Multimedia Content Downloading In VANET with Density Estimation

E.Lalitha[1], D.Jayachandran[2]

[1]Research Scholar (PG), KSR College of Engineering

E-mail- lalithaeswaran24@gmail.com

ABSTRACT – The existence of Internet-connected navigation and infotainment systems is becoming a truth that will easily lead to a remarkable growth in bandwidth demand by in-vehicle users. This content downloading system will induce the vehicular user to use the resource to the same extent as today's mobile customers. By this approach communication-enabled vehicles are paying attention in downloading different contents from Internet-based servers. We summarize the performance limits of such a vehicular multimedia content downloading system by modeling the content downloading process as an optimization problem, and maximizing the overall system throughput with density measurement. Results highlight the methods where the Roadside infrastructure i.e., access points are working at different capabilities irrespective of vehicle density, the vehicle-to-vehicle relaying, and the penetration rate of the vehicular communication.

Keywords— Vehicular ad-hoc network, Multimedia Content, Content downloading System, Max-flow problem, Security issues, Deployment, Density Estimation.

1. INTRODUCTION

Multimedia content downloading in vehicular networks by the vehicles has received increasing attention from the research community. Initially, the availability of Infrastructure-to-Vehicle (I2V) communication capabilities are based on high-throughput Dedicated Short-Range Communication (DSRC) technologies, is seen as an opportunity for transfer of large data to mobile nodes that would not be possible through the existing 2G/3G infrastructure, Next the availability of Vehicle-to-Vehicle (V2V) connectivity has fostered a number of proposals to make use of the cooperation among vehicular users so as to improve their downloading performance. Our framework introduces a DTNG time-invariant graph. We do not assume the contacts between mobile nodes to be atomic but allow them to have random duration, and also account for the presence of roadside infrastructure and channel contention. Such an approach allows us to significantly enhance the AP deployment over the given road layout, since we maximize the overall throughput and also provide the optimal solution instead of an approximation.

At the result, the access point or relay shows the vehicle capability prior and sends the corresponding low quality or high quality file. This achieves the vehicle to receive the proper file resource. Vehicle density is calculated based on previous temporal changes and the new vehicle density is calculated. The access points' capabilities are adjusted so that it works more in high vehicle density environment and works less in low vehicle density environment.

This paper is organized as follows: Section II describes the previous work, while Section III discusses contribution of work. In Section IV, we build the system model and assumption, while we generate the Dynamic Network topology graph in Section V and we formulate the max-flow problem in Section VI, Results, derived in the design guidelines described in Section VII. In section VIII, we evaluate the vehicle density based data downloading. Section IX describes Security issues; finally section X summarizes our major findings and point out direction of future work.

2. RELATED WORK

The authors U. Paul, M.M. Buddhikot, A.P. Subramanian, and S.R. Das were stated that the complete measurement analysis of network resource deployment and the subscriber activities using a large-scale data set collected within a nationwide 3G cellular network. The data set keeps close to more number of subscribers over thousands of base stations. They then examine how efficiently network resources are used by different subscribers as well as by different applications. They also find out the network traffic from the point of view of the base stations and find significant temporal and spatial variations in different parts of the vehicles in network.

In order to address such coverage uncertainties the authors Z. Zheng, P. Sinha, and S. Kumar were given a idea about new the alternating coverage for mobile users, called α-coverage, and examined how such coverage can be attained by systematic deployment of more APs to create an efficiently scalable infrastructure. In other way, a deployment of APs provides α-coverage to a network resource, if the path with length α on the road network meets with at least one AP in network topology. The authors Z. Lu, Z. Zheng, P. Sinha, and S. Kumar were also stated that with increasing popularity of media enabled devices; the need for high data-rate services for mobile users is obvious.

3. MY CONTRIBUTION

The density measurement in vehicular network my contributions to this problem are as follow:

- The access point or relay tracks the vehicle capability prior and sends the corresponding low quality or high quality file. This achieves the vehicle to receive the proper file resource
- Vehicle density is calculated based on previous temporal changes and the new vehicle density is calculated.
- The access points' capabilities are adjusted so that it works more in high vehicle density environment and works less in low vehicle density environment.
- Vehicle density based download scenario is applied to Access Points.

Proposed methods where the Roadside infrastructure i.e., access points are working at different capabilities irrespective of vehicle density.

4. SYSTEM MODEL AND ASSUMPTIONS

4.1. Network Model

We create a network composed of fixed roadside APs and vehicular users, where some of them are downloader's. They are interested in downloading multimedia content from the Internet through the APs. We consider the general case in which every downloader may be interested in different content. Downloader's can either use direct connectivity with the APs, if available, or be assisted by other vehicles acting as intermediate relays. In particular, we consider the following data *transfer paradigms*:

Direct transfers, a direct communication between an AP and a downloader. This shows the typical way mobile users interact with the infrastructure in today's wireless networks;

Connected forwarding, the result shows traffic relaying through one or more vehicles that create a multi hop path between an AP and a downloader, where all the links of the connected path exist at the time of the data transfer. This is the conventional approach to traffic delivery in ad hoc networks;

Carry-and-forward, the traffic relaying through one or more vehicles that store and carry the data, and delivering them either to the target downloader or to another relay which meet such downloader sooner.

Our approach allows us to processing a road layout and an associated vehicular mobility trace, so as to build a time expanded graph that represents the temporal network evolution. By using this graph, we formulate a max-flow problem whose solution matches our goals.

5. DYNAMIC NETWORK TOPOLOGY GRAPH

Dynamic network topology graph (DNTG) generate a from a different vehicular mobility trace in network topology, considering that on the corresponding road layout there are: (i) a set of A candidate locations (a_i, i = 1, . . . ,A) where APs could be located, (ii)a set of V vehicles (v_i, i = 1, . . . , V) travel over the road layout and participating in the network, and (iii) a set of D vehicles that wish to download data from the APs.

The major aim of the DNTG is to model all possible opportunities through which data can flow from the APs to the downloader's, possibly via relays. With known mobility trace, we identify the *contact events* between any pair of nodes (i.e., two vehicles, or an AP and a vehicle).

Each contact event is characterized by:

Link quality, The quality level of the link between the two nodes; specifically, we take as link quality metric the achievable data rate at the network layer, which depends on the distance between the two nodes

The contact starting time, i.e., the time instant at which the link between the two nodes is established or the quality level of an already established link that takes on a new value;

A contact ending time, i.e., the time instant at which the link is removed, the quality level of link has changed.

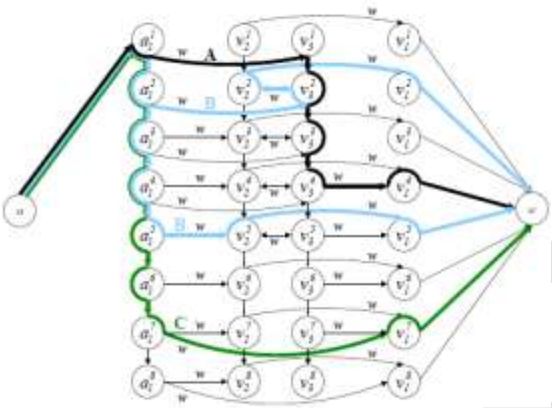


Figure1. A sample DNTG, in presence of one Access point A and three vehicles v1,v2 & v3, the first of which (v1) is a downloader while the others (v2, v3) can act as relays. The connection established in network during each frame is represented by a row of vertices. In the above graph, we highlight paths that are agent of the carry and-forward (A), connected forwarding (B), and direct (C) transfer paradigms.

Each vehicle V_i participating in the network at frame k is represented by a vertex V_i^k $(1 \leq i \leq V)$ in the DNTG, where as each candidate AP location A_i is mapped within each frame k onto a vertex $A_i^k (1 \leq i \leq A)$. We denote by V^k and A^k theset of vertices representing, respectively, the vehicles and APs in the DNTG at time frame k, while we denote by $D^k \subseteq V^k$the subset of vertices representing the downloaders that existin the network at frame k. All non-downloader vehicles in$R^k = V^k \backslash D^k$can act as relays, according to the data transfer paradigms outlined above.

Within each frame k, a directed edge $(V_i^k \in V_j^k)$ exists fromvertex $V_i^k \in R^k$ to vertex $V_j^k \in V^k$ if a contact between thenon-downloader vehicle V_i and another vehicleV_j is active during that frame. Each edge of this frame type is associated with a weight w (V_i^k, V_j^k), equal to the rate of that corresponding contact event. The set including such edges is defined as L_v^k . Similarly, a directed edge (A_i^k, V_j^k) comes from vertex $A_i^k \in A^k$ to vertex $V_j^k \in V^k$ if a contact between the candidate AP Ai and the vehicle V_j is active during frame k. Again, these edges are associated with weights w(A_i^k, V_j^k), equivalent to the contact event rate, and their set is defined as L^k a. A directed edge (V_i^k, V_i^{k+1}) is also drawn from any vertex $V_i^k \in R^k$ to any vertex $V_i^{k+1} \in R_i^{k+1}$, for $1 \leq k \leq F$. While the edges in L_v^k and L_a^k represent transmission opportunity, those of the form (V_i^k, V_i^{k+1}) model the possibility that a nondownloader vehicle $V_i$physically carries some data during its association from frame k to frame k + 1. Accordingly, these edges are associated with a weight representing the vehicle storage capabilities, since they do not involve any rate-limited data transfer over the wireless medium. However, dealing with vehicular nodes as conflicted to resource-constrained hand-held devices, we take the weight of such edges to be assume on an infinite value. A directed edge (A_i^k, A_i^{k+1}) of infinite weight is also drawn between two any vertices representing the same candidate AP at two consecutive frames, i.e., from $A_i^k \epsilon A^k$ to $A_i^{k+1} \epsilon A^{k+1}$ $(1 \leq k \leq F)$. We will refer to the edges of the kind (V_i^k, V_i^{k+1}) or (A_i^k, A_i^{k+1}) as intra-nodal.

The DNTG is therefore a weighted directed graph, representing the network topology development over time. An example of DNTG is given in Fig. 1, in presence of one AP and three vehicles v1, v2,& v3, with v1 being a downloader and v2, v3 possibly acting as relays. There, contact events divide different frames that correspond to rows of vertices in the DNTG, where intra-nodal edges connect vertices which represent the same vehicle or candidate Access point over time. To minimize the graph size, in this example we assume the achievable network-layer rate w to be constant during the complete lifetime of a link; in our performance evaluation, instead, we consider a more complex model, which accounts for pragmatic variations of the rate as a function of the distance between the two nodes. And also, note that the graph allows the capture of all the data transfer paradigms previously discussed. It is thus possible to identify paths in the graph that correspond to (1) direct download from the Access point to the downloader, as path C, (2) connected forwarding through 3-hops (frame 2) and 2-hops (frame 5), as path B, and (3) carry-and-forward through the movement in time of the relay vehicle v3, as path A.

6. THE MAX-FLOW PROBLEM

With specified DNTG, our next step is the formulation of an optimization problem whose goal is to maximize the flow from $\propto$ to ω, i.e., the total amount of downloaded data by the downloader's. Denoted by x (V_i^k, ω) the traffic flow over an edge connecting two generic vertices, our intention can be expressed as:

$$max \sum_{k=1}^{F} \sum_{V_i^k \in D^k} x(V_i^k, \omega). \qquad (1)$$

The max-flow problem needs to be solved taking into account several constraints for e.g., non negative flow and flow conservation, maximum number of APs that can be activated, and channel access. We detail such constraints below.

6.1 Constraints

Non-negative flow and flow conservation: The flow on each existing edge in DNTG must be greater than or equal to zero. Also, for any vertex in the graph, the amount of flow entering the vertex must equal the amount of outgoing flow.

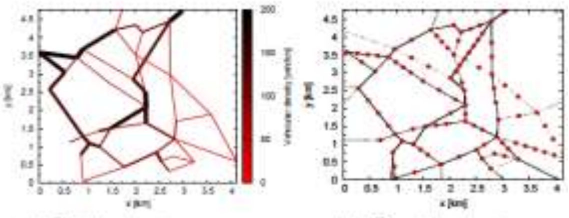
Channel access: In view of the fact that we consider an IEEE 802.11-based MAC scheme with RTS/CTS and we assume unicast transmissions, two or more of the following events cannot take place simultaneously for a tagged vehicle, and the time duration of each frame must be shared among the tagged vehicle:

- The vehicle transmits to a neighboring vehicle;
- A neighboring vehicle receives from any relay;
- The vehicle receives from a neighboring relay;
- A neighboring relay transmits to any vehicle;
- The vehicle receives from a neighboring AP;
- A neighboring AP transmits to any vehicle.

Here, we only consider the total amount of data carried by each flow. Due to the use of RTS/CTS in 2) a neighboring vehicle receiving data is accounted, considering that: 1) is a subcase of 2); 3) is a subcase of 4); 5) is a subcase of 6), for the generic vertex $V_i^k \epsilon V^k$ and for any frame k. In addition, for each candidate AP, we have that its total transmission time during the generic frame k cannot exceed the frame duration. Thus, for any k and $A_j^k \epsilon A^k$, we have the equation as:

$$\sum_{V_i^k \in V^k (a_j^k, v_i^k) \epsilon L_a^k} \frac{x\left(a_j^k, v_m^k\right)}{x\left(a_j^k, v_m^k\right)} \leq \tau^k \qquad (2)$$

The above constraints allow a vehicle under coverage of an AP to use I2V and V2V communication within the same frame. Next, we consider the case where a vehicle under the coverage of either one AP is not configured to work in ad hoc mode, i.e., the communication with other vehicle is not possible. Then, for every frame k and $V_j^k \in R^k$,$V_m^k \epsilon v^k$ such that $(V_j^k, V_m^k) \in L_v^k$, the following constraint holds:



(a) Vehicular density over space (b) AP candidate locations

Figure2. Simulation scenario: (a) road layout and average density of vehicles computed over a whole day; (b) giving out of the AP candidate locations over the road layout.

$$\mathrm{x}(v_j^k, v_m^k) \leq \left(1 - \max_{\substack{k \\ a_i^k \in A^k \\ (a_j^k, v_i^k) \epsilon L_a^k}} \{y_i\} \right) w(V_j^k, V_m^k) \tau^k \qquad (3)$$

Wherey_i, i = 1, . . . ,A, are Boolean variables, whose value is 1 if the candidate AP Ai is activated and the value becomes 0 otherwise.

Maximum number of active APs: The final set of constraints imposes that no more than one candidate APs are selected, through the variables yi. Then, for any i, we can write:

$$y_i \in \{0,1\}\,;\ \sum_{i=1}^{A} y_i \leq \hat{A}\,; x(\propto . a_i^1) \leq M y_i \qquad (4)$$

Where M ϵ R is a randomly large positive constant.

7. DERIVING DESIGN GUIDELINES

We influence the problem formulation obtained in the previous section to show which factors issue the most in content downloading in vehicular networks and to provide practical hints for the design of a real system. We consider a real-world road topology, covering an area of 20 km2 in the urban area. The vehicular mobility in the region has been synthetically generated at urban area, through a multi-agent microscopic traffic simulator. In Fig. 2(a), we describe the road layout, high lighting the different traffic volumes observed over each road segment.

We consider a traditional technology penetration rate, i.e., that only a fraction of the vehicles, namely 10%, is equipped with a communication interface and is ready to participate in the content downloading process, either as relays or as downloader's. Also, the number of vehicular downloader's that concurrently request content is assumed to be 1% of the vehicles participating in the network. AP locations are selected along the roads such that the distance between two adjacent APs is slightly equal to 150 m, resulting in 92 candidate locations, shown in Fig. 2(b). The value of the achievable network-layer rate between any two nodes is attuned according to the distance between them. We bounded the maximum node transmission range to 200m; this distance allows the establishment of a reliable communication in 80% of the cases. In the urban, village, and suburban traces, each lasting about 5 hours, this leads to an average density of 90, 62.5, and 33.5 veh/km respectively. The value of the attainable network-layer rate between every two nodes is adjusted according to the distance between them. To summarize, we illustrate the following conclusions:

- Traffic relaying, through either connected forwarding or carry-and-forward, can considerably increase the average per-downloader throughput, even when the road layout is covered by more APs;
- Multi-hop data transfers involving more than one relay are less beneficial to the content downloading process.

8. VEHICLE DENSITY BASED ACCESS POINT DATA DOWNLOADING

In addition, the access point or relay tracks the vehicle capability prior and sends the corresponding low quality or high quality file. This achieves the vehicle to receive the proper file resource.

Vehicle density is calculated based on previous temporal changes and the new vehicle density is calculated. The access points' capabilities are adjusted so that it works more in high vehicle density environment and works less in low vehicle density environment.

9. SECURITY ISSUES

9.1 Digital signatures as a building block

The message authenticity is necessary to protect VANETs from outsiders. But since safety messages will not contain any sensitive information confidentiality is not required. As a result, the exchange of safety messages in a VANET needs authentication but no need for encryption of message. Symmetric authentication mechanisms usually encourage less overhead per message than their asymmetric counter parts. But digital signatures are a better choice in the VANET setting, because safety messages are typically standalone and should be sent to receivers as quick as possible.

9.2 Estimation of the signature size

As we intend using a PKI for supporting security in VANETs, it is significant to choose a Public Key Cryptosystem (PKCS) with a tolerable implementation overhead in the vehicular network. According to DSRC, safety messages are sent with a periodicity of 100 to 300 ms. this imposes an upper bound on the processing time overhead; this overhead is shown as follows:

Toh(M) = Tsign(M) + Ttx(M|SigPrKV [M]) + Tverify(M)

Where Tsign (M), Ttx (M), and Tverify (M) are the necessary time durations to sign, transmit, and verify a message M, respectively; SigPrKV [M] is the signature of M by the distributing vehicle V and includes the CA's certificate of the signing key. The above expression shows the two factors that affect the choice of a particular PKCS: (1) the execution speeds of the signature generation and the verification operations, and (2) the sizes of key, signature, and certificate.

10. CONCLUSION

We examined the main factors affecting the performance of content downloading process in vehicular networks, by formulating and solving a max-flow problem over a time extended graph representing a realistic vehicular trace.

The major findings in our analysis are as follows:

Our major ideas are that a density-based AP deployment yields performance close to the optimum result, and that multi-hop traffic delivery is valuable, although the gain is negligible beyond 2 hops from the AP.

The access points' capabilities are adjusted so that it works more in high vehicle density environment and works less in low vehicle density environment.

To our best knowledge, this paper addressing the security of vehicular networks in a systematic and quantified way. In terms of future work, we aim to further develop this proposal. In particular, we plan to explore in more detail the respective merits of key distribution by the manufacturers or by legislative bodies; we will also going to carry out additional numerical evaluations of the solutions.

REFERENCES:

[1]. M. Francesco.C. Claudio,C. Carla-Fabiana and F. Marco, "Optimal content downloading in vehicular networks," proc. IEEE INFOCOM, July 2013.

[2]. U. Paul, A.P. Subramanian, M.M. Buddhikot, and S.R. Das, "Understanding Traffic Dynamics in Cellular Data Networks," Proc. IEEE INFOCOM, Apr. 2011.

[3]. K. Pentikousis, M. Palola, M. Jurvansuu, and P. Perl, "Active good put measurements from a public 3G/UMTS network," IEEE Communica-tions Letters, vol. 9, pp. 802–804, 2005.

[4]. P. Reichl, M. Umlauft, J. Fabini, R. Lauster, and G. Pospischil, "Project WISQY: A measurement-based end-to-end application-level performance comparison o f 2 .5G and 3G networks," in Proc. Fourth Ann. Wireless Telecomm. Symp (FTS), 2005.

[5]. K. Mattar, A. Sridharan, H. Zang, I. Matta, and A. Bestavros, "TCP over C DMA2000 networks: A cross-layer measurement study," in Proc. PA M , 2007

[6]. R. Keralapura, A. Nucci, Z.-L. Zhang, and L. Gao, "Profiling users in a 3G network using hourglass co-clustering," in Proc. ACM MobiCom, 2010.

[7]. Z. Zheng, P. Sinha, and S. Kumar, "Alpha Coverage: Bounding the Interconnection Gap for Vehicular Internet Access," Proc. IEEE INFOCOM, Apr. 2009.

[8]. VeriWise Asset Intelligence. http://www.ge.com/equipmentservices/ asse intelligence/.

[9]. A. Balasubramanian, R. Mahajan, A. Venkataramani, B. N. Levine, and J. Zahorjan. Interactive Wi-Fi Connectivity for Moving Vehicles. In Proc. of ACM SIGCOMM, Sept. 2008.

[10]. Laura Garelli, Claudio Casetti, Carla-Fabiana Chiasserini, Marco Fiore, " Mob Sampling: V2V Communications for Traffic Density Estimation" Proc.IEEE INFOCOM 2011

[11] V. Bychkovsky, B. Hull, A. K. Miu, H. Balakrishnan, and S. Madden. A Measurement Study of Vehicular Internet Access Using In Situ Wi-Fi Networks. In Proc. o f ACM MOBICOM, Sept. 2006.

[12] J. Eriksson, H. Balakrishnan, and S. Madden. Cabernet: A Wi-Fi-Based Vehicular Content Delivery Network. In Proc. o f ACM MOBICOM, Sept. 2008.