DESIGN STANDARD

E. Communication Services

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Contents

Revision log

Current issue

E. Communication Services - UoA Design Standards. FINAL Version 4. August 2018

Previous issues

Version	Authors	Description	Revision	Date
1.0	Peter Hughes, UoA Technology Services,UoA	E. Communication Services - UoA Design Standards	DRAFT Version 1	December 2017
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List of revised items

Version	Authors	Revised items	Date

Revision management

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

Endorsement body

Director of Infrastructure

Owner

Capital Projects Delivery

Contact person

Associate Director, Capital Project Delivery

Authors and acknowledgements

The standards have been developed by Capital Projects with the assistance of UoA staff, external consultants, contractors, and colleagues from other education institutions. The University conveys its thanks.

Abbreviations

ACMA	Australian Communications and Media Authority
AFFL	After Floor Finish Level
AS/NZS	Australia or Australian/New Zealand Standards
BCA	Building Code of Australia
BD	Building Distributor
BMCS	Building Management and Control Systems
CAD	Computer Aided Design
CD	Campus Distributor
CES	Communications Earth System
CM	Capital Projects Delivery
CP	Consolidation Point

Abbreviations continued

CPD	University of Adelaide- Capital Projects Delivery
DDA	Disability Discrimination Act
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
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
NCC	National Construction Code
OSH	Occupational Safety and Health
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
SEPP	State Environmental Planning Legislation
SFF	Small Form Factor (connector)
SiD	Safety in Design
SMOF	Single-mode Optical Fibre
TO	Telecommunications Outlet
TPF	Test Point Frame
TRC	Telecommunications Reference Conductor
UoA	University of Adelaide
UofA	The University of Adelaide
USOC	Universal Service Ordering Code
UTP	Unshielded Twisted Pair
UV	Ultraviolet
WAP	Wireless Access Point
WHS	Work, Health and Safety
WLAN	Wireless Local Area Network

1. Introduction

This section outlines the purpose, structure, related documents, and definitions for the University of Adelaide (UoA) Design Standards.

1.1 Purpose of the document

The UoA Design Standards (the Standards) respond to the strategic vision for the University, outlined in Beacon of Enlightenment 2016-2035, and the guiding planning principles contained in the UoA Masterplan 2016-2035. Prepared in recognition of the University's unique historical context, the Standards are guided by the aims of supporting physical, social and cultural connectivity, embracing diversity, equity and accessibility, and promoting sustainability and academic excellence.

The Standards specify the minimum, mandatory requirements for the design, construction and management of all University of Adelaide infrastructure projects. Requirements are specific to the University's needs, and are over and above minimum mandatory Authority requirements. They include:

- Methodological requirements for project delivery; and
- Technical requirements for the finished product.

The objective is to support the consistent delivery of a high quality product, while allowing sufficient scope for innovation, creativity and technological advancements.

The Standards must be used by any parties involved in the planning, design, construction, occupation management, maintenance and operation of UoA facilities. This includes external consultants and contractors, UoA planners, designers and project managers as well as professional and faculty staff, facility managers, maintenance contractors and other service providers – all of whom must be aware of the Standards as they apply to their project and scope of work.

1.2 Structure of UoA Design Standards

E. Communication Services Design Standard (this document) is a part of the UoA Design Standards suite of documents (the Standards).

The Standards are divided into the following volumes for ease of use:

- A. Project Process Checklist
- B. Building and Architecture
- C. Mechanical Services
- D. Electrical Services
- E. Communication Services (this document)
- F. Hydraulic Services
- G. Fire Services
- H. Security Services
- I. Vertical Transport
- J. External Works
- K. Documentation
- L. Metering and Monitoring
- M. Audio Visual
- N. Signage and Wayfinding

The Standards must be considered in their entirety, regardless of the project's size, specific disciplines or responsibilities.

In particular, UoA staff and consultants using this volume must ensure familiarity with the mandatory project procurement obligations, detailed in A. Project Process Checklist.

Each volume within the Standards is structured into four parts:

- Part 1 – Introduction
- Part 2 – General requirements
- Part 3 – Technical requirements
- Part 4 – Schedules

1.3 Related documents and legislation

1.3.1 Documents

During the earliest strategic feasibility and planning stages of the project, review and analysis of the latest edition of the following UoA strategic planning documents must be carried out and outcomes of that review reflected in the Project Brief (refer to clause 1.4 – Definitions of this volume).

These documents should also be read in conjunction with the UoA Design Standards.

- UoA Masterplan 2016-2035
- UoA Strategic Plan - Beacon of Enlightenment, 2013-2035
- Disability Action Plan 2013-2019
- Campus/ Building-specific Disability Action Plans
- Dormwell Framework
- UoA Reconciliation Statements
- Campus/ Precinct/ Building-specific Masterplans (e.g. Waite Masterplan, Union House Masterplan)
- Campus/ Building-specific Conservation Management Plans
- Faculty Masterplans
- Technical discipline/ space-specific Masterplans, including:
  - ITS Strategy Masterplan
  - Mechanical Services Masterplan
  - SAMP
  - Teaching Spaces Masterplan
  - Labs Standards and Masterplan
  - Library of the Future Masterplan
  - Space Standards Guidelines
  - Deferred Maintenance Schedule
  - Bushfire Prevention Plans
  - Campus Water Management Plan
- Campus Sustainability Plan 2017 and associated documents, including:
  - The Carbon Neutral Adelaide Action Plan 2016-2021
  - Innovation Hub/ Smart Cities
  - Building Performance Rating System

1.3.2 Relevant legislation

The planning, design and construction of each UoA facility must fully comply with current legislation. Legislation includes but is not limited to:

- Australia or Australian/ New Zealand Standards (AS/NZS)
- National Construction Code (NCC)
- Building Code of Australia (BCA)
- Occupational Safety and Health (OSH) legislation
- Disability Discrimination Act (DDA)
- Accessibility Aspiration Design Factors
- State Environmental Planning Legislation (SEPP)
- Commonwealth and State Legislation
- Local Council and Authority requirements
- Relevant Heritage Acts (for both Places and Natural Resources)

- 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)

1.4 Definitions

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

Must	Indicates that a statement is mandatory
Should/ shall	Indicates a recommendation
May/ can	Indicates the existence of an option
The Standard/s	The University of Adelaide Design Standards
Project Manager	University of Adelaide staff member responsible for delivering the building project
Project Brief	The strategic brief detailing project scope and objectives, developed at the project feasibility and initiation phase, from which the Return Brief shall be developed.
Return Brief	The detailed design brief prepared by the Design Team and signed off by the Project Stakeholder/s prior to commencement of Concept Design

2. General requirements

This section outlines:

- General administrative requirements related to the use of the B. Building and Architecture, and the process for project delivery for all projects, including: project specific documentation; discrepancies; departures; certification of compliance; project procurement process; value management; safety in design; WHS; environmental management; independent building commissioning; manufacturer's specifications; and professional services requirements; and
- General design requirements related to the B. Building and Architecture, including the University policy on sustainable design as well as durability, economy and flexibility.

2.1 Project specific information

Project-specific information will be contained in project- specific documentation, such as Project Brief. The Standards will supplement any project-specific documentation. Refer below clause 2.2- Discrepancies for clarification of precedence, should a discrepancy between Project Specific Documentation and The Standard arise.

Extracts from the Standards may be incorporated in contract documentation specifications. However, the consultant and the contractor must fully investigate the needs of the University and produce designs and documents that are entirely fit for purpose, which meet the intent of the Project Brief.

2.1.1 The project brief

In accordance with A. Project Process Checklist and clause 2.4 Certification of Compliance, the Project Brief must be developed and signed-off in the following manner, and utilised as a measure, against which periodic certification must be carried out.

- The Pre-feasibility Statement and preliminary project brief contained therein, communicates proposed project objectives and scope, preliminary budget and any project- specific strategic targets (if known).
- The Strategic Project Brief is typically developed by the University during the feasibility phase of the project. This brief reflects outcomes of the strategic project investigations. The Strategic Project Brief must be interrogated and verified by the Project Delivery Unit, Project Manager and key strategic stakeholders, prior to proceeding to the next Detailed Briefing Phase of the project delivery process. It is from this verified Strategic Brief, that the consultants brief will be developed.

The Strategic Project Brief must:

- Identify project- specific sustainability targets, over and above the Standards, and associated reporting obligations;
- identify proposed project budget and funding source. This must include:
- Capital Budget (separated into construction and university costs), and
- Operating Budget (reflecting project- specific sustainability targets);
- identify other strategic targets associated with the project;
- identify list of known Stakeholders with a preliminary engagement plan developed. This includes identification of key stakeholders with whom sign-off approvals obligations will sit. Refer below Clause 2.4 Certification of Compliance with the Standard;
- identify general spatial and operational requirements of the end users;
- identify decanting and relocations proposals associated with works;
- identify a list of further investigations that are required (e.g. Heritage, DDA etc.);

- identify an indicative project program for the delivery of works;
- identify strategic risks associated with the project (Refer Clause 2.7 Risk Register);
- communicate any safety in design risks identified to date (Refer Clause 2.8 Safety in Design);
- The Return Brief (also referred to as Project Brief) is typically prepared by the Consultant at the end of the detailed briefing phase, during which intensive stakeholder consultation has occurred. The Project Brief must be signed-off by key stakeholders prior to proceeding to the next Concept Design Phase of the project delivery process. It is against the signed- off Return Brief (also typically referred to as Project Brief), that the mandatory, milestone, compliance certifications will be measured. (Refer to clause 2.4 Certification of compliance, in this document). For very simple projects, compliance may be measured against the Strategic Project Brief, or equivalent, provided it meets all mandatory due diligence obligations, related to the development of a brief, listed in A – Project Process Checklist.

The Return Brief must:

- Meet the obligations of the Strategic Project Brief (including, but not limited to budget and sustainability targets);
- identify detailed operational and spatial requirements of the end users;
- include room data sheets for complex projects (refer to A. Project Process Checklist for clarification).

2.2 Discrepancies

The Standards outline the University's general requirements above and beyond mandatory authority requirements and legislation.

Where the Standards outline a standard higher than the relevant legislation, the Standards will take precedence.

If any discrepancies are found between any relevant legislation, the Standards, or project-specific documentation, these discrepancies must be highlighted in writing to the Associate Director, Capital Projects Delivery.

2.3 Departures

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms.

In addition, University staff, consultants and contractors are expected to apply industry best-practice and strive for improvement and innovation in design and construction techniques wherever possible. In recognition of this expectation, application to depart from the Standards, must be made in writing to the Associate Director, Capital Projects Delivery via the UoA Project Manager, using the Alternative Design Solution Application Form. The application must include:

- Reference to the Standard clause under consideration
- Details of the departure and alternative proposal
- Impact of that departure on:
  - Compliance with the Project/ Return Brief
  - Project capital budget
  - Operating budget

Where a departure from the Standards is sought, dual-approval to proceed must be issued in writing by both the Associate Director, Capital Projects Delivery and the Director of Infrastructure. Until this approval is granted, the consultant is not authorised to proceed to the next project phase. Any departures made without written confirmation must be rectified at no cost to UoA.

At the completion of the project, all authorised Alternative Design Solution Application Forms must be submitted to the Associate Director, Capital Projects Delivery by the UoA Project Manager. Alternative Design solutions shall be monitored over time for success and may be considered for inclusion in subsequent versions of the Standards.

2.4 Certification of compliance

At regular intervals the consultant team must certify in writing that both the Standards, and the Project Brief, have been met.

This can be done using the templates provided in A- Project Process Checklist, or an equivalent, approved reporting tool.

Discrepancies and departures must be declared, with justification, at this time, in accordance with clauses 2.2 Discrepancies and 2.3 Departures of this document.

Approval must be granted prior to proceeding to the next project phase in accordance with the process outlined in A- Project Process Checklist.

It should be noted that The Standards, as they relate to this clause, refer to all Volumes of the Standard, including A- Project Process Checklist.

2.4.1 Frequency of certification

Frequency of certification is based on the size and complexity of the project. Refer to A. Project Process Checklist for frequency of certification requirements based on the complexity of the project.

For new all new building projects, (multi-disciplinary) projects, or projects with a value greater than $500,000, Certification must occur at the end of each of the following project phases:

- Concept Design Phase
- Design Development Phase
- 50% Complete Contract Documentation Phase
- 100% Complete Contract Documentation Phase
- Project Hand-Over Phase

For very small or simple (single discipline) projects, Building Standard Certification must occur at the following times:

- At an agreed point, prior to the end of the 50% Complete Documentation Phase
- At an agreed point prior to the end of the 100% Complete Contract Documentation Phase

2.4.2 Additional certification requirements

In addition to the above mandatory certification check-points, certification of compliance with the Design Standards and The Project Brief, must also occur as part of any Value Management Session, in accordance with clause 2.6. Value management of this document.

2.5 Project procurement process

All project team members must follow the project process outlined in A. Project Process Checklist. The checklist is a planning and tracking tool to be used by the project manager, consultants and contractors, to ensure adherence to the approved UoA process for project delivery and to ensure the Standards are achieved as a minimum on all projects.

A. Project Process Checklist Design Standard caters for different project complexity types. For clarification of the project complexity type, refer to Manager, Capital Projects Delivery.

A. Project Process Checklist Design Standard does not alleviate any responsibility to ensure familiarity and compliance with all aspects of the Design Standards. The checklist (or an approved, project specific version) must be maintained as an active document throughout the project, and must be submitted to the Manager, Capital Projects Delivery, via the UoA Project Manager at project completion.

A. Project Process Checklist Design Standard is divided into project delivery phases. While the order of actions listed can be varied to suit a project, all actions listed must be completed, and certified as complete, prior to proceeding to the next phase. Project-specific variations of the checklist involving alteration to the number of mandatory milestone certification checkpoints, or elimination of any action, must be treated as a departure from the Standards and submitted for approval to the Associate Director, Capital Project Delivery at the commencement of the project start-up phase.

Project managers, consultants and contractors must ensure that adequate time and resources are allocated to meet the requirements of A. Project Process Checklist Design Standard and, in particular:

- Mandatory milestone certification checkpoints and associated approvals processes (refer to clause 2.4 Certification of compliance)
- Engagement and consultation obligations with stakeholders
- DDA, Safety in Design, and Risk Management workshops
- UoA peer reviews
- Two-step value management process, refer to 2.6 Value- management

2.6 Value management

1. A mandatory two-step value management (VM) session must be carried out when the project has reached the 50% Complete Contract Documentation Phase (or at a time deemed appropriate by the UoA Project Manager). Additional value management sessions may be required and must follow the same process. Consultants and Project Managers must make appropriate allowance for resources and time to meet the requirements of this clause.

Any value management sessions must take the following two-step process:

- Value management (VM) session; followed by
- Written certification (in accordance with disclosure and approvals obligations set out in clause 2.4 Certification of compliance in this volume), that the proposed value managed solution:
    1. Meets the requirements of the Design Standard
    2. Meets the requirements of the Brief. This includes (but is not limited to) confirmation of the following:

- Estimated order of cost for capital and operating budget; and
- Project-specific sustainability objectives

2.7 Risk Register

The Risk Register records details of all the risks identified at the beginning and during the life of the project, their grading in terms of likelihood of occurring and seriousness of impact on the project, initial plans for mitigating each high-level risk, the costs and responsibilities of the prescribed mitigation strategies and subsequent results.

This Risk Register must be maintained for all projects, throughout the life of the project. Initial risk assessment must form part of the Project Feasibility Phase for the project. If strategic risks are identified, they must be recorded and managed separately to those that are related to worksplace health and safety. The preliminary register (or list of issues) must be communicated in the Strategic Project Brief.

The register must continue to be developed and maintained by the UoA Project Manager for all projects. Later the register will be maintained by the Managing Contractor, Service Delivery maintenance staff, and potentially end-users. The register will be updated regularly as existing risks are re-graded in the light of the effectiveness of the mitigation strategy, and new risks are identified. For larger projects a Risk Management Plan may be required also. In smaller projects, the Risk Register can be used as the Risk Management Plan.

Refer to clause 2.8 for further discussion about Safety in Design and the mandatory Safety in Design Risk Assessment Workshop.

Refer to A. Project Process Checklist for the Project Risk Register Template.

Refer to clause 2.8 Safety in Design/ workplace health and safety for discussion on cultural safety.

2.8 Safety in Design/ workplace health and safety

Safety in Design (SiD) aims to prevent injuries and disease by considering hazards as early as possible in the planning and design process. A safe design approach considers the safety of those who construct, operate, clean repair and demolish an asset (the building, structure, plant or equipment) as well as those who work in or with it. Designers are in a unique position to reduce the risks that arise during the life cycle of the asset during the design phase.

In accordance with Safety in Design/ WHS Legislation, at each phase of the design process, risk identification must take place with the view to eliminating the risk, or where this is not possible, reducing risk as low as reasonably practicable, through the implementation of control measures. Safety in Design Risk Assessments must be carried out throughout the job and reported on at regular team meetings, keeping the status of control measures and the residual risks at a current level. Refer to clause 2.7 Risk Register for further information about reporting obligations.

For all new building projects, complex refurbishment projects, or high-risk projects a mandatory Safety in Design Risk Assessment Workshop must be carried out no later than the 50% Documentation Phase. This should be led by a member of the consultant team and in addition to the contractor, the consultant team and relevant other parties such as fabricators/ operators specific to the project, the workshop must be attended by a UoA WHS Representative and the UoA End-User Representative.

The assessment should involve hazard identification, assessment of risk of harm for each hazard, and strategy for eliminating or controlling the risk. One outcome of the assessment may be that Safe Operating Procedures (SOP) need to be developed. The SOPs identified in the Safety in Design Risk Assessment Workshop must be incorporated into the End-User Building User Guide and Safety Induction.

As part of the Safety in Design Risk Assessment, confirm with the Associate Director Capital Projects Delivery, as to whether consultation with the Gender Equity and Diversity Committee (or delegate) is required, to establish risks associated with cultural and gender safety associated with the project.

2.9 Independent building commissioning

For all new buildings, or where the Project Brief requires it, an independent commissioning agent not involved with the design or construction of the project must be engaged.

Detailed testing and commissioning requirements must be specified for each project by the UoA-appointed consultant/designer.

Project hand over inspection and testing plans (ITPs) must be developed by the consultant/contractor to allow the system to be handed over to the University. Detailed testing and commissioning records must be provided for each system and each component, taking into account the requirements of the Standards. All such records must be witnessed and verified by the UoA-appointed project consultant/ designer.

2.10 Post-occupancy Building Services Performance Report

After one seasonal cycle of operation, an independent building services performance review must be carried out and report prepared. Refer to the Manager, Sustainability for details. This may be carried out internally, or by an external consultant. Requirements of the Post-Occupancy Building Services Performance Report will be established by the Manager of Sustainability.

2.11 Manufacturer specifications

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.

2.12 Sustainable design

The adoption of environmentally sustainable building philosophies must be considered a primary objective of all projects, regardless of size. Opportunity to implement responsible design and construction solutions must be considered as a matter of course during every phase of the project. Project specific sustainability initiatives and targets must be identified in the Project Brief along with associated reporting obligations relating to both:

a. the requirement for the designer to certify/ rate/ measure the proposed design solution prior to construction; and

b. the requirement for the designer to include physical equipment and processes for measuring the performance of the building throughout its life- cycle (refer Vol Metering and monitoring).

In the absence of the identification of project- specific sustainability targets, and in addition to sustainability considerations covered in the relevant Volumes, the following must be incorporated in all architectural and engineering services designs.

2.12.1 Energy demand and thermal comfort

To minimise energy demand and improve thermal comfort in buildings, the following must be considered:

a. Use of basements and underground parking areas and labyrinths to pre-cool intake fresh air in mechanical systems if viable and where excessive dehumidification is not required.

b. High levels of thermal insulation to roof, floors and walls.

c. Reflectance of external building materials.

d. Thermal and solar performance of glazing.

e. External shading of north, east and west facing windows and walls.

f. Building orientation and massing.

g. Design glazing to achieve optimal day lighting and solar heat gain and to minimise the need for mechanical heating or cooling.

h. Appropriate design for temperature, air velocity, fresh air ventilation rates, relative humidity for different functional spaces as required by C. Mechanical Services Design Standard.

2.12.2 Use of natural daylight

a. Design façades and windows to maximise natural daylight in usable floor areas and incorporate use of sky lights, light wells and internal atriums or courtyards where appropriate.

b. Avoid overshadowing and visual intrusion onto adjoining sites.

c. Design buildings to avoid undesirable glare impacts on pedestrians, motorists, people using open spaces and those in other buildings.

d. Minimise the impact of night lighting on adjacent sites and buildings.

2.12.3 Indoor environmental quality

a. Provide appropriate lighting to suit the use of the space in accordance with E. Electrical Design Standard. Record the as-designed lighting levels and controls per functional space within the post-construction As-built documentation package.

b. Use materials, fittings and furnishings with low-VOC content i.e. paints, adhesives, sealants, carpets, timber products and furniture to avoid and minimise off-gassing impacts on building occupants' health.

c. Design to minimise unacceptable noise.

d. Utilise natural cross ventilation of habitable rooms and corridors to minimize the requirement for mechanical air conditioning.

2.12.4 Energy efficiency

a. Electrical appliances with the highest Australian Government Energy Star Ratings must be used for the relevant capacity ranges of appliances. These appliances include but are not limited to refrigerators, freezers, clothes dryers, dishwashers, electric hot water boilers, televisions, computer monitors and air-conditioning units.

b. Preference must be given to locally manufactured products where multiple products have the highest energy rating.

c. Electrical equipment, including specialised laboratory equipment not covered by Energy Star Rating Scheme must include energy efficiency as part of the selection criteria and have controls to prevent unnecessary energy consumption.

d. All buildings must provide utility meters to monitor, electricity, gas and water in accordance with C. Mechanical Services Design Standard, D. Electrical Services Design Standard, F. Hydraulic Services Design Standard, and L. Metering and Monitoring Design Standard:

— Energy efficient lighting and lighting controls must be provided to meet minimum illumination requirements in accordance with the D. Electrical Services Design Standard.

- Buildings must incorporate technology to reduce peak power demand, i.e. use of thermal storage for cooling and heating, power factor correction devices, etc.
- Roof design must maximise orientation to the northwest to northeast to optimise potential for installing roof top solar energy systems.

2.12.5 Water use

a. Water sub-metering must be provided to monitor large water consuming processes in accordance with F. Hydraulic Services Design Standard and L. Metering and Monitoring Design Standard.

b. All sanitary fixtures and tap ware must achieve WELS ratings specified in F. Hydraulic Services Design Standard.

c. Rainwater harvesting and reuse (toilets, cooling towers, fire test water and landscape irrigation) must be considered for all projects and applied where feasible. Ensure system design allows for future upgrade and expansion. Opportunities to integrate 'demonstrator' education must be explored. Refer also to F. Hydraulic Services Design Standard.

2.12.6 Water sensitive urban design

University campuses must implement water sensitive urban design principles by:

a. Reducing potable water demand through water efficient appliances, hydraulic standard.

b. Capturing rainwater for beneficial reuse including irrigation, cooling water and toilet flushing.

c. Minimising wastewater generation and treatment of wastewater to a standard suitable for effluent re-use and or release to receiving waters.

d. Passively treating urban stormwater using bio-filtration and wetlands systems to meet water quality objectives for reuse and or discharge to surface waters.

e. Using stormwater in the urban landscape to maximise the visual and recreation amenity of developments.

f. Grey water must not be reused where expensive wastewater treatment involving significant inputs of energy, chemicals and high maintenance is required.

2.12.7 Materials

a. Materials must be selected to meet sustainability requirements specified in Section 12 of B. Architecture and Building Design Standard (this document).

b. Selection of construction materials must consider 'cradle-to-grave' environmental impacts which look at impacts associated with raw materials extraction, manufacture, use and re-use potential and disposal.

c. Preference must be given to construction materials with recycled content and reused materials where practical.

d. Life cycle costing principles must be considered in selection of materials and systems. This includes capital, operations and maintenance, and disposal costs.

e. Use recycled and recyclable content in building materials, where fit-for-purpose from a durability and performance perspective.

f. Use suitable demolition materials for on-site fill.

g. Rainforest timber and timber from Australian high conservation forests must not be used.

h. Consider appropriate design detailing for engineered products to avoid any off-gassing potential from volatile compounds used in manufacture.

2.12.8 Noise mitigation

a. During the planning process isolate noise generating activities to avoid impact on sensitive receptors and quiet activities.

b. Protect all occupied spaces from noise pollution from external and internal sources.

c. Plant and equipment located on roofs must have acoustic treatment if they generate excessive noise.

d. Plant locations and noisy equipment must be designed and situated to avoid noise impacts on sensitive receptors and local residents.

e. Minimise noise emitted from external equipment such as fans, air-conditioners, compressors, and from other noise generating sources.

f. Minimise noise transmission within multiple occupancy buildings.

2.12.9 Construction and demolition waste

Building contractors and designers must provide infrastructure for recovery of building, construction and demolition materials to minimise waste disposal to landfill. They must:

a. Prepare and implement a materials recycling and waste management plan in the construction phase for all construction and demolition waste as part of the project environmental management plan.

b. Identify the range of materials that will be collected for recycling and describe procedures, management practices and reporting.

c. Formally apply dimensional co-ordination where it will practically assist the efficiency of material use, preference for modular components and materials supplied in set sizes or dimensions.

d. Consider ease of disassembly and recycling of construction materials and components at the time of refurbishment or completion of a facility's life.

e. Ensure project planning, specification and programming for the recovery, storage and transfer of reusable materials from demolition works including their transport from site to recycling and re-use facilities.

f. Implement procedures for disposal or recycling of hazardous materials at properly licensed facilities.

2.13 Durability, economy and flexibility

The University's goal is to achieve the optimal balance between capital and operating costs, whilst providing occupants a high level of environmental quality and service throughout the lifetime of each building. A whole-of-life asset value-for-money solution must be sought.

The University's building elements, services and external spaces must be:

- Cost-effective to operate and maintain.
- Designed with consideration of capital as well as operating expenditure in mind.
- Robust and durable.
- Easily and safely cleaned and maintained.
- Standardised to minimise individual specialisation and customisation.
- Flexible in the design to allow for expansion or adaption to new uses.
- Designed with built-in flexibility of space, plant and equipment to reasonably accommodate future uses.

2.14 Building compartmentation and sealing

Building fire compartments (existing and proposed) must be clearly identified within the contract documentation package and within the post-construction package. All penetrations through the barrier must be fire treated. Provide motorized dampers connected to the fire alarm system for any fixed open louvers such as at elevator shafts. Provide damper and controls to all air intakes/ exhausts.

Building envelopes must be designed and constructed with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components on construction documents and detail the joints, and penetrations of the air barrier. The air barrier must be durable to last the anticipated service life of the assembly. Do not install lighting fixtures with ventilation holes through the air barrier.

3. Technical requirements

This section outlines the specific technical requirements for E. Communication Services Design Standards.

3.1 Structured cabling

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

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.

UoA 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.

3.1.1 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.

3.1.2 System description

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

- Manufacturer's Warranty - Cabling equipment suppliers offer an automatic channel warranty of 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.
- Consistency - Single matched installation maintains consistency across the environment, this allows for easier management and operation of the structured cabling system.

System architecture

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

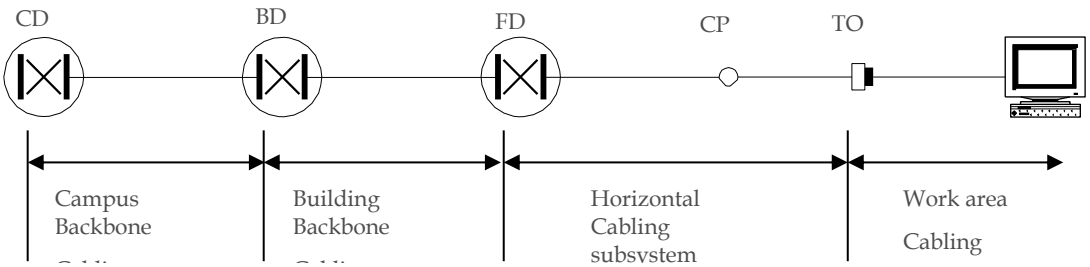

Figure 1. Generic cabling system

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 Structured Cabling System within UoA 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 TOs from the FD with extensive ongoing costs to facilitate such changes.

3.1.3 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.

3.1.4 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), but does not include work area cords between the terminal equipment and the TO.

All horizontal cabling must not exceed 90m. All user area field TO's must be installed within 2m of the work station. All concealed space TOs must be installed within 2m of the customer equipment ie (Wireless Access Point).

TOs shall be cabled to the same level comms room as the TO is located unless otherwise specified.

The horizontal cabling shall be a star topology connecting each workplace telecommunications outlet to a patch point at a distributor as shown.

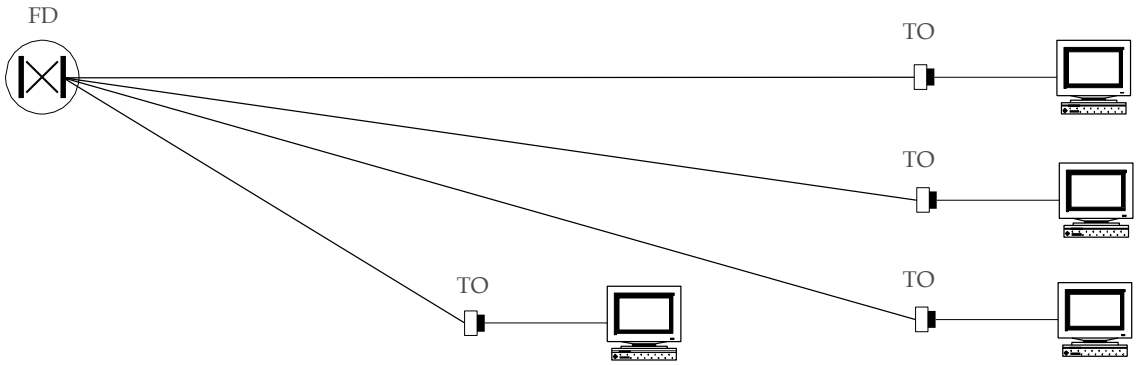

Figure 2. Horizontal cabling

3.2 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 3080 for the relevant performance Class.

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

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

3.2.1 Patch and work area cords

Patch cords must have RJ45 connectors at both ends complying with 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.

Pin assignments and colour codes shall conform to the "T568A" arrangement in accordance with AS 3080 Z.B.2, and are 8-Position 8-Contact modular plugs.

All patch cords and work area cords shall be factory assembled, terminated and certified and fitted with male modular plug.

3.3 Optical fibre

Optical fibre cable for UoA cabling systems for campus use shall be constructed using OS2 SMOF.

The only exception is for Data Centres where the use of MMOF OM4/OM5 can be used for inter server rack connectivity.

3.3.1 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 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.

3.4 Cable pathways and containment

3.4.1 General

Cable pathways shall be selected and designed to:

- Maintain minimum segregation from other services as mandated by AS/CA S009 and AS 3000 in accordance with AS/NZS 3080 ZA.3.1.

- Minimise interference in accordance with AS/NZS 3080 ZA3.2.
- All other Services shall have their own supporting infrastructure. Exemptions must be signed off by Associate Director Technology Operations.

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 all other building services and in accordance with the respective clauses of the UoA Design and Construction Standards.

All Cable pathways shall be accessible at all times and not have access restricted by permanent fixtures, eg solid ceilings.

Solid ceilings must have access hatches located where the tray changes direction and where cabling passes through walls. Tray access hatches shall be no further than 2m apart to provide adequate access to the Communications Pathways.

3.4.2 Carrier service entry

The lead-in cable providing the interface to carrier services shall be determined, in consultation with UofA, 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.

3.4.3 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:

- Where such location is considered inordinately expensive, disruptive or impracticable. In which case suitable neat ducting may be used.
- Clipsal TAL Plus Trunking (PL50150)
- Must be three division option with internal barriers the full length of the ducting

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

Where cable is run through a fixed, open or suspended ceiling it shall be supported by means of suspension from fixed non-movable structural features, purpose installed cable trays or by one or more catenary wires.

3.4.4 Communication 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 four 100mm conduits. Communication shall be used for communication cabling, all risers must be locked using a Technology Services lock and signage installed on the door.

3.4.5 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 UoA 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.

3.4.6 Cable tray

Cable trays shall be installed in accordance with AS/NZS 3084

3.4.7 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.

3.4.8 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.

3.4.9 Underground pathways

Refer to J. External 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.

3.4.10 Trenches

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

3.4.11 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.

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.

Size shall be a minimum of 100mm in diameter.

3.4.12 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 900mm x 900mm x 900mm deep x 100mm thick.

Pits shall be provided with all required accessories including:

- Trafficable covers and support bars for covers as required (minimum AS 3996 Class D)
- Covers to be permanently and appropriately labelled with “Communications” and indicate conduit directions
- Cable support bars

- Bellmouth for conduit entry
- Gaskets and seals
- Split Gatic lid for easier opening
- Maximum lid size shall be 900x450mm with a minimum of 2 lids per pit

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.

3.4.13 Penetrations

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

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).

3.5 Equipment rooms

3.5.1 General

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

- Relevant Australian Standards
- Room for future expansion
- HVAC requirements – Network Services prefer commercial grade wall mount split systems.
- 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
- Exclude all other building penetrating services other than the room requirements.
- Raised floors to have a minimum under floor height of 180mm to the underside of the tiles.
- Raised floor tiles to be Tasman C38, wood core, grey star laminate tiles or similar
- Raised floor support to be 'stringer support' system

3.6 Campus core rooms

The campus 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. These rooms are considered critical IT locations for the University, and thus should be appropriately equipped.

For Campus Core locations, a full load test needs to be completed and measured against the specification of the cooling system.

3.6.1 General

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

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

Racks shall be designed for 19" equipment mounting.

The rack(s) within the core equipment room containing core switching equipment shall provide minimum 43 rack units (43 RU) equipment mounting space.

All equipment rooms at a site shall be fitted with building access control and coordinated with the security requirements.

Racks shall be fitted with an appropriate lock.

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

Black finish is preferred for racks.

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

3.6.2 Racks

Racks shall typically be provided as 43 RU and shall be installed on 100mm plinth.

Racks shall be 1000mm deep when used as the rack for active equipment. For Campus Core locations rack shall be a minimum of 1200mm deep.

3.6.3 Wall mount cabinets (RU and Type 1)

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

Wall mounting cabinets shall be provided as 12 RU and minimum internal depth of 700mm , excluding door.

Where a Type 1/ Type 2 cabinet is used it shall have a minimum of two doors that are vented and be sized to suit the application.

3.6.4 Rack installation

Communication racks shall be located to achieve maximum operator convenience. No wet services, i.e., piping for Fire Sprinklers, shall be installed above the communications racks.

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

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

If communication room has a door that opens inward into the room, minimum distances shall be maintained, this includes hand rails and steps.

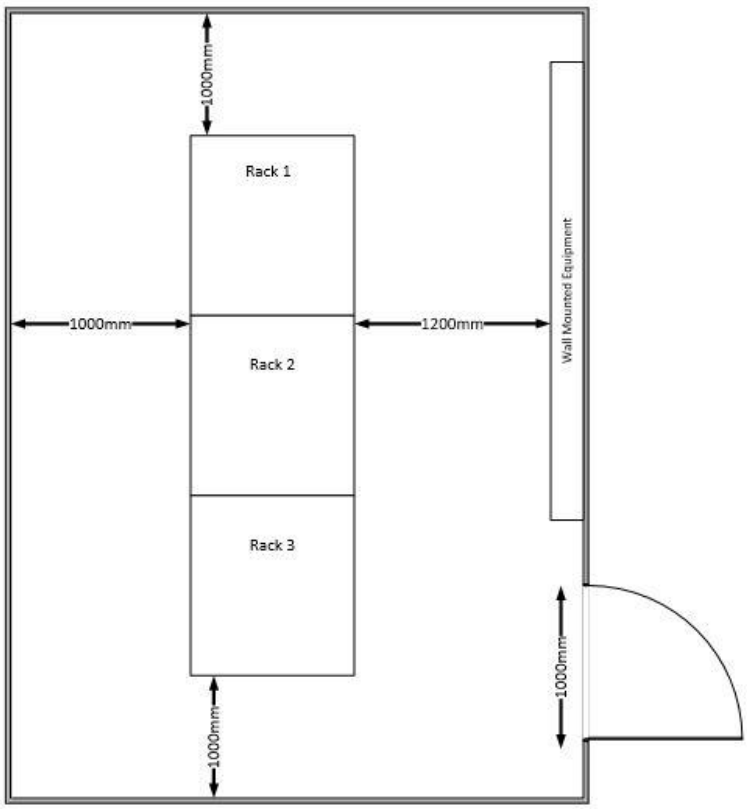

Figure 2. Typical Communications Room Arrangement Detail

3.6.5 Rack minimum clearance

The vertical footprint for wall mount cabinets shall not extend beyond 1.8m m nor lower than 0.5m AFFL. Minimum clearance above the racks 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 rack.

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

Racks shall be bonded to the protective earth system.

3.6.6 Rack layout

Each rack shall be provided with sufficient spare space and cable management for future installation and maintenance activity. The rack layout to be defined by Technology Services.

3.7 Rack power

3.7.1 Campus core

Power supply for equipment within Campus Core Communications rooms shall be provided by means of a a separate distribution switchboard.

A minimum 2 x dedicated 20 amp circuits for each rack. 20 amp Clipsal 56C320-EO round pin plug bases. 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 rack in the form of (x2) 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. Rails shall be a minimum of 12 way per rail and a minimum 10A rating.

3.7.2 Building/ floor distributor

A minimum 2 x dedicated 20 amp circuits for each rack. 20 amp Clipsal 56C320-E0 round pin plug bases. 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 rack 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.

Electrical Switchboards

All dedicated Switchboards providing power for the Communications room are to be located within the communications room.

3.7.3 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 (Lacing Bars) 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 two adjacent racks/racks, cable shall be installed across the rack tops and vertical cable management installed between them.

3.8 Terminations

3.8.1 General 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 (Patch Panels) 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 and PDS may be used for termination of outdoor (external) and multi-pair copper cables.

Category 6

Insulation Displacement Connection (IDC) Highband Ultim8 Disconnection modules to be utilised where a 55 way frame solution has been utilised for Category 6 cabling.

The cable colour shall be grey and the socket shall be black

Category 6a

Highband 25' Cross Connection Solution to be utilised where Category 6a cabling has been utilised

The cable colour shall be grey and the socket shall be black

3.8.2 Outlets

- Wall plates shall be the window model type allowing for a machine printed outlet identification
- All other plates/rails are to be labelled with Treffolyte labels and be white with black text
- Outlets mounted on cable basket/tray shall be enclosed as to prevent mechanical damage from the rear and suitably mounted.
- Desktop mounted outlets shall be enclosed to prevent mechanical damage and in a Harmony or equivalent style rail secured to the desk.
- Soft Wiring shall be cabled with a patch cord that shall be factory assembled, terminated and certified and fitted with male modular plug at one end. The desktop end shall be terminated with a black RJ45 socket that is the same standard as the horizontal cabling from the Communications Room.

3.9 Wireless

3.9.1 Wireless LAN Interfaces

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

The following guidelines are for contractors to follow

- All Access points are to be installed as below (Where this is not possible contact is to be made with the University to approve a subsequent location):
  - Within 2000mm of the location indicated on the map;
  - under the ceiling visible to users;
  - not within 500mm of a light or aircon duct;
  - Within 2m of data outlet in ceiling space;
  - Fixed ceilings will require access panels.
- Timing of Installs (users are usually using the wireless service while work is being completed, all reasonable effort to reduce impact on users should be taken)
  - Where possible replacement should be done prior to 9am;
  - where possible all installations should be completed prior to do replacements
  - where replacing/relocating access points reasonable effort should be made to reduce the time the access point is down.
- Any change in AP locations must be documented on the floor plans and returned to the University
- The included patching/install records are to be completed and returned to the University
- At the completion of any building contact the University
- External Antenna installs
  - Arrange a time for completion of install with University staff;
  - University staff will test at the time of install ;
  - may be required to make changes to antenna direction during this time.

3.10 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 racks.

Core equipment rooms shall be on UofA's access control system. Refer H. Security Services Design Standards.

3.11 Audio visual cabling

Any network cabling that does not terminate in the local communications room is to be coloured either green or orange and not utilise the communications pathways. Must have its own pathway created (eg. separate catenary runs).

3.12 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 rack 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 rack 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 G. Fire Services Design Standards.

3.13 Environmental factors

3.13.1 Lightning protection

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

3.13.2 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.

3.13.3 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.

3.13.4 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 ZB2.3.4.8.1.

Racks 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 rack.

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.

3.14 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/CA 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.

3.15 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.

3.16 Labelling

3.16.1 General

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

- Cable and TO numbering shall be the same and as per below;
- Levels with multiple communications rooms feeding the same level – "COMMS ROOM-NUMBER" CC424-251 / CC424-252
- Levels with a single communications room – "NUMBER" 251 / 252

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 a machine printed label to suit the window faceplate or Treffolyte. Shall not be labelled using Dymo lables.

The method of designation shall be in general accordance with AS/NZS 3085.

3.16.2 Voice

Backbone voice cable shall be clearly marked in all exposed areas. Exposed areas would be at a point the cable terminates on the CD/BD/FD frames 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 ADELAIDE."

Backbone voice cables terminating on Krone frames 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 rack.
- The frame 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 CD (eg building number "M458", etc)
- Vertical
- Pair Range

3.16.3 Fibre

Each fibre termination through connector location in the termination unit shall be sequentially numbered from bottom to top and left to right with the appropriate engraved Treffolyte labels. 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 cable sequence number for the route. Cable sequence numbers shall be determined in consultation with UoA Network Services

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.

Labelling of the cables shall be stainless steel labels affixed with stainless steel ties.

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

3.16.4 Outlets

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

3.17 Testing, commissioning and certification

3.17.1 General – current tester standards

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. Vendors recommended tester shall be used.

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.

3.17.2 Balanced cabling and connecting hardware

Test personnel and the test methodology shall comply with the requirements of AS/NZS IEC 61935.1:2006.

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 and certified to its Class channel performance in accordance with clause 6 of AS/NZS 3080:2013.

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.

3.17.3 Outdoor and indoor voice 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%.

3.17.4 Optical fibre backbone cabling

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 dB
- Date and time of testing
- Name and signature of testing engineer

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.

3.18 Documentation

3.18.1 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 rack/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 to Figure C2 of AS/NZS 3085.1)
- As-constructed equipment room layouts, including associated services equipment
- As-constructed physical rack layouts. (Refer Figure C3 and C4 of AS/NZS 3085.1)
- 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 UoA.
- Equipment lists detailing (type/make/model for) the installed equipment including racks, outlets
- 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

- 25 Year Warranty documentation
- Contractor details.
- TCA1

Refer to K. Documentation Design Standard for documentation requirements.

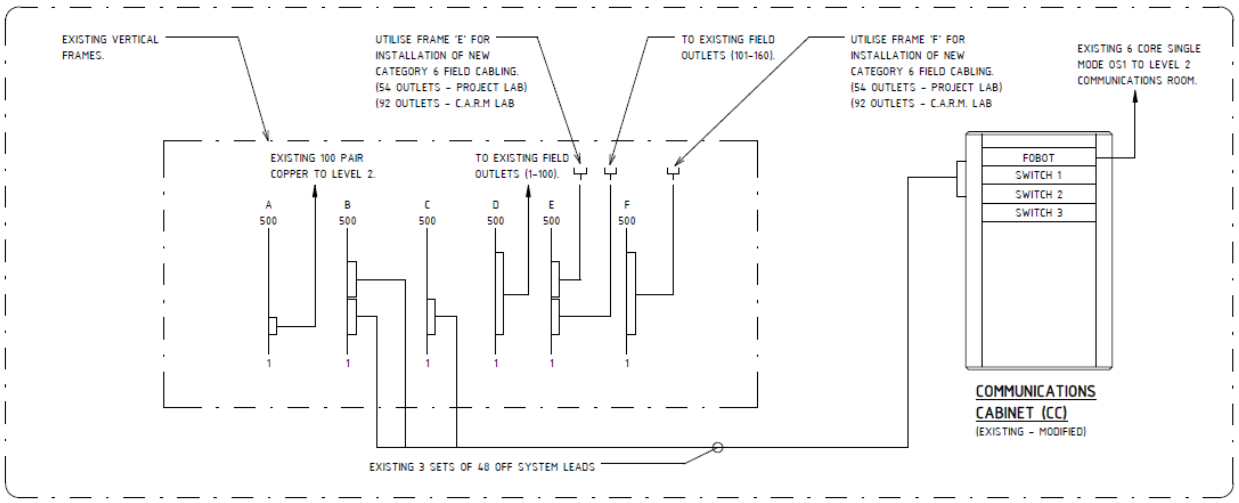

Figure 3. Typical Frame Layout Detail

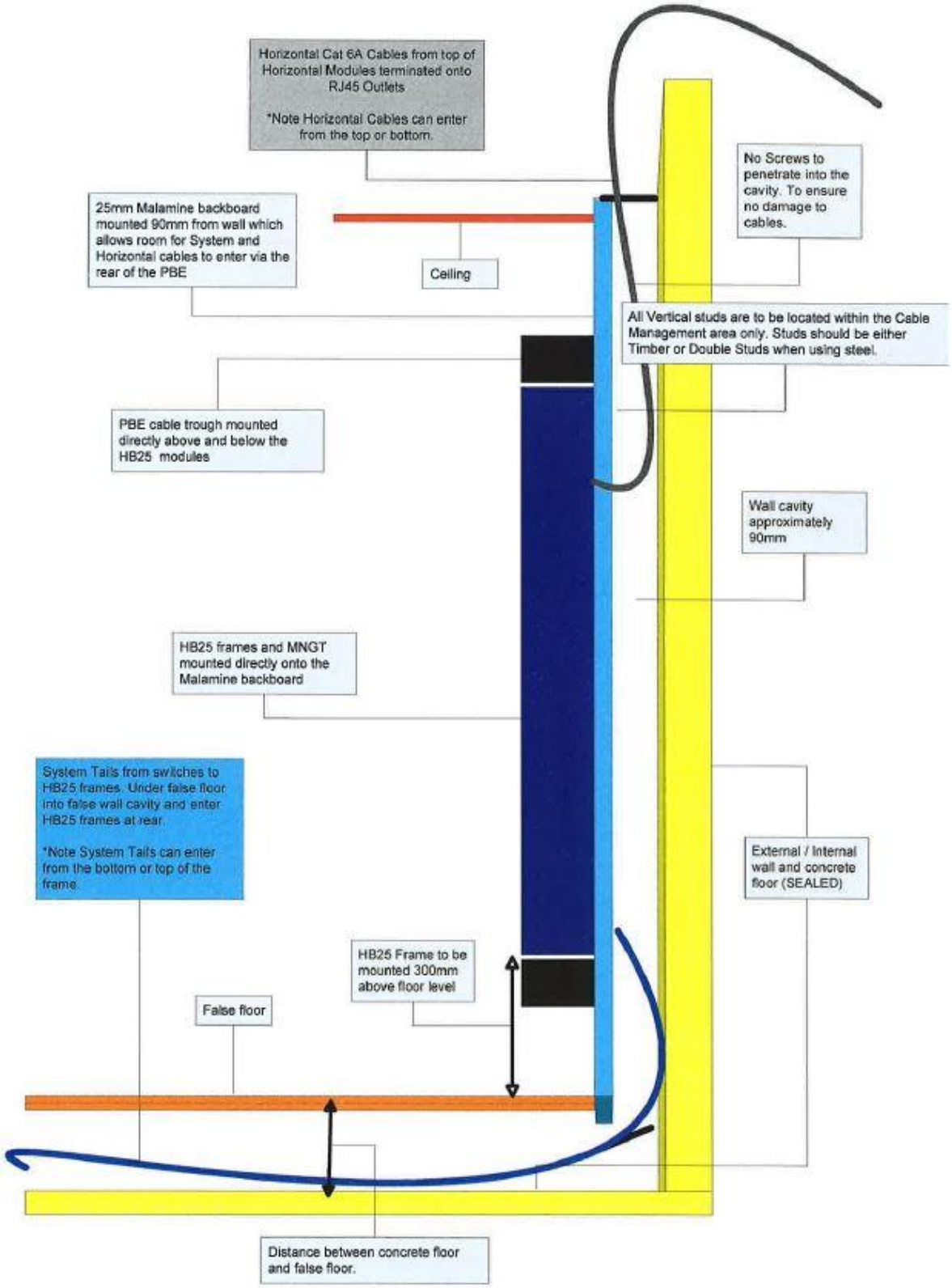

Figure 4. Typical False Wall layout example (Cat 6A)

SCHEDULES

E. Communication

4. Specifications

4.1.1 Preferred manufacturers

ITEM	PREFERRED MANUFACTURER
Racks	Rittal / MFB or equivalent
Structured Cabling System	
Copper (Internal)	TE Commscope or equivalent
Copper (External)	TE Commscope or equivalent
Fibre (Internal)	TE Commscope or equivalent
Fibre (External)	TE Commscope or equivalent
Cabling Support	
Cable Ladder Tray	Unistrut
Power Distributor Unit	To match rack (Smart PDU)

4.2 Cabling

Campus backbone cabling (external inter-building)

OS2 12-core single-mode optical fibre minimum.

Building backbone cabling (internal intra-building)

OS2 12-core single-mode optical fibre minimum

Inter-building copper backbone cabling

All Inter-Building copper backbone cables shall be ACMA 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 AS/CA S008.

Cables shall not be direct buried.

Intra-building copper backbone cabling

The backbone cable shall be ACMA approved voice grade. The minimum wire diameter shall be 0.40mm and 50/100 pair cables should be used.

Backbone cabling shall be used to connect the CD / BD to all FDs where installed.

Termination

The backbone cable shall be terminated on Highband 25' Cross Connection Solution Module mounted on the CD, BD, FD. The termination shall conform to all ACMA regulations and the manufacturers' recommendations.

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 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.

- External Cable Jacket – Blue or Black
- Internal Cable Jacket - Yellow

Optical fibre cables shall terminate at the fibre break out trays (FOBOTS) located at distributors. Each cable shall be continuous from one Comms room to the destination Comms room without intermediate joins or connections. The cable strength member shall be securely fastened at the termination rack.

Optical fibre cable shall be terminated with LC fibre connectors. Racks shall be filled from left to right.

Copper work area cords

- The total number of work area cords shall equal the number of outlets.
- Work area cable lengths shall be 1.2m, 2.1m in length.

- Quantities of each length shall equal 0.5 x number of outlets.

Optical fibre patch cords

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 rack 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 for Single Mode and Aqua for Multimode

4.3 Capital works programs

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

4.4 Expansion and upgrade to existing facilities

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

4.5 Cable containment

Cable ladder

Cable Ladder Tray shall be coordinated with all services, of galvanised sheet steel. Electrical continuity shall be maintained along the full length of cable trays.

Communications trays to be mounted in a way that allows for ease and accessibility for future alterations/installations, (Not to be mounted higher or above the electrical).

Ducting and conduits

Ducting when used shall be tamper-resistant, three compartment, rectangular section, metal body. 150 x 50 Clip-in covers shall not be used for exposed or accessible ducting. Horizontal ducting in office/class areas will be skirting style metal triple channel 150mm x 50mm with screw on covers.

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

4.6 Cable pathways

Underground pathways

The minimum conduit count and size for lead-in cables to any permanent building is two 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.

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 (18.6)

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 20 4-pair cables for Category 6/6A.

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 7.4.3.1.

4.8 Cabinets

Freestanding racks 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 rack
- 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 with Clipsal 56CSC320 round pin plug top
- Removable rear and side panels
- Keyed, lockable, perforated steel front door or split front door
- Keyed, lockable, perforated steel rear door or split rear door
- Levelling adjustment
- Earth bar as part of Communications Earth System

4.9 Specific space requirements

General offices

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

- Each enclosed area
- Each network connected device
- Each network connected device