Sperimentazione di una rete regionale con controllo automatico del consumo energetico e della Qualità del Servizio per bande ultralarghe

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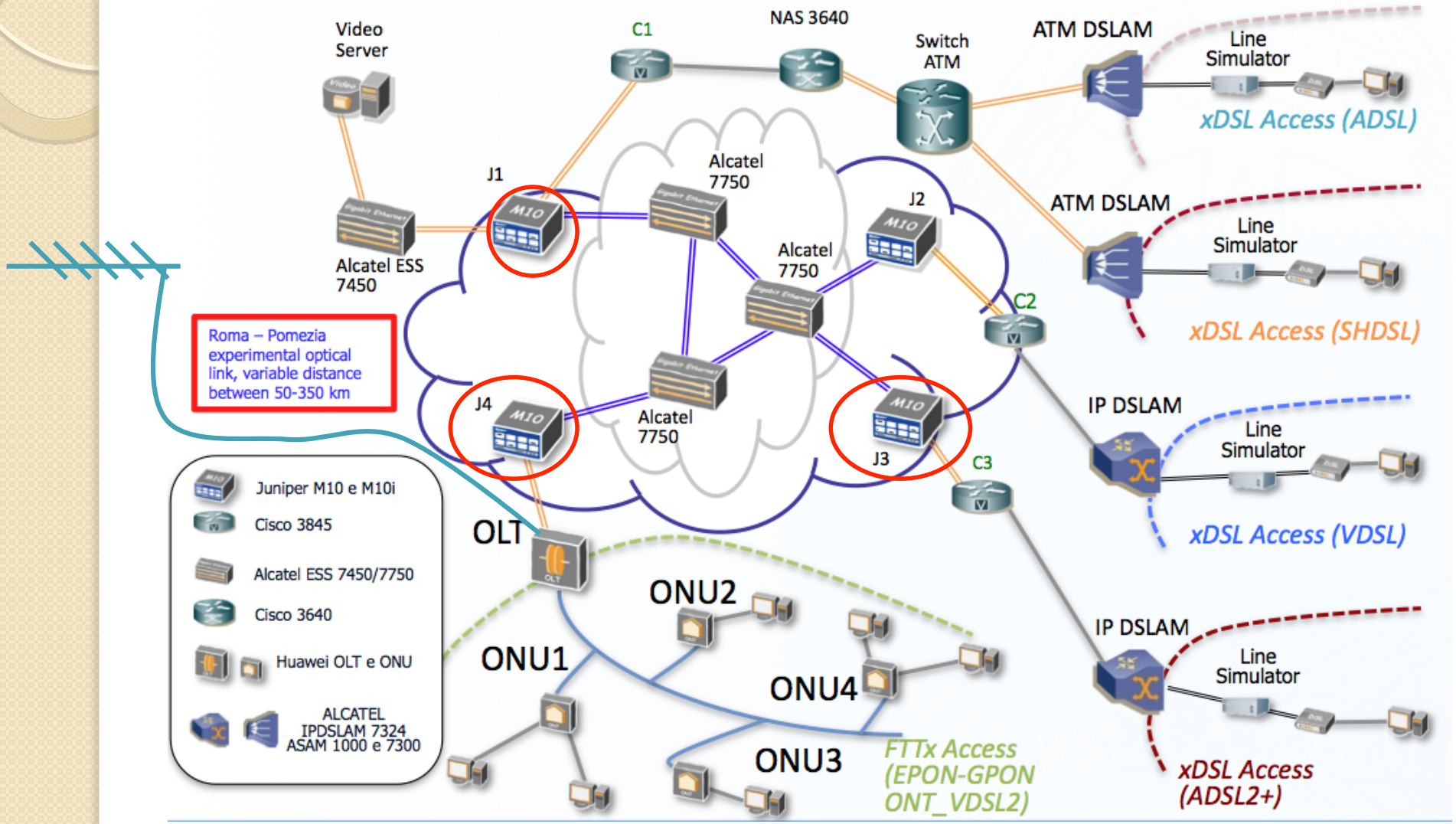
Outline

- **All optical access network (GPON): TV+IP**
- Save energy in TLC networks
- QoS management: Service Level Agreement
- Software Defined Network approach
- Test bed
- QoS measurements
- Energy saving vs QoS: results
- TV over fiber
- Optical wireless
- Conclusions

NGN TEST BED


Video Server
C1
NAS 3640
Switch ATM
ATM DSLAM
Line Simulator
xDSL Access (ADSL)
J1
Alcatel 7750
J2
ATM DSLAM
Line Simulator
Alcatel ESS 7450
Alcatel 7750
xDSL Access (SHDSL)
C2
Roma – Pomezia experimental optical link, variable distance between 50-350 km
J4
Alcatel 7750
J3
IP DSLAM
Line Simulator
C3
xDSL Access (VDSL)
OLT
ONU2
Juniper M10 e M10i
Cisco 3845
Alcatel ESS 7450/7750
Cisco 3640
Huawei OLT e ONU
ALCATEL IPDSLAM 7324 ASAM 1000 e 7300
ONU1
ONU4
IP DSLAM
Line Simulator
ONU3
FTTx Access (EPON-GPON ONT_VDSL2)
xDSL Access (ADSL2+)

Energy saving in TLC (FP7 TREND)

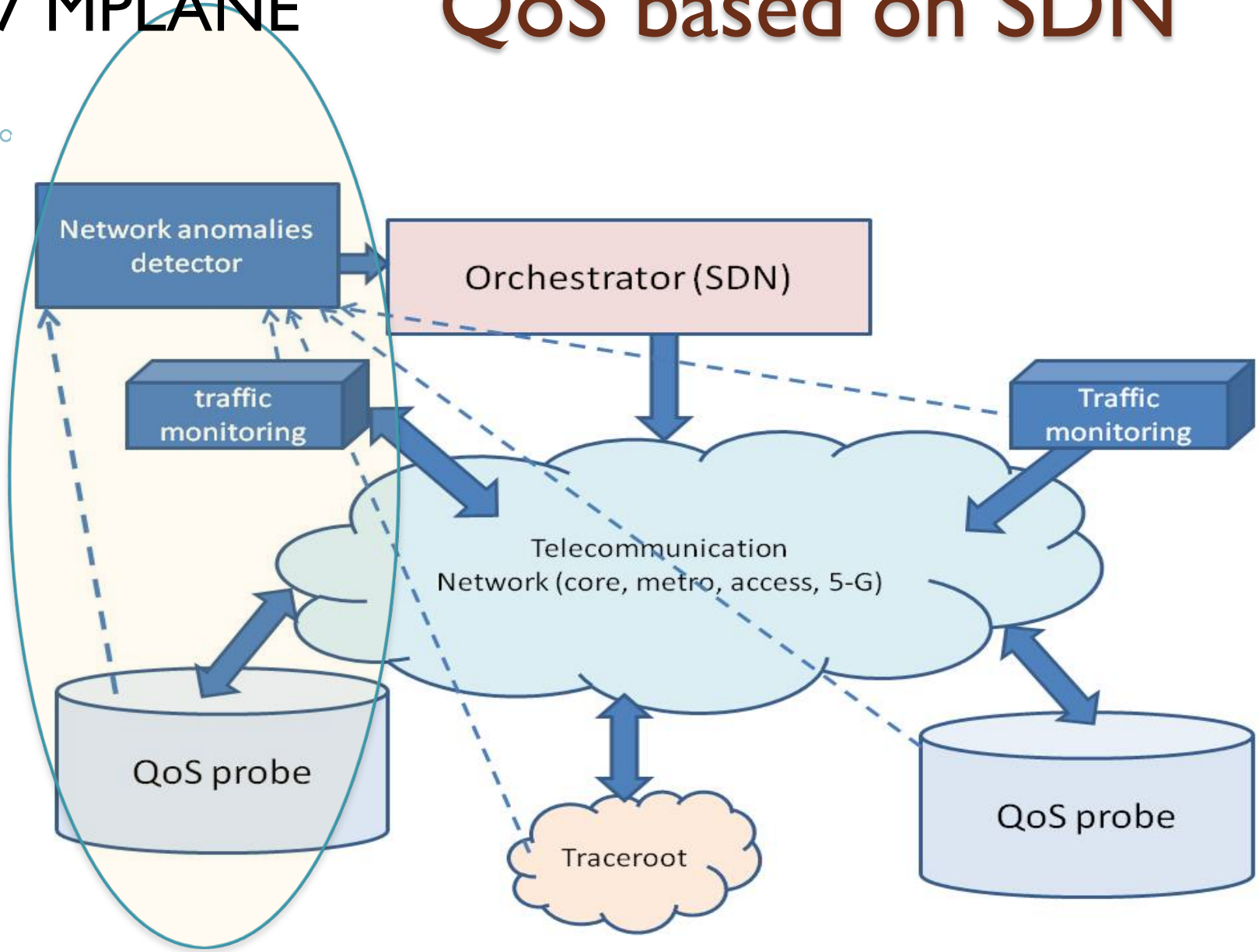
- In core networks switch-off of links with low traffic.
- Several algorithms defined

- Fixed Upper Fixed Lower (FUFL): Both the routing of IP traffic (upper virtual layer) and the realization of light paths (lower WDM layer) are fixed over time.

- We allow to shift traffic between parallel light paths though. Line cards of empty light paths are switched off.

FP7 MPLANE

QoS based on SDN



QoS measurements

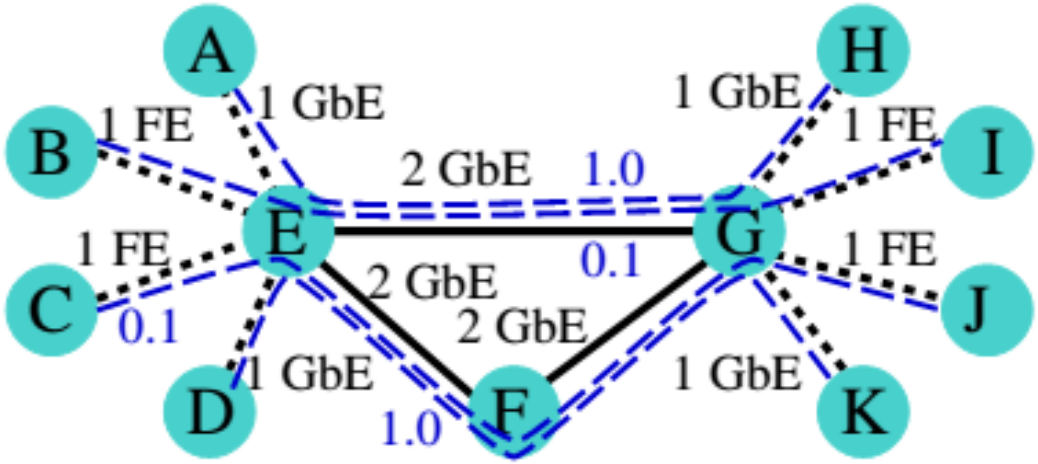
- Throughput, Packet loss, jitter, delay (RTT)
- Generally speed test based on TCP. It does not measure line capacity!
- In MPLANE QoS measurement also to verify SLA:
  - TCP test for Layer 4
  - UDP test for Layer 2 (line capacity)

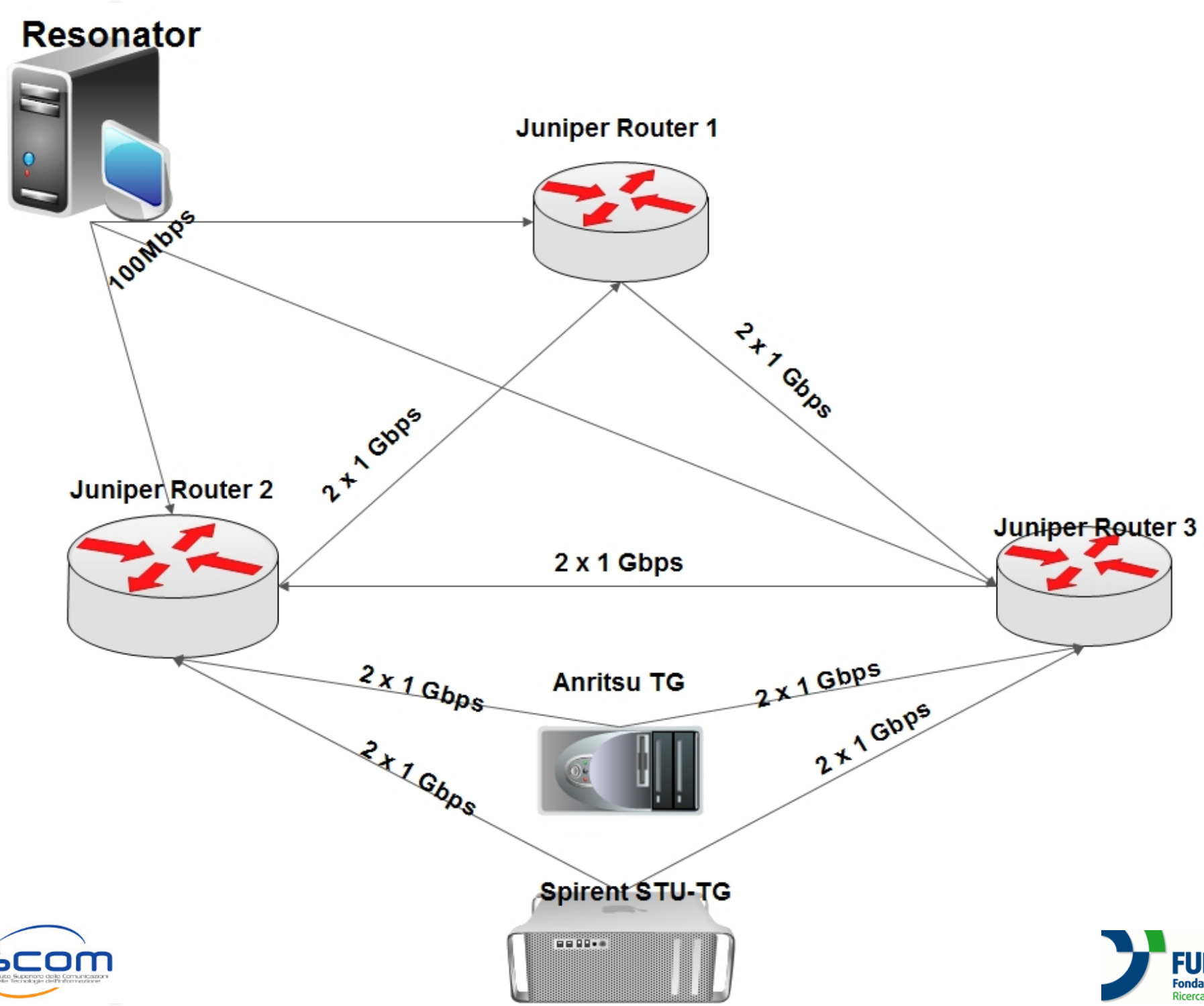
SDN approach

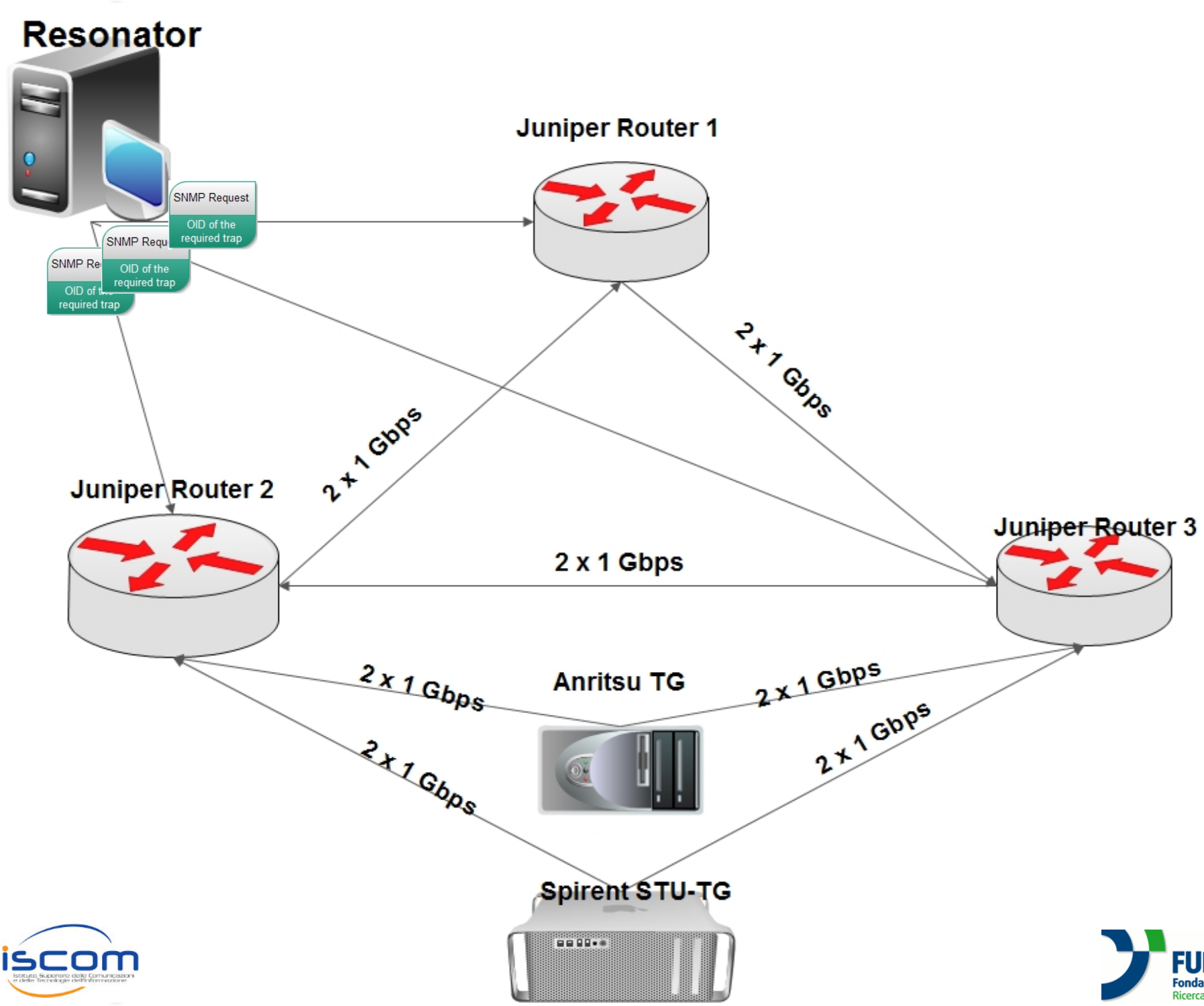
- Input for orchestrator: traffic measurement to switch off links with low load;
- Input for orchestrator to identify network anomalies
- Reaction to manage routers by means of Simple Network Management Protocol (SNMP)

Traffic generated

Traffic Demand	Traffic Type	Min [Gbps]	Max [Gbps]	Period [s]
A–H	random	0.97	1	-
B–I	sine-like	0	0.1	200
C–J	sine-like	0	0.1	200
D–K	random	0.97	1	-




Resonator
Juniper Router 1
100Mbps
2 x 1 Gbps
2 x 1 Gbps
Juniper Router 2
Juniper Router 3
2 x 1 Gbps
2 x 1 Gbps
Anritsu TG
2 x 1 Gbps
2 x 1 Gbps
2 x 1 Gbps
Spirent STU-TG


Resonator
SNMP Request
OID of the required trap
SNMP Requ
OID of the required trap
SNMP Re
required trap
Juniper Router 1
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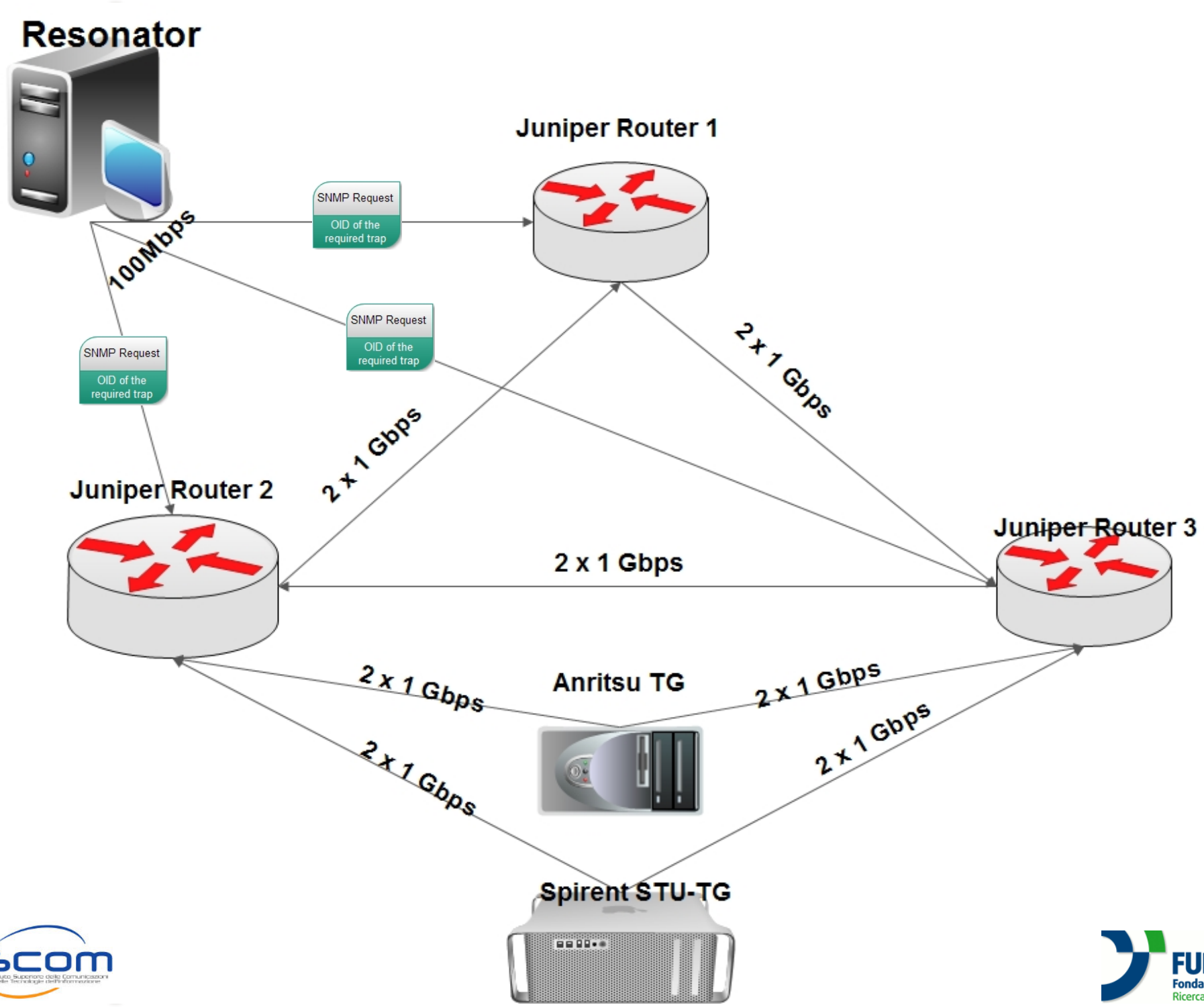
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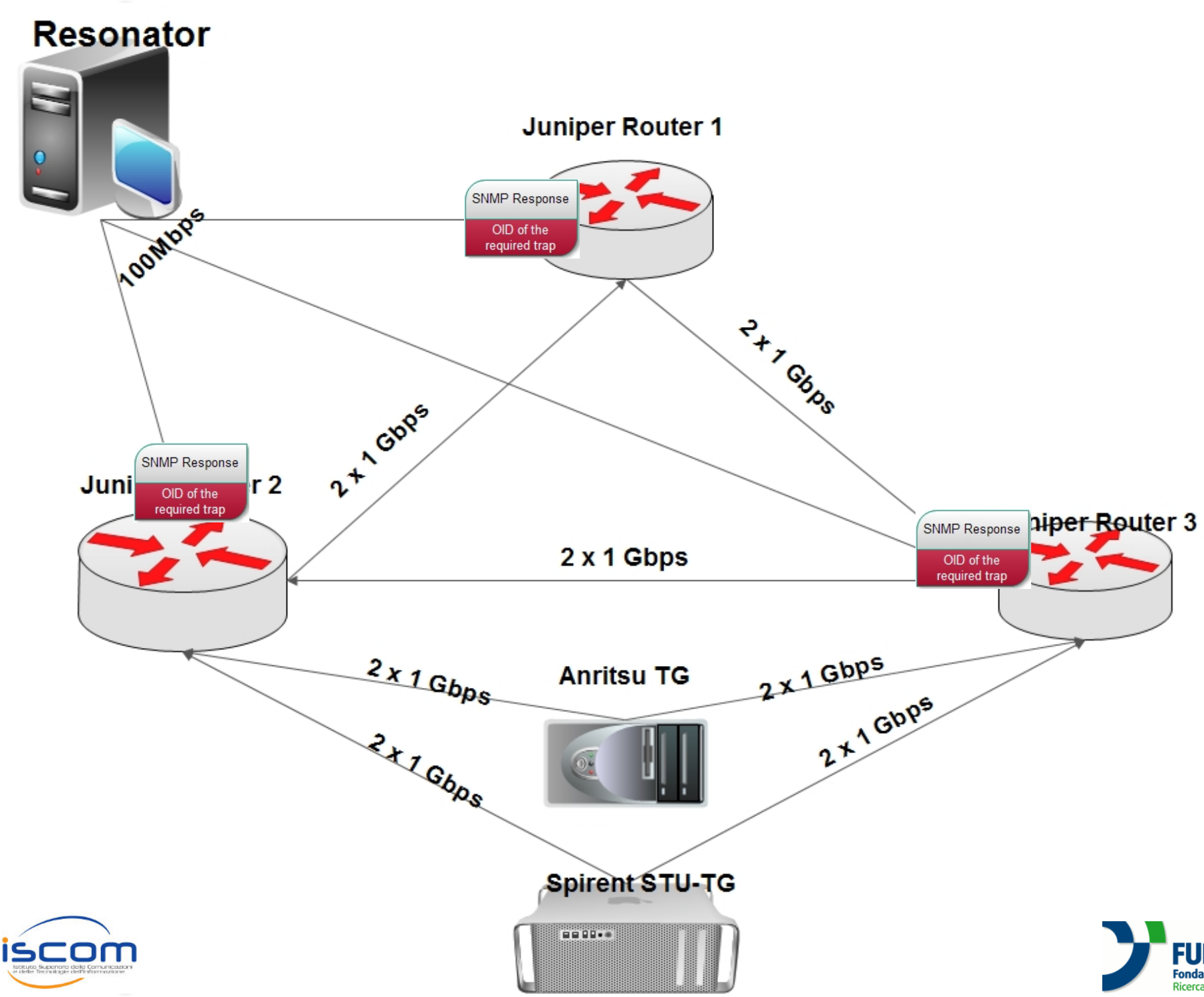
Resonator
Juniper Router 1
SNMP Response
OID of the required trap
100Mbps
2 x 1 Gbps
2 x 1 Gbps
SNMP Response
OID of the required trap
r 2
SNMP Response
OID of the required trap
niper Router 3
2 x 1 Gbps
2 x 1 Gbps
Anritsu TG
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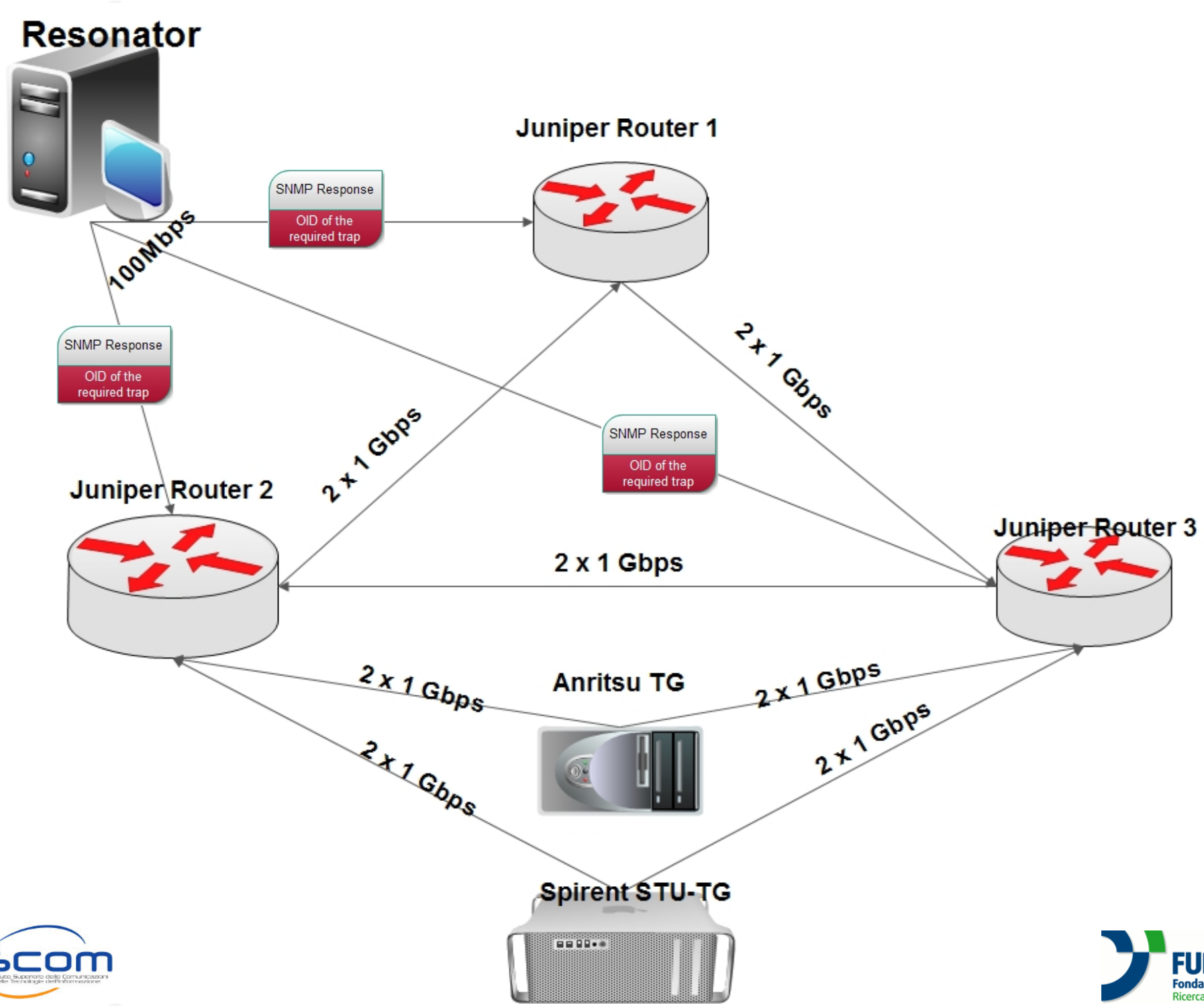
Resonator
Juniper Router 1
SNMP Response
OID of the required trap
100Mbps
SNMP Response
OID of the required trap
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SNMP Response
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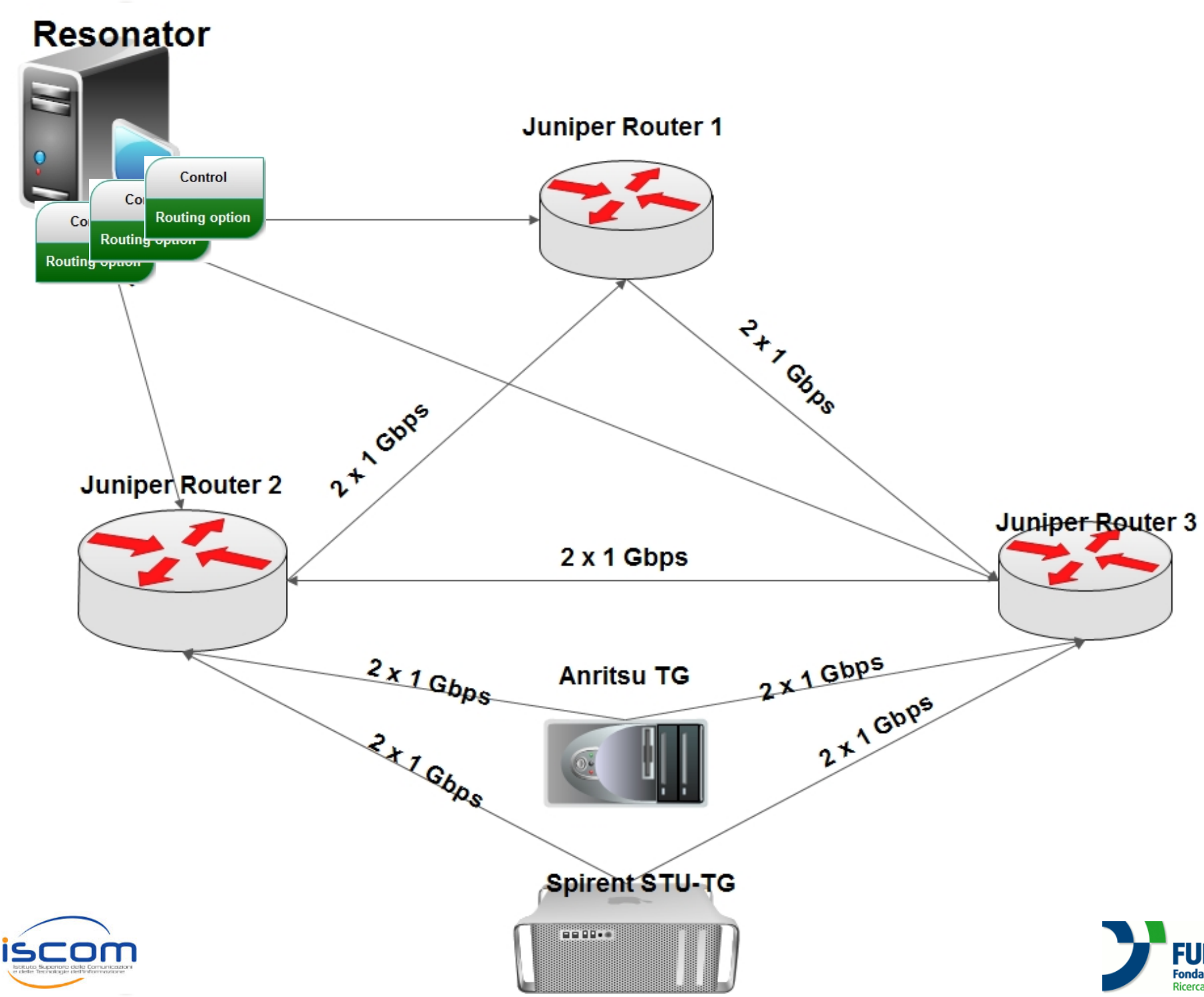
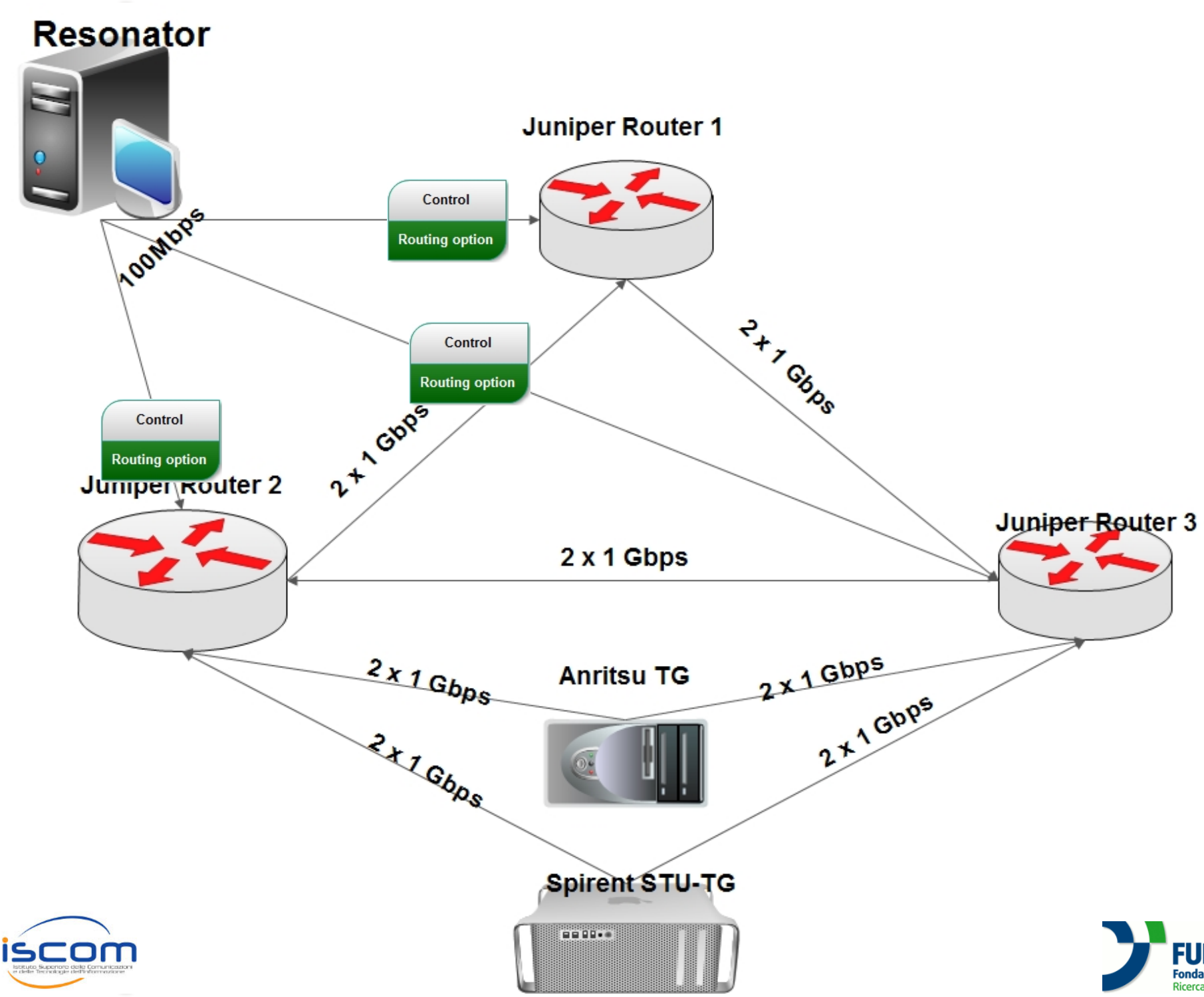

Resonator
Control
Routing option
Juniper Router 1
Juniper Router 2
Juniper Router 3
2 x 1 Gbps
2 x 1 Gbps
2 x 1 Gbps
2 x 1 Gbps
Anritsu TG
2 x 1 Gbps
2 x 1 Gbps
2 x 1 Gbps
Spirent STU-TG


Resonator
Juniper Router 1
Control
Routing option
100Mbps
Control
Routing option
2 x 1 Gbps
Control
Routing option
Juniper Router 2
2 x 1 Gbps
Juniper Router 3
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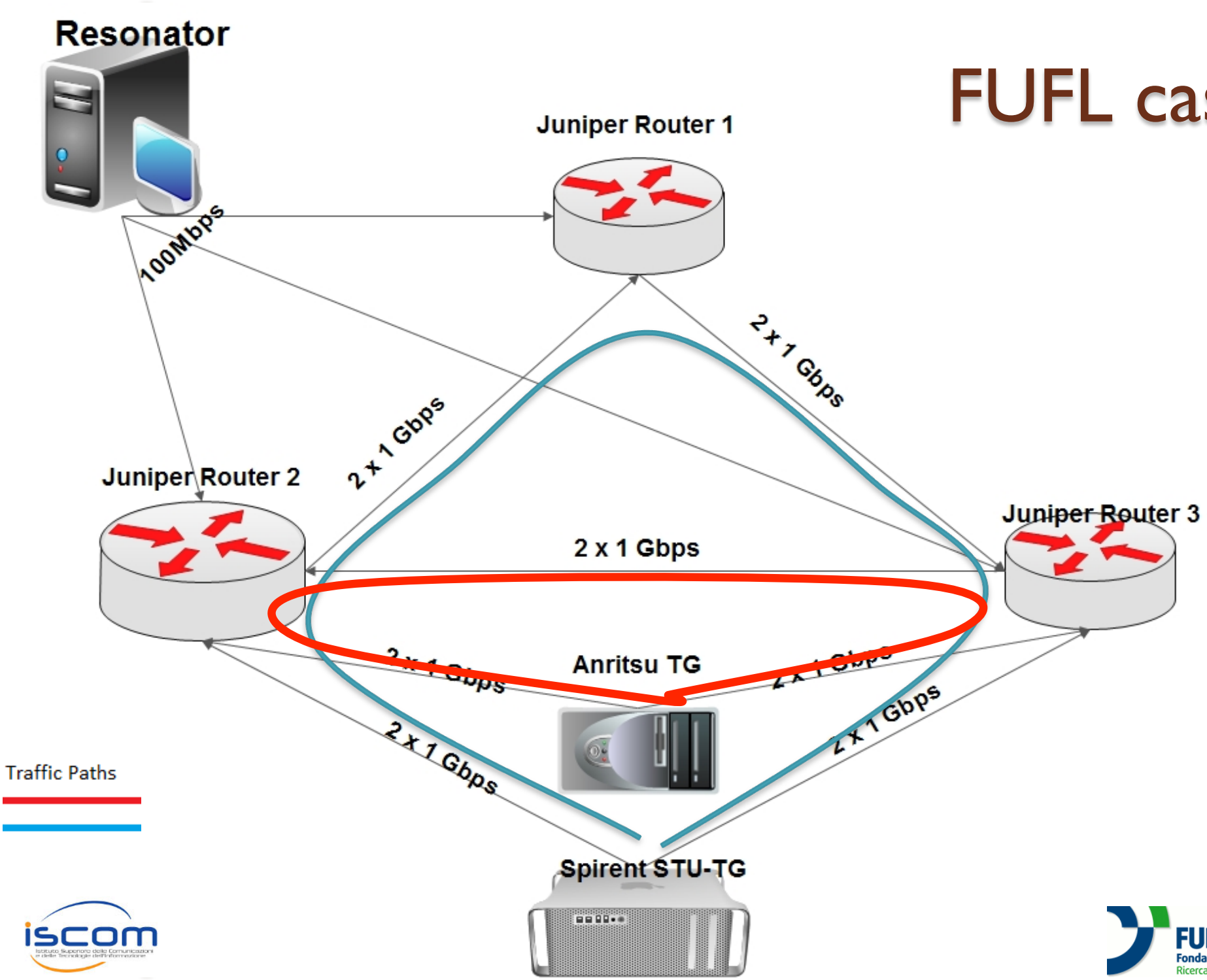
FUFL case



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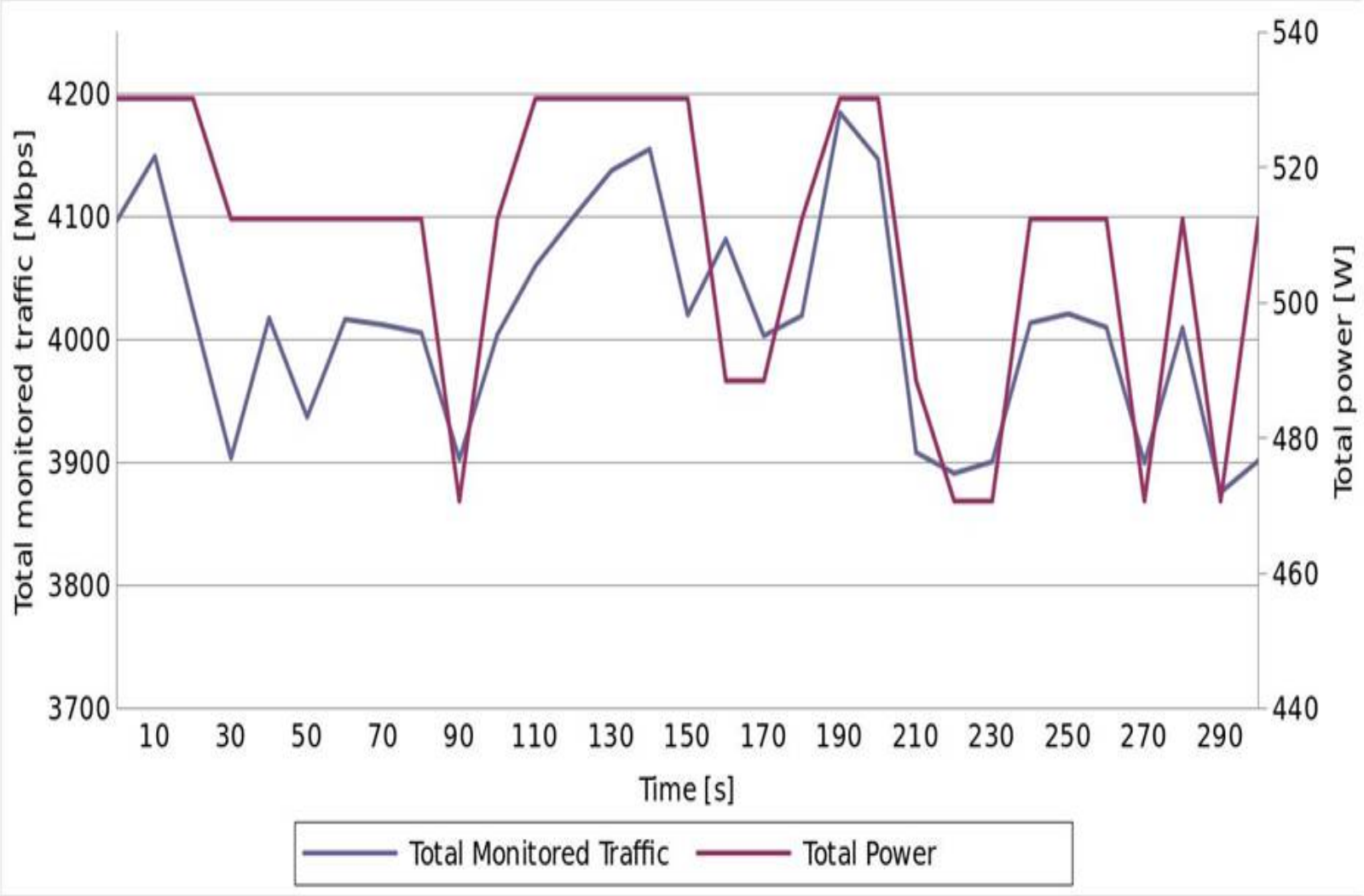
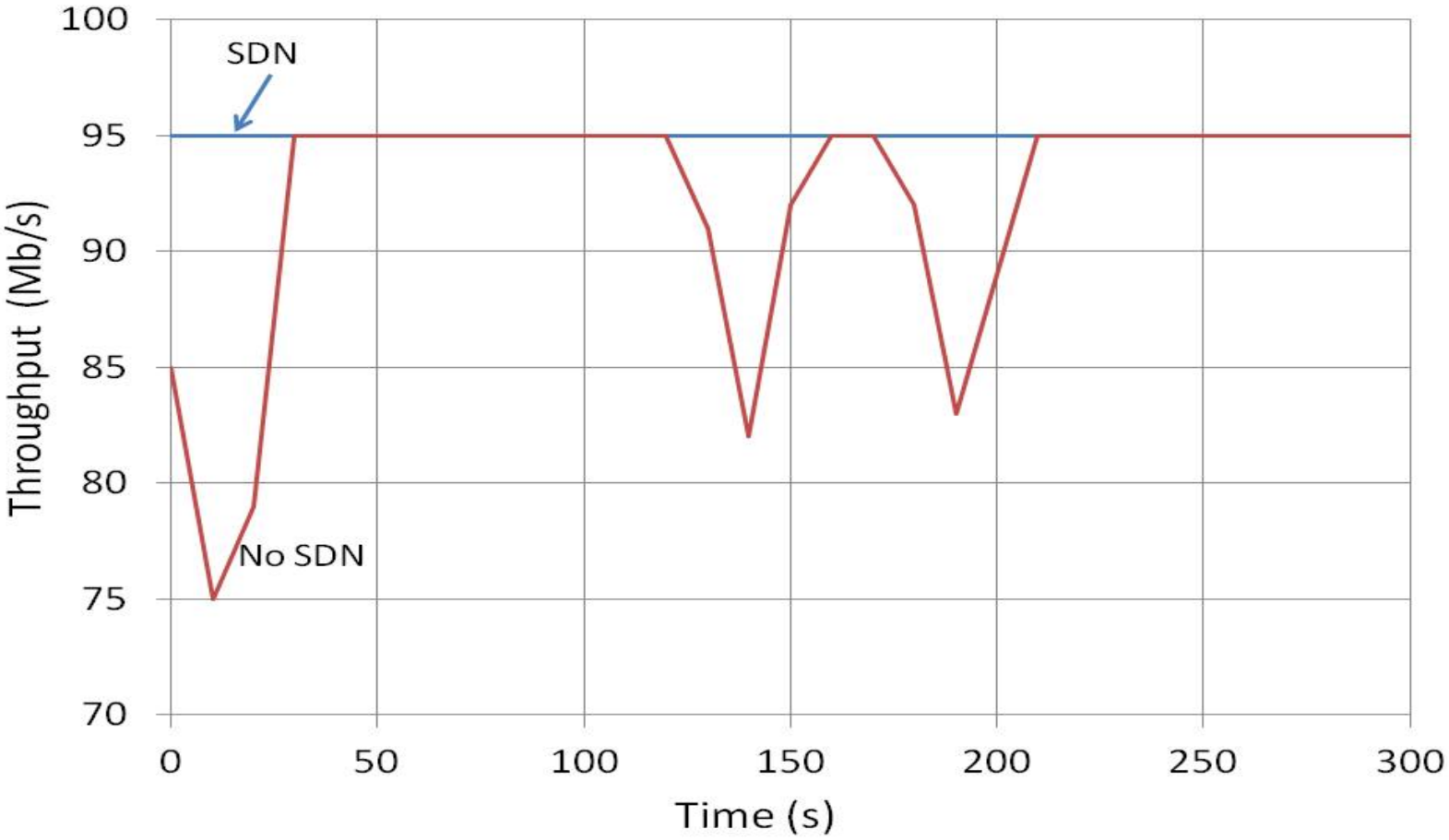
Ricerca e Innovazione

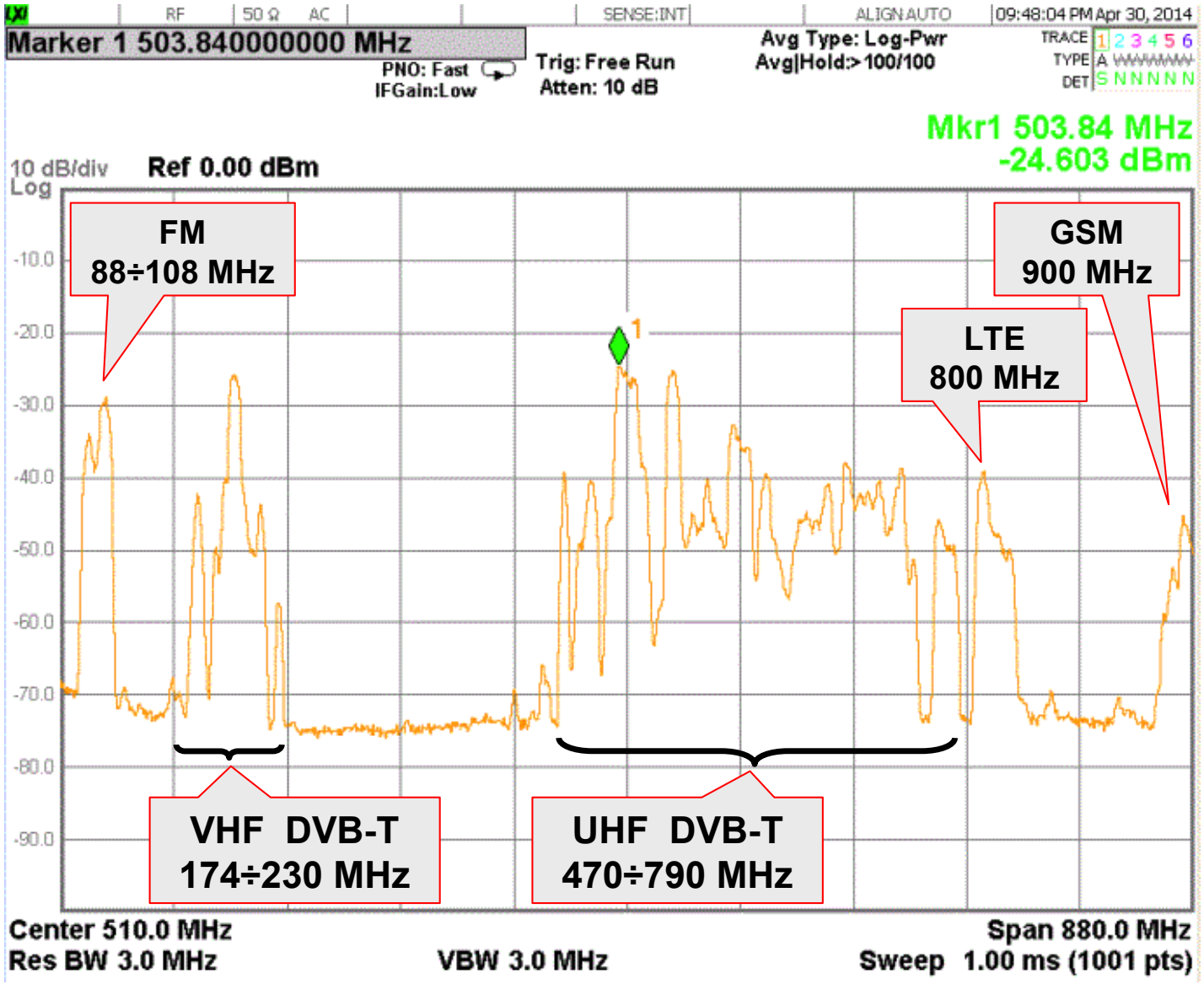
Energy saving results: FUFL



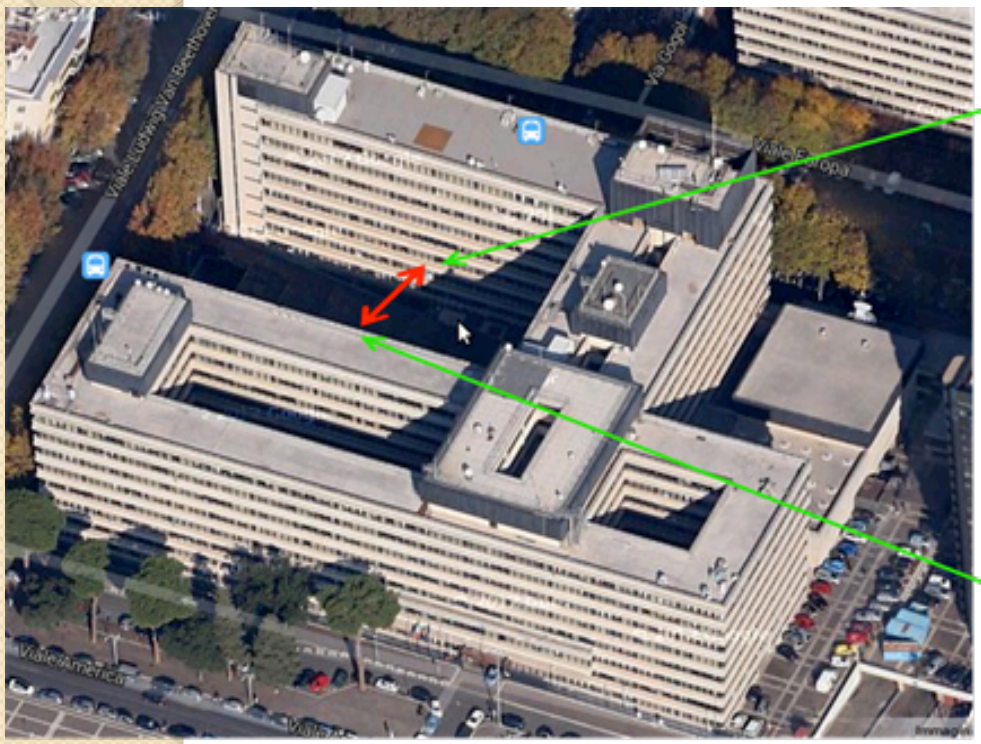
QoS control based on SDN

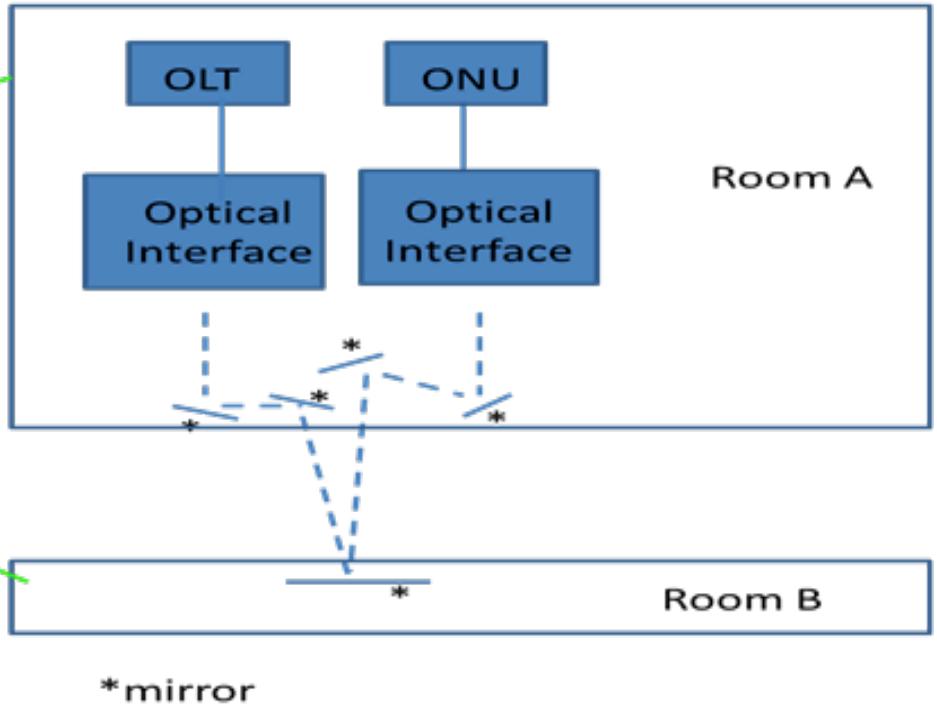


Optical spectrum of RF signal



Optical wireless tests on Gpon





Conclusions

- Complete optical network for TV and IP services
- Experimental demonstration of energy saving and QoS control based on SDN
- In this experimental approach QoS and Energy Saving do not introduce conflicts in the procedures
- TV over fiber
- Optical wireless
- Investigation on wider networks
- Further investigation on App
- SMNP vs OPENFLOW