Imperial College
London

Information & Communications Technology
Network Infrastructure Group

Network Infrastructure Standards
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Appendix B - Examples

Version 1.5

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Note: All these calculations are for budgeting and estimations only as each case needs to be evaluated individually.

As an example we will use the Commonwealth building in the Hammersmith Campus. We will use the same building throughout this Appendix and follow through to completion.

1.0 Introduction

As a rule of thumb the CWC should be in the centre of a volume with a 45m radius on all planes. This allows us to assume that there would not be locations outside of reach of the CWC, cables being limited to 90m.

If a standard CWC was to be placed in the top floor of the Commonwealth building (10th) the serviced area would be that same floor and one below. To maximize the serviced area in order to reduce the number of CWCs in the building, and taking into consideration the maximum distances allowed, the 8th floor was considered to be the optimal location.

The 8th floor will be able to provide services to the 10th, 9th, 8th, 7th and 6th floors as the location for the CWC is within reach of the furthest place.

2.0 Equipment cabinet capacities

Note: There is a change from previous versions here as we now use less space in each cabinet for analogue voice and we can also continue the use of higher density installations by using flat V panels (see Appendix C “CWC”, Appendix E “Ordering” and Appendix F “UTP Cabling” for more information).

Given information:

- 1100sqm per floor
- 100 meter maximum distance from East to West
- Placement of the CWC in the middle of the floor space (50m to each side)
- Placement of CWC will allow maximum cable length of 80m to furthest point 2 floors up and down therefore it can cable 5 floors (including its own)
- There will be as a standard 4 sockets per person unless otherwise agreed with ICT.

Calculation:

a) For traditional installations

- 400 outlets per floor (Total gross area divided by 11 square meters 1100/11=100 then multiplied by 4 outlets 100x4=400)

- Capacity to cable 5 floors (400x5=2000)
- 40% allowance for expansion (2000+40%=2800)
- Considering that each cabinet will hold 336 connections we will need 9 cabinets (2800/336=8.3)

b) For high density installations (Flat V)

- 400 outlets per floor (Total gross area divided by 11 square meters 1100/11=100 then multiplied by 4 outlets 100x4=400)
- Capacity to cable 5 floors (400x5=2000)
- 40% allowance for expansion (2000+40%=2800)
- Considering that each cabinet will hold 480 connections we will need 6 cabinets (2800/480=5.83)

Sizing

Given information:

a) For traditional installations

- 9 cabinets needed for 5 floors (no fibre aggregation or router)

Calculation:

- The space occupied by the cabinets will be 7,200mm wide (9x800mm=7,200mm) and 875mm deep.
- The space needed for the comms room will be 9,200mm wide (7,200mm + 1,000mm right side + 1,000mm left side = 9,200mm) and 2,875mm deep (875mm + 1,000mm front side + 1,000mm back = 2,875mm)
- Example in Figure 1 below

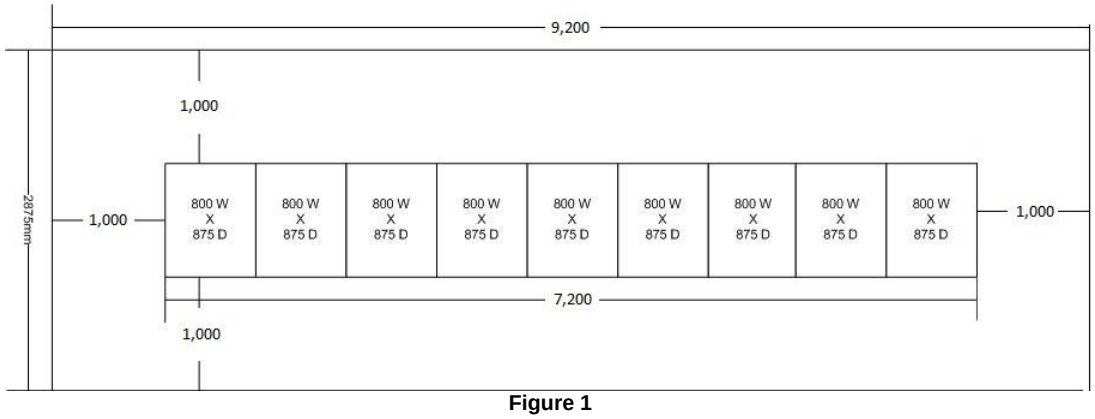


Figure 1

b) For high density installations

- 6 cabinets needed for 5 floors (no fibre aggregation or router)

Calculation:

- The space occupied by the cabinets will be 4,800mm wide (6x800mm=4,800mm) and 875mm deep.
- The space needed for the comms room will be 6,800mm wide (4,800mm + 1,000mm right side + 1,000mm left side = 8,400mm) and 2,875mm deep (875mm + 1,000mm front side + 1,000mm back = 2,875mm)
- Example in Figure 2 below

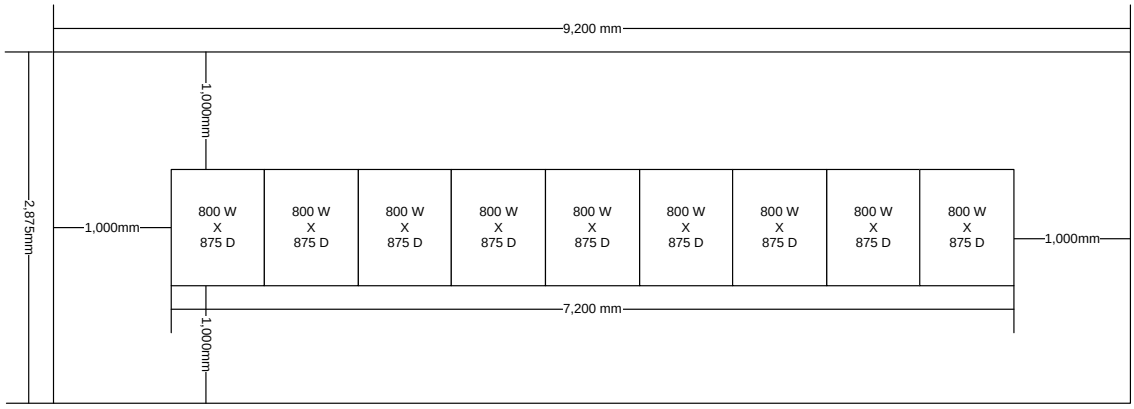


Figure 2

We are now using CAT6a as the standard install for new buildings and in refurbishments where this product can be installed. As this cable is wider and stiffer, more space is required to accommodate the amount of cable capable of being installed. For this reason the cabinets will be increased to 1,000mm deep versions. These will be the baseline installation for most locations from this revision of the standards and onwards.

Figure 3

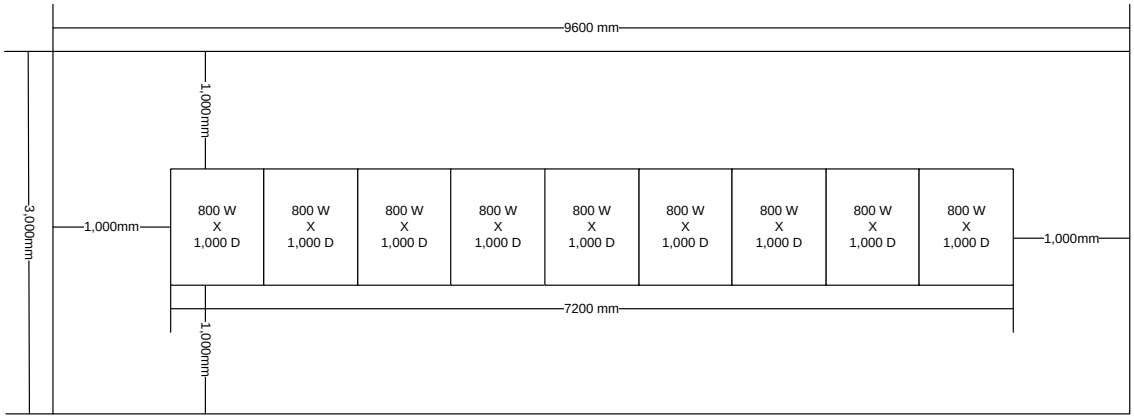


Figure 4 is an example of the above specified cabinet (with and without front doors).

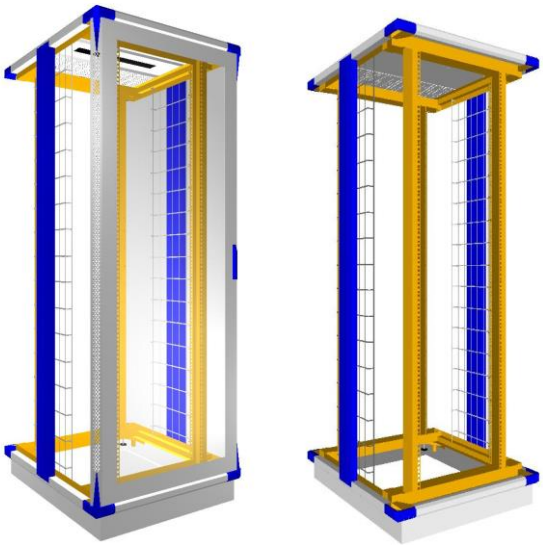


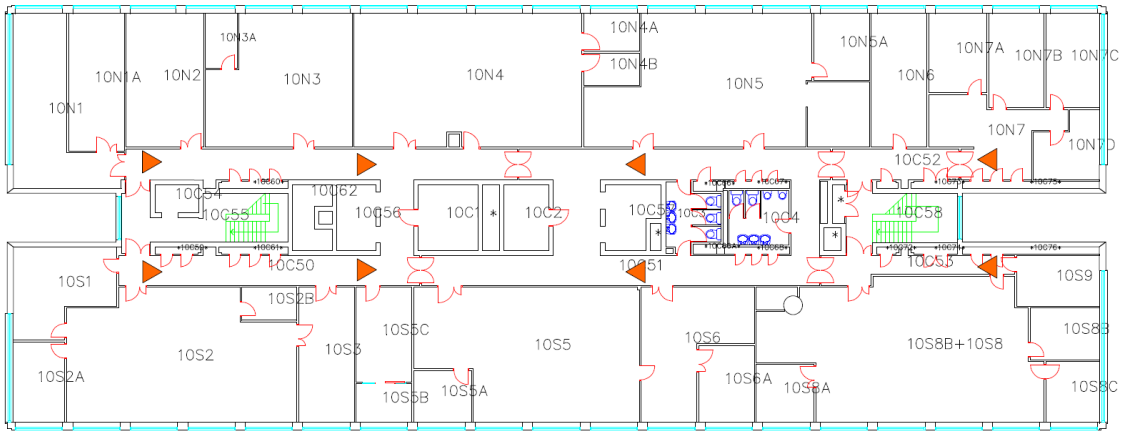
Figure 4

Currently the Cooper B-Line cabinet is the standard cabinet used in the College (for more information see Appendix E – Ordering).

3.0 Wireless Access Point (WAP) numbers

The calculations of WAP implementation will be done by ICL ICT on a case by case basis, depending on diverse factors.

In this particular example it was decided to use 8 in the specific floor.



This should provide blanket coverage as intended.

For Wireless design please contact ICL ICT.

4.0 Active equipment requirements

Starting with the easiest requirement, which is to provide connectivity and power to the WAPs, we can calculate the first active device numbers.

- Juniper® EX4300-48P

Given information:

- 12 units per switch
- 8 WAPs per floor
- 5 floors

Calculation

- 8 WAPs x 5 floors = 40 WAPs / 12 WAPs per switch = 3.3 Switches
- As there can't be 3.3 switches they need to be rounded up to the next unit (4)

A total of 4 switches and 40 high level sockets (for the WAPs) would be needed if all floors were to have the same configuration.

Now we can calculate the number of the other active devices.

- Juniper® EX4300-48P

Given information:

- 400 sockets per floor
- 5 floors
- One third will be made live from day one

Calculation

- 400 sockets per floor (est.) x 5 floors = 2,000 sockets
- 2,000 sockets / 3 (one third of total nbr of sockets) = 667
- 667 active sockets expected / 48 ports per switch = 13.90

As there can't be 13.90 switches it will be rounded up to 14 switches.

5.0 Fibre core calculation

5.1 Vertical distribution

Given information:

- 4 x 48 ports per stack (192 sockets)
- Each stack will be dually attached
- Each attachment will take 2 cores

Calculation:

- 14 switches to be installed / 4 = 3.5 ie 4
- 4 stacks * 2 cores = 8 cores

8 Cores to be used for single attachment but the requirement is for dual attachment (in resilient routes) which will bring us to:

- 2 x 8 cores

2 x 8 cores are necessary for the work. As it is common to have occasional problems with cores and it would not meet the 40% capacity for expansion.

- 8 cores + 40% capacity = 11.2 cores

The next available fibre cable is 16 cores (8, 16 and 24). It is then required to have at least 2 x 16 cores to connect the standard CWC to the BODF.

- Nevertheless, the minimum installation at Imperial College will be 2 x 24 cores.

Note: In a purely financial side the price difference between 8 and 16 cores is usually minimal.

5.2 Backbone

As working on the backbone infrastructure is usually a time consuming and expensive job, with associated risks in terms of Health & Safety we will install from day one enough fibre to maintain the entire building rather than adding up at a time. This fibre is run from the site router locations to the nominated primary CWC for the building; typically the nearest to ground level.

Given information:

- Commonwealth Building will have 3 CWCs at the end of the refurbishment
- Each CWC will have been sized for the same area and number of sockets

Calculation:

- 2 x 24 cores per CWC x 3 CWCs = 2 x 48 (2 cables with 24 cores) will be run to the router locations.

In the Commonwealth Building, the primary CWC happens also to be a site router location. Therefore 48 of the cores would remain local and only fibre patch cords would be necessary. The other 48 cores would be run to the second router location (Burlington Danes in this case).

6.0 Patch cords

6.1 CWC patching

The projects need to provide patch cords according to the number of active ports required by the client, plus an equal amount for the phone requirements and an extra 10% (of varied sizes) for emergency and possible changes (for both data and telephones).

The project will also provide patch cables for WAPs and any other special services.

6.2 Socket and port patching

The projects need to provide patch cords according to the number of active ports required by the client plus an extra 10% (of varied sizes) for emergency and possible changes (for data). Patching services should also be included using one of ICT's approved contractors (see Appendix A).

Given information:

- 14 switches
- 48 available ports per switch
- 40 WAPs

Calculation:

- 14 switches x 48 ports = 672 available ports
- 672 ports + 10% = 739.2 (rounded up to 740)

740 blue patch cables will have to be provided (CWC patching)
740 Grey patch cables will have to be provided (Client patching)
40 Red patch cables will have to be provided (CWC patching – Wireless)
40 Grey patch cables will have to be provided (wireless patching)

1560 patch cables to be provided for data.

xx Blue patch cables to be provided for VoIP voice patching in the CWC (where xx is the number of connections requested by the client). Any Legacy voice will need Green cables.

Note: Exact numbers and lengths of patch cables must be agreed with ICT before ordering. Delivery address and storage of patch cables must also be agreed with ICT.

Note: Whilst this is an example which is quite broad we anticipate that these requirements will also cover for the patching of other services such as:

- AV; Red patch leads in the comms room with a label saying “AV”+”<room number>”
- BMS; red patch leads in the comms room with a label saying “BMS”
- Security; red patch leads in the comms room with a label saying “Security”
- Meeting rooms, lecture theatres and other public spaces where

services might be expected to will be labelled day one and with a wraparound label saying “Meeting Room + <Room number>”, “Lecture Theatre + <Room Number>” and “Public access +<Room number>”