



Information Systems

NTU Networking Standards

NTU Data Communications Cabling Specification

Purpose of this Document

This document sets out the specification required for NTU data communications cabling

This document will be reviewed every 6 months

Author:	R Browne
Version:	1.8
Date:	08/05/18

Roles	Email addresses
Information Systems	
IS Head of Infrastructure and Operations	peter.nicholson@ntu.ac.uk
IS Infrastructure Services Manager	amanda.ferguson@ntu.ac.uk
Members of the IS Project and Programme Management Office (PPMO)	
Estates and Resources	
Head of Estates Services	
Minor Works Manager	craig.hession@ntu.ac.uk
Contractors	
Account Managers/Key Contacts at Regular cable contractors	
PR Power Installations	Matt Russell matt@prpowerinstallations.co.uk Neil Wardle neil@prpowerinstallations.co.uk
Electranet UK Ltd	david.darlington@electranetuk.com
NI Solutions	steve.perry@ni-solutions.co.uk

Document Control:

Version	Author	Date	Version details	Reviewer	Date
1.2	P Davis	13/5/2014	Final		
1.3	M Pearson	14/1/15	Extracted comms room sections 3.4 and 6 to separate "NTU communications room specifications" document		
1.4	R. Browne	09/03/16	Extensive revisions to improve readability. Minor changes to specification.		
1.5	M Pearson	26/4/16	Add specific detail about use of external UTP		
1.6	M Pearson	7/7/16	Amended section on fire stopping		
1.7	M Pearson	6/5/17	Added additional colour for patch cords in section 8.1		
1.8	M Pearson	8/5/18	Updated to specify Cat6a cabling and new CPR regs along with other minor changes		

Contents

Document Control:	2
1 Introduction	5
1.1 Preface	5
1.2 Acknowledgements	5
1.3 Information Systems Contacts	5
1.4 Abbreviations	5
2 Standards.....	6
2.1 British and international standards	6
2.2 Health and safety standards and documentation	6
3 Design	6
3.1 General design principles	6
3.2 Cabling and containment.....	7
4 Installation	7
4.1 Provision of ducts.....	7
5 Cabling practices	8
5.1 UTP Cabling.....	8
5.1.1 Use of External UTP	8
5.1.2 Face Plates	8
5.1.3 Patch Panels	8
5.1.4 Patch cords.....	8
5.2 Fibre Optic cabling	9
5.2.1 Single Mode Fibre (9/125µm) (OS1)	9
5.2.2 Multimode Fibre (50/125µm) OM3	9
5.3 Cable containment	9
5.4 Cable protection and fire-stopping through walls.....	10
6 Labelling.....	10
7 Test results.....	10
7.1 UTP Cables.....	11
7.2 Fibre optic cables	11
8 Patching within Communication Rooms.....	12
8.1 Patching standard	12
9 Hand-over acceptance criteria	12
9.1 Requirements	12
9.2 Specific project details	12
9.3 Operational acceptance.....	13

10 Manufacturers and products	13
10.1 Communication Room cabinets	13
10.2 Patch panels, Faceplates, Modules and RJ45 Outlets	13
10.3 Patch cords and fly leads.....	13
10.4 Steel and PVC containment.....	13
10.5 UTP Cables	13
10.6 Fibre optic cable.....	13

1 Introduction

1.1 Preface

This document governs the installation of the structured cabling infrastructure throughout the Nottingham Trent University (NTU) and is mandatory to contractors and others employed by the university. It does not apply to dedicated cabling for systems not maintained by IS, such as security, building management or fire control.

This document is issued by NTU Information Systems (IS) with the authority of the University.

The University has approved manufacturers and products that must be used in any cabling installation and established standards for the Communication Rooms, cable runs and cable laying. Specific details can be found in Appendix II. All references to cabling in this document that are not qualified (e.g. electrical) shall be taken to mean copper or fibre optic cable.

Non-compliance in following this cabling standard will result in installations being rejected and having to be replaced at the contractor's expense.

If there are any doubts as to what action should be taken or what product used, the matter must be referred to IS for a decision and cannot proceed until a positive response has been made. It will not be acceptable afterwards to say that either these standards were not clear or that they did not address the matter.

1.2 Acknowledgements

This document has been influenced by work done at Leeds University and other institutions and comments from colleagues in NTU Estates and Resources.

1.3 Information Systems Contacts

The following IS staff can be contacted for further information:

Infrastructure Services Manager	Amanda Ferguson	amanda.ferguson@ntu.ac.uk	0115 848 8632
Core Networking Team			
Mark Pearson	Team Leader	mark.pearson@ntu.ac.uk	0115 848 8287
Roger Browne	STSA	roger.browne@ntu.ac.uk	0115 8488505
Glenne Nelson	STSA	Glen.nelson@ntu.ac.uk	0115 848 8292
Jon Eaton	STSA	Jon.eaton@ntu.ac.uk	0115 848 8514
Bryan Brockington	TSA	Bryan.brockington@ntu.ac.uk	0115 848 8504
Nigel Lynch	TSA	Nigel.lynch@ntu.ac.uk	0115 848 8605
Richard Nightingale		Richard.nightingale@ntu.ac.uk	0115 848 3248

1.4 Abbreviations

BMS	Building Management Systems
CCTV	Closed Circuit Television
CR	Communication Room
FT	Fibre Tray
IP	Internet Protocol

IS	Information Systems
LSZH	Low Smoke Zero Halogen
OTDR	Optical Time Domain Reflectometer
PP	Patch Panel
PoE	Power over Ethernet
PVC	Polyvinyl Chloride
UTP	Unshielded Twisted Pair
AP	Wireless Access Point

2 Standards

2.1 British and international standards

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

- BS 6701 Telecommunications equipment and telecommunications cabling (master standard)
- BS 7671 IET Wiring Regulations

and where relevant:

- EN 50310 - Building design - bonding
- EN 50173 - Information technology - Generic cabling systems design
- EN 50174 - Information technology - Cabling installation
- EN 50346 - Information technology - Testing
- EN 50085 - Cable Trunking

All designers, architects, consultants and installers must be wholly conversant with these standards as they are the criteria by which work will be judged. Consideration must also be given to the Construction Products Regulations (CPR) being drafted in relation to BS 6701 and BS 7671.

2.2 Health and safety standards and documentation

Any contractor must comply with all the relevant health and safety laws and regulations whilst working on University premises. Attention is particularly drawn to the following University's policies:

- Safe Use of Electricity Policy
- Personal Protective Equipment Policy
- Risk Assessment Policy

3 Design

IS are the design authority for all IT cabling within the University. The network design must be agreed and signed-off prior to installation.

Communication room requirements are covered in a separate Network Standard.

3.1 General design principles

- a) A structured cabling scheme is required for all University installations, designed and installed to relevant BS EN standards. A typical installation will use CAT6a cabling within a building, with single mode fibre between buildings. All major buildings will be served by two physically diverse fibre routes. Active equipment will be suitably housed as per the Network Standard for

Communications Rooms. Internal and external wireless equipment will be provided as per the Network Standard – Wireless.

- b) Drawings and specifications must be submitted to the IS project manager, for comment, prior to the work commencing or after revision.
- c) All documents must be subject to adequate version control
- d) Removal of redundant cabling. Wherever network cabling is to be cut or disconnected from use permanently within rooms/areas being refurbished, they must be removed throughout their entire length all the way back to the appropriate patch panel within the CR and removed from that patch panel. It is essential that this work is carried out by the accredited cable contractor.

3.2 Cabling and containment

- a) Containment will be used to carry all cabling. When installing cables in new containment specification must allow for a minimum 50% future expansion. All new containment should be specified for Cat6a cabling regardless of whether cat6a is used or not.
- b) Network splitters, mini hubs etc. are not acceptable for use.
- c) For new building projects and complete refurbishments CAT6a cabling must be used. For smaller or temporary occupation type buildings or where the features of Cat6a is not justified then Cat6 cable can be used. This decision must be deferred to Information Systems Project Manager. One cable manufacturer only is to be used on any installation (no mixing of cables will be permitted). Termination is to be on an RJ45 socket.
- d) The cable to be used for part-refurbishment of existing buildings is specified in section 10.
- e) The installed UTP cable length should not exceed 90 metres in length. This allows for a total from network switch to PC etc. (including patch leads to be within the 100m maximum specification.)

4 Installation

4.1 Provision of ducts

- a) Underground ducts

All underground ducts should be of non-porous durable material and should have smooth internal walls. Sections should be jointed to prevent the ingress of foreign material. The minimum duct external diameter should be 110mm. Metallic tape should be laid and buried with the duct to help with locating the duct in future. Ducts should be cut flush where they enter buildings and access chambers.

All underground ducts should be sealed to prevent the ingress of gases, water or rodents at points of entry to buildings. The sealing material should be of a composition such that it may be easily removed for cable installation purposes and re-instated to form an effective seal.

All ducts should be laid at a minimum depth of 600mm.

- b) Jointing/Access chambers

To facilitate cabling operations, jointing/access chambers should be built on duct routes where required. These chambers should be constructed from concrete and be capable of withstanding the passage of vehicles if this is a potential hazard. Light duty chambers with round lids are unacceptable. If ducts are installed in carriageways, a 'carriageway inspection pit' should be installed. A draw-pit should be installed every 30 metres and where there is major change of direction (greater than 45 degrees). All chambers must be a minimum size of 1200 x 600mm (1200 in direction of fibre) with a sump of 500mm below the level of the duct pipes, with soak-away drainage.

- c) Draw-pit design (including lid design) must be agreed with the IS project manager prior to installation to ensure it is adequate for the purpose. Lids will be heavy-duty and secured to prevent access by unauthorised personnel.
- d) To facilitate the pulling in of additional cables a draw rope, of suitable non-rotting material, should be left and secured within the ducts. To maintain the facility, another draw rope should be pulled in with each new length of cable to replace the original.

5 Cabling practices

5.1 UTP Cabling

Cable must be 4pair low smoke zero halogen, unshielded twisted pair, in purple, to CE specification. All wiring is to be straight through (no crossover), to the wiring schedule EIA 568B.

For details of the cable to be used see section 10.

5.1.1 Use of External UTP

NTU does not use UTP copper cabling externally between buildings even if it is external grade. Fibre optic cabling is to be used to connect buildings externally. Any queries should be directed to the Core Networking team.

5.1.2 Face Plates

All face plates (either single or double outlet as required) to be shuttered, in white plastic, unless otherwise stated. For approved manufacturer see Section 10.

5.1.3 Patch Panels

The cables are to be gathered back to the distribution point into a high-density RJ45 panel (24 ports per 1U depth), category to match cabling, patch panel of 24 or 48 port capacity. The labelling on the panels should be printed to fit in with the University requirements of odd numbers on the top 24 ports and even numbers on the lower 24 ports. Category to be clearly marked.

For approved manufacturer see section 10.

5.1.4 Patch cords

Patch cords in the IT equipment rooms will be usually be patched by IS. If the contract calls for the supply of patch cords, they should be stranded category 6/6a cable, straight wired, with category 6/6a RJ-45 plugs at each end, preferably unbooted. The patch cords should be available in several external jacket colours.

5.2 Fibre Optic cabling

The University uses 2 different types of optic fibre cables, dependent upon the project requirement. At the start of each project the IS project manager will determine which is to be used. Blown Fibre is being introduced where practicable.

5.2.1 Single Mode Fibre (9/125µm) (OS1)

- a) Used where multimode OM3 will be out of specification and between buildings.
- b) All fibre should be of outdoor / indoor type and of low water content glass, with an attenuation of $\leq 0.25\text{db/km}$ @ 1550nm.
- c) Patch panels to be suitable for 19" rack mounting with a recessed front panel. All the connections on the patch panel must be LC type connectors.
- d) Each pair (single LC connector) to be installed as crossover between patch panels. This is to allow use of x-over patch leads to ensure correct end to end polarity.

5.2.2 Multimode Fibre (50/125µm) OM3

- a) Used internally within buildings usually to connect node rooms.
- b) All fibre to be 50/125 loose tube, of outdoor / indoor type and of a quality compliant with all Ethernet standards 10 to 10000 MB/s. Maximum attenuation of $\leq 3.2\text{ db/km}$ @ 850nm and $\leq 0.9\text{ db/km}$ @1300 nm.
- c) Patch panels to be suitable for 19" rack mounting with a recessed front panel. All the connections on the patch panel to be LC type connectors.
- d) Each pair (single LC connector) to be installed as crossover between patch panels. This is to allow use of straight-through patch leads.

5.3 Cable containment

The following instructions shall apply:

- a) Cable containment shall be used to support all cables.
- b) Cables should be adequately supported along the entire length using containment (free spacing of cables is not acceptable). Cable containment should also be continuous in length. On conduit systems, inspection boxes to be fitted at every change of direction and at every 6 metres on straight runs.
- c) All cable containment systems should be designed such that ease of access can be gained for future cable installations, repair and maintenance.
- d) In multi-compartment trunking power cables must be installed in the lower compartment and copper data cables installed in the top compartment. It is preferable that the data cables are separated from the mains cables by at least 60mm. The in-room wall mounted trunking should

be 3 compartment (3C), square-edged where the middle compartment is unused to keep data and electricity cables separated.

- e) All PVC containment is to be fixed using plug and screw method. Self-adhesive trunking can only be used in exceptional circumstances. No containment is to be fixed to asbestos containing materials, alternative routes should be sought.
- f) In some new builds there is a requirement for cables to be concealed (i.e. no trunking on view). In this case it is imperative that cable routes are still, in some way, accessible for future changes and maintenance purposes.
- g) Containment to allow for future replacements and expansion i.e. no routes to be fully populated. Allow for retro fitting of cables through existing containment. All new containment should be specified for Cat6a cabling regardless of whether cat6a is used or not.

5.4 Cable protection and fire-stopping through walls

This section should be adhered to by referencing and abiding by instructions contained in the "NTU Passive Fire Protection Specification" document. This document is maintained by the NTU Estates department.

In addition:

- a) Where walls will be penetrated for the routing of cables, all cables shall be routed on or within containment through the walls.
- b) The contractor is to ensure that all new and existing entry points through walls are to be sealed with a fire resistant material.
- c) Cable containment systems should not contain sharp edges or corners that may potentially cause damage to cables.

6 Labelling

Equipment designation numbers for cabinets, patch panels, fibre optic trays, active equipment will be allocated by the IS project manager and ID labels are to be placed on front- left and front-right of panels.

7 Test results

Test results are required a minimum of 10 working days prior to practical completion in order that they can be checked prior to acceptance of the installation. The test results shall be provided electronically in PDF format. The project will NOT be deemed complete until such time as these results have been accepted by the IS project manager (refer to Section 9).

Electrical or optical tests shall be carried out on cables used for the distribution of voice, data and video services. These tests are to be carried out following the terminations and labelling of the cabling.

7.1 UTP Cables

All cables must be subjected to 100% testing. The minimum acceptable results for Cat6/6a UTP cable are defined in BS-EN 50173 and BS-EN 50174 respectively.

Test results must include the following information for each individual circuit tested:

- The name of the test operator.
- The date of the test.
- Each individual cable test must show the Communications Room number, the patch panel number and the patch panel position number.

Complete test results should be submitted with a valid calibration certificate for the test equipment used.

7.2 Fibre optic cables

Individual fibre cores must be tested bi-directionally using optical time domain reflectometer (OTDR); only machine readable files are acceptable. They 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 write/read it.

- The date of the test.
- The tester's details.
- The equipment used for the test and the ID of the launch or tail cords used (in case the tests need to be repeated).
- The wavelength of the light used for the test.
- The ID and type of fibre optic tested.
- The fibre tray FT number, core and location for each end.
- The direction in which the measurement was made.

The optical fibre optic link shall meet optical class link performance testing as specified in current FIA standard. Refer to The Fibre optic Industry Association's Technical Support Guides that are based on international standard:

FIA-TSD-2000-4-2-2 "Optical Fibre optic cabling – Testing – Installed Cabling Using Optical Time Domain (OTDR) Equipment".

OTDR Tests are carried out in both directions in order to identify any problems that are direction dependent (e.g. changes in refractive index of the fibre optic at intermediate joints) or when single ended measurement techniques are used. The direction in which the measurement was taken is recorded in the results. All cores to be presented in industry standard colour sequence at either end within each optical fibre tray. Continuity tests to be carried out on each core using a trailing fly lead and results obtained:

- For singlemode testing a launch lead with a minimum length of 1 km is required.
- For multimode testing a launch lead with a minimum length of 50 metres is required or a launch conditioning lead / mandrel wrap that is longer than the dead zone of the OTDR.

8 Patching within Communication Rooms

8.1 Patching standard

All major patching exercises are carried out by IS staff

IS have adopted a standard when patching in the communication rooms. IS install various coloured patch leads. The current colour codes are as follows:

Table 4 patch lead colour scheme

Type	Colour
Data/Voice	White
Printer	White
Wireless	Green
Security/BMS	Red
Audio Visual	Orange

9 Hand-over acceptance criteria

9.1 Requirements

The following information must be submitted to the IS project manager upon completion of the works, and prior to occupation, by the Estates project manager. NB: IS will not connect any new infrastructure to the University network until satisfied that all handover documentation is acceptable.

This will verify that the Nottingham Trent University cabling standard has been adhered to and the cabling infrastructure is ready to be handed to IS for operational acceptance.

9.2 Specific project details

Within this section should be an overview of the project giving details of who the client is and scope of the build. It should include details of the main contractor, mechanical and electrical contractor, client and project manager. It should include addresses and contact telephone numbers.

For operational acceptance (and mandatory before installation of any network equipment), the following pack of information should be submitted, along with the information above, a minimum of 10 (working) days prior to practical completion:

a) Floor plan (as fitted)

Drawings detailing plans of each floor showing final outlet positions, risers, containment runs, communication rooms and final room numbering scheme.

b) Numbering scheme

Excel spread sheets showing details of Cat6/6a UTP patch panel and Cat6/6a outlet numbering scheme which should have all installed outlets listed.

c) Test results

- UTP:

- Patch panel to Cat6/6a outlet
- Cat6/6a test results for UTP 100% tested.
- Fibre optic cables (normally completed by IS employed contractors):
 - OTDR Tests

d) Defects

The defects date is 52 weeks after practical completion (defects that are discovered or become apparent and have to be made good). Within the first 4 weeks following practical completion, the defects correction period will be 1 week – thereafter 2 weeks.

9.3 Operational acceptance

Acceptance of any installation will be dependent upon:

- The installation complying with the Nottingham Trent University cabling standards
- All the information listed in Section 9 has been received, verified and accepted by IS

10 Manufacturers and products

10.1 Communication Room cabinets

- U Systems or equivalent (check with IS)

10.2 Patch panels, Faceplates, Modules and RJ45 Outlets

- Commscope, Excel or Hellerman-Tyton UTP Patch Panel 24 Port 1U or 48 port 2U
- Commscope, Excel or Hellerman-Tyton Faceplate with RJ45 outlet
- All RJ45 outlets to be Commscope, Excel or Hellerman-Tyton

10.3 Patch cords and fly leads

- IS always supply the patch leads (UTP and fibre optic cables) as a chargeable item.

10.4 Steel and PVC containment

- Pemsas, Cablofil or equivalent basket tray.
- All proposed single compartment trunking to conform to BS4678.
- All cable tray to be galvanised medium duty return flange.
- All in-room trunking to be square edged 3-compartment for power/data segregation

10.5 UTP Cables

- Commscope, Excel or Hellerman Tyton

10.6 Fibre optic cable

- Singlemode and Multimode optical fibre cables will be specified prior to any installation by the IS Core Network Team.