An Efficient Predictive Algorithm for Custodians Management in VDTN

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Abstract

Vehicular networks (VN) working over Delay Tolerant Network (DTN) define Vehicular Delay Tolerant Network (VDTN). We propose a predictive algorithm to dynamically assign the appropriate quantity of custodians depending on the user´s demands and characteristics of the environment such as type of network, type of communication and road conditions to guarantee hop by hop reliability avoiding congestion

Ⅰ. Introduction

VDTN has arisen as a profitable and auspicious network that improves the ubiquitous communication services across the moving vehicles. Furthermore, VDTN adopts the bundle layer to go beyond storage-forward paradigm, providing intercommunication on heterogeneous management, context management and reliability through custody transfer. Communication between custodian nodes [1] and the semantics of the transfer operation [2] address hop by hop reliability under fixed network configuration i.e. fixed quantity of custodians which causes problems of congestion when the network utilization rate is high. To avoid congestion and improve the mobile network reliability the dynamics of the user's demands i.e. rate requests in rush hours and characteristics of the environment such as type of network i.e. rural or urban, type of communication i.e. vehicular to vehicular (V2V), vehicular to infrastructure (V2I), and road conditions i.e. paths have to be evaluated to allocate custodians nodes intelligently.

In this paper, we present an algorithm to select custodians using data-mining with time-series to dynamically allocate custodians nodes based on VN's knowledge discovered previously. Section II provides related work in the field. Section III describes the custodian's resource-efficient solution. Finally we conclude our work in section IV.

Ⅱ.Related Work

Custodian's technique to solve the congestion problem (Storage resources overload) [3], applies Storage Routing (SR). SR is a set of algorithms invoked by DTN custodians when congestion becomes evident. The algorithms include message, node and retrieval selection, without consider environmental patterns. The adaptive vehicle infotainment system [4] follows a client-server model where a set of centralized content servers store all files and several client machines are linked via a local area network. This approach solves several resource assignment problems efficiently in terms of the performance metrics; including blocking probability, dropping probability and average latency delay but using selection policy when the problem of congestion is already there instead of predict congestion to efficiently select the right quantity of custodians nodes before congestion appears.

Ⅱ. Proposed Scheme

VN manage different types of environments hence our main scenario is a supply chain well adjusted, allowing us to analyze how the environment affects the type of communication (V2V/V2I) and the optimal number of custodian nodes that must exist, as shown in Fig.1.

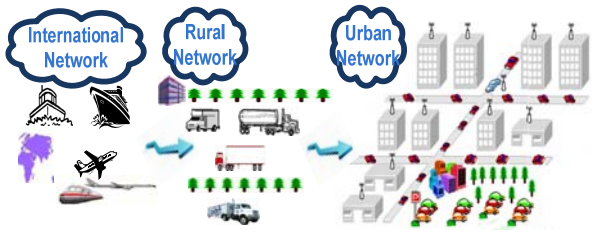

Fig.1 Supply chain scenario

During high traffic jam the requests rate is high causing storage problems, due to insufficient custodian nodes. But in a rural network, with a lower request rate, this network configuration is enough. Therefore, we propose a dynamically network configuration by selecting efficiently

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the quantity of custodian nodes to manage the request rate avoiding congestion and improve reliability.

A. Algorithm

Data-oriented and data driven [5] paradigms aid to include variables of the environment to recognize behavior patterns of the dynamic environment and predict and intelligent VN network configuration where custodian nodes are strategically allocated. Hence, we use a UML profile for the conceptual modeling of data-mining with time-series in data warehouses [6] using multidimensional modeling i.e. environment conditions, to associate data with a particular period of time i.e. rush hours in our scenario. Moreover, the data-mining model focused on metadata interchange using XML and UML seamlessly work with the XML-based protocols of DTN. The solution is predictive, therefore it adds a Custodian's manager as a new entity, who sends messages for the dynamic adjustment of the number of custodians in a fixed time t, as showed in Fig 2.

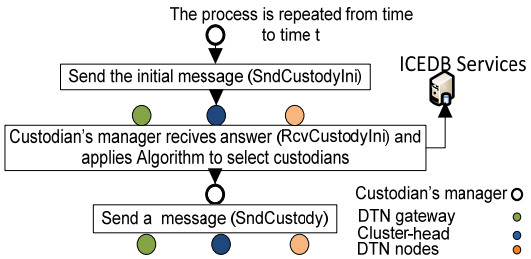

Fig.2 Flow messages. (ICEDB Services [7])

According with our supply chain scenario the algorithm uses several dimensions, as presented in the Fig 3.

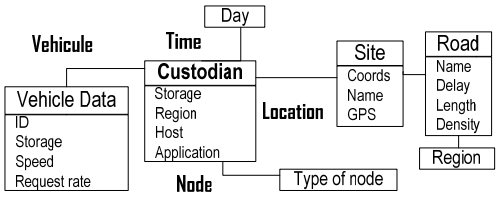

Fig.3 Multidimensional Model Supply chain scenario

B. Analysis & Evaluation

To evaluate the efficiency of our algorithm, an urban scenario is selected and three dimensions are defined: time, vehicle and node.

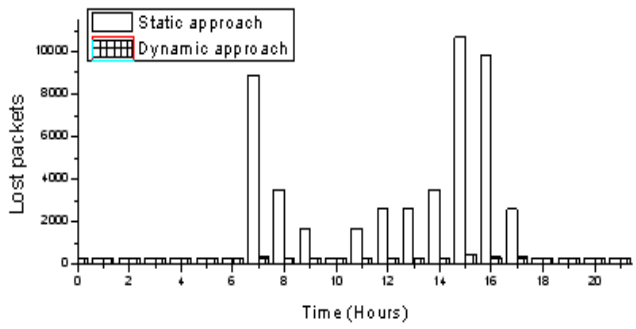

Fig.4 Comparison of packet loss

We adopt the distribution of flows rates from the San Francisco streets [8] and the probability of vehicular flow per hour, with daily flow of 400 cars, data transfer rate of 0.25 packets/s, and packet size of 512 bytes as specified in [9]. A 1Mb of storage capacity per vehicle is assumed, and 2Mb for a Base Station (BS). We compare our dynamic solution to a static solution which has a fixed number of 5 vehicles custodian nodes and 2 BS custodian nodes. Fig 4 shows that the packet lost in rush hours in our solution is less than the static approach avoiding efficiently network congestion.

III. Conclusion

This proposal is based on data-mining model with time series to predict the behavior of VN and efficiently assign the right quantity of custodian nodes, providing storage management and control. The storage management and control improves significantly avoiding congestion and providing reliability.

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