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Computer Network Performance evaluation based on Network scalability using OMNeT++ Simulation Environment

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----------**ABSTRACT**----------
Present research paper is focusing on performance evaluation of computer networks through Network scalability using OMNeT++ Simulation environment. The performance of the Network is evaluated on the basis of Throughput. To investigate the issue we have use OMNeT++ network simulation framework and Nclient application module from INET framework. Present research paper studies the network scalability effects.

Keywords - **Clients, Datarate, INET, NClients, Network Scalability, OMNeT++, Server, Simulation, Throughput.**

I. INTRODUCTION

The performance of the Network configurations is measured using simulation environment. We preferred OMNeT++ Version 4.2 (Objective Modular Network Testbed) object oriented modular discrete event network simulation framework with INET framework for OMNeT++ with 2.2.0-ae90ecd release. Development of OMNeT++ is started in 1992, since then many people contributed to OMNeT++ with several models. It is primarily used to simulate the communication networks and other distributed systems. It is used for academic as well as Industrial research purposes. OMNeT++ runs on Windows, Mac & Linux Operating Systems. Here are the features of OMNeT++ which makes it different from other simulation environment:

1. OMNeT++ is designed to support network simulation on a large scale.
2. Modular structure.
3. The design of NED (Network Description).
4. GUI Interface with Graphical Editor.
5. Separation of Model and Experiments.
6. Simple Module Programming Model.
7. Design of the Simulation Library.
8. Parallel Simulation Support.
9. Real-Time Simulation, Network Emulation.
10. Animation and Tracing Facility.
11. Visualization of Dynamic Behavior.
12. Enriched Result Analysis Mechanism

INET consists of several simulation application models. We use Nclients network application with basic HTTP network setup from INET to carry out our experiments. It consists of client server environment with variable number of clients with single server and two server setup.
Performance evaluation parameters are set through initialization (INI) and Network Description (NED) files and in our experiments those files are basicHTTP.ini and Nclients.ned and result of the experiments are collected through answer (ANF) file. We evaluated Network performance in terms of Server Throughput. Throughput from the server is measured through ThruputFrom module while throughput to the server is measured through ThruputTo module. Throughput is number of bits transferred per second from server or to the server.

II. RELATED WORK

Research Paper entitled On-Chip Networks from a Networking Perspective: Congestion and Scalability in Many-Core Interconnects focuses on congestion control in on-chip bufferless networks and has shown such congestion to be fundamentally different from that of other networks, for several reasons. Research examined both network performance in moderately-sized networks and scalability in very large networks, and they find congestion to be a fundamental bottleneck. Researchers develop an application-aware congestion control algorithm and show significant improvement in application-level system throughput on a wide variety of real workloads for NoCs.

Research paper VL2: A Scalable and Flexible Data Center Network present a new network architecture which puts an end to the need for oversubscription in the data center

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network, a result that would be prohibitively expensive with the existing architecture. VL2 benefits the cloud service programmer. Today, Programmers have to be aware of network bandwidth constraints and constrain server to server communications accordingly. VL2 instead provides programmers the simpler abstraction that all servers assigned to them are plugged into a single layer 2 switch, with hotspot free performance regardless of where the servers are actually connected in the topology. VL2 also benefits the data center operator as today's bandwidth and control plane constraints fragment the server pool, leaving servers under-utilized even while demand elsewhere in the data center is unmet. Instead, VL2 enables agility: any service can be assigned to any server, while the network maintains uniform high bandwidth and performance isolation between services.

Research paper MegaPipe: A New Programming Interface for Scalable Network I/O introduces a new programming interface for high-performance networking I/O. This is applicable for Message-oriented network workloads, where connections are short and/or message sizes are small, are CPU-intensive and scale poorly on multi-core systems with BSD socket API. MegaPipe exploits many performance optimization opportunities that were previously hindered by existing network API semantics, while being still simple and applicable to existing event-driven servers with moderate efforts. Evaluation through microbenchmarks, memcached, and nginx showed significant improvements, in terms of both single-core performance and parallel speedup on an eight-core system.

III. RESEARCH METHODOLOGY

To investigate Performance evaluation of Computer Networks through Network Scalability we use Simulation environment with OMNeT++ framework. We have used Nclient application form INET to simulate our research. There are three basic setup provided under Nclients in INET those are TelenetApp, File transfer and basicHTTP module. Out of these we choose basicHTTP module with TCPBasicCliApp and TCPGenericSrvApp modules. TelenetApp generates very low traffic.

Initially we setup network configuration with a server and variable number of clients from 10 number of clients to 150 Number of clients with the interval of 10 number of clients on a server and collect the throughput also we measure the throughput by changing datarate from 10Mbps to 100Mbps with the interval of 10Mbps. In the next phase we change network configuration from a single server to two servers by keeping remaining configuration like initial setup; with this setup we have shared the Network load of single server with two servers. Throughput readings Collected from single server setup and two server setup are compared to investigate the performance of the networks. We have kept data packet size constant i.e. 256bytes for both the configurations.

Fig1: Nclients.Ned: Network Configuration setup with single server

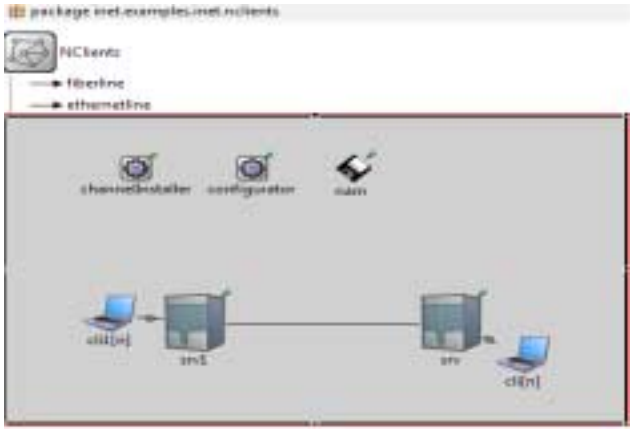

Fig2: Nclients.Ned: Network Configuration setup with two servers.

To measure the performance of the present network we use thruputMeter modules. This module is placed between TCP and TCPApp layer. We required two modules to collect result for incoming and outgoing traffic to the server. Our client and server are the StandardHost modules provided in the INET. We have modified the StandardHost with thruputMeter and modified structure of standardHost along with thruputMeter is show in figure 3 below. The result of the experiment is collected in excel file from the default .ans file. .ans file in OMNeT++ gives two types of results vector and scalar. Vector results are recording of time series data and scalar results are supposed to record a single value per simulation run. We have considered scalar result as avg. thruput for our analysis purpose, Throughput of both thruputMeter i.e. thruputFrom & thruputTo related to the server.

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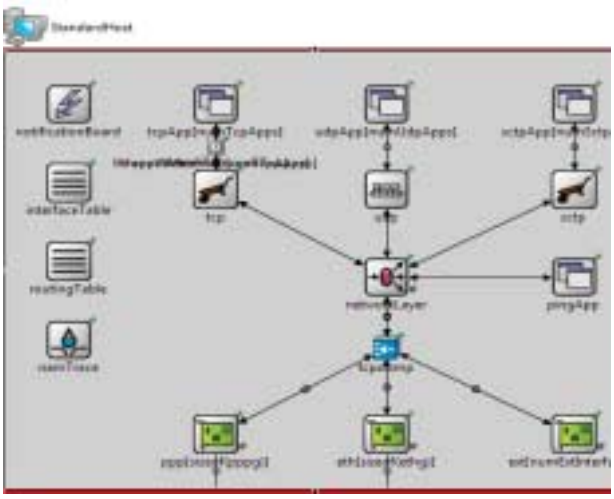


FIG 3: STANDARDHOST WITH THRUPUTMETER MODULE BETWEEN TCPAPP & TCP.

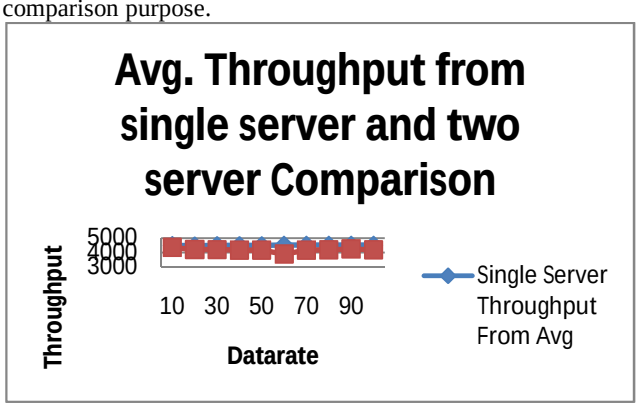
We collect the reading of the simulation experiment for both the setups i.e. with single server and with two servers by changing datarate of the network setup and by increasing the network load with number of servers.

1. We Kept datarate constant and changed the number of clients on the server and average throughput scalar values are collected for respective experiments.
2. For specific client setup on a server we change the datarate and collect the scalar average throughput in excel files.

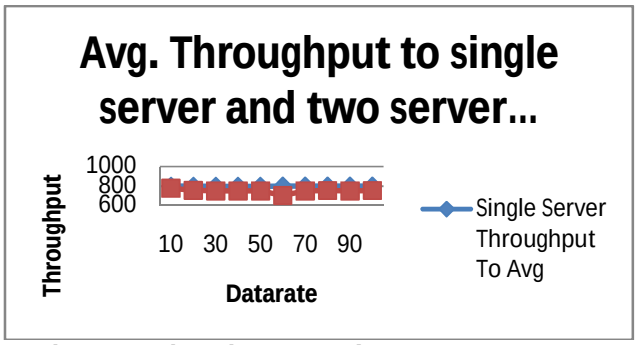
We collected the throughput results by running the simulation experiment with single server 10 (datarate variance from 10Mbps to 100Mbps with the interval of 10Mbps) ×15 (no of client variance from 10 clients to 150 clients with the interval of 10) =150 times, and same is repeated for two server setup too i.e. 10 × 15 =150 times.

IV. RESULT ANALYSIS:

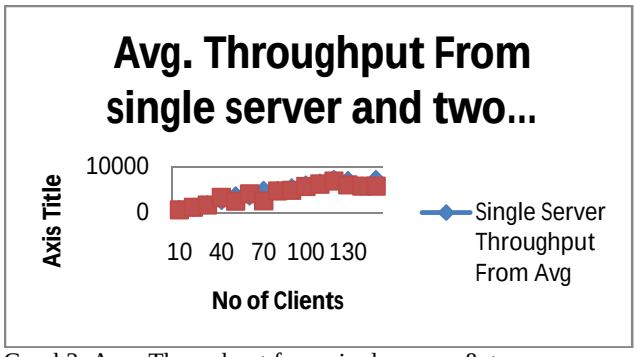
Throughput values of the simulation experiment is collected in excel file. We have collected results at 10, 20, 30, 40, 50, 60, 70, 80, 90, 100Mbps datarate with 10, 20, 30,……130, 140, 150 clients per server with single server and same setup is also used with two servers to evaluate the performance of the Computer Network by keeping all other parameters same for both the setups. In the Network configuration with two servers we have divided the load of single server on to two servers equally. These results are collected by keeping packet size constant i.e. 256Mbps. At specific datarate we took reading of throughput from the server and throughput to the server by changing number of clients from 10 numbers to 150 numbers of clients with the interval of 10 clients per server. We took these readings at different datarates ranging from 10Mbps to 100Mbps with the interval of 10Mbps. After collection of the readings we took average of all the throughput from the server and throughput to the server readings. The same procedure is followed for the Network configuration with two servers too. These averaged throughput values at specific datarate and with specific number of clients are then used for actual comparison between network configurations with single server and two servers. The throughput values with two servers are summed for comparison purpose.



Graph1: Avg. Throughput Form single server & two server comparison with datarate variance.



Graph2: Avg. Throughput to single server & two server comparison with datarate variance.



Graph3: Avg. Throughput from single server & two server comparison with client variance.

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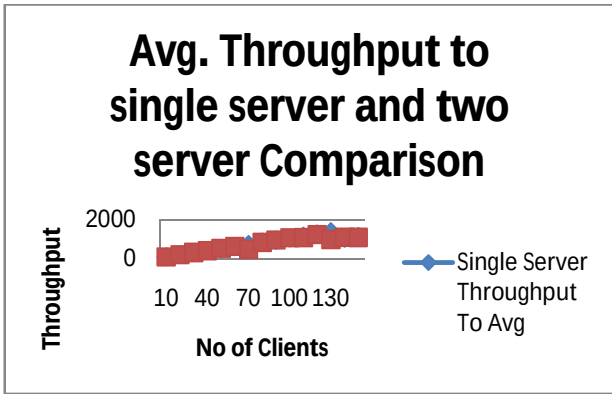

Graph4: Avg. Throughput to single server & two server comparison with client variance.

Analysis shows that average throughput from the server and average throughput to the server with single server are higher than the average throughput from and to the server with two servers. Graph1 & Graph2 shows average throughput from and to the server comparison between single server and two servers at variable datarates ranging from 10Mbps to 100Mbps with the interval of 10Mbps. It shows that average throughput form and to the server with single server is higher than the average throughput from and to the server with two servers. It also shows that average throughput from the single server and to the single server are giving steady performance with increase in the datarates from 10Mbps to 100Mbps while average throughput from the server and to the server with two server setup are giving maximum value at 10Mbps datarate and minimum value at 60Mbps. Graph3 & Graph4 shows average throughput from and to the server comparison between single server and two servers with variable number of clients from 10 to 150 clients with the interval of 10 numbers of clients on server. It shows that average throughput from the single server is higher than the average throughput from the two servers with the number of clients on the servers except readings with 40 & 60 number of clients on the servers. While average throughput to the server readings shows that similar type of average throughput with both the setups except readings with number of clients 70, 110 & 130 on server, where it shows remarkable difference between the readings i.e. lower throughput to the server with two servers.

V. CONCLUSION

Finally we say that when we divide the network load of single server on to the two servers we found subsequent decrease in the average throughput from & average throughput to the server. We got maximum average throughput from and to the server with single server.

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REFERENCES

[1] George Nychist, Chris Fallin, Thomas Moscibroada, Onur Mutlu, Srinivasan Seshan, On-Chip Networks from a Networking Perspective: Congestion and Scalability in Many-Core Interconnects. *SIGCOMM' 12, August 13-17, 2012, Helsinki, Finland,* ACM 978-1-4503-1419-0/12/08.

[2] Albert Greenberg, Srikanth Kandula, David A. Maltz,, James R. Hamilton, Changhoon Kim, Parveen Patel, Navendu Jain, Parantap Lahiri, Sudipta Sengupta. VL2: A Scalable and Flexible Data center Network, *SIGCOMM'09, August 17-21, 2009, Barcelona, Spain,* ACM 978-1-60558-594-9/09/08.

[3] Sangjin Han, Scott Marshall, Byung-Gon Chun and Sylvia Ratnasamy, MegaPipe: A New Programming Interface for Scalable Network I/O. *To appear in Proceedings of USENIX OSDI* 2012.

[4] Plamenka Borovska, Ognian Nakov, Desislava Ivanova, Kamen Ivanov, Georgi Georgiev. Communication Performance Evaluation and Analysis of a Mesh System Area Network for High Performance Computers. ISSN: 1790-2769 & ISBN:978-960-474-188-5.

[5] Andras Varga, Rudolf Hornig. An Overview of the OMNeT++ Simulation Environment. *SIMUTools, March 03-07, 2008, Marseille, France.* ISBN:978-963-9799-20-2.

[6] Fan Cen, Tao Xing, Ke-Tong Wu. Real-time Performance Evaluation of Line Topology Switched Ethernet. *International Journal of Automation and computing*, 05 (4), October 2008, 376-380

[7] Dhobale J V, Dr. Kalyankar N V, Dr. Khamitkar S D. Computer Network Performance Evaluation based on Datarate and Number of Clients Per Server Using OMNeT++ Environment, *submitted to Global Journal of Computer Science and Technology, GJCST Volume 14 Issue 3 Version 1.0*, May-2014.

[8] HON-HING WAN & YU-KWOK. High Data Rate Video Transmission Using Parallel TCP Connections: Approaches and Performance Evaluation. *The Journal of Supercomputing*, 35, 119-139, 2006.

[9] Esma Yildirim –Tevfik Kosar. End-to-End Data-Flow Parallelism for Throughput Optimization in High-Speed Networks. *J Grid Computing (2012)* 10:395-418.

[10] András Varga and OpenSim Ltd. *OMNeT++ User Manual Version 4.2.*

[11] INET Framework for OMNeT++ *Manual.*

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