

# Imperial College London

**Information & Communications Technology  
Network Infrastructure Group**

**Network Infrastructure Standards**  
**January 2018**

Version 1.5

## Revision History

Version	Date	Author	Description
Draft	12/03/2007	Antonio Barbosa	Initial document
1	13/06/2007	Matthew Williams	Revisions
1.1	30/05/2008	Antonio Barbosa	Small revision on all appendixes (except appendix J - AV). Sent to Networks group for comment.
1.2	17/03/2010	Antonio Barbosa	Small revision on most appendixes. New products and revised specifications.
1.3	03/07/2013	Antonio Barbosa Margaret Chambers	Contact updates. New contractors, fire strategy and minor updates.
1.4	30/11/ 2016	Margaret Chambers Antonio Barbosa	New Contractor matrix and revisions on several appendixes.
1.5	30/01/2018	Antonio Barbosa (Collaboration: Margaret Chambers, Tania Bozinovska)	Update changes to most document. Most noticeable the inclusion of an external infrastructure appendix, Optical Distribution Frames and their implementation strategy changed, Inclusion of new CPD regulations and new cabling. Containment improvements and comms rooms power.

## Notes

Who	Date	Note
Peter Seal	22/05/2006	Fire specifications in CWCs.
Ceri Davies	23/05/2006	Security specifications in CWCs.
Andrew Vincent	30/01/2007	Copper backbone labelling.
Roy Dickerson	11/05/2007	Engineering and CAD issues/strategies.
Stuart Kerr	29/04/2008	Telecoms review in the document.
Lugman Jalloh	17/03/2010	Estates TPS for power in CWCs
Andy Hammond	15/12/2016	General comments on M&E integration
Paul Martin (Legrand)	26/10/2017	Technical requirements for containment (non-commercial support)
Hannah Webb (Corning)	31/01/2018	ODF specifications and products and complete support strategy and delivery via distribution.
Helen Wadsworth (Brand Rex)	31/01/2018	Cabling standards and new regulations.
Andy Hammond	21/02/2018	CWC – Appendix C – Updates and updated links to Estates documentation and requirements.

## Last Changes:

*Main document:* Distribution list and notes updated. Introduction of the “Intake Rooms” and updated figure 3. External infrastructure included into the standards (item 1.5)

*Appendix A:* Clarification on the moves requirements to use ICT contractors and the levels of service provided, that can be used as an aide to the Project Managers and User Coordinators for the tender process and management of the process (item 2). Clarification on the need to use an ICT consultant on Major projects (Item 2). Clarification on the importance of the supervisor role onsite (item 2). Correction on Redstone’s address. Figure 3 change to include intake rooms into the building. Insertion of the External Infrastructure table. Added External infrastructure contacts for Data Techniques on Appendix A.

*Appendix B:* Added a clarification on the number of data points per user (item 2.0). Added Meeting rooms and lecture theatres and others to the patching requirements (item 6.2).

*Appendix C:* Changed initial text to reflect the fact we have both UTP and F/FTP cabling specification and critical advice highlighted in bold as it is missed continuously during the design stages. Enforced the necessity to keep all wall sockets to a single comms room in a specific cable (Item 1.1). Flat V installation made the default option (Item 1.2). Changed power feeds into comms rooms to enable dual supply to make Facilities Management team’s work easier and increase resilience to rooms, removed option to install commando sockets on wall and retain solely installation on overhead containment (Item 1.3.2). Insertion of item 1.8 to clarify intake rooms.

*Appendix D:* Included dual feed of power to comms rooms (CWC).

*Appendix E:* Introduction of Cablofil containment. Changed ODF from Tyco to Corning and added product information

*Appendix F:* Introduction of item 6.1 containment, introduction of protection of cabling when moving out of containment (item 6.1). Introduction of a black basked containment to enable choice for architectural reasons (item 6.1). Correction on item 19 on patch panel labelling and updated on labelling convention regarding use of specific letters. Inclusion of 10GbaseT into the standards. Addition of CAT6a F/FTP to the standards in a clearer way with inclusion of the new CPR (Construction Products Regulation) and the standards sought by Imperial (items 1.0 and 3.0), including change of name of the Annex. removal of tie wraps and inclusion of Velcro wraps (item 4.0). Enforcing the provision of service to wall plates from a single comms room (item 4.0). Improved mechanical protection with the inclusion of waterfall system and supports for flexible duct (item 7.0). Inclusion of number of outlets to be installed to the end users (item 16.0). Introduction of fire protection (Item 26.0)

*Appendix G:* Introduction improved (item 1.0). Cable capacity updated (item 3.0). Removed reference from outdated Appendix F and updated reference (item 4.0). Fire safety includes EZ-Path as a way of clarification (item 9.0). Several corrections to labelling to simplify process (item 11.3). Reference to route types to Appendix F (item 11.4). Removed reference to UTP cabling to a generic type (item 13.0).

*Appendix H:* Change to LC termination in the cabinets on OS1 (item 1.0). Clarification on use of blo-fibre and micro-blo also known as “blown cable” (item 2.0). Addition

*of containment information (item 3.1 added) to prevent confusion over type of containment to be used. Highlighting the importance of the installation of EZ-Paths for fire protection (item 6). Changes to labelling format, clarification regarding information on risers (item 7). Inclusion of cable markers as an option in the labelling (item 7). Clarification of labelling item <Fibre ID> (item 7). Introduction of an installation procedure for fibre services from 3<sup>rd</sup> parties. Introduction of lose tube fibre as a possible option for installation (item 9.0).*

Appendix I: No changes

Appendix J: CHANGES TO BE ADDED

Appendix L: This is a completely new appendix to the standards. External infrastructure standards.

## Distribution

Who	Role
<b>ICT</b>	
Mike Russell	CIO
John Shemilt	Director of ICT
Paul Jennings	Head of Technology
Matthew Williams	Networks and Security Manager
<b>Estates</b>	
Nicholas Roalfe	Director of Estates Operations
Sara Muir	Head of Building Operations
Roy Dickerson	Strategic Infrastructure Manager
Andy Hammond	Engineering Manager
Paul Felton	Quality Assurance
Adrian Dorrington	Fire Officer
Terry Branch	Head of Security
<b>Procurement</b>	
Andy Hitchman	Deputy Head of Purchasing
Adrian Woodmore	Category Manager – Construction
<b>Others</b>	
ICT Preferred contractors	
Estates Framework	Framework contractors (distribution by Estates)

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Appendix D – Completion

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Appendix F – UTP Cabling

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Appendix H – Fibre Installation (vertical and backbone)

Appendix I – Active Equipment

Appendix J – AV standards

Appendix J – External Infrastructure

## 1.0 Introduction

### 1.1 Overview and objectives.

This is a working document for all ICT infrastructure projects in the College. It sets out the standards for design and implementation of network installations in both stand-alone projects and as part of integrated refurbishments and new builds. It is also intended as a guide to understanding of the requirements of the ICT Department.

As part of ICT, the Network Infrastructure Group is responsible to College for the proper implementation of the standards. It relies on the services of carefully chosen partners who will work in cooperation to carry out the works. This is one of the main groups targeted by this document which is a working (and live) document that will reflect current and new technologies. It will also reflect the feedback received from the technicians and consultants working in the field.

### 1.2 Projects

As part of the continuous efforts by Imperial College to maintain and improve the high standards of education and research, a programme of investments is continuously implemented and reviewed. This is potentially one of the single most disruptive and challenging activities in what concerns ICT Infrastructure. Therefore, the guidelines of these standards should be strictly followed and any clarifications should be made by a request for information to the Network Infrastructure Manager by a project representative.

#### 1.2.1 Project Manager (PM)

All PMs should be introduced to this document by an ICT representative. It will be for the PM to contact the Network Infrastructure Manager to that effect.

#### 1.2.2 ICT and M&E Consultants

All M&E or ICT consultants should be introduced to this document. It will be for the companies working within the College's framework to request this of the Network Infrastructure Manager. ICT will consider that, if no request has been made, this document has been fully understood and followed and any errors and omissions in the projects specifications will be the responsibility of the company or its representatives.

#### 1.2.3 Cabling companies

ICT has a list of approved contractors that will be used on all cabling jobs in the College. Please see Appendix A for the approved list of contractors.

This list will be reviewed on a continual basis therefore any comments or evaluations from the project regarding the cabling companies will always be welcomed.

To be a part of the approved list the cabling companies will have to be vetted by ICT and they must have been inducted to the College Estates Health & Safety Policy and

have enough local knowledge to execute their tasks.

### **1.3 Operations**

These standards are also applied to daily operations.

### **1.4 Naming conventions**

The lack of a single naming convention in the past has led to several problems occurring in projects and will not be acceptable. These might be updated and or increased, as any other part of this document, in the future.

Throughout this document there will be some words that will be important to use appropriately. These will be marked with a bold and italic formatting.

To put all in perspective and prevent any confusion and communication between all the involved parties it is very important for all projects in the College to adhere to the following naming convention:

#### **1.4.1 CWC – Communication and Wiring Centre**

This is the designation of the communication room. The distribution of data and voice is done via these centres that may have the following equipment inside:

- Active equipment (switches, routers, security swipe access control panels, UPS/RPS systems, environmental monitoring)
- Passive equipment (cabling terminations for voice and data)

#### **1.4.2 Data Centre**

This is the designation of server locations.

#### **1.4.3 Wireless or Access Point (WAP)**

These are designations for the location of a single Wireless access point. This will include all necessary infrastructures to support the equipment and the equipment itself. These will be an integral part of any new installation.

### **1.5 The Network Infrastructure**

To start the implementation of the network infrastructure we need to consider a blank canvas and we will go through several steps. These steps can be omitted when no need for them.

First step would be the external infrastructure into the campus.

Telecom operators will connect to “Meet Me” chambers in the perimeter of a campus. Because of current legislation we will consider two groups: BT + others.

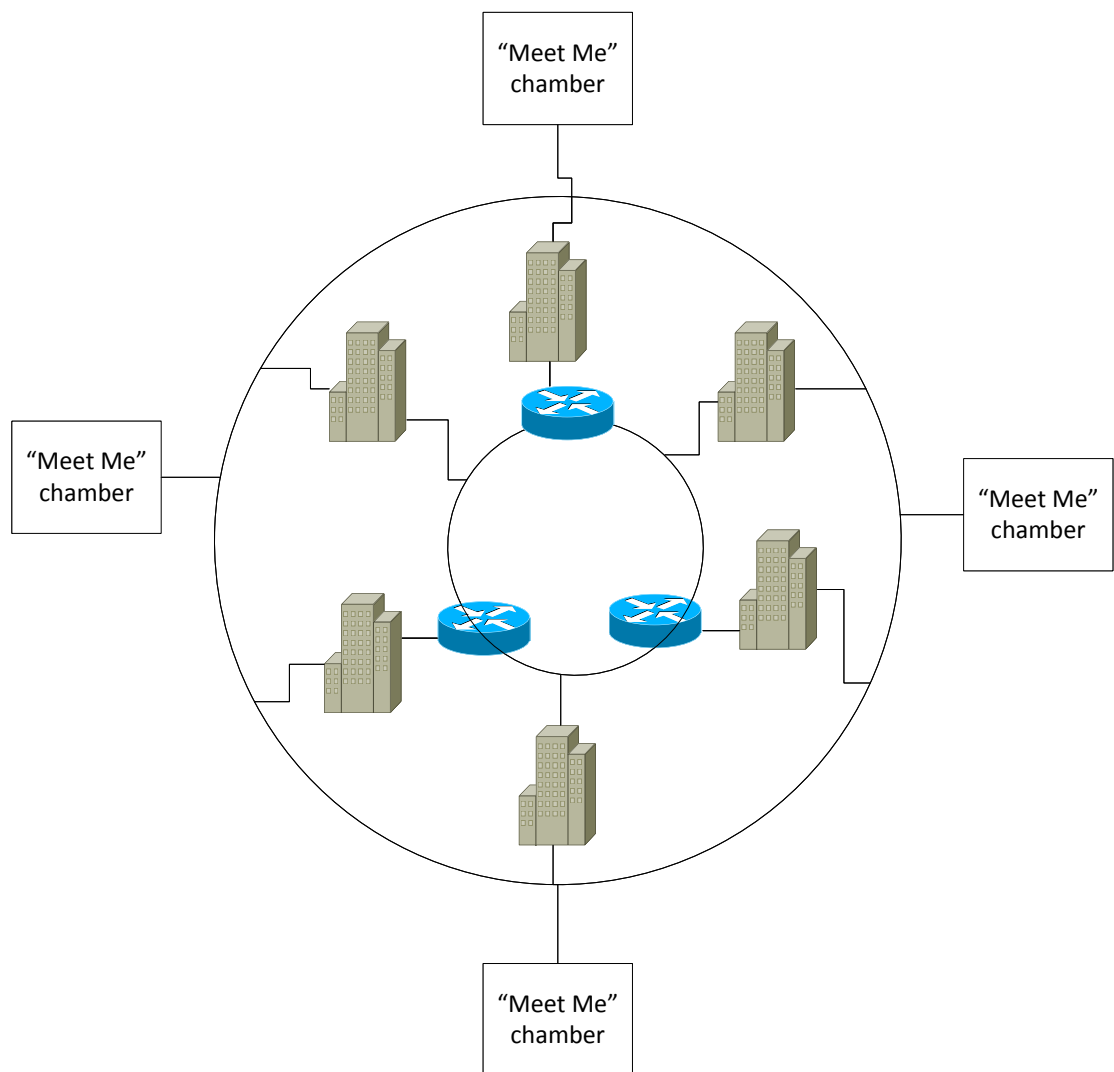
We will consider that BT will mirror the others but with chambers and ducts that will comply with their own standards. So we will only address the installation of the other

operators and consider that BT (with a smaller install) will be copying the other installs as a pre-requisite.

The meet me chambers will be installed in strategic locations to enable multiple entry points into the campus so that a range of routes and telecoms operators can be used to provide connectivity with a physical resilience inbuilt into the plan.

One external and one internal ring around the campus will be sought when possible. Imperial will be responsible and control the whole of the campus infrastructure. Imperial will use the infrastructure irrespective of service.

All buildings will connect to the external and internal ring (or to one of them if the other doesn't exist). If only one ring exists, the two connections will be done to the existing ring via different physical routes as if two rings exist.



The second step is to establish the routing and distribution locations on campus, if none exist.



The Imperial College infrastructure is currently built according to the following principles:

There are 3 core routers at 3 major routing locations in the South Kensington campus. Each connects to the other two routers to provide a ring topology, as figure 1 shows.

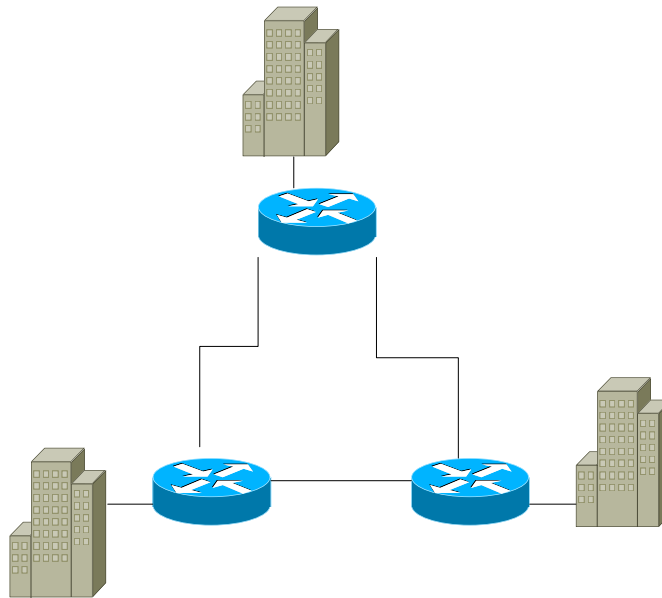


Figure 1

Each building will be dually connected (figure 2) to two of these locations. There will be diverse routes for resilience. This implies that length will have to be taken into consideration to comply with fibre specifications.

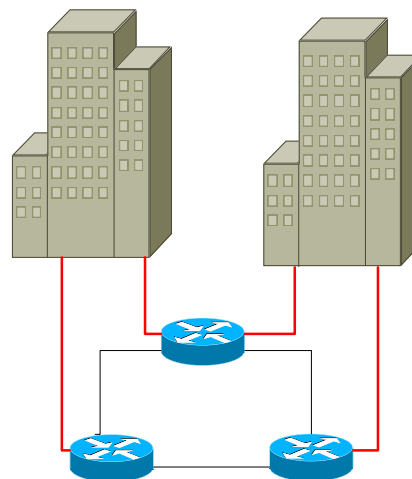


Figure 2

Each building will have two intake rooms to receive the incoming services. These rooms will be small areas where the ducts or tunnels join the building. The only requirement in the rooms is that they are:

- Clean
- Light

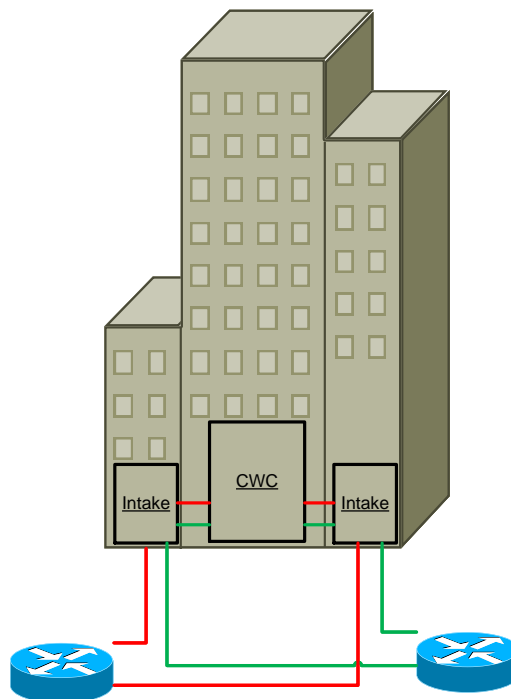
- Secure
- Sized to enable:
  - o Access to the ducts or tunnel containment
  - o The installation of an ODF (Optical Distribution Frame) and subsequent installations of fibre
  - o A Krone frame for multipair copper (for BT and similar services).
- Accessible to ICT engineers and Telco (and other third party) personnel.

These rooms will be used to be the handover locations for Telco services and equipment (fibre or copper). There will be an inter-connect to the main CWC within the building as seen in the image below. The interconnects are ICL services and infrastructure.

Within each building there will be a **fibre aggregation** location in a CWC. This is usually on the CWC on the lowest floor of the building (i.e. if there are CWCs in floors 1, 4 and 7; the one in floor 1 may be sized to be used as an aggregation location). From these locations the fibres will be installed to connect both:

- The building to the routers (figure 3).
- The other CWCs within the building (figure 4).

This has been typically been done this way for legacy reasons but it is not a requirement from ICT. There has been a trend to change this and any proposals for change will be welcomed if it improves operations.



We refer to all of these connections up to this point as our **backbone cabling** infrastructure (figure 3).

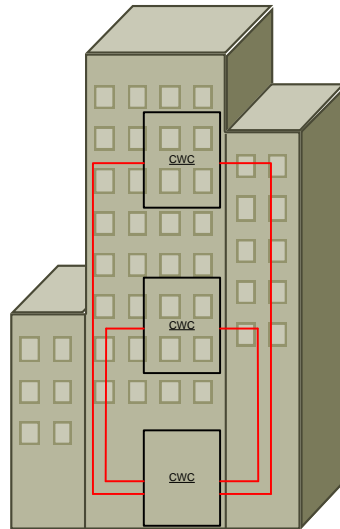


Figure 4

The connection between the aggregation location and the CWCs will be done via two diverse routes. This will be our **vertical distribution** cabling infrastructure (figure 4).

The CWCs within the buildings will provide the **horizontal distribution** cabling (even if we are talking of more than one building floor to a specific CWC) to the many individual sockets on the floors. These will be distributed in the building according to a previously outlined strategy, which takes into consideration that the copper cable runs cannot exceed 90m. The sizing of the rooms needs to be done taking into consideration the maximum number of sockets per floor that could be cabled back to the CWC.

The current policy followed by the Networks Infrastructure Group is to have the least possible number of CWCs in the building (but making sure that their sizes are not such that cable routes and others become a problem). This allows a concentration of resources on a better managed and more adaptable platform, which facilitates the implementation of new technologies.

All other campuses are governed by the same rules and strategy. The main difference is that they will have one or two routers. This will depend on campus size and strategy. What we need to have in mind is that all of them need to be the same line speed throughout the network.

## 2.0 Projects

### 2.1 Scope

It is the responsibility of the project to deliver a network infrastructure which complies with ICT standards.

This includes (in its entirety or parts):

- Routes
- Containment
- Backbone cabling

- Vertical cabling
- Horizontal cabling
- CWC provision
- Active equipment (switches and WAPs)
- Telephone equipment
- Patch cables and leads
- AV equipment

It is the responsibility of the ICT department to provide support and guidance to the project so that it delivers to specification and to the best interests of the College.

This will include:

- A resource that will act as the ICT department's stakeholder (Duty Holder as per College denomination).
- Connection to the rest of the network.
- Services to procure the active network equipment required by the project.
- Services to configure and install the active network equipment required by the project.
- Other consultancy service to Estates as required.
- Telephone services
- AV services

## **2.2 Pre-site occupation**

In most situations the projects will be done in areas previously occupied or partially occupied.

Because of this it is very important to follow some steps to prevent any incidents during the project.

- Inform ICT when area is vacated and request removal of active equipment (switches and WAPs)
- Request ICT's presence for a walk around to identify live services and do data and telephone cable isolations.
- Request building infrastructure strategy so that the project incorporates the strategy into its design.
- Maintain channels of communication open to enable quick resolution of any possible snag.

## **2.3 Process and procedure**

It will be the Project Manager's responsibility or of any agent acting on his/her behalf to request from the ICT duty holder a sign off on each stage. Failure to do so may cause the project to be unable to deliver infrastructure conforming to the ICT standards. In extreme cases this may result in it being impossible to connect the project's installed infrastructure to the remainder of the College's network.

All ICT deliverables are specified in this document but if there are queries or potential misunderstandings please contact ICT's Duty Holder or any person appointed by him to support the project.

## **2.4 Hand over**

A complete inspection of the infrastructure installation and delivery of all the required documents is required before the Duty Holder will sign it off as accepted. This sign-off is required before the connection to the College Campus Network will be made.

The acceptance document is to be provided by the project and failure deliver it will imply no connection.

## **2.5 Occupation**

It will be the responsibility of the project to provide the following information to ICT (data and voice):

- Data patching schedule
- Voice patching schedule

This will be done using a specific form, provided by ICT or the Telephone operator, and filled in by the Project Manager and/or by the client.

This document (provided by ICT to be filled in by the client) will have to be delivered 3 weeks before any move can happen. If this is done at a shorter notice all works will be done at “best effort” and may incur on an extra cost.

## **3.0 The standards**

### **3.1 How to use the documents**

For a full and detailed explanation of all the items that are mandated during an infrastructure project please refer to the appendixes to this document. These are an integral part of the standards.

These appendixes can be updated autonomously from this document and will be identified by date and revision number whenever referred to during a project.

The appendixes describe in full detail of all the infrastructure implementation requirements and will provide invaluable help in understanding how to implement network infrastructure at the College.

### **3.2 Feedback**

If any errors or omissions are noticed in the standards (or any of its composing documents) please inform the Network Infrastructure Manager for correction or review.

If any part of the document is causing misunderstanding of the College requirements or difficult to interpret, please inform the Network Infrastructure Manager for correction or review.

If this feedback is not provided it will be difficult, or impossible, to detect causes of possible problems. This will cause delays and further costs to both, or either, the College or the Contractors working for the College.