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Vehicular Adhoc Network (VANET) Handoff Mechanism- An Approach

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Abstract: In globalization, wireless communication technology plays a vital role in mobile and vehicular adhoc network. In this paper we want to represent the proposed architecture for the vehicular adhoc network and also prepare and handoff algorithm for the proposed architecture.

Keywords: networks, communication, handoff.

I. INTRODUCTION

This Driving means changing constantly location. This means a constant demand for information on the current location and specifically for data on the surrounding traffic, routes and much more. This information can be grouped together in several categories. A very important category is driver assistance and car safety. This includes many different things mostly based on sensor data from other cars. One could think of brake warning sent from preceding car, tailgate and collision warning, information about road condition and maintenance, detailed regional weather forecast, premonition of traffic jams, caution to an accident behind the next bend, detailed information about an accident for the rescue team and many other things. One could also think of local updates of the cars navigation systems or an assistant that helps to follow a friend's car. Another category is infotainment for passengers. For example internet information as next free parking space (perhaps with a reservation system), detailed information about fuel prices and services offered by the next service station or just tourist information about sights. A possible other category is car maintenance. For example online help from your car mechanic when your car breaks down or just simply service information. So far no inter-vehicle communication system for data exchange between vehicles and between roadside and vehicles has been put into operation.This document is a template. An electronic copy can be downloaded from the conference website. For questions on paper guidelines, please contact the conference publications committee as indicated on the conference website. Information about final paper submission is available from the conference website.

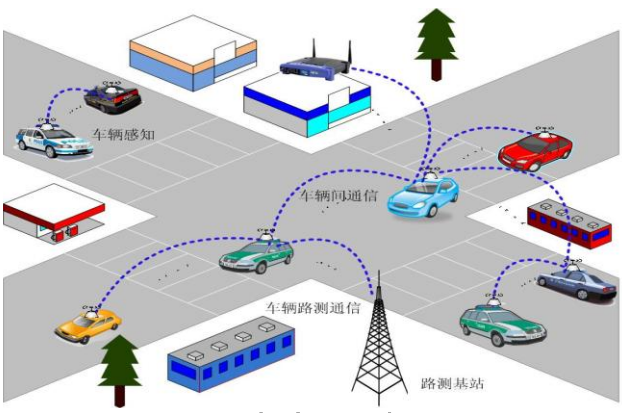

Fig. Vehicular Network

Vehicular Networks are a stylish, comfort and dynamic network of the Intelligent Transportation Systems (ITS) [3]. Vehicles reveal with each other via Inter-Vehicle Communication (IVC) as well as with roadside base stations. A VANET is a technology that uses moving cars as nodes in a network to create a mobile network, enables communication between moving vehicles and the road side units (RSU's) [1]. VANET is the special type of MANET, so the routing Protocols and IEEE standards used in MANET are also applied in VANET Environment [25].

VANET provide a communication model, vehicles are considered as VANET nodes with wireless links. Vehicles access of fast speed internet which will change the automobile's on-board system from an effective widget to necessary productivity equipment, making nearly any internet technology accessible in the car. Multiple ad-hoc networking technologies such as, ZigBee, IRA, WiMAX IEEE, and WiFi IEEE for convenient, effective, exact, simple and plain communication within automobiles on active mobility.

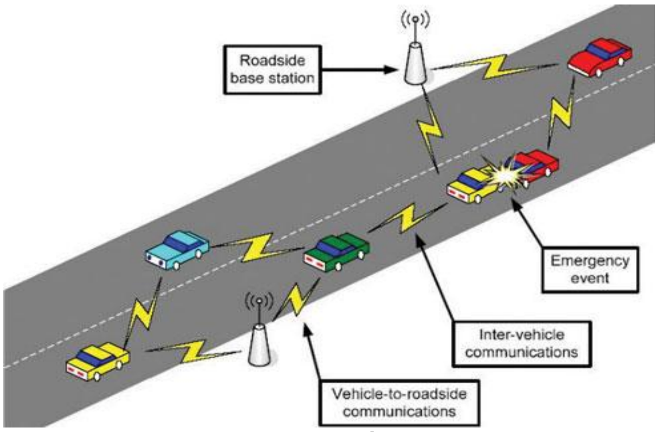

Fig.VANET With RSU

Only a few VANET are made and dealt with the vehicular communication inside the city where enough road side units are present[4]. Next goal to create high-presentation, extremely measurable and secured technologies of VANET shows an unusual challenge like handoff to the investigate community of wireless.

VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 meters of each other to connect and, in turn, create a clustered network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes.

Communications through Cellular Network

The first method connects vehicles to the Internet through cellular data networks using any of the following technologies: EV-DO, 3G, GPRS, etc. [23]. This service is already commercially available from car manufacturers [20] and from other third-parties [25]. In most commercially available solutions, the vehicle is transformed into a IEEE 802.11 (WIFI) hotspot and the Internet connection can be shared by many computers in the car. Usually, a limit is set on the amount of data transfer (e.g., 1GB or 5GB maximum per month). The main advantage of this method of connection is that the vehicle will have Internet access wherever cellular coverage is available. The main drawbacks are the dependence on the cellular operator coverage network and the limited available data rates (rates vary around 500Kbps-800Kpbs).

Vehicle to Roadside Infrastructure Communications

The second method uses roadside infrastructure. Here, vehicles connect to other vehicles or to the Internet through roadside access points positioned along the roads. Two main variants can be found in the literature: the access points could be installed specifically for the purpose of providing Internet access to vehicles or the latter could make use of open 802.11 (WiFi) access points encountered opportunistically along city streets [18]. The advantage of this method of connection is that vehicles will be able to connect to the Internet using much higher data rates (e.g., 11Mbps) than through the cellular network. The drawbacks include the cost related to installing access points along the roads to obtain reasonable coverage. Additionally, in the case where open access points are used, the access point owners' consent would legally be required before such a service is deployed [18].

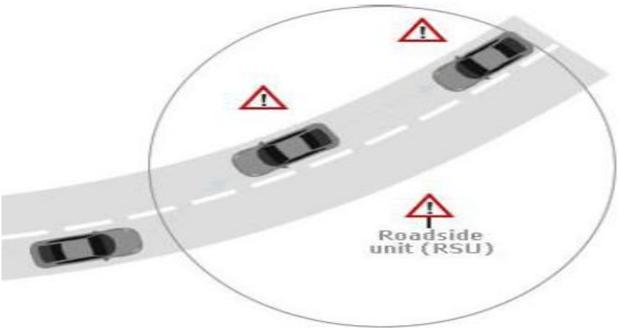

Fig. Vehicle-to-Roadside Communication

Vehicle-to-vehicle (ad hoc) Communications

Using Internet-based communications to and from vehicles will probably remain the method of choice for communications as long as the ratio of WiFi-enabled vehicles remains low. The advantage here is the addition of a distinct, high bandwidth network to the existing infrastructure network. The main drawback is that these networks could require new set of protocols as the viability of vehicular networks applications described above is conditioned by whether or not VANET routing protocols are able to satisfy the throughput and delay requirements of these applications.

Fig. Inter-Vehicle Communication

In June 2007, General Motors 'GM' addressed the previously mentioned applications and announced for the first wireless automated collision avoidance system using vehicle-to-vehicle communication (Fig. 1.9, [13]), as quoted from GM, "If the driver doesn't respond to the alerts, the vehicle can bring itself to a safe stop, avoiding a collision".

Fig The GM's V2V system and a sample transceiver

Handoff Process

Switching a cellular phone call from one radio channel to another. Also called "handover," it mostly occurs when a mobile user travels into the range of an adjacent cell. The handoff can be managed within the base station; the base station controller (BSC) that manages several base stations; or the mobile switching center (MSC) that sets up and tears down the calls. In a primitive taxi system, when the taxi moved away from a first tower and closer to a second tower, the taxi driver manually switched from one frequency to another as needed. If a communication was interrupted due to a loss of a signal, the taxi driver asked the base station operator to repeat the message on a different frequency.

Types of Handoff

Handoff mechanism handles subscriber station (SS) switching from one Base Station (BS) to another. Handoff is divided into two broad categories—hard and soft handoffs. In hard handoffs, current resources are released before new resources are used; in soft handoffs, both existing and new resources are used during the handoff process.

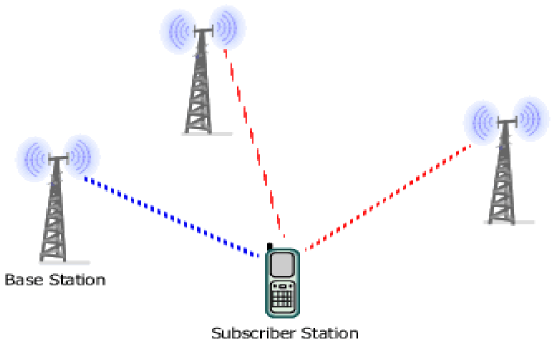

Fig. Soft Handoff

A soft handover is one in which the channel in the source cell is retained and used for a while in parallel with the channel in the target cell. In this case the connection to the target is established before the connection to the source is broken, hence this handovers is called make-before-break. The interval, during which the two connections are used in parallel, may be brief or substantial. For this reason the soft handovers is perceived by network engineers as a state of the call, rather than a brief event. Soft handovers may involve using connections to more than two cells, e.g. connections to three, four or more cells can be maintained by one phone at the same time. When a call is in a state of soft handovers the signal of the best of all used channels can be utilized for the call at a given moment or all the signals can be combined to produce a clearer copy of the signal. The latter is more advantageous, and when such combining is performed both in the downlink (forward link) and the uplink (reverse link) the handover is termed as softer.

Softer handovers are possible when the cells involved in the handovers have a single cell site .A SS maintains multiple connections. Delay is very minimal Soft handoff is used in voice-centric cellular networks such as GSM or CDMA. It uses a make-before-break approach whereas a connection to the next BS is established before a SS leaves an ongoing connection to a BS. This technique is suitable to handle voice and other latency-sensitive services such as Internet multiplayer game and video conference. When used for delivering data traffic (such as web browsing and e-mail), soft handoff will result in lower spectral efficiency because this type of traffic is busty and does not require continues handover from one BS to another. A SS maintains a connection to a single BS at any given time.

Fig. Hard Handoff

A hard handover is one in which the channel in the source cell is released and only then the channel in the target cell is engaged. Thus the connection to the source is broken before or 'as' the connection to the target is made—for this reason such handovers are also known as break-before-make. Hard handovers are intended to be instantaneous in order to minimize the disruption to the call.

Purpose of Handoff

In telecommunications there may be different reasons why a handover might be conducted:

- When the phone is moving away from the area covered by one cell and entering the area covered by another cell the call is transferred to the second cell in order to avoid call termination when the phone gets outside the range of the first cell.
- When the capacity for connecting new calls of a given cell is used up and an existing or new call from a phone, which is located in an area overlapped by another cell, is transferred to that cell in order to free-up some capacity in the first cell for other users, who can only be connected to that cell.
- In non-CDMA networks when the channel used by the phone becomes interfered by another phone using the same channel in a different cell, the call is transferred to a different channel in the same cell or to a different channel in another cell in order to avoid the interference.
- Again in non-CDMA networks when the user behavior changes, e.g. when a fast-travelling user, connected to a large, umbrella-type of cell, stops then the call may be transferred to a smaller macro cell or even to a micro cell in order to free capacity on the umbrella cell for other fast-traveling users and to reduce the potential interference to other cells or users (this works in reverse too, when a user is detected to be moving faster than a certain threshold, the call can be transferred to a larger umbrella-type of cell in order to minimize the frequency of the handovers due to this movement);
- In CDMA network to reduce the interference to a smaller neighboring cell due to the "near-far" effect even when the phone still has an excellent connection to its current cell.

II. LITERATURE REVIEW

VANET is an advanced version of Mobile ad-hoc network (MANET). Most of the MANET features can be applied in the VANET environment also [7]. In VANET the vehicles move in an organized and predefined road. VANET is the special type of MANET, so the routing Protocols and IEEE standards used in MANET are also applied in VANET Environment [8][9]. In MANET, the nodes are moving at random and their speed is normal. Most of the existing research works have been done on MANET. However these works cannot be directly applied to VANET due to the fundamental difference between VANET and MANET. In vehicular network, the mobility nodes are vehicles which are moving in a high speed of nearly 200 km/hr on a predefined road. The movement of nodes is dependent on the road structure, traffic and traffic regulation.

Due to this high speed of the vehicles the usual mobile ad-hoc technology IEEE802.11 is not well suited for VANET. For this reason a suitable amendment is made on the existing standard 802.11 that becomes a new vehicular technology 802.11p. Another big challenge is creating the vehicular network outside the city area. The real issue is to develop a model for the highway mobility outside the city. Therefore a new highway mobility model is developed with a new cluster concept that increases the efficiency of the data communication. In the new concept a simple highway system is taken for characterizing the VANET. The newly proposed system takes into consideration the two scenarios:

i. Service Discovery when a vehicle moves inside the city.

ii. Service Discovery when a vehicle moves outside the city.

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The intra-vehicular communication from vehicle to vehicle through the RSU's and inters-vehicular communication through the RSUs are shown in figre. In the non-urban area, limited road side units are available for data communication. For effective vehicular communication each vehicle acts as a router to exchange information. Each vehicle is equipped with a global positioning system (GPS) [17]. Broadcasting and routing algorithms use the information provided by the GPS and make effective communication. For the road safety, new applications are proposed for vehicular networks, i.e. car to car communication, travel and tourism information distribution and game applications. These applications need reliable communication equipment with high data rates and also a stable connectivity between the transmitter and the receiver under high reliability condition.

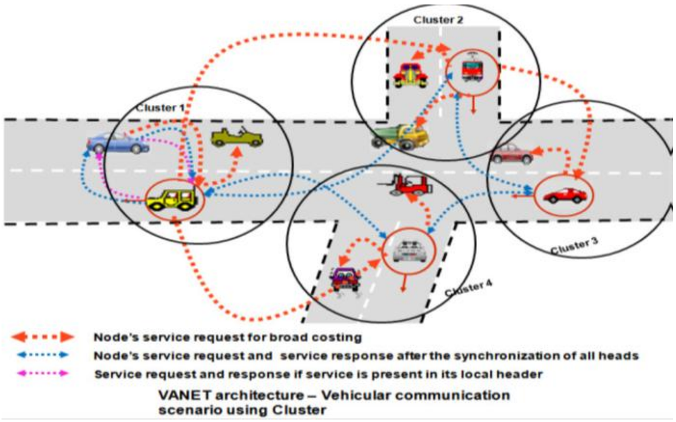

Fig. Vehicular architecture with clusters

The Cluster creation process in the proposed model is different from the existing model [18]. The size of the cluster changes only during unavoidable situations like sudden increase in the number of vehicles moving in a particular road due to traffic changes. The cluster remains in the same frequency, so the cluster areas are created as fixed ones. While creating a cluster, it should be ensured that the cluster head does not frequently cross the cluster boundary. If the vehicle moves out frequently, the Cluster head election algorithm often elects a new cluster head. The VANET area has been split into a number of clusters by using the proposed cluster formation algorithm. Each cluster has a cluster head. The cluster head may be either RSU or any one of the vehicles with good database storage and access capabilities. Each cluster head has all the service descriptions that are available in the network. All the cluster heads in the VANET are regularly updated if a new service centers in the network.

In a Cluster environment, the Cluster head receives information from any node of that cluster and sends it to another cluster head. Cluster-based solutions provide less propagation delay and high delivery ratio. The earlier VANET models discussed only the communication between vehicles through the RSU. Most of the researchers used standard 802.11 for VANET model with the movements of mobile nodes within the city area. The new SHWM model without using cluster concept and the standard 82.11p outperforms the existing models that use roadside units. For efficient data communication the protocol used in the given model is important.

One of the most important issues is how to efficiently support mesh client handoff between different routers, In paper [5] since wireless users in WMN are free to move to anywhere at any time. To address this issue, a mobile agent (MA) based handoff approach for WMN. In this approach, each mesh client has a MA residing on the attached mesh router. The mesh client intends to make a handoff, the client MA will move to the new mesh router beforehand and pre-setup a new communication channel for the handoff call. Then, the mesh client will accomplish the handoff process and use the new channel to resume the call. For the MA based handoff in WMN, it is very important to employ the call admission control (CAC) mechanism in the mesh router. So there are some challenges to handoff using mobile agent.

III. DESIGN/PROPOSED ARCHITECTURE

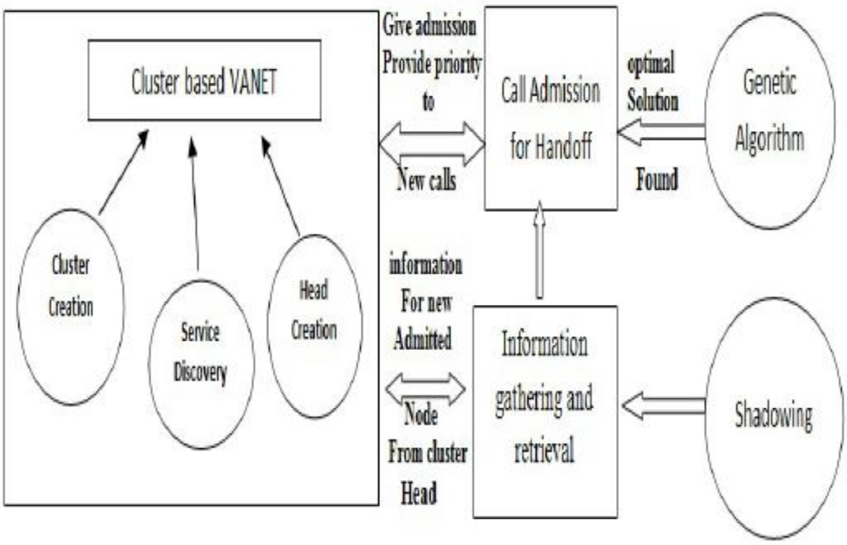

Fig. Cluster Based VANET handoff Architecture

Working of Proposed Architecture

Cluster Based VANET

A simple highway system is used for the VANET [21]. Each vehicle is using a global positioning system (GPS) [19]. Clusters are created dynamically in VANET the clusters remain stationary and predefined [12]. In VANET the cluster architecture follow the following steps:

Cluster creation: In the present architecture, the VANET area has been split into a number of size clusters having cluster head and storage capability according to bandwidth, direction, velocity as per the cluster formation algorithm given. For information gathering between the cluster heads, a service announcement procedure takes place.

Cluster Head Creation: It is the process of finding the cluster head in all the created clusters. Each cluster Head has its own responsibilities and powers.

Service announcement: After creating cluster using cluster creation algorithm if any node wants to announce any service in the network then all the cluster heads update their values according to the algorithm.

Call Admission Control for Low Bandwidth Handoff

According to the Service announcement the cluster head provide admission to the call. A better handoff strategy should be applied to the VANET, when node hanges their cluster. A call admission (CA) mechanism is used in vehicles while changing the clusters. A genetic algorithm is used for searching optimal solution for CA on the router (vehicle), which adopts threshold structure and gives handoff calls first priority and new calls second priority [10]. We assume there are ‘Cn’ clusters in VANET and a node among all the clusters wants to change the cluster the two possible case can arise

i. it is simply a vehicular node
ii. it is a Cluster head. If node is a Cluster Head then it will be accepted is it has an optimal bandwidth and Genetic algorithm decide which device needs a priority first. Then we need to find new cluster Heads in All the clusters otherwise the node is accepted.

Information Retrieval Mechanisms Using Mobile Agent

In order to gets the complete benefit of information gathering in VANET. A mobile agent based information retrieval system is introduced in VANET. Mobile agent migrate in the network for getting the information from the appropriate node, if node is searching for the information in all the clusters C1 to Cn retrieve information from the cluster head if Cluster head not found then find the cluster head and retrieve information after service announcement.

Shadowing Effects

A problem can arise while retrieving the information from cluster head in VANET, that when searching a node in cluster for information retrieval and two clusters having the information of same node then Shadowing helps in retrieving the latest information values by finding the cluster where the node is currently lies.

IV. MECHANISM FOR PROPOSED ARCHITECTURE

STEP I: Cluster Creation Algorithm

While (Mobile Node Status is Active)
{
Find relative distance between Nodes;
Find the relative velocity among nodes;
Case I: If (velocity==th&& dir==same)
{
//Create small size cluster;
Bandwidth();
Device_type();
NoOfAvailableNodes();
}
Case II If (velocity==t && dir! =same)
{
//Create large size cluster;
Bandwidth();
Device_type();
Quanity();
}
Case III If (velocity!=t && dir==same)
Create Cluster();
Case IV If (velocity!=t && dir!=same)
{
Create Cluster();
get_ position( );
Return position;
}
get_ position(Cluster_name)
{
While (cluster list not empty)
If (node € C)
// €, is belongs to;
Return Cluster_name;
}
Bandwidth(B)
{
If (B>=threshold)
Return;
Else
Exit;
//do not consider in cluster
//until bandwidth not increases.
}
Device_type (ExistingDevice, DeviceType)
{
If (ExistingDevice ==DeviceType)
Return ExistingDevice;
// consider it in cluster.
Else
Exit;
// do not consider it in cluster until
//Device type not matched.

}
Direction (NewDevice)
{
If (ExistingDevice == NewDevice)
{
New device will included in
cluster;
// consider it in cluster.
}
Else
Exit;
// do not consider it in cluster until
Direction not match.
}
Quanity(MaxNoOfDevicesInCluster,
ExistingNoOfDevicesInCluster)
{
If(MaxNoOfDevicesInCluster>=Existing
NoOfDevicesInCluster)
{
AllowToJoinThisCluster
// consider it in cluster.
}
Else
DenyDeviceInThisCluster;
// do not consider it in cluster
}

STEP II: Cluster Head Creation Algorithm

Cluster_Head(int y)
For existingCluster C1 to Cn
{
For node Node1 to Noden
{
Assume Velocityth and Directionth .
If (Velosity<=Vth &&Direction<=Dth)
Cluster headi = Nodei;
Return ClusterHeadi;
}
}

service_announcement()
{
CASE-I

For ExistingCluster C1 to Cn
For all ExixtingClusterHead ClusterHead1 to
C,usterHeadN
{
Update all the values on ClusterHeadi ;
if (NewNode found)
{
ClusterHeadi= values (NewNode);
Update ClusterHeadi;
}
}

CASE-II

For ExistingCluster C1 to Cn
For all Node Node1 to Noden
if (Nodei announce a service)
{
ClusterHeadi= values (Nodei);
Update ClusterHeadi;
}

STEP III: Call Admission Control for Low Bandwidth Handoff

When request arise
{

For all existing Cluster C1 to Cn
For all node Node1 to Noden
{
CASE-I if (Nodei==Cluster Head)
{
If (optimalThresholdBandwidth found)
AcceptNode;
ClusterHead();
ServiceAnnouncement();
}
Case-II if (Nodei! =Cluster Head)
Accept;
ServiceAnnouncement ();
}

Genetic algorithm perform the following operations for the better optimal solution
{
Create an initial population of nodes
For Cluster C1 to Cn
For all node Ni
{
If(StateOfNode Ni == ReadyForHandoff)
NoOfNodeReadyForHandoff = Ni++;
}
}
// Selection
For every Node
While (OptimalBandwidth >= BWth)
{
{
For (Node j=1 to n)
For (NodeReadyForHandoff =1 to n)
Node[j] = BW [NodeReadyForHandoff]
// crossover function.
X[t] =BW values after insertion sort;
// set priority, mutation;
For (int j=1 to n)
For (int t=1 to n)
Node[j] =X[t];
// termination;

V. Results

We experimented with different scenario parameters such as vehicle densities, vehicle speed, and broadcast rate. We also switched between the propagation model where no aggregation mechanism is used and the model in the presence of an aggregation mechanism. However, due to space limitation we limit the results here to the experiments with different vehicle densities in which the aggregation mechanism is used.

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