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ANALYSIS OF THE DETECTION TECHNIQUE IN DELAY TOLERANT NETWORKS USING VDTN FRAME WORK

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ABSTRACT

An unbroken connection between the source and the destination may not exist in Delay Tolerant Networks (DTNs). It is possible for nodes to link and communicate spontaneously. This chapter of a book provides a high-level introduction to DTNs, zeroing in on Vehicular DTNs and discussing their salient features, difficulties, and ongoing research. This paper presents a comprehensive overview of the most recent advancements in vehicular DTNs, with a special focus on routing. This is the first study to our knowledge to compare and contrast a number of different Vehicular DTN (VDTN) routing protocols based on criteria such as implementation complexity, degree of infrastructure support, and other distinguishing features.

Keywords: Vehicular Delay Tolerant Networks (VDTNs), Novel-Congestion Aware Spray and Wait (CASaW), Normal-SprayAndWait, Epidemic

INTRODUCTION

DTN is a subfield of networking that focuses on solving problems that arise in networks that are intermittently linked or completely cut off from one another. DTN is designed to function reliably across very long distances, as those seen in interplanetary communications [1]. In such a setting, latency times on the order of hours or days are unavoidable. In other cases, as the one presented in the work on the DTLSR routing protocol [2], the delay might be as lengthy as a whole calendar year.

Requirements on DTNs

Space missions to Mars and testing the water quality of rural lakes are two examples of networking scenarios where current Internet protocols do not work well. There is a common thread between the two situations, and it lies in the increasing prevalence of devices that incorporate computer and networking technologies into less conventional networking contexts. New approaches and protocols are needed for computer networking in these contexts. These difficulties may be summed up as follows.

Intermittent Connectivity: The TCP/IP protocols used for end-to-end communication are useless if there is no direct connection between the sending computer and the receiving computer. The lack of an end-to-end path in these communications necessitates the development of new protocols.

Long or Variable Delay: Internet protocols and applications that rely on prompt return of acknowledgements or data can be disrupted by factors such as end-to-end path delays, which are exacerbated by factors such as intermittent connectivity, long propagation delays among nodes, and variable queuing delays at each node.

Asymmetric Data Rates: If you have cable TV or asymmetric DSL, you can have a moderate asymmetries in your bi-directional data rate on the Internet. However, if the asymmetries are too great, the established conversational protocols will break down.

High Error Rates: When a packet is lost or corrupted due to a bit error on the transmission link, the entire packet must be resent, which can increase overall network traffic. When comparing hop-by-hop and end-to-end retransmission, it is clear that the former requires fewer retransmissions for a given link-error rate.

LITERATURE REVIEW

Nabil Benamar et al (2020) presented that A detailed analysis of the routing protocols suggested for use in VDTNs. DTNs are used in a wide range of operating settings, including high-delay, high-disruption, and high-interruptibility networks such Vehicular Ad-Hoc Networks (VANET). We zero down on a subset of VANETs in which there is very little vehicular activity and no guarantee of a straight passage from one communication party to another. Therefore, the term Vehicular Delay Tolerant Network best describes the kind of communication used here (VDTN). Due to the RSU's (Road

Side Unit) restricted transmission range, distant cars in VDTN may not be able to connect directly to the RSU, necessitating the use of intermediary vehicles to relay the packets. In heavily partitioned VANETs, full end-to-end pathways may not exist throughout the message relay phase. The intermediate conveyances are therefore obligated to act as a message buffer and to transmit data wherever possible. Even if the source and the destination never establish an end-to-end connection, the message may still be sent to its intended recipient via the use of buffer, carry, and forward. The primary goal of DTN routing protocols is to optimise delivery probability while decreasing total transit time. Since the efficacy of DTN routing protocols is intrinsically linked to population and mobility models of the network, vehicular traffic models are also crucial for DTN routing in vehicle networks.

In the event of a fully networked environment, several traditional routing protocols were developed for VANETs with the goal of establishing end-to-end communication among network nodes [F.Li, 2008]. However, when traffic levels are low, these protocols cannot be employed. It is no longer possible to create a connection from one end to the other via a middle node [J. Kurhinen, 2008]. Therefore, these types of routing protocols are not able to provide data in low-density environments such as low-traffic areas, networks with partitions, or opportunistic vehicular networks. Rather than relying on a straightforward carry-and-forward mechanism, vehicular networks may distribute data using the store-carry-and-forward (SCF) paradigm of DTNs [V. Cerf, 2007]. Since an end-to-end network link is not necessary immediately accessible, but rather that such a way exists over time, asynchronous, large and variable-length messages (called bundles) may be opportunistically directed towards the destinations across intermittent connections. Vehicular Delay Tolerant Networks (VDTNs) are DTNs designed for use in a vehicular setting [Soares et al., 2008]. Due to the unique challenges presented by vehicular DTNs, a great deal of attention and research effort has been devoted to the study of routing.

RESEARCH METHODOLOGY

When developing protocols for VDTNs, it is important to take into account their unique characteristics, which combine those of DTNs and VANETs. More so, it has been recognised that advancements must be made to DTN ideas before they can be used to VDTNs, which motivates more study in this area. Particular features of vehicular networks are discussed in a 2007 study of routing protocols for VANETs [12].

According to Figure 1, there are three distinct kinds of nodes that make up the VDTN architectural model: terminal nodes, mobile nodes, and relay nodes.

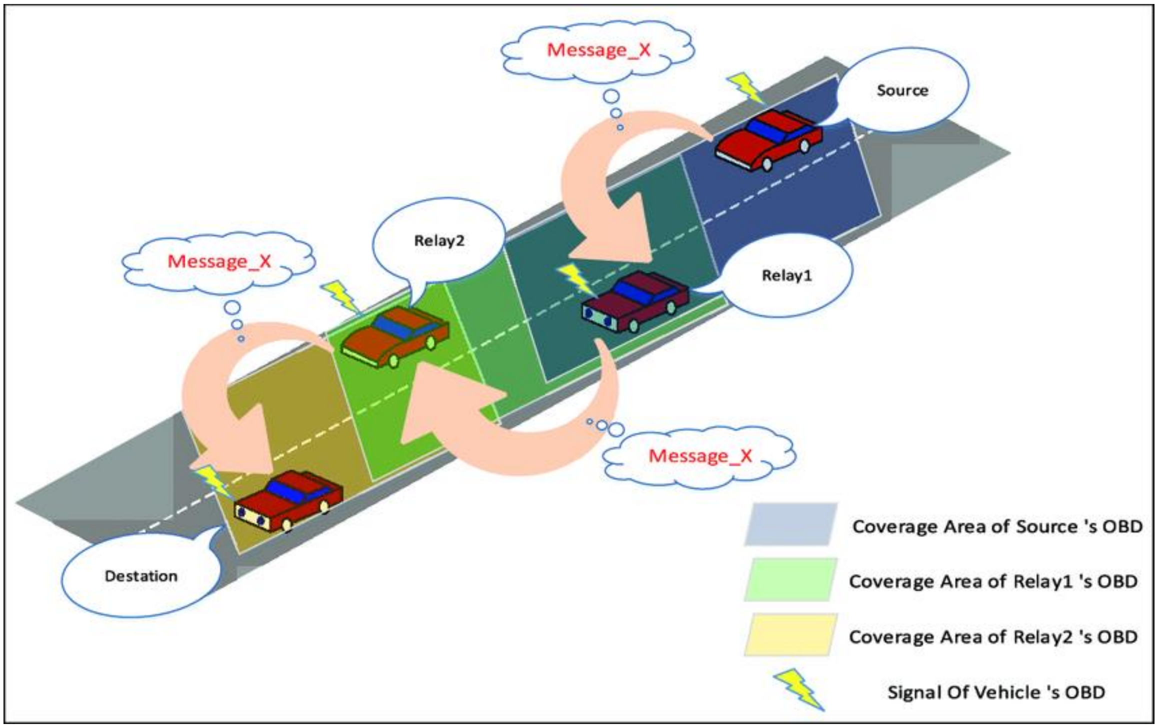


Figure 1: Example of VDTN

Despite their remote locations, terminal nodes link users to the network. They are often located in the VDTN's periphery and are in charge of handling all the data processing and network with other networks (such as, the Internet). In a virtual private network (VDTN), terminal nodes serve as entry points that allow users to access and use various applications.

The network's communication infrastructure is provided by mobile nodes (e.g., automobiles), which also serve as data collectors and distributors. Transportation modes that move along highways and transmit data between terminal nodes may either go at random (like automobiles) or adhere to predetermined itineraries (like buses and trams) (figure 1).

In a communications network, a relay node is a stationary device used at a crossroads to temporarily store and transmit information. They are strategically positioned at crossroads to increase the number of network links and the quantity of bundles that may be accessed by every passing vehicle. They increase the overall message delivery probability by letting passing mobile nodes gather and leave data on them. As and when mobile nodes meet, they are able to share information. At the intersections of the smart city streets, relay nodes may function as audio signal traffic lights.

Figure 3 depicts the basic operation of a VDTN network. In the scenario, a mobile node and a relay node both discover each other at time t+t0 and begin exchanging signalling messages through the control plane link connection. When deciding which packages to forward, each nodes consult their own routing information. Then, at time t + t1, the data plane connection is set up and made live on both nodes using this information. After then, until time t + t2, packages of data are traded with one another. After that moment, the data plane connection is disabled since the nodes are no longer within data plane link range of each other.

As a matter of fact, the goal is to reroute communications of far greater size than IP packets. There will be reduced complexity, cost, and energy savings as a consequence of fewer packet processings and routing choices.

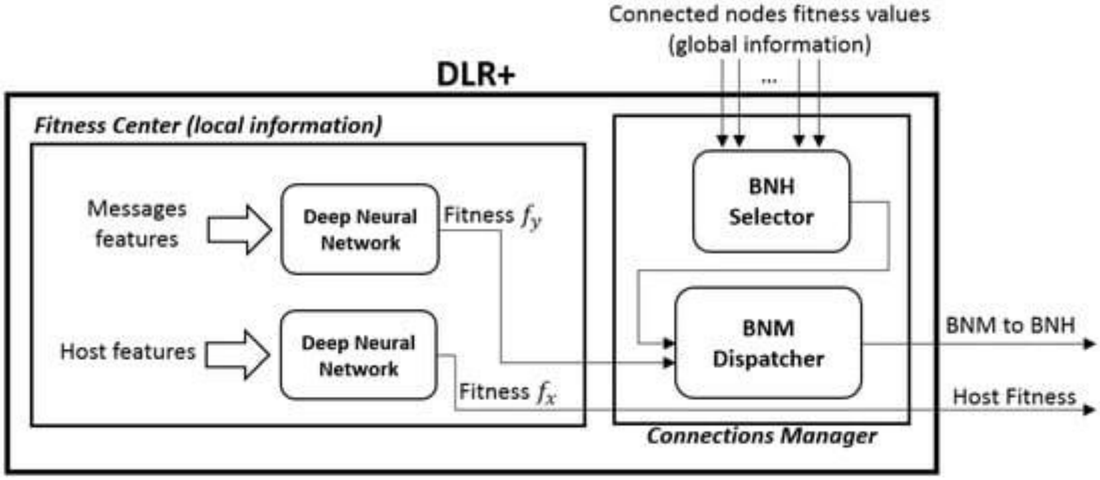


Figure 2: Illustration of VDTN

Incoming IP messages are bundled together at the BAD layer before being transported in the data plane and then de-bundled at the destination. When establishing a connection, a signalling protocol is implemented at the Bundle Signaling Control (BSC) layer. The nodes communicate through control data to learn about one another and set up the data plane for transmission. Routing algorithms are also a part of this layer. Optical Burst Switching [10] is essentially similar to this method in that it uses a separation of the control and data planes. It is generally accepted that there are three distinct kinds of nodes: terminal nodes, mobility nodes (e.g., automobiles) that transport messages between terminal nodes, and relay nodes, which are stationary nodes positioned at crossroads to enhance message delivery. Because they just need to support the first three tiers of the protocol stack, relay nodes are easier to build. To simulate mobile nodes, a prototype testbed was built [12] using Lego Mindstorm NXT robotic cars that were each outfitted with a Personal Digital Assistant (PDA) device (e.g., vehicles). Desktop and portable computers play the role of terminal and relay nodes. There is always an active Bluetooth connection processing out-of-band control data. Wi-Fi is engaged for data transfer when it is required. This helps save power, which is crucial for nodes in a network that have limited resources, such as stationary relay nodes, which must conserve power. The prototype facilitates research into and analysis of network node behaviour, including caching, carrying, and forward/routing techniques. New protocol services may be created and compared to simulated outcomes with the help of the testbed. The VDTN project has shown that a dedicated control plane may reduce wasteful energy use by making better use of the data plane's capacities. Scheduling and dropping policies, traffic differentiation, node localization, stationary relay nodes, geographic routing, and caching mechanisms have all been investigated as potential means of improving communication through this project.

IMPLEMENTATION

We have created a group with 200 nodes. We deployed this many nodes to boost communication between them and eliminate dead spots in the network. In particular, we built up the node groups for automobiles and trams. Both of these subsets have a shared background while also benefiting from unique environments.

For this simulation, we made use of a VDTNsim. The foundation of VDTNsim is the Opportunistic Network Environment simulator (ONE) version 1.3.0 [5, 6]. ONE was created as part of the TEKES ICT-SHOK Future Internet project and the Nokia Research Center (Finland) programmes SINDTN and CATDTN. It's an up-to-date agent-based discrete event simulator that's been utilised in plenty of DTN studies. In a nutshell, this simulator can do the following: i) generate node movement using a variety of internal and external movement models; ii) support a variety of node types; iii) support a variety of DTN routing schemes; iv) display, in real time, information related to message transfer and node movement in a graphical user interface; v) generate reports about node movement, message passing, and general statistics. Details on this simulator may be found in [8], and its Java source code can be downloaded for free at [9]. Because ONE supports the store-carry-and-forward paradigm also utilised in the VDTN architecture, the authors opted to modify and improve this DTN simulator rather than a VANET simulator. Vehicular artificial mobility models for vehicles are supported by ONE. Furthermore, it enables the development of simulation scenarios, such as the one seen in Figure 1, including groups of nodes with varying characteristics (such as mobile, stationary) and capabilities (such as storage capacity, radio interface). To mimic the operation of the VDTN architectural solutions for vehicular communications, it was necessary to build a number of extensions for ONE, which were then implemented. The created components that mimic the VDTN architecture function together in a single simulator, as seen in the UML deployment diagram shown in Figure 2.

RESULT

The different performance parameters considered for evaluation are: Delivery Probability, Overhead Ratio and Average Latency. Delivery Probability is the ratio of number of messages successfully delivered to the destination to the number of messages sent by the source. Overhead Ratio is the ratio of difference between the number of relayed messages and total number of message delivered to the total number of message delivered. Average Latency is average time taken by a message from source to destination.

Table 1: Simulation parameters

Parameters	**Car (vehicle)**
Number of cars (nodes)	**200**
Buffer Capacity	**10 MB**
Range	**100 meters**
Simulation tool	**VDTNsim**

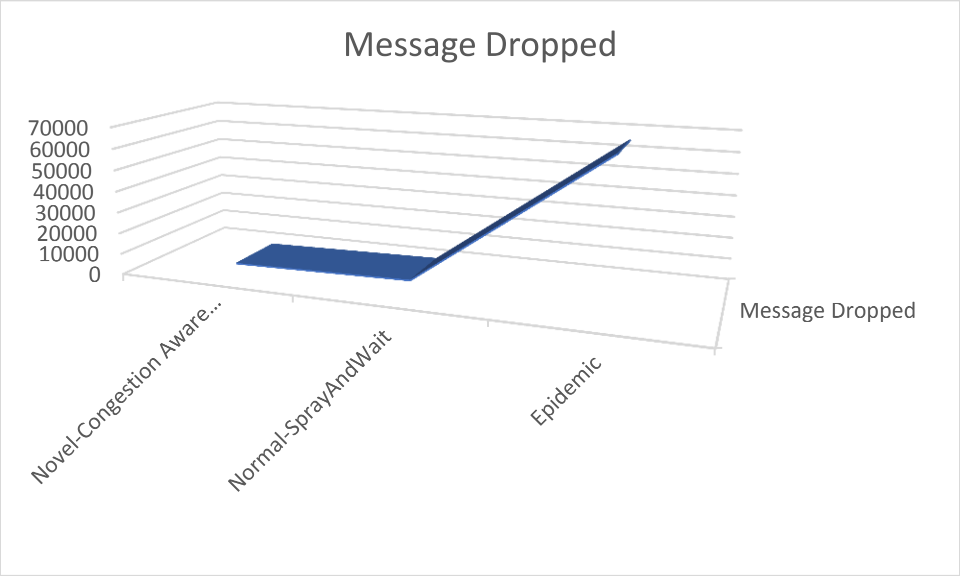
We conducted a number of experiments. The configuration file of the ONE simulator was reconfigured for a significant number of times to fit specific simulation scenario. The goal of the experiment is to observe the changes in the number of messages dropped and the rate of message delivery as the size of the node.

For this simulation scenario, we set the buffer of the nodes to be 5MB. After the running experiments for the VDTN routing protocols, we obtained the number of message dropped from the MessageStats file in the reports file of the ONE simulator.

TABLE 2: Messages Dropped at 5MB Buffer Size

Protocols	**Message Dropped**
Novel-Congestion Aware Spray and Wait (CASaW)	2065
Normal-SprayAndWait	3594
Epidemic	67392

Figure 3: Simulation Result



From the figure 3 above, it can be seen that at 10MB, our novel-CASaW protocol dropped the least amount of message. The MaxProp protocol on the other hand dropped the highest amount of message followed by the epidemic protocols respectively.

CONCLUSION

In this study, we considered congestion for the VDTN so as to minimize the rate of packet drops in the network in order to improve the awareness of drivers in the vehicular environment, optimize the probability of message delivery to the destination and improve road safety. To achieve this, we evaluated the generic VDTN routing protocols implemented in the ONE simulator so as to reliably make a choice of the most efficient routing protocol and use that protocol as our benchmark protocol. After evaluating the VDTN routing protocols, we selected the Spray and Wait protocol as our benchmark protocol because it performed better than other evaluated generic VDTN protocols. We then designed and implemented an updated congestion awareness algorithm for the spray and wait VDTN protocol so as to minimize the rate of the packet losses in the vehicular network.

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