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1 INTRODUCTION

1.1 PURPOSE

The *UWA Design and Construction Standards* (the *Standards*) outline UWA's expectations for its built forms in order to achieve consistency in the quality of the design and construction of those built forms. They are aligned with UWA's Campus Masterplan 2020 principles and UWA's requisites for aesthetic appeal, maintainability and environmental sustainability, while ensuring that there is sufficient scope for innovation and technological advancements to be explored within each project.

The Standards are intended for use by any parties who may be involved in the planning, design and construction of UWA facilities. This includes external consultants and contractors, UWA planners, designers and project managers as well as faculty and office staff who may be involved in the planning, design, maintenance or refurbishment of facilities. These Standards also provide facility managers, maintenance contractors and other service providers with an understanding of UWA services in order to assist in the maintenance and operation of facilities.

1.2 SERVICES

The UWA *Design and Construction Standards for* ***Communications Services*** (this document) are a part of *UWA Design and Construction Standards* set of documents (the Standards). The Standards are divided into the following service documents for ease of use, but must be considered in its entirety, regardless of specific discipline or responsibilities:

A Building and Architecture
B Mechanical Services
C Electrical Services
D **Communication Services (this document)**
E Hydraulic Services
F Security Services
G Fire Services and Fire Safety Engineering
H Structural Works
I Civil Works
J Irrigation Services
K Sustainability
L Vertical Transport
M Metering

1.3 RELATED DOCUMENTS

1.3.1 University Documents

The Standards are to be read in conjunction with the following relevant University documents:

- UWA General Preliminaries
- UWA Specification for As-Constructed Documentation
- Relevant UWA planning and policy documents such as the *UWA Campus Masterplan, UWA Space Plan, Disability, Access and Inclusion Plan and Environmental Sustainability Strategy.*
- Relevant UWA operational and maintenance documents such as preferred supplier lists, room data sheets, operational and maintenance manuals, etc.
- Other documents as referenced within the *UWA Design and Construction Standards*.

1.3.2 Relevant Legislation

The planning, design and construction of each UWA facility must fully comply with current relevant legislation, including but not limited to:

- Relevant Australian or Australian / New Zealand Standards (AS/NZS),
- Statutory legislation and codes of practice;
- National Construction Code (NCC),
- Occupational Safety and Health (OSH) legislation,
- Disability Discrimination Act (DDA),
- Accessibility Aspiration Design Factors, and
- Local council and authority requirements.

The latest amendments (available at the time of design) and all sub-parts of codes, guidelines, and standards shall be applied in all cases.

1.3.3 Manufacturer Specifications and Data Sheets

All installation must be carried out in accordance with manufacturer specifications, data sheets and product related documentation to maximise efficiency and reliability of all equipment and safeguard warranties.

1.3.4 Project Specific Documentation

Requirements specific to a particular project, campus or other variable, will be covered by project specific documentation, such as client briefs, specifications and drawings. These Standards will supplement any such project specific documentation.

The Standards do not take precedence over any contract document, although they will typically be cross-referenced in such documentation.

Extracts from the Standards may be incorporated in specifications, however it must remain the consultant's and contractor's responsibility to fully investigate the needs of the University and produce designs and documents that meet the necessary project requirements to effectively fulfil its designed function and address the specific needs of the project.

1.4 DISCREPANCIES

The Standards outline the University's requirements above and beyond the above-mentioned legislation. Where the Standards outline a higher standard than within the relevant legislation, the Standards will take precedence.

If any discrepancies are found between any relevant legislation, the Standards and project specific documentation, these discrepancies should be highlighted in writing to the appointed UWA project manager and Associate Director Estate Strategy, Campus Management.

1.5 DEPARTURES

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms. Where a departure from the Standards is proposed, this shall be requested in writing by the consultant or the contractor to the appointed UWA project manager and Associate Director Estate Strategy, Campus Management.

All requested departures shall clearly demonstrate a benefit to the outcome of the project. Any departures made without such written confirmation shall be rectified at no cost to UWA.

1.6 PROFESSIONAL SERVICES

For all works, it is expected that suitably qualified and experienced professionals are engaged to interpret and apply these Standards to UWA projects. Works cannot be carried out by unqualified and unlicensed consultants or contractors.

1.7 STRUCTURE OF DOCUMENT

This document is structured into 4 parts:

Part 1 Introduction (this Section)

Part 2 General Requirements – general requirements or design philosophies adopted at UWA

Part 3 Checklist for project team (if applicable) – checklist of items for consideration at various stages of a project

Part 4 Specifications (if applicable) – materials specifications and/or preferred lists for materials,

processes or equipment used by UWA.

1.8 DEFINITIONS

For the purpose of this document, the following definitions apply:

Can: Implies a capability of possibility and refers to the ability of the user of the document, or to a possibility that is available or might occur.

May: Indicates the existence of an option.

Shall: Indicates that a statement is mandatory.

Should: Indicates a recommendation.

Where the meaning of common terms and definitions are unclear, the consultant or contractor shall clarity this with UWA

2 GENERAL REQUIREMENTS

The **Communications Services Standards** defines the mandatory technical, spatial and operational requirements for the planning, design, installation and commissioning of all communications infrastructure across university facilities. This document provides a unified framework to ensure that communications systems are high-performing, secure, maintainable and scalable across the full life of UWA buildings.

This Standard sets out UWA's expectations for structured cabling, communications pathways, equipment rooms, communication racks and enclosures, backbone and horizontal cabling, wireless infrastructure, labelling, testing and documentation. It applies to all new capital works, refurbishments, upgrades and extensions to existing networks.

Key components of this Standard include:

- **Design principles and performance objectives**, covering system functionality, consistency across the campus, maintainability, safety, spare capacity planning, redundancy and future scalability.
- **Compliance with national and international standards**, including AS/NZS 11801, AS/CA S008/S009, NCC, Australian Communications and Media Authority (ACMA) requirements, Worksafe WA and relevant electrical, earthing and telecommunications codes.
- **Structured Cabling System (SCS) requirements**, including cable architecture, backbone design (OS2 fibre), horizontal cabling topologies, copper cabling classes, consolidation points / Multiuser Telecommunication Outlet (MUTO) use, and matched-brand cabling solutions to support warranty and performance obligations.
- **Equipment room and enclosure standards**, detailing minimum room sizes, access control, Heating Ventilation and Air-Conditioning (HVAC), noise, fire protection, rack configuration, earthing, power distribution and spatial allowances for future expansion.
- **Cable pathways and containment**, including intra-building and inter-building pathways, risers, ducting, trays, pits, trenches, underground conduits, segregation requirements and environmental resilience (lightning, heat, salt, corrosion).
- **Wireless Local Area Network (LAN) integration**, with requirements for modelling, Power over Ethernet (PoE) delivery, access point cabling, survey validation and interface with University IT (UniIT) design principles.
- **Testing, commissioning and certification**, outlining mandatory performance testing for copper and optical fibre networks, documentation requirements, warranty provisions and handover deliverables.
- **Project team responsibilities and approval checkpoints**, aligning communications design with UWA's governance gates, UniIT review processes, equipment room planning, spatial provisions and campus-wide network topology.

Together, these requirements ensure that every UWA project delivers robust, flexible and future-ready communications infrastructure that can support the University's teaching, research, administrative and operational technologies over the long term.

2.1 DESIGN CONSIDERATIONS

Consistency

Within buildings, and across campuses, UWA seek uniformity in communications systems design, effectively achieving coherence and compatibility across components both portable and fixed.

Combining communications systems that vary in manufacturer and operating principles cause unnecessary complications during operation and maintenance periods.

Functionality

UWA expect designers to understand the functions of the space and produce designs that practically serve the intended purpose of the space, permitting simplistic usability for everyday operation and maintenance.

Determining logical functionality shall involve consideration of several factors including special communications requirements, overall (long term) cost and probability of expansion.

Safety and Maintainability

Maintenance of communications equipment and systems is crucial. Poor maintainability of equipment often leads to unexpected failures and lengthy outages.

Reducing maintenance difficulties and optimising availability of products is essential. Design solutions shall prioritise safety at all stages from equipment selection through to construction and ongoing operation and maintenance.

Innovation

Incorporate contemporary technology and innovative engineering for aesthetics and functionality. Designers shall perform life cycle analysis on systems to ensure that selected equipment is commensurate with technology to be expected for the life of the building and replacement equipment remains available throughout. In particular, the serviceable life for a communications network system is expected to be at least 15-20 years.

2.2 NETWORK FUNCTIONS

The functional requirements of the communications network shall be determined in conjunction with the requirements of the communications services to be delivered over the network. These services include various voice and data functions for building users, audio visual services and other building functions (for example, BMS, lighting controls, emergency lighting monitoring, lift monitoring and the like).

Refer to UniIT reference documents, in particular:

- Network Access Layer – Communications Rooms and
- Network Access Layer – Cabling and Equipment.

2.3 SPARE CAPACITY

Communications systems shall have capacity to deliver the project's quality parameters to within tolerance of the end use equipment specifications, without exceeding the manufacturer's ratings for reliable operation of any system component. Systems shall have capacity to accommodate expansion as defined by UWA.

Particular spaces such as laboratories and data facilities within UWA tend to change in size throughout the life of the building. Provide communications infrastructure capable of accommodating expansion as defined by UWA.

The cabling system and equipment shall be dimensioned to provide spare capacity as detailed below:

- Equipment rooms shall allow for future installation of additional racks. Allow for one future rack where the initial deployment is four racks or less. Allow for two future racks where the initial deployment is between five and eight racks. Above eight racks, the expansion capacity shall be defined by UWA.
- Enclosures and racks shall not be more than 60% occupied.
- Pathways and cable containment shall provide not less than 50% spare capacity
- Conduits shall not be filled to more than 40% capacity
- Backbone cabling shall be fibre optic. A minimum of 1 spare core shall be provided for every core allocated to a service.

2.4 REDUNDANCY AND CRITICALITY

Redundancy is the duplication of critical components of a system with the intention of increasing overall reliability. Redundancy contributes to reducing the possibility of complete data outages due to a failure of a single piece of equipment or portion of the cabling system.

The level of redundancy provided within the network cabling system for any specific building or project shall be determined in accordance with the functionality and criticality of the services supported over the network. The necessary provisions shall be coordinated with UniIT.

2.5 ENERGY CONSERVATION AND SUSTAINABILITY

Energy conservation is a fundamental design principle and shall comply with the requirements of the

- National Construction Code (NCC) and
- UWA Design and Construction Standards – Sustainability

Consultants shall coordinate with the broader design team to consider environmentally sustainable design (ESD), including environmental impacts and energy efficiency.

2.6 STANDARDS AND CODES

New installations and modifications to existing systems must comply with all relevant Australian Standards, NCC, ACMA requirements, WA Electrical and Licensing Regulations and Work Health and Safety Requirements (Public Buildings) Regulations.

Where Australian Standards are not available, relevant International Electrotechnical Commission (IEC) and/or International Organisation for Standardisation (ISO) standards shall be referred to.

Applicable Standards include (but are not limited to) those listed within the References section of this document. Standards listed should be reviewed for current versions and additional amendments.

2.7 WARRANTIES

Cabling Manufacturer's Warranty period of 20 years is required. A period of 25 years is preferred.

2.8 QUALIFICATIONS OF THE INSTALLER

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

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

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

All electrical work is to be undertaken by qualified electricians in accordance with the relevant Australian Standards.

2.9 COORDINATION WITH OTHER WORKS

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

- Use of the site and access facilities
- Scheduling of the works and site construction resources and utilities
- Maintaining mandatory segregation of services
- Liaison as required for BMS and security systems
- Demolition
- Reinstatement

2.10 REDUNDANT CABLING AND EQUIPMENT

All redundant cabling and equipment removed during demolition, or modifications to the existing systems shall be returned to UWA in the condition in which it was removed.

Where cabling cannot be completely removed, the cable ends shall be confirmed and made safe by means of junction boxes, termination connectors and information tags.

2.11 DATA CENTRES

This guide is to apply only in relation to horizontal and backbone cabling. Data Centre active equipment rooms / facilities and infrastructure design will be specified independently to meet the specific requirements of the project.

2.12 STRUCTURED CABLING SYSTEM (SCS)

2.12.1 General

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

The cabling system may be quite small and simple, linking just a few nodes, or it may be extensive, linking several buildings with hundreds of nodes. The SCS shall provide a uniform design regardless of the size of the installation.

To facilitate the day-to-day operations of a normal office environment, the SCS shall readily enable additions, moves and changes, wherever and whenever necessary. Furthermore, the structured cabling

system must also be flexible and provide the capability to carry a wide variety of applications - from high-speed LAN applications to voice and low speed data.

UWA cabling systems are generally intended to serve for a long period of time. Whilst it is likely that transmission system requirements will change during the life of the cabling system, the system shall be provided to accommodate the likely needs over the life of the installation. For this reason, it is important to plan the SCS to provide flexibility and to accommodate increased bandwidth requirements as far as possible. This is particularly important where cabling is installed underground or in other locations where upgrades to plant can be expensive and disruptive.

2.12.2 Cable Utilisation

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

- Distances between distributors and edge devices
- Compatibility with existing cabling and equipment
- The equipment that will use the structured cabling system and constraints that such equipment may introduce with regard to supported interface modules
- Environmental factors such as salt atmosphere and prevalence of lightning
- Functional requirements of Voice and Data service delivery
- Compatibility and interface with building services functions such as: BMS, security and lighting control.

2.12.3 System Description

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

- **Manufacturer's Warranty -** Cabling equipment suppliers offer an automatic channel warranty of 20 to 25 years if the installation is a "Single Brand Solution" that is installed by a certified or accredited contractor, rather than the 1 to 5 years available for a cabling system constructed from mixed brand products.
- **Performance Improvements -** Independent testing has revealed that mixing cabling products from a number of manufacturers can have significant impact upon the performance of the structured cabling system thereby limiting the useful life of the installation.

2.12.4 System Architecture

The conceptual arrangement of a generic cabling system (from *AS/NZS 11801*) is illustrated in the figure below.

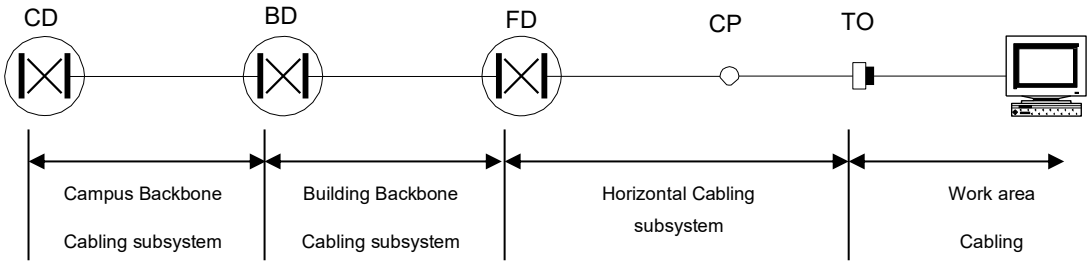

Figure 1 Generic Cabling System

The distributors provide the means to construct different structured cabling system topologies such as bus, star, ring, and mesh or a combination of these. Furthermore, the distributor functions may be combined, and the consolidation point may or may not be included in the cabling between the Telecommunications Outlet (TO) and the distributor. The SCS within UWA facilities will often combine the Building Distributor (BD) and Floor Distributor (FD) functions.

In general terms, use of Consolidation Points (CP) is discouraged and should be used only when planning for the project identifies that there is a need for localised architectural layout changes (for example, to wall or desk layouts) that would necessitate re-wiring of TO's from the FD with extensive ongoing costs to facilitate such changes.

2.12.5 Backbone Cabling

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

Campus backbone communications cabling shall be single mode optical fibre.

2.12.6 Horizontal Cabling

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

The horizontal cabling shall be a star topology connecting each workplace TO to a patch point at a

distributor as shown.

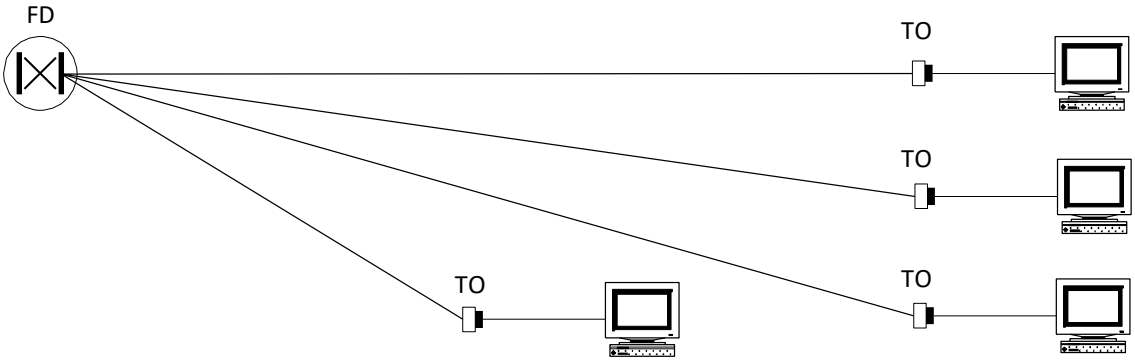

Figure 2 Horizontal Cabling

2.12.7 Horizontal Cabling Variations

Where variance from the preferred arrangement is considered necessary, (for example, to facilitate changes to an existing installation) these may be permitted when approved by UWA. Such variances could include the use of CPs and MUTOs.

CP and MUTO arrangements are primarily intended to reduce the effort associated with rearrangements occurring in open-office style environments.

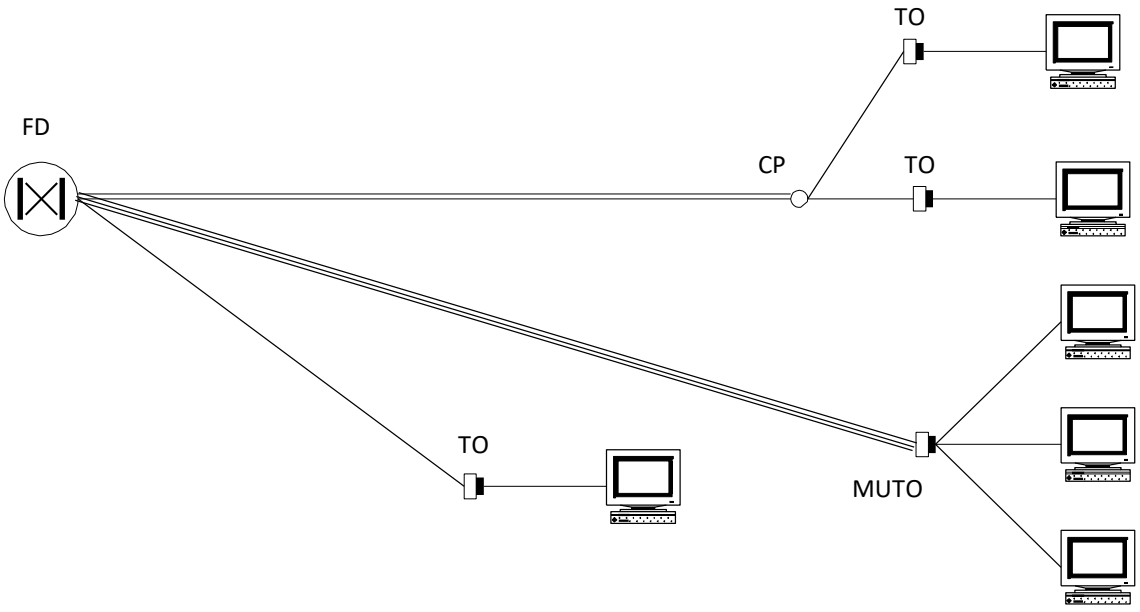

Figure 3 CP and MUTO Arrangement

CPs are used with solid copper unshielded twisted pair (UTP) cables and generally constructed using insulation displacement punch-down termination blocks.

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

2.12.8 Balanced Cabling

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

Balanced cabling shall meet the requirements of *AS/CA S008* and shall meet or exceed the performance requirement of *AS/NZS 11801* for the relevant performance Class.

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

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

2.12.9 Patch and Work Area Cords

Patch cords and work area cords shall be constructed of stranded cable terminated with RJ45 connectors at both ends complying with *Clause 10.2 of AS/NZS 11801.1*.

Patch cords and work area cords shall be from the same manufacturer as the horizontal cable and matched to the *AS/NZS 11801* performance Class of the cabling system in which they are used. Small Diameter cords may be used where they are of the same performance Class and are not subject to derating over their operational length.

Pin assignments and colour codes shall conform to the “T568A” arrangement in accordance with *AS/NZS 11801.1 Clause 10.6.*

All patch cords and work area cords shall be factory assembled, terminated and certified and fitted with moulded boots.

2.12.10 Optical Fibre

Optical fibre cable for UWA cabling systems shall be constructed using OS2 SMOF.

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

- Increased bandwidth and resultant ability to support higher transmission rate applications
- Improved protection against damage due to voltage transients, electrical noise and lightning.
- Geodiversity is required for all buildings to ensure redundant pathways, terminating in a distribution point and traversing alternative pathways via “pits and pipes”.

2.12.11 Optical Fibre Patch Cords

Optical fibre patch cords shall be minimum 9/125µm OS2 according to the application.

Except in some instances of extension to an existing installation, patch cords supplied shall be from the same manufacturer as the backbone cable and matched to the to the *AS/NZS 11801* optical fibre cable type of the cabling system in which they are used. In an existing installation extension, preference is for

patch cords to match the existing, unless prohibitively expensive.

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

2.12.12 Cable Pathways & Containment

Cable pathways shall be selected and designed to:

- Maintain minimum segregation from other services as mandated by *AS/CA S009* and *AS/NZS 3000* in accordance with *AS/NZS 11801.1 ZB.5.*
- Minimise interference in accordance with AS/CA S009.

Pits and external plant shall be placed as unobtrusively as practicable so as not to attract attention, avoid trip hazards and minimise interference to other services.

All cable pathways and containment systems shall be fully coordinated with the electrical cabling systems installation and in accordance with the respective clauses of the *UWA Design and Construction Standards – Electrical Services*

2.12.13 Carrier Service Entry

The lead-in cable providing the interface to carrier services shall be determined, in consultation with UWA, as appropriate to each building/ project.

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

Carrier service entry facilities shall be planned in consultation with the carrier. The facility shall be easily accessible to the carrier.

2.12.14 Intra-Building

No fixed horizontal cabling shall be visible within the workplace unless for architectural featuring. Cabling shall be coordinated with all other wiring systems within the building and installed in conduits, on cable trays or through under floor cavities.

It is preferred that cabling be concealed in roof, floor or wall spaces, however, cabling may be surface mounted within ducting in the following circumstances:

- Between outlets within the one room, in which case suitable neat ducting may be used
- Where such location is considered inordinately expensive, disruptive or impracticable.

Cables shall be installed parallel to walls, floors and ceilings as far as is practicable.

Where cable is run through a suspended ceiling it shall be supported by means of suspension from fixed non-movable structural features, purpose installed flat cable trays or by one or more catenary wires. Fixed, non-movable features exclude water pipes, sprinkler systems and trunked electrical power.

Horizontal cabling external to a building shall be kept to a minimum.

2.12.15 Vertical Risers

Where there is more than one floor, risers shall be located vertically one above the other and shall be vertically interconnected by conduits or wiring access tray with the equivalent space of not less than three 150mm conduits.

2.12.16 Inter-Building Pathways

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

Underground pathways shall be provided unless this is proven to be impractical.

The specific requirements for the incoming services for a new facility shall be determined in conjunction with UWA on a project-by-project basis. All new buildings and capital works shall have a defined means of ingress for voice and data cables created, with reserved ducted access for the entire distance to the Building Distributor room.

The crawl space under elevated buildings shall be considered an external environment and proper consideration shall be given to the choice of components used in this space i.e., external grade type cabling shall be used. Factors to be considered shall include dampness, flooding, ultraviolet (UV) radiation, vermin, and future access.

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

2.12.17 Cable Tray

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

2.12.18 Ducting and Trunking

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

Ducting shall be screw fixed to walls using suitable fixings (e.g., cavity fasteners for cavity walls and masonry anchors for concrete slabs, columns and the like). Fixings shall be of a type that does not cause undue distortion to the ducting when tightened.

Ducting shall be run in an inconspicuous manner. Excess cabling shall not be stored in the duct.

2.12.19 Fasteners/Fixings/Ties

Generally fixings shall be of a type suitable to the situation in which they will be used.

Where fixings are to be used externally or exposed to the weather stainless steel or brass is preferred. Plain steel will not be accepted. Where fixings are used internally, cadmium plated may be used.

All fixings, fastenings and supports shall be of adequate strength and size and arranged to ensure the installation against mechanical failure under normal conditions of use and wear and tear.

All surface mounted conduits, duct, cable trays and support branches on masonry shall be fixed in position using plugs, masonry anchors or other approved means.

Cadmium plated , "Ramset" or equivalent masonry anchors shall be used for fixings in concrete, clay or concrete brickwork.

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

Bolts or machine screws with nuts, washers and anti-vibration devices shall be used where necessary for fixings to masonry construction including plastered expanded metals. Such plugs shall be used only for minor shear loadings.

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

Only hook and loop cable ties e.g., Velcro style, shall be used.

2.12.20 Underground Pathways

Refer to the *UWA Design and Construction Standards – Civil Works* for further details regarding in-ground services.

Underground pathways shall be designed and constructed in accordance with *AS/NZS 3084.*

Copper and fibre backbone cables shall follow the same routes. Copper and fibre shall be run in separate conduits between pits and penetrations unless there is no other physical means of entering a building or structure or reaching the next pit.

Underground pathways are preferred for external cable routes. Above ground routes may be used provided that the pathway is fully covered and the cabling is installed within protective conduit or ducting for the entire external section of the cable route.
External (outdoor) cable routes utilising balanced copper cabling are subject to the following additional constraints:

- The link distance shall not exceed 90m
- The electrical earths of the buildings in which the cable terminates shall be bonded. The potential difference between building earths shall not exceed 1V r.m.s.
- Transient voltage (surge) protection is provided at each termination point of the cable.

2.12.21 Trenches

Trenches for communication cabling shall be constructed to provide the depth of cover and segregation specified in *Clauses 9 and 18 of AS/CA S009*. Depth of cover in this case means the distance between the finished ground surface and the top surface of the communications conduit.

2.12.22 Conduits

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

Conduits shall be white communications type PVC.

Sweeping bends shall be used to allow for cable bending radii.

A spare 100mm diameter, PVC, white communications conduit shall be installed along the complete route of the underground inter-building pathway system for future installations.

All conduits shall be installed with a 3mm nylon draw cord.

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

2.12.23 Pits

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

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

The minimum pit dimensions shall be 600mm x 600mm x 700mm deep.

Pits shall be provided with all required accessories including:

- Trafficable covers and support bars for covers as required (minimum *AS 3996 Class C*)
- Covers to be permanently and appropriately labelled
- Cable support bars
- Bushes (PVC) for conduit entry

- Gaskets and seals

Where pits are installed in traffic areas, the correct approved strengthening ring for the pit lip shall be used and covers shall be a minimum of Class C.

Shared service pits with other services (e.g., gas, electrical, water) shall not be used.

Pits shall include a drain point at the bottom to allow for any water drainage.

2.12.24 Penetrations

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

Where ladders or trays pass through ceilings, walls and floors, provide neat, close-fitting apertures. At openings through fire rated elements, terminate the ladders or trays on either side of the opening and provide certified fire stopped holes for the cables only. Firestopping shall comply with the *NCC*.

2.13 EQUIPMENT ROOMS

2.13.1 General

Equipment rooms shall be developed in conjunction with the briefing from UniIT and require the coordinated input of the Architect and other building services consultants. Rooms shall be designed with due consideration of the following:

- *AS/NZS 3084 Clause 6 and Appendix ZB*.
- Room for future expansion
- HVAC requirements
- Fire protection systems
- Gallagher access and security requirements
- Protection against water ingress
- Safety – equipment layout shall not restrict escape routes
- Acoustic/ noise requirements
- Suitable access to equipment for installation and maintenance
- Permanently clear and unhindered access, for both personnel and equipment, to equipment rooms/ spaces from an accessible corridor or unoccupied space
- Access through a private office, laboratory, learning or privately controlled space is not acceptable
- Access doors must be via Gallagher access control systems
- Access to/from the equipment room to external parking for the transport of equipment
- Spare capacity
- Redundancy and Criticality

- Earthing

Minimum room dimensions shall be as follows.

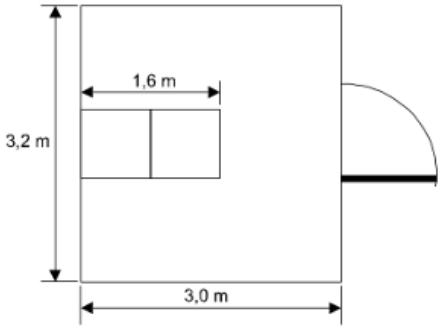

Figure 4 Minimum room dimensions for distributors supporting up to 500 outlets

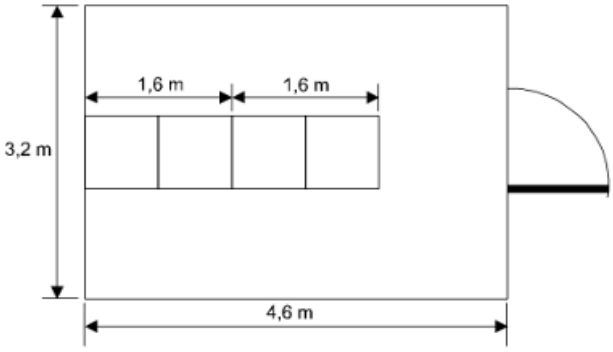

Figure 5 Minimum room dimensions for distributors supporting between 501 and 1,000 outlets

For small, non-critical areas, the Floor Distributor may be located in a closet with the following minimum dimensions.

2.13.2 Carrier Entrance Rooms

Access to Internet and wide area network services will normally be provided via the UWA network, either by an existing service or by a dedicated link to an existing carrier point of presence on campus.

Where a new, direct carrier connection is required, a dedicated pathway shall be provided from the campus boundary to the Building Distributor. The route shall be coordinated with the carrier and UWA.

2.13.3 Campus Distributors

The UWA network is organized into a number of Fibre Distribution Areas (FDA). Each FDA has an active Fibre Distribution Node and one or more passive Fibre Aggregation Points. These effectively act as Campus Distributors providing distributed, redundant links for the backbone infrastructure.

Table 3 Fibre Distribution Areas & Aggregation Points

Fibre Distribution Area	Fibre Distribution Node	Fibre Aggregation Points
South (Science Distribution Point (DP))	Building 446 (Barry J Marshall Library)	Building 405 (Agriculture Central)
Middle (Physics DP)	Building 245 (Physics)	Building 106 (Arts)
North (Fairway DP)	Building 658 (Ken and Julie Michael Building)	Building 681 (Architecture Landscape and Visual Arts)
QEII Medical Centre	Building 502 (QEII M Block)	Building 500 (Oral Health Centre WA)

The general requirements for Equipment Rooms will apply to any new Campus Distributors, but specific requirements will be defined in the project brief.

2.13.4 Building Distributor

The Building Distributor (BD) is the main equipment room in a building used to accommodate the major items of communications equipment such as routers and switches and shall be the central point of the cabling system.

Diverse fibre connections shall be provided from the BD to a Fibre Distribution Node and a Fibre Aggregation Point. Diverse connections to two Fibre Aggregation Points is acceptable.

The BD may also include Floor Distribution functions.

For critical buildings, dual redundant BDs may be provided with diverse fibre lead-ins. Floor Distributors should be connected to both BDs.

Separate racks should be provided for passive and active equipment.

2.13.5 Floor Distributor

All horizontal network cabling shall terminate in a Floor Distributor (FD).

The FD shall include a backbone connection to the BD.

Active and passive components may be combined in the same rack where a single rack is sufficient to house all the components and meet the spare capacity requirements. This typically applies to the closet FD configuration. Otherwise, active and passive components should be housed in separate racks.

FDs shall be centrally located to ensure that cable lengths do not exceed 90m.

2.14 ENCLOSURES AND RACKS

2.14.1 General

Communication enclosures are used to house and restrict access to hubs, cabling, all active LAN components and other communications hardware.

Enclosures fall into one of the following categories

- External Communications Equipment Cabinet (CEC)
- Wall mounted cabinets
- Open Frame racks
- Enclosed racks

Enclosures shall be designed for 482.6mm (19”) wide equipment mounting with 44.45mm (1RU) vertical mounting points.

Enclosures shall comply with the relevant requirements of *IEC-60297*. Markings for each rack unit shall be silk screened onto the rack.

All enclosures at a site shall be fitted with keyed alike doors and coordinated with the security requirements and building access provisions.

Enclosures shall provide facilities for ventilation in the form of fans, vented panels or the like. Metal surfaces of the enclosure and accessories shall be powder coated, painted or otherwise protected against corrosion.

Grey finish is preferred for cabinets. Black finish is preferred for racks.

All enclosures shall be bonded to the protective earth system or communications earth system (CES).

2.14.2 Communication External Cabinets (CEC)

Free standing external enclosures shall typically be installed on a 100mm plinth.

CECs shall be:

- Built with 2.5mm (minimum) marine grade aluminum
- Double skinned
- IP55 rated (minimum)
- Provided with hinged front and rear lockable doors
- Keyed to UWA’s communications room standard
- Have 19” front and rear mounting rails
- Fed by 2 x 100mm diverse communications conduits
- Fed by 1 x 50mm electrical conduit

- Suitable for DIN rail mounted equipment including a Fibre Optic Break Out Tray (FOBOT), 48VDC power supply and industrial switch.

2.14.3 Wall Mount Enclosures

Where wall mounting enclosures are approved for use, they shall be swing frame design to facilitate rear access and mounted on adequate structural support.

Wall mounting enclosures shall be provided as 18 RU and minimum internal depth of 550mm, excluding door.

The enclosure shall be supplied by a dedicated 15A General Power Outlet (GPO) mounted inside the enclosure.

2.14.4 Open Frame Racks

Open frame racks may be used for fully passive applications where only patch panels and distributors are mounted, or for light-weight active equipment such as switches.

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

UWA's preference is for open frame racks to be used for passive cabling and enclosed racks only to be used when the mounting of active equipment is required.

Open frame racks to be four-post and shall be mechanically secure and supported at the base and top.

Open frame racks shall be provided as 38 RU or 45 RU.

2.14.5 Enclosed Racks

Enclosed racks shall be

- 42RU unless otherwise specified
- 800mm wide
- Between 800mm and 1,200mm deep, depending on the dimensions of mounted equipment
- Fitted with front and rear 19" mounting rails
- Fitted with vertical cable management on both sides of the rack
- Fitted with removable side panels
- Fitted with perforated steel, lockable, keyed, removable front and rear doors
- Fitted with a minimum of two supporting shelves
- Fixable to the floor with leveling adjustment
- Fitted with an earthing bar for connection to the Communications Earthing System
- Suitable for baying

- Capable of including fans, cable entry chimneys and other cable management accessories

Rack Elevation

Each rack/ enclosure shall be provided with sufficient spare space and cable management for future installation and maintenance activity. The typical rack front elevation is indicated in the figure below

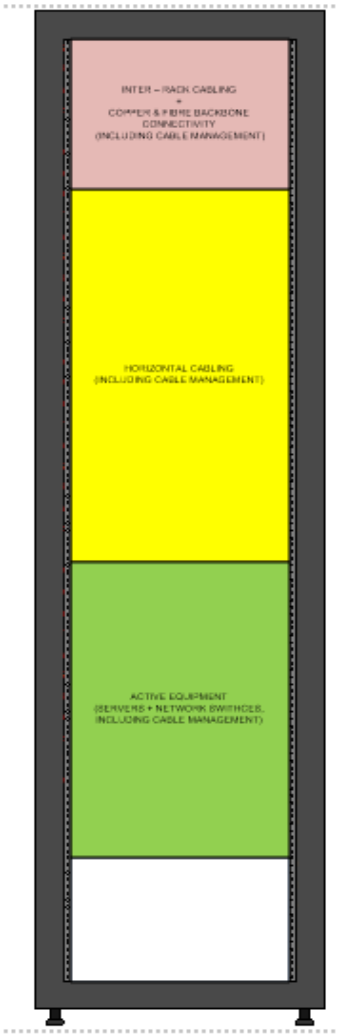

Figure 6 Typical Rack Front Elevation

Rack Cable Entry

Cabling shall enter the racks from above and in position to avoid obstructing access to the rear of the racks.

Cabling entering from a ceiling space to the top of the rack shall be supported by a vertical cable support system.

The vertical cable support system shall extend from the backbone/horizontal cable pathway to the base of

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

The vertical communications cabling support system shall have the same metal construction, colour and finish as the communications rack and be separate trays from other services, i.e., separate vertical cable trays for power and data.

Rack Power

Power supply for equipment within Communications rooms should be provided by means of a separate distribution switchboard, with dedicated circuit breakers for each item of equipment. Details of power supply requirements shall be coordinated with the Electrical services designers to ensure that the requirements for Essential Power (backed up by standby generator).

Generally, racks should be fed by an Essential Power circuit, these should be minimum 15A from a captive socket. 2 x Essential Power sockets should be provided.

Power distribution within equipment racks shall be provided as an integral part of the enclosure in the form of 2 x vertically mounted power distribution units supplied by independent circuits and attached securely to the rack. Outlet type, rating and quantity should accommodate the equipment to be installed in the rack, ensuring there is adequate capacity to fully fill the rack in all available spaces.

2.14.6 Enclosure Installation

Communication enclosures shall be located to achieve maximum operator convenience. No wet services, i.e., piping, shall be installed within the same space as the communications enclosures.

The design shall ensure that racks are arranged to permit installation of other equipment and enclosures with adequate access spaces for inspection, wire termination and patch field alterations.

Enclosures shall be provided with sufficient clearance for installation and maintenance activity. Typical minimum clearances for enclosures are indicated in the sketches below.

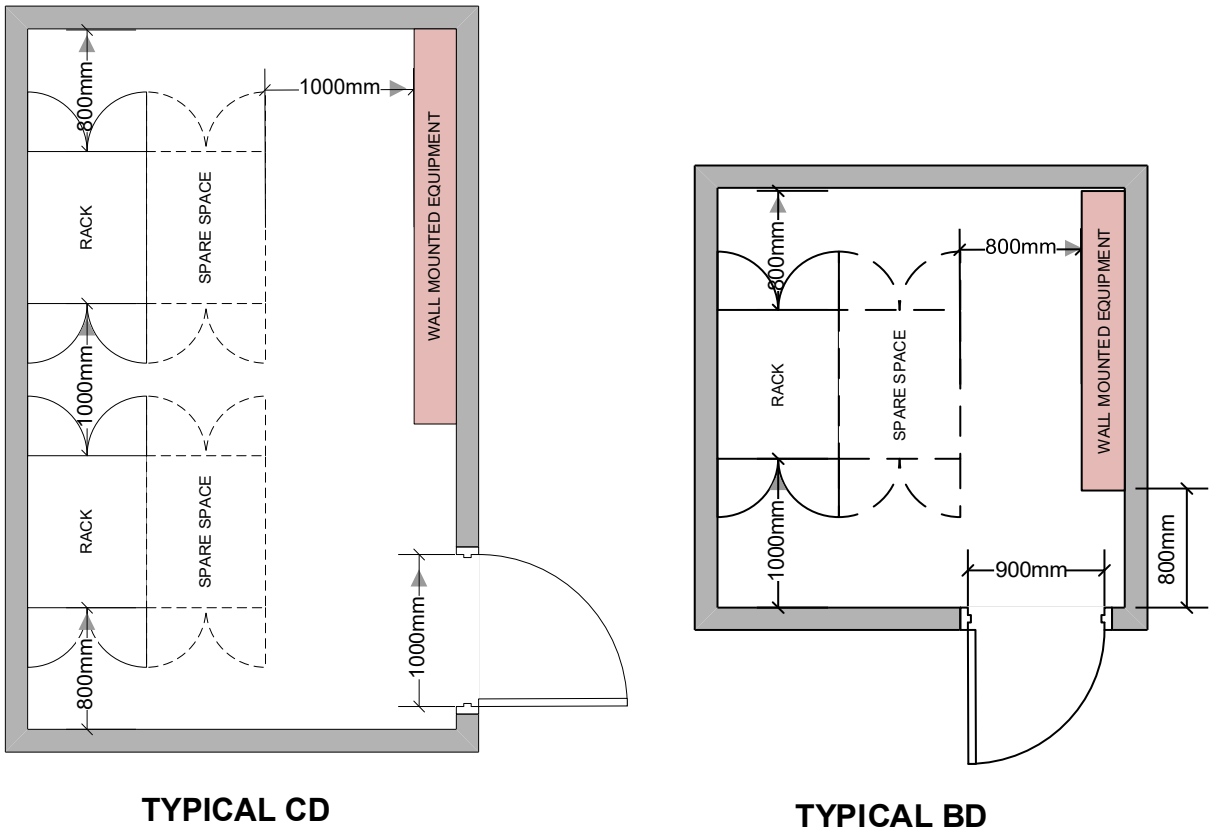

Figure 7 Enclosure Minimum Clearances

The vertical footprint for wall mount enclosures shall not extend beyond 2.4m nor lower than 0.5m above finished floor level (AFFL). Minimum clearance above the enclosures shall be adequate for cable access including provisions for future expansion. Wall mount locations shall be selected such that there is no risk of injury through striking arising from walking past or rising from beneath the enclosure.

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

Enclosures shall be bonded to the protective earth system.

2.14.7 Cable Management

Racks shall be supplied with cable management panels to facilitate the support and organising of patch cords between patch panels. For each 2 RU of active equipment in the rack there shall be a corresponding 1 RU cable management panel. Vertical cable containment shall be provided to both sides of each

equipment rack. Horizontal cable management is to be provided below each switch where switch stacks are installed.

A rear cable support system shall be utilised to offer strain relief for cables entering the rear of the rack.

For installations with more than 2 adjacent racks, cable ladder or tray shall be installed across the rack tops and vertical cable management installed between them.

2.14.8 Terminations

Balanced Cable Terminations

The general method for termination of copper cabling shall be modular 8-pin sockets (commonly known as RJ45) and plugs using the *T568A* wiring standard.

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

Modular Plug Terminated Links (MPTL) as specified in *AS/NZS 11801.1* may be used subject to approval.

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

Fibre Optic Cable Terminations

Fibre optic cables shall be terminated in a FOBOT and presented as SC/UPC as required connectors. A maximum of 96 cores shall be terminated in a 1RU FOBOT.

MTP®/MPO pre-terminated cables may be used for fibre links with suitable adaptors in the FOBOT to remove the requirement for splicing tails on site.

2.15 WIRELESS LAN (WLAN)

WLANs provide an alternative to wired LAN architecture but are usually deployed in conjunction with cabling infrastructure. The WLAN equipment is not considered to form part of the cabling system; however horizontal cabling should be used to interconnect wireless access points to the network infrastructure.

Outlets used to interface with WLAN access points will be determined in conjunction with UniIT operational and functional requirements, with full consideration of the physical nature of the space.

The cabling shall be suitable for delivering Power over Ethernet in accordance with *IEEE 803.bt.*

Allow 5m slack for repositioning of the access point.

Wireless coverage modelling shall be undertaken and the resulting design submitted to UniIT for approval. Post installation, a wireless survey shall be conducted to verify that the system meets the design requirements.

2.16 SECURITY

It shall be necessary to pass at least two points of restriction to access equipment from outside the building. This shall generally be achieved using locked or access-controlled doors at the equipment room or other equipment enclosures. Where access to the building is unrestricted, consideration should be given to controlling and / or monitoring the rack doors as part of UWA's access control system.

Equipment rooms shall be on UWA's access control system. Refer *UWA Design and Construction Standards – Security Services*.

2.17 ACOUSTIC NOISE

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

Equipment enclosure locations shall be selected such that noise levels in work areas arising from active equipment, when combined with other sources of work area noise, shall be maintained within the limits specified by *AS/NZS 2107*.

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

Fire alarms and Emergency Warning Information Systems shall be audible at the equipment racks. Refer *UWA Design and Construction Standards – Fire Services*.

2.18 ENVIRONMENTAL FACTORS

2.18.1 Lightning Protection

Special consideration shall be given to earthing practices in areas prone to lightning activity. Copper cabling extending outside a building shall be terminated on a surge protection device in the distributor(s).

2.18.2 Salt

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

Equipment racks and distribution equipment shall not be installed in open areas. Equipment room vents shall be fitted with filters to minimise salt ingress.

2.18.3 Chemical Corrosion

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

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

2.18.4 Heat

Equipment room design, including HVAC and venting, shall be adequate to accommodate the heat load of active equipment likely to be fitted in the room and to maintain a comfortable working temperature in accordance with *AS/NZS 3084 ZB2.3.4.6.2*.

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

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

The duty cycle of any venting or HVAC provided shall be 24 hours / 7 days.

Side panels and doors shall not be removed to improve ventilation.

2.19 EARTHING

All equipment racks, cable tray systems and the like shall be earthed in accordance with *AS/NZS 3000* to the building protective earth system.

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

Catenary wires used for cabling support shall not be bonded to the Telecommunications Reference Conductor (TRC) (where provided) but may be bonded to building protective earth system.

2.20 TRANSIENT PROTECTION

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

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

2.21 LABELLING

2.21.1 General

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

Labels may be computer generated using a proprietary labelling system. Use of Dymo label, felt tipped pen and the like will not be accepted.

Telecommunications outlets shall be labelled with moulded removable plugs to fit flush plate apertures.

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

2.21.2 Enclosures

Each enclosure shall be labelled with a unique designation:

Refer *UWA Specification for As Constructed Documentation* for room numbering details.

The naming standard for enclosures is Building / RackID. The RackID is determined using the Operational Support System (OSS)..

The first sequence shall be a three- or four-digit number to signify the building (e.g., 102 for the Administration building, 441 for the Business School building, etc.).

The first character of the second sequence shall be alphanumeric and signify the level within the building (e.g. 1 for Level 1, G for Ground, B for Basement, etc.)

The second character of the second sequence shall be a sequential alpha (A, B, C, etc.) signifying the particular enclosure on the respective level. The letters O, Q, I and L shall be omitted.

For example, 658/1A is the first enclosure on level 1 of building 658, and 658/1B is the second enclosure on the same level.

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

2.21.3 Patch Panels

The naming standard for patch panel ports is Building ID/Rack ID/ 3-digit patch port number. For example, 658/1A/001 is the first patch panel port in enclosure 658/1A.

Patch panel ports within the enclosure shall be sequentially numbered, left to right, top to bottom, using three digits. Sequences shall start at 001 for each enclosure

2.21.4 Horizontal Copper Structured Cabling System

The horizontal wiring shall be labelled with the enclosure designator (the second character of the second sequence) and patch panel port identifiers as specified above. The building and floor are known. If the enclosure is on a different floor from the outlet, then all characters of the second sequence are required (building level and enclosure designator. Labels shall be attached to the cable at the rear of the telecommunications outlet. The size and length of the marking system carriers shall be sized to suit the cable size and the text required for proper identification.

2.21.5 Backbone Cabling

Fibre Optic cable shall be used for backbone cabling.

Each fibre termination through connector location in the termination unit shall be sequentially numbered from left to right. Each end of each fibre core must be labelled with an attached number tag. Cores must be sequentially numbered within the cable.

Each end of each cable jacket must be clearly identified by a 4-digit cable sequence number for the route. Cable sequence numbers shall be generated using OSS in consultation with UniIT.

Fibre optic cable must be clearly marked in all exposed areas. Exposed areas would be at a point the cable leaves ducting or cable trays, in cable pits and fibre termination points.

Marking is to consist of an optical fibre warning tag and is to include cable sequence number and the words “UNIVERSITY OF WA”.

2.21.6 Outlets

Each telecommunications outlet is to be labelled with the full identification of the corresponding patch panel outlet, e.g., 102/BA/15.

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

For example, 139/GA/73 signifies horizontal port 73 from enclosure A on level G of Building 139.

2.22 TESTING, COMMISSIONING AND CERTIFICATION

2.22.1 General

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

Testing shall be performed at the channel level wherever practicable.

Testing shall only be performed using calibrated Level III test and simulation equipment.

The test results, for all cables, connectors and outlets shall be fully documented and tabulated, identifying each cable and each outlet or interface port by its label. All test results shall be included in the handover documentation.

Test results shall meet the requirements of *AS/NZS 3085.1 Section 9*.

2.22.2 Balanced Cabling and Connecting Hardware

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

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

- Cable and outlet/port identification
- Test equipment and test configuration details
- Wire map testing
- Cable length
- Cabling performance parameters as specified in *AS/NZS 11801*
- Date and time of testing
- Name and signature of testing engineer

The cable system shall be tested in accordance with, and certified to, its Class channel performance in accordance with Clause 6 of *AS/NZS 11801*.

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

The cabling system installer shall certify the performance of each channel (horizontal and backbone) to its Class for all pairs as detailed in *AS/NZS 11801*.

2.22.3 Optical Fibre Backbone Cabling and Related Hardware

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

- Cable identification
- Test equipment and test configuration details including equipment settings
- Length of fibre segment in metres
- Loss over fibre segment in decibels (dB)
- Date and time of testing

- Name and signature of testing engineer

Cable length shall be determined for each core.

Optical loss testing shall be conducted on each core of all installed optical fibre cable runs. Actual through put loss, in dB, of the fibre link at the wavelength of system operation shall be tabulated from both ends of each fibre link.

Testing for OS2 optical fibres shall be carried out at the optical wavelengths of:

- 1,310nm
- 1,550nm

For short (less than 1km) runs and where the fibre does not have any splices, a Light Power tester may be used, otherwise Optical Time Domain Reflectometer (OTDR) testing shall be carried out using a suitable launch cable and clearly show loss at all splices and connectors.

2.23 DOCUMENTATION

2.23.1 Handover Documentation

The following documentation shall be supplied at the completion of the project:

- As-constructed scale site and building/floor location plans showing the location and size of pathways and the cables installed therein, cable routes, pit locations and enclosure/distributor locations. Scale drawings shall be to a reasonable accuracy in the event that CAD drawings of the site are not available. (Refer Figure C1 of *AS/NZS 3085.1*)
- As-constructed schematic diagrams detailing the quantity and types of cables linking distributors.
- As-constructed equipment room layouts, including associated services equipment
- As-constructed physical enclosure layouts. (Refer Figure C3 and C4 of *AS/NZS 3085.1*)
- As-constructed schematic diagrams detailing patch panel layout and port numbering
- As-constructed physical layout drawings detailing outlet positions and identification numbers
- Cabling infrastructure patching records (Refer Appendix D and Appendix E of *AS/NZS 3085*). Records shall be generated and recorded in accordance with the data storage requirements of UWA.
- Equipment lists detailing (type/make/model for) the installed equipment including enclosures, patch panels, outlets and the like
- Test reports detailing procedures, equipment configuration and test results for balanced copper cable
- Test reports detailing procedures, equipment configuration and test results for optical fibre cable
- Certificate of Compliance to *AS/NZS 11801* performance as specified for the particular cabling system
- Certificate of Compliance to *AS/NZS 3000* regulations
- Warranty documentation
- Contractor details.

Refer *UWA Specifications for As Constructed Documentation* for documentation requirements.

3 CHECKLIST FOR PROJECT TEAM

The following activities shall be considered by the project team during the planning of the project.

ACTIVITY	RESPONSIBILITY	STAKEHOLDER(S)	TIMEFRAME
Establish network capacity (including bandwidth, speed, topology)	UWA communications systems users/ Communications consultant	UniIT / CM / Client (e.g. School)	Gate 2 Feasibility
Determine service entry locations	Communications consultant	CM (Engineering)	Gate 2 Feasibility
Ensure communications design has considered spare capacity for expansion	Communications consultant	UniIT / CM (Engineering / Client)	Gate 2 Feasibility
Design for redundancy based on the criticality of the space	Communications consultant	UniIT / CM (Engineering)	Gate 2 Feasibility
Allow for upgrade of any in-ground or backbone infrastructure	Communications consultant	UniIT / CM (Engineering)	Gate 2 Feasibility
Spatial requirements and distribution philosophy	Communications consultant	UniIT / CM (Engineering)	Gate 2 Feasibility
Approval of structured cabling designs/ topology	Communications consultant	UniIT / CM (Engineering)	Gate 3 Planning
Design of cable pathways	Communications consultant	CM (Engineering / Building Operations)	Gate 3 Planning
Design of equipment rooms (including number, location, size and access control)	Communications consultant/ Architect	UniIT / CM (Building Operations)	Gate 3 Planning
Allow for provisions for associated services (HVAC, fire protection, security, power, BMS, services interface)	Communications and other services consultant	CM (Engineering / Building Operations)	Gate 3 Planning
Network configuration and allocation of outlet address	UniIT / Communications consultant	CM (Engineering / Building Operations)	Gate 4 Design
Ensure labelling is as per UWA requirements	Communications consultant / Contractor	UniIT	Gate 5 Construction

4 SPECIFICATIONS

4.1 PREFERRED MANUFACTURERS

Table 5 Preferred Manufacturers

Item	Preferred manufacturer
Racks	Panduit or equivalent
Structured Cabling System Copper (Internal) Copper (External) Fibre (Internal) Fibre (External)	 Panduit or equivalent Molex or equivalent CommScope or equivalent Corning, CommScope or equivalent
Cabling Support Cable Basket	 To match electrical services
Power Distributor Unit	To match rack

4.2 CABLING

4.2.1 Campus backbone cabling (external inter-building)

OS2 12-core single-mode optical fibre minimum.

4.2.2 Building backbone cabling (internal intra-building)

OS2 12-core single-mode optical fibre minimum.

4.2.3 Intra-Building Copper Data Cabling

Copper data cabling shall be ACMA approved 4-pair Category 6A (Class E_A) or greater UTP. The cable performance shall comply with *AS/NZS 11801* Clause 6.

An alternative class of cable may be used where there is a specific requirement to maintain compatibility with existing SCS infrastructure.

The use of shielded cable should be considered for specific applications (for example if uncompressed video using HDBaseT is to be carried).

Cables shall be terminated on RJ-45 sockets mounted in TO's or patch panels.

Category 6A cables shall be terminated using Blue sockets both in TO's and in patch panels in order to distinguish these cables from legacy infrastructure.
Refer to 2.14.8.1 Balanced Cable Terminations.

4.2.4 Optical Fibre Cabling

Optical fibre cabling shall meet the requirements of *AS/CA S008* and shall meet or exceed the performance requirement of *AS/NZS 11801* Clause 9.5 for the relevant performance class.

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

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

Optical fibre cable shall be terminated with fibre connectors. Enclosures shall be filled from left to right. Equipment that uses Small Form Factor pluggable (SFP) optical connectors shall be interfaced to the connectors at the patch panel using optical patch cords to provide adaptation between the patch panel and the particular SFP connector.

Refer to 2.14.8.2 Fibre Optic Cable Terminations.

4.2.5 Work area Cords

The total number of work area cords shall equal 1.2 x number of outlets.

Work area cable lengths shall be 2.0m, 3.0m and 5.0m in length.

Quantities of each length shall equal 0.4 x number of outlets.

4.2.6 Patch Cords

The total number of patch cords per distributor shall equal 1.1 x number of sockets.

80% of the patch cords shall be 2.0m.

20% of the patch cords shall be 3.0m.

Table 6 Patch Lead Colours

Patch Lead Colour	Work Area
Blue	Generally all areas
Green	Alternative where required to differentiate for operational reasons

4.2.7 Optical Fibre Patch Cords

The total number of optical fibre patch cords shall equal one each end of an active pair.

Optical fibre patch cords shall be provided as standard manufactured items of standard length and shall be

as short as is practicable to minimise excess cable management requirements. Longer patch cords will be required where network equipment is not installed in the same enclosure as the optical fibre termination / distribution panel.

Optical fibre patch cords will not necessarily be provided at the time of installing the optical fibre, as the client may not know what the exact active equipment type will be.

Optical Fibre patch cords shall be coloured yellow.

4.3 CAPITAL WORKS PROGRAMS

Horizontal cabling systems for capital works shall be of Category 6a (Class EA) balanced cabling.

4.4 EXPANSION AND UPGRADE TO EXISTING FACILITIES

Upgrade or expansion works are to maintain uniformity with this standard (i.e. Cat 6a or OS2).

4.5 CABLE CONTAINMENT

4.5.1 Cable Tray

Cable trays shall be coordinated with Electrical services, of galvanised perforated sheet steel. Minimum steel thickness for cable tray shall be:

- 1.0mm for trays up to 150mm wide and
- 1.2mm for trays up to 300mm wide.

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

Alternative basket tray of equivalent size may be offered for University consideration.

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

4.5.2 Ducting and Conduits

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

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

4.6 CABLE PATHWAYS

4.6.1 Underground Pathways

The minimum conduit count and size for lead-in cables to any permanent building is 2 off 100mm conduits.

Minor campus pathways shall consist of a minimum 4 off 100mm conduits. Major campus pathways shall consist of a minimum 6 off 100mm conduits.

Cable pits shall be of sufficient size for termination of conduits and drawing in of cables and of category suitable for the trafficability function of the location of installation.

4.6.2 Trenches

In general the depth of cover required shall be;

- 450mm under public footway or roadway
- 300mm in other areas except where soil conditions preclude a trench depth to provide 300mm cover in which case the depth of cover shall be in accordance with *AS/CA S009* Clause 18.6.2.

4.7 INTERNAL CATENARY

Catenary wires used for support of internal cablings shall be installed within ceiling spaces. Catenary wires shall have an insulating sheath.

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

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

4.8 SPECIFIC SPACE REQUIREMENTS

4.8.1 Transportable Buildings

Temporary buildings shall be fitted with not less than eight (8) telecommunications outlets. UniIT need to be consulted to advise on location and number of Wireless Access Points (WAP) Ports required in ceilings.

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

4.8.2 Learning Spaces

Every learning space should have at least eight (8) telecommunications outlets (TO). Consideration needs

to be given to the location of TO in relation to existing infrastructure such as switched socket outlets (SSO) so as not to create any potential occupational, health and safety issues. Each outlet should have an adjacent dual SSO.

4.8.3 General Offices

Unless otherwise specified the minimum distribution of data outlets for offices shall be triple telecommunications outlets cabled to the appropriate floor distributor for:

- Each enclosed area
- Each designated work area
- For every 15m^2 of open office space

ABBREVIATIONS

ACMA	Australian Communications and Media Authority
AFFL	Above Floor Finish Level
BD	Building Distributor
BMS	Building Management Systems
CAD	Computer Aided Design
CD	Campus Distributor
CEC	Communications Equipment Cabinet
CES	Communications Earth System
CP	Consolidation Point
CM	Campus Management
DB	Decibels
DP	Distribution Point
DTE	Data Terminal Equipment
EMC	Electromagnetic Compatibility
ESD	Environmentally Sustainable Design
FD	Floor Distributor
FDA	Fibre Distribution Area
FOBOT	Fibre Optic Break Out Tray
GPO	General Power Outlet
HVAC	Heating, Ventilation and Air-Conditioning
IDC	Insulation Displacement Connection
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
LAN	Local Area Network
MPO	Multi-fibre Push On
MPTL	Modular Plug Terminated Link
MTP	Mechanical Transfer Push On
MUTO	Multi-user Telecommunications Outlet
NCC	National Construction Code
OSS	Operational Support System
OTDR	Optical Time Domain Reflectometer
PoE	Power over Ethernet
PVC	Poly Vinyl Chloride
RJ45	Registered Jack 45 (USOC reference)
RU	Rack Units (1RU = 44.5mm)
SCS	Structured Cabling System
SFP	Small Form Factor pluggable (connector)

SMOF	Single-mode Optical Fibre
SSO	Switched Socket Outlet
TO	Telecommunications Outlet
TRC	Telecommunications Reference Conductor
UniIT	University IT
UTP	Unshielded Twisted Pair
UV	Ultraviolet
UWA	The University of Western Australia
WA	Western Australia
WAP	Wireless Access Point
WHS	Work Health and Safety
WLAN	Wireless Local Area Network

REFERENCES

ARPANSA	Radiation Protection Series Publication No. 3
AS/ISO 1000	The International System of Units (SI)
AS/NZS CISPR 22	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
AS/CA S008	Requirements for customer cabling products
AS/CA S009	Installation requirements for customer cabling
AS/NZS 1269	Occupational noise management
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 2032	Installation of PVC Pipe Systems
AS/NZS 2053	Conduits and Fittings for Electrical Installations
AS/NZS 2107	Acoustics – Recommended design sound levels and reverberation times for building interiors
AS/NZS 2211.2	Laser safety – Safety of optical fibre communications systems
AS/NZS 2648	Underground Marking Tape
AS/NZS 3000	Wiring Rules
AS/NZS 11801	Information technology - Generic cabling for customer premises
AS/NZS 3084	Telecommunications Pathways and Spaces for Commercial Buildings.
AS/NZS 3085.1	Telecommunications Installations Administration of Communication Cabling System - Part 1: Basic Requirements
AS/NZS 3087.1	Telecommunications Installations - Generic Cabling Systems - Specification for the testing of balanced communications cabling
AS/NZS 3087.2	Telecommunications installations - Generic cabling systems - Specification for the testing of patch cords in accordance with AS/NZS 11801
AS/NZS 3100	Approval and test specification - General requirements for electrical equipment
AS/NZS 60950	Safety of Information Technology Equipment
AS 3996	Access covers and grates
AS/NZS 4117	Surge protection devices for telecommunication applications
AS/NZS 4129	Fittings for Polyethylene Pipes for Pressure Applications
AS/NZS 4130	Polyethylene Pipes for Pressure Applications

AS/NZS 4251.1	Electromagnetic compatibility (EMC) – Generic emission standard Part 1: Residential, commercial and light industry
AS/NZS 4586	Slip resistance classification of new pedestrian surface materials
IEC-60297	Part 1 and Part 2 Dimensions of mechanical structures of the 482.6mm (19in) series
IEEE 802.3	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications
IEEE 802.3bt	Power over Ethernet standard. Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications-- Amendment Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
NCC	National Construction Code of Australia
TIA-942	Telecommunications Infrastructure Standard for Data Centres
NOHSC:1007	National Standard for Occupational Noise

DOCUMENT APPENDIX

Title	Description	Link
WA Network Access Layer – Communications Rooms (available from UniIT)	Communication Room Layout files	Uni IT Standards
UWA Fibre Master Plan	UWA Fibre Master plan	Crawley JOINTS & Building Connections - 06 Feb 2019.pdf
Fibre Specifications	UWA Fibre Specifications.	Fibre Specification Sheets Prospective
Comms room standards	Update on current standards	Connected Campus Comms Room Standard-1.2 1.docx

CHANGE LOG

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years. This version differs from the previous version in the following areas:

Section	Title	Description
2.3	Spare capacity	Clarified spare capacity requirements.
2.4	Redundancy and Criticality	Deleted unnecessary text.
2.6	Standards and Codes and throughout the document	Update on current standards
2.12	Structured Cabling System (SCS)	Updated to align with AS/NZS 11801
2.13	Equipment Rooms	Updated terminology and room functions to align with AS/NZS 11801.
2.14	Enclosures and Racks	Clarified enclosure types and removed room details.
2.15	Wireless LAN	Included requirements for modelling and surveys.
	Generally	Deleted text referring to legacy technologies (voice, Cat 3, OM1, blown fibre)
References		References updated to current Australian standards
2.14.8	terminations	Updated Connections to be SC/UPS from LC to align with standards