Performance Evaluation of National Knowledge Network Connectivity

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ABSTRACT

Due to rapid growth of information sharing on the network, there is a need to setup high speed bandwidth network connectivity and in India it has been setup by Government of India called as a National Knowledge Network (NKN). In this network, higher specifications of devices like routers, bridges, switches, cables, etc are used for setting the network infrastructure. In the current work, a case-study of a Babasaheb Bhimrao Ambedkar University, India is considered to evaluate the performance of National Knowledge Network link which was provided by the Government of India.

General Terms

Performance Evaluation, NKN, et. al.

Keywords

Router, Switch, Bridge, Network Architecture, Performance Evaluation.

1. INTRODUCTION

Nowadays, people are sharing the long files on the network whether the type of network is Local Area Network (LAN), Metropolitan Area Network (MAN) or Wide Area Network (WAN). If the speed of network is slow, then there is a problem to share very long files available in the forms of audio and video. To share the audio and video files on the network, Government of India has launched a Nationwide Project called as National Knowledge Network which has been setup by National Informatics Centre (NIC), New Delhi in the year 2009[1]. This network is considered to be a very high speed knowledge network supporting multigiga bit data accessing speed. The motive of the Government for setting this type of network infrastructure is mainly to support the quality of research work by knowledge sharing among the people Universities/ Institutions/Research labs, etc and thus it is used to provide different quality oriented services like digital libraries, virtual classrooms, data centers, etc. The core of this network is based upon the distributed approach [2] in which more than one computer are interconnected with each other using different kinds of network. These interconnected computer systems are based on different kinds of topologies which are capable of collaborating on a task in order to perform the execution of the tasks. In the distributed computing system, the systems are capable of sharing the memory and program execution space. The computing performed in the distributed computer system architecture is known as distributed computing system. A lot of work has already been done on distributed computing concept. A Grapevine project [3] has been created by using the distributed computing approach and the multicomputer systems have been setup to establish real applications under the distributed computing system environment. An overview

on distributed computing approach is well explained by Tanenbaum & Forouzon [4], [5]. The complete infrastructure details for setting the computer networks are given by these authors. By these networks, each and every organization can share data from one location to another location in a very fast and an authenticated manner. By the use of LAN, MAN or WAN, every organization implements data sharing among them. Computer network connection is formed by using different network creating devices like routers, switches and bridges, etc. When these networking devices [6] are interconnected with each other they form well designed computer network architecture, as shown in figure 1.
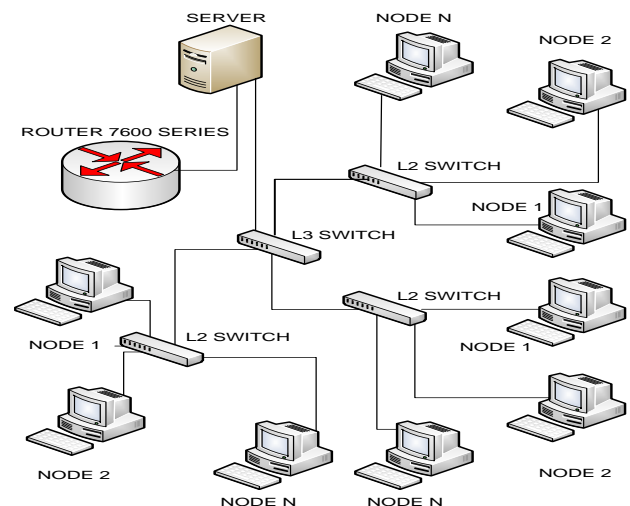

Fig 1: Distributed computing networks

In order to perform a proper communication among the connected systems different types of protocols have been designed like TCP/IP [7]. These protocols run regularly in order to have the data transmission throughout the network in a secure manner. In order to support the functioning of interconnected computers, there is a need of proper network supporting operating system software [8]. Recently, Saxena & Mishra [9], [10] have studied the NKN Project and elaborated the benefits of the network for the higher education system especially in the current higher education system. In the present work, authors evaluated the performance of this link provided by Government of India to the Babasaheb Bhimrao Ambedkar University; Lucknow & computed some of the important observations depicted in the form of tables and graphs, on the basis of above figure.

2. NETWORK DEVICES

Different types of networking devices are used to establish the said connectivity which is interconnected in the form of LAN, MAN or WAN network systems. The brief descriptions of the devices used for this purpose are explained below:

2.1 Router

The router used in the recent case study is a CISCO router [11] of series 7600 and model no. is 7609. The CISCO routers are used generally at places where there is need of high performance network traffic. This router consists of Nine-slot chassis as represented in the figure 2. Some of the important features of 7600 series routers are given below:

1. It has 720 Gigabits per second (Gbps) in a single chassis, or having a 40 Gbps capacity per slot;

2. It has a choice of form factors purpose-built for high availability;

3. It consists of Cisco I-Flex design which is a considered to be having facility of Shared Port Adapters (SPAs) and SPA Interface Processors (SIP's) which controls voice, video, and data experiences;

4. It has scalable and extensible suite of hardware and software capabilities due to which intelligent carrier Ethernet services get enabled;

5. It has Integrated Video Call Admission Control which supports both broadcast as well as Video on Demand (VoD);

6. It has intelligent services gateway, which provides the facility of multidimensional identity capabilities and policy controls;

7. It has Integrated Session Border Control with quality of experience in both Session Initiated Protocol (SIP) and non-SIP applications.

Fig 2: Cisco 7609 router

2.2 Switch

Switches are the smart devices used to form a network. Switches [12] used in the current network are based on the layer three architecture and that's why called as layer 3 switches as represented in figure 3.

Fig 3: A layer 3 (L3) switch

With the help of above switch, the entire campus of Babasaheb Bhimrao Ambedkar University has been divided into about 8 VLAN's as categorised below with unique Internet Protocol (IP) address:

I. Administrative Block (192.168.1.0/24)
II. School for Ambedkar Studies (192.168.50.0/24)
III. School for Environmental Studies (192.168.10.0/24)
IV. Boys Hostel (192.168.70.0/24)
V. Vice Chancellor Residence (192.168.20.0/24)
VI. Teachers Residence (192.168.60.0/24)
VII. Rearing House (192.168.40.0/24)
VIII. Guest House (192.168.30.0/24)

Along with the layer 3 switch implementation, the layer 2 switches are also used in the entire campus of Babasaheb Bhimrao Ambedkar University.

Fig 4: A layer 2 (L2) switch

Figure 4 shows the Layer 2 switch which forwards the traffic based on MAC layer addresses. This layer 2 switch is also considered to be as a multiport transparent bridge.

2.3 Performance Issue

Since the network system is very complex, as it consists of LAN, MAN & WAN, therefore, one of the main issues regarding an interconnected computers network system is its performance. The performance issue simply states about the network traffic handling mechanism so that congestion and contention could be managed. The network traffic performance is related with the time taken by the data packets to travel from source to destination. In the present work authors have studied the interconnected computers network architecture of Babasaheb Bhimrao Ambedkar University according to different aspects and obtained some of the important results of the network traffic performance in terms of corresponding load. The performance and occurrence of load have been studied and described in the next section.

3. EXPERIMENTAL RESULTS

For evaluating the performance of interconnected network system & occurrence of load, authors used Internet Security and Acceleration (ISA) server management [13] utility generally used to handle the network server. Packet filtering

Technique is implemented by the ISA server to control inbound and outbound access. It is required that the packet filtering features should be enabled in order to get the ISA server utility to implement the control on inbound and outbound access. Packet filtering should be enabled in the following situations:

a) ISA server is working at the edge of the network;

b) At situations where trihmoed ISA server is been configured;

c) At situations when the services and applications are going to be run on the ISA server.

Some of the important cases are studied by the authors in order to get the result of network traffic which is described below in brief:

3.1 Network Traffic Generated by Users

In the said University, users are working from 6 A.M. to 11 P.M. & on the basis of this, Table 1 presents the data related to the network traffic occurred due to uploading and downloading of data in GB by the top fifteen users.

Table 1. Data send and received by top 15 users (in GB)

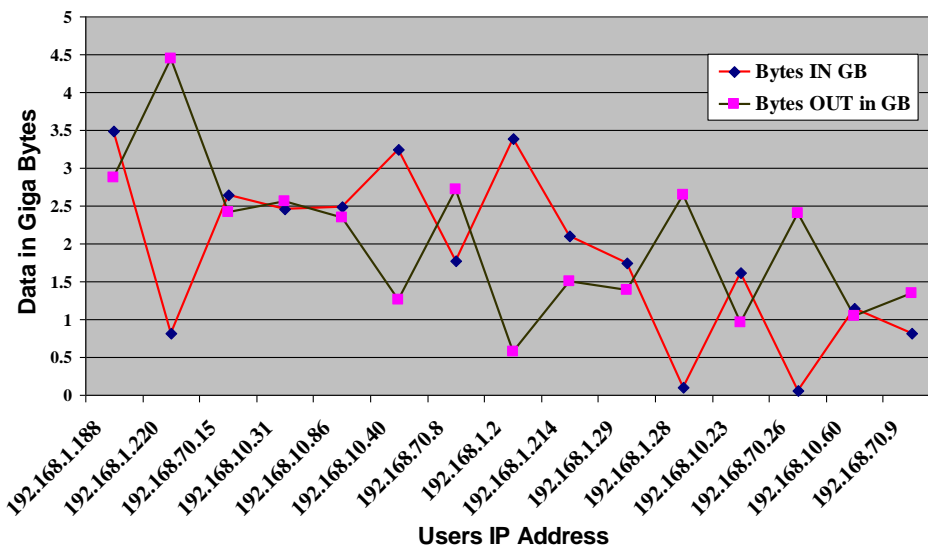| SNo.	Users (IP Addresses)	Bytes IN GB	Bytes OUT GB
1	192.168.1.188	3.48	2.87
2	192.168.1.220	0.82	4.45
3	192.168.70.15	2.64	2.42
4	192.168.10.31	2.46	2.56
5	192.168.10.86	2.48	2.34
6	192.168.10.40	3.24	1.26
7	192.168.70.8	1.77	2.72
8	192.168.1.2	3.39	0.56
9	192.168.1.214	2.1	1.5
10	192.168.1.29	1.74	1.38
11	192.168.1.28	0.10	2.65
12	192.168.10.23	1.62	0.96
13	192.168.70.26	0.05	2.4
14	192.168.10.60	1.14	1.05
15	192.168.70.9	0.82	1.35

Fig 5: Network traffic generated by top 15 users (in GB)

Figure 5 shows the graphical view of the network traffic due to uploading and downloading of data by the top users. Top users are categorized by their IP addresses. The data recorded through ISA server which shows the uploaded as well as downloaded data in GB. The two lines show the data uploading and the data downloading. From the table it is observed that maximum & minimum downloading are 3.48 GB & 0.05 GB while uploading are 4.45 GB & 0.56 GB, respectively.

3.2 Communication Protocols Used to Carry Network Traffic

During the traffic flow in the said University, the requests that have been given by the users are carried out by the use of the different protocols. These protocols are as Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), User Datagram Protocol (UDP) and so on. Data has been recorded in tabular format for the requests with the different protocols in order to study the network traffic.

Table 2. Requests occurred using different protocols

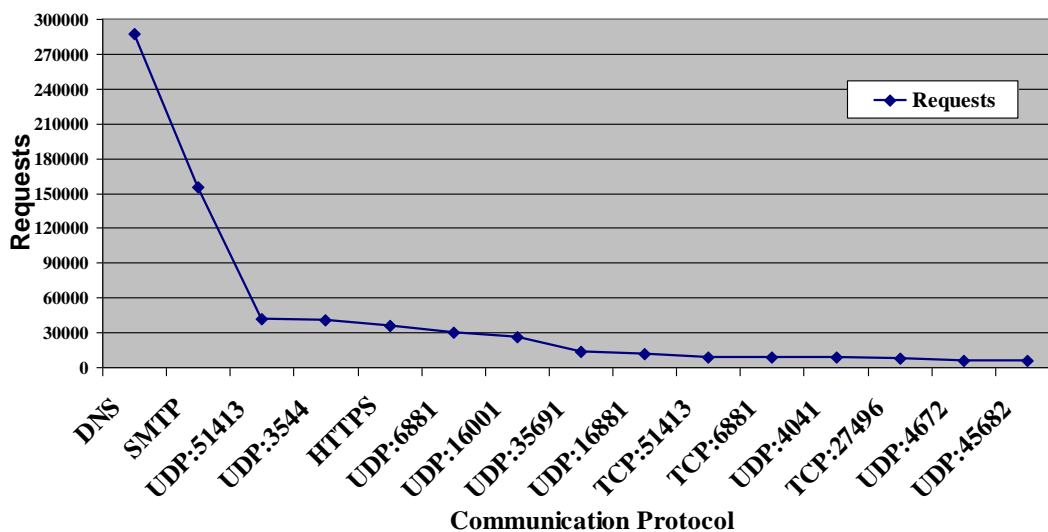| SNo.	Protocol	Requests
1	DNS	287069
2	SMTP	155277
3	UDP:51413	41918
4	UDP:3544	41245
5	HTTPS	36194
6	UDP:6881	30307
7	UDP:16001	26058
8	UDP:35691	14074
9	UDP:16881	11483
10	TCP:51413	9001
11	TCP:6881	8956
12	UDP:4041	8271
13	TCP:27496	7353
14	UDP:4672	6291
15	UDP:45682	6247

Fig 6: Request generated by different communication protocols

Graphical views of the different protocols used for the requests users sent and received through these different types of communication protocol are depicted in figure 6. It is observed that User Datagram Protocol (UDP) is mostly used for communication on network traffic.

3.3 Traffic Generated due to Different Destination Places

User's of said Universities use to access different destination places in order to fulfill their requirements. The accessing of different destination places have been studied and data uploaded and downloaded from different destination places have been recorded to get the network traffic of data generated due to destination places for which requests are made.

Table 3. Data send and received by accessing 15 destination places

| SNo.	Destination IP	Bytes In MB	Bytes Out MB
1	124.124.252.79	2280	23.25
2	98.113.136.122	1100	15.39
3	98.114.66.154	1090	16.23
4	115.248.220.212	559.69	327.71
5	68.192.187.230	723.05	11.44
6	178.33.144.144	607.89	9.68
7	24.98.236.126	10.3	565.55
8	86.7.228.83	9.53	553.16
9	94.170.151.240	517.79	8.87
10	187.37.79.113	4.24	518.36
11	209.85.153.83	333.1	167.24
12	115.242.113.139	330.95	151.01
13	110.159.157.175	454.63	7.83
14	124.124.252.76	431.49	2.33
15	121.129.244.65	417.2	6.55
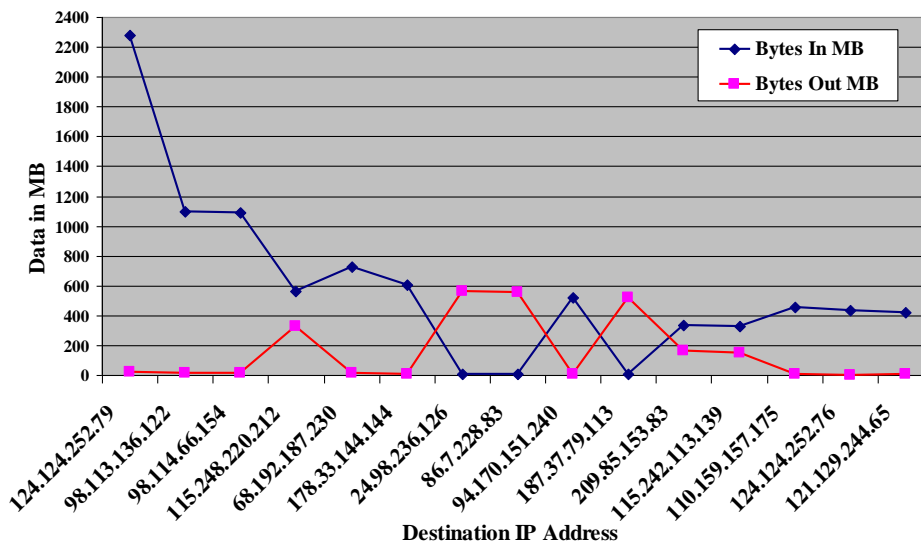
Fig 7: Network traffic generated by 15 destinations IP (In MB)

Figure 7 shows the network traffic generated due to access of destination places requested by the users in Megabytes (MB). The line graph shows the data upload and download from the destination to which the users have requested. The maximum and minimum downloading in MB are 2280 & 4.24 while uploading are 565.55 & 2.33 respectively.

3.4 Network Traffic Measured based on Time

The network traffic generated by the users during the time period of 6 A.M. to 11 P.M. has been studied and the data accessed at different time stamps have been recorded in following table. The accessed data is recorded at different consecutive time periods to study the traffic of the network.

Table 4. Network traffic at different time stamps

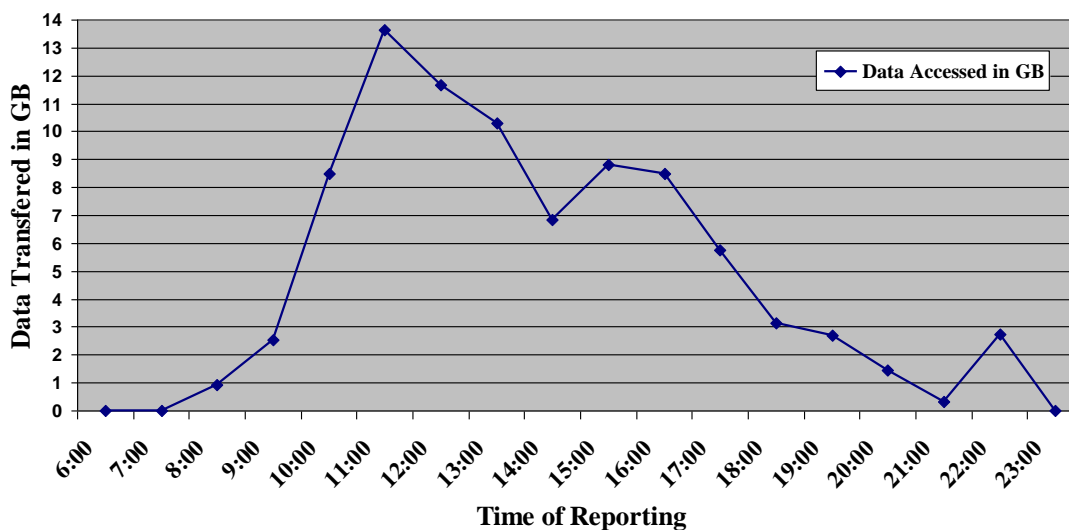| SNo.	Time	Data Accessed in GB
1	6:00 AM	0.0026
2	7:00 AM	3.05
3	8:00 AM	3.85
4	9:00 AM	8.15
5	10:00 AM	6.06
6	11:00 AM	6.01
7	12:00 PM	9.86
8	1:00 PM	6.48
9	2:00 PM	6.77
10	3:00 PM	6.74
11	4:00 PM	3.43
12	5:00 PM	4.74
13	6:00 PM	6.62
14	7:00 PM	4.01
15	8:00 PM	4.7
16	9:00 PM	12.56
17	10:00 PM	13.36
18	11:00 PM	7.11

Fig 8: Network traffic generated at different time stamps

Figure 8 shows the network traffic recorded at different times by line graph which shows how much amount of the network traffic was been sent through ISA server throughout the working hours. It is observed that minimum amount of data i.e. 0.0026 GB is accessed at 6 A.M. while maximum amount of data about 13.36 GB is accessed at night i.e. 10 P.M.

4. CONCLUSION

The present work is based upon the study of a network connectivity which has been established in Central University by Government of India under National Knowledge Network project. The main focus of present study is based upon the evaluation of Performance of network traffic used by the various users of the University from 6 A.M. to 11 P.M. & observed that maximum use of this connectivity is in the night at 10 P.M. while minimum use is in the morning at 6 A.M. The above work can be extended in many directions and one of the important directions is to filtering of data transmitted from one end to another end. Since the firewall concept is not implemented by aforesaid government agency, therefore, the study of the dynamic trends is necessary for the study of network traffic.

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