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IT Company-Expansion
Assignment Report

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Department: Computer Science and Engineering

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Table of Contents

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Assignment Report

1. Business Case

The objective of this project is to analyze and identify the networking opportunities, challenges and their solutions in expanding an IT company, Diya Systems, by adding branches in different cities. The networking challenges associated with this expansion are studied and solutions are proposed. Use of current, state of the art technology is studied to ensure that the company does not lag behind its competitors with regards to its networking infrastructure.

Additional care is taken to ensure that important requirements of the network such as security, flexibility, and speed of communication are not neglected. The final goal of the project is to develop a model that satisfies the requirements of the network, while taking care of the identified network challenges.

1.1. Current State Summary

Diya Systems is an IT company with its headquarters in Mangalore which provides technology solutions such as website development and hosting and software development to organizations across India. The most recent quarterly reports show a trend of a steady increase in business. As a result of this, and in hope of such growth continuing, the company is looking to hire more employees.

The limited talent pool available in Mangalore, along with the unwillingness of potential employees to relocate to Mangalore, means that the company must open offices in metropolitan cities like Bengaluru and Mumbai in the near future.

The current network is limited to the company's offices in Mangalore. At present, all servers of the company are located within the Mangalore offices. Increasing load on these servers has affected the performance and reliability of all the applications that rely on these servers. In Mangalore, the cost of maintaining data centers at their optimal operating temperatures of 20-21°C has lead the company to consider moving its data centers to a location with a cooler climate.

1.2. Opportunities

Adding branches in cities like Bangalore, Hyderabad, and Mumbai provide the company with a number of advantages. Bangalore in itself has ten times the number of people that Mangalore does. So there is a much larger potential employee base in the larger cities. Also, potential employees from outside these cities are more likely to be ready to move to a larger city than Mangalore.

Having branches in more cities increases the exposure the company gets to potential customers. This will both allow the company to get more customers in India and also create the possibility of gaining customers from abroad. Customers would be more comfortable working with the company if there was a branch in their city as they would be able to provide better technical support to the customer.

Since metropolitan cities have a much more diverse array of people and serve as a launching pad for global opportunity, we could be more active part of the global community by expanding to such cities. Furthermore, these cities give us the ability to use state of the art technologies like MPLS VPN, which may not be a possible or economically viable option in more remote cities like Mangalore.

To have our servers running at an optimum temperature, we need cheap, efficient and reliable cooling facilities. The monetary aspect of this can be tackled by moving to better climates inland, where the effects of high temperature and humidity are less pronounced.

2. Communication / Networking Requirements

One location, for a growing business, is typically not enough. With enough personnel and capital, many businesses prefer to set up multiple offices to attract different regions of customers. With separate offices it is a challenge for a company to install a network so all the locations can work, communicate, and share information easily, instantaneously, and effectively. New advancements in communication technology—including improvements to virtual private networks, remote desktops, and the cloud—allow instantaneous information and file sharing with an extremely cheap price tag.

The designing of a reliable, scalable, and secure network is a complex task that requires knowledge and experience over the wide area of computer networking, including knowledge of network device configuration, network types, routing protocols, potential security threats and many more.

Primarily, an architectural model lays the foundation for any computer network that spans over an area. An architectural model hence precedes any further network requirements. We need to decide which architecture is better – MPLS WAN Connectivity and Centralized Internet Access (or) De-centralized Internet Access at each branch. Topological models are often used as starting point in the development of a network. Usually the network is built using more than one of the architectural models.

Another requirement is the number of routers to be used for the network. As the size of a branch increases, the number of routers (connections) increases, and also the issues number we have to consider are also increased. Also, we need a secure communication with the enterprise hosts.

An enterprise should be able to prevent packets being read by attackers when they traverse the Internet. An option is VPN as it allows the enterprise to trust packets coming from legitimate branch office.

We need data centers and WAN to enable our Company to efficiently span over distant locations. QoS, service level agreements, and encompassing encryption will help ensure security of high definition video, voice, and data services.

Label Switching

In a traditional IP network: Each router performs an IP lookup ("routing"), determines a next-hop based on its routing table, and forwards the packet to that next-hop.
Rinse and repeat for every router, each making its own independent routing decisions, until the final destination is reached.

MPLS does "label switching" instead: The first device does a routing lookup, just like before, but instead of finding a next-hop, it finds the final destination router. And it finds a pre-determined path from "here" to that final router. The router applies a "label" based on this information. Future routers use the label to route the traffic Without needing to perform any additional IP lookups. At the final destination router the label is removed. And the packet is delivered via normal IP routing. Essentially a unidirectional tunnel between a pair of routers, routed across an MPLS network. An LSP is required for any MPLS forwarding to occur.
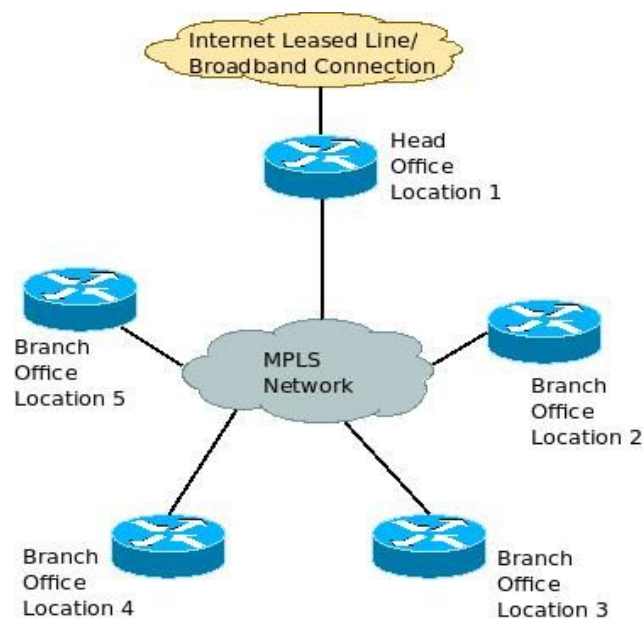
3. Communication / Networking Challenges

Every growing business hopes its network will be reliable, secure, flexible, expandable and cost-effective. In order to achieve this, the company must   be able to balance various factors effectively.

FLEXIBILITY:

To be on pace with users and the different ways of working of the back-end systems, network security has adapt speedily. Flexibility and variety are increasing at both sides of the enterprise network these days. On the outside, users are operating with a growing range of hand-held computing devices. On the inside, virtualized servers, unique storage devices and mechanisms to back up data are replacing what used to be a simple cluster of static servers.

Both user needs and business needs are adding new requirements to the list of features that a network must support. New personal computing devices, with modern operating systems and brand new capabilities, are materialising at an exponential rate. Business must be flexible in

adopting the technical changes in order to stay in advance in the business world and make sure the changes are incorporated in its sub branches as well.

The era of static desk-bound PCs, running a prescribed OS image and a prescribed set of applications, has passed. The enterprise network must now be a more open platform. This flexibility in end-point devices and applications brings security issues.

SECURITY RISKS:

The modern operating systems and their data traffic allow the probability of uncommon forms of viruses and cyber-attacks. Lifting restrictions on which devices are able to connect to the network also notably increases the opportunities for fraud users to gain access.

Now that network users as well as guests can connect to the devices of their choice, the process of affirmation is a lot more challenging. During the expansion process , appropriate measures have to be taken to ensure a secured network communication. Information security is a challenge that has to be taken into notice.

Virtual servers and their data are increasingly being copied and transferred to offsite locations in case of recovery in unfortunate circumstances. Maintaining security during expansion of the company introduces another part in the networking security puzzle.

CAPABILITIES:

- MPLS(Multiprotocol label switching) networking is not feasible on global scale, hence maintaining the expected bandwidth throughout the company's sub branches will be challenging.

- For new protocols to take affect , existing infrastructure should be modified accordingly.

- IT specialists with knowledge on handling complex feature sets in the network should be hired. Within many industries there is a drive to reduce the total cost of ownership of network infrastructure. Thus an efficient and capable network must be maintained with little or no increase in budget.

- Overhead for the main central IT branch will increase, as MPLS circuit is situated in this location, through which leased lines are accessed. Hence this Branch capacity decreases and it will face intra-branch communication problems.

TROUBLESHOOTING:

- The company's sub parts all simultaneously face difficulties when they lose internet connectivity due to problems in the main branch.
- Lack of MPLS networking knowledge means network issues will be resolved with a higher delay, thereby halting communication with its branches.

SPEED:

As IT companies concentrate on centralizing and strengthening their infrastructure to increase efficiency, business is slowly and surely becoming more dispersed as different branches and remote offices are opened in various regions, each requiring fast and safe access to associated applications that might be present in the head branch. To tackle this scenario, network managers must manage and take into control unauthorized applications carefully to assure that the business performs at its maximum efficiency.

A) Negative User Experience: User satisfaction is one of the most sought after requirement that a good network ought to have. Waiting for the system or an application running in the system, is usually due to unknown applications traversing the network, and in result the amount of traffic each of these fraud applications are producing. This additional load depreciates the overall dependability of the network, and the performance of authorized applications. The outcome of this is a perception of incompetent network performance, mainly its speed.

B) Compromised application performance: The more users connected to business and personal computing equipment at work, the heavier the corresponding load on the network will be, resulting in a downgrade in the network speed at that individual branch.

Impact: With the speed at which business moves, keeping up is a constant task that never gets any easier. If you can't keep up and move quickly, your competitors will. They won't hesitate to leave you in the dust if you can't think on your feet. As an important factor in product development, to meet various deadlines, it is difficult to overstate the importance and impact of speed and performance in business.

4. Networking Solutions:

Almost all IT companies have many branches. In order to connect them and to ensure the smooth communication between various branches, proper architecture is to be adopted. Since we need to connect branches in various cities, we use WAN (Wide Area Network), but the kind of connectivity in WAN that we choose should be suitable.

We choose MPLS WAN connectivity and centralized internet access or decentralized internet access at each branch. The reasons we chose MPLS WAN connectivity over others are explained below:

Point to Point leased lines are traditionally used in connecting the various branches. But, MPLS networks have gained popularity in recent times.

Point to Point Leased Lines:

Diagrammatic representation of point to point leased lines is shown below:

As one can see, point to point leased line is formed by connecting each location to every other location using leased lines. This private network is primarily used for site-to- site locations. So an organization containing five locations, we need four lines for every location. So if we have n locations, we require n (n-1) leased lines to connect all sites which can be found expensive.

Point to Point Leased Line Architecture
to connect Five Locations

Location 1

Location 5

Location 2

Location 4   Location 3
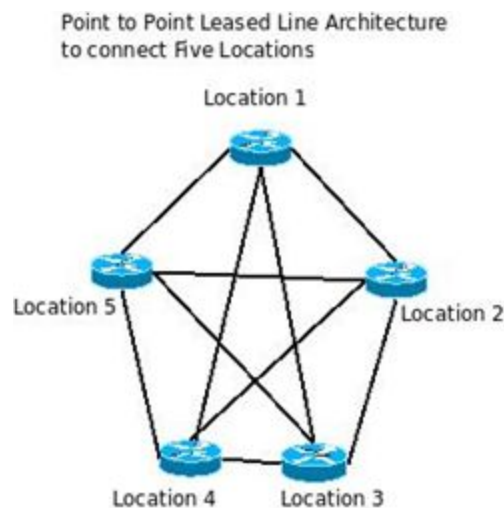
MPLS Network

Diagrammatic representation of a MPLS Network is shown:

An MPLS Network is formed by connecting each location to a service provider MPLS network. Full form of MPLS is multi-protocol label switching. Any packet coming out of location (sender) is encapsulated with a label by MPLS service provider which is discarded when packet travels back to destination from service provider.

MPLS VPN Network Architecture to connect Five Locations
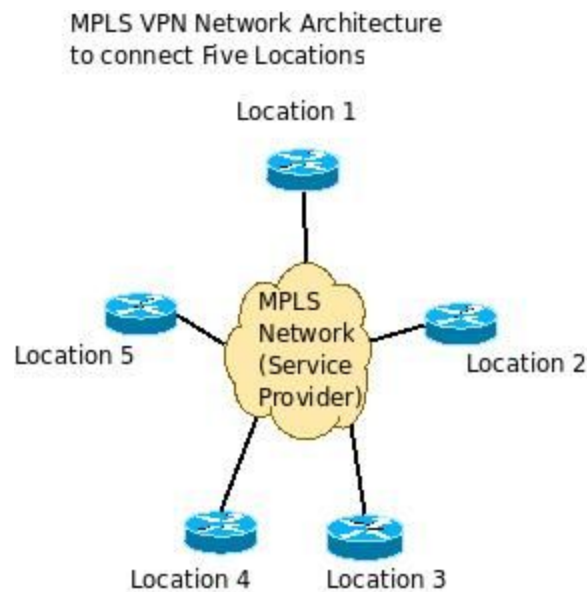
Now we know about MPLS network, let's discuss how it is implemented in connecting various branches of an IT company.

MPLS WAN Connectivity and Centralized Internet access:

In this model, we connect the head office and all other branches to MPLS service provider and direct internet connection is provided only to the head office. Branches can access internet through MPLS network and accessing internet through head office.

The main advantage of having this type of architecture is minimization of underutilization of bandwidth and also cost effective. The security policies can be applied well from one branch to head office, which gives more control to the head office. One of the major disadvantages is

the slow internet connection to member branches which results in delay of office transactions which can affect growth adversely.

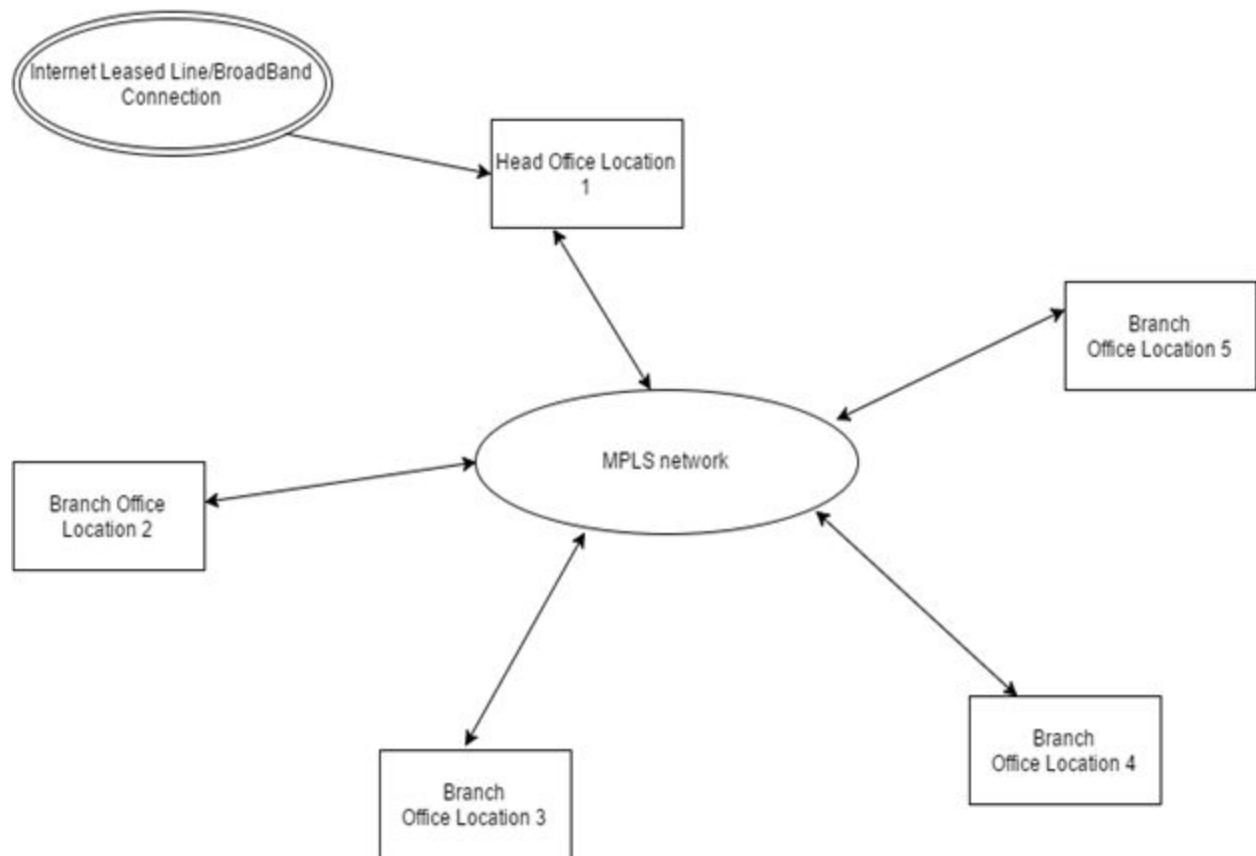## MPLS WAN Connectivity and Decentralized Internet Access:

This model is very much similar to the previous one, the difference being only the internet connection is provided to every branch. Since internet connection is provided, the users no longer experience slow internet connections and also inter-branch communication travel in MPLS circuits and internet traffic goes through internet leased lines without disturbing MPLS.

The main advantage if planned well can give best performance in data traffic and internet traffic. One of the disadvantages can be the underutilization of bandwidth provided for each branch. It is more expensive than the previous architecture. Since costs of MPLS service providers are very high, it might be difficult to connect branches if they are situated on different countries.

To improve performance, network managers need to have complete visibility of all conversations and applications on the network to be able to proactively control what traffic is given priority to ensure legitimate business applications perform optimally.

5. Proposed Models

MPLS WAN Connectivity and Centralized Internet access:

MPLS WAN Connectivity and Decentralized Internet access:
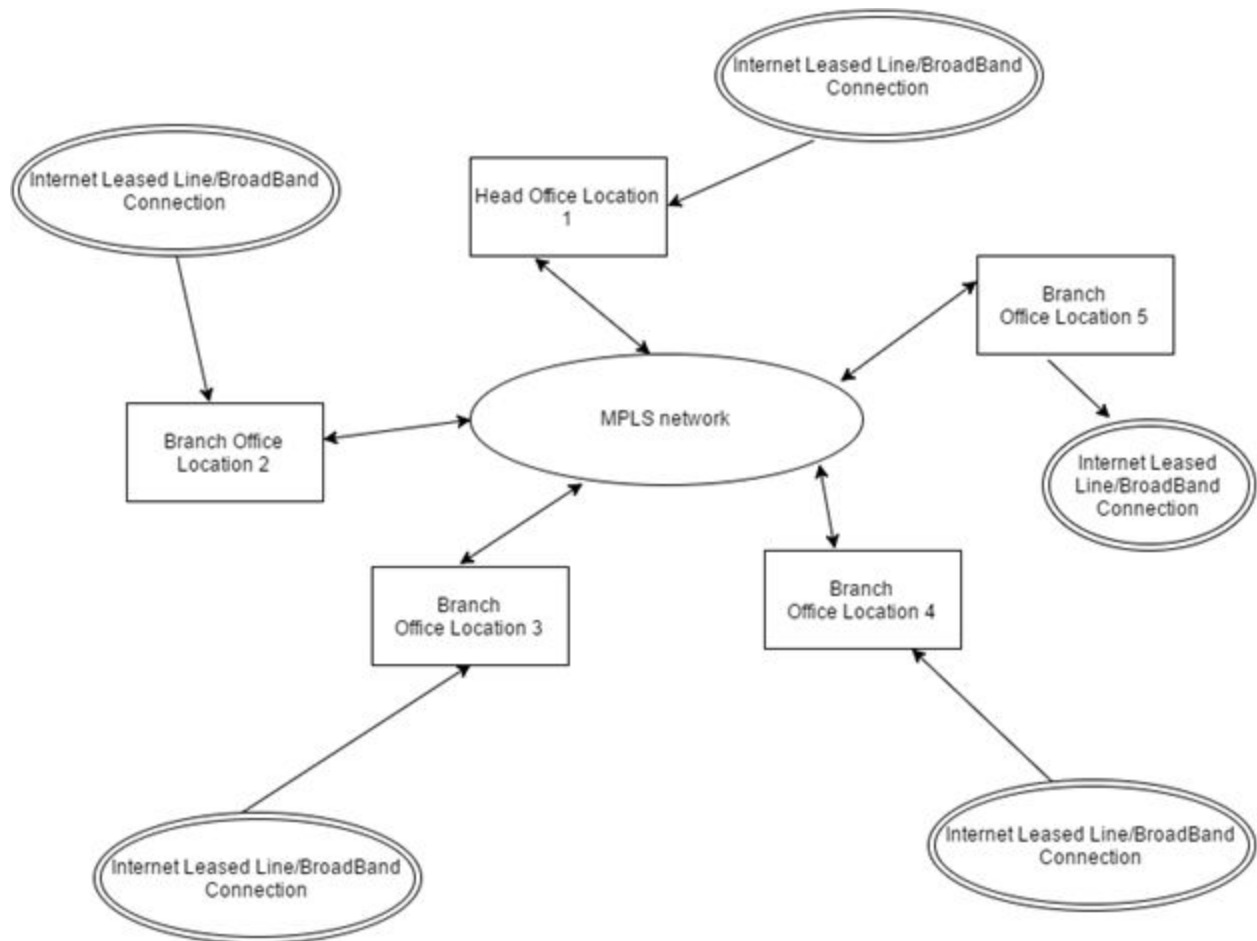
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6.	14CO206	Chinthapulusu Bugga Yuvaraj	Worked on Network Solutions and proposed models.
7.	14CO207	Chiranjeevi AR Hegde	Worked on Network Solutions and proposed models.
8.	14CO208	Deepak Srikanth	Worked on Business case

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