A Survey on Vehicular Internet Access Techniques

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Abstract—**The usage of mobile internet is increasing rapidly, with the increasing popularity of media enabled handhelds such as laptops, smart phones, tablets. This increasing demand of data constantly surpasses the processing capacity of mobile communication networks. Downloading of different contents, real time data from the internet is the major need for the users. In this paper, we have reviewed different techniques that are used for the vehicular internet access. The performance of these techniques are analyzed to find the optimal technique that provide better throughput.**

Index Terms— **Contact opportunity, α-coverage, Access Points, Beam Steering.**

I. INTRODUCTION

Mobile devices are changing the way, we connect with others online and how we access and share content. Over the last few years wire line connectivity has been increasingly replaced by wireless connectivity, as we moved first from desktops to laptops and then to smart phones and tablets. Today, wireless data access has become the primary way to be online and to keep in touch with friends and colleagues. Recently, there is a strong interest in developing Networking techniques for moving vehicles, to enable wireless connection between vehicles or between vehicles and fixed infrastructure. Large scale wireless LANs (WLANs) can provide such a service, but they are expensive to deploy and maintain. Open WLAN access points, on the other hand need no new deployments, but can offer only opportunistic services, lacking any performance guarantees.

A carefully planned sparse deployment of roadside Wi-Fi provides an economically scalable infrastructure with quality of service assurance to mobile users. Wi-Fi hotspots are rapidly mushrooming in every city to meet the ever increasing demand of data that surpassing the capacity of wireless networks. They operate either independently as a competitive way of data access or acts as a complementary service and help offload the overburdened mobile networks. The objective of using roadside access points (APs) is to provide quality of service assurance to mobile users. In this paper, we study deployment techniques for providing roadside Wi-Fi services.

To provide service to mobile users, different techniques are used. The techniques are differing in the resulting throughput and in the connection duration with the single AP.Vehicular content deliveries are not well suited with many networking protocols. One of the reasons is, current end to end data transfer and congestion control protocols do not work well when connectivity is only a few seconds longand intermittent (because of the mobility the end node is not under continuous coverage).

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In this paper, we envision a wireless service provider that implements a deployment using two types of APs, new APs that are deployed for serving mobile users exclusively and existing APs are initially deployed for serving static users or users with limited mobility. By using this access point's network, we have to give continuous coverage that resulted in guaranteed performance to the end users. We also have to ensure that the performance should be delay tolerant and to be provided at minimum cost. These works either assume perfect knowledge of vehicle mobility in both space and time and do not provide a scalable solution with performance guarantee or focus on a single expected scenario of road traffic and ignore the capacity constraints of APs.

Some of the parameters considered during the deployment of APs and during the implementation of the system are

•Many Short Connections:

Establish connectivity quickly to take advantage of brief connection opportunities. The system must enable the use of many brief connection opportunities. It may expect the mean connection time at least 10 seconds correspondingly the mean time between successful encounters is also lower.

•Fast Connection Establishment:

Establishing an internet connection over a wireless AP, here uses request-response mode. In each step, involves a request followed by a response. Also it verifies whether an end to end connection is available.

•Improved Transport Performance:

Use improved end to end, reliable, stream oriented transport protocol that aims to achieve reasonable throughput for data transfers over a series of short connections.

The framework and its implementation are immediately usable by various service providers for enabling WLAN based services for mobile users. By using planned incremental deployment, service providers can install few APs for large interconnection gaps to begin with and overtime add new APs to gradually bring down the values of the interconnection gap. Besides Wi-Fi deployment, our solution can also be used in positioning sensors in a road network for monitoring and tracking purposes.

II. METHODOLOGY

The use of high performance navigation systems, information as well as other entertainment related applications are increasing day by day which will definitely lead to drastic growth in bandwidth demand by the vehicular mobile users. Vehicular network is a communication system in which vehicular users

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communicate with the roadside units (AP) and provide information to each other. Our work basically relates to roadside infrastructure deployments (AP), efficient optimization of data downloading and performance evaluation of the system and to increase the overall system throughput.

A. α-coverage Technique:

A deployment of roadside units is a crucial aspect for data communication. The overall infrastructure deployment strategies proposed up-to-date, that can be able to maximize the amount of time a vehicular user remains within the radio range of an access point. It is obvious that longer duration of time instances within an AP coverage can surely support the downloading mechanism of vehicular users.

The concept of continuous coverage for vehicular users called α-coverage. The objective of α-coverage is to provide worst case guarantees on the interconnection gap while using significantly fewer APs than needed for full coverage. The study of placing APs at roadside are done to provide guarantees on the quality of data service that a vehicle can obtain when moving in a citywide road traffic. In this the APs are assumed to have direct Internet access. The main challenge is to define a metric that is representative of real performance, while avoiding uncertainties hard to predict at the deployment stage. So that interconnection gap is chosen as an optimization target.

For the experimental purpose a road network is considered as the graph and the APs are taken as points in road network. First, we are seeking a solution that provides the worst-case guarantee to the interconnection gap, and therefore make the most conservative assumption about the contribution of each AP. Second, we are considering a sparse deployment, and therefore, we ignore the case where the coverage regions of multiple APs overlap with each other. Hence, each AP is represented by a point in road network closest to it and we can make these points as vertices of the graph when needed. In this first determine if the deployment provides the desired coverage (to be defined), and if not find a minimum set of points A in GR so that when new APs are deployed at these locations, provides the desired coverage. But this technique does not provide quality of service guarantees.

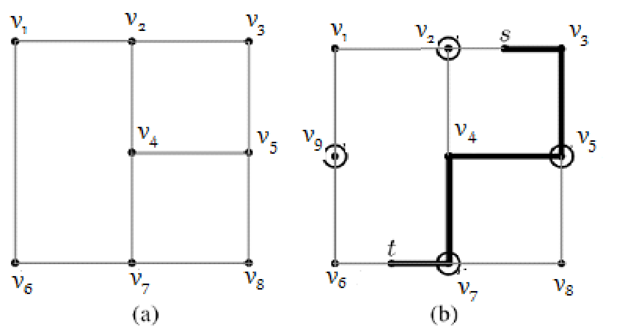

Fig. 1: (a) Graph G_R representing a small road network. Every edge except (v_1,v_6) has length 2. (b) Path f_{st} of length 4 is highlighted. Where **s** is the midpoint of (v_2, v_3) and **t** isthe midpoint of (v_6,v_7). dist(s,t)=3.

B. Mobisteer Technique:

In this work, we investigate the use of directional antennas and beam steering techniques to improve performance of 802.11 links in the scenario of communication between a moving vehicle and roadside APs. To this end, we develop a framework called Mobisteer that provides practical approaches to perform beam steering. Mobisteer can operate in two modes - cached mode - where it uses prior radio survey data collected during “idle" drives, and -online mode-where it uses probing.The goal is to select the best AP and beam combination at each point on the drive given the available information, so that the throughput can be maximized. For the cached mode, an optimal algorithm for AP and beam selection is developed that works in all overheads.

In this method, the roadside APs used Omni directional antennas and the vehicles used a steerable beam directional antenna. This model is chosen for two reasons. First the Omni directional antennas may be associated to multiple vehicular nodes in different directions. Second, the use of this architecture opens up the possibility of using existing 802.11 networks. This enables the cars to directly use public hotspots, mesh networks etc. The array antenna system consists of eight element phased arrays driven by eight individual T/R boards that receive radio signals from the wireless card. The phased arrays combine radio waves by introducing different phase differences and gains in the eight arrays. Various beam patterns are possible by setting the phases and gains in different boards. The antenna is set to behave identically for transmit and receive processes.

In order to get the location of the vehicle along the route it travels, a USB based GPS receiver is used, which is connected inside the car. This GPS receiver provides the position accuracy of less than 3 meters 95% of the time. On the two modes of mobisteer, the cached mode is applicable when the car is in a familiar driving route. The RF signature database is populated and maintained whenever the mobisteer node is not in communication. This database is used later to drive an optimal beam steering and AP selection algorithm, when the mobisteer node wishes to communicate and is on a familiar route. Thus, any idle drive provides mobisteer with samples for the multidimensional <location, timestamp, AP, channel, data rate, beam, SNR> dataset. More drives on the same route provides more samples and thus better statistical data. The data collection is done in two methods in order to build the RF signature databases, they are – passive scanning and active probing.

The applicability of the cached mode technique is not limited to the routes driven by the same user. It is possible to share RF signature databases by multiple mobisteer nodes. For example, databases could be uploaded to a central server and all nodes can benefit from such shared database. Whenever a user wants to travel a particular route, they candownload the RF signature database, run the algorithm on it to get an optimal beam steering and AP selection for the route.

In the online mode of operation, no such database is available. This mode of operation is used when the user

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travels in a previously untraveled route and wants to communicate with APs in the route. Here, the mobisteer node scans the environment in all the beams and channels using active probing and chooses the best beam and AP combination depending on the SNR values of the probe response frames received. The mobisteer technique improves the connectivity duration as well as PHY- layer data rate due to better SNR provisioning. Mobisteer improves the throughput in the controlled environments by a factor of 2-4. In "in situ" experiments, it improves the connectivity duration by more than a factor of 2 and average SNR by about 15 dB. In this work, a physical layer enhancement - directional communication- to improve network connectivity in vehicular context is used. By focusing energy in one direction, a directional antenna can get a better transmit or receive gain for a targeted direction compared to an Omni directional antenna. In addition, directional antenna has the potential to provide a better immunity from co-channel interference and multipath fading. However, having a directional antenna alone is not sufficient for a moving vehicle.

The direction must be steered appropriately for the best link quality. The steering must be done on a continuous basis as the car moves so that good connectivity can be maintained to the appropriate network node. The beam steering should be done in such a way so as to increase the duration of connectivity and improve the link quality.

C. Cabernet technique:

Cabernet is the system for delivering data to and from moving vehicles using open 802.11 Wi-Fi access points encountered opportunistically during travel. The network connectivity in cabernet is both fleeting (access points are typically within range for a few seconds) and intermittent (because the access points do not provide continuous coverage). In this technique two new components for improving open Wi-Fi delivery to moving vehicles are used. One is 'Quick Wi-Fi', is a streamlined client-side process to establish end-to-end connectivity. The second thing is CTP, is a transport protocol that distinguishes congestion on the wired portion of the path from losses over the wireless link. Cabernet a viable system for a number of non-interactive applications. Cabernet is well suited for applications that deliver messages (e.g., traffic updates, parking information, event and store information, email) and files (e.g., maps, software updates, documents, web objects, songs, movie clips, etc.) to users in cars, as well as for applications that deliver messages and data from devices and sensors on cars to Internet hosts. These applications do not require the interactive end-to-end connectivity between a sender and receiver.

When a car connects via a Wi-Fi AP, it can potentially transfer data at the same rates as static clients connected to the same network. However, as cars move, their connectivity is both fleeting, usually lasting only a few seconds at urban speeds, and intermittent, with gaps from dozens of seconds up to several minutes before the next time they obtainconnectivity. In addition, we observe that packet loss rates over the wireless channel are both high (often 20%) and vary over the duration of a single AP association. The primary goal of Cabernet is to develop techniques that allow moving cars to obtain high data transfer throughput, despite these adverse conditions.

Cabernet incorporates three techniques to mitigate the adverse problems:

1. To reduce the time between, when the wireless channel to an AP is usable and when Internet connectivity through the AP is actually achieved, a technique Quick Wi-Fi is developed, which is a stream lined process that combines all the different protocols involved in obtaining connectivity (across all layers) into a single process, including a new optimal channel scanning policy.
2. To improve end-to-end throughput over lossy wireless links, the Cabernet Transport Protocol (CTP) is developed, which outperforms TCP over opportunistic Wi-Fi networks by not confusing Wi-Fi losses for network congestion. Unlike most previous work on efficient wireless transport protocols, CTP does not require modifications to APs; instead it uses a lightweight probing scheme to determine the loss rate from Internet hosts to an AP.
3. To improve link rates, the impact of bit-rate selection in vehicular Wi-Fi is studied.

As a car drives down the road, the onboard embedded computer repeatedly scans for, and attempts to associate with, open APs. It then attempts to establish end-to-end connectivity with a cabernet enabled host, to retrieve or upload data. Software running on the embedded computer uses Quick Wi-Fi to connect as quickly as possible and CTP to deliver data. Finally, communication with legacy Internet hosts is done using a proxy that serves two functions: first, it hides intermittent connectivity from protocols running on fixed Internet hosts and shields them from changing IP addresses, and second, it translates between CTP and popular protocols like HTTP and TCP. At a high level, Cabernet's design can be described by the following three objectives:

1. Establish connectivity quickly to take advantage of brief connection opportunities.
2. Split congestion control between wired and wireless portions of the path to cope with high non-congestive wireless loss rates.
3. Expose the appearance and disappearance of connectivity to Cabernet-enabled applications on the mobile node.

The data was collected using a single Wi-Fi radio on each car. The radio scanned continuously for open APs until one was found. It then associated with the AP and maintained the connection until the access point went out of range. Only APs that provided end-to-end connectivity are used. In this, an encounter is defined as the interval between when the first beacon was heard from an AP and the time at which the last packet was heard from the AP. This duration is an upper bound on the time that could profitably be spent communicating, because it does not include the time it might take for a client to actually achieve end-to-end connectivity.

Stock implementations of the IEEE 802.11 and Internet protocols typically require several seconds to establish a connection. By considerably shortening this time, Quick

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Wi-Fi is able to exploit the bulk of these fleeting opportunities.

Packet losses over the wireless link are common in our observed encounters. To collect this data, the cars sending bursts of back to back packets to the AP, with the link layer retries enabled. MAC layer ACKs were used to verify transmission is success or failure. Most of the packet losses are unlikely to be due to congestion and are instead caused by a combination of marginal links and mobility. To reduce the packet losses, a congestion control mechanism is used. In CTP this problem is solved by, implementing a lightweight probing protocol to independently detect congestive losses on the (wired) path to the AP.

The distribution of times between encounters depends on the density of open APs in the area and the speed of travel. For new applications, the CTP API provides prompt feedback (through OS signals) whenever end-to-end connectivity disappears and reappears. These notifications allow applications to begin transfers when connectivity appears and avoid having to implement complex application-specific timeouts or connection polling techniques to determine if connectivity is available. If improved signal quality is available, there is an improvement in end-to-end performance.

The cabernet is a content delivery network for vehicles moving in cities. The fundamental capacity of cabernet is much higher than current cellular networks. Given enough access points, the high link speed and intense spatial reuse of Wi-Fi is unlikely to be matched by any cellular system. When Wi-Fi data transfers are available, the cabernet can perform at broadband speed. But in cabernet network connectivity is both fleeting and intermittent, it suffers from high packet loss rates.

D. *Wiffler technique:*

Mobile Internet access today is suffering the curse of popularity. The sparse 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. So the system called wiffler is designed to augments mobile 3G capacity.

Its two key ideas are **leveraging delay tolerance** and ***fast switching*** **to 3G**. We observe that many applications such as email or file transfer can afford to delay data transfers without significantly hurting user experience. Wiffler leverages this observation to trade-off higher application latency for lower 3G usage. Instead of transmitting data immediately, it waits for Wi-Fi to become available. By using a simple method to predict future Wi-Fi throughput, it waits only if 3G savings are expected within the application's delay tolerance. Additionally, so that the performance of delay and loss sensitive applications is not hurt. Wiffler quickly switches to 3G if Wi-Fi is unable to transmit the packet within a time window. To measure availability, the vehicle and the server periodically send data to each other over UDP. Availability is measured over 1 second intervals. In each interval, an interface (Wi-Fi or 3G) is considered available if at least one packet was received in the interval. Availability is defined as the number of available 1-second intervals divided by the total number of intervals. For less-demanding applications, such as email or file transfer, intervals longer than 1 second are more appropriate for measuring availability.

The three measures to determine the performance of 3G and Wi-Fi networksare UDP throughput, TCP throughput, and loss rate. To measure the upstream and downstream UDP throughput, the vehicle and server each send 10 back-to-back packets every 20 ms. To measure loss rate, the vehicle and server each send a 20-byte packet every100 ms. To measure TCP throughput, the vehicle and the server each create a TCP connection and send 100KB data to each other repeatedly. At the end of a 100KB transfer, the TCP connection is closed and a new connection is created.

The goal of wiffler is to reduce 3G usage by leveraging Wi-Fi connectivity when available, but to do so without affecting application performance. The key insight in the leveraging delay tolerance is that delay tolerance allows applications to trade-off completion time for 3G usage. Wiffler delays data transfers to reduce 3G usage, but only delays a transfer if the added delay results in 3G savings and is within the application's delay tolerance. For applications with strict quality of service requirements, such as VoIP and video, Wffler uses the fast switching mechanism. When using Wi-Fi, it promptly switches packets to 3G if Wi-Fi cannot deliver them within a certain time period.

Wiffler takes as input application data, which is characterized using S, the size of the transfer, D, the delay tolerance and an application-specified QoS metric. Based on these characteristics and those of the operating environment, it decides how to distribute the data across 3G and Wi-Fi.. Wiffler estimates future Wi-Fi throughput and delay transfers only if the estimate indicates that delaying transfer will reduce 3G usage. Wiffler uses the predictor to estimate offload capability of the Wi-Fi network until the delay tolerance threshold. The decision is to either wait for a potential Wi-Fi offload opportunity or to send immediately on 3G is made based on the predicted Wi-Fi capacity and the application workload.. To capture this trade-off, we introduce a tuning parameter called the **conservative quotient**. The conservative quotient is a number between 0 and ∞. For a given value of c, the Wiffler offloading algorithm is shown in Figure 2.

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D:earliest delay tolerance threshold among queued transfers
S: size in bytes to be transferred by D
W: estimated Wi-Fi transfer size

if (Wi-Fi is available):
    • send data on Wi-Fi and update S
if (W < S . c and 3G is available):
    • send data on 3G and update S
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Fig. 2: Wiffler's prediction based offloading

The algorithm considers the total data S that needs to be transferred within the earliest delay tolerance

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threshold, and the total data the node can transfer on Wi-Fi, W. The next two steps are done in parallel. If Wi-Fi is available, we use it immediately to transfer data. 3G connectivity is used only if we estimate that W <S .c.

If c < 1, Wiffler will wait for Wi-Fi offload opportunity even if only a fraction c of the total application data can be transferred on Wi-Fi in expectation. Therefore, this strategy will offload more data on Wi-Fi at the expense of completion time. On the other hand, if c > 1, Wiffler waits for Wi-Fi only if the Wi-Fi capacity is substantially more than the load. Therefore, the completion time of the strategy is likely to be lower, but it also has a lower offload potential. The conservative quotient can be set not only by the system or the application but also by the 3G provider. Wiffler uses low-level, link-layer information to enable fast switching to 3G in the face of poor Wi-Fi conditions. Link layer information is needed because the Wi-Fi NIC frequently takes a long time to complete retransmission attempts.

Our fast switching mechanism is simple: it sends the packets on 3G if the Wi-Fi link-layer fails to deliver the packet with in a delay threshold. The motivation for this algorithm is that waiting for Wi-Fi link-layer retransmissions incurs delays. In addition, when a packet is lost, there is a high chance that the retransmission will fail, since losses are bursty in the vehicle environment. Thus, it is better to send time-sensitive packets on 3G rather than waiting for likely more failures on Wi-Fi. Choosing the delay threshold involves a tradeoff between better application performance and 3G loads.

Wiffler is designed to reduce the overburdened 3G usage by leveraging Wi-Fi connectivity. It is a joint characterization of 3G and Wi-Fi. The simplest policy for using Wi-Fi is to send data on the Wi-Fi network when available and switch to the 3G network when Wi-Fi is unavailable. Results from the measurement study show, however, that this policy does not work well in practice because of two key challenges. First, the average availability of Wi-Fi can be low|11% in our measurements, which severely limits the fraction of data that can be offloaded to Wi-Fi. Second, Wi-Fi loss rate is higher than 3G. For applications that are sensitive to losses, such as VoIP, using Wi-Fi irrespective of its loss characteristics will degrade application quality. Wiffler technique uses a simple model of the environment to predict Wi-Fi connectivity. The experiments show that Wiffler significantly reduces 3G usage. For a realistic workload, the reduction is 45% for a delay tolerance of 60 seconds.

E. Contact Opportunity technique:

The evaluation of wireless data access by mobile users using “in situ” (or “open”) Wi-Fi networks, and in various controlled environments, have confirmed the feasibility of Wi-Fi based vehicular Internet access for non-interactive applications most existing works, however, consider an unplanned deployment of APs based on open-APs. Consequently, these solutions fail to provide any throughputassuranceto a mobile user; they can only provide opportunistic services to mobile users.

To provide guaranteed performance to mobile users, this method presents a new metric, called Contact Opportunity, as a characterization of a roadside Wi-Fi network. Informally, the contact opportunity for a given deployment measures the fraction of distance or time that a mobile user is in contact with some APs when moving through a certain trajectory. Such a metric is closely related to the quality of data service that a mobile user might experience while driving through the system. Our objective is to find a deployment that ensures a required level of contact opportunity with the minimum cost.

Ideally we would like to have a scalable deployment of APs that is able to serve mobile users on the go with guaranteed performance in terms of some intuitive metric such as average throughput. Such an objective is complicated by various uncertainties such as unpredictable traffic conditions, unknown moving patterns of mobile users, and the dynamics involved in the performance of APs.

A movement on a road network is modeled as a simple path on the corresponding graph. Let A denote a set of known candidate locations and L denote the set of all sub segments in the road network. The model assumes that there is a set of movements denoted as P, given as part of the input to the deployment decision maker, P could be a set of shortest paths or most frequently travelled path between a set of sources and destinations.

Given a deployment$S \subseteq A$, the contact opportunity in distance of a path$p \in P$, denoted as η_p^d, is defined as the fraction of distance on p that is covered in some AP in S. Formally,

$$\eta_p^d = \frac{\sum_{l \in L_p \cap L_s} d_l}{\sum_{l \in L_p} d_l}$$

Given a deployment S⊆A and a scenario k ∈ K, the contact opportunity in time of a path p, $p \in P$ as

$$\eta_p^t = \frac{\sum_{l \in L_p \cap L_s} d_l / v_l(k)}{\sum_{l \in L_p} d_l / v_l\,(k)}$$

Which captures the fraction of time that a mobile user is in contact with some AP when moving through p.

A	Set of candidate locations for deploying APs.
L	Set of road sub segments
d_l	Length of road segment l
v_l	Driving speed on road segment l
λ	Contact opportunity
P	Set of movement paths
L_p	Set of sub segments on path p
L_s	Set of sub segments covered by $S \subseteq A$
η_p^d	Contact opportunity in distance over path P
η_p^t	Contact opportunity in time over path p
w_a	Cost of installing an AP at location $a \in A$

Table 1: Notation List

The simple greedy algorithms are used to find the contact opportunities. The algorithm starts with an empty

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set and in each iteration picks a new candidate location that maximizesthe incremental difference. The procedure repeats until the required contact opportunity is achieved. Optimization algorithms are used to predict the cost and the result is used to minimize the cost in future scenarios. The throughput is maintained even in uncertain conditions such as traffic jams, accidents etc.

Algorithm: Minimum cost contact opportunity
Input: A, P, λ Output: A subset $S \subseteq A$ 1. $S \leftarrow \emptyset$; 2. **While** $\eta^{d}(S,\lambda) < \eta^{d}(A,\lambda)$**do** 3. Find $a \in A/_{S}$ that maximizes $\frac{\eta^{d}(S\cup\{a\},\lambda) - \eta^{d}(S,\lambda)}{w_a}$; 4. $S \leftarrow S \cup \{a\}$;

Fig.3 : Minimum cost contact opportunity algorithm

The performance of this technique depends on both its travel speed and the contact duration when it is associated with some APs. However, both the contact time and travel time are not fixed due to uncertainties of traffic conditions. The traffic condition also affects the number of mobile users that are in the range of the same APs at the same time competing for the bandwidth of the AP. To model these, interval based approaches are used. It ensures the quality of service guarantees to the users thus provides better throughput at minimum cost.

III. PERFORMANCE ANALYSIS

The Alpha Coverage method, which provides worst-case guarantees on the interconnection gap. For the experiment, where α equals to 3000 m and the speed limit is 55 miles/hour. 21 APs are used in the deployment. The data is accumulated over all the five mobile nodes and 10 movement patterns. The α_n and αpcoverage along the path is calculated using suitable greedy algorithms.

Mobisteer technique is designed to maximize the duration and quality of connectivity between the moving vehicles and the fixed access points (AP). It operate in two modes *cached* and *online* modes. In cached mode, the probe response times are sent using the same data rate of 1 Mbps. SNR of received frames determine the quality of the link. The main penalty incurred while using online mode is the probing time. In online mode probing time is 440ms. The channel switching delay is around 10ms. The connection between a moving car and a roadside AP can be maintained while driving at different speeds between 80-180 km/hour. In this approximately a third of the connections can be reasonably used and communication is possible for about 4-9 seconds in these speeds. Up to 9 MB.This paper analyzed various vehicular internet access methods that deliver data to the moving vehicles. All these methods use Wi-Fi access points encountered during drives for network connectivity. This connectivity presents several challenges, includes coverage problems, congestions, packet loss rates etc. Most wide area data services fail to provide an economically scalable infrastructure for serving mobile users with QoS guarantees. After evaluating the techniques, contact opportunity technique is taken as the technique that provide better performance than other techniques. In the survey, our focus is on to find the technique that provides optimal performance i.e. better throughput at the cost as low as possible. In this the term cost represents the number of nodes between the two end parties. The contact opportunity technique uses efficient deployment algorithms for minimizing the cost and for ensuring required average throughput. It presents higher throughput than other methods of data could be transmitted at speeds around 80 km/hour. In mobisteer cached mode is superior to online mode because about 39% less packets are received when using online mode. The average SNR using mobisteer in cached mode is 18 dB with a 7 dB gain over mobisteer in online mode.

The cabernet provide faster connectivity. It uses quick Wi-Fi technique to associate with the first open AP it encounters as it scans through the wireless channel. It establish connection with in 100ms but it does not provide end-to-end connectivity. If there is no transmission for 500 ms, it assumes that the vehicle moves out of range of the AP.

Wiffler technique is used to augment the 3G capacity. It combines multiple interfaces with different cost andiniquitousness, with the goal of reducing the total cost of data transfer while meeting application requirements. It works with Wi-Fi, when 3G is not available at the moment. For the transfers of 5Mb application data with delay tolerance of the 60s, wiffler reduces 3G usage by 45% for the generation interval of 100s. For this the data delivery is delayed up to 60s. It works depend on the delay tolerance of the application it handled at the time.

In the contact opportunity method, experiments conducted on the road with the travel speed of each segment is in the interval [10m/s,20m/s].Each road intersection is a candidate location for deploying APs with a data rate in the interval [5Mbps,10Mbps]. Each AP has a unit cost. In this the mobile node is configured with multiple channels so that it can download data from any APs in range, but the association protocol ensures that a node is associated with at most one AP at any time. Whenever a node encounters a new AP or is disassociated from an old AP, it chooses from the set of APs in range the one with the least number of users associated, where the tie is broken by giving higher priority to the newly encountered AP. An AP serves all the nodes associated with it in an equal data rate with the total rate bounded by 1 Mbps.

Among all these methods contact opportunity provides better performance in all scenarios. The Alpha coverage technique provides continuous coverage but not the quality of service. The mobisteer technique provides operation in online mode also; all other methods use previously collected data only. But the online mode gives poor performance than cached mode of operation. So techniques to collect, maintain the survey data need to be improved. In cabernet quick connection establishment is possible so it provides optimized performance when the connection is continuous. But due to the intermittent

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connectivity, high connection establishment latency and high Wi-Fi loss rates are occurring. It subsequently reduces the throughput. In wiffler technique, it comes into action if Wi-Fi service is not available. It is suitable for delay tolerance applications. For delay sensitive processes, it quickly switches to 3G if Wi-Fi is unable to successfully transmit the packet within a small time window.

IV. CONCLUSION

This paper analyzed various vehicular internet access methods that deliver data to the moving vehicles. All these methods use Wi-Fi access points encountered during drives for network connectivity. This connectivity presents several challenges, includes coverage problems, congestions, packet loss rates etc. Most wide area data services fail to provide an economically scalable infrastructure for serving mobile users with QoS guarantees. After evaluating the techniques, contact opportunity technique is taken as the technique that provide better performance than other techniques. In the survey, our focus is on to find the technique that provides optimal performance i.e. better throughput at the cost as low as possible. In this the term cost represents the number of nodes between the two end parties. The contact opportunity technique uses efficient deployment algorithms for minimizing the cost and for ensuring required average throughput. It presents higher throughput than other methodsand also provide QoS guarantees to the users, which is more useful for the mobile users and application designers.

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