Comparative Analysis on Routing Protocols in MANET

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Abstract
Ad Hoc network is one of the types of network that facilitates numbers of clients to make access to different application without configuring a prior path to travel or make communication in between multiple communicating devices. Besides this, there encountered certain challenges to retain or select the most appropriate route to travel by data packets in such a network. With a motto to reduce packet dropping, data packet loss, amount of traffic sent or received by stations, load in any network, response time for the page to be accessed, routing protocols are encouraged to be configured at all the stations and routers in a network. Different class of routing protocols are configured for multiple scenarios and then comparative analysis for these performance metrics has been done. To attain a comparative analysis of performance OPNET IT GURU EDUCATIONAL VERSION 14.5 Modeler is used.

KEYWORDS
Ad Hoc Network, Routing Protocols, Hybrid Routing, ZRP, OLSR, GRP, AODV, Traffic Sent/Received, Load, Traffic Dropped, Page Response Time;

1. INTRODUCTION TO AD HOC NETWORKS

Ad hoc network [1], [4] is one of the types of decentralized cloud computing [2], [3] infrastructure. Ad hoc network is a wireless network that works under a decentralized manner of operation. The network is said to be as ad hoc when it need not to maintain or manage any kind of pre-specified infrastructure to establish communication in between the connected devices. The usefulness of ad hoc network is generally maintained by implementing Access Points (AP) [5] in every autonomous segment for each grouped numbers of device. APs are responsible to make an initiative to enable or disable communication in-between the proposed scenario of devices. It is assumed that in an ad hoc network no individual station can be treated as an AP, and cannot act or permit devices to communicate at certain time span. Implementing an ad hoc network will permit every device in a network to communicate without any restrictions. Hence each and every communicating device is allowed to transmit or flood numbers of packet at anywhere-anytime functionality, and so ad hoc is formerly recognized as 'on-the fly' network.

Since every device can transfer or flood data packets in a network freely, then decision is to be taken regarding the data packet transmission to avoid unnecessary congestion [2], [6] in particular transmission. To accomplish this, a dynamic process is encouraged that will be responsible to take decisions that which device should communicate at which time span while communication is established. Unless, the traditional use of switches, routers, and hubs [7] in a network, ad hoc networking stands off-clear in all the aspects.

Mobile Ad Hoc Network (MANET) [8] is one the aspect that includes a factor of mobility in all the devices that were intended to communicate in an ad hoc network primarily, along with the fact that mobility does not make any effect onto performance of the network or any of the communicating devices. Devices in MANET are able to move along a network while communicating or making access to resources and services. Unlikely to existing ad hoc network, MANET also concludes to be an infrastructure less, and self-configuring network and in a continuous manner.

Paper can further be classified under numbers of sections such as, Section 2: underlines about what common routing protocols in any network, and Hybrid Routing Protocols (HRP) [9] consisting of an algorithm; Section 3: underlines a simulation process necessary for the successful comparison

of normal routing protocols along with the HRP; Section 4: consists of an analysis for the proposed scenarios in section 3; Section 5: includes conclusions, findings and future scope for the proposed work in the paper.

2. USEFUL WORK ABOUT ROUTING PROTOCOLS

For successful ad hoc network, there exists numbers of routing protocols in any network. Routing protocols [2], [4], [8], [10] are generally those rules or set of standards made for the communicating device in any network to better make decisions regarding the appropriate path needed to transfer the information or to establish a reliable communication link in between the two or more destined devices.

To initiate computing in between the connected devices, a topological architecture is followed to make successful transfer of data packets from one device to another device. Since devices in an ad hoc environment doesn't know in advance the dedicated routes towards multiple destined devices with in the network boundaries. To enable this facility, routing protocols are being used which inspects the data packet and connected devices to choose most appropriate path to travel along the network.

Most frequently used routing protocols lies under the following four section in ad hoc networks, these would be such as:

Table-driven Routing Protocol

This is also known as pro-active routing protocol [11]. Under this scheme, all the routers are responsible to distribute the routing information to every other router periodically and makes a new list of destination devices every time a distribution is performed. This may result in maintaining abundant of non-useful data at routers, which may lead to slow down in eradicating failures.

On-Demand Routing Protocol

This is also known as reactive routing protocol [11]. This scheme facilitates a mechanism in which every router floods a Route Request (RR) packet to all other routers in any network on an on-demand basis. These conclude in increased latency in finding an appropriate route, and moreover results in clogging of routes.

Hybrid Routing Protocol:

This scheme is a combination of both table-driven and on-demand routing protocols [9], i.e. it consists advantages and disadvantages of both the routing protocols. At initial, all routers will establish certain proactive routes and start computing. Afterwards, an on-demand scenario will start working by flooding multiple RR packets. Zone Routing Protocol (ZRP) [11] is one of the type of routing protocol that is hybrid in nature.

ZRP protocol is both the pro-active and reactive in nature on sending data packets in any network to the destined devices. ZRP is an efficient and reliable protocol to be used in any ad hoc network, as it supports an appropriate manner to send and receive necessary routing information from all the routers within the boundaries. Thus, this method is an efficient method to find the most appropriate route to establish computing in between the devices.

ZRP contributes towards in faster delivery of data packets to destination devices and helps in reducing the processing overhead by a series of operations needed to select the most appropriate route to data transfer. An architecture is being followed in any network enabled with ZRP routing protocol. The figure 1 depicts working architecture for ZRP in an ad- hoc environment.

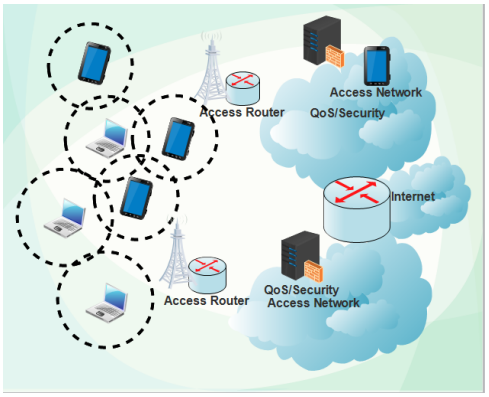

Fig 1: ZRP Working Architecture in Ad Hoc Network

Fig. 1 depicts ZRP architecture, how communication is taking place using routing protocols. For security purposes Authentication Authorisation Accounting (AAA) [12] Server is installed to safeguard the information from breaching out.

3. SIMULATION

This section is an experimental section that includes simulation environment under which scenarios need to be implemented to measure the performance metrics for numbers of station operating in any segment of the network. In the proposed simulation environment, computing with routing protocols is encouraged along with ad hoc network methodology, i.e. work stations operating in this environment are allowed to move freely in a network and are allowed to communicate while moving along the network.

In the proposed simulation, MANET is also introduced, so that ad hoc networking is performed by the stations that are set to mobile, *i.e.*, includes some factors associated with moveable character. Different scenarios are implemented to measure the performance metrics for devices that computes. Furthermore, configuration for the network can be described, such as:

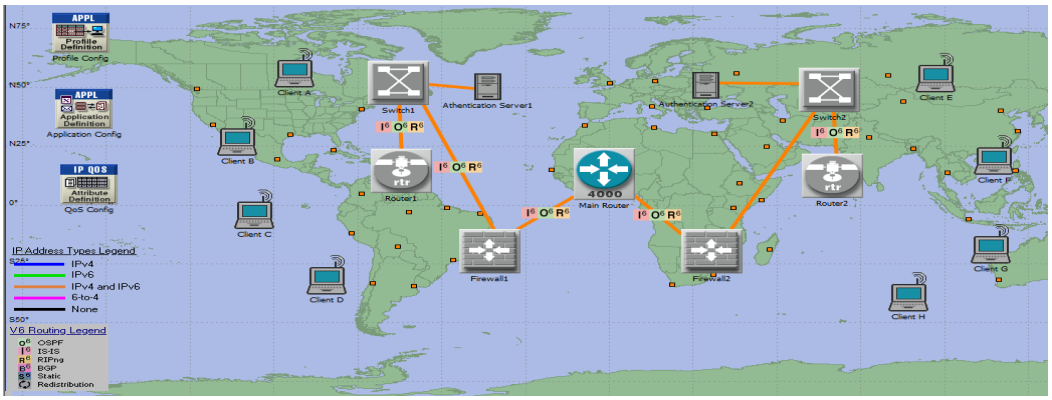

Fig 2: Scenario with routers enabled with routing protocols in Ad Hoc Network

In the above environment, three scenarios can be implemented in the following manner, consisting each for pro-active, reactive and hybrid routing protocols in an Ad Hoc network. The list of scenarios can be, such as:

A. Simple Pro-active Routing environment:

In this scenario, all the routers are implemented to operate their take proactively while a communication need to be done, i.e., Optimized Link State Routing (OLSR) Protocol [13] is implemented.

B. Simple Reactive Routing environment:

In this scenario, all the routers are enabled with reactive routing protocol at their end, and are tend to operate on an o-demand basis whenever a data packet has to travel along the network, i.e., Asynchronous On-Demand Vector (AODV) Routing Protocol [14] is implemented.

C. Hybrid Routing environment:

Under this scenario, all routers are enabled with hybrid routing protocol, i.e., all the routers can efficiently operate and can utilize the advantages of both reactive and pro-active routing protocols, *i.e.*, Geographical Routing Protocol (GRP) [15] is implemented.

All 03 scenarios are depicted by the Fig. 2. Furthermore, the detailed configuration includes, 04 MANET stations, 02 Ethernet Switch, 01 Cisco 4000 series routers [1], [5], 02 Ethernet Servers, 02 Firewalls, 02 MANET Wireless Local Area Network (WLAN) Routers [16], [17], 01 Application Configuration module, 01 Profile Configuration module, and 01 Quality of Service

(QoS) [2], [18] Configuration module. Application module is used to provide services to the clients; Profile module is implemented to make an access to all the applications; QoS module is utilized in a sense that there must be some method to enhance the quality of work or performance of stations. Apart from this configuration, 01 servers are enabled with AAA as an access server. All the stations are enabled to operate in an Internet Protocol version-6 (IPv6) [1], [2], [5], [19] environment.

4. SIMULATION ANALYSIS

This section underlines the analysis of scenarios based on certain experimental factors. An analysis has been done to judge the performance of communicating devices through a list of performance metrics. Further analysis is done to measure the performance for Hyper Text Transfer Protocol (HTTP) [16] Application server in an IPv6 environment.

D. ***Page Response Time:*** Page response time [20] can be referred to as amount of time spent by the server or client to process back to the request made by one of the stations in a network. Fig. 3 depicts the page response time in HTTP Application Server.

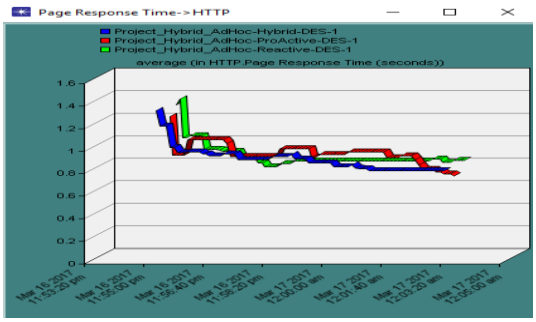

Fig 3: Page Response Time packets/sec: HTTP Application

E. ***Traffic Sent/Received:*** Traffic Sent or traffic Received [18], [21] is the total traffic i.e. sent or received by numbers of stations in a network. Fig. 4, 5 depicts traffic sent or received by HTTP Application Server.

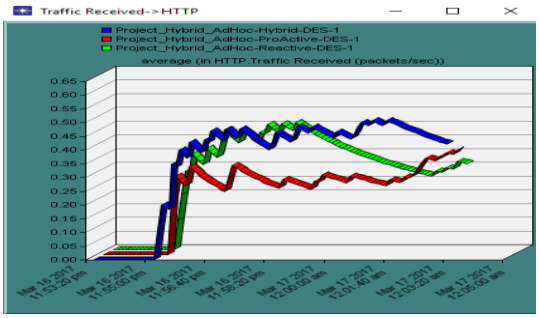

Fig 4: Traffic Received packets/sec: HTTP Application

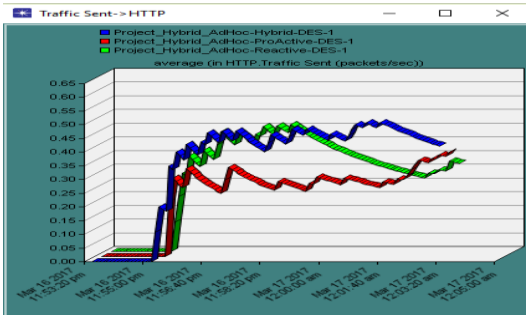

Fig 5: Traffic Sent packets/sec: HTTP Application

F. *Packets Dropped:*Packets dropped, or packet loss [18] is an amount of data packets that are discarded by the stations and not received or delivered successfully by any of the destined stations in any network. Fig. 6 depicts traffic dropped in an IPv6 environment.

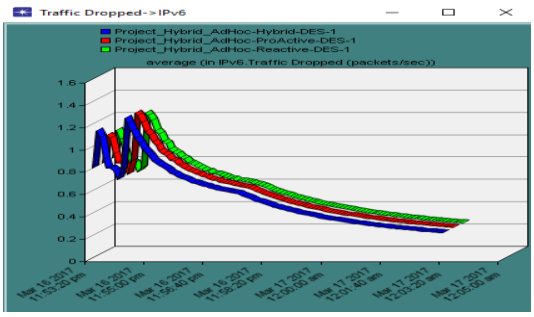

Fig 6: Traffic Dropped packets/sec: IPv6 Environment

G. Load in HTTP Application: Load [22] in any application can be justified as amount of traffic that has not been maintained or managed properly in any network on or before time out has occurred. Fig. 7 depicts th eload factor in HTTP Application Server.

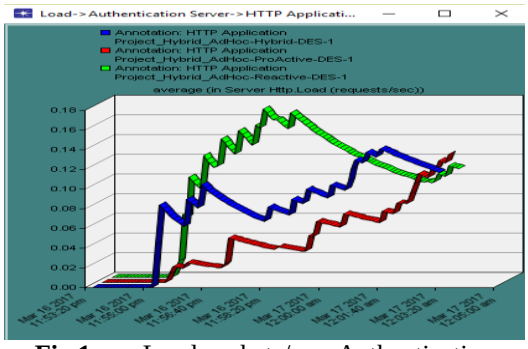

Fig.1 Load packets/sec: Authentication Server-HTTP Application

Table 1: Analysis for Routing Protocols in Ad Hoc Network

S. No.	Performance Metric / Protocol Class	Page Response Time	Traffic Sent / Received	Packets Dropped	Load
1	Proactive	Extensive increase	Higher packet loss	Constant as time increases	Decreased gradually
2	Reactive	Moderate increment	Moderate packet loss	Constant as time increases	Gradually increased
3	Hybrid	Reduced	Moderate packet loss	Constant as time increases	Moderate increment
Conclusion		Hybrid routing protocols are good to implement in any network or reactive routing protocol.			

5. CONCLUSION AND FUTURE SCOPE

Ad Hoc routing is one of the alternative to configure a network without having prior set configuration. Each and every station or communicating device is given authority to provide an infrastructure-free or prior configuration-free network environment to establish successful communication in between numbers of devices. In this paper an ad hoc environment is implemented onto which three classes of routing i.e. routing protocol for ad hoc routing are also configured, namely: OLSR (pro-active routing protocol), AODV (reactive routing protocol) and GRP (hybrid routing protocol). A simulation was performed out of which is has been analyzed that stations with HRP implemented at their end, performs much better than the two other routing protocols.

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