**Network Design Proposal for Apollo Business Consulting**

**Prepared for Simon Galton**

**COMP 10019**

**Fall 2024**

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**Introduction**

The purpose of this document is to provide a thorough overview of SHANA Networks' proposed 3-tier network solution for Apollo Business Consulting's new 5 floor campus.

At every stage of our process, we have made design decisions with your future in mind. In the dialogue we've had with your representatives, and the supplementary research we've done into your enterprise, it has been made abundantly clear that our design needs to support the growth your company expects to see over the coming years. We at SHANA believe our design will provide you with a fast, robust, and scalable network that can act as a sturdy foundation the folks at Apollo Business Consulting can rely on for years to come.

This report will clarify the specifics of our design, rationalize those decisions in the context of your organization, and provide insight and analysis where appropriate.

At a glance, this design will provide your campus with a suite of high-end Cisco switches including: 3x Catalyst 9300X (C9300X2-24Y), and a series of Cisco Business 350 switches in various sizes (8x CBS350-24FP-4X, 8x CBS350-48FP-4X, and 5x CBS350-8FP-E-2G). These switches will be interconnected by 345 meters of multi-mode fibre, and 13483 meters of Category 6 cabling all of which comply with TIA/EIA 568 standards. Additionally, we have provided a Cisco FirePOWER 3140 Next Gen Firewall (FPR3140-NGFW-K9) to protect your network traffic and a Cisco Catalyst 9800 Wireless Controller (C9800-40-K9) which will serve to control 5 preliminary access points (C9120AXI-EWC-A) we have opted to bundle with this network design.

We look forward to bringing this project to life and on behalf of the SHANA team:

*Thank you for the opportunity to provide this proposal.*

**Executive Summary**

This report provides a thorough overview of the 3-tiered network SHANA networks is proposing for Apollo Business Consulting's new 5 floor campus.

This design makes use of high-end, enterprise grade Cisco products including a Cisco FirePOWER 3140 Next Gen Firewall (FPR3140-NGFW-K9), three Cisco Catalyst 9300X switches (C9300X2-24Y) for both the core and distribution layers as well as a suite of Cisco Business 350 series switches such as CBS350-24FP-4X (8x), and 8x CBS350-48FP-4X (8x) which will provide access level connectivity. Additionally, our design will provide a set of Cisco CBS350-8FP-E-2G (5x) switches which will allow for the implementation of an AP array after a thorough site survey is conducted. This hardware will be connected vertically by a 345 meter multi-mode fibre backbone and distributed to your employee workstations via 13,483 meters of Category 6 cabling all of which comply with TIA/EIA 568 standards.

This design will provide all 311 employees of Apollo Business Consulting and its president each with a 1 Gigabit connection to this network with significant room for growth.

Our installation estimate will amount to a total of $XXX and our team has calculated a yearly upkeep of $XXX which includes any necessary service, maintenance, and upkeep.

* Need to finalize costs
* Add additional hardware specifics if intro is edited

**Business Profile**

Over its 15 year history, Apollo Business Consulting's commitment to corporate excellence has fuelled it's growth to an impressive 311 employees which span a hierarchy of 11 distinct departments.

This year marks a bold milestone for Apollo, as the company has opted to relocate their operations to a brand-new, cutting-edge 5 floor campus; citing a dedication to provide their staff with an environment that fosters collaboration and innovation. This move will provide Apollo with the opportunity to develop and deliver meaningful initiatives to the clients and communities that have come to rely on their services and will undoubtedly stoke the next 15 years of their growth.

At the heart of this operation is an impressive 311 employee workforce which is broken down into 11 major departments: HR, Finance, Sales and Marketing, Legal, IT, Security, Communications, Business Consultants, Client Management, Research and Analysis, and Project Management. Their staff attributes their success to the hierarchical structuring of these departments and the integration of its executive individuals into each of their respective departments where they work alongside their staff as a unified team.

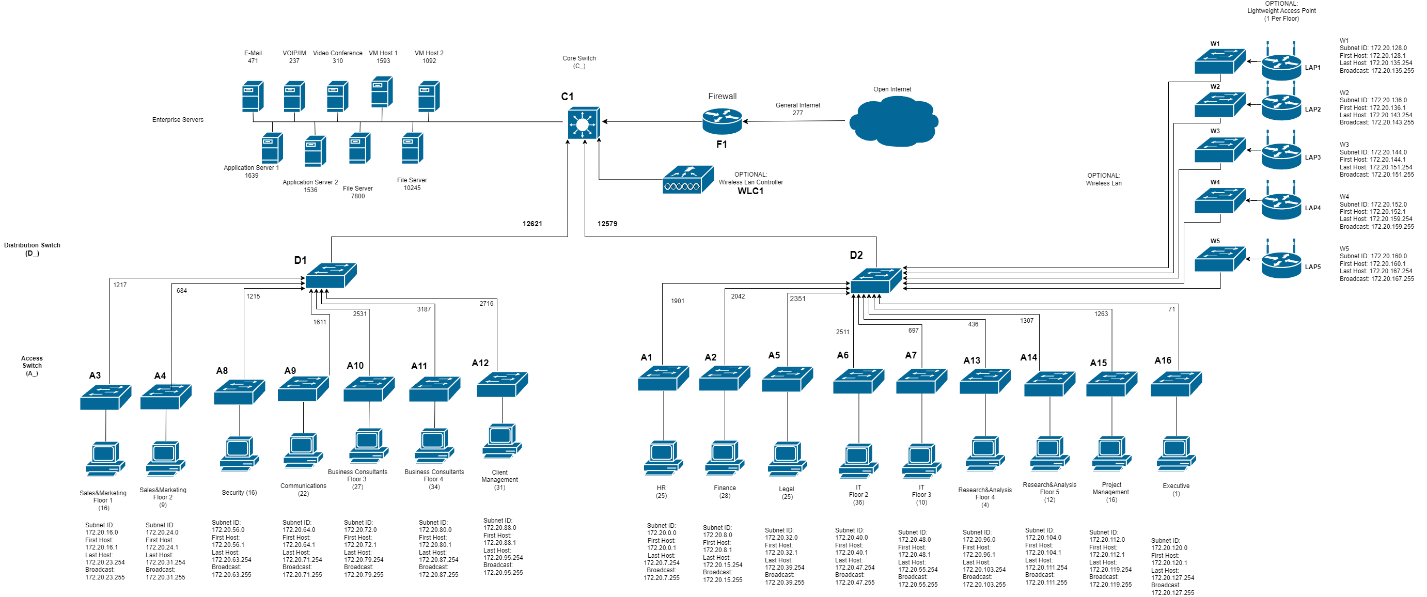
To support this workforce and their clients, Apollo Business Consulting maintains a series of networked printers and VOIP phones as well as several on-site physical and virtual servers. These servers provide internal staff with e-mail and other office productivity services like file sharing, and collaborative task management. Additionally, these servers host numerous web-services which provide clients with access to real-time analytics, collaboration tools, and database services all through a convenient and modern dashboard interface. This modular implementation of virtualized servers provides Apollo with the flexibility to grow seamlessly with the demands of their clientele, and demonstrates Apollo’s continued dedication to innovation and productivity.

* acknowledge the business, it's growth etc
* share department breakdown and the services they use

**Proposed Logical Network Layout**

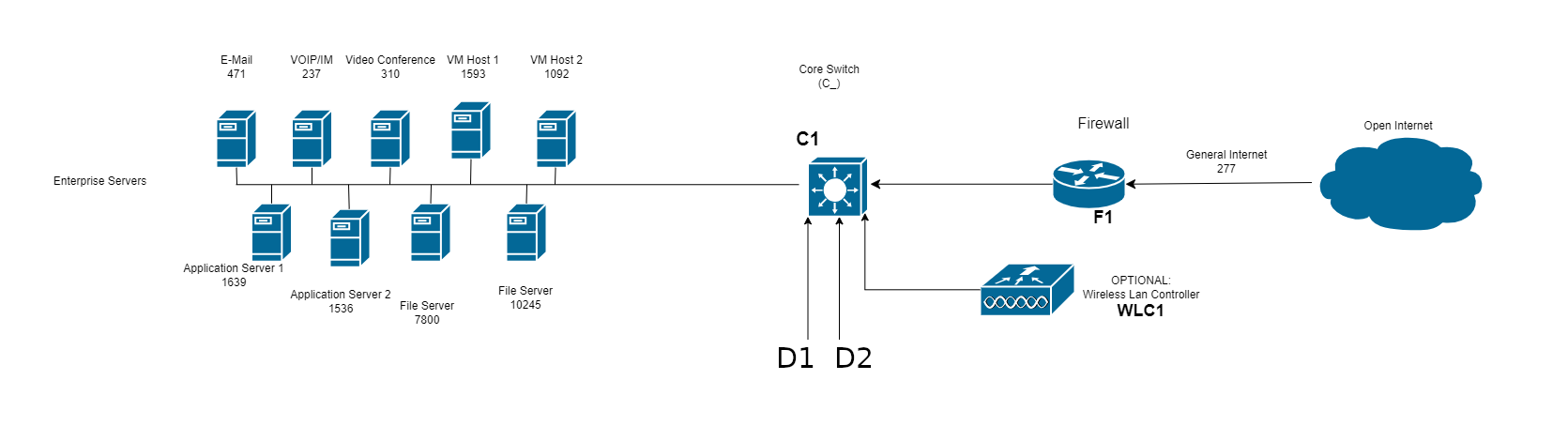
The following diagrams outline the proposed logical network for Apollo Business Consulting’s 5 story campus. For the sake of clarity, this design will be explained as a set of 4 logical sectors: C1, D1, D2, and W.

**Logical Overview**



For each sector, a brief description of the hardware and its connections will be provided and will be detailed later in this document (see Hardware). Additionally, preliminary subnetting has been provided to help clarify how this network can be logically segmented (see Appendix B).

**C1 (Core)**

****

In our design, your Rogers Business Internet Connection is fed to a FirePOWER 3140 firewall which will protect your network from the open internet. From there, “C1” serves to represent your primary core switch. This Catalyst 9300X is where your enterprise servers will directly connect to the network and where a Catalyst 9800 WLC will be connected to control an array of access points we will detail later in this document. Both of the distribution tier switches we have provided will connect to C1 at this level.

**D1 (Distribution 1)**

**A diagram of a computer network

Description automatically generated**

Depicted in this diagram a switch we refer to as “D1”, another Catalyst 9300X which will serve as the first in a set of 2 distribution switches for your network. 7 access level switches are connected to “D1” and these switches will provide direct connections for your employees to access the network. Notably, each of the depicted departments are isolated on individual switches which will provide added network security for your daily operations.

**D2 (Distribution 2)**

**A diagram of a computer network

Description automatically generated**

Like “C1” and “D1”, “D2” is also a Catalyst 9300X and will serve a connection to 9 more access level switches. As was the case with “D1”, each department is isolated on their own access switch for network security. Notably, the “D2” trunk of our topology includes another 5 switches which serve a connection to a set of access points we have included in this design. See sector “W” for details.

**W (Wireless Foundation)**

**A diagram of a network

Description automatically generated**

Pending a formal site survey, our design provides 5x CBS350-8FP-E-2G switches and 5x C9120AXI-EWC-A Access Points which will each serve an individual floor of your campus and is provided its uplink by the “D2” trunk.

This configuration, and the aforementioned site-survey will be detailed in the “Wireless” component of this report.

**Proposed Physical Network Layout**

This design makes use of a first-floor entrance facility (EF) which houses the demarcation point provided by Rogers. This demarcation point will be extended through conduit directly up to the second floor which will provide a short and efficient channel between the the EF and the primary equipment room (ER).

Although the EF occupies some portion of the first-floor finance office and the ER occupies the majority of the second floor East IT office, we have calculated the space the EF and ER will occupy and are confident the space will NOT displace any employees as you currently plan to have them situated.

Specifically, the ER will occupy 144m2 which will leave 115m2 for the staff that will work there. Given the 10 employees and an average cubicle size of around ~6m2 this will leave roughly 55m2 for walking and airflow which we anticipate will be more than sufficient. The ER itself will contain the primary core switch (C1), firewall (f1), WLC, and all of your enterprise servers and virtual hosts.

**A table of numbers with letters

Description automatically generated**From the ER, a backbone of multimode fiber is provided to the telephone rooms (TR) on the second floor. These TR’s each will house a distribution switch (D1 and D2 respectively) and several access switches. From these distribution switches, a vertical backbone of multimode fibre provides direct connection to access level switches on each floor, all housed in the TR’s that alight vertically as depicted in the following diagrams. These access level switches will serve connection each of your 311 employees and your president via Category 6 cable. This cabling is omitted from these diagrams for clarity but are detailed in the ”Cabling” section of this document.

The following diagrams outline the proposed physical network for Apollo Business Consulting’s 5 story campus. A legend has been provided along side each floorplan for your convenience and clarity

All devices are named and mapped on a floor by floor basis as per the attached table. And detailed lists of this hardware will be provided in the “Hardware” section of this document.

**First Floor**

A blueprint of a building

Description automatically generated

A screenshot of a computer

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**Second Floor**

A blueprint of a building

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A screenshot of a computer

Description automatically generated

**Third Floor**

A blueprint of a building

Description automatically generated

A screenshot of a computer

Description automatically generated

**Fourth Floor**

**A blueprint of a building

Description automatically generated**

A screenshot of a computer

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**Fifth Floor**

A blueprint of a building

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A screenshot of a computer

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**Cabling**

Our plan is to install a demarcation point extension from the first floor entrance facility to our equipment room via plenum rated multi-mode fiber cable directly into our firewall. From here, the same plenum fiber connects to our core switch in our equipment room where 2 fiber trunks span to our distribution switches separately located in telecommunication rooms TR2A and TR2B. These distribution switches connect with fiber to each of our access switches vertically through our TRs and horizontally to the appropriate switch according to how our network bandwidth is load balanced.

Horizontal cabling is organized with cable trays attached to existing building infrastructure with threaded rods, allowing plenty of room within plenum space for cable expansion and providing easy cable management. Our access switches use Category 6 plenum rated cables to reach client work areas and access jacks within each office, all of which comply with TIA/EIA 568 standards. These jacks connect to Category 6 work area cables for each office, providing all employees with a reliable, fast network connection. Additionally, plenum rated fiber cables provide network redundancy between telecommunication rooms on each floor, and patch panels within network device racks allow fast accessibility to every port on every switch.

**Total Cable Lengths**

|  |  |  |  |
| --- | --- | --- | --- |
| Placement | Type | Total Length | Cost Estimate |
| Work Area | Category 6 | 1691 meters | ~$4,633.34 |
| Horizontal | Category 6 | 11792 meters | ~$124,363.35 |
| Backbone | Multi-mode Fiber | 345 meters | ~$3,057.60 |
| TR Patch Cables | Cat6/Fiber | 163 meters | ~$1,040.45 |

**Work Area Cable**

|  |  |  |  |
| --- | --- | --- | --- |
| Cable | Description | Amount | Image |
| RJ45 Cat6 UTP Ultra-Thin Patch Cable - Premium Fluke® Patch Cable Certified - CMR Riser Rated | Category 6 cables of various lengths per office provide client node access within each office | 311 cables between 1-13 meters:  ~$2.74/meter | Close up of a cable  Description automatically generated |

**Note**: All measurements are in **METERS**, please disregard the following table headers showing feet.

**Floor 1 - Work Area (Calculations in Meters)**

A calculator with numbers and text

Description automatically generated

**Floor 2 - Work Area (Calculations in Meters)**

A calculator with numbers and text

Description automatically generated

**Floor 3 - Work Area (Calculations in Meters)**

A calculator with numbers and text

Description automatically generated

**Floor 4 - Work Area (Calculations in Meters)**

A calculator with text

Description automatically generated

**Floor 5 - Work Area (Calculations in Meters)**

A calculator with numbers and text

Description automatically generated

**Horizontal Cabling**

|  |  |  |  |
| --- | --- | --- | --- |
| Cable | Description | Amount | Image |
| 304.8 meters 4 Pair CAT6 Solid U/UTP 550Mhz 23AWG CMP Plenum Bulk Cable | Plenum rated Category 6 cabling is bought in bulk to cover the 11697 meters required for the entire company | 39 boxes @ $362.50/each | A box with a cable  Description automatically generated |
| Middle Atlantic 6’ Long 5/8” Threaded Rod | Threaded rods connect our cable trays to our ceiling cable runs within hallways to our work areas | ~400 @ $48.99/each | A drawing of a metal frame  Description automatically generated |
| Tripp Lite Rack Enclosure Cabinet 10ft Roof Cable Manager Ladder 10' - rack roof mount cable manager ladder | Cable trays provide cable organization and easy management within the office’s hallways and infrastructure | ~400 @ $225/each | A metal frame with wires on top of it  Description automatically generated |
| OM4 Multimode 50 Micron Indoor (Corning ClearCurve) - OFNP Plenum Fiber Bulk Cable - 12-Strand | Plenum rated fiber cable connects between TR rooms on each floor providing redundant connections between both distribution trunks | 95 meters @ $6.63/meter | A close-up of a cable  Description automatically generated |

**Floor 1 - Horizontal (Calculations in Meters)**

**A table of numbers and letters

Description automatically generated with medium confidence**

**Floor 2 - Horizontal (Calculations in Meters)**

**A screenshot of a computer

Description automatically generated**

**Floor 3 - Horizontal (Calculations in Meters)**

**A screenshot of a computer

Description automatically generated**

**Floor 3/4 - Horizontal (Calculations in Meters)**

**A screenshot of a computer

Description automatically generated**

**Floor 4/5 - Horizontal (Calculations in Meters)**

**A close-up of a document

Description automatically generated**

**Note:** An additional 95 meters of multi-mode fibre can connect between TR1-5A and TR1-5B on their respective floors providing redundancy between distribution branches.

**Backbone Cabling**

|  |  |  |  |
| --- | --- | --- | --- |
| Cable | Description | Amount | Image |
| OM4 Multimode 50 Micron Indoor (Corning ClearCurve) - OFNP Plenum Fiber Bulk Cable - 24-Strand | Plenum rated fiber cable bought in bulk to connect from Demarcation to F1 to C1 with D1 and D2 | 74 meters @ $12.73/meter | A close-up of a cable  Description automatically generated |
| OM4 Multimode 50 Micron Indoor (Corning ClearCurve) - OFNP Plenum Fiber Bulk Cable - 12-Strand | Plenum rated fiber cable bought in bulk to connect each access switch with its distribution switch | 271 meters @ $6.63/meter | A close-up of a cable  Description automatically generated |
| 3m LC/PC 12-Fiber OM4 Multimode Simplex 50 micron - 900um Pigtail - Color Coded | Spliced pigtails allow our fiber cable to connect with our fiber patch panels and backbone switches | 7 @ $45.55/each | A close-up of a cable  Description automatically generated |

**A close-up of a document

Description automatically generated**

**A close-up of a document

Description automatically generated**

**Note:** Distribution switches located in TR2A and TR2B to save on fibre cabling costs and increase security

**Telecommunication Rooms Patch Cabling**

|  |  |  |  |
| --- | --- | --- | --- |
| Cable | Description | Amount | Image |
| RJ45 Cat6 UTP Ultra-Thin Patch Cable - Premium Fluke® Patch Cable Certified - CMR Riser Rated | Category 6 cables for connecting switches with patch panels within our racks – 6 inches | 156 @ $2.10/each | A close-up of a computer cable  Description automatically generated |
| RJ45 Cat6 UTP Ultra-Thin Patch Cable - Premium Fluke® Patch Cable Certified - CMR Riser Rated | Category 6 cables for connecting switches with patch panels within our racks – 1 foot | 156 @ $2.21/each | A close-up of a computer cable  Description automatically generated |
| OM4 Multimode Duplex LC/LC 50 Micron - Fiber Optic Patch Cable - 2mm Jacket - LSZH/OFNR - 0.5m | Fiber cables for SFP+ connects between switches | 46 @ $8.05/each | A close up of a cable  Description automatically generated |

**Hardware**

Every tier of this network design makes use of high-end Cisco switches. Each device was carefully selected based on available features and specific models and sizes were selected to support the growth Apollo Business Consulting expects to see over the next several years.

**Firewall**

A back side of a white electronic device

Description automatically generated

**Cisco FirePOWER 3140 Next Gen Firewall (FPR3140-NGFW-K9) (1x)**

Boasting a 48Gbit throughput, this firewall ensures that security will never be a bottleneck on your system. The model implemented in our design provides an 8-port interface to allow for all types of physical configurations as needed. We understand Apollo Business Consulting deals regularly with sensitive company and client information and we believe this firewall will provide Apollo and its clientele with the assurance that their data will be protected at all times.

**Core and Distribution**

A close up of a device

Description automatically generated

**Cisco Catalyst 9300X – 24 Port (C9300X2-24Y) (3x)**

This 24-port stackable switch comes from a line of Cisco products that are built for enterprise grade security, mobility, and scalability. It offers flexible uplinks of either 100, 40, 24, 10, or 1 Gbit and all provided ports are SFP28 and allow for fibre or CAT-6 expansion in either 1, 10, or 25 Gbit configurations. Should future expansion require it, this line of switches offers full backward compatibility, and their modular design allows for higher uplink and throughput speeds to ensure bandwidth is never an issue even on even the largest networks. The 9300X is a rack mountable managed switch, that provides a myriad of useful features like integrated routing (11 protocols), ACL support, Cisco’s StackWise technology, Full duplex mode, Layer 3 VPN support, Private VLAN functionality, Virtual Extensible LAN, VLAN double tagging and much more. Should your IT department choose to implement a VLAN to support your growth, rest assured your core and distribution switches are prepared to manage it.

**Access Switches**

A group of white electronic devices

Description automatically generated

**Cisco Business 350 (CBS350-48FP-4X) x8, (CBS350-24FP-4X) x8, (CBS350-8FP-E-2G) x5**

Our access-level design is provided by Cisco’s Business 350 series of switches. Each department has been provided either a 24 or 48-port switch depending on the number of employees that need to be served on each floor. Departments that exist on separate floors have been provided with a separate switch respectively. Although admittedly costs could have been cut for smaller departments by making use of smaller port count switches from this line of products, our design opted to lean in in the direction of higher port counts to support the inevitable growth of Apollo Business Consulting. All ports on these switches are POE+ and will be capable of supporting the variety of POE devices like VOIP phones we expect your employees will be making use of. These switches are also managed and come packed with additional features like dynamic Layer 3 policy-based routing, DHCP services, ACL functionality, and of course VLAN support. The Business 350 switches in our design all serve Gigabit Ethernet on each port with 4x 10 Gbit SFP+ uplinks.

In addition to the 16 access level switches provided from this line of products, we have included 5 addition Business 350 switches (CBS350-8FP-E-2G) to support an array of access points (see Wireless).

**Wireless**

**WLC**



**Cisco Catalyst 9800 Wireless Controller (C9800-40-K9)**

This top-of-the-line Cisco product will provide your network with a best-in-class wireless experience by way of this robust, and secure wireless controller. The Catalyst 9800-40 provides seamless software updates and is recommended for midsize or large enterprises as it provides the capability of controlling up to 2000 wireless access points and 32,000 clients.

**Access Points**

A white square object with a black button

Description automatically generated

**Cisco Catalyst 9120AXI Access Point (C9120AXI-EWC-A) x5**

Our design includes 5 resilient and secure access points from Cisco’s 9120 line of APs. Perfect for networks of all sizes, this product is designed to support the latest innovations in the growing realm of the Internet of Things (IoT) and supports Wi-Fi 6 (IEEE 802.11ax), an emerging standard in wireless technology.

Although Apollo Business Consulting did require wireless functionality for this network, the team at SHANA typically bundles an initial set of access points (~1 per floor) for configuration and testing. Additional details on our philosophy and process are provided below.

**Optional: Wireless Site Survey**

Given the nature of your new 5-floor campus, planning the installation of a wireless network will require a thorough Wireless Site Survey. As mentioned previously, SHANA Networks provides an initial bundle of access points in all of our designs to facilitate the testing that this survey will require.

***Please note this survey is highly recommended but entirely optional.***

All wireless site surveys are different and standard office layouts can differ wildly in their physical construction and in the various sources of radio interference that may be situationally present.

The goal of a site survey will be to ensure seamless, strong signal in all work-areas, and constant reliable connection to network resources; all at reasonable throughputs. Although we’re confident the network we have designed is more than capable of supporting your enterprise, there is no doubt that the convenience of a wireless configuration will support Apollo’s commitment to fostering the environment of innovation and collaboration that will stoke the growth you expect over the coming years.

This survey will include an RF spectrum analysis which will identify any points of interference and account for them in our calculations, a coverage analysis to determine optimal AP locations and mitigate the possibility dead-zones, and finally a thorough set of documentation which we will provide to Apollo that will serve as a set of recommendations and as a guide should any future maintenance or installation be required.

For the purposes of this proposal, we would like to recognize that 5 access points are a lightweight solution to a problem you do not yet have. However, if your staff determines there is value in expanding this initial configuration, the team at SHANA Networks will be more than happy to execute this survey and provide you with a fast and seamless wireless network.

**Cost Estimates**

The xxxxx

* Provide thorough cost analysis
* Include table

A screenshot of a computer screen

Description automatically generated

**Conclusions**

The xxxxx

* Any additional remarks, contexts, rationale can go here
* Conclusions, thanks etc.

**Appendix A – Current Office Layout**

The unoccupied offices are currently configured as follows:

* Include original svg files for reference

**Appendix B – Subnetting**

Suggested subnet configuration:

Private Class B Ip Address: 172.20.0.0  
Default Subnet Mask: 255.255.0.0   
Subnet Mask: 255.255.248.0 /21  
Need 21 Subnets, Need 5 Subnet Bits

**Note:** Subnets assigned in physical ascending order and wireless subnets are optional

172.20.[00000]000.00000000  
Each subnet has 2046 Hosts Available

|  |  |  |
| --- | --- | --- |
| **A1 – HR** Subnet ID: 172.20.0.0 First Host: 172.20.0.1 Last Host: 172.20.7.254 Broadcast: 172.20.7.255 | **A2 – Finance** Subnet ID: 172.20.8.0 First Host: 172.20.8.1 Last Host: 172.20.15.254 Broadcast: 172.20.15.255 | **A3 - Sales&Marketing, Floor 1** Subnet ID: 172.20.16.0 First Host: 172.20.16.1 Last Host: 172.20.23.254 Broadcast: 172.20.23.255 |
| **A4 - Sales&Marketing, Floor 2** Subnet ID: 172.20.24.0 First Host: 172.20.24.1 Last Host: 172.20.31.254 Broadcast: 172.20.31.255 | **A5 – Legal** Subnet ID: 172.20.32.0 First Host: 172.20.32.1 Last Host: 172.20.39.254 Broadcast: 172.20.39.255 | **A6 - IT, Floor 2** Subnet ID: 172.20.40.0 First Host: 172.20.40.1 Last Host: 172.20.47.254 Broadcast: 172.20.47.255 |
| **A7 - IT, Floor 3** Subnet ID: 172.20.48.0 First Host: 172.20.48.1 Last Host: 172.20.55.254 Broadcast: 172.20.55.255 | **A8 – Security** Subnet ID: 172.20.56.0 First Host: 172.20.56.1 Last Host: 172.20.63.254 Broadcast: 172.20.63.255 | **A9 – Communications** Subnet ID: 172.20.64.0 First Host: 172.20.64.1 Last Host: 172.20.71.254 Broadcast: 172.20.71.255 |
| **A10 - Business Consultants, Floor 3** Subnet ID: 172.20.72.0 First Host: 172.20.72.1 Last Host: 172.20.79.254 Broadcast: 172.20.79.255 | **A11 - Business Consultants, Floor 4** Subnet ID: 172.20.80.0 First Host: 172.20.80.1 Last Host: 172.20.87.254 Broadcast: 172.20.87.255 | **A12 - Client Management** Subnet ID: 172.20.88.0 First Host: 172.20.88.1 Last Host: 172.20.95.254 Broadcast: 172.20.95.255 |
| **A13 - Research & Analysis, Floor 4** Subnet ID: 172.20.96.0 First Host: 172.20.96.1 Last Host: 172.20.103.254 Broadcast: 172.20.103.255 | **A14 - Research & Analysis, Floor 5** Subnet ID: 172.20.104.0 First Host: 172.20.104.1 Last Host: 172.20.111.254 Broadcast: 172.20.111.255 | **A15 - Project Management** Subnet ID: 172.20.112.0 First Host: 172.20.112.1 Last Host: 172.20.119.254 Broadcast: 172.20.119.255 |
| **A16 – Executive** Subnet ID: 172.20.120.0 First Host: 172.20.120.1 Last Host: 172.20.127.254 Broadcast: 172.20.127.255 |  |  |

|  |  |  |
| --- | --- | --- |
| **OPTIONAL WIRELESS SUBNETS:** | **W1** Subnet ID: 172.20.128.0 First Host: 172.20.128.1 Last Host: 172.20.135.254 Broadcast: 172.20.135.255 | **W2** Subnet ID: 172.20.136.0 First Host: 172.20.136.1 Last Host: 172.20.143.254 Broadcast: 172.20.143.255 |
| **W3** Subnet ID: 172.20.144.0 First Host: 172.20.144.1 Last Host: 172.20.151.254 Broadcast: 172.20.151.255 | **W4** Subnet ID: 172.20.152.0 First Host: 172.20.152.1 Last Host: 172.20.159.254 Broadcast: 172.20.159.255 | **W5** Subnet ID: 172.20.160.0 First Host: 172.20.160.1 Last Host: 172.20.167.254 Broadcast: 172.20.167.255 |