Deakin Digital Services

ICT Volume 7: Network Standards

ICT 7.0 2023 Wireless LAN Standards

Audio Visual and Networks Unit

Document Version 2.9

Abstract

This standard outlines the specifications for Wireless LAN (Wi-Fi) services throughout Deakin University and associated locations managed by Deakin Digital Services

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1   Occupational Health and Safety

One of the major objectives of the University is to ensure that staff, students, visitors, and the community do not suffer injuries and illnesses because of the activities and operations of and at the University

It is a requirement that all Contractors and any nominated sub-contractors have fulfilled all aspects of the Deakin University Contractor Registration and all persons of the Cabling Contractor, and any nominated sub-contractors have completed and passed the Deakin University Contractor Induction.

The Contractor and any nominated sub-contractor shall make available the necessary resources to comply with all relevant Occupational Health & Safety Acts and Regulations, thereby ensuring that the workplace environment is safe and without risk to health.

Everyone in the workplace environment is required to be aware of potential hazards and take steps to prevent workplace accidents, injuries, and illnesses.

It is therefore important to note that Contractors, any nominated sub-contractors, and their staff shall conform to normal site safety requirements.

2   Maintaining a Safe Working Environment

Consideration for the following should be understood to maintain a safe working environment during the installations.

Safety of students, instructors and Contractors shall be always observed.

All Contractors that perform any work on a Deakin University site are to undertake a site safety induction, where applicable.

Where applicable, no Contractor is permitted to commence any work on site at a Deakin University Campus without having completed this site safety induction.

Where applicable, the safety induction program will be arranged with the Deakin University Site Manager.

3   Note of Concern

The Contractor, any sub-contractor and staff are to adhere to policies and procedures DS Audio Visual & Network, Digital Service scribed within the Deakin University Asbestos Management documentation available from Deakin University upon request.

The Asbestos Register identified within the Deakin University Asbestos Management documentation is available from Deakin University upon request.

4 Standards Brief

This standard defines the specifications for wireless LAN (Wi-Fi) services, including their installation and management, throughout Deakin University and associated locations managed by DS Audio Visual & Network, Digital Services.

This standardization is paramount to providing quality and guaranteed services to the Deakin University premises and locations managed by DS Audio Visual & Network, Digital Services.

Wi-Fi is considered an essential service and a requirement in all managed spaces.

Product substitution

Only product and part numbers of DS Audio Visual & Network, Digital Service scribed in the Deakin University Standards shall be used. No deviation from the product or parts list shall occur without the express permission of the DS Audio Visual & Network, Digital Services Audiovisual and Networks Unit Leader. If a specified product or part is no longer available this is to be brought to the attention of the DS Audio Visual & Network, Digital Services AV, and Networks Unit Leader, who will advise appropriate alternative product or part.

Under no circumstance is the installer to substitute parts without the express permission of the DS Audio Visual & Network, Digital Services AV, and Networks Unit Leader.

4.1 Policy Applicability

This standard is applicable to all Wi-Fi services throughout Deakin University and associated locations managed by DS Audio Visual & Network, Digital Services.

4.2 Standard Document Access

All Deakin University Digital Services and contracted personnel are provided access to this document.

DS Audio Visual & Network, Digital Service signers, installers and contractors must ensure they have the most current version of all standards prior to engaging in any work.

The most recent version of the Standards and associated Resources can be found on the internet at: https://blogs.deakin.edu.au/avn-docs/standards-documents/network-standards/

4.3 Related Documents

Many aspects of the system DS Audio Visual & Network, Digital Services sign requirements are specified in other companion documents within Volume 6 of the Deakin ICT Standards. **All documents within Volume 6 must be read together to constitute the complete Standard.**

4.4 Conflict of Information or Clarification

Whenever a conflict of information occurs or clarification of instruction is required all query shall be made to the 'Deakin University DS Audio Visual & Network, Digital Services AV and Networks Unit Leader or their delegate', hereafter referred to as the Deakin AVN Representative.

For all projects or tasks that include data cabling a Deakin AVN Representative will be assigned. This person is to be the first point of contact for all queries. If this person is not available to answer queries the DS Audio Visual & Network, Digital Services AV and Networks Unit Leader is to be contacted for alternative representation.

4.5 Non-standard configurations

All non-standard implementations *must* be approved in writing by the **DS Audio Visual & Network, Digital Services AV, and Networks Unit Leader** strictly on a case-by-case basis.

4.6 Roles and Responsibilities

The following roles are referenced in this and related standards:

Role	Responsibility
DS Audio Visual & Network, Digital Services AV, and Networks Unit Leader	Holds responsibility for all audiovisual and network standards and their adherence, provision, maintenance, and security of all audiovisual and network infrastructure. All Communications Engineers ultimately report to this role.
DS Audio Visual & Network, Digital Services Senior Network Engineer (AV/Networks)	A staff member with significant technical experience whose role is to provide architectural DS Audio Visual & Network, Digital Service sign and quality control of audiovisual and network fit outs.
DS Audio Visual & Network, Digital Services Network Engineer (AV/Networks)	A staff member with technical experience whose role is to audit, provision and maintain audiovisual and network infrastructure.
Project Manager DS Audio Visual & Network, Digital Services	Responsible for ensuring DS Audio Visual & Network, Digital Services-supplied deliverables agreed to by formal project board are delivered on time, to budget and within agreed quality parameters while managing project communication, dependencies, and reporting. Defects with an audiovisual or network fit out will be reported to the Project Manager DS Audio Visual & Network, Digital Services by DS Audio Visual & Network, Digital Services Communications Engineer (AV/Networks).
Project Manager	Responsible for ensuring supplied deliverables agreed to by formal project board are delivered on time, to budget and within agreed quality parameters while managing project communication, dependencies, and reporting. Defects with an audiovisual or network fit out for which are responsible will be reported by the Project Manager.
External supplier	A company such as a third-party audiovisual or integration vendor, or network cabling provider, contracted by Deakin University to provide specified products and/or services.
Subcontractor	A company or other agent hired by an external supplier to provide all or some products or services required to fulfil a contract the external supplier holds with Deakin University.

5 Installation standards and conditions

This document does not replace, supersede, or override formal contractual terms and conditions between the parties. This section draws suppliers' attention to some important requirements.

5.1 General Information

Deakin University has specific DS Audio Visual & Network, Digital Service sign requirements and methodologies that shall be adhered to for all new and refurbished buildings and associated spaces throughout Deakin University and associated locations managed by DS Audio Visual & Network, Digital Services.

Where product has been indicated the specified product shall be used, no substitution of product is permissible.

All horizontal data cabling shall be installed to Deakin standard *ICT 6.4 Horizontal and inter building cabling*.

Deakin University standards are supplemental to Australian Standards and manufacturer requirements or methodologies. Where Deakin University standards have not made comment then the DS Audio Visual & Network, Digital Service sign and methodologies of the associated Australian Standards or product manufacturer apply.

As-built documentation shall be supplied for all builds. As-built documentation shall be supplied in electronic format in both CAD and PDF. Wireless survey will be supplied for all new and refurbished installations in their native survey software format as well as a report in PDF or Word.

Any questions regarding the standards, product or methodology shall be directed to the DS Audio Visual & Network, Digital Services AV, and Networks Unit Leader.

5.2 Variation agreements

Any deviation from the Standard specification must be agreed to in writing by DS Audio Visual & Network, Digital Services AV, and Networks Unit Leader prior to commencement of any work. Any building features such as plaster, carpet tiles, roof tiles that are altered during the installation process must be restored to original condition, to the satisfaction of the site supervisor.

5.3 Contractor to fully self-inform

The contractor shall fully self-inform and not rely on representations.

5.4 Fit-for-purpose

Solutions shall be fit-for-purpose.

5.5 DS Audio Visual & Network, Digital Services site inspections

The contractor shall agree to regular site visits from DS Audio Visual & Network, Digital Services project representatives and have in place a means of communication and escalation between senior technical staff within both organizations prior to commencement of work.

6   Coverage specification

Deakin University requires that all teaching, academic, student congregation areas, staff occupied spaces, public-transport waiting areas on-campus and adjacent to campus and nominated external open areas can access the Deakin wireless networks with adequate reception and data throughput.

6.1   New buildings and renovations

All new buildings and renovations are to provide coverage throughout the new or renovated areas.

To ensure that adequate wireless reception is achieved DS Audio Visual & Network, Digital Services AVN must approve proposed locations for the installation of WAPs. It is therefore a requirement of building project planning that DS Audio Visual & Network, Digital Services AVN that a wireless survey is conducted.

7   Performance specification

All serviced areas must deliver the minimum signal strengths specified below in both the 2.4, 5 and 6 Ghz bands to provide IEEE 802.11 a, b, g, n, ac, ax (Revision1&Revision 2) services.

The University has identified four distinct areas requiring differing DS Audio Visual & Network, Digital Service sign rules. These are high density, medium density, standard density, and outdoor installations. The following definitions apply. In all circumstances the approved latest technology IEEE 802.11 a/g/n/ac, ax (Revision1&Revision 2) technologies shall be utilized.

7.1   Density Specifications

Minimum throughput for all deployments at 18MB/s based on 4k video throughput per device for 5 and 6 GHz only.

High Density:
Applies to areas whose usage is predominantly for teaching and in staff areas with a capacity above 50 devices, where staff and students congregate such as cafeteria, library, and lecture theatre locations. These areas must accommodate a minimum average density of two to three user devices per square meter. A minimum of three access points visible at this signal level -65 dBm signal strength in these areas at 2.4, 5 and 6 GHz.

- 50+ users
- Minimum: 2-3 devices per square meter
- 1st AP View Signal strength: -65 dBm at 2.4, 5 and 6Ghz
- Devices per access point shall not exceed 25 per WAP Radio
- Visible by 3 access points (second access point at -75dBm)
- Designed for client transmit powers of 5dbm at 2.4Ghz, 8dbm at 5Ghz and 8dbm at 6Ghz

   Reference: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-7/b_wireless_high_client_density_design_guide.html

Medium Density:
Applies to areas whose usage is predominantly for teaching areas with a capacity between 20 and 50 users. These areas are to provide a service offering of no less than
 -65 dBm signal strength with a minimum of two access points visible at this signal level at both 2.4, 5 and 6 GHz.

- 20-50 user devices
- Minimum: 1-2 devices per square meter
- 1st AP View Signal strength: -65 dBm at 2.4,5 and 6Ghz
- Devices per access point shall not exceed 15 per WAP Radio
- Visible by 1-2 access points (second access point at -70dBm)
- Designed for client transmit powers of 5dbm at 2.4Ghz, 11dbm at 5Ghz and 11dbm at 6Ghz

Standard Density:
Refers to areas that are predominantly used for areas such as a corridor, plant rooms or multi-level car park. These require a service offering of no less than -65 dBm signal strength at both 2.4, 5 GHz and 6 GHz.

- 1-19+ user devices
- Minimum: 1 device per square meter
- 1st AP View Signal strength: -65 dBm at 2.4,5 and 6Ghz
- Visible by 1 access point (second access point at -75dBm)
- Designed for client transmit powers of 8dbm at 2.4Ghz, 11dbm at 5Ghz and 11dbm at 6Ghz

Outdoor Areas:
Refers to public-transport hubs on or adjacent to the campuses, transient areas between buildings that are frequented by students and open car parks. These require a best effort service offering up to -65 dBm signal strength as per standard definition.at both 2.4, 5 GHz and 6 GHz. High user throughfares shall be designed with additional coverage.

- 1-19+ user devices
- Minimum: 1 device per square meter
- 1st AP View Signal strength: -65 dBm at 2.4,5 and 6Ghz
- Visible by 1-2 access points
- Designed for client transmit powers of 11dbm at 2.4Ghz, 14dbm at 5Ghz and 14dbm at 6Ghz

7.2 Real Time Location Services (RTLS) and Location Analytics

For installation in High Density area's locations that have been identified as requiring Real Time Location Services, Location, or Occupancy Analytics the following considerations must be applied.

- Throughout the coverage area all devices must be able to be detected by an absolute minimum of 3 WAPS at no worse than -75dBm regardless of the density type. Additional WAPs shall be required in locations where location accuracy is paramount.

- WAP placement shall typically be placed in corners in addition to centrally mounted WAPS, covering perimeters and NOT in a straight line with outer WAPs

- The average indoor distance between WAPs shall be 10meters with a minimum separation of 8.5meters

8 Wireless Surveys

Consultant to provide detailed radio survey using the prescribed software "Ekahau".

Site surveys are to be provided back to DS Audio Visual & Network, Digital Services a PDF document indicating proposed WAP positioning and coverage in their native survey software format as well as a report in PDF or Word. Any moves or changes to a floor (i.e., wall movements) requires a survey.

Wireless survey types will be determined by the AVN Network Engineer.

Survey Types:

- Predictive
- Pre-Deployment Survey
- Post installation / Verification Survey

All Surveys are to include:

a) The proposed wireless coverage areas and areas that are to be excluded.

b) Floorplan showing user and seating density and equipment layouts

c) User network throughput expectations

d) Construction floorplan which identifies every wall type and other building materials.

e) Wall Types Index. This is needed to determine each type of wall and corresponding signal attenuation.

f) Reflected Ceiling Floorplan (RCP) – To ensure WAP performance is no compromised by lighting fixtures, air conditioning duct work, smoke alarms, fire sprinklers, speakers etc.

    i. WAPs must be installed well clear of all metal duct work (minimum of 60 cm, preferably 100 cm away from any metal obstructions), as well as away from any other significant obstructions (concrete columns, structural beams, or fixed office furnishings).

    ii. The RCP also provides information on whether horizontal mounting of WAPs is possible, and to aid in the specification of right-angle brackets or antennas as required.

g) Elevation Plan is essential to ensure WAP maintenance, and WAP height for signal coverage propagation across the floor.

h) WAP and Antenna model which will be deployed. Deakin approved models are described in Appendix B

i) Any special aesthetics or other mounting restrictions preventing WAPs from being mounted in specific areas.

9 Wireless Access Points (WAP) and antennae

Only Deakin approved WAPs, and antennae shall be used.

Approved models are described in Appendix B.

10 Installation

10.1 WAP Physical Installation Requirements

All WAPs shall be installed no more than 2.4 to 2.8 meters above floor level.

All WAP shall be ceiling mounted. In cases where the ceiling is above the approved height, other obstructions or aesthetic considerations preclude direct ceiling mounts an approved wall mounted bracket shall be used.

WAPs shall not be mounted in concealed locations or plenums without approval of the AVN assigned engineer.

The WAP shall be positioned such that the indication lamps can be easily viewed.

WAPs and data outlets shall not be placed in stairwells, ceiling spaces or other easily

unmaintainable locations.

WAPs must be installed well clear of all metal duct work and other ceiling fixtures.

Where duct work is present WAP must be mounted well below or relocated.

10.2 WAP data connection

Every WAP shall be installed with a single data point. The single data point shall be installed with the bottom edge of the data point plate 50 mm above the WAP's top edge.

Double outlets are to be installed depending on requirements.

Each WAP unit shall be connected to the Deakin Network using a 0. 5-meter CAT6A white patch lead. **Excessive patch-lead length, e.g., wound several times around the WAP, or loose hanging is completely *unacceptable*,** nor shall it be draped nor cause a personnel snagging hazard.

10.3 Post installation documentation

On completion of an install, contractors are to provide DS Audio Visual & Network, Digital Services with a marked-up floor plans showing WAP names, MAC address, data point numbers and switch port numbers.

11 Wireless Mesh

In buildings with no existing LAN infrastructure to act as back haul for the WAP's and under direct consultation with AVN representatives a wireless mesh installation shall be used. The installation is to adhere to other specified standards within this document regarding product selection.

12 Management Systems

12.1 DNA-C

All wireless installation and modification projects shall include resources to update Deakin's Network Management System DNA-C to AVN standards.

Appendix A – Definition of terms

Abbreviation	Definition
AP	Access Point
AVN	Audio Visual and Networking
DS AUDIO VISUAL & NETWORK, DIGITAL SERVICES	Digital Services

dB	Decibel
dBm	Decibel-milliwatt
FSD	Facilities Services Division
GHz	Gigahertz
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IT	Information Technology
LAN	Local Area Network
MAC	Media Access Control
MUTOA	Multi-User Telecommunications Outlet Assembly
RF	Radio Frequency
SNR	Signal-to-noise ratio
WAP	Wireless Access Point
WLC	Wireless LAN Controller

Appendix B – Standard parts list

Standard Install Bundles:

Deakin University use standard models of wireless equipment to maintain consistency and simplify configuration and management. Only the following component bundles are to be supplied and installed.

Internal WAP Bundle:
Used for all indoor wireless coverage

- 1x C9136I-Z -Cisco Catalyst 9136I Series, Internal Antennas, -Z Regulatory

External Bundle Selections:
Used for coverage on the exterior of buildings, outdoor spaces and specific indoor areas requiring specialized radio configurations

External Bundle1: (Directional) (WAP mounted internal within a building, antenna outdoors)

- 1xCisco Catalyst Series C9130AXE-Z
- 1x AIR-AP-BRACKET-9
- 1x C-ANT9103

External Bundle2: (Omni Directional - Bell) (WAP mounted internal within a building, antenna outdoors)

- 1xCisco Catalyst Series C9130AXE-Z
- 1x C-ANT9102

External Bundle3: (Omni Directional – Outdoors rated) (WAP mounted outdoors)

- 1x C9124AXI-Z
- 1x AIR-MNT-ART1

External Bundle4: (Directional – Outdoors rated) (WAP mounted outdoors)

- 1x C9124AXDI-Z
- 1x AIR-MNT-ART1

Accessories
Other approved antennas and accessories (as identified in wireless survey)

Cables
- AIR-CAB-002-D8-R (per antenna with RP-TNC connectors)
- AIR-CAB-003-D8-N (per antenna with N Type connector)
- AIR-CAB-003-D8-D8 (91cm DART extension lead)

Antennas for legacy environments
- "Quad Patch bundle small" 1 x Terrawave 2.4/5GHz 6dbi Quad Patch - M6060060MP1D43602
- "Quad Patch bundle large 1 x AIR-ANT2513P4M-N= Patch Antenna 4 x Low loss extension cables - CISCO   5 ft Low Loss RF cable w/RP-TNC and N-type

Power Injectors
- AIR-PWRINJ-60RGD2=
- AIR-PWRINJ-60-PMK=

Mounting WAP Brackets
- Oberon brackets – Right-Angle Bracket – with cover and Sidewalls 1011-00/8A (Bracket If identified in Wireless survey)
- AIR-MNT-VERT1 (if pole mounted)

Appendix C – WAP installation examples
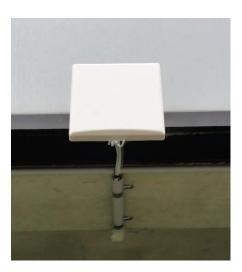
Retired Wall mounted 2802I with Oberon Bracket

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Wall mounted 2802E

Retired 2802E with Omni or Patch Antennas

Terrawave 4 Lead Dual Band OD Omni

Terrawave 2.4/5GHz 6dbi Quad Patch

AIR-ANT2513P4M-N= Patch Antenna

Appendix D References

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Throughput requirements for some popular applications is given in the table below:

Application	Throughput
Web Browsing	500 kbps (kilobits)
VoIP	16 - 320 kbps
Video conferencing	1.5 Mbps
Streaming - Audio	128 - 320 kbps
Streaming - Video	768 kbps
Streaming - Video HD	768 kbps - 8mbps
Streaming - 4K	8 mbps - 20mbps

Reference:
https://documentation.meraki.com/Architectures_and_Best_Practices/Cisco_Meraki_Best_Practice_Design/Best_Practice_Design_-_MR_Wireless/High_Density_Wi-Fi_Deployments

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