University of Oxford IT Services
Infrastructure Installation Specification Strategy

IISS-00-001:
Infrastructure Installation Specification Strategy: Overview

1 INTRODUCTION

1.1 Scope

This document provides an overview of the necessary contents of an effective specification for a telecommunications cabling infrastructure within customer premises served by University of Oxford IT Services.

For the purposes of this document and others produced by University of Oxford IT Services, telecommunications is defined in the widest possible terms (in line with similar definitions within European and international standards) to cover the transmission, emission and reception of signs, signals, writing, images and sounds (that is, information of any nature) by cable, radio, optical or other electromagnetic systems.
NOTE: The term telecommunications has no legal meaning when used in this document.

Detailed requirements and recommendations for specific parts of the infrastructure are covered by number of other documents in the ISP series. However, the planning, installation and quality assurance of the distribution cabling (as shown and designated in Figure 1) is the responsibility of the customer (defined as the college or University, as appropriate).

Over the past fifteen years a substantial amount of standardisation has been completed by British and European standards organisations that specifically address the planning, installation and quality assurance of telecommunication cabling and equipment.

An overarching objective of this document is to ensure that University of Oxford IT Services and the customer, together with those organisations delegated with design and planning responsibilities, have discharged the obligations of “the owner of the premises” as specified in BS 6701.

Although BS 6701, entitled “Telecommunications equipment and telecommunications cabling - Specification for installation, operation and maintenance”, contains its own requirements for “the owner of the premises”, it explicitly requires the additional implementation of the requirements of other British Standards including:

- BS 7671: Requirements for electrical installations: IEE Wiring Regulations: 18th edition;
- BS EN 50174-1:2018 Information technology - Cabling installation - Part 1: Installation specification and quality assurance;
- BS EN 50174-2:2018 Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings;
- BS EN 50310:2016 Information technology - Telecommunications bonding networks for buildings and other structures.
  NOTE: An amendment to BS EN 50310 will be published in 2019 but this will not affect the fundamental technical requirements of the 2016 edition

The combination of BS 6701 and BS EN 50174-1 provide an excellent foundation for the effective specification of telecommunications cabling infrastructures. Much of the content of BS EN 50174-1 concentrates on the availability of adequate space within rooms identified as telecommunications distributors and the requirements for adequate planning of the pathways necessary to accommodate both the initial quantities and any predicted (if not planned) extensions to the cabling infrastructure.

This issue of the document contains specific warnings regarding the design, planning and installations issues relating to the increased use of telecommunications cabling for remote powering of devices in order to support an increasing use of building services. In addition, it introduces a modified generic cabling infrastructure which complies with BS EN 50173-6 dedicated to distributed building services – and which also may be useful for general telecommunications infrastructures.

1.2 Responsibilities

The University of Oxford IT Services is a privately-owned branch system linking most colleges and University premises in Oxford via its own duct network. It operates under a Telecommunications Services Licence (TSL) that allows the University and its allied institutions to operate a private branch system.

All exchange equipment together with the external cabling infrastructure and external pathway systems (typically underground ducts) are the property of University of Oxford IT Services. Access to, or connection through, this equipment is prohibited without the express authority of the Network Operations Manager.

Once the external cabling enters the customers' premises the responsibilities for the design, and accommodation, of the distribution of the telecommunication and related services become more complex.

Figure 1 shows a schematic of the elements used to create the University of Oxford IT Services Entrance Facilities and how they relate to the other cabling-related functional elements within the premises served. Figure 1 uses the definitions and abbreviations of Annex B.

While the elements of the University of Oxford IT Services Entrance Facilities are the property of University of Oxford IT Services they are accommodated within the premises served and the ownership of that accommodation lies with the customer.

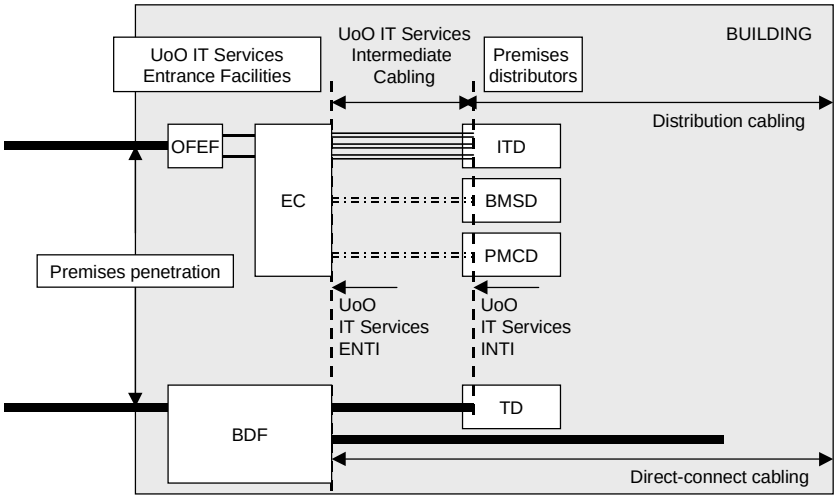

Figure 1 - Schematic of premises infrastructure served by University of Oxford IT Services

2 INSTALLATION SPECIFICATION DOCUMENTS

2.1 Introduction

BS 6701 requires the documentation requirements of BS EN 50174-1 to be applied to all telecommunications cabling and equipment.

BS EN 50174-1 requires that an installation specification shall be prepared, and agreed with the installer prior to the commencement of the installation, which contains:

- the technical specification (see clause 3 of this document);
- the scope of work.

The importance of a full and detailed technical specification in accordance with the requirements of BS EN 50174-1 cannot be overemphasised. The minimum requirements, and recommendations, for certain cabling components, cabinets and pathways

systems are defined in other University of Oxford IT Services documents. This clause highlights important aspects concerning the use of those products in order to ensure that the final installation will remain functional, maintainable and repairable over its desired lifetime.

2.2 Strategic planning

The effective implementation and operation of telecommunications cabling infrastructures requires that the design and planning of the telecommunications cabling takes into account the following within the installation specification:

- predictable expansion to the cabling system, whether from the need to support additional users or increases in quantity or type of applications, with reference to:
    a. pathways;
    b. capacity and type of pathway systems;
    c. quantity and location cabinets, frames and racks;
    d. quantity and location of termination points;
    e. capacity and distribution of the mains power supply system;
- the application(s) to be supported by the installed cabling highlighting, where relevant, current and future requirements for compliance with information technology/telecommunications networking standards;
- repair and resilience planning;
- security requirements (including accidental or malicious physical damage and damage caused by animals) leading to access restrictions for pathways, pathway systems, cabinets, frames, racks, closures and cords;
- planning to support remote powering.

It should be noted that minimum assumptions of growth are recommended in documents ISP-03-002 covering direct-connect telecommunications cabling. However, the growth in demand for IT infrastructure cabling as described in ISP-03-003 requires careful consideration since effective management of the operation of such cabling is dependent upon adequate accommodation being provided for cabinets and pathway systems. More details are provided in 4.2 and 4.3.

2.3 Co-ordination

The effective implementation and operation of telecommunications cabling infrastructures requires that the design and planning of the telecommunications cabling takes into account the following within the installation specification:

- other building services such as mains power distribution and bonding networks (BS EN 50310 specifies requirements for bonding networks to support the operation of telecommunications cabling and equipment);
- circuits for smoke/fire detection and associated controls;
- heating, ventilation and air conditioning (HVAC) infrastructures;
- piping systems (water supply and waste, fire suppression);
- other relevant infrastructures.

3 TECHNICAL SPECIFICATION

3.1 Operational environment

The technical specification shall detail deviations, where known or predicted, of the intended installation and operational environmental conditions from standard room conditions (i.e. benign). The following non-exclusive list includes examples of such environmental characteristics:

- mechanical effects (shock/bump, vibration, tensile force, crush, impact, bending and flexing, the effects of wind or the movement of air within buildings);
- ingress of contaminants (immersion);
- climatic effects (temperature range, rate of change of temperature, humidity range including condensation and icing effects, solar radiation;
- chemical (liquid or gaseous chemical pollution) or biological attack (e.g. mould or fungal growth);
- electromagnetic effects (including the impact of both direct lightning strike and lightning induced overvoltages).

The requirements for component performance or mitigation within the technical specification shall reflect the results of a risk assessment where such deviations are recognised to exist (on a regular or temporary basis) - taking into account their nature and duration.

3.2 Lifetime objectives

The technical specification shall detail requirements:

- for the operational lifetime of the cabling installation;
- to maintain supply of the cabling components or suitable alternatives during maintenance, repair and extensions throughout the operational lifetime of the installed cabling.

3.3 Performance and configuration

3.3.1 General

The technical specification shall contain the requirements for the cables, closures and termination points and the required transmission performance of the cabling:

- when subject to the defined operational environment;
- in conjunction with existing cabling.

ISP-03-002 describes the design recommendations for direct-connect telecommunications cabling.

ISP-03-003 describes the minimum design recommendations for IT infrastructure cabling which ensures that the cabling design conforms to the minimum requirements of BS EN 50173-2.

ISP-03-004 describes the minimum design recommendations for distributed building services cabling which ensures that the cabling design conforms to the minimum requirements of BS EN 50173-6. Also IISS-00-002 discusses additional issues in relation to generic cabling for distributed building services in relation to cable heating.

Within the backbone cabling, both ISP-03-003 and ISP-03-004 recommend a mixture of balanced cabling, multimode and singlemode optical fibre cabling - based on the backbone cabling lengths to be achieved. However, the quantities of each type of cabling are dependent on the number of users connected to the backbone cabling via the horizontal cabling.

> Emphasis should be placed on the use of singlemode optical fibre cabling for data rates in excess of 1 Gb/s, independent of transmission distance, since the use of multimode technologies will increasing demand the use of parallel optics (e.g. 20 No. optical fibres for a single 100 Gb/s channel). Such “optical fibre”-intensive solutions should be avoided for reasons of infrastructure cost, cable volumes, cabinet space and operational complexity (both administration and fault-resolution).

The technical specification shall contain the requirements for:

- the pathways, pathway systems (including mitigation products or techniques necessary to allow the components selected to be installed and operate as specified when subjected to the defined environmental conditions);
- cabinets, frames, racks;
- installation accessories and processes to be used during the installation;
- the bonding of cabling components and accessories.

3.3.2 Horizontal cabling of ISP-03-003

For horizontal cabling, ISP-03-003 adopts the configuration of cabling in accordance with BS EN 50173-2 - which is intended for the delivery of cabling to “work areas” in office or similar areas.

ISP-03-003 (Issue 2018-01) recommends a minimum of Class E_A cabling, constructed from Category 6_A components, in line with the recommended implementation of EN 50173-2:2018 and the requirements of BS EN 50173-6:2018.

NOTE Earlier editions of ISP-03-003 recommended a minimum of Class D cabling, typically constructed from Category 5 components as specified in BS EN 50173-1 (equivalent to Category 5e in ANSI/TIA-568-2.D) which supported 1000BASE-T over distances of up to 100 metres.

3.3.3 Service distribution cabling of ISP-03-004

For service distribution cabling, ISP-03-004 adopts the configuration of cabling in accordance with BS EN 50173-6 - which is intended for the delivery of a wide variety of building management (BMS), process monitoring and control (PMC) and non-user specific IT applications.

ISP-03-004 recommends a minimum of Class E_A cabling, constructed from Category 6_A components, in line with the requirements of BS EN 50173-6:2018.

This cabling serves diverse, distributed, outlets such as those used for extended coverage services such as wireless access points and more general building services (access control, building monitoring, environmental control, surveillance etc). It uses the same components, as detailed below, for the horizontal cabling, and is subject to many of the same rules of design strategy.

3.3.4 Other cabling performance options

Other cabling performance options exist (Class F or Class F_A cabling, typically constructed from Category 7 and Category 7_A components) and may be suggested to customers by suppliers, their consideration should take into account:

- Category 7 and Category 7_A cables (used to construct Class F and Class F_A cabling respectively) may have larger diameters and greater minimum bend radii requirements than the Category 6_A cables used to construct Class E_A cabling - this may have a significant impact of their accommodation in pathway systems;
- Classes F and F_A cabling requires the use of screened cabling which may put restrictions on the electrical earthing systems within the premises;
- if screened cabling is required then it is an option for all Classes, but if electromagnetic interference is of concern then optical fibre cabling may be appropriate;
- the enhanced performance requirements of Category 7 and Category 7_A connecting hardware may force the introduction of non-“RJ45” interfaces which may have administration implications;
- no applications exist that demand the performance of Classes F and F_A cabling.

However, it should be noted that the increased use of remote powering suggests that the operating temperature of the cables will rise (to values dependent upon the total currents delivered, the size of cable bundles and the ventilation provided). This temperature increase may serve to reduce the distance over which network applications are able to be delivered. As cables of higher Category have lower “room temperature” attenuation, they may be used to mitigate any reduction of viable channel length. For further details see IISS-00-002.

The presentation of cable elements at interfaces to the installed cabling and the treatment of cable elements not terminated within connecting hardware are described in ISP-03-002, ISP-03-003 and ISP-03-004.

3.4 Warning against the use of non-conformant balanced cables

3.4.1 General

As stated above, ISP-03-003 and ISP-03-004 recommend a minimum Class E_A cabling, typically constructed from Category 6_A components as specified in BS EN 50173-1 (equivalent to Category 6A in ANSI/TIA-568-C) which supports 10GBASE-T over distances of up to 100 metres.

This sub-clause contains further information in order to protect customers from potential risks of using inappropriate or non-conformant cables.

In order to deliver the required Class of installed performance, this document requires the use of the cables in accordance with either the European or international standards listed in Table 1.

Table 1 – Horizontal cable requirements

Required Class	EN cable specification	IEC cable specification
E_A	EN 50288-10-1 (unscreened) or EN 50288-11-1 (screened)	IEC 61156-5, Category 6_A (unscreened or screened)
F	EN 50288-4-1	IEC 61156-5, Category 7
F_A	EN 50288-9-1	IEC 61156-5, Category 7_A

3.4.2 "Horizontal" vs. "cord" cables

For every Category of cable there are two specifications. One specification applies to the horizontal and building backbone cables (complying with EN 50288-x-1 or IEC 61156-5 standards, see Annex A for details) and the other is relevant to the cable used to produce cords (complying with [BS] EN 50288-x-2 or IEC 61156-6 standards, see Annex A for details).

A recent trend encourages the use of "cord" cables as "horizontal" cables and is allowed by one method of conformance to the creation of end-to-end channels of the BS EN 50173 standards. This is tempting since there is less copper in the cable making it both lower cost and smaller.

However, as is explained in IISS-01-001, these cables produce results that are not conformant to the length-dependent requirements for certain parameters when assessing installed links. More importantly, cord cables have substantially higher d.c. resistance than horizontal cables and the heating effect could be significantly greater than expected when supporting remote powering applications (see Annex B).

As a result, the practice of using such cables (typically containing 26 AWG conductors), sometimes referred to as zone cables, cannot be recommended – independent of the lengths over which they are to be installed.

3.4.3 Copper coated aluminium or steel cables

A recent trend has seen the increased availability of cables masquerading as Category-based products but which are actually built from copper coated aluminium or steel conductors. Such cables cannot conform to any standards-based Category system and exhibit technical and operational problems which may only be seen following installation. Moreover, as is explained in IISS-01-001, these cables produce:

- systematic failures of transmission parameters against the Class requirements of BS EN 50173-1;
- poor reliability of terminations of cables within connecting hardware;
- results that are not conformant to the length-dependent requirements for certain parameters when assessing installed links and, most importantly, have substantially higher d.c. resistance than horizontal cables and the heating effect could be significantly greater than expected when supporting remote powering applications (see IISS-00-002).

As a result, the practice of using such cables (typically containing 26 AWG conductors), sometimes referred to as zone cables, cannot be recommended – independent of the lengths over which they are to be installed.

3.5 Inspection, test and acceptance

3.5.1 Contractual test schedules

The technical specification shall contain the requirements for:

- requirements for inspection and testing – it is important to note that the type and sampling levels have to be specified for all transmission performance tests (BS EN 50174-1 only mandates the 100% testing of wire-map/optical fibre polarity);
- additional requirements for acceptance of the installation.

In addition, in order to enable the sample assessment of test results by OUT (see 3.5.2), any test results obtained against the relevant transmission Class of BS EN 50173-1 shall:

- be undertaken with test equipment that is in accordance with the appropriate Level (as defined in BS EN 61935-1);
- include the characteristic plots for the parameters across the relevant frequency range.

These requirements shall be included in the technical specification.

3.5.2 Sample inspection and testing by University of Oxford IT Services

To avoid inadvertent acceptance of cabling comprising the type of components described in 3.4, University of Oxford IT Services reserves the right to inspect and assess, on a sample basis:

- cables being installed on customers property;
- test results obtained during the installation of horizontal, service distribution and backbone cables.

Further information is provided in IISS-01-001.

3.6 Administration

3.6.1 Minimum system requirements

Cabling infrastructure administration is as important as correct initial specification. Administration comprises a system of identifiers, appropriate labelling and record-keeping which is in concert with the initial documentation specified for the installation The Level 2 requirements of BS EN 50174-1 represent a minimum requirement for premises connected to University of Oxford IT Services. This is defined in Table 2.

3.6.2 Identifiers

The elements of the telecommunications infrastructure that are required, by the specified administration level, to be subject to an identifier scheme shall each have an identifier that:

- is unique within the administration system;
- explicitly defines the element to which it refers (e.g. closure, cable, outlet etc).

The identifier scheme shall conform to the requirements of ISO/IEC TR 14763-2-1 unless the installation specification requires an alternative scheme that also meets the above requirements.

3.6.3 Labels

Requirements for both non-machine readable and machine readable labels are provided in BS EN 50174-1 and BS EN 50174-2. It should be highlighted that the contents of a label do not have to be same as the identifier (this may be desirable for security reasons).

Table 2 - Minimum requirements of Level 2 administration system

IDENTIFIERS	
Cabinets/frames	Yes
Cables	Yes
Closures	Yes
Spaces	Yes
Termination points including joints	Yes
LABELS (fixed to the item or are part of the item)	
Cabinets/frames	Yes
Closures (unless indicated by visible termination point labelling)	Yes
Spaces (at entrances)	Yes
Termination points including joints [a]	Yes
RECORDS (AND/OR DRAWINGS) that provide information about the item together with other items related to it	
Fixed cabling	Manual [b]
Cord connections	Manual [b]
NOTE Manual records include paper-based systems. Electronic records include spreadsheets, databases etc	
[a] indicating the treatment of cable elements at the joint [b] manual records include paper-based systems	

3.7 Documentation

The technical specification shall define the:

- range of documentation to be supplied by the installer including any requirements to link records to each other and to other building services records;
- format of the documentation (e.g. to match the administration system) to facilitate changes to be made to the installed cabling throughout its intended operational life;
- format of inspection and test documentation;
- format of acceptance test result documentation (e.g. to match the administration system) together with other information relating to the test e.g. type of tester used, date of test, operator, termination point identifier, remedial action taken in the event of failed test, re-test results.

Drawings within the installation specification shall use commonly understood, unique and unambiguous symbols (an example of such a system is IEC 60617).

4 PLANNING CONSIDERATIONS

4.1 Introduction

Much of the content of BS EN 50174-1 (and that of its sister international standard ISO/IEC 14763-2) concentrates on the availability of adequate space within rooms identified as telecommunications distributors and the requirements for adequate planning of the pathways necessary to accommodate both the initial quantities and any predicted (if not planned) extensions to the cabling infrastructure.

A number of the requirements and recommendations of these standards are listed below in order to provide a planning foundation for telecommunications cabling infrastructure that will remain functional, maintainable and repairable over its desired lifetime.

NOTE: Where the requirements are not applied and the recommendations are not considered as best practice, it is probable that the cost of ownership and the service provision may suffer significantly over time.

4.2 Spaces

4.2.1 General

Spaces shall not be located:

- in emergency escape ways (where they obstruct);
- in areas that are subject to risk of flooding.

Dimensions of spaces allocated to entrance facilities and distributors shall take into account the initial volume and future expansion of information technology cabling and associated equipment.

Spaces shall be located to provide appropriate levels of security (restricted access) to the cabling and equipment to be contained within them.

The provision of mains, or other, power should be adequate to support the operation of the information technology equipment intended to be housed within the space.

In addition:

- spaces should be located centrally in the area they serve;
- positive air pressure systems (including appropriate filters) should be used to prevent ingress of dust and other contamination to the space;
- any water and drain pipes that pass through the space should be located away from and not directly above cabling or equipment.

4.2.2 Entrance facilities inside buildings

University of Oxford IT Services requirements are specified in ISP-01-001 and ISP-01-002.

4.2.3 Rooms containing building, floor and service distributors

4.2.3.1 General requirements

BS EN 50174-2:2018 introduces minimum requirements for room dimensions (previously these were recommendations only). The requirements of 4.2.3.4 match these requirements.

Rooms containing distributors shall be provided with access 0,9 m (min) wide and 2 m (min) high.

In addition to these requirements:

- floors, walls and ceiling should be selected and treated to minimise the generation of dust;
- consideration should be given to application of floor covering comprised of anti-static material;
- building elements (e.g. doors, floor, lifts) that provide access to rooms containing distributors should accommodate the probable weights and sizes of equipment to be brought to the rooms.
  NOTE: Equipment is often pre-assembled off site and delivered as complete cabinet/frame/rack units.

While access is required to cabinets, frames, and racks, lighting shall provide a minimum of 500 lux measured 1 m above the finished floor in front (and at the rear, if applicable) of the cabinets, frames, and racks.

Where the rooms are intended to contain active equipment in addition to the distributors:

- the temperature and humidity shall be maintained to allow continuous operation of the active equipment (and guidance on applicable ranges is given in BS EN 50174-2:2018);
- adequate mains power shall be provided.

The location of the distributors within the room and any relevant mounting shall be capable of supporting the loads applied during the construction and operation of the distributors and associated equipment. It shall be verified that proposed loading does not exceed the loading limit of the supporting structure.

4.2.3.2 Cabinet capacity

Calculations of total cabinet capacity should be based on 1U of cabinet capacity:

- per 6 No. balanced cabling termination points to be included;
- per 6 No. optical fibre cabling termination points to be included.

This assumption is based upon allowances for those terminations, cable and cord management and associated transmission equipment together with a limited amount of space for expansion. This planning benchmark should be confirmed for each cabinet in order to determine the availability of actual requirements for equipment and planned expansion space.

4.2.3.3 Room height

The University of Oxford IT Services recommends that all cabinets should be of a 42U configuration (minimum).

For cabinets served by underfloor pathways, BS EN 50174-1 (and ISO/IEC 14763-2) requires that rooms in which cables are routed using underfloor pathways shall be provided with raised floor with an underfloor depth of no less than 200 mm (300 mm is recommended).

For cabinets served by overhead pathways, BS EN 50174-1 (and ISO/IEC 14763-2) requires that the height of cabinets, frames and racks shall not exceed 75 % of the room height. For a 42U cabinet this requires unobstructed room height to be a minimum of 2.8 metres. Where this room height is not available the number of cabinets to provide a given service has to increase proportionately as shown in Table 3.

For clarity, if the equipment and cabling justified 2 42U cabinets:

- *a multiplier of "Roundup(Nx1.07)" requires three cabinets;*
- *a multiplier of "Roundup(Nx1.55)" requires four cabinets*

Clearly, an increase in the number of cabinets has implications for the floor area of the room as indicated in 4.2.3.4.

Table 3 - Minimum requirements of Level 2 administration system

Available, unobstructed, floor-ceiling height (m)	Maximum cabinet configuration (underfloor cabling)	No. of cabinets equivalent to "N" 42U cabinets	Maximum cabinet configuration (overhead cabling)	No. of cabinets equivalent to "N" 42U cabinets
2.8	42U	N	42U	N
2.6			39U	Roundup(N x1.07)
2.4			27U	Roundup(N x1.55)
2.2				
2.0	39 U	Roundup(N x1.07)		
1.8	27 U	Roundup(N x1.55)		
1.4			Not supported	

4.2.3.4 Room area

University of Oxford IT Services requires that all cabinets shall be of a 1000 mm (min) deep x 800 mm wide. Based on this requirement:

- the minimum room dimensions for distributors containing up to 500 outlets within 42U cabinets shall be 3,4 m (length) x 3,0 m (width) (see Figure 2a);
- the minimum room size shall be increased by 0.8 m along the line of cabinets for each additional cabinet (see Figure 2b).

NOTE These requirements are based on the use of 1000 mm x 800 mm cabinets that allow for sufficient cord management for fully utilized cabinets or open racks with vertical cable management for sufficient cord management for fully utilized racks, this will also accommodate access from both front and back of the cabinets or rack to install additional cabling and equipment.

4.2.4 Enclosures containing distributors

Where the enclosure is intended to contain active equipment in addition to the distributor:

- the temperature and humidity shall be maintained to allow continuous operation of that active equipment;
- adequate mains power shall be provided.

The location of the enclosure and any relevant mounting shall be capable of supporting the loads applied during the construction and operation of the distributor and associated equipment. It shall be verified that proposed loading does not exceed the loading limit of the supporting structure.

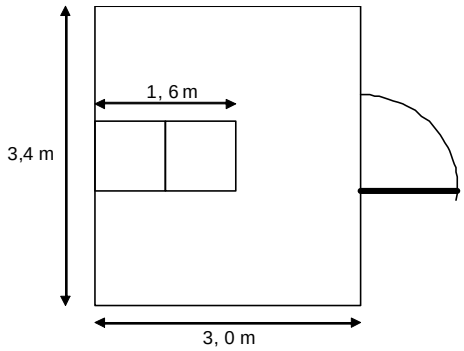

Figure 2a
Minimum room dimensions to support distributors containing up to two cabinets (independent of room height)

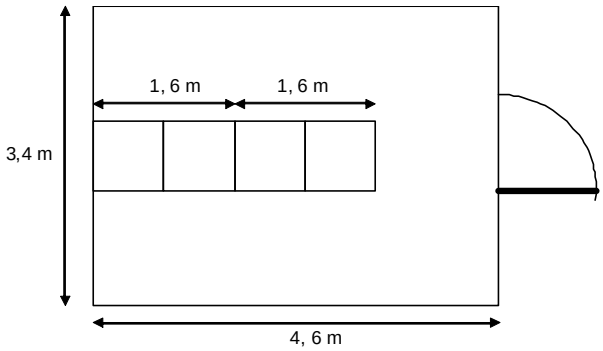

Figure 2b
Minimum room dimensions to support distributors containing up to four cabinets (independent of room height)

Figure 2 - Dimensions of rooms containing distributors

4.2.5 Cabinets, frames and racks

4.2.5.1 Requirements

The location of cabinets, frames and racks shall:

- allow subsequent measurements, repair, expansion or extension of the installed cabling to be undertaken without risk of injury to personnel;
- be consistent with the space, floor loading and other services required for information technology equipment;
- allow the installation of the necessary cabling together with the delivery and removal of larger items of apparatus;
- provide a minimum clearance of 1,2 m on all faces where access is required;
- allow for the installation of additional cabling without major disruption.

The location of cabinets, frames and racks shall take into account that, cables that are not terminated in a cabinet, frame or rack shall not be routed within the physical boundaries of that cabinet, frame or rack.

Cabinets, frames and racks shall not be installed:

- in toilet facilities and kitchens;
- in emergency escape ways;
- in ceiling or sub-floor spaces;
- within cabinets or closures containing fire hose reels or other fire-extinguishing equipment.

Advice shall be sought from University of Oxford IT Services before final locations of cabinets, frames and racks are agreed and contracted for specific premises.

4.3 Pathways

4.3.1 Fire performance

BS 8492 is a Code of Practice that provides advice on the techniques for fire protection and fire prevention with respect to telecommunication cabling.

NOTE: BS 8492:2016 + Amendment 1:2017 includes the implications of the extension of Construction Products Regulation to communications cables.

Fire compartmentation is a critical aspect of this work. The recommendations of BS 8492 for fire barriers and fire stopping techniques shall be considered as requirements of this document.

Fire barriers shall be designed to facilitate their refurbishment following cable installation and the cables passing through fire barriers shall be segregated to minimise disruption to the fire barriers during any subsequent installation (or removal) of cables (and in accordance with the segregation requirements of BS EN 50174-2).

4.3.2 Pathway design

4.3.2.1 Mechanical

The detailed design and planning of pathways and pathway systems should aim to minimize the cost and disruption associated with unscheduled installation activity.

Cables to be installed to provide redundancy should be installed in separate pathways.

Pathways and/or the pathway systems within the pathways shall provide the cabling components with the necessary levels of physical and climatic protection (during installation and operation) to address the specified requirements in 3.1. Pathway systems shall achieve the necessary protection by their location, design features or a combination of both.

Pathway systems shall be used to provide protection to the installed cabling except in areas (e.g. risers, above suspended ceiling, below access floors, equipment rooms) where the cabling can neither be damaged nor have its transmission properties adversely affected.

Pathways selected shall allow the fixing of the selected pathway systems and subsequent loading of those systems due to:

- the installation methods used;
- the weight of the proposed quantities of cable;
- the possibility of additional loads being applied by other services or third parties.

Elements of other supply systems such as water, heating, HVAC or sprinklers shall not be used as pathway or support for pathways systems due to the potential environmental impact and the risk that cable support will disappear by changes made to the supporting system.

The location of pathways should avoid localised sources of heat, humidity or vibration that increase the risk of damage to either the cable construction or performance. Pathways should not be contained within lightning conductor voids or lift shafts. The location of existing pathways should be verified to avoid accidental damage during the construction of new pathways and spaces.

Where hidden pathways are necessary (e.g. conduits in plaster etc) they should have either horizontal or vertical orientation.

4.3.2.2 Accommodation

The space allocated to pathway systems shall be adequate to allow reasonable levels of expansion. BS EN 50174 specifies recommendations in this area.

Table 4 shows dimensional requirements where no expansion is planned. Table 5 shows the general requirements where expansion is planned.

NOTE: Table 4 and Table 5 do not take into consideration any separation requirements necessary to minimise thermal impact of remote powering as described in EN 50174-2.

Table 4 – Dimensions of distribution pathway systems with no allowance for expansion

Final quantity of Category 6_A, 7 or 7_A cables	Pathway cross-sectional area (mm^2)	Pathway cross-section for tray/basket for cable bundles	Pathway cross-section for tray/basket for loose laid cables
24	1200	50 mm x 50 mm	75 mm x 25 mm
48	2400	75 mm x 50mm	150 mm x 25mm
72	3600	75 mm x 50 mm	225 mm x 25 mm
96	4800	75 mm x 50 mm	300 mm x 25 mm
120	6000	150 mm x 50 mm	450 mm x 25 mm
240	12000	300 mm x 50 mm	-

Table 5 – Dimensions of distribution pathway systems allowing for expansion

Initial quantity of Category 6_A, 7 or 7_A cables	Pathway cross-sectional area (mm^2)	Pathway cross-section for tray/basket for cable bundles	Pathway cross-section for tray/basket for loose laid cables
24	2400	75 mm x 50mm	150 mm x 25mm
48	4800	150 mm x 50 mm	300 mm x 25 mm
72	7200	225 mm x 50 mm	450 mm x 25 mm
96	9600	300 mm x 50 mm	600 mm x 25 mm
120	12000	300 mm x 50 mm	-

Pathways, entry points to the pathways and the pathway systems selected shall ensure cables are able to be installed and, where appropriate, fixed in accordance with the applicable minimum bend radius (during installation, during operation – static and during operation – dynamic) by using identifiable techniques including pre-fabricated curved corners, drop-outs and radius limiters. Where multiple cable types are involved, the largest minimum bend radius shall apply. For guidance purposes:

- the minimum bend radius for 4-pair balanced cables shall be 8 times the cable diameter (resulting is a (typical minimum bend radius of 50 mm);
- the minimum bend radius for optical fibre cables shall be 10 times the cable diameter - resulting is a (typical minimum bend radius of 120 mm).

Where TOs are housed in floor-boxes, sufficient space shall be allocated to allow a service loop of 3 m length to allow the floor-box to be repositioned.

5 OTHER DOCUMENTS IN THIS SERIES

IISS-00-002: Infrastructure Installation Specification Strategy: Distributed building services
IISS-01-001: Assessment of balanced cabling test results
IISS-01-002: Installation and acceptance testing of singlemode optical fibre cabling
ISP-00-001: Overview
ISP-00-002: Access to University of Oxford IT Services facilities (later)
ISP-01-001: University of Oxford IT Services Entrance Facilities - Product and design specification
ISP-01-002: University of Oxford IT Services Entrance Facilities - Accommodation requirements
ISP-02-001: University of Oxford IT Services Intermediate cabling (INTI-ENTI) - Product and design specification
ISP-02-002: University of Oxford IT Services Intermediate cabling (INTI-ENTI) - Accommodation requirements
ISP-03-001: Distribution cabling - Recommendations: Overview
ISP-03-002: Direct-connect cabling - Recommendations: Telecommunications infrastructure
ISP-03-003: Distribution cabling - Recommendations: IT infrastructure
ISP-03-004: Distribution cabling - Recommendations: Distributed building services infrastructure

NORMATIVE REFERENCES

The following documents shall be applied in a normative manner (i.e. mandated) by the users of this document.

BS 6701:2016+ Amendment 1:2017	Telecommunications equipment and telecommunications cabling - Specification for installation, operation and maintenance
BS 8492:2016 + Amendment 1:2017	Telecommunications equipment and telecommunications cabling. Code of practice for fire performance and protection
IEC 60512-99-001:2012	Test schedule for engaging and separating connectors under electrical load: Connectors used in twisted pair communication cabling with remote power

BIBLIOGRAPHY

The following documents are considered useful reference sources for the users of this document.

ANSI/TIA-568-0.D	Generic Telecommunications Cabling for Customer Premises
BS 7671:2018	Requirements for electrical installations: IEE Wiring Regulations: 18th edition
BS EN 50173-1:2018	Information technology - Generic cabling systems - General requirements
BS EN 50173-2:2018	Information technology - Generic cabling systems - Office premises
BS EN 50173-3: 2018	Information technology - Generic cabling systems - Industrial premises
BS EN 50173-6:2018	Information technology - Generic cabling systems - Distributed building services
BS EN 50174-1:2018	Information technology - Cabling installation - Part 1: Installation specification and quality assurance
BS EN 50174-2:2018	Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings
BS EN 50310:2016	Information technology - Telecommunications bonding networks for buildings and other structures.
BS EN 60617 series	Graphical symbols for diagrams
BS EN 61935-1:2015	Specification for the testing of balanced and coaxial information technology cabling - Installed balanced cabling as specified in the standards series EN 50173
IEEE P802.3bt	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI): Amendment 2: Power over Ethernet over 4 Pairs
ISO/IEC 14763-2:2012	Information technology. Implementation and operation of customer premises cabling. Part 2. Planning and installation
BS PD ISO/IEC TR 14763-2-1:2012	Information technology. Implementation and operation of customer premises cabling. Part 2-1. Planning and installation – Identifiers within administration systems

Annex A
Balanced cable specifications

EN 50288-2-1	*Multi-element metallic cables used in analogue and digital communication and control - Part 2-1: Sectional specification for screened cables characterized up to 100 MHz - Horizontal and building backbone cables*
EN 50288-2-2	*Multi-element metallic cables used in analogue and digital communication and control - Part 2-2: Sectional specification for screened cables characterised up to 100 MHz - Work area and patch cord cables*
EN 50288-3-1	*Multi-element metallic cables used in analogue and digital communication and control - Part 3-1: Sectional specification for unscreened cables characterised up to 100 MHz - Horizontal and building backbone cables*
EN 50288-3-2	*Multi-element metallic cables used in analogue and digital communication and control - Part 3-2: Sectional specification for unscreened cables characterised up to 100 MHz - Work area and patch cord cables*
EN 50288-4-1	*Multi-element metallic cables used in analogue and digital communication and control - Part 4-1: Sectional specification for screened cables characterised up to 600 MHz - Horizontal and building backbone cables*
EN 50288-4-2	*Multi-element metallic cables used in analogue and digital communication and control - Part 4-2: Sectional specification for screened cables characterised up to 600 MHz - Work area and patch cord cables*
EN 50288-5-1	*Multi-element metallic cables used in analogue and digital communication and control - Part 5-1: Sectional specification for screened cables characterized up to 250 MHz - Horizontal and building backbone cables*
EN 50288-5-2	*Multi-element metallic cables used in analogue and digital communication and control - Part 5-2: Sectional specification for screened cables characterized up to 250 MHz - Work area and patch cord cables*
EN 50288-6-1	*Multi-element metallic cables used in analogue and digital communication and control - Part 6-1: Sectional specification for unscreened cables characterised up to 250 MHz - Horizontal and building backbone cables*
EN 50288-6-2	*Multi-element metallic cables used in analogue and digital communication and control - Part 6-2: Sectional specification for unscreened cables characterised up to 250 MHz - Work area and patch cord cables*
EN 50288-9-1	*Multi-element metallic cables used in analogue and digital communications and control - Part 9-1: Sectional specification for screened cables characterised up to 1 000 MHz - Horizontal and building backbone cables*
EN 50288-9-2	*Multi-element metallic cables used in analogue and digital communications and control - Part 9-2: Sectional specification for screened cables characterised up to 1 000 MHz - Work area and patch cord cables*
EN 50288-10-1	*Multi-element metallic cables used in analogue and digital communication and control - Part 10-1: Sectional specification for cables characterized up to 500 MHz - Horizontal and building backbone cables*
EN 50288-10-2	*Multi-element metallic cables used in analogue and digital communication and control - Part 10-2: Sectional specification for cables characterized up to 500 MHz - Work area and patch cord cables*
EN 50288-11-1	*Multi-element metallic cables used in analogue and digital communication and control - Part 11-1: Sectional specification for un-screened cables, characterised up to 500 MHz, for horizontal and building backbone wiring*
EN 50288-11-2	*Multi-element metallic cables used in analogue and digital communication and control - Part 11-2: Sectional specification for un-screened cables, characterised up to 500 MHz - Work area and patch cord cables*
IEC 61156-5	*Multicore and symmetrical pair/quad cables for digital communications - Part 5: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz - Horizontal floor wiring - Sectional specification*
IEC 61156-6	*Multicore and symmetrical pair/quad cables for digital communications - Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz - Work area wiring - Sectional specification*

Annex B
Definitions and abbreviations

Definitions

For the purposes of this series of documents, the following definitions apply.

Building distribution frame	The cabinet or frame containing the connecting hardware upon which the incoming University of Oxford IT Services balanced cables are terminated. It is the property of University of Oxford IT Services and houses the balanced cabling ENTI(s).
BMSD panel	A panel terminating an intermediate cable at the building management services distributor.
Building management services distributor (see Note 1)	The functional element providing onward distribution of building management services throughout the customers' premises, typically via structured cabling components. It is the property of the customer but accommodates the closure(s) housing the University of Oxford IT Services INTI(s).
Consolidation point (CP)	A connection point between a TO and a horizontal cabling distribution panel. It is the property of the customer.
Customer	A college or the University, as appropriate, responsible for the premises served by University of Oxford IT Services.
Direct-connect cabling	Cabling providing services from the building distribution frame to service outlets within the premises either direct or via distribution points. It is the property of the customer.
Distribution cabling	Cabling providing services from the various distributors to the service outlets within the customers' premises. The distribution cabling for different services may use different structures and or components.
Distribution panel	A panel terminating generic distribution cables in a customers cabinet. It is the property of the customer.
Equipment cabinet	The cabinet containing the connecting hardware upon which the incoming University of Oxford IT Services optical fibre cables are terminated. It is the property of University of Oxford IT Services and houses the optical fibre cabling ENTI(s).
External network test interface	The test point used to ensure satisfactory performance of the external cabling infrastructure. It is the property of University of Oxford IT Services.
Internal network test interface	The test point used to ensure satisfactory performance of the external cabling infrastructure in conjunction with the intermediate cabling. It is the property of University of Oxford IT Services.
IT distributor (see Note 1)	The functional element providing onward distribution of IT services throughout the customers' premises, typically via structured cabling components. It is the property of the college or University but accommodates the ITD panel(s) housing the OUT INTI(s).
ITD panel	A panel terminating intermediate cables at the IT distributor. It is the property of University of Oxford IT Services.
Line Jack Unit (LJU)	A service outlet within direct-connect distribution cabling
Optical fibre entrance facility (OFEF)	The cabinet containing the joint between the external optical fibre cables and the OFEF-EC link cables. It is the property of University of Oxford IT Services.
Pathway	A defined route for cables between termination points.
Pathway system	An area or volume defined by markings or a specific cable management system including those specified in the EN 50085 and EN 50086 series of standards.
PMCD panel	A panel terminating an intermediate cable at the process monitoring and control distributor.
Process monitoring and control distributor (see Note 1)	The functional element providing onward distribution of process monitoring and control services throughout the customers' premises, typically via structured cabling components. It is the property of the college or University but accommodates the closure(s) housing the University of Oxford IT Services INTI(s).
TD line	The service provision at an interface to the TD panel. This may be presented using one or two pairs within an Intermediate BDF Cable.
TD panel	A panel terminating an intermediate cable at the telecommunications distributor.
Telecommunications distributor (see Note 1)	The functional element providing onward distribution of telecommunications services throughout the customers' premises, typically via structured cabling components. It is the property of the

	college or University but accommodates the TD panel(s) housing the University of Oxford IT Services INTI(s).
Telecommunications outlet (TO)	A service outlet within generic, ”structured”, distribution cabling
NOTE 1:	A distributor is not a physical element such as a cabinet. It is a “space” and can be co-located with other distributors (for example the TD and ITD may be housed in the same cabinet).

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579 **Abbreviations**
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581 For the purposes of this series of documents, the following abbreviations apply.
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BDF	Building distribution frame
BMSD	Building management services distributor
CP	Consolidation point
d.c./DC	Direct current
EC	Equipment cabinet
ENTI	External network test interface
ITD	IT distributor
INTI	Internal network test interface
LJU	Line jack unit
OFEF	Optical fibre entrance facility
PMCD	Process monitoring and control distributor
TD	Telecommunications distributor
TO	Telecommunications outlet

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