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Estimation based design for roadside information conveyance frameworks

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ABSTRACT

Due to the rapid growth of smart phones and tablet PCs, making thin computing devices nearly ubiquitous at work, at home, and on the road. Using the Wi-Fi, GPS, and cellular 3G interfaces built into these devices, mobile users are now accustomed to having location-aware information at their fingertips. Location-aware information services such as digital versions of restaurant menus, shopping-mall maps, transportation schedules, grocery store circulars, and movie trailers can be delivered via mobile applications. However, delivering rich content is challenging, particularly for highly mobile users in vehicles. Technologies such as cellular-3G provide limited bandwidth at significant costs. This paper provides a high-bandwidth of cellular-3G and scalable. Info-station system that incorporates device-to-device data scavenging, where nearby vehicles share data received from the info-station. It allows both broadcast and unicast throughput to scale with device density.

Indexterms: Wireless, Wide-Area Networks, Communication, Networking and Information Technology, Computer Systems Organization, Performance of Systems

INTRODUCTION

Mobile computing is human-computer interaction by which a COMPUTER is expected to be transported during normal usage. Mobile computing involves mobile communication, mobile hardware, and mobile software. Communication issues include ad hoc and

infrastructure networks as well as communication properties, protocols, data formats and concrete technologies. Hardware includes mobile devices or device components. Mobile software deals with the characteristics and requirements of mobile applications [1].

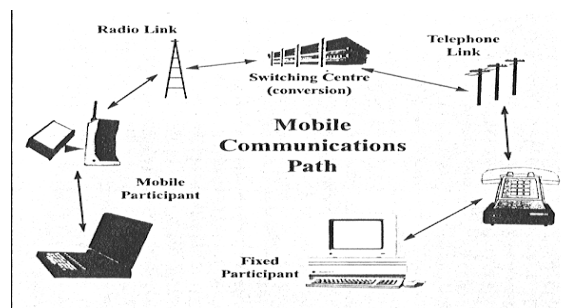


Figure 1: Mobile Communication Path

With today's ubiquity of thin computing devices, mobile users are accustomed to having rich location-aware information at their fingertips, such as restaurant menus, shopping mall maps, movie show times, and trailers. However, delivering rich content is challenging, particularly for highly mobile users in vehicles. Technologies such as cellular-3G provide limited bandwidth at significant costs [2].

In contrast, providers can cheaply and easily deploy a small number of Wi-Fi info-stations that quickly deliver large content to vehicles passing by for future offline browsing. While several papers have proposed systems for disseminating content via roadside info-stations, most use simplified models and simulations to guide their design for scalability [3-5].

Many suspect that scalability with increasing vehicle density is the major challenge for info-stations, but few if any have studied the performance of these systems via real measurements. Intuitively, per-vehicle throughput for unicast info-stations degrades with the number of vehicles near the info-station, while broadcast info-stations are unreliable, and lack rate adaptation.

This paper provides a high-bandwidth and scalable info-station system that incorporates device-to-device data scavenging, where nearby vehicles share data received from the info-station. It allows both broadcast and unicast throughput to scale with device density [6,7].

The design of info-station based data dissemination systems using insights from a large experimental measurement. It performs detailed measurements on a public highway using a fleet of four vehicles travelling at up to 96 km/h (60 mph), each equipped with a Wi-Fi-enabled laptop and communicating with a roadside info-station. Using data from nearly 200 h of on-road driving, it measures the impact of vehicular density on both unicast- and broadcast-based systems. The measurements show that both broadcast and unicast have their limitations. For broadcast, the high loss rates of the wireless channel severely degrade the dissemination throughput [8].

Application level encoding at the info-station improves reliability, but the coding overhead and lack of rate adaptation limit the total achievable

throughput. For unicast, per-vehicle throughput degrades due to time sharing as vehicle density increases.

Remarkably, the measurements also show that data reception across multiple vehicles exhibit both temporal diversity, where different vehicles have the opportunity to receive different data, and spatial diversity, which produces uncorrelated loss across vehicles receiving the same data. To get either broadcast- or unicast-based info-station to scale and disseminate content at high bandwidth, it proposes to augment info-station bandwidth with communication bandwidth between the devices [9-11].

The proposed data scavenging, where immediately after passing through an info-station, vehicles cooperate and share information with others nearby. Intuitively, data scavenging exploits natural diversity produced by vehicle mobility in order to achieve throughput improvements similar to network coding.

It exploits both receiver spatial diversity and temporal diversity to compensate for packet losses without retransmissions, and also increases the info-station's achievable dissemination throughput. Scavenging requires no hardware modification to vehicle devices (or info-stations), and is ideal for location-aware content delivery, where neighboring vehicles seek to obtain a common content package and can effectively help each other [12].

The proposed data scavenging technique into both broadcasts and unicast info-stations. The info-station based content distribution system, Starfish, has a high data dissemination rate that scales as the number of devices grows. It makes four key findings.

1. At higher vehicle densities, data dissemination across vehicles exhibit both spatial and temporal diversity.
2. Data scavenging between vehicles is feasible, and can provide a scalable dissemination service when combined with either efficient broadcast or unicast.
3. For broadcasting info-stations, scavenging improves dissemination reliability without sacrificing throughput; for info-stations using unicast, data scavenging allows dissemination to scale with number of vehicles.

4. Unicast with scavenging outperforms broadcast with scavenging in most scenarios, except when both vehicle density and speed are high.

location-aware content with starfish

The goal of our work is to design an efficient and scalable delivery system to distribute location-aware content for mobile users on the move. In this section, it describes Starfish, an info-station-based content delivery system for highly mobile users. It begins by defining the problem of delivering location aware content, and then describes designs for Starfish based on roadside info-stations using either wireless unicast or wireless broadcast.

LOCATION-AWARE CONTENT DELIVERY

In scalable ways, to deliver location-aware content to mobile users with specified range. To define location-aware content as local information of interest to travellers on the go the user device. Consider for example, a family driving on a highway, where there are several services (e.g., entertainment, food, gas) at the next 10-20 exits. Ideally, they would like to take an exit which has the best combination of services and prices. Now imagine, a road-side info-station is deployed a few miles ahead of the first exit.

As the vehicle passes by this info-station, they can download brochures describing local entertainment options and information such as gas stations and shopping malls. Once they download all this information, they could peruse it and decide on their best option. Similarly, in an urban scenario imagine travelling around the city where several info-stations are deployed, each providing latest information about services offered in an area.

As users drive by the info-station, their tablet, PC receives digital maps of all stores, along with hours, sales, and available parking spots. They could also download graphical menus of restaurants with colourful photos and nutritional data. Again, once they download this data they could decide which of these services they would be interested in.

These types of content are typically organized as a collection or hierarchical list of files, each

provide details on an item or location of interest. For example, restaurant menus are lists of descriptions of dishes, while traffic reports are collections of reports each describing a nearby intersection or crossroads.

While users normally would interactively browse the list and view specific files, this is not possible for highly mobile users, whose vehicle might be in range of an info-station for only 4-12 s (at highway speeds). Without time to interact with content, user devices must proactively fetch and cache the entire collection so users can browse them at their leisure offline.

STARFISH WITH UNICAST INFO-STATIONS

Info-stations using unicast can leverage MAC mechanisms like rate adaptation and packet retransmissions to achieve reliable data delivery. In our context, it needs an info-station design that maximizes the benefits of rate adaptation to reliably transmit the most number of files. Since the info-station can only send to one receiver at a time, it should transmit to the in-range device with which it can establish the best connection.

If only a single device is in range, dissemination performance will be determined by the info-station's ability to retransmit lost packets and adapt transmission rate to minimize packet transmission time. But when multiple vehicles are in info-station range, scheduling of the packets among multiple vehicles greatly affects the dissemination throughput. Scheduling involves both selecting the next packet to send and the vehicle to send that packet to.

As previously observed, naively unicasting packets using round-robin to all receivers brings down the throughput of the system to that of the farthest receiver. Clearly, better performance requires an improved scheduling algorithm. A good scheduling algorithm should consider varying link quality at receivers. If the goal is to maximize the average files delivered per-vehicle (without considering fairness), the info-station should transmit to the in-range device with the best connection.

To do so, each starfish info-station, it maintains an up-to-date scheduling list that contains an entry for every device in its radio range. To maintain this list, it uses a simple hello protocol where the info-station broadcasts hello packets every times. Each device that receives the hello packet unicasts a response to the info-station with the received signal strength embedded inside.

The info-station parses hello responses and ranks responding devices in the scheduling list by the embedded signal strength. Whenever it begins to transmit a new file, the info-station examines the devices with the best received signal strength, and makes a change in it's transmit destination if and only if the new device has a considerably better signal strength than the currently scheduled device.

STARFISH WITH BROADCAST INFO-STATIONS

Using broadcasts for info-station dissemination has the benefit that per-vehicle throughput is not a function of the number of devices in range. This makes the infestation inherently more scalable. However, for broadcasts, the 802.11 MAC families do not use acknowledgments, packet retransmissions, or rate adaptation mechanisms. As it later confirms using measurements, this produces significant packet losses in our highly mobile environment. In addition, no rate adaptation means that info-station transmissions will be limited to a basic parameterized rate. The Starfish broadcast info-station design is simple.

The info-station iterates over all files, broadcasting all files in order. Any device in range can receive the packet, which could be corrupted due to random propagation effects. Thus, the challenge is to increase resilience to packet losses. Starfish can leverage several existing techniques to improve resilience in broadcast data delivery, ranging from physical layer techniques like smart antennas to application layer solutions such as forward error correction and source coding. Many of these, however, come at the cost of high complexity and overhead.

This simple method divides each file into blocks of m packets, and encodes each block independently into n packets. From our measurements, it observes that packet loss is often burst. Thus rather than broadcasting all packets in each block contiguously, the info-station interleaves encoded packets of multiple blocks.

STARFISH DATA SCAVENGING

The measurements show that both broadcast and unicast info-stations have their own limitations. Even with advanced info-station design, per vehicle throughput is fundamentally limited by the transmission capacity, and by the number of vehicles in range (in unicast). To address these limitations, it proposes to augment info-station bandwidth using bandwidth offered by the devices.

The proposed device data scavenging, where nearby vehicles share data among themselves shortly after passing through an info-station, boosting dissemination throughput. Next, to present the detailed motivation, design, and feasibility study of the proposed solution.

In addition to all the existing system approach, the proposed system carries out the following approach. During broadcasting, the receiver decides whether or not to broadcast the message. The proposed algorithm is a novel broadcasting algorithm that can significantly reduce the number of broadcasts in the network. It is shown that using the proposed receiver-based algorithm, two close neighbours are not likely to broadcast the same message.

ALGORITHMS

Unicast routing

Most of the traffic on the internet and intranets known as unicast data or unicast traffic is sent with specified destination. Routing unicast data over the internet is called unicast routing. It is the simplest form of routing because the destination is already known. Hence the router just has to look up the routing table and forward the packet to next hop.

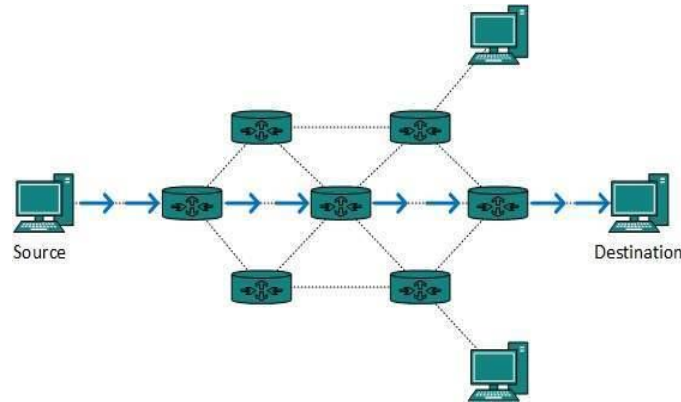


Figure 2: Unicast Routing

Broadcast routing

By default, the broadcast packets are not routed and forwarded by the routers on any network. Routers create broadcast domains. But it can be configured to forward broadcasts in some special cases. A broadcast message is destined to all network devices.

Broadcast routing can be done in two ways (algorithm)

1. A router creates a data packet and then sends it to each host one by one. In this case, the

router creates multiple copies of single data packet with different destination addresses. All packets are sent as unicast but because they are sent to all, it simulates as if router is broadcasting. This method consumes lots of bandwidth and router must destination address of each node.

2. Secondly, when router receives a packet that is to be broadcasted, it simply floods those packets out of all interfaces. All routers are configured in the same way.

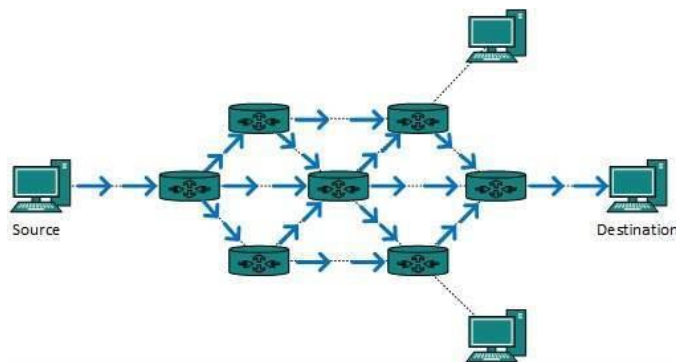


Figure 3: Unicast Routing

This method is easy on router's CPU but may cause the problem of duplicate packets received from peer routers. Reverse path forwarding is a technique, in which router knows in advance about its predecessor from where it should receive broadcast. This technique is used to detect and discard duplicates.

A GENERAL SENDER-BASED ALGORITHM

In this module, each node schedules a broadcast for a received message if the node is selected by the sender and if it has not scheduled the same

message before. Clearly, each message is broadcast once at most by a node.

Each node may only schedule a broadcast when it receives a message for the first time in existing systems. But, here a broadcast schedule can be set at any time. For example, a message can be dropped after the first reception but scheduled for

broadcast the second time. Clearly, the main design issue is how to select the forwarding nodes.

This module proves that in a collision-free network, achieves full delivery if it uses a slice-based selection algorithm to select the forwarding nodes.

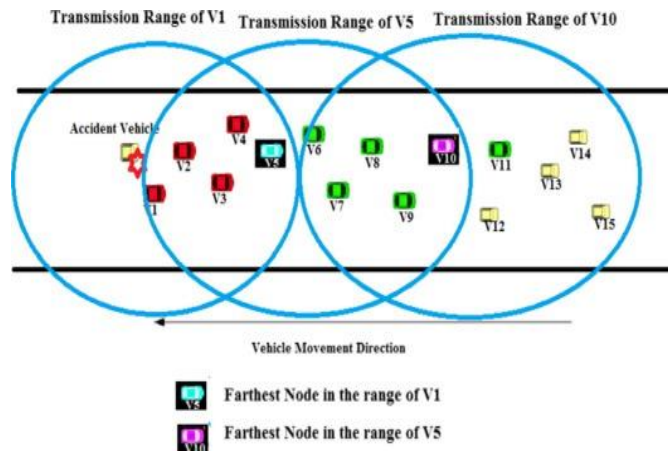


Figure 4: Sender Based Algorithm

HIGHLY EFFICIENT RECEIVED BASED BROADCASTING ALGORITHM (RESPONSIBILITY-BASED SCHEME)

This module implements the proposed RBS. The main idea of this Algorithm is that a node avoids broadcasting if it is not responsible for any of its neighbors. A node N_A is not responsible for a neighbor N_B if N_B has received the message or if there is another neighbor N_C such that N_C has received the message and N_B is closer to N_C than it is to N_A . Suppose N_A stores IDs of all its neighbors that have broadcast the message during the different period. When executed by a node N_A ,

The Algorithm first uses this information to determine which neighbors have not received the message. It then returns false if and only if it finds a neighbor N_B that has not received the message and length of $AB \leq$ length of BC . for any N_A 's neighbor N_C that has received the message. The

output of RBS determines whether or not the broadcast is redundant.

This algorithm proves that, each node broadcasts a message at most once. Therefore, broadcasting will eventually terminate. By contradiction, suppose there is at least one node that has not received the message after the broadcasting termination. Let us consider the set $A = \{(N_X, N_Y) | N_X \text{ and } N_Y \text{ are neighbors; } N_X \text{ has received the message; and } N_Y \text{ has not received the message}\}$, Suppose N_S is the node that initiated broadcasting, and N_T is a node that has not received the message. The network is connected; thus, there is a path between N_S and N_T . Clearly, it can find two neighbor nodes N_B and N_A along the path from N_T to N_S such that N_B has not received the message, while N_A has. Consequently, Clearly, N_A has not broadcast since N_B has not received the message. Therefore, there must be a node N_C such that N_C has received the message and length of $C'B' <$ length of $A'B'$ less than or equal to R .

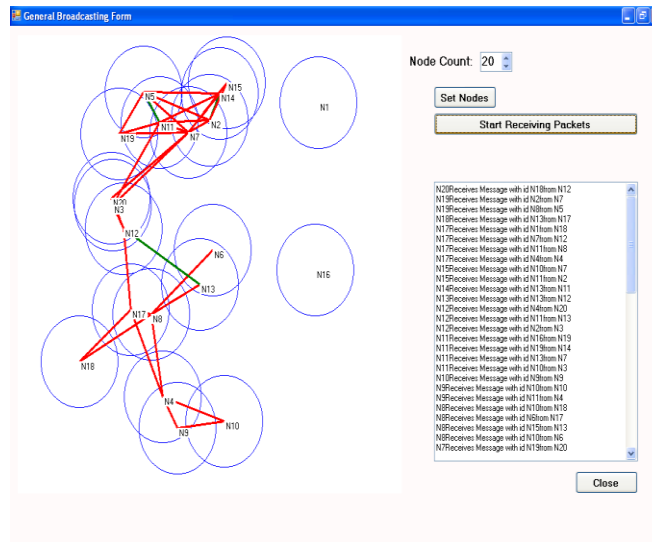


Figure 5: Sender Based Algorithm

RELATED WORKS

Augmenting Mobile 3g Using Wi-Fi

Wi-Fi access can be used to augment 3G capacity in mobile environments. It first conducts a detailed study of 3G and Wi-Fi access from moving vehicles, in three different cities. It finds that the average 3G and Wi-Fi availability across the cities is 87% and 11%, respectively.

Wi-Fi throughput is lower than 3G throughput, and Wi-Fi loss rates are higher. It then designs a system, called Wiffler, to augment mobile 3G capacity. It uses two key ideas leveraging delay tolerance and fast switching to overcome the poor availability and performance of Wi-Fi.

For delay tolerant applications, Wiffler uses a simple model of the environment to predict Wi-Fi connectivity. It uses these predictions to delays transfers to offload more data on Wi-Fi, but only if delaying reduces 3G usage and the transfers can be completed within the application's tolerance threshold. For applications that are extremely sensitive to delay or loss (e.g., VoIP), Wiffler quickly switches to 3G if Wi-Fi is unable to successfully transmit the packet within a small time window.

It implements and deploys Wiffler in our vehicular tested. Our experiments show that Wiffler significantly reduces 3G usage. For a realistic workload, the reduction is 45% for a delay tolerance of 60 seconds.

Mobile Internet access today is suffering the curse of popularity. The ubiquitous deployment of cellular data networks has drawn millions of users to these networks, which is in turn creating immense pressure on the limited spectrum of these networks. Subscribers, especially in big cities, are experiencing deteriorating 3G quality because the network cannot cope with the high demand.

UNDERSTANDING WIFI-BASED CONNECTIVITY FROM MOVING VEHICLES

In this paper using measurements from VANLAN, a modest-size tested that it have deployed, it analyze the fundamental characteristics of Wi-Fi based connectivity between base stations and vehicles in urban settings. Our results uncover a more complex picture than previous work which was conducted in more benign settings. The interval between a vehicle coming into and going out of range of a base-station is often marred by intermittent periods of very poor connectivity.

These “gray periods” are hard to reliably predict because their arrival is not signaled by metrics such as signal strength, loss rate, speed or distance from the base station. At the same time, they also do not consistently occur at the same spot.

Our analysis suggests that gray periods are not caused by the motion of the vehicle per se but by the variability in the urban radio environment combined with the vehicle traversing locations that are poorly covered by the base station. It also finds that knowledge of past connectivity can be used to identify regions where gray periods are more likely to occur as well as regions where the vehicle is likely to experience good connectivity.

However, it is not clear a priori that 802.11 can be co-opted for this purpose. At vehicular speeds, its short range could make it difficult to provide uninterrupted connectivity because base stations would come in and go out of range quickly. Its radio environment is also hostile, with high variability and interfering sources.

Vehicular mobility only makes it worse: the wireless environment will change rapidly as the vehicle moves. To investigate feasibility, it has deployed a modest-size, Wi-Fi based testbed, called VANLAN. It currently has eleven base stations and two clients that are mounted on vans.

In this paper, it analyzes measurements from VANLAN to understand connectivity between moving vehicles and base stations. It is interested in the basic nature of Wi-Fi based connectivity, such as how it varies as the vehicle moves and whether it is stable across traversals of the same location. As such, unlike previous work, it considers raw connectivity rather than performance obtained by current transport protocols and does not consider the impact of overheads such as client authentication and IP address acquisition.

Our analysis reveals a challenging environment. Instead of being continuous between the times the client comes in and goes out of range of a base-station, the connectivity is often marred by intermittent “gray” periods of very poor connectivity. This is unlike the three phases of connectivity: poor quality “entry” and “exit” phases and a good quality “production” phase reported in an earlier, smaller-scale study that was conducted in a more controlled environment.

We find that the occurrence of gray periods is hard to predict based on current measurements of, for instance, loss rate, signal strength, speed, or distance from the base-station. Gray periods do not consistently occur at the same location, and they are also unlikely to occur due to vehicular mobility

itself. But they likely occur due to a combination of variability in the urban radio environment and the vehicle encountering locations that are poorly covered by the base-station.

VANETCODE: NETWORK CODING TO ENHANCE COOPERATIVE DOWNLOADING IN VEHICULAR AD-HOC NETWORKS

In this paper Inter-vehicular communication is fast emerging as a popular application for mobile ad-hoc networks. Content distribution in Vehicular Ad-Hoc Networks (VANET) is particularly challenging due to the high mobility, rapidly changing topology and intermittent connectivity observed in these networks. Effective mechanisms are needed to enable rapid sharing of real-time data such as traffic warnings and multimedia rich files.

In this paper, it proposes a novel network coding based co-operative content distribution scheme called VANETCODE.

The randomization introduced by the coding scheme makes distribution efficient. Our scheme also leverages on the broadcast nature of the wireless medium to expedite the dissemination of the encoded blocks amongst the one-hop neighbors and is entirely independent of routing.

It has carried out extensive simulations to demonstrate that VANETCODE effectively enhances cooperative content sharing in VANETs without introducing additional overhead.

In this paper, it proposes a novel content distribution scheme tailored for VANET called VANETCODE, which is based on the concept of network coding. In this scheme, the content is divided into smaller blocks and the nodes linearly encode their constituent blocks.

The resultant is then shared amongst the neighboring nodes. In ad hoc networks, since each node can act as a router, the network coding can be done at the network layer at each node without hampering the upper layer protocols.

This scheme also takes advantage of the broadcast characteristics of the wireless medium to speedily distribute the encoded blocks amongst one-hop neighbors.

VANETCODE eliminates the need of peer selection, content selection and neighbor

discovery, which take up significant time and resource in other cooperative downloading mechanism proposed for VANETs.

CARTORRENT: A BIT-TORRENT SYSTEM FOR VEHICULAR AD-HOC NETWORKS

In this paper, it describes the architecture, implementation, and experiment of a Bit Torrent like software system for vehicular ad-hoc networks (VANETs) called Car Torrent. It have run Car Torrent on two laptops and shown the detection of available files with periodic gossips and the successful downloading of files. The application is one of its kinds in the vehicular ad hoc wireless networks. It is conceivable that vehicular network will extend to support not only vehicle to-vehicle communication but also multi-media-rich Internet. There are a few characteristics of vehicular networks that differentiate it from conventional ad-hoc networks. First, vehicles have high battery and computing power.

Thus, they are not subject to limitation of computation processing in conventional ad hoc networks. Secondly, vehicles have high mobility up to 50 miles/hr. thirdly, the vehicular ad hoc networks are densely populated.

This characteristic is taken into account of the fact that vehicles have become the main transportation system and the number of vehicles on the road will not likely to decrease in the future. Given these characteristics, conventional client-server approaches do not scale well in the vehicular network.

Because of the nature of high mobility in the network, a vehicle only enjoys a transmission window on the order of a minute at most. A new paradigm using peer-to-peer swarming protocols is more suitable in the vehicular ad-hoc network. In this new paradigm, nodes act as routers for the other nodes in the network. Nodes do not cooperate with one another to obtain their desired files. The high mobility of nodes cooperate with intermittent connectivity provides incentive for nodes to cooperate. The “flash crowds” has shown that cooperative nodes improve the overall network performance.

As Internet access and file sharing are moving toward peer-to-peer cooperative paradigm, there are many interesting applications besides car safety in the vehicular ad-hoc networks. These applications will extend and complement the Internet in that it provides Internet access and file sharing to people in an area unreachable before.

The countless applications such as car-on-wheels, online entertainment, civic defense, and criminal investigations only show the promising outlook of vehicular ad-hoc network since the peer-to-peer cooperative networking paradigm.

CONCLUSION

This paper presents the measurement-based design of an info-station-based content delivery system, where vehicles passing by a roadside info-station proactively fetch and cache content for offline browsing. It finds that both unicast- and broadcast-based systems fail to scale as vehicle density increases. In addition, it is observed that data dissemination exhibits both temporal and spatial diversity across vehicles.

It also proposes to exploit this diversity via data scavenging, where vehicles passing by the info-station share data between them to both recover from wireless loss and extend the effective range of the data transmission. Through detailed experiments, it shows that the scavenging techniques achieves close to the optimal predicted performance.

In addition, an efficient broadcasting algorithm for ad-hoc network using improved mechanism in worst case scenario is developed. In particular, RBS based receiver algorithm to address the broadcasting problem is proposed. It proves the correctness of the algorithm and demonstrated the effectiveness.

The proposed algorithms provide powerful broadcasting especially when the number of nodes in more in transmission ranges of sender node.

The new system eliminates the difficulties in the existing system. It is developed in a user-friendly manner. The system is very fast and any transaction can be viewed or retaken at any level. It reduces the time to analyze the broadcasting algorithm.

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