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International Telecommunication Union

End to End QoS Control over heterogeneous network

http://www.euqos.org

Olivier Dugeon FTR&D

Olivier.Dugeon@orange-ft.com

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Outline

1. Business aspect of QoS control
2. Technical requirements for QoS control
3. End to End path concept
4. EuQoS system architecture
5. EuQoS prototype deployment
6. Conclusion

1 - Who we are

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- 5 network providers (Prime Contractor is Telefonica)
- 5 Corporates
- 5 SMEs (consultants, small development companies)
- 9 Research Institutes

EuQoS Approach

Support the evolution of the Internet into a multi-service network

Take a pragmatic approach

Sell QoS as a new source of revenue.

Define business models

Funding over 3 years
Kick-off 1 September 2004

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1 - Over-Provisioning solution

- Simple to deploy
- OPEX is equivalent
  - Operational just manage bigger router and link
  - The technology is the same – just increase capacity
  - No more platform
- CAPEX is just investment made with 6 months advance (source Sprint)
- But over-provisioning just guarantee Bw & Lost
  - No guarantee for delay & jitter
    - VoIP is sensible to this QoS parameters
    - This occur for long distance when cross several AS

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1 - Over-provisioning effects

- Flat rate model price & capacity availability advantage service provider
  - Application like skype used the over-provisioning network for free of charge
  - Operators didn't get more money from independent service provider
- Assumptions: A network with 4 CoS with limited link capacity for BE (load around 60%)
  - Skype or other's will not work correctly in loaded BE
  - Users must buy extra capacity for QoS i.e. VoIP CoS
- Both Service provider & Operators win money in this case

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1 - End-to-End QoS needs

- E2e QoS correspond to the international part of PSTN
  - To yet studied in standardization: each Fora concentrate to the access network
  - Could be in such situation with national call provide by 2 different Service Provider
- IMS is not sufficient
  - AS path computation is not of service role: it depend of the transfer and control level
  - Not all AS will implement an IMS i.e. transit AS
  - All AS will certainly implement a QoS control function

2 - Requirements

- Scalable QoS architecture
  - IntServ over DiffServ
    - This was done by performing IntServ CAC in the Access network and used DiffServ in the Core backbone
  - Lightweight IntServ/RSVP
    - This was done by study/develop a new protocol. NSIS could be a candidate
  - Endpoints only CAC methods
    - This was done by setup Traffic engineering tunnel or by measurement at the endpoint
- Finally EuQoS is a mix of them

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2 - Divide and Conquer the problem

- Addressing the network deployment across a large number of autonomous systems (AS)

- Hierarchically and functionally decomposed into:
  - Horizontal paradigms
    - Service, Control and Transport planes
  - Vertical network partition - heterogeneous technologies
    - LAN, WiFi, xDSL, Satellite, UMTS, IP/MPLS/GMPLS
    - HomeLAN, Access/Aggregation, Core, inter-domain
  - Time/Process division
    - Provisioning, Invocation, OAM (assurance)

- 2 end-to-end layers
  - One for the session: EQ-SIP end-to-end signaling
  - One for the QoS: RM-SSN end-to-end signaling
- 2 sub-layers
  - End-to-end QoS path computation: qBGP
  - Local QoS configuration: RA

- Three levels integrated & synchronised
  - Application – Control – Transport

3 - End2end path vs. complexity of AS and BR connectivity

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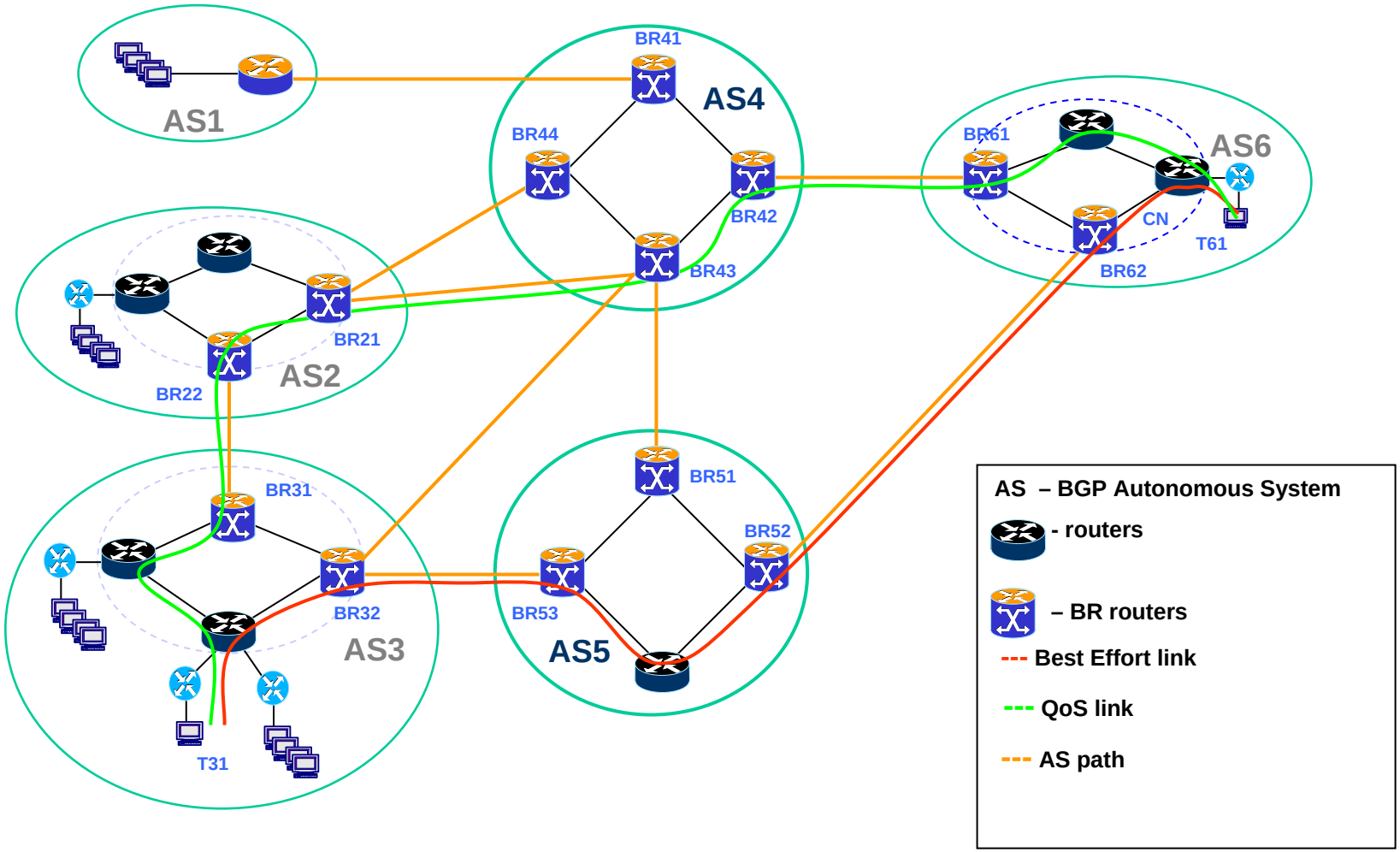

3 - EuQoS End2end path concept

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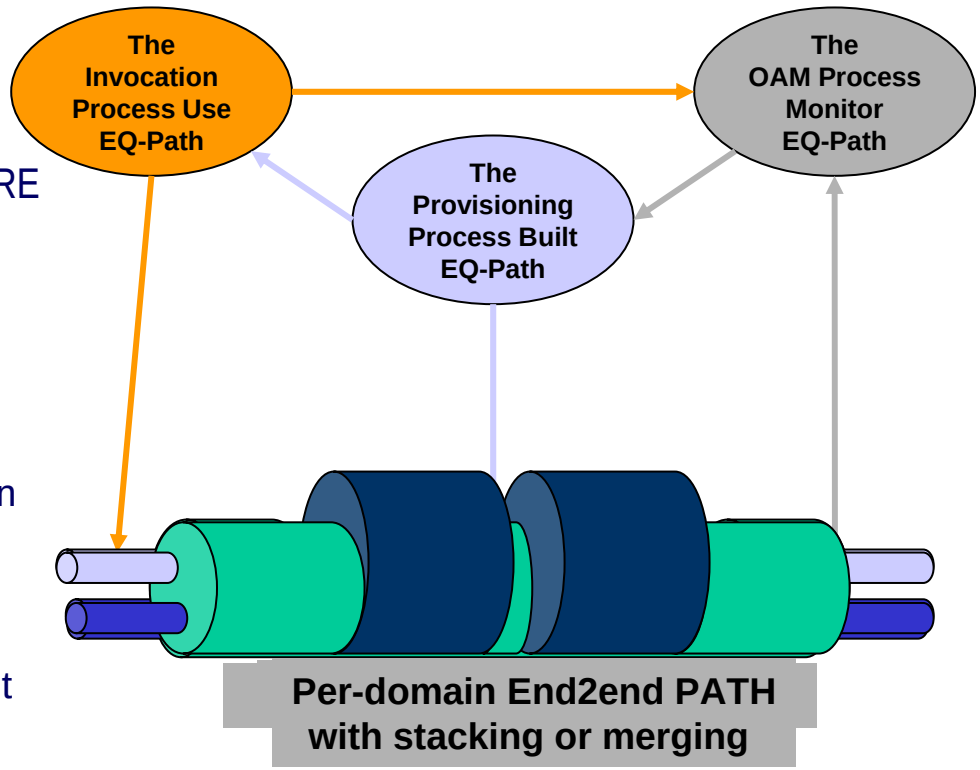
- End2end path provide a QoS path between 2 Access Network to reach a given prefix or @IP through several backbone for a given Class Of Service
- The end2end QoS belong to a given CoS
  - Bandwidth of the end2end path
  - Maximum delay, jitter, packet loss
- Must be setup by provisioning
  - At layer 2: ATM VP, VLAN
  - Or at Layer 3: MPLS-TE LSP, GRE tunnel, DiffServ
  - For each type of network
  - Manually or automatically
- Controlled during Invocation
  - By Call Admission Control
  - By appropriate device configuration
- Monitored by OAM
  - Fault tolerance
  - Measurement reporting/adjustment



3 - EuQoS vs. PSTN model

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PSTN		EuQoS
oTrunk •Routing •CoS •Resources Provisioning •Backup link	Provisioning	oPer CoS EQ-path •Based on BGP AS path for the « loose model » •Based on MPLS tunnel for the « hard model »
oPSTN Signaling •Find the suitable trunk to reach the destination •Reserve an IT for this connection •Reject call if no trunk or full trunk	Invocation	oSIP Signaling •Find suitable EQ-path for the CoS to reach the destination •Reserve Bw inside this EQ-path •Reject call if no EQ-path or no Bw
oAdjust Trunk capacity •Traffic Matrix	OAM	oAdjust EQ-path capacity •By monitoring and measuring the EQ-path usage

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3 - End2end path regarding QoS route

- EuQoS system must be aware of the QoS capabilities along the data path
  - By means of enhanced version of BGP or Traffic Engineering
- Enhanced version of BGP guarantee an AS path inside a given CoS for delay, gigue & lost parameters
  - There is a PhB continuity along the AS path
  - There is no bandwidth guarantee
- MPLS-TE guarantee an AS path tunnel inside a given CoS for bandwidth, delay, gigue & lost parameters
  - There is no bandwidth guarantee inside the tunnel
- CAC must be perform in order to
  - Choose the appropriate End2end path to meet the CoS
  - Perform bandwidth control to protect the QoS end2end path

3 – EQ-Path setup procedure

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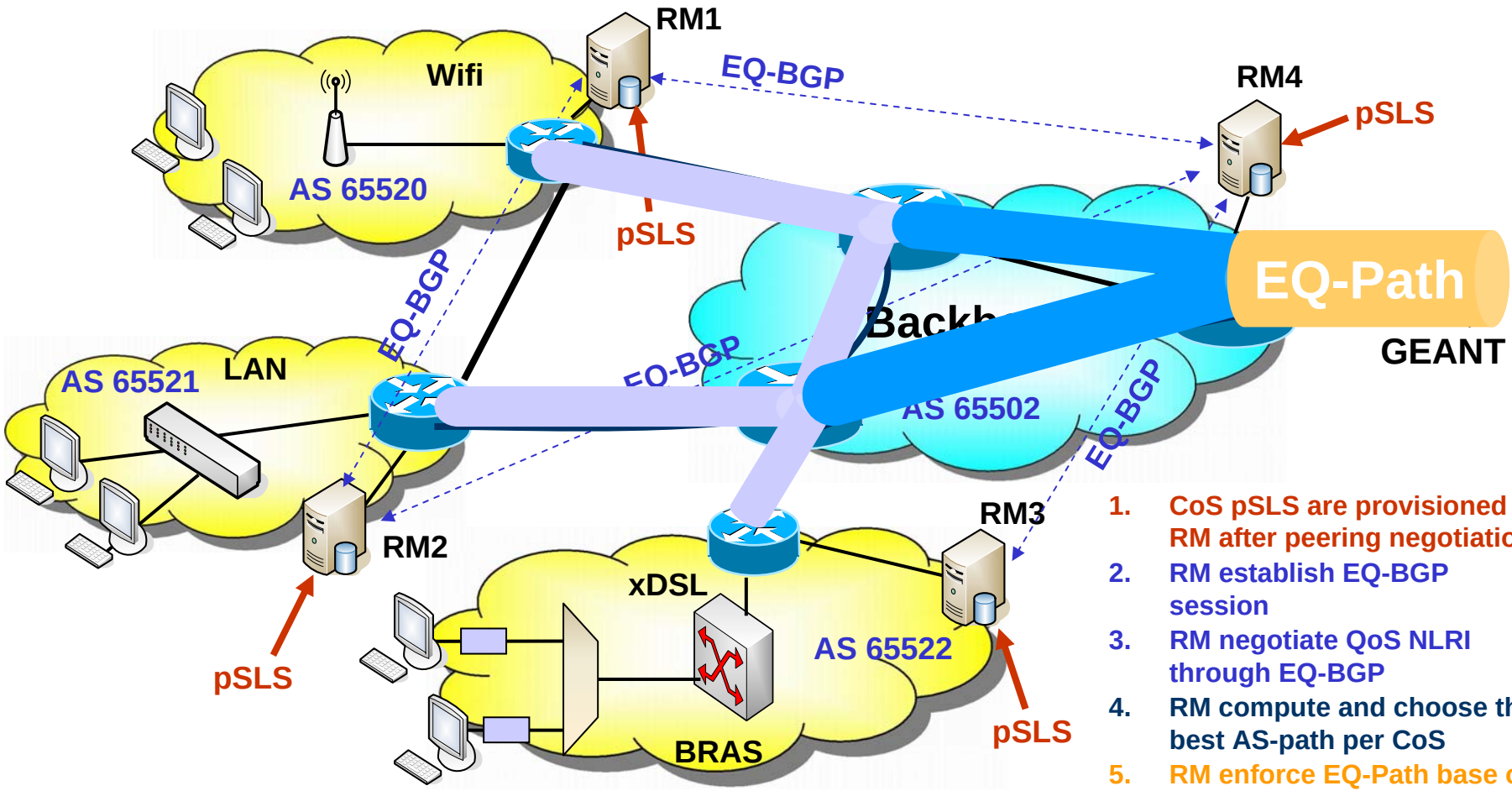

1. CoS pSLS are provisioned in RM after peering negotiation
2. RM establish EQ-BGP session
3. RM negotiate QoS NLRI through EQ-BGP
4. RM compute and choose the best AS-path per CoS
5. RM enforce EQ-Path base on AS-path computation and stacking model

3 – Loose model vs. Hard model

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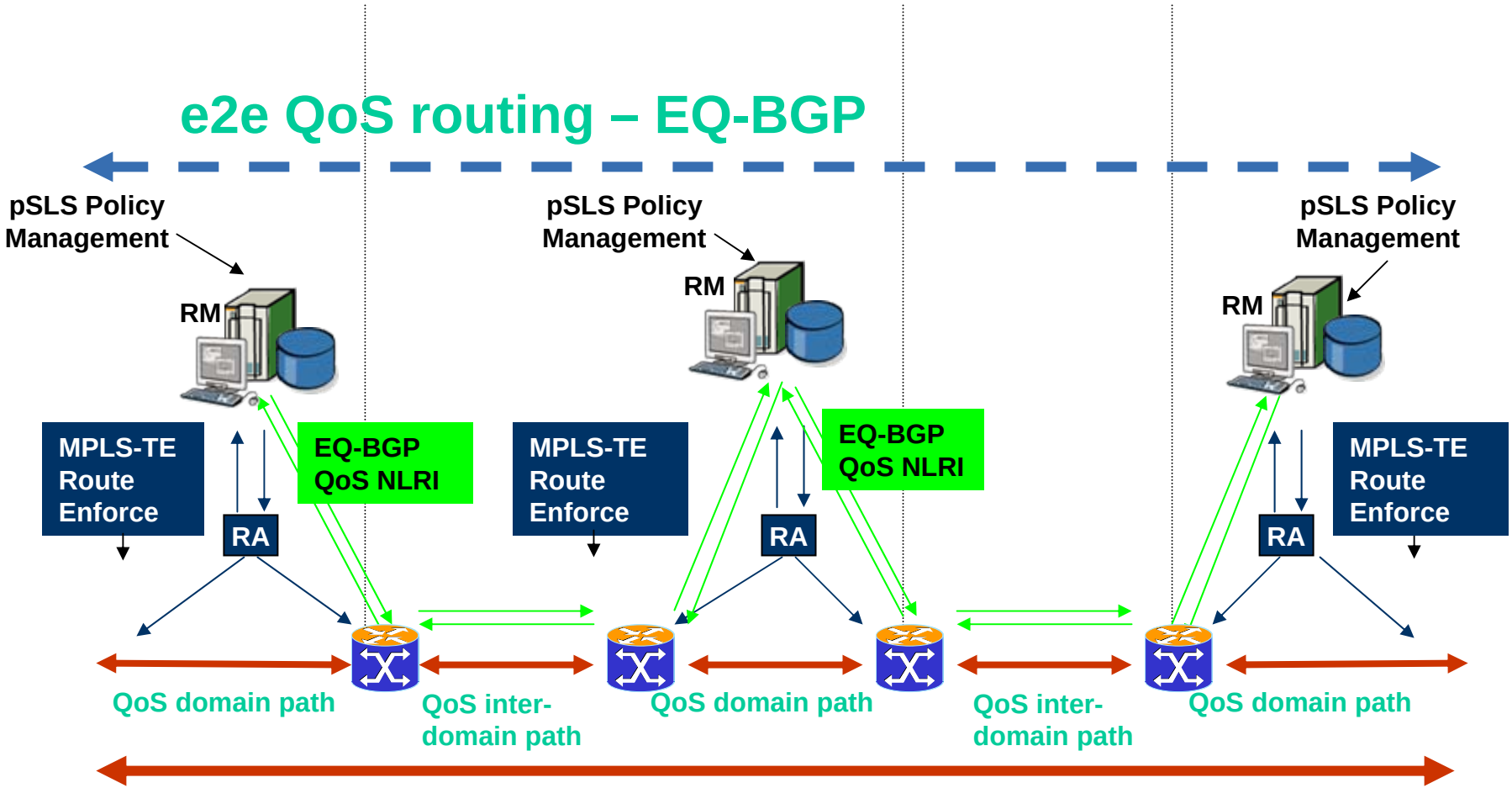
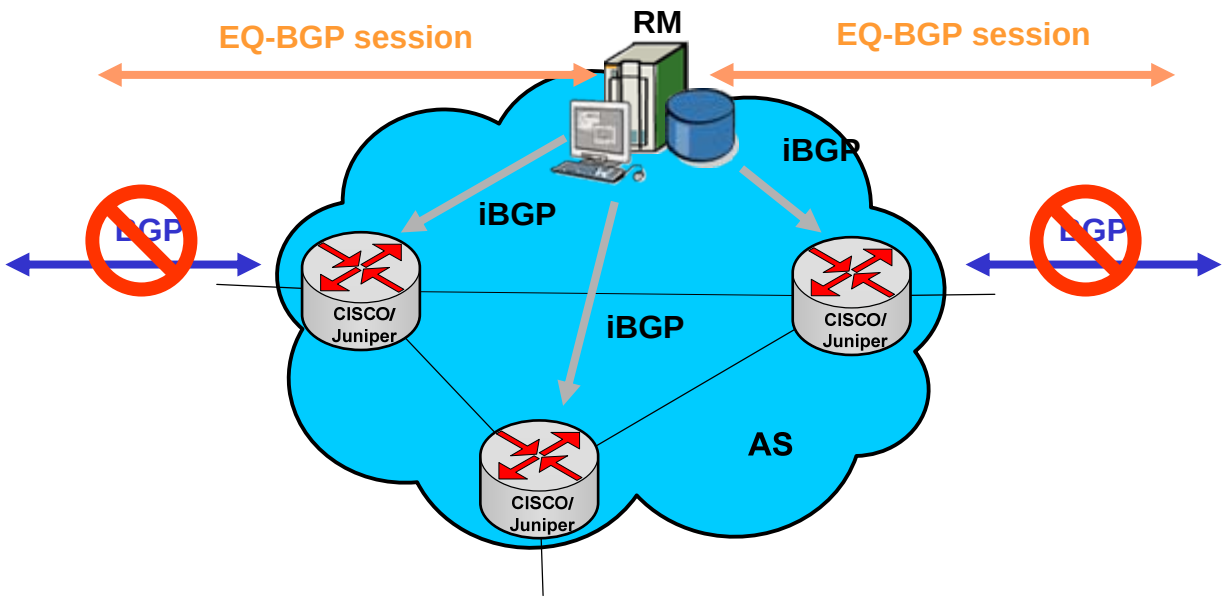


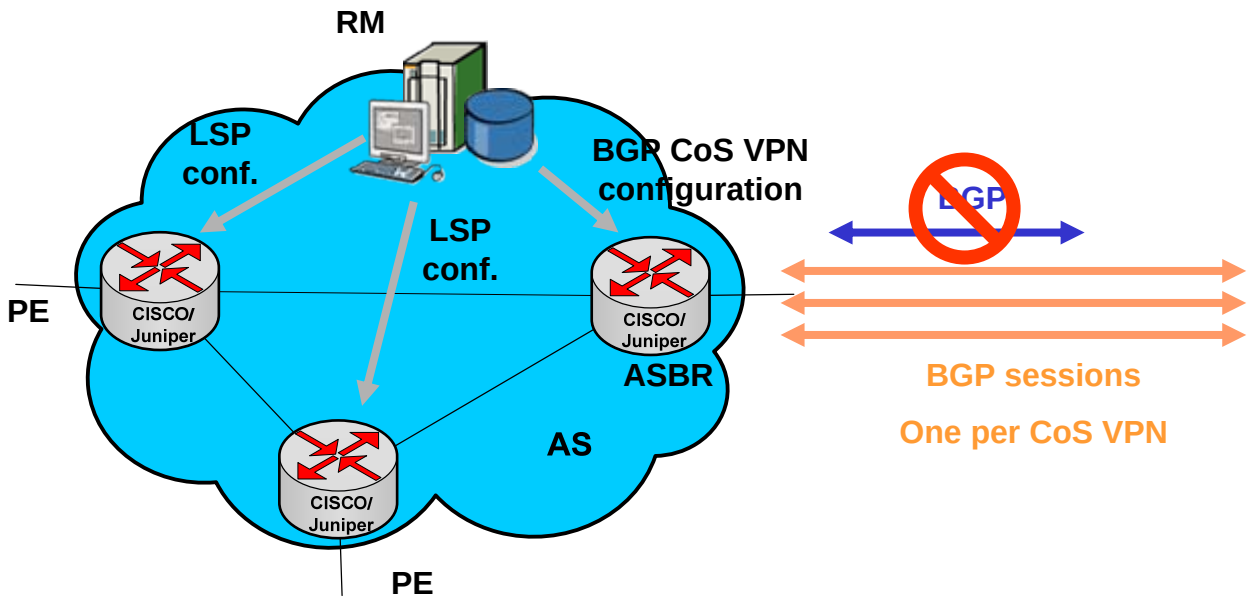
3 – EQ-BGP deployment in Loose model

- Standard BGP sessions established with peering routers are disconnect
- And replace by EQ-BGP sessions between peers RM
- Then we provide routing information to all border routers by means of iBGP



3 – EQ-BGP deployment in hard model

- Multiple standard BGP sessions are established through MPLS VPN (RFC 2547)
  - One BGP session per Class of Service (CoS)
- RM setup appropriate BGP configuration inside each CoS VPN
- LSP (normal or TE) are setup to carry traffic from PE to the corresponding CoS VPN



4 - EuQoS Architecture

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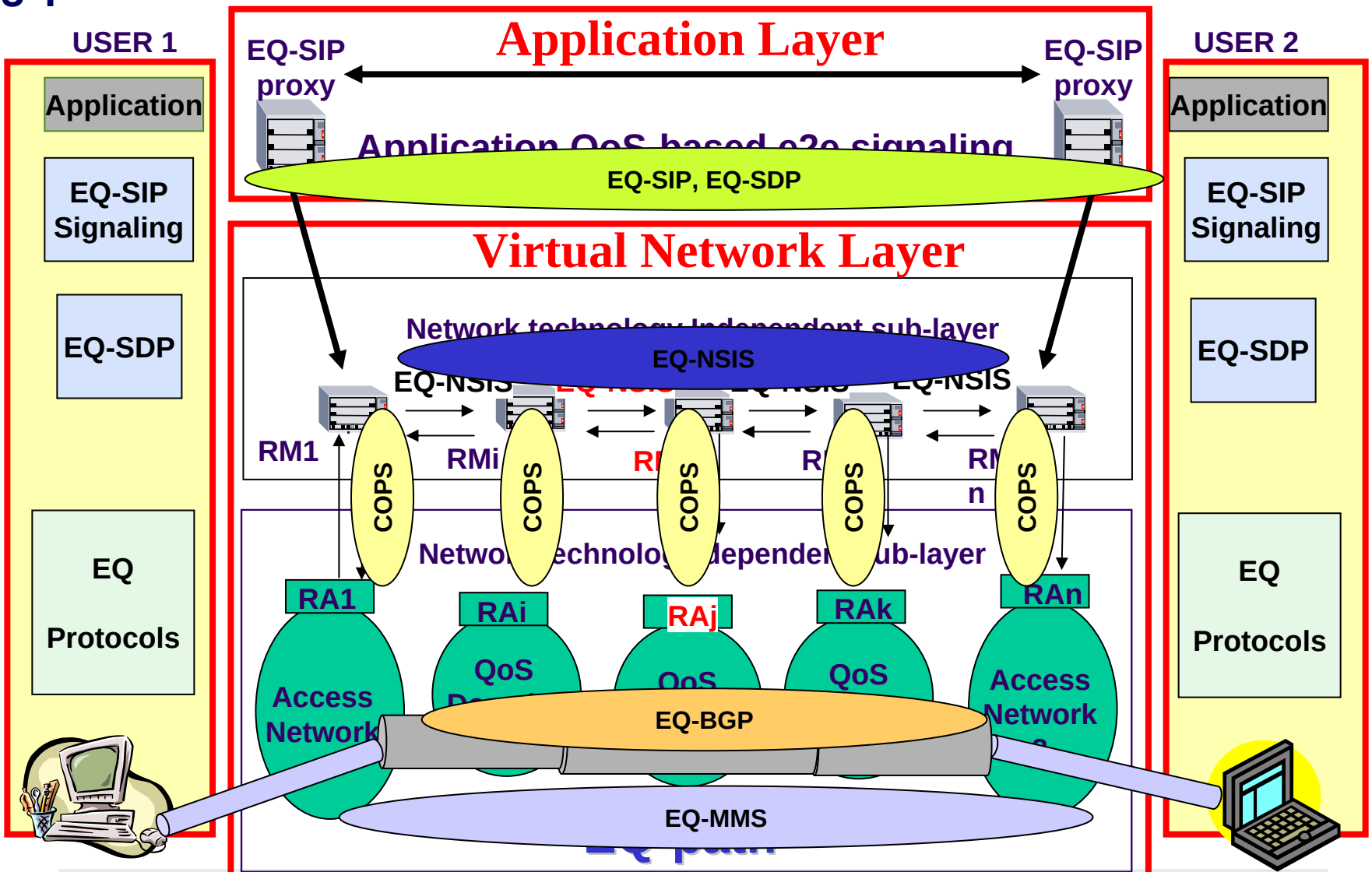

4 - EuQoS connection setup

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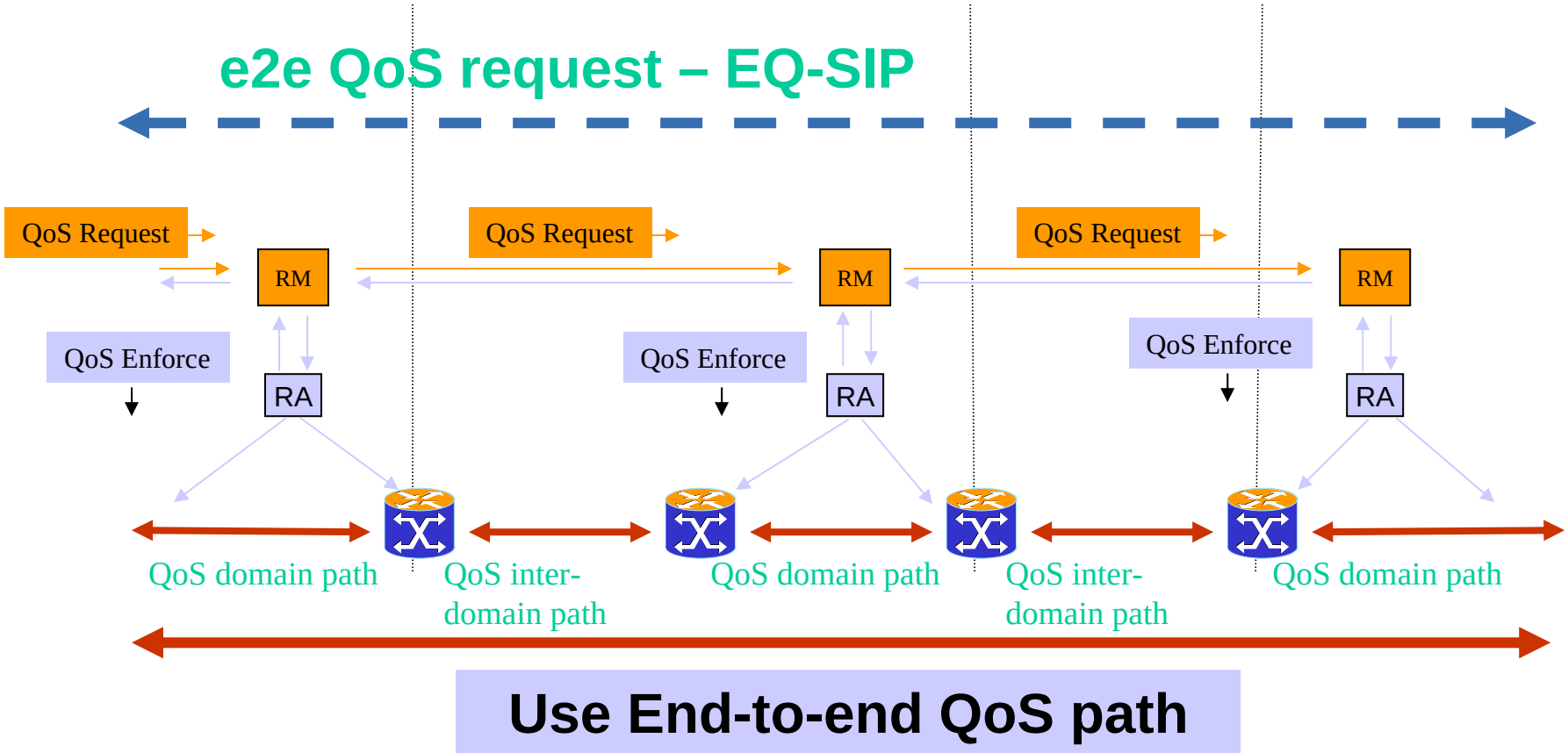

5 - EuQoS Network General Overview

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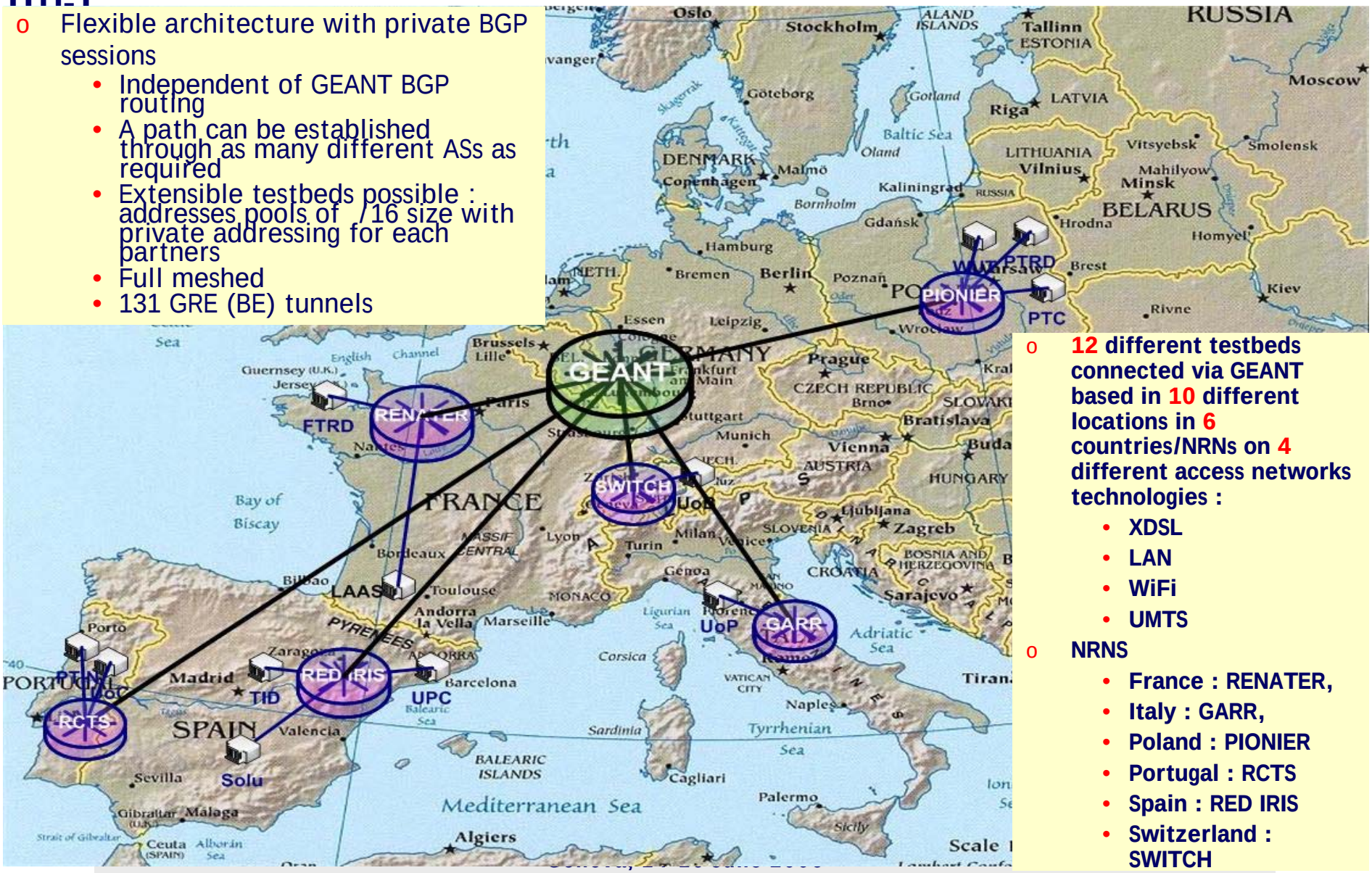
- Flexible architecture with private BGP sessions
  - Independent of GEANT BGP routing
  - A path can be established through as many different ASs as required
  - Extensible testbeds possible : addresses pools of /16 size with private addressing for each partners
  - Full meshed
  - 131 GRE (BE) tunnels



- **12 different testbeds connected via GEANT based in 10 different locations in 6 countries/NRNs on 4 different access networks technologies :**
  - **XDSL**
  - **LAN**
  - **WiFi**
  - **UMTS**
- **NRNS**
  - **France : RENATER,**
  - **Italy : GARR,**
  - **Poland : PIONIER**
  - **Portugal : RCTS**
  - **Spain : RED IRIS**
  - **Switzerland : SWITCH**

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6 - Conclusion

- EuQoS system is based on End2end path concept
- End2end path is efficient, reliable and scalable
  - Efficient since the invocation used them and not built them
  - Reliable since the OAM process monitor the end2end path
  - Scalable as they describe AS path and could be merge
- End2end path could be accommodate to various configuration and technology
  - Both "loose" and "hard" model are supported
  - End2end path could be setup at Layer 2 or Layer 3
  - Over-provisioned network are also supported through dummy end2end path
- EuQoS system will be built progressively
  - Phase0: End2end path will be setup manually (done)
  - Phase1: End2end path will be setup with the loose model (done)
  - Phase2: End2end path will be setup with both loose and hard model

Questions ?

Thank you for your attention