

**Specification for the
Installation of
Fibre Optic and Copper
Network Cabling
At Aberystwyth University**

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Document Version History

Issue	Date	Reason	Implemented By
5.1	25-11-2013		Peter Hinxman, AU
5.2	13-03-2015	Added MPO, label changes, cab changes, heat detectors, more example photos, tester calibration certificate info, standards (installation and drawing), fibre pair chart amendment, TE SL punchdown tool, and many smaller changes. Design considerations removed to a separate document Added options for equivalent manufacturers to TE Components & Rittal materials	Peter Hinxman, AU
5.3	05-02-2016	Change references from 'TE Connectivity' to 'Commscope AMP', add extra MPO part number information, Pre-terminated fibre information (Appendix B.5), remove any dust/debris from trunking and work areas, added Commando socket installation distances, updated electrical supply requirements, as-installed drawing documentation updated, CDM considerations re-instated,	Peter Hinxman, AU
5.3	30/01/2018	CAD drawing requirement, and departmental name changes.	Hefin James, AU
6.0	01/10/2018	Fibre termination update Fire regulations. MPO removed. Remove reference to AMP	Hefin James, AU

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1. Introduction

This document describes how the choice of fibre optic and copper network cabling products and their installation should be undertaken on all Aberystwyth University (AU) sites.

The installed product ranges for both copper and fibre optic must be supported by a manufacturer's warranty for at least 25-years.

The copper solution must be of a modular jack system and the patch panels must allow for cables to be brought in perpendicular to the patch panel so that individual modules can be accessed in the future.

Detailed test results for the network installation must be provided to AU.

AU has previously used network products from the **Commscope** range, that are covered by their 25-year warranty for both copper and fibre optic projects for several years, and found these to be a robust and reliable product range. This range includes components from the AMP and Krone ranges, both of which are now owned by Commscope. Any proposed alternative manufacturer's network solution must be produced by a genuine manufacturer of structured cabling systems, and offer the equivalent level of warranty and project support as Commscope. All components proposed must be approved by AU before the works begin.

Installation must be carried out by certified engineers from a certified installation company, and a manufacturer's warranty for at least 25 years on the installation must be applied for by the installation company. The qualifying certification must be passed to AU upon completion. This is true for all fibre optic and Category 6 UTP installations on AU premises.

This document shall be revalidated regularly and will be available on the AU Estates Department website. The version number on the front page will increase with subsequent versions.

2. Contacts

If you require further clarification on any points, please contact AU Information Services Network Support staff listed below, or the Estates Department project manager.

Information Services Network Infrastructure staff:

- Hefin James, 01970-622456, ahj@aber.ac.uk
- Damian Longree, 01970-622382, dnl1@aber.ac.uk
- Jim Finnigan, 01970-622481, jaf@aber.ac.uk
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Before any existing cabling infrastructure is installed or removed, the contractor must liaise with Information Services Network Infrastructure staff.

3. Contractors - General Notes

Before commencement of any works, all contractors must provide evidence that their safety management system is accredited by ConstructionLine (<http://constructionline.co.uk>). Accreditation to alternative SSIP (Safety Systems In Procurement) schemes, such as CHAS (Contractors Health and Safety Assessment Scheme, <http://www.chas.gov.uk/>) or SAFEcontractors scheme, (<http://www.safecontractor.com/>), may be acceptable, if advance written approval is obtained before project works commence, from the AU Estates Department.

The installer of either a copper or fibre optic network solution must be certified by the manufacturer to carry out the installation which will result in at least a manufacturer's 25-year warranty on all the network cabling and installation works of a project. Certificates to prove this compliance must be provided to AU.

Any proposal to vary from the cabling specification must be confirmed in writing from AU Information Services prior to installation. Any cabling that was not agreed with AU that has been installed, will have to be replaced at the installer's expense.

When the job is finished, the contractor is responsible for cleaning the project area of dust, and other debris that was generated by the works.

3.1. Fibre Optic Installations

The IT contractors installing (pulling in, terminating and testing) fibre optics must be certified by the products' manufacturer for installing, terminating and testing the fibre optic, and must provide documentation to show proof of certification before commencing any works on site. The installation company must also provide a manufacturer's 25-year warranty to cover the complete installed fibre optic systems. This shall include the fibre optic cable, terminations and patch panels.

All exposed internal and external fibre optic cable should be physically protected, by installation within protective and supportive containment.

3.2. Copper Installations

The IT contractors installing (pulling in, terminating and testing) the copper UTP/STP network cabling must be manufacturer-certified installers for the products that are being installed. The installation company must provide documentation to show proof of certification before commencing any works on site.

3.3. Cabling Standards

The installation of the fibre optic or copper cabling must adhere to the following industry standards.

European Standard(s)	EN 50310	Application of equipotential bonding and earthing in buildings with information technology equipment
	EN 50173	Information technology - generic cabling systems
	EN 50174-1	Information's technology - specification and quality assurance
	EN 50174-2	Information technology - installation planning and practices inside buildings
	EN 50174-3	Information technology - installation planning and practices outside buildings
	EN 50346	Testing of Installed Cabling
	EN 50575	Cables for general applications in construction works subject to reaction to fire requirements
TIA/EIA Standards	TIA/EIA-581.B.1	Commercial Building Telecommunications Cabling Standard
	TIA/EIA-581.B.2	100 Ohm Twisted Pair Cabling Standard
	TIA/EIA-581.B.3	Optical Fibre Standards
	TIA/EIA-569-A	Commercial Building Standard for Telecommunications Pathways and Spaces
	TIA/EIA-570-A	Residential Telecommunications Cabling Standard
	TIA/EIA-606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
	TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications
ISO/IEC Standards	ISO/IEC 11801	Generic Cabling for Customer Premises
	ISO/IEC 14763-1	Customer Premises - Administration
	ISO/IEC 14763-2	Customer Premises – Planning and Installation
	ISO/IEC 14763-3	Testing of optical fibre cabling
	IEC 61935-1	Specification for the testing of balanced communication cabling in accordance with ISO/IEC 11801- Part 1: Installed cabling

4. Network Infrastructure Design Considerations

4.1. CDM and Asbestos Management

Before any on-site works commence, it is the contractor's responsibility to liaise with the AU Estates Department (or the Project Manager) to ensure that all CDM paperwork is in place, and that appropriate asbestos checks have taken place.

4.2. Network Feeds Between Cabinets

Where the area is being refurbished or to be built, then the design must include at least two diversely-routed fibre optic links from different current network cabinets feeding the new cabinet(s). The cabinets from which to feed the new cabinet(s) will be specified by Aberystwyth University Information Services. This is to allow a secondary network route to the cabinet in the event of failure of the primary route.

External fibre optic is required to be spliced to internal fire grade fibre optic cabling as soon as possible within the building, or at an external location near the building, as shown in Fig 4-1.

Fibre Optic feeds and Interconnects

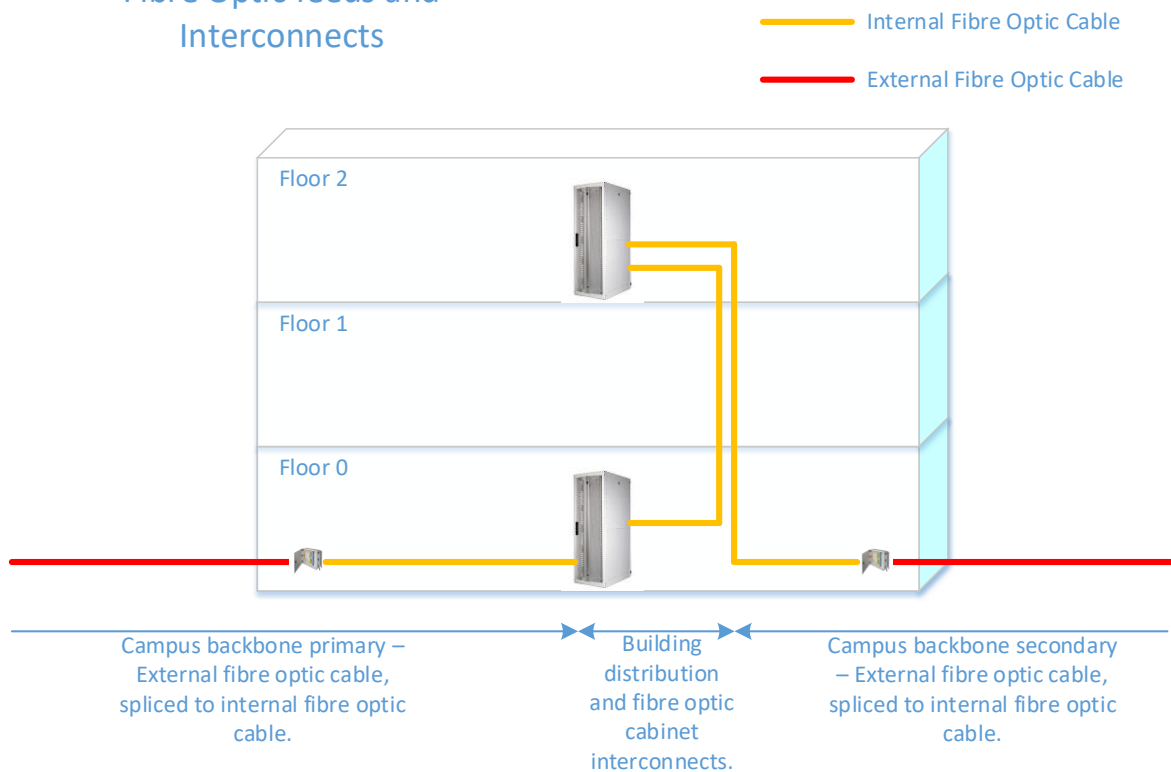


Fig 4-1: Typical Fibre optic feeds and cabinet interconnections.

4.3. Network Cabinet Locations

- 4.3.1. The location of any network cabinets must not be in areas that require notice to be given to occupants before access is available. The network cabinets must be located where external access is available 24 hours a day. For example, in works involving Halls of Residence buildings, the cabinets must **not** be located within any flat (including any kitchen, communal areas or study/bedroom area). A dedicated room that is not used for any other purpose, preferably with its own external access is required.

4.3.2. Unless written confirmation to the contrary is received from Aberystwyth University, the doors to any room where a network cabinet is to be located must be large enough to pass a constructed cabinet through without dismantling. This may require the installation of high or wide doors to the room, or any other doors that a cabinet may be passed through, when delivered to the cabinet room.

4.3.3. Where a new cabinet is to be installed, sufficient switch-controlled mains-powered lighting must be installed which will light up the front and inside of the cabinet for future work in the cabinet. As a guide, this should be located approx. 1m in front of the front door of the cabinet.

4.3.4. Where a new cabinet is to be installed, the Fire Safety Advisor in Aberystwyth University's Health, Safety and Environment Office must be consulted on the appropriate fire and heat detection mechanisms that may be required to be installed, and/or amendments made to the existing fire detection systems.

4.4. Telephony

The Aberystwyth University telephony facility is installed and managed by Information Services, and the supply and installation of any part of such a system, apart from the Category 6 cabling (as part of the wider network infrastructure) is not part of the contract, unless written confirmation to the contrary is received from Aberystwyth University.

Funding for these will come from the works project, but will not be the responsibility of the contracting company to supply or configure, unless written confirmation to the contrary is received from Aberystwyth University.

4.5. Network Switch Equipment

Aberystwyth University Information Services will arrange the purchase of any network switch equipment to be installed in the cabinets, unless written confirmation to the contrary is received from Aberystwyth University.

Funding for these will come from the works project, but will not be the responsibility of the contracting company to supply or configure, unless written confirmation to the contrary is received from Aberystwyth University.

4.6. Uninterruptable Power Supplies (UPS)

Aberystwyth University Information Services will arrange the purchase of any UPS equipment to be used to protect the electrical supplies to the network equipment installed in the network cabinets, unless written confirmation to the contrary is received from Aberystwyth University.

Funding for these will come from the works project, but will not be the responsibility of the contracting company to supply or configure, unless written confirmation to the contrary is received from Aberystwyth University.

4.7. Network Socket Allocation

For general office work areas, an allocation of 2 UTP sockets per user should be used. For other areas, e.g. laboratories, please contact Aberystwyth University Information Services staff for clarification.

In some locations, two twin mains sockets and a double network socket are used around a dado. These must be installed with the network sockets between the two mains sockets as shown in Fig 4.2.



Fig 4.2: Example of the layout of a twin mains, double data, twin mains provision on dado trunking

4.8. Network Sockets in Communal Rooms in Halls of Residence

Where the area to be cabled includes communal areas within student accommodation blocks, and it is the intention to install a wall-mounted television, then a single network connection must be provided to connect the television to the network, in addition to any aerial connection.

4.9. Network Patch Leads

The supply of Cat6/Cat6a patch leads for the installation is not required by the contractor. These will be sourced via Aberystwyth University Information Services, unless written confirmation to the contrary is received from Aberystwyth University.

5. External Cabling

5.1. External Fibre Optic Cabling

All external fibre optic cabling runs that include any external ducts must be non-metallic armoured and LSZH, as detailed in Appendix B, unless notification is given in writing from AU for alternative materials.

5.2. External Copper Cabling

External copper network cable should **not** be used, unless specifically directed, with authorisation in writing from AU Information Services.

6. Internal Cabling

6.1. General Installations of Fibre Optic or Copper Cabling

- 6.1.1. **All internal cabling works must conform to ISO/IEC 11801.**
- 6.1.2. All internal copper and fibre optic cabling runs must be LSZH, with CPR Euroclass of Cca-s1a,d1,a1. For information, Appendix B contains the Commscope part numbers.
- 6.1.3. All cable runs should be either in trunking/conduit or secured onto data basket/tray. All bends, tees and crossovers shall be gusseted to allow for adequate bend radii of the installed cables. All trunking needs to be of sufficient capacity to allow for the minimum bend radii of the fibre and copper cables. All trunking must be Category 6 compliant for Cat6 cables, and Category 6a compliant for Cat6a cables.
- 6.1.4. To accommodate the Cat6/Cat6a module in trunking, a backbox that is at least 40mm deep must be used. This may limit the number of Cat6/Cat6a cables that can be run immediately behind the backbox, or preferably the cables run above or below the backbox in a separate compartment.
- 6.1.5. Where mains power is run in the same trunking, compartmentalised trunking must be used, and the correct use and separation procedures adhered to.
- 6.1.6. The acceptable minimum radius for the cables should be obtained from the manufacturer.
- 6.1.7. Cables must be installed to avoid bearing on sharp edges or frictional overheating.
- 6.1.8. Cable sheaths/jackets must not be damaged during installation. Any cables that are damaged or kinked, must have the entire cable replaced between the cabinet and the outlet socket at the installer's expense. These must then be re-tested.
- 6.1.9. Cables must be protected with suitable mechanical protection/sleeving where they pass through holes in walls or ceilings. Where fire-break walls are breached, either through existing or in new holes, they should be re-instated

with a suitable fire-retardant material, as approved by the AU Estates Department.

- 6.1.10. Hook-and-loop ties must be used and tightened to comfortably hold but not constrain the outer sheath of the cable to cable basket/tray. **Nylon cable ties must not be used**, other than to lightly hold an individual cable in place on the rear cable management bar of the patch panels.
- 6.1.11. Cables entering the network cabinets should be securely tied to the vertical cable tray within the cabinets, and tied and loomed neatly after termination. Cable should not be attached directly to the main cabinet 19-inch stanchions.
- 6.1.12. All non-vertical cabling basket with more than 10 cables installed within it, must be lined with Class 0 fire retardant basket matting to a depth of at least 6mm.
- 6.1.13. All trunking needs to be cleaned of dust before the trunking lids are fixed in place. Any cleaning of the inside of trunking is to be undertaken by the installing company, to ensure proper care of any installed cabling.

6.2. Internal Fibre Optic Cabling Installations

In addition to the points in section 6.1, the following points must be adhered to.

- 6.2.1. All cables must be continuous between patch panels, unless splicing between external and internal fibre cabling. (In which case, all cores need to be spliced.)
- 6.2.2. Each fibre optic cable run should have at least 5 metres of excess cable at each end prior to termination to facilitate more easily the termination process.
- 6.2.3. Each fibre optic cable run should have at least 2 metres of cable coiled up in or by the cabinet after termination, to allow for future relocation of the patch panel within the cabinet. The minimum bend radius of the cable must be adhered to. These must be securely fixed and not left hanging loose, and installed so as not to obstruct the installation of further patch panels and equipment into space between the cabinet stanchions.
- 6.2.4. Any vertical cable runs of 'Loose Tube' fibre optic cable should have an additional three loops every three floors. The minimum bend radius of the cable must be adhered to. These must be securely fixed and not left hanging loose.
- 6.2.5. All fibre optic patch panels must have the couplers securely screwed to the panel, and not left loose.

6.3. Internal Copper Cable Installations

In addition to the points in section 6.1, the following points must be adhered to.

- 6.3.1. The data cabling installation must meet the TIA/EIA-568-B standard.
- 6.3.2. **No copper permanent link runs should be longer than 90 metres.**
- 6.3.3. All cables must be continuous between the outlet modules and the patch panel terminations.
- 6.3.4. Where network cables run in parallel with mains or high voltage cables in risers and ceiling voids, they must have a separation distance of at least 200mm from such cables, and to comply with both BS 6701 and EN 50174 Part 2. In dado trunking, they must be kept in different compartments of the dado.

- 6.3.5. Any basket/tray containment installed shall provide adequate space for the current installation and 40% future expansion.
- 6.3.6. Any cable runs that are to be behind a fixed ceiling or other area where future access is severely restricted, must have access panels in the wall or ceiling panels installed. These must be adjacent to the cable tray/basket to allow for easy access.
- 6.3.7. Each cable run should have at least 1 metre of spare cable at the cabinet end and 5 centimetres at the outlet end to allow for terminations. This allows for subsequent checking of the patch panel and outlet ends following termination.
- 6.3.8. When secured onto vertical or overhead cable trays, Category 6/6a cables should be secured at intervals of not greater than 1m, using non-slip hook-and-loop cable ties.
- 6.3.9. Horizontal copper network cabling must not be stacked more than 100mm high on the cable basket or when within containment. If more cable is to be installed, then additional cable basket / cable tray or suitable containment must be installed.
- 6.3.10. Where data cables cross power cables, they should only do so at 90 degrees from the direction of the power cable.
- 6.3.11. Velcro ties must be used and tightened to comfortably hold but not constrain the outer sheath of the cable on the outlet module. The compression of the pairs from the over-tightening of the Velcro ties may change position of the pairs and affect performance.
- 6.3.12. After termination, there must be at least 300mm of slack cable available to allow for future maintenance. This must also not obstruct the insertion of full-depth 19-inch wide powered equipment in the adjacent rack slots.
- 6.3.13. When the cables are pulled through, and before termination, the sheath at each end of the cable should be numbered with a printer label, an indelible ink or permanent marker pen, to enable identification of the cable at both ends to ensure sequential numbering of sockets at both ends. See example in Fig 6.1.



Fig 6.1: Example of cable label on UTP at the back of the patch panel

6.4. High Level Network Sockets

High level UTP sockets are used for networking components for:

- potential location of wireless access points
- attendance monitoring systems,
- door access control systems
- CCTV systems.

These should normally be located high up by a plasterboard ceiling, or above a suspended ceiling, or located at least 3 metres off the floor level to minimise unauthorised physical access.

The final location of all the WAP (Wireless Access Point) sockets must be agreed with AU Information Services before installation. It is expected that more WAP sockets are installed than WAPs. This method allows for the final location of WAPs to be adaptable to allow for future furniture or other obstacles that might cause reflection or absorption of radio waves. The WAPs are powered using Power-Over-Ethernet, and so no additional power sockets are required by the socket outlet locations.

Each WAP location must consist of a single Cat6a network socket.

Other high level sockets may be for use for information monitors/networked televisions, and so these sockets may need to be located so that they will be hidden by the installed screen. The exact location for the sockets will be given from AU.

The labelling of the high level sockets requires additional labelling as described in section 9.2.2.2 and 9.2.2.3.

6.5. Sockets in Floor boxes

Where network cabling is required in a floor box, at least two LJ6C format Category 6 outlets must be installed. The LJ6C angled fascias must be positioned so that any patch leads used in the sockets, are leading towards the centre of the box, to ensure no sharp bends are introduced into the patch leads, as shown in Fig 4.3.



Fig 4.3: Example of the layout of a floor box, showing the LJ6C angled fascia sockets pointing towards the middle of the floor box.

6.6. Loose Network Sockets in Floor Voids

Where network sockets are to be installed in floor voids, they shall be mounted into surface metal back boxes with LJ6C compatible metal-clad faceplates and angled fascias.

7. Cabinet Installation

7.1 General Considerations on Cabinet Installation

- 7.1.1. Where a new cabinet is to be fitted, this is to be purchased and installed as part of the contract, unless written confirmation to the contrary is received from AU.
- 7.1.2. All cabinet locations **must** be confirmed with AU Information Services before installation of any cables or cabinets.
- 7.1.3. All new cabinets must be fully lockable on all doors and side panels.
- 7.1.4. Although the preferred choice of cabinets is from the Rittal range in the table below, alternative network cabinet manufacturers will be considered, if considered to be of an equivalent quality by AU Information Services.

Cabinet Part Number	Location
Rittal TS IT Server Rack	For floor-standing cabinets to be located in fully air-conditioned room
Rittal TE8000 Networking Rack	For floor-standing cabinets in non-air-conditioned environments (including rooms with thermostatically controlled extractor fans)
Rittal Flatbox Series, 700mm wide x 700mm deep	For wall-mounted locations
W07 Lockable Fibre Optic Wallbox 72 position (144 fibre cores), double door (360mm high x 350mm wide x 120mm deep) - unloaded	For wall-mounted locations where a 19-inch rack cannot fit. This should only be used if confirmation in writing is received from AU Information Services.



Fig 7.1: W07 Fibre Optic lockable wall box (double door)

- 7.1.5. Any new floor-standing network cabinet installed as part of the project must be no smaller than 800mm wide x 1000mm deep. They must be supplied with both castors and feet. The minimum height of any floor-standing cabinet to be installed is 42u, unless otherwise directed by AU Information Services.

7.1.6. All floor-standing cabinets must be complete with metal rear door(s), and metal or glass front door(s). All cabinet side panels must be solid metal.

For cabinets in non-air-conditioned environments:

- the rear doors must be solid metal, and not perforated,
- the front door would normally be clear glass/Perspex or solid metal (not perforated).

For cabinets in full, air-conditioned environments:

- the front and rear doors must be perforated.

Any proposal to vary from this must be confirmed in writing from AU Information Services prior to installation.

7.1.7. All panels and door must include locks on all doors and side panels. All cabinet keys for the locks **must** be supplied to AU Estates Department or Information Services by handover. The keys must **not** be handed to other AU staff from other departments, even if they work in the University department where the work is being carried out.

7.1.8. Any new wall network cabinet installed as part of the project must be no smaller than 700mm wide x 700mm deep. The minimum height of any wall cabinet to be installed is 12u.

7.1.9. Components pigtails and couplers or equivalents. Any holes not used, must be fitted with blanking plated or empty fibre couplers.

7.1.10. The newly installed cabinet must be sited so that there is at least 0.6 metre from the cabinet to the nearest wall, to allow access and free movement of air. The front and one side of the cabinet must have at least 1.2 metres of uninterrupted space to allow for access.

7.1.11. The cabinet must be adjusted so that there must be **at least 220mm** from the **front door** of the cabinet to the main **front 19-inch mounting** stanchion angles. This must be done before the installation of any patch panels.

The cabinet must be adjusted so that there must be **at least 550mm** from the **front main mounting** stanchion to the **rear mounting** stanchion, to allow for installation of other network associated equipment.

This must be before any patch panels or other equipment is installed in the cabinet. This must be done before any patch panels containing terminated cabling or other equipment mounted in the cabinet. If this is not possible for any reason, then AU Information Services staff **must** be contacted before any further works are carried out.

7.1.12. Unless prior authorisation is received in writing from AU Information Services, all cabling (fibre optic, UTP, and mains cabling, etc), must enter the cabinet at floor level, and not through the sides or roof of the cabinet.

7.1.13. Before any cables are installed into a floor-standing cabinet, PVC cable tray or cable basket must be installed up at least one side of the cabinet, on the **outside** of the 19-inch rack stanchions. This installed PVC tray must run the full height of the cabinet. Sufficient PVC tray shall be installed to provide adequate space for the current installation as well as 40% future expansion. The loaded cable tray / basket must be kept clear of the 19-inch gap between stanchions so as not to prevent the installation of equipment that extends between the front and rear stanchions. The basket must be positioned so that it is facing **outwards** from the central cabinet space, as shown in Fig 7-2, leaving the central area in the main body of the cabinet clear to allow easy insertion of rack-mounted equipment.

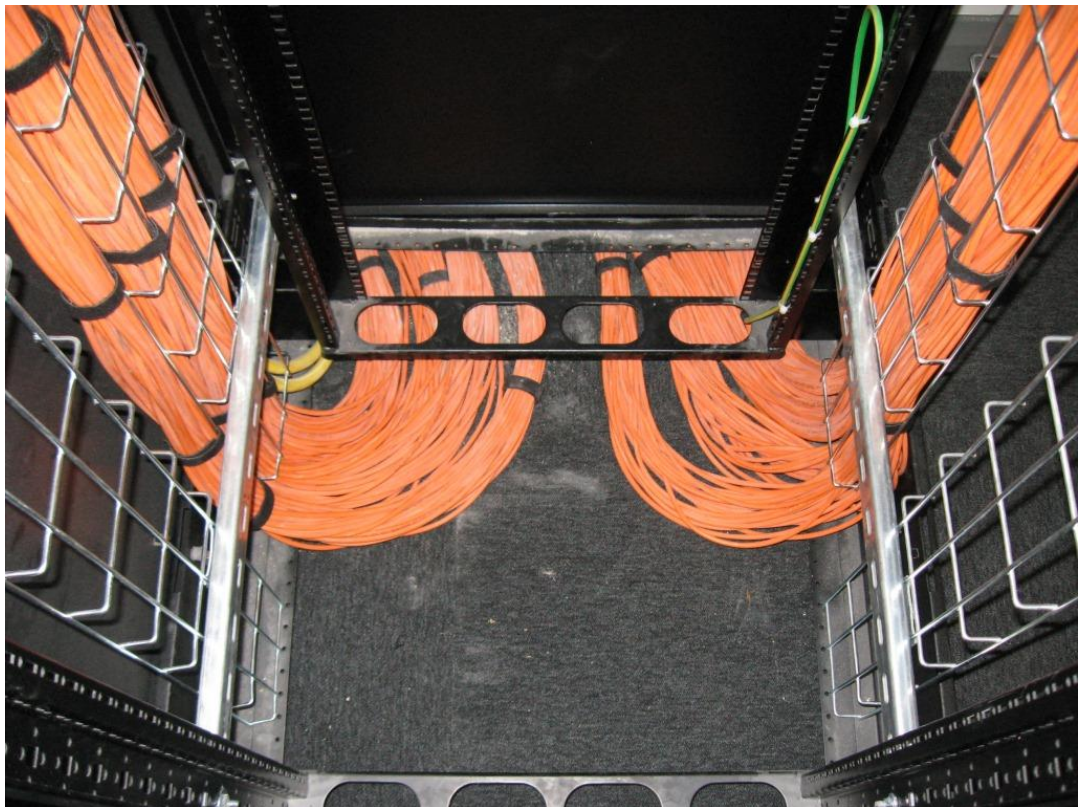


Figure 7-2: Example of how cable basket is to be installed in the cabinet and cable dressed into the vertical drops.

7.1.14. The new cabinet provided shall have capacity to support 40% additional future growth in numbers of connections.

7.1.15. A space of at least 8u must be left free from intrusions and obstructions at the bottom of the cabinet to allow for the future unimpeded installation of a UPS (uninterruptable power supply). This supply of the UPS falls outside the scope

of the network installation contract, unless explicitly requested in writing from AU Information Services.

- 7.1.16. When an existing cabinet is to be used then access to it must be via a key signed out from AU Information Services. When not directly working in a cabinet, the cabinet must be locked to prevent unauthorised access to the existing connections. This is important as there are often fibre optic connections in the cabinets (usually using the invisible parts of the optical spectrum), which, if unplugged could cause harm to personnel. The door and lock must not be forced in any way, or the contractor is liable to replace the damaged parts as required by Information Services. When the work is completed, the key **must** be returned to Information Services.
- 7.1.17. If any other equipment is to be installed in the cabinet (eg. lighting control systems, access control systems, or CCTV systems), then it must be able to be supported on its own within the cabinet, either by fixing to the stanchions or by installed on a shelf which is fixed to the stanchions. Equipment must not be left supported by other equipment underneath it.

7.2 Electrical Supply Requirements

- 7.2.1. Where a new network cabinet is to be installed, it should be earthed as directed by the AU Estates Department, in accordance with *BS 7671-The IEE Wiring Regulations* (current edition), and *BS 7430-Code of Practice for Earthing*. This must include a dedicated, protective earthing conductor direct back to the area's MET (Mains Earth Terminal) where practicable. Connecting back to anywhere else (such as a sub-main MET), can only be accepted if prior written confirmation authorising this is obtained from AU. Earth bonding must not be daisy-chained via other cabinets.
A test certificate showing that the resistive earth for the protective earthing conductor is no greater than 0.05 Ohms when using the R2 method must be supplied to AU.
- 7.2.2. Each **floor-standing cabinet** must have its own 200-250V 16A 'Commando-style' BS 60309 mains connection on a dedicated, radial circuit to be protected by a 16A **Type C MCB** (10kA rated). This should be mounted in an accessible location, no higher than 500mm from the floor, and typically between 300mm and 1 metre from the cabinet. The circuit must be suitably mechanically protected where practicable.
- 7.2.3. For each **wall-mounted cabinet**, there must be two, red faceplated, unswitched, twin 13A sockets on a dedicated, radial supply, protected by a **Type C MCB**, mounted in an accessible location within 1 metre of the cabinet. The exact location of the 13A sockets and commando connection has to be agreed with AU Information Services, as it will depend on cabinet access panels, and the proposed location of other networking equipment (eg. switches) within the cabinet.
- 7.2.4. If any other equipment is to be installed in the cabinet (eg. lighting control systems, access control systems, or CCTV systems), then there must be

alternative power supplies provided for them. These must **not** have red faceplates, and must **not** be on the same circuit as those red, unswitched, sockets provided for networking equipment. If UPS provision is required, this must be separate from that used for the other networked equipment.

8. Termination of Cables

8.1. Fibre Optic Termination

- 8.1.1. All fibre optic terminating contractors must be manufacturer-certified to install and terminate fibre optic cable, and be able to obtain the manufacturer's warranty for the installation as defined in section 3.1.
- 8.1.2. The cabinet must be adjusted so that there must be at least **220mm** from the **front door** of the cabinet to the **main front 19-inch mounting** stanchion angles. This must be done before the installation of any patch panels.
- 8.1.3. The fibre optic termination must be spliced to LC-pigtails.
- 8.1.4. The pigtails in the patch panels must then be neatly coiled around 4-armed plastic '*spiders*' or the sunken sections of the fibre patch panel.
- 8.1.5. All splice holder/bridges must include a fitted lid and 3M sticky-pad fixing.
- 8.1.6. The fibre optic patch panel(s) **must be mounted at the top of the cabinet**.
- 8.1.7. All LC couplers mounted in the patch panels must not be loose or just clipped in, but **must** be securely screwed in place to the front of the patch panel.
- 8.1.8. All unused cut-outs in the fibre optic patch panel must be filled with a dust cover/blanking plate, and not left with a coupler.
- 8.1.9. All fibre optic terminated pairs must be in the same order at each end.
- 8.1.10. Each pair of core cables shall be swapped over at one end, i.e. core A of a pair on one bulkhead/coupler at one end, is connected to core B of the same pair of the bulkhead coupler at the remote end.

8.2. Copper Cable Termination

- 8.2.1. All copper cabling terminating contractors must be manufacturer-certified to install and terminate copper cabling installations, and be able to obtain the manufacturer's warranty for the installation as defined in section 3.2.
- 8.2.2. Termination of the cable is the 'punching down' of each individual core into the receiving slots at the rear of the data outlet module and on the patch panel module.
- 8.2.3. All terminations shall be carried out in accordance with TIA/EIA-568-B colour coding and pin numbering specifications, as described in Appendix D.
- 8.2.4. At each outlet and patch panel module, where a pair of cores within the building cable has been untwisted to allow termination to take place, the maximum permitted length of untwisted cable shall be 6mm. The maximum permitted length of exposed core cable will be 20mm.
- 8.2.5. Cable ties must be used and tightened to comfortably hold but not constrain the outer sheath of the cable on the rear cable management plates for the patch panels. Each cable must be **individually** cable-tied to the corresponding metal 'T-bar' level with the corresponding RJ45 module in the panel, not to any other 'T-bar', ie. not skewed.

- 8.2.6. The correct termination tool must be used as specified by the manufacturer for all copper terminations. Where Commscope SL jacks are used, the TE SL punch-down termination tool must be used.
- 8.2.7. Each patch panel should only contain cabling for **one** floor level. There must not be instances of a patch panel containing cables that go to different floors, unless written confirmation to the contrary is received from AU.
- 8.2.8. The network cables in the patch panels must be strapped to the cabinet and the patch panel back cable management bar, so that the cables do not intrude into the space left for active network equipment to be installed, as shown in Fig 8-1.



Fig 8-1: Shows how network cable should be installed to avoid intruding into space used for network equipment

- 8.2.9. When the new cabling is terminated into patch panels, but other works are still ongoing, then the exposed UTP sockets in the patch panel must be protected from dust by covering them with a strip of non-marking tape across the front of the patch panel for the rest of the duration of the installation.

9. **Labelling**

9.1. **Labelling of Fibre Optic Installations**

9.1.1 The patch panels must be labelled with a machine-printed (not handwritten) label and must be of a Traffolyte-style embossed/engraved type, and **not** a Dymo-style label. They must contain the following information:

- The pairs of the local fibre panel that are included in this cable (abbreviated to '**P1 – P4**' to mean pairs 1 through pair 4 inclusive), followed by a ':'.
- Where the remote end of the cable is, comprising the University cabinet unique identifier (see Appendix E),
- The 'U' number (from the top of the cabinet) the fibre patch panel at the remote cabinet that the cable is terminated into (which is obtainable from AU Information Services).
- Which pairs within the remote cabinet that the cable is terminated into (eg. '**P5 – P8**' to mean pair 5 through to pair 8 inclusive), followed by a '/'.
- Short date form, eg Jun18
- The fibre optic patch panel should be labelled in the following format.
- Eg. "**P1-P4:C123-U4-P5-P8/Jun18**" which would mean local pairs 1 to pair 4 of this patch panel connects to cabinet C123 into fibre patch installed a position 4U's from the top, on pairs 5 to pair 8 of that remote panel. This allows for a panel that has multiple cables terminated inside it to be accurately and uniquely recorded, and date terminated
- The cabinet identifier numbers for the current and any new network cabinets are available from any of the contacts listed in section 2.

9.2. Labelling of Copper Installations

9.2.1 Both the outlet faceplate and the patch panel must be labelled with a schema obtained from AU Information Services. The labels must be machine-printed (not hand-written), and must be firmly attached to the faceplate or the patch panel. Both the patch panel and outlet ends must be of a Traffolyte-style embossed/engraved type, and **not** a Dymo-style label.

9.2.2 Labelling schema for outlet faceplates

The labelling schema for the outlet faceplates will be of the form of 3 hyphen-separated sections in the layout of **CXXX-Y-ZZZ** where:

- **CXXX** is an alphabetic code (identifying the network cabinet that feeds the socket). The cabinet identifier code for the current University cabinets are available in Appendix E. For new cabinets, please contact AU Information Services and a new cabinet number will be allocated.
- **Y** is a *single* character to denote the floor level. Some buildings use numbers for their floor levels, (0, 1, 2, 3, etc), some use letters (A, B, C, etc), and some use 2 letters (eg. GF (ground floor), FF (first floor), SF (second floor), etc). In the latter case the single character to denote the floor shall be the numerical equivalent (eg. 0, 1, 2, 3, etc). Negative numbers must not be used to denote floors below floor zero; contact Information Services Network Support for clarification if this situation arises.

- **ZZZ** is a **3-digit number** starting from **101** rising sequentially.
- The fields must be separated by hyphens, and not slashes or any other punctuation.
- The outlet sockets must be labelled sequentially around the installation.

Each outlet socket must be individually labelled with the full schema (**CXXX-Y-ZZZ**). This must be stuck onto the faceplate above the module when in dado trunking, and not the module itself.

For example, **C204-3-105** refers to:

- Cabinet number 204
- Floor 3
- Socket number 105

9.2.2.1. Labelling location for outlets on walls and dado up to 1.8m off the floor level.

An acceptable example of a Cat6/Cat6a installation outlet socket label for a dado or standalone wall-mounted socket is shown in Figure 9-1.

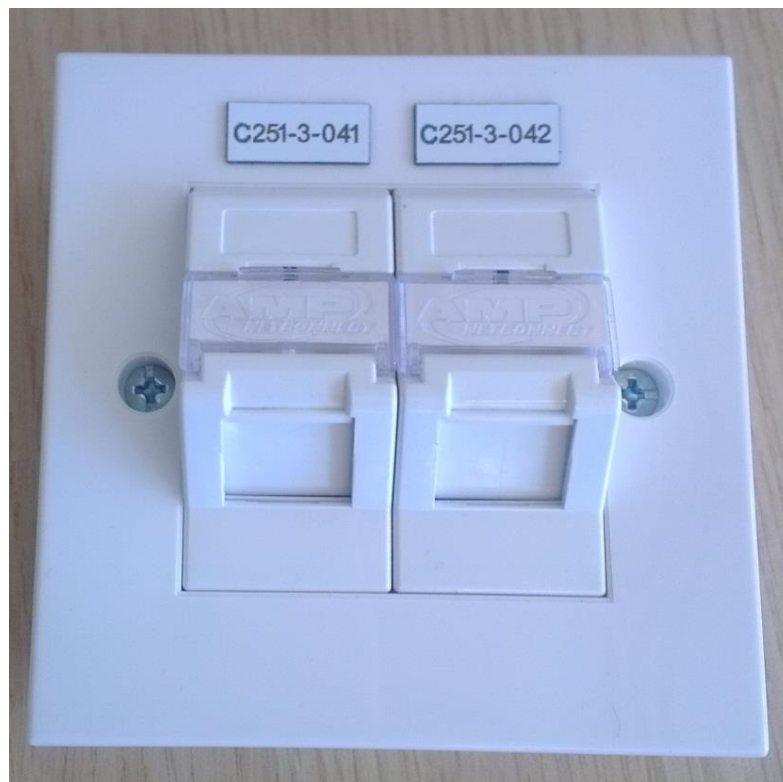


Figure 9-1: Example of labelling on a Cat6 Outlet socket

9.2.2.2. Labelling location for outlets on walls above 1.8m off the floor level.

For higher level sockets above 1.8m, the labels must be placed on the bottom side of the patch so that it faces straight down. In some places

where there is no room underneath a patch panel then the label needs to be on the bottom faceplate, where it can be read easily, as shown in Fig 9-2.



Figure 9-2: Example of labelling position on a high level patch panel box, so it is visible from below

- 9.2.2.3. If sockets are installed above a suspended ceiling, then there needs to be a second label with the full socket numbers installed on the framework of the suspended ceiling underneath where the socket has been installed, to aid locating the hidden sockets, as shown in Fig 9-3.



Figure 9-3: Example of labelling below suspended ceiling

9.2.3. Labelling schema for patch panels

Each patch panel socket must be labelled with 5 characters, denoting the floor, a hyphen, and the 3-digit socket number of the form “**Y-ZZZ**”, eg. “A-108” for floor A, socket 8. The sockets in the patch panel must be labelled sequentially with a patch panel only feeding one floor, unless written confirmation to the contrary is received from AU to allow mixed patch panels. An example of an acceptable label is shown in Figure 9-3.

As all new installations should not include end socket numbers less than 100, this should not occur, but where it has been agreed that existing cables can be re-used, then leading zeroes should be used to provide a 3-digit socket number, as shown in Fig 9-2.

When installing a patch panel label, the full-width label with all 24-sockets labelled must be supplied, to allow for future use.

The typed text must be at least 6mm high, to maximise readability.

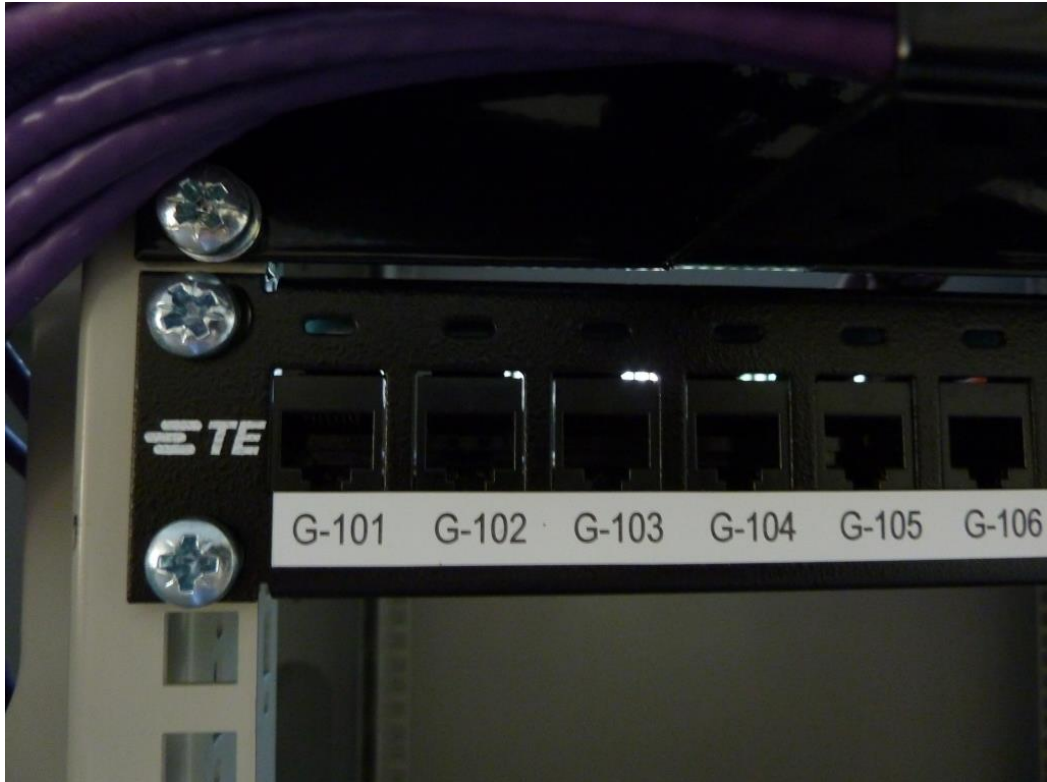


Figure 9-3: Example of labelling on a patch panel

10. Testing

All stated standards must be adhered to, but not limited to, where applicable. In the case of a conflict between standards the most onerous standard must be adhered to for the individual section under discussion.

Test Standard	Use
ISO 11801 Class E Permanent Link	Cat6
EN50173 Channel Class E	TE Cat6

The testing of a fibre optic or UTP Cat6/6a cable shall include the carrying out of all the tests necessary to show that the cable being tested will perform to the appropriate standards. The tester must have had a reference test performed immediately prior to the testing of the installed cabling.

The tester must have the latest available version of the software installed.

The results page for each cable tested must include:

- The full unique identifier of the cable as per the University's labelling schema (including the cabinet identifier in the case of copper cabling)
- The name of the person and company conducting the test.
- The correct date and time of the test.
- The model numbers and serial numbers of the main and remote test equipment
- The software version of the test equipment
- The test undertaken, eg. ISO 11801 Class E Permanent Link
- The type of cable tested, eg. Cat6
- The measured length of the cable
- If the cable under test passed or failed.
- The date and time of the reference test carried out on the test launch leads

If, after the full testing has taken place, any network sockets are required to be made live before handover to AU (eg. for an emergency telephone line in a lift, BMS, door access control systems, or other networked equipment), then a full set of annotated socket location maps and full test results must be provided to AU Information Services to allow AU staff to knowledgeably patch in sockets.

AU Information Services may wish to counter-test a selection of newly-installed Cat6/Cat6a or fibre optic network connections to compare the results with those of the contractors. Any discrepancies will require re-testing by the contractor, at the contractor's expense, and if there is sufficient doubt that the original tests are bona fide, then the whole installation will need to be completely retested at the contractor's expense.

10.1. Test Equipment Calibration

Any test equipment used must have a certificate to show that it has been calibrated or re-calibrated to the manufacturer's requirements in order to issue a valid installation test certificate. A copy of these certificates **must** be included in the documentation pack.

10.2. Testing Fibre Optic Cable

All cables to be installed must be tested for conformance to ISO/IEC 14763-3 fibre optic testing standards including the use of "Test Reference Cords", and not normal patch cords. The tester, defined in Appendix C, must be installed with the latest manufacturer's version of firmware and standards database, to ensure the correct parameters are met.

As well as the criteria listed at the top of section 10, the test results should include:

- The number of adapters/connectors in the test
- The number of splices
- Propagation delay
- Losses in dB at 850nm and 1300nm (multi-mode cable)
- Losses in dB at 1310nm and 1550nm (single-mode cable)
- Loss limits (dB)

- Loss margins (dB)
- Reference (dBm)

10.2.1. Multi-mode Fibre Testing

The test equipment must be able to deliver tests for the following types of network connection:

- FDDI 10BASE-FL 100BASE-FX
- 1000BASE-SX 1000BASE-LX 10GBASE-LX4
- Token Ring 4 Fibre Optic ATM 52 Fibre Optic ATM 155 Fibre Optic
- ATM 155SWL Fibre Optic ATM 622 Fibre Optic ATM 622SWL Fibre Optic
- Fibre Channel 133 Fibre Channel 266 Fibre Channel 266SWL
- Fibre Channel 100-MX-SN-I Fibre Channel 200-MX-SN-I
- Fibre Channel 200-MX-SN-I: This channel is certified for 200 Megabytes per second Fibre Channel application over multimode fibre with short wavelength 850 nm laser source.

10.2.2. Single-mode Fibre Testing

The test equipment must be able to deliver tests for the following types of network connection:

- FDDI 1000BASE-LX 10GBASE-LX4
- 10GBASE-L 10GBASE-E ATM 52 Fibre Optic
- ATM 155 Fibre Optic ATM 622 Fibre Optic Fibre Channel 266
- Fibre Channel 100-SM-LC-L Fibre Channel 200-SM-LC-L Fibre Channel 400-SM-LC-L
- Fibre Channel 1200-SM-LL-L
- Fibre Channel 1200-SM-LL-L: This channel is certified for 1200 Megabytes per second Fibre Channel application over singlemode fibre with long wavelength 1310 nm laser source.

10.3. Testing UTP Cable

All cables to be installed for use will be tested for conformance to ISO 11801 Class E Permanent Link standards. The acceptable test unit required to test category 6 installations should be TSB67 Level III compliant as a minimum, and chosen from the list in Appendix C. The tester must be installed with the latest version of firmware and standards database to ensure the correct parameters are met.

When testing, the correct cable type must be used on the Fluke DTX/DSX tester.

As well as the criteria listed at the top of section 10, the full test results (one page per cable) should include NVP percentage, and wire map diagram, as well as graphs of frequency against NEXT, ACR-F, ACR-N and RL.

10.4. Failed cabling

Should any cable fail to meet the Cat6 / Cat6a or fibre optic standards outlined above, the contractor will be responsible for rectifying the fault, either by re-termination of the cable or by re-running the complete cable if necessary, both at no additional cost to the University. In either case, the cable must be re-tested to ensure that the rectified cable meets the required standards.

10.5. Test Results Documentation

The full test results (not just summaries) for all installed (or altered) fibre optic and copper cables must be provided in an electronic format (eg on CD) in **Fluke FLW file format (*.flw)**. The test results **must** contain the full, final socket labels as cable-ID references, as per the labelling schema obtained from AU Information Services, described in section 9.

Where the project includes UTP cabling to different cabinets, or includes fibre optic cabling as well as UTP cabling, then these results must be saved into separate FLW and PDF files.

11. Installation Documentation

At the end of the contract the following documents must be passed to AU.

11.1. Test Results Documentation & Tester(s) Calibration Certificate(s)

The full cable test results as outlined in section 10. This must also include a copy of the most recent calibration certificate for the tester units.

11.2. Annotated Socket Location Maps

As-installed plans showing the location of every socket, including their **full label** (eg. C341-1-123), must be provided as part of the contract (as some areas may have sockets fed from different cabinets). Electronic versions of blank maps of the building can usually be provided to the installer if required.

CAD drawings as DWG format, of the as-installed plans must be supplied which include the layers that show:

- Title (including building name or area)
- The date of the network amendments
- the building walls (and doors if known),
- final room numbers,
- network socket outlets (including noting those at high level)
- network socket numbers
- any legend to describe the symbols used

CAD Drawings must be supplied to AU that show the location of **all** the sockets included in the project, unless written confirmation to the contrary is obtained from AU.

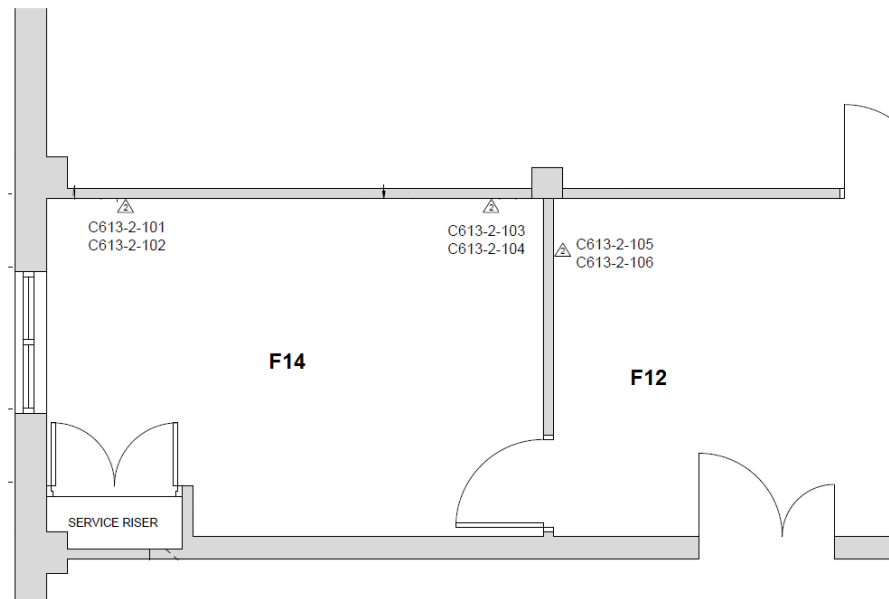


Fig 11-1 Example of information a portion of a CAD drawing showing the building walls, doors, and networking layers

If, after the full testing has taken place, any network sockets are required to be made live before handover to AU (eg. for an emergency telephone line in a lift, BMS, door access control systems, or other networked equipment), then a full set of annotated socket location maps and full test results must be provided to AU Information Services to allow AU staff to knowledgeably patch in sockets.

11.2.1. Projects involving mains and/or other services

Where the network is part of a wider project including installation of mains electricity cabling and/or other services, then the as-installed drawings must be supplied in DWG format, and compliant with the AEC(UK) (Architectural, Engineering and Construction in the UK) CAD standards. The drawing must have the networking on its own layers, as described in

<https://aecuk.files.wordpress.com/2011/08/aecukcadstandardsforlayernaming-v3-01.pdf>

11.3. Installation Warranty

A copy of:

- the manufacturer's 25-year Warranty document for the Cat6/Cat6a UTP cabling installation, or alternative manufacturer's equivalent.
- the manufacturer's 25-year Warranty document for the fibre optic installation, or alternative manufacturer's equivalent, **must** be passed to AU as part of the handover documentation.

11.4. Fibre Optic Core Colour Chart

A copy of the fibre optic colour charts used in the fibre optic installations **must** be included in the documentation. This is required even if the colours used are in the Fibre Colour Charts described in Appendix D.

Appendices

Appendix A - Commscope Cat6/Cat6a Component Part Numbers

For information, these are the Commscope part numbers that have been used at AU for previous installations. The colour and other requirements for these components listed in this appendix should be adhered to if an alternative product range is used.

A.1 Commscope Category 6/6a UTP LSZH Solid-Core Cable Reel

Solid-Core Cable Component	Commscope Part Number
Cat6 LSZH Solid-core Cable Reel (Orange) (Cca-s1a,d1,a1)	884040604/10
Cat6a LSZH Solid-core Cable Reel (Blue) (Cca-s1a,d1,a1)	884044014/10

A.2 Commscope Netconnect 24-way, 1u-high Patch Panel (unloaded)

Patch Panel Components	Commscope Part Number
Netconnect 24-way 1u-high Black Flushmount Patch Panel (Unloaded)	2153437-1

- The strain reliefs provided with the RJ45 module jacks must be used when installed in the patch panel.
- Each cable must be attached to the rear management using a cable tie.
- See Section 9 for labelling requirement.

A.4 Commscope Netconnect Category 6 RJ45 SL-series Modular Jack

SL-Series Components	Commscope Part Number
Netconnect Cat6 RJ45 SL series black Modular Jack including bend-limiting strain relief clip	1375055-2
Netconnect Cat6a RJ45 SL Series Blue Modular Jack including bend-limiting strain relief clip	1933476-6 (1933476-2)



Fig A4: Commscope SL-series jack and bend-limiting cable strain relief clip

- This is to be used in dado trunking, patch box and floor box locations.
- The bend-limiting strain relief clip is supplied with each jack and **must** be installed at the patch panel terminations, but **should not** be used in patch box outlet terminations.
- See Section 9 for labelling requirement.

A.5 Commscope LJ6CE Network Sockets (Euromod)

LJ6CE (Euromod) Components	Commscope Part Number:
LJ6CE Angled Shuttered Fascia Module ("Euromod") (25mm x 50mm)	1711275-1
Single Gang Faceplate (for 2 shuttered modules)	1711399-1
Dual Gang Faceplate (for 4 shuttered modules)	1711400-1
Blanking Plate (25mm x 50mm)	1711403-1
Blanking Plate (12.5mm x 50mm)	1711404-1



Fig A5: Commscope SL-series Angled Shuttered Fascia and faceplate accessories

- These are to be used in dado trunking and pattress box locations.
- All above-floor sockets must have angled, shuttered fascias as per the table above, unless confirmation in writing is obtained from AU Information Services.
- The Commscope NetConnect Category 6 RJ45 SL series Modular Jack must be used with these network sockets.

- All fascias, faceplates and blanking plates must be white, unless written confirmation from AU Information Services is obtained. In some locations the faceplates may be required to be grey, but direction from AU Estates Department will be given.

A.6 Commscope Netconnect LJ6C Outlets

LJ6C Components	Commscope Part Number
LJ6C Shuttered Angled Fascia Module (25mm x 39mm)	1859096-1
Single Gang, Single Port (for 1 shuttered module)	1711301-1
Single Gang, Dual Port (for 2 shuttered modules)	1711302-1
Blanking Plate	1711491-1



Fig A6: Commscope LJ6C unloaded shuttered fascia and faceplates accessories

- For use in floor boxes only, which should be LJ6C sized.
- All floor boxes must have angled, shuttered fascia modules for Cat6 sockets.
- All fasciae, faceplates and blanking plates must be white.

Appendix B: Commscope Fibre Optic Cable Component Part Numbers

These are the part numbers for the Commscope range of components. If an alternative manufacturer is used, then they must be equivalent components to these.

To enable the manufacturer's warranty, which covers defects in either materials or workmanship for at least 25 years, the installations **must** be undertaken by manufacturer-certified contractors.

Section B.1: External Spliced Fibre Optic Installation

External Spliced Fibre Component	Commscope Part Number	
Commscope Netconnect, GRP (Glass-Reinforced Plastic) non-metallic armoured, single-mode, OS2, 9/125um, with ULSZH sheath	8-core	1-599170-4
	12-core	1-599172-4
	24-core	1-599175-4

Section B.2: Internal-only Spliced Fibre Optic Installation

All spliced fibre optic components for internal-only fibre optic runs must use the following type of cable:

Internal Spliced Fibre Component	Commscope Part Number
Commscope Netconnect, Tight-Buffered, 24-core, single-mode, OS2, 9/125um, with ULSZH sheath, Cca s2,d1,a1	1594559-6

Section B.3: General Spliced Fibre Optic Installation Components

Spliced Fibre Component	Commscope Part Number
Commscope NETCONNECT Fibre Patch Panel 24 Way SM LC 12x Duplex Sliding Drawer Plastic Grey	70331084-12
Commscope NETCONNECT Fibre Patch Panel 48 Way SM LC 24x Duplex Sliding Drawer Plastic Grey	70331084-24
Commscope NETCONNECT Fibre Pigtail Tight Buffered SM LC OS2 9 White (L)1Mtr (1 per pack)	6536880-1
Cable Gland: Nylon, PG11, Strain relief, IP68-rated, Panel hole size 19mm	(eg. RS Stock No: 392-078)
Cable Gland: Nylon, PG21, Strain relief, Panel hole size 28.3mm	(eg. RS Stock No: 392-090)
Commscope NETCONNECT Splice Protector SMOUV Heat-Shrink 100 Clear (L)62mm	657054-000
Ultima 24 Way Splice Holder Self Adhesive Black	802562
Screws to secure coupler into patch panel 4g x 3/8-inch, Pan-head, Type AB, Pozi, Self- tapping screws	(Any manufacturer)

All single-mode fibre optic cables must be connected to **blue LC** bulkhead/couplers in the patch panel.

To ensure the warranty is awarded, all fibre optic installation components must be approved by the company giving the warranty.

Appendix C: List of Acceptable Test Equipment

AU Information Services require that only the **Fluke DTX or DSX series** Certification testers be used to test and certify the fibre optic and copper network installations. These must possess valid calibration certification, which must be passed to AU Information Services before any testing has commenced.

Appendix D: TIA-598-A Fibre Optic Core Cable Colour Chart

TIA/EIA-598 defines identification schemes for fibres, buffered fibres, fibre units, and groups of fibre units within outside plant and premises optical fibre cables. This standard allows for fibre units to be identified by means of a printed legend. This method can be used for identification of fibre ribbons and fibre subunits. The legend will contain a corresponding printed numerical position number and/or colour for use in identification.

Each pair of core cables shall be swapped over at one end, i.e. core A of a pair on one bulkhead/coupler at one end, is connected to core B of the same pair of the bulkhead coupler at the remote end, as shown in Figure D-1, D-2 and D-3.

On fibre optic cable with more than 12 cores it is normal that the original 12 colours are repeated with a tracer/ black mark on them, these should be terminated as cores 13 to 24, as per the TIA/EIA-598 standard.

For example on a 24-core cable, pair one will consist of the *Blue* and the *Blue with black tracer* cores. Each pair of core cables shall be swapped over, i.e. core A on one bulkhead/coupler at one end is connected to core B of the bulkhead coupler at the remote end.

Fibre Main Panel	Colour	Fibre Remote Panel	Colour
1a	Blue	1a	Orange
1b	Orange	1b	Blue
2a	Green	2a	Brown
2b	Brown	2b	Green
3a	Slate	3a	White
3b	White	3b	Slate
4a	Red	4a	Black
4b	Black	4b	Red

Figure D-1: 8 Core Fibre Optic cable TIA/EIA-598 colour code

Fibre Main Panel	Colour	Fibre Remote Panel	Colour
1a	Blue	1a	Orange
1b	Orange	1b	Blue
2a	Green	2a	Brown
2b	Brown	2b	Green
3a	Slate	3a	White
3b	White	3b	Slate
4a	Red	4a	Black
4b	Black	4b	Red
5a	Yellow	5a	Violet
5b	Violet	5b	Yellow
6a	Rose	6a	Aqua
6b	Aqua	6b	Rose

Figure D-2: 12 Core Fibre Optic cable TIA/EIA-598 colour code

Fibre Main Panel	Colour	Fibre Remote Panel	Colour
1a	Blue	1a	Orange
1b	Orange	1b	Blue
2a	Green	2a	Brown
2b	Brown	2b	Green
3a	Slate	3a	White
3b	White	3b	Slate
4a	Red	4a	Black
4b	Black	4b	Red
5a	Yellow	5a	Violet
5b	Violet	5b	Yellow
6a	Rose	6a	Aqua
6b	Aqua	6b	Rose
7a	Blue + Tracer	7a	Orange + Tracer
7b	Orange + Tracer	7b	Blue + Tracer
8a	Green + Tracer	8a	Brown + Tracer
8b	Brown + Tracer	8b	Green + Tracer
9a	Slate + Tracer	9a	White + Tracer
9b	White + Tracer	9b	Slate + Tracer
10a	Red + Tracer	10a	Black + Tracer
10b	Black + Tracer	10b	Red + Tracer
11a	Yellow + Tracer	11a	Violet + Tracer
11b	Violet + Tracer	11b	Yellow + Tracer
12a	Rose + Tracer	12a	Aqua + Tracer
12b	Aqua + Tracer	12b	Rose + Tracer

Figure D-3: 24 Core Fibre Optic cable TIA/EIA-598 colour code

Appendix E: Aberystwyth University Network Cabinet Identifiers

The 3-digit number to be used as the cabinet reference, is to be taken from the list devised by AU Information Services. The latest list is available from any of the contacts in Section 2.

If the project involves a new cabinet in a new location, then please contact AU Information Services who will allocate a new cabinet number.

Appendix F: Fibre Optic Installation Documentation

When a fibre optic cable is terminated then the installation needs to be documented. This includes the completed tables of information below. Electronic versions of these tables **must** be supplied and the data **must** be typed and not hand-written. Examples of the type of information we expect to be included are in Appendix G.

Fibre Optic Cable Description on cable	
Number of Single Mode Cores	
Grade of Single Mode cores	
Number of Multi Mode Cores	
Grade of Multi Mode	
External Sheath colour	
Near End Location	
Near End Fibre Patch Panel	
Near End Connector Type	
Far End Location	
Far End Fibre Patch Panel	
Far End Connector Type	

Near End Cabinet Identifier and Patch Panel:		Far End Cabinet Identifier and Patch Panel:	
P1a		P1b	
P1b		P1a	
P2a		P2b	
P2b		P2a	
P3a		P3b	
P3b		P3a	
P4a		P4b	
P4b		P4a	
P5a		P5b	
P5b		P5a	
P6a		P6b	
P6b		P6a	
P7a		P7b	
P7b		P7a	
P8a		P8b	
P8b		P8a	
P9a		P9b	
P9b		P9a	
P10a		P10b	
P10b		P10a	
P11a		P11b	
P11b		P11a	
P12a		P12b	
P12b		P12a	

Appendix G: Fibre Optic Installation Documentation Templates

Below is an example of the type of information that we require in the documentation handed back to the University for each new non-MPO fibre optic cable involved in the project. In this example would be for a 24-core single mode cable from pairs 1 to 12 in fibre patch panel FP2 in cabinet C123, connecting through to pairs 5 to 16 in fibre patch panel FP3 in cabinet C456.

Fibre Optic Cable Description on cable	Commscope 599175-4
Number of Single Mode Cores	24
Grade of Single Mode cores	OS2
Number of Multi Mode Cores	0
Grade of Multi Mode	n/a
External Sheath colour	Light Blue
Near End Location	C123
Near End Fibre Patch Panel	FP2
Near End Connector Type	LC
Far End Location	C456
Far End Fibre Patch Panel	FP3
Far End Connector Type	LC

Near End Cabinet Identifier and Patch Panel:		Far End Cabinet Identifier and Patch Panel:	
C123-FP2		C456-FP3	
P1a	Blue	P1b	Orange
P1b	Orange	P1a	Blue
P2a	Green	P2b	Brown
P2b	Brown	P2a	Green
P3a	Slate	P3b	White
P3b	White	P3a	Slate
P4a	Red	P4b	Black
P4b	Black	P4b	Red
P5a	Yellow	P5b	Violet
P5b	Violet	P5a	Yellow
P6a	Rose	P6b	Aqua
P6b	Aqua	P6a	Rose
P7a	Blue + Tracer	P7b	Orange + Tracer

P7b	Orange + Tracer	P7a	Blue + Tracer
P8a	Blue + Tracer	P8b	Orange + Tracer
P8b	Orange + Tracer	P8a	Blue + Tracer
P9a	Blue + Tracer	P9b	Orange + Tracer
P9b	Orange + Tracer	P9a	Blue + Tracer
P10a	Blue + Tracer	P10b	Orange + Tracer
P10b	Orange + Tracer	P10a	Blue + Tracer
P11a	Blue + Tracer	P11b	Orange + Tracer
P11b	Orange + Tracer	P11a	Blue + Tracer
P12a	Blue + Tracer	P12b	Orange + Tracer
P12b	Orange + Tracer	P12a	Blue + Tracer

Appendix H: Documentation Checklist

Following the completion of works, the following must be completed and the documentation passed to AU.

For Cat6/Cat6a Copper Installations:

- Cat6/Cat6a outlet ends properly labelled.
- Cat6/Cat6a Patch panels properly labelled.
- Cat6/Cat6a lines tested and all pass, and test results (including the Fluke FLW file) passed to AU.
- Copy of the tester valid calibration certificates for any test equipment used.
- Electronic map showing annotated locations of all sockets and the final room numbers passed to AU.
- 25-year manufacturer's warranty documentation passed to AU.

For Fibre Optic Installations:

- Fibre Patch Panels at both ends properly labelled.
- Copy of the tester valid calibration certificates for any test equipment used.
- All fibre pairs tested and all pass, and test results (including the Fluke FLW file) passed to AU.
- For MPO fibre installations, 2 sets of test results are required for each cable (see section 6.2.6):
 - o The first set of test results **before** installation.
 - o The second set of test results **after final** installation.
- 25-year manufacturer's warranty documentation passed to AU.
- Completed, electronic copies of the connection information from Appendix F (colour code charts)