# Loughborough University Specifications for Networking Standards
## Part 1 – Structured Data & Fibre Optic Cabling

## 1. Introduction

This document is intended to act as guidance and mandatory specifications for any: new build, refurbishment or minor works at Loughborough University that incorporates any networking related element of Information Technology (IT). It is impossible to provide for every situation in such a document; however, it should cover most frequently asked questions and related issues expected to arise in such projects.

Adherence to this document should ensure potential problems are minimised and handovers completed in a straightforward and timely fashion.

Deviations from this document will only be allowed by written (including email) permission from the named IT Services contacts in section 1.1.

This document is one of several covering different aspects of the IT infrastructure:

- Part 1 Structured Data & Fibre Optic Cabling
- Part 2 Communication Rooms
- Part 3 Wireless Installations

This document is issued by Loughborough University IT Services, and the most recent version of this document can always be found at: https://www.lboro.ac.uk/services/it/staff/network/data-cabling/

### 1.1 IT Services Contacts

The following IT Services staff can be contacted for further information:

| Anthony Tunley | Network & Comms Team Manager | a.tunley@lboro.ac.uk | 01509 226043 |
| Jonathan Oakden | Senior IT Services Specialist | j.p.oakden@lboro.ac.uk | 01509 226070 |
| Pranay Pancholi | IT Services Specialist | p.m.pancholi@lboro.ac.uk | 01509 226067 |

### 1.2 Document Control

| Date | Version | Author | Comments |
|------|---------|--------|----------|
| 01/10/19 | 1.0 | Pranay Pancholi | Initial Draft |
| 18/10/19 | 1.1 | Matthew Cook | Minor Edits |
| 21/10/19 | 1.2 | Pranay Pancholi | Edits to fibre optic testing |
| 01/11/19 | 1.3 | Pranay Pancholi | Updates to section 4.6 fire stopping |
| 09/11/20 | 1.4 | Pranay Pancholi | Updated IT Services Contacts |
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## 1.3 Abbreviations

LU – Loughborough University
FM – Facilities Management
IT – IT Services
AP – Wireless Access Point
UTP – Unshielded Twisted Pair
OTDR – Optical Time Domain Reflectometer
IP – IP Protocol

## 1.4 Review

To be reviewed every 12 Months

Author:  Pranay Pancholi, IT Services Specialist.  Email: P.M.Pancholi@lboro.ac.uk

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## 2. Standards

All cabling work for the University must be undertaken to the most recent version of the following standards:

## 2.1 British Standards & regulations

| Standard | Description |
|---|---|
| BS 7671:2018 - 18th Edition | Requirements for Electrical Installations. IET Wiring Regulations |
| BS 6701:2016 +A1:2017 | Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance |
| BS 8492:2016 | Telecommunications equipment and telecommunications cabling – Code of practice for fire performance and protection |

## 2.2 European (CENELEC) Standards

| Standard | Description |
|---|---|
| BS EN 50173-1:2018 | Information technology. Generic cabling systems. General requirements |
| BS EN 50173-2:2018 | Information technology. Generic cabling systems. Office Spaces |
| BS EN 50173-3:2018 | Information technology. Generic cabling systems. Part 3: Industrial Spaces |
| BS EN 50173-4:2018 | Information technology. Generic cabling systems. Homes |
| BS EN 50173-5:2018 | Information technology. Generic cabling systems. Data Centre Spaces |
| BS EN 50173-6:2018 | Information technology. Generic cabling systems. Distributed building services |
| BS EN 50174-1:2018 | Information technology. Cabling installation. Installation specification and quality assurance |
| BS EN 50174-2:2018 | Information technology. Cabling installation. Installation planning and practices inside buildings |
| BS EN 50174-3:2013 +A1:2017 | Information technology. Cabling installation. Installation planning and practices outside buildings |
| BS EN 50310:2016 | Application of equipotential bonding and earthing in buildings with information technology equipment |
| BS EN 50346:2002+A2 2009 | Information technology. Cabling installation. Testing of installed cabling |

## 2.3 Other Standards

| | |
|---|---|
| EIA/TIA 598 | Optical fibre cable colour coding standard |
| EIA/TIA T568B | pin/pair assignments for eight-conductor 100-ohm balanced twisted pair cabling |

## 3. Project Management

It is important to establish an early and clear dialogue with IT Services on projects that have any sort of IT impact. Failure to do so may result in delays to the project, additional project costs, and incorrect installations which will not be accepted.

### 3.1 Communication

For projects >£50k, the project manager should contact the following two IT staff:

| Jonathan Oakden | Senior IT Services Specialist | j.p.oakden@lboro.ac.uk | 01509 226070 |
| Pranay Pancholi | IT Services Specialist | p.m.pancholi@lboro.ac.uk | 01509 226067 |

Project managers undertaking smaller projects, requiring IT input, should contact the University IT Services Service desk to ensure your request is directed to the correct person.

Email: IT.Services@lboro.ac.uk
Phone: 01509 222 333

*Note: IT do not expect to be consulted for the installation of a small number of additional copper cable sockets in buildings as long as guidance and mandatory specifications in this document are strictly adhered to.*

### 3.2 Documentation

Where suitable, IT Services should be issued with the following documentation:

- Floor layout plans in Autocad format and PDF;
- Communication room locations and layouts;
- Cable containment and fibre route plans;
- Number of data outlets terminated at each comms room;
- List of building network connected services (e.g. Wireless Access Points, BMS, Door Access Control, CCTV, Intruder Alarms etc);
- Cabling test results and certificates;
- Warranty and certification (if appropriate).

### 3.3 Costs and Budgets

The project is responsible for funding all IT costs as per the exact specification in this document; this includes, but is not limited to:

- Construction work to connect into the data duct system;
- Installation of specified fibre optic cables;
- Installation of internal building fibre and copper cabling;
- Purchase and installation of data cabinets;
- Purchase and installation of power distribution units within each rack;
- Purchase of active networking equipment (switches, wifi and optics);
- Purchase of patch cabling;
- Purchase of network installation equipment.

## 4. Copper Cabling

## 4.1 Cabling Systems

Loughborough University IT Services have selected the following two cabling systems which must be used for any installation. The components installed must be part of a single manufacturer system and must be installed by an approved installer of that manufacturer.

Loughborough University IT Services have elected to use either **Excel** or **Hellermann Tyton** as the mandatory cabling manufacturers for all installations at the University.

Existing buildings which already have an 80% install base of a specific cabling system in place, will mandate that installers should continue to install the same system for installation. There should be no mixed patch panels of two different manufacturers.

## 4.2 Installation

The internal copper cabling is to be a Category 6a U/FTP S-Foil construction with a low-flammability sheath (complying to current **BS EN 6701 A1: 2017 Cca-S1b, d2 a2 Classification** as a minimum).

- All installed cabling must be supplied with a minimum warranty of 25 years covering the cable work;

- The cable must be low smoke zero halogen sheathed;

- The flammability performance must meet **EuroClass Cca-S1b d2 a2** as a minimum;

- The components to be used must be complete Excel or Hellermann Tyton end-to-end cabling systems with associated components including patch panels and keystones;

- At least two installations engineers shall have successfully completed the chosen cabling system installation training course. One of these engineers shall be present on site when any works are being undertaken;

- The structured cabling system provided must be based on a star-wired topology, incorporating 258A (T568B) wired, four pair, balanced twisted pair cable running from user patch panels to the work area telecommunication outlets;

- All cabling installation work must be carried out by qualified and OE Vendor approved/trained installation engineers;

- All internal cable routes must be agreed prior to commencing work with IT Services, and must only radiate from the mutually agreed and IT specified Communications Rooms;

- The framework of the system must incorporate Excel or Hellermann Tyton standard RJ45 plug and socket presentation and IDC cable terminations;

- The cable should be a U/FTP 4 pair, 24AWG 100 Ohm solid copper conductor, to a minimum performance level of Category 6a, as specified in the documents created by TIA TR41.8.1 and ISO/IEC JJC 1/SC 25/WG3

- The cable, patch panels, keystone jacks, modules and associated fixtures and fittings must be supplied by and/or approved by the Cable System OE Manufacturer thus ensuring that a full system guarantee can be issued;

- The length of cable from patch panel to room outlet will not exceed 90 metres;

- Copper cabling must not be used to link buildings;

- Wireless access points should be provided with a copper double outlet;

- All cables shall be continuous from the user patch panel to the work area telecommunications outlet.  Where a cable becomes damaged due to broken conductors or the sheath becomes torn or cut, the entire cable shall be removed and replaced with a known good one. The practice of jointing cables will not be accepted;

- A plastic cable tie will secure the cable to the termination block;

- Cables will be secured together in groups of no more than 24 by velcro straps to avoid cable damage;

- All cables will be labelled with appropriate cable management within the communications racks.

*NOTE: Only in special cases, the general cabling specification may be deviated from, when agreed in writing from IT Services:  Where a small number of additional data points are required, and to enable integration with existing patch panels or installed infrastructure (for example, installing 6x category 6 data points in a part populated cat 6 panel).*

## 4.3 Room Outlets

The data outlets will be of the matching manufacturer cabling system and be unshielded RJ45 presentation and modular in design wired to 258A (T568B) presentation:

- All Data Outlets must be fitted in pairs (Dual Outlets);

- A spring-loaded shutter must cover the entrance to the RJ45 jack;

- The outlet printed circuit board (PCB) and the patch panel PCB must utilise PCBs from the OE Manufacturer to ensure complete system compatibility;

- Port labelling and identification should be by way of a printed slide label running under a protective polycarbonate mask;

- Room outlet accessories should match the general electrical installation;

- Any work that involves the modification, reinstallation or relocation of a room outlet requires retesting and recertification to be completed.

## 4.4 Patch Panels

The Patching Panels must be cable OE Manufacturer approved panels, managed in groups of 24 RJ45 ports in each 1U segment:

- Each circuit should be individual modular PCB, wired to 258A (T568B) specification;

- Label identification should be by way of a printed slide label running under a protective polycarbonate mask.

- Cables should enter the patch panel from the side.

## 4.5 Cable Containment

Cabling is typically provided as part of the building M&E specification;

The cable containment system will have usable space (BS EN 50174-1:2000, Section 4.8.2) that allows for a minimum 50% future expansion.

## 4.6 Cable protection and fire-stopping through walls

Cable installers must ensure any penetration through walls is provided with appropriate fire-resistant material, approved by the project leader.

The contractor needs to seek approval for any works through a fire-wall from Facilities Management and will be issued with the required permits as necessary, the suitability of the wall for the size, amount of penetrations needs to be confirmed and FM to receive a fire certificate, including certificate of conformity of the fire stopping installed on completion.

Responsibility and relevant specifications for appropriate fire control rest with the University Facilities Management department.

## 4.7 Labelling

Data points will be labelled as follows (each part separated by a"/")

[Part A]/[Part B]/[Part C]

Where:

Part A Comprises the floor (G = Ground, 1 = 1$^{st}$ Floor, 2 = 2$^{nd}$ Floor etc.);

Part B Comprises the terminating Cabinet Number (supplied by IT Services);

Part C Comprises a 3 digit reference number (001-999).

Example:  0/032/001

- All data labels must comprise laser cut, black text on white background, rectangles protected by a Perspex window.

- All Patch Panels must be labelled in a corresponding fashion in ascending numerical order.

- Data points should be labelled in a consecutive and logical manner (e.g. data points 25-48 in Room 'B' should follow data points 1-24 in the adjacent Room 'A' etc.)

When additional sockets are added to an existing installation, the data labels shall be contiguous from the existing socket labels.

## 4.8 Use of External UTP

Loughborough University does not approve the use of external UTP copper cabling between buildings.  Fibre optic cable is to be used to connect buildings externally.

Where there are any rare use cases of external grade UTP to be specified, IT Services must be consulted first for specific approval in writing.

## 4.9 Copper Testing

All test equipment used to characterise the performance of the installation shall be approved by the cabling system manufacturer, prior to system testing.

- Prior to system hand-over, a 100% test shall have been conducted on the installed cabling;

- The testing shall identify any faults due to open circuits, cross or split pairs as well as a series of performance faults;

- The testing must satisfy the manufacturers installation guidelines in order to carry the manufacturer backed warranty. In some cases a representative of the manufacturer may be required to witness the testing;

- Loughborough University reserves the right to witness some of the testing;

- All test results shall be recorded and certification handed to IT Services on completion;

- Any cabling failures will require resolution of the fault and retesting before completion.

## 5. Fibre Optic Data Cabling

All buildings on campus are normally to be connected to two other identified buildings within the relevant campus park by completely diverse cable routes.

### 5.1 Installation

- Fibre optic cables that span geograph parks will follow a duct route to be identified by IT Services in advance;

- All buildings require both singlemode OS2 (9/125) and multimode OM3 (50/125) fibre cores. A minimum of eight cores of each type of fibre are required to each connected building;

- Fibre routes should be kept separate as far as practically possible both within and without the building as well as within the communications room;

- The current campus infrastructure has both traditional multicore fibre as well as blown fibre varying by location. The project must identify with the aid of IT Services what sort of fibre installation will be suitable;

- All fibres will be installed in one continuous length without any intermediary joints. Any cable faults found at the time of installation, will require replacement of the entire faulty cable.

### 5.2 Patch Panels

All fibre optic cores are to be terminated in 19" rack mount patch panels.

- The fibre bundle will enter the patch panel through a cable gland at the rear of the panel;

- The patch panel will be equipped with Duplex LC connectors. The LC connectors will be colour coded such that singlemode connectors are white and multimode connectors are aqua.

### 5.3 Cable Containment

The most suitable cable containment method must be indicated before work is undertaken. Normally this would be basket, or tray work for large amounts of cable but pvc may be suitable for small amounts of cable.

- Tray work or basket must be initially installed with no more than 75% of the capacity used to allow for expansion in future;

- Existing tray work along the cable path can be reused. If the existing containment is full then IT Services should be consulted in order to determine whether or not the existing containment should be replaced or supplemented.

### 5.4 Labelling

All fibre tubes should be labelled at each building entry point with their fibre number and the names of the buildings at each termination point. The fibre number, prefixed by "F" will be provided by IT Services.

## 5.5 Testing

Post installation a random selection of cable containment will be visually inspected to ensure that the provided cable containment meets any agreed standards and principles.

Individual fibre cores should be tested bi-directionally using OTDR; only machine-readable files are accepted.  The should be presented in digital format.  In all cases the test result and its fibre optic are unambiguously and clearly matched and should state:

- The type of file and the program used to read/write it;
- The date of test;
- The tester's details;
- The equipment used for the test and the ID of the launce or tail cords used;
- The wavelength of the light used for the test;
- The ID and type of fibre optic cable tested.
- The fibre tray number, core and location for each end.
- The direction in which the measurement was made.

## 5.6 Patch Leads

All patch leads for the project will be supplied by a supplier by IT Services. Patch leads from any other supplier will not be used.

## 6. Ducts and Groundworks

- External ducts for Data services between buildings shall be twin walled rigid duct, minimum 100mm diameter, externally ribbed with a smooth interior in green;

- All data ducts are to be buried to at least a depth of 1 meter;

- Manhole covers over splicing or access chambers shall be robust and suitable for the chamber environment (e.g. appropriate load and security ratings where required);

- Access chambers for data ducts shall be independent of access chambers for other services, such as power, heating, BMS systems, water, control cabling, etc;

- All ducts shall be provided with draw ropes, of suitable non-rotting material, should be left and secured within the ducts to permit pulling of cables at a later date;

- Data Ducts must not be used for any other purpose (e.g. LV/HV Electrical or other services);

- As-Built Drawings for ducts and Fibre routes must be provided to both IT Services and Facilities Management electronically in DWG formats.

# 7. Hand Over acceptance

## 7.1 Requirements

The following information must be submitted to the IT Services representative on the project upon completion of the works, and prior to completion, by the Facilities Management project manager.

This will verify that the Loughborough University cabling standard has been adhered to and the cabling infrastructure is ready to be handed to IT Services for operational acceptance. IT Services will not connect any new infrastructure to the University network until satisfied that all handover documentation is acceptable.

For operational acceptance (and mandatory before installation of any network equipment), the following pack of information should be submitted, along with the information above, prior to practical completion:

- **Floor plan (as fitted)**
  Drawings detailing plans of each floor showing final outlet positions, wireless access point locations & hardware mac addresses, risers, containment runs, communication rooms and final room numbering scheme. This should be in AutoCAD and PDF format.

- **Other plans (as fitted)**
  Drawings detailing plans of communication room locations, layouts, cabling containment, and fibre route plans.

- **Numbering scheme**
  Spreadsheets listing details of Cat 6A UTP patch panel and Cat 6A outlet numbering scheme which should have all installed outlets listed and providing an overall number of data outlets terminated in each comms room.

- **Test results**
  UTP:
  - Patch panel to Cat 6A outlet
  - Cat 6A test results for UTP 100% tested.

  Fibre optic cables:
  - OTDR Tests

  Warranty and certification (if appropriate).

- **Misc (if appropriate, and not undertaken by IT Services directly)**
  List of building network connected services (e.g. Wireless Access Points, BMS, Door Access Control, CCTV, Intruder Alarms etc);

## 7.2 Operation Acceptance

Acceptance of any installation will be dependent upon:

- The installation complying with the Loughborough University cabling standards;
- All of the information listed in Section 7.1 has been received, verified and accepted by IT Services.