Evaluating the performance of wireless network with & without load balancing using OPNET modeler

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Abstract— **Wireless networking has experienced fast development in the last few years. A large number of handhelds, portables have become implanted with wireless communication capabilities. The mobility and the freedom offered by these wireless devices allow users to remain connected to their enterprise networks, while on the move. This paper explains about various wireless technologies which are currently being used. It also deals with the result analysis with and without load balancing, under this various analysis has been done on behalf of DB traffic sent & received, FTP download & upload response time, FTP traffic sent & receive, HTTP traffic sent & received, Wireless load, WLAN delayed, HTTP page response time and WLAN throughput. The whole result analysis deals with browsing behavior for a Web client and simulation study addressing the performance of the campus area network. This is done by designing the model using OPNET.**

Index Terms— **Wireless, Ad-hoc, WLAN, FTP, HTTP.**

I. Introduction

In a wireless Ad-hoc environment, a network can be seen as a collection of end systems that are free to move randomly while maintaining a reliable connection. This kind of network requires no centralized administration or fixed network infrastructure, and can be easily and inexpensively deployed as needed. Ad-hoc wireless networks have recently received a lot of attention. This is mainly due to their potential to support a variety of applications without the need for a fixed infrastructure. The principle behind ad hoc networking is multi-hop relaying in which messages are sent from the source to the destination by relaying through the intermediate hops (nodes). In multi-hop wireless networks, communication between two end nodes is carried out through a number of intermediate nodes whose function is to relay information from one point to another. A static string topology is an example of such network. Some of the applications where such networks can be usefully deployed are military applications, emergency, search and rescue applications, university campuses, conferences, and hospitals. A key advantage of Ad-hoc networks over conventional WLAN configurations is that Ad-hoc networks have no single point of failure. Most modern networks are based on pre-established relationships between clients and service providers. In most cases, the movement of users from their established environment may cause various difficulties and problems. To overcome some of these difficulties, wireless Ad-hoc networks provide a number of solutions. The first of these relates to ease and simplicity. A node, which is capable of reaching one or more available neighboring nodes, can be added easily to the network. Secondly, wireless Ad-hoc networks allow the users to overcome geographical and location limitations. This is due to the fact that all nodes in the network can provide connectivity as opposed to a single access point. Scalability is also an advantage as Ad-hoc networks are robust and can be easily scaled up. Finally, wireless Ad-hoc networks offer a significant cost saving, as the existing environment does not have to be modified drastically to accommodate the addition of nodes to the existing and evolving network.

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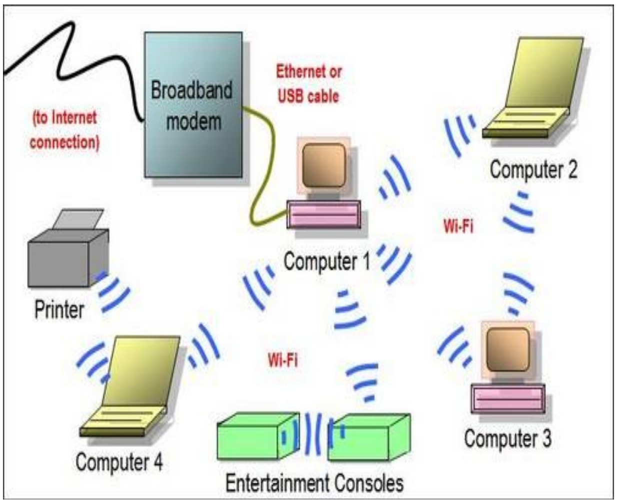

Fig.1: Ad Hoc Wireless Network Diagram

II. BACKGROUND

Wireless is a term used to describe telecommunications in which electromagnetic waves carry the signal over part or the entire communication path. The wireless method of communication uses low-powered radio waves to transmit data between devices

2.1 Current Wireless Technologies

The rapid growth of the Internet together with the proliferation of mobile computing devices such as laptops, and Personal Digital Assistants (PDAs), have led to a brisk increase in the use of wireless technologies for the LAN environment. The quick access to the information involves not only new opportunities for the investors, but a challenge for the research community in order to provide suitable means for the communications to occur without restrictions. In this sense, wireless networks are one of the best technologies to offer mobility and location-independent multimedia communications.

2.2 IEEE 802.11

Wireless networking hardware require the use of underlying technology that deals with radio frequencies for data transmission. The most widely used standard is IEEE 802.11 developed by IEEE in 1997. This standard defines a Medium Access Control (MAC) sublayer, and a physical layer (PHYs). The PHY layer, which actually handles the transmission of data between nodes, can use Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS), or infrared (IR) pulse position modulation. IEEE 802.11 supplies data rates of either 1 Mbs or 2 Mbps.

2.3 IEEE 802.11a/b/g

In 1999, the IEEE published two supplements to the initial IEEE 802.11 standard: IEEE 802.11a and IEEE 802.11b. Like the initial standard, the IEEE 802.11b operates in the 2.4GHz band, but data rates can be as high as 11 Mbps and only direct sequence modulation is specified. IEEE 802.11b provides 11 channels, each channel being 22 MHz in width, and each channel is centred at 5 MHz. This means that there are only three channels, which do not overlap (Channels 1, 6, 11). IEEE 802.11b uses DSSS with a single carrier per channel. The IEEE 802.11a standard operates in the 5.8 GHz band with data rates up to 54 Mbps.

2.4 802.11 Specifications

The 802.11 specifications were developed specifically for Wireless Local Area Networks (WLANs) by the IEEE and include four subsets of Ethernet-based protocol standards: 802.11, 802.11a, 802.11b, and 802.11g.

802.11 operated in the 2.4 GHz range and was the original specification of the 802.11 IEEE standards. This specification delivered 1 to 2 Mbps using a technology known as phase-shift keying (PSK) modulation. This specification is no longer used and has largely been replaced by other forms of the 802.11 standard.

2.4.1 802.11a

802.11a operates in the 5 - 6 GHz range with data rates commonly in the 6 Mbps, 12 Mbps, or 24 Mbps range. Because 802.11a uses the orthogonal frequency division multiplexing (OFDM) standard, data transfer rates can be as high as 54 Mbps. OFDM breaks up fast serial information signals into several slower sub-signals that are transferred at the same time via different frequencies, providing more resistance to radio frequency interference. The 802.11a specification is also known as Wi-Fi5, and though regionally deployed, it is not a global standard like 802.11b.

2.4.2 802.11b

The 802.11b standard (also known as Wi-Fi) operates in the 2.4 GHz range with up to 11 Mbps data rates and is backward compatible with the 802.11 standard. 802.11b uses a technology known as complementary code keying (CCK) modulation, which allows for higher data rates with less chance of multi-path propagation interference.

2.4.3 802.11g

802.11g is the most recent IEEE 802.11 draft standard and operates in the 2.4 GHz range with data rates as high as 54 Mbps over a limited distance. It is also backward compatible with 802.11b and will work with both 11 and 22 Mbps U.S. Robotics wireless networking products. 802.11g offers the best features of both 802.11a and 802.11b, but as of the publication date of this document, this standard has not yet been certified, and therefore is unavailable. All four standards are based on the CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) Ethernet protocol for path sharing. The most significant contribution of the 802.11 specification is that it allows for interoperability among different vendors' equipment.

III. RESULTS AND DISCUSSIONS

Results Analysis with and without load balancing

Fifteen graphs were selected after simulating the model (Figures 3.1 through 3.15). All graphs show a combination of the 2 scenarios. From figure 3.1- 3.2 it has been observed that the Database traffic sent and received (bytes/sec) with load balancing is less in comparison with unbalanced network. From figure 3.3 & 3.4 shows the average database query response time with the load balancer is more than without load balancing, which indicate the performance improvement in case of Database Query response time.

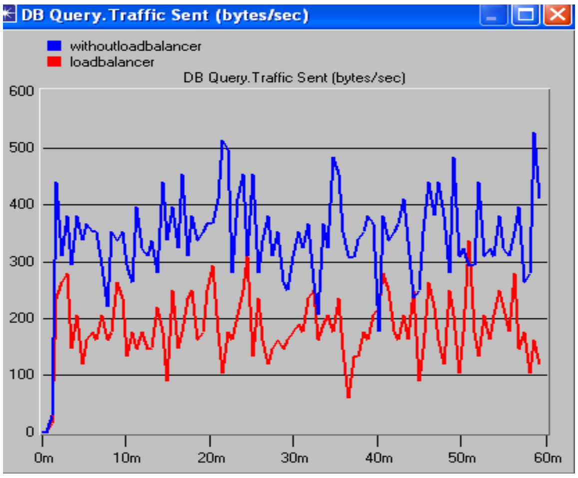

Fig 3.1 DB Traffic Sent (bytes/sec)

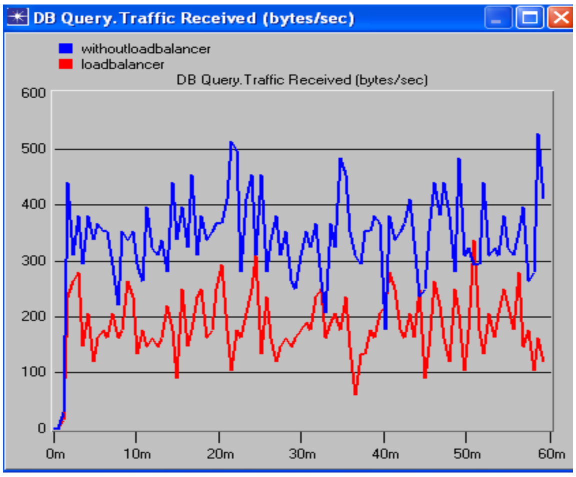

Fig 3.2 DB Traffic Received (bytes/sec)

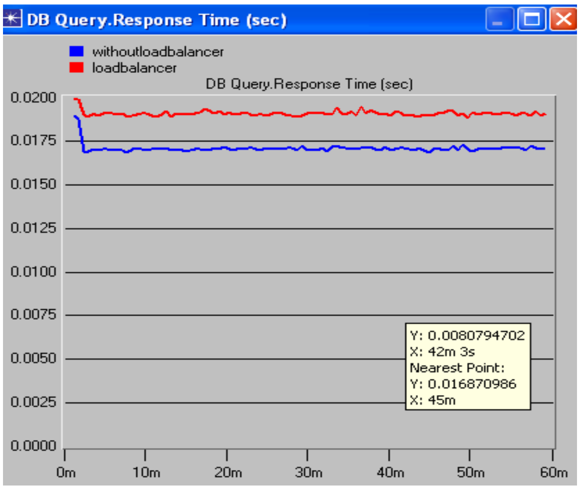

Fig 3.3 DB Response time (sec)

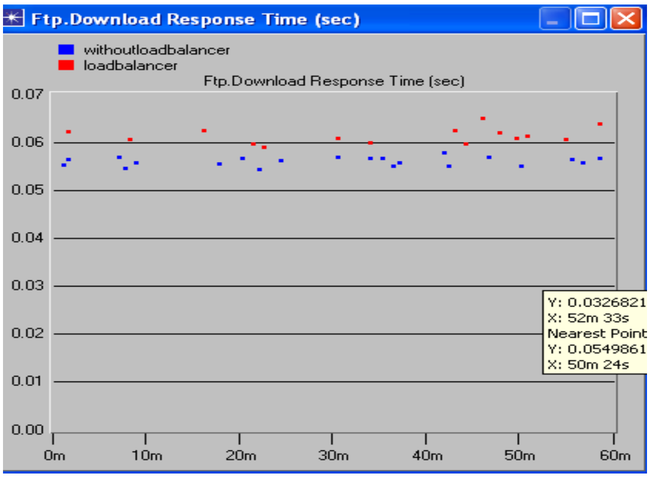

Fig 3.4 FTP Download Response time (sec)

Fig 3.5- 3.7 deals with FTP parameters, FTP upload and download response time (sec) both are better in without load-balancer than the load-balancer by approx 0.01(sec) with respect to distance and FTP traffic sent and received (bytes/sec) are better in without load balancer than the with load balancer by 800 bytes/sec at 0-3m and then approximately same at above 3m.

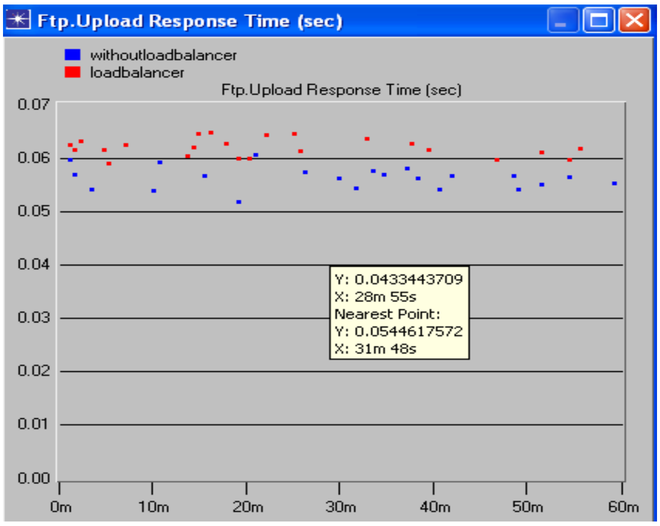

Fig 3.5 FTP Upload Response time (sec)

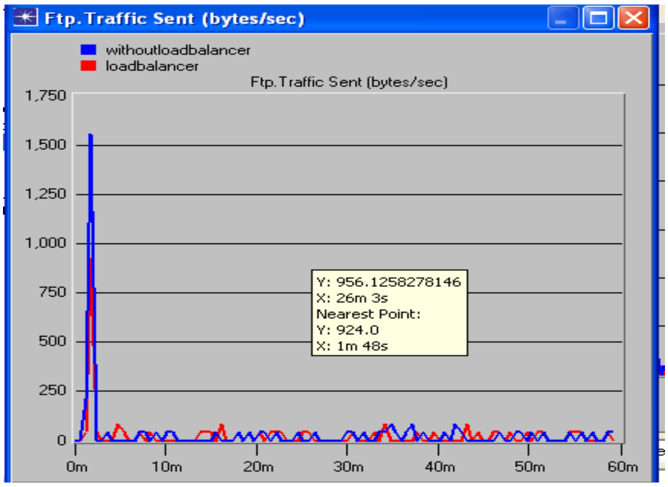

Fig 3.6 FTP Traffic Sent (bytes/sec)

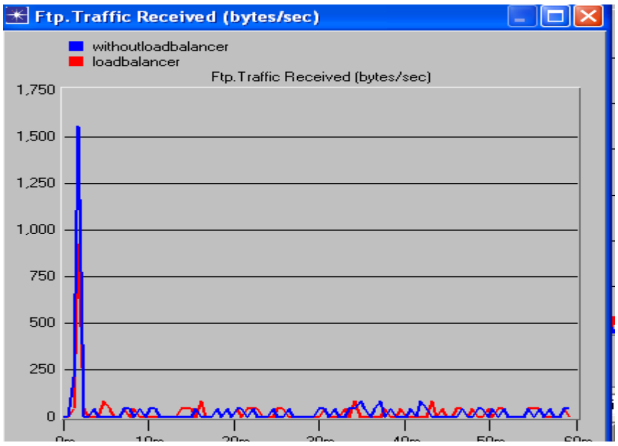

Fig: 3.7 FTP Traffic Received (bytes/sec)

Fig. 3.8 & 3.9 deals in HTTP parameters, Traffic received and sent (bytes/sec) gives better response in without load-balancer than the with load-balancer by approx 1800 bytes/sec with 0-2 m then after 2 m it will better just 300 bytes/sec.

Fig. 3.10 & 3.11 shows about page response time and object response time it shows better result in load-balancing by 0.015 and 0.022 respectively in seconds than unbalance network at all distances.

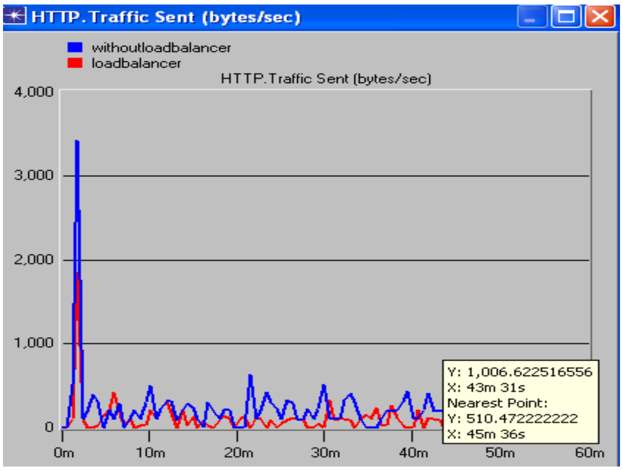

Fig 3.8 HTTP Traffic Sent (bytes/sec)

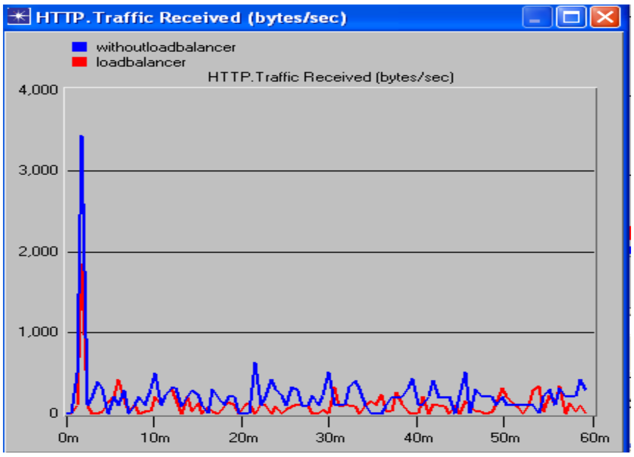

Fig 3.9 HTTP Recieved (bytes/sec)

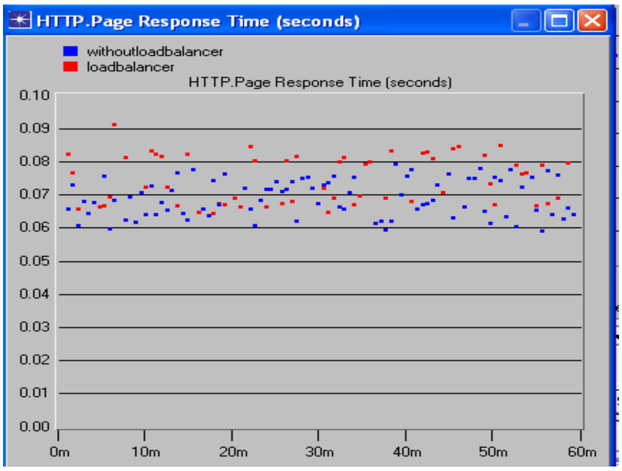

Fig 3.10 HTTP Page Response time (sec)

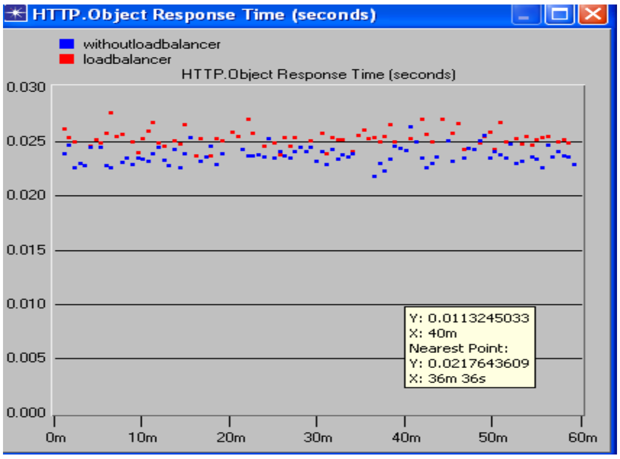

Fig 3.11 HTTP Object Response time (sec)

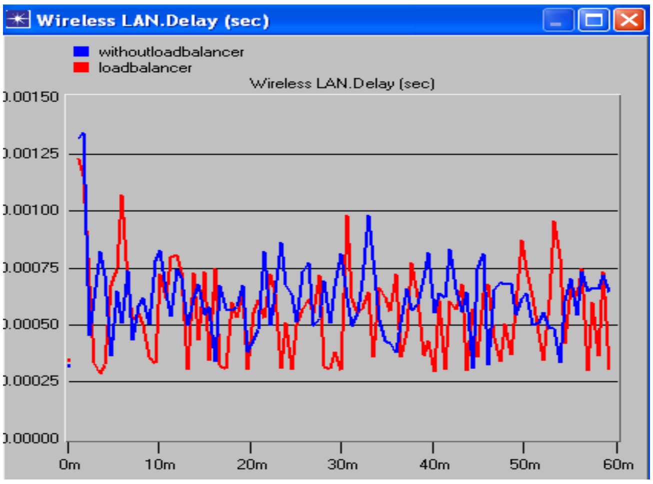

Fig 3.12 WLAN delay (sec)

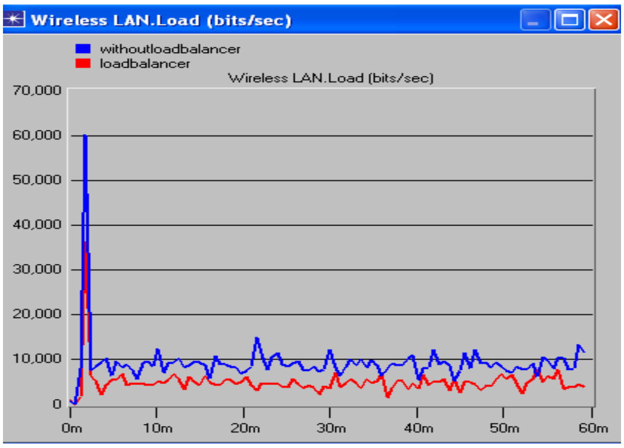

Fig 3.13 Wireless Load (LAN bits/sec)

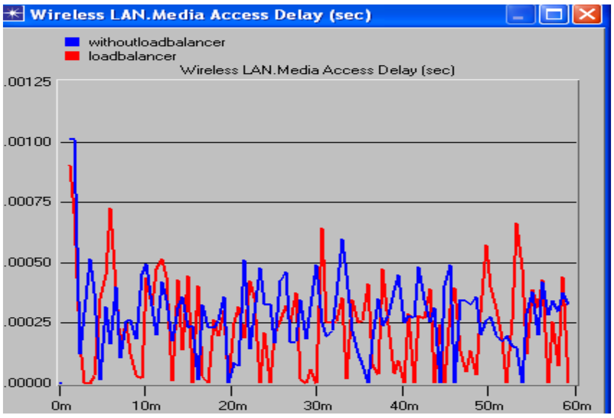

Fig 3.14 Wireless LAN Media Access Delay (sec)

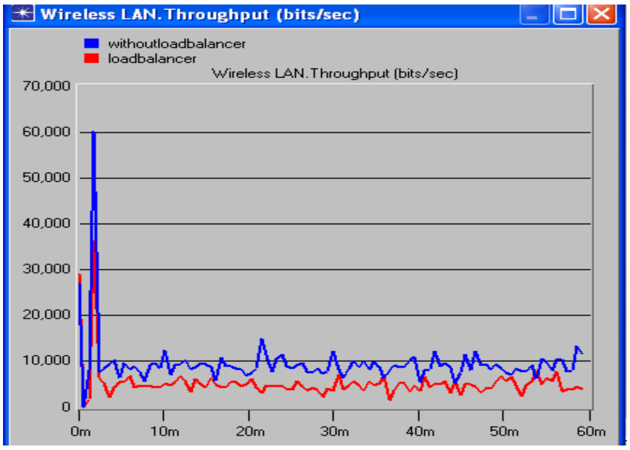

Fig 3.15 WLAN Throughput (bits/sec)

We have built a model of browsing behavior for a Web client, and use this model in a simulation study addressing the performance of the campus area network. Based on OPNET we have focused on the HTTP, FTP and Database statistics in the wireless network environment, and the impacts of factors such as page/object response time, wireless LAN media access delay, HTTP, FTP and Database server utilization have been seen. Moreover the comparative investigation on various performance metrics in wireless and wire-line LAN for a balanced and unbalanced network has been presented.

Fig. 3.12- 3.15 deals in Wireless LAN parameters, Delay is better in without load balancer than the with load balancer and Media access delay(sec) is also same as delay and if talked about Load and Throughput(bits/sec) it will show much better in without load balancing than with load balancing.

IV. CONCLUSION

It has been observed that the Database traffic received (bytes/sec) with load balancing is less in comparison with unbalanced network improvement in case of Database Query response time. In FTP, HTTP parameters, FTP upload and download response time (sec) both are better than HTTP in without load-balancer than the load-balancer at all distances and FTP traffic sent and received (bytes/sec) are better than HTTP in without load balancer than the with load balancer at all distances. Overall FTP server is better than HTTP and database server in balanced (with load) and unbalance (without balance) network.

V. REFERENCES

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