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Network Mobility in Intelligent Transportation System

(Avoiding Handoff and Interference in Intelligent Transportation System)

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Abstract— with a rapid development of the mobile technologies, Intelligent Transportation System (ITS) plays an important role in shaping the future ways of Transport Sector and Mobile Networks. To maintain the Internet connectivity of a cluster (group) of nodes in ITS, whereas the Network Mobility Basic Support (NEMO BS) is adopted as a mobility management protocol for the moving Networks. Even though NEMO BS provides mobility for Mobile Network Nodes (MNNs) in a moving network, Mobile Router (MR) need to participate in mobility signaling but packet loss in NEMO increases dramatically during the handover. Enhanced FMIPv6 based on NEMO (EfNEMO) is an efficient fast handover scheme significantly diminishes the tunneling burden and handover latency. In this paper, we proposed EfNEMO is used to reduce the tunneling and handover latency of the data. It also includes the analysis of data packet cost and data packet loss. In addition, the Greedy interference Avoidance algorithm is used to reduce the interference occurs during the data packet transmission. This algorithm works depends on codeword matrices and it is formed by using iterative method. The experimental results show that our greedy algorithm technique provides a well-defined vehicular environment suitable to avoid the interference in mobility.

Keywords— Intelligent Transportation System (ITS); Vehicular Networks; Network Mobility (NEMO); Efficeient Fast Network Mobility (EfNEMO); FMIPv; Greedy Interference Avoidance Algorithm

1 Introduction

THE Intelligent Transportation System aim at providing new advanced solutions to today's transport problems. Communications among ITS stations for improving the road safety, efficiency during driving. The new applications designed for vehicular environments in conducting research on Vehicular Communication Network (VCN). These applications were basically designed for safety-oriented communications has rapidly taken an important place. One example of applications on safety-oriented side is the notification of emergency situations (e.g., car accidents or bad weather conditions). The examples of infotainment applications go from using vehicle-to-infrastructure (V2I) communications for Internet-based applications.

A vehicle-to-vehicle (V2V) communications for the distributed games that are played among passengers in neighboring vehicles. The primary objective of VCN is to increase safety for drivers and passengers in vehicular technologies, the infotainment applications has a faster adoption of the required equipment and supporting infrastructure. As a result, it becomes necessary to have protocols that facilitate not only the intelligent and secure flooding of information, but the mobile networks providing connection to the passengers. A set of protocols has to handle the safety and emergency communications to handle IP based applications. In this way, the general IPv6, the IP mobility has been suggested to be managed by Mobile IPv6 (MIPv6) and NEMO BS.

Figure 1 shows a considered network topology wherein a vehicle ITS station implementing IPv6 mobility, that is, NEMO changes its point of attachment from an access router, AR1 to a new access router, AR2. The vehicle ITS station is assumed to be equipped with a Mobile Router (MR) functionality is defined in this diagram. Each access router provides the Internet connectivity to the vehicle in its access network. The home agent (HA) is located at Internet.

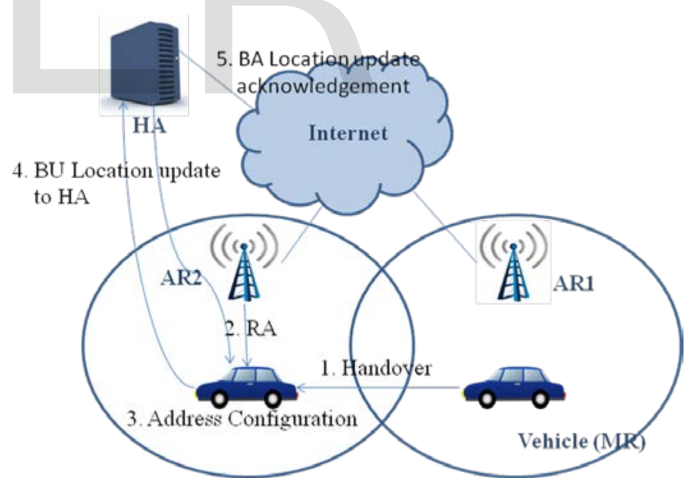

Figure 1: Movement of a vehicle

NEMO BS provides the continuous network connectivity to a group of nodes that are moving together (i.e., Mobile Network). The Mobile network is managed by a MR that provides connection to the set of nodes Mobile Network Node (MNN). Similar to MIPv6, NEMO BS uses the concept of fixed IPv6 and Mobile Network to provide the global reach ability to the mobile network. When Mobile Router (MR) connects to an Access Router (AR) in a visited (new) network, it acquires valid IP address Care of Address (CoA), followed by the registration of this CoA with HA. Then, HA creates an entry that directs the traffic destined to the mobile network to be routed to the newly assigned CoA. NEMO BS establishes a bidirectional tunnel between the MR and HA, which is used every time a MNN communicates with any Correspondent Node (CN).

The NEMO BS seems to fit in the context of ITSs by providing connectivity for the MNN attached to the MR, it has several problems. One of the problems is that packet loss and long handover latency during the handover were inherited from MIPv6. This issue is more critical in NEMO as MNNs in a mobile network move at the same time. The main idea behind these solutions is to incorporate an EfNEMO. The other problem of NEMO is that NEMO BS does not incorporate route optimization (RO) by which MNNs can directly communicate with CNs. In this paper, we develop an analytical model for EfNEMO to compare the predictive and reactive mode.

The rest of this paper is outlines as follows. Section 2 discuss about the system architecture. Section 3 discuss about the related works. Section 4 discuss about the protocol analysis. Section 5 introduces the greedy enhancement of the mobility.

2 System Architecture

Consider an Intelligent Transportation System. In this configure fixed access control and Local control module with Infrastructure Network. After that, connect the Infrastructure Network access. Finally establish V2V connection link and each vehicle contains wideband wireless access. Then, efficient fast handover network mobility is used to handle tunneling and handover latency.

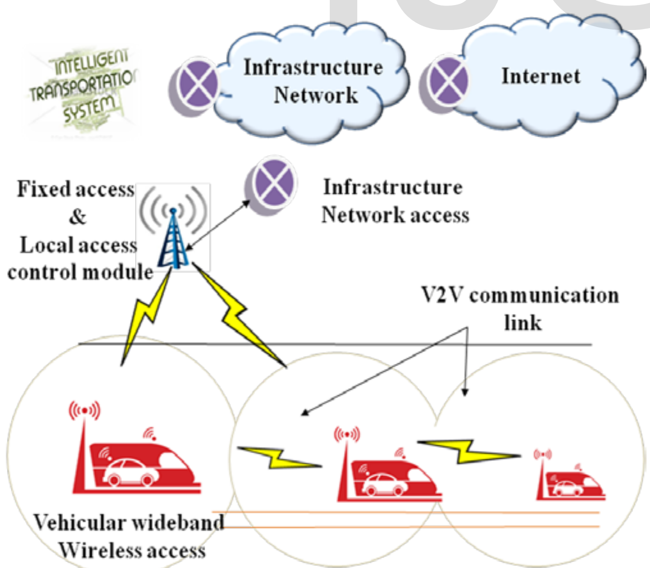

Figure 2 System Architecture

In EFH-NEMO, reduces the packet loss and handover latency by using tunneling. For example, many MNNs connected to MR in the NEMO simultaneously move, which can cause serious performance degradation due to the tunneling burden during handover. Tunneling increases the traffic burden on the link between the Previous Access Gateway (PMAG) and the New Access Gateway (NMAG). When many MNNs transmit or receive data packets in high traffic density the tunnel is particularly overloaded, causing serious congestion. After that, the signaling overhead is defined as the handover signaling cost incurred during a session and it is calculated by the product of message's length and the number of hops. Derive the cost function of location update and packet delivery to find out the optimal size of a regional network. The total signaling cost in location update and packet delivery is considered as the performance metric.

Using Greedy Interference Algorithm is used to reduce the interference in the Intelligent Transportation systems. Greedy algorithm, number of activated users will vary at each signaling interval based on pre-determined interference threshold. Here, it calculates the fixed point by using codeword matrices. Each matrix is created by using Eigen values and Eigen vector.

3 Related Works

3.1 NEMO BS Protocol

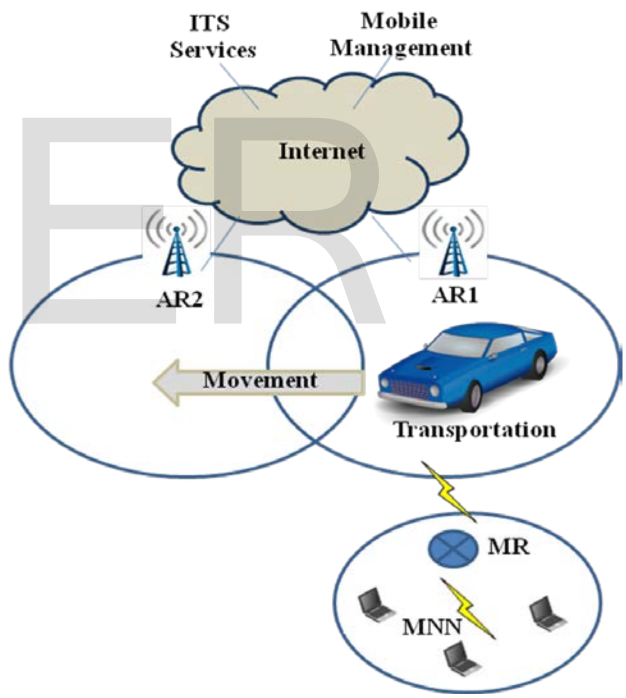

Figure 3 NEMO with ITS Architecture

To support ITS applications, Internet access is required in the vehicle. For example, fixed vehicle sensors, passengers, mobile devices moving with a vehicular network may connect to the Internet. To reduce the signaling burden of each node in the vehicle, the NEMO BS, which supports network mobility in the vehicular networks, was introduced. NEMO BS is an efficient and scalable scheme because the mobility management is transparent to each node in the vehicle. That is, MNNs are nodes connected to an MR but it does not send and receive signaling messages during the handover session. Figure 3 shows an architecture overview of NEMO with ITS architecture. This NEMO BS protocol is used to maintain session con-

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tinuity between the MNNs and the CNs, whereas the MR changes its point of attachment.

4 Protocol Analysis

4.1 MIPv6

MIPv6 is a global mobility management protocol. The mobile node can reach the entity in its home network. In NEMO, the mobile router is defined to extend the MN of MIPv6 by adding ability routing between its point of attachment and subnet which moves with the MR. MIPv6 are designed to handle the terminal mobility and that is not suitable for handling the NEMO. MIPv6 has been proposed to support the network layer mobility. This protocol allows MN to maintain the connectivity to the Internet while moving from one network to another network. Each MN is identified by its Home Address. When connecting via foreign network, the MN receives RA message. To obtain the information on the new network, Router Solicitation (RS) and Router Advertisement (RS) messages are exchanged between MR and AR. Then, the MR creates NCoA and Duplicate Address Detection (DAD). If the CoA is usable, the MN sends its location information to its HA to perform Binding Update (BU), which intercepts packets for the MN and tunnels them to the MN's current location.

4.2 FMIPv6

In order to improve MIPv6 to support the Handover, Fast Mobile IPv6 (FMIPV6) is proposed. NEMO BS seems to fit well in the context of ITSs by providing connectivity for the MNN is attached to MR and it has several problems. One of the problems is that packet loss and handover latency during the handover session which is inherited from MIPv6. This problem is more critical in NEMO as MNNs in a mobile network move at the same time. The idea behind these solutions is to incorporate a fast handover scheme (FMIPv6) with NEMO BS. FMIPv6 reduces the packet loss by using buffering and tunneling but the tunneling burden may sustain packet loss during the handover. FMIPv6 is designed for a single MN, a tunnel between the PAR and NAR is established during the handover which is used for single MN.

4.3 EFNEMO

In this paper, we propose an enhanced fast handover scheme (EfNEMO), which is an effective scheme for NEMO in ITSs. This protocol eliminates the tunneling burden of FMIPv6. In addition to mitigating the tunneling burden, EfNEMO further reduces the handover latency. EfNEMO adopts the tentative BU scheme proposed in [25] to register a New Care-of-Address (NCoA) with the HA. Then the data packets are destined for MNNs are delivered via the various paths between HA and NAR. In EfNEMO, it performs registration to the HA that develop the handover performance. When several parts of the handover process are performed, a tentative registration is also performed. EfNEMO eliminates the burden on the tunnel between the PAR and the NAR, and reduces the failure of the tunnel. The handover latency is reduced because the registration to the HA is performed. As a result, EfNEMO may be a solution for NEMO in ITS.

5 Greedy Enhancement

The main objective of this greedy enhancement is used to avoid the interference in Intelligent Transportation System. A wireless network consists of large amount of mobile nodes. There is a chance for interference is very high because data packets are transmitted simultaneously. In this greedy algorithm, forms a codeword matrix based on the network attributes like total bandwidth utilization, available bandwidth, signal strength. It also calculate the gain for each and every mobile in the ITS.

Based on the code word matrix and gain of the mobile node it creates Eigen values and Eigen vector. Based on the calculation, the mobile node having minimum Eigen value and Eigen vector is allowed to the transmitting data packet. This calculation is processed for all mobile nodes.

5.1 Greedy Intereference Avoidance

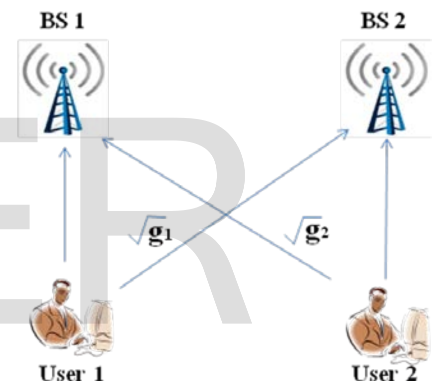

Figure 4 A Systems with two transmitters and two receivers

Consider a figure 4 we start with a simple system consisting of two base stations (BS), each BS having only one user associated with it, which is considered by [3]. We unambiguously assume that users transmit the information using CDMA approach for which we apply the greedy interference avoidance to adaptation of user codeword.

5.2 Algorithm Steps

1. Multipliers Initialize the user codeword matrices $\{U_l\}$ and gains $\{g_{ij}\}$ between users and bases (BS)
2. For each user-base pair i = 1,2,…,B

   (a) For each codeword $u_j(i)$ of U_i, j=1,2,3,….Mi. Replace $u_j(i)$ with minimum eigenvector of $R_i - u_j(i) u_j(i)^T$
3. Repeat step 2 until fixed point is reached.

6 Simulation Results

Network Simulator is a discrete event simulator targeted at networking simulation research. It provides extensive support for the simulation of TCP, routing and other multicasting protocols for wired and wireless networks. Simulator not only supports most commonly used IP protocols but also allows the users to extend or implement their own protocols. The performance differentials are analyzed using varying simulation time. The simulations are accepted out using Network Simulator. The Dynamic Source Routing (DSR) is the source routing protocol, which is maintained at all the routing information in all MNs. DSR protocol allows the network to be entirely self-configuring without the need for any existing network infrastructure.

The main approach of this protocol during the route creation phase is to launch a route by flooding the route request packets in the network. DSR uses the reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach.

6.1 Packet Transmission Delay

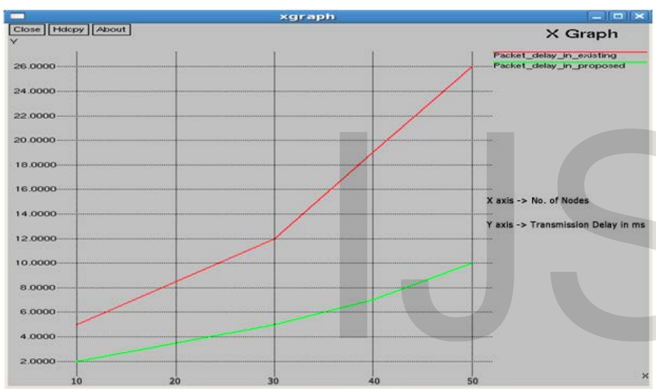

Figure 5 Packet Transmission Delay

In this figure 5, illustrates the packet transmission delay in network mobility. Here, the transmission delay is minimized by using greedy algorithm.

6.2 Packet Loss Optimization

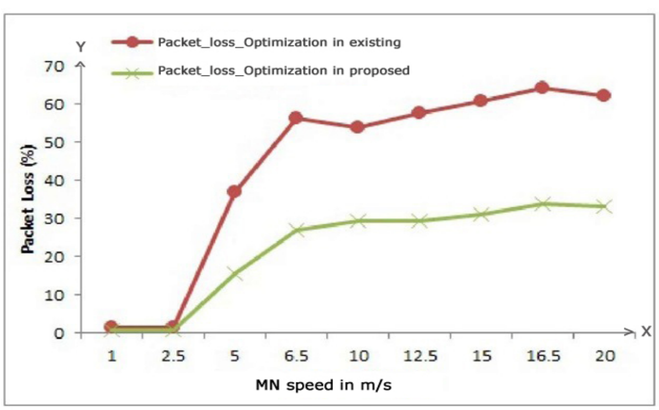

Figure 6 Packet Loss Optimization

In figure 6, illustrates the packet loss optimization in Network Mobility. Here, packet loss is minimized by using greedy algorithm.

6.3 Packet Delivery Ratio

The ratio of the data packets delivered to the destinations generated by the CBR sources. Packets delivered and packet lost is taking into consideration.

6.4 Throughput

There are two representations of throughput; one is the amount of data transferred over the period of time expressed in kilobits per second (kbps). The other is the packet delivery percentage obtained from a ratio of the number of data packets sent and the number of data packets received.

6.5 Simulation Parameters

The following table describes the various parameters that are used in the simulation.

Parameter Types	***Values***
Number of Nodes	0 – 29 (variable)
Simulation Area	1250m x 1250m
Simulation Time	50sec
Speed	10 m/s
Pause Time	5sec
Transmission Range	250m
Routing Protocol	DSR

Table 1 Simulation Parameters

Conclusion

EfNEMO is used to reduce the tunneling and handover latency of the data. It also includes the analysis of data packet cost and data packet loss. In addition, the Greedy interference avoidance algorithm to reduce the interference occurs during the data packet transmission. This algorithm works depends on codeword matrices and it is formed by using the iterative method where the Eigen values and Eigen vectors are used to calculate the codeword. The proposed work overcomes the disadvantages of existing system. Hence, it is highly effective from an existing work. In future, this system can be enhanced in the way of increased throughput, adjusting load balancing, and can be decrease in end to end delay.

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