Network Upgrade Proposal

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Executive Summary

The network upgrade proposal makes implications for the organization to make infrastructure changes to the network to meet latest standards. Currently, the network architecture is lacking in efficiency due to an extended period of time since the previous upgrade. As technology advances at a rapid pace, it is crucial that the organization analyzes and plans for a stronger and more effective network. This proposal will outline the current situation, as well as the methods to obtain a high-functioning, faultless network environment. Results of the upgrade are:

- Seamless and smooth Internet speed
- Increased work efficiency
- Decrease for maintenance
- Update to date hardware

Current Environment

At the moment, the organization employs the legacy token ring structure. The legacy token ring network is outdated for LANS and simply is not sufficient for 250 employees in the 30,000 square foot office space. With the ring topology, a break in the ring can disrupt the network due to the unidirectional flow. This peer-to-peer method can be faulty with such a high volume of users on the network, while the passing of tokens one node by one simply is unreliable and time-consuming. For maintenance, the structure is not ideal since the removal and addition impacts the network's performance. Additionally, with 125 laptops, 6 servers and printers, and 250 VoIP's, it can cause lethargic movement during communication. Overall, it is no longer suitable for an organization with our characteristics:

- 250 desktops
- 125 laptops
- 6 servers (one email, one print, two files, and two DNS/DHCP/AD)
- 6 multi-function printers (situated against the walls, with two in each direction of the North, South, East, and West parts of the floor)
- 250 VoIP phones
- Terminating ISP contract

Existing Network Architecture
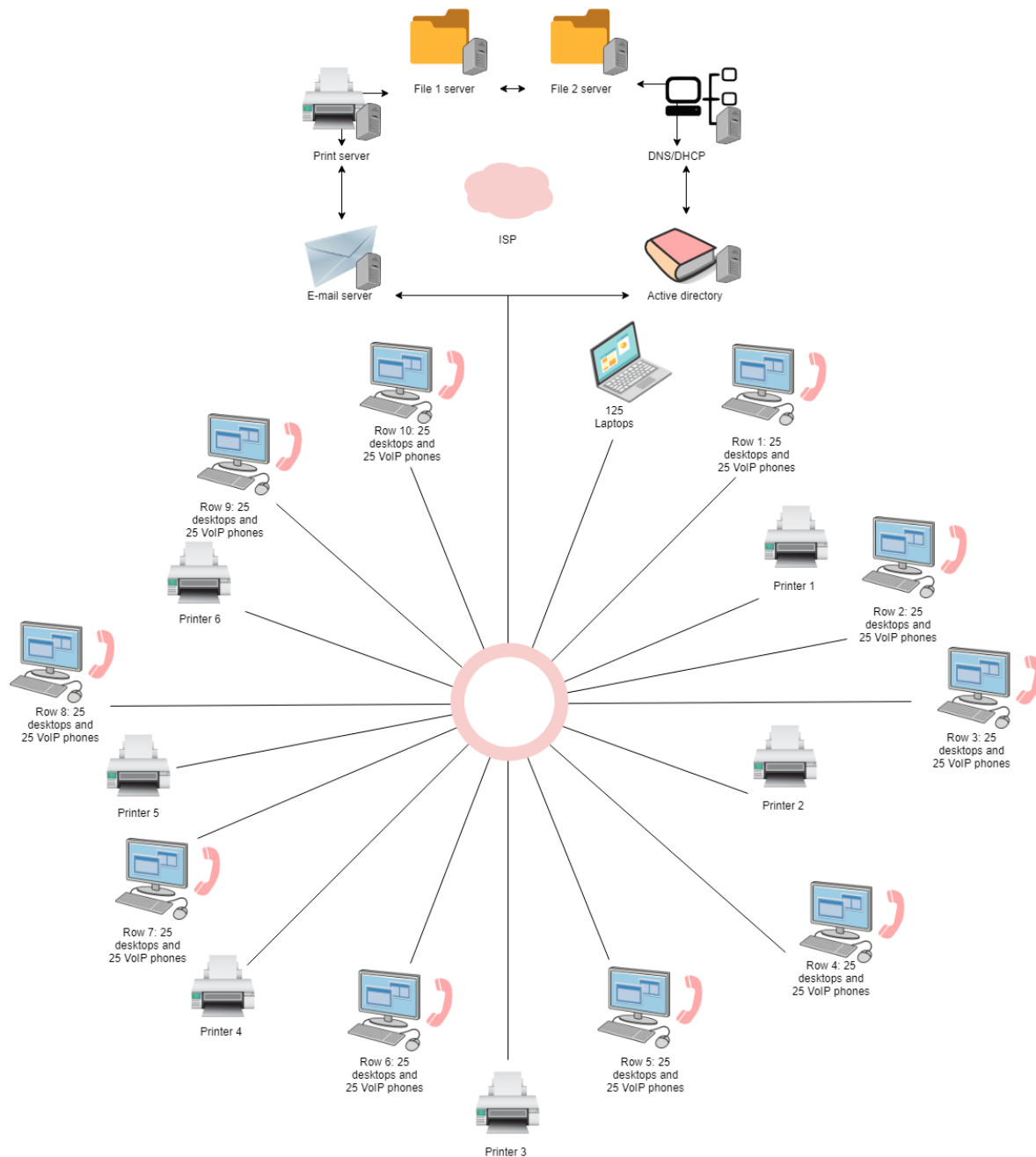
Total nodes: 381

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- 125 laptops
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Environment Upgrade Objectives

As shown above, the current architecture is no longer suitable for a company our size. This proposal will further outline the proper movements towards a well-functioning network environment.

The primary goals of the network upgrade are as follows:

- Deploy a fault-tolerant topology (token ring is outdated)
- Find a high-speed ISP to replace the terminating one
- Create a wireless environment for hosts
- Implement IPV6 addressing
- Create VLAN throughout the network
- Replace power bricks with PoE for VoIP phones
- Reconfigure printers to the network

IEEE Standards

This network follows the IEEE 802.11ac Wave 2 standards of wireless Ethernet. Wave 2 is defined as MU-MIMO (Multiple User Multiple Input Multiple Output), allowing more than one client to communicate at once. The bandwidth operates for both 2.4 and 5 GHz frequencies, thus supporting more devices on the network. The 802.11ac standards also support high-speed Gigabit Ethernet, which is what shall be applied into the newer design.

Upgraded Network Architecture
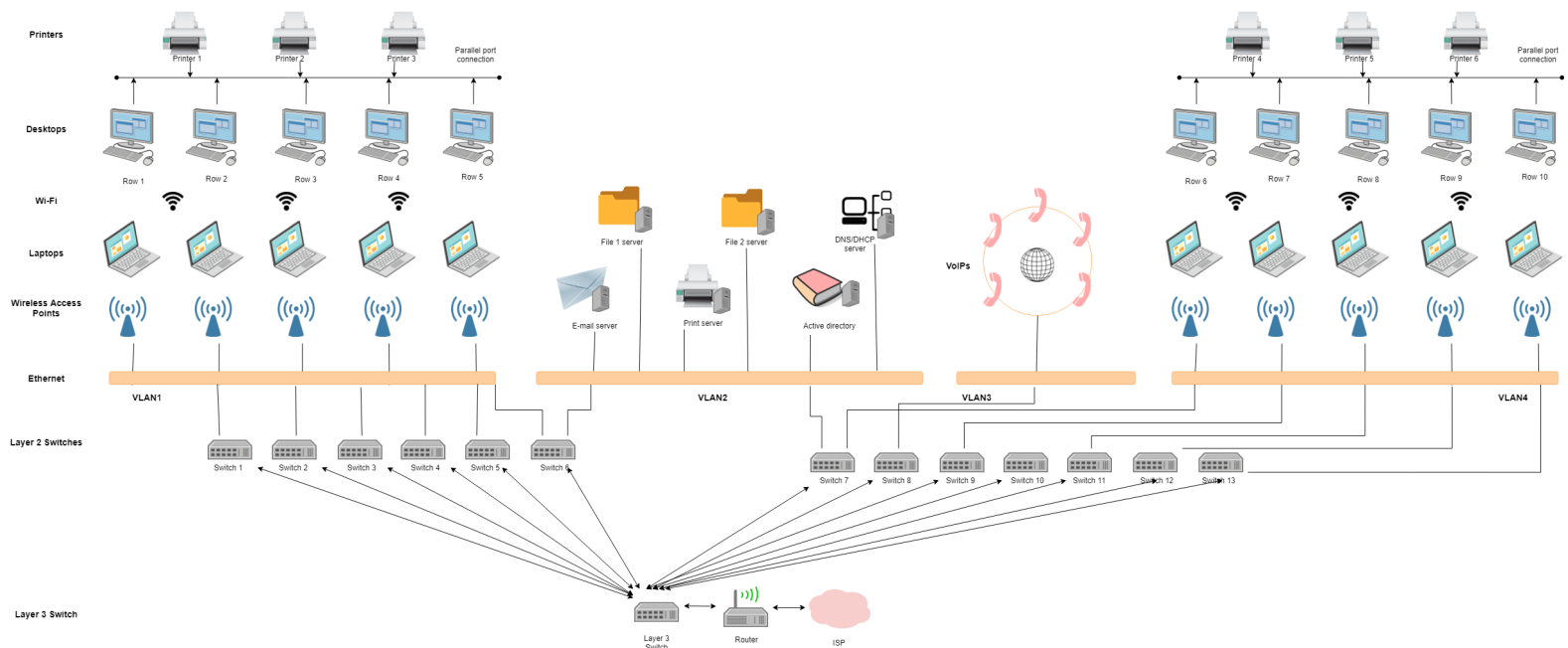
The proposed architecture for the upgraded network is a hybrid star-bus topology that implements wireless connection. The star topology offers fault tolerance compared to other structures. The additional bus topology configuration of desktops and printers allows workstations to communicate with one another easily and share data. Segmenting the desktops, laptops and printers on their own virtual networks allow the load of traffic to be distributed.

Though upgraded, the network still supports the 10 rows of 25 desktops and 125 laptops; this is by the addition of 20 wireless access points connected by the PoE Layer 2 switches across VLAN 1 and 4.

VLAN Configuration

The network will implement four VLANs total. Due to 250 employees each being on their hosts, it is important to segment the network's load. There are VLANs 1 and 4 (2001:db8:cad:1::/64, 2001:db8:cad:4::/64) dedicated to desktops, laptops and their respective printers. There are 25 desktops per row, therefore there are 125 desktops, 62-63 laptops, and 3 printers per respective virtual network. VLAN 3 (2001:db8:cad:3::/64) is primarily dedicated to VoIP to avoid potential interference from nodes that can be performing actions such as downloading by other devices. The last VLAN 2 (2001:db8:cad:2::/64) will host the mail, printer and file servers as well as the directories.

IP Protocol

IPV6 has a larger address space, and likely will be implemented in higher volumes in the coming future as it serves as the long-term solution for space exhaustion. Compared to IPV4's 32-bit unique address, IPV6 uses 128-bit addressing. This will allow the network to subnet for more hosts and devices. VLAN 1 and 4 will require 250 (desktop) + 125 (laptop) + 20 (WAP) = 295 total IP addresses. VLAN 3 will need 250 (VoIP) IP addresses. The servers on VLAN 2 will need six IP addresses.

The first 48 bits on the IPV6 address represents the network prefix. The remaining 64 bits are the interface ID belonging to the host.

VLAN	Network address
1	2001:db8:cad:1::/64
2	2001:db8:cad:2::/64
3	2001:db8:cad:3::/64
4	2001:db8:cad:4::/64

Network Components	IP Range
Desktops (125 per VLAN)	2001:db8:cad:1:1::/64 - 2001:db8:cad:1:126::/64 or 2001:db8:cad:4:1::/64 - 2001:db8:cad:4:126::/64
Laptops (62-63 per VLAN)	2001:db8:cad:12:1::/64 - 2001:db8:cad:12:64::/64 or 2001:db8:cad:42:1::/64 - 2001:db8:cad:42:164::/64
VoIP phones (250)	2001:db8:cad:3:1::/64 - 2001:db8:cad:3:251::/64
Wireless access points (10 per VLAN)	2001:db8:cad:13:1::/64 - 2001:db8:cad:13:11::/64 or 2001:db8:cad:43:1::/64 - 2001:db8:cad:43:11::/64
Servers (6)	2001:db8:cad:2:1::/64 - 2001:db8:cad:2:7::/64

Network Equipment

Layer 2 Switch

SonicWall Switch SWS14-48FPOE - Switch – managed

This 48-port switch is advertised for small and medium businesses. It supports PoE, which is essential for the wireless access points and VoIP phones for connection with 740W. This switch will be housed in the 42U rack among other Layer 2 and Layer 3 switches.

Layer 3 Switch

Linksys Business LGS528P 28-Port Managed Gigabit PoE+ Switch with 2 SFP Combo Ports

The purpose of this switch is to manage static routing with support of advanced features ranging from traffic control to security. The 28 ports are all managed and supports Gigabit Ethernet. This switch will be housed in the 42U rack among other Layer 2 and Layer 3 switches.

Router

Linksys - WRT AC3200 Dual-Band WiFi 5 Router

According to the 802.11ac standards, devices must have a frequency band of 2.4 / 5 GHz, which is why this router was chosen. It supports Gigabit Ethernet and is MU-MIMO. Another special feature of this router is the open-source features to make it more customizable for the office.

Cat5 Cable

NavePoint Cat5e UTP Ethernet Network Patch Cable UL Listed - 10 Ft. Black 10-Pack

The Cat5e cable is necessary for connecting devices on the network. They are specially designed for speeds up to 1 Gbps with a copper conductor and gold-plated conductors. It will be used widely among desktops, VoIP phones, switches, servers, routers, and wireless access points for a reliable connection.

Wireless Access Point

Ubiquiti Networks UniFi nanoHD 4x4 MU-MIMO 802.11ac Wave-2 Access Point

These discreet wireless access points are the key to the network. The devices will be spread across the 30,000 sq. ft office space to provide coverage for all devices. It is to be connected with the Cat5e cables and powered by the use of PoE. It offers 2.4 / 5 GHz frequencies with MU-MIMO, as defined by the 802.11ac Wave 2 standards.

Wireless Adapter – Server

Intel Ethernet Server Adapter I350-T4 - network adapter

The network adapter is needed by the six servers to connect to the wireless Ethernet. It supports the Gigabit Ethernet that will be used.

ASUS Dual Band 802.11AC Wireless-AC2100 PCI-E Bluetooth 5 Gigabit Wi-Fi Adapter

The dual-band 2.4 /5 GHz frequencies are compliant with the 802.11ac standards. The 250 desktops will be using these adapters to connect to the many access points. The product also states the 160 MHz employed doubles the speed and lowers latency.

Wireless Adapter — Laptop

Plug & Play Hackintosh macOS M.2 NGFF BCM94360NG Wifi 802.11ac Bluetooth 4.0 Network Card

This laptop adapter is compliant with 802.11ac standards (2.4 / 5 GHz) and will be used for the 125 laptops currently owned. Again, it will connect to one of many access points.

Patch Panel

TRIPP LITE 48-Port 1U Rackmount Cat6 110 High Density Patch Panel

Cable management allows for easy access and quick maintenance. If there are any future issues in the server room, it is imperative that everything is organized and can be reached effortlessly. These patch panels will serve for wire management for the 13 Layer 2 switches.

Power Strip

APC Basic Rack PDU Rackmount Power Strip

With two server racks, we will need two power strips. The power strip comes with 10 NEMA 5-20R outlets and is rack mountable – an important feature to have for the organization of the server racks.

Network Rack

Eaton RS Enclosure Network (42U) and Solution Direct's 20U Rack Cabinet

To enclose all switches and servers, network or server racks must be used. This will protect and maintain a peak environment for the devices to stay. Both racks allow mounting and significant airflow — two very important components that go into maintaining the health of the devices.
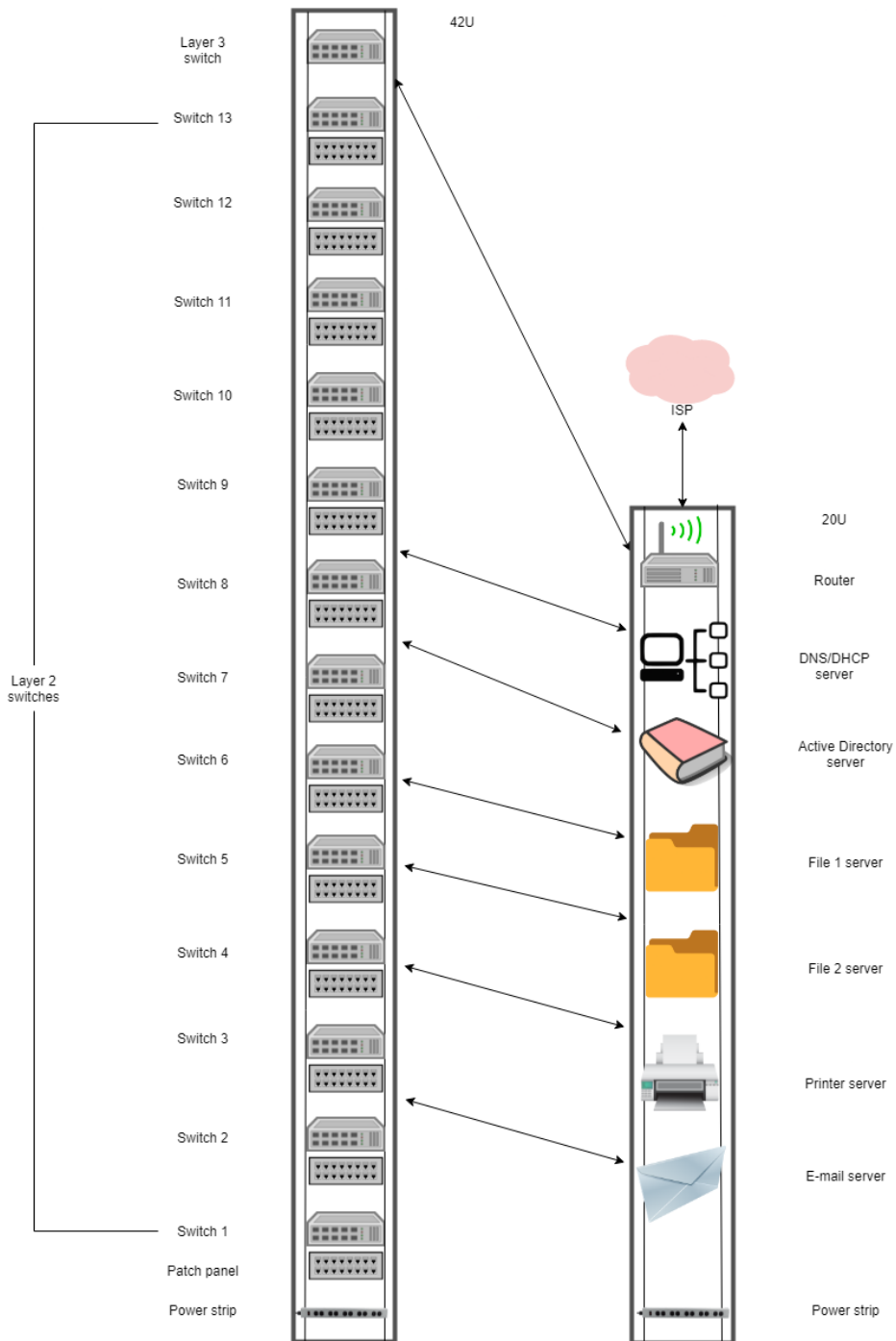
Printers

The printers provided are in still performing well and do not to be replaced. Instead, to improve print management, the printers will connect to the computers through Window's Network Printer. It allows multiple computers to share a printer through these steps:

1. Access the printer's setup menu
2. Navigate to Wi-Fi Network and enter password
3. Move to computer's settings and find devices
4. Add a printer/scanner
5. Choose the printer from results
6. Test print to confirm it is in working order

VoIP Phones

The power brick has been eliminated by the use of Power over Ethernet for the VoIP phones. This will give us electrical power over the Layer 2 switch ports. The VoIP phones will be on their own VLAN to avoid interference from other nodes. This will ensure calls are seamless and do not get interrupted by computer traffic.

Server Room

Layer 3 switch

42U

Switch 13

Switch 12

Switch 11

Switch 10

Switch 9

Switch 8

Layer 2 switches

Switch 7

Switch 6

Switch 5

Switch 4

Switch 3

Switch 2

Switch 1

Patch panel

Power strip

ISP

20U

Router

DNS/DHCP server

Active Directory server

File 1 server

File 2 server

Printer server

E-mail server

Power strip

The server room will host two server racks. The first rack is 42U, housing the Layer 2 and Layer 3 switch(es). Alongside is the second server rack of 20U, which contains the router as well as the six servers.

Internet Service Provider

The updated Internet service provider chosen to fit this network is the Business Internet 1 Gig Plan from Comcast. This plan is described to be best fit for organizations with multiple devices that require fast downloads for large files, web hosting and more. In other words, it supports the IEEE 802.11ac Wave 2 wireless standards this network is built upon. This high-speed plan is essential for the number of employees present to ensure everyone is covered.

Summary

As technology advances at such a rapid pace, the organization must match the criteria. The proposed wireless, star-bus hybrid network is best fit for the company's needs.

The attached Excel sheet outlines the full price and quantities of components needed for this network. The total cost is $51,987 for the network's entirety, which is below the given budget of $125,000.