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Impact of Relay Nodes on Performance of Vehicular Delay Tolerant Network

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Abstract- The main aim of this paper is to design and implement different protocols for the VDTN and also check the performance of the same. Here in this paper we will be developing and showing the result for Spray and wait protocol. Here we have to create a vehicular delay tolerant network for spray and wait protocol. We have to show that as the number of relay nodes increases the number of connectivity opportunities increases which in terms increases message delivery probability.

Index Terms- Message delivery probability,Contacts,Average delay

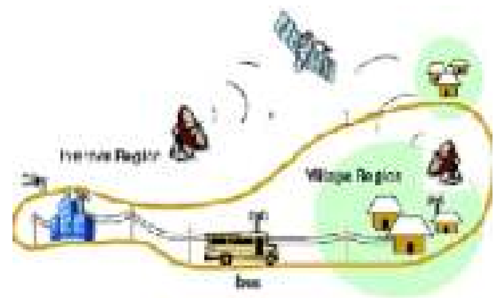

Fig 1: DTN model

I. INTRODUCTION

Wired and wireless networks have enabled a wide range of devices to be interconnected over vast distances. For example, today it is possible to connect from a cell phone to millions of powerful servers around the world. As successful as these networks have been, they still cannot reach everywhere, and for some applications their cost is prohibitive. The reason for these limitations is that current networking technology relies on a set of fundamental assumptions that are not true in all environments. The first and most important assumption is that an end-to-end connection exists from the source to the destina-tion, possibly via multiple intermediaries. This assumption can be easily violated due to mobility, power saving, or unreliable networks. For example, if a wireless device is out of range of the network, it cannot use any application that requires network communication.

A. Delay Tolerant Network

Delay tolerant network (DTN) is a type of wireless mobile network that does not guarantee the existence of a path be-tween a source and a destination at any time. When two nodes move within each others transmission range during a period of time, they contact or meet each other. When they are out of each others transmission range, the connection is lost. The message to be delivered needs to be stored in the local buffer. The message delivery in this kind of network is multi-hop and the connection between nodes is non-predictable [2]. One of the major properties of delay tolerant networks (DTN) is that there does not always exist a complete path from a source to a destination. What all existing communication solutions in DTN share in common is that mobile nodes must be exploited to carry messages around the network to overcome path dis-connection, which refers to store-carry-and-forward scheme. Most solutions for routing in DTN are reactive approach, where nodes rely on their inherent movements to disseminate data when nodes encounter each other. Due to unpredictable mobility, this random behavior leads to low delivery rates and large delays [3]. Examples of this sort of network include inter-planetary networks, wildlife tracking and habitat monitoring sensor networks, and etc [4]. DTNs deal with communication in extreme and performance-challenged environments, where continuous end-to-end connectivity cannot be assumed. In a DTN, nodes use opportunistic connectivity over intermittent links for communication. Such opportunistic links are gen-erally provided by mobile routers. They offer connectivity by acting as data mules to carry data to and from servers with continuous network connectivity (i.e., Internet access). There are many applications for DTNs. In developing regions, especially rural areas, they can be used to provide network access for education, health care or government services. They can also augment low bandwidth Internet connections to transfer large files at low cost, while using the Internet connection for control messages. DTNs are also applicable in vehicular ad-hoc networks and undersea communication [8].

Fig 1 shows a hypothetical village served by a digital courier, a wired dialup Internet connection, and a store-and-forward LEO satellite .These satellites have low to moderate bandwidth (around 10 Kbps) and are visible for 4-5 short periods of time passes per day (lasting around 10 minutes

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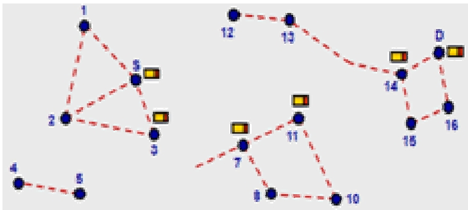

Fig.2: Spray and wait method

per pass, depending on the orbit inclination and location on Earth). We call the opportunity to communicate a contact, which is characterized by duration of time, a capacity, and a propagation delay. In addition, depending on the type of connection used, buffering constraints may also need to be considered. The digital courier service represents a high-bandwidth, high latency contact, the dialup represents a low-bandwidth, low-latency contact, and the LEO satellite represents a moderate-bandwidth, moderate-latency contact. The problem of selecting which contacts to carry messages and when represents an instance of the DTN routing problem. Route selection may depend on a variety of factors including message source and destination, size, time of request, available contacts, traffic in the system, or other factors [9].

II. ROUTING IN DELAY TOLERANT NETWORK

This method consists of two phases Spray phase: For every message originating at a source node, message copies are initially spread forwarded by the source and possibly other nodes receiving a copy to distinct relays. Wait phase: If the destination is not found in the spraying phase, each of the nodes carrying a message copy performs direct transmission (i.e. will forward the message only to its destination).

III. PROPOSED WORK

Delay Tolerant Networks (DTN) are a class of networks de-signed to address several challenging connectivity issues such as sparse connectivity, long or variable delay, intermittent con-nectivity, asymmetric data rate, high latency, high error rates and even no end-to-end connectivity. The DTN architecture adopts a store-and-forward paradigm and a common bundle layer located on the top of region-specific network protocols in order to provide interoperability of heterogeneous networks (regions). In this type of network, a source node originates a message (bundle) that is forwarded to an intermediate node (fixed or mobile) thought to be more close to the destination node. The intermediate node stores the message and carries it while a contact is not available. Then the process is repeated, so the message will be relayed hop by hop until reaching its destination.

A. PROPOSED WORK

The main aim of the project is to design and implement different protocol for the VDTN and also check the performance of the same. Here in the project we will be developing and comparing the results for two different protocol namely Epidemic and Spray and wait protocol. Here we have to create a vehicular delay tolerant network for two main protocols epidemic and spray and wait. We have to show that as the number of relay nodes increases the number of connectivity opportunities increases which in terms increases message de-livery probability. Then we compare both methods for message delivery probability and message average delay for different relay nodes.

B. Vehicular Delay Tolerant Network Model

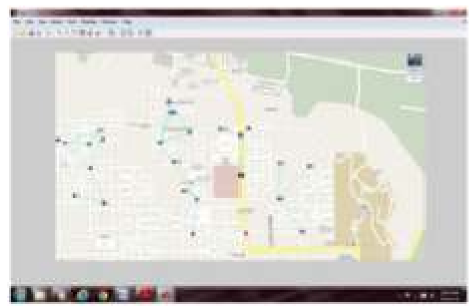

Fig.:3 VDTN model

In this project we exemplify the use of a Vehicular DTN (VDTN) to provide asynchronous communication between mobile nodes and relay nodes, on an part of a city (Fig 3). Mobile nodes (e.g., vehicles) physically carry the data, exchanging information with one another. They can move along the roads randomly (e.g. cars), or following predefined routes (e.g. buses). Relay nodes are stationary devices located at crossroads, with store-and-forward capabilities. They allow mobile nodes passing by to pickup and deposit data on them. We can also envision the possibility for the relay nodes to be able to exchange data with each other, and at least one of them may have a direct access to the Internet

C. Flowcharts

In these section flowcharts of algorithm is displayed.

(a) S and W protocol

(b) S and W protocol

Fig. 4. spray and wait protocol

IV. SIMULATION

Simulation of system is highly considered because it may be too difficult, hazardous, or expensive to observe a real, operational system. Simulations help us to, analyze systems before they are built, reduce number of design mistakes, optimize design, analyze operational systems, create virtual environments for training, entertainment etc.

A. Network Model

The network model considered in our scheme consists of number of mobile nodes and relay nodes communicating with each other. We simulate using MATLAB tool. The network model is shown in fig

Fig.5: VDTN model

B. Simulation Inputs

The following simulation input parameters are used in evaluating the performance of our proposed work.
Total mobile nodes(cars) N = 25,50 Total relay nodes (constant) R = 10 Car and car range = 60
Relay and car range = 150
Distance between two relay node = 100 Buffer size of car 150 MB
Buffer size of relay 500 MB message size 500 KB
Number of cars generates message per unit= 3 Total time 10 hours
Simulation time 200 units

C. Simulation Procedure

In our scheme, we use a MATLAB tool to simulate our proposed scheme. N number of mobile nodes is generated. R number of relay nodes is generated.
Set buffer size of relay as 500MB. Set buffer size of car as 150MB.
Distance between two relay nodes as 100 units. Calculate distance between relay and car.
Setup a communication path between car and relay, car and car.
If relay is in the range of car exchange information. If car is in range of another car exchange information. Calculate total number of contacts.
Calculate total received messages.
Calculate total number of transmitted messages.
Calculate message delivery probability using MDP = received messages / transmitted messages Calculate average delay.

A computer simulation is a computer program that models the behavior of a physical system over time.

V. RESULTS

Fig.6: Spray and Wait Protocol.

Above fig 6 shows the snapshot for the coding results for Spray and wait protocol. As shown in the figure above we can see the time instant and the number of message transmitted to the nearby vehicle using the relay node in the design.

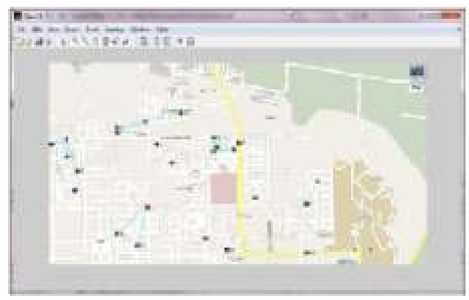

Fig.7: Map for spray and wait protocol.

Above fig 7 shows the snapshot for the map in spray and wait protocol. As shown in the figure above we can see the message is transmitted to different cars through relay. Pink color box represents a relay node and black color circle represents car. Blue line between two node represents the communication link.

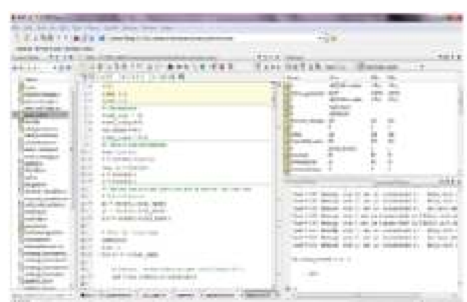

Fig 8: spray and wait protocol.

Above fig 8 shows the snapshot for the coding results for Spray and wait protocol. As shown in the figure above we can see delivery probability for network which is 0.2379.

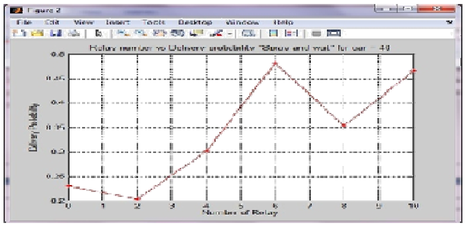

Fig 9: Snapshot for Delivery probability against number of node.

Above fig 9 shows the Snapshot for Delivery probability against number of node. We can conclude form the graph that the probability of delivery increases the total number of relay nodes in the network increases.

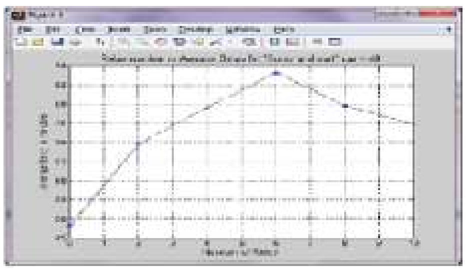

Fig 10: Snapshot for average delay in delivery of message against number of node.

Above fig10 shows the Snapshot for delivery of message against total number of nodes. We can conclude form the graph that the probability of delay in minutes is directly proportional to the total number of relay nodes in the network.

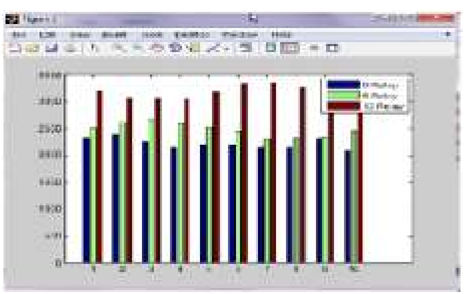

Fig 11: Contact graph for spray and wait..

Above fig 11 shows the Snapshot for delivery of message against total number of nodes . We can conclude form the graph that the probability of delay in minutes is directly proportional to the total number of relay nodes in the network.

VI. CONCLUSION

In this project we studied impact of relay nodes on a VDTN applied to an urban scenario. It was assumed a cooperative opportunistic environment without knowledge of contact op-portunities. The motivation for this work comes from the idea that placing relay nodes at crossroads allows data deposit and pickup by passing mobile nodes, which will increase the delivered messages (probability) to the final destination. Several simulations were conducted varying the number of mobile nodes, and deploying a different number of relay nodes in predefined map locations. It was observed that relay nodes significantly improve the message delivery probability on the routing protocol.

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