

Effective Communication in VANET using Bandwidth Maps

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Abstract: -Wireless Wide Area Networks (WWANs) is expected to provide actual bandwidth at change of location, e.g., vehicle continuously changes its location by fast moving, it is difficult for network providers to eliminate bandwidth changes over a large service area, it may be possible to map network bandwidth over repeated measurements on the road network. In this paper, we proposed earlier problem over bandwidth maps in a heterogeneous network. We show the bandwidth mapping concept of delivering an Internet services from on-board mobile routers to the user with an adaptive multimedia servers for the emerging vehicular system for communication. Using the simulation we detect the data, to improve in Quality of Service (QoS) that can be achieved by taking advantage of the geographical knowledge of bandwidth provided by the bandwidth maps and merging the 3G based technology with Vehicular (VANET). We find that our approach improve the frequency of disruptions in perceived QoS for multimedia applications in high-speed vehicular mobility.

Keywords: Wireless Wide Area Network, VANET, bandwidth mapping, quality of service.

I Introduction

WLAN and WWAN both connect to the Internet wirelessly, but they use different technology to do it. WLAN is intended for “local” use. It is Also referred as Wi-Fi, probably the most common way to wirelessly connect to the Internet. WWAN is a mobile broadband3 option that covers a “wide” area . Commonly it is called as “3G” or in some areas a “4G” network.

1.1WLAN

WLAN connections are normally found in homes, offices, hotels, airports and are somewhere else, free to users. WLAN keeps constantly connected to the network as it is used to move in and around house or network area. WLAN is easy for small businesses to grow and connect more users without adding wires. WLAN is typically faster than WWAN. The area covered by WLAN is fixed and typically small. Because WLAN uses radio waves, signal strength can sometimes be compromised.

WWAN provides regional, nationwide and global wireless coverage. WWAN provides better security than WLAN and built-in with 128-bit encryption. It utilizes cellular technology to securely transfer data or connect to the Internet. Ideal for users away from home needing to connect virtually anywhere in their coverage area .ISP

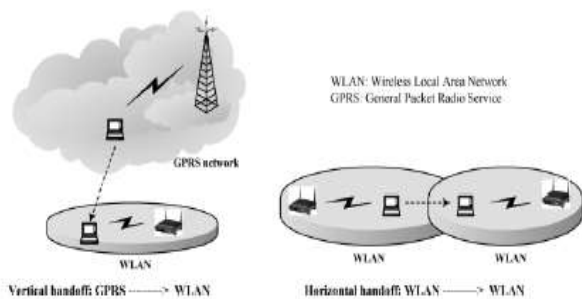


Fig 1: WWAN AND WLAN

contract may cost more than WLAN for those who rarely need or use wireless Internet access.

2. Bandwidth

High Speed Packet Access (HSPA) is an amalgamation of two mobile telephony protocols, High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA), that extends and improves the performance of existing 3rd generation mobile telecommunication networks utilizing the WCDMA protocols. A further improved 3GPP standard, Evolved HSPA (also known as HSPA+), was released late in 2008 with subsequent worldwide adoption beginning in 2010. The newer standard allows bit-rates to reach as high as 168 Mbit/s in the downlink and 22 Mbit/s in the uplink. Evolved HSPA (HSPA+) is a wireless broadband standard defined in 3GPP for WCDMA specification. It provides extensions to the existing HSPA definitions and is therefore backwards compatible all the way to the original Release 99 WCDMA network releases. Evolved HSPA provides data rates up to 84 Mbit/s in the downlink and 10.8 Mbit/s in the uplink (per 5 MHz carrier) with multiple input, multiple output (2x2 MIMO) technologies and higher order modulation (64 QAM). With Dual Cell technology, these can be doubled. Trends show explosive bandwidth growth of the Internet at large and for mobile broadband networks in particular.

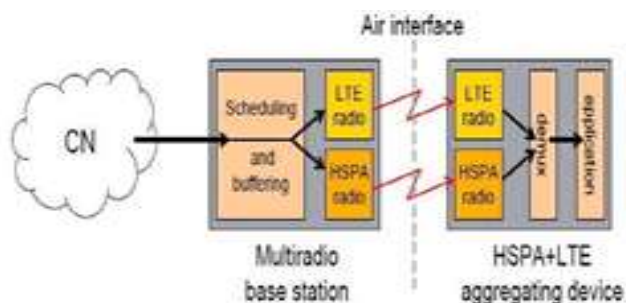


Fig 2: A HSPA + LTE aggregation data flow through a Multi-Radio base station

3. Bandwidth Management

Huge growth in mobile operators are either employing or considering multiple approaches to manage bandwidth.

- Unpaired spectrum

Technologies such as HSPA + LTE allow the use of different amounts of spectrum between downlink and uplink. Additional unpaired downlink spectrum can be combined with paired spectrum to increase capacity and user throughputs. Increased spectral efficiency. Newer technologies are spectrally more efficient, meaning greater aggregate throughput in the same amount of spectrum. Wireless technologies such as LTE, however, are reaching the theoretical limits of spectral efficiency and future gains will be quite modest, allowing for a possible doubling of LTE efficiency over currently deployed versions.

- Unpaired spectrum

Technologies such as HSPA + and aggregation. Operators can increase network capacity by applying new receive technologies at the base station (e.g., large scale antenna systems) that do not necessarily require standards. This can be combined with added capacity on the downlink from carrier aggregation. This type of deployment flexibility suggests that regulators should consider licensing just downlink spectrum in some cases, since that is where it is generally most needed.

Small cells and heterogeneous networks. Selective addition of Pico cells to macro cells to address localized demand can significantly boost overall capacity. Het-nets, which also can include femto cells, hold the promise of achieving capacity gains of a factor of four and potentially even higher with the introduction of interference-cancellation-based devices. The actual gain realized will depend upon a number of factors including number and placement of small cells, user distribution, and any small-cell selection bias that might be applied Off-peak hours. Operators can offer user incentives or perhaps fewer restrictions on large data transfers that occur at off-peak hours such as overnight.

Quality of Service (QoS) By prioritizing traffic, certain traffic such as non-time critical downloads can execute with lower priority, thus not affecting other active users.

4. Video Streaming

Streaming media is multimedia that is constantly received by and presented to an end-user while being delivered by a streaming provider. This refers to the delivery method of the medium rather than to the medium itself. Data applications require varying bandwidth to deliver the required end user experience. Mobile data applications can require anything from a couple of kilobits for text messaging to many hundreds of kilobits for high quality video streaming or conferencing.

In On Demand Streaming the streaming media is available on the server at all times. The Media is delivered to the user upon request. IPTV offers such services on TV's and Personal computers. There are also a lot of websites providing On Demand Streaming and one of the biggest examples is that of YouTube. The important thing with On Demand Streaming is that the server has to store the media at all times and a considerable amount of space on the server is required at all times.

Live Streaming With Live streaming we first have to capture the media using an A/V input device. The captured media then has to be encoded using an encoder and then transmitted on the fly. Live streaming does not require as much storage space as On Demand Streaming but requires a large amount of computing resources and extra hardware.

Adaptive Streaming adapts to the varying network conditions. It ensures that the user receives the best quality video under the present network conditions experienced by the user. A user with an Internet connection of fixed bandwidth does not get the guaranteed bandwidth at all times, instead this bandwidth can change depending on the traffic from other users. If there were no adaptive streaming the user

would experience interruptions and buffering periods, when there is no video available to the user. But when using Adaptive Streaming instead of this pause and interruption, can switch to a lower quality video that is available at the server. This helps to avoid interruption in playing video at the user, and the user always gets the best quality video under its available network conditions.

$$TFRC_{rate} = \frac{s}{R\sqrt{\frac{2p}{3}} + t_{RTO}\sqrt{\frac{27p}{8}p(1 + 32p^2)}}$$

In the above equation, p denotes the loss event rate, which is received as feedback from the receiver, t_{RTO} refers to the TCP retransmission time-out, and s is the packet size. Then used in conjunction with an adaptive streaming algorithm, the streaming bit rate is directly controlled by the sending TFRC rate.

5. Bandwidth Mapping

QoS is usually specified in terms of delay jitter, utilization, delay, packet loss ratio, etc. The packet loss in a network is mainly due to buffer overflow; therefore, the probability of buffer overflows in a network. Varying in a network's QoS with respect to a change in the bandwidth of an incoming data traffic flow is extremely helpful in the effective performance of a network to achieve its target QoS. Existing approaches, such as enhanced bandwidth WWAN bandwidth exhibits the PTMTP property. The historical knowledge of location-specific bandwidth can be leveraged by mobile applications to rapidly adapt to the bandwidth fluctuations occur inherent in a high mobility scenario. The creation of bandwidth maps, as a means for representing bandwidth data, by superimposing summary statistics of past bandwidth observations on road network maps Mobile applications can use these maps and learn about the expected bandwidth conditions at future locations. Such purpose bandwidth maps are created.

Either by using Active or Passive measurement tools bandwidth samples are collected. The active

measurement user can be deployed on their mobile device. The measurement server can be hosted by the WWAN service providers. The advantage of the active approach is the ability to control the measurement process, e.g., the sampling frequency. Drawback of this method is that it introduces overheads, since probe packets are actively injected into the network. Moreover, the bandwidth usage of the probes can be kept to a minimum by appropriately adjusting the measuring parameters [7]. In the passive measurement approach, a simple client can be installed on the mobile device, which can infer the bandwidth by monitoring the network activity over the wireless interface [19]. Since passive techniques do not inject any traffic, they do not incur overheads. However, the measurement can only be conducted when there is network activity, thus providing little control. The bandwidth samples collected (using either approach) must be tagged with the corresponding location coordinates and time and stored in a repository (either at the client or server) for later processing. When the mobile client has built-in GPS receiver, the location coordinates required for geo tagging can be directly collected from the receiver. Alternatively, Wi-Fi or cellular localization techniques [20] could be employed, albeit with a coarser location granularity.

6. Multi homing Traffic Scheduling

In this section, we present a second application of bandwidth maps, which enhances the QoS offered by an on-board communication network connected to the Internet via multiple WWAN links. The proposed bandwidth maps with the traffic scheduler in an on-board network. The average bandwidth from past observations of different locations in making load balanced.

7. Simulation and Results

Thus the simulations is conducted in ns-2. The simulated an on-board NEMO network as illustrated in Fig. 16. The MR maintains three parallel WWAN connections,

which correspond to providers A, B, and C from our empirical measurements in Section 3. We refer to Fig. 16 for the network parameters used in the simulation. As in Section 5, we simulate the vehicle mobility by playing back the corresponding bandwidth trace files from the three providers for a particular trip. We consider a scenario, wherein, several on-board users are streaming audio (e.g., radio talk shows and webinars) from different Internet servers, which are denoted as Corresponding Nodes (CN).

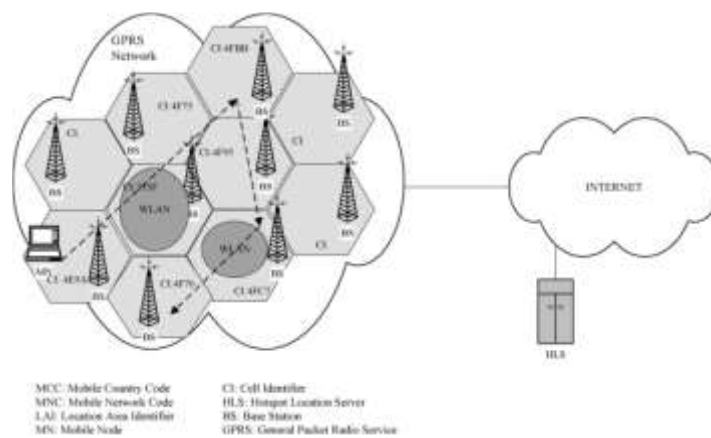


Fig 3: Interfacing bandwidth maps with a multi homed Scheduler

In the simulation video is encoded to G711- 64 Kbps constant bit rate (CBR) flows [36]. Flow arrival follows Poisson distribution with mean $\lambda=10$ flows/minute. Assume the session duration is exponentially distributed with mean $\lambda=180$ s. Note that, these traffic load settings represent a scenario when the system load is close to saturation. The plain reactive closed-loop scheduling scheme as React. In our implementation, the MR implements a monitoring agent that passively estimates the throughput for each WWAN link over each 2-second interval and reports it to the HA. Note that, the reported throughput may not accurately represent the actual link bandwidth. For example, when a link is underutilized, the estimate computed by the MR reflects the actual traffic load assigned to the link rather than the link bandwidth. To infer the actual bandwidth, we use a simple

Multiplicative Increase Multiplicative Decrease (MIMD) algorithm. When the reported throughput of a WWAN link is lower than the assigned traffic load, the HA assumes that the link is overloaded. In this case, the HA estimates the bandwidth as half of the assigned traffic load on the link. Otherwise, when the measured bandwidth of the link equals the assigned load, the link is deemed as underutilized. In this case, the bandwidth is estimated as 1.1 assigned traffic load. The parameters for the MIMD algorithm have been chosen based on our experiments (excluded for reasons of brevity). Based on the bandwidth estimates, the HA uses (11) to schedule flows. Rescheduling is also triggered with the traffic load in the on-board network changes due to a new flow starting or an existing flow ending. We refer to our bandwidth map supplemented closed loop scheme as BW-MAP. We assume that the HA is always aware of the current vehicle's location. (The MR is equipped with a GPS and sends periodic location updates to the HA.) Recall that, as described in Section 6.2, the key difference between BW-MAP and React is that, when the vehicle enters into a new location, BW-MAP uses the location specific mean bandwidth values of all WWAN links to reschedule the flows using the formula.

$$\lambda_i = \frac{\bar{b}_{i,l}}{\sum_i \bar{b}_{i,l}} \times \lambda.$$

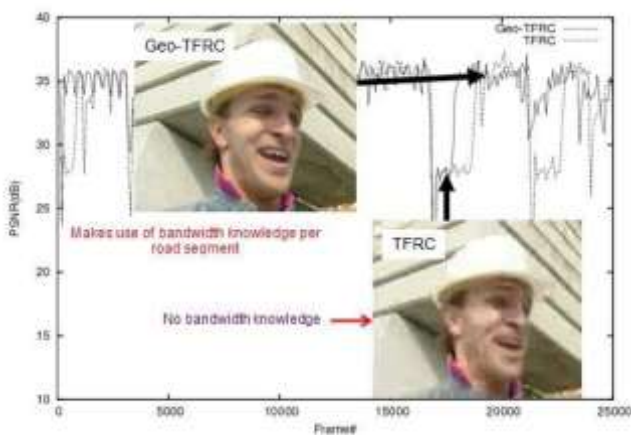


Fig 4: Bandwidth Traffic

TFRC employs TCP's slow-start algorithm, it requires considerable time to ramp up its sending rate. Further, observe that the exponential increase during slow start leads to packet loss following which, the sender enters congestion avoidance. On the contrary, BW-MAP-TFRC bypasses slow start completely. The sending rate is bootstrapped at the past mean bandwidth at the initial location. As a result, the sending rate converges to the current bandwidth within 10 s. The improved convergence achieved by BW-MAP-TFRC is reflected in the PSNR results. Fig. 12b shows that the PSNR of BW-MAP-TFRC quickly converges to 35 dB and remains steady around that value. On the contrary, TFRC significantly underutilizes the bandwidth and thus misses out the opportunities to transmit a better quality stream. As a result, the picture quality is poor, wherein users suffer consecutive glitches. Fig. 13 offers a snapshot of the different viewing experience for both schemes by displaying the decoded frame, which is played. Note that, the picture quality with TFRC is pixelated, whereas the frame delivered by BW-MAP-TFRC is crystal clear.

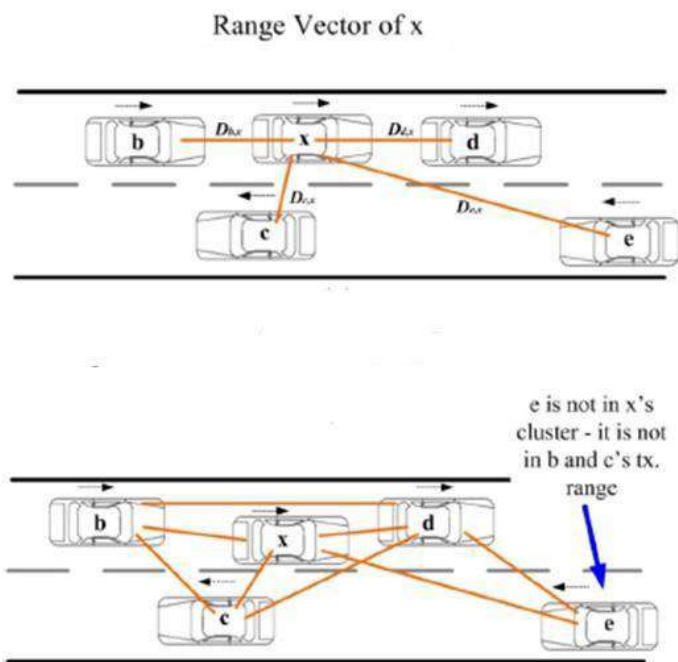


Fig 5: Vehicular Ad-hoc network Transmission

8. Conclusion

The emerging WWANs do not guarantee bandwidth uniformity over the geographical coverage. More precisely, at any given time, it is possible to receive significantly different bandwidth from the same network provider at different locations of the same street. We have found that the past bandwidth information is a good indicator of the actual bandwidth experienced at a given location. While time of day also influences the mobile bandwidth, our analysis of empirical traces has shown that location appears to have a far greater influence than time. We have shown that it is not difficult for vehicular users to capture the past bandwidth knowledge in the form of geographical bandwidth maps for part of the road network frequently traveled. We have further demonstrated the usefulness of these maps with two representative case studies, adaptive multimedia and mobile router-based vehicular Internet. Our work has shown that the use of past location-specific bandwidth knowledge can significantly improve the QoS of multimedia streaming applications in high-speed mobility.

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