MITATE: Mobile Internet Testbed for Application Traffic Experimentation

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1. 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 back-end logic is deployed, in a timely manner. Previous studies have shown significant variation in end-to-end mobile network performance that affects application request delay [4, 6]. Yet, many important aspects of mobile network performance across time and coverage areas remain poorly understood. As a result, developers lack the means to predict whether communication protocols they design will meet user expectations, or lead to user frustration and slower application adoption.

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. For example, previous studies have shown that packet size and transmission intervals in cellular networks can significantly affect end-to-end message delay [2, 14]. Further, cap-and-throttle, traffic redundancy elimination (TRE), and deep packet inspection (DPI) deployed by network operators may affect request delay without being reflected in aggregate network performance metrics [8, 9, 15].

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?" MITATE is currently being deployed on the M-Lab platform.

2. MITATE

To meet these goals we are developing the Mobile Internet Testbed for Application Traffic Experimentation (MITATE). MITATE allows participants to evaluate application layer transaction traffic exchanged between mobile users and cloud datacenters, on which the back-end logic of many mobile applications is deployed. These transactions are defined as sequences of messages of specific size, to be exchanged with specific timing, between identified Internet end-points. Such exchanges can emulate communication patterns of real-time streams during application testing without making its functionality public. To allow developers to study the effects of traffic shaping, if any, MITATE allows explicit specifications of application layer headers, or of entire messages.

To use MITATE a developer defines an experiment as a sequence of application layer transfers and a set of mobile device criteria, such as location, or carrier. A mobile that meets the criteria will send and receive the specified transfers between the MITATE mobile app and MITATE back-end servers on public cloud datacenters and M-Lab serviers defined in experiment transfers. Following an experiment, MITATE Web interface reports transfer durations, associated metadata, such as a mobile's location, velocity, or signal strength, as well as network metrics, such as latency, loss, or available bandwidth.

MITATE is a collaborative framework, in which participants contribute their mobile network resources to run traffic experiments on others' devices that meet experiment criteria. Mechanisms similar to BitTorrent's tit-for-tat ensure sufficient system capacity to support experimentation without overwhelming user willingness to contribute mobile bandwidth.

Our proposal differs from existing experimental network testbeds in that it allows experimentation over production networks (as opposed to [7, 10, 12]), has wide geographic coverage (as opposed to [11, 13]), and extends functionality to end-hosts (as opposed to [1, 3, 5]).

3. EARLY RESULTS

Figure 1 shows data collected in a sample MITATE experiment that investigates the impact of packet size on uplink and downlink transmission delay among mobiles around Bozeman, MT. Larger packets result in longer delays, especially on the more tightly provisioned uplink channels.

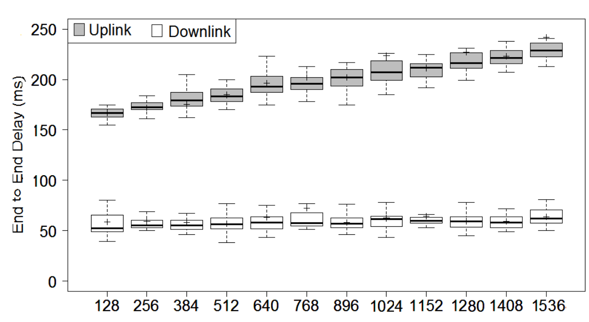

Figure 1: Packet latency over time.

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