Methodological Analysis of Inter VANET Data Handovers with Metaheuristic Algorithms

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ABSTRACT
When Vehicles communicating among themselves, and communicating to devices located in the margins of roads and highways form Vehicular Ad hoc Networks (VANETs) that are a suitable type of Mobile Ad hoc Networks (MANETs). VANET can go upto a high speed of network nodes that can go up to 200 km/h, and which impacts directly on the capability the network has to deliver data, we can have a network formed for a small amount of time. Ant-based routing can be successfully incorporated to both wireless and wired networks as it has been checked it various tests. This work set ups to propose Ant Colony Optimization (ACO) methodologies that take advantage of information available in vehicular networks such as the vehicles' position and speed, in order to design an ant-based algorithm that performs well in the dynamics of such networks and adapts to the conditions appropriately.

Keywords
VANET, MANET, ACO.

1. INTRODUCTION
Until now there has been rapid development in wireless communication networks that has made inter-Vehicular Communications (IVC) and road-vehicle communications (RVC) possible in Mobile Ad Hoc Networks(MANETs), due to such a new type of MANET known as the Vehicular Ad Hoc Networks(VANETs) has emerged. Vehicular ad hoc networks (VANETs) enables the communications required to deploy and install Intelligent Transportation Systems (ITS). While incorporating data handovers through various VANET for throughput improvement, Metaheuristic algorithms (ACO) can be studied in order to find optimal configurations and conditions for upto the mark performance. Research thus primarily aims to accommodate the performance improvements when optimized configurations may be used for data transfer & handovers in various VANET system.

Various algorithms that can be made to use for sensor data handovers in this work needs to employ on such an application layer protocol that permits the *end-to-end data* transfer in inter VANET communications to make itself the dependable criterion for performance analysis. This implies that considering about the interconnection nodes and routing issues can be avoided, since they are carried out by the earlier down layer protocols. Which makes it possible for us to focus on application layer for data transfers. VANETs communications are carried out in a hostile environment which can provoke packet loss in the communication process, it raises a need which will reduce such data losses for improvement in reliability of deployment. In order to come up with such issues, we need to rise to imply data transfers with such an algorithm which makes handovers more powerful and accurate.

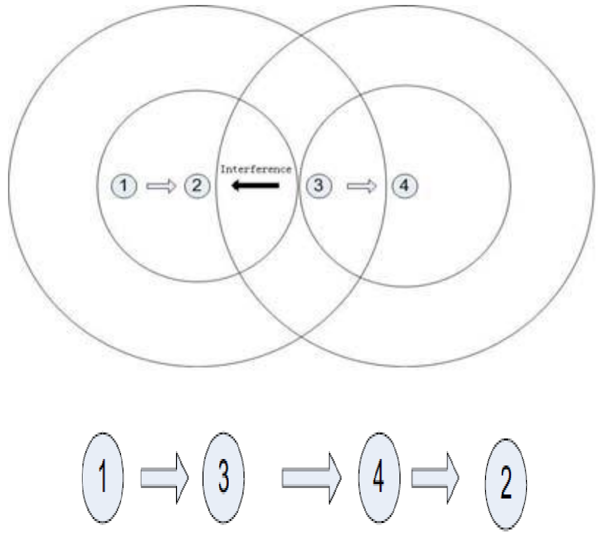


Fig 1: Inter-VANET Data Dependencies.

Wireless technologies and come up with data handovers which can be used for deploying these kind of networks. Such technologies need to be present the chance to develop efficient systems capable of data gathering, processing, and distributing information. For example, a driver assistance system could gather accurate and up-to-date data regarding the surrounding environment, check for potentially dangerous situations, and inform the driver. In VANETs, the WIRELESS problems are in coverage and capacity of the channel, the high mobility of the nodes, and the obstacles lead to packet loss, regular topology changes, and network fragmentation. So, a great deal of effort is required & has to be worked upon to offer new optimization techniques and to design efficient, powerful data transfer protocols. So, in these kind of networks, handovers is a backbreaking task, because there exists no central authority for finding the data paths among different nodes. Different optimizing strategies have been designed upon prior *ad hoc* network architectures via targeting some specific VANET needs of scenarios and applications. Such protocols are grouped into by means of Metaheuristic algorithms (ACO).

2. ABOUT VANET HANDOVERS
VEHICULAR *ad hoc networks* (VANETs) which mainly works with a new generation of wireless technologies for vehicles and roadside infrastructure is focuses to provide *Vehicle-to-Vehicle* (V2V) and *Vehicle-to- Infrastructure* (V2I) communications to briefly targets the efficient *Intelligent*

Transportation Systems (ITS) [1]. Thus due to veracity in the phase of applications system demands to develop powerful applications which may include co-operative traffic monitoring, prevention of collisions, control of traffic flows, blind crossing, and real-time detour routes computation, among others Vehicular systems.As per ITS these vehicular applications & services can be categorized into Safety applications, Traffic management and monitoring systems & Comfort applications[2]. The safety applications again include Cooperative collision warning, Incident management, Emergency video streaming while monitoring applications includes Platooning ,Vehicle tracking, Notification services. Another applications like comfort applications also required services like Parking place management.Distributed games and/or talks & Peer to peer applications. All these aspects of the services are very demanding and require optimized services of data exchange among the nodes. So for these large variety of applications utilizing wireless networks (VANET) & will demand features such as real-time, high-availability, and even instantaneous high-bandwidth in some cases. Therefore, it is imperative for network service providers to make the best possible use of the combined resources of available heterogeneous networks this give rise to data handover [3] through multiple nodes.

The majority of work on vehicular networks aims at finding optimizations that may be least efficient to solve the data transfer problems in context with data handover as majority of optimizations are for routing protocols that may have been introduced by considering the predefined network parameters, while optimizations for data information distribution protocols have been engineered by considering speeds, topologies and inter-contact probabilities. So as per previous observations the successful design and implementation of an application depends on a correct interpretation of the key elements like Broadcast Optimization, Fairness and Admission Control [4] underlying to which the behavior of the network can be specified which runs on it.

Thus in the case of vehicular networks, it is difficult to avoid dependencies on mobility and locality which represent the integrative VANET system. Secondly as data handoff plays the key role when the multi data transfer form the centralized unit of operation via multi layer inter-VANET systems, it is clear that granting to vehicles continuous and high-quality wireless connections for maximize throughput is a very challenging objective, due to the dynamicity of vehicular networks [5].

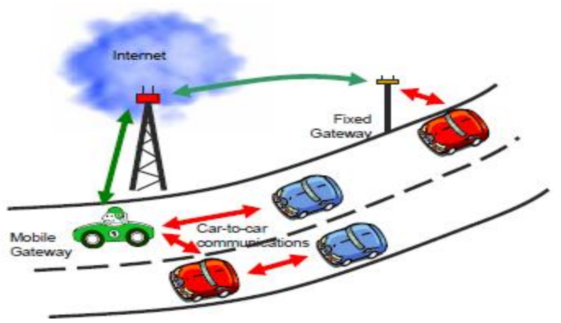


Fig 2 :Reference Scenario for Central Gateway.

Henceforth necessity arises to discuss some inter-layer cooperation principles that could drive the augmentation of widely deployed protocols briefly at the application layer to provide vehicular users good service with reliability & maximum throughput & good puts with the necessity of central gateway [5]. To maximize the throughput in multi level data handover vehicular model require strong system model and assumptions which may require to analyze the performance of channel [6], proceeding with these analysis throughput & reliability analysis can also be done on the base of system model. Leading to requirement of high throughput system demands the theme of enhanced good put which constrained to reduce probability of errors in respect to payload of fragmented data [7].

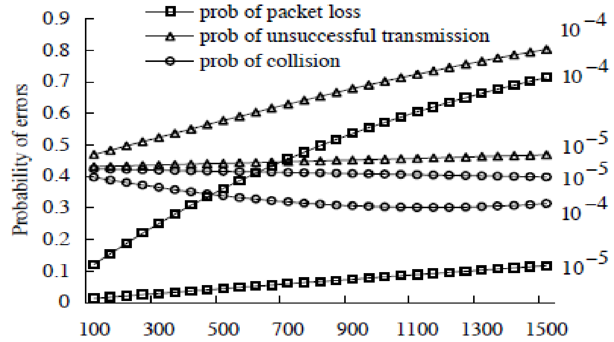


Fig 3: Fragmented MPDU payload length

Though numbers of methodologies are available there need certain indexes set by throughput laws to set parametric criterion for handover improvements [8]. As also Vehicular ad hoc networks (VANET) have been developed to improve the safety, security and efficiency of the transportation systems and enable new mobile applications and services for the traveling public. One of the most important factors that would make it possible to reach this goal is the design of effective broadcast protocols for end to end throughput optimization [9][11].

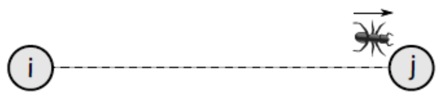
Thus as studied large portion of the messages sent in a vehicular network will be broadcast messages. Some of the uses for broadcast messages are: sending emergency warning messages, periodically broadcasting a vehicles state, etc. Many research challenges must be fully studied before VANETs can be successfully deployed in this multiple handover networks [11]. Deployment of such VANET needs different Metaheuristic algorithms require for data handovers, which give rises to ACO approach. Major challenges in such network environments include varying path characteristics and vulnerable channel quality resulting from dynamic traffic conditions and the design of the road [13].

In VANETs, the changes in the weather and the traffic conditions, the motion of the vehicles, and the presence of different types of obstacles affect the propagation of the signals in multi VANET data handover system. So information flow in most VANET applications is either from vehicles to infrastructure or from infrastructure to vehicles. Vehicular ad hoc networks are increasingly choosing as an essential alternative for different transmissions in the present and are considered as one of the most important kinds of next generation networks (NGNs), in which user can access to the information anywhere and at any moment, without having to find a fixed place of connection. To imply this, ACO metaheuristic algorithm can enhance and speed up the resolution of hard-to-solve optimization problems by taking advantage of the available processing power [15] to find the shortest data transfer path which again leads to maximizing the throughput.

3. INTER VANET DATA OPTIMISATION

During the 1990s, the combinatorial optimization which is based on the ant colonies (ACO, Ant Colony Optimization) came up so a novel bio-inspired technique intended to solve hard combinatorial optimization problems. ACO is a metaheuristic i.e., an approximate algorithm used for obtaining better solutions for various backbreaking combinatorial optimization barriers within a reasonable computational time. Inspiration Source for the ACO metaheuristic was the foraging behavior of actual ants. While in search for food, they initially check out the area near their nest, in a random pattern, by leaving on the path they pass through a special chemical substance known as pheromone. This substance was later used by the ant to find the way back to their nest, because the ants follow pheromone tracks. As the ant finds a specific food source, it evaluates it and gets some of the food back to its nest. During the way back to the nest, it again leaves pheromone on the way it came upon. Amount of pheromone which was deposited on the path might depend on the quantity and quality of the food which will guide other ants towards the food source. Due to this indirect communication through pheromone the ant trails to find the shortest path in between the nest and their food source. Such behavior of the real ant colonies is modified in the artificial colonies, that act as the basis for the ACO method. The central component of an ACO algorithm is a parameterized probabilistic model, which is known as the pheromone model, and in this model, two mechanisms being the most important: the method in which pheromones are left in the paths where the ants cater through and the way these blows of within the time. Such two mechanisms are being discussed in the further subsections.

Pheromone deposit: The amount of pheromone on a path tells the efficiency of that path is, i.e., it determines the quality of the path, and further the cost. Considering the link-ij , an ant iterating through it – moving from one node to another, leaves a sufficient amount of pheromone on the path. When it comes to implementation, the ant when arrives at node j, the pheromone level of the data in the routing table of j having i as both destination and next hop, is incremented of a __ij .Figure 3.1 shows the pheromone table of the node j after receiving an ant from the neighbor node i.



Destination	Next Hop	Hop Count	Pheromone Level
i	i	1	ΔΦ

Fig 4 : Ant walking through the link ij

The routing table at j shown in the figure, after the ant reaches j and shows the pheromone deposit mechanism. Equation (2) comes up with Link ij- as being the amount of pheromone deposited in the way for the link ij , and this sum up with the earlier level (assuming the path existed earlier), or let it be the actual level, if it is a new route.

$$\Delta\phi_{ij} = P_R + \frac{t_{link}}{t_{MAX}} \quad (2)$$

In Equation (2), P_R is considered the thought of probability of successfully forwarding the message that is sent through a certain distance, i.e, the chances of j receiving a information from i or vice versa, having the distance between both of them is d meters. t_{link} is the route lifetime, provided by the Kinetic Graphs framework, and t_{MAX} be the value that is defined for the maximum route life. To avoid having the upper bound exists too large values of the route lifetime estimation. Using the fading model gives us well the dynamics of a VANET in highways and also in urban scenarios ,as we are going to use this in our research and analytical, simulation models.

$$P_R(d, CR) = e^{-m(d/CR)^2} \sum_{i=1}^{m} \frac{\left(m\,(d/CR)^2\right)^{i-1}}{(i-1)!} \quad (3)$$

Equation (3) doesn't consider the interference effects. Our pheromone deposit equation now becomes;

$$\Delta\phi_{ij} = e^{-m(d_{ij}/CR)^2} \sum_{i=1}^{m} \frac{\left(m\,(d_{ij}/CR)^2\right)^{i-1}}{(i-1)!} + \frac{t_{link}}{t_{MAX}} \quad (4)$$

The Quantity of pheromone that is to be deposited in each and every link visited by the ants is given by Equation (4), which will act as the chances of reception of information through this route summed up with the ratio between the lifetime estimation of that route and the maximum allocated lifetime. The probability of reception indicates about the quality and efficiency of the path, but exceptions are always there so only in cases where the distance between the sender and the destination nodes is less as compared to wireless transmission range. Considering multi-hop routes whose length is much more than the transmission range, estimated lifetime for that path is the only indicative of quality we have.

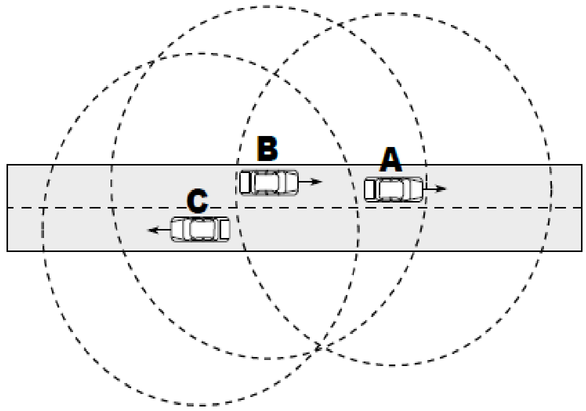


Fig 5 : Road with three cars showing their transmission coverage area

Suppose B is nearby of both A and C, but A and C are not nearby themselves. In Figure 3.2, if we see the route from A to C (through B), pheromone deposit procedure would be taken into account only if the estimated path lifetime of the entire path – the least value of the found lifetime from each part of the route, A to B, and B to C – as the distance in between A and C is much bigger than the transmission range, here (i.e., the probability of reception will be zero here).

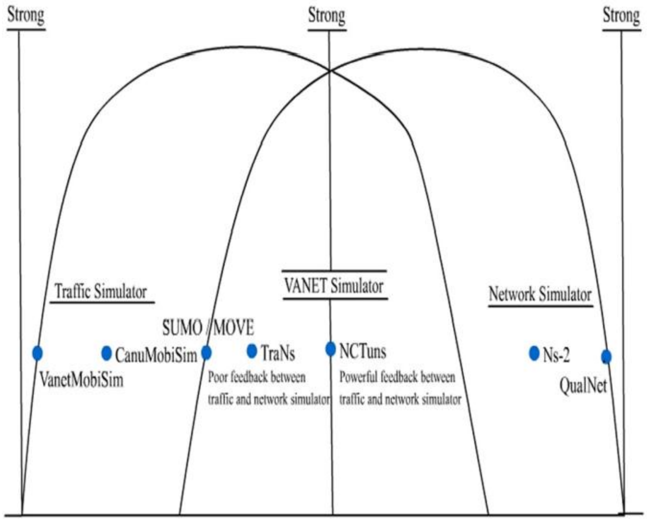


Fig 6 :Challenges to inter VANET data handover methodologies.

As we gone through above, an important requirement of VANETs is efficient security support. Various VANET security backbreakers now also have to be come upon in the areas of authenticity, driver confidentiality, and availability. The search for a lightweight, scalable authentication frameworks that are capable of securing vehicular nodes from attackers damaging the network by using a false identity, recognizing attacks that directly suppress, fabricate, alter or replay important messages, revealing spoofed GPS signals, and disable the introduction of misinformation into the network. Coming to the driver confidentiality, we have to come up with more reliable and robust secure protocols that enable security of message exchanges between the nodes of a vehicular network from threats such as unauthorized collection of messages through eavesdropping or location information (through broadcast messages). To provide availability, we also need provisions that can detect and suppress attacks (such as Denial of Service) that can prevent authenticated users to access the network. Efficient message exchange, security and authentication schemes working for Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications are being researched upon. For instance, mechanisms that can enable fast authentications in between vehicles and roadside infrastructure units are required to decrease delays. Using a central, trusted authority and public/private key-based solutions for such communication not only suffer high operational costs and response times but also lead to in-scalability. We are still working upon innovative fast, low-cost message exchange solutions in which communication overheads will remain constant on increasing the number of vehicles in the communication range. We further require novel encryption protocols which enable us to operate at high speed as compared to earlier public key-based solutions which have more delays and overheads while encrypting messages from nearby nodes.

4. AIMS AND OBJECTIVES

This work aims to propose such a model which will analysis inter VANET data handovers with metaheuristic algorithms. So, the analysis results will be indicating the proposed analytic model and data handover algorithm that can enhance the system throughput and ensure reliability of inter VANET sub-systems.

The modeling of the simulation environment and the analysis of the results in order to make use of protocol parameters are required to provide the fast and reliable seamless handover when the system is transferring sensor data for the safety & non-safety VANET applications while moving between the transmission ranges of different infrastructure or wireless nodes. Handover strategies will be based on parameter choice that can be presented for further research. The research will present a system that has been developed in order to allow setup the desired handover parameters for throughput improvements. This system also includes analysis capabilities for the simulation results, considerably enhancing the research workflow.

5. CONCLUSION

The convergence of computing, telecommunications (fixed and mobile), and various kinds of services are enabling the deployment of different kinds of VANET technologies. In the past decade, many VANET projects around the world have been undertaken and several VANET standards have been developed to improve vehicle-to-vehicle or vehicle-to infrastructure communications. In this work, we reviewed some of the main areas that researchers have focused on in the last few years and these include security, routing, QOS, and broadcasting techniques and we highlighted the optimization techniques for inter VANET data handovers to date. We presented a thorough analysis of various simulation tools that are available for VANET simulations. We hope this taxonomy on VANET simulators will be helpful to future VANET researchers in choosing the optimal VANET simulator best suited for their VANET design goals. Finally, we discussed some of the challenges that still need to be addressed in order to enable the deployment of VANET optimization technologies, infrastructures, and services cost-effectively, securely, and reliably.

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