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A Comparative study of On-Demand Data Delivery with Tables Driven and On-Demand Protocols for Mobile Ad-Hoc Network

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Abstract

Mobile ad-hoc network offers a unique art of network formation and can be established in the absence of any fixed infrastructure. Due to the absence of centralized supported structure, an ad-hoc network suffers with various challenges. Some of the known challenges to this area include battery power, routing, bandwidth and security. Routing is an integral part of network communication process. It essential stands for route establishment for data transfer among different nodes of the network. Routing schemes for a mobile ad-hoc network can classify into one of many types. With the invention of Mobile Ad-hoc On-Demand Data Delivery Protocol (MAODDP) a new routing family of on-demand data delivery has introduced in the existing portfolio of routing protocols of an ad-hoc network. The contribution of this work is to extend some of the previous work of MAODDP comparison with DSDV and AODV. This work gives an insight into protocol performance against each other and can be utilized in further extension of the studied schemes.

1.Introduction

Mobile ad-hoc network is deployed in applications such as disaster recovery and distributed collaborative computing, where routes are mostly multi-hop and network hosts communicate via packet radios [11]. Routing is one of the challenging issues in mobile ad-hoc network. Much effort is under going to invent an efficient routing algorithm for mobile ad-hoc network. Existing protocols for ad-hoc network can generally be categorized into one of many types. In this context on-demand data delivery can be seen as one of the new addition [10]. In the existing literature several studies highlighted relative benefits and benefits of various routing schemes. This paper presents a comparative study of MAODDP with Destination sequence distance vector routing and Ad-hoc on-demand distance vector routing (AODV) protocols. Each of the studies protocol belongs to different family of an-ad-hoc network. This effort is to further explore the basic foundation theme of different families of an ad-hoc network and their benefits. In this context this paper has been organized as follows in section 1 a brief introduction of each of the studied protocol is focused. Section 2. presents a comparative study of MAODDP against DSDV and AODV and conclusions and future work is presented in section 3.

2. Protocols Studied

The following section presents a brief introduction of the protocols being studied and compared.

2.1. Destination-Sequenced Distance-Vector Routing Protocol (DSDV)

The destination sequenced distance vector routing protocol (DSDV) is an extension of classical bellman ford routing mechanism [3]. DSDV maintains consistent network view via periodic routing updates. Routing information is stored inside routing tables maintained by each node. Each entry is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones thereby avoiding the formation of routing loops. New route broadcasts contain the address of the destination, the number of hops to reach destination, the sequence number of the destination and a new sequence number unique to broadcast. Broken links are described by ∞ metric, infinity, which could be any value

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greater than the maximum allowed metric. Mobile nodes receiving new broadcasts can find the fresh route by comparing receiving information with those that are previously recorded in their routing table. A route with a recent sequence number is considered as a fresh route. If sequence numbers are found to be the same than the route with better metric will be selected.

2.2. Ad-hoc On-demand Distance Vector Routing (AODV)

AODV is a combination of both DSR [7] and DSDV [3]. It inherits the basic on-demand mechanism of route discovery and route maintenance from DSR and the use of hop-by hop routing sequence numbers and periodic beacons from DSDV. AODV provides both multicast, and unicast connectivity in a mobile ad-hoc environment. The main feature of AODV is quick response to link breakage in an active route[8]. AODV [4,8] builds routes using a route request and route reply query cycle. For destination source nodes with no prior information it broadcasts a route request (RREQ) packet. Nodes receiving RREQ update their information and set-up backward pointers to the source node. When the source node receives the RREP it begins to forward data packets to the destination. AODV defines route discovery, route maintenance and route error messages types. AODV uses ‘hello’ message to check the status of neighbouring nodes. If a node in AODV fails to send ‘hello’ message within the prescribed time limit it will consider as inactive node and the link will be considered as broken.

2.3. Mobile Ad-hoc On-Demand Data Delivery Protocol (MAODDP)

MAODDP is a simple multi-hop routing protocol to establish routing while considering some other routing related issues [5]. MAODDP offers self starting; secure; loop free unicast and multicast routing among various hosts of a mobile ad-hoc network. The key feature of MAODDP is route establishment and data delivery simultaneously one after the other. MAODDP enables mobile nodes to identify route breakage or expired route so that such route could be deleted and marked as invalid using the route error message. MAODDP is well known for offering routing with reduced bandwidth and power consumption [4, 5].

3. Comparative study of MAODDP against DSDV and AODV

In the reported literature MAODDP has previously been compared with DSDV [8] and AODV [6-8]. This section is divided into two parts in section one MAODDP is compared against DSDV and in section 2 it is compared against AODV.

3.1. MAODDP versus DSDV

DSDV [1,2] is a table-driven approach and most of the table driven routing techniques [8, 12] offer routing without addressing some of the main issues such as limited bandwidth and battery power of MANET [12-13]. DSDV requires nodes to periodically transmit routing table updates packets regardless of the network traffic [12]. DSDV maintains a consistent view of the network, for which it has to broadcast route updates periodically. This approach creates extra overhead on the network and slows down the overall routing operation [17, 18]. MAODDP is an on demand data delivery routing technique that offers route discovery and data delivery simultaneously [10]. Unlike DSDV it does not broadcast route updates to all network nodes on periodic bases [8]. This approach considerably reduces the network overhead and network bandwidth is utilized efficiently. It also reduces the routing table size by avoiding the periodic updates [13].

When the number of nodes in the network grows the size of the routing tables and the bandwidth required to update them also grows. This overhead is considered as the main weakness of DSDV. DSDV is well known for its poor performance at high mobility rate. In some simulation studies DSDV performed well for fairly static topologies but became unreliable as node mobility and the number of traffic sources increased [8]. MAODDP allows nodes to sleep, if they are not involved in an active transmission and through this approach it saves battery power considerably [4]. At present mobile ad-hoc network does not adopt any standard security policy [11]. This means

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that someone could make an active attack on the network to exploit it or to disable the mobile ad hoc network. DSDV assumes that all nodes are trust worthy and cooperative. Once the false sequence has been established the attacker will continuously send out new packets to update the value. Thus, more hosts will be cheated [8] therefore a single misbehaving node can pose a serious threat for the entire network. While MAODDP is considered to be the first protocol that deals with security alongside routing and has its own security mechanism [11].

DSDV also pose a period of convergence before which routes will not be known and packets will be dropped [2, 8]. This could also limit the number of nodes that can connect to the network since the overhead grows as O (N^2). Moreover, DSDV works only with bidirectional links [8]. DSDV is mentioned in several simulation studies. The results were mixed but later papers show results where DSDV is not performing well compared to the other protocols [8]. In DSDV Optimal values for parameters like settling time is not easy to determine. That might result in unnecessary bandwidth consumption [8]. On the other hand, MAODDP does not involve complex calculation for finding suitable routes [4]. In DSDV routing loops can occur while the network is reacting to a change in the topology. DSDV use distance vector shortest-path routing as the underlying routing protocol. It has a high degree of complexity especially during link failure and additions [8].

DSDV performed well with a network that is fairly static, small and does not offer high mobility but as mobility of the network and size increases, DSDV fails to perform well[8]. Increase in network mobility may need the nodes to be updated more frequently in order to maintaining a consistent overview of the whole network, which become rather difficult in periodic updating. On the other side, MAODDP is scalable to large networks and addresses the scalability issue effectively [4]. One of the main advantages of DSDV is loop free routing [8]. DSDV uses the concept of sequence number to assure loop free routing. MAODDP also provides loop free routing by using combination of sequence numbers and broadcast ID [8].

Group communication or multicasting is an essential factor for mobile ad-hoc applications [9]. An efficient multicast model helps in achieving effective group communication in MANET. At present, multicasting routing in mobile ad-hoc networks is gained by adopting one of two approaches: flooding and tree-based routing. Flooding offers the lowest control overheads with very high data traffic, while tree-based routing reduces data traffic in the network but requires many control data exchanges. Studies show less efficient performance of these techniques on mobile ad-hoc network.DSDV does not offer multicast routing and is one of the main drawbacks of DSDV [11, 12]. MAODDP support both unicast and multicast routing [8, 12]. One other main advantage of MAODDP over DSDV is saving battery power through power saving mechanism [17].Each mobile node has a limited battery power and if a node runs out of battery then it could cause a great problem in active transmission[8].

Mobile ad hoc networks suffer with high mobility, frequent topology changes, bandwidth constraints, limited power and hidden terminal problem. Our research concluded that almost all of these issues are interrelated with the overall routing mechanism [9]. Therefore for a routing mechanism to be good enough for such an environment, it should be able to address some or all of these issues at a certain level. Most of the tables driven protocols address routing without addressing the side effects on the other related issues such as limited bandwidth and battery power of ad-hoc networks.

3.2. MAODDP versus AODV

AODV is an on demand approach but still use periodic broadcast of ‘hello message’ to track neighbouring nodes [3]. This periodic propagation causes network overhead in AODV [8]. On the other hand, instead to maintain fresh topology information MAODDP relies on one of four different messages types. It is expected that MAODDP might consume less bandwidth than AODV in the absence of periodic updates. In AODV the quality of path is not known prior to call set-up. It can be discovered only while setting up the path. Moreover quality of path must be monitored by all intermediate nodes in an active session at the cost of additional latency and overhead penalty [6]. It makes AODV quite unsuitable for real life applications. MAODDP follows on demand data

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delivery routing technique thus, considerably reduces the network overhead and efficiently utilizes network bandwidth. It also reduces the routing table size by avoiding the periodic updating [13].

Loop free routing is an important factor in mobile ad hoc routing; since it considerably reduces the network overhead [2]. AODV and MAODDP support the selection of fresh routes through uses of sequence number to support loop free routing and to ensure the freshness of received packets [7, 13]. Scalability is an important factor that is not supported by many routing protocols. The routing mechanism of both AODV and MAODDP are scalable to large network [8]. AODV and MAODDP save battery power at considerable level [13]. MAODDP and AODV allow mobile nodes to be in the sleep mode at random intervals of time. In case of AODV this time interval could decrease due to control packets at a higher rate. This further explains improved performance of the MAODDP power saving mechanism which might consume less bandwidth than AODV. MAODDP could offer faster data transmission than AODV as nodes do not wait for the establishment of the route before data delivery take place. Nodes in AODV store only route that are needed. Nodes use the routing caches to reply to route queries. These results in 'uncontrolled' replies and repetitive updates in hosts' caches yet early queries cannot stop the propagation of all query messages which are flooded all over the Network.

MAODDP is a secure routing protocol and uses an efficient security technique to ensure security against various routing attacks [11]. AODV in its initial specification is not a secure routing protocol and does not follow any secure mechanism to guard against various routing threats [13]. In AODV any node with possible route to the destination can send route replies back to the source node [3]. In MAODDP only destination node issued acknowledge message on receiving data from source node [7]. This Acknowledgement packet is the confirmation of successful transmission. AODV and MAODDP rely on tables to store route information [8]. MAODDP supports a special type of message called a 'Joining' message that is broadcasted only once at the time of joining an ad-hoc network [8].

4. Conclusion and Future Work

The contribution of this paper is to critically evaluate protocols belong to three different routing families of mobile ad-hoc network. MAODDP is compared against DSDV and AODV from tables driven and on demand routing types respectively. In future, we intend to conduct a comprehensive study highlighting MAODDP comparison against protocols belong to routing families not focused in this work. We intend to contribute our findings with the ongoing research in this area.

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