



NETWORK UPGRADE PROPOSAL

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Executive Summary

We are currently experiencing a high maintenance network with low efficiency. Our current architecture is alive on borrowed time. Our objective is to upgrade the networking backbone of the company as the token-ring network has completed its end-of-life decades ago. As per our estimates (Refer to Excel sheet for reference), our network architecture will reduce or eliminate the security incidents by as much as 35%, increase lifespan by 46%, and lowering the cost by 28%.

Our proposed network suggests to upgrading the Token-Ring network topology with wired Ethernet (IEEE 802.3) and wireless network (IEEE 802.11). The benefits of such a network are as follows but not limited to:

- a. Better establishment of a secure connection.
- b. Less time for maintaining the network.
- c. Better printing efficiency.
- d. Fast and resilient internet connection.

We will be placing a firewall after our ISP to drop all the insecure connections from the internet to our corporate environment. The new backbone layer 3 switch will enable IEEE 802.1n standards so that we can use VoIP phones in our office. Below are the details of the network architecture diagram, a list of all devices, pricing of the individual devices, and total cost of the upgrade.

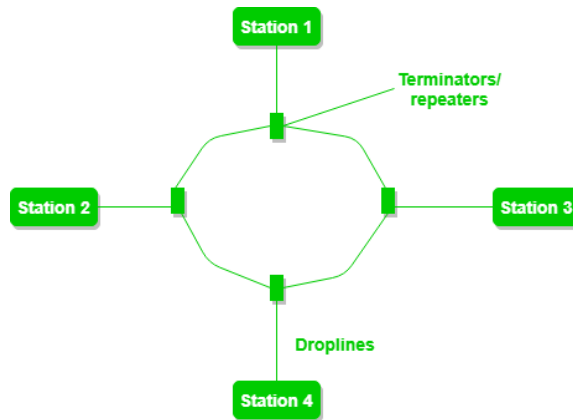
Current Situation

We are using legacy Token-Ring topology for our corporate network which has many drawbacks not limited to:

- a. A small disturbance in the network can cause failure in the entire network.
- b. Not scalable
- c. Slow performance.
- d. WAP cannot be used in legacy token ring topology
- e. Highly efficient printers cannot be used over our current topology
- f. VoIP is not supported
- g. New devices do not support hardware interfaces and software drivers.

Existing Network Architecture

Our existing network looks similar to this where all the stations are interconnected to one another. In order to pass data all, the servers/devices rely on each other which degrades the efficiency of the services.



This topology is a Local Area Network in which all the components pass one or more logical tokens from host-to-host. Token ring topology is more expensive than Ethernet and Wireless networking at similar speeds. With these said I will continue with the solution for our legacy network.

Project Objectives

Before proposing the system, I will discuss here the objectives of the network. The main objective of the system is to upgrade the network that is following the legacy token ring architecture.

- Main aim of the proposal is to provide a network solution to the IIT for the purpose of having independent association that will have no dependency on other networks.
- Goal of the proposal is to deliver a healthy and practical network function for the organization.
- From the thorough assessment, it is clearly known the mandatory information related to required devices and their effective method of implementation in the network.
- With the use of compatible and precise network devices, the project aims to build a design setup for a wireless and a wired network.
- Thorough analysis of the assessment has shown the exact number of devices required and displays all solutions possible to the IIT association.

IEEE Standard Network Design

An access network (which connects terminals to their access routers) utilizing technologies based on the family of IEEE 802(R) standards is specified in this recommended practice.

A Floor Plan that includes entities and reference points along with behavioral and functional descriptions of communications among those entities is provided in this recommended practice.

Wired Network

There are two RJ45 interfaces on a single faceplate near each workstation and one RJ45 to access the middle row between each workstation. One is used for the Internet and the other is utilized for VoIP phones. Now, since we have POE+ ports on switch VoIP phones don't require power bricks to power VoIP phones.

- Rj45 faceplates are kept in the server room and they are connected to it and wired through the Patch Panel.
- They are connected to ports which are located on the switches to the respective VLAN they belong to.
- By this, Desktops and Printers are been taken care of.
- There are total 6 WAPs in the office (2nd floor).
- We would run Cat 6 Cables over the ceiling where wireless access points are plugged in.
- Utilization of **IPv4 addressing** would be implemented, as there are very small number of nodes and devices to be connected.
- Now, we have **POE+ ports** on the switch (discussed later), this is the reason we no longer need power bricks to run VoIP phones.

Wireless Network

Wireless networks have several components, each with its own costs. Some elements will be required, while others, like printers, will be an optional addition. For the sake of this cost guide, we're only focusing on the necessary components.

A wireless router will be required to make the wireless connections in your new office network.

Wireless Access Point

WS-C3560G-48TS-S Cisco Catalyst 3560 48 10/100/1000T + 4 SFP + IPB Image.



Details: -

Manufacturer: Cisco Systems, Inc

Product Series: 3560

Product Model: 3560G-48TS-S

Product Name: Catalyst 3560 Gigabit Ethernet Switch

Product Type: Ethernet Switch

Interfaces/Ports

Total Number of Network Ports: 48

Number of Network (RJ-45) Ports: 48

Port/Expansion Slot Details: 48 x Gigabit Ethernet Network

Port/Expansion Slot Details: 4 x Gigabit Ethernet Expansion Slot

Media Type Supported: Twisted Pair

Twisted Pair Cable Standard: Category 5

Ethernet Technology: Gigabit Ethernet

Network Technology: 10Base-T

Network Technology: 10/100/1000Base-T

I/O Expansions

Number of Total Expansion Slots: 4

Expansion Slot Type: SFP

Number of SFP Slots: 4

Network & Communication Layer Supported: 4

Memory Standard Memory: 128 MB

Memory Technology: DRAM

Flash Memory: 32 MB

Reliability MTBF: 173400 Hour

Power Description

Input Voltage: 110 V AC

Input Voltage: 220 V AC

Power Source: Power Supply

Redundant Power Supply: Yes

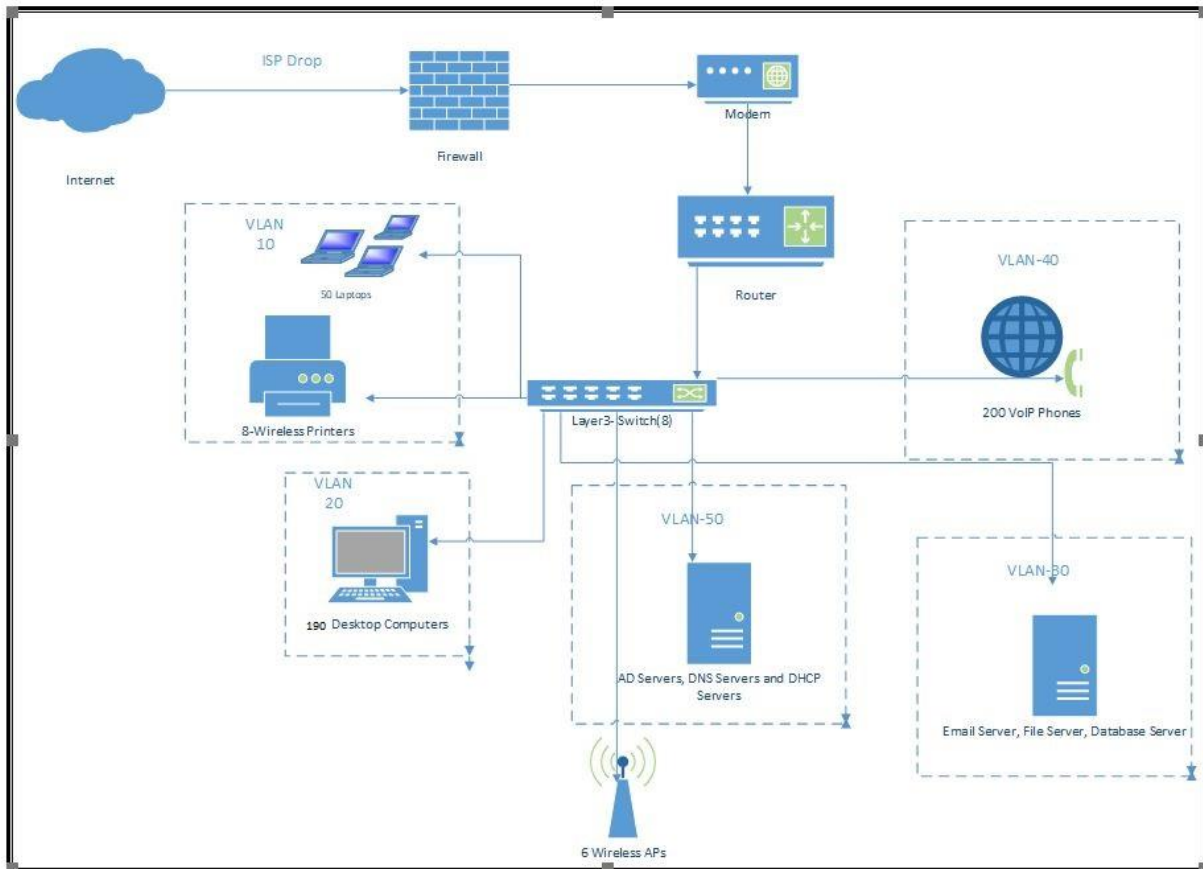
Proposed Solution

At the core of any successful business is a functioning, well-organized network. The design of that network can be a daunting task for even the most skilled of Information Technology and Networking Professionals. To make that task more manageable it's easier to divide it up into the key components needed to implement a successful network design. The entire backbone is removed to acknowledge Ethernet based Layer 1 Hardware. This will enable new technologies to be welcomed for the better future. There would be a replacement of Ethernet Network Interface Cards on Desktops which has Token Ring Cards.

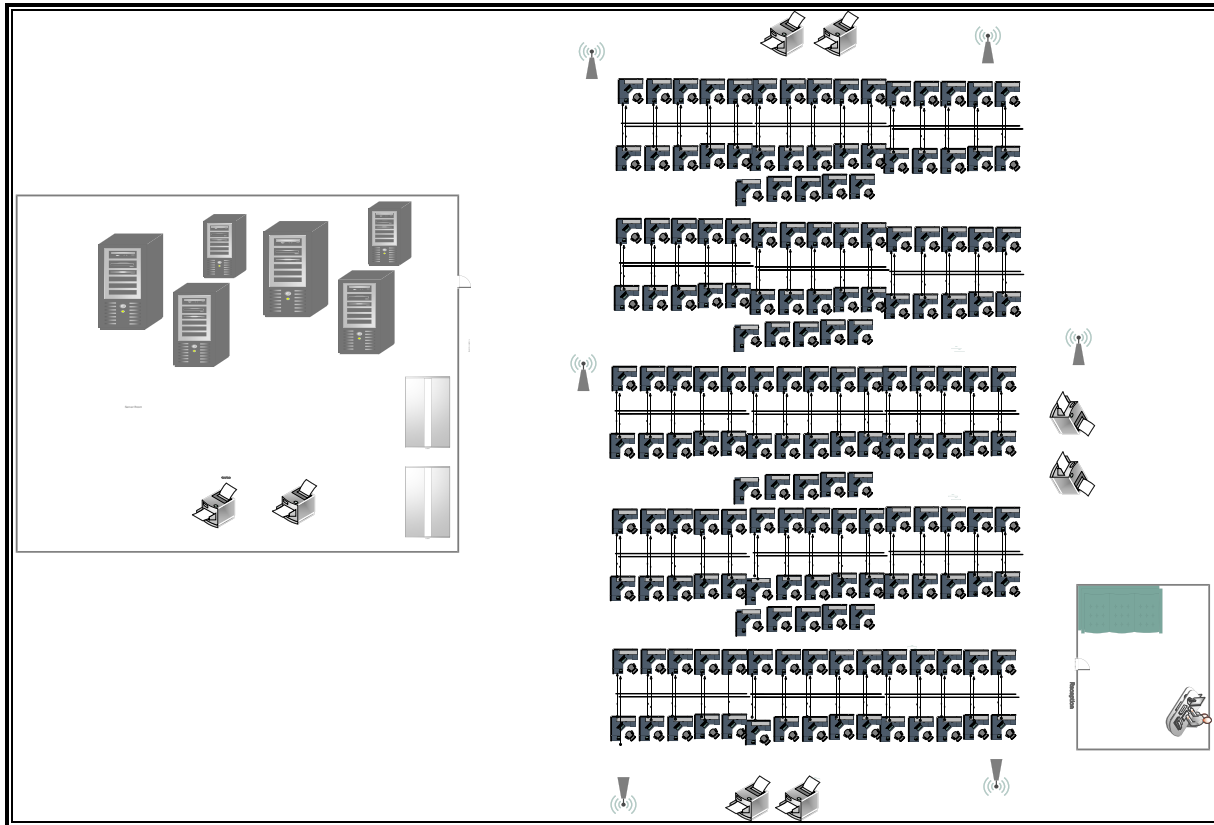
The proposed backbone are as follows: -

- Network installation of 190 Desktop Computers with 50 Laptops (as shown in the proposed diagram)
- Secured connection with the Internet with the fastest speed
- Secured and reliability of the fastest connection to the Servers.
- Utilization of Network Printers with new features installed
- Utilization of 200 VOIP Phones for employees to talk to one another.
- Utilization of the latest printers with new features installed
- There are total of 8 x (Layer 3 Switches) that would be connected to all the desktops and laptops (as shown in the proposed diagram).
- Fresh cabling of Cat 6 cables over the ceiling (to make sure no wired are jumbled up)
- Switches behave as a static router between the VLANs and therefore provide the fastest network that will reduce network traffic
- They will enable VoIP Telephones so that Employee can talk with each other at any given point in time
- They will enable Wireless Access for Laptops and Desktops

Overall Network Architecture



Floor Plan



The floor plan consists of: -

- 190 Desktop computers arranged with 15 computers per row and in the middle 5 PCs.
- There are 6 wireless access points in each direction which include a connection that ensures to every desktop computer
- Two printers in each direction
- Server room is on the left of the office with two 12U Mount Racks
- There is a reception on the right side of the office

VLAN Configuration

We are using VLAN 10 for Laptops and Printers, VLAN 20 for Desktops, VLAN 30 for Servers (Email Servers, File Servers and database Servers), VLAN 40 for VoIP's, and VLAN 50 (AD Servers, DNS Servers, and DHCP Servers).

IP Protocol

The Internet Protocol version 4 (IPv4) supports a 32-bit binary address format, which is preferred as the protocol for communication. We are using this IPv4 scheme to utilize our different VLANs.

VLAN 10 - Laptops and Printers - 192.168.0.0/24

VLAN 20 - Desktops - 192.168.10.0/24

VLAN 30 - Servers - 192.168.20.0/24

VLAN 40 - VoIP phones - 192.168.30.0/24

VLAN 50- AD, DNS, and DHCP - 192.168.40.0/24

VLAN ID	Device Group	Network Address	No of Hosts
VLAN 10	Laptops and Printers	192.168.0.0/24	255
VLAN 20	Desktops	192.168.10.0/24	255
VLAN 30	Email Servers, File Servers and Database Servers	192.168.20.0/24	255
VLAN 40	VoIP Phones	192.168.30.0/24	255
VLAN 50	AD Servers, DNS Servers, and DHCP Servers	192.168.40.0/24	255

Network Components

The network components are crucial to any network required for communication and interaction between devices. The below components are recommended to build the network infrastructure: -

Security Appliance:

SonicWall NSA 3600 - Security appliance - 10 GigE - 1U



The NSA 3600 is designed specifically with the needs of growing businesses, branch offices, and school campuses in mind. The hardware and associated security services prevent intrusions, block malware, and control access to questionable web content.

Benefits

- Intrusion prevention with sophisticated anti-evasion technology
- It has 2 GB RAM, 10 GB Ethernet, VOIP Standards SIP, H.323 v3, H.323 v4, H.323 v1, H.323 v2, H.323 v5
- Network-based anti-malware with CloudAssist for 24x7 protection from over 14M variants of malware
- Integrated wireless controller, easy-to-deploy Clean Wireless technology
- Easy-to-integrate user authentication (SSO/LDAP/RADIUS) support for numerous user identification technologies
- WAN Failover/Load Balancing – supported out of the box for easy configuration
- SSL decryption and inspection to protect against threats hidden in encrypted traffic
- High port density with more interfaces to help in more complex network environments
- Integrated 10 Gb SPF+ interfaces for future investment against growing bandwidth needs
- Over 50 categories of content/URL filtering to prevent undesirable web content
- Easy to use real-time application visibility, control, and bandwidth management

Router:

CISCO SG350X-48P-K9 Small Business Sg350x-48p Managed Switch - 48 Poe+ Ethernet Ports And 2 Combo 10 Gigabit Sfp+ Ports And 2 Sfp+ Ports.



8 Switches provide 384 high-speed ports connected to the patch panel.

- Each switch has a capacity to switch at 10 GBps
- Total Ports 48 Fast Ethernet + 4 Gigabit Ethernet (2 Combo Ports)
- This Layer 3 switch supports VLAN Trunking Protocol which enables a stack of Switches connected with Inter-Switch Links to share VLAN configurations over the stack. as per IEEE 802.1Q specifications.
- The Layer 3 of this Switch functions as an IPv4 DHCP Server leasing IP addresses for multiple DHCP pools depending on the VLANs set up.
- It offers advanced defense mechanisms, including Dynamic ARP Inspection (DAI), IP Source Guard, and Dynamic Host Configuration Protocol (DHCP) snooping, detect and block deliberate network attacks. Combinations of these protocols are also referred to as IPMB (IP-MAC-port binding).
- It includes embedded QoS intelligence to prioritize delay-sensitive services such as voice and video and help ensure consistent network performance for all services.

Ethernet cards for desktop and laptops

Intel Gigabit CT PCI-E Network Adapter EXPI9301CTBLK



Brand	Intel
Hardware Interface	Ethernet
Item Dimensions LxWxH	0.5 x 0.5 x 0.5 inches
Data Link Protocol	Gigabit Ethernet
Data Transfer Rate	1024 Megabits Per Second

Ethernet cards for Servers

Intel EXPI9404PTLBLK PRO/1000 PT Quad Port LP Server Adapter Network PCI Express x4 Gigabit Ethernet

- Two Intel 82571GB Gigabit controllers
- Low-profile
- Virtualization
- Interrupt moderation
- Compatible with x4, x8, and x16 full-height1 PCI Express slots



Patch panel

Tripp Lite 24-Port Cat6 / Cat5 Patch Panel, RJ45 Ethernet 1U Rackmount TAA (N254-024)



- **24 PORT:** Tripp Lite's Cat6 Feed-Through 24-port patch panel provides patching without punching down the bulk wire to the back of the panel.
- **CAT6/CAT5 PATCH PANEL:** Cat6 RJ45 Jacks on both sides of the panel.
- **CERTIFIED:** Fully meets or exceeds Cat6 specifications - works with USOC, T568A, and T568B wiring.
- **EASY INSTALLATION + CABLE MANAGEMENT:** 19" width mounts easily in 2-Post Relay Rack or a Wall-Mount Hinged Rack. Detachable cable management bar keeps patch cables neat and tidy on the back of the panel.
- **LIFETIME WARRANTY & FREE TECH SUPPORT:** Tripp Lite warrants this product to be free from original defects in material and workmanship for life.

Network Rack

Tripp Lite 12U Wall Mount Rack Enclosure Server Cabinet, Hinged, 20.5" Deep, Switch-Depth (SRW12US)

- **Unit Dimensions:** 23.63" W x 21.6" D x 25" H | Weight: 60 lbs
- Wall-mount cabinet secures and organizes 12U of 19-inch rack equipment up to 20.5 inches deep in locations with limited floor space
- Maximum load Capacity of 200 pounds
- Swings away from the wall on hinge for Easy back door access
- Mounts to wall or rolls on the floor



Power Distribution Unit (PDU):

Tripp Lite Metered PDU, 10 Outlets (8 C13, 2 C19), 200-240V, C20/L6-20P Adapter, 3.2-3.8kW, 12 ft. Cord, 1U Rack-Mount Single-Phase PDU, TAA (PDUMH20HV)



- 208/240 & 230V Metered 1U horizontal mount Power Distribution Unit (PDU)
- 20A maximum capacity (Agency de-rated to 16A)
- Includes L6-20P and C20 line cord options (detachable via C20 inlet)
- 10 total output receptacles (8 C13 and 2 C19)
- Outlets are arranged in a single unbrokered, metered load bank

RJ-45 Cable:

RJ45 interface is the most common twisted-pair connector for Ethernet cables and networks. “RJ” means “registered jack”, which is a standardized telecommunication network interface for connecting voice and data equipment to a service provided by a local exchange carrier or long-distance carrier. The physical connectors that registered jacks use are mainly the modular connector and 50-pin miniature ribbon connector types. RJ45 connector is an 8-position, 8-contact (8P8C) modular plug and jack, which is commonly used to connect computers onto Ethernet-based local area networks (LAN). RJ45 cable plug is usually made of a plastic piece with eight pins on the port. Four of the pins are used for sending and receiving data, and the other four are used for other technologies or power networking devices.

RJ-45 Faceplate:

- Toolless connection Just plug one ethernet cable into the front and one into the back.
- Easy install. With standard size ethernet wall plate, single gang low voltage mount bracket for easy installation. Screws included.
- Fits standard outlet boxes. The white color matches your home.
- Keystone in wall plates is removable for future upgrades.
- Provide a year of quality protection. If you have any problems with the use of the process, please contact us, we will be free to your exchange and to help you.

Billing

The estimated implementation of the network upgrades as per recommendation will total cost of **\$47,218.20**

<i>Purchase Items and Costs</i>					
Item No	Item Type	Item Description	Qty	Rate	Total Amount
1	Security Appliance	SonicWall NSA 3600 - Security appliance - 10 GigE - 1U	1	\$3,995.00	\$3,995.00
2	Layer 3 Router/Switch	SG350X-48P-K9	8	\$1,275.00	\$10,200.00
3	Wireless Access Point	WS-C3560G-48TS-S Cisco Catalyst 3560 48 10/100/1000T + 4 SFP + IPB Image.	6	\$390.00	\$2,340.00
4	Intel NICs for Servers	INTEL i350-T4 1gb Quad Port PCI-E FH Network Card THGMP	8	\$90.00	\$720.00
5	Intel NICs for Desktops	Intel Gigabit CT PCI-E Network Adapter EXPI9301CTBLK	190	\$55.00	\$10,450.00
6	10 Outlet PDU	Tripp Lite Metered PDU, 10 Outlets (8 C13, 2 C19), 200-240V, C20/L6-20P Adapter, 3.2-3.8kW, 12 ft. Cord, 1U Rack-Mount Single-Phase PDU, TAA (PDUMH20HV)	2	\$142.97	\$285.94
7	12 U Rack	Tripp Lite 12U Wall Mount Rack Enclosure Server Cabinet, Hinged, 20.5" Deep, Switch-Depth (SRW12US)	2	\$329.99	\$659.98
8	24 Port Patch Panel	Tripp Lite 24-Port Cat6 / Cat5 Patch Panel, RJ45 Ethernet 1U Rackmount TAA (N254-024)	16	\$188.99	\$3,023.84
9	Face Plates	Cat6 Wall Plate and Keystone, Fly Tiger, RJ45 Jack Ethernet Connector, Female to Female, White (2 Port)	200	\$9.99	\$1,998.00
10	Patch Cords	AmazonBasics Snagless RJ45 Cat-6 Ethernet Patch Internet Cable - 10-Foot, Black, 5-Pack	200	\$12.99	\$2,598.00
11	Patch Cords	iMBAPrice (10 Pack) (1ft) Molded UTP Cat6 Ethernet Patch Cable RJ45 M/M	400	\$15.00	\$6,000.00
12	Cat 6 Cables	Cable Matters UV-Resistant PE 23 AWG Solid Bare Copper Outdoor Bulk Cable (UTP Cat6 Cable) in Black - 1000 Feet	10	\$184.99	\$1,849.90
		Total			\$44,120.66
		Illinois State Tax @ 6.26%			\$2,757.54
		Net			\$46,878.20

Network Installation Cost

A large part of the cost that you pay for a wireless computer network installation will involve the labor of actually installing the network. Professional networking technicians will perform this job and are typically sent by an Internet Service Provider. They will install all jacks, cables, and components, and connect the entire network to ensure it works properly.

The installer comes from ISP (Internet Service Provider), the cost of installation is usually charged as a one-time fee. There may be additional charges for extra services or components, such as if you need an additional Ethernet jack installed. In the national average \$350 wireless network installation, we estimate a total project time of around 4 hours, which would be approximately \$240 in labor costs.

Wi-Fi Installation Cost

Typically, if you already have the Internet in your office, there will be no installation cost or effort involved in adding Wi-Fi.

If you are having Wi-Fi installed and a technician is also installing the hardware (routers, modems, etc.), you may pay them a flat rate or hourly rate for their service. The average is around \$100 for a one-time fee.

Approximately Total Cost: - \$47,218.20

VoIP Phones

Implementation of VoIP without Power Bricks

Some advanced models have Power over Ethernet capabilities which means it can be powered simply by virtue of the ethernet connection that can be replaced by Power Brick.

Here we have used a layer 3 switch ***CISCO SG350X-48P-K9 Small Business Sg350x-48p Managed Switch - 48 Poe+ Ethernet Ports And 2 Combo 10 Gigabit Sfp+ Ports And 2 Sfp+ Port.*** that supports IEEE 802.3 which enables VoIP technologies.

But the power requirements for VoIP phones are a real issue when it comes to disaster management and business continuity plans. All VoIP devices should be connected to the back-up power source to ensure that they continue to work even during any emergencies.

Network Management and Security best practices

Network best practices

After the network setup, you need to keep the following things in mind

- First and foremost, create a standard baseline image of the network in all VLANs.
- All networking equipment, including but not limited to firewalls, routers, and switches shall be configured and maintained in accordance with standards set by Enterprise Network Infrastructure.
- Current applicable security patches and updates shall be applied on all network equipment.
- All default passwords that come with network hardware and software shall be changed prior to connecting to our company's network.
- IT Support shall limit the ability to read and alter networking equipment configurations to the appropriate network personnel.
- Network devices shall be monitored by IT support for proper functioning and availability.
- Firewalls shall be designed, deployed, and operated to meet business, security, and administrative objectives.
- Firewalls shall be physically secured against unauthorized access.
- Internal and External network audits should be performed on the regular basis.
- IT Support shall not change firewall rules without written approval from an executive team.
- Public and internal DNS information shall not be located on the same production server.
- All major network devices (e.g., routers) shall be secured against unauthorized electronic and physical access.
- Access to network management consoles shall be secured from unauthorized access.
- The network architecture shall be clearly documented.
- All changes to the network shall be documented and should have a network management system where all the changes or any network related issues will be recorded.
- Network systems documentation (e.g., network diagrams, routing tables, IP addresses, etc.) is classified as Confidential and shall be restricted to authorized personnel only.

Physical Security

- Access to server rooms and IT equipment rooms must be restricted to only those whose job responsibilities require their access.
- Server rooms and IT equipment rooms should have redundant power supplies to prevent any unexpected system outages caused by a power failure.

Security Best Practices:

- Firewall logs should be enabled and collected for security monitoring
- The default condition of the firewall shall be to deny all connections to and from the network.
- Access to network elements for administration purposes shall be uniquely identified and authenticated. Shared or generic user accounts are prohibited.
- Access to remote diagnostic ports on network devices shall be securely controlled and open only to authorized access.

Conclusion

Because of evolving new network technologies and constant emerging attacks in the network, we try to improve our network architecture with the best security solution available for our employees and customers. I recommend using wired technology for this project because it ensures the fastest speed than using wireless technology and also it is more secured.

Our goal is to restructure the network infrastructure as per the proposed architectural design. The upgrade process will be implemented in an organized manner which will be tested, documented, and monitored for further improvements.

We have provided a state of art with the best practice network architecture keeping security in mind. There is no financial burden for this advancement in IT networking since the budget is \$125,000 and I have proposed rebuilding in \$47,218.20.

Please let me know if you have any further queries. I am sure I will be able to clear your concerns.

For any network proposed inquiries please contact: foram.shah@hawk.iit.edu

References

Sources used: -

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