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Routing Problems in Mobile Ad hoc Networks (MANET)

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Abstract- *Mobile ad hoc networks (MANETS) may be defined as networks that have many free and self-created nodes however these nodes are connected with each other in peer to peer fashion. DSR (Dynamic Source Routing) is an on-demand routing protocol for wireless mesh ad hoc networks that it forms a route on demand when a transmitting node requests other. However it uses source routing instead of relying on routing table at each intermediate devices. DSR are used to reduce flooding of route requests. But with the increase in network size, node mobility and local cache of every mobile node cached route quickly become stale or inefficient. In this paper, for efficient searching, we have proposed a generic searching algorithm on associative cache memory organization to faster searching single/multiple paths for destination if exist in intermediate mobile node cache with a complexity O(n) (Where n is number of bits required to represent the searched field).The other major problem of DSR is that the route maintenance mechanism does not locally repair a broken link and Stale cache information could also result in inconsistencies during the route discovery /reconstruction phase. So to deal this, we have proposed an optimized cache coherence handling scheme for on -demand routing protocol (DSR).*

Keywords- *DSR, Efficient Searching, Cache Coherence, MANETS etc.*

I. INTRODUCTION

Mobile ad hoc networks (MANETS) may be defined as networks that have many free and self created nodes, sometimes composed of mobile devices or other mobile pieces interconnected to each other by multi-hop wireless paths in a strictly peer to peer fashion. Caching is an important part of on-demand routing protocol for wireless ad hoc networks. The nodes cooperate to dynamically establish and maintain routing in the network. Communication is carried out by forwarding packets not directly but within the wireless range. Instead of using the periodic or background exchange of routing information common in most routing protocols , an on-demand routing protocols searches for the attempts to discover a route to some destination node only when a sending node originates a data packet addressed to the node. An on demand routing protocol must cache routes previously discovered to avoid the need for such a route discovery to be performed before each data is sent. Many routing protocols for wireless ad hoc networks have used on-demand mechanisms. Some of those are temporally ordered routing algorithm (TORA), Dynamic source Routing protocols (DSR), Ad hoc on demand distance vector (AODV), Zone routing protocol (ZRP), and Location-Aided Routing (LAR). For instance, in the Dynamic Source Routing protocol, when some node X originates a data packet destined for a node Y to which S does not currently know a route, X initiates a new route discovery by beginning a flood a request reaches either Y or another node that has a cached route to Y, this node then returns to X the route discovered by this request. It may cause a large number of request packets to be transmitted, and add latency to the subsequent delivery of data packet that initiated it, hence performing such a route discovery can be a costly operation. However, this route discovery can also be beneficial as it may result in the collection of a large amount of information about the current state of network that may be useful in future routing decisions. In particular, X may receive a number of route replies in reply to its route discovery flood, each of which returns information about a route to Y through a different portion of the network. The performance of this protocol degrades rapidly in high-mobility environment because the route maintenance mechanism does not locally repair a broken link. In this paper, for efficient searching, we have proposed a generic searching algorithm on associative cache memory organization to faster searching single/multiple paths for destination if exist in intermediate mobile node cache with a complexity O(n) (Where n is number of bits required to represent the searched field).The other major problem of DSR is that the route maintenance mechanism does not locally repair a broken link and Stale cache information could also result in inconsistencies during the route discovery/reconstruction phase. So to deal this, we have proposed an optimized cache coherence handling scheme for on -demand routing protocol (DSR).

II. GENERAL PROBLEMS IN MANET

A. Security

There is a major problem for security because the signal is transmitted through air everyone is able to receive the signal. If people have the correct equipment for receiving a specific signal, they are able to get it easily (i.e. radio, TV…). Using a wireless communication is equivalent to shouting information from the top of a roof so that all the people around us could hear it easily. To make wireless signal secured it is important to encrypt it (data encryption).

B. *Bandwidth*

Wireless networks are less efficient in case of low and unreliable bandwidth, mainly caused due to the radio media. A radio transmission is affected by various factors like: interferences, obstacles, mobility…etc. As we know number of frequencies is limited for every channel, and as the bandwidth is proportional to the frequency, the radio frequency space is cut in channels.

C. *Energy*

A main problem of radio links is the amount of energy they need these links need energy not only for the amount of calculation needed for modulation, but also needs energy mainly for the antenna. When a device wants to communicate with a wire, it uses all its energy on this wire. Antennas are usually Omni-directional for wireless communication, as they need much more energy.

D. *Interference*

This is the major problem with mobile ad-hoc networks is the interference. As links come and go depending on the transmission characteristics. During the transmission one node can interfere with another node easily by which interference came.

E. *Dynamic Topology*

It is also the major problem with ad-hoc routing as the topology is not constant in any route. The mobile node might move or medium characteristics might change. The changes that occur in network these changes must be also represented in routing table that means routing table need to be updated accordingly to network .This updating of tables takes some time and for MANET it should be as less as possible.

F. *Routing Overhead*

In wireless ad-hoc networks, nodes often change their position inside network. So, some stale routes are generated in the routing table which results in unnecessary routing overhead.

III. ROUTING IN MANET

Each device in a MANET is free to move and will therefore change its links to other devices.
Routing is the way used in communications to find a best path between two objects. The role of routing in a network is similar to the role of a road map for a post office, in both cases. We need to deliver messages at proper location and in an appropriate way.

A. *Routing Problems In Ad Hoc Networks*

In infrastructure mode, the routing part is handled by the access point and the distribution system; every wireless device just need to forward all its data packets to this access point. But, in AD Hoc networks, there is no common access point for connections, and, every device acts as a router. This scenario is totally new. Adding to this, devices are not fixed, they can be mobile, contrary to the Internet where every router has fixed neighbours (excepts if a link fails). For solving this problem, the IETF (Internet Engineering Task Force), powerful standardisation authority in the communication world, created the MANET work group. This group has a mission to create and discuss routing protocols for Ad Hoc networks. This document presents the 4 main constraints for routing on Ad Hoc networks, such as dynamics topology, bandwidth constraints, energy constraints and low physical security. The group has then to comply with these constraints in order to build an efficient algorithm of route calculation.

B. *Ad-Hoc Routing Protocols*

There were different approaches, and then, different solutions. The two main approaches are proactive protocols, reactive protocols.

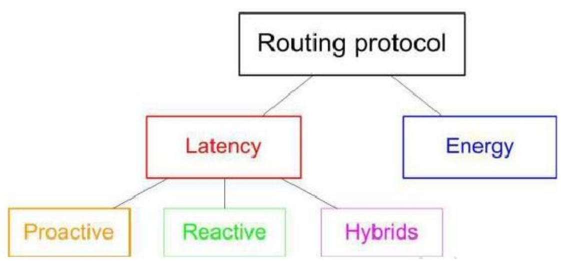

Fig1

1) Proactive

Proactive protocols are similar to wired routing protocols in the manner that It maintains new lists of destinations and their routes by periodically disposing routing tables all-around the network . That means these protocols are constantly making requests to their neighbours (if any) in order to draw a network topology, and then, build the routing table. The demerit of this principle is that it is non- reactive to topology changes, as the tables are re-established. At the time the data has to be sent, it is not certain that the gateway designed by the routing table will still be there to route the data to the destination or not.

2) Reactive

Reactive protocols are more specific to Ad Hoc networks. As compared to the proactive algorithm, they ask their neighbours for a route when they have data to send. If the neighbours do not have any known route, they circulate the request all around the network, and so on. Once the final destination has been reached by these circulations, an answer is inherent and forwarded back to the source. This source can then transmit the data on the newly discovered route. Each device used for forwarding the routing packets has learned the route at the same time. The disadvantage of this design is the load of routing traffic exchanged between devices. Excessive flooding lead to network clogging. It also can result in a high latency.

IV. PRO-ACTIVE PROTOCOLS

As proactive protocols are persistently updating their routing tables in order to be ready when data has to be sent, they are called table-driven protocols. This type of protocol is close to wired networks where the same mechanisms are used in order to take routing decisions. These mechanisms are used for finding the shortest path across the network topology; it can be the ―Link state method or the ―Distance Vector method. The link-state protocol is performed by every switching node in the network . The basic concept of link-state routing is that every node constructs a map of the connectivity to the network, in the form of a graph, showing which nodes are connected to which other nodes. Each node then independently calculates the next best logical *path* from it to every possible destination in the network. Each collection of best paths will then form each node's routing table. This contrasts with distance-vector routing protocols, which work by having each node share its routing table with its neighbours. In a link-state protocol the only information passed between nodes is connectivity related.

A. ***Destination Sequenced Distance Vector (DSDV)***: was one of the first proactive routing protocols available for Ad Hoc networks. It was developed by C. Perkins in 1994, 5 years before the informational RFC of the MANET group. It has not been standardised by any regulation authorities but is still a reference.

1) *DSDV Algorithm*

It is based on the Bellman-Ford algorithm. First designed for graph search applications, this algorithm is also used for routing since it is the one used by RIP. The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently . The sequence number is a time indication sent by the destination node. It allows the table update process, as if two identical routes are known, the one with the best sequence number is kept and used, while the other is destroyed (considered as a stale entry).

2) Performance: As with every table-driven protocol, DSDV reduces the latency by having a route when the data has to be sent. But, DSDV presents a few problems, mainly in the route table update process. One of the major problems is that data is exchanged only between neighbours, and then, a change in the topology can take time to be spread in the whole topology. That introduces the notion of route fluctuation. When a node disappears, it takes time for this change to be reflected in the whole topology. So, if the topology is dynamic, the routing layer will be unstable until changes are reflected everywhere. Updates are sent after events, links broken and new links. At t+1, the routing protocol will transmit routing table updates according to the newly detected events. But, once these updates are processed by nodes D, B and E, nodes C and D still have no routes for G, and it will take two more updates until the entire topology will be updated on all nodes.

*3) Ad Hoc On-Demand Distance Vector (AODV): A*ODV was proposed to standardization by the RFC 3561 in July 2003. It was designed by the same people who designed DSDV. Source floods route request in the network. Reverse paths are formed when a node hears a route request. Each node forwards the request only once (pure flooding). Unused paths expire based on the timer.)

4) Algorithm

The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multi hop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner.

The operation of AODV is loop-free, and by avoiding the Bellman-Ford "counting to infinity" problem offers quick convergence when the ad hoc network topology changes (typically, when a node moves in the network). When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. One distinguishing feature of AODV is its use of a destination sequence number for each route entry.

The destination sequence number is created by the destination to be included along with any route information it sends to requesting nodes. Using destination sequence numbers ensures loop freedom and is simple to program. Given the choice between two routes to a destination, a requesting node is required to select the one with the greatest sequence number.

. AODV uses ―HELLO packets on a regular basis to check if they are active neighbours. Active neighbours are the ones used during a previous route discovery process. If there is no response to the ―HELLO packet sent to a node, then, the originator deletes all associated routes in its routing table. ―HELLO packets are similar to ping requests. While transmitting, if a link is broken (a station did not receive acknowledgment from the layer 2), a ―ROUTE ERROR packet is uncast to all previous forwarders and to the sender of the packet.

5) Illustration

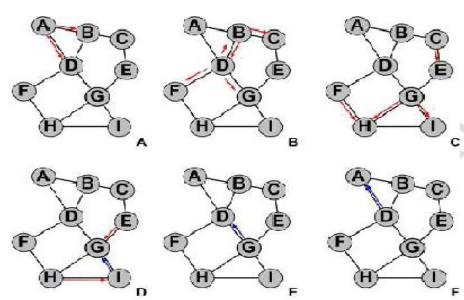

Fig 2

In the given example A has to send a data packet to I first it sends a route request to B then D in A fig ,A needed to add B and D in the routing table. as a reverse route, and forward the ―ROUTE REQUEST packet to their neighbours (b). B and D ignored the packet they exchanged each others (as duplicates). The forwarding process continues while no route is known (c). Once I receives the ―ROUTE REQUEST from G (d), it generates the ―ROUTE REPLY packet and sends it to the node it received from. Duplicate packets continue to be ignored while the ―ROUTE REPLY packet goes on the shortest way to A, using previously established reverse routes (e and f). The reverse routes created by the other nodes that have not been used for the ―ROUTE REPLY are deleted after a delay. G and D will add the route to I once they receive the ―ROUTE REPLY packet.

B. *Dynamic Source Routing (DSR*):As a reactive protocol, DSR has some similitude with AODV. Thus, the difference with AODV is that DSR focuses on the source routing rather than on exchanging tables.

1) *Algorithm***:** It works on the concept of source routing. Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which, the packets are forwarded.The advantage of source routing is : intermediate nodes do not need to maintain up to date routing information in order to route the packets they forward. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance". DSR requires each node to maintain a route – cache of all known self – to – destination pairs. If a node has a packet to send, it attempts to use this cache to deliver the packet. If the destination does not exist in the cache, then a route discovery phase is initiated to discover a route to destination, by sending a route request. This request includes the destination address, source address and a unique identification number.

If a route is available from the route cache, but is not valid any more, a route maintenance procedure may be initiated.

This mechanism also avoids routing loops. This process is very similar to the AODV protocol as a route request is broadcast to the initiator neighbourhood until a route is found. Thus, the difference is that every node used for broadcasting this route request packet deduces the route to the originator, and keeps it in cache. Also, there can be many route replies for a single request.

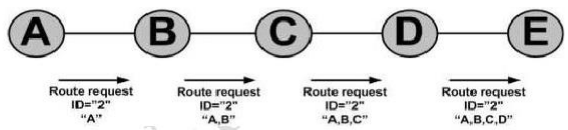

Fig 3

In figure 3, A wants to send a packet to E. It broadcasts a route request to its neighbours with a temporary chosen ID. Neighbours forward this broadcast, and at each node, the reverse route entry is added into the route request packet. When E receives this route request, it can sent a route reply to A using the reverse route included in the packet. The route reply packet contains the request ID and the reverse route. Another difference with AODV is in the route maintenance process. DSR does not use broadcasts such as AODV‟s ―HELLO packets. Instead, it uses layer two built-in acknowledgments.

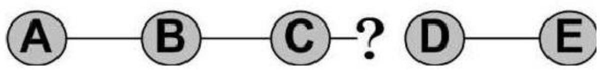

Fig 3.1

In Figure 3.1, A is responsible for the flow between A and B, B is responsible for the flow between B and C, and so on. If A is sending data to E, with a previously cached route, and C didn’t receive any acknowledgment from D, then, C deduces the link is broken and sends a ―ROUTE ERROR packet to A and any other nodes who had previously used this link. Concerned nodes will then remove this route from their table, and use another one if they had other answers from their previous queries. Otherwise, the route discovery process is used in order to find another path to E.

V. CONCLUSION

During this review we have found the various problems associated with Ad Hoc networks, particularly more problems in Routing on Ad Hoc networks. We also find some solutions to these problems they may include various routing protocols, First protocol is the Proactive protocol; table driven protocol maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. The main disadvantages of such algorithms are: Respective amount of data for maintenance. Slow reaction on restructuring and failures. DSDV The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. Then we found a reactive protocol; On demand protocol This type of protocol finds a route on demand by flooding the network with Route Request packets. They have the advantage of not being vulnerable to dynamism in topologies. The main disadvantages of such algorithms are: High latency time in route finding. Excessive flooding can lead to network clogging.They can rely mainly on Ad Hoc On demand Distance Vector(AODV) and

Dynamic Source Routing. Even by testing protocols, there is no perfect solution. The test carried out shows that protocol efficiency depends on the context. On large and dynamic topologies, proactive protocols will be more efficient.

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