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Comparative Study of MANET Protocols on Cloud Based Applications through Simulation Model

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Abstract— Now days, most of the organisations are in need of distribution of application which has to be done collaboratively. The work or task can be shared to all the members of the group where they can work together on it by using their own machines or laptops over a network. In collaborative work multiple users can work on the same task in parallel mode. To implement it traditional client server architecture can suites for sharing the application for collaborative work. Individual server runs the application and client machines or remote machines allow to access these services. However, there are chances to decrease computation capacity of server in terms of processing and memory. In that case, it may down the response time in accessing the application. To match these requirements cloud computing with ad hoc networking is best option. Ad- hoc cloud computing means allow cloud services to run on existing heterogeneous hardware. In other words running cloud services on ad-hoc network. Computational and storage resources within organizations are often under-utilized. By using this concept we can increase the utilization of general purpose computers & other hardware devices. In this work, we have constructed a detailed simulation model using OPNET 14.5 simulator. Simulation model was designed in a manner that servers were working in ad hoc mode as well as clients were also working in ad hoc mode with different ad hoc routing protocols. Servers were running with cloud services and all clients were accessing all those services by sending large amount of traffic for every second. Simulation runs for 300 seconds. In this work we have also tested the performance of ad hoc routing protocols over cloud services that are AODV, DSR, and OLSR, GRP and TORA using parameters like throughput, delay, load, retransmission attempts, data dropped and data sent & received.

Keywords—Ad hoc-network protocol, ad hoc cloud computing, performance analysis, simulation models, OPNET 14.5

I. INTRODUCTION

Computational and storage resources within organizations are often under-utilized. This is likely to increase with further adoption of cloud services. A volunteer cloud infrastructure, supporting what we term ad hoc cloud computing, would allow cloud services to run on existing heterogeneous hardware [12]. In current era of IT companies are in need of distribution of application which has to be done collaboratively. The application instance can be shared to all the users within group where they are working together with their own machines over a network.

In shared work environment multiple users can work on the same task in parallel mode. To implement it traditional client server architecture can suites for sharing the application for collaborative work. Individual server runs the application and client machines or remote machines allow to access these services [3]. However, there are chances to decrease computation capacity of server in terms of processing and memory. In that case, it may down the response time in accessing the application. To match these requirements cloud computing with ad hoc networking is best option. A cloud computing can offer an environment where users can have scalable resources, infrastructure and services. To avail these services user has to pay some amount to access the resources to get the performance guarantee and security [2].

Since the network nodes are mobile, an ad-hoc network will typically have a dynamic topology which will have profound effects on network characteristics. Network functions such as routing, address allocation, authentication, and authorization must be designed to cope with a dynamic and volatile network topology.

To produce the significant cost saving it is necessary to have PC's which are possessed by contributing users in ad hoc networking mode which will help to build cloud computing environment. The cloud computing provides a platform where client and providers come together to get better solution with several application along with its quality of service in reasonable cost [6]. Quality of service can be measured in two parts of work, one concern with technology and secondly in concern with quality of service. Quality of service provides a mechanism to achieve the customer's satisfaction. Availability of data and Easy access of data anywhere is a demanding feature for mobile devices relying on Internet clouds to perform resource intensive computation tasks [1].

In traditional client and dedicated server mobile based application for accessing the cloud services can be inefficient considering performance metrics such as energy consumption, CPU usage, and network delay [1]. In this work we have considered five subnets, which are located at different locations. Subnets are named as Sydney Main Subnet, SA Main Subnet, USA Main Subnet, London Main Subnet and India Main Head Quarter respectively. Out of which India Main Head Quarter contains five dedicated servers. Dedicated applications are run on each server. Server details are FTP

Server, Email Server, Database Server, HTTP Server and Print Server respectively, where all these servers' runs on cloud. Rest of four subnets consists of 50 wireless nodes, which are working in ad-hoc mode.

In all four subnets researcher has tested one protocol at a time, AODV protocol in one scenario, DSR protocol in second scenario, OLSR protocol in third scenario, GRP protocol in fourth scenario and TORA protocol in fourth scenario. In this Chapter, network architecture was designed in a manner that servers were working in ad hoc mode as well as clients were also working in ad hoc mode with different ad hoc routing protocols. Servers were running on cloud services and all clients were accessing all those services by sending large amount of traffic for every second. Simulation runs for 300 seconds. In this chapter also researcher has tested the performance of MANET protocols that are AODV, DSR, and OLSR, GRP and TORA using parameters like throughput, delay, load, retransmission attempts, data dropped and data sent and received.

To measure the network performance following parameters researcher have taken into consideration.

- Network Delay
- Network Load
- Data Dropped
- Retransmission Attempts
- Data traffic received and sent
- Throughput

II. SIMULATION MODEL

As shown in figure 2.1 each subnet contains 50 wireless Mobile Wireless ad-hoc workstations along with Access point 3 (wireless lan based router with one ethernet interface), Switch (ethernet16_switch supporting up to 16 Ethernet interfaces) and Gateway (ethernet2_slip8_gtwy node IP-based gateway) which are connected by 100BaseT duplex link.(represents an Ethernet connection operating at 100 Mbps).

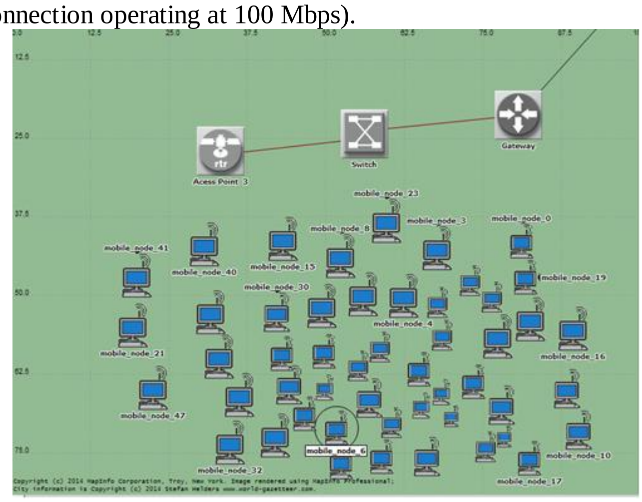

Figure 2.1 Wireless Mobile Nodes in subnet

As shown in figure 2.2, India Main Head Quarter subnet consists of five ad-hoc servers connected with wired LAN, namely FTP Server, Email Server, Database Server, HTTP Server and Cloud printer. Since the profile has been created, each server performs their respective tasks efficiently. FTP server contains applications executing on Transmission control protocol and User datagram protocol. The Linux_Server supports to the client server architecture and also runs over Transmission control protocol and User datagram protocol. It needs specific defined time to transmit the data. Cloud printer server contains applications executing on Transmission control protocol and User datagram protocol. The transmission speed is considered by the data transfer links which are connected to them. Nodes are categorized under Ethernet connection.

Figure 2.2 Ad hoc Servers in subnet

III. NETWORK DELAY

In the figure 3.1 initially, DSR delay was started with zero as simulation progressed delay was gradually increased for few seconds and it reached to 0.052 seconds. After that delay was immediately dropped down to 0.017 seconds. Then delay was increased to maximum level 0.056 seconds and again it dropped down to 0.014 seconds. Afterwards delay was varied between 0.007 seconds to 0.020 seconds till the end of simulation. Minimum delay observed was 0.00005 seconds and Maximum delay was 0.05690 seconds throughout the simulation, average delay observed was 0.016508 seconds which is fairly acceptable. Delay varies 0.00005 sec 0.05647 sec for maximum time of the simulation. It has been observed that DSR has shown fluctuating throughput and delay.

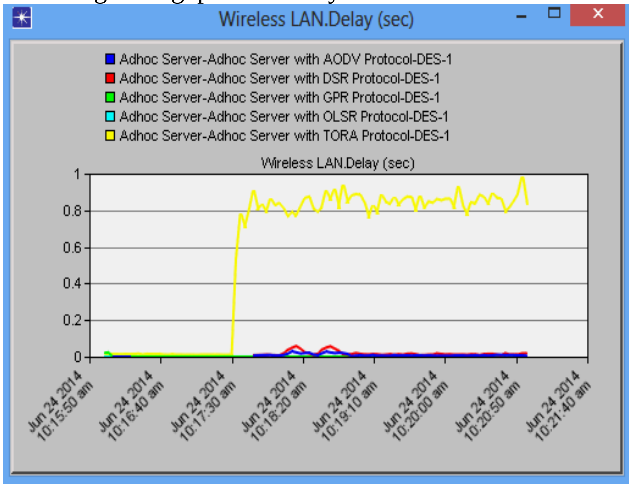

Figure 3.1 Network Delay (bits/sec)

IV. NETWORK LOAD OF ALL PROTOCOLS

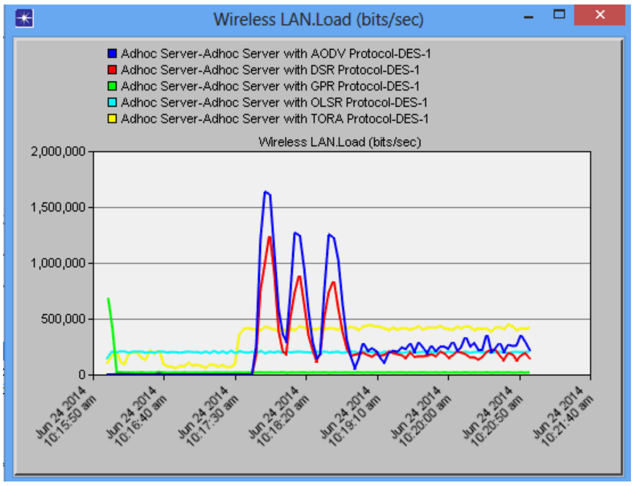

Figure 4.1 Network Load (bits/sec)

As shown in the figure 4.1 initially load of DSR protocol was started from zero, after few seconds it immediately reached to the maximum level 1,225,856 bits/sec. and suddenly it dropped down to 1,62,250 bits/sec. after that it was fluctuated between 1,43,489 bits/sec. to 8,54,389 bits/sec.

Similarly, in case of AODV Load on the network was initially 0 and gradually it reached to the maximum load 1,539,936 bits/sec. After few seconds the network load dropped down to 3, 04,693 bit/sec. immediately after that load was increased and decreased for few seconds. Afterwards load was settled down in between 1, 08,277 bits/sec to 3, 99,029 bits/sec. till the end of simulation. The maximum load on the network was 1,539,936 bits/seconds. Throughout the simulation on an average load was 293,000 bits/sec on network.

Wireless LAN load of OLSR protocol was observed identical throughout the simulation. At the beginning of simulation it was observed that load started from 1, 49,152 bits/sec and increased to 2, 04,192 bits/sec. immediately it started fluctuating simulation. Maximum load was 210,976 bits/sec and minimum load was 149156 bits/sec. OLSR model has shown 199,414 bits/sec average load.

Average load on network was less in OLSR model as compared to DSR and AODV protocol models. OLSR model has shown minimum load with minimum throughput as compared to AODV protocol. But OLSR has shown maximum throughput and maximum Load as compare to DSR protocol.

Maximum load of GRP protocol was observed 665,267 bits/sec and minimum load was 15,840 bits/sec. The average load was around 28,356 bits/sec of the MANET model.

Load of TORA protocol on network was also rising and falling throughout the simulation. Load on network was fluctuating between 58,240 bits/sec to 4, 45,440 bits/sec. TORA has shown 129,841 bits/sec average load on the network.

V. DATA DROPPED

In the figure 5.1 initially, DSR protocol Data dropped was observed zero for few seconds, then at one time it reached to maximum data dropped 3157 bits/seconds. After that data dropped was scale down to almost zero. In the case of AODV data dropped was observed very less as comparative to other protocols. Consistently data dropped was observed with GRP and OLSR protocol. Data dropped of TORA protocol started with zero then it continuously fluctuated throughout the simulation.

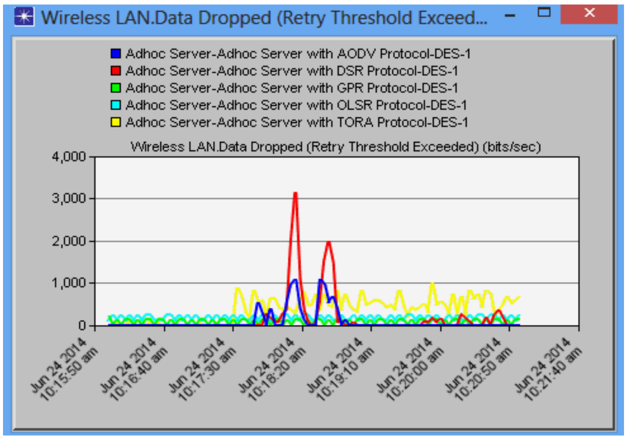

Figure 5.1 Data Dropped (bits/sec)

VI. RETRANSMISSION ATTEMPTS

Simulation model is attempting retransmission when node was busy. Every nodes of the model were performing differently on different time. As shown in figure 6.1 average retransmission attempts were observed between 0 to 1 packets/ seconds with DSR and AODV protocols. TORA protocol has shown continuous retransmission throughout the simulation. Figure 6.1 states that OLSR protocol has shown minimum retransmission packets throughout the simulation. Retransmission attempts in GRP protocol, was observed 2 packets per transmission then it downgrade towards zero and continued with the same.

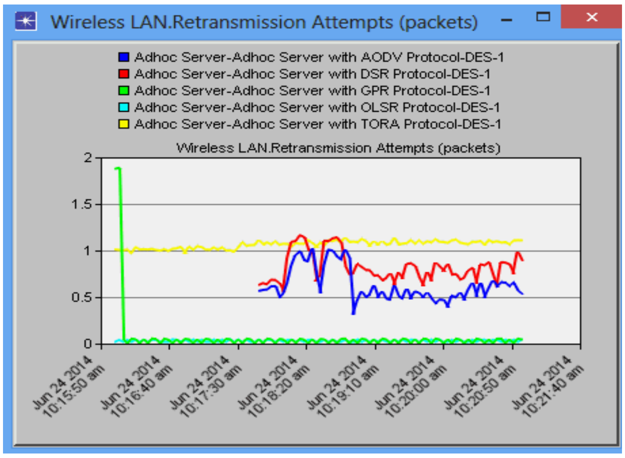

Figure 6.1 Retransmission Attempts (bits/sec)

VII. DATA TRAFFIC RECEIVED AND SENT

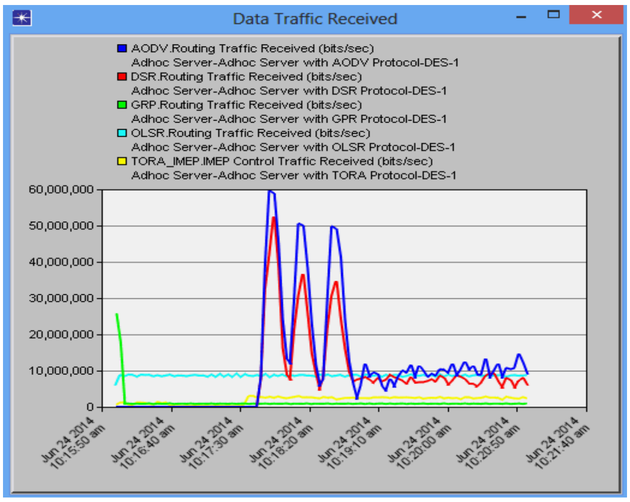

Figure 7.1 Data Traffic Received (bits/sec)

Figure 7.1 clearly shows the data traffic received by AODV and DSR protocol is greater than the other protocols. Again TORA and GRP protocol have shown poor performance in terms of data traffic received comparatively.

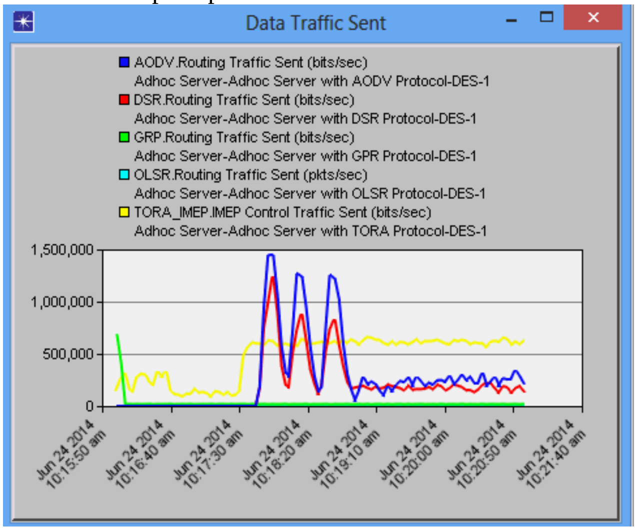

Figure 7.2 Data Traffic Sent (bits/sec)

Similarly in figure 7.2, we have observed the data traffic sent by AODV and DSR protocol is higher than the other protocols. OLSR and GRP protocol have shown very poor performance in data traffic sent.

VIII. WIRELESS LAN THROUGHPUT OF ALL PROTOCOLS

As shown in the figure 8.1 maximum throughput of DSR protocol was observed 53,306,197 bits/sec between 111 and 117 seconds simulation time. The average throughput of the simulation model was 8,638,495 bits/sec. In case of AODV initially throughput was started from zero and it gradually increased to maximum level 62,402,773 bits/sec. then immediately it dropped down to 13,531,978 bits/sec. afterwards it again increased and decreased in between 49,26,880 bits/sec to 54,051,573 bits/sec. for few seconds. Later on throughput was fluctuated till the end of simulation.

Performance of simulation model under OLSR routing protocol was fluctuating throughout the simulation. Initially it started from 7,418,549bits/ sec and increased to 10,145,589 bits/ sec. immediately it started fluctuating 9,389,184bits/sec to 10,490,816 bits/sec. till the end of simulation. Maximum throughput of the model was 10,490,816 bits/sec and minimum throughput of the model was 7418549 bits/sec. OLSR protocol fall under the category of proactive routing protocol which follows the table driven approach. In this type OLSR update the topology information continuously and exchange it with other nodes.

The maximum throughput of GRP protocol was observed 26,201,760 bits/sec.and it directly drop down to 9,96,048 bits/sec , The throughput of this simulation was between 7, 87,893.33 to 27,0735,20 bits/sec. On an average throughput was around 1,311,908 bits/sec of the MANET model.

As shown in figure 8.1 the performance of TORA protocol with reference to wireless LAN throughput was fluctuating throughout the simulation. Initially throughput observed was 2, 07,040 bits/sec. then it increased to 4, 79,168 bits/sec. and afterwards for few second it continued to fluctuate between 19,768 bits/sec to 5,64,608 bits/sec. At the end of simulation throughput suddenly increased to maximum level 7, 83,680 bits/ sec and continued to fluctuate more till the end.

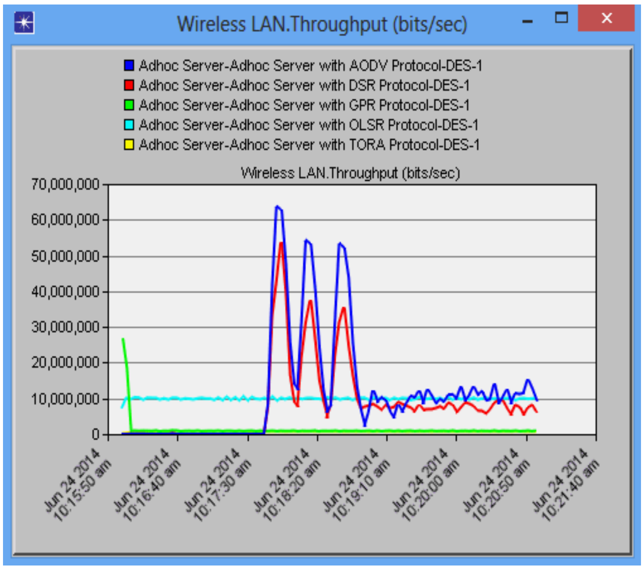

Figure 8.1 Wireless LAN Throughput (bits/sec)

IX. CONCLUSIONS

Table 9.1 Comparative Analysis of all Protocols

Protocols	Average Throughput (bit/Sec)	Average Delay (bit/Sec)	Average Load (bit/Sec)	Average Traffic Received (bit/Sec)	Average Traffic Sent (bit/Sec)	Retransmission (packet/Sec)	Data Dropped (bit/Sec)
AODV	122,04,454	0.009401	2,93,000	582,28,352	2,79,901	41	62.25
OLSR	99,09,935	0.00027	1,99,414	86,20,092	1,76,910	1	190
DSR	86,38,495	0.016508	2,00,469	84,34,354	2,00,373	1	1
GRP	13,11,908	0.000664	28,356	12,71,357	28,260	1	1,808
TORA	2,53,220	0.10014	1,29,841	6,09,563	1,97,274	1	89.1

- The test results have shown AODV protocol is having high throughput as compared to DSR, OLSR, GRP and TORA protocols.
- Although TORA protocol is showing minimum delay with compare to all other protocols but throughput was observed less than the other protocols.
- DSR Protocol has shown fewer throughputs than AODV and OLSR protocols and higher than the GRP and TORA protocols.
- TORA and GRP have shown poor performs in terms of throughput and data dropped.

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