

# Crowdsourcing ISP Characterization to The Network Edge

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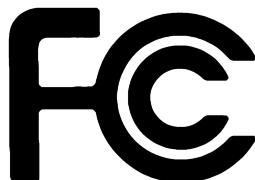
AquaLab

# ISP Characterization

- *What is it?*
  - Understand how various factors affect performance
- *Who needs it?*
  - Subscribers shopping for alternative ISPs
  - Companies providing reliable Internet services
  - Governments surveying the availability of high-speed Internet services to their citizens

ISPs ‘still mislead’ on broadband

July 26, 2011

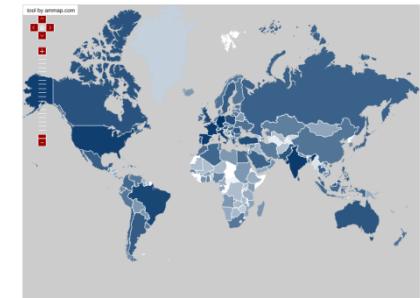


Broadband Speeds Are Largely as Advertised

August 2, 2011

# ISP characterization – how should it be done?

- At scale
  - To capture the diversity of providers and services



- Continuously
  - To capture dynamic changes in management policies, and unscheduled events, ...

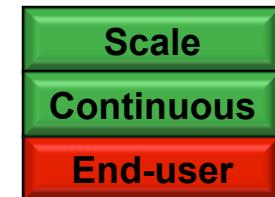
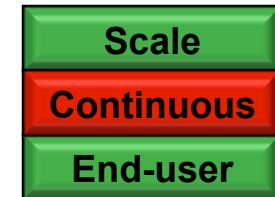


- From end users
  - To guarantee accuracy, reduce bias



# Existing approaches to characterization

- Web-based, user-initiated tests against dedicated or cloud servers
  - E.g. Netalyzr, Speedtest, ...
- End-host monitoring from dedicated servers
  - E.g. Dischinger et al. (IMC07) , Croce et al. (PAM09)
- Installing special monitoring devices at PoPs or home networks
  - E.g. BISMark, SamKnows, Keynote
- *An unavoidable tradeoff among vantage points, coverage and continuous monitoring?*



# Our Approach

- *Crowdsourcing ISP Characterization to the Network Edge (C2E)*
  - Leverage the views of popular, network-intensive applications from the end-user
    - (e.g. VoIP, P2P, IPTV, gaming, ...)
  - Reduce number of active measurements
  - Based on experience of end users
  - Continuous monitoring achieved by combining views of multiple subscribers
  - Application usage can grow with the network edge

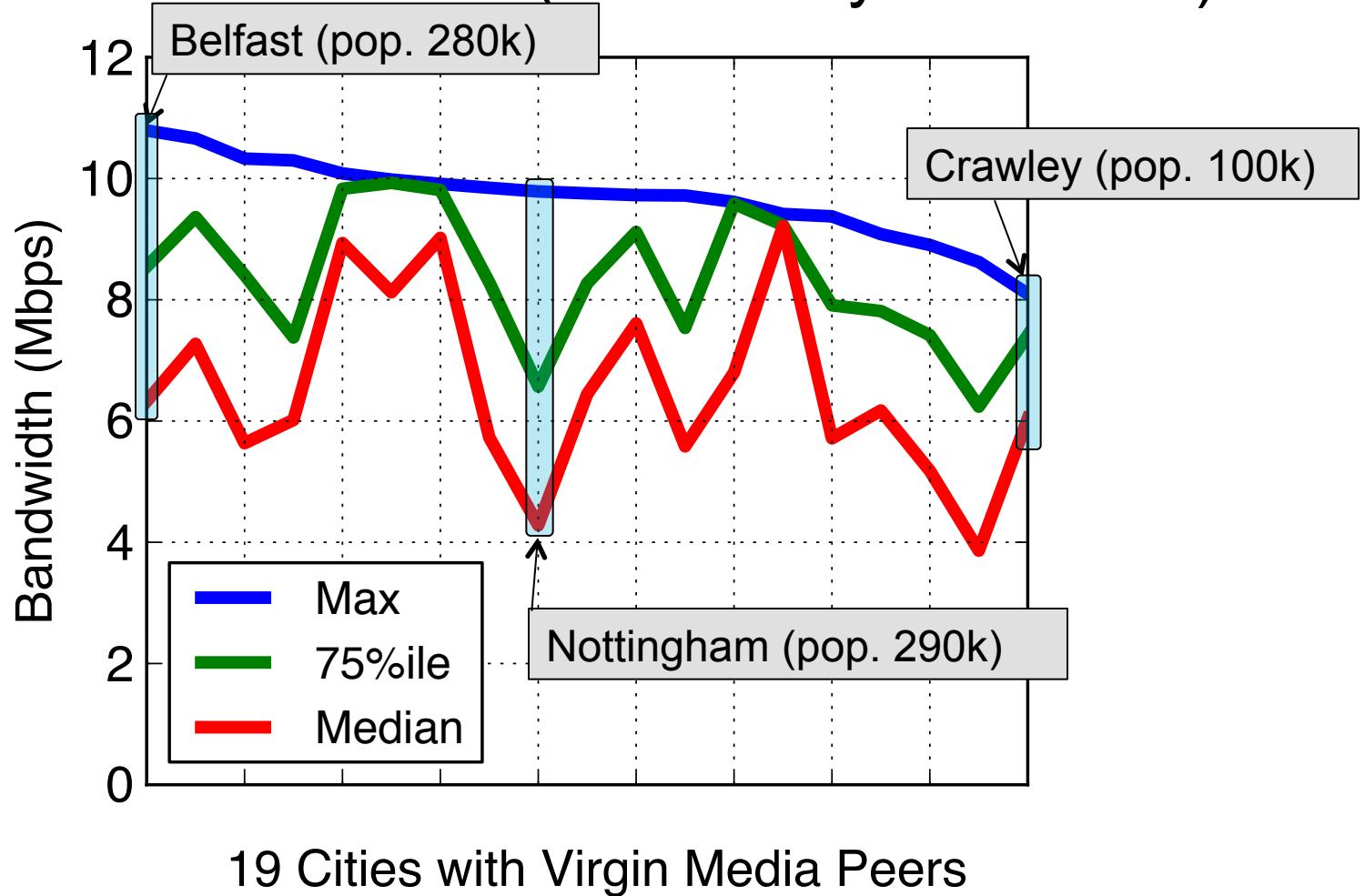


# BitTorrent as a Hosting Application

- *BitTorrent*
  - Relatively long session times
  - High bandwidth usage
- *Ono* – client extension for Vuze
  - Aims to improve performance by suggesting “closer” peers
  - Users voluntarily contribute performance statistics
  - In total, about 1.3+ million users world-wide
  - Datasets from November 2009 and 2010

# At Scale

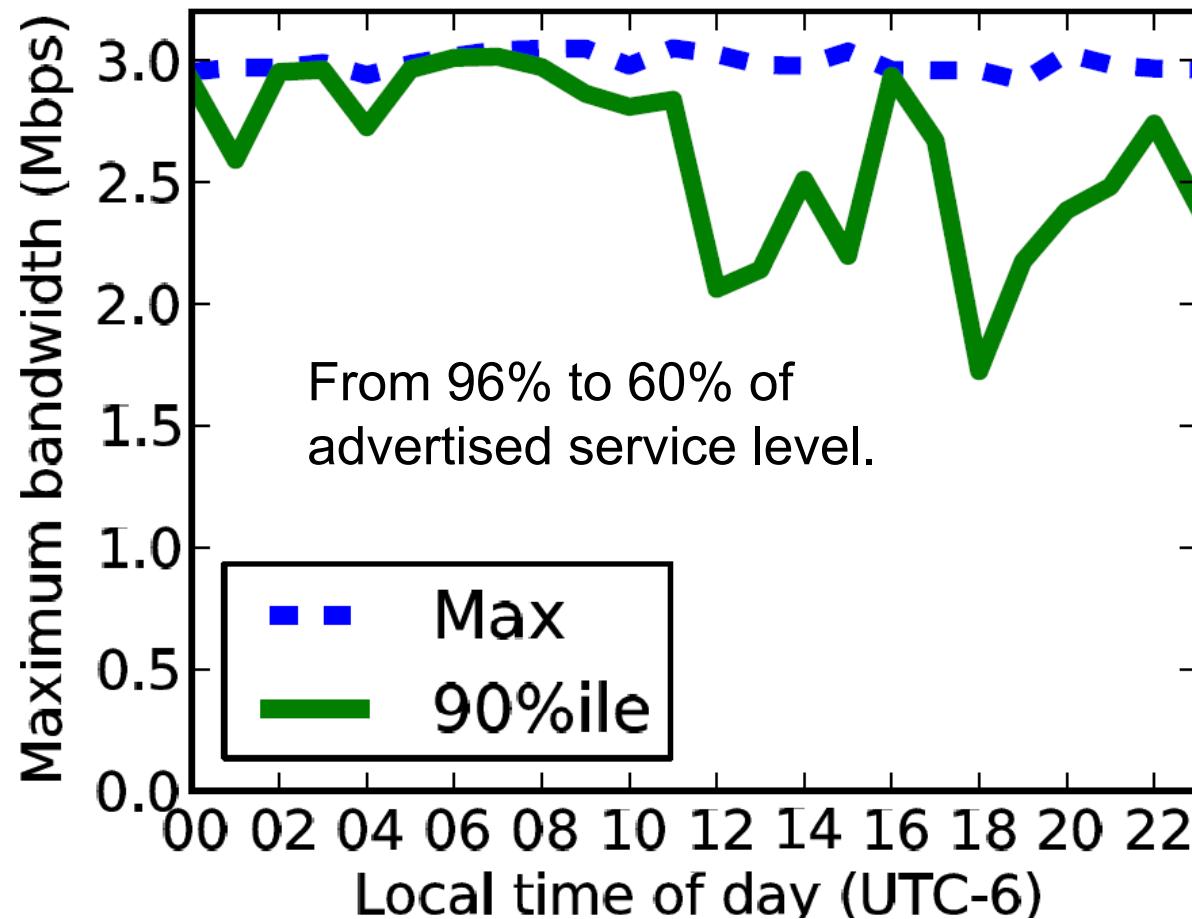
- Variations within a service level among 19 Virgin Media covered UK cities (ordered by maximum)



Scale
Continuous
End-user

# Continuous Monitoring

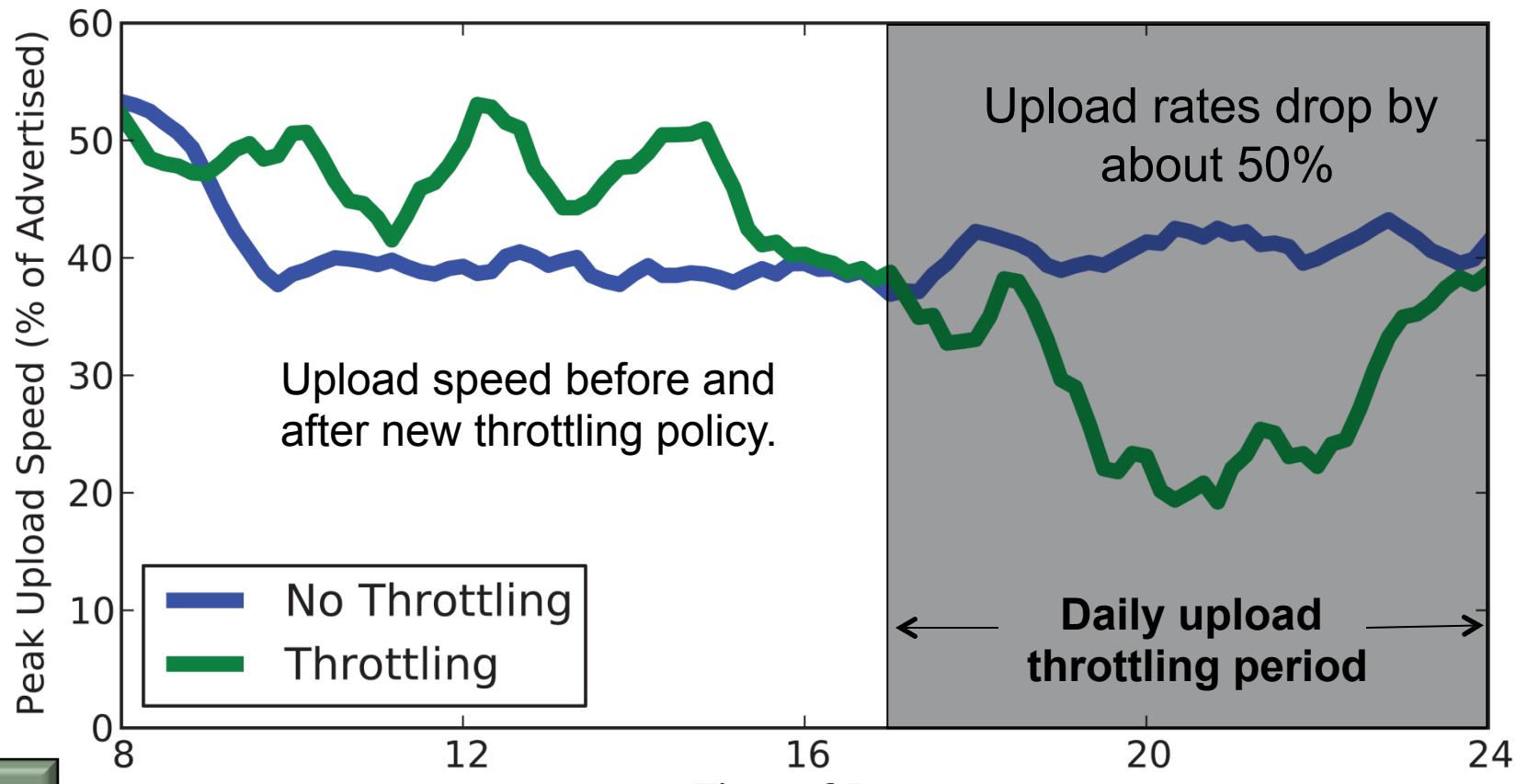
- Variations on Rogers performance during the day (aggregated over Nov. 2009)



Scale
Continuous
End-user

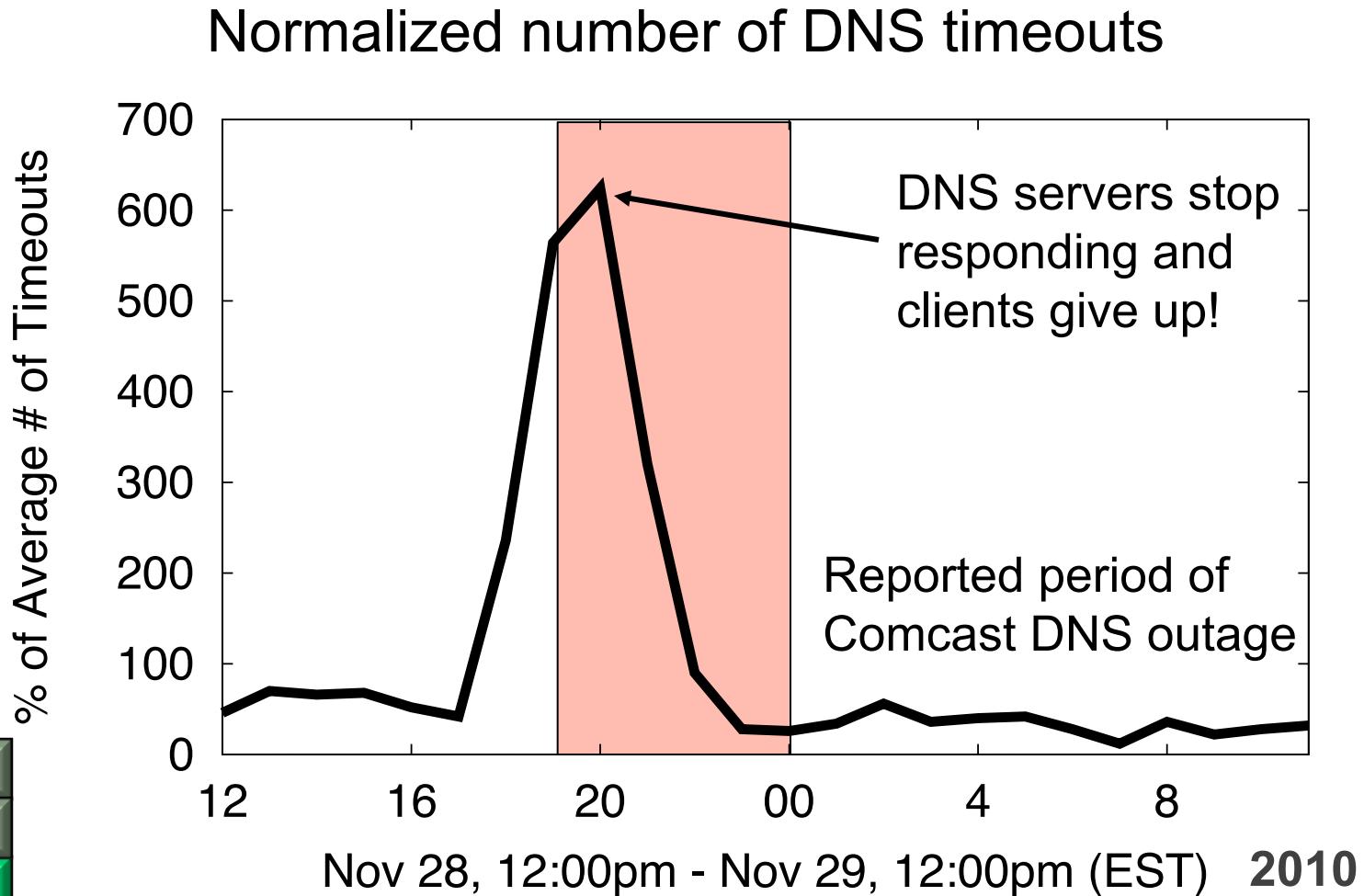
# Continuous Monitoring

- Virgin Media new throttling policy in effect



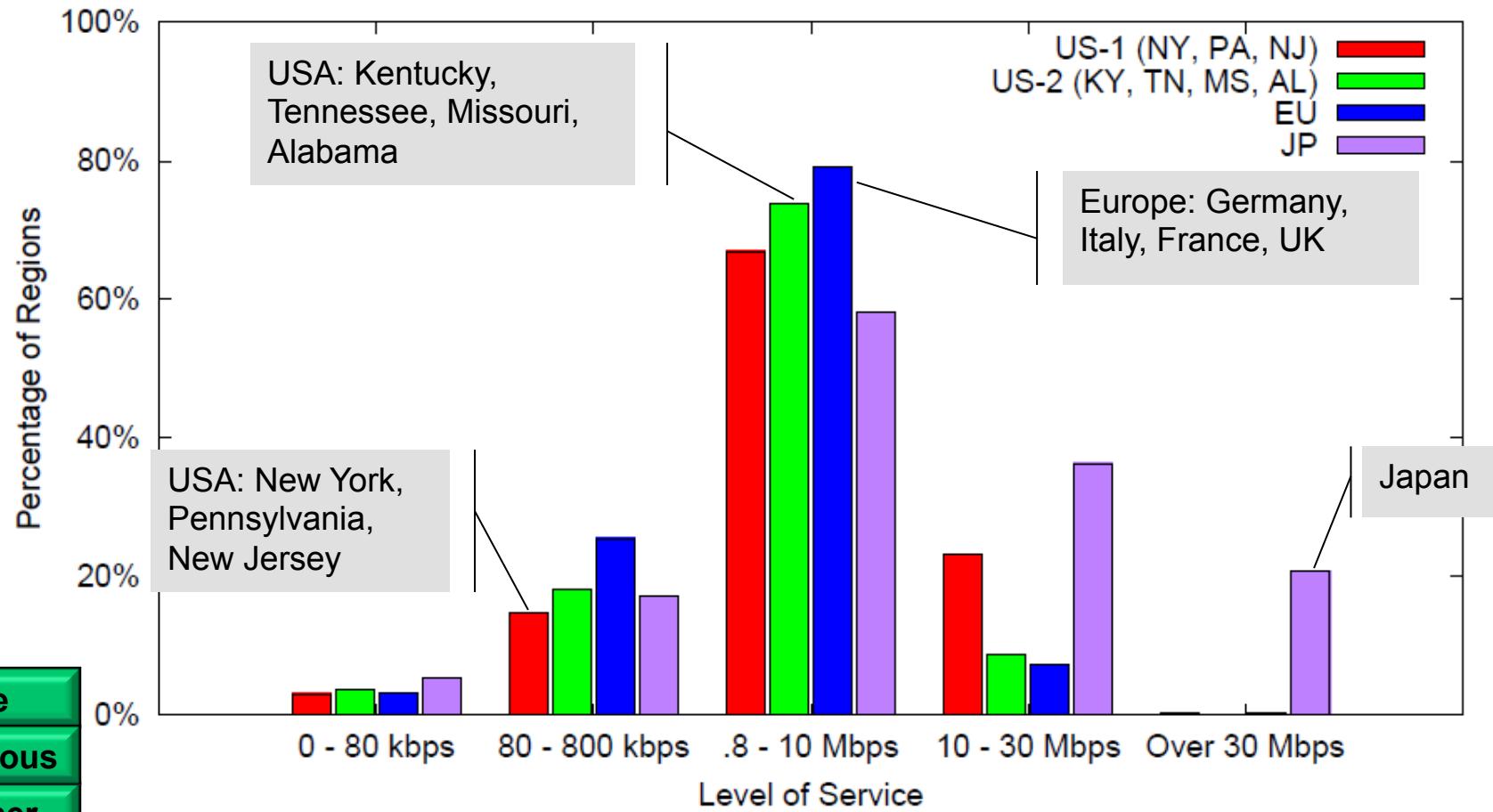
# From the End-User

- Capturing the end-user's view



# Beyond single ISP characterization

- Percentage of cities containing at least one ISP providing each category of service



Nov. 2009; mapped with GeoLite

# Current Status

- Looking to leverage other network-intensive applications
- Dasu – C2E implementation
  - Inform users of ISP performance
  - Eliminate confounding factors
    - Cross traffic
    - Wi-Fi or Ethernet?
  - Complementary to SamKnows/BISMark



# Dasu v3

The screenshot shows the Dasu v3 application window. On the left is a sidebar with sections for VUZE, FILES, DEVICE PLAYBACK, SUBSCRIPTIONS, DVD BURN, and PLUGINS & EXTRAS. The main area displays network diagnostic results for the 'Internet' tab.

**DASU**  
You shall know the truth, and the truth shall make you mad.  
— Aldous Huxley

AquaLab  
"Planetary-scale distributed computing"

**Internet**

This tab displays results for tests related to your Internet connection, including the network latency to your configured DNS server(s), alternative public DNS services, and several popular websites.

## DNS Server Latency

### DNS Configuration Diagnostics

Status	Description
OK	Server #1 has lower latency than the best tested public DNS servers.
OK	Your primary server has the lowest latency.

### Locally Configured DNS Servers

Order	IP Address	Responding IP	Domain	Latency (ms)
1	192.168.1.1	69.252.66.201	null	13

### Latency Comparison to Public DNS Services

Configured #1

Service	Latency (ms)
Configured #1	13
Google Public DNS	15
OpenDNS	18
Cloudflare	20
Quad9	22
8.8.8.8	25
8.8.4.4	28
8.8.8.1	30
8.8.4.4	32
8.8.8.8	35
8.8.4.4	38
8.8.8.8	40
8.8.4.4	42
8.8.8.8	45
8.8.4.4	48
8.8.8.8	50
8.8.4.4	52
8.8.8.8	55
8.8.4.4	58
8.8.8.8	60
8.8.4.4	62
8.8.8.8	65
8.8.4.4	68
8.8.8.8	70
8.8.4.4	72
8.8.8.8	75
8.8.4.4	78
8.8.8.8	80
8.8.4.4	82
8.8.8.8	85
8.8.4.4	88
8.8.8.8	90
8.8.4.4	92
8.8.8.8	95
8.8.4.4	98
8.8.8.8	100
8.8.4.4	102
8.8.8.8	105
8.8.4.4	108
8.8.8.8	110
8.8.4.4	112
8.8.8.8	115
8.8.4.4	118
8.8.8.8	120
8.8.4.4	122
8.8.8.8	125
8.8.4.4	128
8.8.8.8	130
8.8.4.4	132
8.8.8.8	135
8.8.4.4	138
8.8.8.8	140
8.8.4.4	142
8.8.8.8	145
8.8.4.4	148
8.8.8.8	150
8.8.4.4	152
8.8.8.8	155
8.8.4.4	158
8.8.8.8	160
8.8.4.4	162
8.8.8.8	165
8.8.4.4	168
8.8.8.8	170
8.8.4.4	172
8.8.8.8	175
8.8.4.4	178
8.8.8.8	180
8.8.4.4	182
8.8.8.8	185
8.8.4.4	188
8.8.8.8	190
8.8.4.4	192
8.8.8.8	195
8.8.4.4	198
8.8.8.8	200
8.8.4.4	202
8.8.8.8	205
8.8.4.4	208
8.8.8.8	210
8.8.4.4	212
8.8.8.8	215
8.8.4.4	218
8.8.8.8	220
8.8.4.4	222
8.8.8.8	225
8.8.4.4	228
8.8.8.8	230
8.8.4.4	232
8.8.8.8	235
8.8.4.4	238
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8.8.8.8	250
8.8.4.4	252
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8.8.4.4	258
8.8.8.8	260
8.8.4.4	262
8.8.8.8	265
8.8.4.4	268
8.8.8.8	270
8.8.4.4	272
8.8.8.8	275
8.8.4.4	278
8.8.8.8	280
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8.8.8.8	295
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8.8.4.4	348
8.8.8.8	350
8.8.4.4	352
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8.8.4.4	358
8.8.8.8	360
8.8.4.4	362
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8.8.4.4	428
8.8.8.8	430
8.8.4.4	432
8.8.8.8	435
8.8.4.4	438
8.8.8.8	440
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8.8.4.4	468
8.8.8.8	470
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8.8.4.4	678
8.8.8.8	680
8.8.4.4	682
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8.8.4.4	688
8.8.8.8	690
8.8.4.4	692
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8.8.4.4	718
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