Distributed platforms for measuring and monitoring broadband access networks

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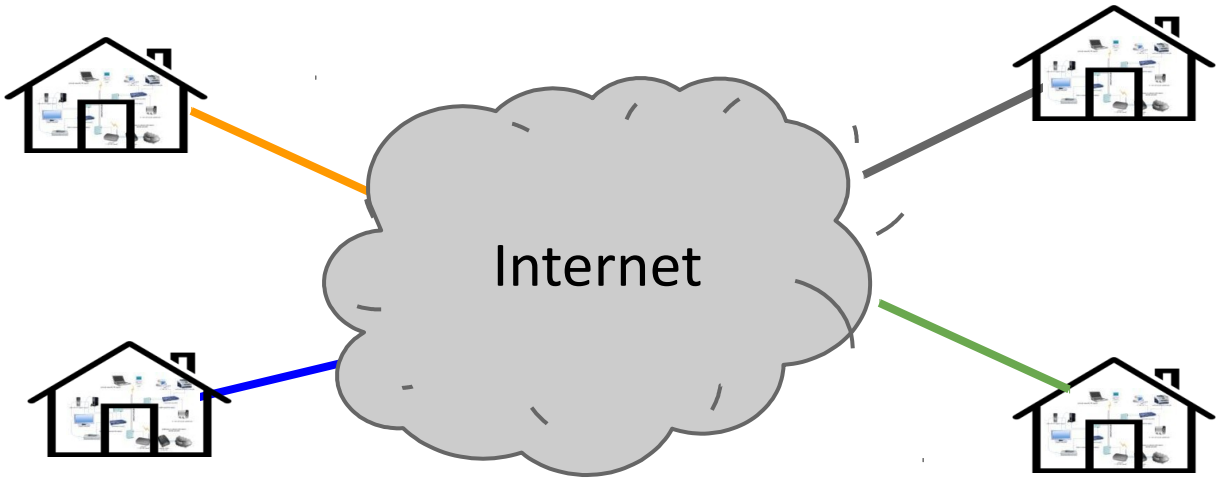
Introduction

Large scale measurement platforms are necessary for studying residential Internet access networks

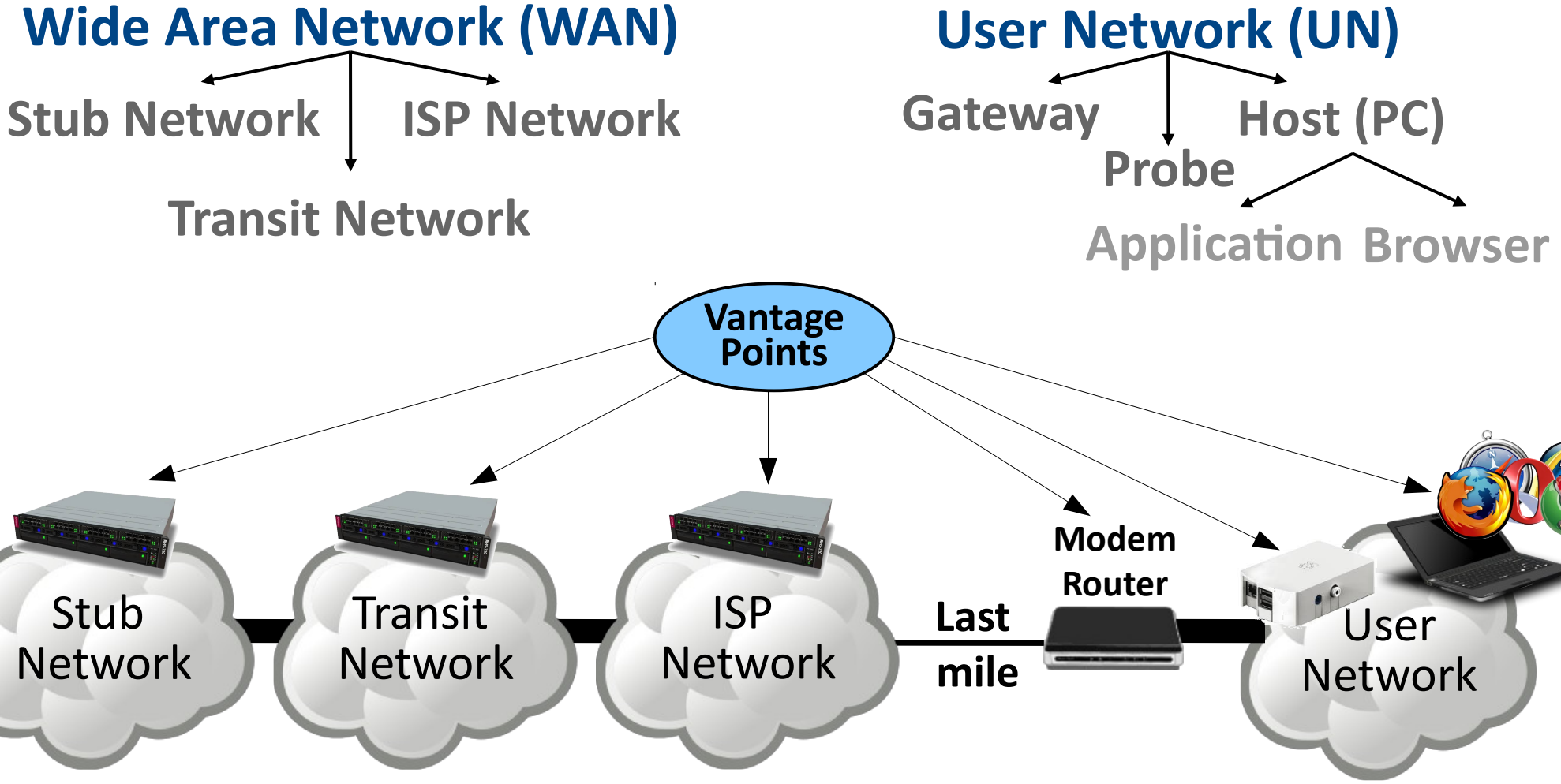


➔ Several approaches and platforms have been adopted

➔ Standardization effort is ongoing while deployed platforms are not interoperable yet

A taxonomy of existing approaches

Based on where VPs initiating measurements are located



A taxonomy of existing approaches

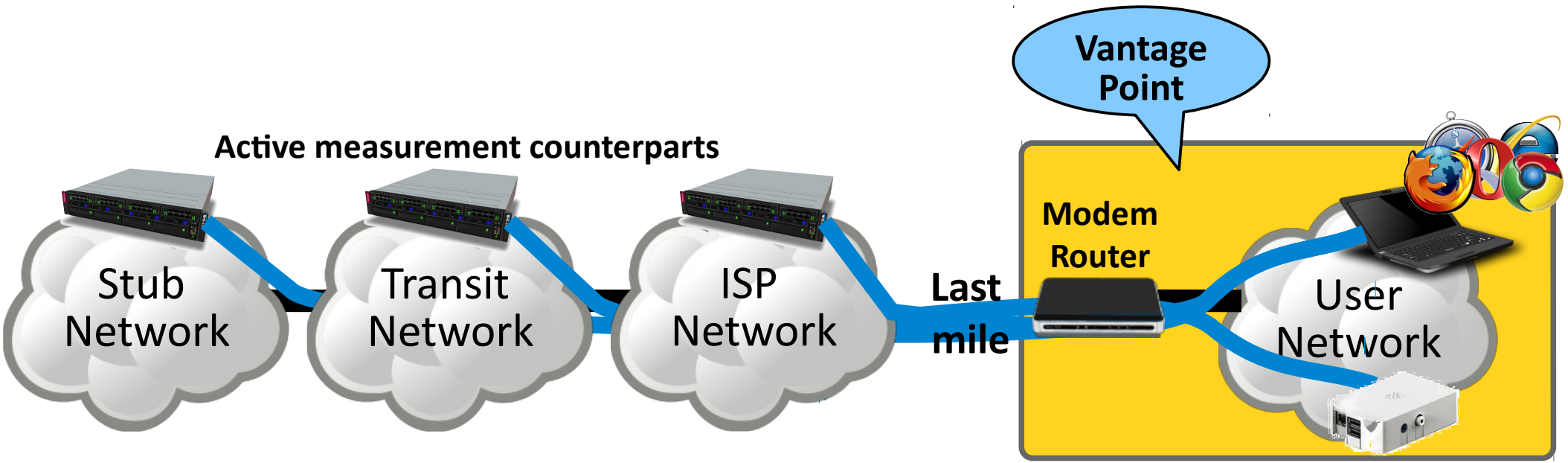
Based on where VPs initiating measurements are located

Wide Area Network (WAN)

- Stub Network
- ISP Network
- Transit Network

User Network (UN)

- Gateway
- Host (PC)
- Probe
- Application
- Browser



UN-based platform requirements

Optimal operating conditions

VPs should cover most geographic areas, ISPs, and service plans

Enough measurement servers should be available at the shortest network distance to most VPs

Functional requirements

Two complementary platforms - One architecture

BISmark

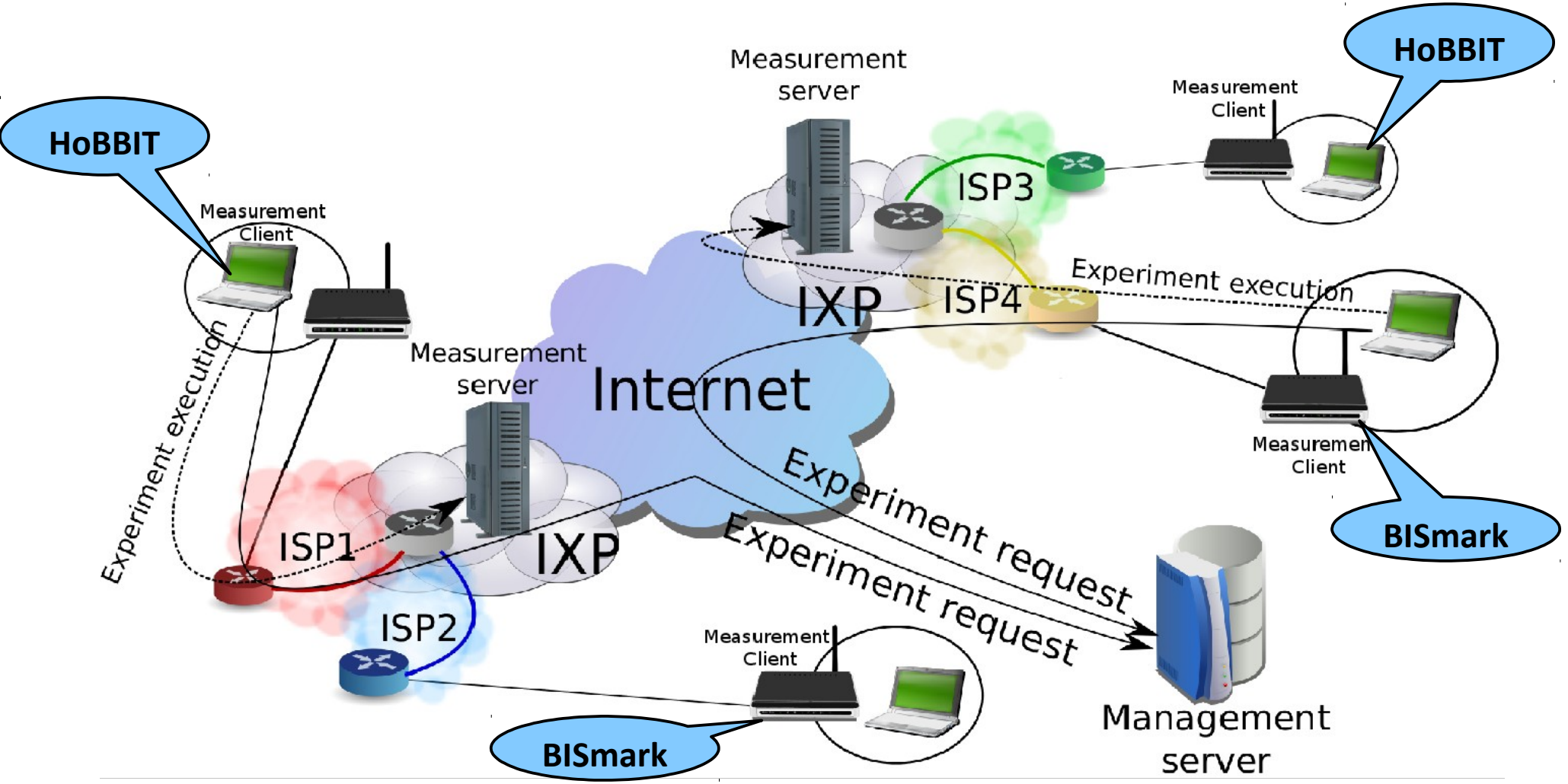
(Gateway-based)

http://projectbismark.net

HoBBIT

(Application-based)

http://hobbit.comics.unina.it



Common features

(Gateway-based)

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(Application-based)

Support for pre-existing measurement tools

- Well tested tools are more accurate

Implicit management of measurement targets' resources

- Avoids overloading targets (supports unmanaged existing services)

Automatic remote upgrade/configuration

- User intervention is required only when strictly necessary

Accessible real-time reports

- Transparency on obtained results

Specific features

(Gateway-based)

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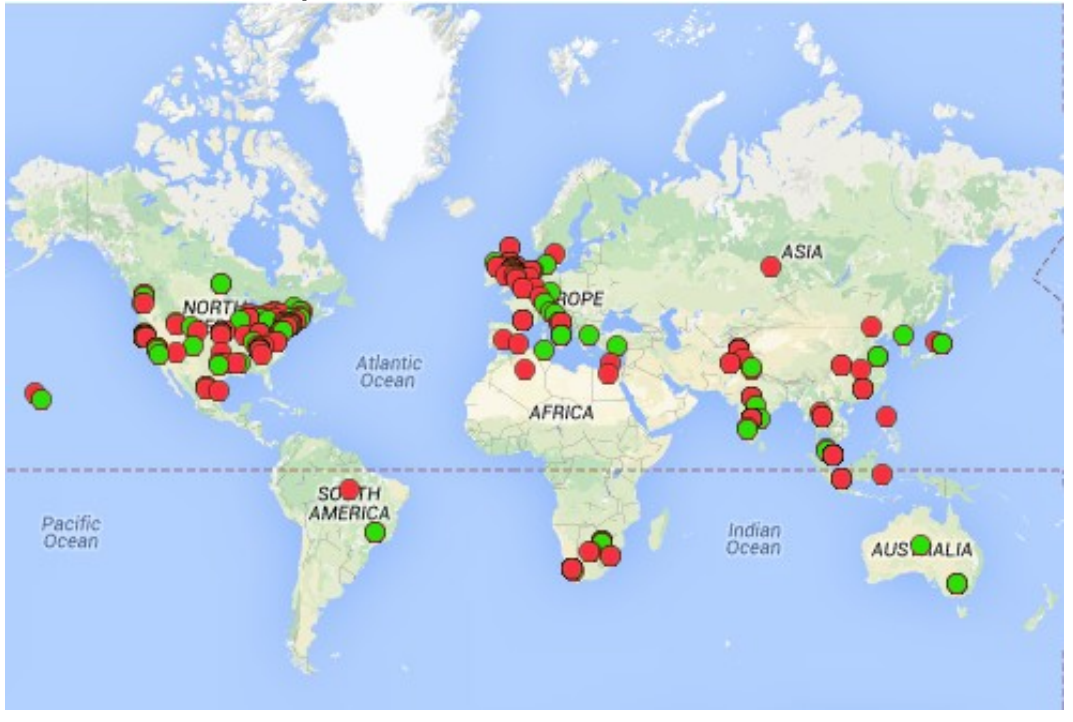
(Application-based)

Customized OS (OpenWRT-based)	Multiplatform client based on Qt libraries and bash/awk wrappers
Remote access to router console for troubleshooting	Identification of connection ISP and service plan details
Captive portal-based one-time device registration	Possibility to temporarily suspend the measurements
Measurements as OpenWRT packages	Flexible measurements (when, which tool, and how to run it)
Monitoring of gateways health	Controlled-overlap scheduling algorithm for “intrusive” measurements
Crosstraffic-aware measurements	Users aware of current activities
Opt-in passive measurements	

Current deployments

	BISmark (Gateway-based)	HOBBIT (Application-based)
Scope	**Worldwide**	**Italy**
Vantage Points	**417**	**489**
Users	**417**	**416**
Measured Access Networks	**417**	**700**
Cities	**176**	**345**

70%
12%
18%



Basic active measurements & tools

BISmark (Gateway-based)

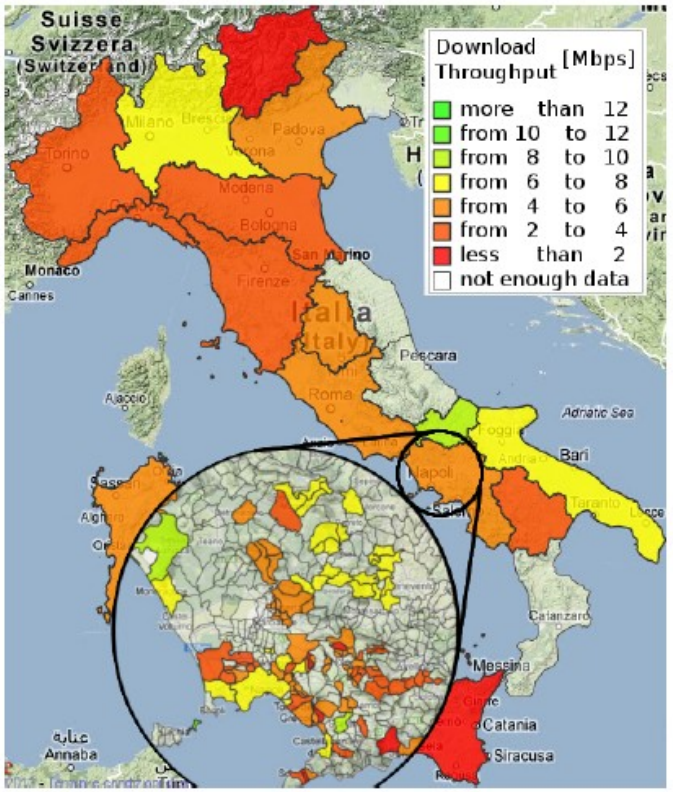
HOBBIT (Application-based)

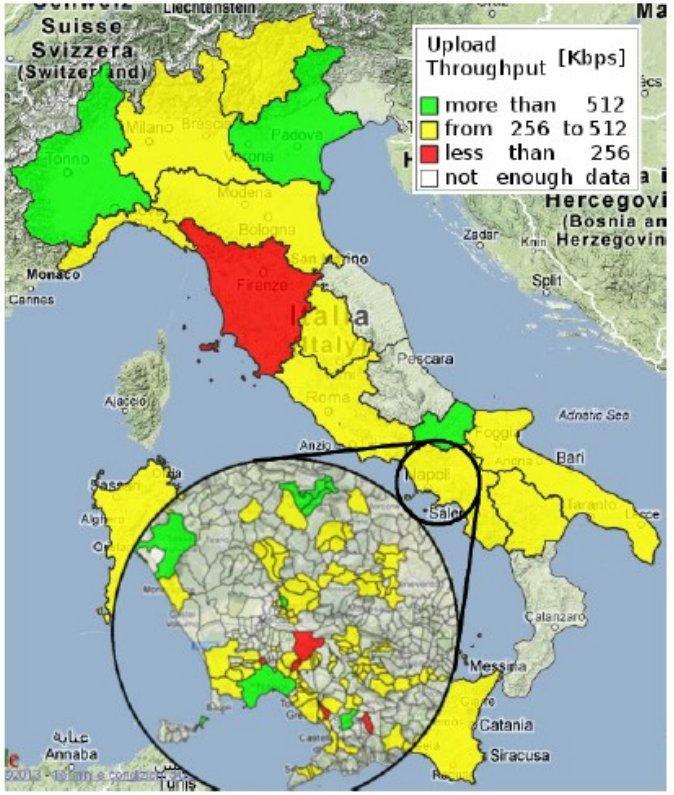
What	How
upstream throughput (multiple TCP flows)	Netperf
downstream throughput (multiple TCP flows)	
round-trip latency (ICMP)	Ping
round-trip jitter	D-ITG
round-trip packet loss	
upstream/downstream capacity	Shaperprobe
upstream/downstream shape rate	
DNS latency	nslookup
DNS failure rate	
forward/reverse IP level path	paris-traceroute
round-trip latency under load	Netperf + ICMP

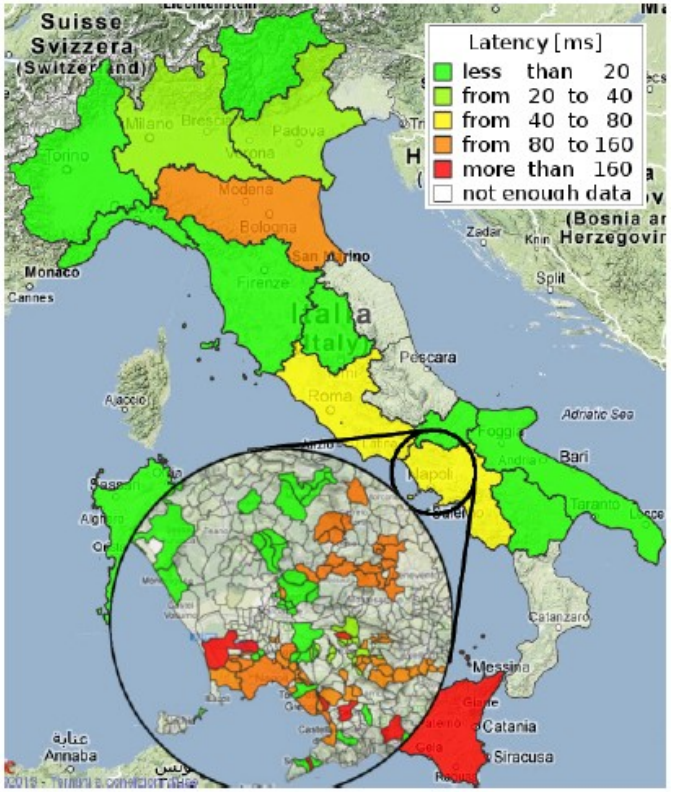
What	How
upstream throughput (single TCP/UDP flow)	D-ITG
downstream throughput (single TCP/UDP flow)	
round-trip latency (UDP)	
round-trip jitter	
round-trip packet loss	
BitTorrent upstream throughput	
BitTorrent downstream throughput	

The power of mapping results (Hobbit)

Average performance over different regions/municipalities



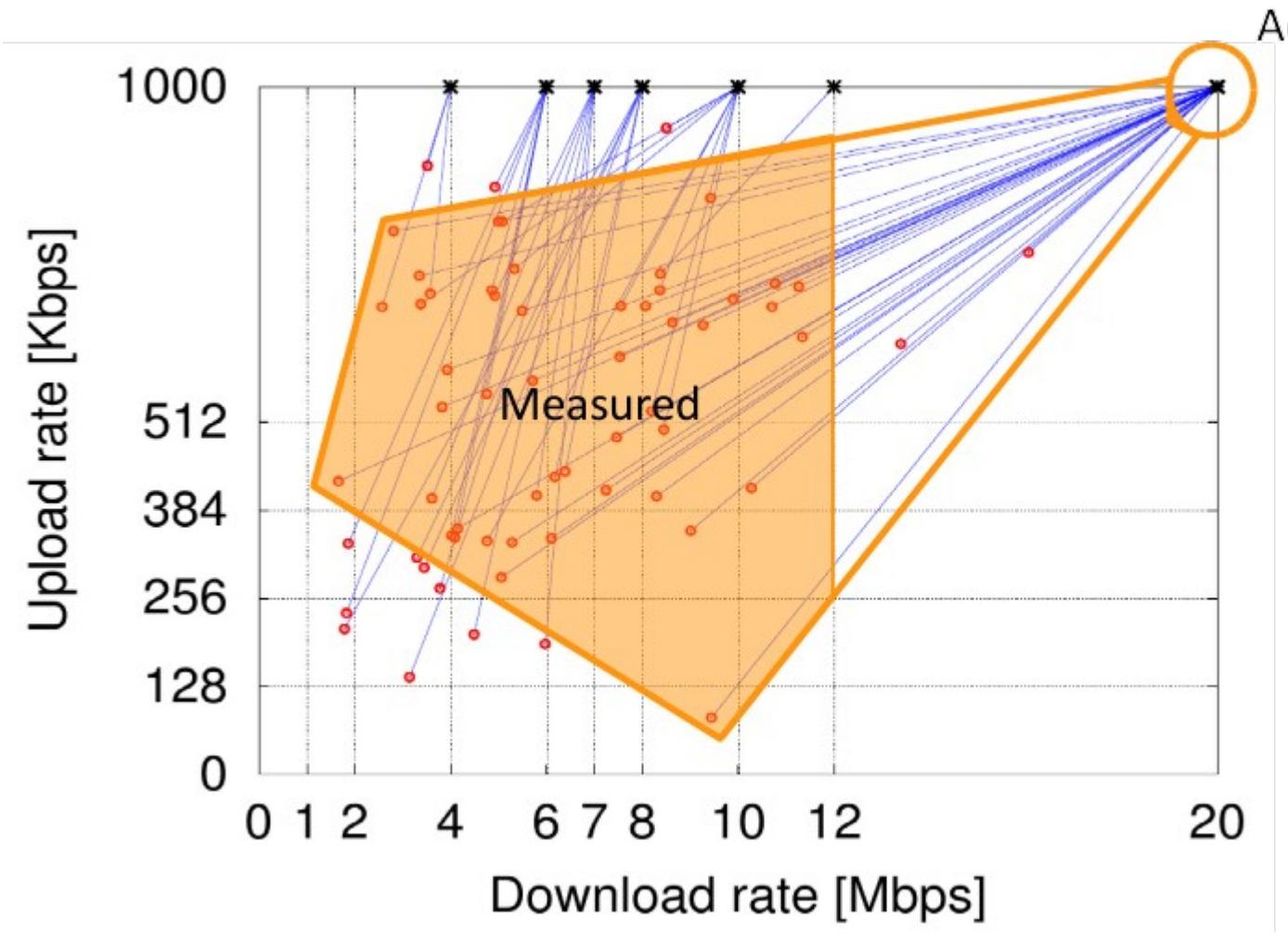




Maps give a quick sketch of average performance over the geographical areas

Looking for answers from collected data (Hobbit)

To what extent ISPs offer the advertised performance?



xDSL

Often the same performance could be obtained with a cheaper service plan

This is more evident for high-end service plans

Main lessons learned

- ➔ Gateway- and application-based approaches have complementary aspects

  they might cooperate to get more insights on performance

- ➔ Encouraging participation is challenging, while loosing it is very easy

  users give to the probe the responsibility for any problem they experience

- ➔ Form factor matters

  users often trust commodity hardware over custom hardware

- ➔ Duration of measurements makes the difference for some metrics

  long term throughput might be very different from short term one

- ➔ Using fine granularity when storing results is a good practice

Open points

- ➔ Large scale and dense deployment of VPs

  for obtaining more accurate insights on performance by geographical location and ISP

- ➔ Cooperation among available platforms

  for improving performance analysis effectiveness

- ➔ Proper scheduling of measurements

  for enabling scalability while managing overlap among measurements

- ➔ Access to technology-specific layer 2 parameters (e.g. DSL negotiated bitrate, signal attenuation, SNR, interleaving/fast)

  for tuning measurement tools and better interpreting results

- ➔ Layer 2 technology detection techniques

  for enabling technology-aware measurement techniques

Thanks!!!

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