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A Survey of Routing Protocols in Wireless Ad- Hoc Network

Chirag Bhalodia
Computer Engineering Department
R K University, India

Abstract – Wireless ad-hoc network represents complex distributed system that includes wireless mobile nodes. Wireless mobile nodes that can freely move across network and dynamically create self organize temporary topology. It allows people add devices to internet work in areas where not any infrastructure network create. Networks have been used for only communication between networking application same as ad-hoc network also used. New technologies such as Bluetooth, Infrared, IEEE 802.11 are used to create wireless ad-hoc network. Wireless ad-hoc network mostly used commercial and military application deployment. Now a day's revolution have been generating a renewed and fast internet in the R&D of wireless ad-hoc network. If any nodes want communication with other node within the network a routing protocol is used to find routes between nodes. The main purpose of routing protocol is an efficient route establishment between any pair of nodes, so it can be easily transfer message with in sufficient time manner. The other necessary purposes of protocol are bandwidth and power constraint. Because each node of wireless ad-hoc network is act as a router and Packet forwarder. Bandwidth and power consumption are very demanding issue in now a day's research process in wireless ad-hoc network. Wired network protocols are never used in wireless ad-hoc network because node is mobile. The ad-hoc routing protocol are mainly classified into two class: Table driven and On-demand based. In this paper we review and discuss about routing protocol of each category.

Keyword: Wireless ad-hoc network, routing protocol, table driven, on-demand, proactive and reactive.

I. INTRODUCTION

Now a days, Wireless ad-hoc network become very popular in industry.Wireless Network provides mobility in network.So every node become moving free within network. There are two different wireless network available : First one is infrastructured(a network with fixed and wired gateways) network.In infrastructure network one Access point (AP) and other Basic Service Sets (BSS) are connected through AP.Second one is Infrastructure less network also called Ad-hoc network.In ad-hoc network all the mobile node connected with each other no need to AP. In ad-hoc network no fixed routers. So all node are continously moving here ande there and be connected in an arbitary manner. These node act as a router ehich find and maintain route between other nodesin network. Some applications of ad-hoc network are students using laptop to participate in an interactive lecture, business associates sharing information during a meeting, soldiers relaying information about situation awareness in a battlefield, and emerging disaster relief after an earthquake or hurricane. Ad hock networks are created, for example, when a group of people come together and use wireless communication for some computer based collaborative activities; this is also referred to as spontaneous networking [1]. Wireless ad-hoc network is collection of mobile nodes,which create temporary network without any centralized device. Mobile nodes are continously moving in ad-hoc network so topology change fast and unexpectadely. If some Node route have multiple hops, so such network is called "multihop wireless ad-hoc networks".

II. Classification Of Wireless Ad-Hoc Network Protocol

Wireless ad-hoc network routing protocol are classified into different criteria, reflecting fundamentals design and implementation.

A. Communication Model

Using communication model protocol can be created and designes may be based on single channel and Multi-channel. Multi-channel protocol highly used in TDMA or CDMA based networks.example of multi-channel protocol is CGSR[2].Single channel protocols mostly used in one shared medium.Single channel protocols widely used in CSMA/CA network[2].

Some Wireless ad-hoc network protocols on link layer properties, its works on RTS/CTS control sequence. It is used in 802.11,MAC layers to avoid collissions due to hidden and exposed terminals. When node are exchanging information at that time source first send RTS control frame to the receiver,it annoucing upcoming frame transmission.Receiver receives RTS frame and reply by a CTS frame to indicate it is ready to receive. RTS and CTS contain total duration of transmission,transmit data frame and the related ACK. So,hidden and exposed terminal station problem depends on transmission range.If transmission range is increase hidden station problem occurs less frequently but the exposed station problem becomes more important as TX range identifies the area affected by the single transmission. Trasmission range computed by radio propogation properties and transmission power.

B. Structure

Some routing protocols can be devide into two part based on structure of network. its dependent on node uniformity.

1) *Uniform Protocols:* In this type,no node take a different role in routing.Every node sends and reply to routing control message in same manner. No Hierarchy structure in network.
2) *Non-Uniform Protocols:* In Non-Uniform protocol routing complexity can be limited by reducing the number of nodes participating in routing calculation.

There are two different methods for non-uniform protocol are called **neighbour selection** and **partitioning.**In neighbour selection method, each node has its own criteria to devide network nodes to near or to remote nodes. In partitioning method use hierarchical protocols have upper and lower level nodes are certain information difference in them.

C. State Information

In this type protocols described state information.it is divided into two categories:

1) *Topology Based Protocol:* These are link state based protocols. Nodes participate in topology based protocol maintain large-scale topology information. Each node take decision based on topology information. They are sending and forwarding traffic.
2) *Destination Based Protocol:* These are Distance vector based protocols. Where each node maintain a destance and vector to a destination. They are not maintin large-scale topology information. They maintain topology information needed to know nearest neighbours.

D. Type of cast

A initial classification of the routing protocols can be done via the type of cast property,

1) *Unicast:* These types of protocols one-to-one communication. one source send messages and only one receive messages. Unicast protocols are also most common in ad-hoc network. One main limitation of these types of prtocols are one sender sent same data to multiple recevier. So, at that time need of multicast.
2) *Geocast:* It provides data delivery to group of nodes which are locaated into specific geographicsl area. This type of protocol can also used to find location information.
3) *Multicast:* It is widely used to create tree or mesh in to a network.This type of protocol also save the information of group joining and group leaving.
4) *Broadcast:* It is basic mode of operation in Wireless medium. Broadcast functionality is implemented as a supported features of broadcast.There is no perfect solution for broadcasting. So using these reason protocols not classified into broadcast protocols.

E. *Scheduling* Wireless ad-hoc network protocol mainely devided in to two types :

1) *Proactive Routing Protocol:* Proactive protocols are also known as Table-driven protocols. Proactiverouting protocols are derived from distance-vector and link-state protocols.They maintain consistent and update routing information for each pair of nodes by proactively,route updates at fixed time intervals.
2) *Reactive on-demand Routing Protocol:* Reactive routing protocols are called on-demand routing protocols. Beacuse in this type of protocol route calculation is start when source want to transfer data to destination. So, no need to maintain unwanted routing information. Route calculation is devided into two phase one is route discovery and other is route maintenance phase. Route discovery is start when source need a route to destination. Route maintanance delete failed routes and re-start route discovery if the topology change. Once a route has been established, it is maintained until either the destination becomes inaccessible (along every path from the source), or until the route is no longer used, or expired [3].

F. Design Issues and challenges

Some following design issues of Wireless ad-hoc network protocols [4]

1) *Autonomous and Infrastructure less:* Wireless ad-hoc network does not depend on any infrastructure. Each node wokr on peer-to-peer mode, acts as an independant router and generate independat data. Network management has to be distributed across different nodes, which brings added difficulty in fault detection and management.
2) *Multi-hop Routing:* No default router available, every node act as a router and forward each other's packet to enable information sharing between mobile hosts.
3) *Dynamically changing network topologies:* In wirelss ad-hoc networks, beccause nodes continous moving in netwrok and topology is continous varying. so frequently and unpredictably resulting in route changes, frequent network partition and possibly packet losses.
4) *Variation in link and node capabilities:* Each node is equipped with one or more radio interfaces that has tranciever capabilities and operate at different function bands[5,6]. This method in node radio capabilities can result in possibly assymetric links. Each node has different configuration resulting in variability in processing capabilties. Designing network protocols and algoritham for this network can be complex which requires dynamic change condition.
5) *Energy constrained operation:* Beacuse each node is mobile in wireless ad-hoc network so all mobile nodes operate using battery with limited power constrained. So, processing power is limited, which in turn limits the services and application that can be supported by each node. Power energy is biggest iusse for wireless ad-hoc network, because additional energy is every time required to forward packet other nodes.
6) *Network Scalability:* Many wireless ad-hoc network applications involve large networks with tens of thousand of mobile nodes as found for example in sensor and tactical networks[7]. Scalability is critical to successful deployment of these networks. If network is large so consisting nodes with limited resources are not straightforward and present

too much challenges that are not solved in areas such as addressing, routing, location management, interoperability, security, high capacity wireless technologies etc.

III. Routing Protocol

Fig 1 gives the classification of wireless adhoc network protocol classification: mainly categorize in two category : Table driven and On-demand routing protocol

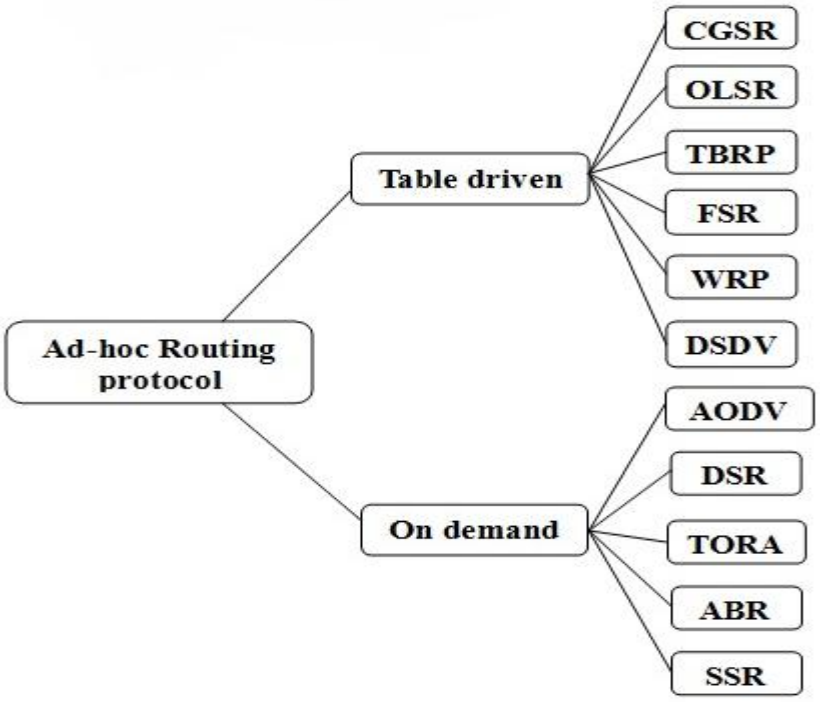

Fig 1. Routing Classification

A. Table Driven

Table driven protocols maintain all node information and send update at fixed time interval. So each node required to store that routing information and when change network topology.Here Some different kind of table driven protocols are:

1) *Destination sequenced Distance vector routing (DSDV):* The DSDV protocol[7] is a distance-vector protocol.In this protocol every node maintain a routing table. In routing table has shortest path of each destination. DSDV widely used to avoid looping from network.Each node increments its sequence number whenever a change occurs in its neighbourhood. This number is used to select among alternative routes for the same destination. Node always select the route which have greatest number.
2) *Cluster Gateway switch routing protocol (CGSR):* CGSR extends DSDV with clustring the protocol scalability[8]. It depends on priority token scheduling, gateway code scheduling, path scheduling are used to improve performance of protocol. Unfortunately, setting up in the structure in a highly dynamic environment since the structure might not persist for a very long time.
3) *Wireless routing Protocol (WRP):* WRP is another loop-free proactive protocol where four tables are maintain.Distance table,link cost table,routes table and message retransmission information table[9]. In this protocol loop avoidance is depends on providing shortest pasth to each destination both the distance and the second-to-last hop information.Different number of routing tables used, and different in routing information maintained in these tables.

Here these 3 proactive routing protocols DSDV,CGSR and WRP are all distance vectore shortest path based routing protocol.Same complexity during link-failure and addition.

4) *Optimized Link State Routing Protocol (OLSR):* OSLR protocol[10]is an optimization for link-state type protocols. The key point of optimization is multipoint relay (MPR). Each node identifies its MPRs. Use of flooding a message to its MPRs, a node is guranteed that the message, when retransmitted by the MPRs, will be received by all its two-hop neighbours. When exchanging link-state routing information, a node lists only the connection to those neighbours that have selected it as MPR,that is MPR selector set.The protocol selects bi-directional link s for routing hence avoiding packet transfer over unidirectional links.
5) *Topology Dissemination Based on Reverse Path Forwarding (TBRPF):* TBRPF[11] is a link-state routing protocol like OLSR. Each node find shortesh path tree to all other nodes, but only optimize bandwidth only part of the tree is propogated to the neighbours.
6) *Fisheye State Routing Protocol (FSR):* The FSR protocol [12] is also an optimization over link-state routing protocol. It used fisheye techniques. FSR propagates link-state information to other nodes in the netowrk depends on how the

node far away. If node is closer link state information more frequent. When node is more far from source, but once message gets closer to the destnation, the accuracy increase. FSR mostly used in intragorup routing.

B. On Demand

These kind of protocols also known as source-initiated protocols.In this type routing protocols route are created when it required. When source want to send message to destination, it used route discovery mechanisms to find the route to a destinations. The route remains valid till the destination is rechable or until the route is no longer needed.

There are different types of on demand routing protocol are

1) *Dynamic Source Routing Protocol (DSR):* DSR is source based, loop-free on-demand routingprotocol [13], where each node maintains a route cache that contains the source route learned by the node. The route discovery process is started when source node have not valid route. When new routes are learned at that time continously route cache are updated.Source routing mostly used in packets forwarding.
2) *Ad-hoc On Demand Distance Vector (AODV):* AODV is reactive improvement of the DSDV protocol. AODV minimizes thenumber of route broadcasts by creating route on-demand [14],as totally oposite to maintain a complete list of routes as in the DSDV algoritham. Similar to DSR, route discovery is started on-demand the root request is then forward by the source to the neighbours, and so on until it reach to the destination.DSR potensially large control overhead and memory requirments than AODV. DSR paket have full route information but AODV packets contain only destination address. DSR can use asymmetric and symmetric both links during routing, while AODV use only symmetric link. In addition of node DSR maintain cache of multiple path beacause in future it help when link failure. So in general AODV and DSR work well with small to medium size moderate mobility network.
3) *Temporally Ordered Routing Algorithm (TORA):* TORA is also sorce-initiated on-demand routingprotocol built on the concept of link reversal of the directed acyclic graph [15]. TORA is also a loop-free nad bandwidth efficient protocols. TORA is most important property is quick root repair during link-failure.This property is suitable for large, highly dynamic wireless ad-hoc network. Disadvantage of TORA is work on synchronization of clock, if any kind of external time source is unavailable or does not have a GPS positioning system, so algoritham fails.
4) *Associativity Based Routing Protocol (ABR):* ABR protocol is also loop free protocol. But when it select routes it use associationstability.So that route discovered can be long-lived and maintained with less frequent update. Limitaion of this protocol is periodic beaconing used to establish association stability metrics,which may result in energy consumption. Signal Stability Algoritham(SSA)[16] is an ABR protocol with additional property of routes selection using signal strength of link

IV. RESULT BY COMPARISION OF TABLE DRIVEN AND ON-DEMAND ROUTING PROTOCOLS

In comparision of both protocols on-demand reactive routing protocols are more efficient than proactive protocols. Because one of the strong reason is on-demand reactive routing protocols minimize control overhead and power consumption since when routes are only established when required. In totally opposite proactive protocols require continous periodic updatesto keep information of routes and also maintain multiple routes which never be needed. So, its adding unnecessary routing overheads. But proactive routing protocols provide better quality of service in compare to on-demand protocols. In proactive routing protocols routing updates are continously updated, routes are always available and up-to-date and hence end-to-end delay can be minimized. Where in on-demand protocols has to wait for route discovered before communication can happen. This route discovery might not be tolerable for real-time communications. In proactive and reactive protocols, another class of unicast routing protocols, that can be known as hybrid protocols.Hybrid protocols have both proactive and reactive features are available. So proactive and reactive both aprroaches used to get new advantages. ZRP (zone based routing protocol) is an example of hybrid protocol. ZRP defines zone in which each node and its neighbours whth in given number of hops from the node. Proactive and reactive algoritham are used by the node route packets within and outside the zone, respectively.

In other terms of comparisions between the two routing protocols are :

1. Throughpu: Proactive protocols performance are better than Reactive protocols.
2. End to end delay: Proactive protocols performance are better than Reactive protocols.
3. Routing Load: Reactive protocols performance are better than Proactive protocols.

V. CONCLUSION

Now a days and in future wireless ad-hoc network will grow more and more. Integration of Wireless ad-hoc network with fixed internet infrastructure is very inevitable. Ad-hoc netwoking is main base of 4th generation wireless technology.Its flexibility, ease of maintenance, no required infrastructure, auto-configuration, self-administration capabilities. Using above characteristis Wireless ad-hoc network is popular. Now a days importance of wireless ad-hoc network is increase both research and industry sides. Open technical and economical issues will play important role to achieve success of wireless ad-hoc network technology. Wide research area activities and fast growing progress made in the wireless technologis in last few years. Most research and other work on routing protocols is being performed in the framework of the IETF MANET working gorup, where four routing protocols are currently under active development. There are two proactive, OLSR and TBRPF and and two reactive routing protocols, AODV and DSR.A wireless ad-hoc netwrok as an evolution of internet. It is totaly depend in IP-centric view of the network, and the use of layered architecture.There are two main use of IP protocol : it simplified wireless interconnection to the Internet, and gurantees the independance from wireless technologies. In this paper I have provided descriptions of several routing protocols and its classification of

wireless ad-hoc network. i.e., table driven and on-demand. I have also provided comparision of these two categories of routing protocols, their features, characteristics.This wireless ad-hoc network environment is continously and fast growing and challenging, and but there are still challenges and more problem with rapid change in topology. Wireless ad-hoc network will widely used in next few year because of low cost and easily creation of network.

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