

Advanced Computer Network Project

- **Scope:**

The proposed network is designed to help start our own music store called Quality Sounds in a suburban area of the town. The initial plan is to start off with two stores which are located at a distance of five miles from each other. The store plans to sell new and used music and also plans to allow customers to get "online" from within the stores and download music. The store also plans to offer classes on know-hows of downloading music and configuration of MP3 devices.

- **Business Goals:**

- 1) Start our own music store called Quality Sounds in a suburban area in town.
- 2) Start off with two stores located at a distance of 5 miles from each other
- 3) Provide a training center within the store with 6 computers where people can come and learn the steps to download music as well as learn about configuration of mp3 devices.
- 4) Allow customers to go online within the store and download music.
- 5) Protect the internal store documents and other store details from the customers.
- 6) Provide 2 websites - one general purpose website and one secure website where people can buy music online.
- 7) Provide a wifi access point within the store
- 8) Provide an efficient POS solution for the store
- 9) Allow visitors to access internet
- 10) Each store with 3 office computers and 1 pos computer
- 11) One centralized printer per store.
- 12) Network should support eventual addition of stores .(Expansion)

- **Technical Goals:**

- 1) Provide a fast and available network.(high bandwidth ,low latency and fast response time)

- 2) Provide security within the network to prevent access of private and sensitive store details and documents by the customer ,i.e provide a network which is functionally isolated from the store's customer.(Authentication,intrusion detection)
- 3) Provide a wifi access point within the store.
- 4) Provide a network with minimal downtime.(maximum 24 hours downtime)
- 5) Provide a scalable network.(Plan to expand to 2 more stores after a year)
- 6) Provide fast internet access for downloading music.(greater downstream than upstream rate)
- 7) Provide centralized management of the network from offsite.
- 8) Provide communication tools for the employees.
- 9) Resilient network.
- 10) Affordable.
- 11) Efficient and Easy to manage.
- 12) Network capacity should be more than adequate to handle traffic load.
- 13) Maximize application layer throughput -This could be affected by factors such as high error rates,packet loss,disk access speed,size of disk cache,processor performance,etc
- 14) High accuracy (minimum collision)
- 15) Adaptable to emerging technologies.

● **Trade-off Chart:**

Availability	17
Scalability	20
Security	20
Network Performance	15
Manageability	6
Usability	7
Adaptability	10
Affordability	10
TOTAL	100

- 1) Redundant components to meet availability needs - >increase.in cost.
- 2) Security -> Slight increase in cost to purchase firewall,anti-virus software,employees might have to forgo ease of use

- 3) Scalable network -> Might cause some issues with availability as addition of new stores could burden the network.

- **Characterizing the existing network:**

There was no existing network

- **Identifying network applications :**

- 1) The general purpose website and the secure website.
- 2) Websites pertaining to information on downloading music, configuration of mp3 devices.
- 3) Sites showing video content.
- 4) Communication tools used by employees such as email, skype ,etc.
- 5) Applications for billing and inventory purposes

- **User Communities :**

User Community Name	Size of Community	Location	Applications used by community
PC users in Office	3	Store Office	Excel,Databases,web services
PC user in POS	1	POS Center	Calculator,Databases,Billing application
PC users in training	6	Training Center	Web,Skype,Email
Users of various devices	20,may grow	Wifi access point inside the store	Web,Skype,Email, etc

Total number of estimated users - 30

- **Characterizing and analyzing the network traffic:**

- Majority of the traffic in the network would arise from the downloads taking place in the network. This would take up most of the bandwidth. (Client-server traffic flow)
- The sites used for training customers would also contribute significantly to the network traffic.
- Traffic from accessing the general purpose and secure store websites.. (Client-server traffic flow)
- Traffic via wifi access.
- Traffic from applications used for billing, inventory and stock taking ,etc. This would need to be protected from unauthorized access by the customers.
- Traffic from the communication tools used by the employees. (Peer to peer traffic flow)
- Traffic from broadcasts by switches used in the network.
- Server/Server traffic flow (To update inventory, stock etc)
- Traffic due to centralized printer

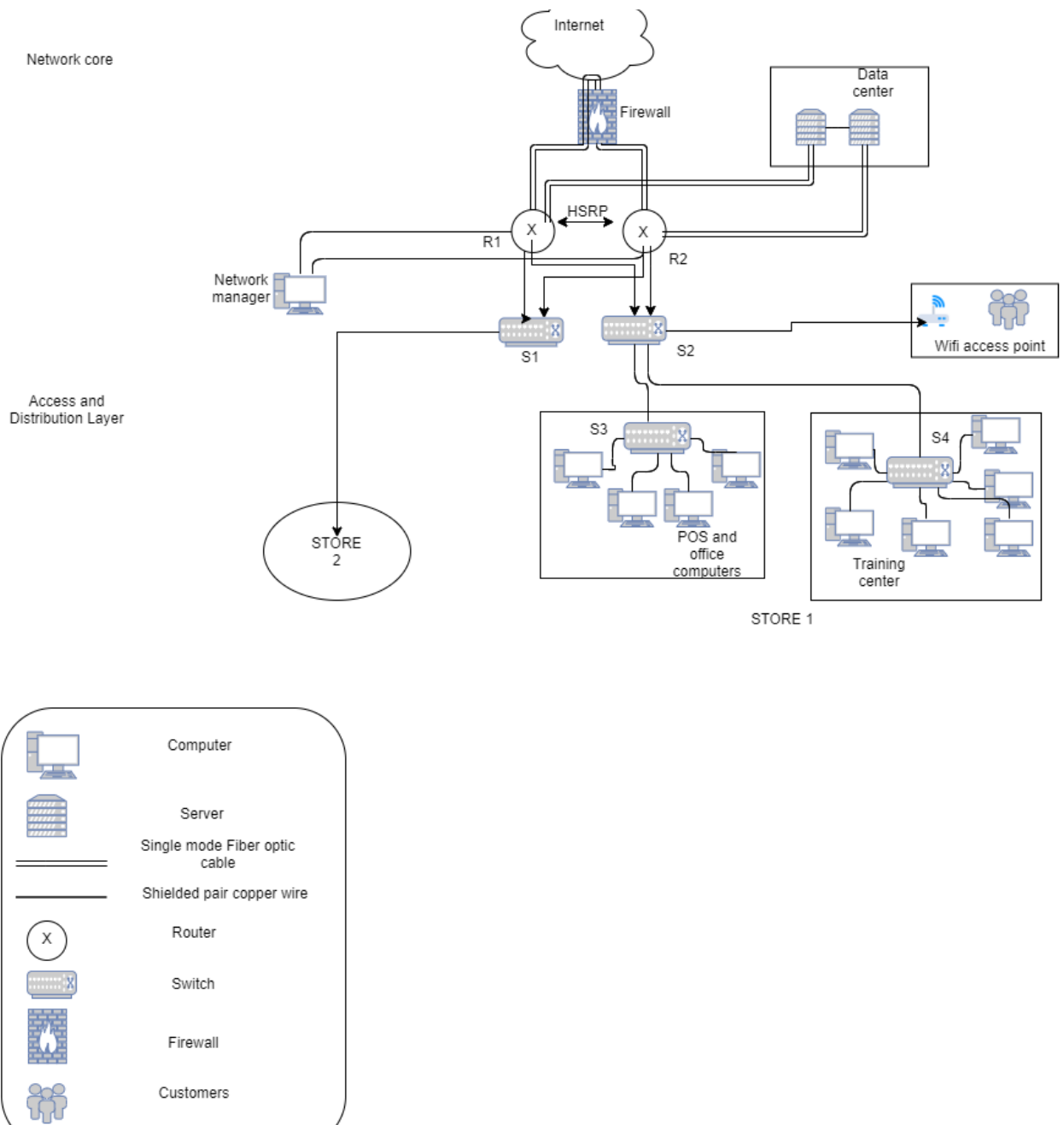
<u>Name of application</u>	<u>Type of Traffic Flow</u>	<u>User communities that use the application</u>	<u>Data stores</u>	<u>Approx bandwidth required for the application</u>	<u>QOS requirements</u>
Sites used for downloading music and training	Client-Server	Computers in the training centers, users using wifi	Hosts	50%	High bandwidth, Protection from virus, Greater downstream rate, low packet loss
Store's general purpose website	Client-Server	Computers in the training centers, users using wifi	Hosts, Servers	10%	Availability, Minimal downtime
Store's secure website	Client-Server	Computers in the training centers, users using wifi	Hosts, Servers	10%	Availability, Security, Low packet loss, minimal downtime
Billing, stock taking application	Client-Server	Pos computer, office	Servers	15%	Security, Availability, Low jitter, low

		computers			downtime
Communication tools	Peer-peer	Office computers,pos computers	Hosts	10%	Security
Others				2%	

- **Analyzing QOS requirements for the applications:**

- 1) Low packet loss - Controlled-Load service.
- 2) Low jitter: This occurs mainly due to congestion in the network. Use of ethernet as opposed to wifi in the 3 office computers, POS computer and 6 computers intended for the customers use and training can help reduce jitter.
- 3) High bandwidth :
 - This could be achieved by allocating a higher percentage of overall bandwidth to prioritize the downloads and for the training center's requirements.
 - Eliminating traffic that is not useful by blocking sites like netflix and other unnecessary sites that consume a lot of bandwidth.
 - Scheduling the network backups and updates at an optimum time so as to impact the least amount of end users.
- 4) Low latency .
- 5) Security in the network.
- 6) Minimal downtime .
- 7) Availability of the services and applications.

- **Proposed network topology:**



• Design choices and trade-off:

- 1) To provide scalability and availability in our network, we plan to use primary and alternate routers in respective places. Optionally, we can also make use of load balancers in our datacenter so as to not overburden one server and to route requests uniformly to all the available servers. This could help in scaling of the network and help in maintaining optimum capacity.

- 2) To provide a fast and reliable internet connection we plan to use single mode fiber optics from the internet service provider and datacenter to the network edge and from there, internal to each store, we have planned to use shielded twisted pair copper wire. For the wifi lounge, we plan to use a wifi modem using which the customers would be able to access wifi. Also, we thought of using Dynamic host configuration protocol for assigning ip addresses to people connecting to the wifi.
- 3) To provide security within the network we plan to use firewalls (to prevent unauthorised access to the store details).The security would also include employee accounts and passwords given to the employees of the store that would give limited access. Also the computers could come with a pre -installed antivirus mechanism (that would have to be renewed on a timely basis) to protect against malicious threats while downloading data.
- 4) For the network ,we plan to use OSPF routing protocol as it supports CIDR,has a mechanism to include IPV6 addresses,is supported on most routers and converges faster.It is also easier to configure and manage and does not create a lot of traffic.
- 5) Switching Protocol: We plan to use the Spanning Tree Protocol as a Level 2 protocol for switching.
- 6) Keeping in mind the storage requirements,each employee computer would have a minimum storage capacity of 10 GB and the computers meant for the customer would
- 7) have a storage capacity of 20GB. The main servers in the datacenter would have a storage capacity of 40 GB at present with a provision to upgrade at later stages by installing a RAM chip.
- 8))To maintain the network and provide centralized monitoring, we plan to have a network management system in place .NMS runs applications to display management data,monitor and control managed devices and communicate with agents.Also,we plan to use Remote Network Monitoring which allows a network administrator to monitor the network from a central site.
- 9) As part of the POS solution, we plan to accommodate - A barcode scanner,credit card reader,upi payments,cash drawer,receipt printer. Optionally,cctv could also be provided for the store.
- 10) Additionally,as part of plans of further expansion,we plan to provide a cloud platform for the store's website by using a SAAS cloud application .Using this,it would be very comfortable and seamless for the store to move to the cloud in the future.

However ,

- We would be compromising with the reliability of data packets by itself as we don't plan to have an encryption and decryption mechanism in place as that would not be highly

required in a normal music store and would lead to unnecessary hike in cost. Also, in the case of the data packets being corrupted, we would have the anti-virus mechanism in place that would be of use.

- We could compromise a bit on the availability part as the service offered by the store is not an essential service.
- Additionally, the use of fiber optics from the internet service provider and servers to the internet edge could be a bit costlier. But it would help in increasing the rate of data flow and reduce response time as well as ensure the customers's satisfaction as the customer could get irritated if the data rate is slow. This in turn could compromise user experience and could lead to an overall negative experience for the user and thereby a loss for the store.
- We don't plan to offer very high security for the wifi (other than the basic security password for accessing the wifi). So, this could lead to some issue with the user's data being vulnerable to theft if sufficient care is not taken by the user/customer.
- The use of redundant routers and load balancers could seem unnecessary and lead to a costlier network but they have been used to provide resiliency and disaster recovery in the case of device failure.
- Firewalls are a costly way of providing security in the network. Instead of using firewall, we can use simpler mechanisms such as providing the employees with a user-id and password before accessing certain records, etc. However, firewalls by themselves come with a lot more features such as intrusion detection, monitoring traffic, etc and is more efficient in the long run.
- Moving to the cloud allows for data redundancy, improved bandwidth and the ability to scale well. But it is quite expensive and involves making some changes in the application to move to the cloud. Not directly opting for cloud storage will reduce the initial expenses. As the company grows they can invest in a complete SAAS model.
- Using centralized data center could lead to an increased response time as data needs to be fetched from the server. However, we chose to use centralized data center because a centralized system allows for consistency of data, better control of hardware configuration, capacity and performance. (It is also easier to scale using data centers as opposed to a decentralised one)

- Approx Cost:

Appliance	Quantity	Cost per piece	Total cost
Desktop	10*2	25000	500000
Server (in datacenter)	2	12000	24000
Switches(16 port,1000mbps)	2*5	1499	14990
Routers	2	35000	70000
PC for network manager	1	30000	30000
Anti-virus	1200 per year	1200	1200
Printer	1*2	3000	3000
Website domain charge	800 per year	800	800
Internet	6000 per year	6000	6000
Wifi router	1*2	1500	3000
Firewall cost	1*1	22000	22000
(Other costs)		20000	20000
		Total	715000
OPTIONAL			
Load balancers	2	20000	20000
		TOTAL	735000