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AN APPROACH FOR DYNAMIC REPLICA ALLOCATION FOR SPARSE (URBAN/SUB-URBAN) AND DENSE REGIONS (CITY SIDE) IN VANET

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ABSTRACT

It is important to determine the place for erecting communication devices such as access points and wireless routers alongside the road to offer communication services to vehicles moving on the road. The vehicle density varies largely in the city areas, urban and sub urban areas. VANET (Vehicular Ad hoc Network) consists of vehicles moving with a high velocity on either direction of road, making them to communicate with each other to exchange safety messages and share other information, useful for the safety of passenger and driver. Vehicle also exchanges data that belongs to infotainment applications such as video streaming. High mobility of vehicles causes frequent path disconnections between them, due to which the data being accessed becomes unavailable. Replication is one of the popular techniques to increase data availability among nodes in any network by making them available at many nodes other than the originating node. While replication increases the data availability, it also adds to the cost of replication which may deteriorate the performance of the system. Since VANET has varying density of vehicles in city and highway locations we decide the number of replicas for dense and sparse region dynamically based on the density of vehicles in both. It is necessary to keep less number of replicas in city region as there is going to be less path disconnection with large numbers of vehicle, whereas highway situation may require more number of replica nodes since it may encounter frequent path disconnections. We propose an algorithm to allocate replica dynamically in this way and prove the benefits obtained in terms of replication cost.

Key words: Dynamic Replication, Quality of Service, VANET, High Availability, Response time, Mobile Cloud, Sparse and Dense Region.

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1. INTRODUCTION

Vehicles in Vehicular Ad Hoc Networks (VANET) communicate with each other in order to share and exchange messages to alert passengers and driver about the environmental risks ahead. Devices in VANET are enabled to sense the environmental data, process and disseminate it to the Internet [2]. Devices which are equipped in Vehicles interacts with other devices such as Tablets, Laptop, , Personal digital Assistants (PDA) and sensors . It requires an unique identification number to enable communication between them which is an extension of pervasive computing to an another era called IoT. [3-8] IoT takes advantage of ITS (Intelligent Transportation System) to provide communication among vehicles [10]. The manufacturers equip Vehicles with Global positioning system (GPS) ,digital maps and Wireless Interfaces [4]. Vehicles can be categorized as Service providers and service requesters. Vehicles that support more storage space and high computational capacity are called as Super vehicles and they offer services to other vehicles on a pay per use basis, forming a vehicular cloud [11].

A vehicle can obtain its current location using GPS services [1]. Since vehicles require a precision of error less than 10 meters, GPS may not be reliable in this case. As shown in Fig.1, RSU's are installed alongside the road which can be contacted by the vehicles to know their exact location. The vehicles are equipped with passive RFID tag and the road side units are equipped with RFID readers. Each vehicle contains AU (Application Unit) and OBU (On-board Unit). Application unit can be used to perform Inter vehicle communication and OBU can be used to perform Intra vehicle communication. The vehicle which does not contain a Passive RFID tag can obtain its current location by contacting other vehicle, also called as reference vehicle which knows its location using time and angle methods as proposed in [1].

2. PROBLEM IDENTIFICATION

Frequent path disconnection occurs in between vehicles due to high mobility, which reduces the availability of data. Replication is performed in which data is duplicated on several other nodes in order to increase accessibility in case of frequent path disconnection between vehicles. But the cost of replication is increased when the number of replica node is higher. [1] Proposed a technique to allocate a replica within the reach of two hops and it ensures that there is at least one replica within five hops. But the replication is performed in the same manner for both sparse and dense region. The vehicle density is more in dense region where the number of connected vehicles is high. The probability for link failure is less in the dense region compared to the sparse region. We exploit this feature and allocate less number of replica in the dense region .The sparse region contains less number of vehicles where the probability for link failure is high. It is necessary to increase the number of replicas in sparse region where path disconnection occurrence will be high. We use the number of connected vehicles at a point of time in a network as a parameter to decide the number of replicas to be allocated. There is a trade-off between the number of replica and degree of reliability. At the same time the cost of replication is also varies based on the number of replicas allocated in terms of time and space required to allocate the replica. We propose an algorithm to allocate replica based on the vehicle count at a particular point of time in the network which will maintain a balance between the replication cost and degree of reliability.

3. LITERATURE REVIEW

[1] Proposed Replication Aware Data Dissemination (RADD) to increase degree of availability of information among nodes in VANET. It also determines the location, to access information and to find path between vehicles. It enables node to determine their current position in the network either using GPS or using time and angle methods as proposed in [1]. It also designates vehicles with more storage space and high computational power as super vehicles which offer services to other vehicles. It uses various parameters such as Connectivity, vicinity, Relative velocity and communication range to select a node for replication.

[12] Proposed a protocol called Mobicast to transfer the information to a particular zone within a specific time. It works only in highway scenario that too for comfort application The work in [13] has proposed an algorithm to replicate data with reduced read and replication cost. It selects node for replica which reduces the read and replication cost during high mobility time which causes frequent network disconnection. The work is applicable in Ad hoc social networks. The work in [14] has proposed Time aware bloom filters for routing in MANET. The bloom filter has a drawback of providing false positives.

4. SYSTEM MODEL

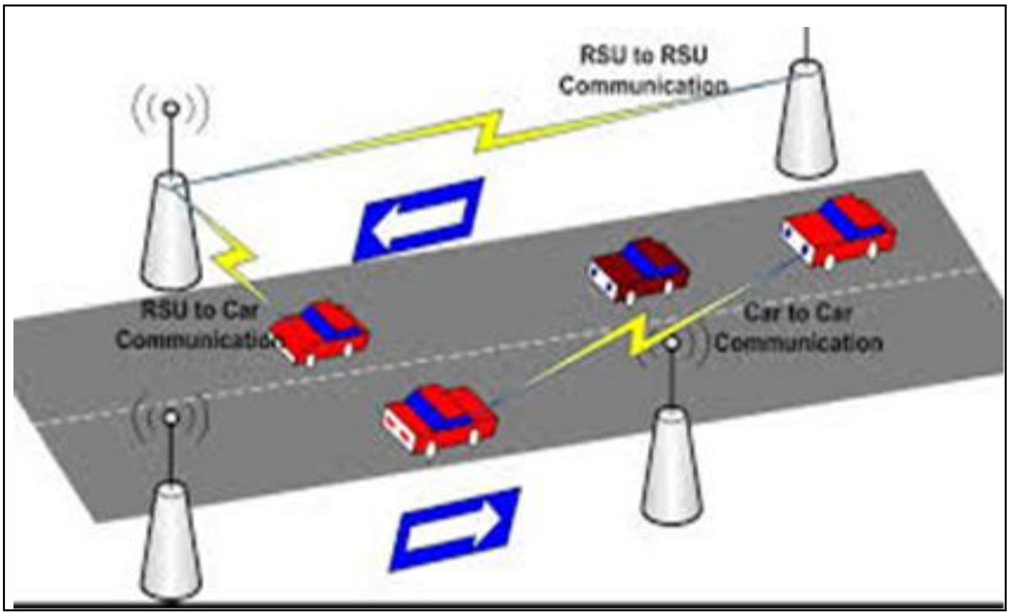

Figure 1 A scenario in VANET [Courtesy: Google]

Each vehicle in VANET is equipped with AU(Application Unit) and On Board Unit to support communication between vehicles and within vehicles. AU interacts with the RSU which is installed alongside the road in a congested area. The number of RSU is kept minimum in the sparse area where vehicle density is less. A vehicle can access the message from the other vehicle if it is connected as part of the current network. Each vehicle mainatins the information about the current network topology to find the path to a particular node. Frequent mobility of vehicle causes path disconnection and changes in network topology. The message contained in a vehicle is replicated on several other vehicles in order to increase the availability of message or information. Several approaches have been proposed in the literature to perform replica allocation in VANET [1]. But the proposed work maintains the same replica count for both sparse and dense region. Since there is a less probability for link failure in densed vehicle environment, the number of replicas can be reduced, as it will reduce replication cost and space required to maintain the replica. We propose a balanced dynamic replica allocation technique to allocate replica based on the density of vehicles in a particular region, so that the overall replication cost will be reduced to a large extent. We present the pseudo for the proposed algorithm and theoretical analysis on the benefits obtained.

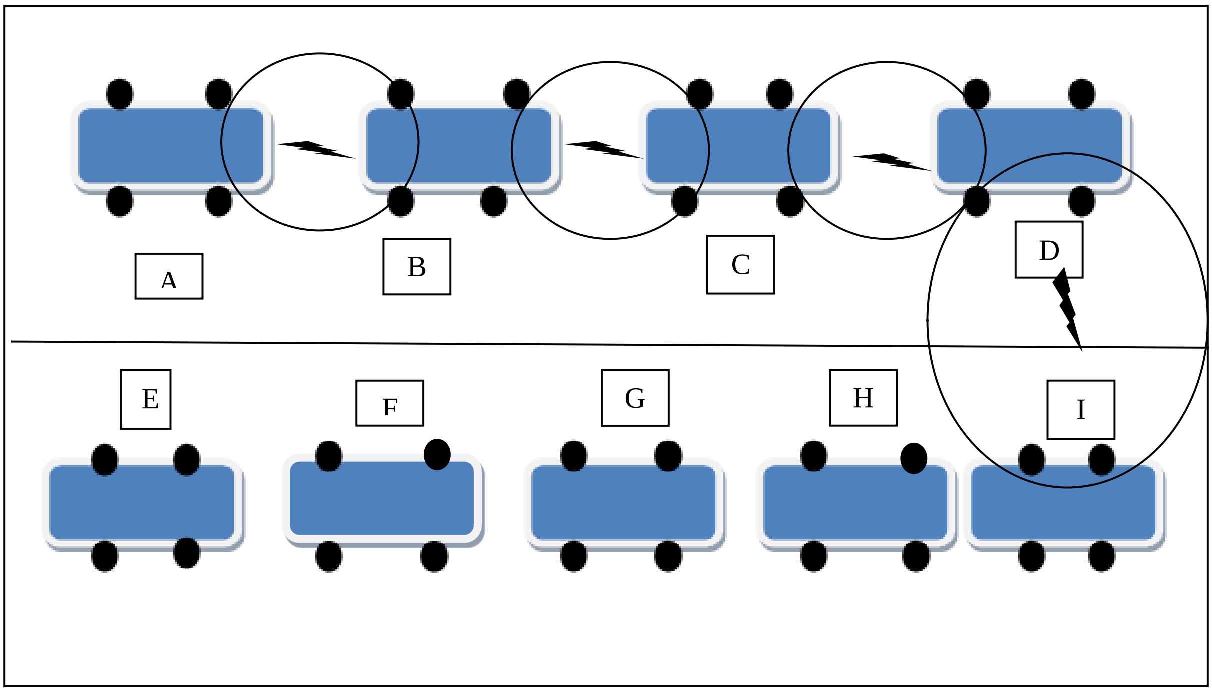

Figure 2 Dense VANET [Node A communicating with Node I]

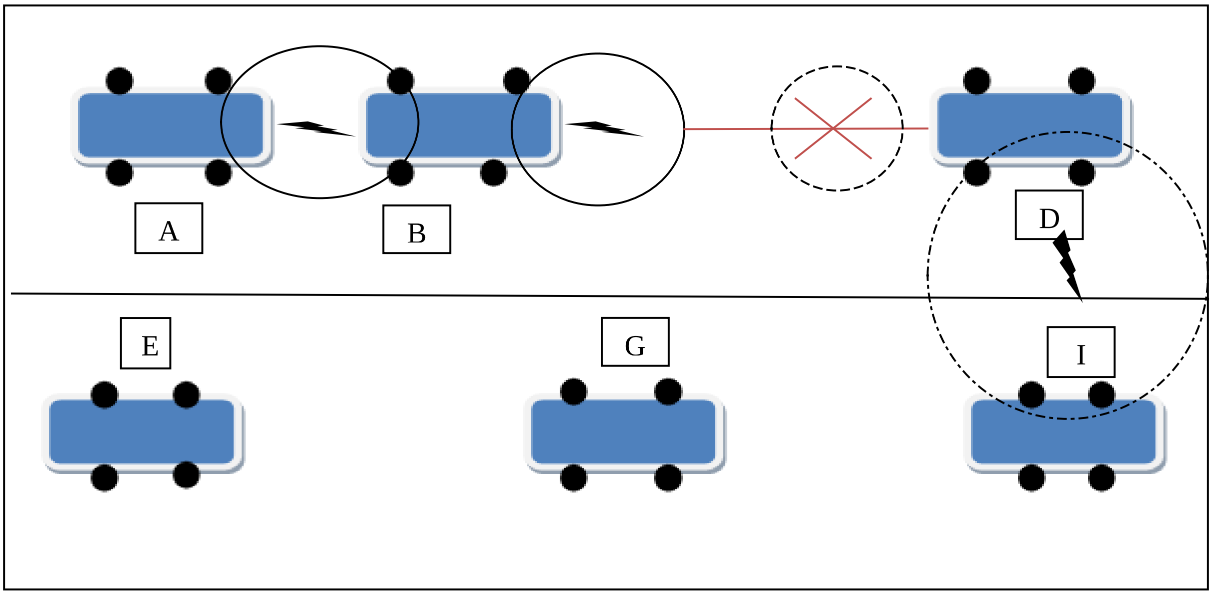

Figure 3 Sparse VANET [Node A communicating with Node I]

5. PROPOSED ALGORITHM

Over a period of time (T_{Ra}) during which replication is performed

```
{
  Find the total number of vehicles in the network: Nv
  No_of_conn.vehicles=Find_conn_vehicles_count ();
If the number of connected vehicles is < threshold
Region type:= Sparse
    Replica count:=maximum
    Else
Region type:= Dense
Replica count:=minimum
}
     Find_conn_vehicles_count ()
{
For   each vehicle i in Nv
Send a probe message to other vehicle to check connectivity
Send the connected vehicle detail to a coordinating vehicle to find the total number of
Vehicles connected vehicles in the network.
Return the connected vehicle count in the entire network.
 }
```

6. ANALYSIS

Replication cost is identified in terms of finding a suitable node which has less mobility rate with more storage space. It also includes the cost of transferring the replica from the origin node to the replica node. The size of data or information being replicated influences the replication cost to a large extent. The replication cost can be minimized by maintaining an optimal number of replicas. [1] Maintains the same number of replica in sparse and dense region. The number of replica can be varied dynamically by checking the number of connected vehicles in the dense region and sparse region. If the network contains more number of connected vehicles then the probability for data availability will be more. So the number of replicas can be minimized. This is possible in dense region which contains the large number of vehicles. But the number of replicas has to be increased in case of less number of connected vehicles, which is the case in the sparse region. The proposed scheme yields benefits in terms of replication cost over a period of time where replica allocation and reallocation is performed.

7. CONCLUSIONS

Replication is performed to increase data availability in presence of high node mobility which causes frequent network partition in VANET. Several algorithms have been proposed in the literature to perform replica allocation. But the proposed algorithms allocate replica in a fixed manner over nodes, where the cost of replication will be higher. We have proposed a technique to reduce replication cost by balancing the number of replicas and the number of vehicles in the network. We keep the replica count variably over sparse and dense region. We consider different regions such as cities, urban and sub urban where the frequency of vehicles varies largely. Based on the measured density we allocate replica dynamically to offer un interrupted service to the vehicles moving on the road. We have presented the algorithm and analysed the benefits of the proposed scheme theoretically.

8. FUTURE WORK

In this paper we have presented the algorithm to allocate replica dynamically to reduce replication cost .We have presented the pseudo code for the algorithm. In future we have planned to implement the functional code and simulate it using MATLAB or NS 2.35 to prove the benefits obtained by the proposed algorithm.

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