The network neutrality bot architecture: a preliminary approach for self-monitoring of Internet access QoS

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The NEXA Center for Internet & society

- Academic research center, founded in 2006
- **Multidisciplinary**: technology, law, economics
- Co-directed by an engineering prof and a law prof
- Coordinator of two large EU funded projects on digital content (COMMUNIA) and Public Sector Information (LAPSI)
- Topics: Freedom of expression online, anonymity, web geography, creative commons, **network neutrality**, Internet governance
- Partner of Harvard University and Keio Univ. (Tokio)
- More info: [http://nexa.polito.it/](http://nexa.polito.it/)
Network Neutrality

- Internet is open and neutral
  - This is a value for our society
  - Extraordinary platform for distributed innovation
  - Level playing field for citizens, companies, ...
- Nowadays, fine-grained discrimination is possible
- How to protect NN?
  - Top-down: the Law (or other norms)
    - The recent Dutch example
  - Self-regulation
  - Bottom-up: giving power to the users
    - What kind of power? First of all, information
Related work

• Active tools
  - NDT [1]
  - Glasnost (Max Planck) [2]
  - NPAD [3]
  - Pathload2 [4]
  - ShaperProbe [5]
  - NetPolice [6]
  - Grenouille [7]
  - Speedtest.net [8]
  - BISMark [13]
  - Ne.Me.Sys. [14]
  - Netfart.no [15]

• Passive tools
  - NANO [9]
  - Weaver, Sommer and Paxson's paper [10]
  - Switzerland (EFF) [11]

• Other approaches
  - **M-Lab**: Distributed server platform for active tools [12]
Neubot: Objective and Design

● Objective
  - perform distributed measurements, collect results, share raw results, publish analysis

● Design
  - Neubot is an active tool and is a bot, hence runs tests automatically (but you can run tests on-demand)
  - Tests emulate existing protocols and Neubot measures “quality” during the test
  - Results are collected at a set of central servers and stored on a local database
Architecture

- **Rendezvous**
  - Get *Test Server* address and test type from *Master Server*

- **Negotiate**
  - Wait for *Test Server* to be ready for a test and negotiate test parameters

- **Test**
  - Perform the test and measure “quality” metrics

- **Collect**
  - Share results with *Test Server*
HTTP test implementation (1)

- Two concurrent TCP connections
- **Round-trip time**
  - Time required to connect()
  - Time required to “HEAD” a resource
- **Achievable bandwidth**
  - Measure time $T$ required to GET/POST $K$ bytes
  - Calculate $\text{bandwidth} = \frac{K}{T}$
  - $K$ adapted so that next test would take $T=5$ seconds (under current conditions)
HTTP test implementation (2)

- Neubot is a background tool: so tests should be precise and “not too long”
- Let the kernel scale send buffer
- Set recv buffer to 256 KiB
  - To make the test more predictable
    - No conflict between cwin growth and automatic recv buffer scaling
    - In many OSes the buffer will not scale to “infinite” in any case
  - As a consequence, Neubot cannot tame “elephants”
Some numbers

• Data
  - Will release by July
  - #Neubots: 2,246
  - #tests: 1,701,073
  - (privacy issues)
• 5 public releases, since November 2010
  - Version 0.3.7, (20 May 2011) was downloaded 2,138 times

• Latest batch of results
  - 12 May → 27 June
  - #Neubots: 1,409
  - #tests: 483,591
  - 52% of the Neubots has done more than 100 tests
  - 18% of the Neubots has done just one test
Bandwidth-delay product distribution

MaxBDP = 512 KiB
nResults = 483,574
Since = 12 May
Until = 27 June

Note: results > BDP go into bucket #7
Download speed distribution

BDP $\leq 488$ KiB (7/8 Max)
rResults = 482,079
Since = 12 May
Until = 27 June

Note: results > 32 Mbit/s go into bucket 32

Frequency [number of occurrences]

Download speed buckets [Mbit/s per bucket]

11% 51% 69% 92% 100%
Ongoing & future work

- Ongoing: Geo-scaling
  - Need more servers
  - Applied to M-Lab
  - Response pending

- Ongoing: BitTorrent
  - Similar to HTTP test
  - Just one connection
  - “Fill the pipe” first
  - Measure at the receiver

- Ongoing: publish
  - Publish raw DBs
  - Deeper data analysis

- Future: P2P tests
  - Neubot like a Test Server
  - Good for geo-scaling
  - More groundwork needed
Thank you!

http://www.neubot.org/
(also on Facebook & Twitter)
http://nexa.polito.it/
References