Implementing QoS in a Service Provider IP/MPLS Core Network – A Case Study

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MPLS 2004

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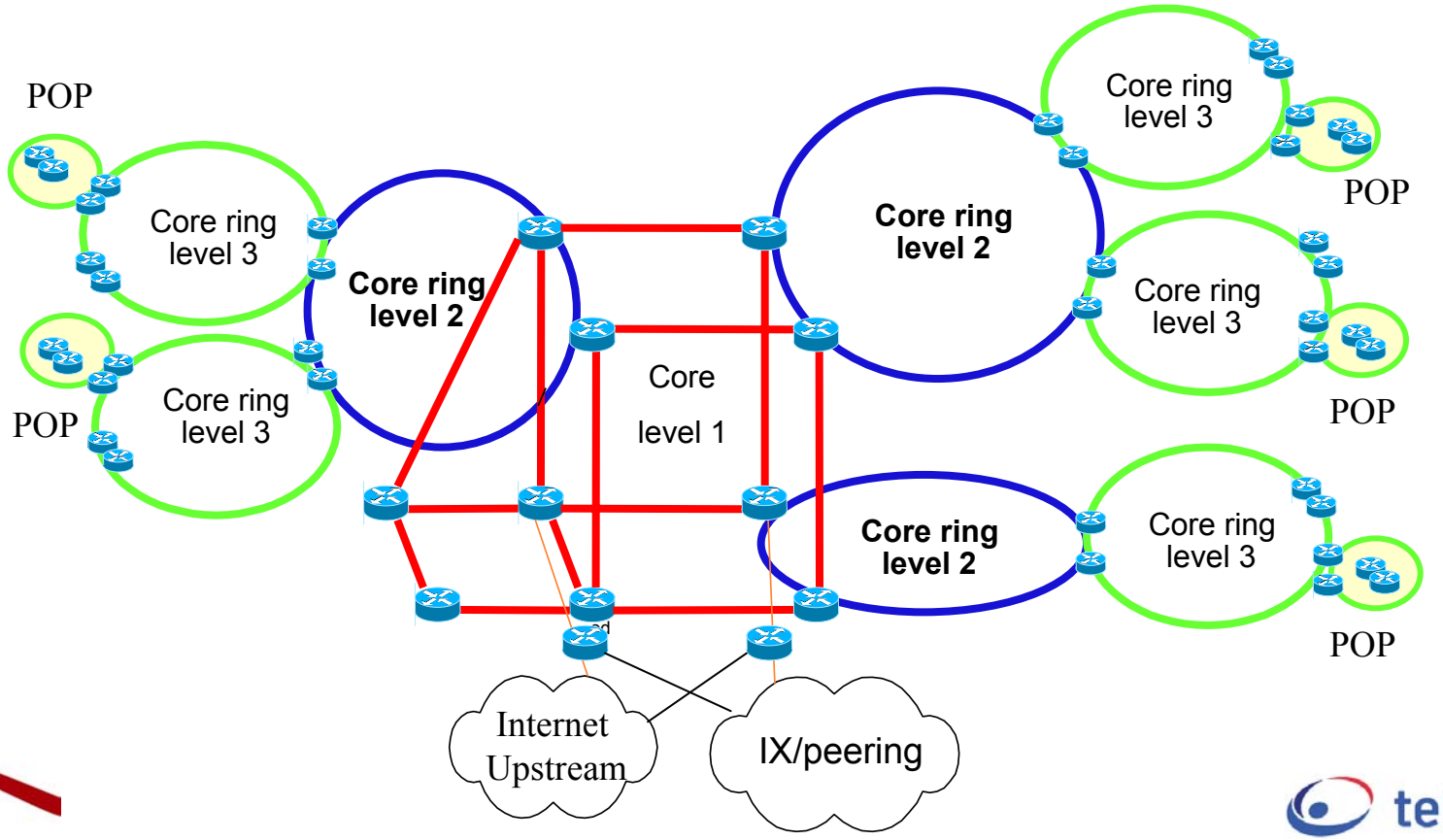
Overview

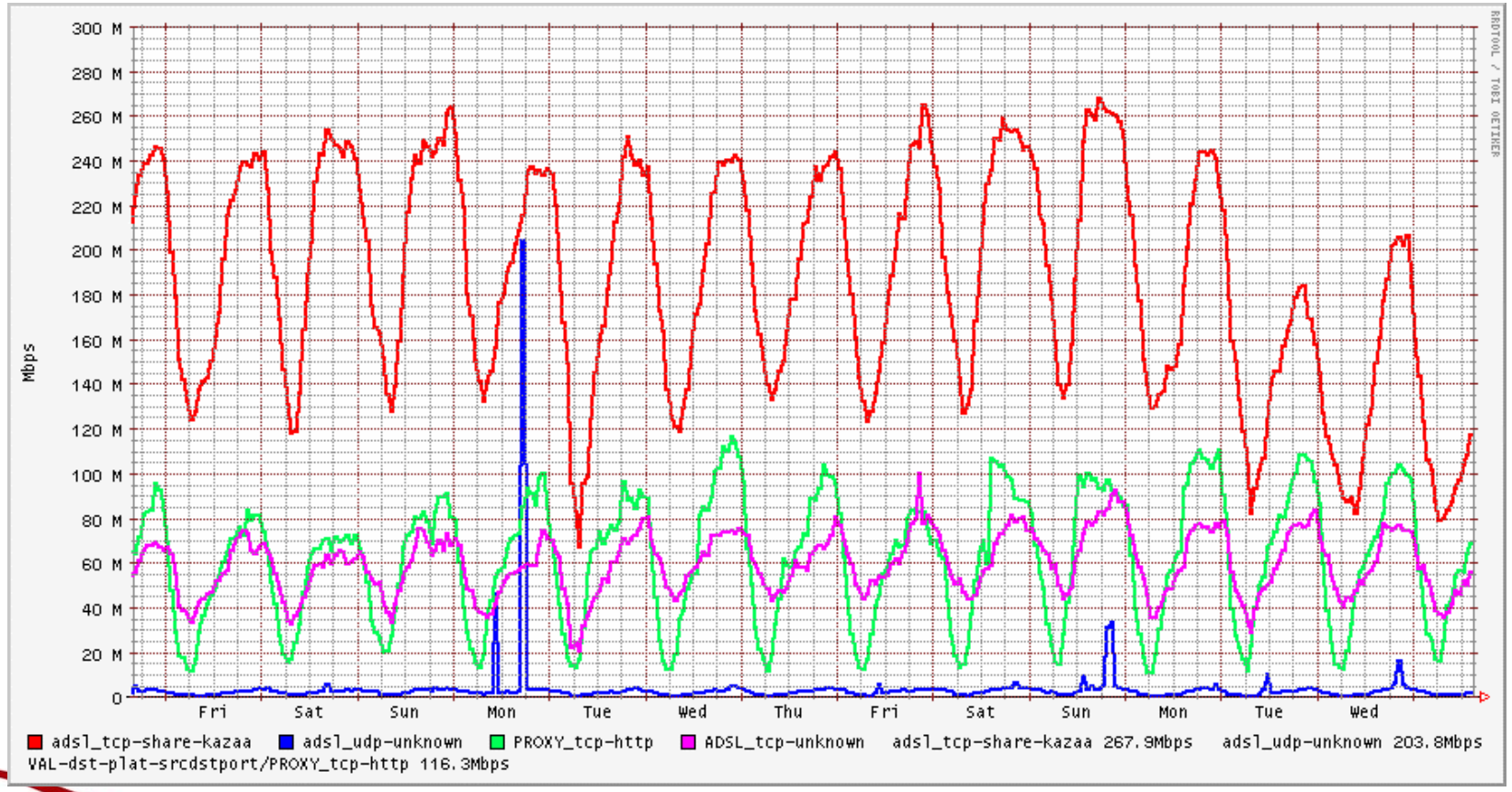
- Driving factors
- QoS design in depth
- Challenges encountered
- Lessons learned
- A few words to vendors

Introducing QoS in core Driving Factors (1)

- A costly fully redundant infrastructure

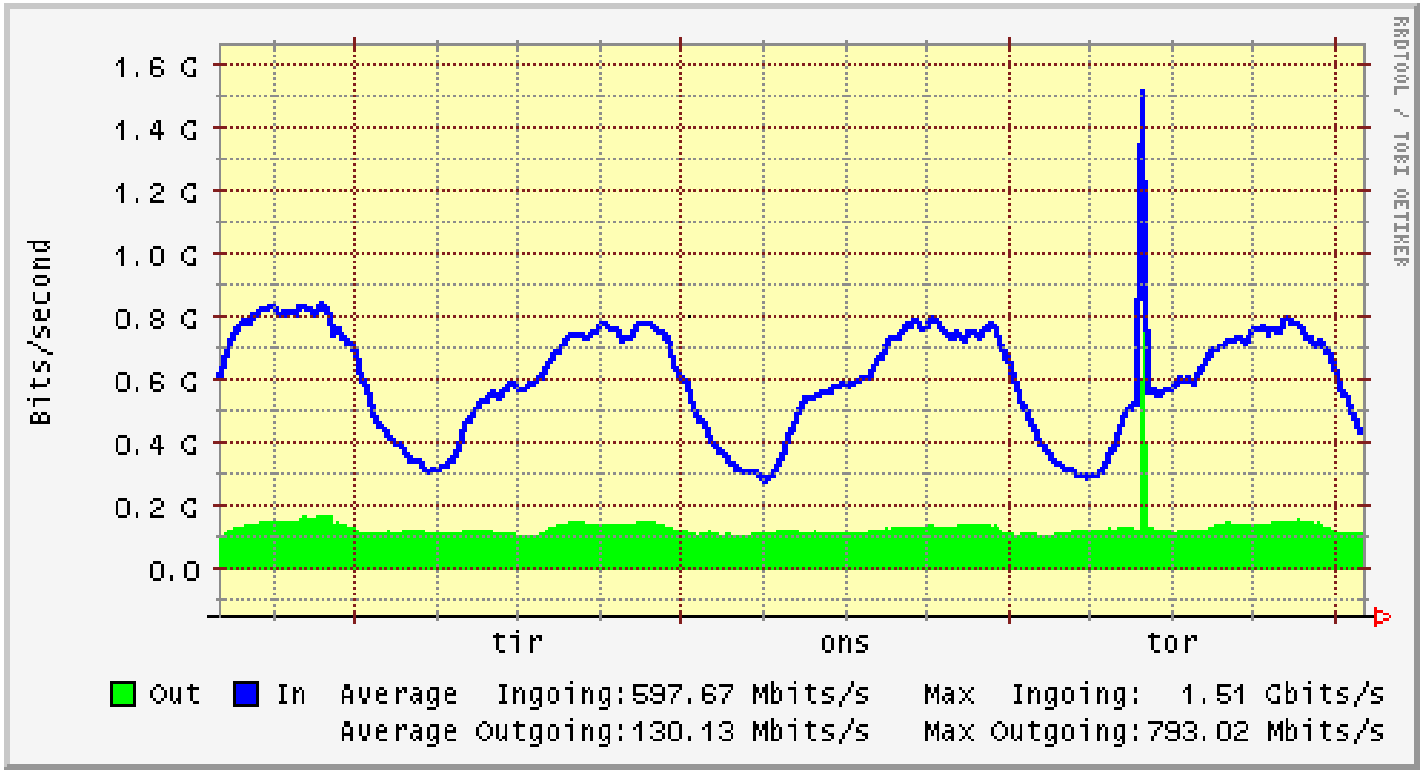


Introducing QoS in core
Driving Factors (2)
P2P traffic: over 60% identified



Introducing QoS in core
Driving Factors (3)

- Denial of Service (DoS) attack

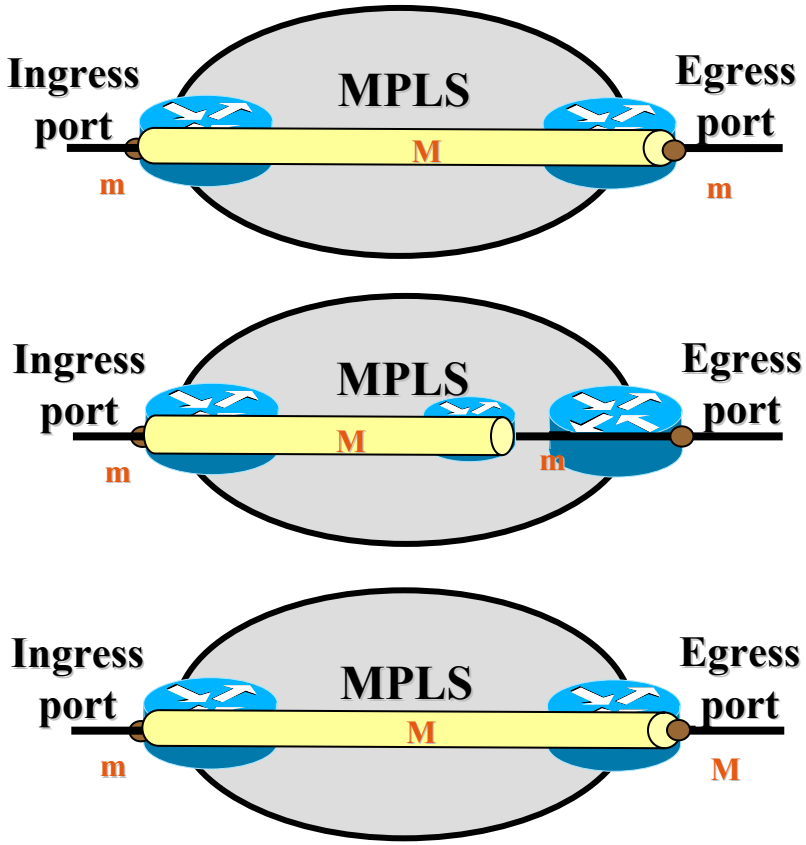


Primary Goals

- Reduce the cost of a redundant infrastructure while still sustain SLA for VPN customers
- Protect business traffic under DoS attacks from Internet
- Secure low latency and low jitter for voice traffic

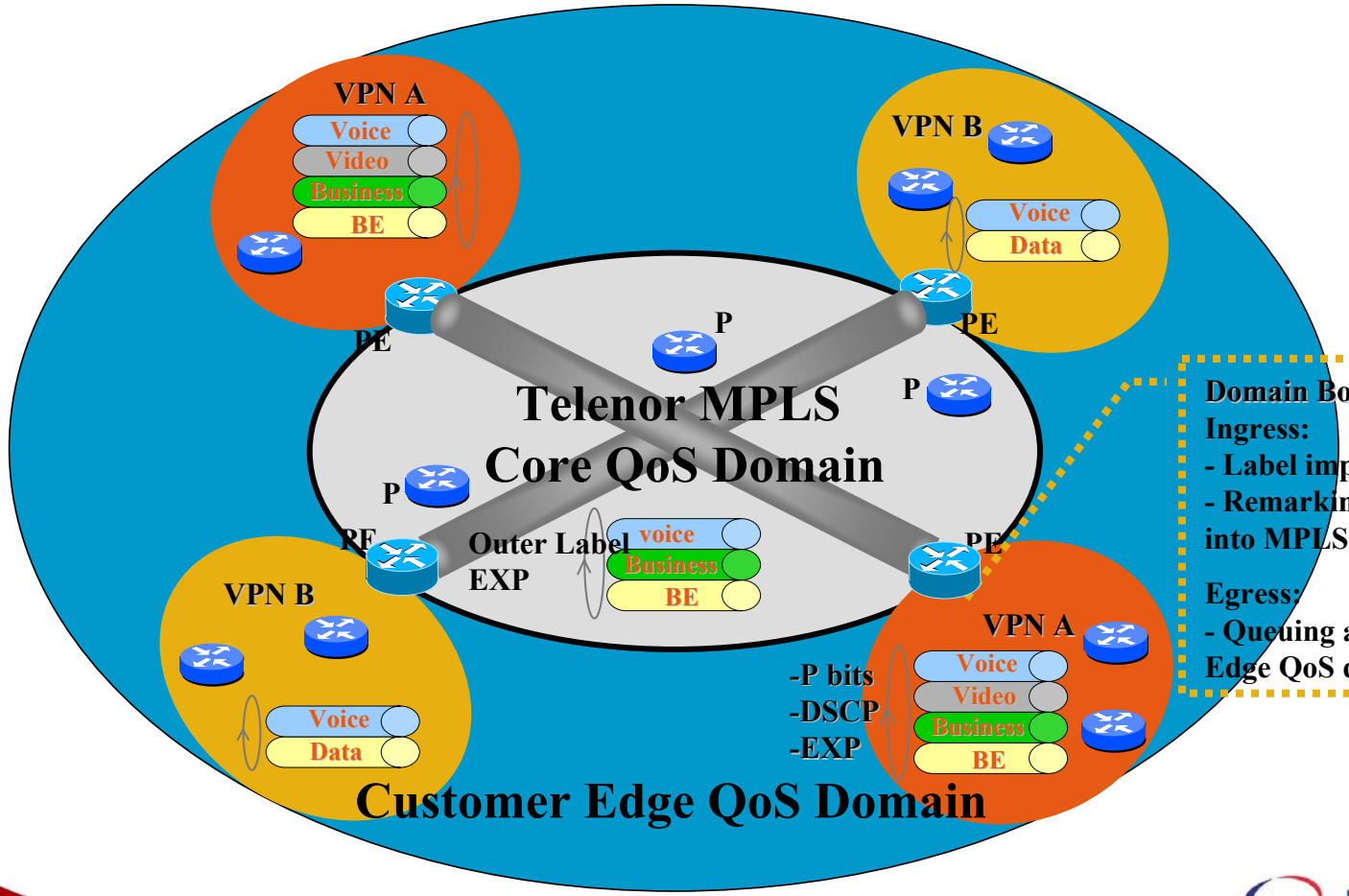
Three DiffServ tunneling models for an IP packet in a MPLS cloud

- Pipe model
- Short pipe model with PHP
- Uniform Model

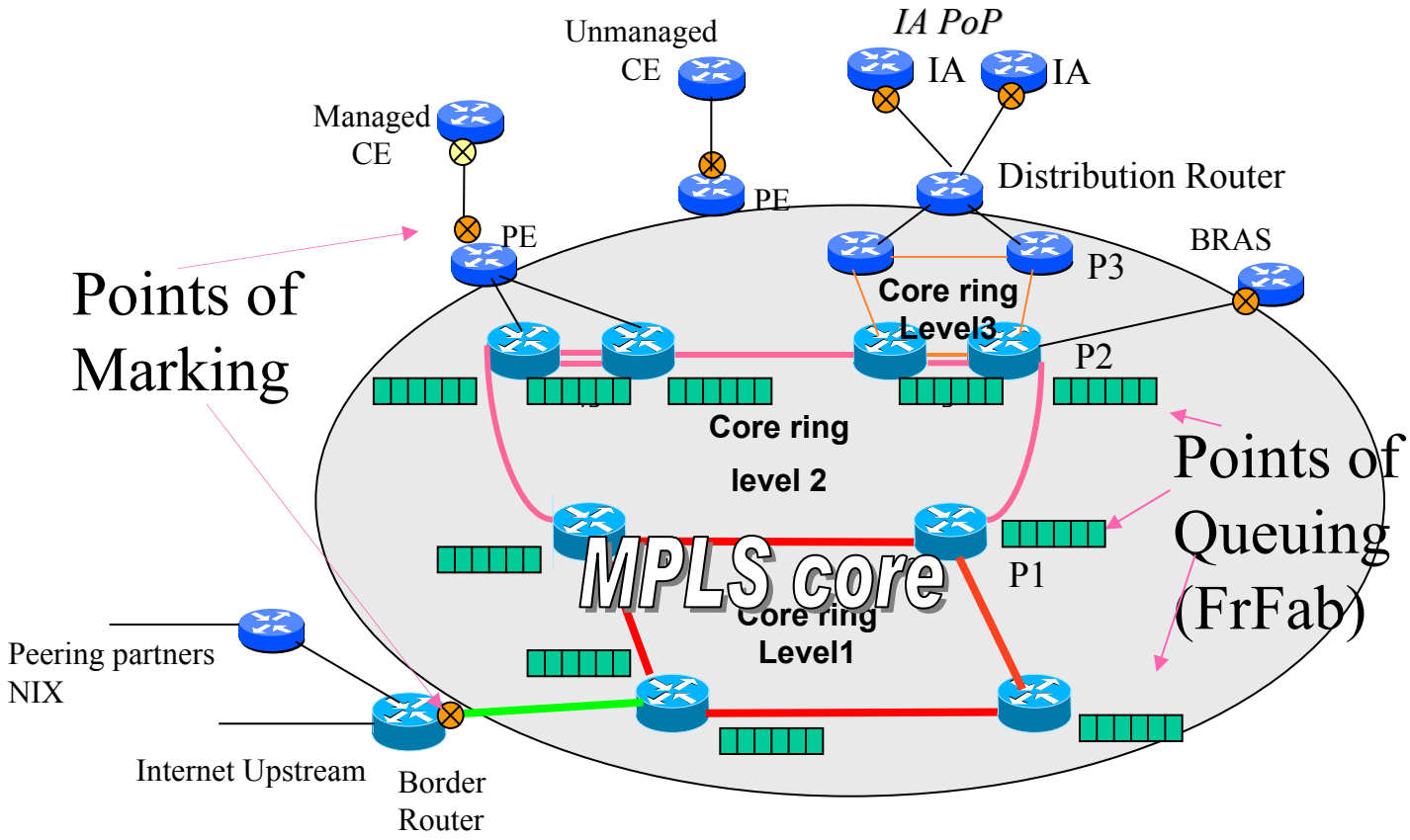


M: LSP Diffserv info in encapsulating packet header
m: Diffserv info in encapsulated packet header

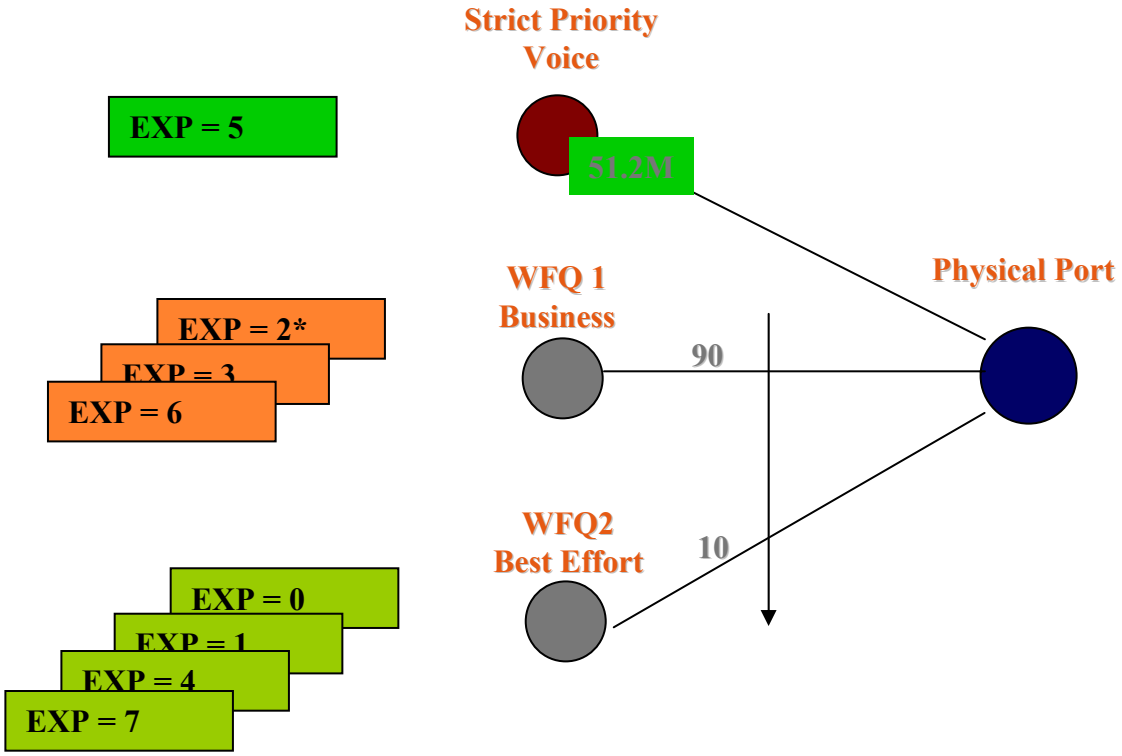
QoS design in depth
Core and Edge QoS domain



QoS design in depth
Points of Marking and Queuing



QoS design in depth
Queuing – three queues



* Work around

QoS design in depth
Marking Scheme (plan)

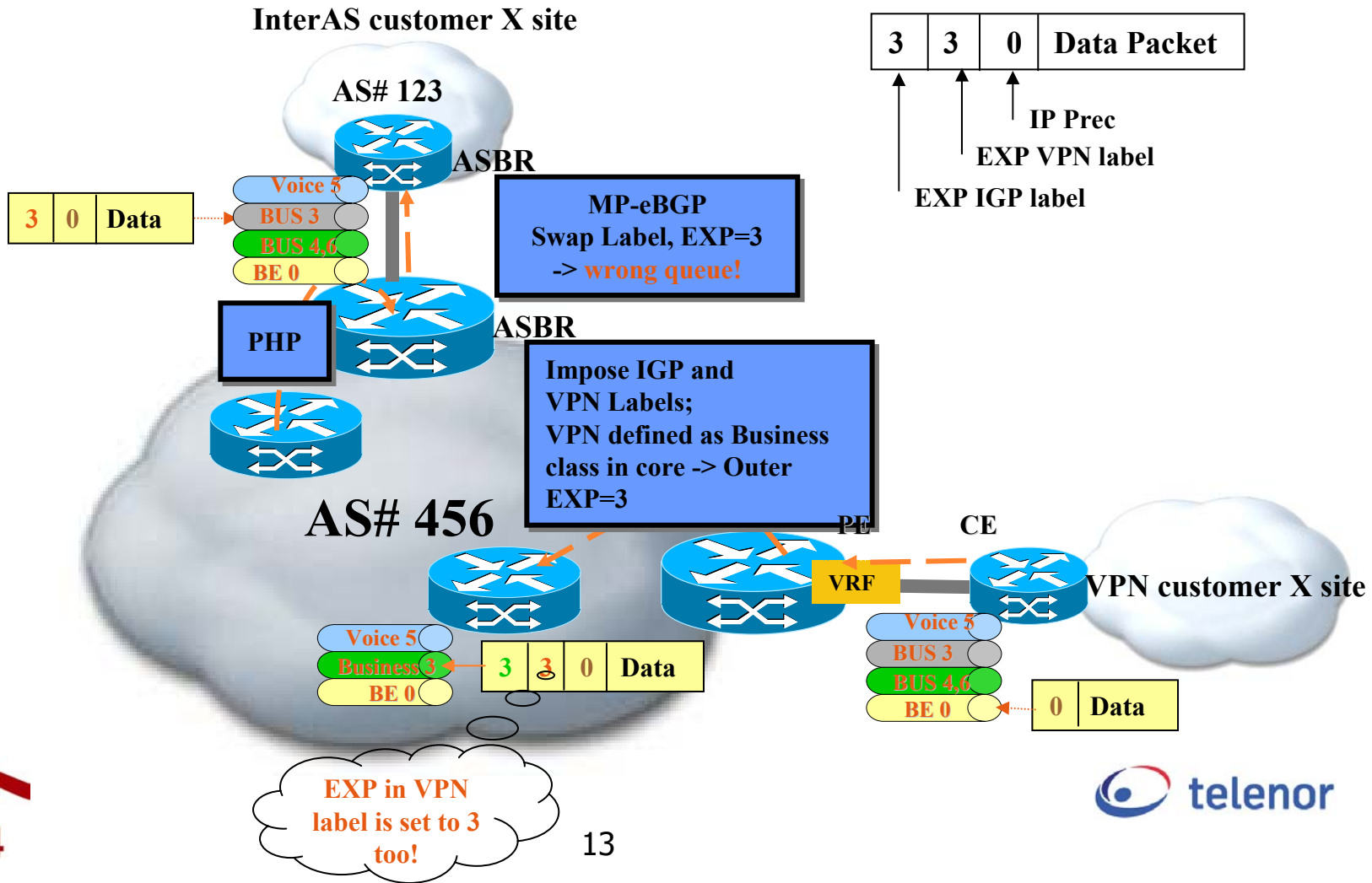
Marking/Mapp -ing points	IP Precedence	VPN (inner) Label EXP	IGP (outer) Label EXP
Internet Border	Unchanged	N/A	0
Internet Access	Unchanged	N/A	0
VPN QoS (Managed CE)	Unchanged	= IP Prec	Prec 5 -> 5 Others -> 3
VPN non-QoS	Unchanged	= IP Prec	3
VPN QoS InterAS	Unchanged	= EXP of incoming packets	EXP 5 -> 5 Others -> 3
VPN WholeSale	Unchanged	= IP Prec	0

QoS design in depth
Marking Scheme (implementation)

Marking/Mapp -ing points	IP Precedence	VPN (inner) Label EXP	IGP (outer) Label EXP
Internet Border	Unchanged	N/A	0
Internet Access	0*	N/A	0
VPN QoS (Managed CE)	Unchanged	= IGP EXP*	5 -> 5 0 -> 2* Others -> 3
VPN non-QoS	Unchanged	= IGP EXP*	2*
VPN QoS InterAS	Unchanged	= EXP of incoming packets	5 -> 5 Others -> 3
VPN WholeSale	Unchanged	= IGP EXP*	0

* Work arounds

Challenges Encountered
Clean cut between core and edge QoS domains



Challenges Encountered
Clean cut between core and edge QoS domains

- Alternative solution: explicit-null between PE-CE
  - Existing QoS configuration between PE-CE would need to be re-configured.
  - Adding requirements for CE devices to support MPLS might increase the cost of CE devices
- Our suggestion: configuration knob to set EXP on each label individually on ingress interface of a MPLS/VPN PE where multiple labels are imposed.

Challenges Encountered

- Prioritizing of router originated traffic
  - Routing protocols: LDP, OSPF, BGP, RSVP
  - SNMP, Netflow, Radius (Cisco default PREC 0)
- Accounting Information/MiB counters
  - Queuing: Forwarding/Discarding statistics
  - Marking: Marked packets statistics per Prec/EXP

Summary: Lessons learned

- The importance of a clear boundary between Core and Edge QoS domain
- Building blocks for the boundary setting
  - Pipe/short pipe model
  - Clear definition which Diffserv information fields to be used in which domain
  - Flexibility to set Diffserv information fields individually in a label stack.

Summary: Lessons learned

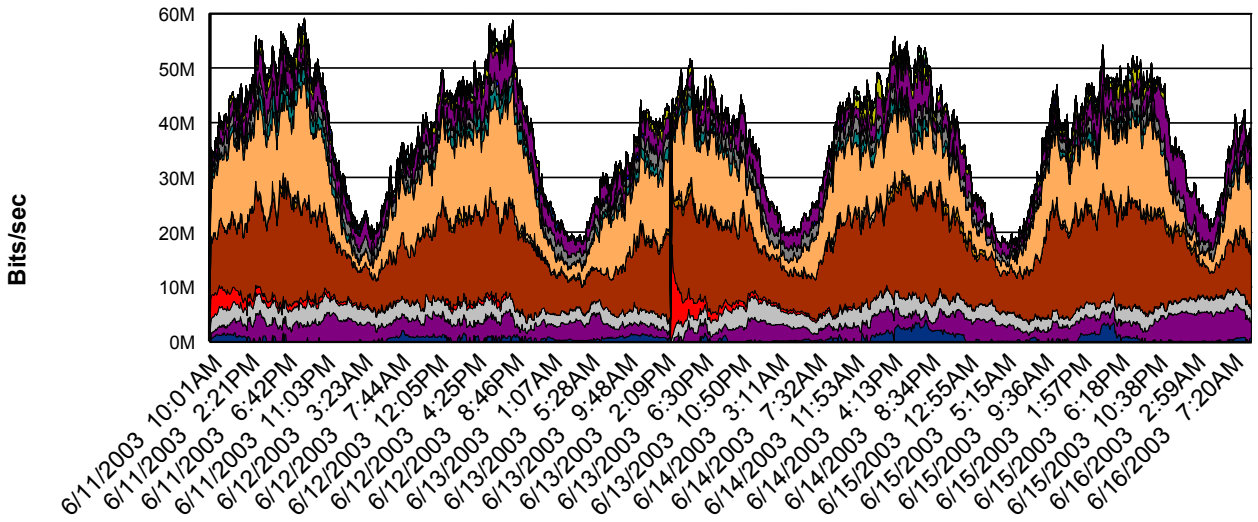
- The importance of NMS integration
  - Critical for SLAs of VPN customer that marking and queuing is done properly, monitoring of all marking and queuing points becomes very important.
  - Critical for Network Planning: new scaling rule

Before QoS:	After QoS:
70% per link	70% per link
50% per ring	50% per voice + Business class per ring
	Requires forwarding statistics per queue!

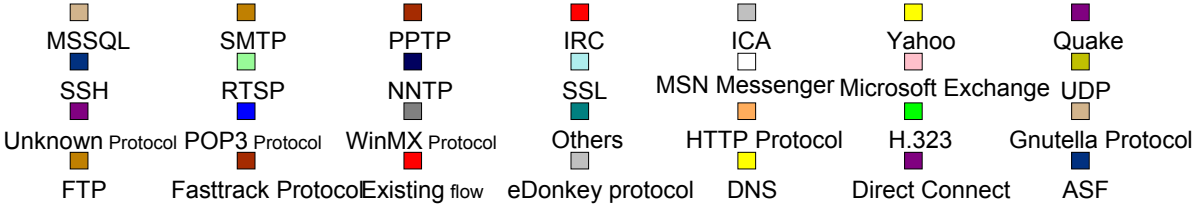
A Few Words to the Vendors

- We do need marking on MPLS EXP in a scalable way!
- We do need statistics on marking and queuing points!
- We do need marking on per protocol basis for router originated traffic!
- We do need possibility to set EXP on each label individually when multiple labels are imposed at same operation!

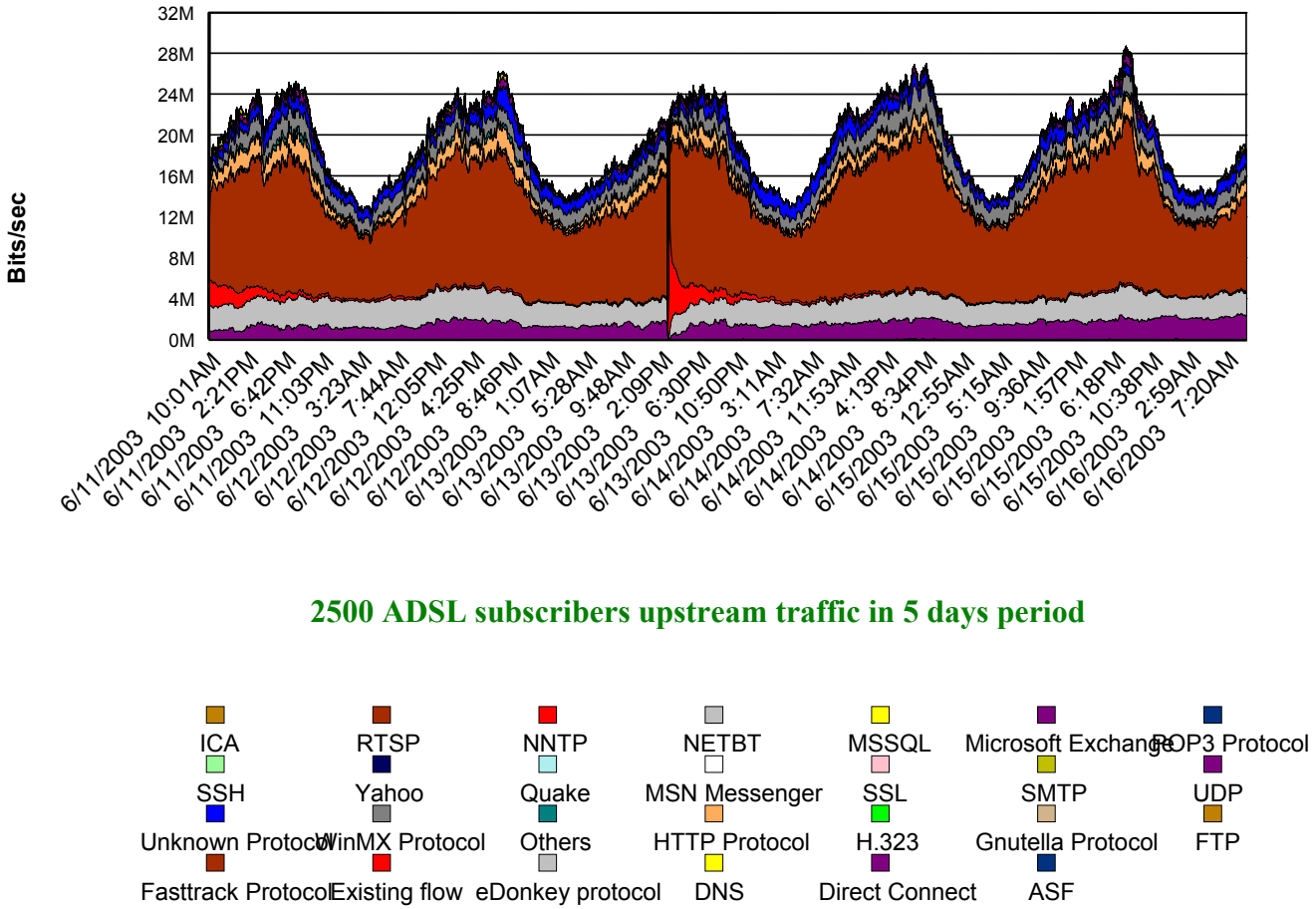
Additional:
P2P traffic downstream: 60%



2500 ADSL subscribers downstream traffic in 5 day period



Additional:
P2P traffic upstream: 80%



2500 ADSL subscribers upstream traffic in 5 days period

Additional: Our work around to solve InterAS site queuing