Journal of Information and Operations Management
ISSN: 0976–7754 & E-ISSN: 0976–7762 , Volume 3, Issue 1, 2012, pp-92-95
Available online at http://www.bioinfo.in/contents.php?id=55

COMPARATIVE ANALYSIS OF PROACTIVE AND REACTIVE ROUTING PROTOCOLS IN MOBILE AD-HOC NETWORKS (MANET)

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Received: December 12, 2011; Accepted: January 15, 2012

Abstract- An ad hoc network is an autonomous system that can communicate freely and dynamically self organize into arbitrary forming a temporary network without the use of any existing network infrastructure or centralized administration improved flexibility and reduced cost. An important and essential issue for mobile ad hoc networks is routing protocol design that is a major technical challenge due to the noisy, limited-range, and insecure wireless transmissions added to mobility and energy constraints of the network. The use of a simulation for ad hoc networks offers a feasible way to design and improve the performance of routing protocols. The main objective is to generate stable routing protocol with mobile nodes, features of various routing protocols. In this articles discuss two types of protocols proactive routing protocol and reactive routing protocol and qualitative based comparison of both routing protocols in mobile ad hoc networks (MANET).
Keywords- Ad-hoc Networks, Proactive Routing, Reactive Routing Protocols, MANET

Citation: Suresh Kumar and Jogendra Kumar (2012) Comparative Analysis of Proactive and Reactive Routing Protocols in Mobile Ad-Hoc Networks (Manet). Journal of Information and Operations Management ISSN: 0976–7754 & E-ISSN: 0976–7762, Volume 3, Issue 1, pp-92-95.

Introduction

A mobile ad hoc network (MANET) [1] group has been formed within IETF. The goal is to support mobile ad hoc networks with hundreds of routers and solve challenges. A mobile ad hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless links. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. An ad hoc network is a collection of mobile computers or mobile nodes that cooperate to forward packets for each other to extend the limited transmission range of each node's wireless network interface. Each must forward traffic unrelated to its own use, and therefore be a router. Wireless networks are an emerging new technology that will allow users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two type's infrastructure network and infrastructure less (ad hoc) networks. Infrastructures network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the Network or called base station within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. Mobile ad hoc networks originated from the DARPA (PRNet) [10] and SURAN project [10]. Being independent on pre-established infrastructures has a several advantages such as rapid and easy to deployment improved flexibility and reduced costs .mobile ad hoc networks gain more and more importance in non military public organization, commercial and industrial areas with including applications such as rescue missions, law enforcement operations, the cooperating industrial robots, the traffic management and educational operations in campus. Mobile ad hoc networks pose several technical and research challenges that need to be addressed. Ad hoc architecture has many benefits, such as self-reconfiguration and adaptability to highly variable mobile characteristics such as power and transmission conditions, traffic distributions, and load balancing. These benefits pose new challenges which mainly reside in the unpredictability of network topology due to the mobility of nodes, which, coupled with the local broadcast capability, caus-

es a set of concerns in designing a communication system on top of ad hoc wireless networks.

Applications of Mobile Ad Hoc NETwork

- **Sensor networks**: Smart sensor nodes and actuators can be buried in appliances to allow end user to manage home devices locally and remotely. Environment application includes tracking the movements of Animals chemical/biological detection, precision agriculture. Tracking date highly correlated in time and space e.g. remote sensors for weather, earth activities[1]
- **Tactical networks:** Military communication, operations, automated battlefields[2].
- **Home and Enterprise networking:** home/office wireless networking (WLAN) e.g. shared whiteboard application Use PDA to print anywhere trade shows Personal area networks (PAN)[2].
- **Emergency services:** search and rescue operations, as well as disaster recovery e.g early retrieval and transmission of patient data (record, status, diagnosis) from the hospital. Replacement of a fixed infrastructure in case of earthquake, hurricanes fire etc.
- **Vehicular services:** Transmission of news, road condition, weather, music, Local ad hoc network with nearby vehicles for road/accident guidance[1, 2].
- **Educational applications:** Setup virtual classrooms or conference rooms and ad hoc communication during conferences, meetings, or lectures [1, 3].
- **Entertainment:** Multi user's games, robotic pets, outdoor internet access.[1]
- **Location aware services:** automating call forwarding, transmission of the actual workspace information services such as advertise location specific, location dependent travel guide services like printer, fax, phone, and server [2].

Characteristics of Mobile Ad Hoc NETwork

Dynamic network topology: Each node in an ad hoc network is free to move randomly this feature makes the network topology change unpredictably and also an ad hoc network may be comprised of both bi-directional and unidirectional links .thus using ad hoc networks could augment mobility and flexibility of nodes in the network [1].

Bandwidth-limited and fluctuating capacity links: wireless links will remain to have substantially lower capacity compared to their hardwired counterparts. Besides the throughput of wireless communication in real environments is often much less than a radios maximum transmission rate, because there may be the effects of multiple access, fading, noise and interference conditions, and so on [3] .

Low-power and resource: limited operation : the networks nodes in a wireless ad hoc network mostly depends on batteries or other exhaustible means for their energy .this feature makes the power budget tight for all the power consuming components in a mobile device [2,3].

Constrained physical security: mobile wireless networks are more likely to be vulnerable to physical security threats than are fixed cable nets. e.g there is the increased possibility of eavesdropping, spoofing ,and denial of service attack that should be carefully considered [2].

Decentralized network control: the decentralized nature of network control in mobile ad hoc network supports extra robustness against the single points of failure of more centralized approaches [1, 3].

a. Challenges in MANET

Limited wireless transmission range: In case of wireless network the radio band will be limited as compared to wired network so that wireless network protocol are required keeping the low overhead as possible for using bandwidth always in optimal manner.

Asymmetric links: It supported asymmetric link that mean node X send a signal to Node Y very good but reverse direction node Y to X is not be good.

Battery constraints: To maintain portability, size, and weight of the device because wireless network have limitation on the power source.

Packet loss due to the transmission errors: In case of wireless network much packet loss due to factors such as high bit rate in the wireless channel , hidden terminals, interfaces, unidirectional links ,due to the mobility of the network.

Mobility induced route changes: wireless network supported highly dynamic topology due to the movement of nodes, hence paths frequently breaks. This condition leads to fast route changes in wireless ad hoc networks (MANET) [1].

Routing overhead: Nodes often to change their location within wireless network so that some stable routes are generated in the routing table which leads to unnecessary routing overhead in wireless mobile ad hoc network (MANET) [1].[1-3]

b. Network Architecture

There are two approaches to provide network connectivity in mobile ad hoc networks.

Hierarchical network architecture: Some nodes such as cluster heads and gateway nodes have a higher computation communication load than other nodes .hence the mobility management becomes complex. The network reliability may also be affected due to single points of failure associated with the defined critical nodes. Hierarchical architectures provide more scalable approach [3].

Flat –routed architecture: in this approach all the nodes are identical in terms of responsibility, and there is no concept of special gateways. Flat architectures do not optimize bandwidth resource utilization in large networks because control massage has to be transmitted globally throughout the network, but they are appropriate for higher dynamic topology .the scalability decrease when the number of nodes increase significantly [3].

c. Mobile Ad Hoc NETwork (MANET)

A "mobile ad hoc network" (MANET) [1, 2, 3] is an autonomous system of mobile routers and associated hosts connected by wireless links .The routers are free to move randomly and organize themselves arbitrarily; thus, the network's Wireless topology may change rapidly and unpredictably. Such a network may be connected to the larger Internet. Basic Routing functionality for mobile ad hoc networks: A routing protocol is the mechanism by which user Traffic is directed and transported through the network from the source nodes to the destination node.

Classification of Mobile Ad Hoc NETwork (Routing Protocol)

Proactive Routing Protocols

The Destination Sequence Distance Vector (DSDV) routing protocol: The Destination Sequence Distance Vector (DSDV) [8]: In routing tables of DSDV, an entry stores the next hop towards a destination, the cost metric for the routing path to the destination and a destination sequence number that is created by the destination. Sequence numbers are used in DSDV to avoid formation of route loops. The route updates of DSDV can be either time-driven or event-driven. Every node periodically transmits updates including its routing information to its immediate neighbors. While a significant change occurs from the last update, a node can transmit its changed routing table in an event-triggered style. Moreover, the DSDV has two ways when sending routing table updates. One is "full dump" update type and the full routing table is included inside the update. A “full dump” update could span many packets. An incremental update contains only those entries that with metric have been changed since the last update is sent. Additionally, the incremental update fits in one packet.

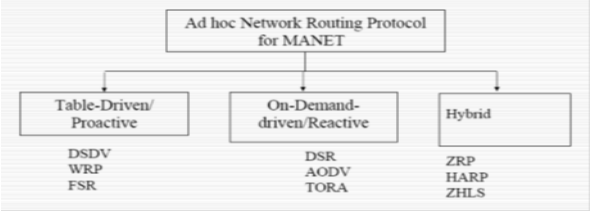

Fig. 1- classification of routing protocol in mobile ad hoc networks

The Fisheye State Routing (FSR)

The Fisheye State Routing (FSR) [6] is a proactive based on Link State routing algorithm with effectively reduced overhead to maintain network topology information. Link state updates are exchanged periodically in FSR, and each node keeps a full topology map of the network. To reduce the size of link state update messages, the key improvement in FSR is to use different update periods for different entries in the routing table. Link state updates corresponding to the nodes within a smaller scope are propagated with higher frequency. FSR maintains the accurate distance and path quality information about the immediate neighboring nodes, and progressively reduces detail as the distance increases.

The Wireless Routing Protocol (WRP)

The Wireless Routing Protocol (WRP) [7] is a proactive unicast routing protocol for mobile ad hoc networks. WRP uses improved Bellman-Ford Distance Vector routing algorithm. To adapt to the dynamic features to ensure the reliable exchange of update messages and reduces route loops. Using WRP, each mobile node maintains a distance table, a routing table, a link-cost table and a Message Retransmission List (MRL). The entry contains cost of the link connecting to the neighbor, and the number of timeouts since an error-free message was received from that neighbor. Features of WRP are a node checks the consistency of its neighbors after detecting any link change. A consistency check helps to eliminate loops and speed up convergence.

The Clusterhead Gateway Switch Routing (CGSR)

The Clusterhead Gateway Switch Routing (CGSR) [14] is a hierarchical routing protocol. The cluster structure improves performance of the routing protocol because it provides effective membership and traffic management. Besides routing information collection, update and distribution, cluster construction and clusterhead selection algorithms are important components of cluster based routing protocols. CGSR uses similar proactive routing mechanism as DSDV. A node broadcasts its cluster member table periodically. After receiving broadcasts from other nodes, a node uses the DSDV algorithm to update its cluster member table. In addition, each node maintains a routing table that determines the next hop to reach other clusters. To improve the performance of CGSR, a Least Cluster Change (LCC) algorithm is proposed. Only when changes of network topology cause two clusterheads are merging into one or a node being out of the coverage of all current clusters, LCC is initiated to change current state of clusters.

Qualitative Based Comparison of Proactive Routing Protocols

Table 1 Comparison of Proactive Routing Protocols

Protocol	Update destination	Update period	Topology	Route type	Multicast capability	Hello message	Route metric	Unidirectional links	Multiple routes
WRP	Neighbors	Hybrid	Flat	Proactive	No	Yes	Shortest path	No	No
DSDV	Neighbors	Hybrid	Flat	Proactive	No	No	Shortest path	No	No
FSR	Neighbors	Periodically	Flat	Proactive	No	No	Shortest path	No	Yes
CGSR	Neighbors & clusterhead	Periodically	Hierarchical	Proactive	No	No	Shortest path	No	No

Reactive Routing Protocols

The dynamic source routing (DSR) protocol

The dynamic source routing protocol (DSR) [5] is an on demand routing protocol. DSR is simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. Using DSR the network is completely self-organizing and self-configuring requiring no existing network infrastructure or administration. The DSR protocol is composed of two main mechanisms that work together to allow the discovery and maintenance of source route in the ad hoc network.

Route discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D .Route discovery is used only when S attempts to sent a packet to D and does not already know a route to D.

Route maintenance is the mechanism by which node S is able to detect .while using a source route to D if the network topology has changed such that it can no longer use it route to D because a link along the route no longer works. When route maintenance indicates a source route is broken. S can attempts to use any other route it happens to know to D or it can invoke route discovery again to find a new route for subsequent packets to D. route maintenance for this route is used only when S is actually sending packets to D.

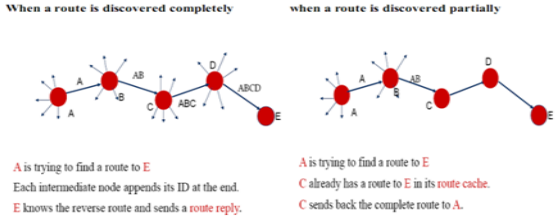

Fig. 2- (a) & (b) route discovery completely and partially

The Ad Hoc On-demand Distance Vector Routing (AODV) protocol

Reactive routing protocol AODV [13] only needs to maintain the routing information about the active paths. Routing information is maintained in routing tables at nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. Moreover, AODV adopts the destination sequence number technique used by DSDV in an on-demand way. In AODV, when a source node wants to send packets to the destination but no route is available, it initiates a route discovery operation. In the route discovery operation, the source broadcasts route request (RREQ) packets. A RREQ includes addresses of the source and the destination, the broadcast ID, which is used as its identifier, the last seen sequence number of the destination as well as the source node's sequence number. Sequence numbers are important to ensure loop-free and up-to-date routes. To reduce the flooding overhead, a node discards RREQs that it has seen before and the expanding ring search algorithm is used in route discovery operation. The RREQ starts with a small TTL (Time-To-Live) value. If the destination is not found, the TTL is increased in following RREQs.

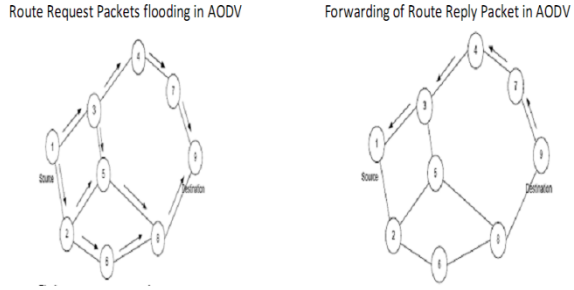

Fig. 3- (a) & (b) Route request and route reply in AODV

Qualitative Based Comparison of Reactive Routing Protocols

Table 2 Comparison of Reactive Routing Protocols

Protocol	Update destination	Update period	Topology	Route type	Multicast capability	Hello message	Route metric	Unidirectional links	Multiple routes
DSR	Source	Event driven	Flat	Reactive	No	No	Shortest path	Yes	Yes
TORA	Neighbors	Event driven	Flat	Reactive	No	No	Shortest path	Yes	Yes
AODV	Source	Event driven	Flat	Reactive	Yes	Yes	Fastest and Shortest path	No	Yes
ABR	Source	Periodically	Flat	Reactive	No	Yes	Link associativity	No	No
SSR	Neighbors	Periodically	Flat	Reactive	No	Yes	Signal stabilty	No	No

Conclusion

In this paper we have provided descriptions of several routing scheme proposed for mobile ad hoc networks. We have provided a classification of these schemes according the routing strategy i.e. table driven and on demand and presented a comparisons of these categories of routing protocols, highlighting their features, differences characteristics .finally we have indentified possible applications and challenges facing ad hoc wireless network. In this article mainly focus on proactive routing protocol and reactive routing protocols which discuss key features of each of these routing protocols in mobile ad hoc network and performance analysis on the basis of qualitative comparison of both routing protocols.

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