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Dynamic source routing protocol with transmission control and user datagram protocols

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ABSTRACT

Dynamic source routing protocol (DSR) is a common routing protocol in wireless network without infrastructure, called ad-hoc network, DSR used just above internet protocol (IP) at the network layer. The upper transport layer provides reliability by transmission control protocol (TCP) and user datagram protocol (UDP). The choice between DSR/TCP and DSR/UDP is an actual issue for network designers and engineers. The question arises: which one provides better quality of service (QoS) parameters, less delay and jitter, greater throughput, and data rates. This paper focuses on the study and analysis of DSR and comparison of DSR/TCP and DSR/UDP by simulation in network simulator (NS2) environment. Another comparison of DSR and ad hoc on-demand distance vector (AODV) is provided. Design and simulation of the protocols in ad hoc network accurately describe the behavior in real system and QoS parameters are obtained.

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1. INTRODUCTION

Dynamic source routing protocol (DSR) is a reactive unicast routing protocol that makes use of a source routing algorithm. It is an on-demand protocol that helps in managing the amount of bandwidth used by managing packets in wireless ad-hoc networks. Unlike table-driven alternatives, this protocol does not require additional work to update the table in accordance with the most recent network conditions. This protocol differs significantly from other on-demand routing protocols in that hello packet transmissions, which are used by a node to notify other nodes nearby to its presence, are not necessary [1].

This protocol's basic method for choosing a route is to build a route by flooding the network with route request (RREQ) packets. In response to receiving an RREQ packet, the destination node sends the route reply (RREP) packet back to the source. The route that the RREQ packet took to arrive at the target node is contained in the RREP packet [2]. DSR is a common ad-hoc network routing protocol, used just above internet protocol (IP) at the network layer. The upper transport layer provides reliability by transmission control protocol (TCP) and user datagram protocol (UDP). The choice between DSR/TCP and DSR/UDP is an actual issue for network designers and engineers. Thus, routing protocol analysis become a major challenging task in ad-hoc network [3]. The question arises which one provides better quality of service (QoS) parameters, less delay and jitter, greater throughput, and data rates.

This paper focuses on the study and analysis of DSR and comparison of DSR/TCP and DSR/UDP by simulation in network simulator (NS2) [4]–[6] environment. Another comparison of DSR and ad hoc on-demand distance vector (AODV) [7] is provided. A wireless network without infrastructure, called ad-hoc network, is an effective solution for connecting a group of people together in a localized area when the internet, electricity, and infrastructure are unavailable. Ad-hoc networks provide connectivity, mobility, flexibility, availability, and low cost associated with the absence of access point (AP).

The IEEE 802. 11 standard governs these networks and the study of different aspects, especially the routing protocols is active today. A thorough performance evaluation of AODV and temporally ordered routing algorithm (TORA) routing protocols is simulated by NS2 [8]. Using the characteristics of packet delivery fraction and end-to-end delay, a research of mobile ad hoc network (MANET) routing protocols was conducted. A network size variation of geographical aided routing protocols in MANET is proposed in [9]. Routing protocols for flying Ad-Hoc network resources are efficiently utilized in [10]. Our focus is on the quality of service (QoS) criteria for dynamic source routing (DSR) protocols, which function at the network layer directly above IP, while TCP and UDP operate at the transport layer.

Most scientific research papers, in recent times, contain a survey [11]–[17], comparison [18]–[22], or review [23]–[25] study of the routing protocols in wireless local area network (WLAN) networks with different applications and properties. This paper is a real study of DSR parameters using NS2 simulator. We concentrated on the results of simulation and comparison presented in several figures, finally we conclude the paper.

2. METHOD

This section is devoted to explaining research methodology. An ad-hoc network creation procedure is first made. Then, similar to what was done in [7] for AODV, TCL, and .NAM files for DSR protocol using TCP or UDP are developed.

2.1. Creating TCL script

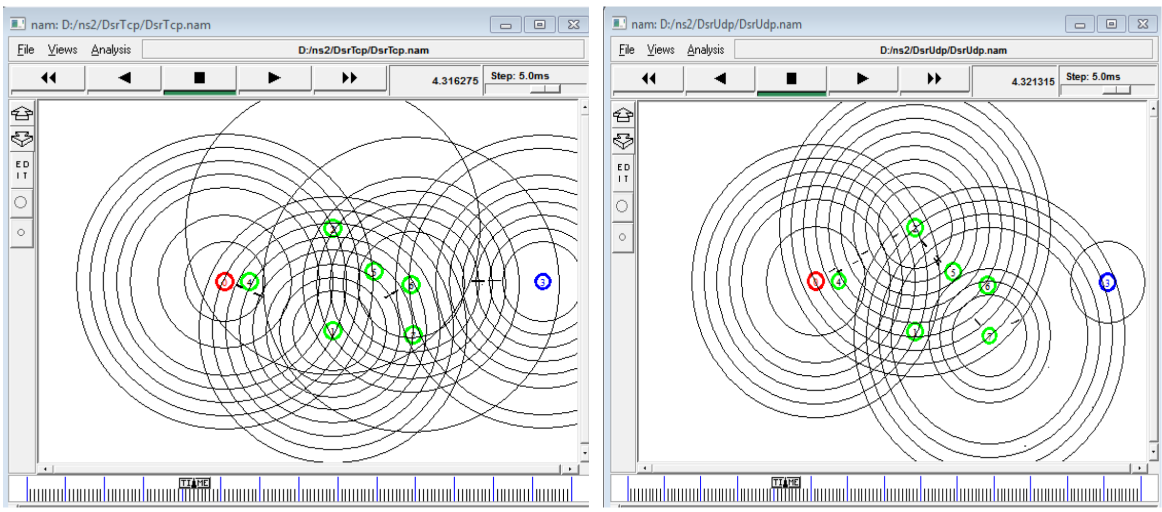
First, we created the ad-hoc network's topology, then we generated the TCL code. The code was saved with a name ending by (.tcl). For the DSR protocol using TCP and UDP, respectively, we designated (DsrTcp.tcl) and (DsrUdp.tcl).

2.2. Running NAM file in NS2

To view the network real-world packet and simulation traces a NAM file is used. Follow the steps below to run the NAM file:

– Open the Cygwin software to create the NAM file and enter the required commands.
– Select the TCL files which named (DsrTcp.tcl) and (DsrUdp.tcl).
– Operate and select a NAM file that we need to execute.
– Simulate ad-hoc network.

Figure 1 depicts how ad-hoc nodes behave when utilizing the DSR protocol. The behavior of the protocol using TCP is shown in Figure 1(a). Figure 1(b) depicts how the protocol behaves while using UDP. When opening the NS2 analyzer, the start screen appeared, then select and load TCL file to choose the scenario file, then select and load the trace file (TR). By choosing one of the nodes to analyze jitter, data rate, delay, and throughput by right-clicking on the node, then the choices of parameters will appear.



(a) (b)

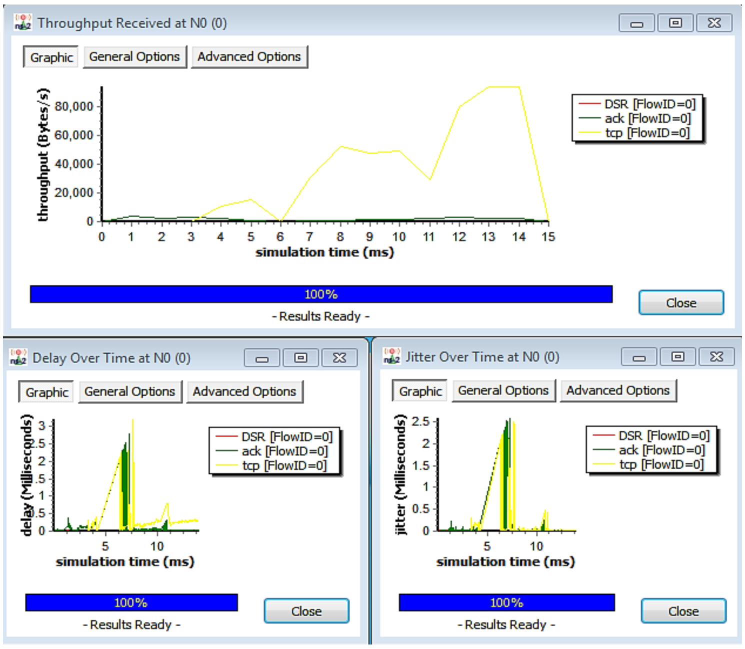
Figure 1. Nodes behaviour for (a) DSR TCP.nam and (b) DSR UDP.nam

3. RESULTS AND DISCUSSION

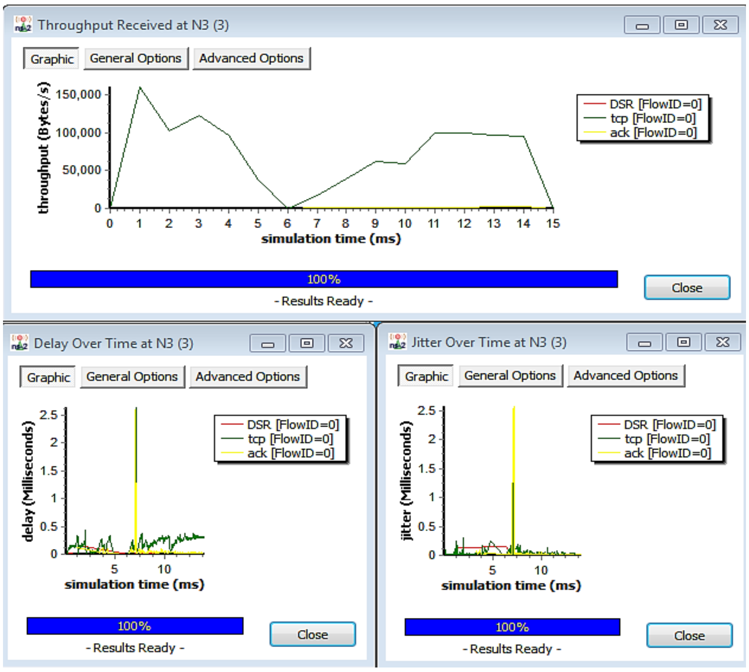
This section presents the simulation results of the DSR protocols with UDP and TCP for nodes N0 and N3. A comparison between the AODV and DSR protocols is also done. Then a discussion of the results is made.

3.1. Simulation results

Figure 2 demonstrates how nodes 0 and 3 behave when the DSR protocol is used with TCP. In Figure 2(a), We indicate that the throughput approached zero value at 3.08 s, changed with time, and was close to its maximum value at 14.52 s, as well as the maximum delay at 7.62 s, and the maximum jitter at 7.66 s of the simulation duration. On the other hand, Figure 2(b) shows the throughput approaching the maximum value at 0.98 s of the simulation duration. We found that the throughput changed over time, along with the maximum delay at 7.85, and the maximum jitter at 7.76 s.



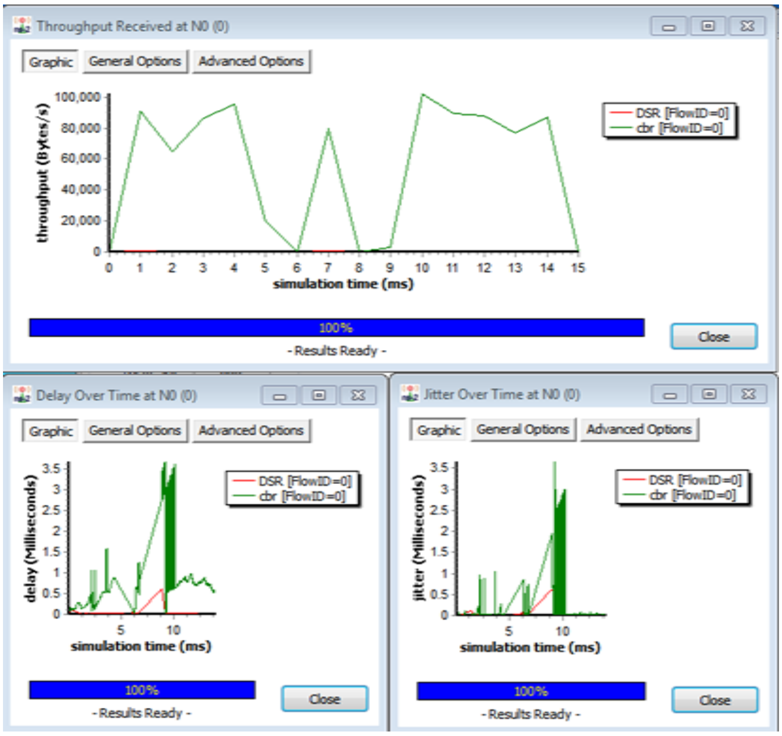
(a)



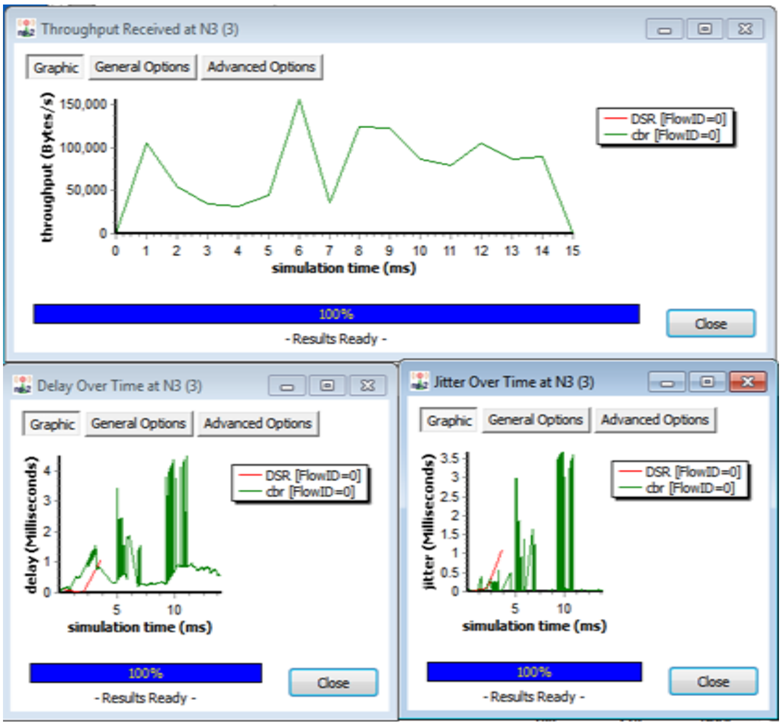
(b)

Figure 2. Throughput of (a) N0 DSR/TCP and (b) N3 DSR/TCP

Figure 3 presents the behavior of DSR protocol with UDP. The behavior of node zero and node three is explained in Figures 3(a) and 3(b) correspondingly, we can monitor the throughput approached the maximum value at 9.88 s time, also the maximum delay at 9.22 s, and the maximum jitter at 9.16 s. From Figure 3(b), the throughput approached the maximum value at 6.02 s time and the maximum delay at 11.45, and the maximum jitter at 9.76 s.



(a)



(b)

Figure 3. Throughput of (a) N0 DSR/UDP and (b) N3 DSR/UDP

3.2. Comparison results AodvTcp, AodvUdp, DsrTcp, and DsrUdp

This section presents a comparison between AodvTcp, AodvUdp, DsrTcp, and DsrUdp in terms of generated data, delay, jitter, data rate, and throughput. Figure 4 shows the generated data results for the protocols. Figure 5 shows the packet delay and jitter results. The throughput of the protocols is shown in Figure 6.

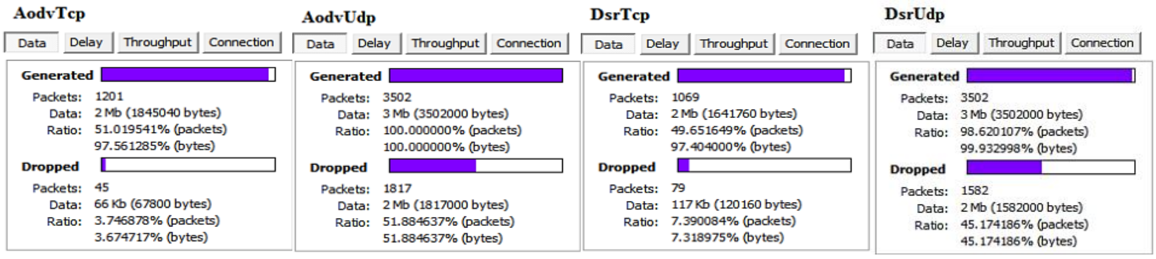


Figure 4. Generated data results

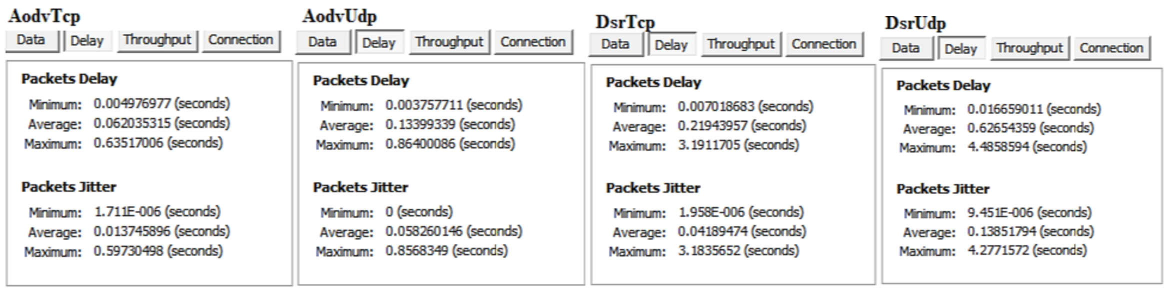


Figure 5. Packet delay and jitter results

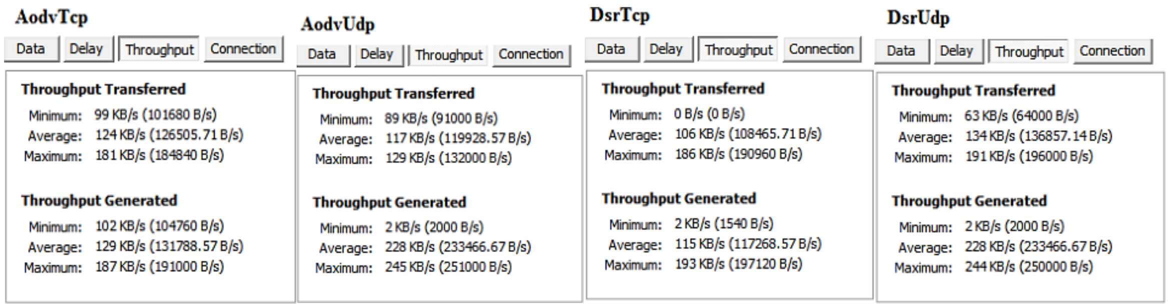


Figure 6. Throughput results

3.3. Discussion

We found that the highest generated and dropped data for AodvUdp, DsrUdp, AodvTcp, and DsrTcp. also, we found the maximum, average, and minimum values of both end-to-end packet delay and jitter for AodvUdp, DsrUdp, AodvTcp, and DsrTcp. The highest transferred and generated throughput for AodvUdp, DsrUdp, AodvTcp, and DsrTcp are also presented.

The maximum data generated during simulation time is 3,502 packets by both AodvUdp, DsrUdp, and dropped is 1817 packets in AodvUdp, this is clear noticing that UDP protocol is connectionless and quick protocol but provides best-effort service, with no guarantees. While TCP is connection-oriented, reliable with acknowledgment but slower than UDP protocol.

Comparing AodvUdp and DsrUdp, we remark that AODV has dropped more packets than DSR. In the case of AodvTcp and DsrTcp we note that AODV generated more and dropped fewer packets than DSR. The results of delay and jitter parameters are proportional to each other while inverse to throughput, this is logically intuitive, as delay and jitter increased, the traffic increased, and the throughput decreased.

All other parameters can be similarly concluded from comparison figures, the choice of routing and transport layer protocol stack is made upon the required ad-hoc characteristic and performance, some applications are sensitive to delay and jitter such as live video and voice, while others are sensitive to throughput and transmitted data packets like e-mail service.

4. CONCLUSION

This paper aimed to compare the QoS parameters of DSR routing protocol with UDP and TCP. Therefore, we designed ad-hoc network in NS2 simulator, and performed multiple runs. From the results of the simulation applied to the designed ad-hoc network, we can conclude the following: i) by using TCP, the delay and jitter increased while the throughput decreased; ii) UDP protocol is simple and fast, so we noted that no acknowledgment can be sent; iii) the simulation process of DSR is light, as it is on-demand, while the AODV is heavy; iv) by careful monitoring of the scenario, we can define the periods of high and low throughput, delay, and jitter; and v) as the scenario can change randomly the performance parameters can change accordingly. Finally, in our scenario simulation, the best QoS parameters are found in the case of DSR with UDP.

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