Survey of Reliable Data Delivery for Highly Dynamic Mobile Ad Hoc Networks

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Abstract— Mobile Ad-hoc Network is a communications less and decentralized network which request a robust dynamic routing protocol. To provide the needs of communications for Mobile Ad hoc Network (MANET) many routing protocols have been proposed in earlier works. Routing is the challenging issues in Mobile Ad hoc Network (MANET). Most existing ad hoc routing protocols are susceptible to node mobility, especially for large-scale networks. In Mobile Adhoc Network there is problem in delivering data packets for highly dynamic mobile ad hoc networks in a reliable and timely manner. In this paper we study the existing routing protocol approaches and address the problem of reliable data distribution in dynamic large scale mobile ad-hoc network. An efficient Position-based Opportunistic Routing (POR) protocol is good in delivering the data in highly dynamic MANETs. But it is affected by the over heading problem and moreover there are no data confidentiality and data security. In order to minimize the black holes in the destination path and make more security, we study the various void-handling approaches. In the case of communication hole a Virtual Destination-based Void Handling (VDVH) schema find an efficient routing path with more security. The survey will helps to understand the problem of existing routing strategy for reliable data delivery and also be used to develop a new or to extend already proposed schemes in reliable and efficient manner.

Keywords— MANET, Routing protocols, void handling approaches.

I. INTRODUCTION

In MOBILE ad hoc networks (MANETs) have been become a more thoughtfulness because of its importance by infrastructure-less transmission, multihop transmission. Due to the error level wireless channel and dynamic network topology the reliable data delivery in MANETs, especially becomes a ambitious surroundings with high quality remains the main issue. Existing topology-based MANET routing protocols such as DSDV, AODV, DSR [1] are relatively vulnerable to node mobility. One of the major reasons is due to the prior estimation of the end-to-end route discovery before data transmission. Owing to the constant and even faster changing network topology, it is very complicated to keep up a deterministic route. Similarly the discovery and recovery process are also time complexity and energy consuming. Due to the process of the route discovery and the recovery process, once the path breaks the data packets will get lost or will be delayed for a long time awaiting the restoration of the route, causing transmission interruptions.

Geographic routing (GR) focus on the areas of the position based, location-based, or directional routing, was originally proposed for packet radio networks [2]. In earlier years with the rapid application of Global Positioning System (GPS) [3] and the development of configuring localization mechanisms [4, 5], it has regained significant attention, as it provides a potential solution for information delivery in next-generation of wireless networks like Mobile Ad Hoc Networks (MANETs), Vehicular Ad Hoc Networks (VANETs), Wireless Sensor Networks (WSNs), and Wireless Mesh Networks (WMNs). Many of geographic routing protocols (GRP), only one-hop geographic information of neighbouring nodes is exploited. Thus, geographic routing need not to require the establishment or maintenance of complete routes from sources to destinations [6]. The localized operation and the stateless feature of geographic routing make it simple and scalable. It is also enabling a geocasting service, which supports the delivery of packets to all nodes in a specified geographic region [7].

In GPSR is a very famous geographic routing protocol, the MAC-layer failure feedback is used to offer the packet another chance to reroute. GPSR protocol when the node mobility increases, still it is difficult to maintain the performance of the system. Due to the broadcast nature of the wireless medium, a particular packet transmission will lead to multiple receptions. If such transmission is used as a backup, the robustness of the routing protocol can be considerably enhanced. The conception of such multicast-like routing strategy has already been demonstrated in opportunistic routing. Most routing strategies use link-state style topology database to select and prioritize the forwarding candidates. In order to acquire the internodes loss rates, periodic network-wide measurement is required, which is impossible for mobile environment. Due to the broadcast nature of the wireless medium single packet transmission will tends to multiple receptions. If such transmission is used as a backup, the robustness of the routing protocol can be significantly enhanced.
Communications void [9] is a major challenging problem for geographic routing and, in order to allow the use of geographic routing (GR) in the next-generation wireless networks, problem must be tackled and solved first. Although the use of wireless nodes can reduce the likelihood of the occurrence of a void in the network, it is still achievable for some packets to encounter voids that are induced by obstacles, untrustworthy nodes, the boundaries of a wireless network. These packets have not needed when only a single greedy-forwarding strategy is used, even though a topologically applicable path to the destination node may still exist. Thus, it is imperative to design a void-handling technique for geographic routing in an effective and efficient manner. In this paper study the detail description of Void Handling Techniques depending upon various Geographic Routing Protocols.

Problem statement

Mostly ad hoc routing protocols are susceptible to node mobility particularly for large-scale networks. One of the main reasons is due to the pre-estimation of an end-to-end route before data transmission. Owing to the constant and even fast altering the network topology, it is very difficult to sustain a deterministic route. The detection and recovery procedures are also time complexity and energy consuming. Once the path breaks data packets will be delayed or get lost for a long time until the reconstruction of route i.e. Causing transmission interruption. Pre-estimation of an end-to-end route will be constructed before data transmission also no guarantee the data will send to the destination. Without knowing location requires more time and energy to discovery and recovery the route to send data. So, there is a need for routing protocol which take advantage of location information is required for high amount of data delivered in highly dynamic mobile ad hoc networks.

A Position based opportunistic routing strategy was introduced in which several forwarding candidates’ cache the packet that has been received using MAC interception. If the best forwarder fails to transmit the packet within a certain time, any other candidate that formed locally in an order may transmit the packet. Thus the transmission will not be interrupted, since there are some candidates to transmit packets. POR’s excellent robustness is achieved by exploiting potential multipath on the fly, on a per packet basis. The POR overcomes the limitation of the traditional opportunistic routing and it provides advantages over the system in data delivery in the highly dynamic MANET system. But in terms of packet over heading and security the POR fall miserably and the system achieves considerable loss. Also the void handling mechanism which is the method of overcoming the communication hole in the MANETS the existing void handling procedure fails in most cases.

II. LITERATURE REVIEW

A. Geographic routing

Geographic routing (location/position-based routing) protocol for communication in ad-hoc wireless networks have recently received increased attention, especially in the energy saving area. In geographic routing (GR) each node have knowledge of their own geographic information either via Global Positioning System (GPS) or network localization algorithms, and broadcasts its location information to other nodes periodically. The next relay node is preferred only based on the location of the source node, its neighbours and its ultimate destination. Therefore, geographic routing (GR) is generally considered to be scalable and applicable to large networks.

The update message size in GSR is relatively large compared to those in some other scheme. Large message size and propagation delay wastes a considerable amount of network bandwidth. That makes it difficult to predict GSR performance on different size of the network. It is not clear why routing information in GSR stored inside three tables besides maintaining neighbour list. This approach is different from traditional link state routing protocol such as DSDV which uses a single table for the same purpose. Keeping information inside three dissimilar tables limits node performance to a certain extent. Not limited to route or address management, these tables have their due effects on battery life of mobile nodes. Efficient retrieval of already stored addresses requires a search operation. Having distributed information could slow down the whole search process. Likewise storing new information could yield the same effect.

B. Greedy Perimeter Stateless Routing (GPSR)

GPSR protocol [8] is the earliest geographical routing protocols for adhoc networks; it can be also used in WSN environment. The GPSR adapts a greedy forwarding strategy and perimeter forwarding strategy to route messages. It makes use of a neighbourhood beacon that sends a node’s identity and its position. However, instead of sending this beacon periodically and add to the network congestion, GPSR piggybacks the neighbourhood beacon on every message that is sent or forwarded by the node. Every node in GPSR has a neighbourhood table of its own. Whenever a message needs to be sent, the GPSR tries to find a node that is closer to the destination than itself and forwards the message to that node. However, this method fails for topologies that do not have a uniform distribution of nodes or contain voids. Hence, the GPSR adapts to this situation by introducing the concept of perimeter routing utilizing the right-hand graph traversal rule. Every packet transmitted in GPSR has a fixed number of retransmits [1, 8]. This information is given to the node by the medium access (MAC) layer that is required to be compliant to the IEEE 802.11 standard. This may cause to be the GPSR protocol unusable in its normal form for WSN. The GPSR
does not elucidate more on the action taken in case a message is unable to be transmitted even in perimeter mode. Finally GPSR disallows the use of periodic broadcast of the beacon nodes and piggybacks these beacons on the messages sent by each node. As a strong geographical routing protocol GPSR is allowing nodes to send packets to a particular location and holding a promise in providing routing support in WSN. Many recent research works in WSN are building applications using GPSR protocol. However, GPSR is not originally designed for sensor networks, several problems are required to be fixed before it is applied in sensor networks.

C. AOMDV

AOMDV shares numeral characteristics with AODV. AOMDV protocol is based on the distance vector conception and uses hop-by-hop routing technique. AOMDV protocol is also found the routes based on the demand using a route path discovery process. In this AOMDV protocol numerous of routes found in each and route discovery process. In AOMDV, RREQ propagation from the basis towards the destination establishes multiple reverse paths both at intermediate nodes as well as the destination. Multiple RREPs traverse these invalidate paths back to form multiple forward paths to the destination at the source and intermediate nodes. AOMDV also provides intermediary nodes with alternate paths as they are found to be useful in reducing route discovery frequency. AOMDV route update rules are applied locally at each node, it plays a key role in maintaining loop-freedom and disjointness properties[8].

AODV is an on demand approach but still it becomes use periodic broadcast of message to track neighboring nodes. This periodic propagation causes network overhead in AODV [10]. In AODV a route has to discover prior to the actual data packet transmission. This type of the initial search latency may degrade the performance of interactive applications [10]. Similarly the quality of the path is not known prior to call set-up. It can be exposed only while setting up the path. Moreover the quality of the path must be monitored by all intermediate nodes in an active session at the cost of additional latency and overhead penalty [11]. That makes AODV quite unsuitable for real life applications.

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

The DSDV protocol is an extension of classical bellman ford routing mechanism [11]. DSDV maintains the consistent network view via periodic routing updates. Routing information is stored within the routing tables maintained by each node. New route broadcasts contain the address of the destination, the numeral of hops to reach the destination, the sequence number of the end path and a new sequence number unique to broadcast. A route with a recent sequence number is considered as a fresh route. If sequence numbers are originate to be the same than the route with a better metric will be selected.

DSDV requires nodes to periodically transmit routing table update packets regardless of the network traffic [6]. When the number of nodes in the network grows the size of the routing tables and the bandwidth required to update them also grows [10]. This overhead is considered as the main weakness of DSDV. DSDV also pose a period of convergence before which routes will not be known and packets will be dropped [10]. 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 [10]. In addition, in DSDV routing loops can occur while the network is reacting to a change in the topology.

III. MOBILE ADHOC NETWORK

In Mobile ad hoc networks (MANETs) represent a self assembling substructure to a lesser extent networks that is comprised of dynamic wireless mobile nodes. In MANET don’t have any formulation structure. The Key applications include MANET are disaster recovery, transportation, heavy construction, mining, defense, and special event management. Earlier years the MANET is considered only communicating network in military side. New technologies such as Bluetooth, IEEE 802.11 and Hyper LAN enable eventual commercial MANET deployments other than the military domain. Nowadays Ad-hoc networks are frequently used for communication purpose, because of its mobility and self assembling surroundings.

A. Communication nodes

In MANETs the nodes can communicate with each other without any preliminary substructure. MANET each and all nodes are independent of other nodes , it can communicate with other nodes in any manner.

B. Proactive routing protocol

MANET applies a proactive routing protocol, it keeps the routing data for all known destination at each source. All nodes exchange their data periodically and also at every topology exchange. It also preserves up-to-date routing data from each node to every other node. Opportunistic routing protocol is a network based routing protocol, in which the routes are founded spontaneously between the mobile nodes. OPR protocol the routes are constructed dynamically i.e the paths are not predetermined . For the next hop of the routing protocol , a node is opportunistically chosen only if it would bring the message closer to the final destination. In opportunistic networking no possibility is made about the existence of a complete path between two nodes caring to communicate. The nodes that are communicating need to be present in the same network and time.
VOID HANDLING APPROACHES

In position-based opportunistic routing (POR) mechanism, numerous receptions can be achieved the best routing path without losing the information. The concept of in-the-air backup first gets the location of the destination and then attaches it to the packet header. POR protocol packet is dropped repeatedly in the neighborhood of the destination node, while the changing destination node’s location simultaneously. Additional checking is introduced to conquer the above problem, in which the node that’s going to forward the packet will check its neighbour list for its transmission range. If the destination node lies in that range, then the packet will be forwarded. This checking mechanism of the location information, the effect of multipath divergence is greatly reduced.

In POR is very difficult to maintain a deterministic route as the nodes are highly dynamic and performance gets degraded when node mobility increases. Packet over heading may also occur in POR. The route discovery and recovery procedures for neighbour nodes are also time and energy consuming. Malicious nodes and node path not detected as no security over this issue. Attacks by attackers in mobile system e.g., DoS attacks. The highly dynamic nature of the system makes the protocol forced to select the malicious path.

C. VOID HANDLING APPROACHES

In this section study the void handling techniques for geographic routing. Each and every Void handling approaches have their own characteristics and principles, independent of other components of geographic routing as well as of any wireless network environment with specific network characteristics.

1) Graph theory: P. Bose et al [12] introduced a planar graph based void handling approach, here it embedded the graph in the plane, so that no edge intersect. In a wireless network the nodes are regarded as vertices and the links as edges. The graph organized by a wireless network is commonly not planar. Thus, extra methods are required to receive a planar sub graph. It ensures the packet delivery ratio in wireless sensor network [12], ensures that the path discovered by the system is topologically valid path or not. Greedy Perimeter Stateless Routing (GPSR) [13] protocol perimeter routing is the one of type of planar graph void handling technique to find the best path discovery on the network.

2) Geometric: Identifying the holes in the network is also difficult, to conquer these problem Geometric void based techniques have been proposed, it is used to identify the holes in a network by making use of the geometric properties of deployed nodes. In this method the paths can be found based on their demand or application requirements and stored locally along the boundaries of the holes. To identify the hole in a wireless sensor network, each and every node first use a rule to detect the possible void node. This task is implemented by the TENT rule [14]. Several methods have been proposed to identify the hole surrounding paths in the wireless network with void node. Bound hole is the effective Geometric routing protocol based Void Handling approach. It demonstrates how a geographic routing protocol can exploit hole-surrounding paths discovered by BOUNDHOLE [15] to handle voids in a network topology.

3) Virtual Destination: Virtual Destination based Void Handling approach is a new method is proposed by [16]. In this method first it selects the trigger node; it is responsible for carrying data in Void situation. During the void handling process, existing of greedy forwarding cannot be achieved as the path that is used to go around the hole is usually not optimal. More important the robustness of multicast-style routing cannot be exploited. In order to make possible opportunistic forwarding in void handling position based opportunistic Routing [17] is the Effective and Efficient Virtual Destination based void handling approach. It is based on geographic routing selective information is replaced amongst node locations that are found via GPS. The location based property makes PO (Position based Opportunistic Routing) is more robust and scalable.

4) Flooding: The idea of Flooding Based Void Handling is assumed that each and every node in the network is supposed to receive a copy of stuck packets, is a simple and efficient approach to handle voids. It’s known as full flooding. Full flooding based approaches are inefficient in terms of resource utilization and they still difficult to handle voids nodes. Thus, some advanced flooding-based void-handling approaches are desired to efficiently handle voids. To efficiently handle the void nodes and make easy to control the range of the flooding void nodes at the desired events with
resource utilization. H. Frey [18] proposed a type of flooding mechanism is called restricted flooding or partial flooding. When a packet gets stuck at a void node for a specific destination, it starts route discovery. The route discovery phase finds a path from the void node to the destination on demand and updates the routing table at all the nodes on the path.

5) **Cost**: F. Ye, A. Chen [19] introduced a cost-based void handling approach, a packet flows from a node with a higher cost to lower cost. Projecting this type of process ,each and all nodes in the network are first allotted a cost, it may be matched to its Euclidean distance to the destination. The void node increases its cost value greater than its Euclidean distance to the destination, as a result that the packet can finally be directed by the cost rule along efficient paths to get around the void.

6) **Heuristic**: Usage of resourcefulness in network topology and geographic properties of void areas is unmanageable. This approach is based on some intuitive thoughts that can’t be mentioned to a rigid theoretical analysis of their effective and efficiency manner. Many of the heuristic voids handling approaches are alternative network, active exploration, and passive participation. D. S. J. De Couto [20] introduced an Intermediate node Forwarding (INF) schema, here the source node of the packet chooses a single intermediary position randomly for a circle around the midpoint of the line between the source node and the destination node. Packets have to traverse that intermediate position. If the packet is redundant again, the radius of the circle is increased and another position is randomly chosen. This is repeated until the packets are delivered to the destination or until a predefined value has been reached and the source node assumes that the destination is unreachable.

**IV. CONCLUSIONS AND FUTURE WORK**

In this paper we study the various positions based opportunistic routing protocol as well as the existing routing protocol mechanism to solve the major problem of reliable data delivery in highly dynamic mobile ad hoc networks. Continuously altering the network topology makes traditional ad hoc routing protocols incapable of providing satisfactory performance. In the case of frequent link breakage due to node mobility, required data packets would get lost or long latency before restoration of connectivity. In MANET routing protocol based on LOR achieves a high packet delivery ratio with the least delay and duplication. In this survey we also studied the various Void Handling approaches for Mobile adhoc Networks to achieve the reliable data delivery. We discussed about the strategies of these Void handling approaches for Geographic Routing. In Void Handling schemes each void handling approach has its own properties and techniques to void handling problem. Comparing all the void handling approaches, Virtual Destination based void handling approach proves to be the efficient technique to deliver data at the time of Communication Void.

Future work aims at resolving the problem of packet forwarding failure caused by node mobility in the unreliable wireless link using Cooperative forwarding strategy. It improves data transmission in a high end reliable manner without delay.

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