Crowdsourcing ISP characterization to the network edge

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Need to get back to this
ISP characterization

- To understand the configuration, policies and quality of service of access network service providers

**Who needs it?**
- Subscribers shopping for alternatives ISPs
- Companies providing reliable Internet services
- Governments surveying the availability of Internet to their citizens
ISP characterization

How should it be done?

– At scale – To capture diversity of providers and services
– Continuously – To capture dynamics due to management policies, unscheduled events, evolution …
– By end users – To guarantee its accuracy
Existing approaches to characterization

- Web-based technology test against dedicated or cloud servers
  - E.g. Netalyzr, Speedtest, YouTube/my_speed, …

- End-host monitoring from dedicated servers
  - E.g. Dischinger et al., Croce et al.

- Installing special monitoring devices at PoPs or home networks
  - E.g. SamKnows and FCC, Keynote

- An unavoidable tradeoff between vantage points, coverage and continuous monitoring?
Engaging the crowd at the network edge

- Leverage the views of Internet-wide ISP performance from popular networked apps

- Our current hosting application – *BitTorrent*

- Scalability and coverage from monitoring an application that growth with the network edge
- Continuously for an ISP
- Capturing the real performance end users receive
A quick roadmap

- Feasibility, of sorts
  - Can we do it from within an application?
  - Capturing performance dynamic variations
  - Capturing space variations

- Going beyond characterization

- Dasu - a new platform for ISP characterization from the edge
Can you do it from within BitTorrent?

- Could application effects impede characterization?

Download rate of BitTorrent users in Rogers

Rogers’ known performance instability makes it a hard case.

Not clear “steps” in download rates!
ISP service levels

Extracting Rogers’ service levels

Rogers’ advertized 500 Kbps and 3 Mbps levels

Scale
Continuous
End-user
Comparing with a hardware-based approach

- Observed ISP performance and that captured by SamKnow’s “white box”

Virgin Media

- Advertised bandwidth: Up to 10 Mbps
- Average speed reported by Ofcom09: 8.1-8.7 Mbps
Capturing service variations over time

- Variations on Rogers performance during the day (aggregated over Nov. 2009)

![Graph showing maximum bandwidth over time.](image)

From 96% to 60% of advertised service level.
Variations on service levels among Virgin Media covered UK cities (order by maximum)

Belfast (pop. 280k), London (pop. 7.2m), Leicester (pop. 280k), Coventry (pop. 300k),
Observed ISP performance and that captured by SamKnow’s “white box”

Sky Broadband

- Advertised bandwidth: *Up to 8 Mbps*
- Average speed reported by Ofcom09: 4-4.7 Mbps

Virgin Media

- Advertised bandwidth: *Up to 10 Mbps*
- Average speed reported by Ofcom09: 8.1-8.7 Mbps
Percentage of sub-regions containing at least one ISP providing each level of service

USA:
- New York, Pennsylvania, New Jersey
- Kentucky, Tennessee, Missouri, Alabama

Europe: Germany, Italy, France, UK

Japan
Dasu – A platform for ISP characterization

- A new extension to BitTorrent Vuze
- Combine passive and controlled active monitoring
  - Passive to capture end user’s view in a scalable manner
  - Controlled active to avoid application-specific bias and for validation
- Enable dynamically extensible monitoring
  - To retain control, flexibility and low-barrier to adoption of software-based models
- Collaboration for eventual ISP comparison
Rule <name>
When {<condition>}
Then {<consequence>}

E.g.
rule “Launch BT test”
when
   $fact: something fishy found;
then
   addPriorityProbe(“dload_n_encr”,
       ProbeType.BTTest);
sendToLog(“Launching BT Test”);
retract($fact);
end

Probe modules: traceroute, ping, ndt, dns, http get, …
Some details on monitoring rules

- **General format**
  
  Rule `<name>`
  When `{<condition>}`
  Then `{<consequence>}`

  E.g.
  
  ```
  rule "Launch BT test"
  when
    $fact: something fishy found;
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    addPriorityProbe("dload_n_encr", ProbeType.BTTest);
    sendToLog("Launching BT Test");
    retract($fact);
  end
  ```

- **Types of conditions**
  - Facts in the knowledge base derived from passive, active monitoring and cron tasks

- **Types of consequences:**
  - Update knowledge base, launch new measurement, schedule new task, contact servers, plot results, …
Dasu prototype

Dashu Client

- Configuration Server
- Configuration
- Monitoring Rules
- Database Server
- Measurement feedback
- Report

- Monitoring Rule Server
- Registration
**Responsiveness to control**

- Rules files are fetched when BitTorrent runs
  - So adoption rate determined by user inter-session times

![Graph showing adoption rate over elapsed time]

*After 10 hours 60%, after 24 hours 80%, and after 48 hours 95%...*
First version released in June, 2010
Without advertisement - > 25,000 users
>1,000 ASes (>5,000 prefixes), 71% are eyeballs (growing at 25-43%)

<table>
<thead>
<tr>
<th>Region</th>
<th>Growth</th>
<th>Dasu Growth</th>
<th>Dasu Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>146.3%</td>
<td>61%</td>
<td>3/5</td>
</tr>
<tr>
<td>Oceania/Australia</td>
<td>179%</td>
<td>58%</td>
<td>2/26</td>
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<tr>
<td>Europe</td>
<td>352%</td>
<td>60%</td>
<td>36/51</td>
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<tr>
<td>L. America/Caribbean</td>
<td>1,032.8%</td>
<td>46%</td>
<td>16/24</td>
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<td>Middle East</td>
<td>1,825.3%</td>
<td>47%</td>
<td>11/15</td>
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<tr>
<td>Asia</td>
<td>621.8%</td>
<td>48%</td>
<td>21/39</td>
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<tr>
<td>Africa</td>
<td>2,357.3%</td>
<td>55%</td>
<td>17/56</td>
</tr>
</tbody>
</table>
ISP characterization needs to be done by end users, at scale and continuously

Network intensive applications may provide a nearly ideal vantage point platform

What can we capture? What metrics should we use? Can we detect application biases? Can we compare ISPs? Can we handle “tricksy” ISPs? …

Exploring these and other questions with Dasu