

CHAPTER 1: INTRODUCTION

1.1 Background

Vehicular Ad-hoc Network (VANET) is promising Intelligent Transportation System (ITS) that enables much application such as safety message, traffic condition notification, accident warning [1], route planning [2], content distribution and entertainment [3]. Although a lot of advantages that created by VANET, there are many number of challenges particularly due to dynamic network topology, large variable number of mobile nodes and also natural fragmentation of network. To make better performance, minimize overhead fast topology changing and maximizing information transfer among the communication is mandatory.

Other challenges in VANET are unexpected driver behavior that makes topology changes and disconnections happen frequently and also road scenario such as highway road and urban road condition. Advance communication in wireless technology is used to integrate with VANET technology. UMTS and LTE are remarkable ones. These Technology offer data services with infrastructure based communication. Cellular communication is first used for safety application in Project Cooperative Cars (Co-Cars) [5] and investigate the concept LTE Connected Car service [6] [7] where the main intention is to make vehicles benefit from the internet access by considering them as moving smart phones. While cellular are beneficial in terms of better coverage, they have drawbacks of satisfying time-critical safety application, available bandwidth, communication cost [8].

Many routing and protocols in VANET has been studied recently and proposed. Delay Tolerant Networks (DTNs) are a class of networks that enable communication where connectivity issues like sparse connectivity, intermittent connectivity; high latency, long delay, high error rates, asymmetric data rate, and even no end-to-end connectivity exist. This model has been applied for vehicular networks called Vehicular Delay Tolerant Networks (VDTN) [9].

Another way to improve the performance in VANET is by implementing clustering routing methods that improve effectiveness and scalability. Clustering is a technique to form grouping of nodes and can greatly network performance. It allows the formation of virtual that support data delivery and also improves consumption of resource [10]. A Good clustering algorithm should not only focus on forming minimum number of clusters but also dynamically maintain the cluster structure without increasing a high communication overhead over the network. Clustering could be implemented based on metrics such as speed, location, direction movement, or radio power meter.

1.2 Reason Choosing Topic

Based on some references and some previous research on VANET especially about VDTN, some point can be summarized:

- a. Prime motivation in VANET is to enhance for safety condition for travelers. Safety application is to warn about critical situations in advance to drivers and thus place stringent requirements on the reliability and delay performance [14].
- b. Communication in VDTN is unique by relaying the message through mobile node from the source to destination. Data will be stored in buffer, as long as the other nodes are not available during relaying process [11]. Then the bundle is forwarded and stored again, and so on, until it finally reaches its destination
- c. VDTN could guarantee that the message will be delivered from with high delay. So that communication in sparse condition, intermittent connection, high latency and delay could be tolerated in DTN. Herewith some VDTN which are concerned in this research as compare as with the proposed routing algorithm:
 - i. Spray and Wait, routing protocol that consists of two phases spray phase and wait phase. In the spray phase the source node initially spray L number of message copies to L distinct relay nodes. After receiving the message copy all L relay nodes go into the wait phase and wait till the direct transmission to the destination. To increase the performance the Spray and Wait was developed into Binary Spray and Wait by spraying the $L/2$ copy message [12].
 - ii. Maxprop is forwarding based routing protocol which is each node initially set a probability of meeting to all the other nodes in network and also exchanges these values to its neighbor nodes. The probability value is used to calculate a destination path cost. Each node forwards messages through the lowest cost path [13].

1.3 Problem Definition and Formulation

Using VANET is possible to communicate between nodes especially in mobile node. In [14] some challenges occur during communication in VANET, i.e. high mobility of vehicles, position of nodes changing quickly, high delay, network loss in sparse area, and etc. Other challenges and requirement in VANET from the technical perspectives are signal fading, limitation bandwidth, connectivity, radius signal, security and privacy, and also routing protocol.

To improve the VANET performance due to the sparse condition and also fast topology changing, some DTN protocols were developed to overcome the problems. Many DTN routing were evaluated the performance.

The most prominent DTN routing in the previous research were Spray and Wait and Maxprop. Base on [15] it can be concluded the research result in the table below:

Table 1 Comparison Spray and Wait and Maxprop

Parameters	Spray and Wait	Maxprop	Explanation
Overhead Ratio	Less	More	
Average Delay	High	Less	Large Buffer & Big number vehicles

Based on the table 1, Spray and Wait and Maxprop have the opposite characteristics and performance. While in [16], it is also mentioned the performance evaluation for some DTN routing. Focus in Spray and Wait and Maxprop, it could be shown in the table as follow:

Table 2 Performance Comparison Spray and Wait and Maxprop

Parameters	Buffer	Latency	Decision	Resource Comsump
Spray and Wait	Sufficient	Depend on Load	Randomness	Less
Maxprop	Unlimited	Less	Previous Node	High

This research is try to adopt the advantages the routing protocol in VDTN and proposed a developed routing by merging the Spray and Wait and Maxprop routing for defined scenarios. This merging creates the proposed developed routing to enhance the delay performance compare to Spray and Wait and also Maxprop routing. Formulation of the problems can be summarized as follows:

- a. VANET condition in fast topology changing and in the sparse condition make the traditional routing such as AODV and DSDV cannot fulfill the communication process.
- b. VDTN as new mechanism is guarantee data from the node could be delivered to the destination in several interval for delay performance.
- c. How to create the configuration and developed an algorithm which can improve the performance during communication in VANET network.
- d. Delay depends on certain condition, so the application cannot work properly in all condition during mobility.

1.4 Scope of Works

To gain the values which are expected of the research we will create limitation problems. The research will be focused on clustering configuration in VANET with adaptive proposed VDTN routing. The research is started by analyze routing VDTN “Spray and Wait” and “Maxprop” routing. Mechanisms which are influencing the research will be described as follows:

- a. Matching the scenarios which are defined for clustering configuration in highway geographical map with some variant speed and node density.

- b. Running the simulation in ONE simulator and generate the data result as the research measurement target.
- c. Comparing the proposed developed algorithm with other VDTN routing both Spray and Wait and Maxprop in V2V network configuration. Both VDTN routing are used as basis in developed the algorithm to get the delay enhancement.
- d. Verifying the result from the proposed developed algorithm with both Spray and Wait and Maxprop algorithm.

1.5 Purpose of Research

This research will carry out the simulation VDTN routing to enhance the delay performance than the previous routing algorithm. The proposed developed algorithm is merging the advantages of existing algorithm “Spray and Wait” and “Maxprop”. The goals that are be expected upon this research could be summarized as follows:

- a. Developing a method to construct a complete clustering configuration in real map in various key parameters and be expected can be implemented in the real life.
- b. Implementing adaptive developed routing by detailed comparison and discussion of various approaches DTN routing (Spray and Wait and Maxprop) for delay enhancement.

1.6 Research Methodology

In summary the research methodologies aims to improve the delay performance in existing VDTN routing. The big picture concept in this research can be shown in the diagram:

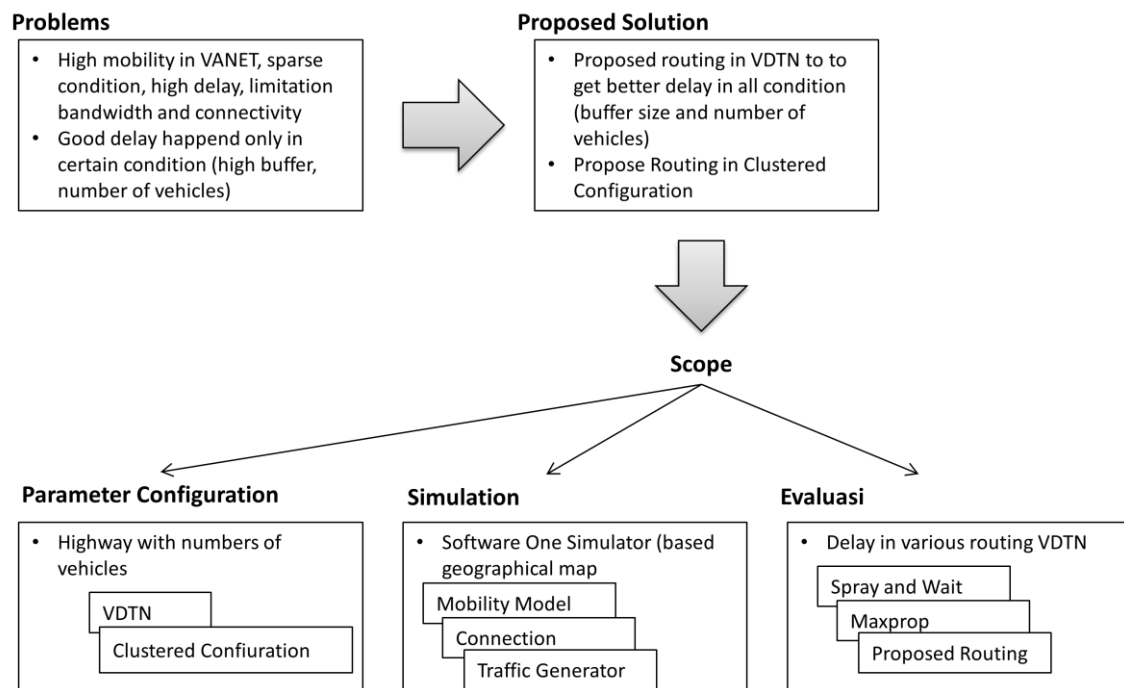


Figure 1 Research Methodology Diagram

1.6.1 Reference Tracing

There are several papers, books and sources from internet which are used as references in the research report. The main papers as references [12][13][15][16] as basis creation for proposed developed routing.

1.6.2 System Design

The research is concern to used the real map at Cikampek highway road along 70 km. The map for simulation is imported form the map format into One Simulator format and shown below:

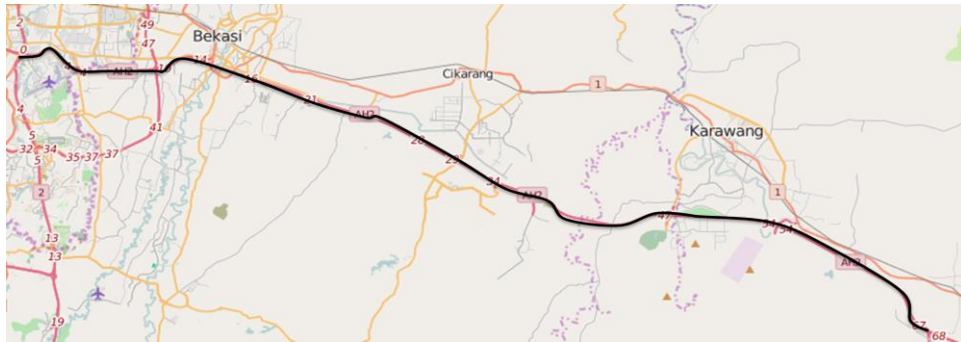


Figure 2 Simulation Map

Simulation is performed in VDTN condition with and network load represented by the change of number vehicles with maximum number are 150 in clustering network based on velocity. The simulation process can be drawn and be described as follow:

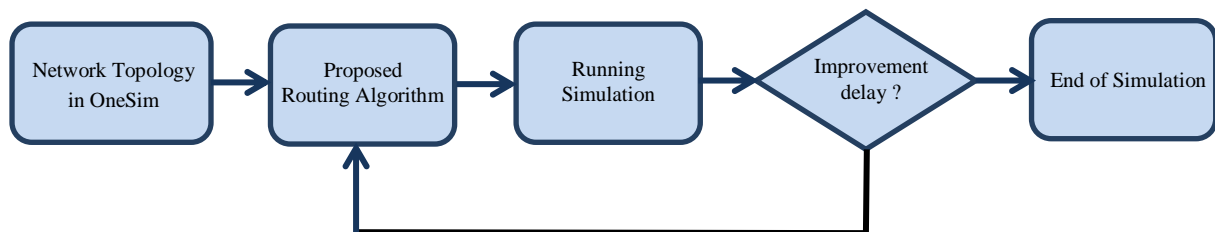


Figure 3 Flow Process

Firstly, network topology is designed as simulation ecosystem to obtain the result for delay enhancement analysis. The research is start form analyze Spray and Wait and Maxprop then compare to combination between both of routing algorithm to get new propose algorithm and implemented in clustering network.

1.7 Hypothesis

Based on previous studies using DTN routing in VANET, Spray and Wait has better delay in small network and Maxprop has better delay in large network [14] [15]. This research will conduct enhancement the routing DTN adaptively for small network even larger network for better delay. The enhancement is not only proposed DTN routing into dynamic routing but also propose the clustering configuration.