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A Study of a DTN-Based Data Transportation System Using Bluetooth Technology

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Abstract— DTN is a network with the routing approach of the store and forward. It is characterized by (i) intermittent connectivity that is a constant path along the length is not available (ii) long delay in delivery of packets starting from source to destination and (iii) the nodes are sparse and mobile. Traditional method can't perform in such an environment, steering in DTN is done using the store-carry-forward method, where the source or the middle node stores the packet until it meets up the node for forwarding. The main confront of this networks are power usage limitation, mobility patterns, choices of middle nodes, efficient handling of the limited network resources like buffer space etc.This paper provides the study of various DTN routing algorithms and DTN routing techniques, their categories, and various routing algorithms. Use of routing techniques is one reason for the performance degradation of present DTN algorithms. So, to overcome with this problem, neighbour discovery needs to be done as determining valid neighbours is the main region of many network functions, for that we will be using Bluetooth techniques to transfer the data for the vehicle to vehicle interactions by keeping in mind that in future every car will be Bluetooth enabled.

Keywords— Delay Tolerant Networks, Data Transportation, Bluetooth Network, DTN Routing Algorithm**.**

INTRODUCTION

There might not be a side way in delay tolerant networks (DTNs) [1, 2, 3, 7, 8, 12]. DTN's basic rule is that it can send data in a "store-carry-forward" way, which means that middle mobile nodes store data to be sent until they find the right relay node to send the data on its way to its target. Figure 1 shows how the DTN network is put together. This network is more important because it can provide flexible and dynamic multi-hop connection by using mobile radio devices to make links when they can [12]. There are DTN nodes that use application-layer bundle protocols to send and receive information with their peers [9]. These protocols are meant to carry the store-carry-forward communication idea of DTN. DTNs can be used for many ad hoc networking and information sharing tasks [9], such as crisis management, tracking wildlife on the battlefield, transportation planning, Pocket Switched Networks, and more. It is possible to improve network reach and delay when DTN is used..

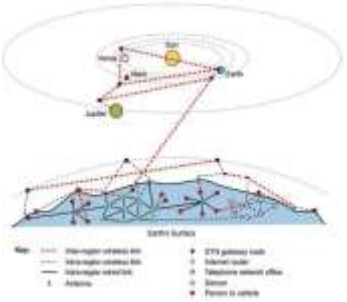

Figure: 1 DTN Example [16]

Due to the discontinuous connectivity and dynamically varying topology of DTNs, there is need to develop a well-organized routing protocol which able to fulfil the requirements like a long delay, high delivery rate (ratio) [10], low delivery overhead, latency median and cost, Buffer Time average, buffer time median etc. The usage of energy - constrained devices in DTN application is a major concern; therefore power is one of the significant aspects to consider for estimating the routing performance. A failure to protect neighbour discovery could lead to information disclosure, incorrect localization, routing problems, and adversary control of the network at any time.This paper gives a smart data transportation simulation system by using vehicle Bluetooth technology, where the data forwarding can be done through vehicle Bluetooth. During traveling, if the system can find out another strong Bluetooth network then data will send to that Bluetooth network. With the help of this information, we can improve data network design using Bluetooth technology.

To avoid this we are using Neighbour Discovery (ND) techniques for executing DTN routing protocol. With the help of these techniques we get the total nodes count in the networks and identify other nodes in its surrounding area with higher strength. The drawbacks of present routing protocols are avoided in terms of performance requirements mentioned above.

A. Application Of DTN

The main purpose of DTN is to provide network solutions to meet the reliability of free transmission of asynchronous messages at limited end-to-end connection and resources. DTNs are networks whose main objective is to enable communication in severed environments, where the absence of end-to-end paths between sender and receiver impairs the communication.

DTN can be used in various application such as Mobile

Ad hoc Network, IPN wireless sensor networks, and other challenged network environments.

DTN routing can be applied in public transport systems to achieve better efficiency.

DTN routing protocol intended for smart cities to make use of the mobility of people, vehicles, and buses travelling around the city

B. Routing Technique

a. Bluetooth[17][18]

Vehicles are getting increasingly equipped with connected Intelligent Transportation Systems (ITS)[17][18]. The existing systems allow vehicles to connect to the Internet using mobile data networks. This communication scheme enables infotainment, local weather/traffic information, and other location-based services requiring Internet access. Bluetooth Low Energy (BLE) [1] [17] a replacement technology to exchange data in between two vehicles at low latency while driving.

b. ZigBee Technology [1][18][21]

This technology has the capability to transmit when the relative speed of the two vehicles is high. It is better to use ZigBee for higher relative speed with small message size.

The data rate of Bluetooth is greater than ZigBee in addition to Enhanced Data Rate [18]. Normally, Bluetooth enabled device can achieve up to 1 Mb/s data rate, which is higher than ZigBee's 250 kb/s. Bluetooth provides low power wireless solutions as compared to other wireless technologies like ZigBee. Bluetooth can utilize for applications comprise of a low duty cycle, require less power consumption and cheap. Both Bluetooth and ZigBee are economical, but the component cost of a BLE compliant chip is less compared to ZigBee compliant chip. So it is better to use BLE as compared to ZigBee. Due to the low cost, we can assume that all the vehicles in the future are enabled with Bluetooth Technology, which will be helpful for data transportation.

LITERATURE SURVEY

A. Related Work

Naeem Mirza et al.[1] established a well-organized term of data exchange among sensor nodes and ECU with BLE in Vehicular Ad Hoc Network using Intra Vehicle Wireless Sensor Network. Intra vehicle communication was done under fixed and dynamic scenarios while V2V communication was done under stationary scenarios with varying distance between vehicles. The system can give packet delivery of nearly 1-2% for static and driving scenarios. The proposed framework that replaces CAN bus and ZigBee with Bluetooth low energy for delay tolerant sensors in stationary and moving vehicle scenarios.

Michael Doering et al. [2] give the DTN routing algorithm for inner-city public transport systems to increase practicality in accordance with the performance evaluation map depending on real cartographic data. All the data related to transportation is provided like line definitions, stops, and schedule of public transportation systems.

Aruna BAL Subramanian Et Al. [3] provides a DTN routing protocol which has the capability to reduce a specific steering metric like worst-case delivery delay or the part of packets that are sent within a time limit. These techniques can maximize the performance of a specific routing metric.

R. Asorey Cacheda et al. [4] presents a crowd-sensing approach that leverages the mobility of public transportation to monitor air quality in different inner-city areas over the course of a day.

Haiping Huang et al. [8] propose an intelligent transportation structure with vehicular delay-tolerant network model, and the smooth travelling model. The Vehicular Delay-tolerant Network routing algorithm derived from Contention is used in the system. Adaptive Traffic-light Control algorithm based on Green-Computing (a.b. ATCG) is proposed.

Shingavi Mayur et al. [21] provide automation of the Public Transport System using ZigBee and RFID. This paper gives a vehicle positioning system derived from an arm. A combination of ZigBee and RFID can upload the vehicle Information like vehicle number, reaching time at different stations, the arrival of the vehicle to centre in time, to control the traffic of public transportation, conveniently.

B. DTN Routing Protocol

a. Sink and Delay Aware Bus (S&DA Bus) Routing Protocol [13]

The aim of S&DA-Bus routing protocol is to select the best node, being a person, a vehicle or a bus, to be used as a relay to deliver data to the DC. S&DA Bus protocol is implemented to use the mobility of people, vehicles travelling around the city. S&DA-Bus get the benefit of the predictable and quasi-periodic mobility that characterizes it. This protocol Defining a centrality metric that takes into account the "social role" of the sink (Sink Aware); Considering the Inter-Contact-Time between buses and sink to estimate the time that will elapse before the next bus-sink contact (Delay Aware).This protocol helps in reducing the Average Delivery Delay at the cost of a small increase in Overhead.

b. Firstcontact Routing [2][14]

FirstContact routing follows a hot-potato approach in which the data is sent to the next available node till the destination is reached. A random node is selected if more than one node is in radio range. Mostly, the nodes send their bundles only once per contact 55 with another node which will help for decreasing network load and permanent loops. This method needs minimal message

buffer on the nodes but causes comparatively high delays.

c. Epidemic Routing [10][15][16]

It is a simple but effective routing method based on flooding. This technique has high delivery rate and optimal latency. When the communication in between two nodes in the network occurs at that time, the data exchange and summary vector evaluation is done and forward the messages which they don't. This strategy leads to a quick distribution of messages.

d. Prophet Routing Algorithm[3][10]

This protocol follows the strategy of data exchange in between two nodes with a higher possibility to reach at the target node compared to other mobile nodes. The Prophet approach depends on the release predictability metric evaluated at every node A for every well-known destination B.

e. Direct Contact[21][23]

In this protocol, the first node builds the bundle and then waits for the target node. It does not carry the information about the network. The delay obtained in getting data package is extremely high and the cost required for steering the data package is very small.

f. Per-Hop Routing[22][23]

In Per-Hop Routing, every middle node will make a decision about the next node to which the packet is to be sent.

g. Spray and Wait[23][24][25]

It is an advanced version of the epidemic routing. Mainly two phases are present in this protocol i.e. spray where Source node forwards L no of message replica to the nodes to which it comes across and set out to the waiting phase where nodes are waiting for delivery authentication. L number of copies of messages are sent to the to the relay nodes. If the target point is not getting in the spray phase at that time the relay nodes will store the message and direct transmission to the destination is done.

Table: 1 Comparison of Different Flooding Based Routing Algorithms

Protocol	Number of messages generated	Resource Utilization	Standard delay	Routing Vector/Table	Delivery Ratio	Latency	Efficiency
Direct contact	Single	Less	High	No	Medium	Long	Bad
Epidemic	N-1	High	Low	Yes	High	Long	Normal
Two-hop	K	Less	Medium	No	Low	Long	Bad
Tree based	1+log(N/2)	Medium	High	No	Medium	Long	Bad
Spray and Wait	>K	Medium	Medium	No	Medium	Long	Bad

Here, N= Number of nodes in the network
K= optimal number of nodes to assure the delivery for Two-Hop its minimum is $\Theta\sqrt{}$

Table: 2 Comparison of Forwarding Based Routing Algorithms

Protocol	Information maintenance	Resource Utilization	Standard delay	Routing Vector/Table	Delivery Ratio	Latency	Efficiency
Source Routing	Normal	Low	High	No	Low	Long	Bad
Per-hop	Medium	Low	Medium	No	Medium	Long	Bad
Per-contact	Medium	Medium	Low	Yes	High	Normal	Normal
Location Based Routing	Low	Low	Medium	No	Medium	Normal	Bad
Hierarchical Routing	High	High	Low	Yes	High	Normal	Good

I. PROPOSED SYSTEM

a. System Architecture

Here, we have introduced the DTN Based Smart Data Transportation System Using Neighbour Discovery (ND) protocol as given in figure 2 of the DTN network to get better resources management in terms of bandwidth, messages delivery. The Neighbour Discovery (ND) techniques give security to present mobile nodes against wormholes to finding out if they are neighbours. Here we are using this protocol to first secure neighbour discovery in DTN networks. The use of DTN can increase the latency and network coverage for message transfer.

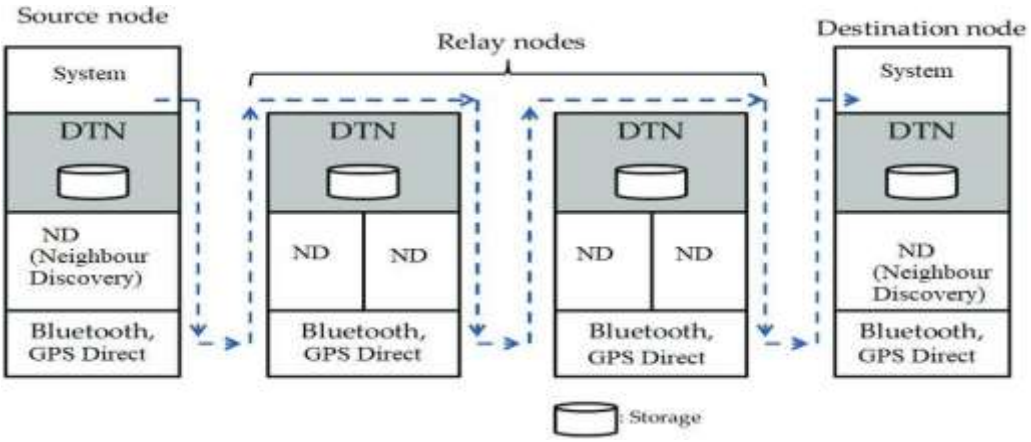

Figure 1: System Architecture

Firstly, the System can send the message to any node in the vehicular BT network. The message contains the road condition like speed breakers, potholes etc. system will search the neighbour BT node. If It Receives Any Strong BT Node then it Sends Data to That BT Node. Otherwise, they keep the message in their queue message.

When any node accepts the message then firstly it will get the all necessary knowledge from the sender neighbours node to rank and possibly evict the Messages In The Queue (QM), Select The Messages To Be Forwarded (FW) and possibly duplicate them (R). When any node receives the message then firstly it will get the all necessary knowledge from the sender neighbours node to rank and possibly evict the messages in the Queue (QM), Select The Messages To Be Forwarded (FW) and possibly duplicate them (R). After the end of the simulation, it will generate the report and graphical analysis. The analysis is done on the basis of these terms like delivered messages, failed transmissions, dropped messages between nodes, buffer time, delivery probability and latency average etc.

CONCLUSION

We looked at a variety of route methods and algorithms for a delay-tolerant network here. Neighbour Discovery (ND) methods are the new way we're going to do things after studying all of these technologies and algorithms in great detail. To find good neighbors is a big part of many network tasks. In a network, not protecting neighbors from finding could lead to information being leaked, wrong location, route issues, or even enemy control of the network at any time.Our main goal is to make the data transfer modeling system more accurate by using large-scale models and Bluetooth technology in vehicles. The system can figure out the percentage of deliveries, the percentage of responses, the overhead ratio, the average and median delay times, the average and median hopcount times, and the average and median buffertime times.

FUTURE SCOPE

Here we are using Neighbour Discovery Protocol (NDP) for forwarding the current messages. This technique helps to gets and exchanges the necessary knowledge to support queue management (QM).

But in these techniques does not provide any validation for interpretation of flooding attacks. Again safety of NDP is significant because of the large exploitation of the open network. In the future, we will consider a machine learning mechanism as an option for authentication to avoid NDP flooding attacks.

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