

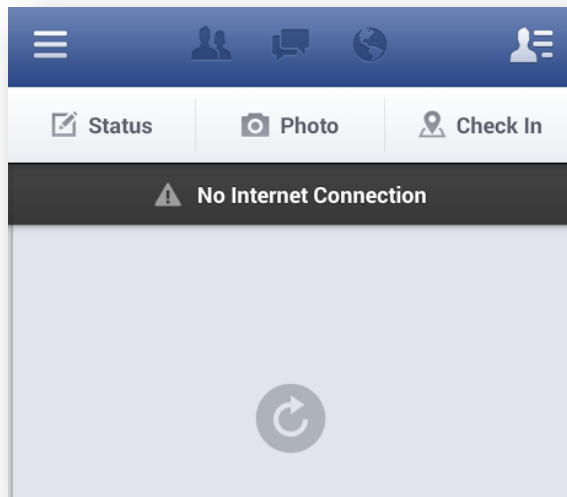
***Mobilyzer*: Mobile Measurement Library Support for Principled Mobile QoE Characterization**

Ashkan Nikravesh[†], Hongyi Yao[†], Shichang Xu[†],
David Choffnes[‡], Z. Morley Mao[†]

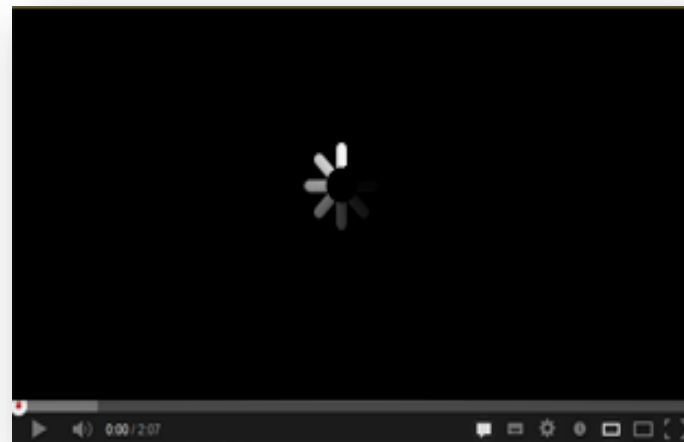
[†] UNIVERSITY OF MICHIGAN [‡]Northeastern University

Mobile apps are increasingly popular

- Dominant mode for data access is **mobile**
- Mobile **networks** suffer from *performance* and *reliability* problems



Facebook: no Internet connection



Youtube: rebuffering

We need measurements

- When YouTube hangs, is it
 - A slow device?
 - Weak signal?
 - Contention for bandwidth?
 - ISP traffic shaping?
 - Load on network?
 - Bad server?
- There is a lack of visibility
- **Key challenge:** Need extensive network measurements to support root cause analysis.

Strawman: There's an app for that



- Unscalable
- Inconsistent and inflexible
- Uncoordinated

Mobilyzer: Multiple Apps, One Library



Balancing Safety and Flexibility

- Measurements supported



A set of measurement primitives:

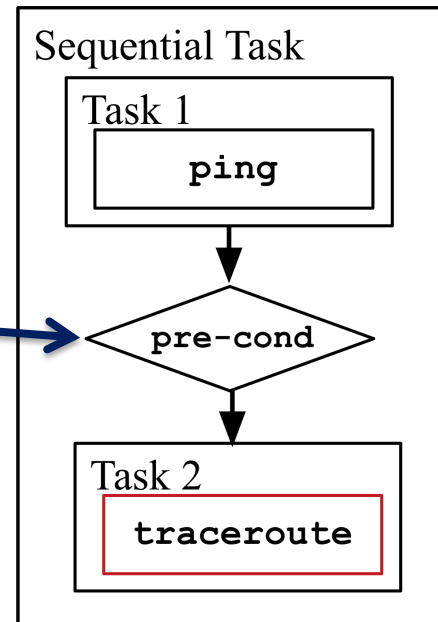
- Executable in sequence or parallel
 - Predictable in data and energy
- API: issue measurements, collect results
 - Fewer than 10 LoC to invoke the API

Flexibility Through Task Composition

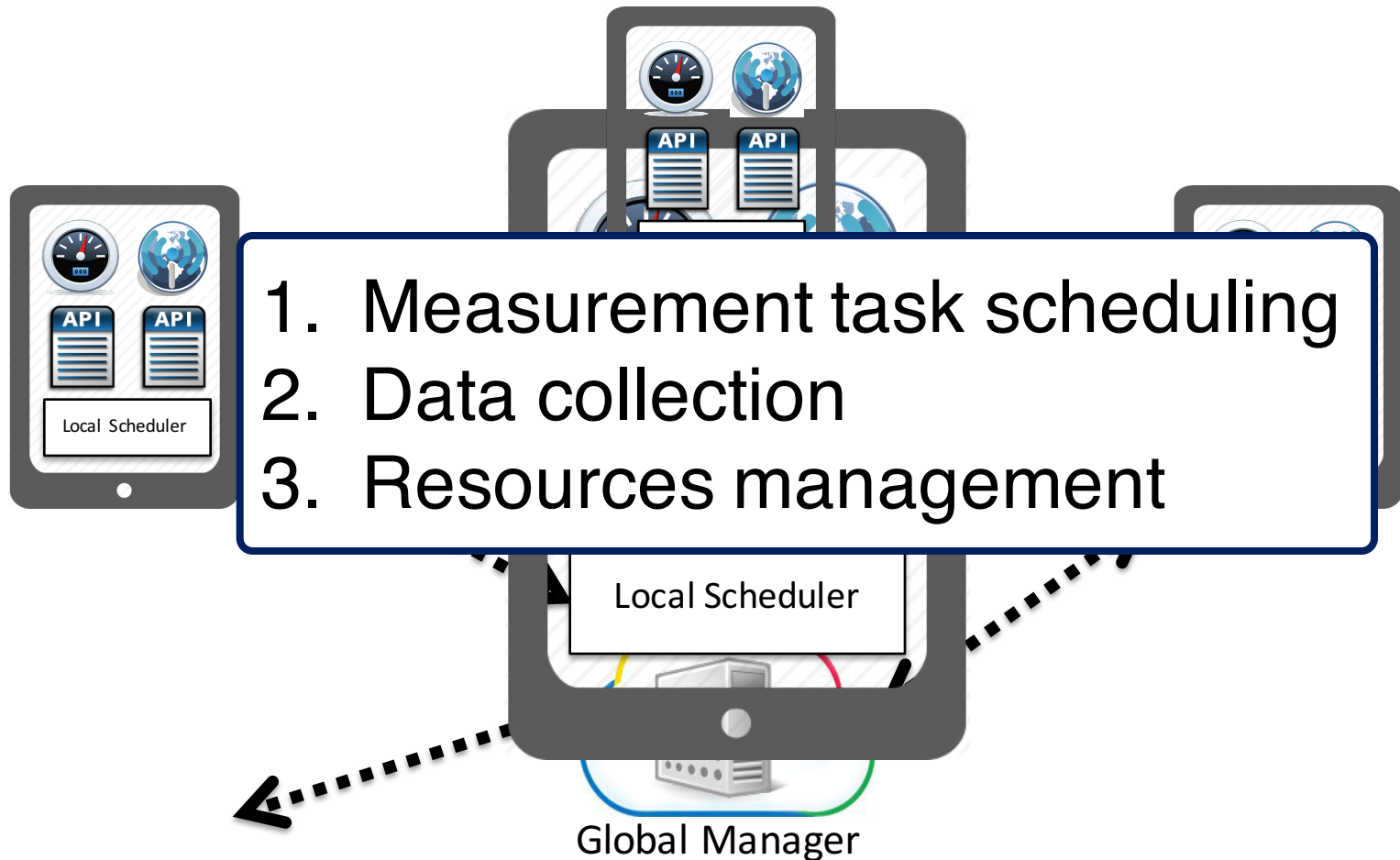
Composed Tasks: simple diagnosis task

Trigger **traceroute** probing for high ping RTT destinations

```
run ping
if
  ping.rtt > median_rtt+std_rtt
  &&
  signal strength == strong
then
  run traceroute
```

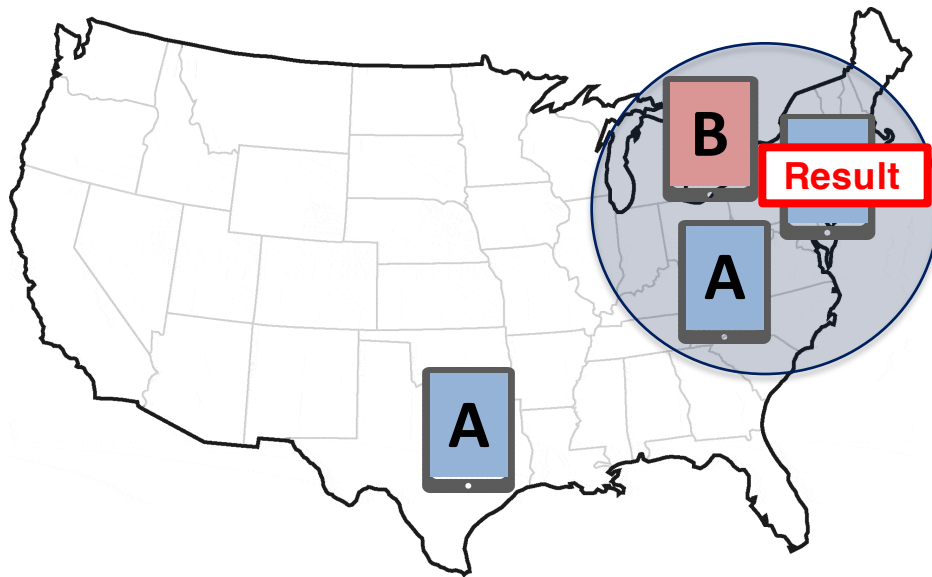


Coordinating Across Devices



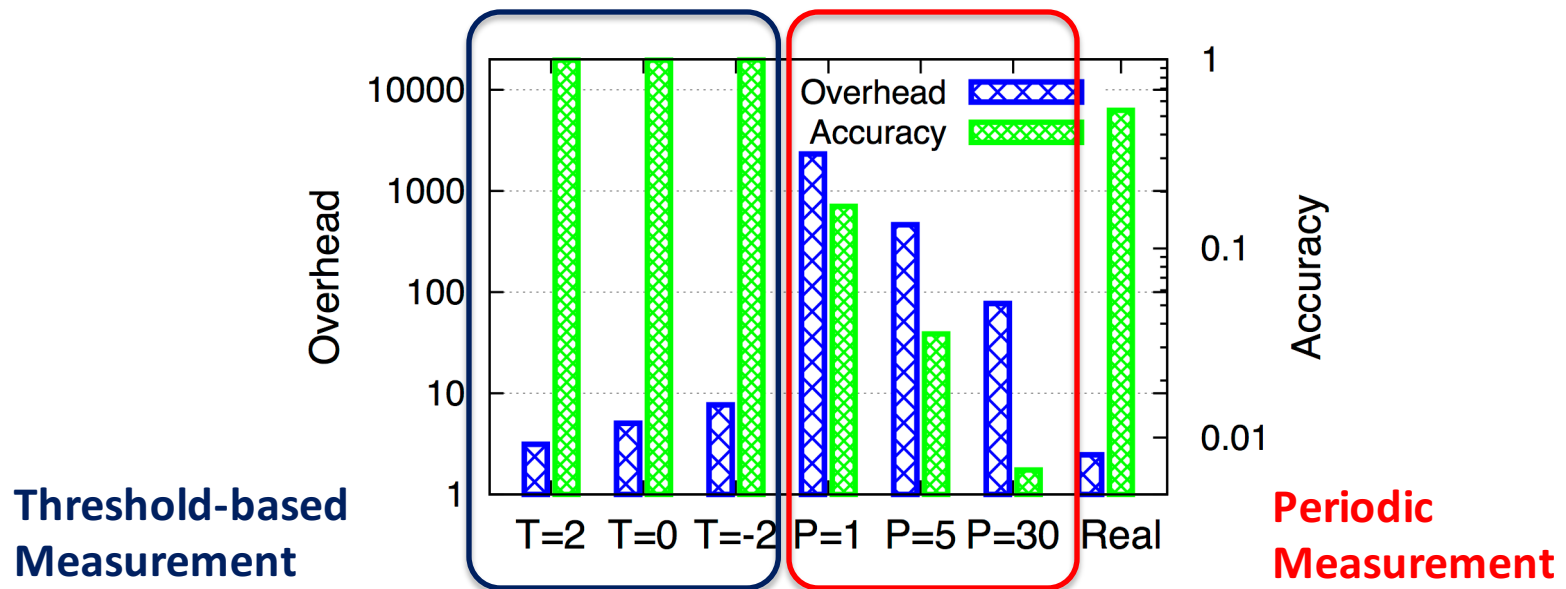
Coordination Enables Diagnosis

Dynamic measurement scheduling:
location, Internet, and/or server problems?



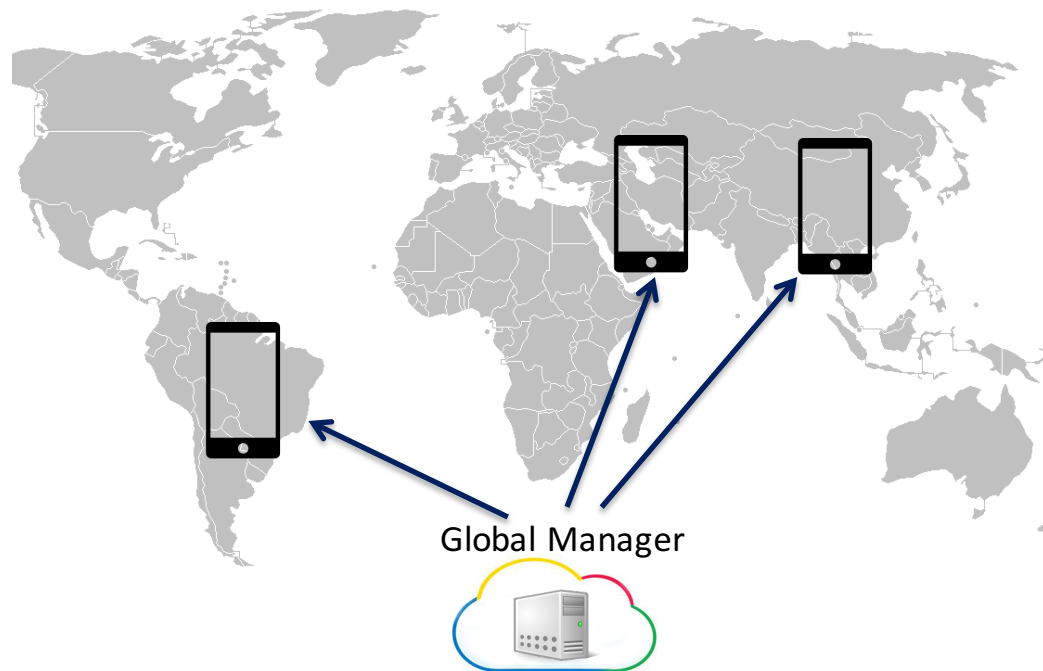
Context Aware Measurements

- Trigger measurements only when necessary, using device context.
 - Use case: performance impact of *handovers* between cells



Context Aware Measurements

- Schedule measurements based on device context.
 - Use case: censorship measurements



Web Browsing Measurement Support

- Crowd-sourced measurements of mobile web page performance:
 - PLT (Page Load Time) and PIT (Page Interactive Time)
 - Navigation Timing API (W3C standard)
 - Network vs. computation time
 - Combining resource timing data with Wprof [1] based dependency graphs for PLT analysis

[1] Wang et al., Demystifying Page Load Performance with Wprof, NSDI 2013

Video QoE Measurement

- Crowd-sourced measurements of video QoE in mobile:
 - Rebuffering
 - Video bit rate
- Compare Capacity Based Adaptive (CBA) with Buffer Based Adaptive (BBA)[1] streaming algorithms

[1] Huang et al., A Buffer-Based Approach to Rate Adaptation: Evidence from a Large Video Streaming Service, SIGCOMM 2014

Who is using *Mobilyzer*?

- Mobiperf
- MySpeedTest (Princeton)
 - Censorship measurements
 - Performance measurements
- MCoverage (University of Michigan ITS)
 - Understanding WiFi/Cellular coverage in Campus
- You?



Mobiperf



MySpeedTest



MCoverage (alpha)



You?

Future Plans for Improvement

- Extending the set of primitive and complex measurements:
 - IPv6 Experiments
 - D2D Connectivity and Performance
 - Network Policy Inference
 - CDN Measurements
- Providing a query based interface
 - Converting the query to measurement tasks that can be scheduled on the devices
 - Predicting performance from historical data

Feedback from Community

- *Mobilyzer* is open source
- Data is anonymized and publicly accessible online

<http://mobilyzer-project.mobi>
info@mobilyzer-project.mobi

- More details:
Mobilyzer: An Open Platform for Controllable Mobile Network Measurements. MobiSys'15