

A STUDY ON METHODS OF WIRELESS MESH NETWORK PROTOCOLS DEVELOPMENTS IN RECENT TRENDS

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ABSTRACT:

Wireless mesh networks (WMNs) have emerged as a key technology for next-generation wireless networking. This paper focuses on a variety of routing protocols that are used in wireless mesh networks. Wireless Mesh Networks can give an answer for many open issues in the field of wireless networks. For WMN to be effective enough, it is required for a chosen routing protocol based on routing metrics that fits application needs to be used properly. Until now, many different routing protocols have been proposed. All of them have their own characteristics and there is no easy way to make any reliable comparison. The proposed paper presents a review of the current state-of-the-art WMN routing protocols and metrics.

Keywords: Reactive Routing Protocol, Routing Metrics, Routing Protocols, WMNs.

INTRODUCTION:

Wireless Mesh Networks (WMNs) play an important role in today communication. WMNs have low investment overhead and can be rapidly deployed; they can extend IP connectivity to regions unreachable by any single access technology. Some features like low-cost, easy network maintenance, robustness, and reliable service coverage allow WMN to take more portion of wireless communication in near future. A typical WMN consists of mesh routers, and mesh clients. Mesh routers have a wireless infrastructure and work with the other networks to provide a multi-hop internet

access service for mesh clients. On the other hand, mesh clients can connect to network over both mesh routers and other clients.

Routing is an important factor to forward the data packet from source to destination node. The Wireless Mesh routing protocols can be divided into proactive routing, reactive routing and hybrid routing protocols.

Hybrid Routing Protocols combines the merits of proactive and reactive routing protocols by overcoming their demerits and find efficient routes, without much control overhead. It employs diverse routing protocols in different part of the infrastructure WMNs i.e. reactive protocols for the ad hoc network area while proactive protocols are employed in wireless backbone.

Routing is an important factor to forward the data packet from source to destination node. To guarantee good performance, routing metrics must satisfy these general requirements are scalability, reliability, flexibility, throughput, load balancing, congestion control and efficiency. The routing metrics for mesh routing protocols are Hop Count, Blocking Metrics, Expected Transmission Count (ETX), The Expected transmission time (ETT), The Weighed

Cumulative ETT (WCETT), MIC,EETT, WCETT-LB, ALARM, iAWARE, Adv-iAWARE, Adv-ILA, LAETT.

PROACTIVE ROUTING PROTOCOLS

In proactive routing protocols paths are established to all the destination nodes regardless of whether or not the routes are needed to transmit data. They are also called table-driven methods. The proactive routing protocols are Destination-Sequenced Distance-Vector Routing (DSDV), Cluster Head Gateway Switch Routing (CGSR), Optimized Link State Routing Protocol (OLSR) and Scalable Routing using heat Protocols.

Destination Sequenced Distance Vector

The Destination-Sequenced Distance Vector (DSDV) protocol is a table-driven routing protocol based on the improved version of classical Bellman-Ford routing algorithm where each node maintains a routing table that contains the shortest path to every possible destination in the network and number of hops to the destination as shown in Fig.1. The sequence numbers allows the node to distinguish stale routes from new ones and avoid routing loops. Each DSDV node maintains two routing tables: one for forwarding packets and one for advertising incremental routing packets. The routing information sent periodically by a node contains a new sequence number, the destination address, the number of hops to the destination node, and the sequence number of the destination. When the topology of a network changes, a detecting node sends an update packet to its neighboring nodes. On receipt of an update packet from a neighboring node, a node

extracts the information from the packet and updates its routing table as follows

A DSDV routing table
 Routing table for node 2

Destination	Next Hop	Metric	Dest. Seq. No.
1	1	1	123
2	0	0	516
3	3	1	212
4	4	1	168
5	4	2	372
8	1	INF	432

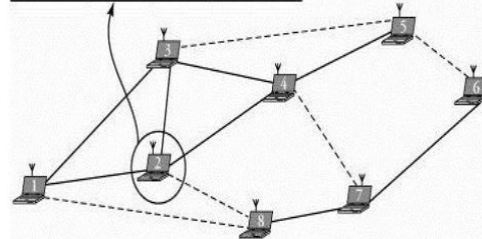


Fig 1: DSDV Routing Protocol in Network

The packet overhead of the DSDV protocol increases the total number of nodes in the ad-hoc network. This fact makes DSDV suitable for small networks. In large ad hoc networks, the mobility rate and therefore the overhead increase, making the network unstable to the point that updated packets might not reach nodes on time.

Cluster-Head Gateway Switch Routing Protocol

The Cluster-Head Gateway Switch Routing (CGSR) protocol is a table-driven routing protocol. In a clustering system, each predefined number of nodes are formed into a cluster controlled by a cluster head, which is assigned using a distributed clustering algorithm. However, with the clustering scheme, a cluster head can be replaced frequently by another node, for several reasons, such as low level energy left in the node or a node moves out of contract.

With this protocol, each node maintains two tables: a cluster-member table and a routing table. The cluster-member table records the cluster head for each destination node, and the routing table contains the next hop to reach the destination. As with the DSDV protocol, each node updates its cluster-member table on receiving a new update from its neighbors.

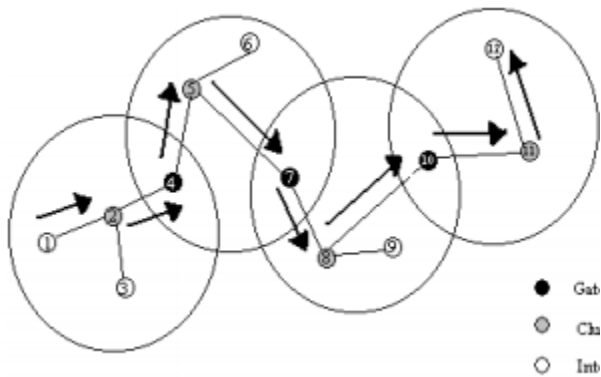


Fig 2: Routing in CGSR from node 1 to 12

Optimized Link State Routing

Optimized Link State Routing (OLSR) is a proactive routing protocol. Each node broadcasts its link state information to all other nodes in the network. OLSR operation mainly consists of updating and maintaining information in 1-hop, 2-hop neighbor table and routing table. OLSR uses hello messages for link state information. Multi Point Relays (MPR) is an important aspect of the OLSR protocol. An MPR for a node N is a subset of neighbors of N which broadcast packets during the flooding process, instead of every neighbor of N flooding the network. When a node propagates a message, all of its neighbors receive the message. Only MPR which have not seen the message before again propagates the

message. Therefore flooding overhead can be reduced.

Scalable Routing using HEAT Protocol

The HEAT protocol uses distribution of temperature. The protocol adopts that each of the nodes of a network is a source of heat. The assumption is that gateways are the warmest, followed by nodes/clients that in the closest vicinity, and that the further from gateways, the temperature becomes lower and lower. Using the temperature distribution, the protocol always sends packets to a neighboring node that has the warmest temperature, thus reaching the destination.

REACTIVE ROUTING PROTOCOLS

In reactive routing protocols, routes are established on demand. Reactive methods are also called on-demand methods. The route discovery process is initiated when the source node requires a route to a destination node. The reactive routing protocols are Dynamic Source Routing (DSR) protocol, Ad hoc On Demand Distance Vector (AODV) protocol, Link Quality Source Routing Algorithm (LQSR) protocol and Temporally Ordered Routing Algorithm (TORA).

Dynamic Source Routing

The Dynamic Source Routing protocol (DSR) is a reactive routing protocol which is based on source routing. The protocol works in two phases: route discovery and route maintenance. When a node wants to send a data then DSR initiates route discovery. In route discovery, the source node looks at the route cache for destination

route. If the route exists then send the data. Otherwise it broadcast the Route Request Packet (RREQ) to its neighbors until it reaches the destination as shown in the Fig. 3 The RREQ Packet contains the source address, destination address, route id and a route record. When the request reaches destination, a route reply (RREP) is sent back to the source node via the recorded route which has the minimum number of hops. In route maintenance, the route error packets are generated at a node during fatal transmission problem.

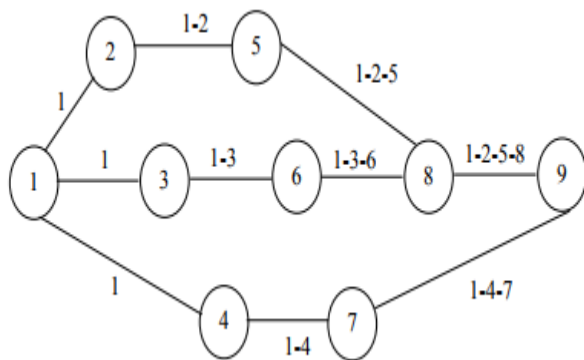


Fig 3: Broadcast Route Request from source node 1 to destination node 9

Ad-Hoc on-Demand Distance Vector Routing Algorithm (AODV)

The AODV protocol belongs to the most popular protocols because they employ simple mechanisms of the type “question - reply” to define routing paths. For this purpose, three types of packets are used: Route Request (RREQ), Route Reply (RREP) and Route Error (RERR). The source node sends RREQ packets when a necessity to send packets arises and then intermediate nodes, provided they know the route, send a RREQ packet further on towards the destination

node, whereas when intermediate nodes do not know the route, they reply with a RERR packet. This process is then repeated until the packet reaches the destination node (the node sends then a RREP packet). In the case when the node receives RREQ.

Link Quality Source Routing Protocol (LQSR)

A reactive routing protocol proposed by Microsoft Research Group that is based on the Dynamic Source Routing (DSR) algorithm. To improve the quality of the link, the LQSR protocol employs single link parameters instead of end-to-end path parameters. In the process of setting a connection path, the protocol describes individual links by the quality metric, and then sends back the information to the node that initiates the setting up of the path. Quality parameters may vary depending on the mobility of nodes and metrics used in the process, e.g. for stationary nodes they may include strictly quality parameters such as ETX, while for mobile nodes this can be a hop-count based parameter such as RTT and ETX. Though the protocol has many advantages, it is still necessary to develop more appropriate routing metrics that would take into account the specificity of the WMN network and the features of the LQSR protocol.

Temporally Ordered Routing Algorithm

The Temporally Ordered Routing Algorithm (TORA) is a loop free, highly adaptive, efficient and scalable distributed routing algorithm for wireless networks. TORA uses destination oriented routing information that

is already available at each node. Nodes only need to know their one-hop neighborhood. By the information of the neighbor TORA builds independently local routing information for each destination node. TORA also exhibits multipath routing capability. Directed Acyclic Graph (DAG) is maintained by each node to every destination. When source node wants to send data to destination node then it broadcasts a Query packet which containing the destination address.

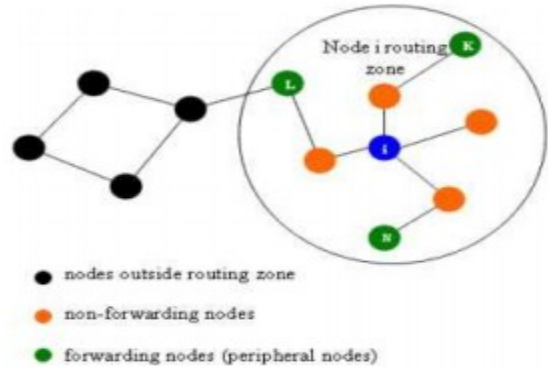


Fig 4: Zone Routing Protocol

HYBRID PROTOCOL

Zone Based Routing Protocol (ZRP) is a hybrid protocol, which take advantage of best of proactive and reactive protocols. A node's local neighborhood is known as a routing zone. A node's routing zone is defined as the set of nodes whose minimum distance in hops form the node is no greater than the zone radius. To construct a routing zone, the node has to identify all its neighbors first which are one hop away and can be reached directly. The neighbor discovery process is managed by the Neighbor Discovery Protocol (NDP). ZRP uses two routing methods: Intra Zone Routing Protocol (IARP) and Inter Zone Routing Protocol (IERP).The IARP is responsible for maintaining routes to all destinations in the routing zone proactively. The IERP is responsible for discovering and maintaining the routes to nodes beyond the routing zone reactively.

Comparison of Routing Protocols for Wireless Mesh Networks

Routing Protocols	Type of Protocol	Routing Metrics	Mobility	Loop Free	Scalability	Reliability	Load Balancing	Congestion control	Throughput	Location aware
DSDV [14]	Proactive	Shortest Path	Yes	Yes	No	Yes	No	No	Decreases with mobility	No
CGSR [6]	Proactive	Shortest Path via CH	Yes	Yes	Yes	Yes	Yes	Yes	Decreases with mobility	No
OLSR [7]	Proactive	Shortest Path	Yes	Yes	No	Yes	No	No	Better compared to DSDV	No
Scalable Routing [8]	Proactive	Hop count	Yes	Yes	Yes	Yes	No	No	Yes	No
DSR [9]	On demand	Shortest Path	Yes	Yes	No	Yes	No	Yes	Decreases with mobility	No
AODV [10]	On demand	Fast and Shortest path	Yes	Yes	No	Yes	No	Yes	Decreases with mobility	No
LQSR [11]	On demand	Hop Count, RTT, ETX	Yes	Yes	No	Yes	Yes	Yes	Yes	No
TORA [12]	On demand	Hop count	Yes	Yes	Yes	Yes	No	No	Better compared to DSDV	No
ZRP [13]	Hybrid	Shortest path (zone)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

LITERATURE REVIEW:

Sonia Waharte et al [1] to have a clear and precise focus on future research in WMN routing, the characteristics of WMNs that have a strong impact on routing must be identified.

Paulo Alexandre Regis et al [2] we assembled a simple mobile mesh network test bed based on COTS products and open-source software. The system provided insights on real situations and allowed to evaluate various scenarios. The experiments

showed how certain uncontrolled variables could affect the system performance.

Shubat S. Ahmeda et al [3] reviews on various types of routing protocols that are used in wireless mesh networks have been presented. Performance comparison is done with regard to the network size, network load. It has been demonstrated that OLSR protocol with ETX metric improves the overall performance in all the considered scenarios.

Naveen N [4] a survey of different aspects regarding WMNs design, current state-of-the-art protocols and algorithms for WMNs that have been proposed to improve their performance

Vijayakumar, K.P et al [5] explains variety of routing protocols that are used in wireless mesh networks and identify the performance of these routing protocols.

JangeunJun et al [6] we propose such a routing protocol and evaluate its performance via simulations. Results show that, for WMNs, the proposed routing protocol outperforms general purpose MANET protocols in terms of routing overhead, packet delivery ratio, network throughput, end-to-end delay, and average hop-count.

OBJECTIVES:

- To study the different types of wireless mesh network routing protocols in recent trends.

- To study the Comparison of Routing Protocols for Wireless Mesh Networks.
- To study the routing metrics and routing table.

CONCLUSION

Routing Protocol is an important component of communication in Wireless Mesh Networks. In this paper, we have presented theoretical details of Proactive routing protocols like DSDV, CGSR, and OLSR and Scalable Routing using heat Protocols. We have also presented theoretical details of reactive routing protocols like DSR, AODV, LQSR and TORA protocols and hybrid protocol such as ZRP. The variety of routing protocols for wireless mesh networks are compared using metrics as shown in Table II. So we can select an effective protocol, depending up on the network and other conditions. This paper aims to provide a straightforward guide to the researcher for those who are interested to carry out their research in the field of WMN.

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