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Performance of voice over frame relay

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Frame Relay (FR) represents one of the most important paradigm shifts in modern telecommunication. This technology is beginning to evolve from data only application to broad spectrum of multimedia users and potential to provide end users with cost effective transport of voice traffic for intra office communication. In this project the recent development in voice communication over Frame relay is investigated. Computer ssimulations were carried out using the powerful simulation software OPNET. Performance measures such as delays, jitter, and throughput are reported. It is evident from the results that real-time voice or video across a frame relay network providing acceptable performance is possible.

1 Introduction

Frame relay is a high-speed communication technology that is used to connect LAN, SNA, Internet and voice applications. Frame relay is a way of sending information over a wide area network (WAN) that divides the information into frames or packets. The frames travel through a series of switches within the frame relay network and arrive at their destination. Frame relay employs a simple form of packet switching that is well suited to powerful PCs, workstations and servers that operate with intelligent protocols. As a result, frame relay offers high throughput and reliability that is perfect for a variety of today's business applications.

A frame relay network consists of endpoints (e.g., PCs, servers, host computers), frame relay access equipment (e.g., bridges, routers, hosts, frame relay access devices or FRAD) and network devices (e.g., switches, network routers, T1/E1 multiplexers). A frame relay network often depicted as a network cloud. A sample Frame Relay network is shown in figure 1.

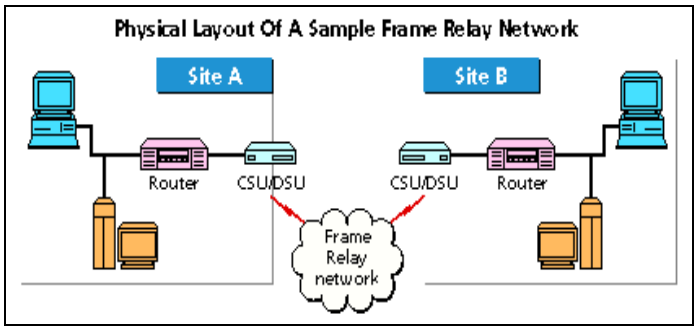

Figure-1 Frame Relay network

Permanent virtual circuits (PVC) can be strung together by FR switching at intermediate network nodes to build an end-to-end path for the traffic across the network. FR can be used around the edges of the WAN to connect remote offices into the Intranet, or can be used as the entire backbone technology for the WAN.

2 Voice over Frame Relay

Voice quality on a packet network is affected by delay and packet loss. Delay has two components, fixed delay and variable delay, also known as jitter. The objective of Quality of service (QoS) features in a packet network is to minimize delay and jitter for voice traffic [1]. Delay can cause two potential impairments to speech. First, long absolute delays cause both speakers to tend to begin to talk at the same time. Second, delay exacerbates echo, which is the reflection of the original signal back to the sender. Echo is indiscernible under low delay conditions and noticeable when the delay becomes too great. Jitter causes gaps in the speech pattern that cause the quality of voice to be "jerky". One-way delays below 150 milliseconds (ms) are considered acceptable for most applications. [2]. Delays ranging from 150 to 400 ms are also acceptable subject to current voice quality Furthermore; higher delays may be acceptable if cost savings are taken into account. Generally, voice networks should be designed to achieve less than 200ms one-way delay.

To run real-time voice or video across a frame relay network, we have to make sure that end-to-end delay isn't too high to degrade quality. Assurance of QoS or using dedicated PVCs, Prioritization of voice traffic at a router or FRAD (which minimizes queuing delay) is necessary for real time application like telephony and videoconferencing [3].

In this project our approach is to set up special PVCs for voice, compression technique is applied for two different types of voice applications to see the various parameters that affect the FR network for voice application. The whole process is done by simulation using OPNET modeler 8.1. To see the actual end-to-end process a practical Frame Relay network is also setup.

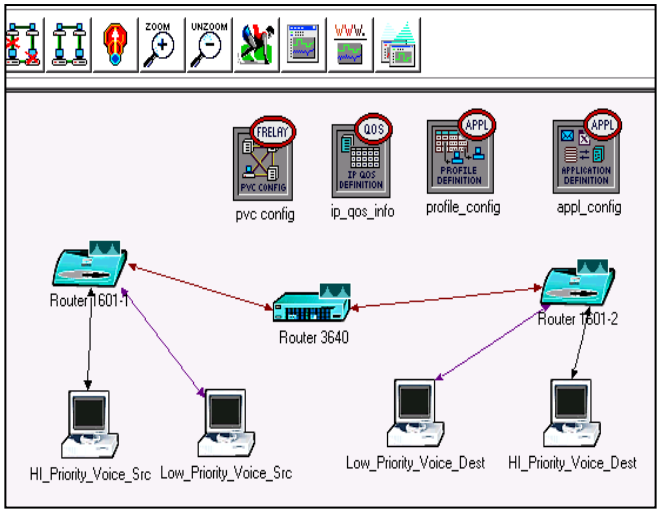

Figure-2 Simulation Model

3 Hardware Experimental Set-up

Cisco 3640 Router (in figure 3) is configured as a Frame Relay switch, which is set up with additional WAN interface card. Router 1601 is also configured and connected with back-to-back WAN cable with the router 3640.Frame relay Network between site A and site B is operated as per design.

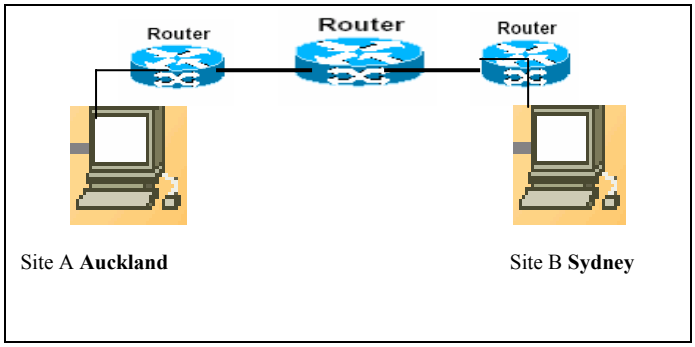

Figure-3 Experimental Set-up

4 Results

Results from fig-4 shows that FR delay and voice packet end to end delay are not more than 2.5ms and around 0.6 ms respectively. Fig-5 shows the average of voice packet delay variation which is

almost constant nearly 4ns after certain time. Fig-6 shows the frame relay PVC throughput that is bursty in nature.

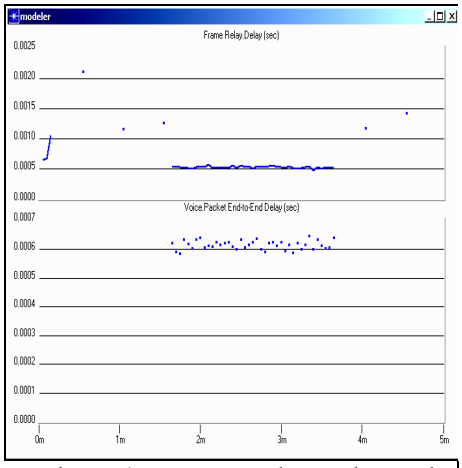

Figure-4 Frame Relay Delay and Packet End to End Delay

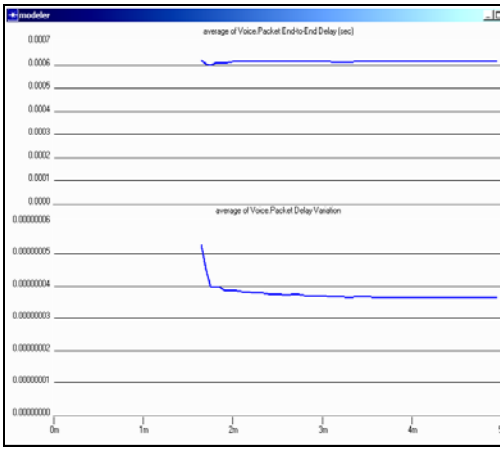

Figure-5 Average of Delays

Packet delay variation or jitter shows in fig-7 does not exceed 50ns, which is clearly within the range and shows acceptable performance under typical load condition for voice application. Fig-8 and 9 are the comparison between the high and low priority voice destination. High priority voice destination has more data received than Low priority node.

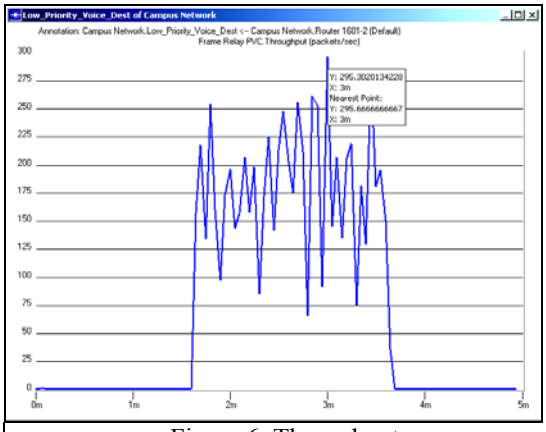

Figure 6. Throughput

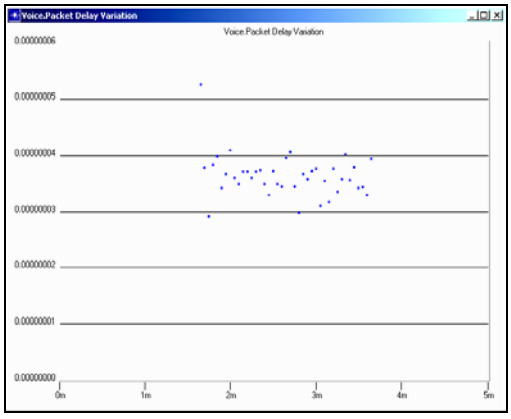

Figure-7 Delay variation /Jitter

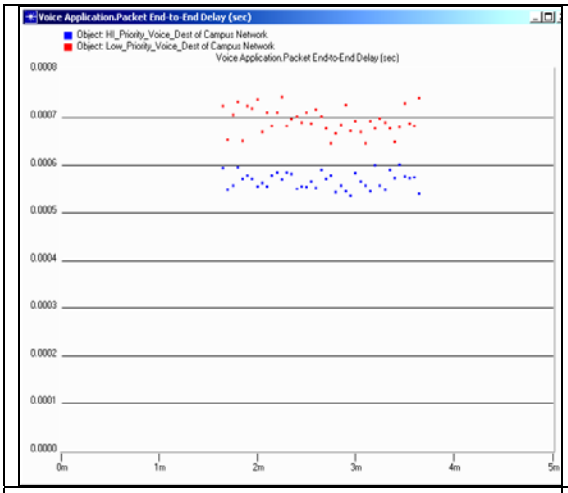

Figure-8 Packet End to End Delay at 2 different Destinations with different TOS

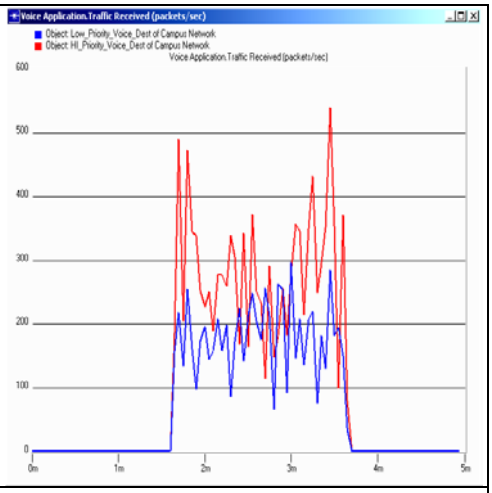

Fig-9 Comparison of Traffic received

5 Discussion

The time sensitive applications like multimedia and real time speech need certain delay constraint to be fulfilled by the network. Packet end-to end delay clearly shows that Low Priority destination node has more delay due to congestion. The results indicate that with proper selection of parameters and encoding techniques, FR can support intra office real time voice communication at a satisfactory level.

6 References

[1] Keagy, S.,: "Integrated Voice &Data Network", Cisco Press, USA, 2000

[2] ITU-T Recommendation: G.114, "One way Transmission Time", Feb.1996.

[3] Hartman, K.,: "Video Over Frame Relay", Science Dynamics Corporation, 2001