International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 02 Issue 04
April 2015

Relation between Interconnection Technologies for Cluster Computing

Anita Pruthi

PG Department Of Mathematics,

D.A.V College, Abohar-152116, INDIA

maths.anita@gmail.com

Cluster computers built from commodity processors are becoming the predominant super computer architecture because of their scalable performance and attractive price. Modern computing environments require low latency, high bandwidth and full time availability. This trend demands crash-safe operation, high level of safety, higher isolation and greater capacity to move data between processing nodes as well as between a processor node and I/O devices. To satisfy all the above-mentioned needs, various technologies have emerged in the era of cluster computing. In this paper, we have investigated various interconnection technologies used in cluster computing such as Giganet cLAN, InfiniBand, Myrinet, Gigabit Ethernet. Further a comparative study has been performed based on different criteria.

Keywords: Cluster Computing, Bandwidth, Latency.

I. INTRODUCTION

When people speak about piles of PCs, the first thing that comes to mind is a cluttered computer room with processors, monitors and snarls of cables all around. Collection of computers has become more sophisticated than in the early days [1]. Today clusters have replaced traditional super computers. As the need of processing power for solving problems is growing day by day, cluster computing is emerging very fast.

The performance of parallel applications running on the clusters depend s on the implementation of the nodes and the LAN or SAN that acts as the communication system [2]. Modern computing environments require low latency, high bandwidth and full time availability. This trend demands crash-safe operation, high level of safety, higher isolation and greater capacity to move data between processing nodes as well as between a processor node and I/O. Clusters need to incorporate fast Interconnection technologies in order to support high bandwidth and low latency inter-processor communication between cluster nodes. Today, improved network technologies help realize the construction of more efficient clusters [3].

The rest of the paper is organised as follows: Section II describes Gigabit Ethernet, Section III describes the interconnect Giganet cLAN, Section IV and V elaborate the interconnection

technologies InfiniBand and Myrinet. In Section VI, comparison of these interconnects in terms of bandwidth and latency is shown. The conclusion is made in Section VII.

II. GIGABIT ETHERNET

Ethernet has been the main component in clustering technology since the very beginning; Gigabit Ethernet is still popular because it is "everywhere". Since its introduction in 2002, 10 Gigabit Ethernet (10GbE) over fiber media has proved itself as a high-bandwidth, Low-latency solution. Multiple Gigabit Ethernet ports can be found on almost every server motherboard. Also the people feel Ethernet technology convenient. It is also inexpensive so that user can consider using it on cluster Gigabit Ethernet also has the ability to offer wide functionality, increased performance, and at the same time reduced cost [4]. Its use may not fit everyone's needs. Those who want a simple cluster with minimal configuration, this is the best. Also the case of implementing a 10-GbE cluster is perhaps what is more attractive [4]. The data-intensive environments demand 10GbE performance. We can find it in digital filmmaking, especially in the areas of animation and special effects.

Name	Medium	Specified distance
1000BASE-CX	Shielded balanced copper cable	25 meters
1000BASE-KX	Copper backplane	1 meter
1000BASE-SX	Multi-mode fiber	220 to 550 meters dependent on fiber diameter and bandwidth
1000BASE-LX	Multi-mode fiber	550 meters
1000BASE-LX	Single-mode fiber	5 km
1000BASE-LX10	Single-mode fiber using 1,310 nm wavelength	10 km
1000BASE-EX	Single-mode fiber at 1,310 nm wavelength	40 km
1000BASE-ZX	Single-mode fiber at 1,550 nm wavelength	70 km
1000BASE-BX10	Single-mode fiber, over single-strandfiber:1,490 nm downstream1,310 nm upstream	10 km
1000BASE-T	Twisted-pair cabling (Cat-5, Cat-5e, Cat-6, Cat-7)	100 meters

1000BASE-TX	Twisted-pair cabling (Cat-6, Cat-7)	100 meters

Table1: Gigabit Ethernet Varieties [5], [6].

Varieties: Table 1 shows the five physical layer standards for Gigabit Ethernet using optical fiber (1000BASE-X), twisted pair cable (1000BASE-T), or shielded balanced copper cable (1000BASE-CX). Ethernet later added 1000BASE-LX10 and -BX10.

III. GIGANET cLAN

Giganet is one of the leading interconnects for cluster of commodity computer systems. Giganet is a connection-oriented interconnect based on a hardware implementation of Virtual Interface Architecture (VIA) and Asynchronous Transfer Mode (ATM) technologies [7]. We cannot exchange messages between communication processes. For this purpose, a Virtual Channel (VC) has to be established. Each VC is allocated buffer queue, routing tables entries and other resources in the network and at the host. Therefore, the size of the cluster is limited by resources that are available at the switching element and the host interface [8]. For Giganet, end-to-end flow control scheme and circuit–based switching are used. Basically, Giganet cLAN is developed with the aim of supporting VIA in hardware & it supports low latency but it only provides a low bandwidth, thus making it not a good choice for implementing fast cluster networks [8].

Total MB in/out	Sent — The rate at which megabytes are sent over cLAN Gigabit network cards from this machine. Received — The rate at which megabytes are received by this machine from cLAN Gigabit network cards.
Frames per second	Sent — The rate at which frames are sent over cLAN Gigabit network cards from this machine. Received — The rate at which frames are received by this machine from cLAN Gigabit network cards.
Interrupts per second	Async. sent — The rate at which interrupt requests are sent by the cLAN network cards (such as those to CPUs). Async. received — The rate at which interrupt requests are received by the cLAN network cards.

Table 2: Gigabit cLAN characteristics.

IV. INFINIBAND

InfiniBand is a powerful architecture, which supports I/O connectivity for the Internet infrastructure. It is an open standard, internet protocol with ultra low latency. The first infiniBand specification was released in 2000. Unlike shared bus architectures, InfiniBand is a low pin count serial architecture that connects devices on the PCB and enables "Bandwidth out of the box", spanning distances up to 17m over ordinary twisted pair copper wires. Over common fiber cable, It can span distances of several kilometers or more [9].

	SDR	**DDR**	**QDR**	**FDR-10**	**FDR**	**EDR**	**HDR**	**NDR**
Theoretical effective throughput, Gbs, per 1x	2	4	8	10	14	25	50	
Speeds for 4x and 12x (Gbit/s)	8, 24	16, 48	32, 96	41.25, 123.75	54.54, 163.64	100, 300	200, 600	
Encoding (bits)	8/10	8/10	8/10	64/66	64/66	64/66		
Latency (microseconds)	5	2.5	1.3	0.7	0.7	0.5		
Year	2001, 2003	2005	2007		2011	2014	2017	After 2020

Table 3: INFINIBAND Characteristics [10], [11], [12].

V. MYRINET

Myrinet is a new type of local area network based on the technology used for packets communications and switching with in massively parallel processors [14]. Myrinet's host interfaces map the network, select routers, and control packet traffic. Its streamlined software allows direct communication between user processes and the network [14]. The basic unit of Myrinet network is a 16-port switching chip, which can be used for making topologies of different sizes.

Myrinet provides reliable, connection–less message delivery between points. This is achieved by maintaining reliable connection between each pair of hosts in the network and multiplexing the traffic between end-points over those reliable paths [15]. The user-level communication protocols employed by Myrinet avoid memory copies required to move data between the application and the kernel. It directly transfers data between the network interface and application resulting in lower communication latencies [16].

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 02 Issue 04
April 2015

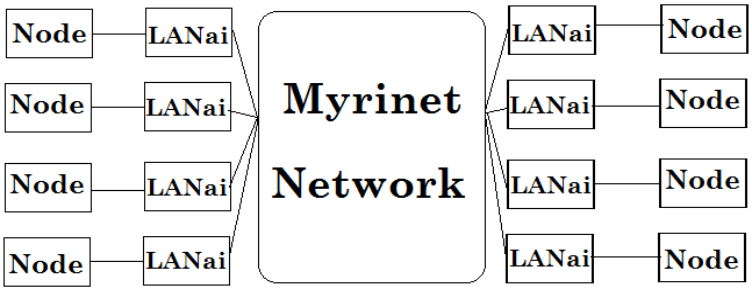

Fig 1: Myrinet Network.

VI. COMPARISON OF INTERCONNECTION TECHNOLOGIES

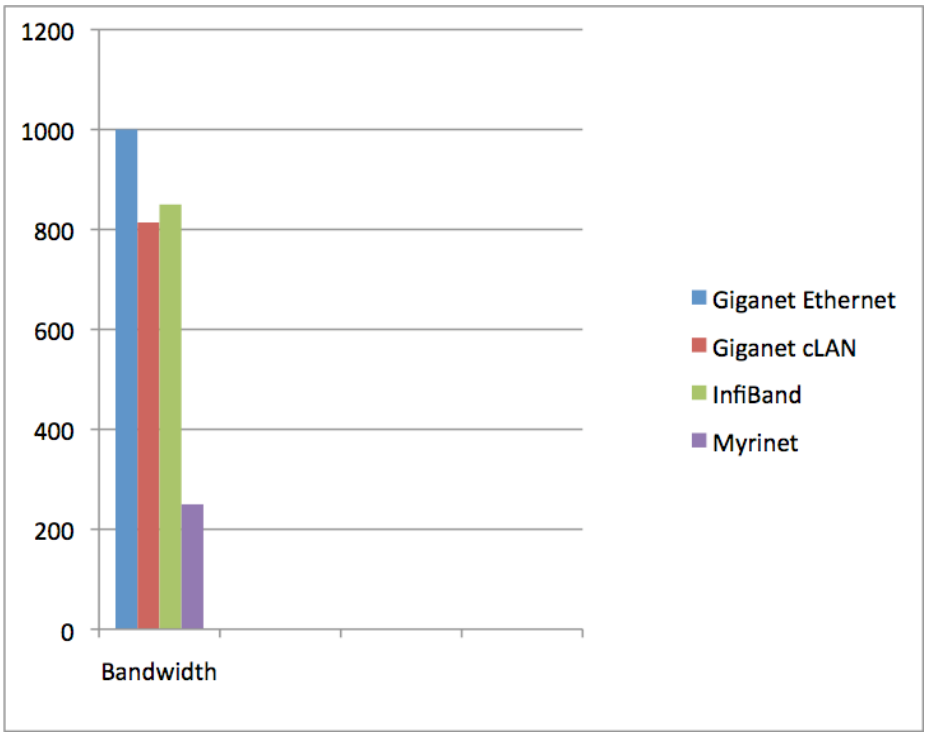

Fig. 2: Bandwidth of four interconnects in Mbps.

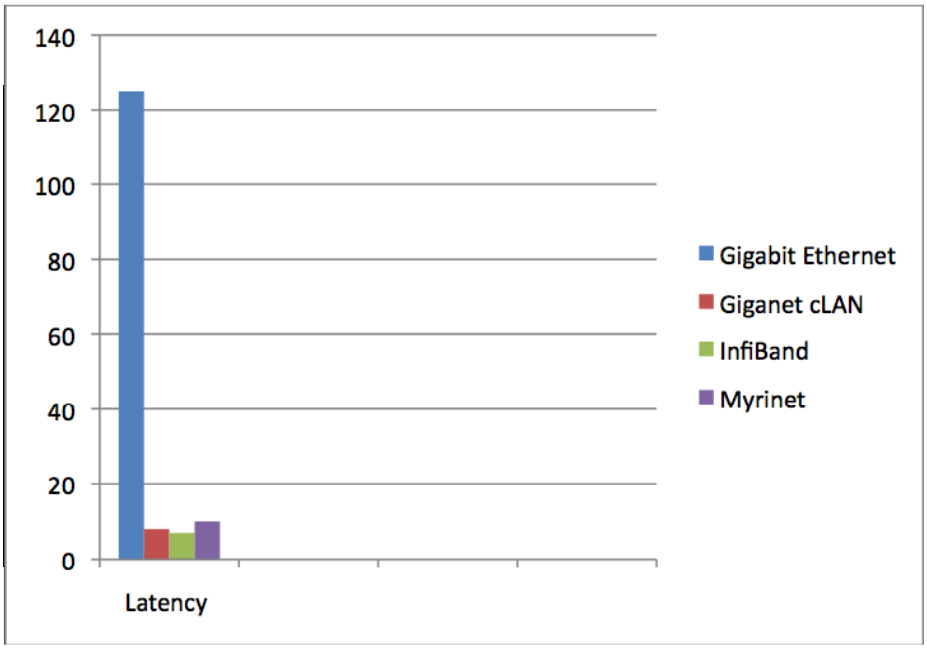

Fig. 3: Latency of four interconnects in microseconds.

The base performance of the four interconnects in terms of bandwidth and latency are shown in Figures 2 and 3, respectively.

VII. CONCLUSION

Clusters provide an excellent platform for solving a range of parallel and distributed applications in both scientific and commercial areas. Designing fast and low latency network is important for any cluster. A lot of work being done in this is in both hardware (InfiniBand, Myrinet) and software (VIA) [17]. Here in this paper we have discussed the four major interconnection technologies available for designing cluster systems. From the figures, we find that Gigabit Ethernet has maximum bandwidth and Myrinet has minimum. Also latency of Gigabit Ethernet is maximum and that of InfiniBand is minimum. These interconnect solutions differ from one another with respect to their architecture, programmability, scalability and performance. This also shows that Gigabit Ethernet is only suitable for compute intensive applications.

VIII. REFERENCES

[1]. Mark Baker, Rajkumar Buyya, Dan Hyde, "Cluster Computing: A High –Performance Contender", Technical Activities Forum, July 1999.

[2]. Hermann Hellwagner, Matthias Ohlenroth,"VI architecture communication features and performance on the Giganet cluster LAN", Future Generation Computer Systems 18 (2002), 421-433.

[3]. Chee Shin Yeo, Rajkumar Buyya, Hossein Pourreza, Rasit Eskicioglu, Peter Graham, Frank Sommers, "Cluster Computing: High–Performance, High-Availability, and High Throughput Processing on a Network of Computers,

[4]. Douglas Eadline, "The 10 Gigabit Ethernet HPC Cluster", 22 October 2009,

[5]. IEEE 802.3-2008 Section 3 Table 38-6 p.111

[6]. "Mode-Conditioning Patch Cord Installation Note", Retrieved February 14, 2009

[7]. Jenwei Hsieh, Tau Leng, Victor Mashayekhi and Reza Rooholamini, "Architectural and performance evaluation of GigaNet and Myrinet Interconnects on Cluster of Small-Scale SMP Servers", 0-7803-9802-5/2000/$10.00(c) 2000 IEEE.

[8]. R. Brightwell and A. B. Maccabe, "Scalability Limitations of VIA- Based Technologies in Supporting MPI", In the Proceedings of the Fourth MPI Developer's and User's Conference, March 2000.

[9]. "Introduction to InfiniBand", Mellanox Technologies Inc, Document Number 2003 WP.

[10]. http://www.infinibandta.org

[11].http://www.hpcadvisorycouncil.com/events/2014/swissworkshop/presos/Day_1/1_Mellanox.pdf

[12]. Panda, Dhabaleswar K.; Sayantan Sur (2011). "Network Speed Accelration with IB and HSE". *Designing Cloud and Grid Computing Systems with InfiniBand and High-Speed Ethernet*. Newport Beach, CA, USA: CCGrid 2011. p. 23. Retrieved 13 September 2014.

[14]. Nanette J. Boden, Danny Cohen, Robert E. Felderman, Alan E. Kulawik, Charles L. Seitz, Jakov N. Seizovic, Wen-King Su, Myricom Inc., " Myrinet: A Gigabit-per- Second Local Area Network", IEEE, Feb. 1995.

[15]. Myrinet, Inc.," The GM Message Passing System",http://www.myri.com,1999

[16]. S. Majumdar and S. Rixer, " Compairing Ethernet and Myrinet for MPI Communication.

[17]. Rajkumar Buyya, Hai Jin, Toni Cortes, "Special issue on Cluster Computing". Journal of Future Generation Computing Systems (FGCS), Elsevier Science, The Netherlands, Vol. 18, Issue 3, January 2002.