INVESTIGATION ON THE, QUALITY OF VIDEOCONFERENCING OVER THE INTERNET AND INTRANET ENVIRONMENTS.

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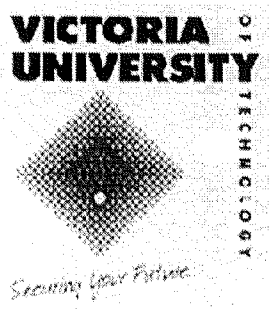

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ABSTRACT

This study deals with the scope and feasibility of video-conferencing on the Internet and Intranet, for a real-time implementation of a classroom atmosphere linking different universities. I have considered the effects of various factors on video conferencing and different tests have been performed to study the data transfer during the online sessions. Readings of send rate, received rate and CPU load have been considered during these tests and the results have been plotted in the form of graphs. The study also gives conclusions at regular intervals on the tests performed and the limitations on various video conferencing sessions. From the statistics collected I have concluded on the hardware requirements for optimized performance of video conferencing over the Internet. The study also states the scope of research to be undertaken in future for much better performance and understanding of different types of protocols. This thesis includes the study of various network-monitoring tools.

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Disclaimer

I hereby solemnly declare that this thesis contains no material that has been accepted for the award of any other degree or diploma in any collage or university or tertiary institute, to the best of my knowledge. It contains no material that has been previously been published or written by any other person, expect where due references are made.

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Date Submitted.

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1. Desktop Video conferencing

1.1. Introduction

Desktop video conferencing has become on of the important forms of communication in the modern world. Bandwidth is the most important concept in video conferencing. While there is a very precise and very technical definition for bandwidth, it can roughly be described as the speed with which information flows. Communication itself is the transfer of information from one place to another. The connection between the two remote sites through which the information flows is called a communications channel. A communications bandwidth is how much information can flow through the channel. Digital Bandwidth is measured in bits/sec. Bandwidth is often the limiting factor associated with communication. And hence becomes a system is referred bottleneck. Transmission of video through a communications channel requires a large amount of bandwidth.

This Chapter gives a brief description on the basic desktop video conferencing systems. This chapter also gives a brief description on the standards. Telecommunications and Internet standards are set by the ITU (International Telecomm nations Union) and IETF (Internet Engineering Task Force). Products, which maintain these standards, allow user's to join a videoconference, regardless of their platform.

Videoconferencing product offerings, coupled with newly adopted transmission standards, have radically changed the financial equation for delivering live, interactive video. Many manufacturers now have available very affordable desktop and small classroom video conferencing systems at a much lower price than previously available, while retaining a level of quality, connectivity, and ease of use that support effective classroom use. In addition, the production of H.323-compliant systems has reached a point that video conferencing systems can be added to existing classrooms, with video conferencing available over the campus IP data network. Lastly, the advent of standards and affordable video conferencing

systems has increased the use and broadened the definition of distance education to incorporate less formal but equally useful applications of interactive video as part of the instructional process.

The quality, variety, and affordability of desktop computer video conferencing systems have reached the point that a computer in a presentation classroom can support videoconferences of suitable quality for numerous distance education applications at a surprisingly low cost. Industry competition in the desktop market has improved the quality of transmission, while lowering the cost to a level within the reach of educational institutions. In addition, the widespread acceptance of video conferencing standards, notably H.320 for ISDN and, more recently, H.323 for IP networks, has ensured interoperability between vendors. All of the major vendors support H.320 and H.323 video conferencing standards, rather than proprietary connection strategies, which limit the interoperability and connectivity that make video conferencing systems most valuable. The reliance on standards ensures that desktop video conferencing units can communicate over the public switched telephone network via ISDN lines or over the campus local area network via IP to any other standards-compliant teleconferencing unit, including room system CODECs and desktop units, regardless of vendor. Given the broad acceptance of the H.320 standard, as well as the developing H.323 standard, an institution can invest in video conferencing systems with confidence that the systems will be able to communicate with a broad range of other systems and resources. Powerful and flexible video conferencing connectivity is now available at a price comparable to other classroom technology components such as document cameras and computer data video projectors. Adding a video conferencing board and associated software to an existing technology classroom computer is easily accomplished for initial connectivity. Portable all-in-one systems provide an ideal solution for incorporating interactive and streaming video into the classroom, transforming the classroom from an isolated, unidirectional delivery facility into an interactive video environment.

1.2. Protocols Supporting Video Conferencing.

The industry adopted H.323 standard provides for video conferencing over IP-based packet-switched networks, such as campus computer data networks. Because H.323 is an accepted standard, hardware and software manufacturers are now creating products that adhere to the standard, which allows interoperability between systems from multiple vendors. The reliance on an international standard avoids the restrictions inherent in proprietary audio and video data formats and transmission schemes. The use of an IP network for transmission of the signal over an existing data network with sufficient bandwidth, rather than the creation of a separate ISDN network to campus classrooms and offices, can offer reduced complexity to campus network installations.

In addition to point-to-point connections, the H.323 standard supports multicast transmissions over the network, providing a non-proprietary solution for broadcast of video over the local area network with minimum bandwidth usage. Multicast allows a single video stream to be sent over the network to multiple recipients, eliminating the redundant bandwidth required by multiple point-to-point connections. Given a proper network configuration, H.323 begins to address interactive video conferencing, network video broadcasts, and video on demand in a widely accepted standards-based environment. The H.323 standard also supports multipoint conferences, so that multiple participants can interact within a multi way videoconference.

Many video conferencing equipment vendors are incorporating both H.320 and H.323 connectivity into their systems, allowing campus network administrators to connect these systems to whichever network is most appropriate currently, while retaining the ability to change to a different transport medium as circumstances dictate. This dual capability ensures that systems and equipment will be functional in the current and future network environment, thus relieving some of the concerns inherent in campus planning and acquisition. H.323 capability is being added to all systems across the product line, from desktop units through the large, high-bandwidth systems found in fully equipped distance

education classrooms. The variety of hardware solutions, coupled with the options of network connectivity, provides a rich set of choices for the technology classroom.

The bandwidth demands of H.323 video will place considerable strain on the campus data network. Considerable care and planning must precede the deployment of H.323 systems to ensure that the data network has sufficient bandwidth and is properly configured to support video streams of 128Kbps up to 768Kbps without degrading network performance, or perhaps compromising the entire network. Switched 10/100Mbps Ethernet, ATM, or some other high-capacity network infrastructure is required to carry the large volume of continuous data involved in video transmission. In addition, network management software may be required to support Quality of Service (QoS) protocols, whereby some portion of the network bandwidth is allocated as needed for particular uses such as video conferencing. QoS networking protocols are required to ensure appropriate functionality for bandwidth-hungry applications such as video, while limiting the bandwidth allocation for the network as a whole to prevent degradation of current network services.

In general, the deployment of video conferencing systems will require an appropriate network to support the intended use. With H.320 systems, ISDN service must be provisioned to supply single BRI, multiple BRI, or fractional T1 bandwidth. Using H.323, the existing data network can be used, but only if it is properly configured to support the large bandwidth requirements of video streams. Depending on the campus network infrastructure, an institution might choose to provide an ISDN solution, H.323 IP solution, or a hybrid network to support current and future video conferencing systems. Without question, the increasing affordability of high-quality desktop and small classroom video conferencing systems will place additional pressures on network administration and development. It is critical that a campus strategy for network growth and support, whether ISDN or IP, be developed to support the inevitable growth of video conferencing and streaming video on demand.

A critical device in the deployment of H.323 video conferencing systems is the gateway. A H.323 gateway bridges H.320 and H.323 systems, performing the necessary transcoding between ISDN and IP transport networks, allowing communications between the two. A

gateway performs two significant design functions: connecting existing H.320 systems to newer H.323 systems on campus, and bridging to the public switched telephone network (PSTN) for reliable wide area and long distance access to remote sites. It would not be a reasonable strategy to deploy H.323 video conferencing systems on campus if such actions make current H.320 systems immediately obsolete. The gateway device connects the two transport networks to provide full connectivity between ISDN and IP systems, thus ensuring that the investment in existing equipment remains functional.

Sufficient bandwidth for video conferencing over the Internet is not available. Consequently, video connections to the wide area network (WAN) typically do not ride over Internet connections but rather the classic switched circuit network available through the PSTN. The gateway device serves as a bridge to connect local area network (LAN) H.323 traffic to the robust carrying capacity of the public switched telephone network for long distance connectivity. A gateway at each end of a campus-to-campus connection converts the transmission from LAN H.323 to ISDN and back to the LAN. In addition, the gateway supports the connection from an H.323 device to a remote H.320 system, without user configuration.

H.323 offers a method for expanding the number of campus video conferencing nodes on campus over the existing data network, provided that the network can sustain the projected bandwidth needs. Instead of running a separate ISDN network line for each system, the IP network infrastructure can be upgraded to provide high bandwidth to the desktop and through the campus backbone. Existing H.320/ISDN systems can still be used in conjunction with the H.323 transport network, and connectivity to the WAN can be seamlessly bridged.

ISDN, or Integrated Services Digital Network, is a suite of internationally adopted standards for end-to-end digital communication over the public telephone network. As this network has been traditionally oriented towards voice services, ISDN is an important step forward in the adaptation of the network to handle the increasing global demand for computer-to-computer data communications. ISDN brings us closer to the goal of a ubiquitous multi-service network, integrating voice, data, and video and image services in a

digital format over a common, global network. While ISDN differs fundamentally from conventional telephone service (called Plain Old Telephone Service or POTS), ISDN has been designed to allow end-to-end compatibility for voice services. Voice calls can be made to or from an ISDN line from a POTS line anywhere in the world. Equally important is the fact that ISDN service can be carried over the existing telephone network infrastructure. This infrastructure represents a massive global investment over the past century in central office switches, which route calls and handle billing; in transmission systems which carry the large volume of calls to remote destinations, largely over optical fiber cable today; and millions of miles of twisted-pair copper cabling to carry services to our homes and offices. While ISDN standards are still evolving, and indeed work is continuing on even higher data-rate services such as full-motion video, two well-defined ISDN interface standards are in common use today:

Basic Rate Interface (BRI) - The term ISDN or ISDN line is often used synonymously with the Basic Rate Interface. The Basic Rate Interface defines a digital communications line consisting of three independent channels: two Bearer (or B) channels, each at 64 Kilobits per second, and one Data (or D) channel at 16 Kilobits per second. For this reason the ISDN Basic Rate Interface is often referred to as 2B+D.

The B channels are used for carrying the digital information, whether computer data, digitised voice, or motion video with appropriate equipment (such as the ISDN NuBus boards for the Macintosh) these B channels can be bonded or linked together to provide an aggregate 128 Kilobits per second data channel. The D channel is used to carry signalling and supervisory information to the network, and can also be used to carry packet-mode data over an X.25 network. The network, allowing for simultaneous voice and data, or data only, connections to different locations, treats each of the two B channels independently. With specialized hardware and software, multiple B channel connections can be aggregated to achieve file transfer rates of several Megabytes of data per minute or more.

Primary Rate Interface (PRI) - The Primary Rate standard is a higher-level network interface defined at the rate of 1.544 Megabits per second (for North America). This particular rate was selected for compatibility with T1 digital lines commonly used today.

The Primary Rate is comprised of 23 B channels, each at 64 Kbps, and one 64 Kbps D channel for signaling. These B channels can interconnect with the Basic Rate Interface, or when carrying voice services to any POTS line.

1.3. ATM (Asynchronous Transfer Mode)

ATM is a protocol for transferring cells. A cell is a small data unit of its size. It is 53 byte long made of a five-byte header and a 48-byte payload. The header contains, among other information, a virtual path identifier (VPI) and a virtual channel identifier (VCI). These two-piece of information are used to route the cell through the network to the final destination. It is a method for dynamic allocation of bandwidth using a fixed 53-byte packet (cell), known also as "fast packet".

ATM is designed to support the transmission of data, voice and video through high data rate transmission such as fiber optic cable. It is a revolutionary idea for restructuring the infrastructure of data communications.

The cells use characteristics of both time-division-multiplexing of transmission media, and packet switching of data networks. A "virtual path" is set up through the involved switches when two endpoints wish to communicate. This provides a bit-rate independent protocol that can be implemented on several network types.

Characteristics of ATM:

- Scalable technology; potential for extremely high speeds.
- Cell switching, a compromise between delay-sensitive and conventional data transmissions.
- Flexible implementation on many media (copper, coax, fibre).

1.4. Videoconferencing Hardware and Software.

Hardware plays a key role in a video conferencing session. The prices of hardware have reduced drastically which helps us in using the fastest and the latest equipment. Major companies have been producing hardware of highest speeds for cheapest prices. Up gradation of our computers is economical.

I have listed out a minimal system for a video conferencing system.

A Pentium-II with 333 MHz of CPU speed, 128 MB of RAM memory, 1.5 GB Hard disk, 32 Spin CD-ROM, 56 K Modem, 1.44 MB Floppy Drive, Multimedia Speakers, High quality Microphone and a good graphics card.

Video-conferencing kit consists of a video capture card and a digital camera. The video capture card support various operating systems such as Windows 95/NT and windows Xp. Vendors provide regular driver updates are more likely to have software bug fixed, for better video/audio quality, Pentium-III or above is recommended. Processor with lower clock speed may experience dropping of video frames and interrupted audio signal.

DVC cameras are available in the market for very comparative prices and are available in a wide variety. For separately purchased capture card and camera, we should make sure they both support the same connector (e.g. S-video, composite video) and video format (PAL, NTSC). S-video and composite video connectors are better than parallel port one.

Full Duplex sound card with microphone and speakers. Sound blaster 16 bit works fine.

Internet Explore 4.0 or above recommended as most of the video conferencing objects run in IE. Microsoft DirectX support on display card and sound card driver Video Conferencing software such as Microsoft net meeting, Class point or Messenger can be used

Chapter 2

2. Compression Techniques

2.1. Introduction:

Compression of video signal is done in number of stages, which results in loss of visual information. In the first stage a small part of the view area is captured by the video camera in low resolution. This analog signal from the camera is converted into digital signal in 18Mbps. Later in the third stage the 3D colours of RGB are converted into 2D presentation, which means that the absolute intensity is separated from the direction of the colour vector, and also reducing the resolution of the picture to a lower one –320*240 pixels. In this stage we reduce the bit rate to lower than 4 Mbps in a 'brutal' way, before we start the smart compression.

The real challenge would be to compress the picture in a factor of 240up to more than 1000 up, without making an abstract scratch. Compression factor of 240:1 is sufficient to transmit a video signal in double ISDN line and compression in a factor of 1067:1 is required for transmitting in a 28.8Kbps modem. This rate of compression ratio can be achieved in some of the ways.

The pattern of video frames is viewed in a 3 dimensional region. Two dimensions would be horizontal and vertical and time in the third dimension. Compression when considering time in third dimension is different compared to static '2D' image. The time pattern transmits only the changes from frame to frame. By using the base frame it is possible to make continuous frames by transferring small amount of data that describes the differences between two continuous frames, until a new base frame is to be transferred.

2.2. MPEG Compression

This technique can be used to perform interpolation to guess the creation of the pattern from the beginning to the end. The MPEG compression is based on this method and the three kinds of frames called I-frame (intra frame) P-frame (predicted frame) B-frame (bi-directional interpolated frame).

In the conventional 2D JPEG compression of a static frame base frame and I-frame are compressed. The JPEG algorithm is based on spectral analysis of the frame and focusing on the major frequency components of the image. The required image quality sets the compression ratio. Changing the compression in the time dimension allows setting the number of interpolated frames (B-frame) and the predicted frames (P-frame), which are stored between one base frames to another.

2.3. Wavelet Compression

Different applications handle compression with different success with each compression type. Some preserve better static details though there are some unaccepted jumps between frames. While other maintain continuous motion but only the rude details could be recognized. The compression technology today, allows transferring a continuous video in 15 frames per second and a resolution of 320*240 pixels on a digital line of 256Kbps.

To achieve a similar quality under standard telephone lines a compression ratio of 10:1 is required. One of the technologies today that might deliver this compression ratio is called Wavelet.

This technology used by the Israeli product VDOLive, is chosen by some important in websites to use this as a base for their video services. It is expected that this product and this technology will lead the market. The most attractive aspects of the WaveLet compression are the ability to improve a degraded image. The compression creates different "layers" of details and with different quality. Hence the quality can be improved by combining more than one layer in the frame within the bandwidth range.

2.4. Video Encoding and Decoding into Web Page.

The difficulties of transferring an audio/video files over the Internet, paved way to understand the limitations, which are to be considered, especially while creating the video files. The limitations are as follows, reduced view area with low detail background should be chosen, objects that are participating in the frames and the fast camera movements must be avoided. Fancy stereo effects should also be avoided.

The audio card and the video capture card do the analog to digital signals conversion. These days every standard audio card can provide the performance needed for "audio over the Internet". Professional equipment is not required for video capturing as well.

The audio and the video files should be inserted into HTML pages, which are used as graphical environment for the video window. The binary files is stored separately form the page as a MIME Extension (Multipurpose Internet Mail Extension), which are standard format for add-ons that are not written in HTML language, and are linked with pages and other hyper-text links to words, via a "dummy" file that is connected to the HTML language and points to the location of the file.

Thus compression techniques for various multimedia objects play a major in video conferencing and boost the performance of a video conferencing session. Various techniques are implemented on different types of session depending on the level of quality required for particular sessions.

We must check the whether the desired quality is obtainable at the connection speed typically used by the target audience.

Chapter 3

3. Major Problems Involved in Video Conferencing

3.1. Introduction

A number of problems occur in a Video conferencing session even though we use a good multimedia system. I have listed some of the problems that occur in a video conferencing session. Some of these problems can be eradicated but when used on an Internet atmosphere the sessions are still unreliable due to the unpredictable nature of the Internet. I have considered some of the aspects which are to be implemented for a video conferencing session. Real time video such as online video conferencing classes involves high quality of data transmissions.

3.2. Video Bandwidth

Streaming technologies are designed to overcome the fundamental problem facing multimedia elements distributed over the Web have a limited bandwidth. While your 28.8-kbps modem or 128-kbps ISDN connection may seem screaming fast, it pales in comparison even to an ancient single-spin CD-ROM drive that can transfer 150K of data each second, where most of us think in bytes per second, the communication would have to think in bits, which come eight to a byte. Our 28.8-kbps modem has a throughput capacity of about 3.6K per second, approximately 1/40 the speed of the ancient CD-ROM drive. As an example, lets take the simple case of transferring sound from one computer to another through a modem. In order to sample the voice, we connect a microphone to a standard sound card that uses a single audio channel, with sample rate of 8-KHZ, 8-bit audio. The binary file then transferred to V.34 modem that in optimal conditions can transmit up to 28,800-bps. Since the sound card generates 64,000-bps, there is a need for compression, which most modems can perform. The receiving side has to reverse this process, decompress the file and to feed the sound card with continues data. A CD-quality sample rate has been set to 44,100 a second with 16 bit per channel. In our case, with a single channel the bandwidth we need is 705,600 bit's per second. The first compression

would be to sample at 8-KHZ instead of 44.1, and at 8-bit instead of 16-bit. That decreases the bandwidth to 1:11 to the original and the result would be a lower sound quality, which shows that we used a lossy compression technique.

When trying to transfer live video, the bandwidth problem becomes much more critical. To transfer voice through modems we needed a compression factor between 25 to 50, however when trying to transfer a video picture that was captures by a low-resolution video camera, we need a compression ratio between 2500 to 5000. Note that the eye resolution is higher at least by a factor of 100 from the resolution of the camera, and the eye-viewing angle is at least twice as large as the camera's. Hence, it seams that in the near future no compression will achieve this target without fundamental changes in the communication bandwidth. Increasing the bandwidth is possible in several ways, all of them are expensive. Replacing the analog phone lines with ISDN lines, which provide a 128-Kbps bandwidth, more that, 4 times the fastest modem. Large organizations can rent digital phone lines with a 256-Kbps to a 34-Mbps.In the near future we will use a cable modem, which will be connected to the cable network and will use the high Coax cables bandwidth. In the far future we will use Cyber Optics cables which in labs achieves bandwidth of billions bits per second and theoretically we are far from exploiting their potential. Internet Delays

3.3. Internet Delays

The Internet will not replace the telephone system. There are a number of basic differences between the two networks that result in very different and distinctive performance characteristics. The most obvious difference is that the telephone system is based on analog signal switching whereas the Internet is based on digital packet switching. The phone system's main strength is its ability to transmit real-time continuous speech. This is unfortunately, unreliable when it comes to transmitting data. The Internet's main strength is its ability to transmit asynchronous data to anywhere in the world, but is unreliable if the data transmission is required in real time. Unfortunately, the Internet is notoriously unpredictable when it comes to transmission performance. Heavy traffic load and internal transmission problems can cause delays that are beyond anyone's control. This can result in disrupted speech and video reproduction at the destination computer. Unlike digital cellular or radiophones, however, there is no loss of data. Disrupted speech in an Internet

transmission is purely a gap in the data stream reproduction. As the Internet grows and expands in overall bandwidth, this problem should be continuously being less evident.

These are some of the problems involved in video conferencing. Dedicated lines and Intranet environments provide high quality of video conferencing. Recent development in cable data transmissions provides high speed internet facilities which are enabling us to use high quality video transmissions. The cost of the services for providing cable internet has also drastically come down which providing us for better quality of video conferencing.

Chapter 4

4. Traffic Monitoring Tools.

4.1. Introduction

This document presents a set of experiments on video conferencing traffic monitoring. It includes a set of experiments on a traffic-monitoring tool called Net.Medic tool. These tests help us to learn about the data transfer rates, strength of Internet, CPU load and modem capabilities. This network-monitoring tool enables in learning all above-mentioned objects.

4.2. Net.Medic

Net.Medic is a very powerful traffic-monitoring tool. It is a powerful user-friendly tool that diagnoses and sometimes fixes problems on the worldwide web as well as a network. Net.Medic identifies problems, offers suggestions for solving them, and some times automatically fixes them. Net.Medic is also a powerful desktop agent for monitoring the performance of the end system.

Net.Medic is an easy, to use and yet very powerful Network monitoring data are available in simple panes. These experiments have been designed to show how Net.Medic can be used to monitor network traffic and how to create any problems on a network.

All the panes show vital information of the status of the DVC, after taking the initial values for the above table. We can start with experimentation.

Each of the pane performs its own individual task's which are explained in details.

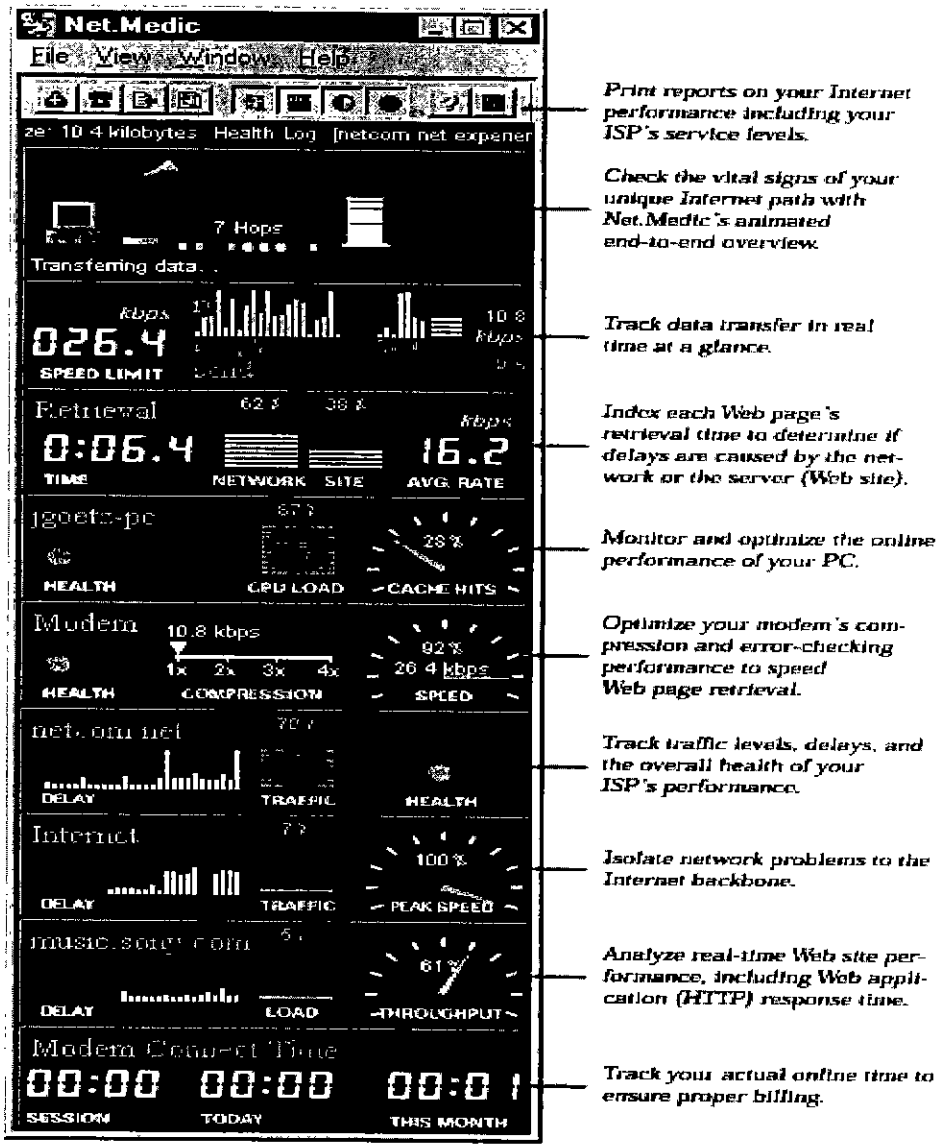


Figure: 4.1. Interface screen of Net. Medic during a video conferencing session.

4.2.1 Connection pane:

Most of the time this pane is idle except when a connection to anew server / site is required. This pane mainly observes the navigation, and helps in proper connection to the new site, First it attempts to resolve the I.P address and name of the new server and later starts establish a connection between both the sites, it also tells us the number of hops to connect to the I.P address/name to be connected, thereby transferring data from node to another. This pane shows the connection between our computer and the other server on to whom we are connected and shows us the I.P address and the name of the sever, which has been connected.

has been connected. If a delay occurs due to net conjunction their reports are generated. Three colors occur at the modem, which are red for heavy conjunction, yellow for moderate and green for good Internet connection. Double clicking on the modem and default icons in the connection pane can see their reports. If an error occurs the Net.Medic tool itself can directly diagnose them. Net.Medic can provide solutions for most of the errors.

4.2.2. My Computer:

This pane has three columns, the leftmost column shows the health of the computer, and the middle section shows the CPU load or the CPU currently utilized. The right most column show the percentage of pages received from local disk cache hits.

This pane shows us the CPU load of our computer or terminal, and the rate of present utilization of the CPU, there by showing the health of the CPU. If the icon is green it shows that the CPU is not completely used. If the icon is red it means that utilization of the CPU is Maximum and the load is very high. If the load on CPU reaches 100%, close any unused programs on our desktop in order to reduce CPU load. If this problem persists, and we would like to speed our on-line performance we may want to consider upgrading our CPU.

4.2.3. Internet:

This pane has three sections of which the left most pane shows the delays in the delay in the network traffic, the middle section shows the percentage of estimated traffic conjunction levels. The right most panels show the percentage of transfer speed in the form of a speedometer.

This pane shows the health of the Internet and the traffic delays, which occur ion the Internet, as the delay factor increases the performance of the Internet decreases. That is as the number of connections to a server increases the load on the sever increases and number of pages to be downloaded decreases, this also depends much on different multimedia objects. If objects such as video and sound are to transfer it takes much time due to the limitations of the data transfer rates and pages being accessed simultaneously from different parts of the world.

4.2.4. Speed limit:

This pane show the receiving and sending data speed on the net. We see the blue dotted lines as the data being transferred. The dark blue indicator is for data send rate and light blue indicator is for data receive rate. The overall speed limit is given in big indicator in Kbps, which is the estimated maximum speed and bandwidth available end-to-end during current transfer.

4.2.5. Modem:

The pane has three sections of which left section shows the health of the modem. If the health has a green light then the modem is transferring data in a good condition. If the health has a yellow light then the health of the modem is moderate. If the health panel has a red light then there is too much of Net Conjunction, and the load on the modem is very heavy, there by it may take much longer time to transfer the data. This pane shows the capability of the modem or the line and the rate of compression taking place and the data being transferred is given in bits per seconds. As the load increases it needs a powerful modem to transfer data. If the connection to the Internet is via a dedicated line, then modem pane need not be considered.

4.2.6. Server:

This pane shows the percentage of load on the server. As the number of pages to be accessed increases the load on the server increases and some times causes bottleneck. This pane has three sections of which the left section shows the delays occurring. The middle sections shows the percentage of load on the server and the last section shows the percentage of throughput in a speedometer form.

This pane shows the capability of the server and the strength of the server on to which we are connected. If a number of connections occur simultaneously on to which we are connected. If a number of connections occur simultaneously on the same sever, then the load on it increases and it takes more time to download all the pages at one instance of time.

4.2.7. Retrieval and send rates:

This pane has three panes, which show the speed limit on the left most section in KBPS (Kilobits Per Second) in a digital format. The centre panel shows the Receive and send

rate in a moving bar chart, which has a fluctuation of chart, as variation in data transfer data is simultaneous as data transfer occurs.

This pane shows the data retrieval from the Internet; it shows the amount of time taken and the amount of data transferred.

4.2.8. ISP (Internet Service Provider):

This pane has three sections of which the left most pane show the delays in the delay in the network traffic, the middle section shows the percentage of estimated traffic conjunction levels. The right most panel shows the overall health of the ISP.

This pane shows the strength of the Internet service provider or the Internet line. As the number of users increases the performance decreases since the load on the ISP's server increases.

4.2.9. Session Time:

This pane shows the session time, i.e., the time spend on the Internet, It shows the session time for this session, today and this month. This pane can be used for measuring transfer of data objects when compared to a fixed time. We can have modem connection time and session connection time in this pane.

Now establish a video conferencing session with another client and we can check the performance of the Internet. Data in all the above panes are tabulated in the table below and the performance of the Internet can be studied.

The following experiments have been performed in studying the different objects in video conferencing:-

Experiment 1: Basic Features of Net. Medic tool.

Experiment 2: Retrieval and Send rate of data traffic

Experiment 3: Strength of the Internet

Experiment 4: CPU Load and its capabilities

Experiment 5: Modem capabilities

Experiment 6: Role of ISP (Internet Service Provider)

4.3. Experiment 1. Retrieval and send rate of data traffic.

This experiment shows the importance of data send and receives rates. The amount of data to be sent or received increase as the load for the transfer increases. They're by disturbing the transfer of data. The amounts for data sent to the network during each interval and the amount of data received to the network during each interval are show in this experiment. The send rates and receive rates are listen down in tables and are represented in graphs. These graphs show us the variation in the send and receive rates.

4.4. Experiment 2. CPU Load and its capabilities

As the amount of data to be transferred increases, the Load on the CPU increases and the number of operations performed will decreases once the load reaches 100%. A number of experiments are performed on various terminals with different processor speeds and the results are to be tabulated. These results are represented in graphs, which give a look at the effect of traffic load on the C.P.U.

4.5. Experiment 3 Modem capabilities.

Performance of a video conferencing session much depends on the modem or a line, as video conferencing objects needs very large data to be transferred at time powerful. Modem help in transferring data and avoiding the delays. This pane (modem) shows details on the overall health of the modem. Estimated compression based on the data rate exceeding the negotiated speed and percent of negotiated speed for current session.

4.6. Experiment 4. Role of ISP (Internet Service Provider)

This pane shows the Delay, percentage of traffic, indicated the health of the ISP these are history of delay attributed at the ISP, Estimated traffic conjunctions level along the ISP path, and the overall health of the internet is connected to the through a network then the above experiments are done on the Intranet. All the data is collected on various modems and is represented in graphs. These results of the above data represented in graph show the variation in Data Traffic flow on various modems.

Data collected in all the above experiments is collected in tables and is represented in graphs.

All the above experiments show the effects of various multimedia objects on the Network traffic flow and the behavior of Internet/Intranet.

Chapter 5

5. Experiments on Retrieval and Send rate

Introduction: As the amount of data to send or received increases the delay for the transfer increases, they're by disturbing the transfer of data. The amount of data sent to the network during each interval and the amount of data received by the network during each interval are given in detail in this experiment.

Experiment 1

Title: Retrieval and Send rate of data traffic

Aim

- To find variation in the receiving and sending rate during a videoconferencing session
- To find its impact on various multimedia objects.

5.1. Procedure:

5.1.1. Step: 1

Start a videoconferencing session, by starting class point software (both instructor and student) on 2 or more terminals and checking all the devices are working properly.

Select the view menu and find for summaries. Select the Throughput in the Summaries menu. A pop up screen appears with the details such as the send rate, Receive rate, and displays the speed limit according to the capability of the modem and strength of the Internet.

5.1.2. Step: 2

For experiments on Audio All other applications such as Video, Chat and white board applications are to be closed down and only the Audio is tested to know the effect of the speed limit factor on Audio. A predefined text of matter is read on a node and the send rate and the Throughput of data are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig 1.1. These graphs are checked for a consistent result.

5.1.3. Step: 3

For experiments on Video All other applications such as Audio, Chat and white board applications are to be closed and only the video is tested to know the effect of the speed limit factor of Video. A small session of videoconference is performed on a node and the send rate and the Throughput of data are noted down. On al the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at lest 5 time's and are plotted in a graph against the time. The data is noted in Fig 1.2. These graphs are checked for a consistent result.

5.1.4. Step: 4

For experiments on Chatting All other applications such as Audio, Video and white board applications are to be closed and only the Chat application is tested to know the effect of the speed limit factor of Chatting. As there is only transfer of text the effect may be less but to be more precise these experiments are considered. A small session of Chatting is performed on a node and the send rate and the Throughput of data are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in fig 1.3. These graphs are checked for a consistent result.

5.1.5. Step: 5

For experiments on White board Applications All other applications Such as Audio, Video and Chat applications are to be closed and only the white board Applications are to be tested to know the effect of the speed limit factor of White board Applications. A small session of White board Applications is performed on a node and the send rate and the Throughput of data are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig 1.4. These graphs are checked for a consistent result.

5.1.6. Step: 6

For experiments on Audio, video, Chat and white board applications All other applications such as Audio, Video and Chat applications are to be closed and only the white board applications are to be tested to know the effect of the speed limit factor of white board applications. A small session of white board applications is performed on a node and the send rate and the Throughput of data are noted down. On all the other nodes the receive speed and the throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig 1.5. These graphs are checked for a consistent result.

All the above graphs are studied to know effect of the send rate and receive rate on different videoconferencing objects.

Note: All the above experiment, are to be performed on machines with different configurations so that we can know the above effects with variation in different configurations.

Five (5) experiments were conducted to check the Send and receive rate experiments were done on a Pentium III system with a processor speed of 500 MHz, and a RAM of 64 MB.

5.2. Analyzing data collected for experiments on Send and Receive rates.

Experiment have been conducted by conducting sessions on different conferencing objects and vital data is collected form these experiments. These results are further tabulated and analyzed to get details results of send and receive rates. These experiments are performed for different objects of intranet and Internet communication, such as Chatting, White Board applications and Video conferencing. Net.Medic was used a tool to measure the transfer of data. The graphical interface provided a detailed flow of data and determined the approximate values.

5.2.1. Experiments conducted on Chatting.

A set of five experiments have been conducted to study the data transfers during Chatting. These results help us in determining the strength of the data flow of the network. The data acquired from these experiments have been tabulated and graphs have been generated to feel the flow of data.

Data transfer is tabulated using the send rate and receive rate over a period of time. I have the time period for each data transfer to be 5 seconds. Total time for the experiment was 70 seconds; each reading was generated for every five seconds.

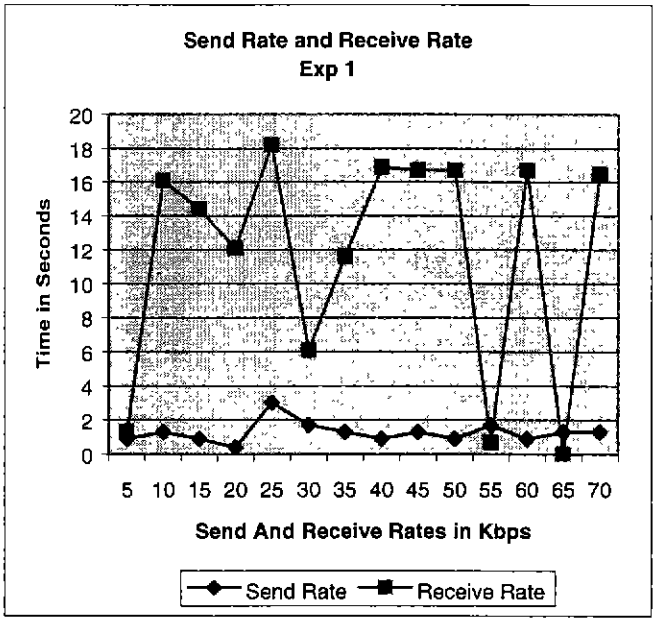
The results are then tabulated and the data is analyzed. I have used Microsoft Excel to generate the graphs. The data supplied in the table is used in excel and automated graphs are generated, giving us the better feel of data transfer.

Experiment 1 for Send And Receive Rates During Chatting.

Experiments conducted on Send rate and receive rate during experiments on chatting.. The Data represented below are from reading no 1.

Time	Send Rate	Receive Rate
5	0.9	1.3
10	1.3	16.1
15	0.9	14.4
20	0.4	12.1
25	3	18.2
30	1.7	6.1
35	1.3	11.6
40	0.9	16.9
45	1.3	16.7
50	0.9	16.7
55	1.7	0.7
60	0.9	16.7
65	1.3	0
70	1.3	16.5

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1.

Figure 5.1.1 Send and Receive Rate experiment No: 1.

Average Send Rate: - 1.271429 Kbps Average Receive Rate: - 11.71429 Kbps

Total time for Experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

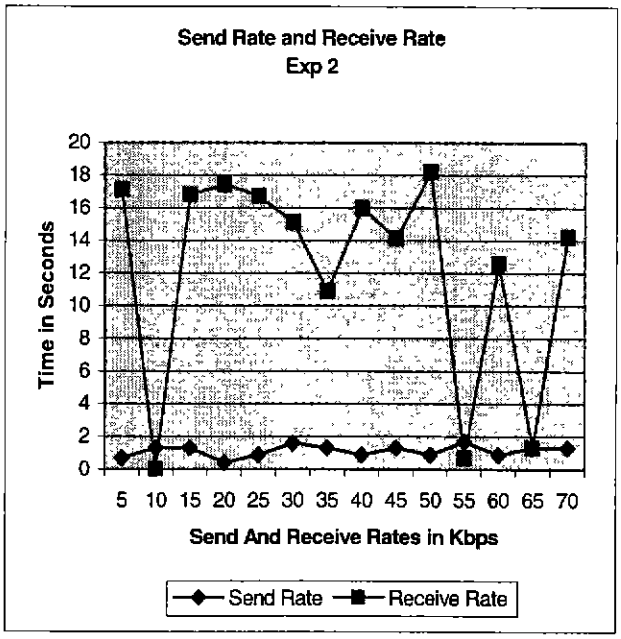
Send rate and Receive rate stated at the same amount of data transfer and the send rate abruptly increased to 16 Kbps then over a period of time stared fluctuation at 55th second the transfer rate reduced down to 0.7 Kbps and again at 63rd second went down to 0 implying there was no transfer at this particular point. At the 64th second transfer increased to 16.5 Kbps. Over all send rate was 1.27 Kbps and Receive Rate was 11.7143 Kbps.

Experiment 2 for Send And Receive Rates During Chatting.

Experiments conducted on Send rate and receive rate during experiments on chatting. The Data represented below are from reading no 2.

Time	Send Rate	Receive Rate
5	0.7	17.1
10	1.3	0
15	1.3	16.8
20	0.4	17.4
25	0.9	16.7
30	1.6	15.1
35	1.3	6
40	0.9	16
45	1.3	14.1
50	0.9	18.2
55	1.7	0.7
60	0.9	12.6
65	1.3	1.3
70	1.3	14.2

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2.

Figure 5.1.2: Send and Receive Rate experiment No: 2.

Average Send Rate: - 1.128571 Kbps

Average Receive Rate: - 12.22143 Kbps

Total time for Experiment: - 70 Seconds

Maximum Modem Speed: - 52.0 Kbps

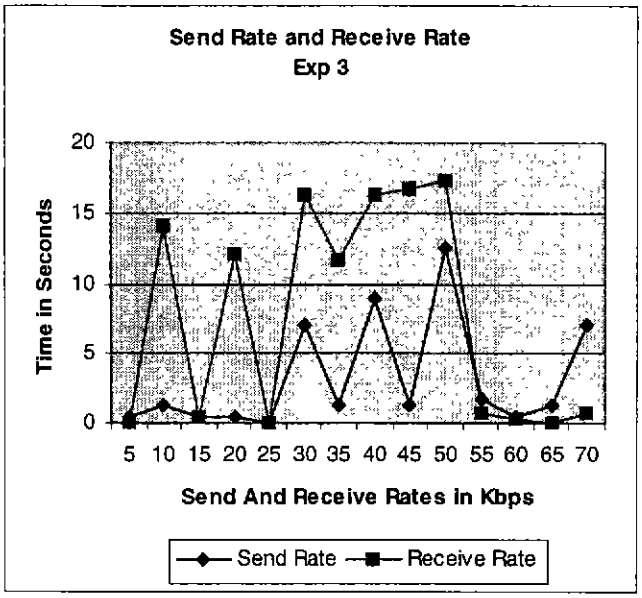
Over a Period of time the receive rate varied drastically and was very heavy due to more transfer of data but the send rate was less comparatively less and was nearly consistent at some points of time i.e. at 8th 55th and 72nd seconds both send rate and receive rates merged over all send rate was 1.128 Kbps and Receive rate was 12.22 Kbps.

Experiment 3 for Send And Receive Rates During Chatting.

Experiments conducted on Send rate and receive rate during experiments on chatting. The Data represented below are from reading no 3.

Time	Send Rate	Receive Rate
5	0.4	0
10	1.3	14.1
15	0.4	0.4
20	0.4	12.1
25	0	0
30	7.1	16.3
35	1.3	11.6
40	8.9	16.3
45	1.3	16.7
50	12.5	17.2
55	1.7	0.7
60	0.5	0.3
65	1.3	0
70	7.1	0.7

Data Collected for experiment 3. Send and Receive rates.



Graphical Representation of data Collected for Experiment 3.

Figure 5.1.3: Send and Receive Rate experiment No: 3.

Average Send Rate: - 3.157143 Kbps

Average Receive Rate: - 7.6 Kbps

Total time for experiment: - 70 Seconds

Maximum Modem Speed: - 52.0 Kbps

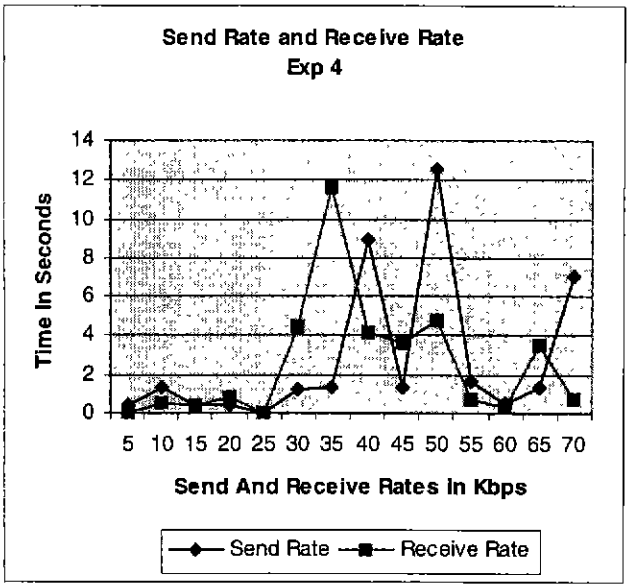
In this experiment at 3rd second, both the send rates and receive rates started at 0 and at the 18th and 27th seconds send rate and receive rates overlapped. The Send rate the send rate was below the 1 Kbps mark and was near to zero implying that the information send at this interval was very less. The average Receive rate was 3.157 Kbps and average send rate was 7.60 Kbps.

Experiment 4 for Send And Receive Rates During Chatting.

Experiments conducted on Send rate and receive rate during experiments on chatting. The Data represented below are from reading no 4.

Time	Send Rate	Receive Rate
5	0.4	0
10	1.3	0.5
15	0.4	0.4
20	0.4	0.8
25	0	0
30	1.2	4.5
35	1.3	11.6
40	8.9	4.2
45	1.3	3.6
50	12.5	4.8
55	1.7	0.7
60	0.5	0.3
65	1.3	3.5
70	7.1	0.7

Data Collected for experiment 4. Send and Receive rates.



Graphical Representation of data Collected for Experiment 4.

Figure 5.1.4: Send and Receive Rate experiment No: 4.

Average Send Rate: - 2.735714 Kbps

Average Receive Rate: - 2.545847 Kbps

Total time for experiment: - 70 Seconds

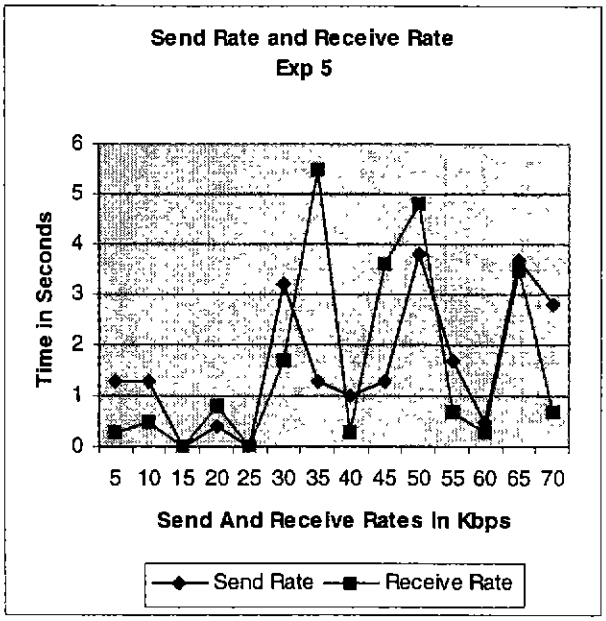
Maximum Modem Speed: - 52.0 Kbps

Data transfer rates till the 27th second were very less and were less than 1.6 Kbps then at the 28th second went abruptly up to 12 Kbps and the send rate went to 12.5 Kbps at the 53rd second mark. There was a lot of fluctuation in the data transfer rates and both the send rate and receive overlapped at many points during the experiment. Overall send rate was 2.74 Kbps and the Receive rate was 2.54 Kbps.

Experiment 5 for Send And Receive Rates During Chatting.

Experiments conducted on Send rate and receive rate during experiments on chatting. The Data represented below are from reading no 5.

Time	Send Rate	Receive Rate
5	1.3	0.3
10	1.3	0.5
15	0	0
20	0.4	0.8
25	0	0
30	3.2	1.7
35	1.3	5.5
40	1	0.3
45	1.3	3.6
50	3.8	4.8
55	1.7	0.7
60	0.5	0.3
65	3.7	3.5
70	2.8	0.7



Data Collected for experiment 5. Send and Receive rates.

Graphical Representation of data Collected for Experiment 5.

Figure 5.1.5: Send and Receive Rate experiment No: 5.

Average Send Rate: - 1.592857 Kbps

Average Receive Rate: - 1.621429 Kbps

Total time for experiment: - 70 Seconds

Maximum Modem Speed: - 52.0 Kbps

In this experiment the data transfers merged at many points. There was a high fluctuation in the data transfer rates, but the overall send rate and receive rates remained low on average at the 37th second the receive rate was maximum at 5.5 Kbps and fell down sharply at the 42nd second. Overall send rate was 1.593 Kbps and average receive rate was 1.621Kbps.

5.2.2. Report for send and receive rate of chatting:

A set of five experiments was conducted to pursue the data transfers for send and receive rate during chatting. It is deduced that the data transfer was unreliable and varied at various intervals and during various times of the day. During the peak hours the performance was low compared to off peak hours. As the amount of data transfer increased the graph showed gradual decline. During chatting the amount of data transfer was low so the performance was better.

The transfer rates varied from 1kbps to 4kbps for the send rate. The transfer of data varied the experiment at various times depending on the network traffic.

The transfer rates varied from 5kbps to 14kbps for the receive rate. The transfer of data varied the experiment at various times depending on the network traffic.

The graph showed a clear picture of how the performance varied during different times of the day depending on the data transfer and gave a clear feel of the data flow. The other tests have been performed based on the results of this experiment.

5.2.3. Experiments conducted on White Board Applications.

A set of five experiments have been conducted to study the data transfers during White board applications. These results help us in determining the strength of the data flow of the network. The results of the experiment have been tabulated and graphs have been generated to feel the flow of data.

Data transfer is tabulated using the send rate and receive rate over a period of time. I have the time period for each data transfer to be 5 seconds. Total time for the experiment took 70 seconds.

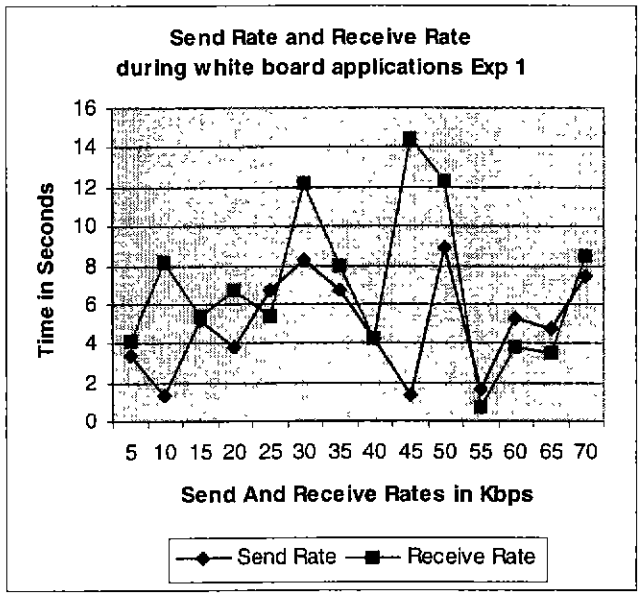
The results are then tabulated and the data is analyzed. I have used Microsoft Excel to generate the graphs. The data supplied in the table is used in excel and automated graphs are generated, giving us the better feel of data transfer.

Experiment 1 for Send and Receive Rates during White board applications.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 1.

Time	Send Rate	Receive Rate
5	3.4	4.1
10	1.3	8.2
15	5.2	5.4
20	3.8	6.7
25	6.7	5.4
30	8.3	12.2
35	6.7	8
40	4.2	4.2
45	1.3	14.5
50	8.9	12.3
55	1.7	0.7
60	5.3	3.8
65	4.7	3.5
70	7.4	8.5

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1.

Figure 5.2.1: Send and Receive Rate experiment No: 1.

Average Send Rate: - 4.92149 Kbps Average Receive Rate: - 6.964826 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

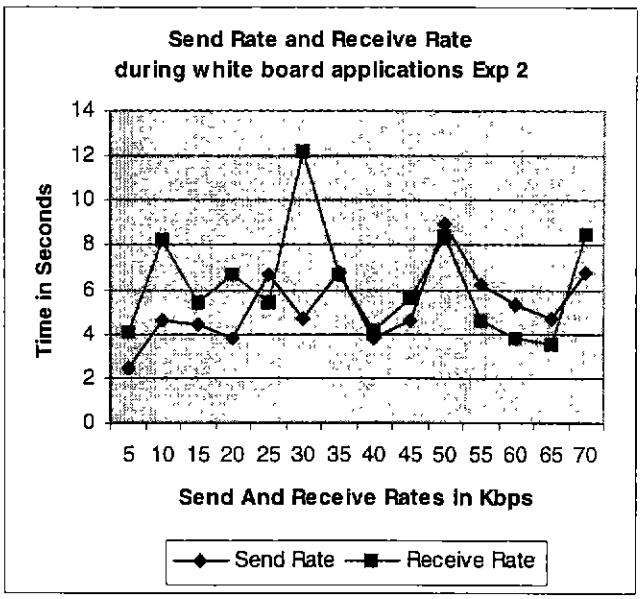
These Experiments were performed for observing data transfers on White board application. Over a period of time data transfer was overlapping. Data transfer of both send rate and receive rates was much higher than in chatting as much data was being transferred in white board application, at 46th second the receive rate was maximum and send rate was minimum. From 60th second to 70th second data transfers were nearly equal. The average send rate was 4.921Kbps and Average Receive rate was 6.964Kbps.

Experiment 2 for Send and Receive Rates during White board applications.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 2.

Time	Send Rate	Receive Rate
5	2.4	4.1
10	4.6	8.2
15	4.4	5.4
20	3.8	6.7
25	6.7	5.4
30	4.7	12.2
35	6.8	6.7
40	3.8	4.2
45	4.6	5.6
50	8.9	8.4
55	6.2	4.6
60	5.3	3.8
65	4.7	3.5
70	6.8	8.5

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2.

Figure 5.2.2: Send and Receive Rate experiment No: 2.

Average Send Rate: - 5.264Kbps Kbps Average Receive Rate: - 6.235Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

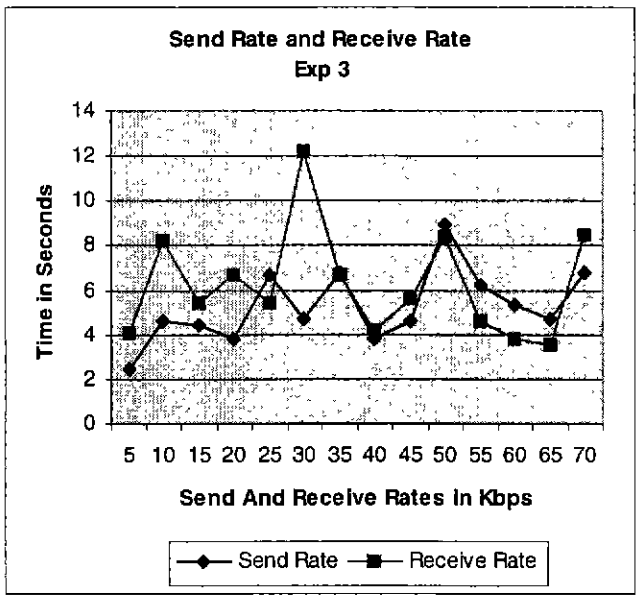
The send rates and receive rates were nearly equal. At 32nd second receive rate was maximum of 13 Kbps. The graph inconsistent result and data drastically changed throughout the experiment. Overall average send rate was 5.264 Kbps and Receive rate was 6.235 Kbps. At 54th second the send rate and receive rate were equal at 9 kbps.

Experiment 3 for Send and Receive Rates during White board applications.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 3.

Time	Send Rate	Receive Rate
5	2.4	4.1
10	4.6	8.2
15	4.4	5.4
20	3.8	6.7
25	6.7	5.4
30	4.7	12.2
35	6.8	6.7
40	3.8	4.2
45	4.6	5.6
50	8.9	8.4
55	6.2	4.6
60	5.3	3.8
65	4.7	3.5
70	6.8	8.5

Data Collected for experiment 3. Send and Receive rates.



Graphical Representation of data Collected for Experiment 3.

Figure 5.2.3: Send and Receive Rate experiment No: 3.

Average Send Rate: - : 5.2646154Kbps Average Receive Rate: - - 6.235714Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

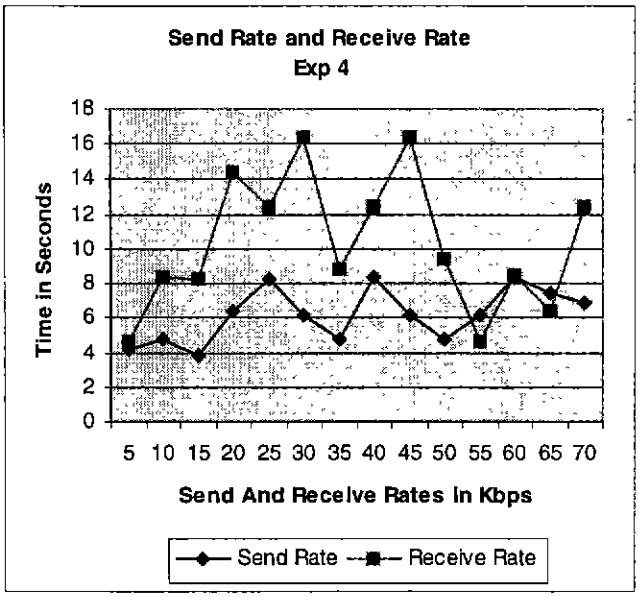
The series of Plotted values had several times overlapped at 34th second there was the maximum receive rate and was 12.5 Kbps and at 54th second the send rate and receive rate were same. The Average Send rate was 5.264Kbps and average receive rate was 6.235Kbps. The minimum receive rate was at 67th second and was 3.5 Kbps.

Experiment 4 for Send and Receive Rates during White board applications.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 4.

Time	Send Rate	Receive Rate
5	4.2	4.6
10	4.8	8.4
15	3.8	8.2
20	6.4	14.4
25	8.3	12.4
30	6.2	16.4
35	4.8	8.8
40	8.4	12.4
45	6.2	16.4
50	4.8	9.4
55	6.2	4.6
60	8.4	8.5
65	7.4	6.4
70	6.8	12.4

Data Collected for experiment 4. Send and Receive rates.



Graphical Representation of data Collected for Experiment 4.

Figure 5.2.4: Send and Receive Rate experiment No: 4.

Average Send Rate: - : 6.197857 Kbps Average Receive Rate: - 10.23571 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

Receive rate in this experiment was very high. At only 2 point i.e. at 53rd and 68th seconds receives rate was lesser than send rate. At 62nd second the send rates and receive rates were equal. At 45th second the receive rate was maximum and 67th second it was minimum. The average send rate was 6.197 Kbps and the average receive rate was 10.235 Kbps

5.2.4. Report for send and receive rate of white board application:

A set of five experiments was conducted to pursue the data transfers for send and receive rate during white board application. It is deduced that the data transfer was unreliable and varied at various intervals and during various times of the day. During the peak hours the performance was low compared to off peak hours. As the amount of data transfer increased the graph showed gradual decline. During white board application the amount of data transfer was moderate so the performance was moderate.

The transfer rates varied from 1.59kbps to 7.5kbps for the send rate. The transfer of data varied the experiment at various times depending on the network traffic.

The transfer rates varied from 1.621kbps to 15kbps for the receive rate. The transfer of data varied the experiment at various times depending on the network traffic.

The graph showed a clear picture of how the performance varied during different times of the day depending on the data transfer and gave a clear feel of the data flow.

5.2.5. Experiments conducted on Video Conferencing.

A set of five experiments have been conducted to study the data transfers during White board applications. These results help us in determining the strength of the data flow of the network. The results of the experiment have been tabulated and graphs have been generated to feel the flow of data.

Data transfer is tabulated using the send rate and receive rate over a period of time. I have the time period for each data transfer to be 5 seconds. Total time for the experiment took 70 seconds.

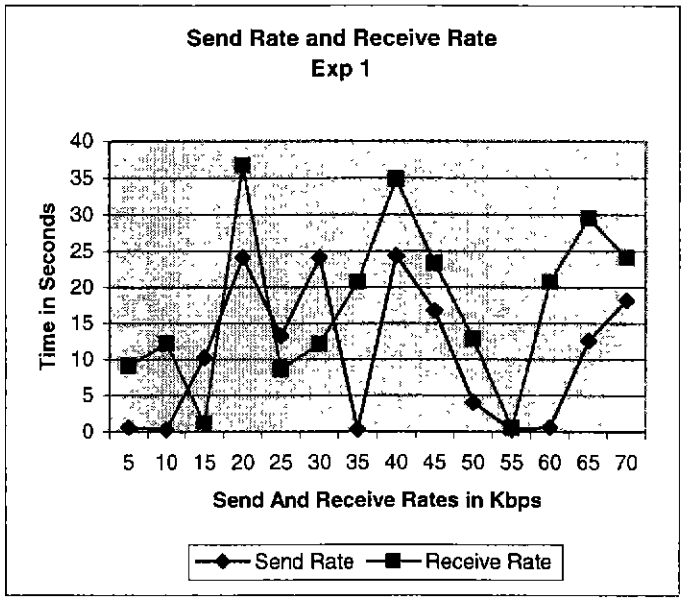
The results are then tabulated and the data is analyzed. I have used Microsoft Excel to generate the graphs. The data supplied in the table is used in excel and automated graphs are generated, giving us the better feel of data transfer.

Experiment 1 for Send and Receive Rates during Video Conferencing.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 1.

Time	Send Rate	Receive Rate
5	0.6	9.1
10	0.3	12.2
15	10.2	1.2
20	24.1	36.7
25	13.2	8.6
30	24.1	12.1
35	0.3	20.7
40	24.3	34.8
45	16.7	23.3
50	4.1	12.8
55	0.3	0.5
60	0.6	20.7
65	12.6	29.6
70	18.2	24.1

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1.

Figure 5.3.1.: Send and Receive Rate experiment No: 1.

Average Send Rate: - : 10.68571 Kbps Average Receive Rate: 17.6 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

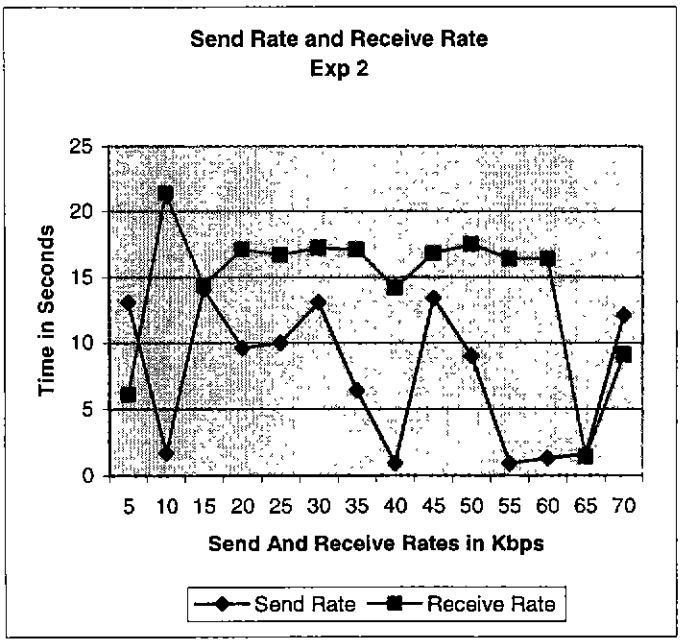
This experiment was conducted for a Video conferencing session. Data transfer rates were very high due to the high volume of data has to be transferred. A maximum data has been received at the 24th second of 36 Kbps and at 44th second 35 Kbps of data was received at 54th second both the receive rate and send rates were 0 Kbps. The average send rate was 10.68 Kbps and the Receive rate was 17.6 Kbps.

Experiment 2 for Send and Receive Rates during Video Conferencing.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 2.

Time	Send Rate	Receive Rate
5	13.1	6.1
10	1.7	21.4
15	14.1	14.4
20	9.6	17.1
25	10	16.7
30	13.1	17.2
35	6.4	17.1
40	0.9	14.2
45	13.4	16.8
50	9	17.5
55	0.9	16.4
60	1.3	16.4
65	1.6	1.4
70	12.1	9.1

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2.

Figure 5.3.2.: Send and Receive Rate experiment No: 2.

Average Send Rate: - 7.651743 Kbps Average Receive Rate: 14.41429 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

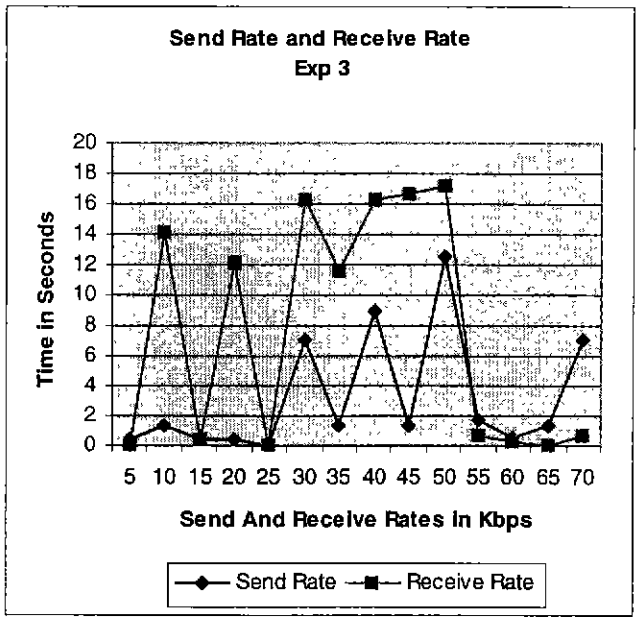
The Receive rate remained high in this experiment and had a very consistent result. At 66th second receive rate was 1 Kbps with a least transfer. At 20th second both receive rates and send rate were same at 14 Kbps. Send rate was fluctuating and at 13th 44th 56th 57th send rates were minimal and less than 1 Kbps. The receive rate was consistent from 20th to 65th second. The Average send rate was 7.651 Kbps and Receive rate was 14.414 Kbps

Experiment 3 for Send and Receive Rates during Video Conferencing.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 3.

Time	Send Rate	Receive Rate
5	0.4	0
10	1.3	14.1
15	0.4	0.4
20	0.4	12.1
25	0	0
30	7.1	16.3
35	1.3	11.6
40	8.9	16.3
45	1.3	16.7
50	12.5	17.2
55	1.7	0.7
60	0.5	0.3
65	1.3	0
70	7.1	0.7

Data Collected for experiment 3. Send and Receive rates.



Graphical Representation of data Collected for Experiment 3.

Figure 5.3.3.: Send and Receive Rate experiment No: 3.

Average Send Rate: - 3.157 Kbps Average Receive Rate: - 7.6 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

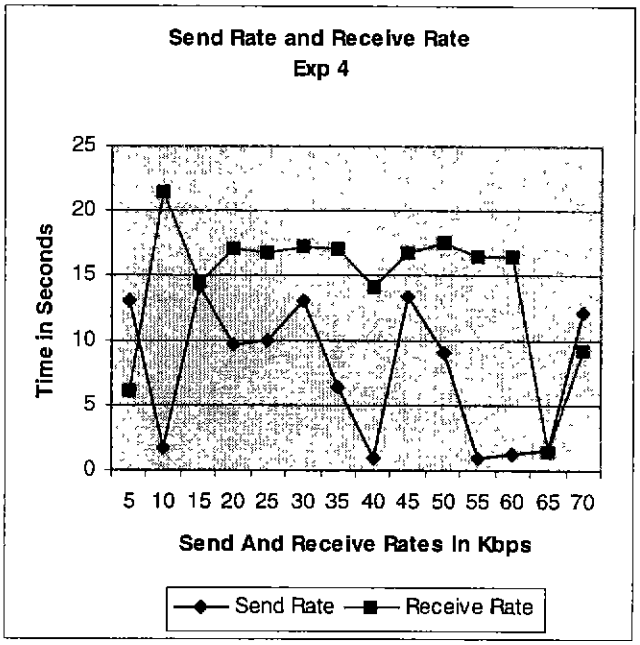
The Receive rate remained high in this experiment and had a very consistent result. At 66th second receive rate was 1 Kbps with a least transfer. At 20th second both receive rates and send rate were same at 14 Kbps. Send rate was fluctuating and at 13th 44th 56th 57th send rates were minimal and less than 1 Kbps. The receive rate was consistent from 20th to 65th second. The Average send rate was 3.157 Kbps and Receive rate was 7.6 Kbps.

Experiment 4 for Send and Receive Rates during Video Conferencing.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 4.

Time	Send Rate	Receive Rate
5	13.1	6.1
10	1.7	21.4
15	14.1	14.4
20	9.6	17.1
25	10	16.7
30	13.1	17.2
35	6.4	17.1
40	0.9	14.2
45	13.4	16.8
50	9	17.5
55	0.9	16.4
60	1.3	16.4
65	1.6	1.4
70	12.1	9.1

Data Collected for experiment 4. Send and Receive rates.



Graphical Representation of data Collected for Experiment 4.

Figure 5.3.4.: Send and Receive Rate experiment No: 4.

Average Send Rate: - 7.651743 Kbps Average Receive Rate: - 14.41429 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

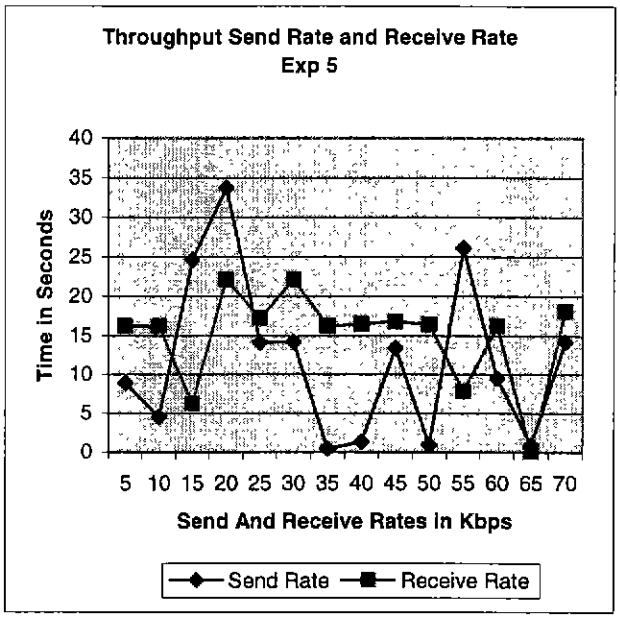
The Receive rate remained high in this experiment and had a very consistent result. At 66th second receive rate was 1 Kbps with a least transfer. At 20th second both receive rates and send rate were same at 14 Kbps. Send rate was fluctuating and at 13th 44th 56th 57th send rates were minimal and less than 1 Kbps. The receive rate was consistent from 20th to 65th second. The Average send rate was 7.651 Kbps and Receive rate was 14.414 Kbps.

Experiment 5 for Send and Receive Rates during Video Conferencing.

Experiments conducted on Send rate and receive rate during experiments for white board applications. The Data represented below are from reading no 5.

Time	Send Rate	Receive Rate
5	8.9	16.2
10	4.5	16.2
15	24.6	6.2
20	33.7	22.1
25	14.1	17.2
30	14.2	22.1
35	0.4	16.2
40	1.3	16.5
45	13.4	16.8
50	0.9	16.4
55	26.1	7.8
60	9.5	16.2
65	0.9	0
70	14.2	18.1

Data Collected for experiment 5. Send and Receive rates.



Graphical Representation of data Collected for Experiment 5.

Figure 5.3.5.: Send and Receive Rate experiment No: 5.

Average Send Rate: - 11.90714 Kbps Average Receive Rate: - 14.857 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The Receive rate remained high in this experiment and had a very consistent result. At 66th second receive rate was 1 Kbps with a least transfer. At 20th second both receive rates and send rate were same at 14 Kbps. Send rate was fluctuating and at 13th 44th 56th 57th send rates were minimal and less than 1 Kbps. The receive rate was consistent from 20th to 65th second. The Average send rate was 11.907 Kbps and Receive rate was 14.857 Kbps.

5.2.6. Report for send and receive rate of video conferencing.

A set of five experiments was conducted to pursue the data transfers for send and receive rate during video conferencing. It is deduced that the data transfer was unreliable and varied at various intervals and during various times of the day. During the peak hours the performance was low compared to off peak hours. As the amount of data transfer increased the graph showed gradual decline. During video conferencing the amount of data transfer was low so the performance was better. The above experiments showed the data transfer rates and data varied in all the experiments showing the inconsistency of the data transfers. Some experiments were even performed on a higher bandwidth lines even then the quality of transfer did not have drastic results as the server on the other end did not have high quality lines.

The transfer rates varied from 6.478kbps to 11.907kbps for the send rate. The transfer of data varied the experiment at various times depending on the network traffic.

The transfer rates varied from 13.25kbps to 17.6kbps for the receive rate. The transfer of data varied the experiment at various times depending on the network traffic.

The graph showed a clear picture of how the performance varied during different times of the day depending on the data transfer and gave a clear feel of the data flow. All the above experiments were performed to determine the data send and retrieval rates and I was able to study the variation in the data rates.

Chapter 6

6. Experiments on Internet and its behavior

Title: To find the strength and behavior of the Internet

Aim: To find the Delay in receiving data during a videoconferencing session and the effects on different videoconferencing objects.

Introduction: As the amount of data to be receiving increases the delay for the transfer increases, they're by causing the delay in videoconferencing session. This experiment is involved most with the Retrieval time of data from the Internet. This pane gives the average time and the average retrieval rate by which we can predict the nature of the Internet.

6.1. Procedure:

Step: 1 Start a videoconferencing session, by starting class point software (both instructor and student) on 2 or more terminals and checking all the devices are working properly.

Select the view menu and find for summaries. Select the Throughput in the Summaries menu. A pop up screen appears with the details such as the Retrieval Time, percentage of Network delay, and the average retrieval rate.

6.2. Step: 2

For experiments on Audio All other applications such as Video, Chat and white board applications are to be closed down and only the Audio is tested to know the effect of the percentage of network delay caused and the variation in the retrieval time on Audio. A predefined text of matter is read on a node and the retrieval time and percentage of Network delay are noted down. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig 2.1. These graphs are checked for a consistent result.

6.3. Step: 3

For experiments on Video All other applications such as Audio, Chat and white board applications are to be closed and only the video is tested to know the effect of the Percentage of network delay caused and the variation in the retrieval time of video. A small session of videoconference is performed on a node and the Retrieval time and percentage of Network delay are noted down. On al the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at lest 5 time's and are plotted in a graph against the time. The data is noted in Fig 2.2. These graphs are checked for a consistent result.

6.4. Step: 4

For experiments on Chatting All other applications such as Audio, Video and white board applications are to be closed and only the Chat application is tested to know the effect of the speed limit factor of Chatting effect of the percentage of network delay caused and the variation in the retrieval time. As there is only transfer of text the effect may be less but to be more precise these experiments are considered. A small session of Chatting is performed on a node and the retrieval time and percentage of network delay are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in fig 2.3. These graphs are checked for a consistent result.

6.5. Step: 5

For experiments on White board Applications All other applications Such as Audio, Video and Chat applications are to be closed and only the white board Applications are to be tested to know the effect of the speed limit factor effect of the percentage of network delay caused and the variation in the retrieval time of white board applications. A small session of White board Applications is performed on a node and the retrieval time and percentage of Network delay are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig 2.4. These graphs are checked for a consistent result.

6.6. Step: 6

For experiments on Audio, video, Chat and white board applications All other applications such as Audio, Video and Chat applications are to be closed and only the white board applications are to be tested to know the effect of the percentage of network delay caused and the variation in the retrieval time and white board applications. A small session of white board applications is performed on a node and the retrieval Time and percentage of Network delay are noted down. On all the other nodes the receive speed and the throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig 2.4. These graphs are checked for a consistent result.

All the above graphs are studied to know effect of the send rate and receive rate on different videoconferencing objects.

Note: All the above experiment, are to be performed on machines with different configurations so that we can know the above effects with variation in different configurations.

6.6.1. Experiments conducted on Video Conferencing.

A set of five experiments have been conducted to study the data transfers during White board applications. These results help us in determining the strength of the data flow of the network. The results of the experiment have been tabulated and graphs have been generated to feel the flow of data.

Data transfer is tabulated using the send rate and receive rate over a period of time. I have the time period for each data transfer to be 5 seconds. Total time for the experiment took 70 seconds.

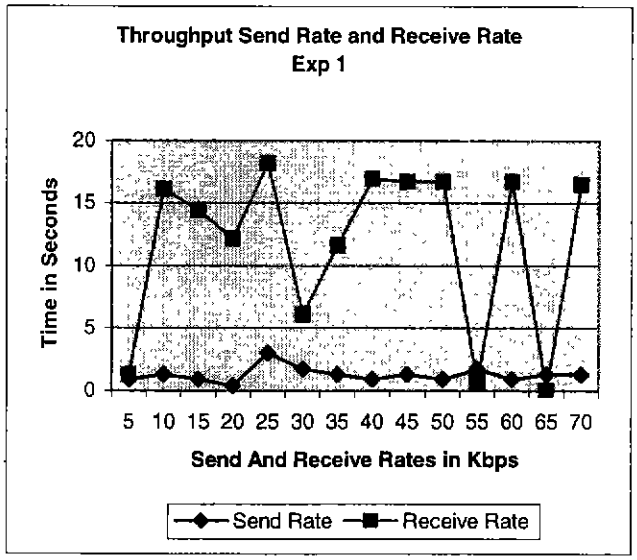
The results are then tabulated and the data is analyzed. I have used Microsoft Excel to generate the graphs. The data supplied in the table is used in excel and automated graphs are generated, giving us the better feel of data transfer.

Experiment 1 for Throughput Rates during chatting: 1.

Experiments conducted for Throughput rates during chatting. The Data represented below are for reading no 1.

Time	Send Rate	Receive Rate
5	0.9	1.3
10	1.3	16.1
15	0.9	14.4
20	0.4	12.1
25	3	18.2
30	1.7	6.1
35	1.3	11.6
40	0.9	16.9
45	1.3	16.7
50	0.9	16.7
55	1.7	0.7
60	0.9	16.7
65	1.3	0
70	1.3	16.5

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1.

Figure 6.1.1.: Throughput Rate experiment No: 1.

Average Send Rate: 1.271428571 Kbps Average Receive Rate: - 11.714285 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

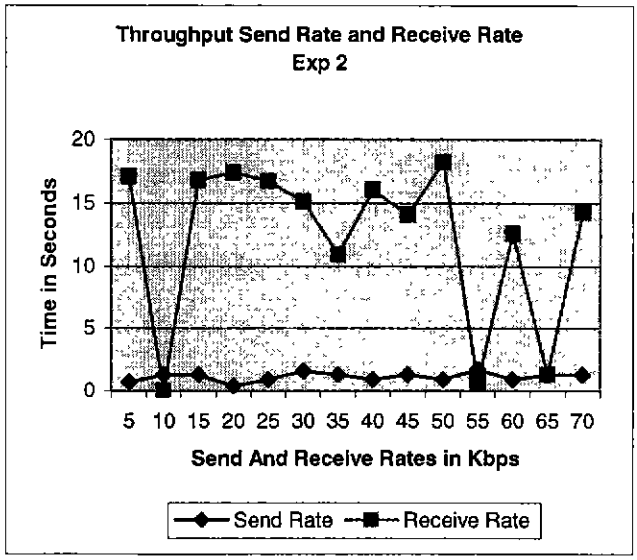
In this experiment the receive rates were much higher than the send rates. There were many fluctuations in the transfer level but the data transfer showed a powerful transfer of data. The send rate was very low and did not even rise till the 5 Kbps level and was less than 3 Kbps. The Receive rates reached up to 19 Kbps. The average send rate was 1.271 Kbps and the Average receive rate was 11.714 Kbps

Experiment 2 for Throughput Rates during chatting: 2.

Experiments conducted for Throughput rates during chatting.. The Data represented below are for reading no 2.

Time	Send Rate	Receive Rate
5	0.7	17.1
10	1.3	0
15	1.3	16.8
20	0.4	17.4
25	0.9	16.7
30	1.6	15.1
35	1.3	10.9
40	0.9	16
45	1.3	14.1
50	0.9	18.2
55	1.7	0.7
60	0.9	12.6
65	1.3	1.3
70	1.3	14.2

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2.

Figure 6.1.2.: Throughput Rate experiment No: 2.

Average Send Rate: 1.1281428571 Kbps Average Receive Rate: - 12.221428571Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

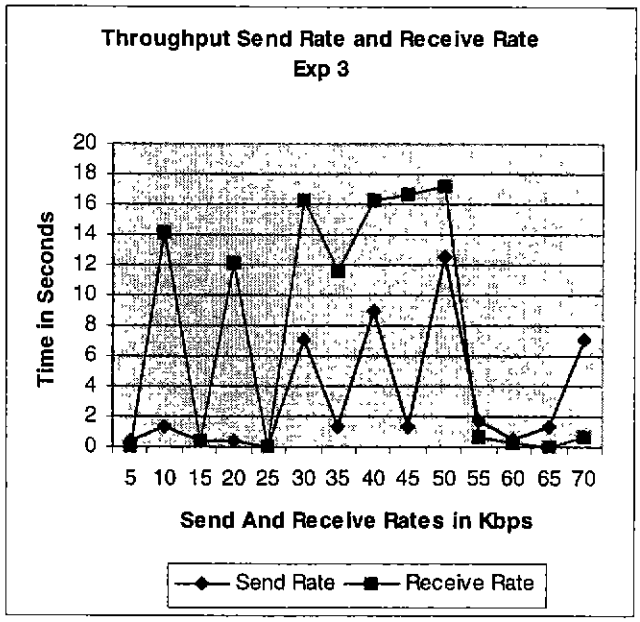
In this experiment the receive rates were much higher than the send rates. There were many fluctuations in the transfer level but the data transfer showed a powerful transfer of data. The send rate was very low and did not even rise till the 5 Kbps level and was less than 3 Kbps. The Receive rates reached up to 19 Kbps. The average send rate was 1.128 Kbps and the Average receive rate was 12.221 Kbps

Experiment 3 for Throughput Rates during chatting: 3.

Experiments conducted for Throughput rates during chatting.. The Data represented below are for reading no 3.

Time	Send Rate	Receive Rate
5	0.4	0
10	1.3	14.1
15	0.4	0.4
20	0.4	12.1
25	0	0
30	7.1	16.3
35	1.3	11.6
40	8.9	16.3
45	1.3	16.7
50	12.5	17.2
55	1.7	0.7
60	0.5	0.3
65	1.3	0
70	7.1	0.7

Data Collected for experiment 3. Send and Receive rates.



Graphical Representation of data Collected for Experiment 3.

Figure 6.1.3.: Throughput Rate experiment No: 3.

Average Send Rate: 3.157142857Kbps Average Receive Rate: - 7.6 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

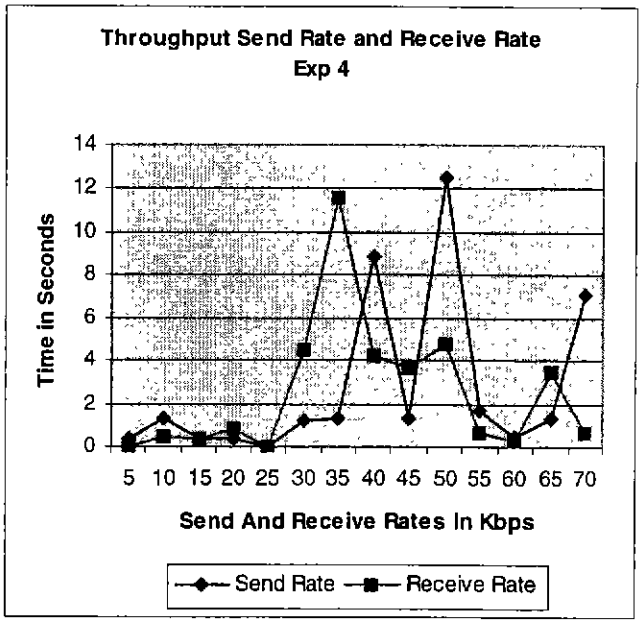
In this experiment the receive rates were much higher than the send rates. There were many fluctuations in the transfer level but the data transfer showed a powerful transfer of data. The send rate was very low and did not even rise till the 5 Kbps level and was less than 3 Kbps. The Receive rates reached up to 19 Kbps. The average send rate was 3.157 Kbps and the Average receive rate was 7.6 Kbps.

Experiment 4 for Throughput Rates during chatting: 4.

Experiments conducted for Throughput rates during chatting.. The Data represented below are for reading no 4.

Time	Send Rate	Receive Rate
5	0.4	0
10	1.3	0.5
15	0.4	0.4
20	0.4	0.8
25	0	0
30	1.2	4.5
35	1.3	11.6
40	8.9	4.2
45	1.3	3.6
50	12.5	4.8
55	1.7	0.7
60	0.5	0.3
65	1.3	3.5
70	7.1	0.7

Data Collected for experiment 4. Send and Receive rates.



Graphical Representation of data Collected for Experiment 4.

Figure 6.1.4. Throughput Rate experiments No: 4.

Average Send Rate: 2.735 Kbps Average Receive Rate: - 2.542Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

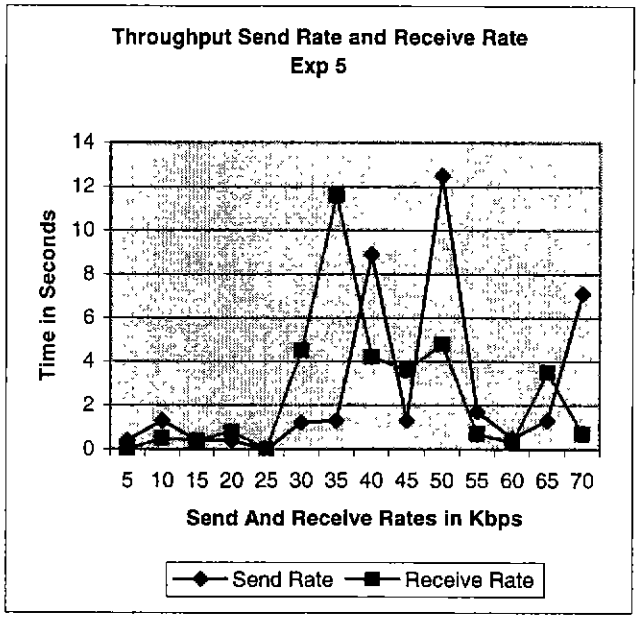
The results plotted for this experiment showed a very sharp graph. The send rate and receive rate of data transfers were well below 1 Kbps till the 30th second and started moving up form the 26th second the transfers will fluctuating at larger rates. From the 64th second mark the send rate started moving up trend where as the receive rate started showing down trend. The average send rate was 2.735 Kbps and the average receive rate was 2.542 Kbps.

Experiment 5 for Throughput Rates during chatting: 5.

Experiments conducted for Throughput rates during chatting.. The Data represented below are for reading no 5.

Time	Send Rate	Receive Rate
5	0.4	0
10	1.3	0.5
15	0.4	0.4
20	0.4	0.8
25	0	0
30	1.2	4.5
35	1.3	11.6
40	8.9	4.2
45	1.3	3.6
50	12.5	4.8
55	1.7	0.7
60	0.5	0.3
65	1.3	3.5
70	7.1	0.7

Data Collected for experiment 5. Send and Receive rates.



Graphical Representation of data Collected for Experiment 5.

Figure 6.1.5.: Throughput Rate experiment No: 5.

Average Send Rate: 2.735 Kbps

Average Receive Rate: - 2.542Kbps

Total time for experiment: - 70 Seconds

Maximum Modem Speed: - 52.0 Kbps

The results plotted for this experiment showed a very sharp graph. The send rate and receive rate of data transfers were well below 1 Kbps till the 30th second and started moving up form the 26th second the transfers will fluctuating at larger rates. From the 64th second mark the send rate started moving up trend where as the receive rate started showing down trend. The average send rate was 2.735 Kbps and the average receive rate was 2.542 Kbps.

6.7. Report for throughput of chatting:

A set of five experiments was conducted to pursue the data transfers for send and receive rate during chatting. It is deduced that the data transfer was unreliable and varied at various intervals and during various times of the day. During the peak hours the performance was low compared to off peak hours. As the amount of data transfer increased the graph showed gradual decline. During chatting the amount of data transfer was low so the performance was better.

The transfer rates varied from 1.27kbps to 6.57kbps for the send rate. The transfer of data varied the experiment at various times depending on the network traffic.

The transfer rates varied from 2.541kbps to 11.715kbps for the receive rate. The transfer of data varied the experiment at various times depending on the network traffic.

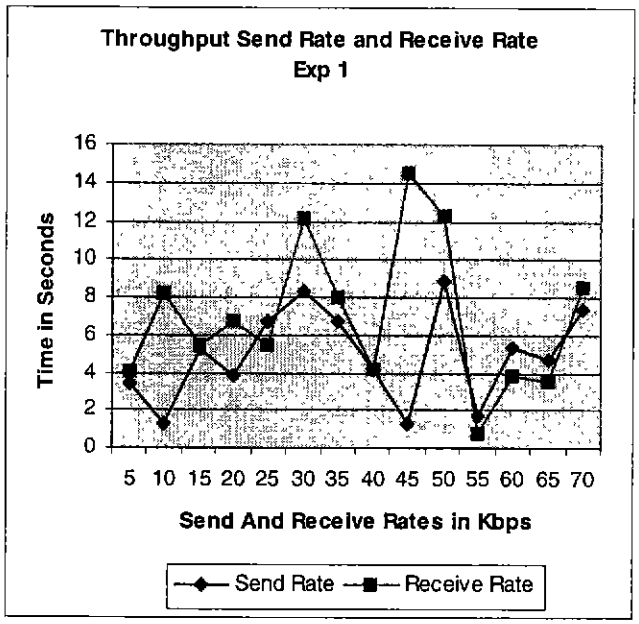
The graph showed a clear picture of how the performance varied during different times of the day depending on the data transfer and gave a clear feel of the data flow.

Experiment 1 for Throughput Rates during White board applications 1

Experiments conducted for Throughput rates during White board applications.. The Data represented below are for reading no 1.

Time	Send Rate	Receive Rate
5	3.4	4.1
10	1.3	8.2
15	5.2	5.4
20	3.8	6.7
25	6.7	5.4
30	8.3	12.2
35	6.7	8
40	4.2	4.2
45	1.3	14.5
50	8.9	12.3
55	1.7	0.7
60	5.3	3.8
65	4.7	3.5
70	7.4	8.5

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1.

Figure 6.2.1. Throughput Rate experiment No: 1.

Average Send Rate: 4.921Kbps Average Receive Rate: - 6.9642Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

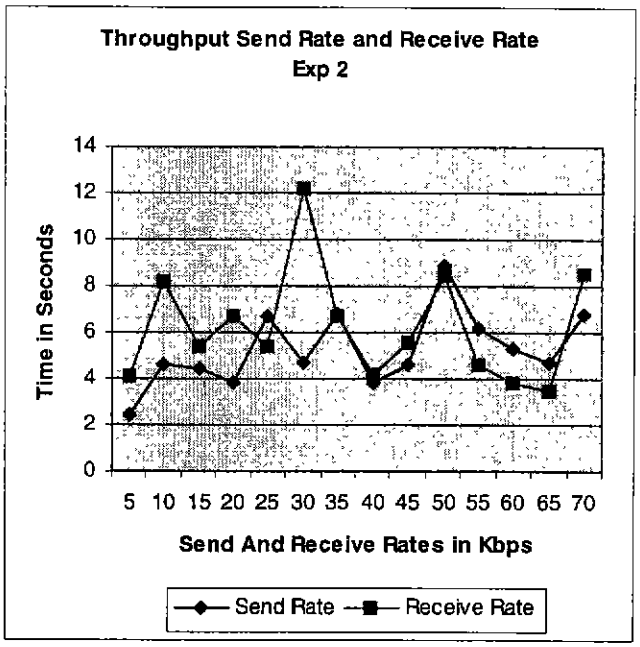
The maximum receive rate was 15 Kbps and the maximum send rate was 8 Kbps. The data transfer for both the send rate and receive rate was inconsistent and varied abruptly at various intervals of time. From the 56th second data transfers showed an up trend. The average receive rate was 6.964 Kbps and the average send rate was 4.921 Kbps.

Experiment 1 for Throughput Rates during white board application: 2.

Experiments conducted for Throughput rates during chatting.. The Data represented below are for reading no 1.

Time	Send Rate	Receive Rate
5	2.4	4.1
10	4.6	8.2
15	4.4	5.4
20	3.8	6.7
25	6.7	5.4
30	4.7	12.2
35	6.8	6.7
40	3.8	4.2
45	4.6	5.6
50	8.9	8.4
55	6.2	4.6
60	5.3	3.8
65	4.7	3.5
70	6.8	8.5

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2.

Figure 6.2.2. Throughput Rate experiment No: 2.

Average Send Rate: 5.2642Kbps. Average Receive Rate: - 6.23571Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

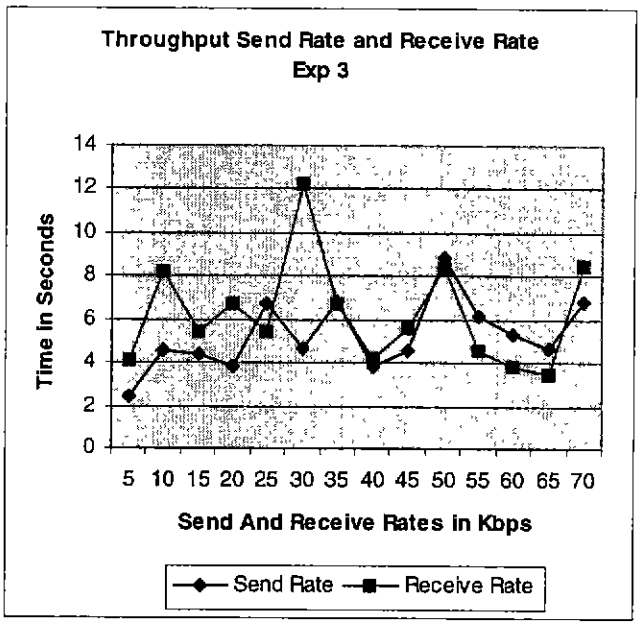
Both the receive rate and send rates were less than 9 Kbps of data transfer expect at the 35th second the receive rate went up to 12 Kbps. Both the receive rate and send rates were over lapping through out the series and showed an equal speeds of data transfers. The results showed an up trend from the 62nd second point. Overall the average Receive rate was 6.235 Kbps and the average send rate was 5.264 K bps.

Experiment 3 for Throughput Rates during White board applications: 3.

Experiments conducted for Throughput rates during chatting.. The Data represented below are for reading no 3.

Time	Send Rate	Receive Rate
5	2.4	4.1
10	4.6	8.2
15	4.4	5.4
20	3.8	6.7
25	6.7	5.4
30	4.7	12.2
35	6.8	6.7
40	3.8	4.2
45	4.6	5.6
50	8.9	8.4
55	6.2	4.6
60	5.3	3.8
65	4.7	3.5
70	6.8	8.5

Data Collected for experiment 3. Send and Receive rates.



Graphical Representation of data Collected for Experiment 3.

Figure 6.2.3. Throughput Rate experiment No: 3.

Average Send Rate: 5.264 Kbps. Average Receive Rate: - 6.2357 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

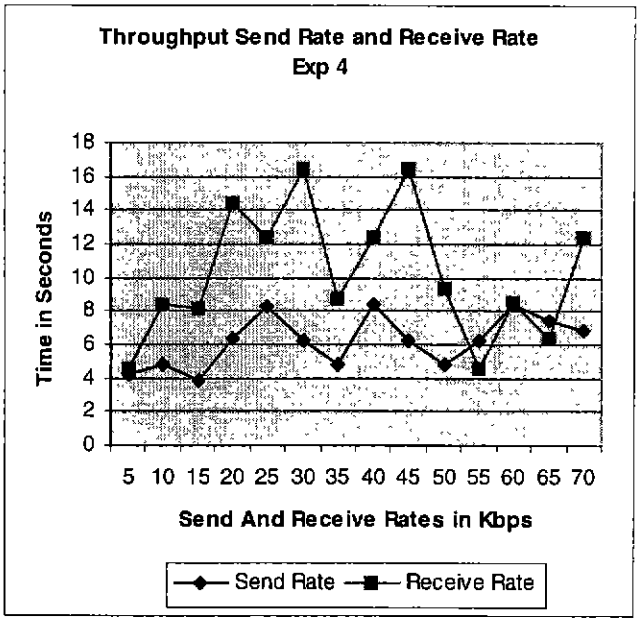
Both the receive rate and send rates were less than 9 Kbps of data transfer expect at the 35th second the receive rate went up to 12 Kbps. Both the receive rate and send rates were over lapping through out the series and showed an equal speeds of data transfers. The results showed an up trend from the 62nd second point. The average Receive rate was 6.235 Kbps and the average send rate was 5.264 K bps.

Experiment 4 for Throughput Rates during White board application: 4.

Experiments conducted for Throughput rates during White board applications. The Data represented below are for reading no 4.

Time	Send Rate	Receive Rate
5	4.2	4.6
10	4.8	8.4
15	3.8	8.2
20	6.4	14.4
25	8.3	12.4
30	6.2	16.4
35	4.8	8.8
40	8.4	12.4
45	6.2	16.4
50	4.8	9.4
55	6.2	4.6
60	8.4	8.5
65	7.4	6.4
70	6.8	12.4

Data Collected for experiment 4. Send and Receive rates.



Graphical Representation of data Collected for Experiment 4.

Figure 6.2.4. Throughput Rate experiment No: 4.

Average Send Rate: 6.192 Kbps. Average Receive Rate: - 10.2357 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

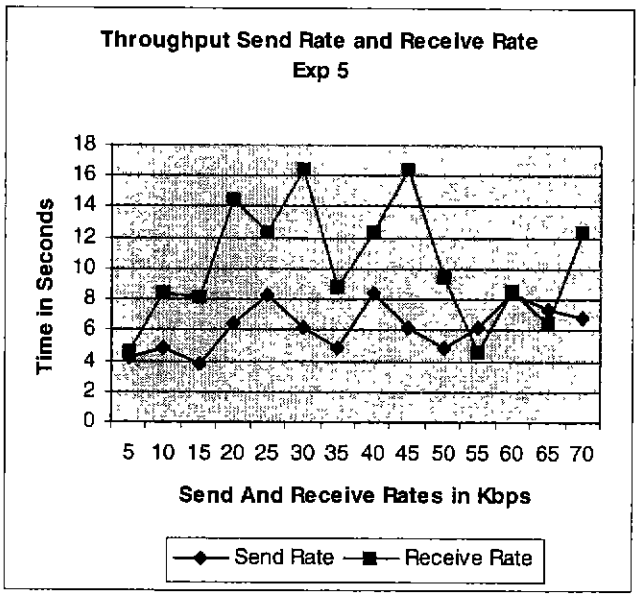
The receive rate showed a major data transfer and was transferring data between 5 to 16 Kbps, whereas the data sending rate was between 5 to 8 kbps. The data received moved rapidly and showed larger amounts of data received, whereas the data sent was consistent and showed significant levels of data transfer. The speeds of transfer of data were equal at the 7oth second at 8 Kbps. The average receive rate was. 10.235 Kbps and the average send rate was 6.192 Kbps

Experiment 5 for Throughput Rates during White board application: 5.

Experiments conducted for Throughput rates during White board applications. The Data represented below are for reading no 5.

Time	Send Rate	Receive Rate
5	4.2	4.6
10	4.8	8.4
15	3.8	8.2
20	6.4	14.4
25	8.3	12.4
30	6.2	16.4
35	4.8	8.8
40	8.4	12.4
45	6.2	16.4
50	4.8	9.4
55	6.2	4.6
60	8.4	8.5
65	7.4	6.4
70	6.8	12.4

Data Collected for experiment 5. Send and Receive rates.



Graphical Representation of data Collected for Experiment 5.

Figure 6.2.5. Throughput Rate experiment No: 5.

Average Send Rate: 6.192 Kbps. Average Receive Rate: - 10.2357 Kbps

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The receive rate showed a major data transfer and was transferring data between 5 to 16 Kbps, whereas the data sending rate was between 5 to 8 kbps. The data received moved rapidly and showed larger amounts of data received. Transfer of data was same at the 7oth second at 8 Kbps. The average receive rate was. 10.235 Kbps and the average send rate was 6.192 Kbps

6.8. Report for send and receive rate for throughput application:

A set of five experiments was conducted to pursue the data transfers for send and receive rate during white board application. It is deduced that the data transfer was unreliable and varied at various intervals and during various times of the day. During the peak hours the performance was low compared to off peak hours. As the amount of data transfer increased the graph showed gradual decline. During white board application the amount of data transfer was moderate so the performance was moderate.

The transfer rates varied from 4.924kbps to 6.190kbps for the send rate. The transfer of data varied the experiment at various times depending on the network traffic.

The transfer rates varied from 4.6352kbps to 10.235kbps for the receive rate. The transfer of data varied the experiment at various times depending on the network traffic

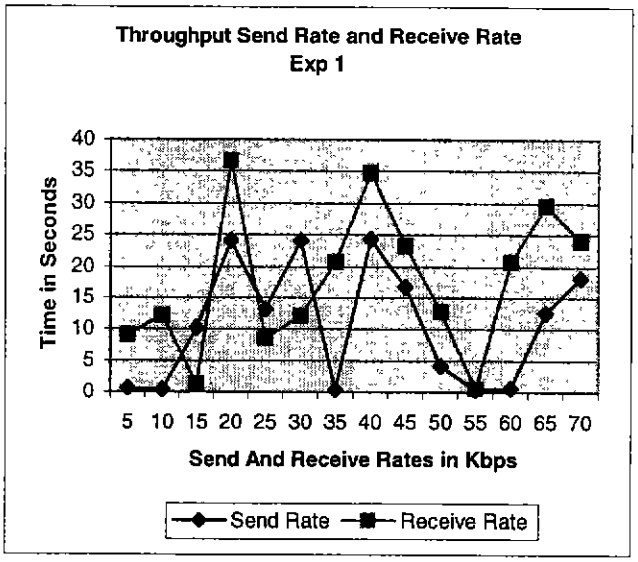
The graph showed a clear picture of how the performance varied during different times of the day depending on the data transfer and gave a clear feel of the data flow.

Experiment 1 for Throughput Rates during Video Conferencing: 1.

Experiments conducted for Throughput rates during Video conferencing. The Data represented below are for reading no 1.

Time	Send Rate	Receive Rate
5	0.6	9.1
10	0.3	12.2
15	10.2	1.2
20	24.1	36.7
25	13.2	8.6
30	24.1	12.1
35	0.3	20.7
40	24.3	34.8
45	16.7	23.3
50	4.1	12.8
55	0.3	0.5
60	0.6	20.7
65	12.6	29.6
70	18.2	24.1

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1.

Figure 6.3.1. Throughput Rate experiment No: 1.

Average Send Rate: 10.685 Kbps. Average Receive Rate: - 17.6 Kbps.

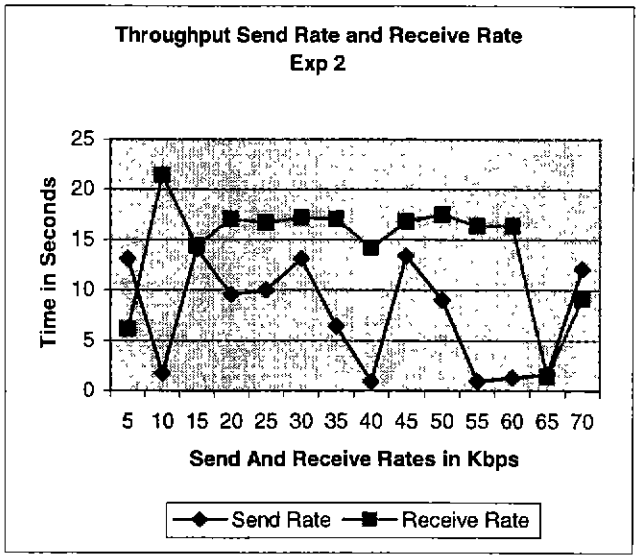
Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

Data transfers in this experiment showed high volumes of data being transferred from the server. The maximum receive rate reached the 36 Kbps of data transfer and was at the 0 kbps on only 2 instances i.e. at 20th and 56th second. Overall the send rate also showed powerful data transfers. The send rate reached the 25 Kbps transfer speed at 3 points. The average send rate was 10.685 Kbps and the receive rate was 17.6 Kbps.

Experiment 2 for Throughput Rates during Video Conferencing: 2.

Experiments conducted for Throughput rates during Video conferencing. The Data represented below are for reading no 2.

Time	Send Rate	Receive Rate
5	13.1	6.1
10	1.7	21.4
15	14.1	14.4
20	9.6	17.1
25	10	16.7
30	13.1	17.2
35	6.4	17.1
40	0.9	14.2
45	13.4	16.8
50	9	17.5
55	0.9	16.4
60	1.3	16.4
65	1.6	1.4
70	12.1	9.1



Data Collected for experiment 2. Send and Receive rates.

Graphical Representation of data Collected for Experiment 2.

Figure 6.3.2. Throughput Rate experiment No: 2.

Average Send Rate: 7.6571 Kbps. Average Receive Rate: - 14.4142Kbps.

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

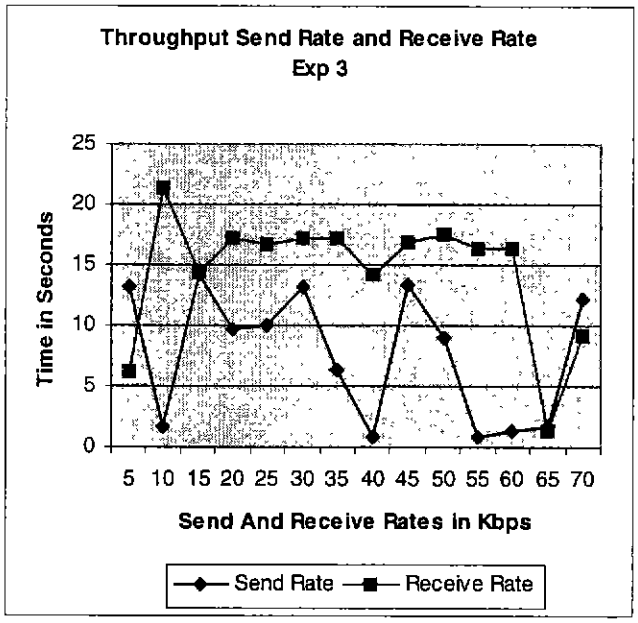
Data transfers in this experiment showed high volumes of data being transferred from the server. The maximum receive rate reached the 36 Kbps of data transfer and was at the 0 kbps on only 2 instances i.e. at 20th and 56th second. Overall the send rate also showed powerful data transfers. The send rate reached the 25 Kbps transfer speed at 3 points. The average send rate was 7.657 Kbps and the receive rate was 14.414 Kbps.

Experiment 3 for Throughput Rates during Video Conferencing: 3.

Experiments conducted for Throughput rates during Video conferencing. The Data represented below are for reading no 3.

Time	Send Rate	Receive Rate
5	13.1	6.1
10	1.7	21.4
15	14.1	14.4
20	9.6	6.4
25	10	16.7
30	4.5	17.2
35	6.4	17.1
40	0.9	14.2
45	5.5	11.2
50	9	17.5
55	0.9	16.4
60	1.3	16.4
65	1.6	1.4
70	12.1	9.1

Data Collected for experiment 3. Send and Receive rates.



Graphical Representation of data Collected for Experiment 3.

Figure 6.3.3. Throughput Rate experiment No: 3.

Average Send Rate: 7.6571 Kbps. Average Receive Rate: - 14.4142Kbps.

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

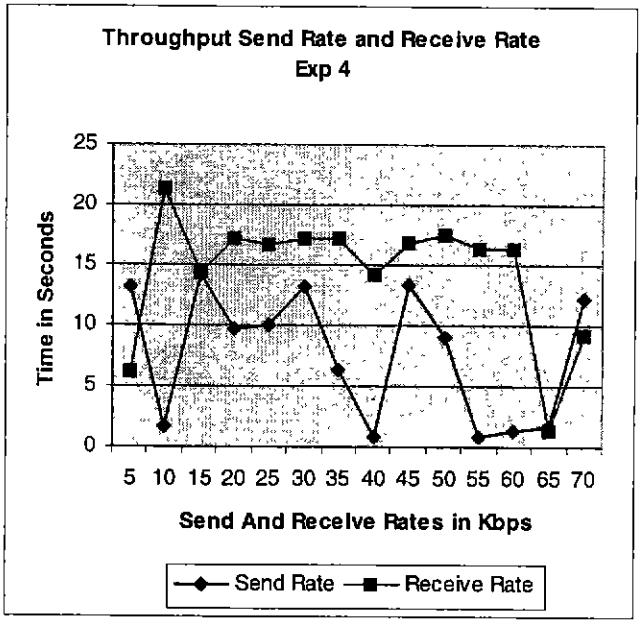
The maximum receive rate reached 21 Kbps and was consistent from 20th to 69th second in the range of 15 to 20 kbps. But latter fell down to 1 Kbps and later showed and up trend. Where as the data send an in consistent transfer of data being at less than 14 Kbps. The data send had abrupt changes and showed wide results when plotted on the graph. The average receive rate was 14.414 Kbps and the average send data was 7.657 Kbps.

Experiment 4 for Throughput Rates during Video Conferencing: 4.

Experiments conducted for Throughput rates during Video conferencing. The Data represented below are for reading no 4.

Time	Send Rate	Receive Rate
5	13.1	6.1
10	1.7	21.4
15	14.1	14.4
20	9.6	17.1
25	10	16.7
30	13.1	17.2
35	6.4	17.1
40	0.9	14.2
45	13.4	16.8
50	9	17.5
55	0.9	16.4
60	1.3	16.4
65	1.6	1.4
70	12.1	9.1

Data Collected for experiment 4. Send and Receive rates.



Graphical Representation of data Collected for Experiment 4.

Figure 6.3.4. Throughput Rate experiment No: 4.

Average Send Rate: 5.3471 Kbps. Average Receive Rate: - 11.34414Kbps.

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

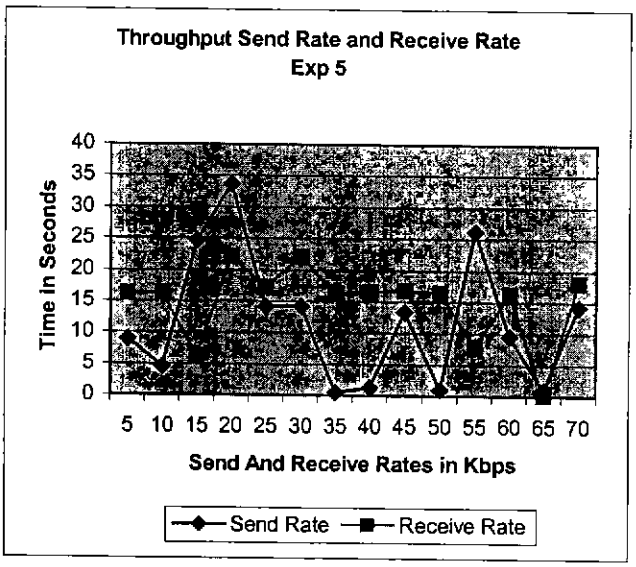
The maximum receive rate reached 21 Kbps and was consistent from 20th to 69th second in the range of 15 to 20 kbps. But latter fell down to 1 Kbps and later showed and up trend. Where as the data send an in consistent transfer of data being at less than 14 Kbps. The data send had abrupt changes and showed wide results when plotted on the graph. The average receive rate was 14.525 Kbps and the average send data was 7.7 Kbps.

Experiment 5 for Throughput Rates during Video Conferencing: 5.

Experiments conducted for Throughput rates during Video conferencing. The Data represented below are for reading no 5.

Time	Send Rate	Receive Rate
5	8.9	16.2
10	4.5	16.2
15	24.6	6.2
20	33.7	22.1
25	14.1	17.2
30	14.2	22.1
35	0.4	16.2
40	1.3	16.5
45	13.4	16.8
50	0.9	16.4
55	26.1	7.8
60	9.5	16.2
65	0.9	0
70	14.2	18.1

Data Collected for experiment 5. Send and Receive rates.



Graphical Representation of data Collected for Experiment 5.

Figure 6.3.5. Throughput Rate experiment No: 5.

Average Send Rate: 11.9071 Kbps. Average Receive Rate: - 14.8572Kbps.

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The maximum receive rate reached 21 Kbps and was consistent from 20th to 69th second in the range of 15 to 20 kbps. But latter fell down to 1 Kbps and later showed and up trend. Where as the data send an in consistent transfer of data being at less than 14 Kbps. The data send had abrupt changes and showed wide results when plotted on the graph. The average receive rate was 14.857 Kbps and the average send data was 11.907 Kbps.

6.9. Report of Throughput rate for video conferencing:

A set of five experiments was conducted to pursue the data transfers for send and receive rate during video conferencing. It is deduced that the data transfer was unreliable and varied at various intervals and during various times of the day. During the peak hours the performance was low compared to off peak hours. As the amount of data transfer increased the graph showed gradual decline. During video conferencing the amount of data transfer was low so the performance was better.

The transfer rates varied from 6.478kbps to 11.907kbps for the send rate. The transfer of data varied the experiment at various times depending on the network traffic.

The transfer rates varied from 13.25kbps to 17.6kbps for the receive rate. The transfer of data varied the experiment at various times depending on the network traffic.

The graph showed a clear picture of how the performance varied during different times of the day depending on the data transfer and gave a clear feel of the data flow.

Chapter 7

7. Experiments on CPU Load and its capabilities

Aim: To find the health of the Internet during a videoconferencing session and the effects on different Videoconferencing objects.

Introduction: As the amount of data to be transferred increases, the Load on the CPU increases and the number of operations performed will decrease once the load reaches 100%. To reduce the load on the CPU, some measures can be taken such as increasing the speed of the processor and increasing RAM.

7.1. Procedure:

7.1.1. Step: 1

Start a videoconferencing session, by starting class point software (both instructor and student) on 2 or more terminals and checking all the devices are working properly. Select the view menu and find for Details. Select My PC in the Details menu. A pop up screen appears with the details such as Health of the PC, CPU Load and the number of cache hits.

7.1.2. Step: 2

For experiments on Audio All other applications such as Video, Chat and white board applications are to be closed down and only the Audio is tested to know the effect of the Percentage of network delay caused and the variation in the retrieval time on Audio. A predefined text of mater is read on a node and the Retrieval time and percentage of Network delay are noted down. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 2 times and are plotted in a graph against the time. The data is noted in Fig3.1. These graphs are checked for a consistent result.

7.1.3. Step: 3

For experiments on video All other applications such as Audio, Chat and white board applications are to be closed and only the Video is tested to know effect of the percentage

of network delay caused and the variation in the retrieval time of Video. A small session of videoconference is performed on a node and the Retrieval Time and percentage of Network delays are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted for every 5 sec intervals for at least 20 readings. These experiments are repeated for at least 2 times and are plotted in a graph against the time. The data is noted in Fig 3.2. These graphs are checked for a consistent result.

7.1.4. Step: 4

For experiments on Chat All other applications such as Audio, Video and white board applications are to be closed and only the Chat application is tested to know the effect of the speed limit factor of chatting effect of the Percentage of network delay caused and the variation in the retrieval time. As there is only transfer of text the effect may be less but to be more precise these experiments are considered. A small session of chatting session is performed on a node and the Retrieval Time and percentage of Network delay are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 4-sec intervals for at least 20 readings. These experiments are repeated for at lest 2 times and are plotted in a graph against the time. The data is noted in Fig3.3. These graphs are checked for a consistent result.

7.1.5. Step: 5

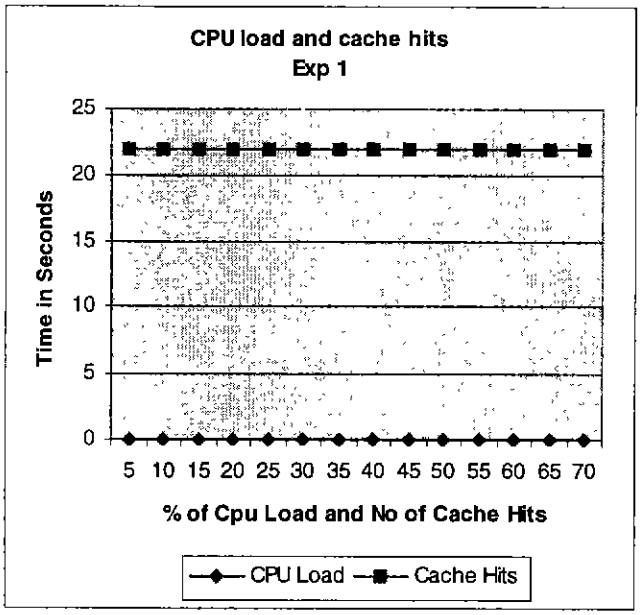
For experiments on white board applications All other applications such as Audio, Video and Chat applications are to be closed and only white board applications are to be tested. This experiment lets us know the effect of the speed limit factor effect of the percentage of network delay, caused and the variation in the retrieval time of white board application. A session of white board applications is performed on a node and the Retrieval time and percentage of Network delay are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 2 time's and are plotted in a graph against the time. The data is noted in Fig3.4. These graphs are checked for a consistent result.

Experiment 1 for CPU Load and Cache hits during chatting: 1.

Experiments conducted for CPU Load and the number of cache hits for experiments on Chatting. The Data represented below are for reading no 1.

Time	Percentage of CPU Load	Number of Cache hits
5	0	22
10	0	22
15	0	22
20	0	22
25	0	22
30	0	22
35	0	22
40	0	22
45	0	22
50	0	22
55	0	22
60	0	22
65	0	22
70	0	22

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1.

Figure 7.1.1. CPU Load and the number of cache hits experiment No: 1.

Average Percentage of CPU load = 0 %. Average Number of Cache hits = 22.

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

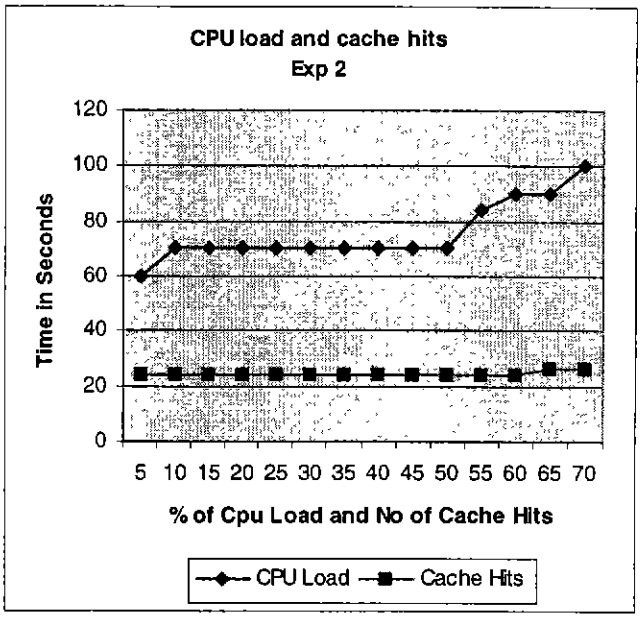
This experiment showed no load on the CPU as only one application was started and no load was put on the CPU. The average Load on the CPU remained at 0%. The number of cache hits remained contacts at 22 and showed a horizontal line on the graph. The average number of cache hits remained at 22 %.

Experiment 2 for CPU Load and Cache hits during chatting: 2.

Experiments conducted for CPU Load and the number of cache hits for experiments on Chatting. The Data represented below are for reading no 2.

Time	Percentage of CPU Load	Number of Cache hits
5	60	24
10	70	24
15	70	24
20	70	24
25	70	24
30	70	24
35	70	24
40	70	24
45	70	24
50	70	24
55	84	24
60	90	24
65	90	26
70	100	26

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2.

Figure 7.1.2. CPU Load and the number of cache hits experiment No: 2.

Average Percentage of CPU load = 75.285 %. Average Number of Cache hits = 24.285.

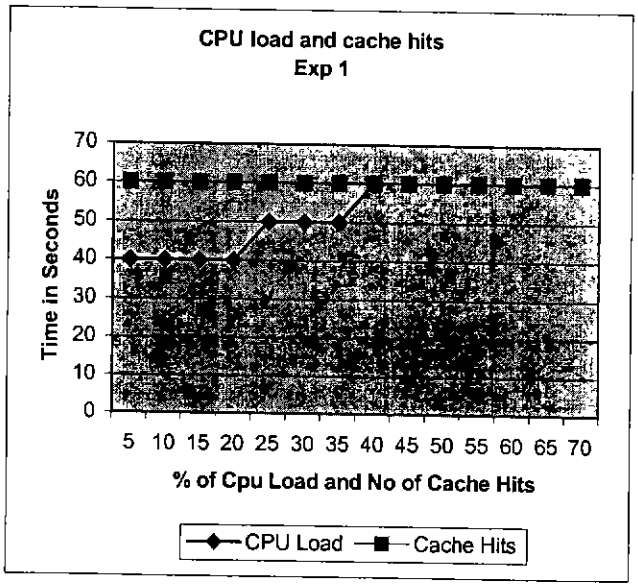
Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The load on the CPU started at 60 % and increased up to 70 % at 15th second and remained constant till 60th second. The Load on the CPU started increasing from the 60th second and showed an up trend. The average Load on the CPU was 75.285 %. The number of cache hit started at 24 and remained constant till 60th second and started to increase from there. The average number of Cache hits was 24.285.

Experiment 3 for CPU Load and Cache hits during White board applications: 3.

Experiments conducted for CPU Load and the number of cache hits for experiments on Chatting. The Data represented below are for reading no 1.

Time	Percentage of CPU Load	Number of Cache hits
5	40	60
10	40	60
15	40	60
20	40	60
25	50	60
30	50	60
35	50	60
40	60	60
45	60	60
50	60	60
55	60	60
60	60	60
65	60	60
70	60	60



Data Collected for experiment 3. Send and Receive rates.

Graphical Representation of data Collected for Experiment 3.

Figure 7.1.3. CPU Load and the number of cache hits experiment No: 3.

Average Percentage of CPU load = 52.142%. Average Number of Cache hits = 60.00.

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

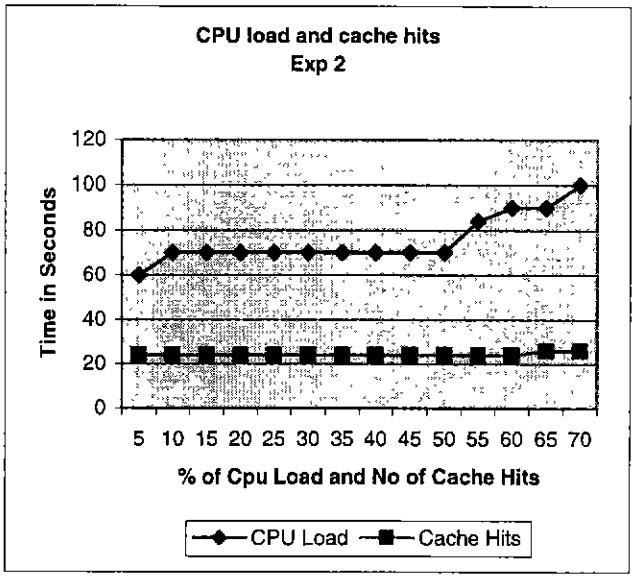
The Number of cache hit remained constant at 60 through out the experiment and the average number of cache hits is 60. The percentage of load on the CPU was constant of 40% till the 25th second the by started an up trend till the 50 % mark till the 50th second. The load on the CPU increased was constant from the 60th second and remained constant. The average load on the CPU was 52.142 %.

Experiment 4 for CPU Load and Cache hits during White board applications: 4.

Experiments conducted for CPU Load and the number of cache hits for experiments on Chatting. The Data represented below are for reading no 2.

Time	Percentage of CPU Load	Number of Cache hits
5	60	24
10	70	24
15	70	24
20	70	24
25	70	24
30	70	24
35	70	24
40	70	24
45	70	24
50	70	24
55	84	24
60	90	24
65	90	26
70	100	26

Data Collected for experiment 4. Send and Receive rates.



Graphical Representation of data Collected for Experiment 4.

Figure 7.1.4. CPU Load and the number of cache hits experiment No: 4.

Average Percentage of CPU load = 73.384 %. Average Number of Cache hits = 24.154

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

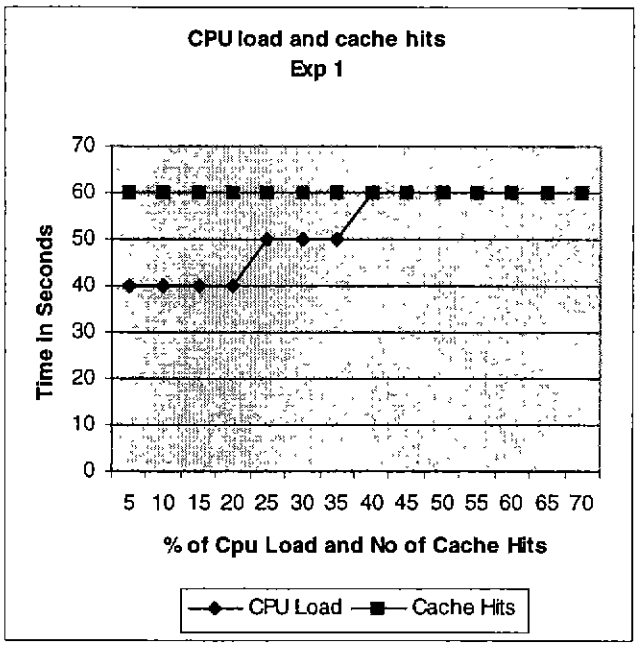
The CPU load started at 60 % and started increasing. The Load on the CPU was consistent at 65 %. At the 60th second showed increasing points on the graph. The average percentage of the load on the CPU was 73.38 %. Cache hits remained consistent and remained at 24 %. The average cache hit was 24.154.

Experiment 5 for CPU Load and Cache hits during Video Conferencing: 5.

Experiments conducted for CPU Load and the number of cache hits for experiments on chatting. The Data represented below are for reading no 1.

Time	Percentage of CPU Load	Number of Cache hits
5	40	60
10	40	60
15	40	60
20	40	60
25	50	60
30	50	60
35	50	60
40	60	60
45	60	60
50	60	60
55	60	60
60	60	60
65	60	60
70	60	60

Data Collected for experiment 5. Send and Receive rates.



Graphical Representation of data Collected for Experiment 5.

Figure 7.1.5. CPU Load and the number of cache hits experiment No: 5.

Average Percentage of CPU load = 52.142%. Average Number of Cache hits = 60.00.

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

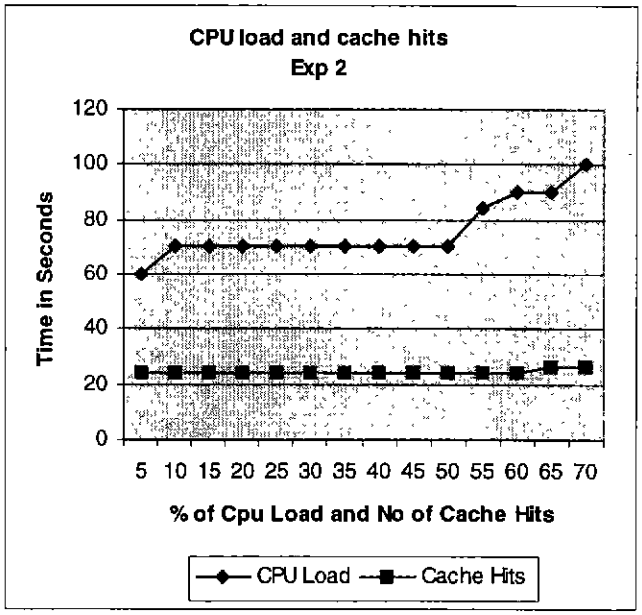
The Number of cache hit remained constant at 60 through out the experiment and the average number of cache hits is 60. The percentage of load on the CPU was constant of 40% till the 25th second the by started an up trend till the 50 % mark till the 50th second. The load on the CPU increased was constant from the 60th second and remained constant. The average load on the CPU was 52.142 %.

Experiment 6 for CPU Load and Cache hits during Video Conferencing: 6.

Experiments conducted for CPU Load and the number of cache hits for experiments on Chatting. The Data represented below are for reading no 2.

Time	Percentage of CPU Load	Number of Cache hits
5	60	24
10	70	24
15	70	24
20	70	24
25	70	24
30	70	24
35	70	24
40	70	24
45	70	24
50	70	24
55	84	24
60	90	24
65	90	26
70	100	26

Data Collected for experiment 6. Send and Receive rates.



Graphical Representation of data Collected for Experiment 6.

Figure 7.1.6. CPU Load and the number of cache hits experiment No: 6.

Average % of CPU load = 74.285 % of Average Number of Cache hits = 24.285

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The CPU load started at 60 % and started increasing. The Load on the CPU was consistent at 65 %. At the 60th second showed increasing points on the graph. The average percentage of the load on the CPU was 74.285 %. Cache hits remained consistent and remained at 24 %. The average cache hit was 24.285.

7.2. Report on CPU Load and cache Hits.

A detailed study for the effects of the load on CPU was performed. All the above experiments performed above helped in analysing the effect on the CPU. During experiments with chatting the load on the CPU and the number of cache hits hit were minimal compared to the experiments on the white board applications and video conferencing,

As the number of multimedia and video conferencing objects increased the load on the CPU and the number of cache hits showed impact there by slowing the performance of the video conferencing session and the performance of the computer also slowed down and the system also hanged unable to handle the load during these experiments.

Experiments were also performed on faster CPU and the experiments provided good results. The faster the CPU the better result was achieved and the Video conferencing session also showed better performance. The number of cache hits also reduced on performing experiments on faster computers. The RAM also played a key role; the optimized hardware for performing the video conferencing was a Pentium II with Intel or AMD (Advanced Micro Devices) with clock speed on at least 333 MHz and a RAM of 267 MB. This hardware up gradations provided better results by keeping the load on the CPU to the minimal and the number of cache hits also reduced.

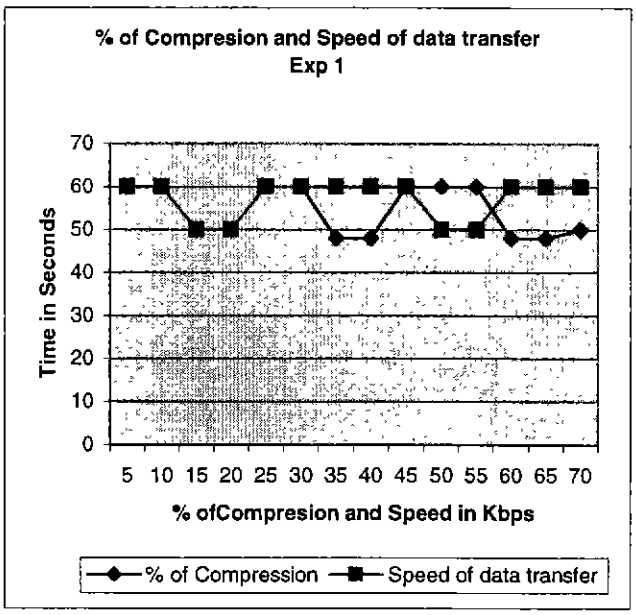
These experiments helped in understanding the effects of hardware on a video conferencing session in various environments.

Experiment 1 for Compression and Speed during chatting: 1.

Experiments conducted for Compression and Speed during chatting The Data represented below are for reading no 1.

Time	Percentage of Compression	Speed in Kbps
5	60	60
10	60	60
15	50	50
20	50	50
25	60	60
30	60	60
35	48	60
40	48	60
45	60	60
50	60	50
55	60	50
60	48	60
65	48	60
70	50	60

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1

Figure 8.1.1. Compression and Speed during chatting experiment No: 1

Average % of CPU load = 52.482 % of Average Number of Cache hits = 57.142

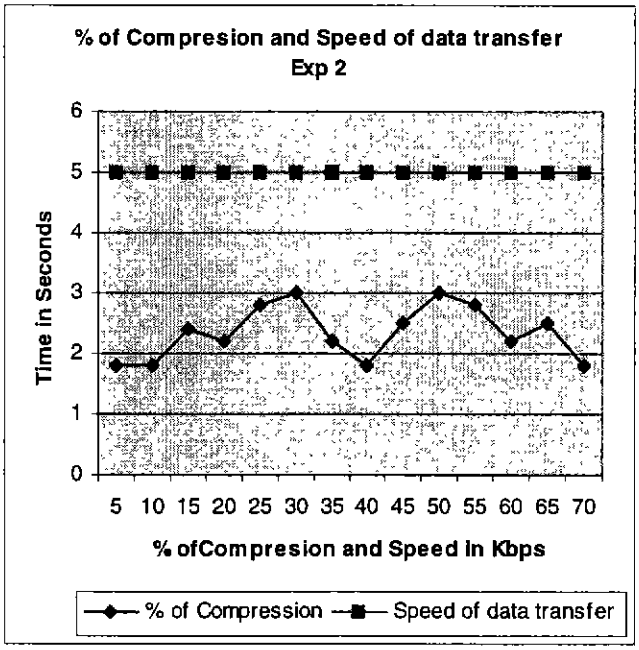
Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The Percentage of compression remained consistent and was between the 60 % and the 48 % range. The average speed of data transfer also remained consistent and moved between the 60 % and the 50 % range. The percentage of compression and the average speed of data transfer overlapped on several instances. The average percent of compression was 52.482 % and average speed of data transfer was 57.142%.

Experiment 2 for Compression and Speed during chatting: 2

Experiments conducted for Compression and Speed during chatting The Data represented below are for reading no 2

Time	Percentage of Compression	Speed in Kbps
5	1.8	5
10	1.8	5
15	2.4	5
20	2.2	5
25	2.8	5
30	3	5
35	2.2	5
40	1.8	5
45	2.5	5
50	3	5
55	2.8	5
60	2.2	5
65	2.5	5
70	1.8	5



Data Collected for experiment 2. Send and Receive rates.

Graphical Representation of data Collected for Experiment 2

Figure 8.1.2. Compression and Speed during chatting experiment No: 2

Average % of CPU load = 23.42% of Average Number of Cache hits = 50

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

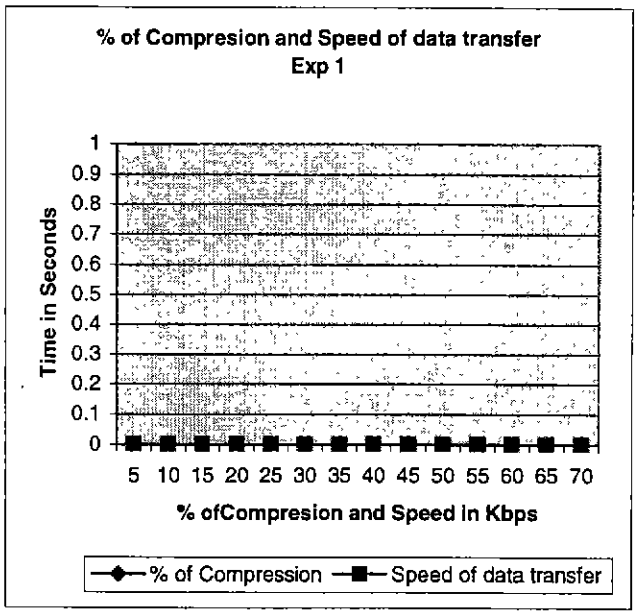
The Percentage of compression remained consistent and was between the 1 % and the 3 % range. The average speed of data transfer also remained constant at 5kbps. The percentage of compression and the average speed of data transfer overlapped on several instances. The average percent of compression was 2.348 % and average speed of data transfer was 50%..

Experiment 3 for Compression and Speed during White board applications: 3.

Experiments conducted for Compression and Speed during chatting The Data represented below are for reading no 3.

Time	Percentage of Compression	Speed in Kbps
5	0	0
10	0	0
15	0	0
20	0	0
25	0	0
30	0	0
35	0	0
40	0	0
45	0	0
50	0	0
55	0	0
60	0	0
65	0	0
70	0	0

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1

Figure 8.1.3. Compression and Speed during White board applications experiment No: 3

Average % of CPU load = 0 % of Average Number of Cache hits = 0

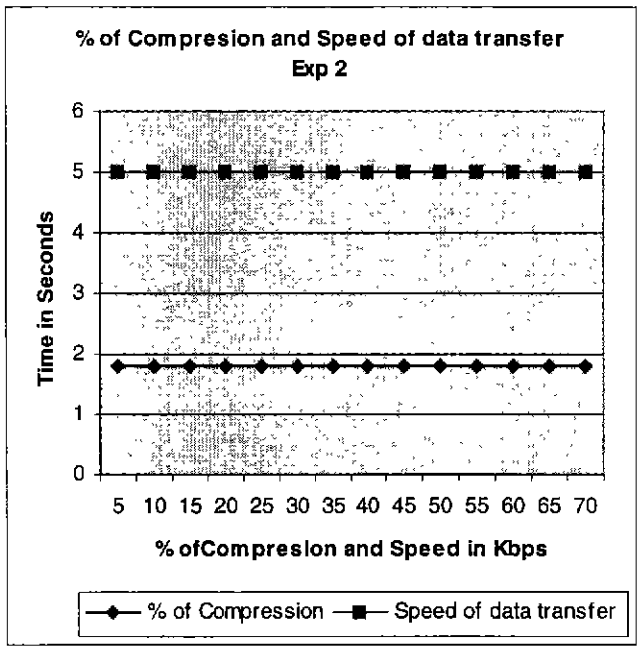
Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The average percentage of compression remained at 0% and average speed of data transfer also 0kbps. There was no data compression for this experiment since there was no data transfer.

Experiment 4 for Compression and Speed during White board applications: 4.

Experiments conducted for Compression and Speed during chatting The Data represented below are for reading no 2.

Time	Percentage of Compression	Speed in Kbps
5	1.8	5
10	1.8	5
15	1.8	5
20	1.8	5
25	1.8	5
30	1.8	5
35	1.8	5
40	1.8	5
45	1.8	5
50	1.8	5
55	1.8	5
60	1.8	5
65	1.8	5
70	1.8	5



Data Collected for experiment 4. Send and Receive rates.

Graphical Representation of data Collected for Experiment 4

Figure 8.1.4. Compression and Speed during White board applications experiment No: 3

Average % of CPU load = 18 % of Average Number of Cache hits = 50

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

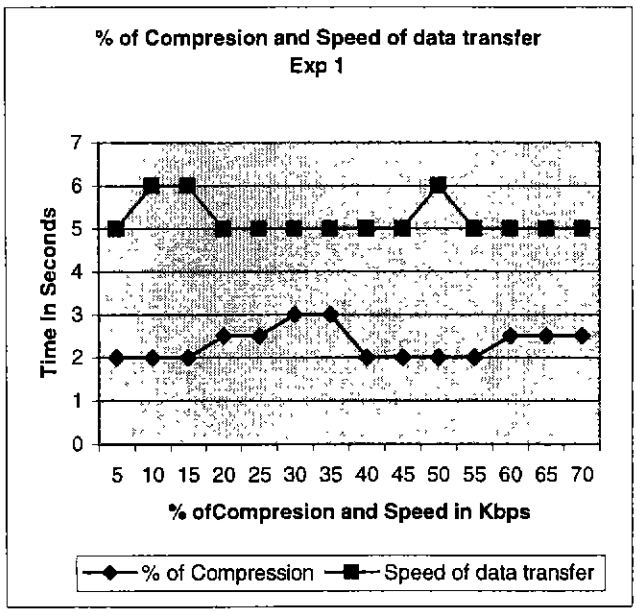
The percentage of speed remained constant at 1.8 Kbps and remained a constant line on the graph. The average speed of compression rate was 1.8 Kbps. The percentage of Speed also was constant at 50 %. The average percentage speed was at 50 %.

Experiment 5 for Compression and Speed during Video Conferencing 5.

Experiments conducted for Compression and Speed during chatting The Data represented below are for reading no 1.

Time	Percentage of Compression	Speed in Kbps
5	2	5
10	2	6
15	2	6
20	2.5	5
25	2.5	5
30	3	5
35	3	5
40	2	5
45	2	5
50	2	6
55	2	5
60	2.5	5
65	2.5	5
70	2.5	5

Data Collected for experiment 5. Send and Receive rates.



Graphical Representation of data Collected for Experiment 5

Figure 8.1.5. Compression and Speed during Video Conferencing experiment No: 1

Average % of CPU load = 23.21% Average Speed of Data Transfer = 52.14%

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

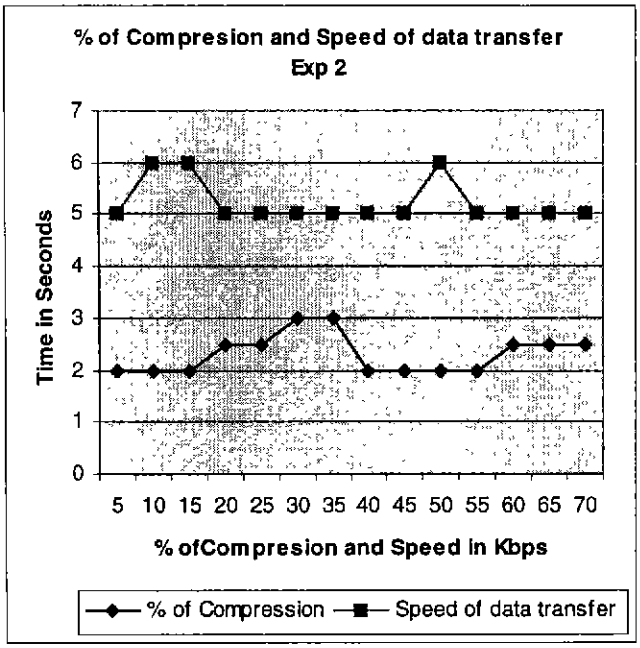
The rate of compression speed started at 2 kbps at the 20th second and over a period of time. At the 25th second started to increase and reached 2.5 kbps. The compression speed fell down to 2 kbps at the 45th second and remained consistent. At the 65th second raised to 2.2 kbps and remained consistent. The percentage of speed reached the maximum of 60 %. The percentage of speed was between 50 % to 0 %. The average speed was 52.30 %.

Experiment 6 for Compression and Speed during Video Conferencing 6.

Experiments conducted for Compression and Speed during chatting The Data represented below are for reading no 2.

Time	Percentage of Compression	Speed in Kbps
5	2	5
10	2	6
15	2	6
20	2.5	5
25	2.5	5
30	3	5
35	3	5
40	2	5
45	2	5
50	2	6
55	2	5
60	2.5	5
65	2.5	5
70	2.5	5

Data Collected for experiment 5. Send and Receive rates.



Graphical Representation of data Collected for Experiment 5

Figure 8.1.6. Compression and Speed during Video Conferencing experiment No: 1

Average % of CPU load = 23.21% Average Speed of Data Transfer = 52.14%

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

The rate of compression speed started at 2 kbps at the 20th second and over a period of time. At the 25th second started to increase and reached 2.5 kbps. The compression speed fell down to 2 kbps at the 45th second and remained consistent. At the 65th second raised to 2.2 kbps and remained consistent. The percentage of speed reached the maximum of 60 %. The percentage of speed was between 50 % to 60 %. The average speed was 52.30 %.

8.2. Report on Modem Capabilities.

Experiments were performed to study the effects of modem in a video conferencing session. Modem played a major role in a video conferencing session since it connects us to the external world. Dial up modems have limited performance.

The above experiments helped in analysing the effects video conferencing objects on the modem. During Chatting and white board application the effect on the modem was less due to the low data transfer rates, but with experiments on Video Conferencing the load on the modem was maximum. Experiments performed for modem capabilities showed a wide variety of results.

The compression rate was consistent. Experiments performed on a dial up connection showed a low result but experiments performed on fixed line showed a better performance. Cable modem and ADSL lines provide a better performance. ATM line gives us the best performance but is not widely available. 56 kbps (Dial Up) modems can be reasonable used for a video conferencing session over the Internet, but their performance is limited and cannot be used for Distance Education Sessions due to the lower capability. Cable modem's, ISDN lines or dedicate lined will help in real time distance education sessions.

The above experiments helped in analyzing the effects of video conferencing on the type of modem used.

Chapter 9

9. Experiments on strength of Internet Service Provider

Aim: To find the strength of the service provider during a videoconferencing session and the variation of data transfer on different Videoconferencing objects.

Introduction: This pane shows the delay, percentage of traffic, and indicated the health of the ISP these are History of delay attributed at the ISP, Estimated traffic conjunction level along the ISP path, and the overall health of the internet respectively. This pane gives information on the service provider.

9.1. Procedure:

Start a videoconferencing session, by starting class point software (both instructor and student) or 2 or more terminals and checking all the devices are working properly.

Select the view menu and find for Details. Select ISP in the Details menu. A pop up screen appears with the details such as Delay. Traffic and Health.

9.1.1. Step: 1

For experiments on Audio All other applications such as Video, Chat and white board applications are to be closed down and only the Audio is tested to know the effect of the Percentage of network delay caused and the variation in the retrieval time on Audio. A predefined text of matter is read on a node and the Retrieval Time and percentage of network delay caused and the variation in the retrieval time on Audio. A predefined text of matter is read on a node and the Retrieval Time and percentage of Network delay are noted down. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at lest 5 times and are plotted in a graph against the time. The data is noted in table below. These graphs are checked for a consistent result.

9.1.2. Step: 2

For experiments on Video All other applications Such as Audio, chat and white board applications are to be closed and only the Video is tested to know effect of the Percentage of network delay caused and the variation in the retrieval time of Video. A small session of videoconference is performed on a node and the Retrieval Time and percentage of Network delay are noted down. On all the other nodes the receive speed and the throughput are noted. These details are noted for every 5 sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig5.2. These graphs are checked for a consistent result.

9.1.3. Step: 3

For experiments on Chat All other applications Such as Audio, Video and white board applications are to be closed and only the Chat application is tested to know the effect of the speed limit factor of Chatting effect of the percentage of Network delay caused and the variation in the retrieval time. As there is only transfer of text the effect may be less but to be more precise these experiments are considered. A small session of Chatting session is performed on a node and the Retrieval time and percentage of Network delay are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in a graph against the time. The data is noted in Fig5.3. These graphs are checked for a consistent result.

9.1.4. Step: 4

For experiments on White board Applications All other applications such as Audio, video and Chat applications are to be closed and only white board applications are to be tested. This experiment lets us know the effect of the speed limit factor effect of the percentage of network delay, caused and the variation in the retrieval time of white board applications. A session of white board applications is performed and the Retrieval Time and percentage of Network delay are noted down. On all the other nodes the receive speed and the Throughput are noted. These details are noted in 5-sec intervals for t least 20 readings.

These experiments are repeated for at lest 5 times and are plotted in graph against the time. The data is noted in Fig4.4. These graphs are checked for a consistent result.

9.1.5. Step: 5

For experiments on Audio, Video, Chat and White board applications All other applications Such as Audio, Video and Chat applications are to be closed and only the white board Applications are to be tested to know the effect of the Percentage of network delay caused and the variation in the retrieval time of White board applications.

A small session of White board Applications is performed on a node and the Retrieval Time and percentage of Network delay are noted down. These details are noted in 5-sec intervals for at least 20 readings. These experiments are repeated for at least 5 times and are plotted in graph against the time. The data is noted in Fig 4.5 these graphs are checked for a consistent result.

All the above graphs are studied to know effect of the send rate and receive rate on different videoconferencing objects.

Note: All the above experiment, which is to be performed on machines with different configurations so that, we can know the above effects with variation in different configurations.

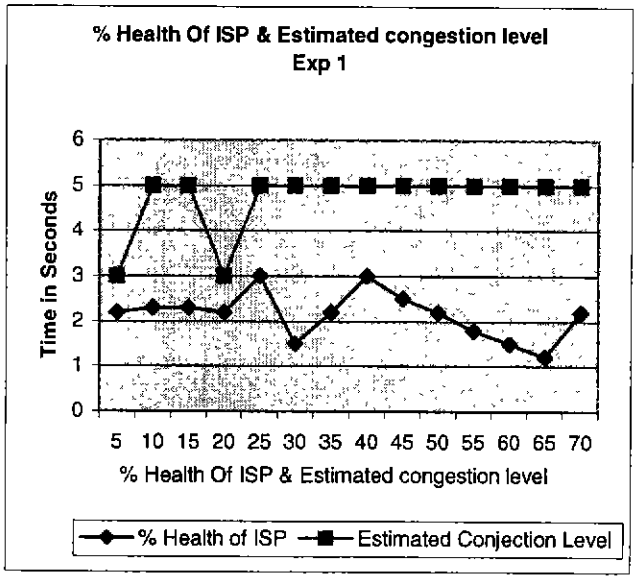
1. The above Experiments are to be repeated for both Internet and also Intranet and results are to be compared between both.

Experiment 1 for Speed of data Transfer during Chatting 1.

Experiments conducted for Percentage of Health of the Internet Service provided and the estimated level of congestion level during chatting The Data represented below are for reading no 1.

Time	Health of ISP (%)	Estimated congestion Level
5	2.2	3
10	2.3	5
15	2.3	5
20	2.2	3
25	3	5
30	1.5	5
35	2.2	5
40	3	5
45	2.5	5
50	2.2	5
55	1.8	5
60	1.5	5
65	1.2	5
70	2.2	5

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1

Figure 9.1.1. Speed of data Transfer during Chatting experiment No: 1

Average Compression rate = 2.14 Kbps Average Speed of Data Transfer = 46 %

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

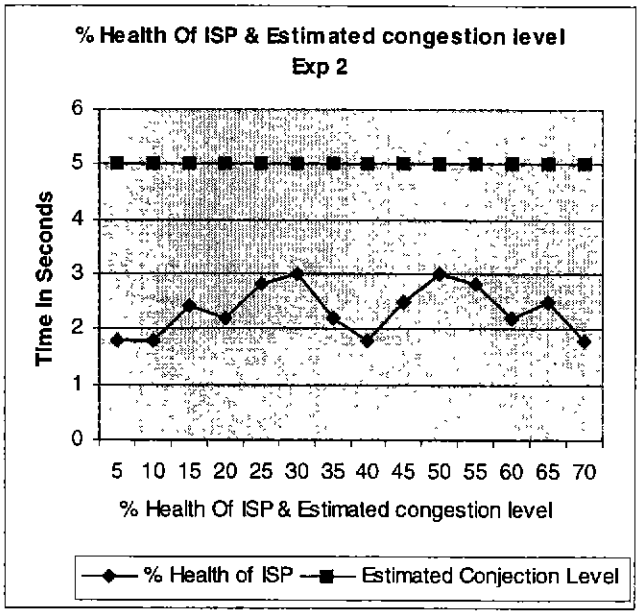
Compression rate remained under 3 Kbps and was not stable the maximum compression rate reached 3 Kbps at only 2 points i.e. at 17th and 47th seconds. Compression rate showed a steady decrease from the 45th second to 67th second and from 67th second started increasing. The average Compression rate was 2.14 Kbps and the average Percentage of Speed was 46. %

Experiment 2 for Speed of data Transfer during Chatting 2.

Experiments conducted for Percentage of Health of the Internet Service provided and the estimated level of congestion level during chatting The Data represented below are for reading no 2.

Time	Percentage of Compression	Speed in Kbps
5	1.8	5
10	1.8	5
15	2.4	5
20	2.2	5
25	2.8	5
30	3	5
35	2.2	5
40	1.8	5
45	2.5	5
50	3	5
55	2.8	5
60	2.2	5
65	2.5	5
70	1.8	5

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2

Figure 9.1.2. Speed of data Transfer during Chatting experiment No: 2

Average Compression rate = 2.38 Kbps Average Speed of Data Transfer = 50 %

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

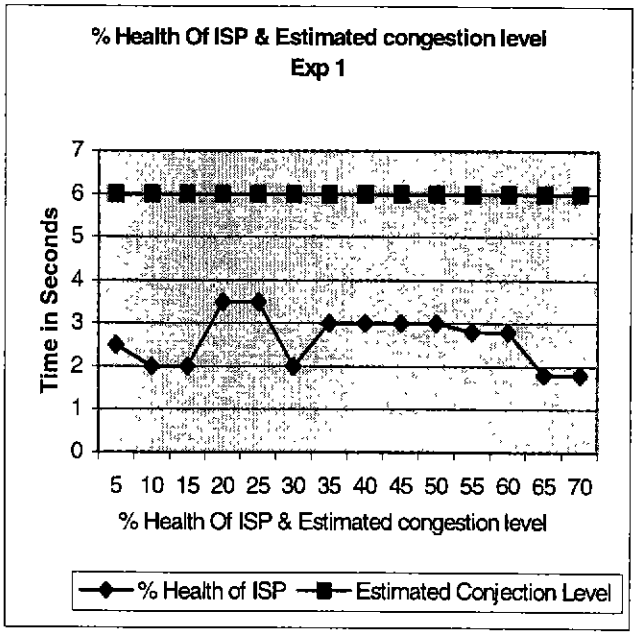
Percentage of Speed in this experiment remained constant at 50 percent and remained on the horizontal axis f the graph. The compression rate remained under 3 Kbps and reached the maximum of 3 Kbps at 30th and 55th second points. The average compression was 2.38 Kbps and the average percentage of speed was 50%

Experiment 1 for Speed of data Transfer during White board applications 1.

Experiments conducted for Percentage of Health of the Internet Service provided and the estimated level of congestion level during White board applications The Data represented below are for reading no 1.

Time	Percentage of Compression	Speed in Kbps
5	2.5	6
10	2	6
15	2	6
20	3.5	6
25	3.5	6
30	2	6
35	3	6
40	3	6
45	3	6
50	3	6
55	2.8	6
60	2.8	6
65	1.8	6
70	1.8	6

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1

Figure 9.2.1. Speed of data Transfer during White board applications experiment No: 1

Average Compression rate = 2.68 Kbps Average Speed of Data Transfer = 60 %

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

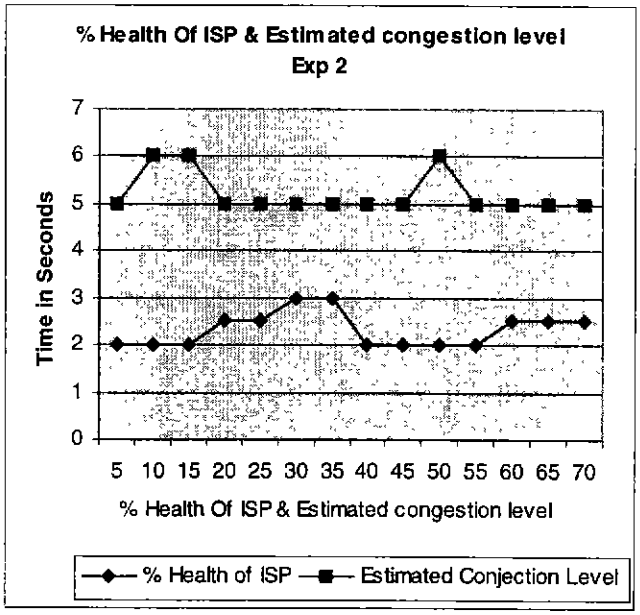
Percentage of Speed in this experiment remained constant at 6 percent and remained on the horizontal axis f the graph. The compression rate remained under 4 Kbps and reached the maximum of 3 Kbps at 20th second points. The average compression was 2.68 Kbps and the average percentage of speed was 60%

Experiment 2 for Speed of data Transfer during White board applications 2.

Experiments conducted for Percentage of Health of the Internet Service provided and the estimated level of congestion level during White board applications The Data represented below are for reading no 2.

Time	Percentage of Compression	Speed in Kbps
5	2	5
10	2	6
15	2	6
20	2.5	5
25	2.5	5
30	3	5
35	3	5
40	2	5
45	2	5
50	2	6
55	2	5
60	2.5	5
65	2.5	5
70	2.5	5

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2

Figure 9.2.2. Speed of data Transfer during White board applications experiment No: 2

Average Compression rate = 2.25 Kbps Average Speed of Data Transfer = 50 %

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

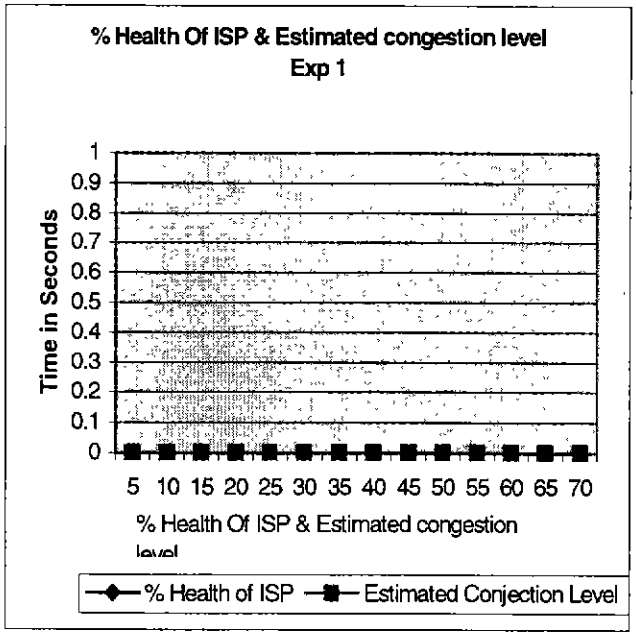
Compression rate varied at various intervals and started increasing at 17th second and again decreased to 2 Kbps at the 45th second and remained on the 2 Kbps line until 57th second. From 57th second increased to 2.5 kbps and remained constant. Percentage of Speed for this experiment did not remain constant, it started at 50 %.

Experiment 1 for Speed of data Transfer during Video conferencing 1.

Experiments conducted for Percentage of Health of the Internet Service provided and the estimated level of congestion level during Video conferencing The Data represented below are for reading no 1.

Time	Percentage of Compression	Speed in Kbps
5	0	0
10	0	0
15	0	0
20	0	0
25	0	0
30	0	0
35	0	0
40	0	0
45	0	0
50	0	0
55	0	0
60	0	0
65	0	0
70	0	0

Data Collected for experiment 1. Send and Receive rates.



Graphical Representation of data Collected for Experiment 1

Figure 9.3.1. Speed of data Transfer during Video conferencing experiment No: 1

Average Compression rate = 0 Kbps Average Speed of Data Transfer = 0 %

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

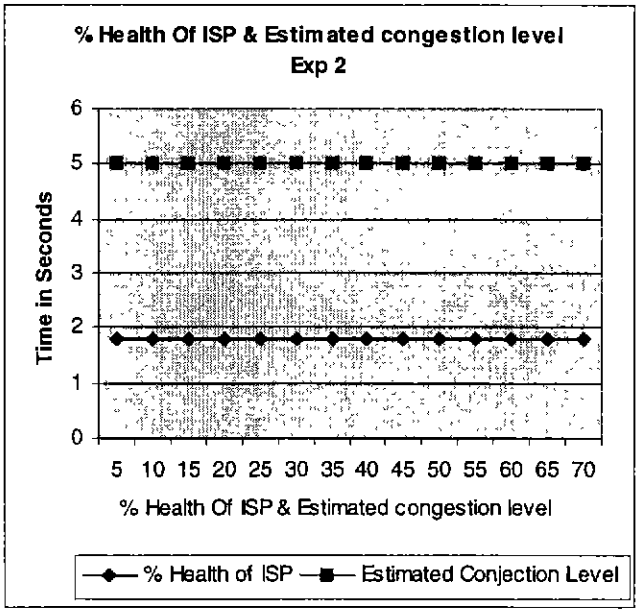
This experiment showed no effect on the compression rate and the percentage of Speed. The average compression rate and the percentage of speed remained at 0.

Experiment 2 for Speed of data Transfer during Video conferencing 2.

Experiments conducted for Percentage of Health of the Internet Service provided and the estimated level of congestion level during Video conferencing The Data represented below are for reading no 2.

Time	Percentage of Compression	Speed in Kbps
5	1.8	5
10	1.8	5
15	1.8	5
20	1.8	5
25	1.8	5
30	1.8	5
35	1.8	5
40	1.8	5
45	1.8	5
50	1.8	5
55	1.8	5
60	1.8	5
65	1.8	5
70	1.8	5

Data Collected for experiment 2. Send and Receive rates.



Graphical Representation of data Collected for Experiment 2

Figure 9.3.1. Speed of data Transfer during Video conferencing experiment No: 2

Average Compression rate = 1.8 Kbps Average Speed of Data Transfer = 50 %

Total time for experiment: - 70 Seconds Maximum Modem Speed: - 52.0 Kbps

This experiment showed average percentage of speed and compression rate were horizontal lines when plotted on the graph. The average compression rate was 1.8 Kbps and the average percentage of speed was 50 %.

9.2. Report on Internet Service provider

Experiments were performed to study the effects of Internet Service Provider in a video conferencing session. During the experiments with a dial up connection the performance of the video conferencing session was minimal when compared to a cable modem connection or a dedicated connection. Video conferencing also depends on the services provider depending on the number of connections it holds as the uplink is shared between the numbers of users connected to the line.

ISP plays a key role for a dial up connection. As the number of users linked to the ISP increases the performance of the Video conferencing Session decreases due to the sharing of bandwidth by the users. I have performed the experiments in various intervals and different times in a day. Video Conferencing Sessions performed in the off peak hours proved a better performance compared to peak hours. As there are a limited user on Cable modems and fixed lines the performances of these sessions has given better results.

For a dedicated line such as the broad band connection, the system can handle huge amounts of data transfers. Dial up connections are not feasible for a professional video conferencing sessions.

The above experiments helped in analyzing the nature of connection to the Internet and the performance on various type of connection in a video conferencing session.

10. Conclusions and future work.

I have performed the above experiments to determine the feasibility of distance education and video conferencing over the Internet, and have drawn the below conclusions. This chapter explains the details and conclusions drawn from the experiments that have been performed with net. Medic, Yahoo Messenger and Class point.

Send and Retrieval rates of data transfer play a major role and the above experiments prove the unpredictable nature of the Internet. I have performed some of the experiments using dialup connection and some on dedicated line. Experiments performed on dialup connections resulted in very poor performance and did not have consistency, since the rated of data transfer was limited and varied at different times in a day depending on the number of users sharing the lines at the Internet service provider. On the other hand dedicated lines had a better performance due to the availability of more bandwidth. But even these lines were not performing a real time data transfer due to a number of limitations. If we have a dedicated line for data transfers the amount of data transfers on both ends will be high and better transfer rates occur, giving us a high quality of video conferencing.

Modem Capabilities Experiments performed for modem capabilities showed a wide variety of results. The compression rate was consistent. Experiments performed on a dial up connection showed a low result but experiments performed on fixed line showed a better performance. Cable modem and ADSL lines provide a better performance. ATM line gives us the best performance but is not widely available. 56 kbps (Dial Up) modems can be reasonable used for a video conferencing session over the Internet, but their performance is limited and cannot be used for Distance Education Sessions due to the lower capability. Cable modem's, ISDN lines or dedicate lined will help in real time distance education sessions.

CPU The above experiments were performed on a Pentium II processor with a clock speed of 233 MHz and Pentium III 500Mhz. The performance on a Pentium II was slower and had a showed bottleneck when compared to a Pentium III processor. RAM (Random Access Memory) also played a key role. For a Real time Video Conferencing session high speed of Processor is suggested. Recently released Pentium IV with 1.4 GHz Speed from AMD (Advance Micro Devices) may revolutionize Video Conferencing over the Internet.

ISP (Internet Service Provider). ISP plays a key role for a dial up connection. As the number of users linked to the ISP increases the performance of the Video conferencing Session decreases due to the sharing of bandwidth by the users. I have performed the experiments in various intervals and different times in a day. Video Conferencing Sessions performed in the off peak hours proved a better performance compared to peak hours. As there are a limited user on Cable modems and fixed lines the performances of these sessions has given better results.

Network Monitoring Tools. Net. Medic is a very user friendly and easy to use tool, but did not provide much information regarding all the panes. It do not provide user details for a particular session the user has to take the readings manually and plot the reading for a particular sessions. Network monitoring tools have to be developed to get much accurate results.

Conclusions

The Project of Video Conferencing has enabled me to understand the network traffic and to understand varies types of protocols, which helps in establishing a video conferencing session.

Glossary

ABR	Available Bit Rate
ATM	Asynchronous Transfer Mode
BER	Bit Error Rate
CBR	Constant Bit Rate
CIF	ITU - T Common Intermediate Format (352 pixels x 288 lines)
DVC	Desktop Video Conferencing
ISDN	Integrated Service Digital Networks
ISO	International Standards Organization
ITU	International Telecommunication Union Telecommunication Sector
MIB	Management Information Base
NIC	Network Interface Card
PSTN	Public Switched Telephone Network
RSVP	Resource Reservation Protocol
SNMP	Simple Network Management Protocol
TCP/IP	Transmission Control Protocol/ Internet Protocol
TIA	Telecommunications Industry Association
TM	Traffic Management
UBR	Unspecified Bit Rate
UDP	User Datagram Protocol
UNI	User Network Interface
VBR	Variable Bit Rate.
VLAN	Virtual LAN

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