The hitchhiker's guide to the Network Neutrality Bot test methodology

Simone Basso Antonio Servetti J.C. De Martin

NEXA Center for Internet & Society
Politecnico di Torino, Italy
http://nexa.polito.it/

Torino, 16 Novembre 2011
Congresso AICA

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, **open data**
- Partner of Harvard University and Keio Univ. (Tokio)
- More info: **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 (Bits of Freedom)
  - Self-regulation
  - **Bottom-up**: giving power to the users
    - What kind of power? First of all, **information**

Related work: quality and neutrality

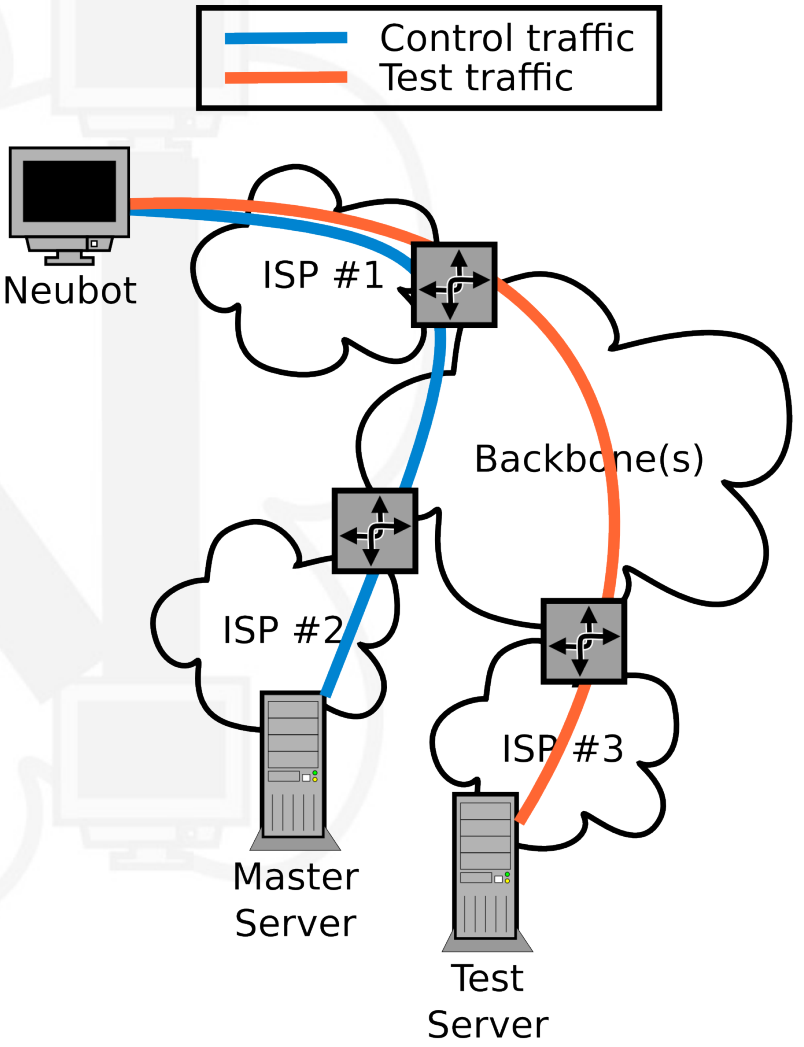
- **Active** tools
  - NDT [1]
  - Glasnost (Max Planck) [2]
  - NPAD [3]
  - Pathload2 [4]
  - ShaperProbe [5]
  - NetPolice [6]
  - Grenouille [7]
  - Speedtest.net [8]
  - BISMark [13]
  - Ne.Me.Sys. [14]
  - Nettfart.no [15]
- Passive tools
  - NANO [9]
  - Weaver, Sommer and Paxson's paper [10]
  - Switzerland (EFF) [11]
- Complementary
  - **M-Lab**: Distributed server platform for active tools [12]
  - Respect My Net: the NN violations hub [16]

Neubot: Objective and Design

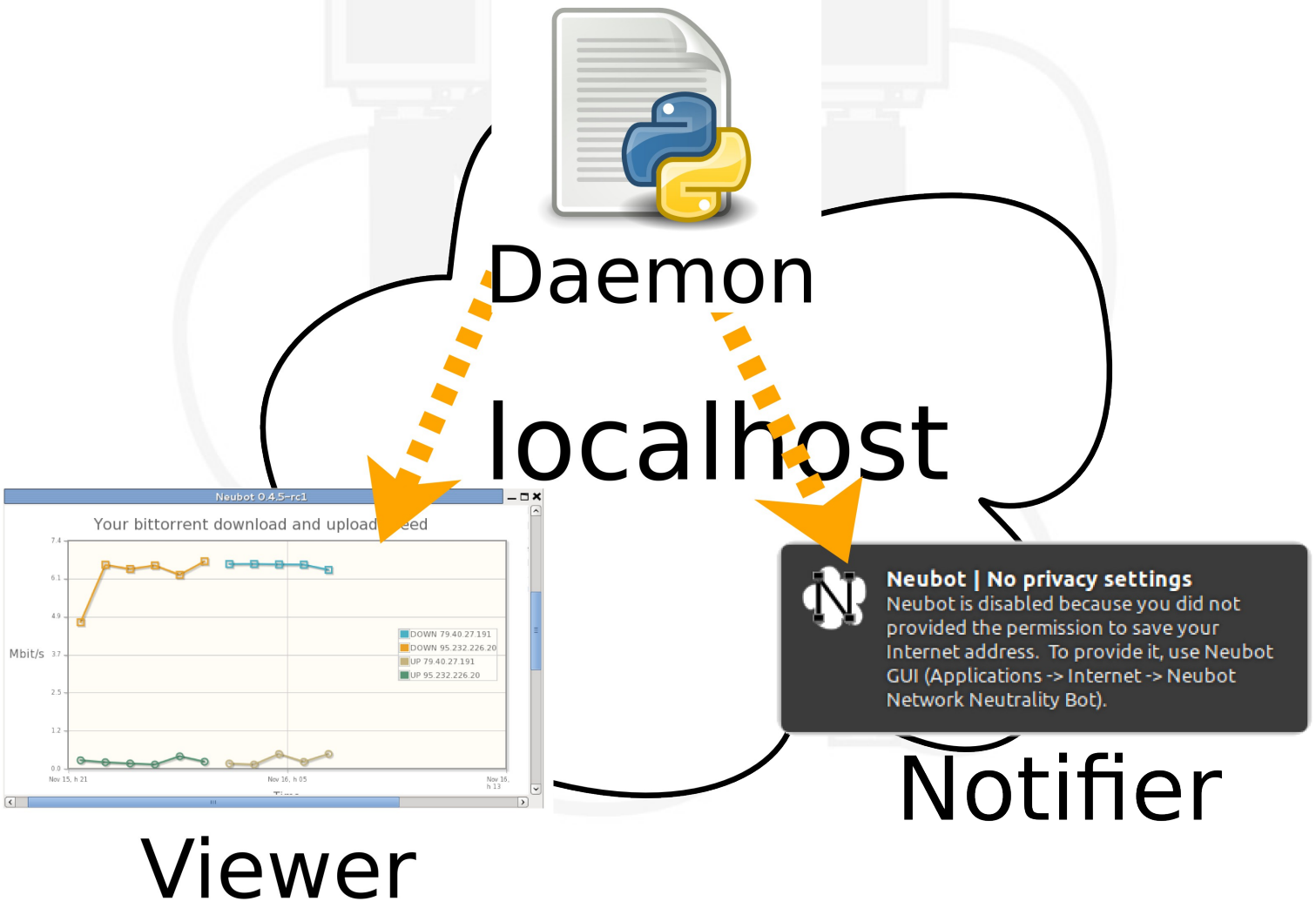
- Objective
  - perform distributed measurements, collect results, **share** raw results, **publish** analysis
  - Become a **client-side platform** for transmission tests
- Design
  - Neubot is an **active tool** and is a bot, hence runs tests automatically (but you can run tests on-demand)
  - Tests **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

Server 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*

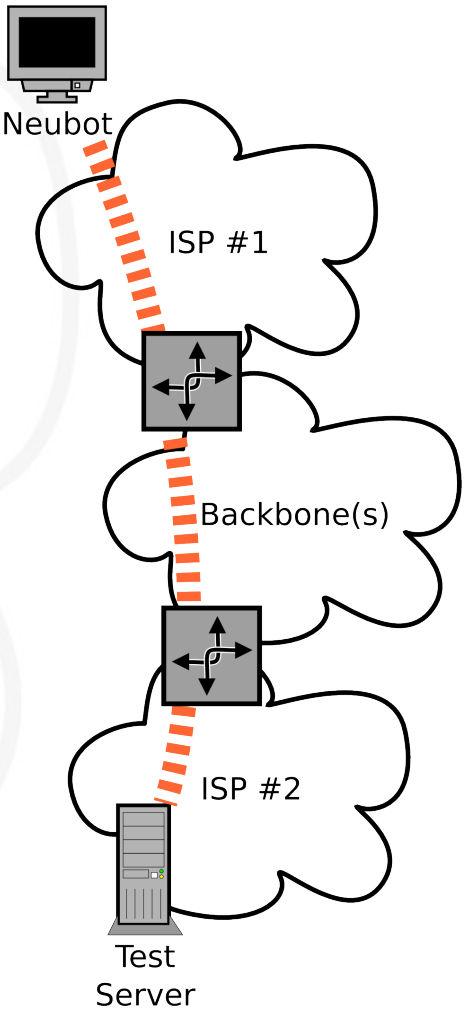


Client architecture



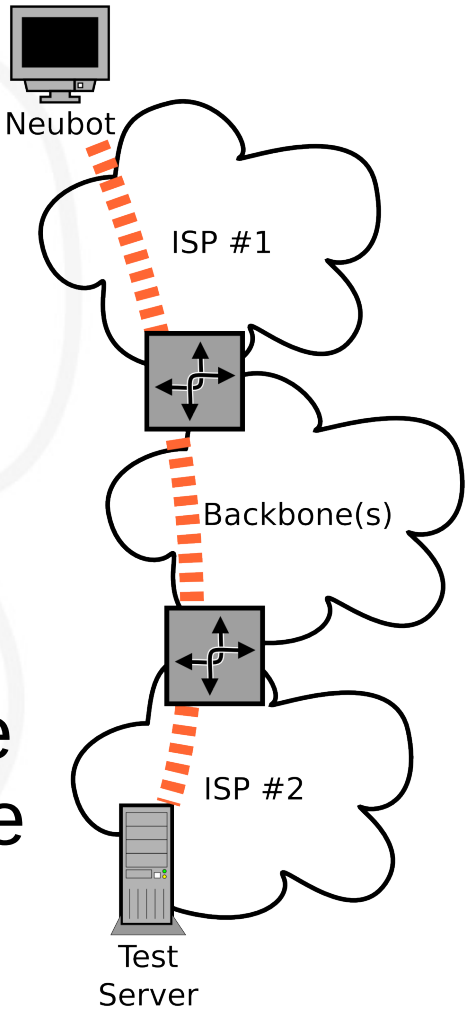
HTTP test implementation

- A single TCP connection
- **Round-trip time**
  - Time required to connect()
  - Time required to “HEAD” a resource
- **Goodput**
  - Measure time *T* required to GET/POST *K* bytes
  - Calculate goodput = *K* / *T*
  - *K* adapted so that next test would take *T=5* seconds (under current conditions)



BitTorrent test implementation

- Similar to HTTP test
- Emulates a continuous transfer by **pipelining** an initial burst of requests and then sending one more request when a new piece is received
- The burst size is 1/3 of the target number of bytes to transfer
- Measurement starts after the first piece is received, assuming the pipeline to be full at that point



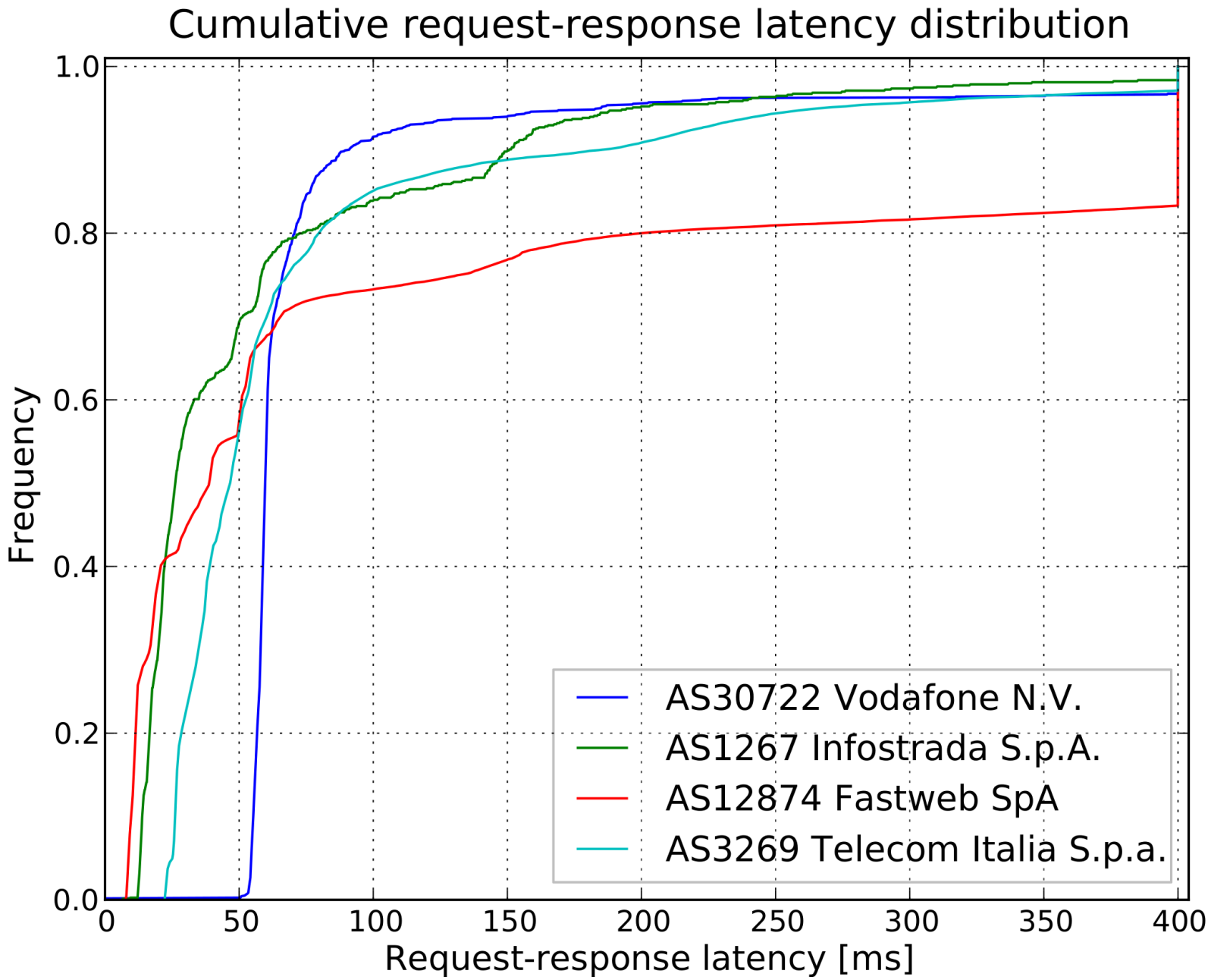
Discussion and caveats

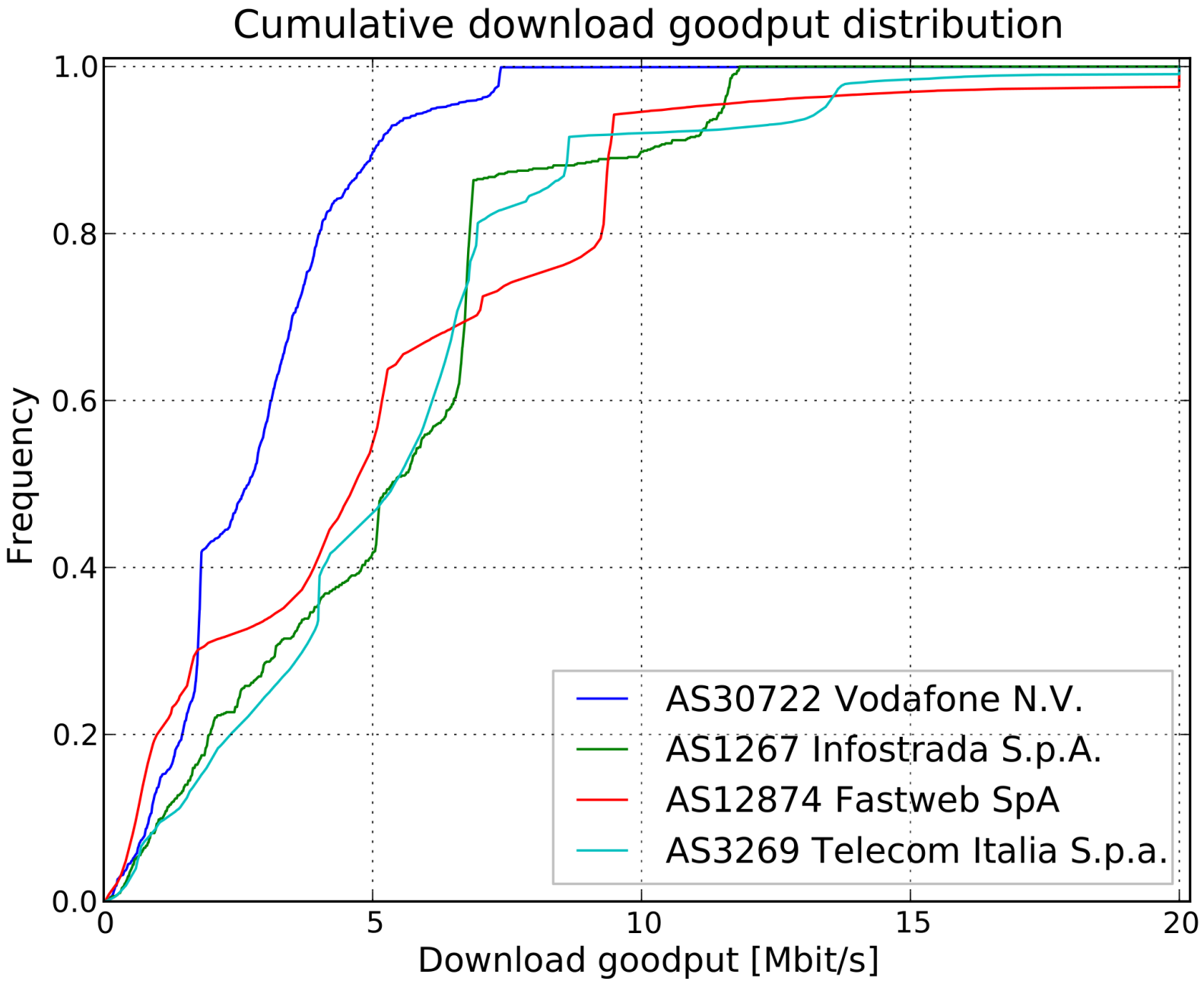
- Discussion
  - SYN/ACK loss for “time to connect”
  - RTT range for comparison
  - Test duration (1 second vs. 5 second vs...)
  - Number of connections
  - Receive buffer
- Caveats
  - User activity
  - Home connection sharing
  - Lossy wireless home connection
  - Congestion in the backbone
  - Server-load
  - ...

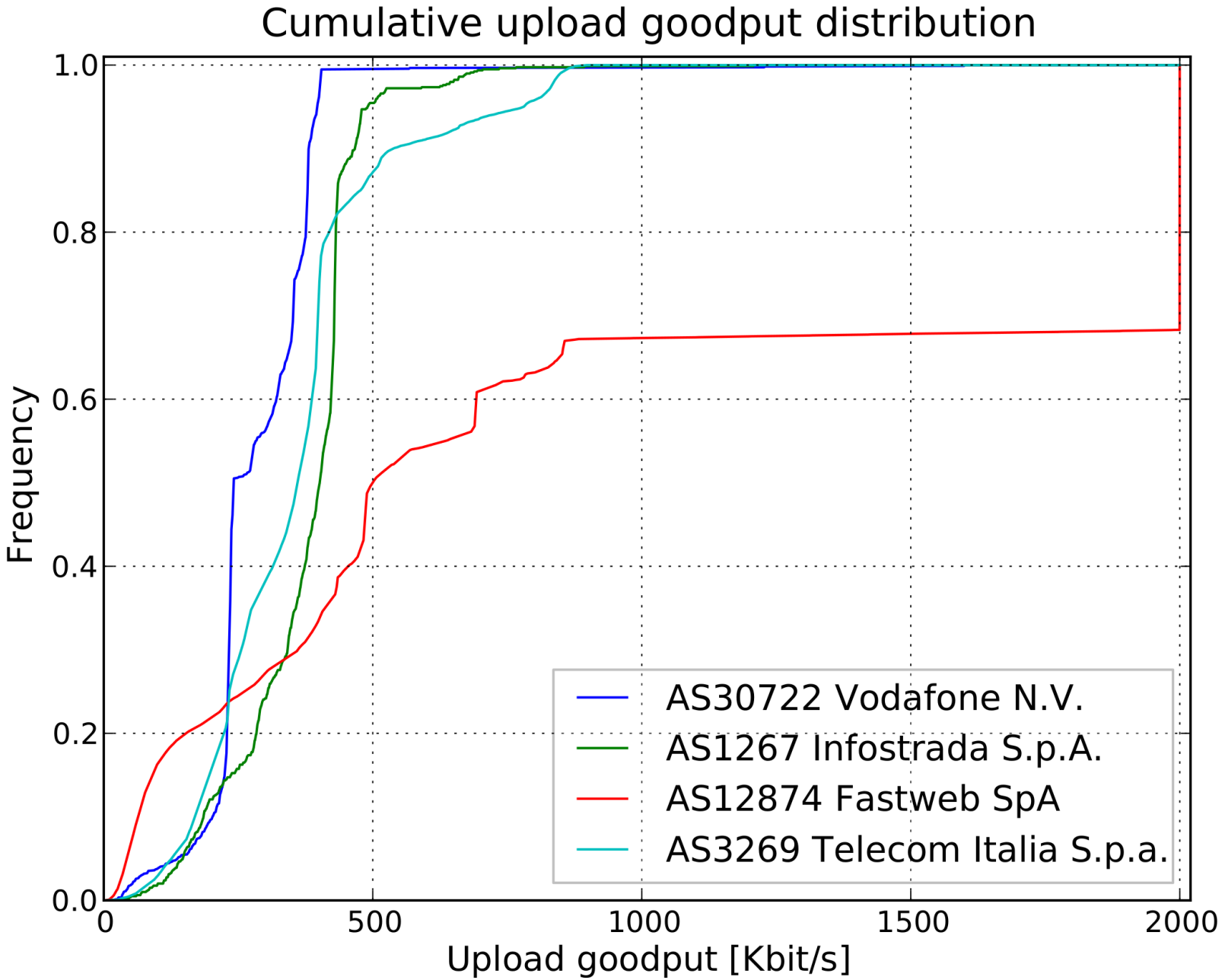
Turin-area data set (http://www.neubot.org/data)

	Whole dataset	Turin area
Number of tests	947729	80196
Number of Neubots	1054	166
First test	30-05-2011	30-05-2011
Last test	13-09-2011	13-09-2011

Autonomous System	Measurements	Neubots
AS2594 CSI Piemonte	77	1
AS44957 OPITEL AS number	45	2
AS8968 BT Italia S.p.A.	1234	2
AS35612 NGI Spa	11	3
AS35719 TEX97 S.p.a	573	3
AS24608 H3G S.p.A.	18	4
AS16232 TIM (Telecom Italia Mobile) Autonomous System	90	4
AS8612 Tiscali Italia S.P.A.	555	7
AS137 GARR Italian academic and research network	26200	25
AS30722 Vodafone N.V.	1162	8
AS1267 Infostrada S.p.A.	794	24
AS12874 Fastweb SpA	24735	44
AS3269 Telecom Italia S.p.a.	24702	65


Cumulative request-response latency distribution
Frequency
Request-response latency [ms]
0.0
0.2
0.4
0.6
0.8
1.0
0
50
100
150
200
250
300
350
400
AS30722 Vodafone N.V.
AS1267 Infostrada S.p.A.
AS12874 Fastweb SpA
AS3269 Telecom Italia S.p.a.


Cumulative download goodput distribution
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
Download goodput [Mbit/s]
AS30722 Vodafone N.V.
AS1267 Infostrada S.p.A.
AS12874 Fastweb SpA
AS3269 Telecom Italia S.p.a.


Cumulative upload goodput distribution
Frequency
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
2000
Upload goodput [Kbit/s]
AS30722 Vodafone N.V.
AS1267 Infostrada S.p.A.
AS12874 Fastweb SpA
AS3269 Telecom Italia S.p.a.

Ongoing & future work

- Ongoing
  - Geo-scaling
    - Deploying to **M-Lab**
    - Will switch to **DONAR**?
  - Skype?
  - Deeper data analysis
- Future
  - Peer to peer tests
    - Neubot will behave like a test server
    - More groundwork is needed

Thank you!

http://www.neubot.org/

(also on Facebook & Twitter)

http://nexa.polito.it/

References

[1] http://www.internet2.edu/performance/ndt/ [2011-06-20]

[2] Dischinger, M., Marcon, M., Guha, S. et al., *"Glasnost: Enabling end users to detect traffic differentiation"*, Proceedings of the 7th USENIX conference on Networked systems design and implementation, 2010

[3] http://www.psc.edu/networking/projects/pathdiag/ [2011-06-20]

[4] Prasad, R., Dovrolis, C., Murray, M. et al., *"Bandwidth estimation: metrics, measurement techniques, and tools"*, Network, IEEE, vol 17 issue 6, Nov-Dec 2003

[5] http://www.cc.gatech.edu/~partha/diffprobe/shaperprobe.html [2011-06-20]

[6] Y. Zhang, Z. Mao, and M. Zhang, *"Detecting traffic differentiation in backbone ISPs with NetPolice"*, Proceedings of the 9th ACM SIGCOMM conference on Internet measurement conference, 2009

[7] http://grenouille.com/ [2011-06-20]

[8] http://wiki.ookla.com/test_flow [2011-06-20]

[9] M. Tariq, M. Motiwala, N. Feamster, et al., *"Detecting network neutrality violations with causal inference"*, Proceedings of the 5th international ACM conference on Emerging networking experiments and technologies, 2009

[10] N. Weaver, R. Sommer, V. Paxson, *"Detecting forged TCP reset packets"*, Proceedings of NDSS, Citeseer, 2009

[11] http://www.eff.org/testyourisp/switzerland [2011-06-20]

[12] http://www.measurementlab.net/ [2011-06-20]

[13] http://projectbismark.net/ [2011-06-21]

[14] https://www.misurainternet.it/nemesys.php [2011-06-30]

[15] http://www.nettfart.no/ [2011-06-30]

[16] http://respectmynet.eu/ [2011-11-16]