ABSTRACT

A vehicular ad hoc Network (VANET) comprises the self managing ad hoc mobile vehicles. VANET is inherited from Mobile Ad hoc Network (MANET) for improving Intelligent Transport System (ITS) where vehicles act as mobile nodes. VANET framework is designed using three essential communicating units- Road Side Unit present at road segments, On Board Unit present in vehicle, and backend infrastructure for interconnectivity among vehicles and internet. Communication can be established in vehicle-to-road units, inter vehicle units, and road-to-road side units. The major concern while communication is related to security, considering confidentiality, integrity, authentication as the prime services to be offered to the vehicles. Therefore, each connecting vehicle in VANET has to prove its liability through authentication and can take the benefit of other security services afterwards.

In this era of expanding transport facilities for users, intelligent pathway coordination and communication is required among the vehicles. Therefore, the current research in VANET is focused on reducing traffic congestion in rush hours of a day, and accidents on the road. In case of occurrence of traffic congestion or road accident, vehicles on the move get stuck that calls for an effective way of choosing an alternate path and hence clear up the jammed traffic. Alternative path map consists of segments that are less occupied and can be followed in unusual situations.

Therefore, the prime objective foundation on which this research work revolves around is to (1) propose a new scheme for data collection which will tend to improve throughput, packet delivery ratio, and reduce latency, (2) extract the possible paths from the data collected using association rule base mining on distributed RSUs, and (3) predict the common and most frequent paths on the basis of position, direction, time of day, and during any accident or jam.

In order to generate efficient path maps in unusual situations like congestion or road accidents, the first step is to collect data from each vehicle about the path that it traverses to reach from one source to destination. Data collection is dependent on numerous factors such as position, direction, and time of the day. RSUs present on the

other side, hold the data collected from different moving vehicles from different source to destination respectively. Vehicles while moving send the data about the path segments that they are going to traverse to their nearest RSU. For each vehicle separate path information is maintained from a specific source to destination.

Different data collection scheme (DCS) are investigated by researcher that can be either RSU initiated or vehicle initiated. In RSU initiated scheme, a beacon message is initiated by the RSU after a fixed interval of time say N seconds to the vehicles present in its vicinity. In response, every vehicle sends a packet to the RSU with information related to the partial path. Road side unit (RSU) use road side probing in which they initiate the procedure of probing in order to enquire every vehicle in its vicinity about the information related to traffic, environmental, or accidents information. On the other side, in vehicle initiated scheme, vehicle starts transmission of path information to the RSU. Vehicle Initiated can be further classified as Vehicle Initiated-RSU find mode (VIR) and Vehicle Initiated-Broadcast mode (VIB).

In VIR, before the vehicle initiates the transmission of packet, it first generates a RSU find message and broadcast it. RSUs which are currently in the vicinity of the vehicle will receive this message but the one who is close to the vehicle replies through a message detailing its address information. VIR is again categorized into two schemes. One is VIR-Complete Path (VIR-CP), here vehicle first collects the information for complete path and then transmit the packet to the RSU. Second is, VIR- New Segment (VIR-NS), here whenever a vehicle receives information related to new path, it transmits the packet to a specific RSU.

In VIB, the transmission of packets is initiated in the broadcast mode through vehicle to all the RSUs that are in its vicinity. VIB scheme is again categorized in two schemes. One is, VIB-Complete Path (VIB-CP), here vehicle first collects the information for complete path, that is, it covers all the path segments first and after reaching the destination it transmits the packet to the RSU. Second is, VIB- New Segment (VIB-NS), here whenever a vehicle receives information related to new path, it transmits the packet.

From the aforementioned existing DCSs, VIB-CP (Vehicle Initiated Broadcast Complete Path) is the best one whose performance index is high in provisions of

communication overhead, average delay, and packet delivery ratio. But VIB-CP is still vulnerable to attacks, as an unauthenticated user can send the wrong data information to RSU. An attacker can also block the resources of RSU by sending unlimited messages. Various types of attacks are possible on VIB-CP that result in low evaluation of the VIB-CP based on communication overhead, packet delivery ratio and average delay. Therefore, improvement is required in VIB-CP as it didn't provide any security features.

With an aspiration to integrate security in existing DCS in VANET, an intelligent Authentication based Vehicle Initiated Broadcast Dynamic Path (IAVIB-DP) is proposed. In IAVIB-DP, Vehicle authentication is performed first on the RSU i.e. the authenticity of the vehicle is first proved at the RSU. A reciprocal security mechanism is required by the RSU to prove its authenticity to the vehicle in a view to support advance authentication mechanism. Once mutual authentication among RSU and vehicle is completed, vehicle may initiate communication with that RSU.

This work aims to implement and compare VIB-CP and proposed IAVIB-DP in OMNet++ to fetch the results in controlled environment set by user. OMNeT++ is an modular discrete event object-oriented network simulation framework that provides graphical user interface (GUI) for the simulation making it interactive system to work with. Moreover, it also provides mobility support in VANET. Communication overhead, Packet Delivery Ratio, and Latency is improved by using IAVIB-DP scheme while achieving authenticity of the vehicles.

Once the data is collected securely from proposed IAVIB-DP data DCS from different vehicles, data is stored at RSUs. Further, data mining is applied to extract all the possible paths considering one source and one destination. Association rule based mining is used to mine huge database to find common and frequent paths followed by different vehicles from one source to destination at distributed RSUs. Multiple paths may exist from a source to destination and this process is repeated for multiple source and destinations.

Minimum support and confidence are applied by setting threshold values that decide whether to accept or reject the pattern generated.This is required to accept the

arrangements for further decision making. A prediction model is designed that is able to decide the next path to choose in unusual situations like accident, jams, or a particular time of day. Therefore, this study comes out with a smart way of getting the best path map at particular time of day to avoid delay. For society, it reduces delay during unusual situations such as in event of accident, theft, morning rush hours, ambulance.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AP	Access Point
APt	Active Path Table
AU	Application Unit
CDT	Cell Dwell Time
CH	Cluster Head
CMP	Candidate Motion Arrangement
DCA	Digital Certificates Authentication
DCS	Data Collection Schme
DoS	Denial of Service
DSRC	Dedicated Short Range Communication Standard
GPS	Global Positioning System
GUI	Graphical User Interface
HMM	Hidden Markov Model
IAVIB-DP	Intelligent Authentication Based Vehicle Initiated Broadcast-Dynamic Path
INSA	Intermediate Node Selection Algorithm
IRE	Intermediary Re-Encryption
ISP	Internet Service Providers
ITA	Intelligent Transport Application
ITS	Intelligent Transport Systems
IVC	Inter Vehicle Communication
LT	Lane Table
MANET	Mobile Ad-Hoc Network
MDS	Minimum Dominating Sets
MP	Motion Arrangement
OBU	On Board Unit
PI	Performance Index
PL	Path Lane
PPC	Position Based Prioritized Clustering
PST	Probabilistic Suffix Trees
PUF	Physical Unclonable Functions
RBRA	Receiver Based Routing Algorithm
RCP	Resource Command Processor
RI	RSU Initiated
RS	Road Segment
RSU	Road Side Unit
SP	Service Provider
TOA	Time of Arrival
V2I	Vehicle To Infrastructure Communication
V2R	Vehicle-To-Road Side Unit
V2V	Vehicle To Vehicle Communication
VANET	Vehicular Ad-Hoc Network
VARM	VANET Association Rules Mining
VEINS	Vehicle In Network Simulation

VIB	Vehicle Initiated-Broadcast Mode
VIB-CP	Vehicle Initiated-Broadcast-Complete Path
VIB-NS	Vehicle Initiated-Broadcast-New Segment
VII	Vehicle Infrastructure Integration
VIR	Vehicle Initiated-RSU Find Mode
VIR-CP	Vehicle Initiated-RSU -Complete Path
VIR-NS	Vehicle Initiated-RSU - New Segment
WAVE	Wireless Access In Vehicle Environment