Fabio Palumbo

Tutor: Antonio Pescapè

XXXIII Cycle - I year presentation

Cloud Infrastructures for Telepathology

Background

- **Graduation:** M. Sc. degree cum laude in Computer Engineering in July 2017
- Currently working in the **COMICS** research group under the supervision of Prof. Antonio Pescapè
- **Fellowship type**: “PON Dottorati Innovativi”
- **Collaborations**:

  Saint Louis University (USA)

  System Management S.p.A. (Italy)

  Ningbo University (China)

Cloud computing for healthcare

- **Cloud computing adoption allows to**
  - + reduce costs
  - + dynamically adapt to user demands
  - + provide innovative telemedicine services
- **but implies limited visibility into network performance**
  - - unknown bandwidth and packet loss
  - - increased latency

Cloud infrastructures for telepathology

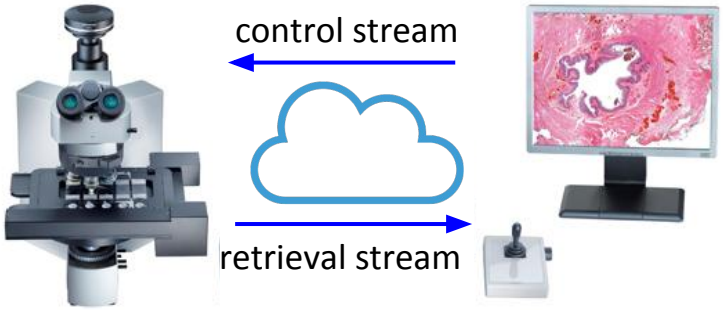
Telepathology requires digitizing tissue images

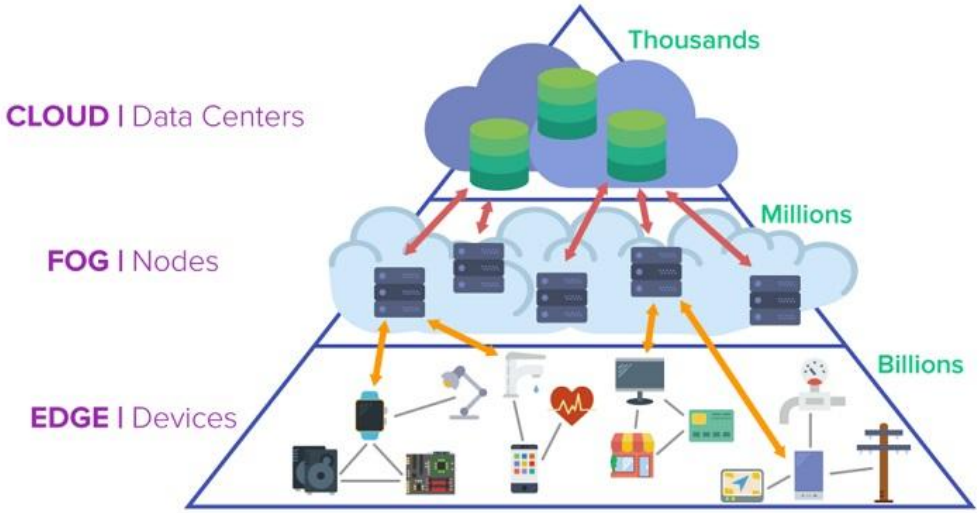
- Real-time *control* and *retrieval* of information streams
- Imposes *load* on the core network

Core Cloud cannot satisfy *latency* requirements by itself

New, *complementary* paradigms to bring resources closer to end-users

- deploying resources in the access network (***Fog computing***),
- or even leveraging users' terminals (***Dew computing***)

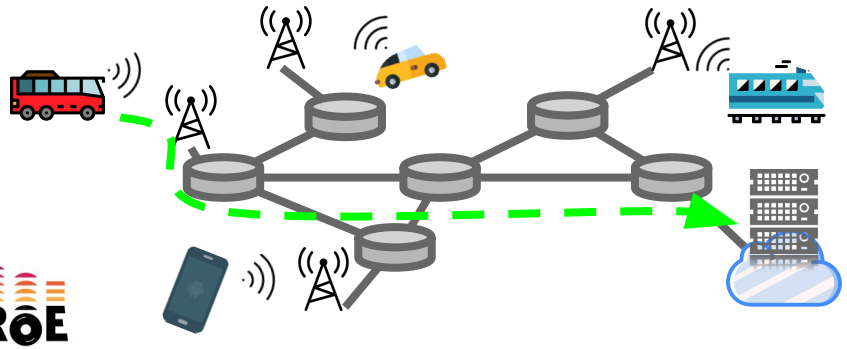




1st-year research activities

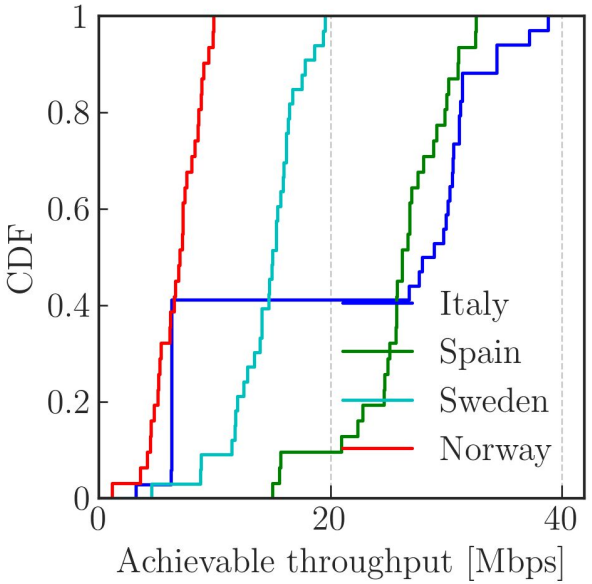
- ***Design* and *evaluation* of network-level monitoring methodology for telepathology in mobile scenarios**
  - Available bandwidth estimation in *mobile broadband networks (MBB)* via *active* [C1] and *passive* (*SDN*-based) [C2] techniques in *real* scenarios
- **Analysis and prediction of network performance of public cloud providers**
  - User-perceived latency towards *commercial cloud providers* from distributed nodes [C3]

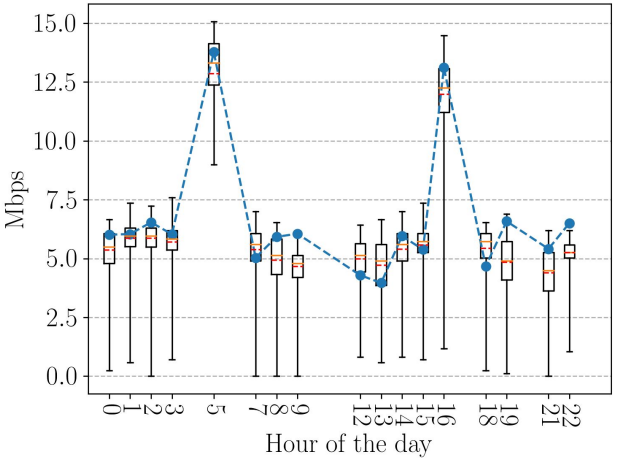
Active bandwidth estimation in MBB [C1]



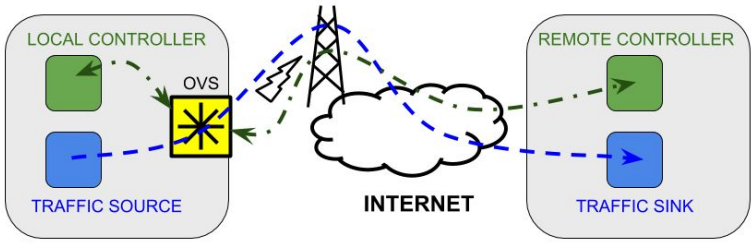
- EU testbed for *MBB* (3G/4G) *network*
- *Active* bandwidth evaluation: D-ITG and Yaz
- 4 countries and 4 Mobile Network Operators tested
- 30+ days experimental campaign

→ *Bandwidth depends on country/operator, time of the day*



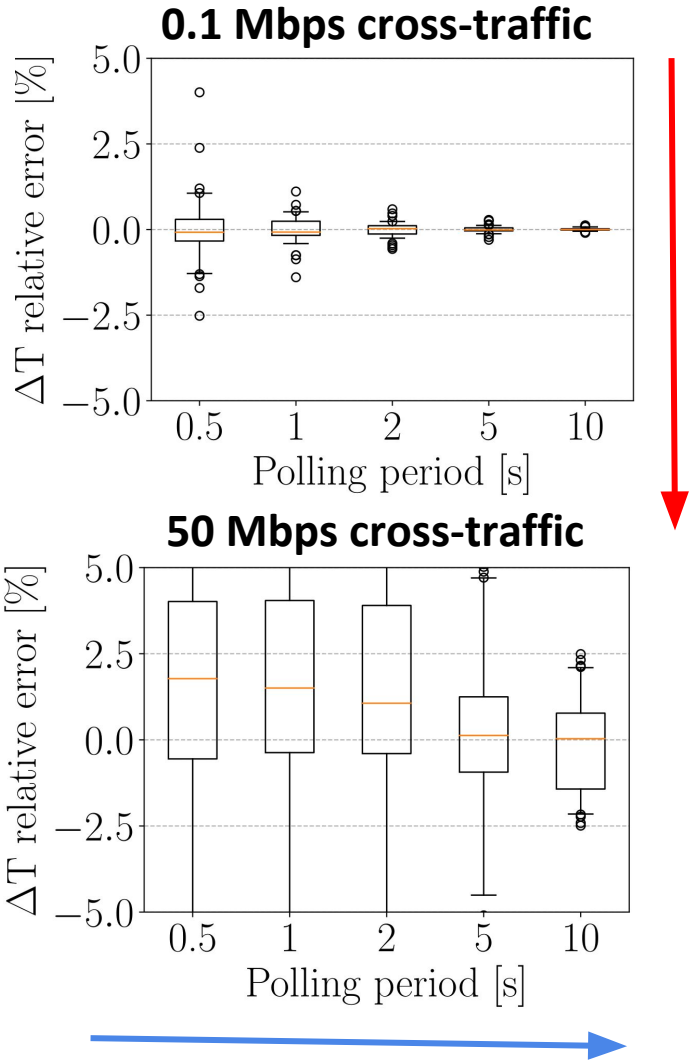


SDN-based bandwidth estimation in MBB [C2]

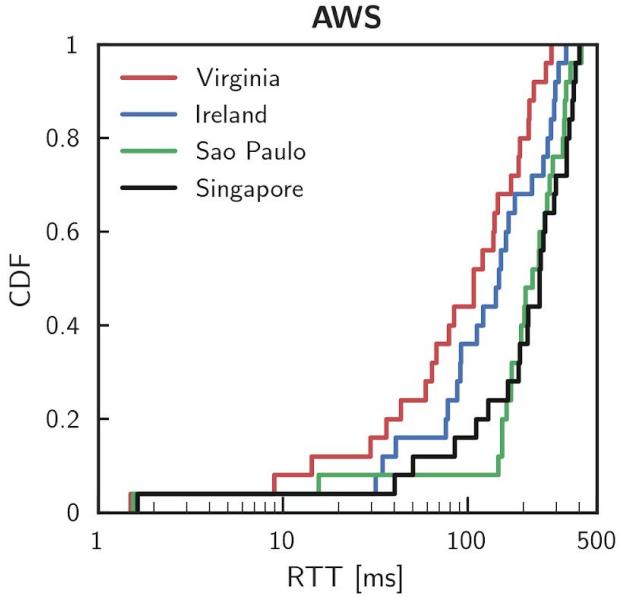


- Evaluation of SDN-based *passive* bandwidth estimation technique in MBB
- Local and remote controller
- Different polling periods and cross-traffic rates

→ *Mean error is low even in the most demanding cases*



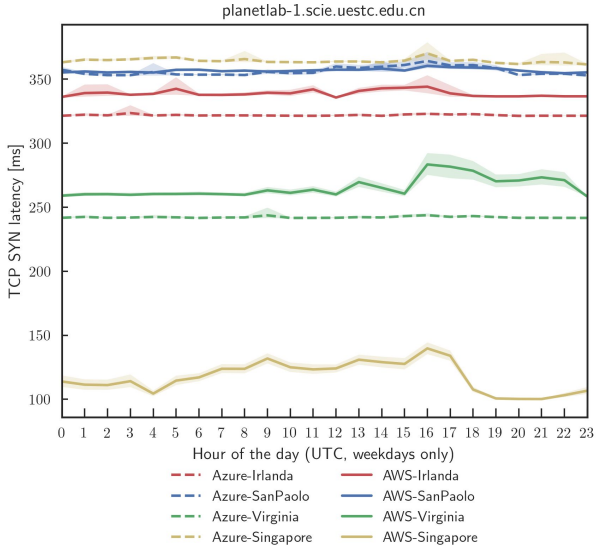
Cloud-to-user latency monitoring [C3]



- Worldwide testbed for network measurements
- Cloud-to-user latency evaluation
- 2 providers in 4 regions

- 25 source nodes across the world

→ *Cloud-to-user latency depends on the destination region tested, may vary over time*



Products

Publications:

C1. G. Aceto, **F. Palumbo**, V. Persico and A. Pescapé, "*Available Bandwidth vs. Achievable Throughput Measurements in 4G Mobile Networks*", 2018 14th International Conference on Network and Service Management (CNSM), Rome, 2018.

C2. G. Aceto, **F. Palumbo**, V. Persico, A. Pescapé and H. Chen, "*Evaluation of SDN-based bandwidth estimation in Mobile Broad Band networks*", 2018 24th Asia-Pacific Conference on Communications (APCC), Ningbo, 2018.

C3. (*in preparation*) "*Measuring latency in public cloud networks*" (tentative title)

J1. (*in preparation*) "*REMBRANDT: REproducible MoBile tRaffic Analysis aND moniToring*" (tentative title)

Next years

- **Credit summary and next years' estimates**

	Credits year 1								Credits year 2								Credits year 3									
		1	2	3	4	5	6			1	2	3	4	5	6			1	2	3	4	5	6			
	Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary	Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary	Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary	Total	Check
Modules	20	0	3	12	0	0	7,2	22	10							0								0	22	30-70
Seminars	5	0,3	1,1	0,4	3,2	0	0,4	5,4	5							0								0	5,4	10-30
Research	35	9,7	5,9	0	6,8	10	2,4	35	45							0								0	35	80-140
	60	10	10	12	10	10	10	62	60							0	0	0	0	0	0	0	0	0	62	180

- **Future steps:**
  - Latency prediction
  - Development of a system prototype