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SIMULATION AND QOS ANALYSIS OF TCP, UDP/AODV

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ABSTRACT

One of the rapidly growing technologies is the ad-hoc (MANET) network, the standards, technical issues, and security aspects are not fully studied and established. Routing is an important function for the reliable utilization of networks. In this paper, we design and build a simulation based system, we compare AODV protocol with TCP and UDP. We design and simulate Ad-hoc network in both cases using NS-2 software. Results of simulation compare delay, jitter, and throughput values for these cases versus simulation time.

Keywords: *TCP, UDP, AODV, WLAN, QoS*

1. INTRODUCTION

Wireless networking becomes an essential requirement in our daily life, the mobility, flexibility, and low cost associated with Wireless Local Networks (WLAN) are impressive characteristics. For more mobility, the Ad Hoc with no Access Point (AP) are standardized by IEEE 802. 11. This type of networks is popular today; some aspects and protocols still need more study and analysis. We concentrate over the Quality of service (QoS) parameters of routing protocols, operating at the network layer just above Internet Protocol (IP) with Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) at the transport layer.

Here we consider the popular routing protocol called Ad Hoc On-Demand Distance Vector (AODV).

Each station in a MANET is free to move independently in any direction and will therefore change its links to other stations frequently. Each station forwards data unrelated to its own use, and therefore perform the function of a router. The primary challenge in designing and establishing a MANET is equipping each station to continuously maintain the information required to properly route traffic. Such networks may operate separately or may be connected to the Internet. MANETs may contain multiple and different transceivers between nodes. This results in a highly dynamic, flexible, and autonomous topology.

MANETs are a kind of wireless ad hoc network. It operates at radio frequencies (30 MHz – 5 GHz) including 2.4 GHz. Which belong to ISM band [1].

IEEE 802.11 is part of the IEEE 802 set of LAN protocols, and specifies the set of media access control (MAC) such as CSMA/CA mechanism and physical layer (PHY) protocols for implementing WLAN.

IEEE 802.11b was the first widely accepted standard for WLAN, followed by 802.11a, 802.11g, 802.11n, and 802.11ac. Other standards in the family (c–f, h, j) used to extend the current scope of the existing standard [2].

Nodes in a MANET are classified by their capabilities. A Server is Large Mobile Host (LMH), a node having a larger share of resources. Servers, due to their larger capacity contain the complete DBMS and bear the primary responsibility for data broadcast and satisfying client queries. A Client is Small Mobile Host (SMH). a node with reduced processing, storage, communication, and power resources. Clients typically have sufficient resources to cache portions of the database as well as storing some DBMS query and processing modules. In a MANET, each node has an area of influence. This is the area over which its transmissions can be heard. A LMH

will initially have a larger area of influence as it generally has a more powerful battery. As the power level decreases, the area of influence of any node will shrink because the power available to broadcast is reduced.

Network nodes may operate in any of three modes that are designed to facilitate the reduction in power used:

- Active Mode (or Transmit Mode):

In this mode, node uses the most power. It allows both the transmission and reception of messages.

- Doze Mode (or Receive Mode):

In this mode, the CPU can process information and receiving notification of messages from other nodes and listening to broadcasts.

- Sleep Mode (or Standby Mode):

The CPU does no processing, and the node has no ability to send/receive messages. The node is inactive. This mode allows a node to turn itself off for short periods of time without requiring power-up or re-initialization [3].

To our best knowledge, after searching the available literature, the mentioned issue is not presented directly in any of papers.

Authors in [4] compares different Ad Hoc routing protocols, a study version of OPNET, which have limited choice of routing protocol, has been used to evaluate performance. A set of references [5], [6], [7], [8] and [9] present an overview of MANET routing protocols and discuss reactive, proactive and hybrid MANET routing protocols. Here, in these references, the AODV is mentioned as popular reactive protocol.

Analysis of QoS of AODV is simulated in [10] under both the CBR and VBR traffic classes by varying node density, transmission rate and transmission range. And in [11] under different unipath and multipath routing protocol and compare the performance of different protocols select the best one among them.

EAODV is an enhanced route discovery mechanism that avoids the RREQ rejection and reduces the delay, the new approach is proposed in [12].

In general, there are several limitations in performing such simulation, the number of stations, simulation time and the number of analyzed parameters are restricted in assumption that obtained results can be applied to larger number of stations.

Our gool is to build a simulation system, which describes Ad Hoc network and suitable for estimating different QoS parameter.

There is a lot of papers about AODV simulation and analysis, the comparison of AODV QoS parameters versus simulation time with TCP and UDP using NS-2 is not discussed previously.

This research paper is divided into 5 sectors: Introduction, AODV Protocol, Simulation Steps, Results of Simulation, and conclusion.

2. AODV Protocol

In this part of paper, we explain the protocols and relation between them. AODV is routing protocol, as it known, these protocols operate at the network layer of OSI reference model. Whereas TCP and UDP operate at the transport layer just above routing protocols.

2.1 AODV

AODV protocol is one of numerous protocols, which have been designed and standardized for ad-hoc networks. Such protocols should face a set of specifications: the limitation in available resources, low bandwidth, high mobility and high-power consumption. AS a reactive unicast protocol, AODV only needs to contain the routing information about the active paths in the routing tables at all nodes based on next hop routing method. This method simplifies routing tables and decreases the load on network.

For the connection to other mobile nodes, in the absence of available rout, the sending node initiates discovery operation by broadcasting route request (RREQ) packets which includes Destination Sequence Number (DSN). When the destination node receives the RREQ, it checks the DSNs in its memory and the one included in the received RREQ. After that the destination node sends unicast route reply (RREP) packet back to the source if the DSN is equal to or greater than the DSN contained in RREQ.

2.2. Difference Between TCP and UDP

TCP is connection-oriented protocol, whereas UDP is connection-less. This means that TCP tracks all data segments sent, requiring acknowledgment for each byte by sequence and acknowledgment numbering. UDP does not use

acknowledgments at all and is usually used for non-sensitive to loss applications.

Because of acknowledgments and sequence numbering, TCP is considered a reliable data transfer protocol. It ensures that no data is sent to the application layer that is out of order, duplicated, or with errors. TCP mechanisms manage transmissions of data traffic to control congestion using, for example, sliding widow technique.

TCP is not suitable for streaming applications such as voice and video, these applications are sensitive to delay and jitter, but TCP is slow.

UDP is a very lightweight and quick protocol defined in RFC 768. No acknowledgment, sequence numbers or sliding widow techniques. The primary uses for UDP include service advertisements, such as routing protocol updates and server availability, one-to-many multicast applications, and streaming applications, such as voice and video, where a lost datagram is far less important than an out-of-order datagram [13].

3. SIMULATION STEPS

To perform the simulation of network and achieving results we act as follows:

- Configure the working environment and use the Cygwin program with windows to activate the NS-2 software.
- Create a TCL file then setup all parameters as Link Layer, Protocol Router and MAC to create nodes.
- Create moving to move these nodes.
- Create a TR and NAM files then run a NAM file to preview the connection and nodes movement and others without analysis.
- Run and merge a TCL and TR files into an analysis program which is NS to get results of QoS namely: delay, jitter and throughput.

3.1. CREATING TCL SCRIPT

After that we design the topology for Ad-hoc network, the TCL code was generated. This code should be saved with a name extended by (. tcl). We named (AodvTcp.tcl) for AODV protocol with TCP and (AodvUdp.tcl) for AODV protocol with UDP.

3.2. RUNING NAM FILE IN NS-2

We use a NAM file for viewing network simulation traces and real world packet traces.

To run NAM file, we follow these steps:

- Create NAM file by opening Cygwin software and enter command as show figures 1 and 2.
- Select the TCL files with names (AodvTcp.tcl), (AodvUdp.tcl).
- Select and operate a NAM file.3

After opening the NAM file, we can see the behavior of nodes in the network when we use AODV protocol with TCP and UDP. The figures 3 and 4 show the nodes behavior.

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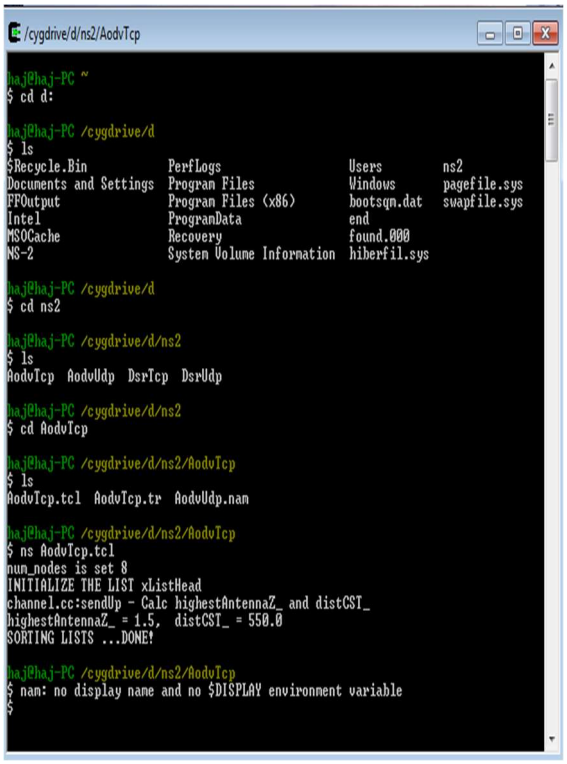

Fig. 1. Cygwin command for AodvTcp.tcl

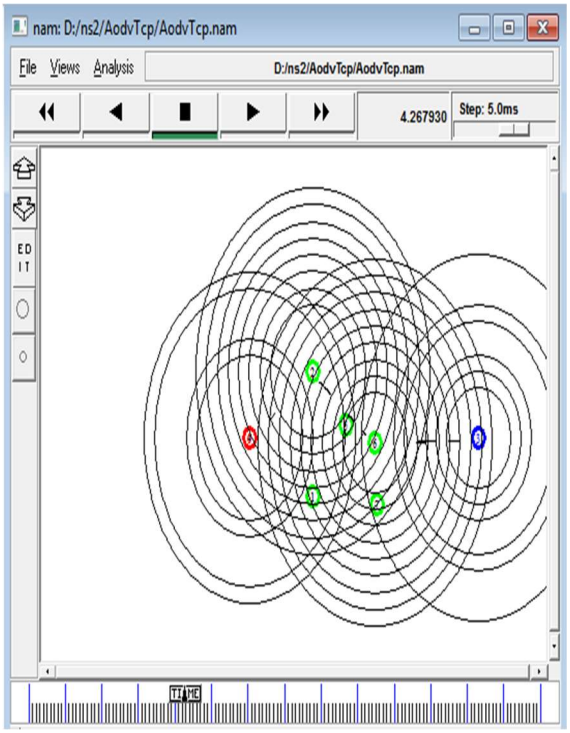

Fig. 3. Nodes behavior for AodvTcp.nam

Fig. 2. Cygwin command for AodvUdp.tcl

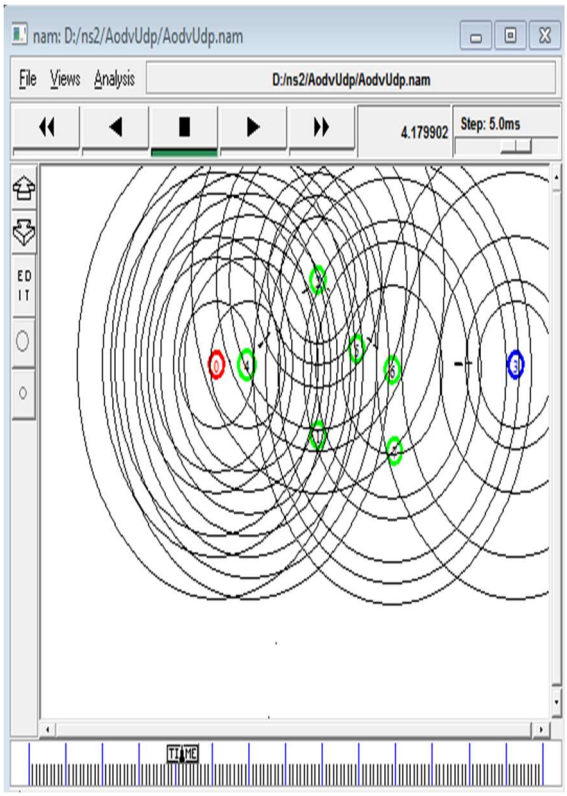

Fig. 4. Nodes behavior for AodvUdp.nam

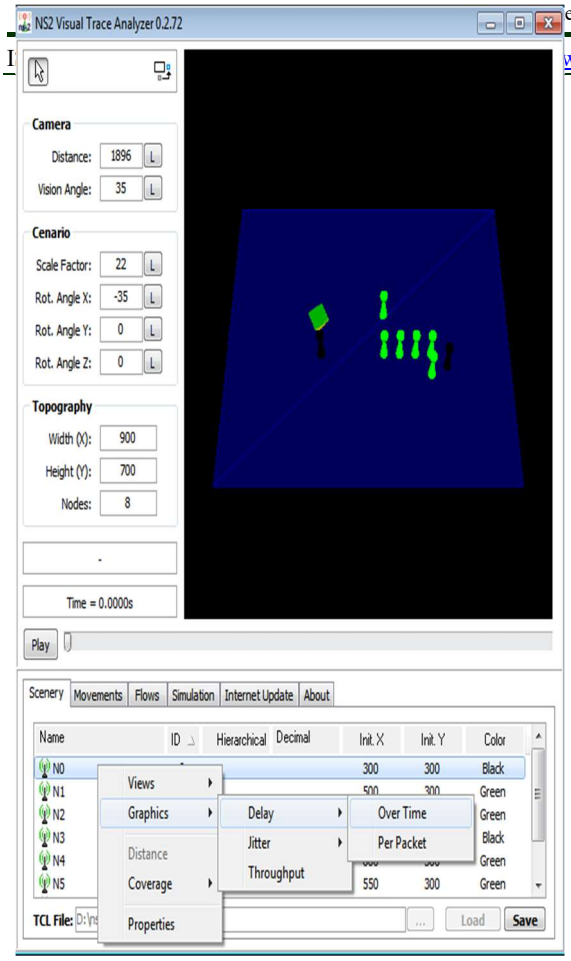

Fig. 5. Choice of node N0

3.3 NS-2 VISUAL TRACE ANALYSER

Now we choose one of nodes to analyze delay, jitter and throughput by right click on the node, then the choice will appear on screen as shown in figure 5.

4. RESULTS OF SIMULATION

In this part of paper, we present the results of simulating the AODV protocol with TCP and UDP. We discuss the delay, jitter and throughput of the network versus simulation time.

I would like to note that this simulation system and analysis of the obtained results was presented and discussed in the graduation project of my students: Noor Al-hawarneh, Sara Al-quraan and Rahaf Al-haj at Al-Huson University College, Al-Balqa Applied University, Jordan

4.1. DELAY, JITTER AND THROUGHPUT VALUES FOR AODV with TCP

Packet delay is an important design and performance characteristic of all types of networks: computer or telecommunications or Ad Hoc network. The delay of a packet specifies how long of time it takes for a group of data bit to travel across the network from the source of information to the destination. It is typically measured in milli seconds. Delay may differ slightly, depending on the distance, location of the specific pair of communicating nodes and waiting time at router [14].

Jitter is a deviation in delay. Packet jitter is packet delay variation and defined as the variation in latency as measured in the variability over time of the end to end delay across a network. Ad Hoc network with variable delay has packet jitter.

Both delay and jitter are important QoS factors in assessment of network performance, especially for interactive, sensitive to delay applications, such as on-line voice and video.

The system or network throughput is the actual data rate that delivered to all nodes in a network. Throughput depends directly on the available bandwidth; it can be analyzed mathematically by applying the queueing theory, which is difficult issue [15], or by simulation as in this paper.

In this case when we use AODV protocol with TCP, we present the behavior of node zero and node three.

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In figure 6, we present the simulation results of throughput, delay and jitter for node zero with

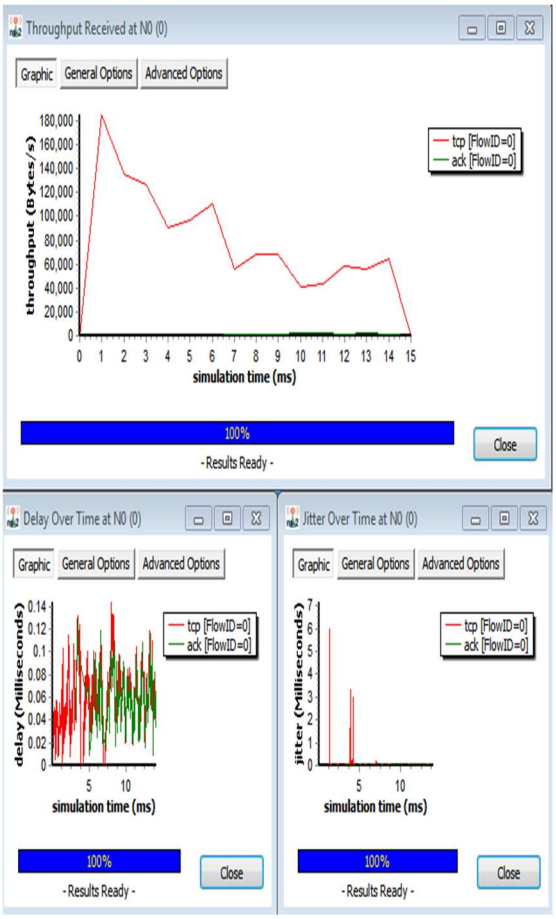

Fig.6 Simulation of node N0 AODV/TCP

AODV/TCP. We see the throughput approached maximum value of 180 Kbytes/s at 1.08 ms of simulation time and we noticed that the throughput

is varied over time, also see the maximum delay

0,14 ms at 7.82 ms, and the maximum jitter 6 ms at 1.96s.

In figure 7, we present the simulation results of throughput, delay and jitter for node three with AODV/TCP. We see the throughput increased slowly varied over time and approached maximum value 80 Kbytes/s at 9.85s, also see the maximum delay 0.9 ms at 4.52s, and the maximum jitter 6 ms at 2.12s.

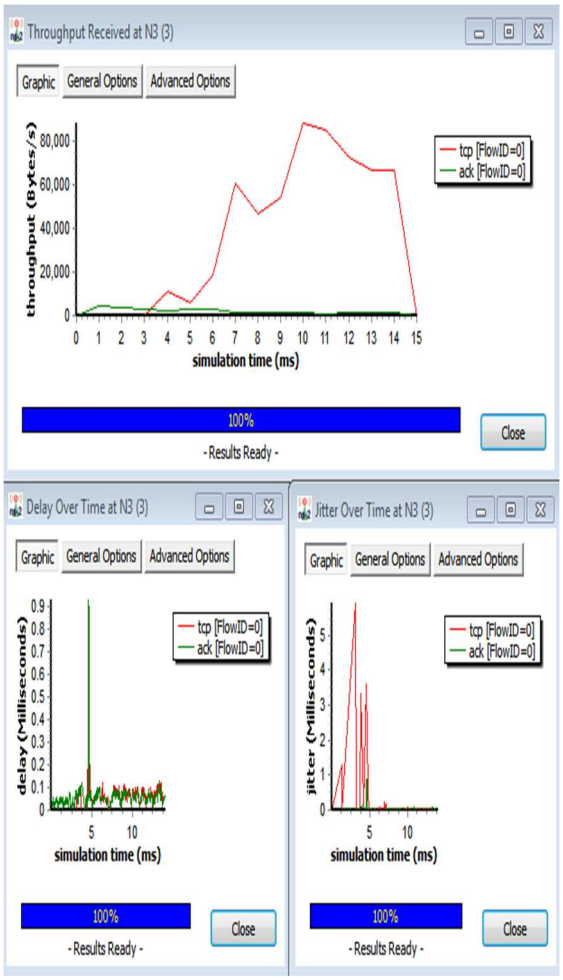

Fig. 7. Simulation of node N3 AODV/TCP

4.2. DELAY, JITTER AND THROUGHPUT VALUES FOR AODV with UDP

Next, we use AODV protocol with UDP, we present the behavior of node zero and node three.

In figure 8 we present the simulation results of throughput, delay and jitter for node zero with AODV/UDP. we see the throughput approached zero value at 5 s of simulation time and after careful monitoring the scenario we noticed that all nodes become out of range of node zero, also the maximum delay 0.52 ms at 1.82s, and the maximum jitter 7.5 ms at 1.83s.

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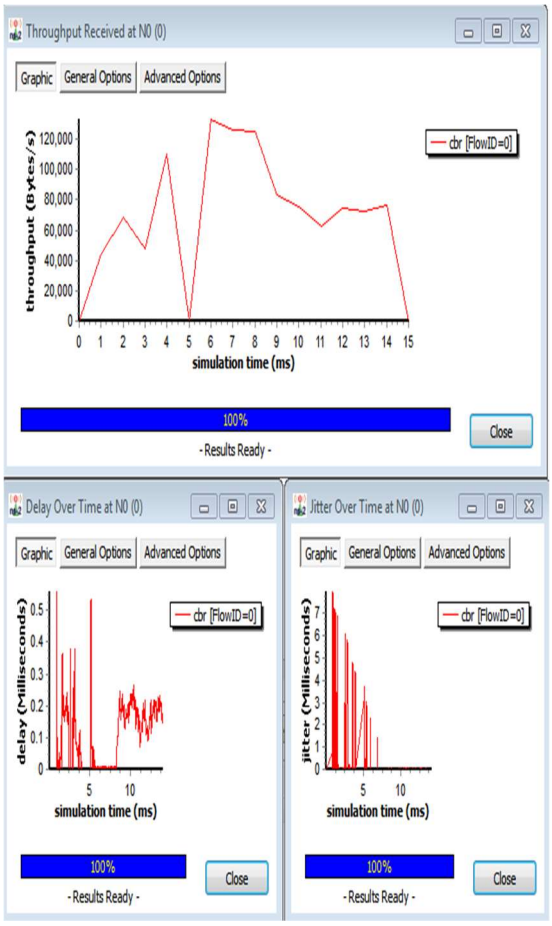
Fig. 8. Simulation of node N0 AODV/UDP



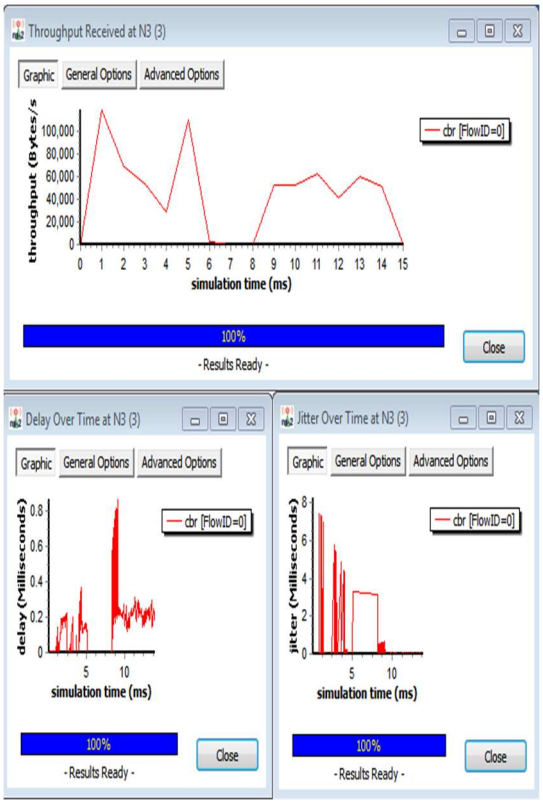


Fig. 9. Simulation of node N3 AODV/UDP

In figure 9, we present the simulation results of throughput, delay and jitter for node three with AODV/ UDP, we see the throughput approached maximum value 110 Kbytes/s at 0.97s time and we noticed that the throughput varied over time, also the maximum delay 0.84 ms at 8.94s, and the maximum jitter 6.8 ms at 1.04s. From 5 to 8 ms, the throughput and delay are zeros.

5. CONCLUSION

At this point, after the simulation results were achieved and discussed we conclude:

- a simulation system, which describes Ad Hoc network and suitable for estimating different QoS parameter is built.
- the proposed simulation methodology is adequately describing the random behavior of nodes in Ad-hoc network
- calculation of performance parameters in each
- second of a predefined scenario.
- with UDP, a zero throughput is achieved for node N0, longer zero throughput is monitored

for node N3, while no thing is seen in TCP throughput curve.

- One of issues that are unattended in this work is the comparison between different routing protocols.

In the future work, a different routing protocols, such as DSR, AOMDV and MDART protocols will be applied to our simulation system and QoS parameters will be abstained and discussed.

Furthermore, additional QoS parameters can be used for the comparison between routing protocols including delay, jitter, throughput, data rate, capacity, bit error rate and bandwidth.

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