Understanding QoS measurements: Experience from the mPlane European Project

Marco Mellia
Politecnico di Torino

ITU Regional Workshop for Europe
New Issues in QoS Measuring and Monitoring
25-26 November 2015

mPlane

SEVENTH FRAMEWORK PROGRAMME

Experience from the mPlane European Project

mPlane

SEVENTH FRAMEWORK PROGRAMME

mPlane project quick facts

- mPlane is an FP7 Integrated Project
- Project acronym: **mPlane**
- Project full title: “mPlane – an Intelligent Measurement Plane for Future Network and Application Management”
- Grant agreement no: 318627
- Staring Date: November 1st 2012
- Total Cost: 11,274,908.00 €
- Duration: 3 years
- Partners: 16
- Coordinator: **Prof. Marco Mellia** – Politecnico di Torino - IT

Who we are

- 3 operators
- 6 research centers
- 5 universities
- 2 small enterprises

Coordinator

Marco Mellia
POLITO

Tech. Coordinator

Saverio Nicolini
NEC

Dina Papagiannaki
Telefonica

Ernst Biersack
Eurecom

Brian Trammell
ETH

Arpad Bakay
NetVisor

Andrea Fregosi
Fastweb

Dario Rossi
ENST

Fabrizio Invernizzi
Telecom Italia

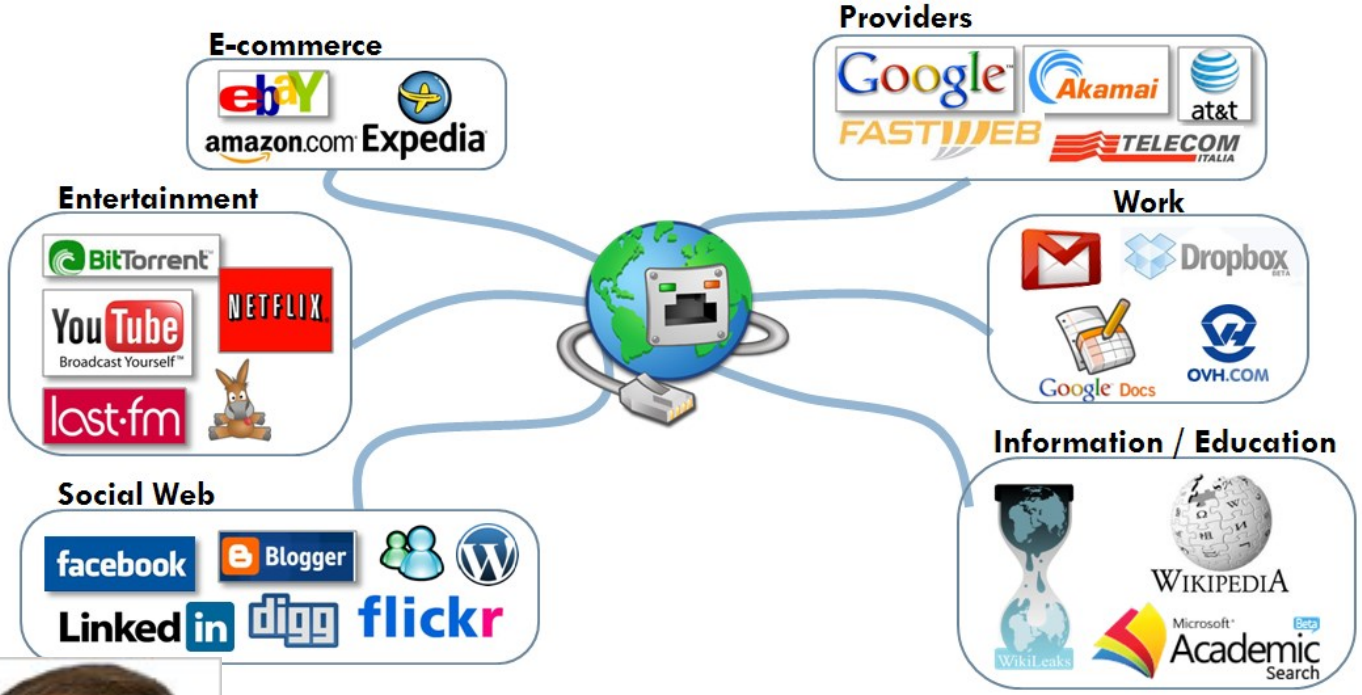
Guy Leduc
Univ. Liege

Pietro Michiardi
Eurecom

Pedro Casas
FTW

Which problem(s) mPlane aims at solving

The nowadays Internet



*"The Internet is the first thing that humanity has built that humanity doesn't **understand**, the largest experiment in **anarchy** that we have ever had."*

Eric Schmidt – ex Google Exec. Chairman

A complicated technology…

Internet: *different technologies are combined to offer a plethora of services*

We sorely miss the technology to understand what is happening in the network and thus to optimize its performance and utilization

Specially when something goes wrong!

A complicated technology…

…that no one controls and understands

- Why WhatsApp is not working?
- Which is the best ISP in my area?
- Where is YouTube traffic coming from?
- …
- **How to measure the QoS?**

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Understanding QoS measurements

Understanding QoS measurements

Zen and the art of speedtest

mPlane

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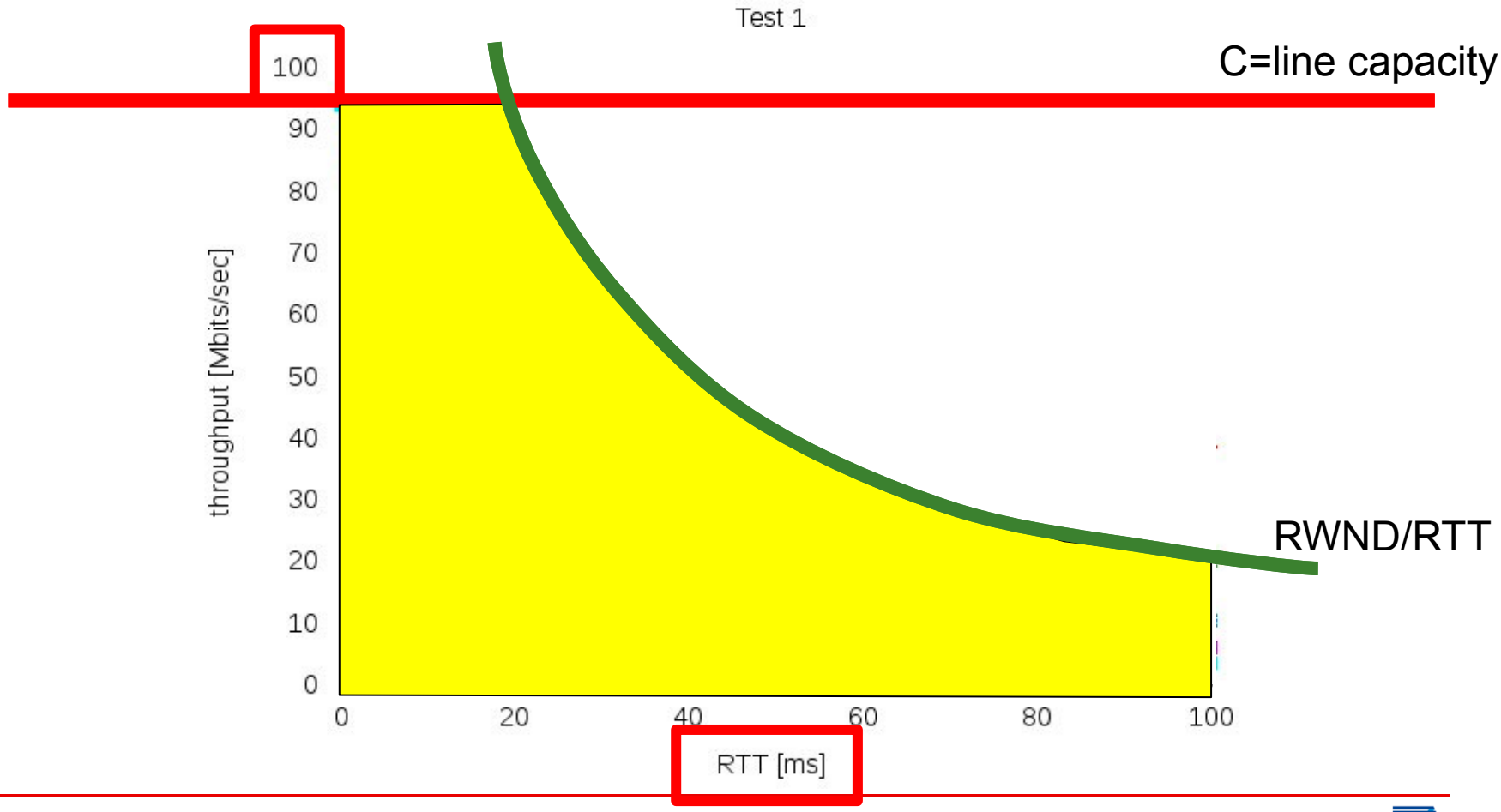
QoS == speedtest

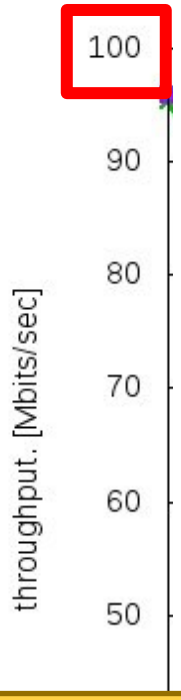
- Trivial idea: Measure the application throughput
  - Download a file of size D
  - Measure the time ΔT to complete the transfer
  - Get throughput as T'put=D/ΔT

- From theory to practice
  - Which server to use?
  - What TCP version?
  - Which configuration?
  - …

Impact of client RWND



Impact of TCP Congestion Control



*"The Internet is the first thing that humanity has built that humanity doesn't **understand**, the largest experiment in **anarchy** that we have ever had."*

Troubleshooting and understanding

SEVENTH FRAMEWORK PROGRAMME

Network Measurements…

- **Active measurements**
  - Exactly define the workload the network is subject to
  - Measure the desired quantity

  Examples: traceroute, speedtest, etc.
- **Passive measurements**
  - Do not change the working point of the network
  - More detailed view of the network status

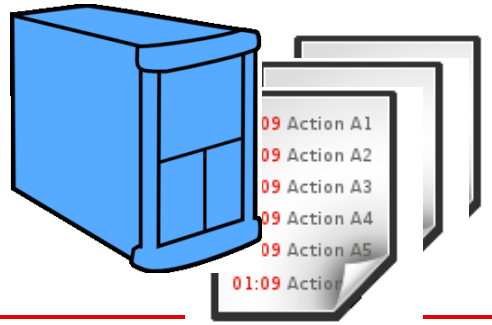
  Examples: wireshark, tcpdump, etc.

Hybrid Measurements

- **Combine active and passive approaches:**
  1. Augment active tests with detailed information obtained from passive measurements
  2. Active measurements generate the desired amount of traffic

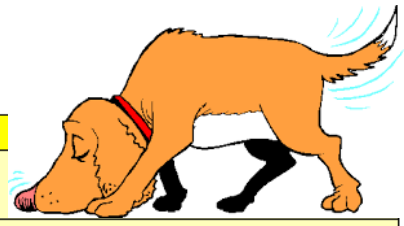
Active probe

Active server



Passive probe: Tstat

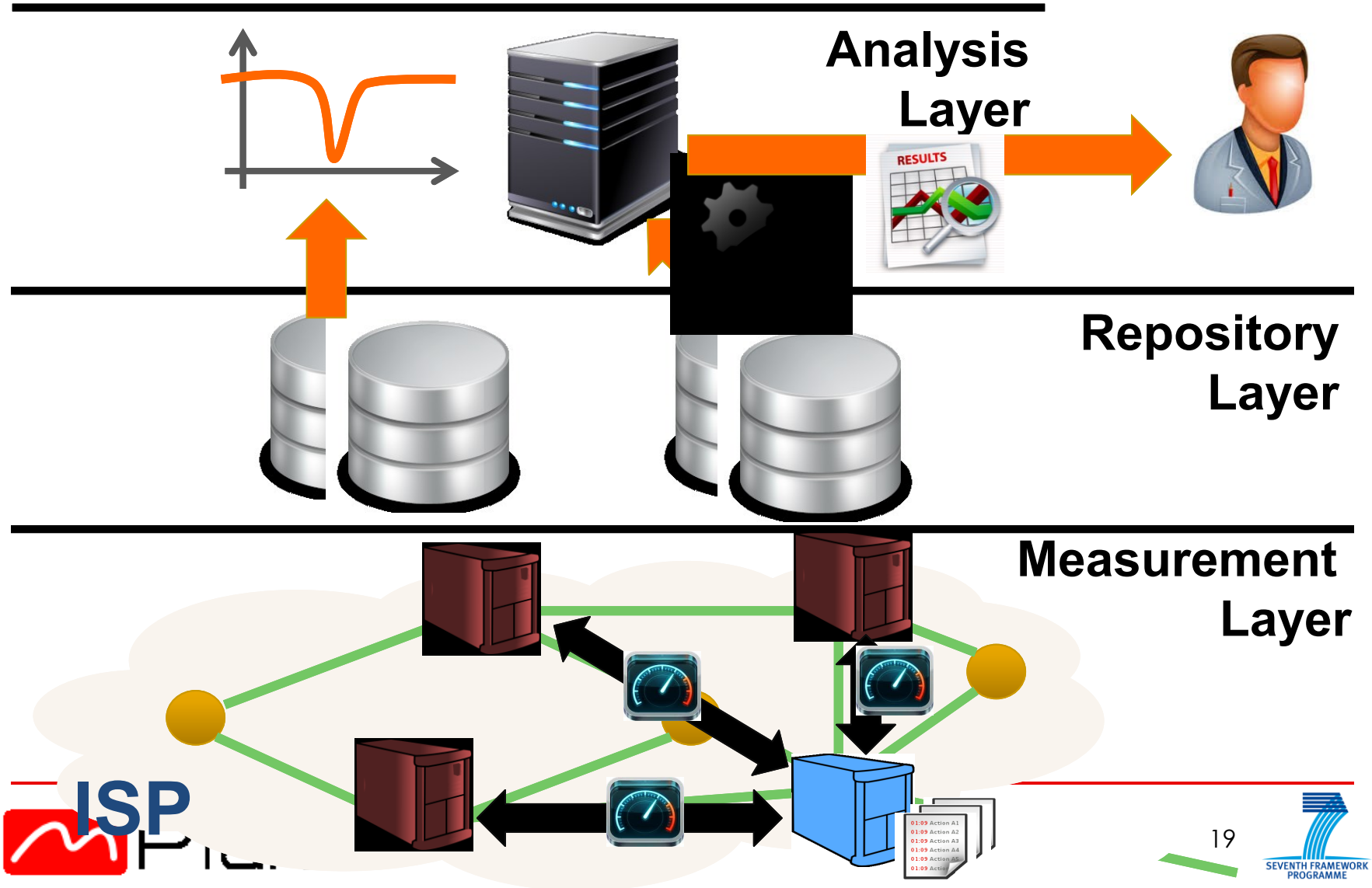
- Captures traffic on the network interface and processes it in **real-time**
- **Rebuilds** TCP/UDP flows
- Computes **100+ statistics,** logged at the end of the flow
- Open-source: http://tstat.polito.it



log_tcp_complete - log_tcp_nocomplete

C2S	S2C	Short description	Unit	Long description
1	45	Client/Server IP addr	-	IP addresses of the client/server
2	46	Client/Server TCP port	-	TCP port addresses for the client/server
3	47	packets	-	total number of packets observed form the client/server
4	48	RST sent	0/1	0 = no RST segment has been sent by the client/server
5	49	ACK sent	-	number of segments with the ACK field set to 1
6	50	PURE ACK sent	-	number of segments with ACK field set to 1 and no data
7	51	unique bytes	bytes	number of bytes sent in the payload
8	52	data pkts	-	number of segments with payload
9	53	data bytes	bytes	number of bytes transmitted in the payload, including retransmissions
10	54	rexmit pkts	-	number of retransmitted segments
11	55	rexmit bytes	bytes	number of retransmitted bytes
12	56	out seq pkts	-	number of segments observed out of sequence

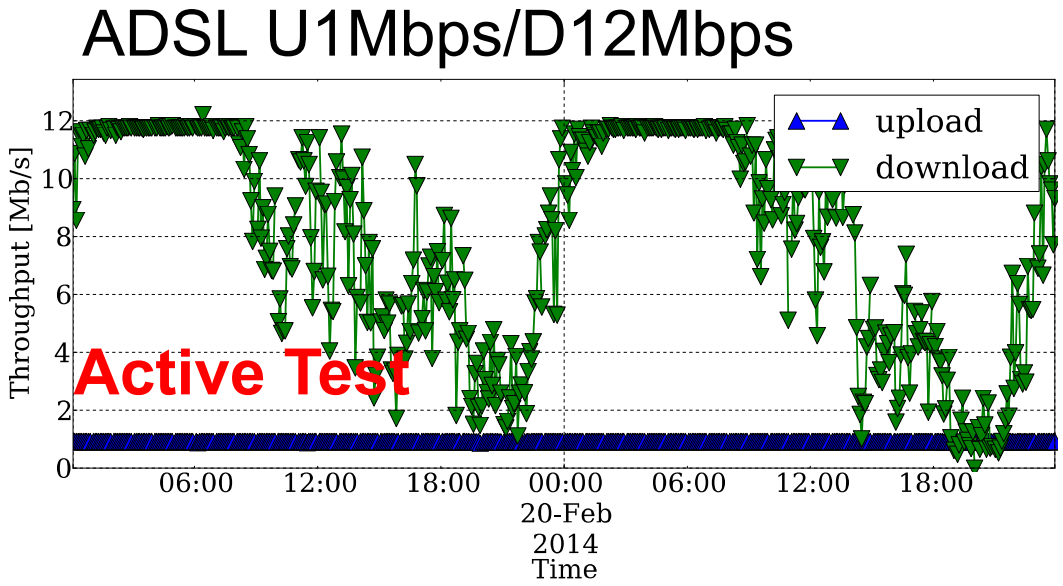
Hybrid Measurements for Network Troubleshooting

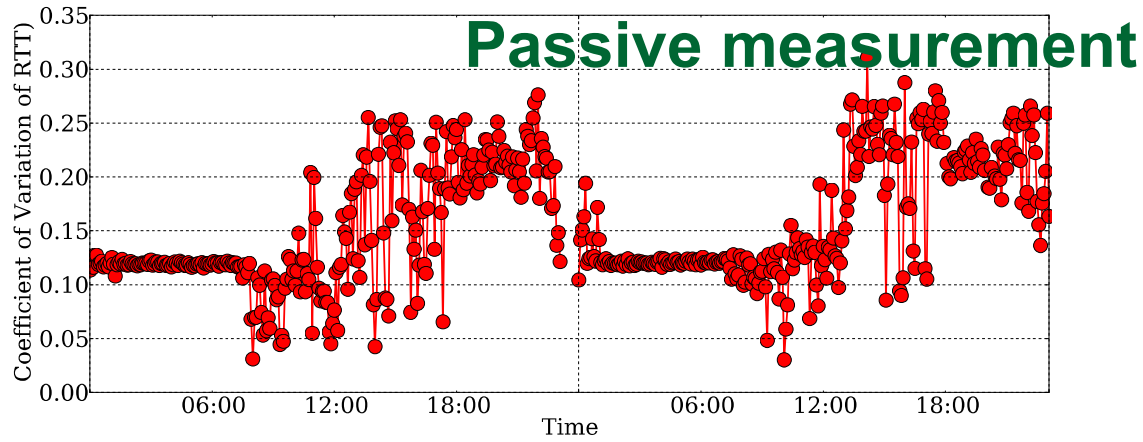


Testbed & Dataset

- **30+** Speetest probes distributed within the network
- Network configurations
  1. ADSL:
     U-1 Mbps/**D-16**Mbps
     U-1 Mbps/**D-12**Mbps
     U-0.5 Mbps/**D-8**Mbps
  2. FTTH
     U-10 Mbps/**D-10**Mbps
- **10-sec** long speedtest every **4min**
  - FTP transfers in both Upload and Download
- **3 months** of tests (**Feb 1st** to **Apr 30th 2014)**
- **More than 1.3M** speed-test reports

Congestion in the Virtual Leased Lines





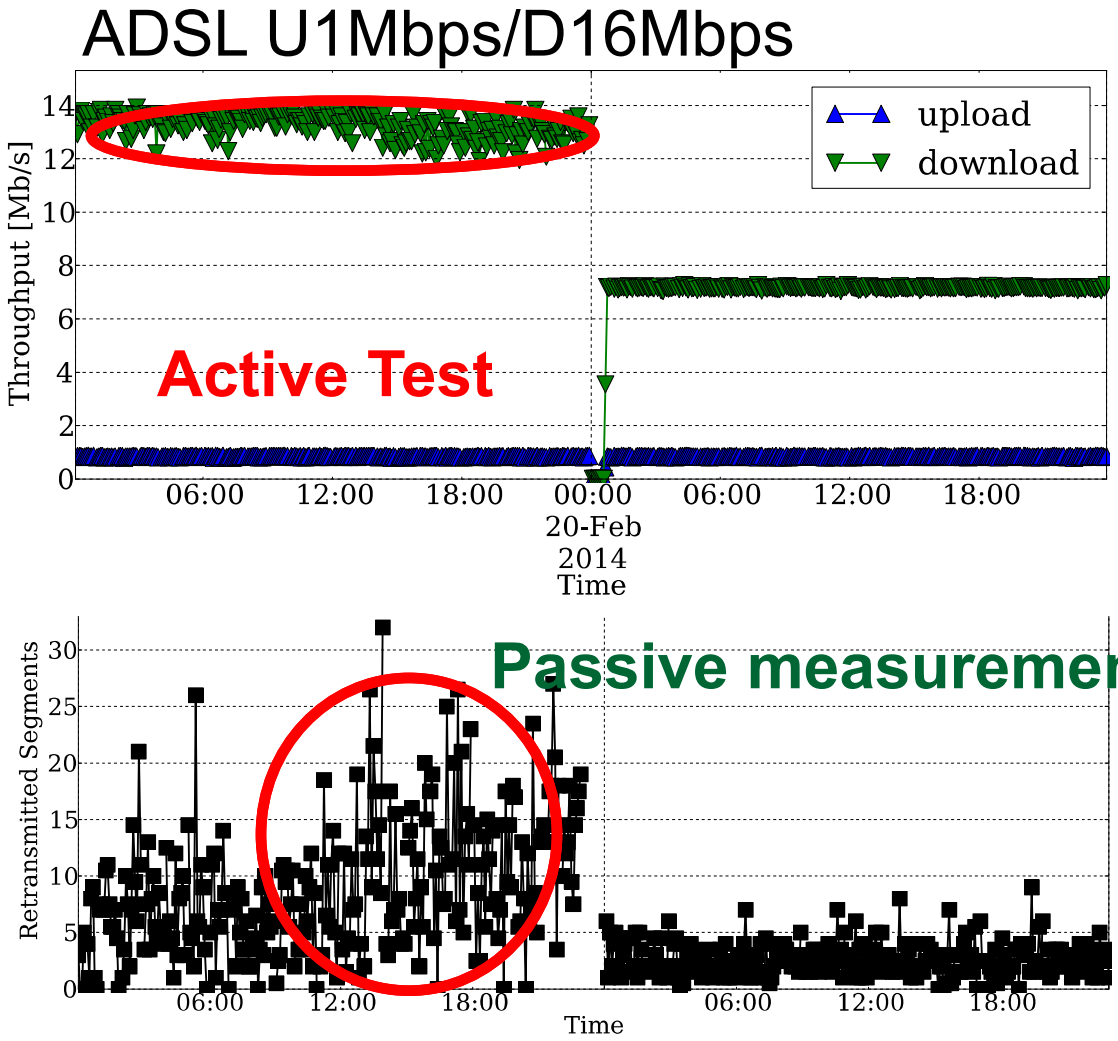
Evident day/night periodicity

+

Large std(RTT)

Congestion in the Virtual Leased Line

Low SNR on ADSL lines



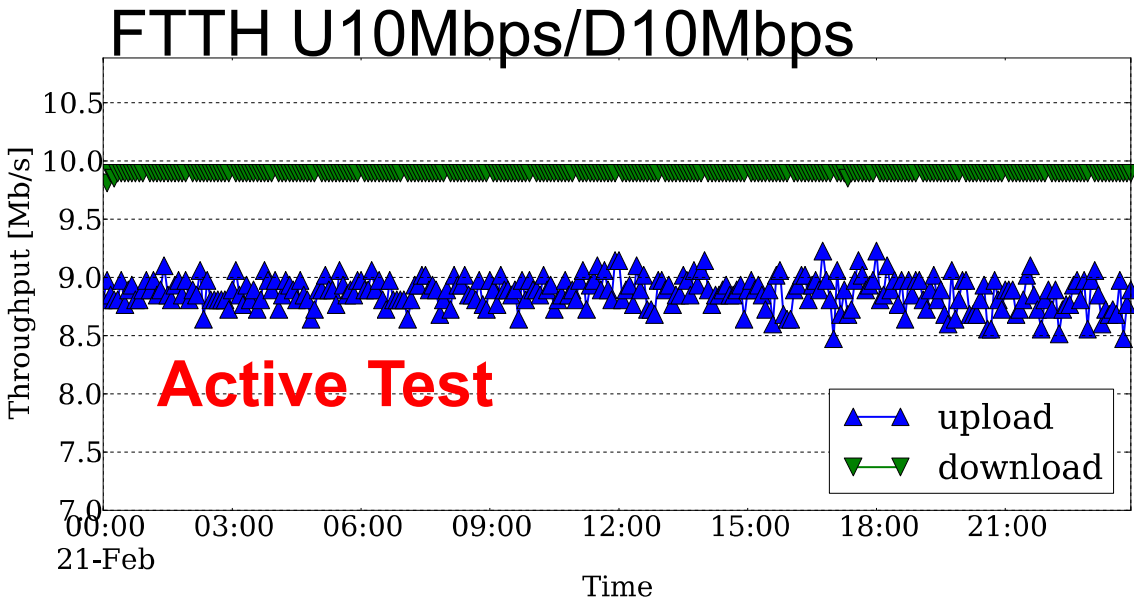
Large RTX rate

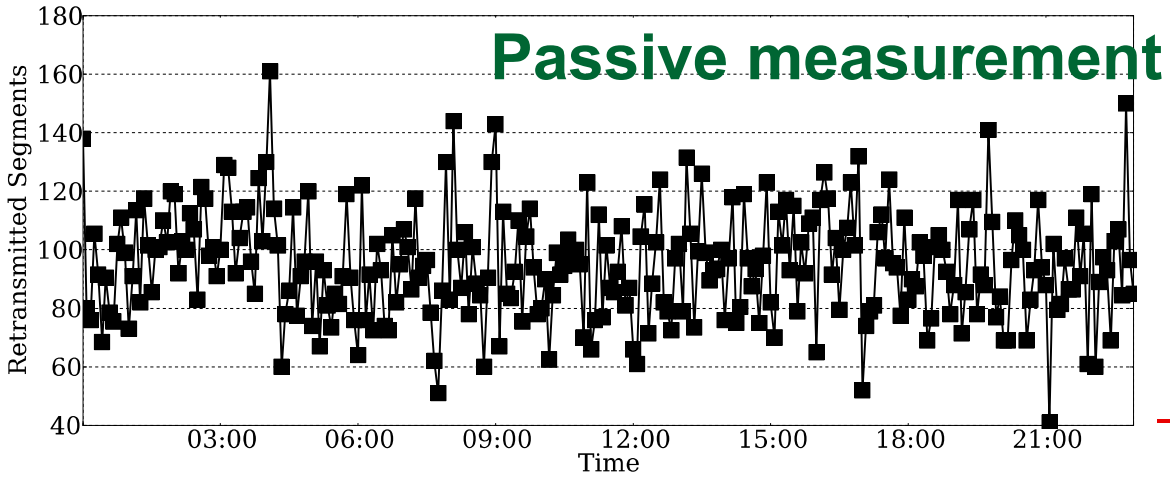
+

No day/night pattern

Large Bit Error Rate

Congestion at the Uplink





FTTH (no SNR issues)

+

No day/night periodicity

+

large RTX segment rate

???

Small buffer at the uplink

Conclusions

- Even simple speedtest measurements are complicated
- Hybrid measurements to find the possible root cause of a issue
- To accelerate the network troubleshooting procedures

- Question: is speedtest an interesting metric?
  - Can I see YouTube with a 100Mb/s line?

Thank you!


Perguntas
Fragen
Domande
Galdera
Otázky
Questions
Spørgsmål
Pertanyaan
kysymykset
Frågor
Spørsmål
Cwestiynau
вопросы
Preguntes
Sorular
Въпроси
Vragen
Pytania