Comprehensive Mobile Bandwidth Traces from Vehicular Networks

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Joint work with Mahbub Hassan, Salil Kanhere, Jun Yao and Garson Zhong
Why we need such dataset? (Example of use)

Our data collection campaigns
  • Bandwidth measurement application
  • Data format
Mobile Data Tsunami

Global Mobile Data Traffic Growth / Top-Line
Global Mobile Data Traffic will Increase 10-Fold from 2014–2019

Exabytes per Month

<table>
<thead>
<tr>
<th>Year</th>
<th>Exabytes</th>
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<tbody>
<tr>
<td>2014</td>
<td>2.5 EB</td>
</tr>
<tr>
<td>2015</td>
<td>4.2 EB</td>
</tr>
<tr>
<td>2016</td>
<td>6.8 EB</td>
</tr>
<tr>
<td>2017</td>
<td>10.7 EB</td>
</tr>
<tr>
<td>2018</td>
<td>16.1 EB</td>
</tr>
<tr>
<td>2019</td>
<td>24.3 EB</td>
</tr>
</tbody>
</table>

Source: Cisco VNI Global Mobile Data Traffic Forecast, 2014–2019

1 EB = 1000^6 bytes = 10^{18} bytes = 1 000 000 000 000 000 000 B = 1000 petabytes = 1 million terabytes = 1 billion gigabytes.
Trend 4: Analyzing Mobile Applications

— Video Usage Increases

Because mobile video content has much higher bit rates than other mobile content types, mobile video will generate much of the mobile traffic growth through 2019. Mobile video will grow at a CAGR of 66 percent between 2014 and 2019, the highest growth rate of any mobile application category that we forecast other than M2M traffic.

Of the 24.3 exabytes per month crossing the mobile network by 2019, 17.4 exabytes will be due to video (Figure 13). Mobile video represented more than half of global mobile data traffic beginning in 2012, indicating that it is having an immediate impact on traffic today, not just in the future.

Figure 13. Mobile Video Will Generate More Than 69 Percent of Mobile Data Traffic by 2019

Figures in parentheses refer to 2014, 2019 traffic share.

Source: Cisco VNI Mobile, 2015
what's the Problem?
Bandwidth Variability in Vehicular Environment

Mobile bandwidth fluctuates rapidly and significantly while in motion

Simple reactive techniques may not result in the best QoE for the users

Our Solution

Intelligent quality selection: prevent re-buffering and maximize the overall quality

Fill the buffer before outage

Predict the Outage

Using Historical Bandwidth Statistics

Video Streaming Quality:
1. Freezing events
2. Quality changes
3. Quality level

Rate Adaptation based on Real-time Bandwidth Observation
Comparing MDP vs. non-MDP-based DASH players

Comparison between MDP and non-MDP algorithms. MDP significantly outperforms non-MDP algorithm by achieving less DM for the same AQ. Testing trips: 66-71, (a) Big Buck Bunny, (b) Different video clips: 1- Elephant Dream, 2- Of Forest and Men, 2- The Swiss Account, 4- Valkamaa

Bandwidth Statistics
Bandwidth Measurement Application

A user friendly Android application:
Measure and store the downstream bandwidth characteristics from any given network
by actively downloading a 1MB file from UNSW-CSE web server using the HTTP protocol.
Bandwidth Measurement Campaigns

Using two Android smartphones to perform the bandwidth measurements for 3G and 4G simultaneously

Bandwidth measurements in different day and night times
Bandwidth Measurement Campaigns

**Version 1 (3G - 2008)**
Sampling rate: 10 Sec
71 traces ( ~30 minutes)
24 Km route, Sydney, Australia

**Version 2 (3G $ 4G - 2015)**
Sampling rate: 10 & 15 Sec
72 traces ( ~15 minutes)
4.7 Km route, Sydney, Australia
Bandwidth Dataset 1

Each sample is time and location stamped
~180 samples per trace for ~30min drive for each trip
~ 56,754 samples in total from all 71 traces/trips for 3 providers

<table>
<thead>
<tr>
<th></th>
<th>time</th>
<th>latitude</th>
<th>longitude</th>
<th>bandwidth (Kbps)</th>
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Example of 6 probes within a specific trip for Provider A
Bandwidth Dataset 2

sampling time, file size, download duration and time, geographical coordinates before and after file download, network operator's information and country name
Thank You

Any Questions?

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