

Specifying an IT Cabling System



This guide will help you produce a specification for an IT cabling system that meets your organisation's needs and gives you value for money. You will be able to give your specification to suppliers so they can give you like-for-like bids for the supply and installation of the cabling system. Depending on your knowledge and the complexity of the requirement, expert assistance may be required to complete the specification.

This guide assumes that you need a conventional cabling system using RJ45 connectors.

Your completed specification will include details on all or some of the following requirements:

- The Class or Category of cabling system. E.g. Class D / Cat 5e
- The number and locations of outlets
- The location and type of telecommunications rooms and spaces
- Backbone cabling between telecommunications rooms and spaces
- Cabling pathways and containment
- Labelling systems and methods
- Patching facilities and patch cords
- Testing
- Administration system
- Minimum warranty period

If you leave it to installers specify any of the above, it may make it difficult to compare prices

PREPARATION

Before starting work on your specification, gather the following information if relevant:

- A plan (preferably) or dimensions of the areas to be cabled.
- The number of staff requiring IT and/or voice services
- The services required per workstation, e.g. voice, data
- Business expansion plans
- Applications to be supported
- The highest network speed anticipated during the expected life of the cabling system
- Ethernet switches and other IT infrastructure hardware to be supported
- Printers and other peripherals to be supported
- Voice backbone / distribution requirements
- The maximum backbone bandwidth expected during the life of the cabling system.
- Building management systems integration
- Telephone system details
- Location of Telecommunications Rooms (for edge networking hardware)
- Location of Equipment Rooms (for core networking hardware)
- Location of Entrance Facilities for incoming telecommunications lines
- Locations for cabinets or racks, or space in existing cabinets and racks
- Cable routes between floors, across floors and between buildings
- Existing earthing facilities.
- The fire rating requirement of the cable
- Any known hazards? E.g. Asbestos, exposed high voltages, etc.

CABLING SYSTEM SELECTION

Standards

Cabling systems are often specified using USA standards, e.g. Cat 5e or Cat 6. However, you should get assurance from your installer that your new cabling system will comply with British Standards, namely:

- BS EN 50173 series for performance and components
- BS EN 50174 series for design, installation, operation and maintenance
- BS 6701 for installation, operation and maintenance
- BS EN 50310 for grounding and bonding
- BS EN 50346 for testing

The standards specify a range of *Classes* or *Categories* of copper cabling systems, correctly referred to as *balanced* cabling systems. Amongst these are:

- **Class D** - Comparable with TIA Cat 5e, supporting Gigabit Ethernet (1000BASE-T).
- **Class E** - Comparable with TIA Cat 6, supporting Gigabit Ethernet (1000BASE-T) and 10Gigabit Ethernet (10GBASE-T) to a distance of 35 metres.
- **Class E_A** - Comparable with TIA Cat 6_A, supporting 10 Gigabit Ethernet (10GBASE-T)
- **Class F** - Comparable with TIA Cat 7, supporting 10 Gigabit Ethernet (10GBASE-T).
- **Class F_A** – Supporting 10 Gigabit Ethernet (10GBASE-T).

Choose a class that will meet your bandwidth requirements for the foreseeable future and that should fit within your budget. Bear in mind that higher class cabling usually requires larger, more costly, containment and pathways as the cables have a larger diameter.

Do not write off Class D (Cat5e). It's a low-cost cabling system that supports 1Gb Ethernet so is suitable for the cabling to most work area outlets (e.g. desk positions).

Choice of Cabling Medium

Bandwidth, lengths of cable runs and environmental influences will influence your choice of cabling medium. In a typical enterprise installation, it is customary to use balanced twisted pair copper cables to service work areas although optical fibre cabling may be a better choice if security or electromagnetic interference are significant considerations.

Class D (Cat 5e), Class E (Cat 6) and Class E_A (Cat 6_A) cables are available as unshielded (UTP) and shielded (e.g. STP, FTP). Class F and Class F_A have an overall shield only and each pair is individually foil-shielded. Unshielded cable is suitable for most installations but shielded cable may be required if high levels of electromagnetic interference are present or if a high "tempest" rating is required for security purposes. Also, in the case of Class E_A, the unshielded variant has a larger diameter so requires larger containment.

The following circumstances, commonly found in backbones, may make it necessary to select optical fibre cabling:

- If the length of a cable run will be over 90m.
- If each end of the cable terminates in different electrical earth zone. This is often the case if nodes are in different buildings – a non-metallic optical fibre cable is far less likely to conduct damaging electricity in the event of a lightning strike.
- If the cable is routed externally. In this case sheaths need to be more rugged and weatherproof. This is more often available for optical fibre cables.
- If the space in cable containment is limited; a multi-core fibre can carry many times the volume of data cable.
- If a high level of security is required; optical fibre is secure against unauthorised access.

Selecting the Right Optical Fibre Cable

The selection of OM1, OM2, OM3 or OS1 optical fibre cabling depends on the network application and the distance. OM1, OM2 and OM3 cables are multimode whilst OS1 cable is singlemode.

Here is a table showing the maximum distances for the most-used Ethernet transceivers or GBIC cards:

Ethernet transceiver / GBIC card	Maximum channel lengths for each multimode optical fibre type			
	OM1	OM2	OM3	OS1
1000BASE-SX (Gigabit SX)	275m	550m	550m	-
1000BASE-LX (Gigabit LX)	550m	550m	550m	5Km
10GBASE-SR/SW (10G SR or 10G SW)	32m	82m	300m	-
10GBASE-LX4 (10G LX4)	300m	300m	300m	10Km

Bear in mind that SX, SR and SW transceivers cost less than LX or LX4 transceivers.

Mechanical Protection and Physical Properties

The selection of cable sheath material such as PVC, Low Smoke Zero Halogen (LSZH) or plenum-rated, depends on the attitude to risk, local regulations and the requirements of other interested parties e.g. premises owners and insurance companies.

Optical fibre cables may need to be armoured and rodent-resistant to give protection in ducts or for direct burial.

Lifetime Cost Effectiveness

A cabling system represents the element of a network that has the longest life span so should be designed and installed with at least 10 years of useable life. To ensure consistent performance throughout the life of the system, the following should be considered:

- Warranty and performance guarantees from component manufacturer
- Quality components proven to meet appropriate Standards
- Manufacturers & suppliers support
- The installers have relevant qualifications and training and their installation methods fully comply with British Standards.

Choice of Cabling System Manufacturer

Many manufacturers make cabling systems. Quality and prices vary so you should make a judgement on what's important for your installation. This will depend on your budget, the required reliability and the planned lifetime of the cabling system.

You may specify a particular manufacturer's cabling system. If, however, you leave the selection to the installation company, it's likely that a low-cost cabling system will be proposed to make their price look more competitive.

If you choose to specify a manufacturer, make sure it is a reputable manufacturer whose products comply with the relevant standards.

CABLE PATHWAYS and CONTAINMENT

Cable pathways can be located above ceilings, under floors, in risers between floors, underground or overhead between buildings. In most instances, the cabling will require dedicated containment such as trunking, conduit, cable tray, matting, cable basket or ducts. The following should be considered:

- Designing pathways that keep cable lengths within limits.
- Specifying the most suitable containment for the pathway.
- Who has responsibility for the pathways and designing the containment system, e.g. architect, mechanical and electrical contractor or the cabling installer?
- Capacity, allowing for future growth and to keep fill ratios within the requirements of the BS and EN standards.
- Segregation from other services, particularly electricity supply cabling in accordance with BS 6701 and BS EN 50174-2.
- Suitability for standards conformity. E.g. to allow correct bend radii for cables.
- You have permission from the landowner for the installation of ducts.
- Protection of the cable from water, heat, sunlight, physical damage and rodents.

INSTALLATION TECHNIQUES

Suitably qualified installers, complying with relevant standards should be selected to undertake the cabling work. Qualifications would include evidence of manufacturer's training or training undertaken at a specialised training establishment and supported by recognised certification.

Adherence to standards, including, where applicable:

- BS 6701
- BS EN 7671 (IEE) Wiring Regulations - 17th Edition
- BS EN 50174 series of standards
- BS EN 50310
- BS EN 50346

A good installer will not:

- Exceed the minimum bend radii for cables
- Exceed the maximum pulling force for cables
- Crush cable (e.g. by over tightening cable ties)
- Strip too much cable sheath at termination points.
- Install cables where they could be damaged.
- Untwist too much of each cable pair.
- Use incorrect tools or fixing techniques

A good installer will:

- Work safely
- Adhere to the necessary standards
- Always follow the manufacturer's guidelines

LABELLING, RECORDS and DOCUMENTATION

If your cabling system is well documented, any implementation, moves, additions or changes will be made simpler and problems more quickly diagnosed. You should develop a full administration scheme, complying with BS 6701. The level of detail will depend on the size and nature of your network and will include the following:

Labelling and records

- Identifiers
- Labels
- Records
- Reports
- Drawings
- Work Orders (documenting all moves, additions and changes)

Documentation should contain some or all of the following:

- Topology diagram (schematic layout)
- Floor plans routes
- Equipment room layout
- Outlet locations
- Patching closet location
- Equipment termination location
- Telecommunications or equipment room layout
- Cabinet layout
- Patching / cross connect records
- Test schedules / results
- Identification of test equipment used
- Certificate of conformity

For further information see Lynx Networks "Guidance for Final Documentation for IT Cabling Systems".

TESTING of BALANCED COPPER LINKS

The specification should state how the cabling system is to be tested and to what Standard.

There are three forms of testing:

- **Certification** – Tests all parameters required by ratified standards and provides a certificate for each channel or permanent link.
- **Qualification** – Only tests the cabling to work for particular applications or network standards.
- **Verification** – Tests only the most essential parameters.

Lynx Networks recommends certification testing for every channel or permanent link. This should prove cost effective in the long term. It is condition of most manufacturers' warranties that the cabling system is 100% certified. The permanent link is the link from the distribution panels and the outlets whilst the channel also includes the patch core and equipment cables.

For every installation where either certification or qualification testing is undertaken, complete individual test reports (or certificates where appropriate) configured in accordance with the agreed standard, should be included with the installation documentation. The format and material on which these reports are to be presented should form part of the contract. (See the Labelling, Records and Documentation section above).

Certification Testing of Balanced Cabling

Certification is carried out with a standards-compliant tester with the required accuracy for the Class or Category of cabling installed. You should state that the cabling system should be certified to BS EN50173 series of standards

By definition, certification testing includes qualification testing.

Qualification Testing of Balanced Cabling

Where a manufacturer warranty is not offered, qualification is a less stringent alternative to certification.

- Uses less accurate test equipment to compare installed cabling performance with the requirements of specific applications.
- Can only provide results for existing application standards.
- Cannot provide any form of 'future proofing' as it deals only with existing applications.
- Is limited to the 'Channel' test model, i.e. includes the equipment, patch and work area type cords.

Verification Testing of Balanced Cabling

This will eliminate common installation errors but will not guarantee that the cabling system will support the network or bandwidth requirements.

- Minimum test and inspection for copper cabling
- A visual inspection of the terminations
- Wire-mapping test to confirm there are no open circuits, short circuits or crossed wires, including the cable screen if present. This will also confirm that telecommunication outlets and patch panels are identified and labelled correctly.

Plus, optionally:

- Cable length
- Test to ensure there are no split pairs.

TESTING of OPTICAL FIBRE CABLING

For optical fibre cabling, certification and qualification are essentially the same thing. There is not an acceptable less accurate alternative to the Loss/Length test set.

Certification / Qualification of Optical Fibre cabling

- Polarity proofing by use of a visible light source
- Link length
- End-to-end power loss at the transmission wavelengths identified in the selected standard
- Calculation of power loss budget in accordance with the selected standard, allowing for the total number of connections and splices within the link.
- Stringent adherence to the test method defined in the selected standard

A final check for end-face cleanliness after certification, and cleaned as required with the correct materials.

Verification of Optical Fibre Cabling

- A visual inspection of terminations and splices.
- Inspection for dirt and scratches using appropriate inspection microscopes, and where necessary cleaned with correct materials.
- Optical fibre loss measurements using a light source and power meter to calculate loss budgets
- Plus, optionally, OTDR measurements to determine length and locate damage and poor connections.

ELECTRICAL INSTALLATION

Installation of electrical wiring is not within the scope of this documents but any related work, such as earthing and bonding, should comply with British Standard BS 7671:2001 IEE Wiring Regulations 17th Edition (plus amendments).

MAINTENANCE and SERVICES

BS EN50174-1 states that "Repair and maintenance are generally captured by the contract between the cabling owner and the cabling maintainer". Additional consideration should be made to ensure:

- A suitable maintainer is identified where desired
- Records are updated to reflect moves and changes
- Alterations upgrades and enhancements are carried out in accordance with existing warranties, topology and standards.
- Emergency support is considered.

WARRANTY

Most cabling systems come with a warranty that covers the materials and installation for fifteen years or more. Some warrant that the cabling system will support specific applications whilst others guarantee to conform to particular Standard. These warranties are valuable and reassure you that the manufacturer has confidence in the cabling system. However, the warranties do not usually specify a response time a fix time.

A few installers offer an enhanced warranty providing, for example, a next working day response to a fault call. Cabling is often a critical part of your network so this type of warranty is beneficial for business continuity. There may be an extra charge and conditions attached to these enhanced warranties.

Every care has been taken in the production of this document to ensure that the information contained herein is accurate. However, Lynx Networks cannot be held responsible in any way whatsoever for any errors or omissions.

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