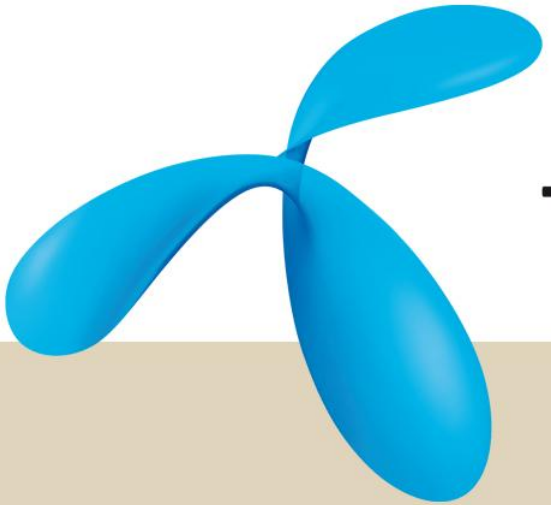

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MPLS applications

Morten Engelsåstrø - NMS-IP Services

morten.engelsastro@telenor.com

Disclamer

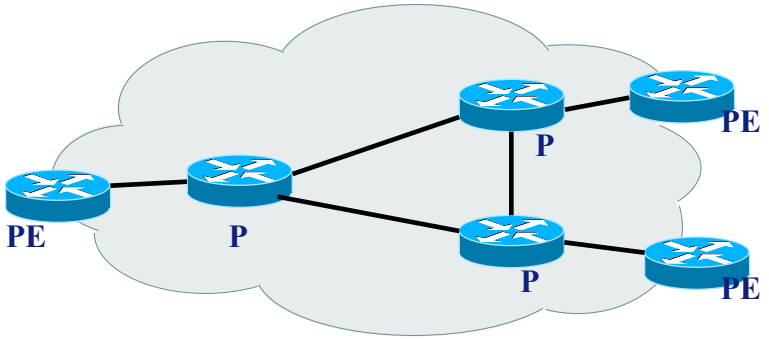
This presentation is in no way specific to the Telenor IP network

Network reference model

Network

•Provider (P): Core routers with no connections to customer

•Provider Edge (PE): Access routers connecting customers to the network



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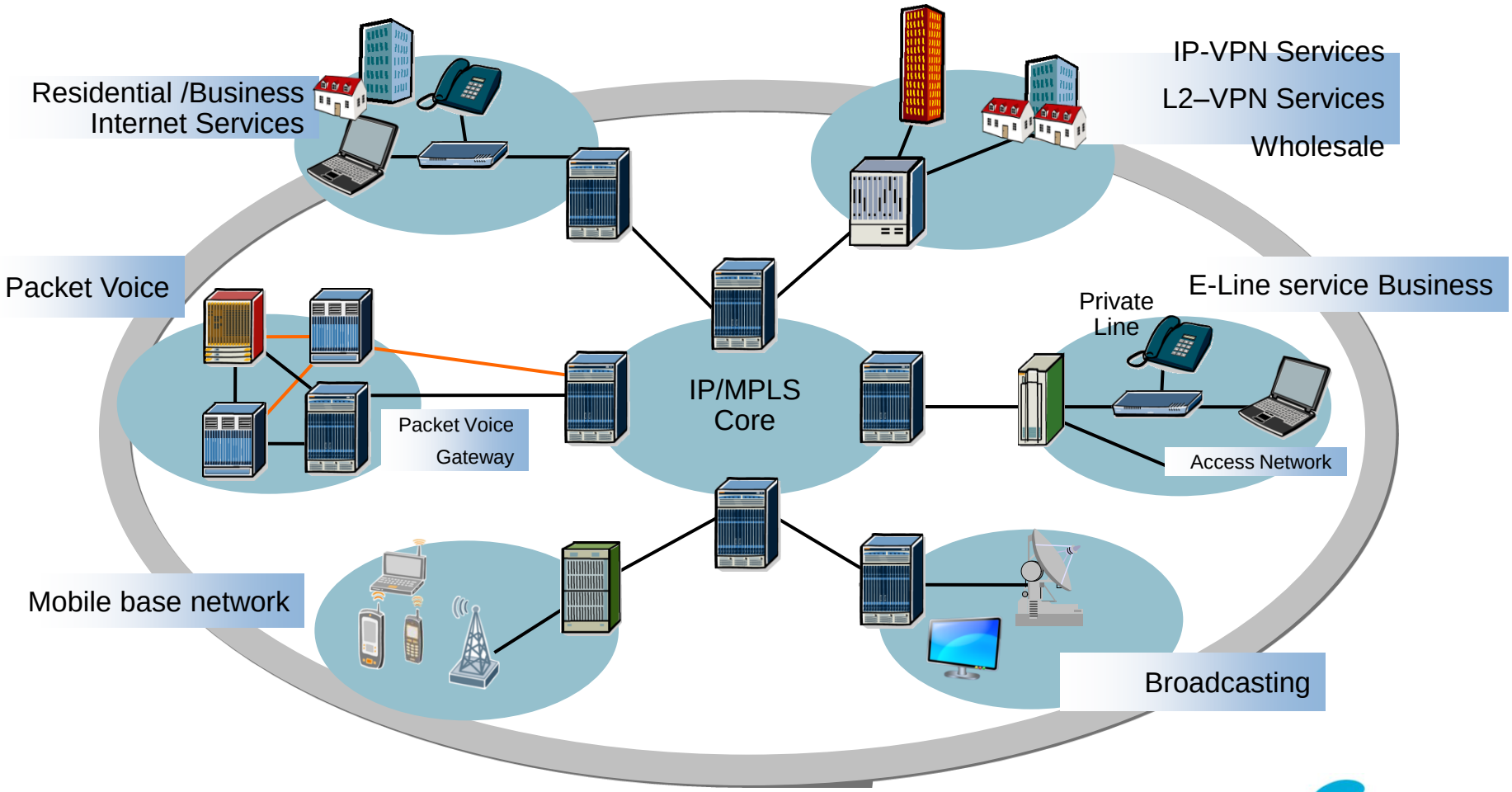
A modern IP/MPLS based network



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Introduction

MPLS (Multi Protocol Label Switching)

- Technology to tunnel any **packet data** across a IP based network (between PE routers)
- Leverages the benefits of circuit switched networks without the drawbacks
  - Excellent scaling properties
  - Tunnels is set up based on IGP or CSPF
  - Tunnels have QoS and traffic protection properties
  - Signalling and Auto-Discovery using Multiprotocol BGP
  - Provides separation of both L2 and L3 domains

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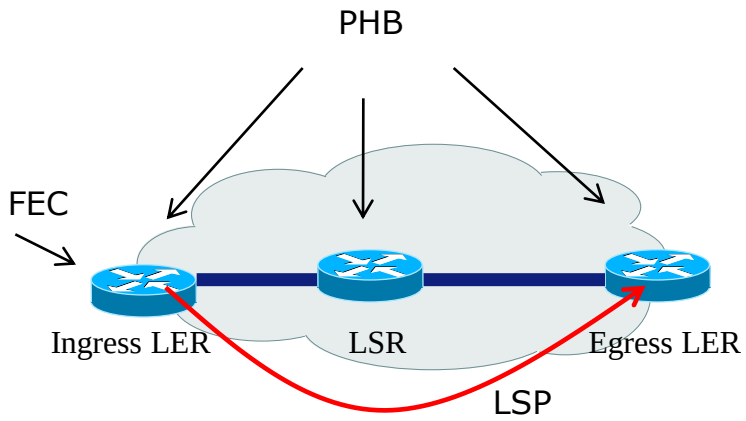
MPLS Terminology

- LSP: Label Switched Path
- LER: Label Edge Router
- LSR: Label Switch Router
- PHB: Per Hop Behaviour
- FEC: Forwarding Equivalence Class



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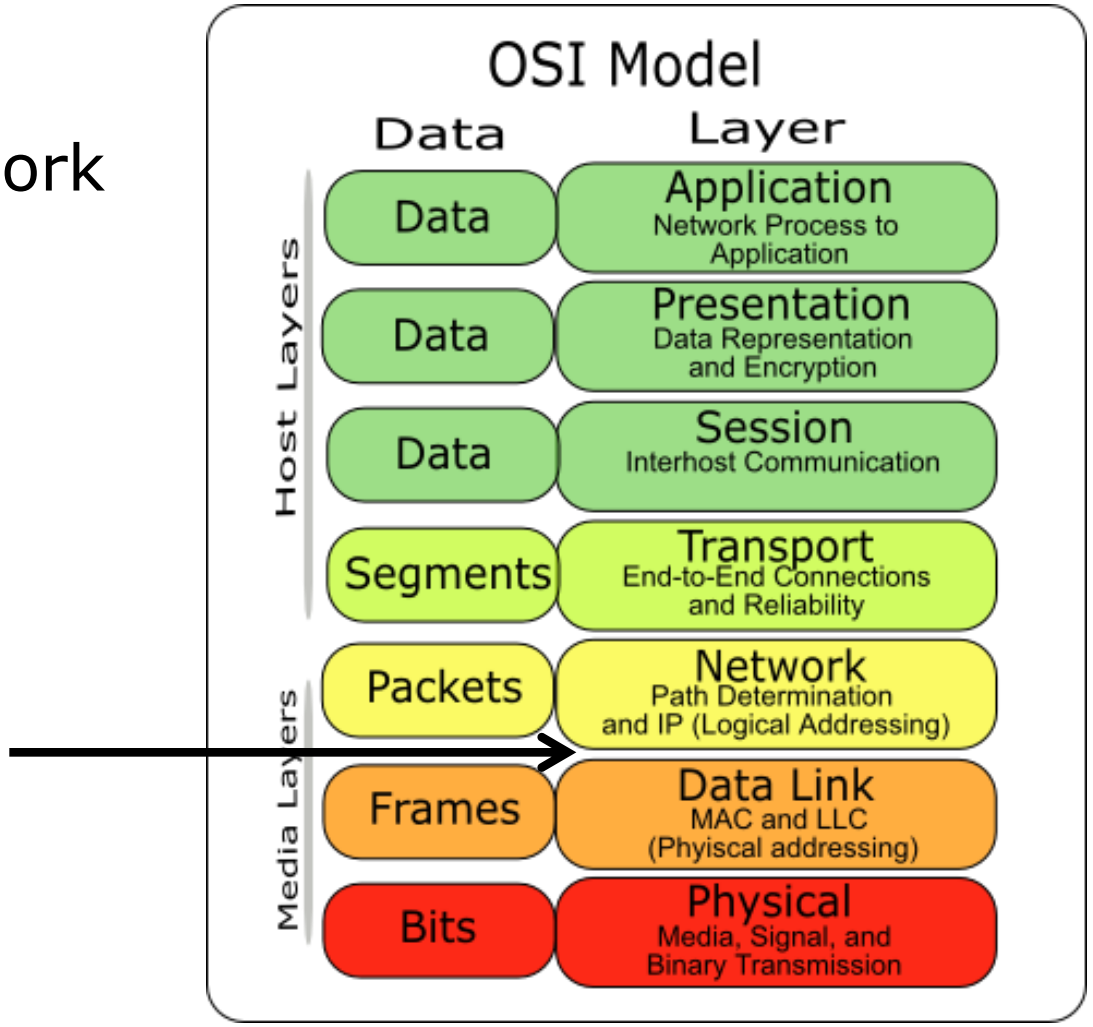
MPLS protocol stack

- MPLS is a layer between the Network and the Data Link layer
- A ”layer 2.5” technology



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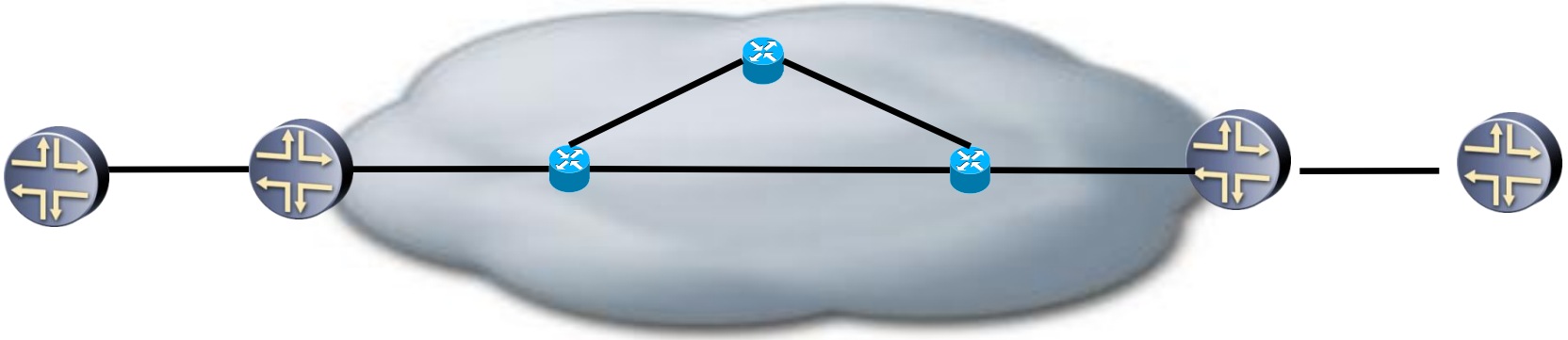
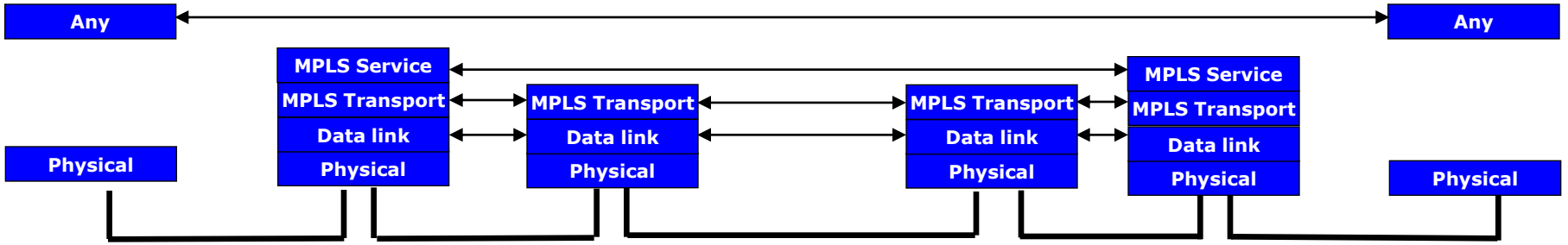
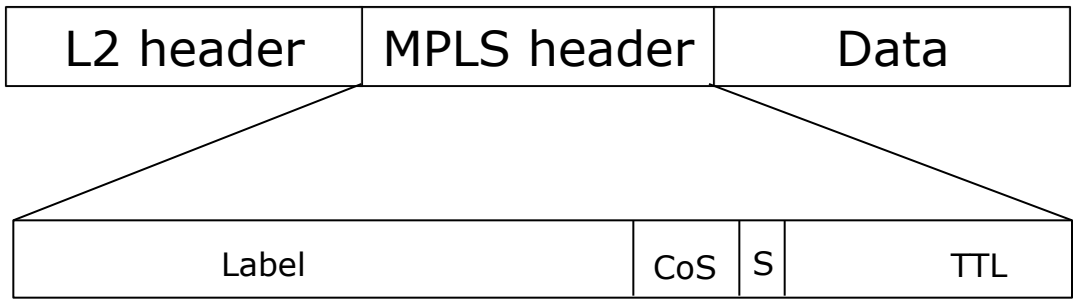
MPLS protocol stack (simplified)





MPLS header

- The MPLS header is prepended to a packet at ingress node after the L2 encapsulation header
- Header consists of
  - 20 bits: Label
  - 3 bits: Class of Service (known as Experimental bits)
  - 1 bit: Bottom of Stack
  - 8 bits: TTL (Time To Live)



MPLS protocols

LDP RFC3036

- Invented to distribute labels
- Automatic discovery of neighbors
- Control plane
  - TCP sessions between neighbors
- Relies on a IGP
  - LSP always follows IGP's shortest path
  - A IGP change will tear down and reestablish new LSPs. Reconvergence has a lower boundry set by the IGP
  - LSPs are limited to IGP boundaries

RSVP

- Originally invented to create bandwidth reservations for individual traffic flows in networks (int-serv)
  - Extended to handle LSPs
    - Bandwidth reservations
    - Traffic protection
- Sessions between LERs must be configured
- Control plane
  - Own protocol number
  - Does not (necessary) follow IGP
- Path of LSP can be setup so that it can only be changed on head end LER
- Path message sent from ingress LER to egress LER
  - Request a label for the path
  - Contain addresses of nodes through which the LSP must pass
- Resv message sent from egress LER to ingress LER
  - Label object
- Periodic refresh of state
- Cross IGP domains

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Comparison RSVP vs LDP

- Configuration
  - LDP
    - Enable on interfaces only
  - RSVP
    - Enable on interfaces
    - Full mesh sessions between LERs
- Scalability
  - LDP scales by number of LDP neighbors
  - RSVP scales by # of LSPs. A full mesh topology have a N-squared problem
    - Additional state (LSPs) added by FRR
- Features
  - LDP: none
  - RSVP: Traffic engineering and fast reroute

MPLS

CAPABILITIES AND APPLICATIONS

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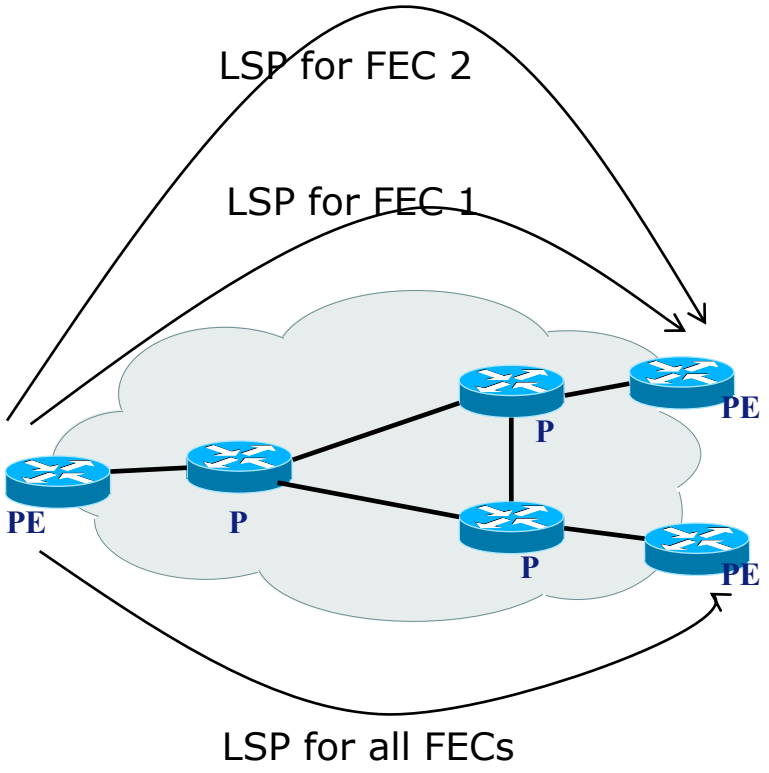
MPLS Capabilites

QoS

- At ingress, the LER maps all traffic with the same QoS properties to a FEC
- The FEC has a mapping to a certain Exp bits combination
- Two PE routers can have one LSP per FEC or one LSP for all FECs with different Exp bits combinations
- Accross the network PHB assures the same QoS behavior based on the Exp bits



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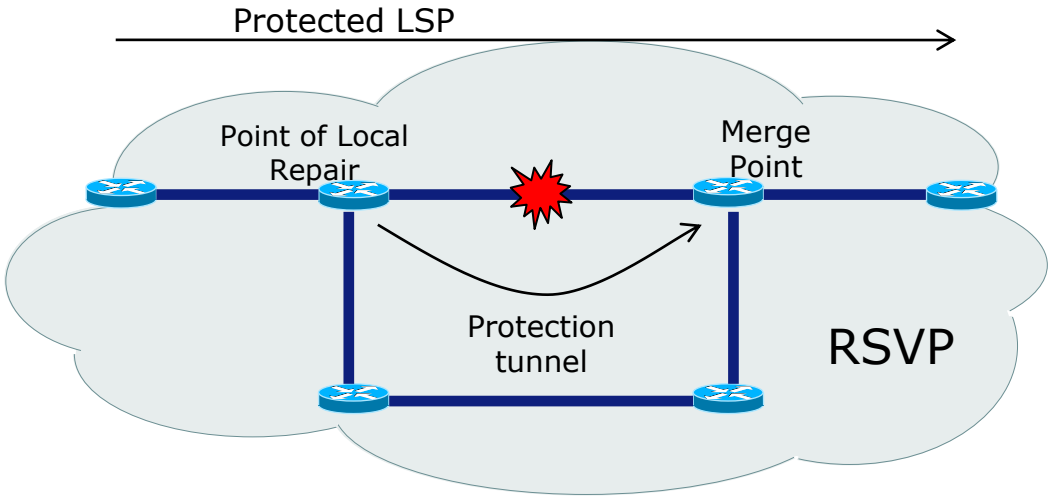
MPLS Capabilities

Fast Reroute

Minimize time during which the traffic is lost

- Local or end-to-end
- Link protection or node and link protection
- RSVP required
- Failure detection
  - Loss of light
  - BFD
  - IGP timeout
  - RSVP timeout



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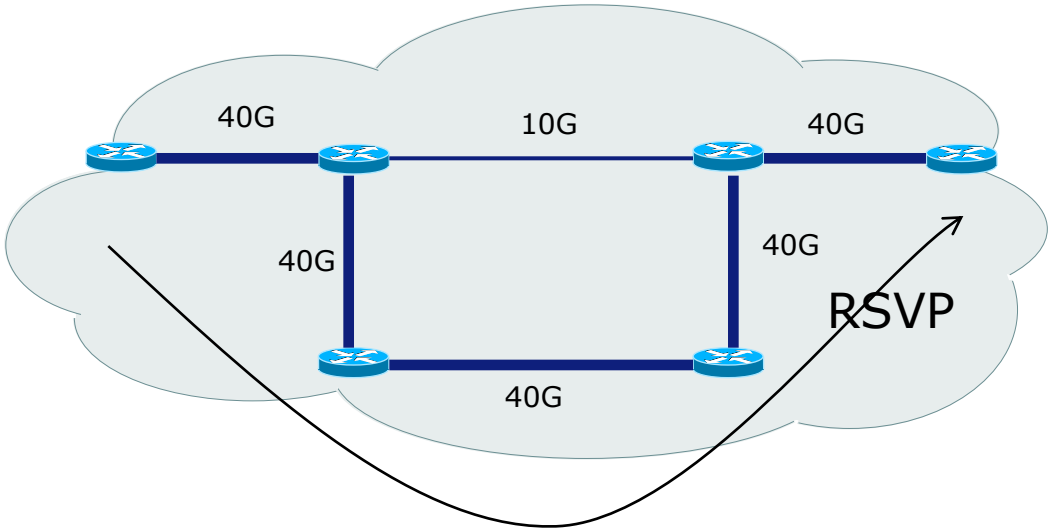
MPLS Capabilities

Traffic Engineering

How to control the forwarding path explicitly to optimize network performance

- CSPF discards links or adds mandatory links
- RSVP uses the CSPF information on LSP establishment



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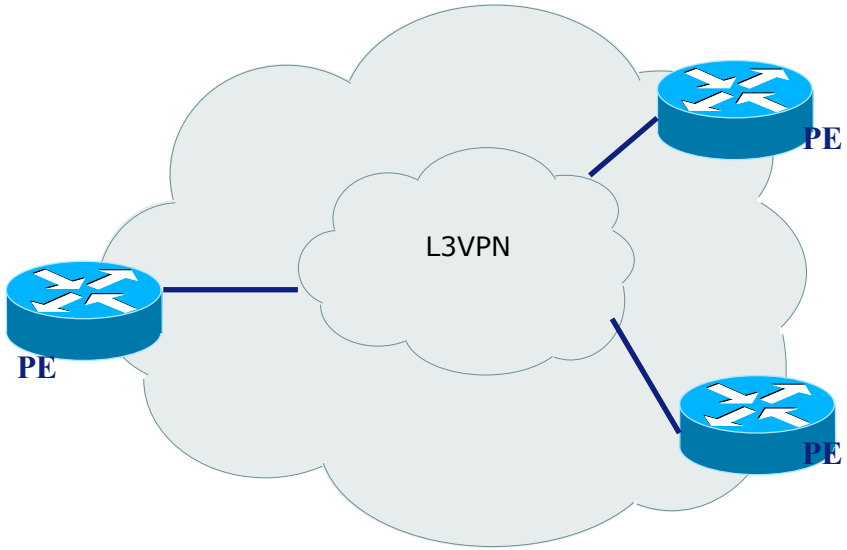
MPLS Applications

L3 VPN RFC2547

- L3 MP2MP Virtual private network over a public infrastructure
- Used by
  - IP customers with >1 sites
  - LTE networks
  - PSTN MGWs
  - L3 Whole Sale ISPs



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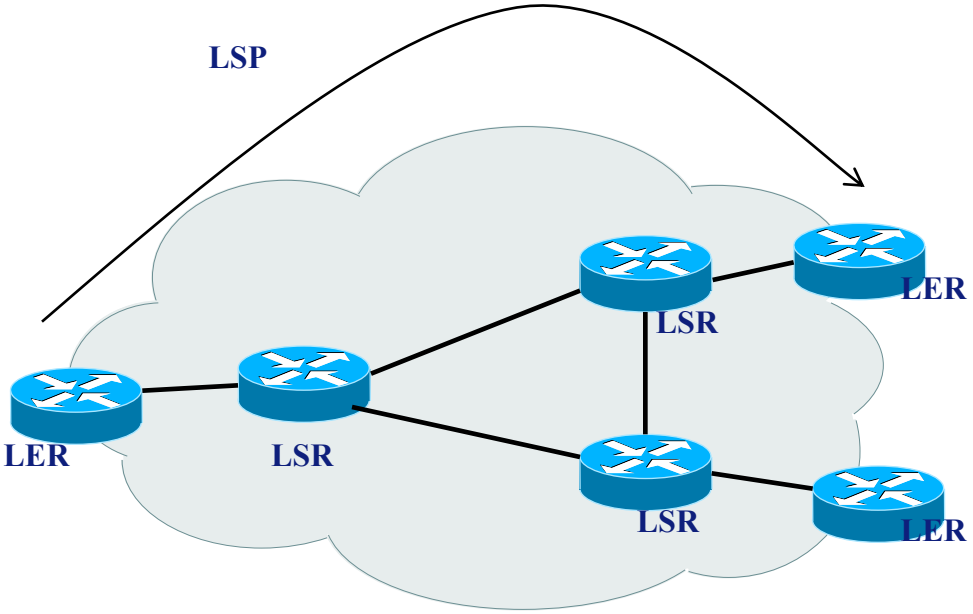
MPLS Applications

L2 Martini RFC 4905

- L2 P2P Virtual private network over a public infrastructure
- Used by
  - ”Legacy” networks like
    - ATM
    - PSTN
    - 2G and 3G networks
  - Ethernet
  - L2 Whole Sale ISPs
- 1:1 vs 1:n aggregation



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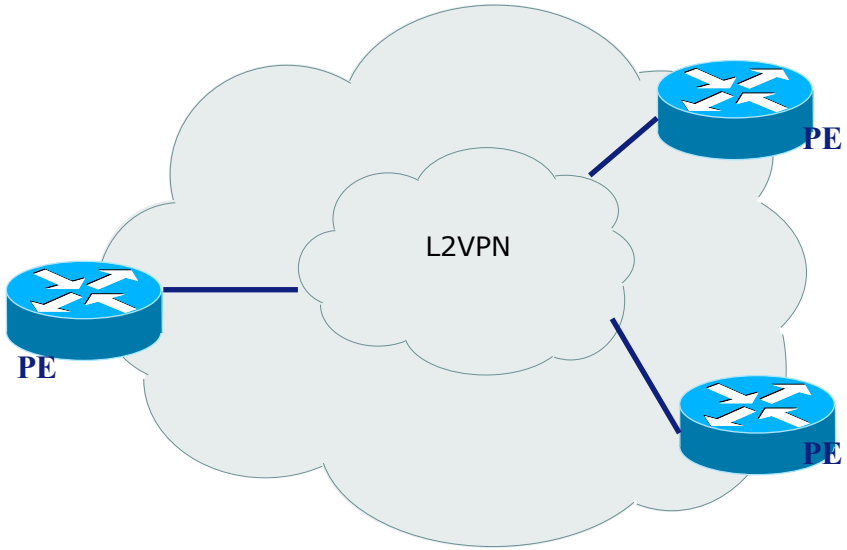
MPLS Applications

VPLS RFC 4761/4762

- Virtual Private Lan Service, MP2MP L2 connectivity
- Used by
  - Large business customers with own networking resources



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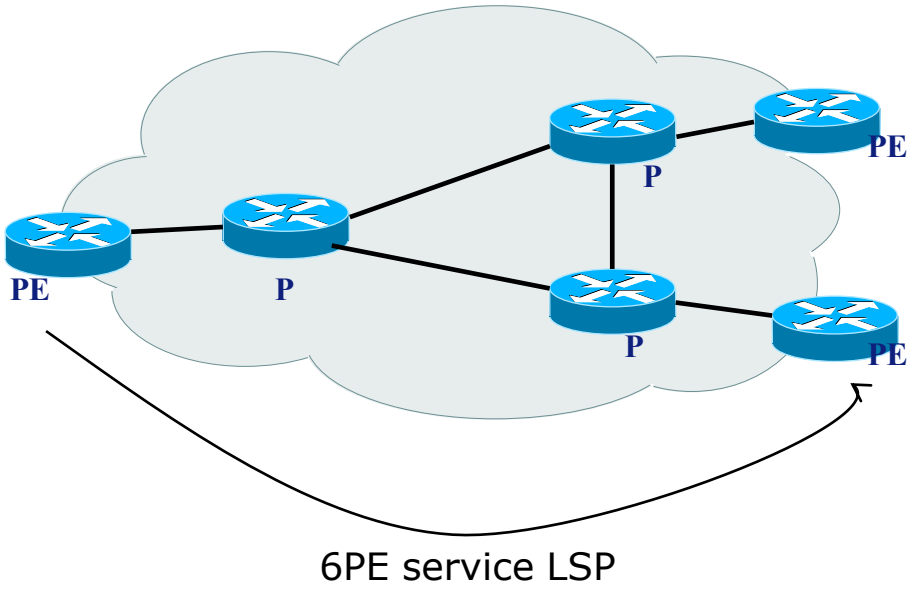
MPLS Applications

6PE RFC 4798

- IPv6 connectivity over a MPLS core
- IPv6 service label
- Keep all the benefits of IPv4/MPLS with IPv6 without enabling IPv6 in the core



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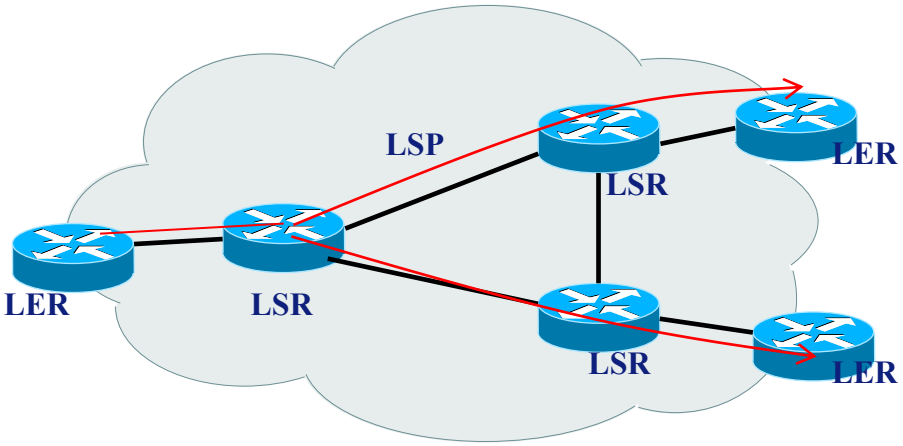
MPLS Applications

Multicast by P2MP LSPs

- Collapse a SSM IP tree topology to a IP directly connected topology
- IP Multicast gets MPLS QoS and traffic protection mechanisms
- IP Multicast does no longer require an IP enabled core



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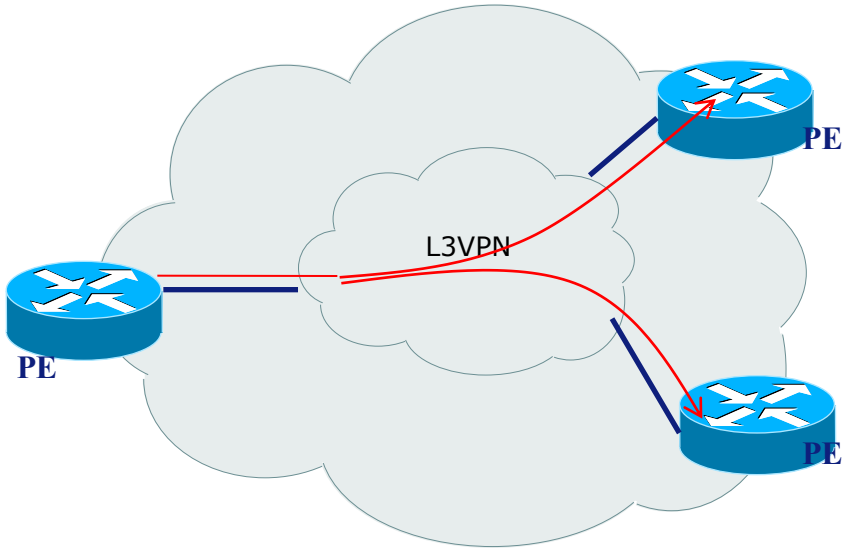
MPLS Applications

NG-MVPN

Multicast in VPN

- P2MP LSPs for forwarding
- Multiprotocol BGP for PIM PE-PE signaling



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MPLS Topologies

- Traffic engineering and fast reroute in core only
  - Not neccessary in POPs
- Reduces # LSPs in core
- LSP hierarchy
  - Core LSPs
  - Tunneled LDP sessions between PE routers

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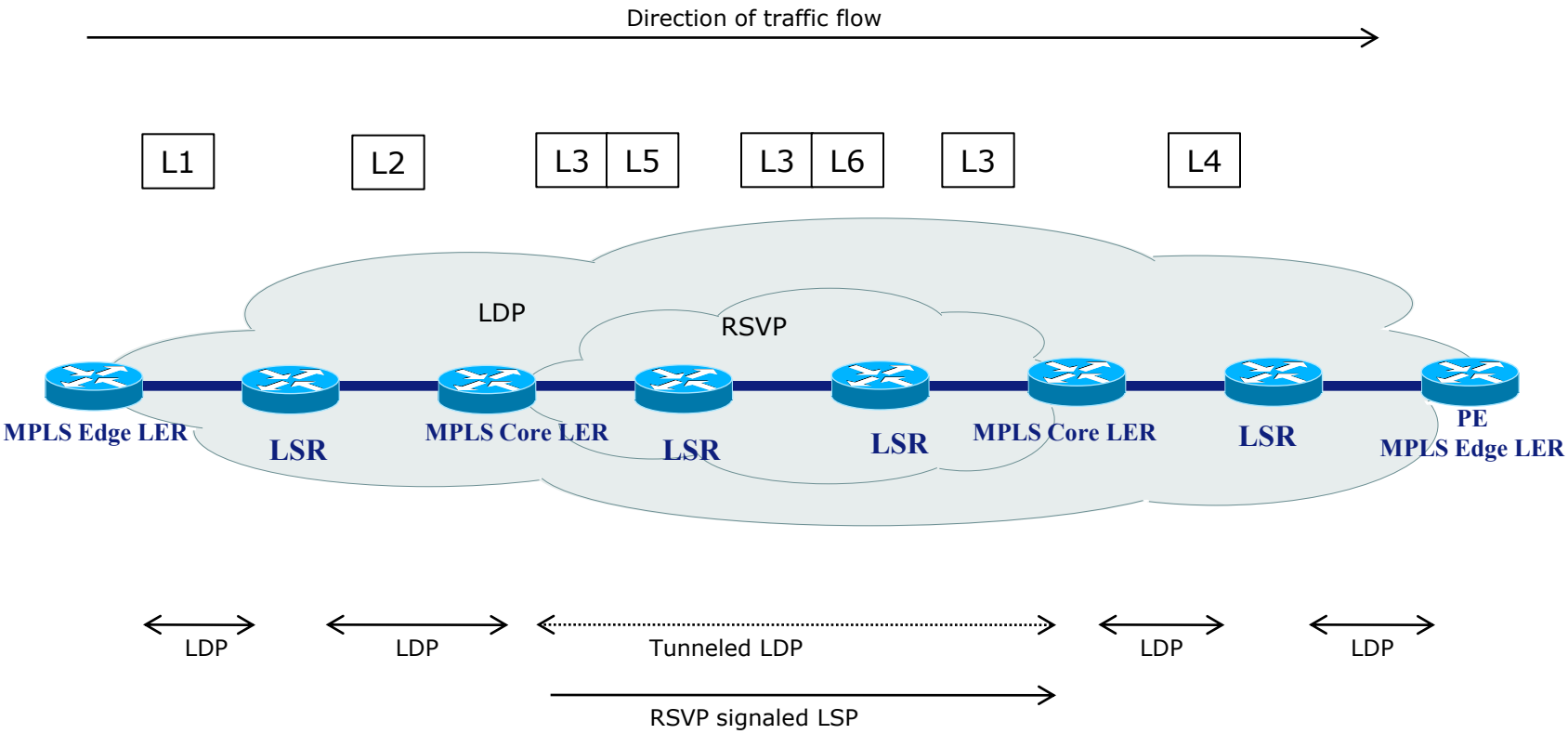
Scaling MPLS topologies



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