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Review on V-PADA: Vehicle-Platoon-Aware Data Replication System Data Access in Vehicular Ad hoc Network VANET

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Abstract— the high mobility of vehicles and the unreliable wireless communication significantly degrade the performance of data access in vehicular ad hoc networks (VANETs). To address this problem, we propose a novel vehicle-platoon-aware data access solution called V-PADA. In this we use different concept are added to this techniques using buffers to replicate data for others in the same platoon and share data with them. When a vehicle is leaves of the platoon, it prefaces interested data and transfers its buffered data to other vehicles in advance so that they can still access the data later it pass away. To attaining this desired result, V-PADA consists of two approaches: Starting we design a vehicle-platooning protocol to recognized formation in platoon and forecast splits in platoon. First using stochastic sequence series perusal to detect platoon and mobility anomalies and further introduce a two-step split prediction method to reduce the false alarm rate because of different shapes & Sizes. Then we are going to the next approaches means handling different Process on data using Data management is designed to guide platoon members to replicate and pre-fetch the most suitable data so that both high data availability and low data access overhead can be attained. Immersive simulation outcomes demonstrate that V-PADA can effectively improve the data access performance in VANETs.

Keywords: Data replication, platoon, vehicular ad hoc network (VANET).

I. INTRODUCTION

The proliferation of low-cost WSN networks, added & increases with the rate of distributed peer-to-peer cooperative systems, is transforming next-generation vehicular networks. Drivers and passengers inside moving vehicles will be able to obtain and share their interested data, such as MP3 music, news, and video clips [1]. However, due to the high mobility of vehicle, depends on the vehicular topology, dynamically changes ad hoc networks (VANET) and disconnections may recurring occur. In that situations they are disconnected (i.e. vehicles), it is not possible to access the data from both sides. Thus, data availability in VANETs is lower than that in randomly used networks i.e. wired. The effect of intermittent connectivity reduces, so we use the Data replication and improve data access performance in distributed systems [2]. By replicating frequently accessed data at clients, they can continue to access data locally or from the nearby nodes that have the replica. Generally speaking, data replication can increase data availability and reduce the query delay if there is plenty of storage space in the vehicles. However, many nodes may only have limited storage space, bandwidth, and power. For example, in a VANET, not only the vehicles but the drivers and passengers can be part of the network as well. Drivers and passengers want to share data with each other, but they may only have resource-constrained mobile phones, which have limited storage, and thus cannot replicate all the data such as large music files or video clips such as the Mob Eyes system [3], resource constrained onboard sensor nodes only have limited storage, bandwidth, and power. To help vehicles and roadside infrastructure easily and quickly get the data, the data may have to be carefully placed. In addition, the contact time of vehicles may not always be long enough to transmit all data items. To replicate the data, nodes need to transmit it from other nodes, and obviously, there will be huge bandwidth and power cost for a large volume of data. By taking these issues into consideration, we expect that the nodes in a VANET, such as vehicles or in-vehicle mobile devices and sensors, should not be able (or willing) to replicate all data items in the network.

In this paper, we propose a novel vehicle-platoon-aware data access solution (called V-PADA) for VANETs, with two approaches. Starting, proposed Protocol i.e. a vehicle-platooning to quickly identify the platoon and forecast splits in platoon. Then next we use, stochastic sequence series analysis is used to detect vehicle platoon and mobility anomalies, and a two-step split prediction method is introduced to accelerate the detection and reduce false alarm because of different shapes & Sizes. after handling different Process on data using Data management is introduced to achieve high data availability and reduce the intra platoon data access cost. Specifically, we propose two cost-effective data replication algorithms to find the best vehicle to replicate each data item inside the platoon, and we provide data prefetch and transfer heuristics when there is a split detected. Extensive simulation results demonstrate that

|To effectively improve the data access performance using V-PADA in VANETs.

II. RELATED WORK

A. Vehicular Networks

Vehicular networks represent an interesting application scenario for not only traffic safety and efficiency but more commercial applications and entertainment support as well, such as service scheduling [6], [7], content sharing [1], [8], [9], peerto- peer marketing [10], and urban data collecting [11]. So far, however, most vehicular network researches have been focused on routing issues [12]–[15]. All these works assume that the data consumer is known beforehand so that the sender can always route the data to its destination. Understanding a quite different data access paradigm in VANETs where each vehicle queries useful data from nearby neighboring vehicles. Our focus is to make use of the *platoon* mobility pattern of vehicles and cooperatively replicate data within platoon to improve the data access performance.

B. Platoon Identification and Anomaly Detection

Although vehicle platoons have not been used as a design parameter to facilitate data access in VANETs, their effects on traffic control and design of traffic signal timing has been studied for a long time. For example, a car-following model [16] was developed to describe vehicle platoon movements. Gaur and Mirchandani [17] and Jiang *et al.* [18] further developed algorithms to identify vehicle platoons from road traffic and optimized the setting of traffic signals. All these existing researches on vehicle platoon identification rely on roadside sensors for centralized vehicle mobility observation and analysis. Our work, however, investigates how to detect the platoon and the platoon partition by vehicles in a distributed manner without any centralized system support.

C. Group-Based Data Access

V-PADA optimizes data access by exploiting the vehicle platoon behavior, where vehicles often travel in closely spaced groups. There has been some work on group-based data access in mobile networks. Wang and Li [19] studied the service coverage problem in case of group partition. They assume that all nodes' mobility parameters are known beforehand to identify the group partition. Later, Huang and Chen [20] and Su and Zhang [21] investigated how to cooperatively share data or allocate channel within each mobile group. They both assume that groups are organized with explicit *join/leave* messages and that the partition is detected only after two nodes move out of their communication range.

D. *DATA REPLICATION*

In traditional Distributed and database systems in this Data replications has been go through in Details However, , and data availability becomes an important issue.[22,23] These approaches are depends on the intuition that, to improve data availability, replicating the same data near neighboring nodes should be avoided. However, this intuition may not be valid when network partition is taken into consideration. Yin and Cao [24] and Fiore *et al.* [25] Studied how to use data cache to increase data availability and reduce the data access cost, but their focus is not on mobility. V-PADA differs from the existing works in that it uses vehicle platoon to optimize data access. More importantly, V-PADA quickly predicts split and pre fetches the necessary data.

III. PLATOON BASED DATA MANAGEMENT

In V-PADA, we exploit the platooning behavior to optimize the data access. First, we analyze the intra platoon data replication problem and propose a cost-effective but centralized data replication algorithm called best-location data replication to help vehicles cooperatively access their interested data inside the platoon. The main purpose of the best-location replication algorithm is to optimally place data replicas at their best locations inside the platoon so that the vehicles in the same platoon can hold more interested data to avoid the long delay and low availability of accessing data not in the platoon. Alternately we using the next step of the best-location algorithm to a more scalable distributed algorithm called neighboring data replication, where each vehicle cooperatively replicates data with their directly connected neighboring nodes. Finally, we provide heuristics for vehicles to prefetch and transfer data before vehicle splits so that vehicles can still access their interested data after split.

A. Protocol Overview

The first component of V-PADA is the vehicle-platooning protocol, which is used to quickly identify the platoon and predict the split process. Fig. 3 uses a finite-state machine to describe the operating process of the platooning protocol. At any given time, each vehicle stays at one of the following states: 1) *Initial*; 2) *Join*; 3) *Quasi-Split*; and 4) *Split*. When a vehicle enters the network, it is at the *Initial* state. Later, when it meets other vehicles in the same direction, it may join them as a platoon member. The join process can be detected with techniques that will be presented in Section IV-B. After one vehicle is detected to join the platoon, it enters the *Join* state and sends out a *platoon-join* message to all platoon members to announce that a new member has added to platoon. These information of *vehicle ID*, its *interest list*, data *list*, and *buffer size contained in the message*. As the platoon leader receives this message, it will use the information to determine the best data replication arrangement for the next replication cycle. When one vehicle detects mobility anomaly (more details in Section IV-C), it switches its state to *Quasi-Split*, where the anomaly will be further analyzed. If the anomaly comes from the change of road layout (e.g., the platoon is passing a curving road), to split the platoon and predict the vehicle is detected or not, and then enters the *Split* state. It posts out a *platoon-split* message to inform other platoon members that it is going to leave the platoon. At the same time, it starts to prefetch its interested data and transfer its buffered data to nearby platoon members. It is possible that messages may be lost for some reasons such as channel interference or collisions. However, this will not affect the performance of the platooning protocol too much because both join and split actions can always be detected by neighboring vehicles through its beacons. Furthermore, existing reliable and efficient broadcasting techniques [9] can be used to provide reliable message delivery.

B. Stochastic Sequence Series Analysis for Platoon Identification

In V-PADA, each vehicle maintains a Cartesian coordinate system, where the moving direction is the X- axis. Each vehicle (called monitoring vehicle) chooses the nearby vehicle as its reference vehicle (see more details in Section IV-C3). The coordinate of the reference vehicle is represented by its shortest distances to the X-axis and the Y -axis.

The monitoring vehicle and its reference vehicle periodically exchange their movement profile through beacon messages, by which the monitoring vehicle can get a series of relative coordinates of the reference vehicle in terms of Δx and Δy. Then, by analyzing the Δx and Δy series, the monitoring vehicle can estimate the relative motion deviation between two vehicles and determine whether they are in the same platoon or not. If the drift irregularity is persistently small, the monitoring vehicle can determine that it may have already joined the platoon. During monitoring, the time interval between any two successive observations of Δx (or Δy) is equal to the same beacon cycle; thus, the whole monitoring process can be regarded as a discrete and same-spaced process *{Xt}* (and *{Yt}* for the Δy series). Therefore, in V-PADA, we can use the stochastic time series analysis on the observed position series to provide precise and automatic platoon identification. Specifically, we use real-time estimates of the variability of Δx and Δy as the forecasting thresholds. If one vehicle is in the *Initial* state and its relative position series of *{Xt}* and *{Yt}* are within the range of the forecasting, the vehicle is considered to join the platoon. According to the time series analysis, by using the observation of Δx as an example, the whole identification process can be represented by a linear model

C. Split Prediction

After joining a platoon, the monitoring vehicle keeps monitoring its reference vehicle and its own mobility pattern, so that it can quickly detect the split and have more time to prefetch and transfer data. In the following, we study how to detect the mobility anomaly and predict the vehicle split.

Algorithm 1: Reference Vehicle Selection

FOR the neighboring vehicle *i*
∗ ∗ RULE I∗ ∗
IF in front of it
Prio(*i*) = 1;
ELSE
Prio(*i*) = 0;
END IF;
∗ ∗ RULE II∗ ∗
Prio(*i*)+ = 1− *d*(*i*)*/R*;
END FOR
∗ ∗ RULE III∗ ∗
Sort vehicles according to *Prio*(*i*);
WHILE (*K* >0)
Start from the vehicle *i* with the highest *Prio*(*i*)
DO
Add vehicle *i* as its reference vehicle;
K−−;
END DO
END WHILE

Algorithm 2: Best-Location Data Replication Algorithm

Input:
l: the number of vehicles in the platoon;
d: the number of available data items in the platoon;
f [][]: the 2-D matrix that records the access probability
Of each vehicle to each data item;
c [][][]: the 3-D matrix that records the access cost of each data item between any two vehicles in the platoon;
Variables:
A[]=0: the average access probability of each data item;
v[][] = 0: the total access cost of each data item for all vehicles in the platoon;

FOR each available data *Dj*
FOR each vehicle *Vi*
$A[j] = A[j] + fij;$
FOR each vehicle *Vk*
$v[k][j] = v[k][j] + fij \times cijk;$
END FOR
END FOR

Algorithm 3: Neighboring Data Replication Algorithm

{begin to replicate data}
all vehicles are marked as "white";
IF vehicle *i* is "white"
FOR all neighboring vehicles of *i*
IF it is "black"
do nothing and continue to the next vehicle;
ELSE
mark it as "black";
send back its data access probabilities and id;
END IF
END FOR

IV. PERFROMANCE EVALUATION

IN THIS PORTION, WE ASSESS THE BEHAVIOUR OF THE PROPOSED V-PADA AND DIFFERENTIATE IT WITH ADDITIONAL RESULT.

In our simulation, vehicles move within a fixed region of I79 (Interstate Highway) from Ohio River Blvd. to Clever Rd. in a suburb of Pittsburgh, PA. It is a two-way highway and has three lanes in each direction. As shown in Fig. 12, there are three exits through which vehicles may pass out the highway. To have a constant number of vehicles in the simulation, we assume that the exit vehicle will enter the highway at the nearest highway end (End A or End B) and immediately start to move toward the opposite direction. Each vehicle in the simulation can initiate queries for its interested data. If the query cannot be served by the vehicle but there is a copy of the requested data in the platoon, the request is sent to the nearest platoon member If none of the vehicles in the platoon has the data, the request will be held until the vehicle meets another vehicle that has the data.

1. Simulation Setup

We implement V-PADA in the ns-2 simulator4 with the CMU wireless extension. Since ns-2 is developed for generic ad hoc networks, it does not support VANET specific topologies and traffic control models. To provide a real VANET environment, we use the GrooveNet simulator5 and a map of the Pittsburgh area6 to generate a real highway topology. Then, we combine the highway topology with the platoon-based mobility model that is defined in Section III-B to create the vehicle mobility trace file, then it is used in the ns-2 simulation.

Experiments were run using different workloads and system settings. The analysis performance and presented here is designed to compare the effects of different workload parameters such as buffer size and Zipf parameter. For each workload parameter, the mean value of the measured data is obtained by collecting a large number of samples such that the confidence interval is reasonably small. In most cases, the 95% confidence interval for the measured data is less than 10% of the sample mean

2. Query Delay

In our simulation, the performance of the non cooperative solution becomes better than the connection-based solution when the buffer size is larger than 30 MB. This is because, as the buffer size increases, more frequently accessed data can be locally buffered in the non cooperative solution. The connection-based solution, however, makes use of cooperation but does not have the split prediction capability. When split happens, the splitting vehicle does not have time to prefetch its interested data and transfer its data to other platoon members. Therefore, the splitting vehicle may not be able to access its most interested data after splitting, and the platoon may also lose some important data, which degrades data access performance.

V-PADA (best-location) and V-PADA (neighboring) have the shortest query delay since they cooperatively buffer and organize data and they can quickly detect split and prefetch the necessary data. As a result, more query requests can be locally served even after disconnection, which further improves the data access performance compared with the distance-based solution. Here, we notice that V-PADA (best-location) achieves a bit better performance than V-PADA (neighboring). This is because the best-location data replication achieves platoon wide optimal data allocation, whereas the neighboring data replication algorithm only tries to eliminate data redundancy among neighboring vehicles.

3. Data Availability

V-PADA cooperatively organizes data replications, either Within the entire platoon (best-location) or among neighboring vehicles (neighboring); hence, V-PADA can hold more different data items than the non cooperative solution, which can be verified by results

4. Split Prediction

In this section, we study the performance of different split prediction approaches, which are measured by the false positive rate and the prefetch time. False positive may happen when a vehicle is still moving within the platoon but is falsely predicted to split. After a split is confirmed, the vehicle starts to prefetch data until it disconnects from the platoon. This time period is called the prefetch time. A long prefetch time indicates quick split prediction and, hence, more time for vehicles to prefetch and transfer data before splitting.

V. CONCLUSION AND FUTURE WORK

This paper has raised a challenging question: how to improve the performance of data access in an intermittently connected VANET. To answer this question, we have proposed V-PADA, which is a novel vehicle-platoon-aware data access solution for VANETs. V-PADA makes use of the "vehicle platoon" mobility pattern to collaboratively replicate data and optimize data access among vehicles. V-PADA consists of two Approaches, first to identify the platoon and quickly predict vehicle split using a vehicle-platooning protocol. Second, a data management component is introduced to achieve high data availability and reduce the intra platoon data access cost. Simulation results have shown that V-PADA outperforms other data access solutions in VANETs. To the best of our knowledge, this is the first work to exploit vehicle-platoon behavior for data access, considering various vehicle splits. The proposed solution in this paper is not limited to VANETs and can be extended to other mobile ad hoc networks. In the future, we will look into solutions for mobility anomaly detection in more complicated road structures and solutions for cooperative data access with the support of roadside infrastructures.

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