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Survivability Strategies in Optical Networks Based on Multistory Building LAN.

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***Abstract*— Optical networks have been developed as the solution to accommodate the high bandwidth demands in the domain of communication. In optical networks the network survivability is of prime concern since a single link or node failure will lead to huge amount of data loss and disruption of services. Optical networks are used to pass the information like file, e-mail, audio, video etc., through LAN connecting to the number of switches which are further connected to the number of PCs via a Ethernet-LAN in the Multistory building LAN. This paper tells us about how this information will be passed and is focused on reducing the consumption of the time while passing the information from server to the PCs. This project proposes a framework consisting of two modules in which the application performance and capacity planning are managed using the OPNET IT Guru Software.**

I. Introduction

In telecommunication networks [11] the optical network is the major aspect for enabling extremely high-speed transport of different forms of data. The provision of network protection mechanisms must be considered in the network design stage itself to protect against various failure scenarios. The physical topology of a network is an important parameter onto which the connection requests are to be mapped since it directly determines

the resource requirements and the complexity of the network. The data or information can be sent on multiple wavelengths of an optical fiber, using Dense Wavelength Division Multiplexing (DWDM) [1]. In this project we are using the OPNET IT Guru software, it provides a Virtual Network Environment that models the behavior of networks, including its routers, switches, protocols, servers, and individual applications [2]. The Virtual Network Environment allows IT managers, network and system planners, and operation's staff to more effectively diagnose difficult problems, validate changes before they are implemented, and plan for future scenarios such as traffic growth and network failures. OPNET's Application Characterization Environment (ACE) module for IT Guru enables enterprises to identify the root cause of end-to-end application performance problems.

We can do "what if" analyses (called scenarios in IT Guru) on network designs, just as we can on spreadsheets with financial business models. However, instead of looking at "bottom line" financial numbers, we will be looking at how response times, latency (delays) and other network performance measures will change under different network design approaches. For creating a network simulation in OPNET IT guru we have to specify the nodes such as switches, computers, and routers etc. in our network and link the nodes to check the application performance.

II. Optical fiber over wireless

A. Reliability

Wireless technologies [3] are constrained by inherent performance limitations that do not apply to fiber optic broadband. Wireless broadband networks, whether licensed by the Federal Communications Commission (e.g., Verizon, AT&T, Sprint Nextel/Clearwire and T-Mobile) or unlicensed by the FCC (e.g., Wi-Fi), use microwave radiation to transmit and receive their signals. Radio signals can be blocked by buildings, trees and other objects, and transmission quality is even subject to atmospheric conditions. Many Wi-Fi networks operate in unlicensed bands of the spectrum and use the same carrier frequency as cordless phones, microwave ovens, and other consumer devices, and are therefore even more subject to interference problems than licensed wireless networks.

Fiber optic technology presents none of these problems. In fact, network traffic moves across fiber optic cables in a manner that makes it even less susceptible to interference from other data traveling along the same fiber cables than other wired technologies

B. Speed and Capacity

Wireless broadband network speeds are significantly slower than fiber optic networks. In addition, the greater the number of users accessing a wireless access point at a given time, the greater is the degradation of service experienced by those users. The current industry standard for fiber optic broadband is 10 Gigabits per second (GB/s or billion bits per second) per fiber optic pair. Bonding multiple 10 GB/s fiber pairs is possible to produce even faster channels. By contrast, the present theoretical maximum speed for an 802.11n dedicated wireless access point is 150 Megabits per second (MB/s or million bits per second). In other words, the standard fiber optic connection for current commercial desktop usage is over 66 times faster than its wireless counterpart.

C. Security

Wireless networks are more expensive and difficult to secure than wired fiber optic networks and are therefore vulnerable to hacking, identity theft, national security threats, and unauthorized surveillance of users. Unlike wired fiber optic networks, wireless networks can be subject to attack wherever a signal is present. Although encryption makes such attacks more difficult, encryption methods do not eliminate this problem. For those with the interest and technical ability (e.g., individual hackers, criminal organizations, and national governments, both foreign and domestic), wireless signals are easily intercepted, tapped, eavesdropped upon, and used as platforms to launch malicious attacks on users.

III. MULTISTORY BUILDING LAN

This project shows the application performance of two different network architectures: Daisy Chain and Collapsed Backbone Network. It shows a collapsed backbone data network in which there is a core switch in the basement equipment room. The core switch is linked directly to a workgroup switch on each floor. Another option is to link the switches in a daisy chain. In this approach, the basement core switch is linked directly to the first floor switch, the first floor switch is linked directly to the second floor switch, and so on. The application latency introduced by connecting building switches in different ways.

The SRM tech park building has 10 floors, each having many users connected to a 10Base-T workgroup switch in the floor's telecommunications closet. The users share an Oracle server and seven file and print servers in the basement. This paper is mainly based on 3 types of network designs of the multistory building such as 3 Scenarios where 2 Scenarios comes under Daisy Chain network design and 1 scenario comes under Collapsed Backbone Network design.

A. Switches used in multistory building LAN

There are two types of switches used in this project core switch and normal switch, the main difference between the core switch and the normal switch is, a normal switch allows all computers to connect together and a core switch allows all switches connect together. The switch which is used in this project implements the spanning tree algorithm to ensure loop free network.

- Spanning tree algorithm

Spanning tree [4] is nothing but a sub graph of the connected undirected graph in which there are no cycles, connected graph means a graph in which every node is reachable from every other node and Undirected graph means a graph where edges do not have an associated direction and the combination of these connected graph and undirected graph is known as connected undirected graph.

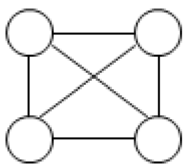

Fig (1) Connected undirected graph

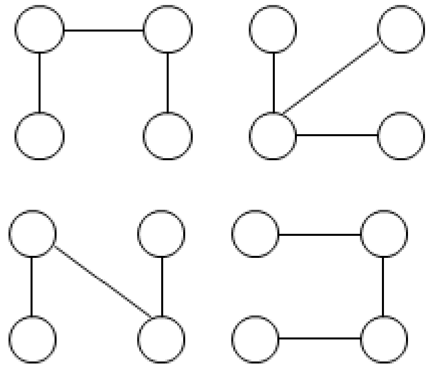

Fig (2) Spanning tree

B. Daisy Chain network

- Scenario 1

In daisy chain network [5] design approach there are two scenarios. In Scenario 1, the switches on each floor are daisy chained to the core switch in the basement. The daisy chain approach introduces high application latency to users on the highest floor because the core switch is placed in the basement of the network design.

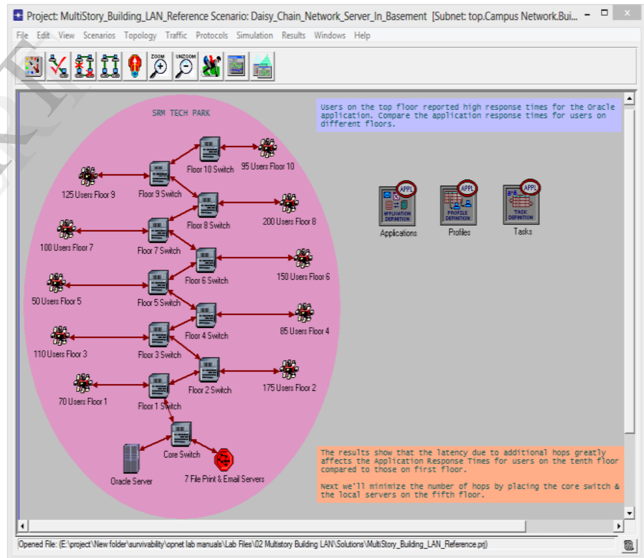

Fig (3a) Daisy chain network scenario 1

In this approach the core switch which is the backbone for the network and the core it is one that ties all the communication together is designed in the basement. By this approach there is the application latency and time delay occurs in the top floors.

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- Results for scenario 1

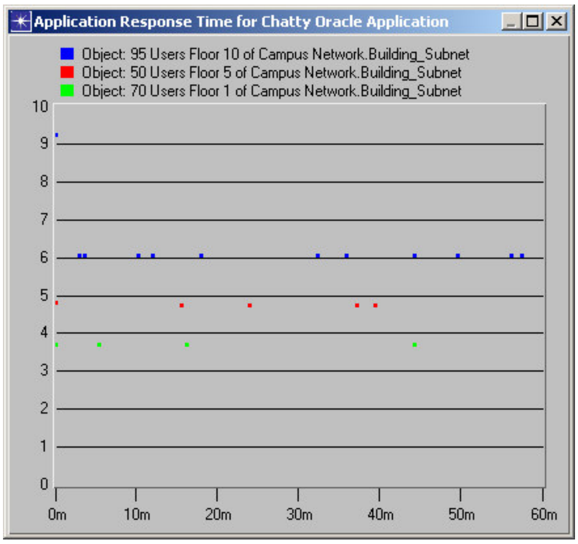

Fig (3b) Results for scenario 1

By observing the results in the first floor the files or any mail can be sent to the first floor in four micro seconds, slowly the time has delayed to 5 micro seconds in the fifth floor and finally when coming to the tenth floor the time has delayed to 6 micro seconds, the goal of this project is to reduce the time delay in the top floors with network protection.

- Scenario 2

Users on the top floor observe high application response times. So to reduce the number of hops for the users on upper floors in Scenario 2, the daisy chain topology is edited and the core switch is moved to the fifth floor, these all are done without any loss of money because just moving the core switch from one place to other place. Here this reduces latency on the top floors but increases it on the bottom floors.

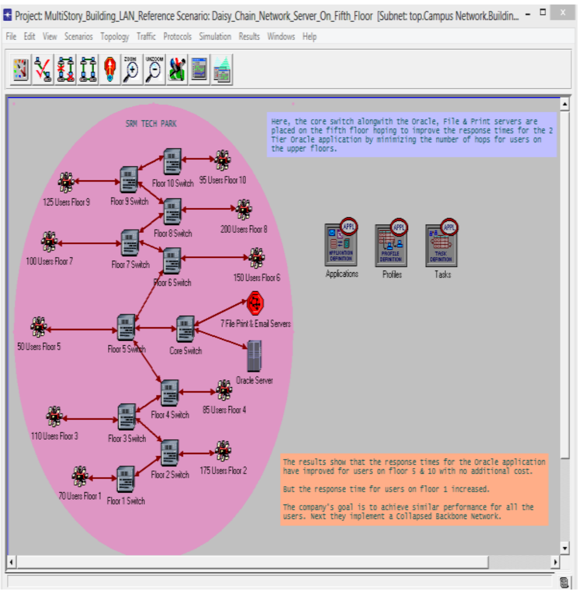

Fig (4a) Daisy chain network scenario 2

By comparing the Application Response Times for users on every floor. We expect that the network should reduce the application response time for users on top floors, because of the core switch placing in the center of the network design i.e., at the 5th floor. The results of this approach are shown below.

- Results for scenario 2

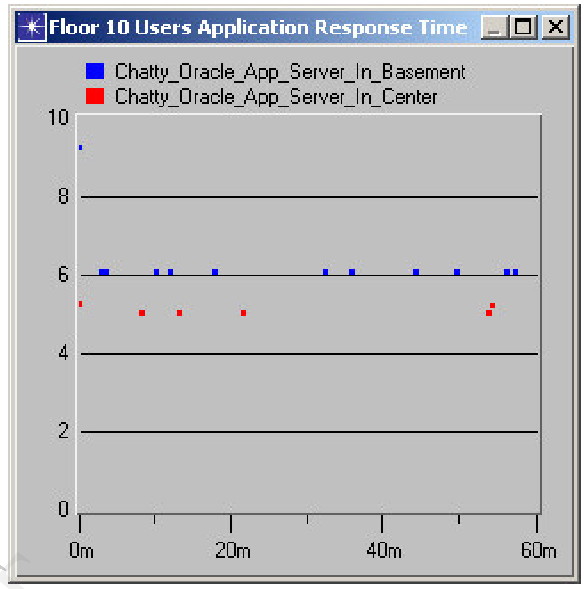

Fig (4b) Comparing results at 10th floor

By comparing results at the 10th floor for the core switch and server at the basement and the core switch and server at the center we can clearly find the change by seeing in the above result in fig (4b) that the response time decreased in the scenario 2 than in scenario 1.

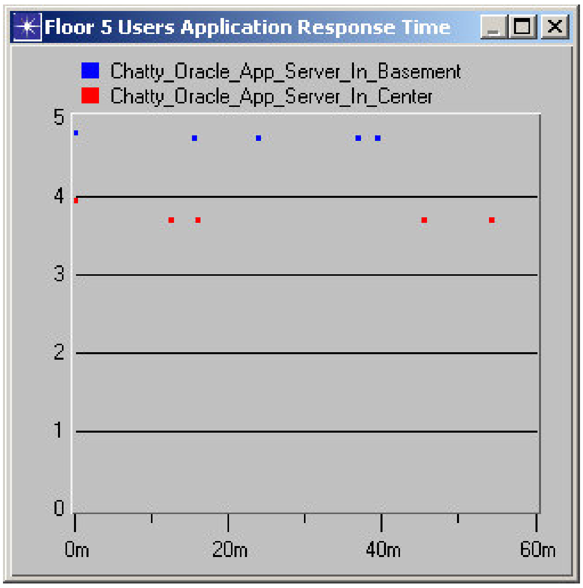

Fig (4c) Comparing results at 5th floor

By comparing results at the 5th floor for the core switch and server at the basement and the core switch and server at the center we can clearly find the change by seeing in the above result in fig (4c) that the response time decreased in the scenario 2 than in scenario 1.

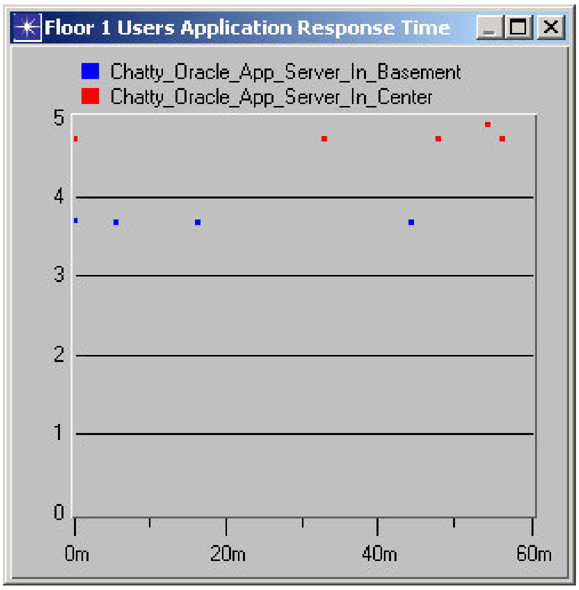

Fig (4d) Comparing results at 1st floor

But when we compare the results at the 1st floor for the core switch and server at the basement and the core switch and server at the center we can clearly find the change by seeing in the above result in fig (4d) that the response time increased in the scenario 2 than in scenario 1 which is a big drawback for the bottom floor. So when we replace the core switch and the server at the center the response time will increase in the bottom floors.

C. Collapsed Backbone Network

The Daisy Chain network [6] is changed to the Collapsed Backbone Network hoping to achieve the same application performance for all the users. This network design overcomes all the drawbacks in the daisy chain network. The response time can be same for all the users in this approach, in collapsed backbone data network there is a core switch in the basement equipment room. The core switch is linked directly to a workgroup switch on each floor. The collapsed backbone network is designed as shown below.

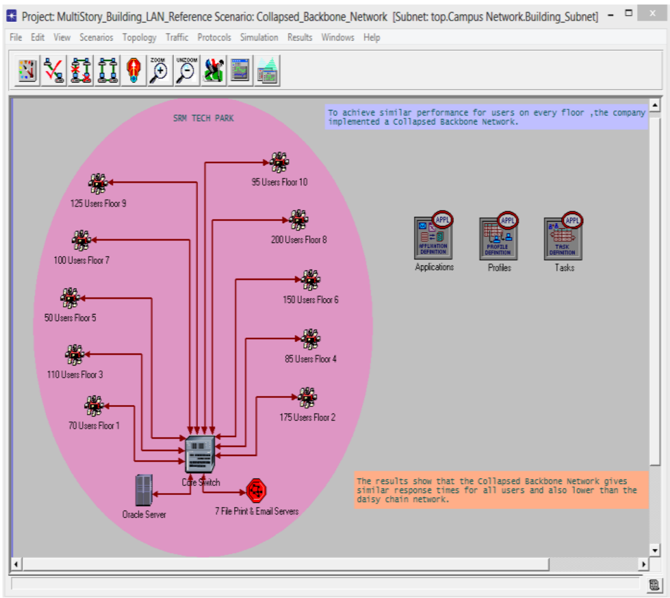

Fig (5a) Collapsed Backbone Network

By observing the network structure the information is expected to be passed to all the floors at a time because the core switch is connected directly to all the floors without using a separate switch for each floor where the delay occurs, the results for this approach are shown below.

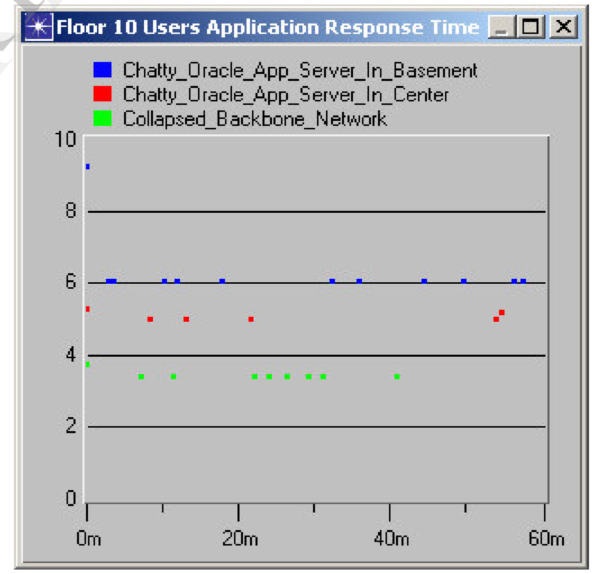

Fig (5b) Comparison of results at 10th floor

By comparing results at the 10th floor for the core switch and server at the basement in daisy chain network, the core switch and server at the center in daisy chain network and the results for the collapsed backbone network can clearly find the change by seeing in the above result in fig (5b) that the response time is decreased in collapsed network design than in the daisy chain network design.

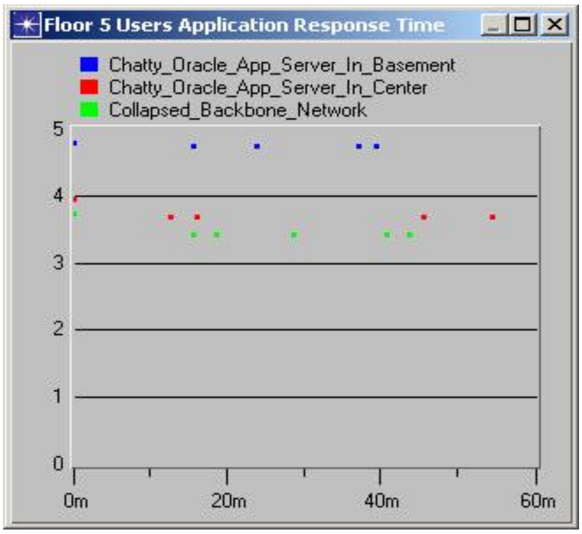

Fig (5c) Comparison of results in 5th floor

By comparing results at the 5th floor for the core switch and server at the basement in daisy chain network, the core switch and server at the center in daisy chain network and the results for the collapsed backbone network can clearly find the change by seeing in the above result in fig (5c) that the response time is decreased in collapsed network design than in the daisy chain network design.

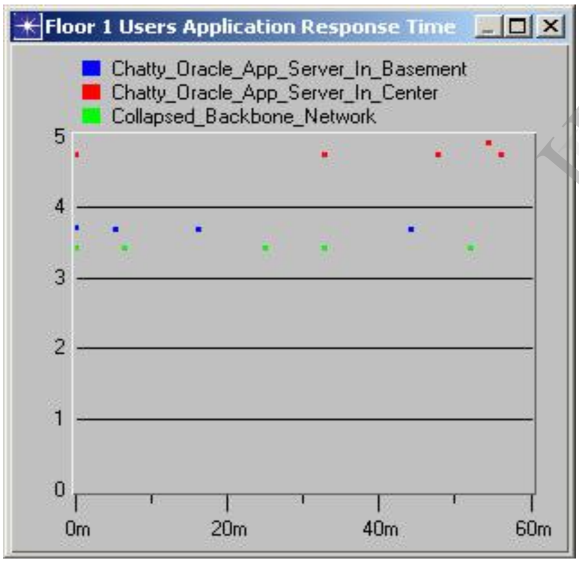

Fig (5d) Comparison of results in 1st floor

By comparing results at the 1st floor for the core switch and server at the basement in daisy chain network, the core switch and server at the center in daisy chain network and the results for the collapsed backbone network can clearly find the change by seeing in the above result in fig (5d) that the response time is decreased in collapsed network design than in the daisy chain network design.

IV. CONCLUSION

In this paper we investigate the problem of time delay and for reducing the time delay in a multistory building LAN while sending the information (files, emails etc.) from server to the users through switches (core switch and normal switches) and the Ethernet LAN (made by optical fiber) and passing the information securely to all the users at a time is achieved.

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