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Mobility and scalability management issues in VANET

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ABSTRACT

VANET is a critical part of ITS, so it has attracted significant research interest as the requirement of mobility and scalability management techniques are increasing. In this paper a comprehensive survey of mobility management techniques and scalability issues for VANET have been presented. In the start, introduction about VANET have been defined .The mobility management section describes ITS (intelligent transport system) of VANET and V2I and V2V communication scenarios. Further, the various factors and problem faces in scalability have been discussed.

Keywords: VANET, ITS, AU, RSU, OBU

I.INTRODUCTION

VANET is a type of Mobile Ad hoc Network which provides communication among vehicles and fixed equipments nearby usually these are called as roadside equipments. VANET are widely used to support the growing number of wireless products which can be used in vehicles. VANET is a special type of mobile ad-hoc network which is divided into V2I and V2V networks .To introduce this many researchers has introduced Media Access Control protocols to improve VANET working. VANET is self-organised network that can be formed by connecting vehicle aiming to improve driving safety and traffic management with internet access by drivers and programmers. Two types of communication are provided in the VANET. First a pure wireless ad hoc network where vehicle to vehicle without any support of infrastructure. Second is communication between the road side units (RSU), a fixed infrastructure, and vehicle. Each node in VANET is equipped with two types of unit i.e. On Board Unit and Application Unit (AU)(Figure 1). OBU has the communicational capability whereas AU executes the program making OBU‘s communicational capabilities [1]. An RSU can be attached to the infrastructure network which is connected to the Internet.

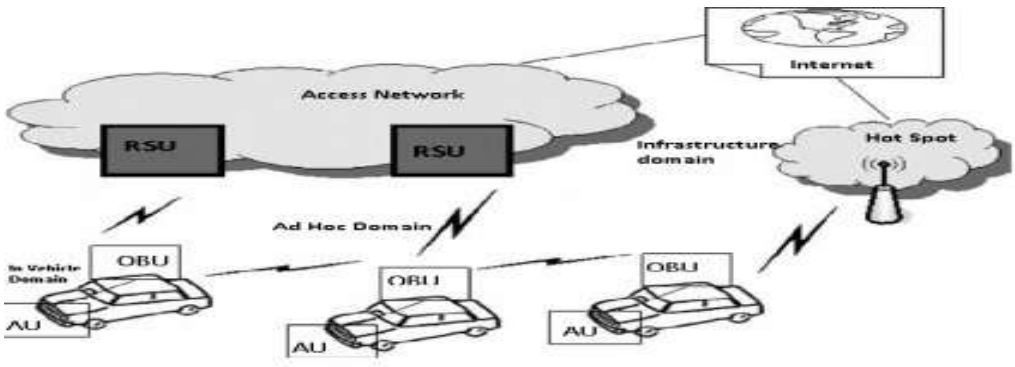

Figure1.VANET architecture [1]

Mobility management has two types of management, one is handoff management and other is location management. Handoff management helps to regulate the active connections between mobile nodes when they change its point of attachment. Location management functions to continuously update and track the current location of mobile nodes.

One very important prerequisite for the successful and also sustainable deployment of VANETs is the scalability of the applied information dissemination scheme. The autonomously acting network must ensure delivery of data to those nodes which are interested in it with low latency, while efficiently leveraging network resources.

II. MOBILITY MANAGEMENT IN VEHICULAR NETWORKS

In this section ITS (intelligent transport system) of VANET is described and V2I and V2V communication scenarios are discussed [2].

2.1. ITS

VANET is a very critical part of ITS i.e., intelligent transport system. ITS provides the user various innovative and resourceful services for different modes of transportation. V2V and V2I communication in VANET is implemented on ITS. Various systems of ITS:

1. Vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication.
2. Advanced Transportation Management System (ATMS). e.g., traffic management centre.
3. Advanced Public System Transportation (APTS) e.g., electronic fare payment.
4. Advanced Traveler Information System (ATIS) e.g., parking information.

2.2. MOBILITY MANAGEMENT FOR V2V COMMUNICATION

Mobility in VANET is managed through route discovery, maintenance and its recovery.

2.2.1 TOPOLOGY MANAGEMENT

Two types of schemes belong to this topology management. In proactive scheme its sends signaling messages periodically to know the scenario of which obtain the topology information. As the main problem which arises in VANET is its large topology. This problem is resolved by using cluster based topology control in which vehicles are grouped together into multiple clusters. Also for interconnection communication COIN network was proposed. Also a prediction based topology was proposed.

2.2.2 LOCATION MANAGEMENT

Due to large latency and overhead ad hoc routing protocols are unable to apply on VANET. Various geographical routing protocols are used to solve this issue like greedy perimeter stateless routing (GPSR), geographical routing algorithm (GRA). Further flooding based approach and rendezvous based approach is used in location management in VANET which gives rise to region based location service management protocol (RLSMP) which support both scalability and locality awareness. In 2002 mobile internet protocol version 4 (MIPv4) was introduced to achieve seamless handover because of problems like IP addresses, weak security, routing problems in 2004 mobile internet protocol version 6 (MIPv6). It removes all the drawbacks of MIPv4. Either for further efficiency improvement hierarchical mobile internet protocol (HMIv6) was produced in 2005.

This HMIv6 has produced a new concept known as Mobility Anchor Point (MAP) which easily manages user location. MAP provides macro mobility and micro mobility management techniques for location management.

2.2.3 HANDOFF MANAGEMENT

Handoff management is needed for successful communication of vehicles. So in VANET special rerouting is one to construct a new path from sender to destination. As packet loss and packet delay are the two basic problems in handoff. Somehow this problem is solved by introducing WIMAX Mobile Multi hop Relay MMR. This technique provides good communication even when vehicles are on high speed freeways.

2.3. MOBILITY MANAGEMENT FOR V2I COMMUNICATION

2.3.1 HOST MOBILITY MANAGEMENT

Researchers until have given many solutions for host specific mobility in VANET. As in link layer when mobile node moves specifically between the accesses points in a common subnet, this mobility are handled by link layer protocols e.g., WLAN. Also Fast DLMAP-IE was introduced to reduce downlink traffic reception during handoff process. Some research work has been done on the various host specific standard mobility and handover management schemes.

2.3.2 NETWORK MOBILITY MANAGEMENT

NEMO (network mobility) was introduced in 2005 for network mobility problems. As base station is not directly accessed by all users, as mobile host can only be accessed by using mobile routers (MR). Mobile router has its own home address. When the MR moves to a foreign access router it requires Care Of Address (COA) from the visited network. When it get its COA it sends the update message to its HA (Home Address). Then HA of the MR forward this message to all data packets. The network mobility solutions like NEMO leads to reduced handoff, scalability, reduced complexity.

III. THE SCALABILITY ISSUES OF VANET

Scalability is the ability of a VANET to accept an increasing number of communicating vehicles without any disruption or loss in data transferring or traffic loading, which increase the administrative complexity and decrease the network's performance.

Designing a scalable and robust network remains an open area of research in VANET because of its challenging characteristics. Many design approaches fall short when VANETs transform from sparse to high dense mode, or from high mobility to slow traffic scenarios. A complete VANET framework that is scalable to different network scales and robust to the topological changes is required. This is an emerging area of research for VANET environment [3].

One of the main challenges inherent to the deployment of VANETs is operability, both in very light and in highly overloaded networks .It is always expected that VANET must work in very low density areas such as roads and highways, as well as in situations with very high traffic density areas, such as cities, urban areas where traffic jams are high and major intersections exist on road.

In large and especially distributed systems or networks, scalability is a very crucial characteristic. In the VANET scenario, scalability issues arise in several different contexts. The number of active nodes (vehicles) has an impact on network connectivity and on the likelihood of congestion on the wireless channel. In addition, protocol design has a great impact on scalability [4]. The most crucial bottleneck is the bandwidth limitation and capacity limitations for ad hoc networks. Due to the shared wireless channel with a CSMA/CA medium access scheme and multihop communication between distant nodes, the limited bandwidth is further decreased by poor channel utilization. While in sparse VANETS, low connectivity must be overcome with intelligent store-and-forward algorithms, controlling the network load is the most important challenge for operability in densely populated network scenarios. The number of messages which have to be sent over the shared medium is predominantly influenced by the number of vehicles and the number of applications deployed in these vehicles. However, network load is additionally influenced by the fact that active safety messages have to be rebroadcast within their target area for the duration of their validity.. This ensures the availability of the message for new vehicles entering the area after the initial broadcast. The basic dissemination scheme used to realize broadcast-based VANETs is the so-called flooding, where each node rebroadcasts every single message it receives. The main problem inherent to the flooding mechanism is the huge amount of superfluous transmissions leading to network congestion. This effect is aggravated with an increasing node density and network size, leading to the scalability problem. Hence, the limited network resources are partially absorbed by redundant traffic, while highly relevant and time-critical messages are prevented from accessing the medium. Williams and Camp provide a comprehensive overview on numerous fundamental algorithms which can be applied to minimize the number of redundant rebroadcasts. Their approaches can be seen as a starting point for more elaborate schemes; however, they do not take into account the relevance of the information for the potential receivers. Several approaches have been suggested to solve the scalability problem.

An important challenge in the domain of vehicular ad hoc networks (VANET) is the scalability of data dissemination. Under dense traffic conditions, the large number of communicating vehicles can easily result in a congested wireless channel. In that situation, delays and packet losses increase to a level where the VANET cannot be applied for road safety applications anymore. Scalable data dissemination in vehicular ad hoc networks (SDDV) is a holistic solution to this problem. It is composed of several techniques spread across the different layers of the protocol stack [5].

The scalability problem occurs in ad hoc networks due to the nature of the multi-hop. The scalability in ad hoc network depends on the network size and forwarded packet capacity in the network[6]. Recently, lot of problems address in large-scaled ad hoc networks. The scalability depends on the following factors:

Equal node priority: All the nodes in the network have same priority to share the physical resources. So, all nodes have same data rate.

Uniform distribution of destination: The packets are distributed equally from source to N-1 nodes

Spreading the node reliably: The transmission capacity of the node should be large enough than their neighbor nodes to avoid interference.

Shortest path: The packets transmitted from source destination depend on the shortest path.

The scalability can preserve by dividing the network area according to their geographical location. The whole network area can be divided into small virtual grid cells such that every node in each virtual grid cell can communicate with other nodes in the same cell.

IV. CONCLUSION

It highlighted the main issues in mobility and scalability and management issues related to various factors. The mobility management for V2V and V2I has been explored. Further scalability factors affecting the VANET performance are discussed .Still now accurate mobility patterns, network models and network performance which are the parameters on which evaluation relies are not available yet. There is a need of improving old technologies by keeping in mind large number of vehicles, frequently changing opologies, highway scenarios and high speed of vehicles. Mobility management issues are increasing rapidly so to resolve these issues there is a lot of scope in this area. Researchers have done a lot of work. Some of the issues have been solved built still there are many unsolved issues. Among all requirements mobility and scalability are the major issues in VANET.

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