THE UNIVERSITY OF WESTERN AUSTRALIA

The University of Western Australia

Design and Construction Standards

COMMUNICATION SERVICES

D

DOCUMENT CONTROL

REVISION LOG

Current Issue

UWA Design and Construction Standards: Communications Services, Version 1.0 (September 2016)

Previous issues

Version	Author(s)	Description	Date completed
1.0	Campus Management	UWA Design and Construction Standards: Communications Services - D	

REVISION MANAGEMENT

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years.

ENDORSEMENT BODY

To be determined.

OWNER

Director, Campus Management

AUTHOR(S)

The Standards have been developed by Campus Management with the assistance of UWA staff, external consultants, contractors and colleagues from other education institutions.

CONTACT PERSON

Associate Director Capital Works, Campus Management

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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 the UWA's Campus Plan 2010 planning 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

1.3 RELATED DOCUMENTS

1.3.1 University Documents

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

- UWA Network Access Layer – Communications Rooms (available from Business Information and Technology Services)
- UWA Network Access Layer – Cabling and Equipment (available from Business Information and Technology Services)
- UWA General Preliminaries Document
- UWA Specification for As-Constructed Documentation
- Relevant UWA planning and policy documents such as the *UWA Campus Plan*, *Commercial Masterplan*, *Landscape Vision* and *Integrated Infrastructure Strategy*, *University Policy on Alterations to University Buildings*, etc.
- Relevant UWA operational and maintenance documents such as preferred vendors 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),
- National Construction Code (NCC),
- Occupational Safety and Health (OSH) legislation,
- Disability Discrimination Act (DDA),
- Accessibility Aspiration Design Factors, and
- local council and authority requirements.

1.3.3 Manufacturer Specifications and Data Sheets

All installation must be carried out in accordance with manufacturer specifications and data sheets to ensure product performance over its intended life and so as not to invalidate any 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 are entirely 'fit for purpose' and which meet the 'intent' of the project brief.

1.4 DISCREPANCIES

The Standards outline the University's generic 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 Associate Director Capital Works, 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. However, consultants and contractors are expected to propose 'best practice / state of the art' construction techniques, and introduce technological changes that support pragmatic, innovative design.

In recognition of this, any departures from relevant legislation, or the Standards, if allowed, must be confirmed in writing by the Associate Director Capital Works, Campus Management.

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 – outlines the 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.

2 General Requirements

2.1 DESIGN CONSIDERATIONS

The design considerations are intended to facilitate the provision of functional spaces which are safe, comfortable and aesthetically pleasing.

Consistency

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

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

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 every day 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 with current technology to be as a minimum of the order of 15-20 years.

2.2 NETWORK FUNCTIONS

The functionality of the communications network shall be derived in consultation with the requirements of the communications services to be delivered. The services to be delivered comprise a variety of voice and data functions for the users of the building/ space, audio visual services and other building functions or services (for example, BMCS, lighting controls, emergency lighting monitoring, lift monitoring and the like).

Refer to the UWA BITS 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 any expansion.

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

- Equipment rooms shall allow for installation of an increase in the number of racks and enclosures by 25%. Enclosures and racks shall not be more than 60% occupied, plus space for active equipment.
- Pathways and cable containment shall provide not less than 50% spare capacity
- Conduits shall not be filled to more than 40% capacity
- Balanced cabling backbone capacity (CD/BD – BD/FD) for communications shall have not less than 50% spare capacity relative to the number of pairs allocated to data and voice services between the FD and connected TOs.
- Balanced cabling backbone capacity (CD/BD – BD/FD) for data communications will comprise fibre optic cabling for almost all services. Where there are services that require copper cabling, there shall be not less than two unused 4-pair UTP cables as spare capacity.

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 determined in full consideration of UWA IT briefing requirements.

All facilities shall have at least the reliability and redundancy necessary for the delivery of engineering services to comply with statutory specifications, plus any other UWA requirements.

Where equipment within a space is considered to be critical in nature to the operation of the space, redundant infrastructure shall be considered. Assess a space's functionality to provide clarity on whether a redundant cabling network is required.

2.5 ENERGY CONSERVATION AND SUSTAINABILITY

Energy conservation is a fundamental design principle within UWA. Communications works shall comply with the requirements of the *National Construction Code (NCC)* and UWA *Design and Construction Standards – Sustainability*.

Consultants shall co-ordinate with the broader design team to consider ecologically sustainable design (ESD), including environmental impacts and energy efficiency.

2.6 STANDARDS AND CODES

New installations and modifications to existing systems must conform to the current versions of the following:

- National Construction Code
- Western Australian Environmental Protection Act 1986
- Western Australian Occupational Safety and Health Act 1984
- Western Australian Occupational Safety and Health Legislation Amendment Act 1995 and 2002
- Western Australian Electricity (Licensing) Regulations 1991
- ACA Radio communications (Electromagnetic Radiation – Human Exposure) Standard 2003

The relevant standards applicable to UWA include (but are not limited to) those listed within the *References* section of this document. Standards listed shall 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 ACA or ACA

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 Building Management and Control Systems (BMCS) 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 of 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)

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 local area network (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.

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: BMCS, Security, Lighting Control..

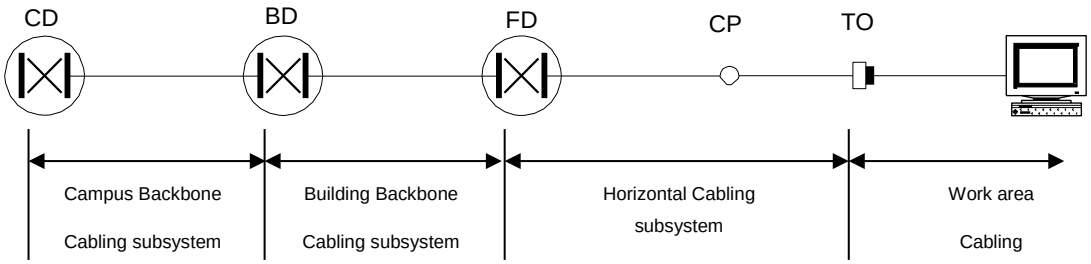
System Description

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.

System Architecture

The conceptual arrangement of a generic cabling system (from *AS/NZS 3080*) is illustrated in the figure below.



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 Structured Cabling System 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.

Backbone Cabling

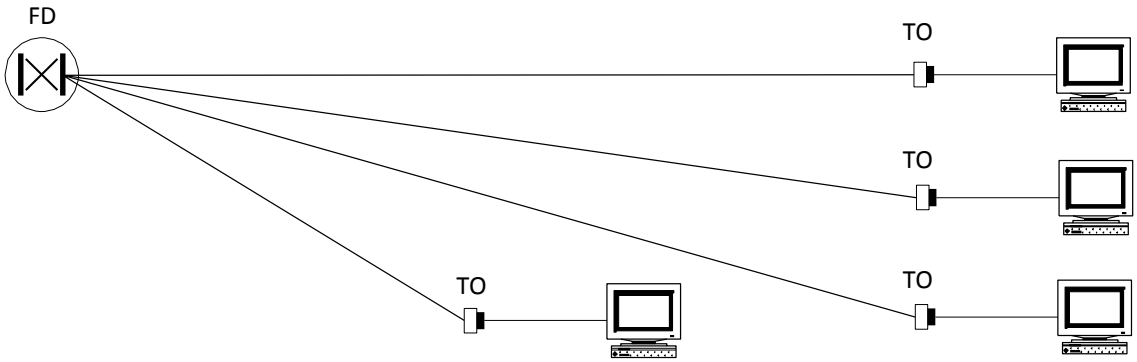
Backbone cabling includes both campus and building backbone cabling subsystems. Campus backbone cabling runs between buildings and Building backbone cabling runs within buildings to provide the interconnection between the floor distributors and building distributors. The backbone cabling generally provides 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.

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 telecommunications outlet to a patch point at a distributor as shown.

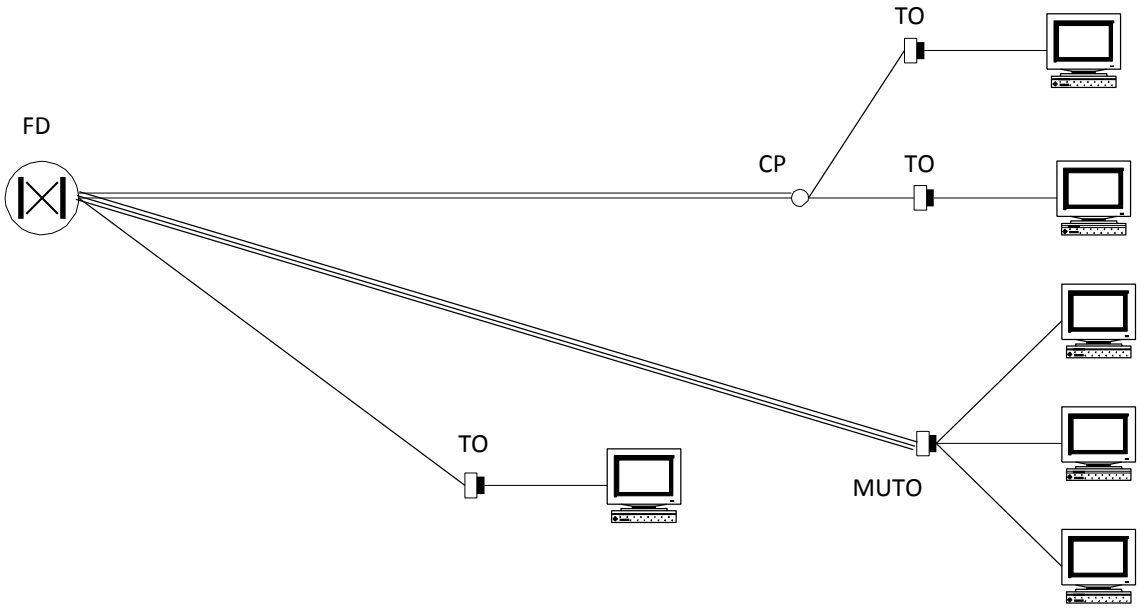


Horizontal Cabling

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 consolidation points (CP) and multi-user telecommunications outlets (MUTO).

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



CP and MUTO Arrangement

Consolidation points are used with solid copper UTP 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.

2.13 BALANCED CABLING

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

Balanced cabling shall meet the requirements of *AS/ACIF S008* and shall meet or exceed the performance requirement of *AS/NZS 3080* 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.

Patch and Work Area Cords

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

Patch cords and work area cords shall be from the same manufacturer as the horizontal cable and matched to the *AS/NZS 3080* 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 3080 Z.A.2.*

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

2.14 OPTICAL FIBRE

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

Composite single-mode / multi-mode (62.5/125µm OM1) optical fibre or OM1 MMOF optical fibre cable may be used where it is necessary to maintain compatibility and:

- It is necessary to interface to legacy network equipment that utilises LED transceivers or otherwise requires an OM1 multi-mode interface
- Length of the cable route does not exceed 200m.

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.

Optical Fibre Patch Cords

Optical fibre patch cords shall be minimum 50/125µm 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 3080* 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.

2.15 CABLE PATHWAYS & CONTAINMENT

General

Cable pathways shall be selected and designed to:

- Maintain minimum segregation from other services as mandated by *AS/ACIF S009* and *AS 3000* in accordance with *AS/NZS 3080 ZA.3.1*.
- Minimise interference in accordance with *AS/NZS 3080 ZA3.2*.

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*

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.

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.

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.

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, UV radiation, vermin, and future access.

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

Cable Tray

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

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.

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 "loxins", "ramset" or terrier" 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.

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, however 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 distance between distributor connection points shall not exceed 25m
- 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.

Trenches

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

Conduits

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

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

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.

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 areas having traffic, the correct approved strengthening ring for the pit lip shall be used.

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.

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 fire stopped holes for the cables only. Firestopping shall comply with the *National Construction Code (NCC)*.

2.16 EQUIPMENT ROOMS

General

Equipment rooms shall be developed in conjunction with the briefing from UWA BITS 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
- 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 to/from the equipment room to external parking for the transport of equipment
- Equipment enclosures are to be avoided in general; however, in the event that approval is granted for use of such, they shall not be installed in positions subject to exposure to moisture

Core Equipment Rooms

The core equipment room shall be used to accommodate the major items of communications equipment such as routers, switches and servers and shall be the central point of the cabling system.

2.17 ENCLOSURES AND RACKS

General

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

Enclosures will generally be free standing or where specifically required and approved by UWA, wall mounted.

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

Cabinets, racks and wall frames shall comply with the relevant requirements of *IEC-60297*. Markings for each rack unit shall be silk screened onto the rack.

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

All equipment/ rooms 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 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 and enclosures. Black finish is preferred for racks.

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

Free Standing Enclosures (Cabinets)

Free standing enclosures shall typically be provided as 42 RU and shall be installed on 100mm plinth.

Enclosures shall be 1000mm deep when used as the rack for active equipment, or 800mm when used as other than an active equipment enclosure.

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.

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 communications cabling and cabinets/enclosures 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.

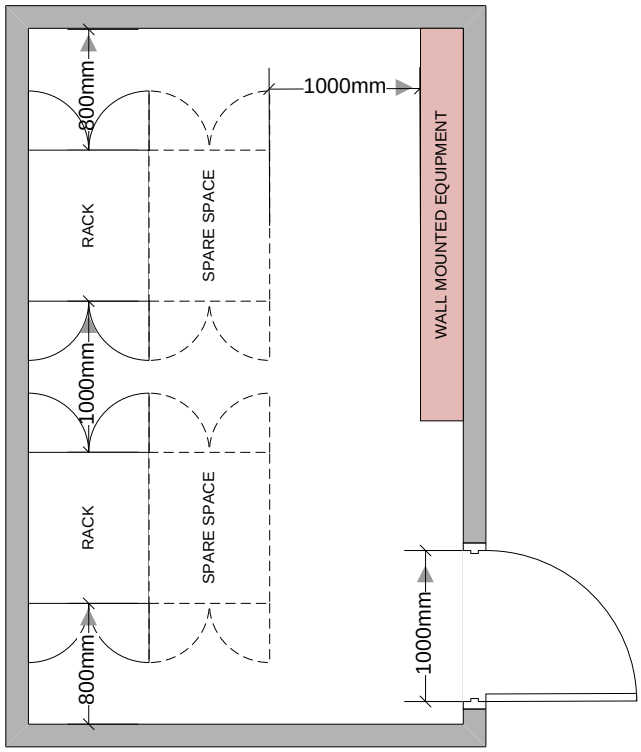
Open frame racks shall be provided as 38 RU or 45 RU.

Enclosure Installation

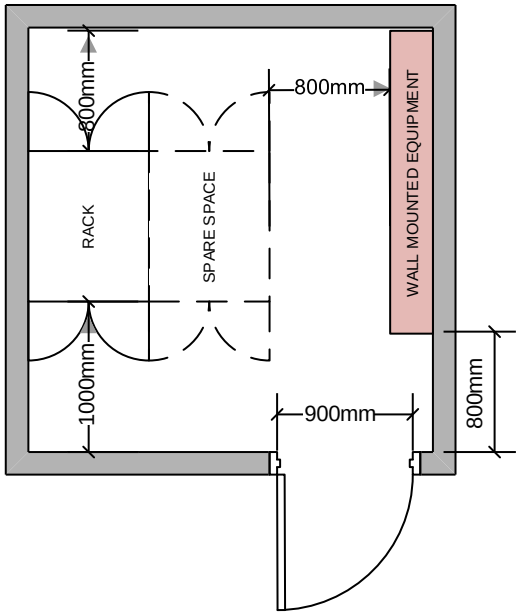
Communication enclosures shall be located to achieve maximum operator convenience. No wet services, i.e., piping, shall be installed within the same space as the communications enclosures.

The cabling Contractor 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.

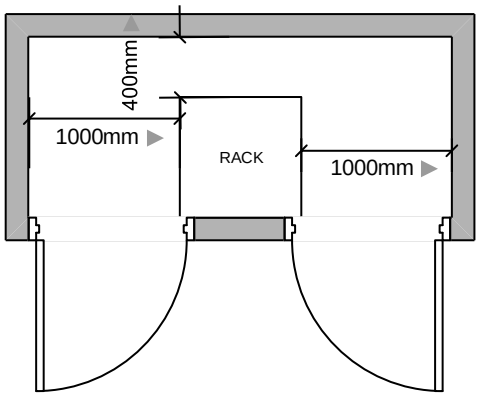
Enclosures shall be provided with sufficient clearance for installation and maintenance activity. Typical minimum clearances for enclosures are indicated in the sketches below.



TYPICAL CD



TYPICAL BD



TYPICAL SINGLE RACK BD

Enclosure Minimum Clearance

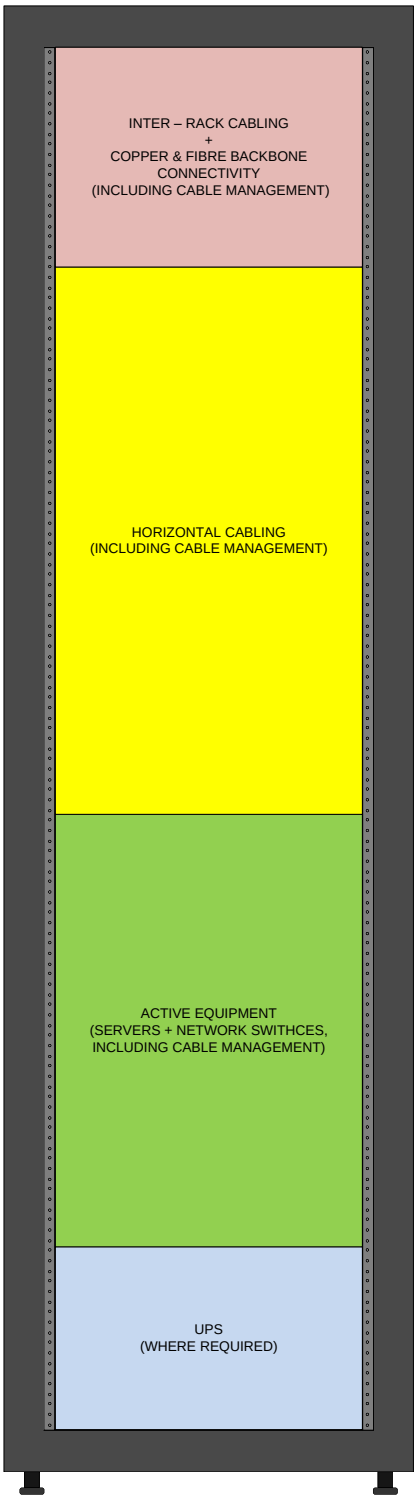
The vertical footprint for wall mount enclosures shall not extend beyond 2.4 m nor lower than 0.5m AFFL. Minimum clearance above the enclosures shall be adequate for cable access including provisions for future expansion. Wall mount locations shall be selected such that there is no risk of injury through 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.

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



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 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), UPS, diversity of supply and safe working are all adequately addressed in the design.

Power distribution within equipment racks shall be provided as an integral part of the enclosure in the form of power rails 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.

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 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 enclosures/racks, cable ladder or tray shall be installed across the rack tops and vertical cable management installed between them.

2.18 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 standard.

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

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

2.19 WIRELESS

Wireless LAN Interfaces

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 can 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 UWA IT operational and functional requirements, with full consideration of the physical nature of the space.

2.20 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.

Core equipment rooms shall be on UWA’s access control system. Refer *UWA Design and Construction Standards – Security Services*.

2.21 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*.

2.22 ENVIRONMENTAL FACTORS

Lightning Protection

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

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.

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.

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.

2.23 EARTHING

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

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

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

2.24 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.

2.25 LABELLING

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.

Enclosures

Each enclosure shall be labelled with a unique designation:

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.)

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

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.

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

Patch Panels

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

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

Backbone or tie cable ports shall be sequentially numbered using the word TIE followed by two digits and enclosure identifier of the destination. Sequences shall start at TIE01 for each enclosure.

Horizontal Copper Structured Cabling System

The horizontal wiring shall be labelled with the enclosure and patch panel port identifiers as specified above. For areas that may be served by multiple enclosures, 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.

Backbone Cabling

The following is the intended schema for all UWA buildings and sites.

Voice

Backbone voice cable shall be clearly marked in all exposed areas. Exposed areas would be at a point the cable terminates on the MDF and in cable pits.

Marking shall consist of an optical fibre warning tag and is to include cable pair range identification and the words “UNIVERSITY OF WA”.

Backbone voice cables terminating on patch panels are to be labelled.

- Ports shall be sequentially numbered, left to right, top to bottom, using the letter V and three digits. Sequences shall start at 001 for each enclosure.
- The patch panel shall be labelled with the identifier of the CD/BD/FD that the backbone voice cable originates from and the corresponding vertical and pair range.

Labelling conventions for voice backbone cabling shall follow the general format:

- Source MDF/CD (eg building number “M458”, etc)
- Vertical
- Pair Range

Fibre

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 CRS cable sequence number for the route. Cable sequence numbers shall be determined in consultation with UWA Business Information and Technology Services (BITS).

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”.

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 could signify horizontal port 73 from enclosure A on level G of Building 139.

2.26 TESTING, COMMISSIONING AND CERTIFICATION

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 test and simulation equipment. A Level III tester shall be used for Class E testing while a Level IIe tester may be used for Class D testing.

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 3085.1 Section 9*.

Balanced Cabling and Connecting Hardware

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

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

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

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

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 the *Standards Australia HB27*.

Outdoor and Indoor Voice UTP Backbone Cabling

The insulation resistance and capacitance shall be tested on a minimum of two randomly picked pairs in every 100 pairs.

The loop resistance of each pair is to be tested with the lowest and highest readings recorded. The difference between the lowest and highest readings shall not exceed 10%.

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
- OTDR Signature
- Length of fibre segment in metres
- Loss over fibre segment in dB
- Date and time of testing
- Name and signature of testing engineer

Cable length shall be determined for each core using an Optical Time Domain Reflectometer.

Optical loss testing shall be conducted on each core of all installed optical fibre cable runs by way of a Light Power Meter. Actual through put loss, in decibels (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

Testing shall be carried out using a suitable launch cable and clearly show loss at all splices and connectors.

2.27 DOCUMENTATION

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. (Refer Figure C2 of *AS/NZS 3085.1*)
- 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 3080* performance as specified for the particular cabling system
- Certificate of Compliance to *AS 3000* regulations
- 15/20 Year 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	BITS/ CM (Engineering Services / Client Faculty)	Gate 2 Feasibility
Determine service entry locations	Communications consultant	CM (Engineering Services)	Gate 2 Feasibility
Ensure communications design has considered spare capacity for expansion	Communications consultant	BITS/ CM (Engineering Services / Client Faculty)	Gate 2 Feasibility
Design for redundancy based on the criticality of the space	Communications consultant	BITS/ CM (Engineering Services)	Gate 2 Feasibility
Allow for upgrade of any in-ground or backbone infrastructure	Communications consultant	BITS/ CM (Engineering Services)	Gate 2 Feasibility
Spatial requirements and distribution philosophy	Communications consultant	BITS/ CM (Engineering Services)	Gate 2 Feasibility
Approval of structured cabling designs/ topology	Communications consultant	BITS/ CM (Engineering Services)	Gate 3 Planning
Design of cable pathways	Communications consultant	CM (Engineering Services / Building Operations)	Gate 3 Planning
Design of equipment rooms (including number, location, size and access control)	Communications consultant/ Architect	BITS/ CM (Building Operations)	Gate 3 Planning
Allow for provisions for associated services (HVAC, fire protection, security, power, BMCS, services interface)	Communications and other services consultant	CM (Engineering Services / Building Operations)	Gate 3 Planning
Allow for UPS power supply, with alarm interface to the BMCS	Communications consultant	BITS/ CM (Engineering Services / Building Operations)	Gate 3 Planning
Network configuration and allocation of outlet address	BITS/ Communications consultant	CM (Engineering Services / Building Operations)	Gate 4 Design
Ensure labelling is as per UWA requirements	Communications consultant / Contractor	BITS	Gate 5 Construction

4 Specifications

4.1 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 ADC Krone or equivalent Corning, ADC Krone or equivalent
Cabling Support Cable Basket Fibre Tube (where applicable)	 To matchelectrical services Emtelle or equivalent
Power Distributor Unit	To match rack

4.2 CABLING

Campus backbone cabling (external inter-building)

OS2 12-core single-mode optical fibre minimum.

7 Tube OS2 12-core minimum Emtelle Microduct to two locations via diverse cable paths is preferred for new capital works and major upgrades.

Building backbone cabling (internal intra-building)

OS2 6-core single-mode optical fibre minimum (hybrid OS1/OM1 cables allowed for compatibility purposes only).

7 Tube minimum Emtelle Microduct between the core equipment room and major server/equipment rooms.

Backbone cabling links used for voice or alarm applications shall have not less than 25% more pairs than the associated horizontal cabling and telecommunications outlets.

Inter-Building Copper Backbone Cabling

All Inter-Building copper backbone cables shall be Austel / ACA / Telstra approved and gel (jelly) filled to prevent the ingress of moisture and impurities.

The inter-building copper cables shall be of Outdoor Cable construction as in ACA TS 008, which in turn refers to AS 1049-2003-2003.

Cables shall not be direct buried.

Intra-Building Copper Backbone Cabling

The backbone cable shall be Austel / ACA approved voice grade or Category 3 type UTP cable. The minimum wire diameter shall be 0.40mm and 25 pair cables should be used.

Backbone cabling shall be used to connect the CD / BD to all FD's where installed and the TPF in the PABX room. Backbone cables will also connect the Distributor to the voice patch panels in the appropriate cabinet..

Termination

The backbone cable will be terminated on KRONE 10 pair Disconnection Modules mounted on the CD, BD, FD and TPF. The Termination shall conform to all Austel / ACA regulations and the manufacturers recommendations.

The backbone cable to the voice patch panel shall terminate sequentially with one pair to each patch panel outlet (jack) and will continue until all the pairs have been terminated on the voice patch panels. Outlets shall be labelled according to *Section 2.25* of this document.

Spare Pairs

Spare pairs that are left over on the last voice patch panel shall be terminated onto the last few patch panel outlets to allow for the connection of 4 wire telephone circuits.

Optical Fibre Cabling

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

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

Cable Jacket	Optical Fibre
Blue or Black	9/125µm (OS1)
Yellow	9/125µm (OS2)

Cable jacket colour requirements

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.

Emtelle microduct shall terminate in a tube management box. A box shall be provided in each communications room and at each level the microduct passes through in the case of a vertical riser. A two tube duct shall be provided from the tube management box to the fibre patch panel. Microduct shall be rated as per a normal cable for indoor or outdoor based on its use.

Optical fibre cable shall be terminated with fibre connectors. Enclosures shall be filled from left to right. Equipment that uses Small Form Factor (SFF) 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 SFF connector.

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.

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.

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

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 E) 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

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.

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

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

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.

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/ACIF S009* Clause 5.5.3.5.2.

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 6.

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

4.8 CABINETS

Freestanding enclosures shall be fitted with:

- Front and rear 19” mounting rails
- Horizontal and vertical cable tidy panels and/or loops
- Vertical cable tray or cable management troughs fitted to both sides of the enclosure
- A minimum of two supporting shelves
- Power rail with adequate quantity of outlets to be accommodated in the rack with not less than 10 outlets and typically 20 outlets
- Removable rear and side panels
- Keyed, lockable, perforated steel front door
- Keyed, lockable, perforated steel rear door or removable panel in cases where insufficient clearance is available to accommodate a door
- Levelling adjustment
- Earth bar as part of Communications Earth System

Open frame racks shall be fitted with:

- Horizontal and vertical cable tidy panels and/or loops
- Vertical cable management fitted to both sides of the rack
- Power rail with adequate quantity of outlets for the active equipment to be accommodated in the rack with not less than 10 outlets and typically 20 outlets.
- Levelling adjustment
- Earth bar as part of Communications Earth System

4.9 SPECIFIC SPACE REQUIREMENTS

Transportable Buildings

Temporary buildings shall be fitted with not less than six (6) telecommunications outlets per space. Preference is for eight (8) telecommunications outlets. All new temporary building placements are to have eight (8) telecommunications outlets.

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.

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.

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 network connected device
- Each network connected device
- For every 15m^2 of open office space

The following table can be used to provide guidance regarding outlet allocation, based on conventional operational requirements. This information can be used to develop minimum likely requirements, but must be adapted in accordance with users requirements, functioning of the spaces and need to incorporate advanced technological solutions.

Room definition	Min No. of Ports	Description
Standard classroom	8	Standard learning area with no high density computing device requirements
Meeting Rooms	4	
Library/Resource Space	8	
Single Office	3	Typically one desk and workstation
Shared Office	5	Typically one desk but space enough for two
Collegiate work areas	1 per staff plus 2 extra	Collegiate work areas are used by postgraduate and honours students. The distribution of data outlets should be 1 per workstation, plus an allowance for printers and phones.

Room definition	Min No. of Ports	Description
Managers work area	4	Includes computer, printer, phone and fax
Staff work area	1 per staff plus 2 extra	Every staff work area. Work area is defined as the workstation for a single person and includes phone.
Media / Print	6	
Photocopier	4	
Function Areas	2	
Laboratories – Work Benches	4	
Laboratories – Wall Phone	1	
Lecture Theatres	8	Refer UWA Business Information and Technology Services (BITS)
Lecture Rooms	8	Refer UWA Business Information and Technology Services (BITS)
Lifts	1	
Foyers	1	
Fire Information Panels	2	1 located inside the panel, 1 beside the panel for wall mounted telephone handset
Laboratories – Computer	1 per computer	1 per machine plus extra outlet per end of row plus allowances for telephone and printers
Seminar Rooms		Refer UWA Business Information and Technology Services (BITS)
Reception Area	1 per staff plus 3 extra	Every reception work area. Work area is defined as the workstation for a single person and includes phone.

Abbreviations

ACA	Australian Communications Authority
AFFL	After Floor Finish Level
BD	Building Distributor
BITS	Business Information and Technology Services
BMCS	Building Management and Control Systems
CAD	Computer Aided Design
CD	Campus Distributor
CES	Communications Earth System
CP	Consolidation Point
CM	Campus Management
DTE	Data Terminal Equipment
EMC	Electromagnetic Compatibility
ESD	Ecologically Sustainable Design
FD	Floor Distributor
GPO	General Power Outlet
HVAC	Heating, Ventilation and Air-Conditioning
IDC	Insulation Displacement Connection
BITS	Business Information and Technology Services
LAN	Local Area Network
LED	Light Emitting Diode
MDF	Main Distribution Frame
MMOF	Multi-mode Optical Fibre
MUTO	Multi-user Telecommunications Outlet
NCC	National Construction Code
OTDR	Optical Time Domain Reflectometer
PABX	Private Automatic Branch Exchange
PVC	Poly Vinyl Chloride
RJ45	Registered Jack 45 (USOC reference)
RU	Rack Units (1RU = 44.5mm)
SCS	Structured Cabling System
SFF	Small Form Factor (connector)
SMOF	Single-mode Optical Fibre
TO	Telecommunications Outlet
TPF	Test Point Frame
TRC	Telecommunications Reference Conductor
USOC	Universal Service Ordering Code
UTP	Unshielded Twisted Pair

UV	Ultraviolet
UWA	The University of Western Australia
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 1269	Occupational noise management
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS 1485	Safety and health in workrooms of educational institutions
AS/NZS 2032	Installation of PVC Pipe Systems
AS/NZS 2053	Conduits and Fittings for Electrical Installations
AS 2107	Acoustics – Recommended design sound levels and reverberation times for building interiors
AS/NZS 2211.2	Laser safety – Safety of optical fibre communications systems
AS 2834	Computer accommodation
AS/NZS 2648	Underground Marking Tape
AS 2834	Computer Accommodation
AS 3000	Electrical installations (known as the Australian / New Zealand Wiring Rules)
AS/NZS 3080	Telecommunications Installations – Integrated Telecommunications Cabling Systems for Commercial 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 3080
AS/NZS 3100	Approval and test specification - General requirements for electrical equipment
AS 3260	Safety of Information Technology Equipment including Electrical Business Equipment

AS 3548	Electrical Interference – Limits and Methods of Measurements 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
HB 29:2000	Communications Cabling Manual, Module 2
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 802.3af	Power over Ethernet standard. Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications-- Amendment Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
NCC	National Construction Code of Australia
TIA-942	Telecommunications Infrastructure Standard for Data Centres

National Standard for Occupational Noise - NOHSC:1007(2000)

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