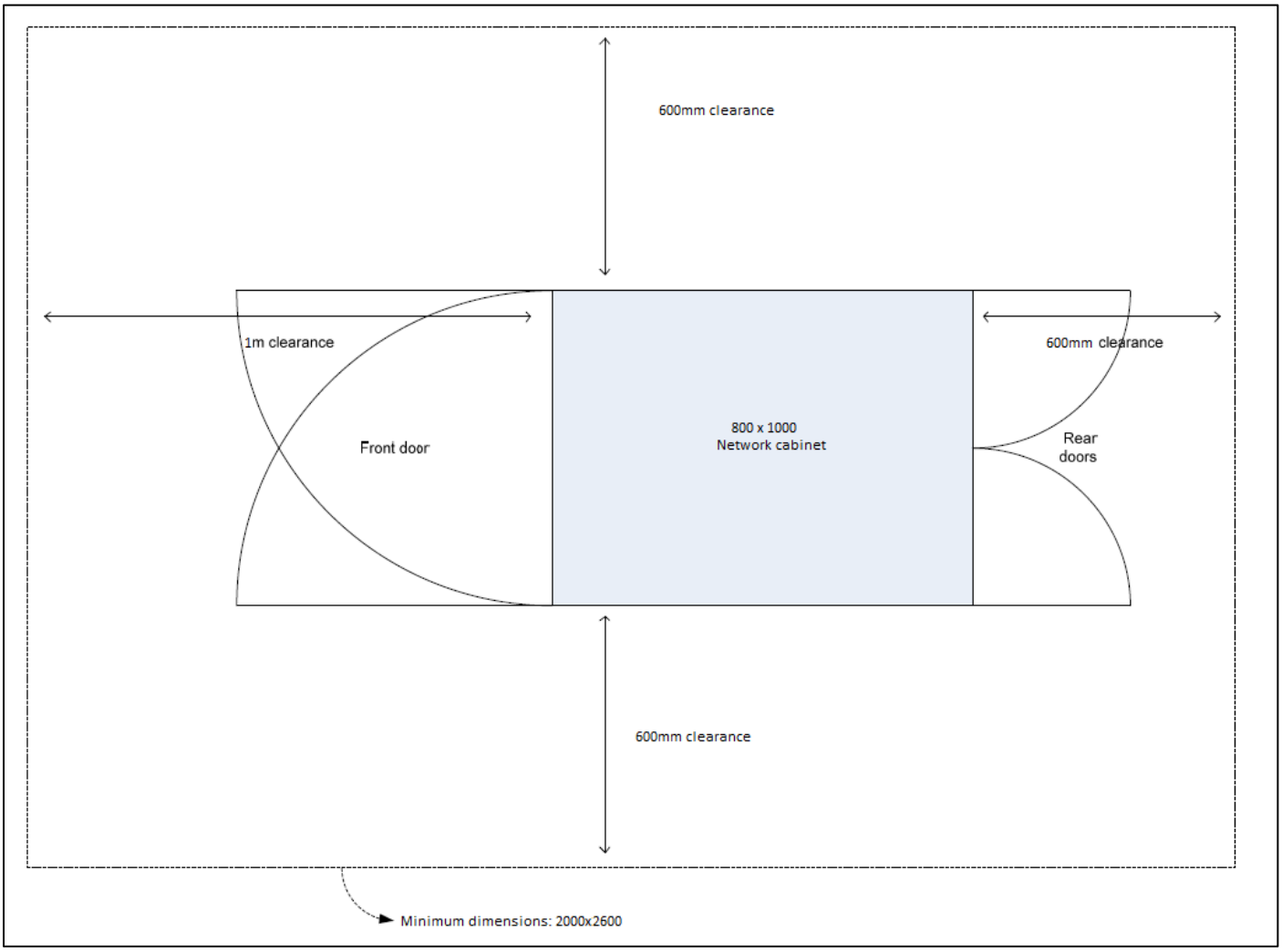


Figure 4: Network Cabinet dimensions and clearances

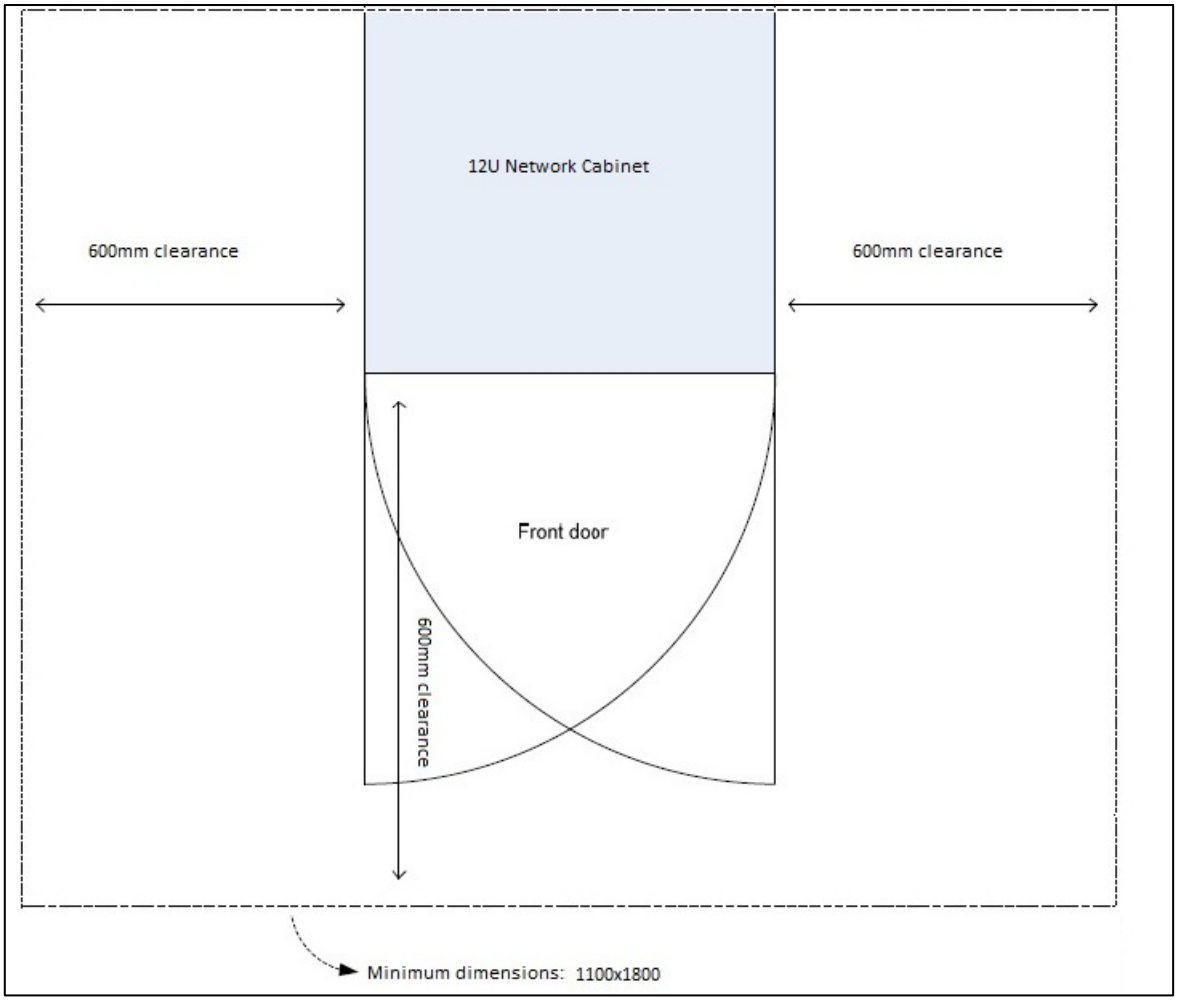


Figure 5: Wall mounted Network Cabinet dimensions and clearances

Section C: Exterior Fibre Optic Reticulation at UCT

1. Design considerations

1.1. Pits/manholes

1.1.1 Inspection pits (manholes) should be installed at suitable locations to facilitate installation and maintenance of cabling including:

1.1.1.1 Building entrances.

1.1.1.2 At distances not exceeding 50 metres along underground pathways.

1.1.1.3 Where significant change of direction or elevation occurs.

1.1.1.4 On both sides of road crossings or culverts.

1.1.2 Pits shall be located such that the conduit/sleeve/duct entry shall be achieved using a straight section wherever practical.

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

1.1.4 Pits in low traffic areas (such as open lawn with no vehicle traffic) may be either constructed from brick and mortar, or consist of an approved PVC stack box that is dug in and back-filled. In higher traffic areas, only constructed (brick) pits may be used.

1.1.5 The minimum dimensions of a constructed pit should be 600 × 600 × 700 mm deep (see **Figure 8**). Where the pit is constructed on a shared services route, it should be 1000 mm deep to accommodate the additional depth of the conduits.

1.1.6 Pit covers shall be specified appropriately for the traffic expected.

1.2. Conduits/sleeves

1.2.1 The existing underground fibre optic reticulation system shall be utilised where possible, provided sufficient capacity exists.

1.2.2 Data conduits (sleeves) should be buried at the following depths:

1.2.2.1 Where data conduits are laid together with other services, they should be buried at a depth of 900 mm, above electrical ducts and below potable water and irrigation services (see **Figure 7**).

1.2.2.2 Where data conduits are laid alone, they should be buried at a depth of 450 mm (see **Figure 6**).

1.2.2.3 Where data conduits cross a load-bearing road, they should be buried at the depths specified above or below the road bed (whichever is deeper).

1.2.3 All exterior, exposed conduits should be vertically-oriented and braced.

1.2.4 No horizontal runs of conduits along exterior walls or rooftops.

1.2.5 Sweeping bends shall be used to allow for cable bending radii. Conduits are to maintain a minimum bend radius of 300 mm and not to exceed two 90° turns per segment (i.e. between inspection pits). Consideration must be given to ensure that the pulling tension when installing fibre optic cables will not exceed the manufacturer specifications.

1.2.6 Conduits shall be 50 mm in diameter unless otherwise specified.

1.2.7 Routes shall be designed not to have an anticipated fill factor of greater than 40%.

1.2.8 Where conduits do not enter the building underground or through the slab, pull boxes should be provided on the exterior wall of buildings where the external conduits meet the internal ones (at the cable ingress point). The minimum dimensions of such a pull box are 300 × 300 × 150 mm (type U7 York).

2. Additional requirements for distribution centres

2.1. A normal network distribution centre only provides connectivity for its local building, and so generally only two fibre optic cables enter the building. Network Distribution centres, on the other hand, provide network connectivity to all the buildings within their sector. This means that buildings designated as network

distribution centres have many (up to about thirty) fibre optic cables entering them. This requires additional capacity in the external reticulation system.

2.2. Whereas normal buildings specify 50 mm conduit, network distribution centres normally require one or more 110 mm conduit (which may or may not be sub-ducted).

2.3. The exact specifications will depend on the sector of the campus the centre is located in, and the specific requirements will normally be provided on an individual basis.

3. Installation considerations

3.1. Trenching pathways

3.1..1. The contractor must mark all proposed pathways with (white) spray paint or chalk, then get confirmation of their suitability from both ICTS and Properties & Services prior to breaking ground.

3.1..2. Trenching must be 500 mm deep for dedicated data routes and 1100 mm deep for shared services routes (see **Figure 6** and **Figure 7** respectively).

3.1..3. Depth of cover – distance between the natural ground surface and the top surface of the conduit/sleeve:

3.1..4. 450 mm under public footway or roadway or where trenching is possible.

3.1..5. 300 mm in other areas where soil conditions preclude a trench.

3.1..6. Plastic marker tape shall be installed 100 mm above all data conduits.

3.1..7. Where conduits transition from a shared service route to a dedicated route, the depth transition should be gradual and over a horizontal distance of no less than 2 metres. Bend radii must be in accordance with **1.2.5**.

3.1..8. All trenches must be back filled with sand and dirt, compacted to 95% and covered with concrete or asphalt where appropriate.

3.1..9. When trenching through established lawn areas, sods must be cut, retained and restored on completion.

3.1..10. Loose paving must be lifted and restored/made good on completion.

4. Pits / Maintenance Holes

4.1.1 All conduits to enter from the vertical sides of the pit, with a clearance of 200 mm to the bottom of the pit (see **Figure 8**). Where brickwork or other constraints dictate that the finished depth of the pit is slightly smaller than specified, the burial depth of 450 mm must be maintained with an absolute minimum clearance of 100 mm to the bottom of the pit.

4.1.2 Conduits must extend into the pit for a distance of approximately 50 mm.

4.1.3 All constructed (brick and mortar) pits must be plastered inside.

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

4.1.5 Pits should be constructed to prevent water from entering the underground system.

4.1.6 Covers should be appropriately labelled.

5. Conduits/sleeves

5.1.1 All joins between segments of conduit shall be watertight.

5.1.2 All metallic conduits runs shall be grounded and bonded where necessary.

5.1.3 All conduits shall have a nylon draw cord installed and tied off at each end.

6. Hand-over considerations

6.1.1 All inspection pit (manhole) covers must be fitted prior to hand-over, unless otherwise agreed or specified. This allows us to ensure that there are sufficient covers for inspection pits, and that none have been misplaced.

6.1.2 All draw cords must be in place and free to move within the conduit.

6.1.3 On hand-over, contractors are expected to demonstrate that underground conduits are clear of obstructions and comply with the specified diameters. They may do this by any mutually-acceptable means, for instance by pulling or blowing an appropriately-sized slug through the conduit.

7. General provisions & specifications

7.1. All buried conduits within 10 metres of any building shall be routed either parallel or at right angles to the building infrastructure and/or walls.

7.2. All conduits must be terminated with bell ends at the manhole, facility or other termination point.

7.3. A minimum of 200 mm separation to be maintained between data sleeves and power ducts/cables.

7.4. Rigid steel conduit, encased in reinforced concrete shall be used in any location subject to unbalanced pressure, such as under slabs, roadways, driveways or foundations.

7.5. During construction, all necessary precautions shall be undertaken by the contractor to prevent the lodging of dirt, plaster or rubbish in all conduit tubing, fittings and boxes.

7.6. All underground systems shall be designed to prevent water runoff from entering any building.

7.7. Where cabling is to be run in an exposed area, it shall be enclosed in heavy duty UV-stabilised PVC or steel conduit.

8. Sample maintenance holes and trench layouts

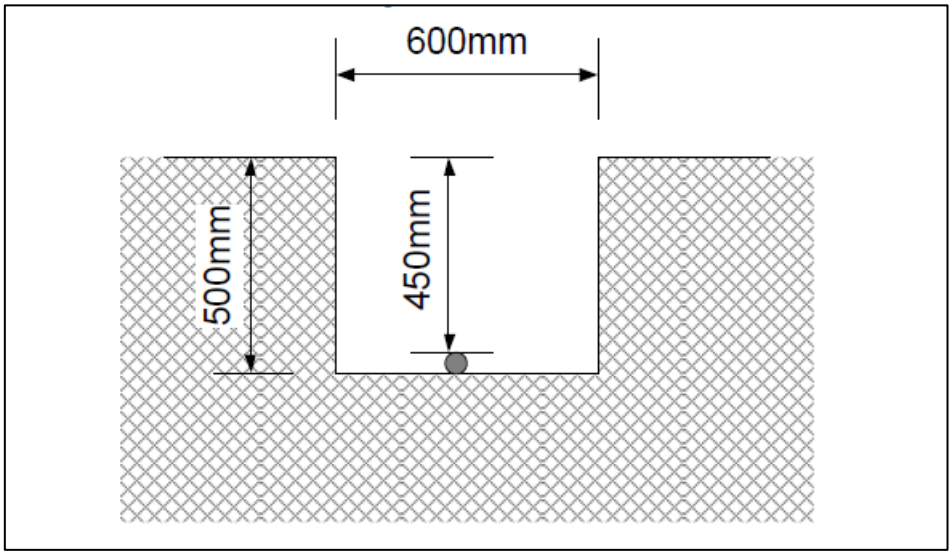


Figure 6: Trench dimensions for data-only installations

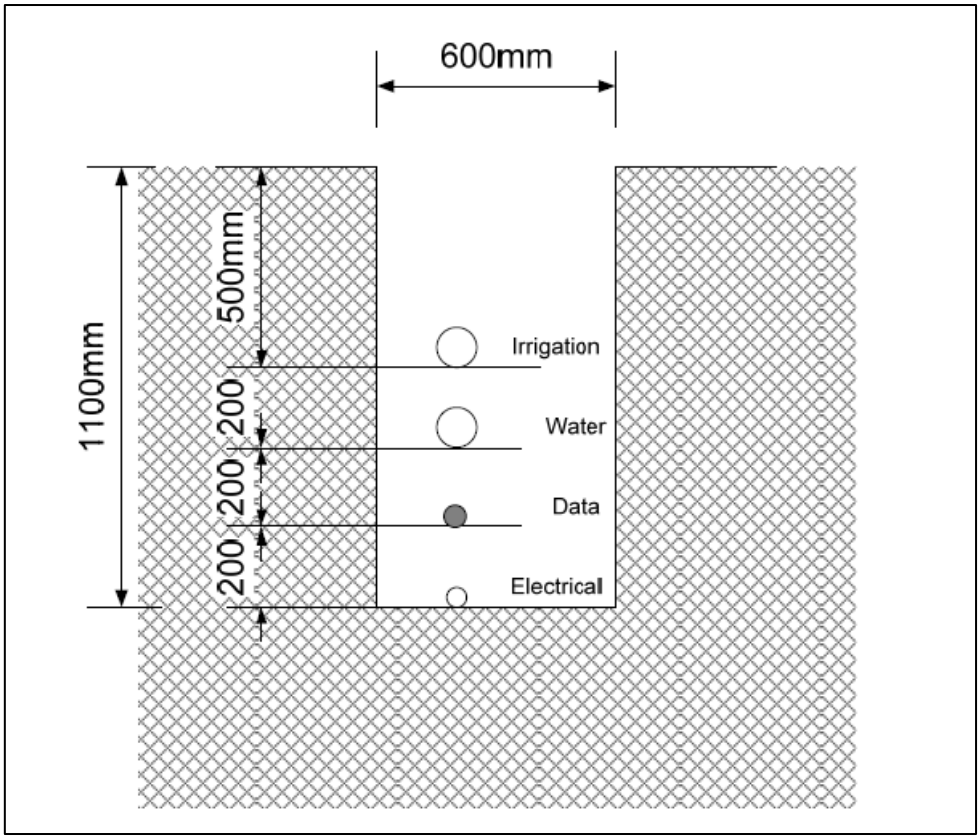


Figure 7: Trench dimensions when co-existing with other services

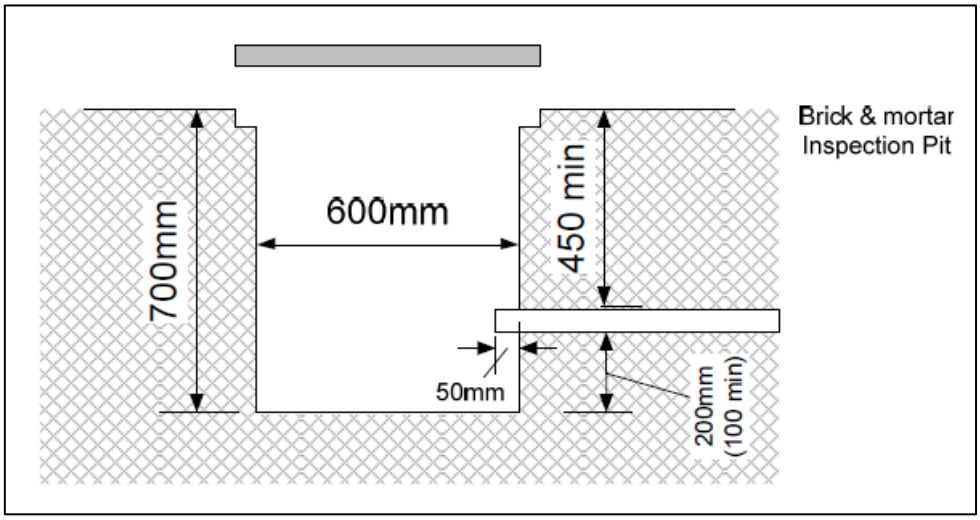


Figure 8: Sample maintenance hole/pit dimensions

Section D: General Provisions for all ICT-Related Contract Work

1. Design considerations

1.1. The proposed plan, layout, materials and routing of the installation must be approved by ICTS prior to work commencing. For small jobs, verbal discussion with an appointed staff member is acceptable; for larger jobs, a comprehensive written plan is expected.

1.2. Any deviations from the specifications contained in this document must be pre-approved by ICTS in writing.

2. Installation considerations

2.1. Installers are expected to comply with the Occupational Health & Safety Act, accepted safe practices, and any on-site safety requirements.

2.2. Installers must make good any damage to walls, floors, ceilings, woodwork, paint, paving, roadways, etc. on completion of the job.

2.3. Installers must remove any debris, rubbish, tools, surplus materials, etc. and make sure all work areas are clean and tidy before handing over the installation.

3. Hand-over considerations

3.1. ICTS expects to conduct a comprehensive inspection of new installations before the building is handed over, and reserves the right to reject any installation or portion of the installation that is not in line with the approved design.

3.2. Random acceptance testing may be performed.

4. General provisions & specifications

4.1. ICTS believes that timeous detection of problems can help prevent complex, costly, and/or time-consuming remedial work at the end of a project. Accordingly, it usually conducts several spot or arranged inspections during the course of any installation work. These visits aim to constructively engage with contractors about potential problems – before work progresses too far for them to be readily rectified.

Section E: Additional IT Budgetary Considerations

Some of the work required to connect a new or refurbished building is carried out by ICTS after the building is handed over to the university and occupancy is assumed. This makes it outside the scope of the project work, but within the scope of the project itself. Accordingly, the project needs to make budgetary provision for these aspects in consultation with ICTS – who will specify more detail for each building. This document provides a non-exhaustive list of things that will need to be considered when preparing such budgets.

1. Exterior Cable Work

1.1. Sufficient lengths of the correct fibre optic cables.
1.2. Fibre optic patch panels.
1.3. Fibre optic connectors.
1.4. Sundry materials for the termination of fibre optic cables.
1.5. Labour (fibre optic cable installation is typically outsourced).

2. Connection to the university's network

2.1. 42U equipment cabinet, power distribution unit, and cable management (if not supplied by cabling contractor – see **Section A, 2.2**).
2.2. Fibre optic patch leads.
2.3. Exception cables for the disconnect frames.
2.4. Network switches.
2.5. Optics (SFP, XFP, or similar required to connect the switches to fibre optic cables).
2.6. Uninterruptable power supply.
2.7. Wireless access points.
2.8. Analogue telephony adapters/lines.

3. Other considerations

3.1. Telephone instruments
3.2. Emergency telephones
3.3. Project management

4. Areas commonly misperceived to be handled by ICTS

4.1. Access control
4.2. Security cameras
4.3. Approval of lab computers (should be the PC Lab sub-committee of the ITSC)

Section F: Health and Safety

Section to be reviewed and updates to information relevant to Health and Safety to be provided by the Properties and Services Health and Safety.

References

- UCT ICTS Network Blue Print
  Available on request
- Wikipedia – Structured cabling
  http://en.wikipedia.org/wiki/Structured_cabling
- International ICT industry standards – TIA
  http://www.tiaonline.org/all-standards/committees/tr-42

- Building Industry Consulting Service International - BICSI