Performance Analysis of Diffferent Routing Protocols for Wireless Communication on The Basis of Quality of Sevice Parameters

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***Abstract*—** The advances in electronics and telecommunication industry in the last few decades have tremendously increased the use of wireless communication systems. The field of wireless communication networks has thus been a keen area of research in the last decade. One of the crucial parameter for efficient operation of any wireless network is the routing algorithm. However the choice of the routing algorithm depends not only on the physical topology and geography of the network but also on the application. This paper presents performance analysis of various routing protocols namely AODV, AOMDV, DSDV, DSR, TORA, SPAN, GEAR, LEACH and GAF. These protocols are analyzed on four network parameters: Throughput, Jitter, Delay and Energy consumption.

***Keywords**- Routing Protocols;AODV; AOMDV;DSDV;DSR;TORA;GEAR;LEACH;SPAN;GAF.*

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I. INTRODUCTION

Wireless communication is among technology's biggest contributions to mankind [1]. The use of wireless devices for various commercial and non-commercial applications has increased tremendously in the last few years. Further on-the-move internet facility and cheaply available wireless devices has added to this increase. Most organizations are potentially moving towards wireless networks today due to its obvious advantages. Further with the use of modern day digital image and video transmission techniques the amount of data which is getting transmitted through these wireless networks has doubled many folds. This increase in the use of wireless technology has put forward the need of higher data rates. To accommodate these needs researchers have proposed various techniques to improve the efficiency and reliability of these wireless networks.

Routing protocol is the most critical factor determining the efficiency of these wireless networks. Routing is the process of selecting paths in a network along which to send network traffic. Different routing protocols have been proposed in the past and yet are getting modified to achieve better throughput and minimum delay. These routing algorithms to some extent depend on the topology and application of the network. For example a routing algorithm may give superior performance in case of mobile ad-hoc networks as compared to its performance in wireless sensor networks.

This paper presents a comparative performance analysis some of the breakthrough routing protocols for wireless networks. The routing protocols are analyzed on the basis of four network parameters: delay, throughput, jitter and energy consumption. The following section discusses these brief the routing algorithms namely AODV, AOMDV, DSDV, DSR, TORA, SPAN, GEAR, LEACH and GAP.

II. LITERATURE SURVEY

A large number of routing protocols has been MANETs proposed so far. Some of them have been a breakthrough in the field of wireless communication networks. Some most commonly used routing protocols are discussed here.

1. Ad hoc On-Demand Distance Vector (AODV)

AODV is a routing protocol for other wireless ad-hoc networks. It is an on-demand routing protocol i.e., a route is established only when it is required. In AODV protocol the network node that needs a connection first requests for connection using broadcasts which is forwarded by other nodes, creating an explosion of temporary routes back to the needy node. The nodes in the network record the details of the node that they heard this broadcast message from and if they have a route to the destination node they respond back to the requesting node through a temporary route. The needy node then begins using the route that has the least number of hops through other nodes. Unused routes in the routing tables are flushed after some time. In case of link failures, a routing error is passed back to a transmitting node, and the process repeats.

Advantages:

a) Routes established on demand
b) Destination sequence numbers are applied to find the latest route to the destination.
c) Lower delay
d) In networks with light or moderate traffic requirements this protocol scales perfectly

Disadvantages:

a) Unnecessary bandwidth consumption due to periodic beaconing.
b) Is problematic for heavy traffic and high mobility networks.
c) Intermediate nodes can lead to inconsistent routes.
d) Lower BW.

2. Ad-hoc on-demand Multipath Distance Vector (AOMDV)

AOMDV is an extension to the AODV protocol for computing multiple loop-free and link disjoint paths [3]. AOMDV computes multiple loop-free paths per route discovery. This helps the protocol to switch routes to a different path in case a path fails without the need for a new route discovery. Route discovery is initiated only when all paths to a specific destination fails.

Advantages:

a) Routes established on demand
b) Link disjoint paths are computed so that paths fail independent of each other.
c) Better BW as compared to AODV
d) Is more suited to moderate to high traffic requirements.
e) Delay is better as compared to alternative routes as compared to AODV

Disadvantages:
a) Requires much more overheads as compared to AODV.

3. Destination sequenced distance vector routing (DSDV)

DSDV is a modified version of the conventional RIP protocol and is based on Bellman-Ford algorithm [4]. It adds a new attribute, sequence number, to each route table entry of the conventional RIP. In DSDV, each node maintains a routing table containing all available destinations routes, the metric and next hop to each destination and a sequence number generated by the destination node. Each node updates the routing table through periodic advertisement.

Each entry in the routing table contains a sequence number, even sequence number denotes link is present and odd number if link is not present or fails. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is dispersed by smaller incremental updates more frequently.

Advantages:
a) Solves routing loop problem efficiently
b) Latency of route discovery is low

Disadvantages:
a) Requires a regular update of its routing tables, which uses up battery power and bandwidth even idle state.
b) Suffers through route fluctuation because of its criteria of frequent route updates.
c) Care should be taken to reduce the number of control messages.

4. Dynamic Source Routing (DSR)

DSR is an on-demand routing protocol based on source routing technique in which a sender determines the exact sequence of nodes through which to propagate a packet [5]. In DSR, every node maintains a route cache to store source routes that it has learned. When a host wants to send a packet to some other host, it first checks its route cache for a source route to the destination. In the case a route is found, the sender uses this route to propagate the packet. Otherwise the source node initiates the route discovery process.

Advantages:
a) It eliminates the need to periodically flood the network with table update messages.
b) Use of route cache reduces the control overhead

Disadvantages:
a) Requires route maintenance mechanism does not locally repair a broken link
b) Connection setup delay is high
c) The performance degrades rapidly with increasing mobility

5. SPAN

SPAN is a distributed randomized algorithm which allows the node to make local decisions to sleep or join forwarding backbone as a coordinator. The nodes make this decision considering the amount of energy available and an estimate of how many neighbors benefit from it being in awake state. Span adaptively elects "coordinators" from all nodes in the network. Span coordinators stay idle continuously and perform multi-hop packet routing within the ad hoc network, while other nodes remain in power-saving mode and periodically check if they should become a coordinator.

Span achieves four goals. First, it ensures that enough coordinators are elected so that every node is in radio range of at least one coordinator. Second, it rotates the coordinators in order to ensure that all nodes share the task of providing global connectivity roughly equally. Third, it attempts to minimize the number of nodes elected as coordinators, thereby increasing network lifetime, but without suffering a significant loss of capacity or an increase in latency. Fourth, it elects coordinators using only local information in a decentralized manner—each node only consults state stored in local routing tables during the election process.

Advantages:
a) Improves the system lifetime as the ratio of idle-to-sleep consumption increases
b) Improves latency and capacity

Disadvantages:
a) Requires the need of synchronized clocks.
b) Not much used since DSR and AODV outperform TORA.
c) Scalability issues.

6. Geographical Energy Aware Routing (GEAR)

GEAR [7] uses a geographical and energy aware neighbor selection to route a packet towards the target region and Recursive Geographic Forwarding or Restricted Flooding algorithm to disseminate the packet inside the destination region. The process of forwarding a packet towards the destination involves choosing a neighbor that is closest to the destination among all the neighbors. If all neighbors are away a neighbor that minimizes the cost value is computed and chosen using:

$$c(Ni,R)=\alpha d(Ni,R)+(1-\alpha)e(Ni) \quad (1)$$

where is d(Ni,R) the distance from Ni to the centroid D of the region R normalized by the largest distance among all the neighbors Ni and is the consumed energy at node Ni normalized by the largest consumed energy among the neighbors of N.

Advantages:
a) Location based protocol
b) Operates on the principle of demand driven data delivery model
c) Creates loop free routes

Disadvantages:
a) GEAR faces a problem of limited scalability
b) (Quality of service) QoS is poor.
c) All nodes are active even though only a part of the network is queried

7. Low-Energy Adaptive Clustering Hierarchy (LEACH)

In LEACH, the nodes arrange themselves into local clusters, with one node acting as the cluster-head. All non-cluster head nodes transmit their data through the cluster head [8]. On receiving the data the cluster head node perform signal processing functions on the data e.g., data aggregation, and transmit data to the remote base-station.

Advantages:

a) Randomized, adaptive, self-configuring cluster formation,

b) Localized control for data transfers,

c) Low -energy media access, and

d) Application, specific data processing, such as data aggregation

Disadvantages:

a) A cluster-head node consumes much more energy for transmission of data than non-cluster-head node. In scenario where all nodes are energy limited, if the cluster head chosen is energy deficient as in case of static election or the cluster head runs out of energy, it is no longer operational. Thus dynamic clustering algorithm is must and is computationally effective.

8. Geographic Adaptive Fidelity (GAF)

Geographic Adaptive Fidelity or GAF is an energy aware location-based routing algorithm [7]. In GAF each node associates with itself a virtual grid using its location information through a GPS module. This divides the entire area several square shaped grids. Now the node having highest residual energy within each grid becomes the master of that grid. GAF aims to maximize the network lifetime by reaching a state where each grid has only one active sensor based on sensor ranking which is based on their residual energy levels.

Advantages:

a) Location based protocol

b) Operates on the principle of demand driven data delivery model

c) Creates loop free routes

Disadvantages:

a) Not very scalable. As the network size increases distance to the base station increases

b) Only the active nodes sense and report data. Hence data accuracy is not very high.

III. Results

To analyze these routing protocols we have implemented a wireless sensor network on NS-2 consisting of 20 wireless nodes. Figure 1 below shows all the graphs for AODV protocol. Figure 2 to 8 below show only the delay and throughput graphs for other routing protocols. Table 1 below shows the comparison on the basis of all four parameters: throughput, delay, energy and jitter.

Table I: Comparison Table

Parameter / Protocol	Delay	Throughput	Jitter	Energy Consumption
AODV	High	Better	High	High
AOMDV	Medium	Best	High	High
DSDV	Low	Better	Medium	Highest
DSR	Low	Good	Highest	High
GAF	Lower	Poor	Medium	Medium
GEAR	Lowest	Poor	Low	Lowest
LEACH	Low	Good	Medium	Medium
SPAN	Medium	Poor	Low	Medium

IV. Conclusion

In this paper, we have presented a performance analysis of eight different routing protocols for wireless network communication. These protocols have been implemented in NS-2 and are analyzed on the basis of four crucial parameters: Throughput, delay, jitter and energy consumption. From the analysis we conclude that AOMDV is better in comparison to AODV, DSR and DSDV as it has best throughput but suffers from high jitter and energy. AOMDV is thus suitable for networks where nodes are having sufficient energy. On the other hand the GEAR is the most energy efficient protocol of them all but it has poor throughput and is thus suitable for some sensor networks where energy is the most critical factor. LEACH is somewhat better in comparison as it gives a good trade-off and has low delay, medium energy consumption and good throughput.

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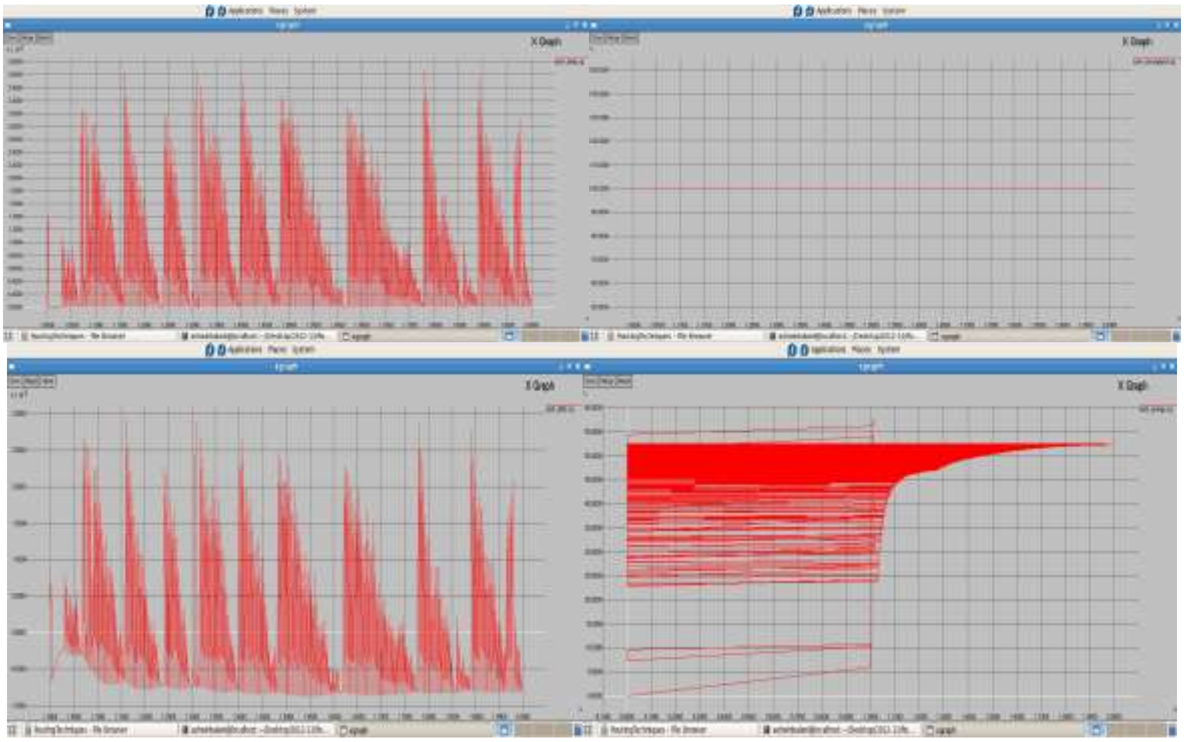

Figure 1.Delay, Throughput, Jitter and Energy consumption graph for AODV

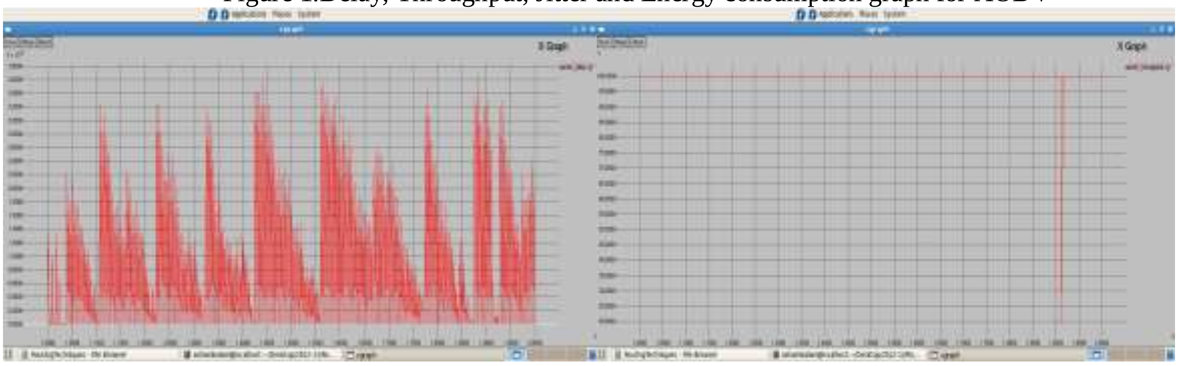

Figure 2. Delay and Throughput graph for AOMDV

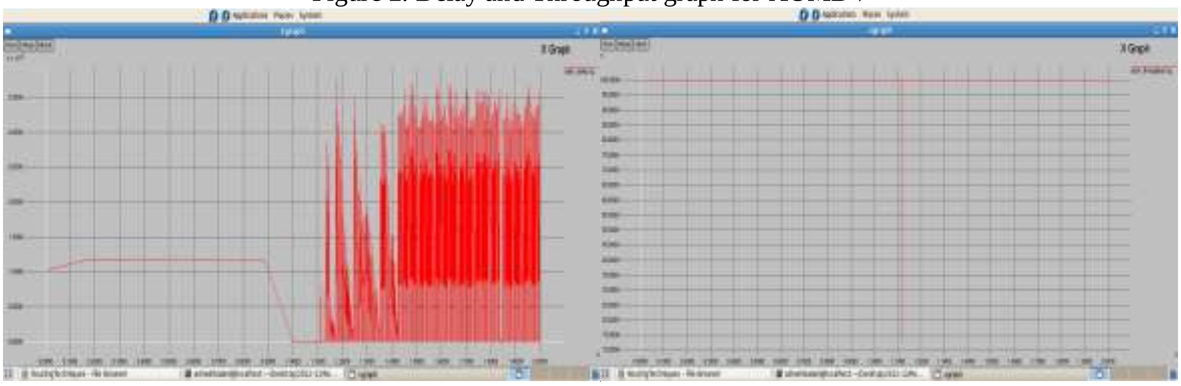

Figure 3.Delay and Throughput graph for DSDV

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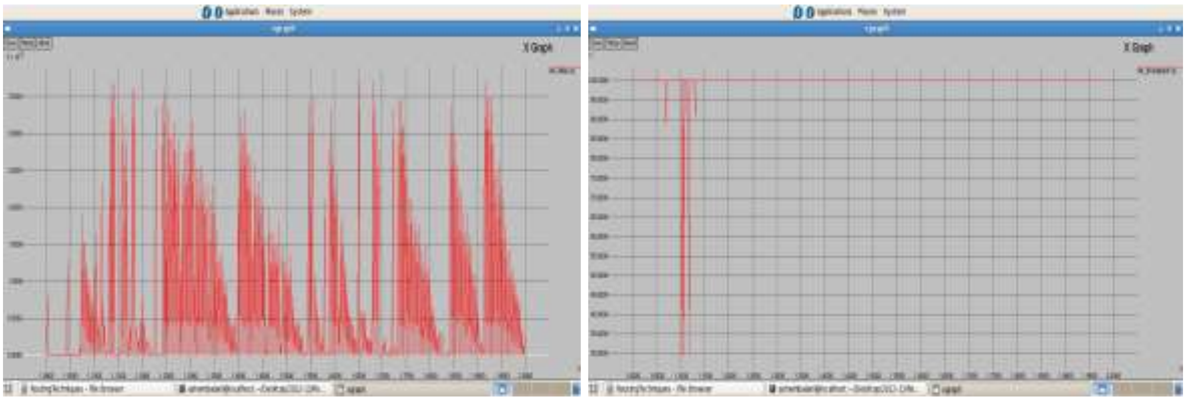

Figure 4.Delay and Throughput graph DSR

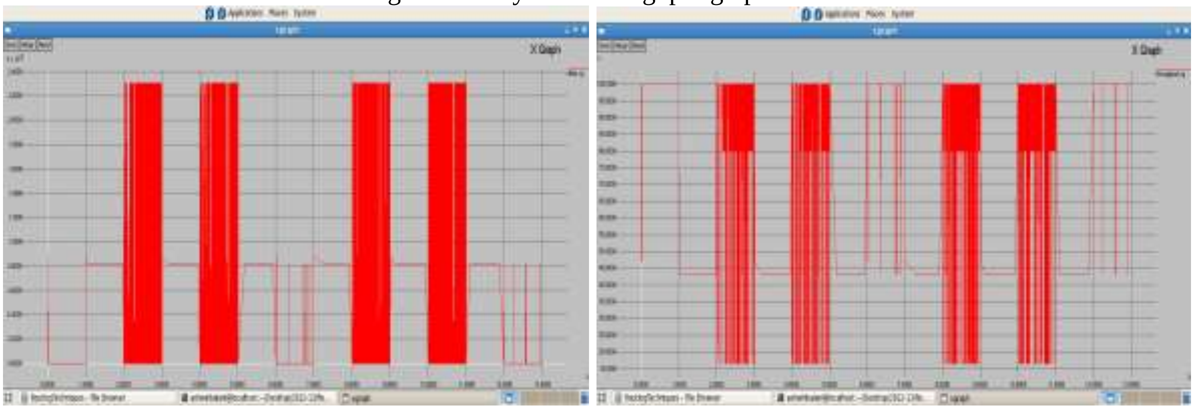

Figure 5.Delay and Throughput graph GAF

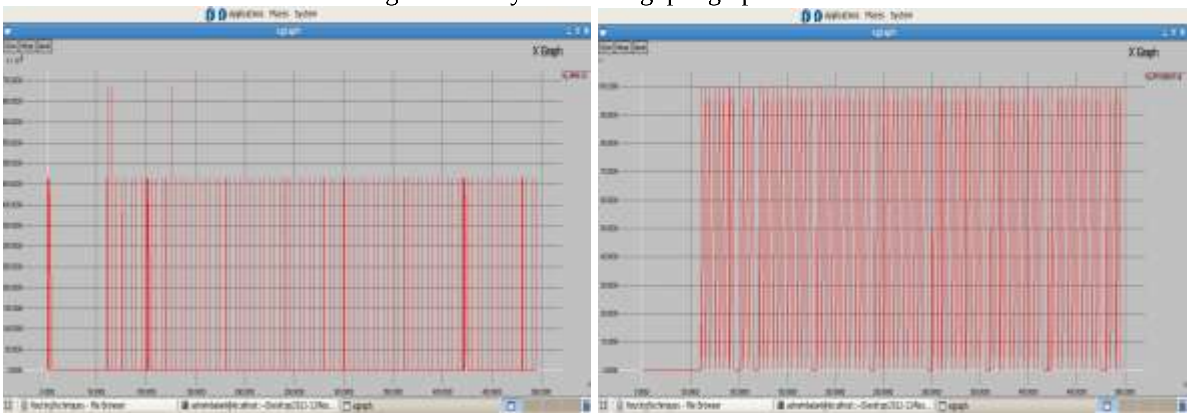

Figure 6. Delay and Throughput graph GEAR

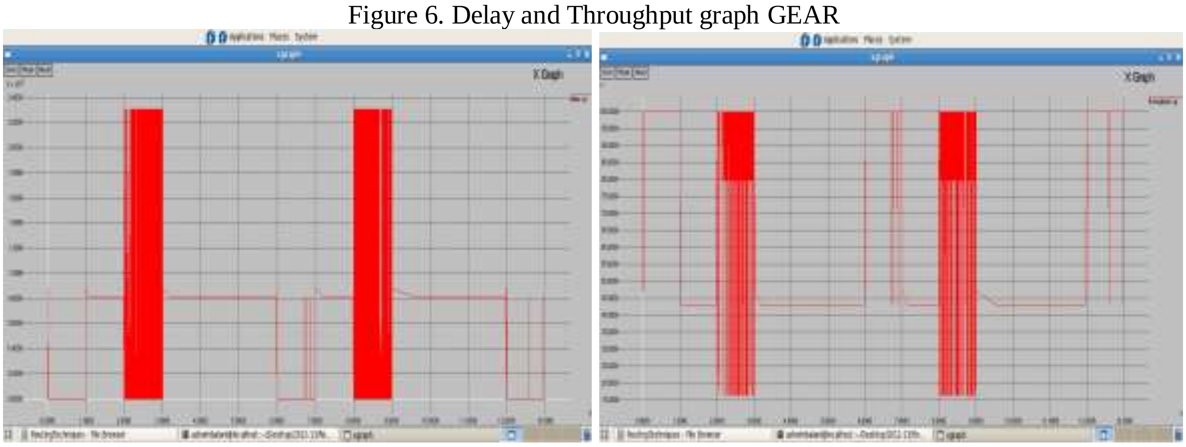

Figure 7. Delay and Throughput graph LEACH

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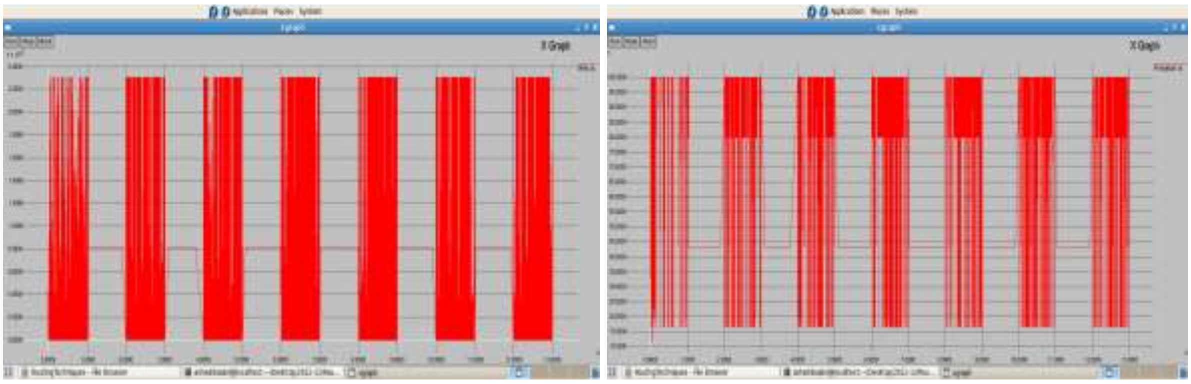

Figure 8. Delay and Throughput graph SPAN