International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 05 | May -2020 ISSN: 2582-3930

NETWORK DESIGN AND ITS IMPLEMENTION in a School in this Pandemic Situation (Covid -19)

DR. Preeti Bala1, Ms .Shweta Singh2

ABSTRACT: This paper describes the basic requirement of network design in this paper a design and implementation of a network model was presented, using routers and firewall. Through the research summary of the existing network security management technologies, A network security management platform based on distributed architecture is proposed. A unified security strategy configuration and centralized security audit of the security device in the network is completed.
So that users of the security management can manage, monitor and audit for the entire network security, which improves the efficiency and enforcement effort of network security management network security management platform based on distributed architecture is proposed. Also this paper provides a checklist to use in evaluating whether a network is adhering to best practices in network security and data confidentiality. The main aim of this research is to protect the network from vulnerabilities, threats, attacks, configuration weaknesses and security policy weaknesses.

KEYWORDS---------Network, Design, Router, Analysis, Jack and Jill

Introduction and Research---

Analysis of the business needs to design the network

The Jack & Jill School of Dance and Drama are in need of several items to capture data for registration and deregistration of students, to keep weekly payment schedule, reliable storage with a backup system in case of shut down, and allow remote access to staff.
Parents need free access to free Wi-Fi while at and school need to be able to stream audio and video.

Administration

Database for registration, student attendance, fee payment, exam results as well as deregistered students, mail merge to keep parents updated with student progress throughout the semester or year, on their performance, registration status and due dates for school fee payments. A monthly e-news letter that keep parents aware on any events, functions that the school will be involved in throughout the year.

Payment systems

Online payment service such as PayPal, payment on electronic cash and student number is used as reference of payment; submit payment confirmation to parent when all financial books correspond with invoice that are submitted as proof of payment.

Cyber crimes

On the e-news letter parents need to be alerted about cyber scams like Phishing and how to avoid being victims to such, they should avoid clicking on link that directs them to J&J school, they rather type the full website name when they plan to log in.

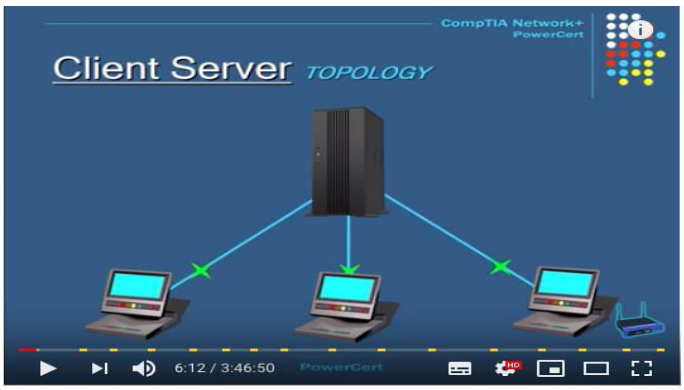
Streaming Audio and Video

Jack and Jill School need to register asocial media channel such as, Instagram, YouTube channel that they will use to upload all their streamed Videos and Audio, and be able store or archive them as part of their heritage and history. Parents and student given links for video and audio streaming on the social media platform

Access to classes

Install a biometric access gate to restrict access and only allow up to date registered students and the biometric will also assist in keeping attendance register up to date. It must also be used with care that it doesn't invade privacy of student movement, so access to data in the biometric system must be restricted to the System Administrator or senior personnel like JACK AND JILL

An example picture of type of network, which meets most of school'sneeds



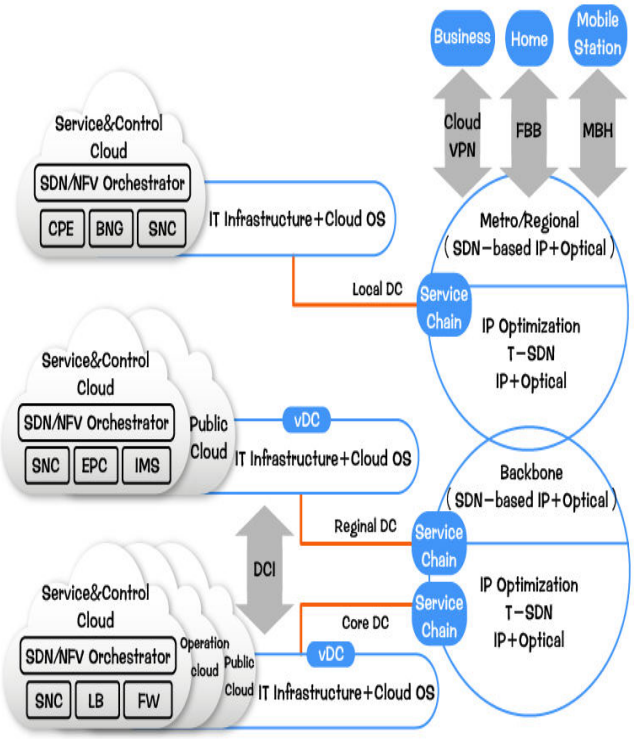
CompTIA Network+ Client Server topology

An evaluation of the hardware and software needed to run the IT networks successfully

Software for Cloud-Server system

Software –defined Networking (SDN) this is new approaching, a central program, which doesn't need expensive servers that are separated from network device themself, manages most of the control functions and is suitable for cloud-computing environment.

Software as a service (SAAS) its subscription based software that is licensed and its centrally hosted, it is accessible via a web browser, its mostly common in Payroll processing systems, Customer relationship management (CRM), Human resource management (HRM) and Content management (CM).



SDN image by: Huawei Product and Solutions

Software for Hardware Server

Network Operating Software (NOS) its primary function is to support personal computers, workstation coordinate network resource, manage communication, and dedicate server computer all applications on the network. Here are widely used example operating systems Microsoft Windows Server, Novell Open Enterprise Server, OpenVMS, and Linux.

Software for client desktop: Microsoft Office will be sufficient for basic office functions like administration work that needs to be performed at the Jack and JILL School the software must have, Word processor, Excel, Power Pointer, Access Database, and Outlook etc.

Anti virusits primary purpose is to detect, prevent, remove any kind of malware that may include worms, Trojans, scareware, spyware and viruses. It is distributed in different forms like Internet security suites; some are bundled with firewall or stand-alone.

Hardware

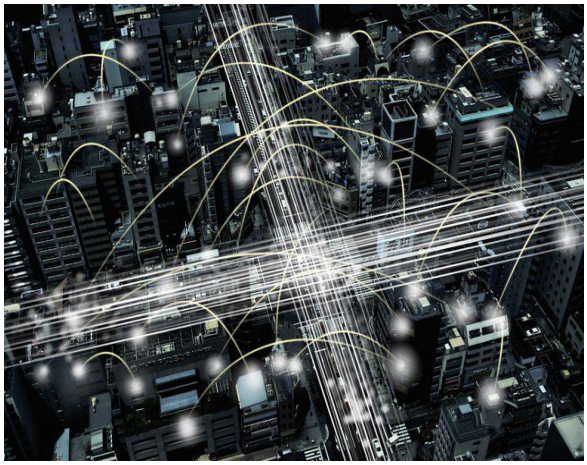
A Server is a computer, which is linked to other computers in a network and perform key functions for client computers, such as storing data, web page display, store and manage network operating system (NOS).

The Network backbone will be base on Fiber-Optics (multi-mode fiber), because it can transmit data over a long distance, it has higher bandwidth which will be very helpful during live streaming of Audio and Video signal for the Jack and Jill Fiber also solves the challenge of copper cable thief thus most of Telco's and Internet Service Providers (ISP) are investing in fiber.

Extreme network Fiber cable 10G SFP+ to SFP+ Active

- Since fiber transmit light as a signal, the advantage of light is that it can travel much longer without signal strength loss, thus lessens signal booster along its path
- It is less susceptible to interference unlike a traditional copper which requires special shielding and protecting it from electromagnetic interference
- Fiber to the Premises (FTTP) the fiber will laid all the way to JACK AND JILL premises and with the vision of future expansion of the school, it makes sense to lay optics technology as it will dominant as the backbone for most enterprises.
- JACK AND JILL can opt for Shared fiber with nearby business to share the cost and

ultimate it will connect to SONET network (such networks are known to carry large volumes of traffic over long distances)
According to Mitchell. B. Published for: Lifewire



- SONET image by: Lifewire
- The SONET provides network reliability whiles requiring less equipment than most protocols
- The SONET is able to carry any high level protocol like Internet Protocol (IP)
- The SONET has built-in support and easy maintenance and management
- SONET offer higher signal security and it support all kinds of traffic that may include data, voice and video
- Angle Polished Connector (APC) will be use at JACK AND JILL network because they good in preventing back reflection of signal, which its impact is serious degrading of signal performance

Information Technology innovation and telecommunication deregulation, computer and telephone networks are converging into a shared Internet based digital, and Internet based standard. Companies such as Verizon, AT&T offer Internet access, television programing service, and mobile phone service According to: Laudon and Laudon (2018, p280)

Server backup system

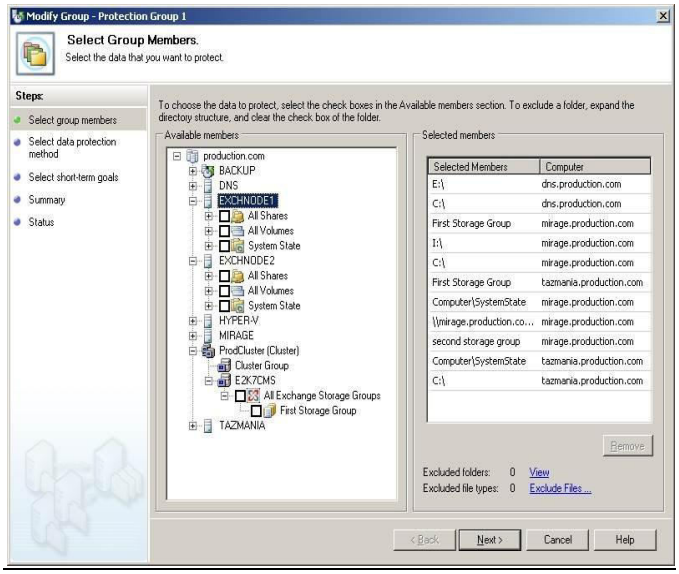
It's a Server consisting of two cluster nodes, an active node and passive node. The Active node is in full functional state, while the passive node is regarded as a sort of hot spare. Microsoft Exchanger 2007 uses a method called Log shipping, that means copy transaction logs from the active node to the passive node, thus allowing up to date logs on passive node and maintain up to date data between Exchange Server database. In case the active node fails, the passive node has up to date data stored and readily available and fully functional until the active node is restored, this method prevent disruptions.

The main challenge with this set-up is that in a shutdown of the active node, the passive node becomes the active nodeand when the active node is restored it will remain passive until you manually activate (tell it) to become the active node. This could become confusing to tell which server is backup or active after several shutdowns.

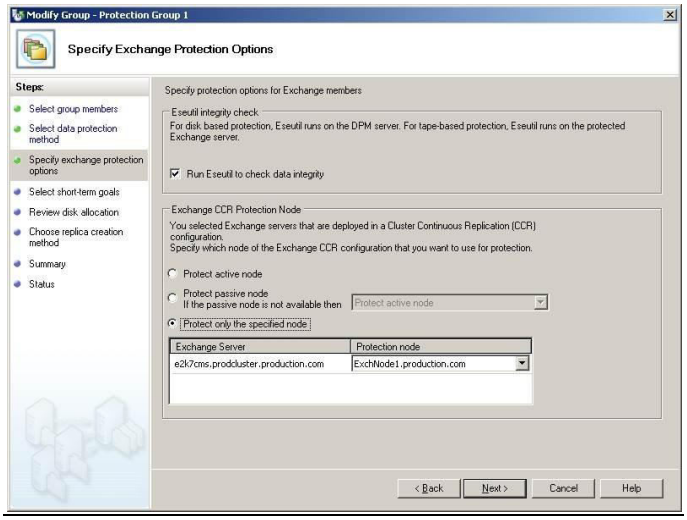
According to Posey. B He states: that most enterprise class data backup applications are cluster aware. A bit of strategy is still needed regarding cluster node backing up. He further explain: "To show you what I mean, take a look at "Figure A (below): Clustered backups" (click on image below for full size). This screen capture was taken from Microsoft's System Center Data Protection Manager 2007 (DPM 2007), which is the data backup application that I use on my own network. This particular dialog box allows you to select the objects that you want to back up. You will notice that there is a listing for a server named EXCHNODE1, and for another server named EXCHNODE2. These are the two nodes in my Exchange Server cluster. "

Microsoft's data protection manager will individually list each cluster. In the picture below notice on the listing ProdCluster, this name resides on both cluster nodes; a listing of cluster mailbox server and a selecting can be made there. DPM 2007 is flexible that you can select a clustered mailbox server you prefer to backup.

Figure A: Cluster backups by: Microsoft Exchanger Server (DPM)

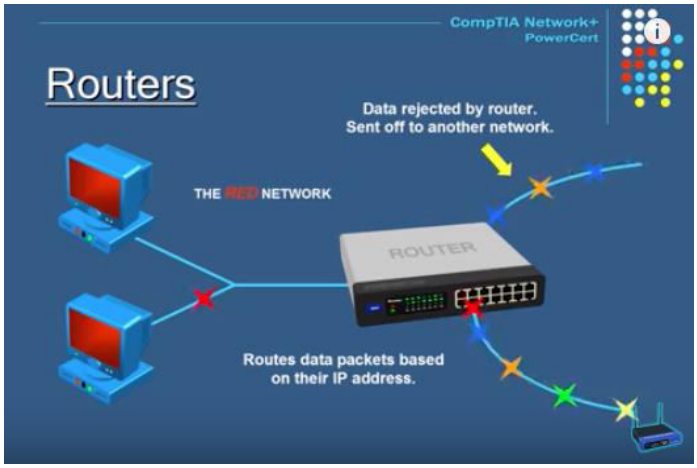


On figure B: Choosing which node to back up by: Microsoft Exchanger Server (DPM)



What should you backup? Posey. B further explains: ”Well, in my organisation, I chose to back up all of the volumes and the system state on the individual cluster nodes. That way, if a node fails I can perform a restoration rather than having to manually rebuild the node.”

Hub a device that connect networks and sending packets of data to all connected devices
Switch it’s a device that filters and forward data to a specific destination on the network its just more intelligence than the hub.
Routerit works as communications processor that routes data to different networks, it ensure data address when sending data. It performs the traffic directing on data packets on the Internet. All data sent in the Internet form part of data packets such as, e-mails, web page. Routers form part of internetwork as they forward packets from one router to the next until the packets reaches its destination node.



CompTIA Network+ image: Routers

An assessment of the methods that can be used to manage the mobile devices on this mobile network

CompTIA Network+ image: 802.11 Wireless

802.11 Wireless Standards
Its wireless standards that follows networking specifications from Institute of Electrical and Electronics Engineers(IEEE). These entire standards 802 group are set on Wireless Local Area Network (WLAN) and specifies Media Access Control (MAC). Communications in Computer uses various frequencies bands and are designed to seamlessly work with Ethernet and can easy carry Internet Protocol. These will provide remote access to staff at Jack and Jill

	802.11a	802.11b	802.11g	802.11n	802.11ac
Speed	64 Mbps	11 Mbps	54 Mbps	600 Mbps	6.933 Mbps
Frequency	5Ghz	2.4 GHz	2.4 GHz	2.4/5 GHz	5 GHz
Released	1999	1999	2003	2009	2014

A critical evaluation of possible solutions to meet the design brief

The important items that the school need to meet the design brief

1. The school needs a system administrator which will be able to remotely access all the resource at any given time, that include the main server and back up server to compare if they are both still on same data volume or to perform restoration in case the is a need for such.
2. The system Administrator need to distinguish privileges for End-user (staff) and possible limited right what they can have access to the system, and ensure that their passwords are refreshed at least once a month and update all their devices mobile and desktop for antivirus
3. Cloud support to keep in check if all nodes are still fully functional as required by the school design.
4. Network support to check if the school network is working at optimum level especial during peak times in the business, that include student performance because videos and audio are live streaming via social media which will demand faster network for good viewership online (YouTube channel, Instagram, Twitter and Facebook comments.
5. End-Users (staff) have access to the school resource remotely using wireless technology as per design and reliable connection to it at any given time.
6. Network as well as server security software is updated and in proper working order to protect all school's data and no data integrity is compromised.
7. Parent are given unique pass code as guest to access school Wi-Fi which are refreshed after every event they attended at the Jack and Jill

The development of viable alternative solutions to meet the design brief

Ethernet over Powerline (Network backup)

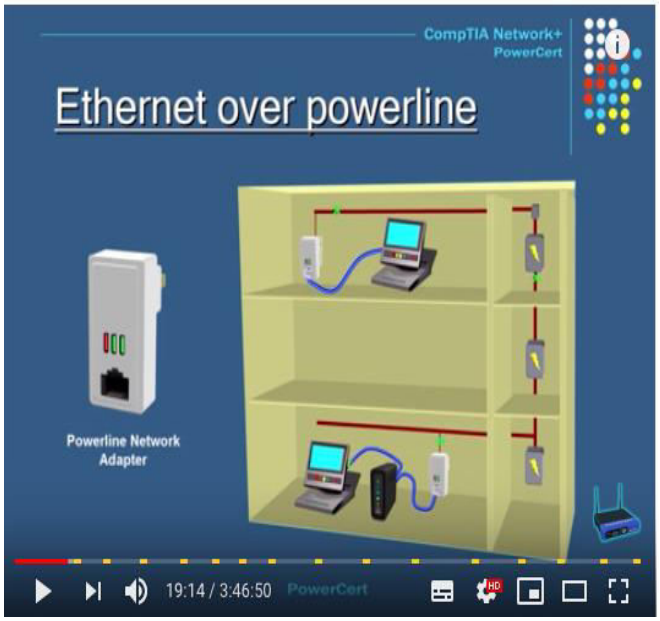
This network will only be based inside the Jack and Jill premises and will relatively be cheap to install since it will be using Power-lines (Home Plug) in the electric grid, which already exit in the school.

Advantages Home Plug over Powerline
It is very cheap
Easy to set-up
Very reliable and good speed

Disadvantage Home plug over Powerline
The Plug does not provide extra features
It does not have Wi-Fi signal convertor

As the internal backup network system inside the JACK AND JILL Premises, in case they have passive back-up Server in the premises. This can work best in worst case scenario whereby the is limited network service or cloud service, at least databases can be updated, passive server back-up still in function mode and minimum functions can still be performed, like file sharing within staff members, thus some work is still performed in a shut-down and when system are restored they can be updated gradually until they reach their full capacity performance.

It's a Network backup system



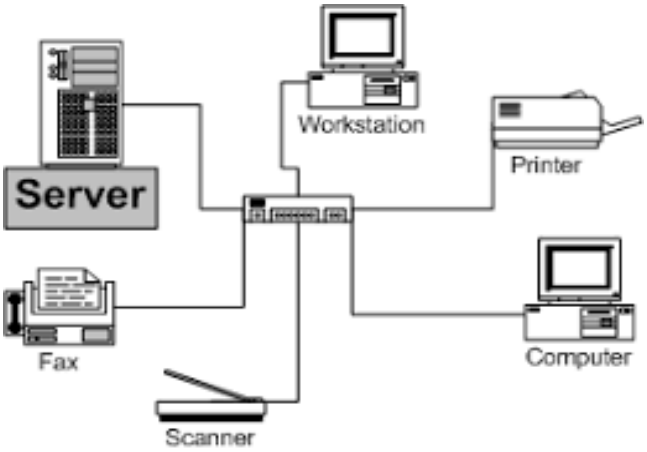
CompTIA Network+ image Ethernet over Powerline

Activity 2

Dana is pleased with your design brief and she has asked you to build the network to meet client brief.

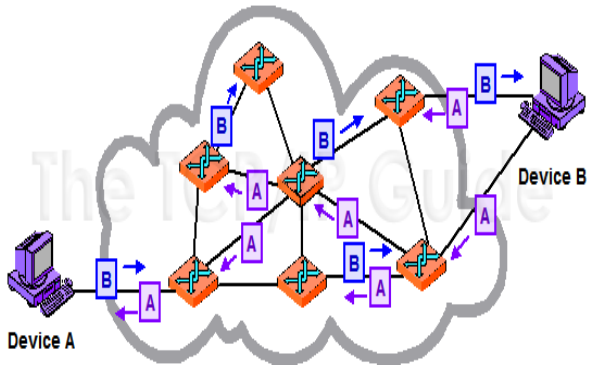
Key digital networking technologies

Present day digital networks and the Internet are based on three key elements: Client/ Server Computing, Transmission Control Protocol / Internet Protocol (TCP/IP) and the use of Packet switching



A simple structure of client / server infrastructure

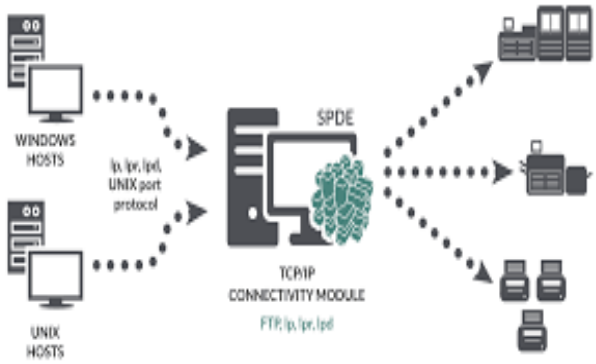
Client / Server computing is a computing model which of its processing power is located within, inexpensive, small computers and reside within handheld devices, laptops, desktops. All these devices are linked to network server computer. Centralized mainframe has been replaced by the client / server computing. The server sets all rules of communication; it coordinates the networktraffic within the network and it issue address to every client PC and is also responsible for managing file servers, and print server



A Simple structure of Packet Switching Network

"Packet switching its method of slicing digital messages into parcel called packets." Laudon and Laudon (2018, p283)

All the packets include information with address and direction and error checksum, all packets take different communication paths in image above it can be path A or B to their destination and when they reach their destination all packets are reassembled into the original message. The biggest advantage of data packets it allows sharing path among many users in the network, thus the path is not dedicated



TCP-IP and Output Modules image by: solimarsystems.com

Transmission Control Protocol (TCP)

It's a protocol that provides error-checked octets of bytes delivered between applications, hosts and communicating via Internet Protocol (IP) network. It is a very reliable protocol and major Internet applications such as e-mails; file transfer, remote administration and World Wide Web rely on it. It works on the transport layer in the ISO model and provides host-to-host communication. TCP holds all transmission details and presents quality of delivery through network socket and handles all handshakes between interfaces

Internet Protocol(IP)

It's a communication protocol that transferring datagrams across network. Its main task is delivering data packets from source to destination using IP Addresses in the packets headers.Datagrams consist of two components a Header (contains source IP Address, destination IP address and other metadata for routing and delivery) and payload (contains the data that is being transported). This method is regarded as encapsulation.

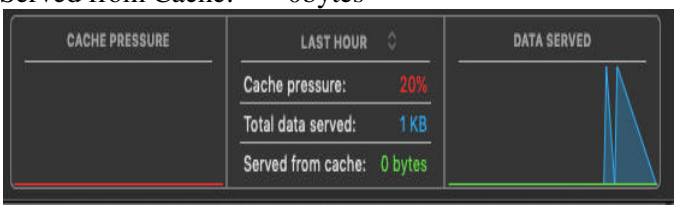
TEST PLAN -------

Test plan objectives are to ensure that all items within the network as well as the server connection are working properly. Several tests I have conducted random during different time intervals to gauge the performance, consistence and accuracy of the

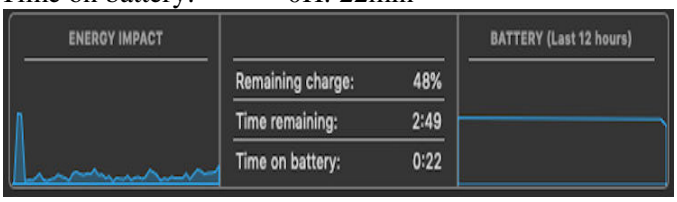
comparative data between the tests. All test screen grabs where performed **26, 28, 31Dec 2018**and **1 Jan 2019** on the Activity Monitor

*NB: A Portfolio of Evidencewith complete Screen Grabs **10 Test** in total. Below is the summary of screen grab; I conducted test on (Cache, Energy, CPU, Hard-drive, Memory, 4*Network tests)

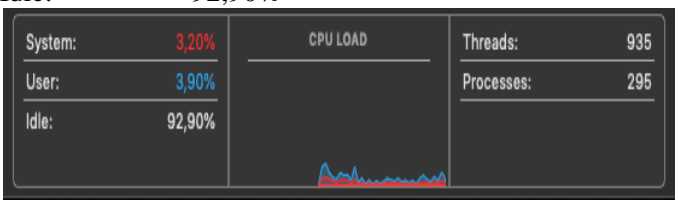
Cache Memory Summary
Cache Pressure: 20%
Data Served: Double picks at 1KB
Total data served: 1KB
Served from Cache: 0bytes



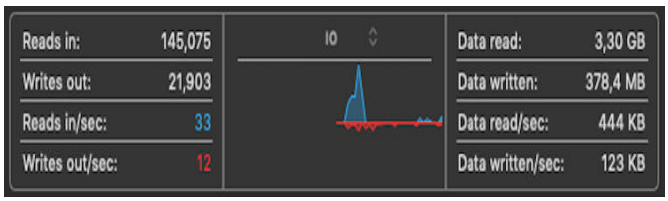
Energy Level Summary
Remaining charge: 48%
Battery: Constant usage
Time remaining: 2H: 29 min
Time on battery: 0H: 22min



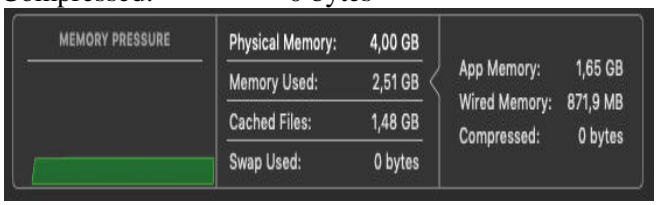
CPU Processing Summary
System: 3,20%
Threads: 935
User: 3,90%
Processes: 295
Idle: 92,90%



Hard-drive Disk Summary
Reads In: 145,075
Data read: 3,30GB
Writes Out: 21,903
Data Written: 378,4 MB
Reads In/sec: 33
Data read/sec: 444KB
Writes Out/sec: 12
Data written/sec: 123KB



Memory Summary
Memory Pressure Constant
Physical Memory: 4,00 GB
Memory Used: 2,51 GB
App Memory: 1,65 GB
Cached Files: 1,48 GB
Wired Memory: 871,9 MB
Swap Used: 0 bytes
Compressed: 0 bytes



Make any amendments to the network based on your testing

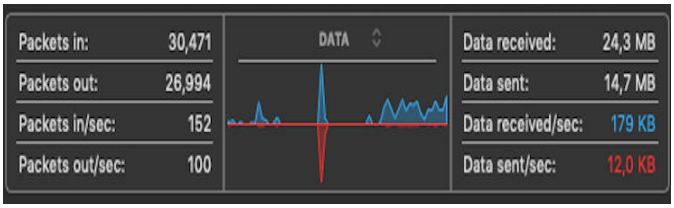
I conducted Network test 4 times because I am monitoring the change in signal if other factors are at play.

1. If social browsing the Internet increases traffic and how much,
2. If traffic is increase by data back up on I Cloud,
3. If traffic is affected at pick times during year crossover 2018/2019 before andafter midnightand these are activities I will do (Video streaming and Downloads on iTunes music/movies + Apps update simultaneous and network browsing.

Below is the comparison of the 4 Test (Network Test Summary 1 – 4)

26 DEC 2018 Test Results

Network Test Summary 1 (normal social browsing the internet)
Data Packets In: 30,471
Data received: 24,3 MB
Data Packets Out: 26,994
Data sent: 14,7 MB
Packets In/sec: 152
Data received/sec: 170KB
Packets Out/sec: 100
Data sent/sec: 12,0KB

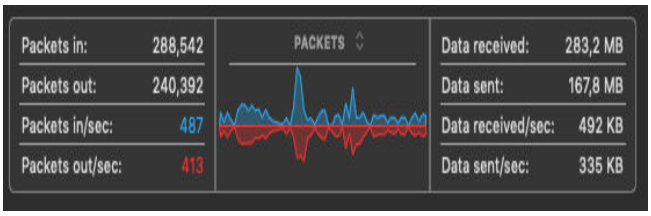


---

28 Dec 2018 Test Results

Network Test Summary 2 (Data back-up on Cloud test)

Data Packets In: **288,542**
Data received: **283,2 MB**
Data Packets Out: **240,392**
Data sent: **167,8 MB**
Packets In/sec: **487**
Data received/sec: **492 KB**
Packets Out/sec: **413**
Data sent/sec: **335 KB**



31 DEC 2018 Test Results

Network Test Summary 3 (Pick-time **before mid-night** year-end 2018 test)

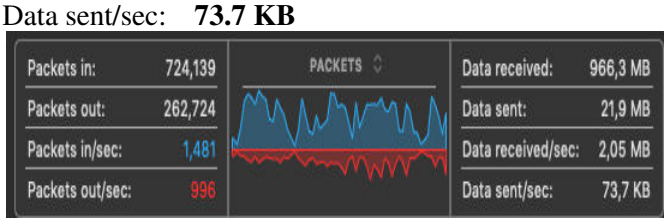
Data Packets In: **300,000**
Data received: **385.6 MB**
Data Packets Out: **107.262**
Data sent: **10.8 MB**
Packets In/sec: **183**
Data received/sec: **249 KB**
Packets Out/sec: **189**
Data sent/sec: **12.6 KB**

---

01 JAN 2019 Test Results

Network Test Summary 4 (Pick-time **after midnight new** year 2019 test)

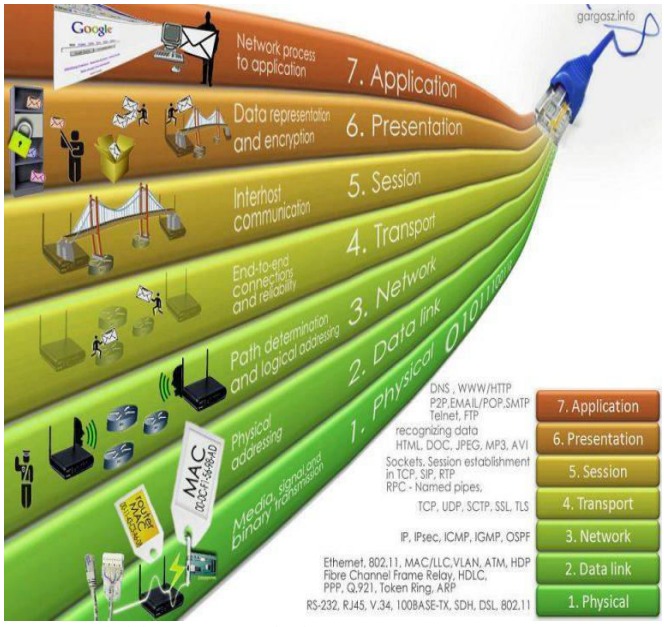
Data Packets In: **724.139**
Data received: **966.3 MB**
Data Packets Out: **262.724**
Data sent: **21.9 MB**
Packets In/sec: **1.481**
Data received/sec: **2.05 MB**
Packets Out/sec: **996**
Data sent/sec: **73.7 KB**



I manage to get high Network reading before midnight and the Highest after the New Year with the assuming that the network was going to be affected since a lot of people are communicating on different platform like social media / call and internet connections. The network was reliable and could handle massive traffic

Activity 4

Evaluates the rules of networks protocols that will apply to this network



ISO Model by: Networkel.com

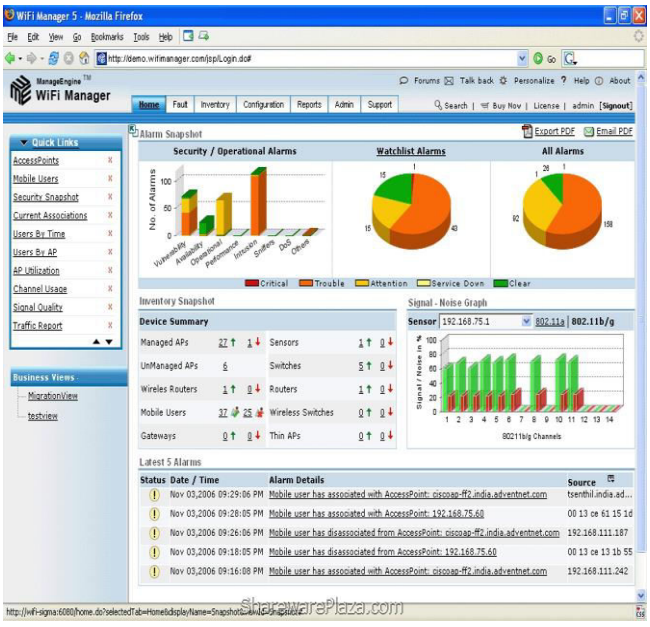
Transmission Control Protocol (TCP) its diverse software and hardware items that need to work together to transmit information from point to point. TCP it's a protocol that can transmit data to long distances using diverse type of computing types. TCP establishes a connection, then transfer data packets and acknowledges that the data packets are sent.

Internet Protocol (IP) its main purpose is to ensure those data packets are delivered and disassembling during transfer and reassembling of data packet at the destination.

Application layer: define the protocol and enables client applications to access other layers, such protocols like HTTP
Transport layer: it provides communication between Application layer and packet service including TCP
Internet layer: its purpose is routing and addressing of data packets called IP datagrams
Network interface layer: its responsibility is receive packets and placing them in the network medium

Analyses the tools that will be used to manage the network

The basic tools to be used to monitor network and its traffic movement Spectrum analyzer it monitor the spectrum as well as interference in the network and also gives a detailed report on time of event
OpManager software, it is real time network monitoring via live dashboards and graphs, it can also monitor physical and virtual server monitor, it also has reactive network monitoring capacity that can perform error correction, it generate alarms
Activity monitor software within the PC which can show detailed information about the network, size of packets, speed used to upload and download those packets and time and date.
Internet service provider(ISP) can also issue a Itemized billing report as hard copy at a fee



Wi-Fi Manager graphic by: Manage Engine 2018

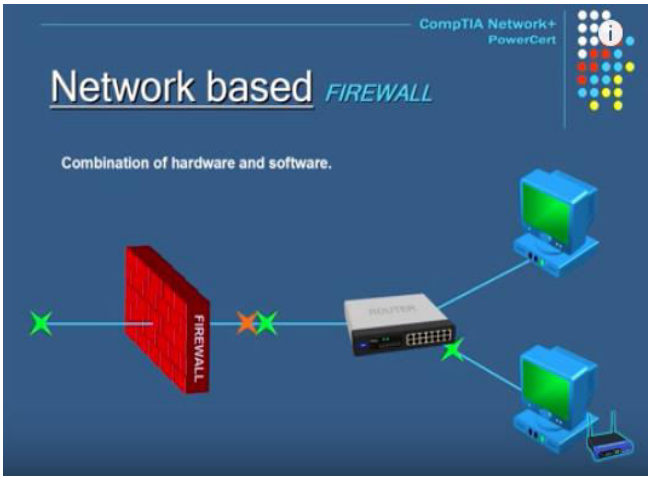
Evaluates the performance issues of the build network against the client brief

Network designed with fiber as backbone and also embraces convergence technology to wireless and Ethernet (Network backup system).
Network Administrator PC installed to give and reserve privileges for End-Users at JACK AND JILL, and ensure that staff have remote access to the server, to perform their functions.
Network Administrator also monitors network performs, issue temporary Wi-Fi password or PIN to visiting parents at the school.
Network Administrator performs backups on both Active and Passive nodes, and ensures that all videos and Audio are streamed online on social media platforms.
Network Administrator ensure that network firewalls are working and anti-virus are updated frequently to prevent attacks.
Network Administrator creates and update Standard Operating Procedure (SOP) for staff regards network threats and good computing practices or behavior

Recommends security requirements that will keep the network safe and secure

Firewall: a security device that protect the network, by monitoring incoming and outgoing traffic and with specified instruction or defined sets of rules it will decide block or allow traffic. Firewall can either be software or hardware. Over the course time firewall have evolved Next-generation firewall (NGFW), which block modern threats such as application-layer attack and advance malware.
According to Gartner, Inc.'s (NGFW) must include

- ✓ Stateful inspection as a standard firewall
- ✓ Addressing evolving security threats techniques
- ✓ Integrated intrusion prevention
- ✓ Paths upgrade to include future information feeds
- ✓ Application control and awareness to monitor and block risky apps
- ✓ Context awareness and to assess more risk assets in the network
- ✓ Dynamic defense response, automation intelligent security and quick reaction to attack
- ✓ Smart detect evasive or suspicious activity, with network and event correlation



CompTIA Network+ Firewall image

Antivirus: it's software that is designed to monitor the system, prevent, or detect and destroy any form of computer virus and other malicious software like Trojans, adware, spyware, botnets, Ransomware rootkits and worms

Good standard Practice

The protection of assets from unauthorized use, access, alteration or destruction, should be part of the organizational Standard Operating Procedure (SOP) in terms of every person behavior and its related sanctions if such code is bridged.

Every user or staff should know its is their responsibility to ensure that all important company data should be kept safe at all times.

1. The implementation a good security system, risks must be identified, determined which are threated assets and how to protect them, determine the total cost of the assets that need priority to be protected,
2. Every user must have user-name or user-ID and password to access computing resources of the organisation
3. Password must be refreshed every month, to avoid unauthorized personnel from guessing possible combinations of passwords
4. Necessary updates in software protection must be installed and kept up to date, to avoid hacker/crackers from stealing valuable information
5. Only authorized personnel install, update and remove any software in the system (network Administrator)
6. In case of malfunction of any system staff must note or document possible symptoms, and call for assistance immediately, and so that it will be easy network administrator to troubleshoot the cause of problem

Reference

[1]Laudon, K.C. & Laudon, J.P. (2018) *Management Information Systems:* Managing the Digital Firm. Fifteenth edition. Pearson

[2]Fowler, B. Article: Best antivirus software for Windows and Mac Computers. Published by: Consumer Report [Online] 30 July 2018 https://www.consumerreports.org/antivirus-software/best-antivirus-software-for-windows-and-mac-computers/
(Assessed)29 Dec 2018

[3[ISO Model Published by: Networkel 25 Dec 2016 [Online]
https://networkel.com/osi-model-7-layer-network-communication/
(Assessed: 29 Dec 2018

[4]TCP-IP input & Output connectivity modules 2018 [Online
https://www.solimarsystems.com/solutions/spde/spde-connectivity/tcp-ip-input-and-output-modules/
(Assessed: 29 Dec 2018)

[5]What is a firewall? Published by: Cisco 2018 [Online]
https://www.cisco.com/c/en_in/products/security/firewalls/what-is-a-firewall.html?dtid=pseggl000183&ccid=cc000890&gclid=EAIaIQobChMIuIrp5-bD3wIVyrTtCh2ONQINEAAYASAAEgII4PD_BwE&gclsrc=aw.ds
(Assessed:29 Dec 2019)

Network Command Line Tools
TrainSignal [Online]
[6]https://www.youtube.com/watch?v=nH85pddWWAk Published: 30 Jul 2013
(Accessed: 21 Dec 2018)

[7]Manage Engine. Wi-Fi Manager 2018 [Online]
https://www.manageengine.com/network-monitoring/?network=g&device=c&keyword=%2Bnetwork%20%2Bsoftware&campaignid=836447466&creative=221250297078&matchtype=b&adposition=1t1&placement=&adgroup=51218405228&targetid=kwd-309090123060&gclid=EAIaIQobChMI482p7qC53wIVBZPtCh2jOgwwEAAYASAAEgKFBvD_BwE
(Assessed: 29 Dec 2018)

[8]Lecture on networking

CompTIA Network + Certification Video Courseand Images 2018 [Online]
https://www.youtube.com/watch?v=vrh0epPAC5wPublished:15 Mar 2016
(Assessed: 24 Dec 2018)

Mitchell. B. Published by: Lifewire 2018 Feb 02. [Online]
https://www.lifewire.com/sonet-synchronous-optical-network-816475
(Assessed 24 Dec 2018)

[9]Extreme network Fiber cable 10G SFP+ to SFP+ Active, Published: Google [Online] 2018
https://www.google.com/search?client=safari&rls=en&q=fiber+optics+cable&ie=UTF-8&oe=UTF-8
(Assessed 24 Dec 2018)

[10]Evans, D. Powerline networking: what you need to know 17 Jan 2018. Published by: Techradar.pro [Online]
https://www.techradar.com/reviews/pc-mac/networking-and-wi-fi/network-adapters/linksys-powerline-homeplug-av2-kit-plek500-1203686/review
(Assessed: 24 Dec 2018)

[11]A simple structure of client / server infrastructure Published by: Yevol 2007 [Online]
http://www.yevol.com/en/networking/Lesson06.aspx
(Assessed 25 Dec 2018)

[12]A simple structure of TCP/IP, Published by: Colocation America: 17 Jan 2018 [Online]
https://www.colocationamerica.com/blog/history-of-ip-address-part-2-tcp-ip
(Assessed: 25 Dec 2018)

[13]A Simple structure of Packet Switching Network, Published by: Google 2018 [Online]
https://sites.google.com/site/cis115textbook/packet-switched-networks
(Assessed: 25 Dec 2018)

[14]Huawei Product and Solutions
https://developer.huawei.com/ict/en/site-sdn/article/03Published: DC- centric Network Architecture based on SDN/ NFV 2018
[Assessed 24 Dec 2018)

Search Data Back-up, Published by: Posey, B. Network server backup best practice 2018 [Online}
https://searchdatabackup.techtarget.com/tip/Network-server-backup-best-practices-Backing-up-clustered-servers
Assessed: 26 Dec 2018