FRAMEWORK FOR INTELLIGENT NETWORK DESIGN

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Abstract- Designing a network can be a challenging task. A network that consists of only 50 meshed routing nodes can pose complex problems that lead to unpredictable results. Attempting to optimize networks that feature thousands of nodes can pose even more complex problems. In this paper, we propose network design framework to simplify the complexities associated with analyzing customer network problems and creating scalable solutions which can provide suggestions to the network designer to use frameworks for a particular network design. This framework may also act as a network analyzer to suggest various steps to be implemented to improve the performance of the current network.

Keywords- Network design constraints, resource planning, switched network, Ethernet

1 INTRODUCTION

The usage of Internet is getting more and more important. Under the consideration of cost and redundancy, multiple link structures is necessary to reduce the network traffic jam for an organization to connect to the Internet. Most of the time, multiple line connections mean multiple Internet Service Provider (ISP). It leads to the management problem for traffic load balancing and multiple ISP routes. This paper explores a network design framework to simplify the complexities associated with analyzing customer network problems and suggesting scalable solutions. This framework may help a network analyzer in providing various steps to improve the performance of the current network. According to Robert Metcalfe, inventor of Ethernet, the value of a network is proportional to the square of the number of users (or hosts) that it connects. This statement, popularly known as Metcalfe's Law, essentially explains the tendency to expand networks to reach more computers, allowing more users to take advantage of their resources. In effect, this positive feedback loop leads to a renewed interest in expanding the network, which now encompasses even more resources, thus attracting new users, which in turn, want to connect more computers [1]. Building networks imply higher infrastructure, maintenance costs and increased sophistication. Any additions or modifications to an operational network necessitate a plan, which should be devised after understanding existing weaknesses and vulnerabilities, and identifying current and future needs.

1.1 Network Design Constraints

A network designer can use many archetypes in order to determine the exact network architecture. Yet, not all networks are created equal: Differences in topology (host, router, and link location and dependencies), software and hardware configuration, and protocol deployment makes every network unique. As a first step in Network

Resource Planning (NRP), the network designer must consider both the functional and non-functional requirements [2].

The functional requirements specify what the software (or hardware) is expected to do. The network resource planning process is presented in Fig. 1.

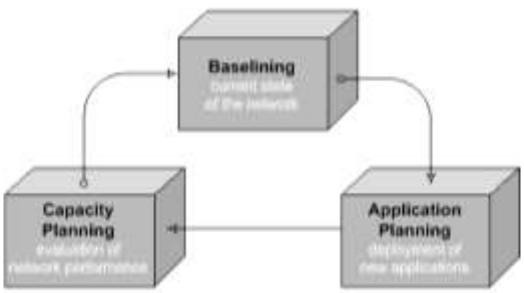

Fig. 1. The Network Resource Planning process.

Base lining identifies the overall enterprise goals, specifies the technical objectives, and records the current network infrastructure and state of operation.

Application Planning produces a characterization of future applications that will be deployed in the current infrastructure.

Capacity Planning uses simulation and modeling to obtain measurements under different scenarios, in order to test alternative network design proposals. Based on the simulation results, the network designer will decide which architectural solutions are better.

1.2 REVIEW OF LITERATURE

A documentation framework was proposed by Appleby, D.S.; Callahan, D. [3] to assist quality assurance teams in the analysis of complex computer network designs. The framework includes three elements: (1) a requirements definition, (2) a design depiction, and (3) the identification of potentially problematical interfaces. Requirements definition begins with nominal statements describing general design requirements; these statements undergo a process of qualification and quantification, increasing their effectiveness in conveying the purpose of the design. Design depiction presents the system at a high level of abstraction that can be decomposed into functional layers and isolated components. Interface identification allows problematic interfaces to be discovered through intra-component and inter-component analyses. The use of a consistent framework should improve the quality of the design review process.

According to [4], an organization's success is tightly coupled to its ability to store and manage information. With the amount of data growing at an incredible rate, your storage strategy must keep pace. In designing a storage strategy for your organization, you must select the right technology for your primary storage system, implement solid backup procedures and ensure ongoing management of the system.

According to [5], although a top-down approach is preferred to the bottom-up method, both have associated advantages and disadvantages. The lists below take a look at some of the relative advantages and disadvantages of each method.

According to [6], the design of a distributed local area network management system is primarily a problem of data reduction, data transmission, and data presentation intermittent faults that cripple. By the time a traditional tool like a cable tester or protocol analyzer is rolled out to monitor the network, the problem has vanished. Users suffer from unreliable LANs while network managers suffer from the wrath of angry users for problems the managers are unable to diagnose.

2. FRAMEWORK FOR DESIGNING COMPLEX SMALL-SIZED NETWORKS

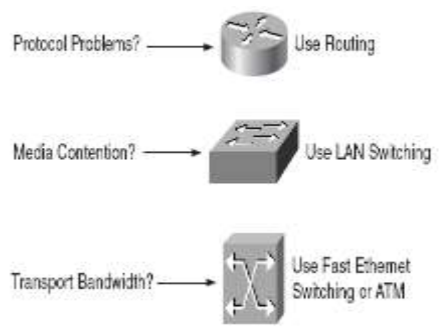

Fig. 2. Small-sized network design framework

If the problems are protocol-related, routing will be used. Many LAN protocols use periodic broadcasts and service advertisements and do not scale well as the network size increases. Routers can be used to further subnet your network and reduce broadcast domains. Access and security policies can be applied on routers.

If the problem involves media contention, LAN switching will be used. For example, if you have too many nodes on a shared network, you will expect to have high utilization; devices will have to compete to obtain access to the network, and application response may be slow. Introducing LAN switching will help resolve the contention on the network.

If high bandwidth is required, consider to switch Fast Ethernet. Switching to Fast Ethernet offers a good cost-to-performance ratio for small to medium-sized networks. Gigabit Ethernet now provides another option in the LAN for the backbone and width-intensive application servers.

Another intelligent approach which can be used is to use a physical address for routing as it permits two or more routers to own the same IP address, but not concurrently. A control protocol, such as Cisco's Hot Standby Router Protocol (HSRP), arbitrates the use of the IP address for routing purposes. The small-sized network design framework is presented in Fig. 2.

3. LAN DESIGN ISSUES AND PROPOSED SOLUTIONS

All schools have been assigned a public IP range. If you keep to this, your network addressing is simple to manage and efficient in data transfer. A fully switched network can help reduce the live broadcast domain but the broadcasts and multicasts will flood to all nodes on your network. The best policy is to reduce the broadcasts at source and then to manage them at network device level.

If your network has more than 500 nodes which include PCs, printers, servers, wireless access points etc. Then consider segmenting your network using subnets or VLANs.

A collision domain is a part of the network where collisions can occur. When a device is sending a packet on the network detects another device on the same segment starting a transmission, it stops and waits for the traffic to clear before resending.

This results in a substantial loss of throughput on that segment causing considerable delays. Switches provide a collision domain between port and device if dedicated cabling is used. Servers and some devices on the network can double data transmission rates by being configured as full-duplex device. This prevents the possibility of the collisions.

3.1 Proposed solutions for design of a switched network

A switch located between the users and the server will not necessarily increase network speed. If everyone is accessing the server and that server is connected to the switch by only one port, they will have to wait. The switch is ineffective because only one individual gets information at a time.

If the switch has three ports dedicated to the server, it can conduct three conversations with three different clients at the same time. All modern network operating systems can use multiple network cards to provide increased bandwidth in this way.

The bottleneck in any client/server architecture is normally between the service (resource) and the switch. Multiple network cards provide one solution. However, installing a Gigabit network card may be easier and more cost effective. A Gigabit module will be required for the switch if this solution is chosen.

3.2 Gigabit Ethernet Technology and proposed Solutions

Gigabit Ethernet is a good choice because it supports Quality of Service (QoS) methods that are increasingly important for avoiding latency problems as voice; video and data share the cable for Next-Generation Networking (NGN) applications. Auto-negotiation can eliminate the possibility of dissimilar technologies interfering with each other.

Gigabit transceivers at the physical layer (PHY) of the Open Systems Interconnection (OSI) model use auto-negotiation to advertise the following modes of operation: 1000BaseT in full or half duplex, 100BaseTX in full or half duplex, and 10BaseT in full or half duplex.

Auto-negotiation enables an easy upgrade path to gigabit speeds by future proofing the server network connectivity with a three-speed network interface card (NIC) or LAN on motherboard (LOM).

A server connected to a Fast Ethernet switch or hub can easily be upgraded to Gigabit Ethernet by connecting the NIC to a Gigabit Ethernet switch. If both the NIC and the switch are set to auto-negotiate, the interface will be automatically configured to run at 1000 Mbps.

4. SCOPE FOR FUTURE WORK

This work can be extended and a framework for MAN and WAN can be proposed. A tool can be developed which can initiate the user to use this framework or can automate usage of this framework.

5. CONCLUSION

A network that consists of only 50 meshed routing nodes can pose complex problems that lead to unpredictable results. Attempting to optimize networks that feature thousands of nodes can pose even more complex problems. In this paper, we have proposed a network design framework to simplify the complexities associated with analyzing customer network problems and creating scalable solutions which can provide suggestions to the network designer to use frameworks for a particular network design. This framework may also act as a network analyzer to suggest various steps to be implemented to improve the performance of the current network.

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