Programmatically Deploying Code on End User Devices: Seattle and Sensibility Testbed

Justin Cappos
New York University
Polytechnic School of Engineering
Computer Science and Engineering
Observations from AIMS

Crowdsourcing provides a useful platform

• Buying hardware does not scale!
• User safety is paramount
  - Security / Performance isolation
  - Privacy Policies
  - Bundling with apps is important

Experimenters want rich interaction

• Flexible expt type / timing / frequency
• Computation with a (standardized?) API
  • What abstraction?
• Does generality cause problems?
Our Vision

Securely Compute on Edge Devices
Securely Compute on Edge Devices
Our Vision

Securely Compute on Edge Devices
Our Vision

Securely Compute on Edge Devices
Seattle Testbed

Open peer-to-peer application hosting

• Unknown users donate resources (VMs)
  - Performance isolated to 10%
• Unknown developers push code
  - Security isolated so “do no harm”
• Tit-for-tat like model for resource sharing
• Commonly used like a P2P PlanetLab

https://seattle.poly.edu/
Practical use

• **Deployed services**
  • Intelligent distributed storage
  • Dynamic DNS remapping
  • Transparent network optimization
  • Censorship avoidance and measurement
  • YouTube CDN mapping
  • Etc.

• **Community support**
  • Android / OpenWRT / Raspberry PI port
  • Runs on PlanetLab, Emulab, GpENI, DOME, etc.
  • GENI workshops, PyCon, etc.
  • Port to Nokia N900 by Nokia
  • NaCl integration by U Victoria / HP Labs
  • iPad 2 port, tun / tap support, etc.
Educational use

- **Classroom experience**
  - Released in Spring 2009
  - Used in **>50** classes (so far)
  - 3 tutorials, 3 library references, etc.
  - 11 battle tested assignments (**Networking and Security**)
    - Overlay routing, flow control, NAT / Non-transitive connectivity, Chord (DHT), web / chat servers, reference monitors, NAT tunneling, etc.
    - OS classes are coming

- **Community support**
  - Supported by educational groups
    - NWDCSD, HandsOnSecurity
  - 2 SIGCSE papers, 3 CCSC workshops, etc.
  - Top ranked SIGCOMM Educational Resource
  - Coming in Computer Networking by Kurose & Ross
    - Most popular networking book!
What Our Current Status?
What Our Current Status?

<table>
<thead>
<tr>
<th>Node Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>University nodes</td>
<td>3,510</td>
</tr>
<tr>
<td>Home machines</td>
<td>7,594</td>
</tr>
<tr>
<td>Other Testbeds (PlanetLab, Emulab, etc.)</td>
<td>859</td>
</tr>
<tr>
<td>Phones</td>
<td>505</td>
</tr>
<tr>
<td>Unclassified</td>
<td>7,977</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20,445</strong></td>
</tr>
</tbody>
</table>
What Our Current Status?

<table>
<thead>
<tr>
<th>Node Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>University nodes</td>
<td>3,510</td>
</tr>
<tr>
<td>Home machines</td>
<td>7,594</td>
</tr>
<tr>
<td>Other Testbeds (PlanetLab, Emulab, etc.)</td>
<td>859</td>
</tr>
<tr>
<td>Phones</td>
<td>505</td>
</tr>
<tr>
<td>Unclassified</td>
<td>7,977</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20,445</strong></td>
</tr>
</tbody>
</table>
What Our Current Status?

<table>
<thead>
<tr>
<th>Node Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>University nodes</td>
<td>3,510</td>
</tr>
<tr>
<td>Home machines</td>
<td>7,594</td>
</tr>
<tr>
<td>Other Testbeds</td>
<td>859</td>
</tr>
<tr>
<td>(PlanetLab, Emulab, etc.)</td>
<td></td>
</tr>
<tr>
<td>Phones</td>
<td>505</td>
</tr>
<tr>
<td>Unclassified</td>
<td>7,977</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20,445</strong></td>
</tr>
</tbody>
</table>
What Our Current Status?

<table>
<thead>
<tr>
<th>Node Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>University nodes</td>
<td>3,510</td>
</tr>
<tr>
<td>Home machines</td>
<td>7,594</td>
</tr>
<tr>
<td>Other Testbeds</td>
<td>859</td>
</tr>
</tbody>
</table>

The Sensibility Testbed Hackaton at SAS 2014 Sensor Development Workshop in New Zealand was a big success!

The workshop was a day-long event where we introduced the Sensibility Testbed for the first time to the public. The participants spent a few hours at our tutorial session, learning step-by-step instructions on how to use the Sensibility Testbed to build mobile apps on phones and tablets donated by users of our testbed. The process is quite straightforward: download our app from Google Play, install a command-line tool, and deploy apps on other people's devices. Participants can easily make each other's device beep, vibrate, and speak. They can also do background measurement of data of their interest, like WiFi signal, Bluetooth interface, battery usage, and GPS.
What Our Current Status?

SAS Workshop 2014: a Success!

The Sensibility Testbed Hackaton at SAS 2014 Sensor Development Workshop in New Zealand was a big success!

It was a all day long workshop where we introduced the Sensibility Testbed for the first time to the public. The participants spent a few hours at our tutorial session, with step-by-step instructions to learn how to use the Sensibility Testbed to build mobile apps on phones and tablets donated by users to our testbed. The process is quite straight-forward: install our app from Google Play, download a command line tool, and deploy apps on other people’s devices. Participants can easily make each other’s device beep, vibrate, and speak! They can also do background measurement of data of their interest, like WiFi signal, Bluetooth interface, battery usage, and GPS.
What Our Current Status?

SAS Workshop 2014: a Success!

The Sensibility Testbed Hackaton at SAS 2014 Sensor Development Workshop in New Zealand was a big success!

It was a all day long workshop where we introduced the Sensibility Testbed for the first time to the public. The participants spent a few hours at our tutorial session, with step-by-step instructions to learn how to use the Sensibility Testbed to build mobile apps on phones and tablets donated by users to our testbed. The process is quite straight-forward: install our app from Google Play, download a command line tool, and deploy apps on other people’s devices. Participants can easily make each other’s device beep, vibrate, and speak! They can also do background measurement of data of their interest, like WiFi signal, Bluetooth interface, battery usage, and GPS.
Demonstration

Typical Seattle Workflow

• Registration
• Download installer
• Acquire resources
  • Use Seattle public clearinghouse
• Deploy application
  • Use shell to locate and control resources
  • (All Pairs UDP Ping?)
Thanks to:
Seattle / Sensibility conclusion

• Seattle widely deployed around the world
  • Geographic diversity, network diversity, device diversity...
  • Tens of thousands of installs, thousands of VMs online at a time, thousands of developers

• Battle tested educational / research / app platform!
• Discussion: Where might we fit in?
  • Testbeds (Seattle / Sensibility) for experimentation
  • Common library for experiments
    • Collab(?) with mobiperf (expose their measurement libs)
  • Toolkit for easily building customized testbeds
    • Seattle, BISMark, ToMaTo, Sensibility Testbed, ICLab, SocialCloud, SciWiNet(?), PhantomNet(?), Mitate(?), etc.

https://seattle.poly.edu/ SeattleOnAndroid (Google Play)
Thanks!