Routing Protocols in Mobile Ad-Hoc Network: A Review

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Abstract. Mobile ad-hoc network comprises of wireless nodes that communicate each other by exchanging the information. The path chosen for transferring the information from one node to another node is called routing and the protocols used is called routing protocols. The requirement of routing protocol is to send and receive information among the nodes with best suited path with the minimum delay. Correct and efficient route establishment between a pair of nodes is the primary goal of routing protocol . Many routing protocols for manet have been proposed earlier. Performance analysis of routing protocol is a significant challenge in the research area. This paper, gives a review work done on existing protocols characteristics of MANET and comparison between them.

Keywords: Routing protocols, MANET, Proactive, Reactive, Hybrid.

1 Introduction

Mobile Adhoc Network (MANET) is a collection of independent mobile nodes that can communicate to each other. MANETs being researched by several organizations and institutes. MANETs employ the traditional TCP/IP structure to provide end-to-end communication between nodes. However, due to their mobility and the limited resource in wireless networks, each layer in the TCP/IP model require redefinition or modifications to function efficiently in MANETs. One interesting research area in MANET is routing.

Most applications in the MANET are based upon unicast communication. Thus, the most basic operation in the IP layer of the MANET is to successfully transmit data packets from one source to one destination. The forwarding procedure is very simple in itself: with the routing table, the relay node just uses the destination address in the data packet to look it up in the routing table. If the longest matching destination address is found in the table, the packet is sent to the corresponding next hop. The problem that arises is how the routing table is built in the nodes in the MANET.

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2 Existing Protocols in MANET

Routing Protocols:
Routing protocols basicaly divided into severals parts:

2.1 Table driven (proactive) routing protocols
2.2 Source initiated (demand driven/reactive) routing protocols
2.3 hybrid routing protocols

2.1 Table Driven Routing Protocol

In this type of routing protocols maintain consistent and up to date routing information of each node in the network. These protocols store there routing information on each node and when there is any changes in network topology updation has to be made throughout the network.various protocols are shown into the fig-1.and the basic characterstics of table driven routing protocol are:

Table 1. Characterstics of table driven routing protocol [16]

Protocol	RS	No. of Tables	Frequency of updates	HM	Critical nodes	Characteristic feature
CGSR	H	2	Periodic	No	Yes, Cluster head	Clusterheads exchange routing information
DSDV	F	2	Periodic and as required	Yes	No	Loop free
FSR	F	3 and a list	Periodic and local	No	No	Controlled frequency of updates
HSR	H	2(link-state table& location management)	Periodic, within each subnet	No	Yes, Cluster head	Low CO and Hierarchical structure
OLSR	F	3(Routing, neighbour & topology table)	Periodic	Yes	No	Reduces CO using MPR
STAR	H	1 and a 5 lists	Conditional	No	No	Employes LORA and/or ORA. Minimize CO
WRP	F	4	Periodic	yes	No	Loop freedom using predecessor info

R =routing structure; HM=hello message; H=hierarchical; F=flat; CO=control overhead; LORA=least overhead routing approach; ORA=optimum routing approach; LM=location manager.

Table 2. Complexity comparison of proactive routing protocols [16]

Protocol	CT	MO	CO	Advantages/Disadvantages
CGSR	O(D)	O(2N)	O(N)	Reduced CO/cluster formation and maintenance
DSDV	O(D.I)	O(N)	O(N)	Loop free/high overhead
FSR	O(D.I)	$O(N^2)$	O(N)	Reduces CO/high memory overhead, reduced accuracy
HSR	O(D)	$O(N^2.L)+(S)+O(N/S)+(N/n)$	O(n.L)/I +O(1)/J	Low CO/location management
OLSR	O(D.I)	$O(N^2)$	$O(N^2)$	Reduced CO and contention/2-hop neighbor knowledge required
STAR	O(D)	$O(N^2)$	O(N)	Low CO/high MO and processing overhead
WRP	O(h)	$O(N^2)$	O(N)	Loop free/memory overhead

CT=convergence time; MO=memory overhead; CO=control overhead; (1)=a fixed number of update tables is transmitted; V =number of neighbouring nodes;N =number of nodes in the network; n=average number of logical nodes in the cluster; I =average update interval; D=diameter of the network; S=number of virtual IP subnets; h=height of the routing tree; X =total number of LMs (each cluster has an LM); J =nodes to home agent registration interval; L=number of hierarchical level.

2.2 Source Initiated Demand Driven Routing Protocol

In on-demand routing protocols routes are generated as and when we required. When a source wants to send any information to a destination,it invokes the route discovery mechanisms to find the path to the destinations. The route remains valid till the destination is reachable or until the route is no longer needed. various protocols are shown into the fig-1.

Table 3. Basic characteristics of reactive routing protocols [16]

Protocol	RS	Multiple routes	BC	Route metric method	RMI	Route reconfiguration strategy
AODV	F	No	Yes, hello messages	Freshest & SP	RT	Erase route then SN or local route repair
ABR	F	No	Yes	Strongest Associativity &SP	RT	LBQ
ARAN	F	Yes	No	SP	RT	Use alternate route or back track until a route is found
DSR	F	Yes	No	SP, or next available in RC	RC	Erase route the SN
FORP	F	No	No	RET & stability	RT	A Flow HANDOFF used to use alternate route
LAR	F	Yes	No	SP	RC	Erase route then SN
SSA	F	No	Yes	Strongest signal strength & stability	RT	Erase route then SN
TORA	F	Yes	No	SP, or next available	RT	Link reversal & Route repair

RS=routing structure; H=hierarchical; F=flat; RT=route table; RC=route cache; RET=route expiration time; SP=shortest path; SN=source notification; BC= Beacons; RMI= Route maintained in; LBQ=localised broadcast query.

Table 4. Complexity comparison of reactive routing protocols [16]

Protocol	TC [RD]	TC [RM]	CC [RD]	CC [RM]	advantage	Disadvantage
AODV	O(2D)	O(2D)	O(2N)	O(2N)	Adaptable to highly dynamic topologies	Scalability problems,large delays,hello messages
ABR	O(D+P)	O(B+P)	O(N+R)	O(A+R)	Route stability	Scalability problems
ARAN	O(D+P)	O(D+P)	O(N+R)	O(A+R)	Low overhead, small control packet size	Flooding based route discovery process

Table 4. (*Continued*)

DSR	O(2D)	O(2D)	O(2N)	O(2N)	Multiple routes, Promiscuou s overhearing	Scalability problems due to source routing and flooding, large delays
FORP	O(D+P)	O(B+P)	O(N+R)	O(N+R)	Employees a route failure minimisatio n technique	Flooding based route disovery process
LAR	O(2S)	O(2S)	O(2M)	O(2M)	Localised route discovery	Based on source routing, flooding is used if no location information is available
SSA	O(D+P)	O(B+P)	O(N+R)	O(A+R)	Route stability	Scalability problems, large delays during route failure and reconstruction
TORA	O(2D)	O(2D)	O(2N)	O(2A)	Multiple routes	Temporary routing loops

TC=time complexity; CC=communication complexity; RD=route discovery; RM=route maintenance; CO=control overhead; D=diameter of the network;
N =number of nodes in the network; A=number of affected nodes; B=diameter of the affected area; G=maximum degree of the router; S =diameter of the nodes in the localised region; M =number of nodes in the localised region; X =number of clusters (each cluster has one cluster-head); R=number of nodes forming the route reply path, RREP, BANT or FLow_SETUP; P =diameter of the directed path of the RREP, BANT or FLow_SETUP; jEj=number of edges in the network.

2.3 Hybrid Routing Protocol

Hybrid routing protocols are a new generation of protocol, which are both proactive and reactive in nature. These protocols are designed to increase scalability by allowing nodes with close proximity to work together to form some sort of a backbone to reduce the route discovery overheads. various protocols are shown into the fig-1.

Table 5. Basic characteristics of hybrid routing protocols [16]

Protocol	RS	Multiple routes	BC	Route metric method	Route maintained in	Route reconfiguration strategy
ZHLS	H	Yes, if more than one virtual link exists	No	SP or next available virtual link	Intrazone and interzone tables	Location request
ZRP	F	No	Yes	SP	Intrazone and interzone tables	Route repair at point of failure and SN

RS=routing structure; H=hierarchical; F=flat; SP=shortest path; SN=source notification; Bc=beacons.

Table 6. Complexity comparison of hybrid routing protocols [16]

Protocol	TC [RD]	TC [RM]	CC [RD]	CC [RM]	advantage	Disadvantage
ZHLS	Intra:O(I)/ Inter:O(D)	O(I)/O(D)	O(N/M)/O(N+V)	O(N/M)/ O(N+V)	Reduction of SPF, low CO	Static zone map required
ZRP	Intra:O(I)/ Inter: O(2D)	O(I)/O(2D)	$O(Z_N)$/ O(N+V)	$O(Z_N)$/ O(N+V)	Reduce retransmission	Overlapping zones

TC=time complexity; CC=communication complexity; RD=route discovery; RM=route maintenance; I =periodic update interval;N =number of nodes in the network; M =number of zones or cluster in the network; ZN =number of nodes in a zone, cluster or tree; ZD =diameter of a zone, cluster or tree; Y =number of nodes in the path to the home region; V =number of nodes on the route reply path; SPF=single point of failure; CO=control overhead.

3 Comparison of Protocols

Comparison between different routing protocols are shown here.

Table 7. Parametric Comparison [14]

Parameters	Proactive Protocols	Reactive Protocols	Hybrid Protocols
Availability of routing information	Available when required	Always available stored in tables	Combination of both
Latency	High due to flooding	Low due to routing tables	Inside zone low outside similar to Reactive protocols
Mobility	Support Route maintenance	Periodical updates	Combination of both
Periodic Updates	Not needed as route available On demand	Yes. Whenever the topology of the network changes	Yes needed inside the zone
Scalability level	Not suitable for large networks	Low	Designed for large networks
Storage capacity	Low generally Depends upon the number of routes	High ,due to the routing tables	Depends on the size of Zone, inside the zone Sometimes high as Proactive protocol
Routing Overhead	Low	High	Medium
Routing Philosophy	Flat	Flat/Hierarchical	Hierarchical
Routing Scheme	On demand	Table driven	Combination of both

Table 8. Pros and Cons Comparison [14]

Protocol	Advantages	Disadvantages
Proactive	Proactive Information is always available. Latency is reduced in the network	Overhead is high, Routing information is flooded in the whole network
Reactive	Path available when needed overhead is low and free from loops.	Latency is increased in the network
Hybrid	Suitable for large networks and up to date information available Complexity increases	Complexity increases

4 Conclusion

The paper begins with a brief introduction of routing protocols in mobile ad-hoc Networks. we reviewed and studied the features of different protocols used in mobile ad-hoc network then we are discussed all the above review persented in this paper. Finally, the stated review work of the routing protocols were discussed in this paper.

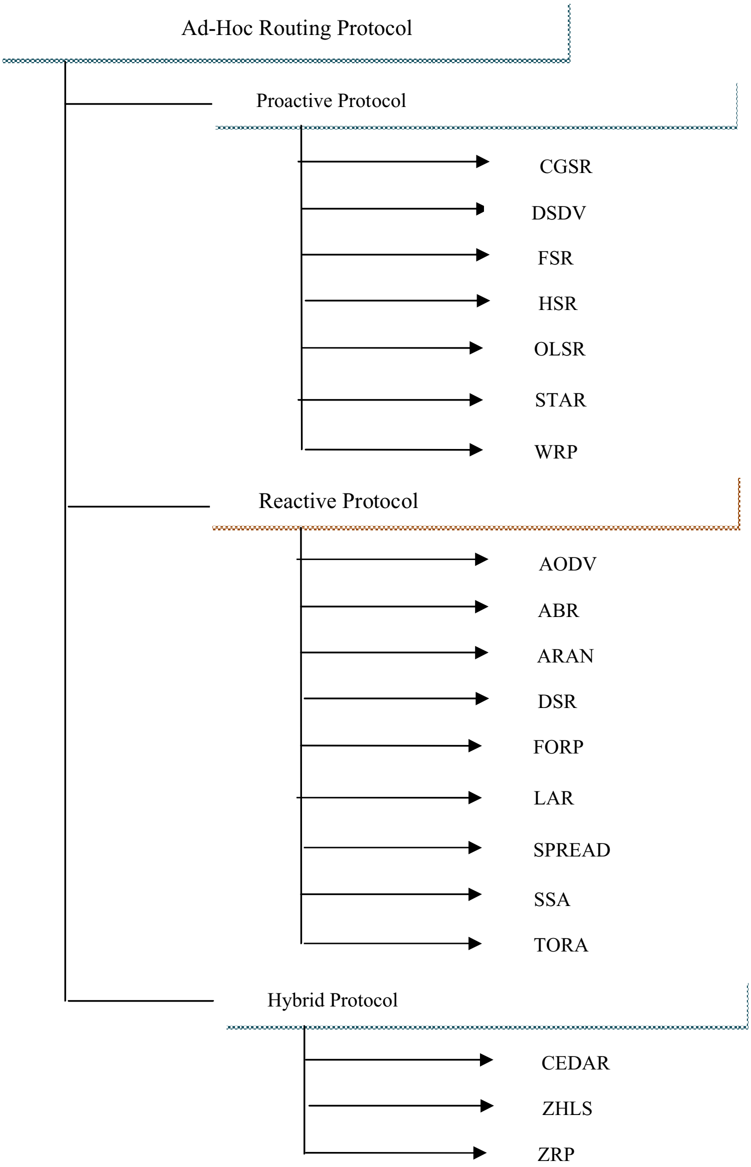

Fig. 1. Ad-hoc Routing Protocol(classification)

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