Routing and Data Compression in SONET

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***Abstract*-- With the increasing growth and demand for capacity in national, regional, and even metropolitan optical networks, we are increasing the bandwidth of the channel so that more data can be sent in appropriate time duration. So transmission delay is the main problem to send a large amount of data. To overcome this problem data should be routed to the minimum possible route for this there are various routing protocols which can be used to route the data in optical networks. In this paper I am using two routing protocol to send the data and analyzing the performance parameters such as end to end transmission delay and throughput of the network.**

***Keyword*: Routing Information Protocol, Open Shortest Path First, SONET, Compression**.

1 INTRODUCTION

Communication is the process of transmitting information from one end to another and now a days optical fibre communication is the best way to communicate with each other because optical fibre is the most common type of channel which posses low loss, allowing long distances between amplifiers or repeaters and its inherently high data carrying capacity, such that thousands of electrical links would be required to replace a single high bandwidth fibre. Optical networks offer the promise to solve many problems which are in the traditional networks [1]. In addition to providing enormous capacities in the network, an optical network provides a common infrastructure over which a variety of services can be delivered. Optical networks are also increasingly becoming capable of delivering bandwidth in a flexible manner where and when needed [2]. When something is discussed about the optical networks, it is the discussion of the synchronous optical networks (SONET) which are capable to provide lower bit error rates and higher capacities than the simple copper based networks. Also fibre links experience effectively no crosstalk, in contrast to electrical transmission lines. Before the birth of Synchronous Optical Network (SONET) / Synchronous Digital Hierarchy (SDH), the transmission system widely deployed in the telecommunications industry was known as the Plesiochronous Digital Hierarchy (PDH) [1]. Plesiochronous means the timing of signals across the network is almost but not precise, and there is not a centralized timing source since each node has its own clock [2].

2 SONET

The SONET standard was designed in the mid 1980's to alleviate these problems [1]. The International Telecommunications Union later generalized SONET into the SDH in order to accommodate the PDH rates in use outside North America, mainly deployed in Europe and Asia-Pacific Countries. SONET/SDH standardized the line rates, coding schemes, bit-rate hierarchies, and operations and maintenance functionality. SONET/SDH also defined the types of Network Elements (NEs) required, network architectures that vendors could implement, and the functionality that each node must perform [2, 3]. Briefly, one or more Operations Systems (OSs) manages the SONET/SDH NEs and the connectivity between them is achieved through a Data Communications Network (DCN) [4].Open System Interface (OSI) was selected as the standard for SONET Section DCC because OSI protocols were accepted as the basis for the larger set of Telecommunications Management Network (TMN) standards.

3 SIMULATION OF ROUTING AND COMPRESSION

Investigating the routing and compression activities under realistic background traffic is an interesting and difficult problem. Such studies can be performed either in a real environment or in a simulated environment [5]. I now briefly summarize these two approaches of simulating Routing and Compression, and their relative merits.

3.1 SIMULATION IN REAL ENVIRONMENT

In this approach many real users produce significant background traffic by using a variety of network services, e.g., mail, telnet, etc. This background traffic is collected and recorded, and routing and compression activities can be emulated by running exploit scripts. The advantage of this approach is that the background traffic is sufficiently realistic, which eliminates the need of analyzing and simulating the patterns of normal user activities. However, the following drawbacks have been reported [6]:·

The testing environment may be exposed to the attacks from the Internet, in addition to the simulated attacks.

The inaccuracy of the results may increase if the background traffic contains unexpected data originated from outside sources.

3.2 SIMULATION IN EXPERIMENTAL ENVIRONMENT

Most researchers perform testing and studies in experimental or simulated environments, due to the high risk of performing tests in a real environment. In this approach realistic background traffic can be generated in the following three ways.

(1) Employing humans to manually perform whatever occurs in a real environment;
(2) Using simulation scripts to generate data conforming to the statistical distributions of background traffic in a real environment; and
(3) Collecting from a real environment and replicating in the simulated environment.

The disadvantages of studying Routing and compression in simulated environments include:

(1) The overload of manually producing background traffic involving many users can be very high.

(2) The behaviours of real users are difficult to model, and there are no standardized statistical distributions of the background traffic.

4 MY APPROACH TO ROUTING AND COMPRESSION SIMULATION

We used OPNET to build the simulated network environment. The network traffic source comes from the library files, which contain various traffic generating nodes. [2]. Alternatively, we could use software tools to generate traffic. Then we defined the profile for the operation of the various clients and servers. For both the clients and the servers, we used own pre-processing tools to extract the traffic information that is necessary for OPNET simulation. The OPNET software provides an ACE (Application Characterization Environment) module which can be used to import packet traces into simulation, supporting packet formats of various sources including TCP files [7].

4.1 SIMULATION MODELS USING OPNET

We are using OPNET for research because of the several benefits it offers. OPNET provides a GUI for the topology design, which allows for realistic simulation of networks, and has a performance data collection and display module. Another advantage of using OPNET is that it has been used extensively and there is wide confidence in the validity of the results it produces. OPNET enables realistic analysis of performance measures and the effectiveness of intrusion detection techniques.

4.2 GENERATING DATA FOR COMPRESSION ROUTING

The data for the compression and routing in OPNET is generated by defining the application configuration. In the application configuration we could define the various types of data generation parameters and could specify the various values for the same. So we defined the various parameters such as ftp, http, email, file print, remote login, etc.

4.3 BUILDING NETWORK MODEL

OPNET IT Guru 9.1 is a modelling and simulation tool that provides an environment for analysis of communication networks. However, it does not have a SONET DCC model in its standard model library. Thus a SONET DCC network model was created to facilitate the simulation. Two different scenarios were created using this OPNET model to simulate the packet flow within the SONET DCC network to understand the usefulness of data compression in fast speed and slow speed network. In the first scenario fast speed optical carrier links (OC-192) are used to connect the routers to each other in the network which have data rate 9953.28 Mbps. While in the second scenario slow speed optical carrier links (OC-1) are used to connect the routers to each other in the network which have data rate 51.84 Mbps.

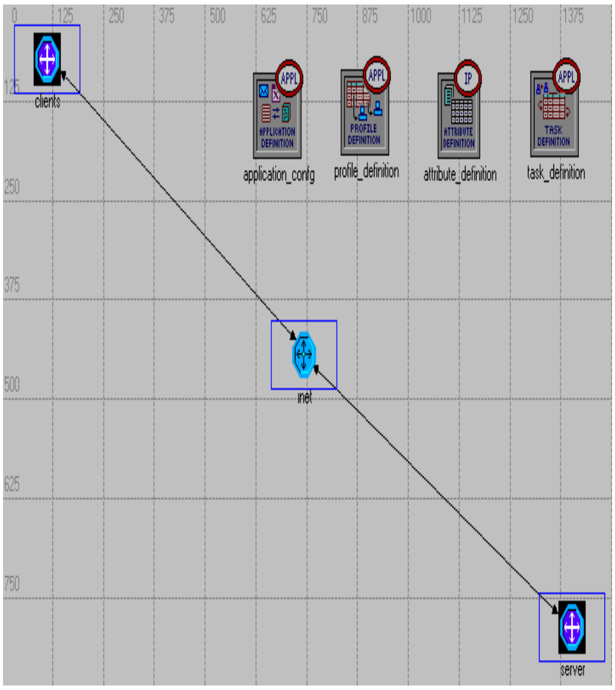

Fig 4.3.1 SONET based DCN

The network configuration for this study consists of two nodes named as servers and clients connected through internet as shown in the figure (4.3.2) given below:

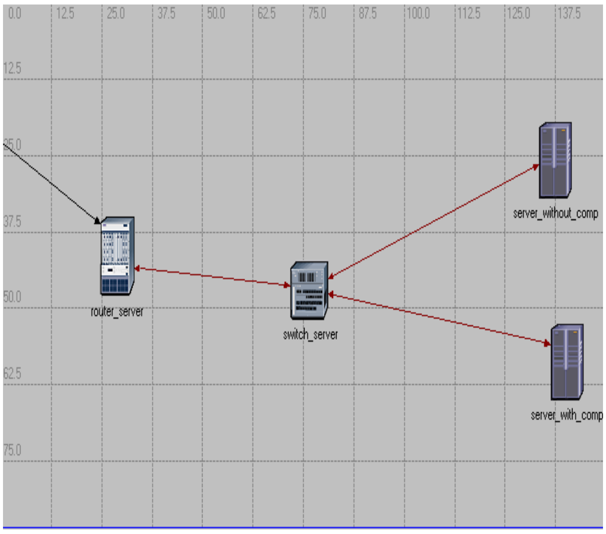

Fig 4.3.2 Internal view of node Servers

The servers node consists two servers (one for data compression and other without data compression) connected to a switch and the switch is connected to a router which is used to route the data to another subnet. The internal view of node servers is shown in the figure (4.3.3) below.

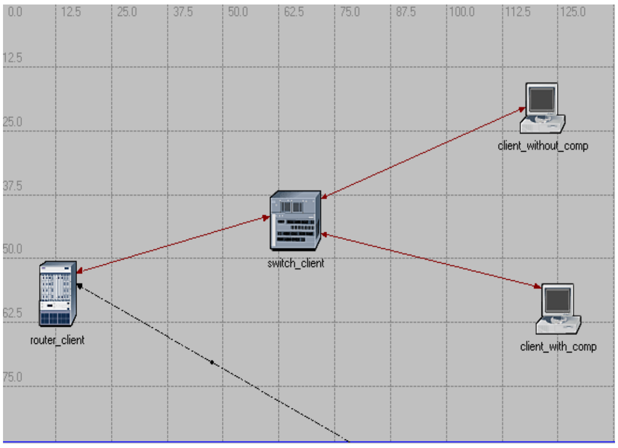

Fig 4.3.3 Internal view of node clients

5 ANALYSIS OF SIMULATION RESULTS

5.1 ANALYSIS OF FAST SPEED NETWORK

When compressed data is sent through the link the frame size become small and the Transmission delay reduces but some time is lost because the compression and decompression processes consume a certain amount of time. The usefulness of data compression is determined based on the balance of time gain and time lost. If fast links are used, the high data rate lead to small transmission delays. Hence, there might be no gain in time when using data compression if fast links and slow compression algorithms are deployed.

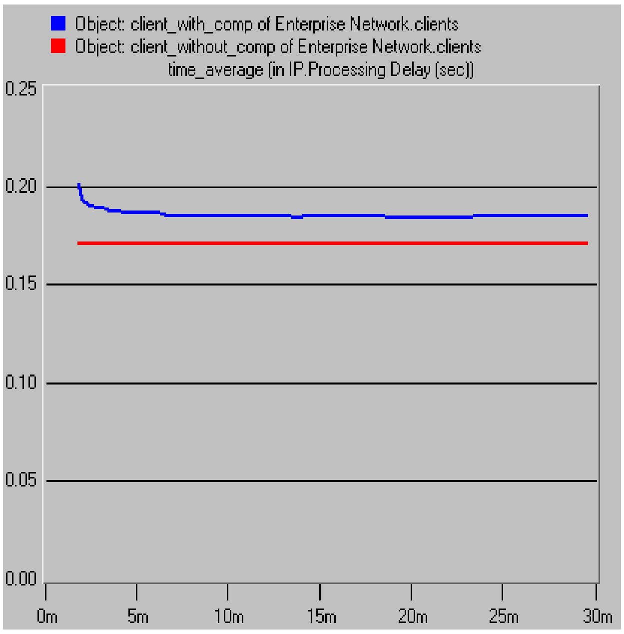

Figure 5.1.1– Comparison of Task response time in fast speed network between compressed and uncompressed data.

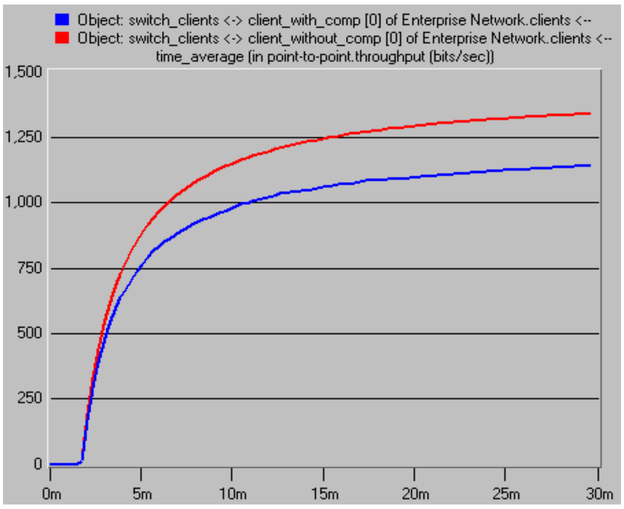

Figure 5.1.2 – Comparison of throughput in fast speed network between compressed and uncompressed data.

The results as shown in the figures (5.1.1) & (5.1.2) given above shows that the throughput between the switch and the client using compression is less than the throughput between the switch and the client that is not using the compression but the response time for the client using compression is higher. In other words, the client loses more time for the compression and decompression processes than it gains from the transmission of the smaller frames.

5.2 ANALYSIS OF SLOW SPEED NETWORK

In contrast to a network deploying fast links, a network using slow links but fast compression algorithms reduces the overall response time of its clients by using data compression. High transmission delays in slow links are compensated by the smaller frames due to data compression. They might also compensate the additional delays incurred while compressing and decompressing. Also data compression in slow speed network reduces the throughput between the switch and client as shown in the figures (5.2.1) and (5.2.2).

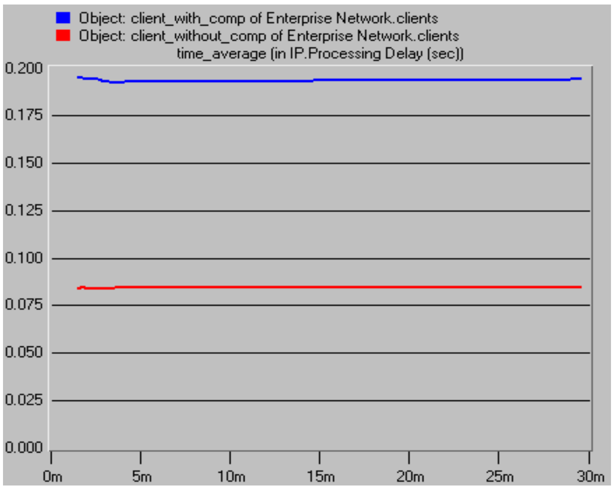

Figure 5.2.1- Comparison of IP Processing delay in slow speed network between compressed and uncompressed data.

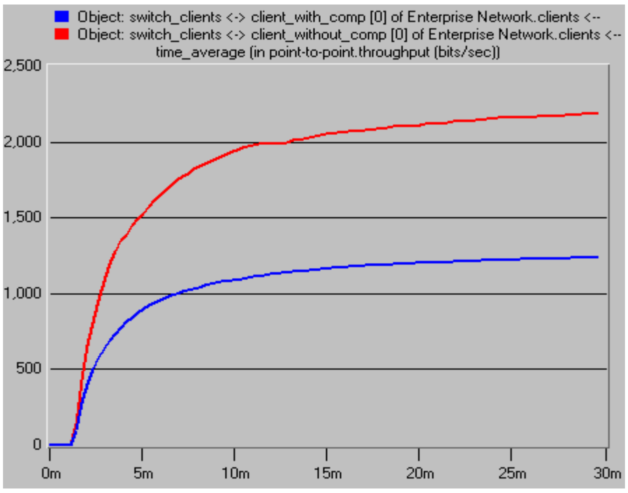

Figure 5.2.2- Comparison of throughput (traffic) in slow speed network between compressed and uncompressed data.

As demonstrated in the results of fast speed network, the throughput on the link between the switch and the client using the compression is less than the throughput between the switch and the client without compression because of smaller data frames. The results of slow speed network show that the client using compression observes a faster response time. This implies that its compression and decompression processing delays are paid off by the smaller transmission delays of its smaller packets.

6 CONCLUSION

Finally on comparing the result of two scenarios we can conclude that high speed network shows less throughput (traffic) but higher overall response time while the slow speed network shows less throughput and less overall response time when compressed data is sent through the link. So we can say that there is no need to transmit the compressed data in the high speed network because it transmits uncompressed data to higher speed than the compressed data as compression and decompression of data takes relatively more time. But we also observe that data compression improves the throughput of the high speed network which is the main advantage of data compression.

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