An *AggreGATE* Network Abstraction for Mobile Devices

Ganesh Ananthanarayanan, David Zats

Motivation

- Mobile devices increasingly have multiple interfaces (Cellular, Wi-Fi, Bluetooth)
- Proliferation of mobile devices means likely often in vicinity of each other

❖ Example Scenarios:

  - Use my 3G, Wi-Fi and bluetooth interfaces in tandem to stream music
  - Collaborate with devices in close proximity to upload media (videos, photos etc.)

Problem Statement

Design a system that seamlessly and simultaneously leverages the multiple connectivity options

Measurements

- Connectivity: location, time and device

❑ Cell: 3G [255, 497] kbps, Edge [36, 182]kbps

❑ Wi-Fi: [625, 1700] kbps

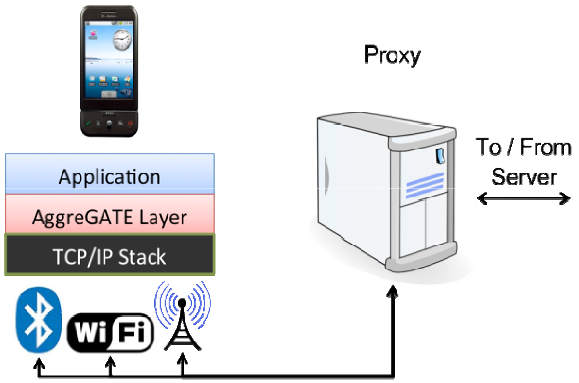
❑ Bluetooth: [335, 450] kbps

❖ Often times, there is significant advantage in combining them

❖ Wi-Fi coverage is spotty and a seamless handoff improves user experience

Proxy-based Design

- Mobile device registers connections with an *AggreGATE* proxy
- Applications access an abstract *AggreGATE* network interface
    - *open(), get(), put()* syntax
    - Application Data Units (ADU)
- *AggreGATE* splits/splices the flow between server and mobile device – agnostic to local interfaces or collaborators
- Advantages:
  - Avoids modifications to TCP/IP stack
  - Avoids modifications to server

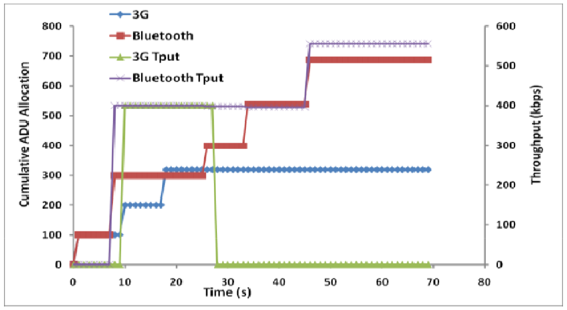


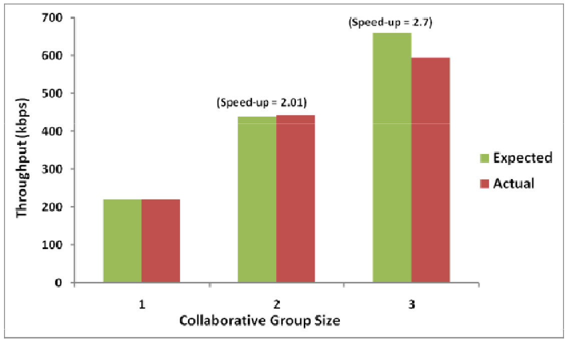
Scheduling

- Dynamically allocate ADU batches
  - Continuously measure throughput
  - Allocate ADUs proportionally
- Handling stragglers
  - Estimated completion based on measured throughputs
  - Progress Report for *slow* connections
  - Reallocate remaining ADUs to best available connection
- Amenable to policy decisions at the proxy/mobile device (Power, Cost ($$))

Handoffs

- Provide uninterrupted service in the face of connections becoming unavailable
  - Mobility-induced loss of signal
  - Collaborator becomes unavailable
- Mobility detection to open *backup* connections
  - Euclidean Distance of signal fingerprints
- Natural extension to scheduling
  - Same as handling stragglers, but measured throughput is zero





Implementation

- Single mobile device:
  - Uploads to server using proxy via Bluetooth and cellular interface (Edge/3G)
    - 2X speed-up, automatic handoff
- Collaborating devices
  - Mobile devices (with their individual 3G/Edge connection) collaboratively upload a file
    - Collaborate using ad hoc Wi-Fi
    - Near-linear speed-up

Future Work

- Mobility detection using accelerometer
- Incorporate policies in to scheduling
- Extensive evaluation