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RESEARCH ARTICLE

Modeling, Evaluation and Analysis of Ring Topology for Computer Applications Using Simulation

Harmeet Singh[1], *Sukhjeet Singh*[2], *Rahul Malhotra*[3]

GTB Khalsa Institute of Engineering and Technology, Malout

(PUNJAB TECHNICAL UNIVERSITY, INDIA)

Abstract— A computer network, or simply a network, is a collection of computers and other hardware interconnected by communication channels that allow sharing of resources and information. In this work performance analysis of the ring network configuration through simulation has been attempted. The work was started with the investigation of the network performance using various types of links. The impact of various network configurations on the network performance was analyzed using the network simulator-OPNET. In this analysis, the parameters investigated in are Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets), Load (packets/sec), traffic Received (packet/sec), Traffic received (packets), Traffic Received (bits/sec), Traffic Received (Bits).A ring network is designed with using OPNET ,having 10 Ethernet work stations. The analysis of above Ethernet parameters have been investigated and have concluded that the throughput diminishes when increased in network size.

I. INTRODUCTION

Networks are being upgraded or deployed from scuff all over the world. The area of network planning is thus fetching all the more noteworthy. Networks have grown swiftly over the past few decades, with confront of connecting the relevant networks together, so that the users can share the network's wealth. The undying thrust of humans to excel and fly beyond the limits of horizon has provided the impulsion for the up-gradation of diverse technologies and Wireless Technology is the blessed upshot of this effort. Change is the law of nature. Over a span of time the wireless Technology has overshadowed the wired technology. Wireless Technology is a rapidly growing segment of the communications industry, with a potential to provide high-speed, high quality information exchange between the portable devices located anywhere in the world. A wireless communication is a flexible data communication system implemented as an extension to or as an alternative for a wired communication. Wireless Local Area Networks (WLANs) have been developed to provide users in a limited geographical area with high bandwidth and similar services supported by the wired Local Area Network (LAN).

Topology refers to the way in which the network of computers is connected. Each topology is suited to specific tasks and has its own advantages and disadvantages. The choice of topology is dependent upon type and number of equipment being used, planned applications and rate of data transfers, required response times and finally the cost. There are FOUR major challenging topologies BUS, RING, STAR, and FDDI. Most networking software supports all topologies.

In Ring Topology, workstations connect to the ring, faulty workstations can be bypassed, more cabling required than bus, the connectors used tend to cause a lot of problems, commonly used to implement token ring at 4 and 16mbps, four wires, generally STP or UTP.

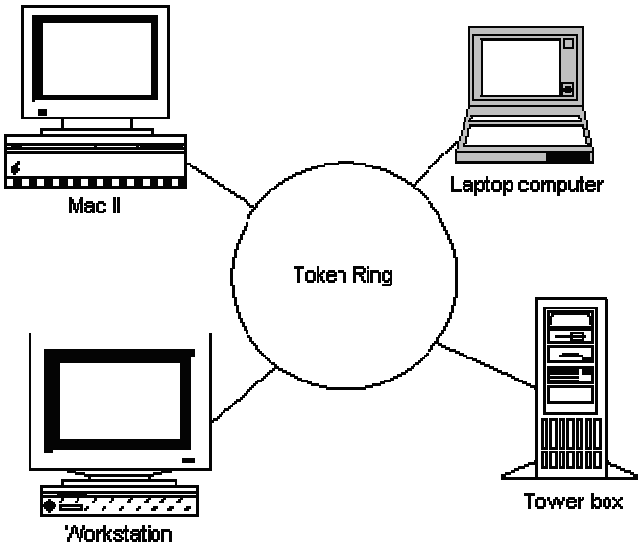

Fig. 1 Module of a Ring Configuration

II. PHYSICAL IMPLEMENTATION OF A RING NETWORK

Each workstation is connected back to a Multiple Access Unit (MAU), which supports up to eight workstations. Additional MAU are cascaded to provide greater workstation numbers.

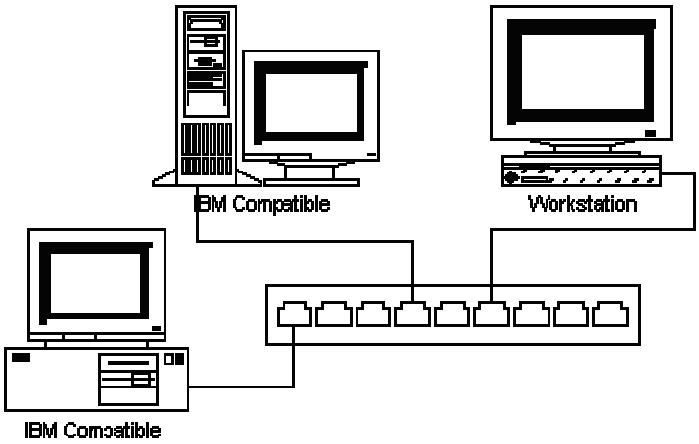

Fig. 2 Physical Implementation of a Ring Configuration

Wiring is performed in a physical star fashion, with cables wired directly from each workstation back to the MAU.

III. PERFORMANCE ANALYSIS OF RING NETWORK

In this work, a ring topology of 10 seeds has been taken to investigate its Ethernet parameters. The parameters investigated in this work are:-

Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets), Load (packets/sec), traffic Received (packet/sec), Traffic received (packets), Traffic Received (bits/sec), Traffic Received (Bits).

- **FTP- Traffic Received (bytes/sec):** This statistic means average bytes per second forwarded to all FTP applications by the transport layers in the network**.**
- **Ethernet – Traffic Received (bits/sec):** This statistic defines the throughput (bits/sec) of the data forwarded by the Ethernet layer to the higher layers in this node.
- **HTTP – Page response time (sec):** Specifies time required to retrieve the entire page with all the contained inline objects.

Performance metrics (Figure 3.22) measured in wireless computer networks are:

- **Wireless LAN- Delay (sec)**: Represents the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layer. This delay includes medium access delay at the source MAC, reception of all the fragments individually, and transfers of the frames via AP, if access point functionality is enabled.
- **Wireless LAN- Media Access Delay (sec):** This delay is calculated as the duration from the time when it is inserted into the transmission queue, which is arrival time for higher layer data packets and creation time for all other frames types, until the time when the frame is sent to the physical layer for the first time. Hence, it also includes the period for the successful RTS/CTS exchange, if this exchange is used prior to the transmission of that frame.
- **Wireless LAN- Retransmission Attempts (packets):** Total number of retransmission attempts by all WLAN MACs in the network until either the packet is successfully transmitted or it is discarded as a result of reaching the short or long retry limit. The retransmission attempt counts recorded under this statistic also include retry count increments due to internal collisions.
- **Wireless LAN- Throughput (bits/sec):** Represents the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

The figure shows the topology created by rapid configuration to design a Ring network composited of 10 Ethernet work stations

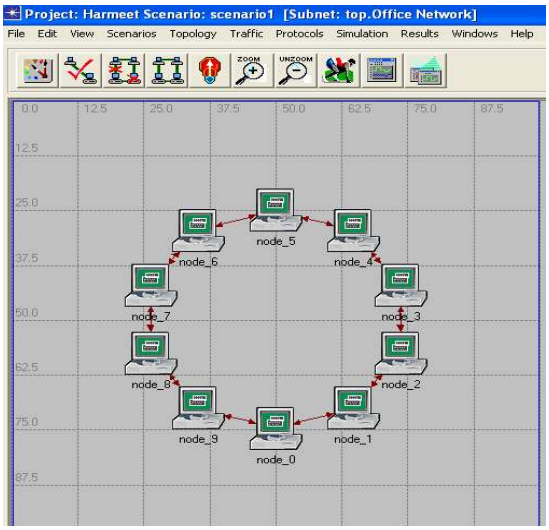

Fig. 3 A view of Ring Configuration in OPNET

Parameters investigated in OPNET are:-

Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets),Load (packets/sec),traffic Received (packet/sec),Traffic received (packets),Traffic Received (bits/sec),Traffic Received (Bits).

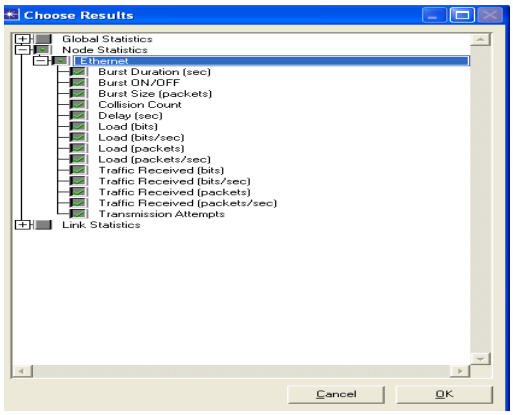

Fig. 4 Parameters investigated of Ring Configuration in OPNET

Simulation analysis for 1 hour duration has been performed by Harmeet Singh on OPNET Modular.

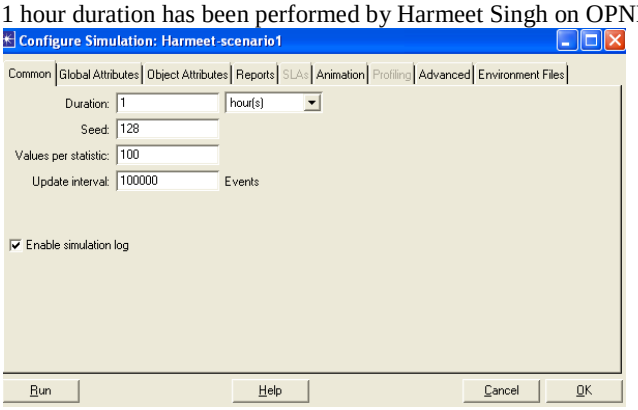

Fig. 5 Configure Simulation of Ring Configuration in OPNET

Stacked Statistics have been analyzed to see the response of Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets),Load (packets/sec),traffic Received (packet/sec),Traffic received (packets),Traffic Received (bits/sec),Traffic Received (Bits) **for node 0**.

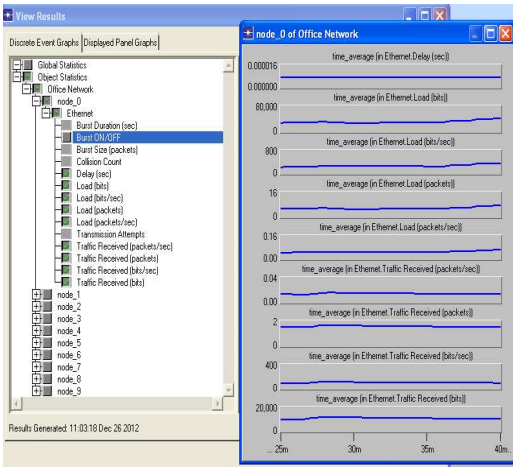

Fig. 6 Stacked statistics of various measured parameters of NODE 0 of Ring Configuration

For the broad analysis of the results obtained, Individual statistics have been taken for the analysis of Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets),Load (packets/sec),traffic Received (packet/sec),Traffic received (packets),Traffic Received (bits/sec),Traffic Received (Bits) **for node 1**.

Figure shows the individual statistics of Ethernet Delay in seconds, measure for data transmission between nodes of ring network in node 1.

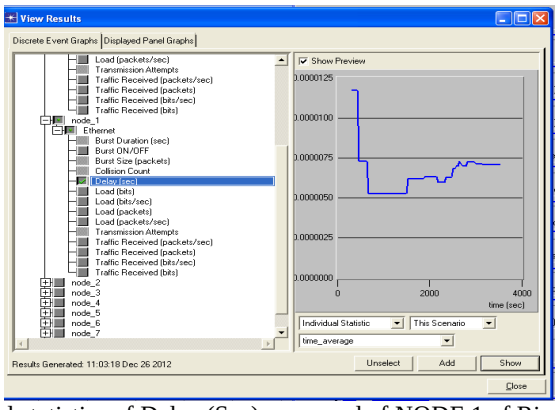

Fig. 7 Individual statistics of Delay (Sec) measured of NODE 1 of Ring Configuration

Figure shows the individual statistics of Ethernet Load in bits, measure for data transmission between nodes of ring network in node 1.

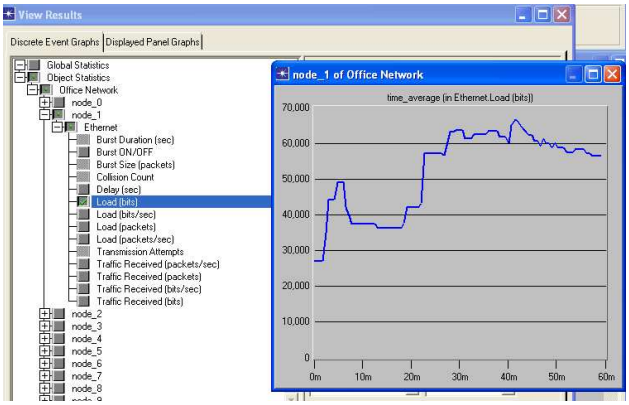

Fig. 8 Individual statistics of Ethernet load (bits) measured of NODE 1 of Ring Configuration

Figure shows the individual statistics of Ethernet Load in bits/sec, measure for data transmission between nodes of ring network in node 1.

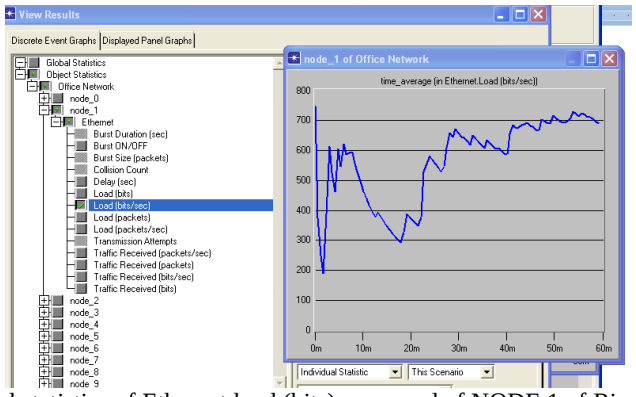

Fig. 9 Individual statistics of Ethernet load (bits) measured of NODE 1 of Ring Configuration

Figure shows the individual statistics of Ethernet Load in packets, measure for data transmission between nodes of ring network in node 1.

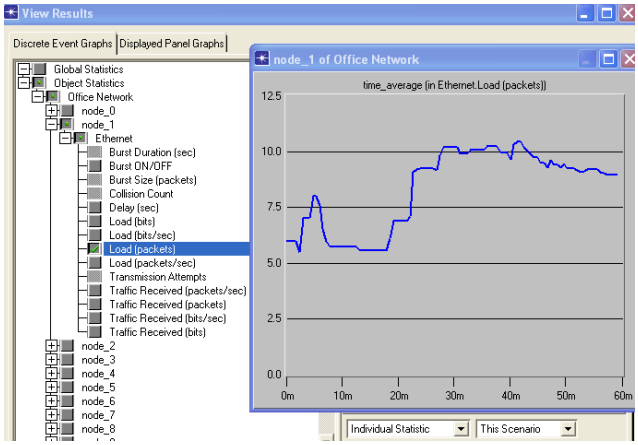

Fig. 10 Individual statistics of Ethernet load (packets) measured of NODE 1 of Ring Configuration

Figure shows the individual statistics of Ethernet Load in packets/sec, measure for data transmission between nodes of ring network in node 1.

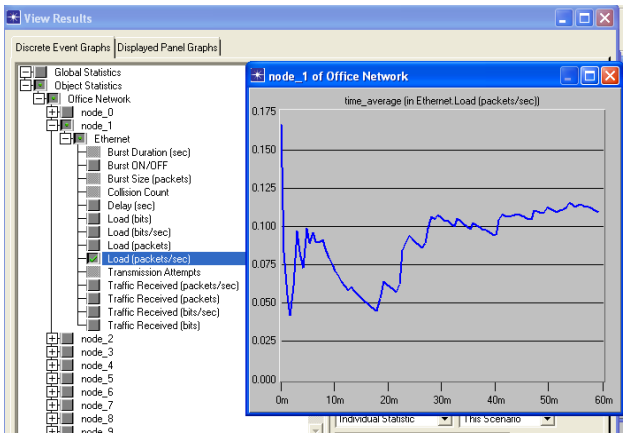

Fig. 11 Individual statistics of Ethernet load (packets/sec) measured of NODE 1 of Ring Configuration

Figure shows the individual statistics of Ethernet traffic received in packets, measure for data transmission between nodes of ring network in node 1.

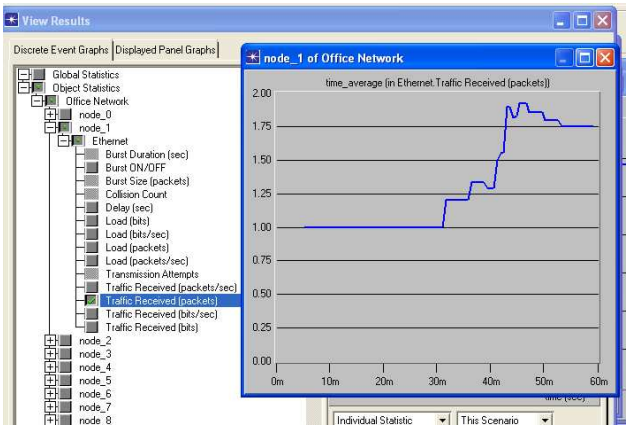

Fig. 12 Individual statistics of Ethernet traffic received (packets) measured of NODE 1 of Ring Configuration

Figure shows the individual statistics of Ethernet traffic received in bits/sec, measure for data transmission between nodes of ring network in node 1.

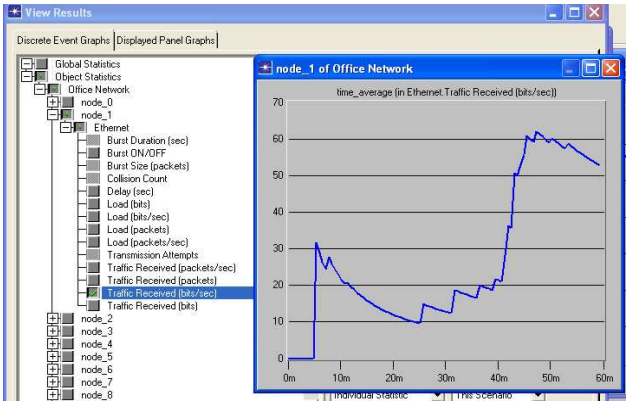

Fig. 13 Individual statistics of Ethernet traffic received (bits/sec) measured of NODE 1 of Ring Configuration

Figure shows the individual statistics of Ethernet traffic received in bits, measure for data transmission between nodes of ring network in node 1.

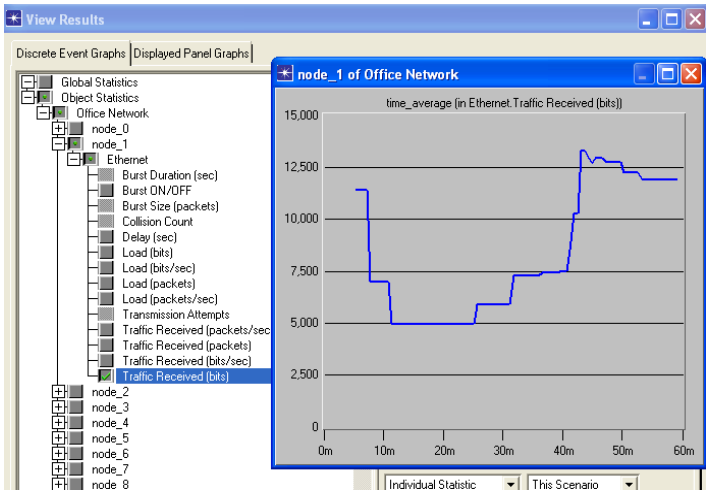

Fig. 14 Individual statistics of Ethernet traffic received (bits) measured of NODE 1 of Ring Configuration

IV. **ANALYSIS FOR NODE 2**

Stacked Statistics have been analyzed to see the response of Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets),Load (packets/sec),traffic Received (packet/sec),Traffic received (packets),Traffic Received (bits/sec),Traffic Received (Bits) for node 2.

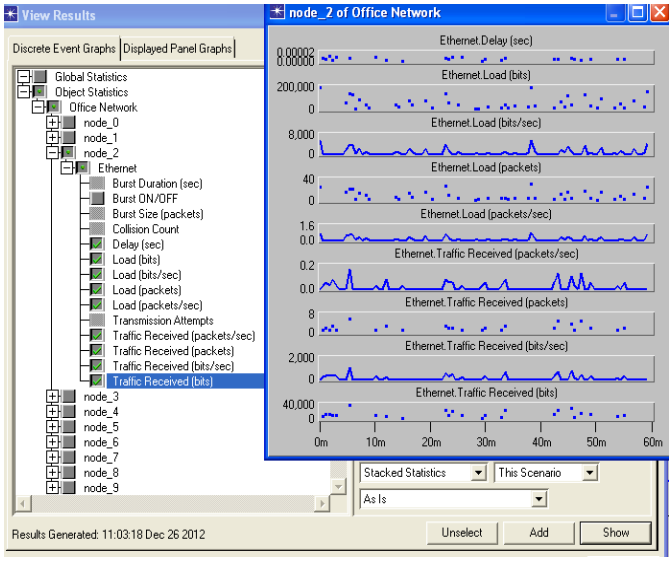

Fig. 15 Stacked statistics of various measured parameters of NODE 2 of Ring Configuration

V. **ANALYSIS FOR NODE 3**

Stacked Statistics have been analyzed to see the response of Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets),Load (packets/sec),traffic Received (packet/sec),Traffic received (packets),Traffic Received (bits/sec),Traffic Received (Bits) for node 3.

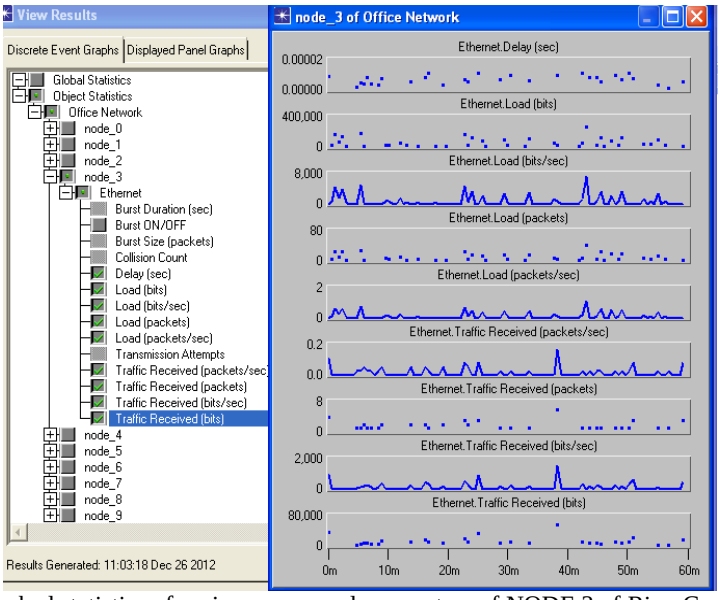

Fig. 16 Stacked statistics of various measured parameters of NODE 3 of Ring Configuration

VI. **ANALYSIS FOR NODE 4**

Stacked Statistics have been analyzed to see the response of Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets),Load (packets/sec),traffic Received (packet/sec),Traffic received (packets),Traffic Received (bits/sec),Traffic Received (Bits) for node 4.

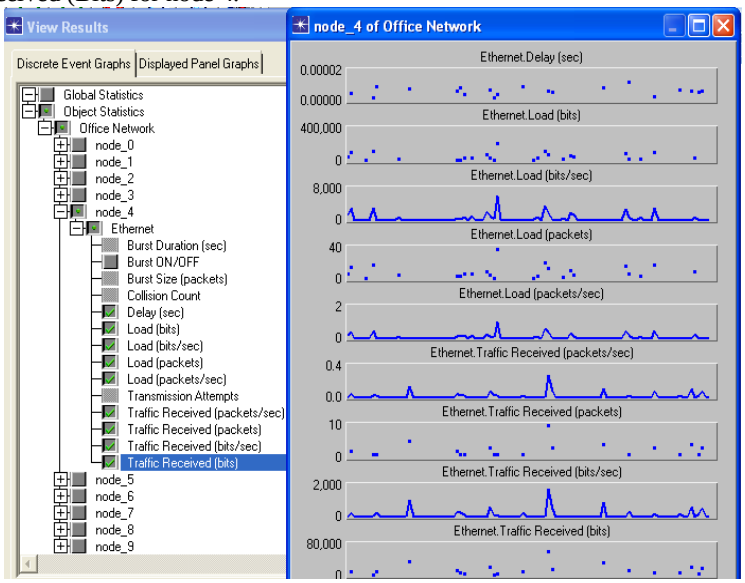

Fig. 17 Stacked statistics of various measured parameters of NODE 4 of Ring Configuration

VII. **ANALYSIS FOR NODE 5**

Stacked Statistics have been analyzed to see the response of Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets),Load (packets/sec),traffic Received (packet/sec),Traffic received (packets),Traffic Received (bits/sec),Traffic Received (Bits) for node 5.

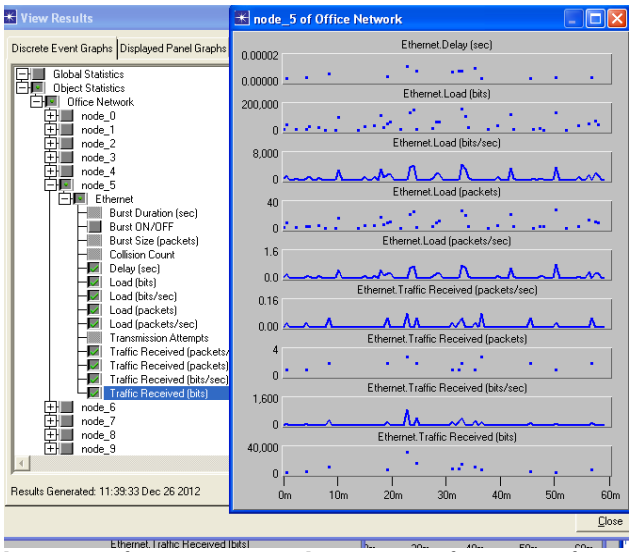

Fig. 18 Stacked statistics of various measured parameters of NODE 5 of Ring Configuration

In this work, a ring topology of 10 seeds has been taken to investigate its Ethernet parameters. The parameters investigated in this work are:-

Delay (Sec), Load (Bits), Load (bits/sec), Load (Packets), Load (packets/sec), traffic Received (packet/sec), Traffic received (packets), Traffic Received (bits/sec), Traffic Received (Bits) for Ethernet network have been investigated for node 0,1,2,3,4,5,6,7,8,and 9.

For detailed analysis, Individual statistics have been investigated in the work and for rest all nodes, stacked statistics have been analyzed.

In this work performance analysis of the ring network configuration through simulation has been attempted. The work was started with the investigation of the network performance using various types of links. The impact of various network configurations on the network performance was analyzed using the network simulator- OPNET. It has been investigated that performance of the wired Networks is good if high speed Ethernet links are used under heavy network loads. The mechanism of load balancing also improves the performance by reducing and balancing the load equally among multiple servers. In addition performance analysis of wireless computer networks has been done for improving the performance of wireless LAN. The investigations of physical characteristics reveal that the infrared type is best in terms of throughput. The variation in buffer size varies the queue size and hence optimizes the throughput.

VIII. CONCLUSIONS

Various factors which impact the network design and performance of wired and wireless computer networks have been analyzed using the network simulator- OPNET. The simulator results indicate that OPNET can be used to save the investment on implementation of real networks, by estimating and predicting the performance of the wired and wireless networks using computer. The main conclusions based on the network modeling and simulations are:

- High speed Ethernet link based Wired LANs provide better throughput.
- The mechanism of Ring topology reduces and balances the load on the server and thus reduces the response time.
- Infra –red type physical characteristics if used can provide increased throughput.
- The increase in the data rate can help increase the network throughput by decreasing the end-to-end delay.

The increase in network size can decrease the throughput marginally

IX. FUTURE SCOPE OF WORK

This paper mainly focused on the performance analysis of wired LANs and infrastructure based WLANs. In future, the work may be extended by including the schemes and techniques to:

- Optimize the security of the wired and wireless computer networks by using firewalls.
- Inculcate other parameters of network.
- Implementation of other topologies in OPNET.

- Study Infrastructure less (Ad Hoc) Networks.
- Study the impact on performance by varying transmission powers of nodes.

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