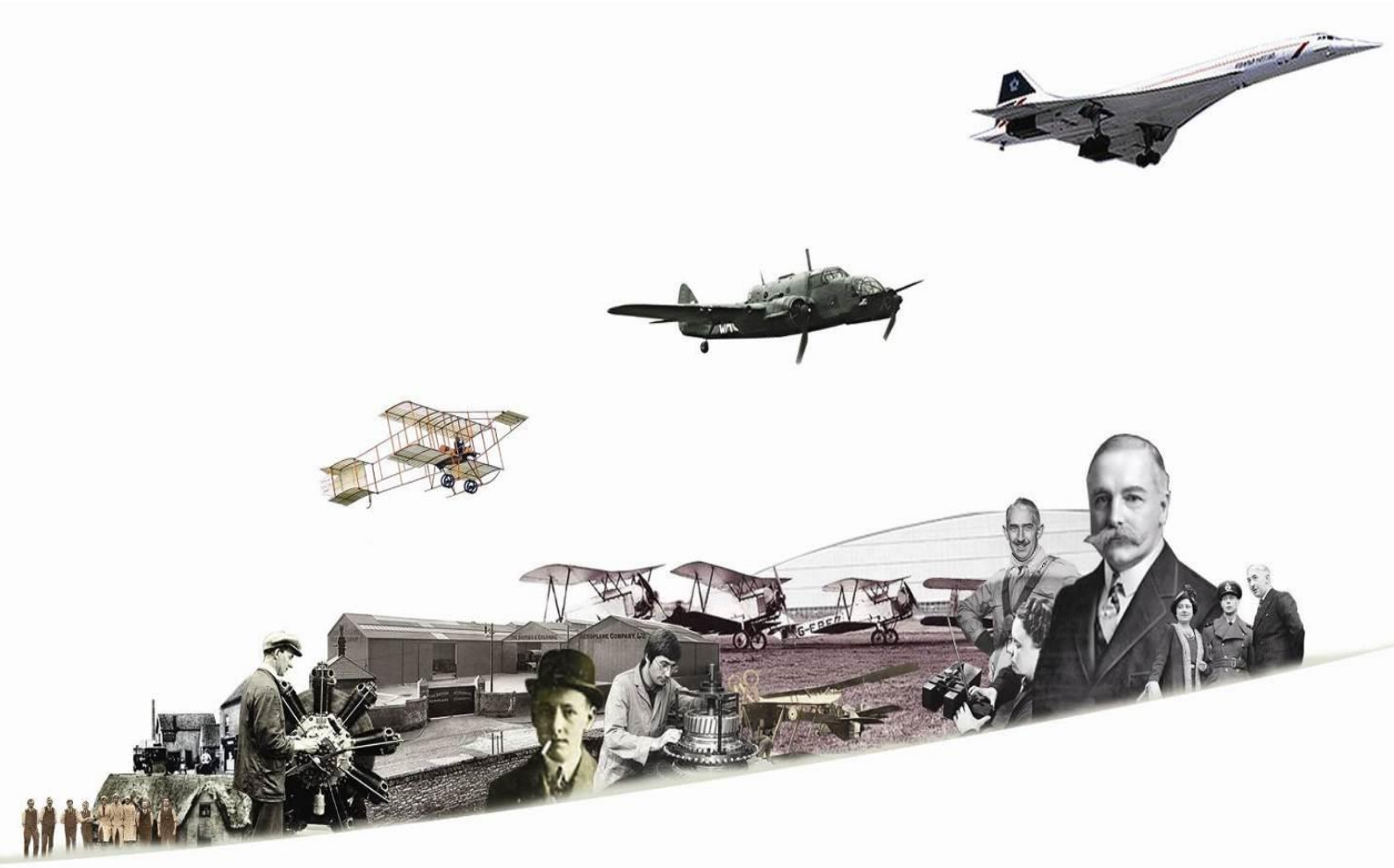
Aerospace Bristol

Active IT System & Wi-Fi

Document Three

IT & Technology Report

February 2017



Focus Offices

Nottingham
Focus House
Millennium Way West
Phoenix Park
Nottingham
NG8 6AS
Tel: 0115 976 5050
E-mail: enquiries@focus-consultants.com
Website: www.focus-consultants.co.uk

Leicester
4 Merus Court
Meridian Business Park
Leicester
LE19 1RJ
Tel: 0116 275 8315
E-mail: leicesterenquiries@focus-consultants.com
Website: www.focus-consultants.co.uk

Lincolnshire
Focus House
Resolution Close
Endeavour Park
Boston
Lincolnshire
PE21 7TT
Tel: 01205 355 207
E-mail: bostonenquiries@focus-consultants.com
Website: www.focus-consultants.co.uk

London
88 Kingsway
Holborn
London
WC2B 6AA
Tel: 0203 4022166
E-mail: londonenquiries@focus-consultants.com
Website: www.focus-consultants.co.uk

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Client:
Bristol Aero Collection Trust
PO Box 77
Bristol
BS99 7AR

Client Lead: Lloyd Burnell, Project Director
Tel: 0797 412 6448
Email: lloyd.burnell@bristolaero.com

Prepared By:
Focus Consultants
Focus House
Millennium Way West
Phoenix Park
Nottingham
NG8 6AS

Focus Contact: Steven Fletcher, Partner
Tel: 0115 976 5050
Email: enquiries@focus-consultants.com

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Authorised By: Steven Fletcher, Partner

Signature:

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date	**25/04/16**
approved	**DD**
signature	
date	**25/04/16**

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Appendix A System Schematic

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1 Executive summary

This report contains information relating to the IT and technology systems that will be required to be installed into Bristol Aero Collections development of buildings 16S and Concorde building.

The design is based on an initial client meeting held late 2015 and a more recent stakeholder meeting in March 2016.

The outcome of these meetings has allowed us to build up a design consisting of network infrastructure elements and back end active network elements, including WiFi provision to both public and conference / office spaces.

The implementation of the design put forward will allow for operation of all activities expected within the building spaces as captured within the stakeholder meetings, but also provide a certain amount of future expansion provision, including a network backbone design that allows for modular expansion.

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2 Introduction

The design of the IT and technology systems for the BAC development can broadly be split into three categories:

- Active network equipment
- Passive network equipment
- End devices

As the fundamental design of the network relies on the requirements of the end devices, the initial phase requires capturing the user requirements. This was undertaken in multiple meetings, however the most comprehensive took place in March 2016.

The details of these stakeholder requirements capture are shown in the following section, however to summarise, we have considered these three, broad categories:

- Datapoints located in areas containing:
    - static media displays
    - workshop machinery
    - retail points
    - office workstations and printers
    - learning / teaching spaces
- WiFi access points covering all areas, with higher density coverage in higher traffic areas such as the cafe and learning spaces
- Data storage & Archiving in diverse locations for redundancy

The use of datapoints in combination with a broad deployment of WiFi access points allows for diverse network connectivity within the building spaces. It will allow for static equipment that may, or may not have WiFi capability, to connect to the network and access both other systems located on the network and services on the internet.

It is expected that in spaces such as offices and workshops, there will be a large number of devices that are of the static variety, i.e. network enabled CNC machines, printers and office PC workstations. In addition to this, we have liaised with the stakeholder to determine the locations in which media displays will be located. These elements have been placed within the drawings as accurately as possible, however final connection via network patch cables will allow deployment within 5 metres of the datapoint location.

Due to the higher number of people within the cafe and conference spaces and due to the fact that the usage type within these spaces is likely to be high, the density of WiFi access point deployment is higher. It is recommended that high quality Cisco access points are utilised throughout the development as they are highly regarded and considered the best within the industry and provide better handover between access points compared to their competitors.

Displays for media, information and wayfinding shall be IP enabled, allowing remote administration and control of these elements. These shall be statically located at strategic locations, based on output from Stakeholder meetings. As a general deployment strategy, these elements will be located between areas of differing usage, i.e. movement between exhibition spaces, conference spaces and cafe areas.

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3 Incoming Connections

3.1 Design Capacity

It is understood that there will be a peak capacity of approximately 1000 persons and based on this it has been determined that a peak network loading (assuming 15% of persons utilising network and allowing 2Mbit/sec per person) of 300Mbit/sec. It is unlikely that the visitors will be utilising high bandwidth services on the internet at all times so it can be assumed that a 300 - 500Mbit/sec connection to the internet would be sufficient for this development.

3.2 Quality of Service & Diverse connections

By utilising QoS strategies, service can be guaranteed for select groups of users, ensuring that businesses and groups using the conference room spaces have priority over the general public.

In addition to a primary business level service providing the necessary bandwidth to the development, it is recommended that a second link is provided. This will allow for continued operation in the event the the primary link suffers an outage. Additionally, it will then be possible to combine the two connections and undertake load balancing to provide additional capacities to the users.

3.3 Costs

At the time of writing, BT have provided a quote for a 1Gbit/sec connection which comes to £23,664 rental per year.

Based on the calculations above, it is recommended that further investigation takes place to determine more cost efficient solutions. Additionally, a reply from Virgin Media on their suitable service offerings is still outstanding and will be included in future revisions of this report and correspondence.

It may also be possible to take out a lower bandwidth connection initially, with view to increasing it's capacity in the future once actual loadings are known.

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4 Datapoints

As previously mentioned, the primary locations of datapoints will be locations in which static equipment is located. Based on stakeholder discussions the locations of these points are generally known. A certain amount of leeway in final equipment locations is possible, approximately 5m of final patching is acceptable, for both device location and data network cabinet patching. This is based on a main cable run maximum of 90m, resulting in an overall cabling distance of 100m.

Figure 4—1 Datapoint in Dado Trunking - Image courtesy of Fiberstore - fs.com

Due to the size of the buildings, there as some areas which will approach the limit of Cat6A distance maximum. Any locations where the limit is exceed shall be identified on the drawings, Multimode fibre shall be used for these cable runs with associated media converters located at each end of the fibre run. This will allow in excess of 500m.

All datapoint locations shall consist of two datapoints within a standard facia as shown above or within floor boxes. This will provide redundancy and also allow for multiple devices within a location. It is expected that where a datapoint location exists, there is likely to be multiple IP enabled devices, I.e. Office workstation and network printer.

4.1 Minimum Requirements

- Two RJ45 data point outlets per points shown on plan drawings, contained within appropriate back boxes / dado rail mounts. Where possible two Cat6A compliant modules shall be contained within a single gang faceplate (i.e. dual Euromod Faceplate).
- Cat6A cabling to all data point locations shown to enable future 10Gbit connection capability
- All RJ45 Data points / modules to be Cat6A compliant
- All cabling to be contained within appropriate containment. No individual cable should be accessible by unauthorised persons. Where cabling passes through exposed areas, it should be within enclosed containment with suitable tamper proof screws on all access / junction points
- Wiring specification T568A & T568B
- Compatible for wire gauges 22 to 26AWG Solid / 24AWG Stranded wire

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5 Network Switches

5.1 Access Switches

All access switches should be enterprise class units capable of being stacked to provide the access points required. The units should be managed units with the capability of interfacing with wireless access point controller units, as part of the overall wireless access point provision.

The switch and wireless access point controller should be able to work in unison to provide the required QoS scaling depending on the user connecting to the wireless access points associated with the system.

The wired datapoint connected to the access switches shall be locked down so that only machines that are allowed to connect to the wired network, i.e. business machines, shall gain access to the network. As a minimum, this should be achieved through machine MAC address lookup and association so that only registered machines can access the network.

5.2 Minimum Requirements

- Integrated wireless controller capability with:
- Up to 40G of wireless capacity per switch (48-port models)
- Support for up to 50 access points and 1000 wireless clients on each switching entity (switch or stack)
- 24 and 48 10/100/1000 data and PoE+ models with energy-efficient Ethernet (EEE) supported ports
- Three fixed-uplink models with 4 x Gigabit Ethernet, 2 x 10 Gigabit Ethernet, or 4 x 10 Gigabit Ethernet ports
- Dual redundant, modular power supplies and three modular fans providing redundancy
- Full IEEE 802.3at (PoE+) with 30 W power on all ports in 1 rack unit (RU) form factor
- Software support for IPv4 and IPv6 routing, multicast routing, modular quality of service (QoS), Flexible NetFlow (FNF) Version 9, and enhanced security features

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6 WiFi Access Points

WiFi access points shall be provided in all spaces, with an emphasis of coverage within conference room spaces, office spaces and cafe spaces. Within the Exhibition spaces, coverage shall be provided, however the use in these areas is expected to be less than that of the more people dense spaces.

Broadly speaking, there are three categories of use and user profiles:

- Public / Guest access
- Conference areas consisting of paying business customers
- Operational personnel access, staff and office areas

The first category, public access, is expected to be used in a general way by members of the public, including social media interactions. This is a category of use that can be used to the advantage of BAC.

In order for the general members of the public to access "Free" WiFi, it is suggested that interaction with the user is undertaken including one or more of the following:

- User registration via email, requiring the user to agree to adverts limited to events and offerings from BAC
- User Facebook check-in's that shows on their social media feed that they are at the BAC and some information on what the BAC has to offer.
- Standard terms and conditions relating to the use of the WiFi within BAC

It is recommended that investigation into WiFi portal providers takes place to understand what offerings exist in terms of user advertisement and interaction can take place.

Quality of service (QoS) shall be implemented to ensure the network provides a standard of service that is acceptable to each user group. The order in which the groups receive priority of service are as follows:

- Conference space users - Businesses that have paid to utilise the suites and facilities
- BAC staff members and educational purpose users
- General visiting public

All of the above user groups should be segregated by ensuring that they reside on their own network, in the form of Virtual LAN's (VLANs). This compartmentalising of user groups on the WiFi network ensures that exposure of potential threats (i.e. malicious users on Public WiFi network gaining access to Cooperate users on the conference network).

Segregating networks based on expected use type and user group profiles is a fundamental requirement to ensure appropriate QoS policies are deployed.

6.1 Minimum Requirements

- Each access point should be fully capable of being remotely managed
- IEEE 802.11b, IEEE 802.11a, IEEE 802.11g, IEEE 802.11n, IEEE 802.11ac
- The units should be able to report to a central management console their usage statistics and provide self recovery in the event of unit failure. A separate RJ45 management port shall be provided for each device.
- As per the plan drawings, two RJ45 data points shall be provided in each data point / WiFi access point locations shown on the drawings

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7 Cabling

Due to the size of the buildings, there as some areas which will approach the limit of Cat6A distance maximum. Any locations where the limit is exceed shall be identified on the drawings, Multimode fibre shall be used for these cable runs with associated media converters located at each end of the fibre run. This will allow in excess of 500m.

Due to the multiple buildings within the project, network connections between the buildings will be required, for both internal networking requirements and also for the access to the outside world via the Internet connection.

Based on the distances between the buildings, 16S and Concord building, fibre communications link utilising Multimode would be within the limit of the cabling, however, Single mode fibre communications channels allow for greater distances and higher bandwidths, therefore it is recommended that Single mode fibre is utilised for inter building communications.

External Duct grade fibre will be required and it is is recommended that at least 8 pair / 16 core fibre is utilised, for redundancy and future expansion options. This is an upgrade from OM4 Multi-Mode fibre to OS1 Single-Mode fibre.

Cat6A is recommend for all copper based network cabling, this is considered the current standard of cabling and can provide 10Gbit communications over the full 100m distance limit. This is an upgrade from Cat6 cabling.

Currently 1Gbit connections for end devices is considered acceptable, however, with the progression of high bandwidth media content, 3D and virtual reality technologies and the archiving or large amounts of data, 10Gbit connections will likely become the standard in the near future.

7.1 PoE

PoE is considered within the design, however, many of the locations where datapoints are required, the use of PoE is not expected, I.e. Office workstations, media displays, workshop IP enabled machinery. WiFi access points shall be PoE enabled and it is also expected that some of the office / conference space datapoints shall also be PoE enabled to allow for elements such as PoE VoIP telephones / intercoms.

Due to this mixed requirement for PoE it is recommended that a mixed PoE / non PoE switch is utilised within the IT hub data cabinets. These switches generally allow for a proportion of their ports to be PoE enabled, I.e. 24 out of the 48 ports might allow for PoE.

By mapping datapoint location to the correct patched port on the network switch it is possible to allocate PoE to the required datapoints served from that hub room. This shall be done to a patch panels and a port mapping / datapoint list.

7.2 Minimum Requirements

- PoE 802.3at/af, PoE+ compliant. Each PoE enabled data point shall be capable of providing PoE+ power levels of 25.5w.
- All data points for WiFi access points shall be PoE+ enabled.
- All network switches shall be capable of providing full PoE+ power to 50% of their ports
- A patching strategy shall exist to ensure that the data points that require PoE capability shall be patched to the appropriate PoE enable port on the access switches within the hub rooms.

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8 Media / Information Displays

It is recommended that 4k Monitors are utilised at locations where Media and information needs to be displayed. It assumed that these locations will include entrance and exit into areas such as:

- Conference spaces
- Café areas
- Retail Spaces
- Exhibition Spaces
- Main entrances
- Learning and Workshop spaces

Figure 8—1 - 4K UHD Monitor, Wall Mountable - Image courtesy of Wasabi Mango

The displays utilised should be of IPS or better technology as they provide excellent viewing angles compared to TN type displays. Additionally, where a 4K TV may utilise only HDMI inputs, 4K monitors are likely to have more PC friendly inputs such as Displayport. 65" IPS monitors are available.

Provision for IP enabled display units has been provided in the form of datapoints.

Due to the multi-use of these information displays, it is suggested that a fully capable mini-PC unit is deployed at each point where a display is located. These mini-PC units are extremely small in size and capable of displaying 4K UHD resolution content, as well as being capable of interaction is required. The cost of these units has plummeted in recent years along with the size.

Figure 8—2 - Gigabyte Brix - image courtesy of Gigabyte - gigabyte.com

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8.1 Minimum Requirements

8.1.1 Screens

- Screen to be UHD and utilise IPS or OLED panel technology
- Screen size to be between 42" and 65", depending on area, as shown on the plan drawings
- Screen to include HDMI version 2.0 and DisplayPort 1.2 / 1.3 connections
- VESA mounting shall be used on all screens

8.1.2 PC Hardware

- Miniature PC's shall be used for driving all displays, allowing for multiple uses of the screens. The units shall be of the Intel NUC form factor. Both Intel and Gigabyte provide these ultra small form factor units, however other manufacturers also provide suitable hardware.
- As a minimum, all units shall utilise Intel Core i3 6th Generation processors ("Skylake"). These offer suitable processing power for displaying 4k video content as well as being more power efficient than previous generations. If available at the time of installation, Intel Generation 7 processors should be utilised as these will provide further efficiency gains.
- All units shall provide DisplayPort 1.2 / 1.3 outputs, capable of driving 4k UHD displays at 60hz.
- Units shall be mounted securely, out of access from general public. Due to the size, it is possible to mount these units behind the display screens with appropriate VESA mounting hardware. Brackets that combine Screen & Mini PC mountings should be explored.
- The operating system installed on the units should be compatible with the final viewing and control solution put forward for the PC based displays. Both Windows based or Linux based solutions are possible, however a Windows based solution will ultimately cost more in terms of licensing than a Linux based option.
- All PC units should be connected to the network via an RJ45 Cat6A connection, via the data point provided at these locations.
- No USB port on the units shall be accessible by unauthorised persons. It is suggested that the units and all associated cabling are secured within the mounting hardware at the display locations.

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9 Network & Data Cabinets

All equipment cabinets utilised should include a lockable door and be of a cabinet type as opposed to an open rack style frame. Based on estimated equipment counts, we are able to provide indicative power / cooling requirements for each cabinet and equipment rooms. This information is located on the schedules and schematic drawings.

Dual power supplies shall be utilised in all equipment, and shall be fed from diverse supplies. It is recommended that one power supply (primary) is connected to the main supply of the hub room, with the redundant power supply linked to the UPS unit within the cabinet. This allows for diversity and redundancy of each piece of equipment should the UPS unit Pass-through power develop a fault.

9.1 Minimum Requirements

- All cabinets within the development that are highlighted on the plan drawings are considered to be full size lockable cabinets, of 42U height, 1000mm depth and 800mm width. This size of cabinet shall allow for cable management.
- Cooling fans shall be provided at the top of the cabinet
- Dual PDU's shall be provided within the cabinet, for connection to dual power supplies for the individual equipment within the cabinet. This diverse supply shall be from mains as well as from the UPS within the cabinet itself.
- A UPS unit shall be provided within all equipment cabinets. These shall be capable of powering the equipment within the cabinets for a period of 15 minutes in the event of power failure.
- Appropriate cooling shall be provided within each of the equipment hub rooms. The cooling shall be of a suitable sizing to cater for the heat output from all of the cabinets within the space. It is calculated that for the cabinets comprising of active server equipment, such as CCTV network video recorders and archiving servers, the power draw / heat generation shall be in the region of 5kw per cabinet. For network equipment only cabinets, consisting of core and access switches, a power draw / heat generation of approximately 3kw will exist.

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10 VoIP

It is recommended that within the development, maximum use of the internal IP network is undertaken, including the reliance on VOIP phone communications. It is understood that at a minimum, two incoming standard telephone lines will be required, however, once within the development boundary, it is recommended that all communications then take place over the IP network. This will reduce the overall cabling requirements as well as increase the future proofing of the system.

Within the development, VoIP should be used exclusively. To allow incoming and outgoing standard telephone connections a PSTN / VoIP gateway will be required, housed within the data communications room in 16S.

This unit shall be rack mountable, however, cloud based solutions from 3rd party providers should also be explored to determine user / cost ratios and ultimately the most cost efficient solution. BT currently offers multiple tiers of cloud VoIP and user hosted services and may be able to offer a solution as part of a managed incoming data / voice package. Detailed discussions with the BT and other providers will be required to understand the most cost effective solution.

10.1 Minimum Requirements

- All VoIP phone systems within the development should utilise PoE+ and not rely on an external power source for their operation
- The external phone line connection and associated phone number should be capable of being forwarded to any phones within the development, on the IP network. It should be possible for external callers to utilise extension numbers to facilitate forwarding of their call to the appropriate extension within the development.
- Investigation into service provider based solutions should be undertaken, i.e. BT's VoIP offerings, to determine the costs and benefits.

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11 Conference Space facilities

One of the key elements to the development is the conference space offering, providing revenue through providing high quality conference room and theatre spaces for businesses, both local and from farther afield.

As previously mentioned, high bandwidth network connections shall be provided in all areas, with QoS and segregation of public / business and private networks to allow for security of network services and ultimately an uninterrupted service for for fee paying customers of high priority spaces, such as the conference room spaces.

Within the spaces projectors shall be provided. Connections to these projectors should be able to cater for a wide variety of users machines display output types.

In addition to the ability to display users computers outputs via a projector, it is recommended that each space also has a screen sharing capability. This will allow users around the conference room space to wirelessly share their computer screens into the projector system.

This can be achieved through the use of one or two technologies.

11.1 USB Based Sharing Devices

These devices connect to the users laptop and after a simple process, are ready to use. The user simply clicks on a button on the dongle and their screen is shared. Multiple users are able to share screens resulting in a very easy to use collaboration system. This system is recommended due to the ease of use, however there is a cost premium associated with this system. An example of such a system is the Barco Clickshare product.

Figure 11—1 Barco ClickShare devices – Image courtesy of Barco

11.2 Google Chromecast

Another option is the popular Google Chromecast unit. This connects to the WiFi within the space and is available over the network. It plugs into a spare HDMI port on the projector / screen and is capable of displaying various 1080P content and audio from many applications. These applications can be based on any device, from phones, tablets through to PC's and laptops. The application must support Google Chromecast however. It is recommended that this product is used in association with other connectivity options and not exclusively, mainly due to it's very low set price of £30.

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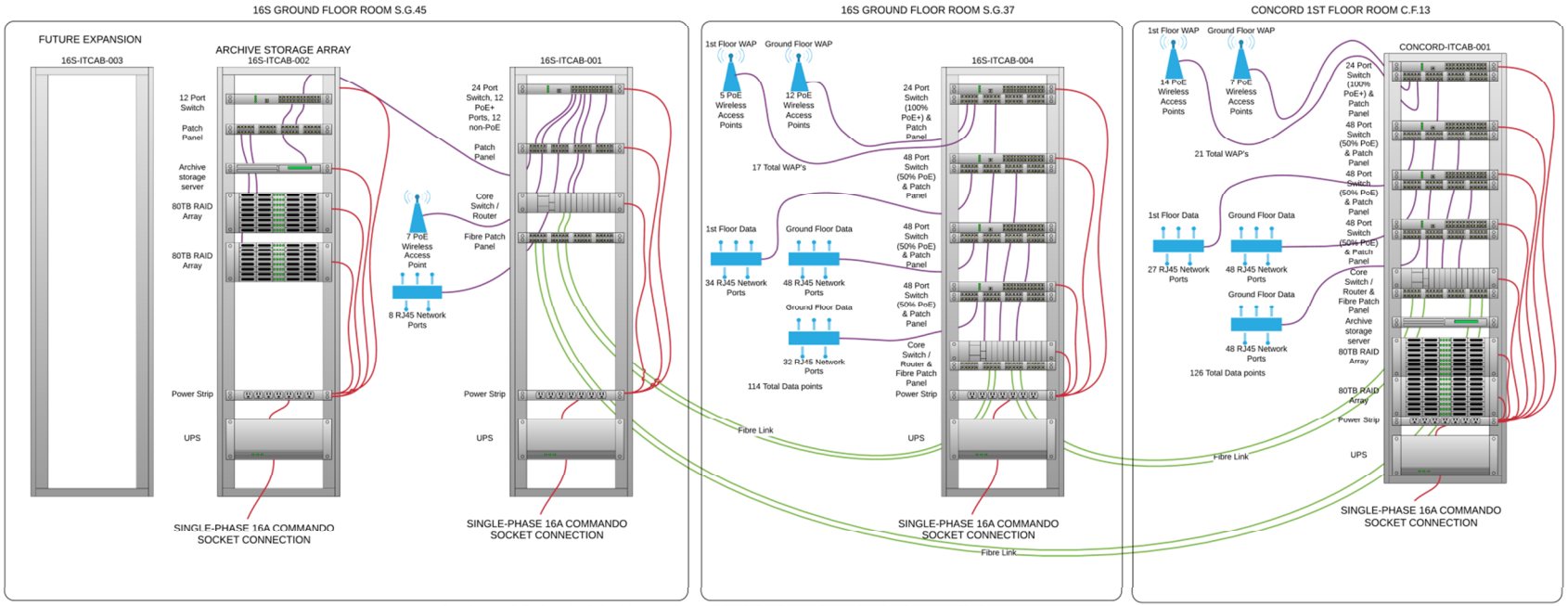
Appendix A System Schematic



Note: Connections shown for indication only. Final rack layouts to be undertaken by installer based on confirmed equipment specification.

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Richard Postma
Buro Happold Limited
Camden Mill
Lower Bristol Road
Bath
BA2 3DQ
UK

T: +44 (0)1225 320 600
F: +44 (0)870 787 4148
Email: richard.postma@burohappold.com