MITATE: Mobile Internet Testbed for Application Traffic Experimentation

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Introduction

A growing number of mobile applications support near real-time user interactions through multiplayer games, video chat, or augmented reality.

The usability of these applications depends on low latency network service to deliver user requests between mobile devices and cloud datacenters, on which backend logic is deployed, in a timely manner.

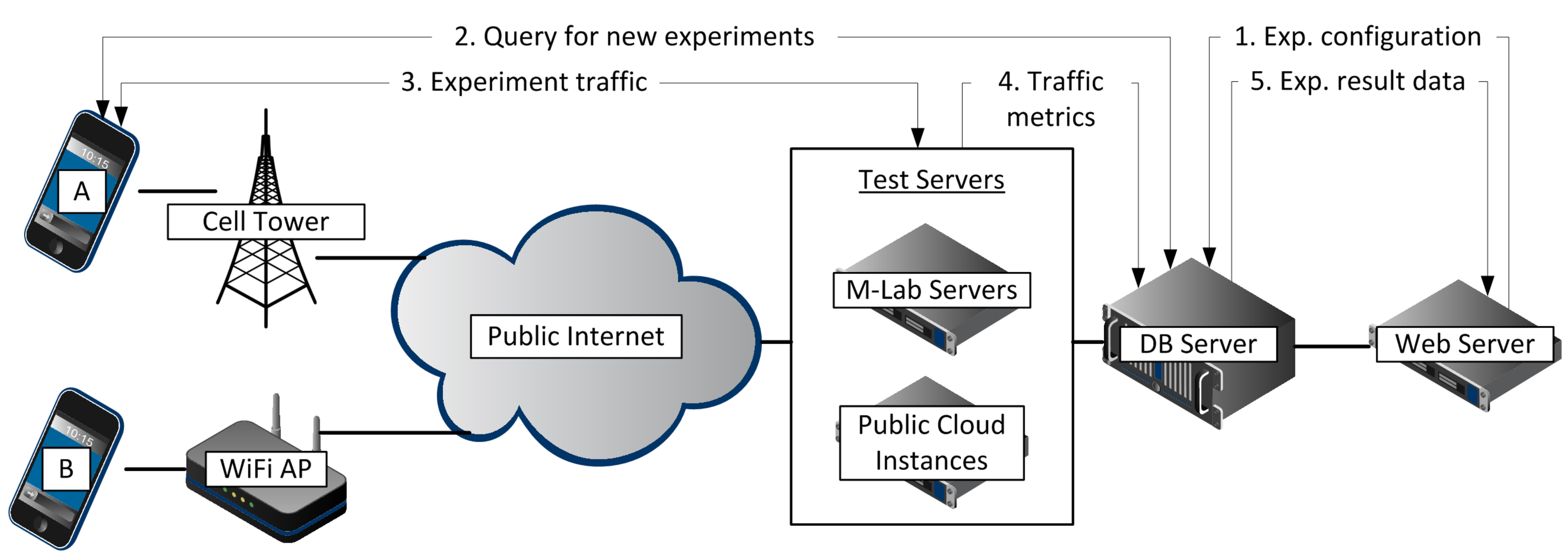
To design communication protocols that keep user request delay low across a range of network conditions, application developers need to know not only network performance characteristics such as latency, loss, or bandwidth, but also specific network configuration and provisioning details that affect packet delay.

Consequently, we propose not another network measurement study, but a platform for mobile network experimentation.

We aim to enable application designers to experiment with different transactional traffic to refine their communication protocols, or customize them for specific carriers, devices, geographic areas, and network conditions.

This functionality would enable developers to answer questions such as: "Will changing message size result in packet fragmentation?," or "Which CDN provides fastest downloads through a particular mobile service provider's network peering points?"

MITATE Architecture



In Step 1, the user creates an experiment by uploading an XML configuration file via the Web interface.

The XML configuration le, described more fully in Section 3.2, identifies a series of data transfers between a mobile device and Internet endpoints, which can be executed by any other user's mobile device registered to MITATE that meets a series of specified criteria.

Experiment data transfers are defined as sequences of messages of specific size, to be exchanged with specific timing, between identified Internet endpoints..

In Step 2, mobile devices registered with MITATE query the database for newly configured experiments, whose criteria they meet..
If device A, for example, meets the geographic location and network type criteria of an experiment, A will begin, in Step 3, to transfer data defined by the experiment to the test servers.
Experiment transfer traffic is timed at each endpoint and, following and experiment, traffic metrics along with metadata relevant to the transfers are reported back to the database in Step 4.
Finally in Step 5, the user may access the Web interface again to visualize, or download the experiment data collected by multiple devices

Conclusions

MITATE is a new platform for network experimentation.

Instead of being another one-off network measurement study, MITATE allows ongoing measurements studies of application traffic performance in mobile networks.

MITATE is intended for experimentation and refinement of application communication protocols prior to deployment.

Our results show that MITATE is can observe various network performance phenomena that affect application message delay.

Interested?

MITATE is currently being deployed on M-Lab. We encourage beta testers and collaborators within the mobile development and research communities to test MITATE and suggest extensions to its feature set before making the tool public.

For more information or to request access to MITATE, please contact Mike Wittie at mwittie@cs.montana.edu .

Experiment Configuration

Welcome to MITATE
http://mitatewebserver/sample.xml

```
▼<entry>
 ▼<defines>
  ▼<transferdefine>
   ▼<transfer>
     <id>t1</id>
     <sourceip>client</sourceip>
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     <bytes>1000</bytes>
     <type>UDP</type>
    </transfer>
   ▼<transfer>
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     <sourceip>54.243.176.74</sourceip>
     <destinationip>client</destinationip>
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     </bytes>
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   </transferdefine>
  ▼<criteriadefine>
   ▼<criteria>
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     <networktype>wifi</networktype>
     <starttime>12:00</starttime>
     <endtime>13:30</endtime>
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  </defines>
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    <count>10</count>
   ▼<criteria>
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    </criteria>
   ▼<transfers>
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     <transferid>t2</transferid>
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    </transfers>
   </transaction>
  </transactions>
</entry>
```
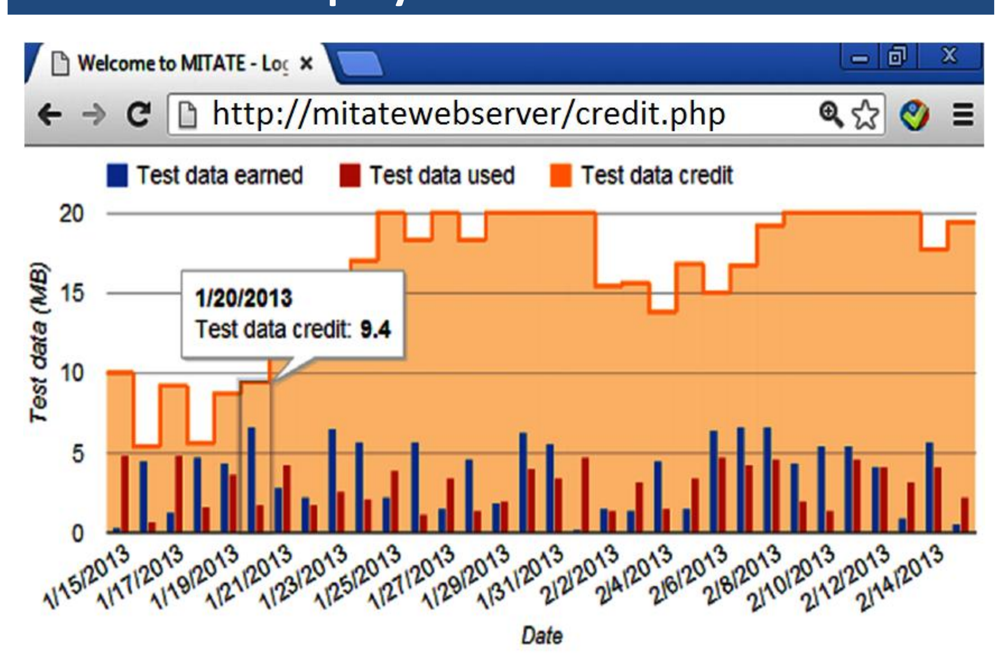

To configure an experiment, a user specifies a sequence of transfers between a mobile and a set of Internet end-points, a set of criteria mobiles must meet, and a sequence of transactions that group transfer and criteria.

The configuration file specifies two transfers, labeled t1 and t2, that transmit the specified number of bytes through UDP, or TCP sockets. Transfer t2 explicitly species the bytes of an HTTP transfer and 550 ms of processing delay. One of the transfer end-points is 'client', or a MITATE client mobile application, the other is a datacenter server IP with MITATE backend logic. The configuration file also species criteria definitions that client endpoints must meet before executing an experiment. In the example above, criteria c1, requires that a mobile be in Bozeman, MT, be connected to a Wi-Fi network, and that the time on the device be between noon and 1:30PM. MITATE allows experimenters to specify a wide set of criteria, for example radio signal strength, or device travel speed.

Deployment Incentives

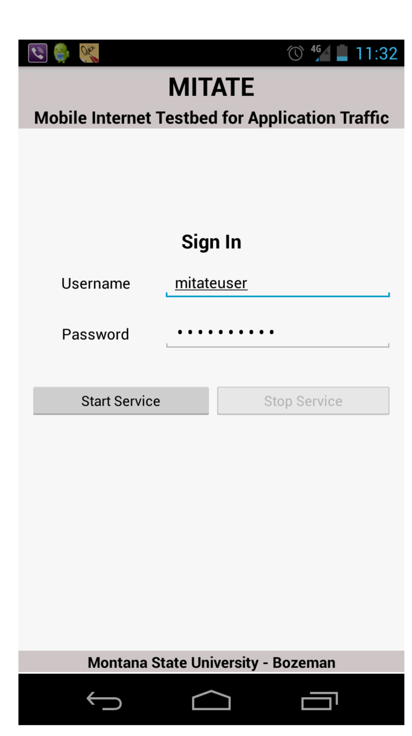


MITATE deployment incentive model is inspired by Bit-Torrent's tit-for-tat mechanisms, where participants are allowed into the system by contributing network resources of their mobile devices to support the experiments of others. Such an exchange of resources will allow users to reciprocally run experiments on others users' devices without overwhelming their willingness to contribute bandwidth.

Mobile Application

A user begins interaction with our system by registering their Google profile with MITATE's Web interface.

After logging in, the welcome page presents an overview of the functionality of MITATE and makes available the mobile application for download (via a link to the Google Play Store).



The user proceeds by downloading and installing the mobile application on his mobile device(s).

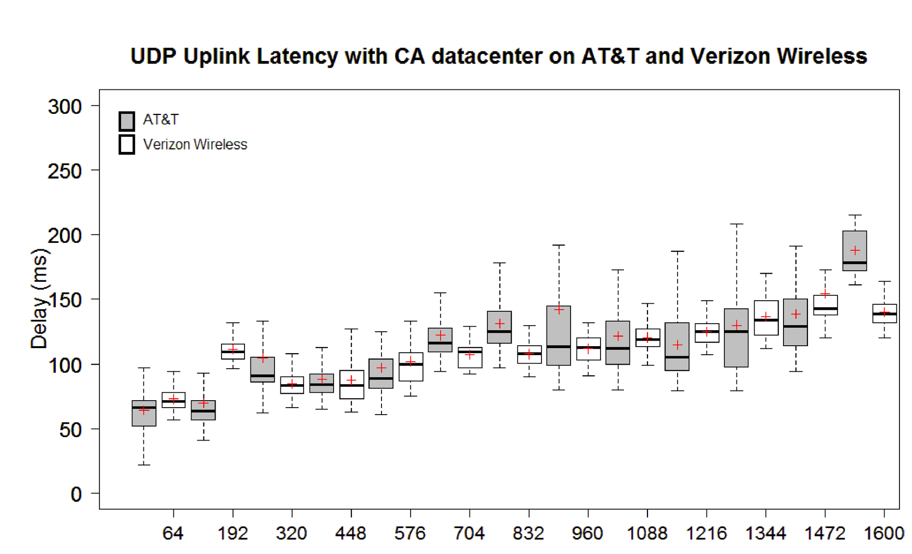
Upon installation, the user registers each device to their MITATE account by entering login credentials and starting the mobile application as a background service.

The mobile application allows users to set limits for mobile data, Wi-Fi data, battery usage, and server polling interval.

To facilitate configuration of multiple devices belonging to one user, these options can also be configured through the Web interface.

We envision allowing a user to set a cumulative data caps across groups of devices.

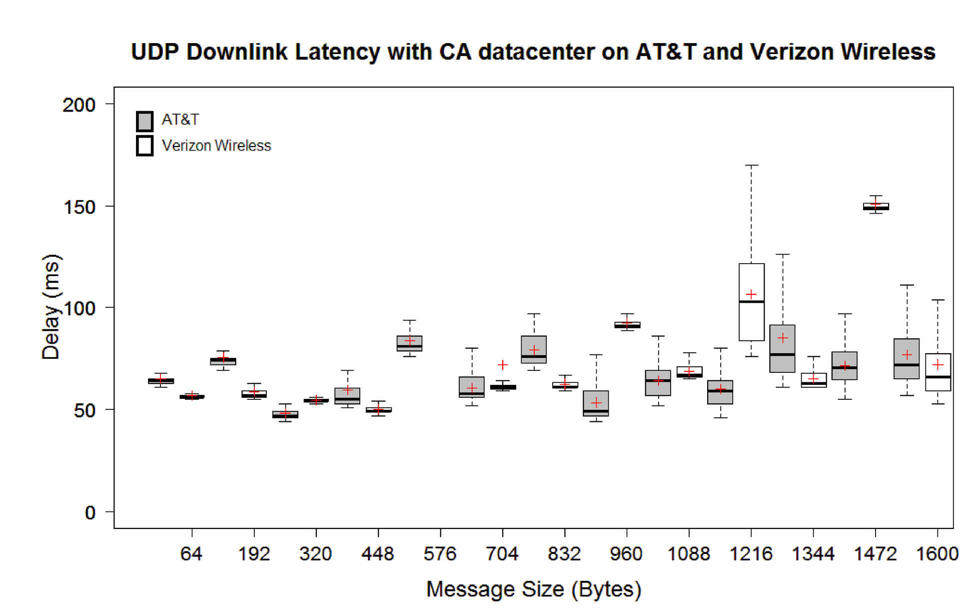
Early Results



The above graph shows the variation in uplink UDP latency based on the choice of message size on Verizon Wireless and AT&T mobile network carriers, tested at 10 AM from Bozeman, MT.

It can be observed from the graph that AT&T uplink is more sensitive on uplink UDP when compared with Verizon Wireless.

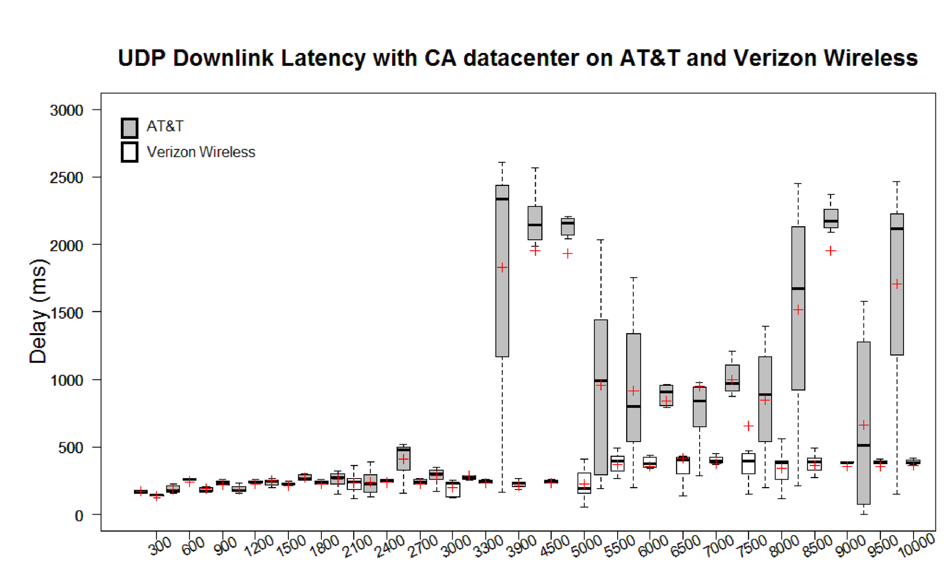
These results can help a mobile developer to choose the correct message size in order to fulfill user's request in a timely manner.



The above graph shows UDP downlink latencies for different message sizes for AT&T and Verizon Wireless mobile carriers, tested at 10 AM from Bozeman, MT.

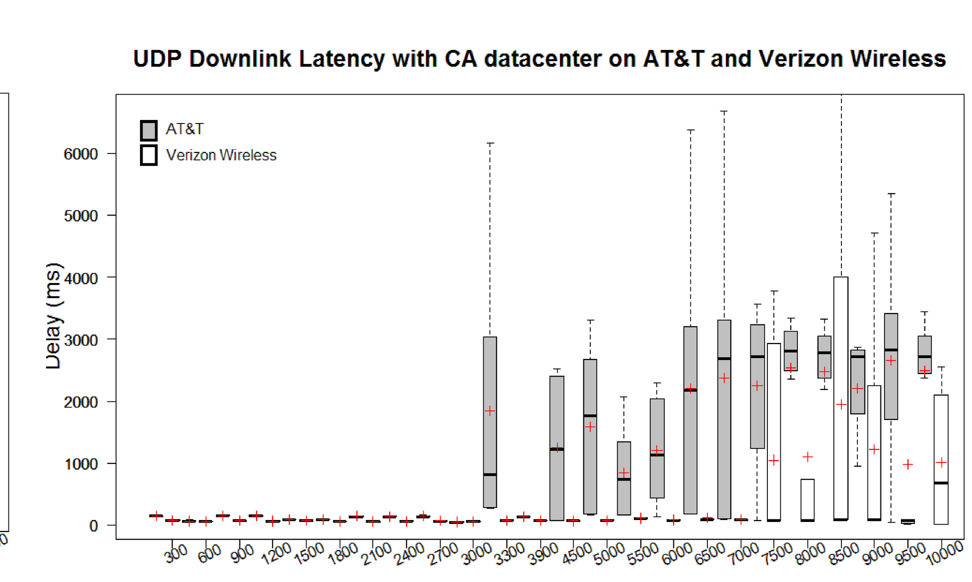
It can be observed from the graph that there is a see-saw pattern on downlink latencies on both Verizon Wireless and AT&T.

This may be due to change in the bandwidth allocation for varying message sizes.



The above graph shows UDP uplink latency based on the choice of transmission interval between packets, tested with AT&T and Verizon Wireless network carriers at 10 AM from Bozeman, MT.

It can be observed from the graph that latency is nearly constant until the 3600ms transmission interval where it takes a jump.



The above graph shows UDP downlink latency based on the choice of transmission interval between packets, tested with AT&T and Verizon Wireless network carriers at 10 AM from Bozeman, MT.

It can be observed from the graph that AT&T is more sensitive on downlink , if high transmission interval is chosen, when compared to Verizon Wireless.

We expect that the higher jump in delay when compared to the uplink result indicates that these delays are due to network allocation timeouts, rather then the device entering a power save mode.