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Communication Performance Over A Gigabit Ethernet Network

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ABSTRACT :-
A present computing imposes heavy demands on the optical communication network. Gigabit Ethernet technology can provide the required bandwidth to meet these demands. However, it has also involve the communication Impediment to progress from network media to TCP(Transfer control protocol) processing. In this paper, present an overview of Gigabit per second Ethernet technology and study the end-to-end Gigabit Ethernet communication bandwidth and retrieval time. Performance graphs are collected using NetPipe in this clearly show the performance characteristics of TCP/IP over Gigabit Ethernet. These indicate the impact of a number of factors such as processor speeds, network adaptors, versions of the Linux Kernel or opnet softwar and device drivers, and TCP/IP(Internet protocol) tuning on the performance of Gigabit Ethernet between two Pentium II/350 PCs. Among the important conclusions are the marked superiority of the 2.1.121 and later development kernels and 2.2.x production kernels of Linux or opnet softwar used and that the ability to increase the MTU(maximum transmission unit) Further than the Ethernet standard of 1500 could significantly enhance the throughput reachable.

I. INTRODUCTION-

A computing, such as that possible with amount of computing power and communication resources available to huge scale applications. It is likely that the Integrated computing power of a cluster of Influential PCs connected to a high speed Ethernet network may exceed a stand-alone high performance the supercomputer. Running large scale parallel applications on a cluster (Impediment to progress) imposes massive demands on the communication Ethernet networks.

Therefore, in the early Since 1970's, one of the design for cluster computing was to limit the amount of communication between hosts. However, due to the features of some applications, a certain degree of communication may be required hosts. As a result, the performance hindrance to the flow of traffic jam (Impediment to progress) to the clear flow of of the network severely limited the potential of cluster computing.

Recent emerging high speed networks such as Asynchronous Transfer Mode (ATM),optical Fibre Channel (FC), and Gigabit Ethernet change the situation somewhat.

These high speed networks offer raw bandwidth ranges from 100 megabits per second (Mbps) to 1gigabit per second(Gbps) satisfying the communication needs of many parallel applications. However, the maximum obtained bandwidth at the application level is still far away for the theoretical peak bandwidth. This is the major Impediment to achieving high speed cluster communication is caused by the time required for the interaction between two software and hardware components.

In this paper, we discuss the communication performance reachable with a PC cluster connected by a Gigabit Ethernet network. Gigabit Ethernet is the third generation of technology and offers raw bandwidth of 1 Gbps . The focus of a work is to discuss the Gigabit Ethernet technology, to evaluate and examine the end-to-end communication latency and achievable bandwidth, and to monitor the effects of software and hardware components on the overall network performance . This paper is organized as follows. gives an overview of Gigabit Ethernet technology. In we describe the hardware and software test conditions. In the end-to-end TCP (Transport control protocol) communication characteristics are presented.

II. INTRODUCTION OF TOOL AND TESTING ENVIRONMENT NETWORK PARAMETERS :-

This section Explaines Hardware and software testing environment for the communication.

Hardware :- The experiments conducted to assess the communication latency and throughput were performed on a cluster of two Pentium II PCs running at 350MHz with 64MB 100MHz (PC100) SD-RAM. The PCs are connected back to back via Packet Engine GNIC-II Gigabit Ethernet adaptors installed in the 33MHz PCI slot. The machines are also connected together through an SVEC 5 port 10/100 Mbps autosensing/autoswitching hub via 3Com PCI 10/100 Mbps Ethernet Cards (3c905B). The machines are solitary from other network traffic. This is important for the accuracy of the tests. In later tests, we swapped the GNIC-II adaptors for Alteon ACEnic adaptors. In addition, several tests were performed using a Celeron processor running at 300 MHz with 66 MHz bus overclocked to 100MHz thus giving an effective processor speed of 450MHz.

Software :- The machines run RedHat Linux or opnet. Several versions of the opnet were installed and tested. The kernel version using in benchmarking will be indicated later in the performance graphs. The software program used to test the communication performance was NetPipe (version 2.1) [1]. NetPipe is a network performance analysis tool developed at Ames Laboratory. It provides accurate and useful information to exhibit the network performance for each different block size. This program can be obtained from. NetPipe increases the transfer of block size from a single byte to huge blocks up to transmission time exceeds 1 second. Specifically, for each block size c, three measurements are taken for block sizes $c-p$ bytes, c bytes and $c+p$ bytes, where p is a perturbation parameter with a default value of 3. This allows examination of block sizes that are might be tiny or huge than the internal network buffer.

NetPipe clearly shows the overhead associated with different protocol layers, in particular TCP(Transfer control protocol). NetPipe a also slightly modified locally to replace the read/write system calls with send/receiving system calls. This improved the strength (power) of the code with experimental drivers.

III. EFFICIENCY OF TOOLS AND NETWORK PARAMETERS:-

A TCP (Transfer control protocol) was originally design to provide a general conveyance protocol, it's not a default optimized for streams of data coming in and out of the system at high transmission rates (e.g 1Gbps). The RFC on TCP/IP (Internet protocol) Elongation for High Performance (RFC 1323) defines a set of TCP parameters to improve performance over large bandwidth _ delay paths and provide reliable operations a high speed paths. Systems that need to consent with RFC 1323 can be configured in the following ways:- Systems must use Path MTU Discovery specified in RFC 1191. It allows the largest possible packet size to be set, rather than the default of 512 bytes. _ The host systems must support RFC1323 "LargeWindows" Elongation to TCP. This RFC defines a set of TCP Elongation to improve performance in excess of large bandwidth linger paths and to provide reliable operation over high-speed paths.

A host system must be support large adequate socket buffers for reading and writing data to the network. Without RFC1323 "Large Windows", TCP/IP(Internet protocol) does not allow applications to buffer more than 64KB in the network, which is inadequate for almost all high speed paths.

The postpone product are linked to the application must be set and its send and receive socket buffer sizes (at both ends) to at least the bandwidth product of the link. application must set its send and receive socket buffer sizes (at both ends) to at least the bandwidth .

In addition, TCP may experience worst performance when multiple packets are lost from one window of data. With the limited information available from cumulative acknowledgments, a TCP sender can only learn about a single lost packet per round trip time. An hostile sender could choose to retransmit packets early, but such retransmitted segments may have already been successfully received. A Selective Acknowledgment (SACK) mechanism, combined with a selective repeat retransmission policy, can help to overcome these limitations. The receiving TCP sends back SACK packets to the sender informing the sender of data that has been received. The sender can then retransmit only the missing data segments. RFC 2018, TCP Selective Acknowledgments (SACK), is in the process of being standardized.

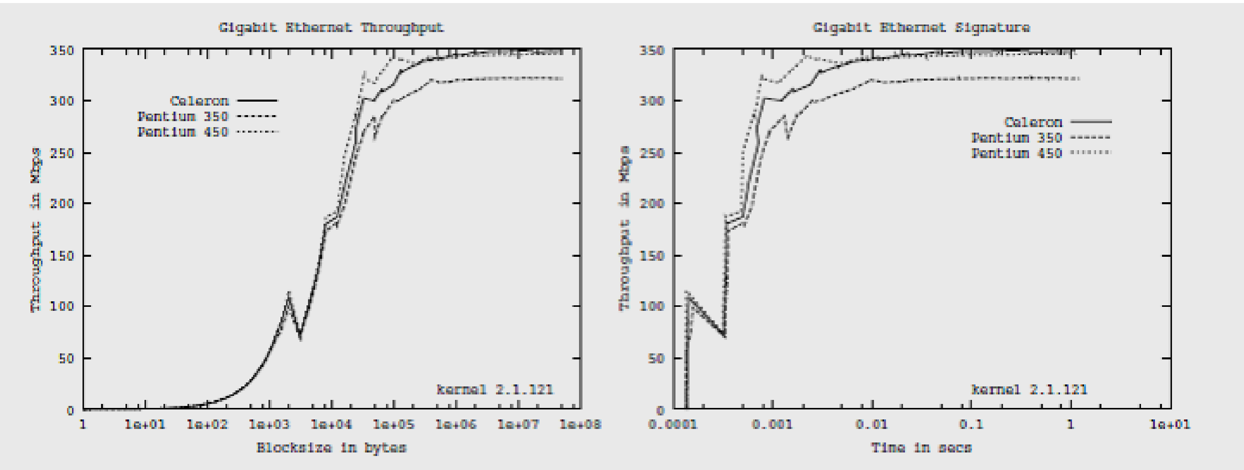
PROPOSE WORK ENHANCED CSMA/CD :- The MAC(medium access control) layer of Gigabit Ethernet uses the same CSMA/CD protocol as defined . As a result, the maximum network diameter used to connect nodes is limited by the CSMA/CD protocol. (10BaseT) defined the original CSMA/CD mechanism. This scheme ensures that all nodes are granted access to a physical media on a first come, first serve basis. The maximum network diameter in 10BaseT is limited to 2000 m. This distance limitation is due to the relationship between the time (also known as slot time) required to transmit a minimum frame of 64 bytes and have the ability to detect a collision (A limit known as propagation delay). When a collision occurs, the MAC(medium access control) layer detects it and sends a halt signal to cause the transmitting nodes to stop transmitting and enter a backoff phase prior to retrying transmission. When the defined 802.3u (100BaseT) in 1994, it maintained the Ethernet framing format and raised the speed limit to 100Mbit/s. As the bit rate increases, the time needed to transmit a frame is reduced by a factor of 10. This implies that the network diameter is slow decreased from 2000 m for 10BaseT to 200 m for 100BaseT A represents another tenfold increase in bit rate as likened with 100BaseT, the network diameter is further reduced by another factor of 10 . But, a network diameter of 20 m is clearly too short for most network configurations and is thus impractical. In addition, this distance is even less if linger in active components such as repeaters are considered. Moreover, with today's silicon technology, it is not yet feasible for vendors of repeater chips operating with a 25MHz clock to scale up to operate with a 250 MHz clock. As a consequence, the working committee redefined the MAC layer for Gigabit Ethernet and introduced a mechanism that will conserved the 200 m collision domain of 100BaseT. This is necessary because two nodes, which are 200 m apart, will not be able to detect a collision when both concurrently transmit a 64 byte-frame at gigabit speed. This inability to detect collisions will eventually lead to network instability. The mechanism to preserve the 200 m network diameter is known as carrier elongation. Carrier extension, developed by Sun Microsystems (California) is a way of maintaining minimum and maximum frame size with a meaningful network diameter. The resultant mechanism leaves the CSMA(carrier sence multiple access)/ CD(collision detection) algorithm unchanged. Carrier elongation increases the slot time to 512 bytes rather than the 64 bytes defined . If the frame is shorter than 512 bytes, then it is transmitted in a 512 byte window and the transmitted frame is padded a carrier elongations symbols.

Upon receipt of a frame carrying carrier elongation symbols, the entire extended frame is considered for collision and dropped if necessary. However, the Frame Check Sequence
(FCS) is calculated only on the original (without Carrier Elongation wastes bandwidth. For example, a small packet of 64 bytes will have 448 padding bytes of carrier elongation symbols. This clearly results in low throughput and an increased collision rate which may increase the number of lost frames. In fact, for a large number of small packets, the Gigabit Ethernet throughput is only marginally better than 100BaseT. To gain back some of the performance lost due to carrier elongation, NBase Communication (Chatsworth, California) proposed a solution known as packet bursting. It is essentially a modification to the carrier elongation procedure.

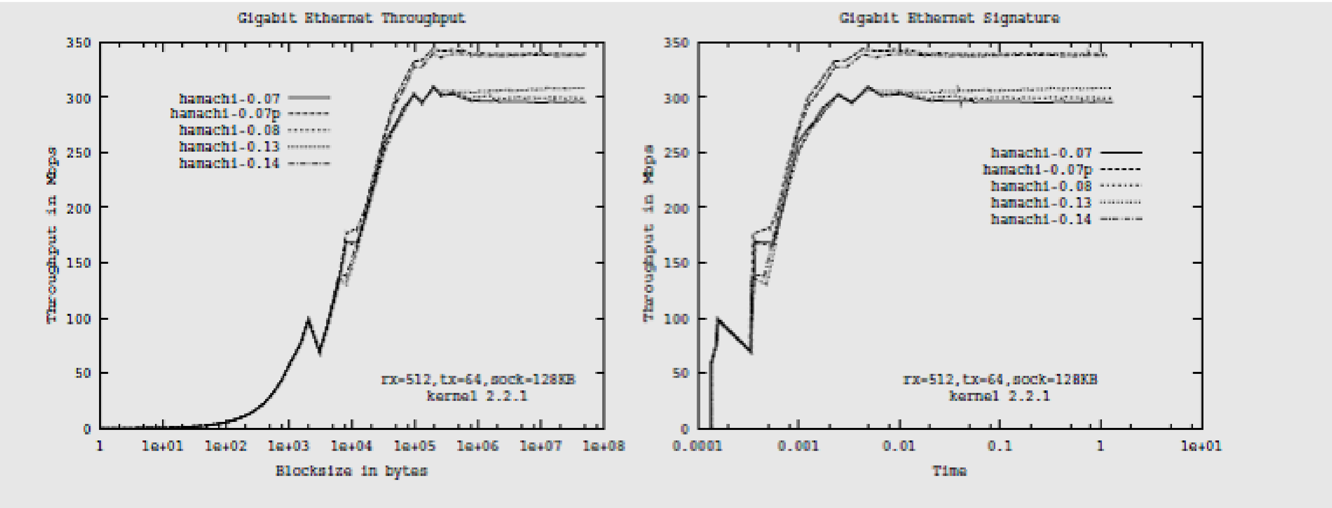
The idea is to transmit a burst of frames every time the first frame has successfully passed the collision window of 512 bytes. Carrier elongation is only applied to the first frame in a burst. This essentially averages the wasted time in the carrier elongation symbols over the few frames that are transmitted. Packet bursting substantially increases the throughput and does not change the dynamics of the CSMA/CD algorithm. It only slightly modified the existing MAC definition .

IV. PROCEDURE / COMPERISION OF WORK :-

Three types of processors were tested to see A processor speed effects the GNIC-II Gigabit Ethernet throughput and being hidden performance .



Processor Comparison: Throughput and Signature Graphs

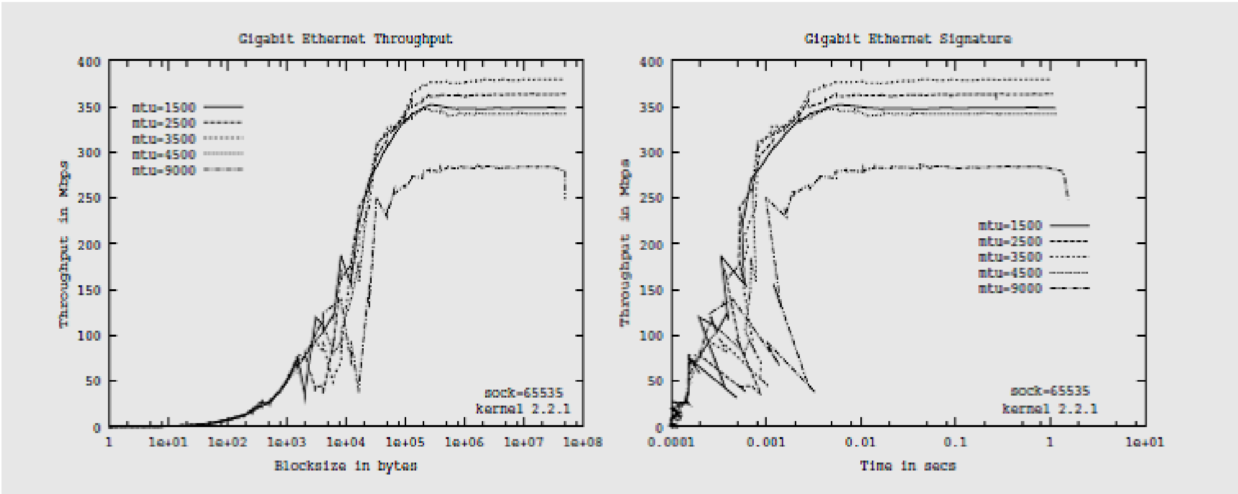


Hamachi Driver Comparison with TCP Socket Buffer of 128KB

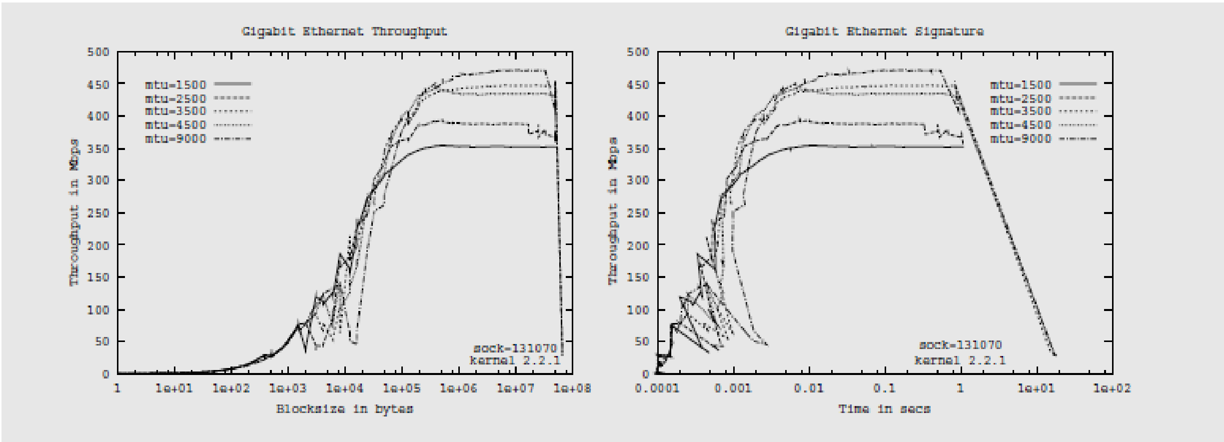
we see that faster processors can attain higher throughput for large transfer block sizes, that is blocks greater than 1MB. The maximum reachable throughput is approximately 348 Mbps for the Celeron and the Pentium II 450 and 320 Mbps for the Pentium II 350. This is largely due to the fact that faster processors can process the protocol stacks and calculate TCP checksums faster than the slower processors. Note that we are not obtaining the 29% increase in throughput to 411 Mbps which one would expect for a 450 MHz processor, if the processor speed were the only or dominant factor in attainable throughput. For transfer block sizes less than 4KB, the performance is approximately the same for all the processors tested. This is because the latency,approximately 139 seconds, is overbearingly the throughput for these smaller transfers. The experiment clearly shows that processor speed is a factor in Gigabit Ethernet network performance.

Driver Comparison :- In this section, we show results of experiments to determine how different versions of the Hamachi drivers affected performance. plots the throughput performance results using socket buffer size of 128KB. The corresponding signature graph is also plotted. Hamachi driver versions v0.07 and v0.08 were written by Donald Becker. Hamachi v0.13, v0.14, and v0.07p are all based on Donald Becker's Hamachi driver. Hamachi v0.13 and v0.14 were written by Eric Kasten. Hamachi v0.07p is written by Pete Wyckoff. In general, the later versions were created to enhance stability and strength rather than to increase throughput. However versions v0.14, and v0.07p support hardware check summing on the receiving side . Hamachi drivers, which support hardware check summing, have better performance as evidenced by the graphs. For example, incorporating hardware check summing in v0.07 raises the peak throughput from 280 Mbps for v0.07 to 320 Mbps for v0.07p. The latency, however, has remained consistent throughout all Hamachi drivers.

MTU Comparison :-



MTU Comparison with TCP Socket Buffer of 64KB

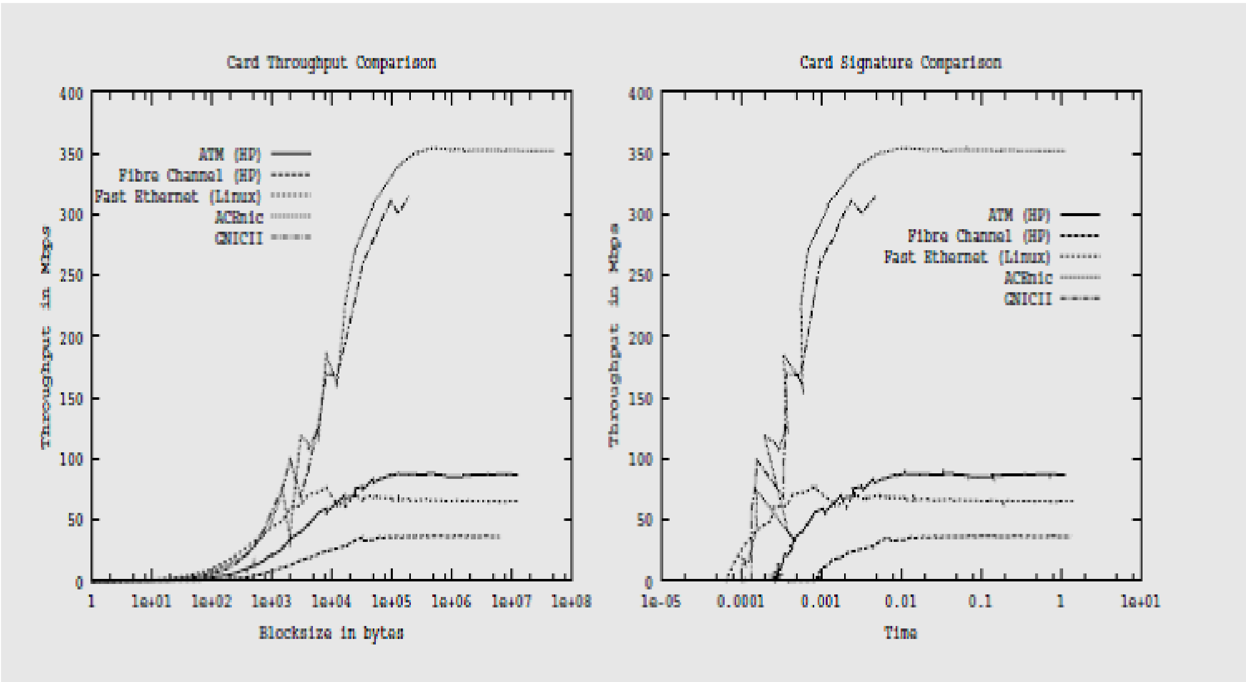


MTU Comparison with TCP Socket Buffer of 128KB

To preserve suitability with 10 Mbps and 100 Mbps Ethernet, the Gigabit Ethernet standard still limits the Maximum Transmission Unit (MTU), that is the maximum frame size that can be transmitted, to 1500 bytes. Standards bodies are reluctant to change this since, among other issues, they wish to avoid the complicated state in specifying how larger frames transitioning From networks with MTU greater than 1500 to ones with MTU of 1500 should be handled. This would be a fairly widespread transition if Gigabit Ethernet supported MTUs greater than 1500, the slower Ethernet standards not. One of the common uses for Gigabit Ethernet is expected to be in amassing on a gigabit link. An efficient implementation of Gigabit Ethernet with MTU greater than 1500 bytes would probably require switches to resegment Ethernet frames greater than 1500 bytes and recompute the checksums. This would Gigabit Ethernet would benefit from an MTU larger than 1500. This is an effect which has been noted for other high speed networks, such as FDDI, ATM [12] and Fibre Channel. In addition to improving the
throughput, one would expect that a larger MTU would also reduce the load on the CPU by reducing the number of frames, which would need to be processed for large message sizes. As a result of these factors, some companies, especially Alteon, have enhanced the Gigabit Ethernet functionality by adding a facility to support MTUs and hence frame sizes greater than 1500 bytes. Alteon coined the name Jumbo Frames for this functionality, and their network interface cards (NICs) and switches support Jumbo Frames of up to 9000 bytes To confirm these supposition about performance, we tested the Alteon ACEnic adaptor, using different MTU sizes. show the throughput using socket buffer sizes of 64KB and 128KB, respectively. There are three interesting supervision from these figures. The maximum achievable throughput is approximately 470 Mbps which is obtained using 128KB socket buffer size and MTU equal to 9000 bytes. However, for socket

buffer size equal to 64KB, the maximum obtainable throughput is only 380 Mbps and the optimal MTU is equal to 3500 bytes rather than 9000 bytes. These results confirm the supposition that large socket buffers and large MTU will give the better throughput. However, for socket buffer size less than or equal to 64KB, the maximum MTU should only be set to roughly 3500 bytes. In fact, for MTU greater than 3500 bytes, sending messages of size greater than 1MB using 64KB socket buffers will result in decreased performance The second observation is the effect of MTU(maximum transmission unit) on the decreased performance The second observation is the effect of MTU on the anomaly mention 3KB for 1500 bytes MTU starts to shift as we increase the MTU size heedless of socket buffer size. The third observation is the performance drop for block size greater than 64MB. This is not a ambush at all since . our machines are only equipped with 64MB of memory and thus we are seeing the bandwidth limitation of accessing virtual memory on disk rather than the limitation of network throughput. However, this observation further confirms that processor speed and memory will become network hindrance in a cluster connected via Gigabit Ethernet since it will be faster to access remote data through the network rather than local data on disk. also show the signature graphs for socket buffer sizes equal to 64KB and 128KB respectively. The retrieval time for a single byte ranges from 177_ to 248_ seconds for a 64KB socket buffer and from 169_ to 249_ seconds for a 128KB socket buffer.

HIGH SPEED NETWORK COMPARISON:-



Comparison of High Speed Networks

In this section, we will compare the performance of various high speed network technologies. Figure shows the comparison graphs. We remark that these are less systematically severe results, since the tests of ATM and Fibre Channel were performed on Hewlett-PackardC180 processor with 128 MB of memory rather than on the PCs used for the Gigabit Ethernet tests. From the figures, it is clear that the ACEnic adaptor has higher throughput and lower latency than the GNIC-II adaptor. In fact, ACEnic is about 11% higher in throughput and 15% lesser in latency than GNIC-II. From these figures, it is also clear that Gigabit Ethernet outperforms ATM,optical Fibre Channel and Fast Ethernet by an order of magnitude. However, Fast Ethernet has the lowest latency among these competing network technologies.

References:-

[1] Q.O. Snell, A.R. Mikler, and J.L Gustafson"Net-PIPE: Network Protocol IndependentPerformanceEvaluator", Ames Laborator Scalable ComputingLab.
[2] Gigabit Ethernet Alliance,"Gigabit EthernetOverview http:/www.gigabitethernet.org
[3] M. Mathis, J.Mahdavi, S. Floyd, A. Romanow,"TCP Selective Acknowledgment Options.
[4] Packet Engines,Gigabit Ethernet Networking with Full-Duplex Repeater Technology.http://www.packetengines.com/
[5] Gigabit Ethernet Alliance, "Gigabit Ethernet Over Copper", March, 2007. http://www.gigabitethernet.org/
[6] S. Elbert, et al, C. Csanady, "Gigabit Ethernet and Low-Cost Supercomputing".http://www.scl.ameslab.gov Publications/Gigabit/tr5126.html
[7] Berouz A Forouzan, "Data Communication Gigabit Ethernet Handbook", McGraw Hill vol 4.
[8] V. Paxson, M Allman, S. Dawson, W. Fenner, J. Griner, I. Heavens, K. Lahey, J. Semke, B. Volz ,"Known TCP Implementation Problems
[9] Switched,Fast and Gigabit Ethernet,Robert Breyer & Sean Riley.
[10] 10 Gigabit optical communication. http:// www.10gea.org
[11] IEEE 802.3an proposed in November 2002,10 BASE Is the latest proposed.
[12] Dec. 2006 Hewlett-pakard Development company,L.P. The Information Contained.
[13] IEEE802.3 CSMA/CD (ETHERNET).
[14] IEEEP 802.3ae 10GB/S Ethernet Task Force http://Standards.ieee.org/resorces/glace html
[15] IEEE 802.3-2005; part3: Carrier Sense Multiple Access with Collision Detection(CSMA/CD) Acess Method and Physical layer Specification.
[16] IEEE 802.3aq-Draft3.1;part:3 Carrier Sense Multiple Amendment: physical layer and management Parameters For 10GB/S Operation,type 10 G BASE-LRM
[17] CDT'S presentation Material on 10 Gigabit ETHERNET By C.T Diminico.
[18] 10 Gigabit Ethernet Cabling Considerations By C.T Diminco

AUTHOR INTRODUCTION:- Prof. Nitish Meena had been done his Graduation in B.TECH from Rajasthan techanical university, Kota (RTU).which is Affiliated from AICTE,New Delhi & post Graduation in M.TECH from (S.U), Rajasthan, Affilited From AICTE& U.G.C After that he is pursuing of Doctrate (Ph.D) Department of Eletronics & Communcation. In Pratap University ,jaipur (Rajasthan). He have three year teaching Experience in his field & recently Works as a vice-principal in SIET Engineering college,Lalsot(jaipur) And continuously researching in his field.