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Comparative Evaluation of Wireless Ad-Hoc Networks Routing Approach

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ABSTRACT:

Wireless Ad-hoc Sensor Networks (WSN) is a recent advanced technology of computer networks and electronics. The WSN are increasingly becoming more practicable solution to many challenging applications. The wireless ad hoc sensor networks depend upon the sensed data, which may depend upon the application and various operations require different algorithms for their routing from one point to another. This paper presents a comparative analysis of routing protocols in ad-hoc sensor networks. This paper will study the working of some well-known routing protocols like DSDV, ADOV, DSR AND IMEP. The most important characteristic is the dynamic topology, which is a consequence of node mobility. Nodes can change their positions quite frequently, which mean that we need a routing protocol that quickly adapts to topology changes. The nodes in an ad-hoc network can consist of laptops and personal digital assistants and are often very limited in resources such as CPU capacity, storage capacity, battery power and bandwidth. This means that the routing protocol should try to minimize control traffic, such as periodic update messages. Instead the routing protocol should be reactive, which means it only calculates routes upon receiving a specific request.

Keywords: Ad-hoc networks, computer communication, routing protocol, DSR, AODV, DSDV.

[1] INTRODUCTION

A wireless ad-hoc network is a collection of mobile/semi-mobile nodes with no pre-established infrastructure, forming a temporary network. Each of the nodes has a wireless interface and communicates with each other over either radio or infrared. Routing is one of the challenging issues in mobile ad-hoc network. Existing protocols for ad-hoc network can generally be categorized into pro-active and re-active protocols types. It is a well-known fact that most of these protocols have certain weaknesses. Some of the main problem includes Limitation: Most of the well known protocols in this area are limited to a particular scenario i.e. does not perform well in all environments; Lack of analytical studies: not sufficient work has been done to evaluate their performance with respect to other techniques of similar types. Moreover, proposed schemes focus on routing without considering their affects on some other routing relates issues [2]. The contribution of this paper is to collect and critically evaluate all those protocols that are proposed as a routing solution for mobile ad-hoc network. We believe via analyzing some of the unknown and famous routing schemes a wider knowledge of the problem could be developed. Moreover, it could also be used to either extend existing schemes or to develop new routing solutions.

[2] ROUTING

Because of the fact that it may be necessary to hop several hops (multi-hop) before a packet reaches the destination, a routing protocol is needed. The routing protocol has two main functions, selection of routes for various source-destination pairs and the delivery of messages to their correct destination. The second function is conceptually straightforward using a variety of protocols and data structures (routing tables). This report is focused on selecting and finding routes.

[3] AD-HOC ROUTING PROTOCOLS DESIRABLE PROPERTIES

If the conventional routing protocols do not meet our demands, we need a new routing protocol. The question is what properties such protocols should have? These are some of the properties [3] that are desirable:

[3.1] DISTRIBUTED OPERATION [2]: The protocol should of course be distributed. It should not be dependent on a centralized controlling node. This is the case even for stationary networks. The difference is that nodes in an ad-hoc network can enter/leave the network very easily and because of mobility the network can be partitioned.

[3.2] LOOP FREE [3]: To improve the overall performance, we want the routing protocol to guarantee that the routes supplied are loop-free. This avoids any waste of bandwidth or CPU consumption.

[3.3] DEMAND BASED OPERATION [2]: To minimize the control overhead in the network and thus not wasting network resources more than necessary, the protocol should be reactive. This means that the protocol should only react when needed and that the protocol should not periodically broadcast control information.

[3.4] UNIDIRECTIONAL LINK SUPPORT [4]: The radio environment can cause the formation of unidirectional links. Utilization of these links and not only the bi-directional links improves the routing protocol performance.

[3.5] SECURITY [2]: The radio environment is especially vulnerable to impersonation attacks, so to ensure the wanted behavior from the routing protocol, we need some sort of preventive security measures. Authentication and encryption is probably the way to go and the problem here lies within distributing keys among the nodes in the ad-hoc network. There are also discussions about using IP-sec [4] that uses tunneling to transport all packets.

[3.6] POWER CONSERVATION [7]: The nodes in an ad-hoc network can be laptops and thin clients, such as PDAs that are very limited in battery power and therefore uses some sort of stand-by mode to save power. It is therefore important that the routing protocol has support for these sleep-modes.

[3.7] MULTIPLE ROUTES [8]: To reduce the number of reactions to topological changes and congestion multiple routes could be used. If one route has become invalid, it is possible that another stored route could still be valid and thus saving the routing protocol from initiating another route discovery procedure.

[3.8] QUALITY OF SERVICE SUPPORT [4]: Some sort of Quality of Service support is probably necessary to incorporate into the routing protocol. This has a lot to do with what these networks will be used for. It could for instance be real-time traffic support. None of the proposed protocols from MANET have all these properties.

[4] DESTINATION SEQUENCED DISTANCE VECTOR - DSDV

DSDV is a hop-by-hop distance vector routing protocol that in each node has a routing table that for all reachable destinations stores the next-hop and number of hops for that destination. Like distance-vector, DSDV requires that each node periodically broadcast routing updates. The advantage with DSDV over traditional distance vector protocols is that DSDV guarantees loop-freedom.

To guarantee loop-freedom DSDV uses a sequence numbers to tag each route. The sequence number shows the freshness of a route and routes with higher sequence numbers are favorable.

[5] AD-HOC ON DEMAND DISTANCE VECTOR – AODV

The Ad Hoc On-Demand Distance Vector (AODV) [6] routing protocol enables multi-hop routing between participating mobile nodes wishing to establish and maintain an ad-hoc network. AODV is based upon the distance vector algorithm. The difference is that AODV is reactive, as opposed to proactive protocols like DV, i.e. AODV only requests a route when needed and does not require nodes to maintain routes to destinations that are not actively used in communications. As long as the endpoints of a communication connection have valid routes to each other, AODV does not play any role.

The advantage with AODV compared to classical routing protocols like distance vector and link-state is that AODV has greatly reduced the number of routing messages in the network. AODV achieves this by using a reactive approach. This is probably necessary in an ad-hoc network to get reasonably performance when the topology is changing often.

[6] DYNAMIC SOURCE ROUTING - DSR

Dynamic Source Routing (DSR) [11] [12] also belongs to the class of reactive protocols and

allows nodes to dynamically discover a route across multiple network hops to any destination. Source routing means that each packet in its header carries the complete ordered list of nodes through which the packet must pass. DSR uses no periodic routing messages (e.g. no router advertisements), thereby reducing network bandwidth overhead, conserving battery power and avoiding large routing updates throughout the ad-hoc network. Instead DSR relies on support from the MAC layer (the MAC layer should inform the routing protocol about link failures). The two basic modes of operation in DSR are route discovery and route maintenance.

DSR uses the key advantage of source routing. Intermediate nodes do not need to maintain up-to-date routing information in order to route the packets they forward. There is also no need for periodic routing advertisement messages, which will lead to reduce network bandwidth, overhead, particularly during periods when little or no significant host movement is taking place. Battery power is also conserved on the mobile hosts, both by not sending the advertisements and by not needing to receive them; a host could go down to sleep instead.

[7] INTERNET MANET ENCAPSULATION PROTOCOL - IMEP

IMEP [3] is a protocol designed to support the operation of many routing protocols in Ad-hoc networks. The primary purpose of the Internet MANET Encapsulation Protocol (IMEP) is to improve overall network performance by reducing the "number" of network control message broadcasts through encapsulation and aggregation of multiple MANET control messages (e.g. routing protocol packets, acknowledgements, link status sensing messages, network-level address resolution, etc.) into larger IMEP messages. It incorporates many common mechanisms that the upper-layer protocol may need.

These mechanisms include:

- Link status sensing
- Control message aggregation and encapsulation
- Broadcast reliability
- Network-layer address resolution
- Hooks for inter router security authentication procedures

[8] COMPARITIVE EVALUATION

So far, the protocols have been analyzed theoretically. Table I summarize and compare the result from these theoretical/qualitative analyses and shows what properties the protocols have and do not have.

TABLE I: Comparison between different ad-hoc routing protocols.

S.No	PARAMETER	DSDV	ADOV	DSR	IMEP
1.	LOOP-FEE	YES	Yes	Yes	NO,SHORT LIVED LOOPS
2.	MULTIPLE ROUTES	NO	No	Yes	Yes
3.	DISTRIBUTED	YES	Yes	Yes	Yes
4.	REACTIVE	NO	Yes	Yes	Yes
5.	UNIDIRECTIONAL LINK SUPPORT	NO	No	Yes	No
6.	QOS SUPPORT	NO	No	No	No
7.	MULTICAST	NO	Yes	No	No
8.	SECURITY	NO	No	No	No
9.	POWER CONSERVATION	NO	No	No	No
10.	PERIODIC BROADCASTS	YES	Yes	No	Yes
11.	REQUIRES RELIABLE OR SEQUENCED DATA	NO	No	No	Yes

As it can be seen from Table I, none of the protocols support power conservation or Quality of Service. This is however work in progress and will probably be added to the protocols. All protocols are distributed, thus none of the protocols is dependent on a centralized node and can therefore easily reconfigure in the event of topology changes.

DSDV is the only proactive protocol in this comparison. It is also the protocols that have most in common with traditional routing protocol in wired networks. The sequence numbers were added to ensure loop-free routes. DSDV will probably be good enough in networks, which allows the protocol to converge in reasonable time. This however means that the mobility cannot be too high. The authors of DSDV came to the same conclusions and designed AODV, which is a reactive version of DSDV.

They also added multicast capabilities, which will enhance the performance significantly when one node communicates with several nodes. The reactive approach in AODV has many similarities with the reactive approach of DSR. They both have a route discovery mode that uses request messages to find new routes. The difference is that DSR is based on source routing and will learn

more routes than AODV. DSR also has the advantage that it supports unidirectional links. DSR has however one major drawback and it is the source route that must be carried in each packet. This can be quite costly, especially when QoS is going to be used.
None of the presented protocols are adaptive, meaning that the protocols do not take any smart routing decisions when the traffic load in the network is taken into consideration. As a route selection criteria the proposed protocols use metrics such as shortest number of hops and quickest response time to a request. This can lead to the situation where all packets are routed through the same node even if there exist better routes where the traffic load is not as large.

[10] CONCLUSION

This paper consists an comparative analysis of the different well-known routing algorithms. Wireless Ad-hoc Sensor Networks have become promising future to many applications. In the absence of adequate security, deployment of sensor networks is vulnerable to variety of attacks. So it is of utmost importance to design a wireless network that should provide substantial security and immunity to attacks. The currently proposed routing protocols for these networks are insecure. It is also shown that no protocol is best. So it can be concluded that the tradeoff exists among these protocols. So in the near future we will propose an integrated protocol which will integrate two different protocols which will be better than the most of the routing protocols features.

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