Panel: Inter-Carrier MPLS Issues

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MPLS Diverse Network Requirements

- Multi-service support
  - Packet Telephony, Ethernet VLANs, IP-VPN, DSL, FTTP, ATM, FR, and Private Line services

- Support L3 IP-VPN across all L1/L2 access technologies

- Support L2 VPN transport for L2 services across common MPLS backbone

- Must provide (selectively?) ultra-high availability

IP-MPLS Network Architecture
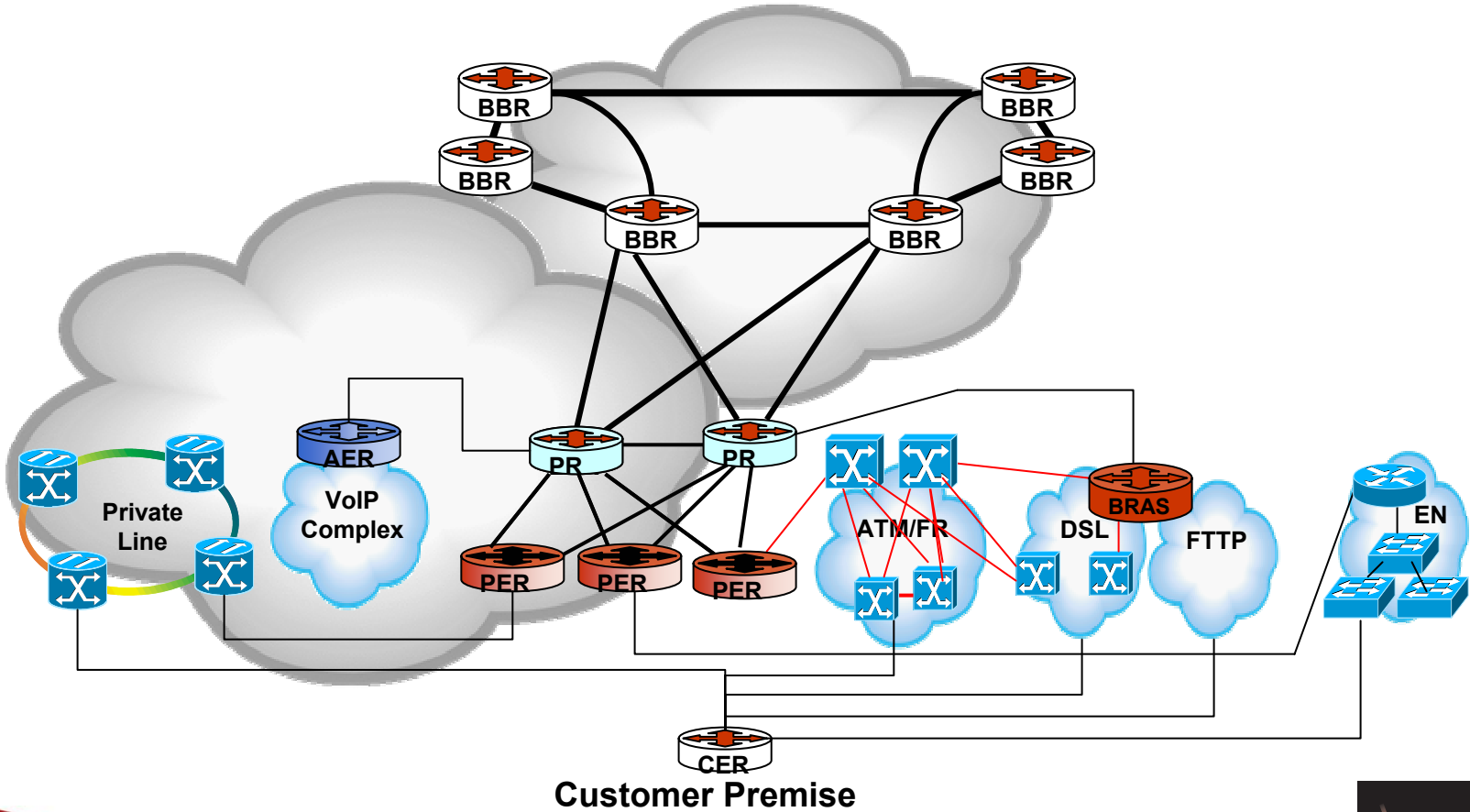
Inter-Carrier MPLS

- Two scenarios
  - InterProvider L3 VPN: Two carriers are peer L3 VPN providers who interconnect two or more customer L3 VPN islands

  - Carrier of Carriers: One Carrier provides IP-MPLS transport of another Carrier's L3 VPN services

- Address providing VoIP services over both scenarios

- Issues, Requirements, Obstacles

Elements of the InterProvider Agreement

Preservation of QoS marking and high level behavior

- Number of classes
- Marking - EXP, DSCP, p bits
- Type of traffic in each class and behavior
- Noncompliance treatment (drop, mark down)

Performance apportioning

- Latency
- Packet loss
- Jitter bounds
- Availability

Performance reporting

- Report content/ format
- Report delivery – web site, paper…

Settlements

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Inter-Carrier MPLS Issues

- By Paul Jin
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What is the driver towards SP Interconnects?

- Enterprise Requirements
  - Generally Multi-National Firms with extensive reach requirement across the globe
- Regional/Domestic Service Providers needing global reach
- Global Service Providers needing regional/domestic reach
- AP, Americas, Europe
  - Need further reach within region
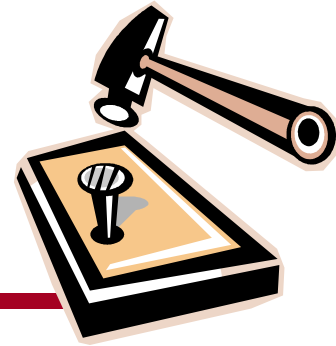
The Challenges

- SLA and QOS
- Each provider's have different:
    - Methods
    - Processes and Procedures
    - Configurations
    - Planning
    - Features
- Customer's expect SLA end to end
- The challenge is making these elements work across both networks

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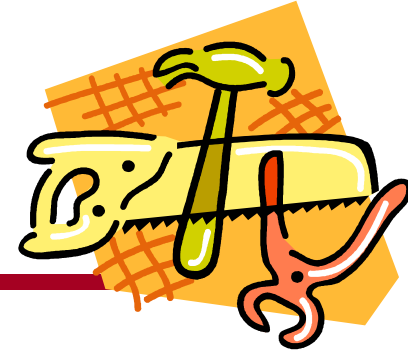
MPLS in MCI

- By Dave McDysan

MPLS – 21st Century Hammer

- Have Deployed
  - Traffic Engineering for IP networks
  - L3 Virtual Private Networks
  - L2 Virtual Private Networks
  - Pseudowires
- Have not Deployed
  - Inter-AS L2 Connectivity
  - Legacy L2 interworking
  - Voice trunking
  - etc.

Improving the MPLS Toolkit

- Scalable, hierarchical traffic engineered LSPs
- Inter-area and inter-AS traffic engineered and fast restorable LSPs
- Coordinating admission control and resource allocation in implementations
- LSP liveliness checks and troubleshooting tools
- Refinements of PW, L2 VPNs, FRR, MIBs based upon operational experience
- Ensuring precise standards and interoperability

Challenges for MPLS

- Scope and deployment extent impact on
    - Scaling of message processing
    - Scaling of routing information exchange
    - Separation/ isolation paradigm of only trusted interfaces supporting labels
- Difficulty of multi-criteria and constraint-based optimization and routing implementations
- Applicability of effectively connection-oriented MPLS signaling paradigm to applications

Inter-AS Requirement from L2-MPLS Network

- Yukio Ito

NTT Com's L2-MPLS Network
# - IP Infra Network -

- Nation wide network that consists of two tier
- Flexible bandwidth path from 1Mbps to 10Gbps
- Variety of service classes enabled by QoS control
- End-to-end path protection (global protection)

NMS
element manager

SZC tier

DCN

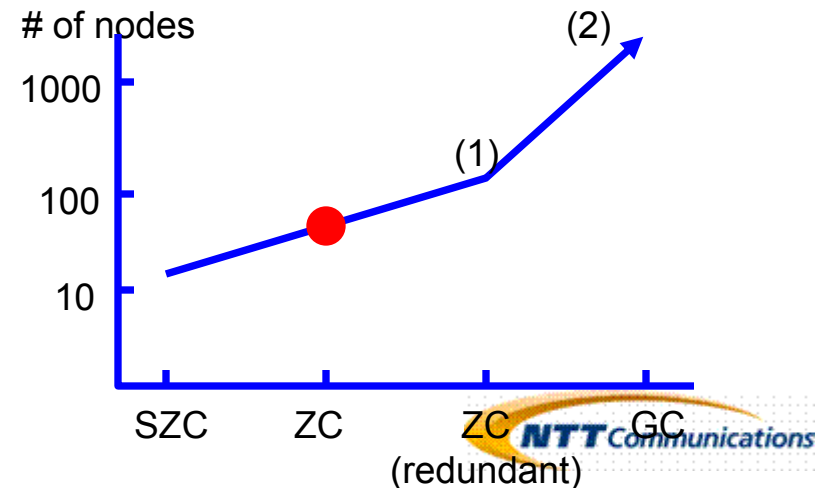**ZC tier**
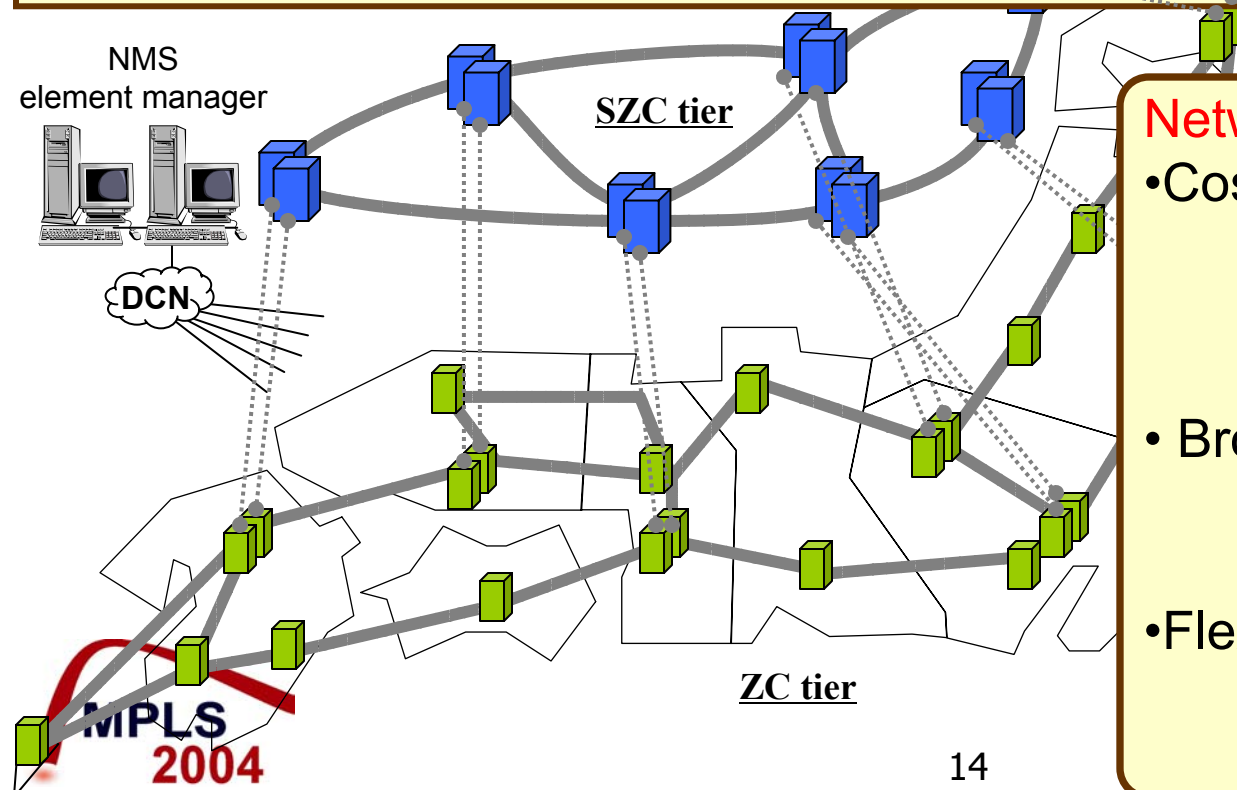
Network Policy
- Cost reduction
  - -Statistical multiplexing
  - -Multi service convergence
  - -Multi layer provisioning
- Broadband
  - -GbE connection
  - (everywhere, every time)
- Flexibility
  - -User friendly interface
  - -Usage based bandwidth

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Expansion Direction of L2-MPLS Network
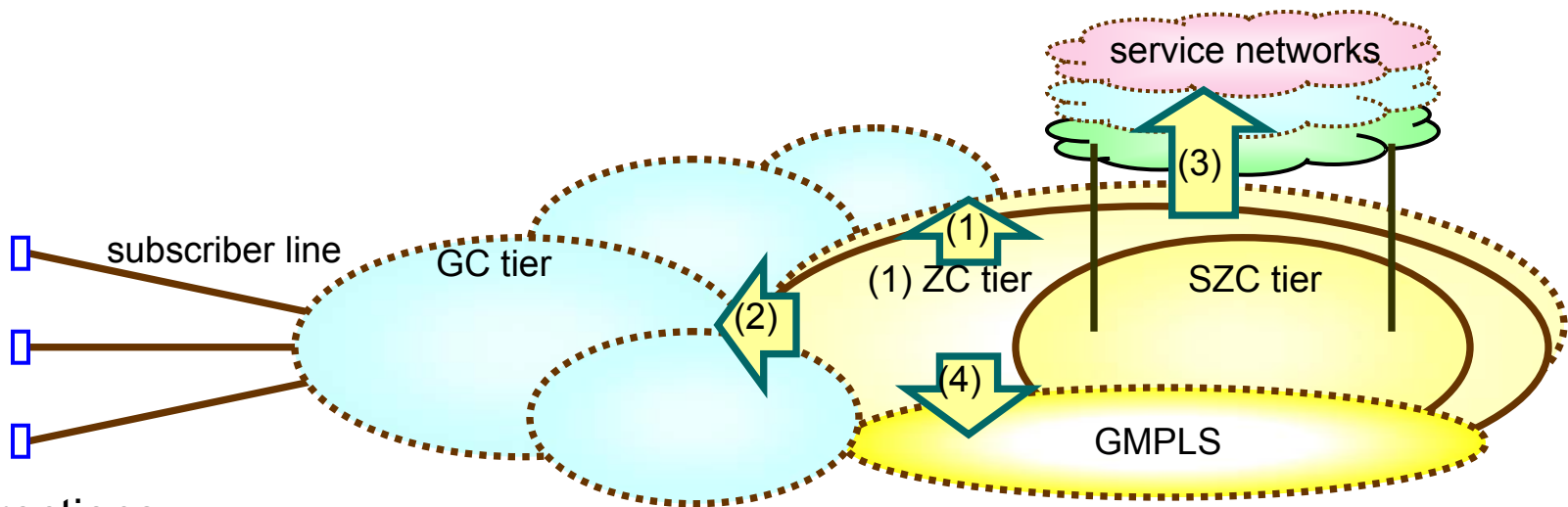
Directions

(1) Redundancy of ZC tier
(2) Expansion toward GC tier
(3) Multi-service accommodation such as
   ATM/FR
(4) Multi-layer network operation by GMPLS

Inter-AS Issues in L2-MPLS Network

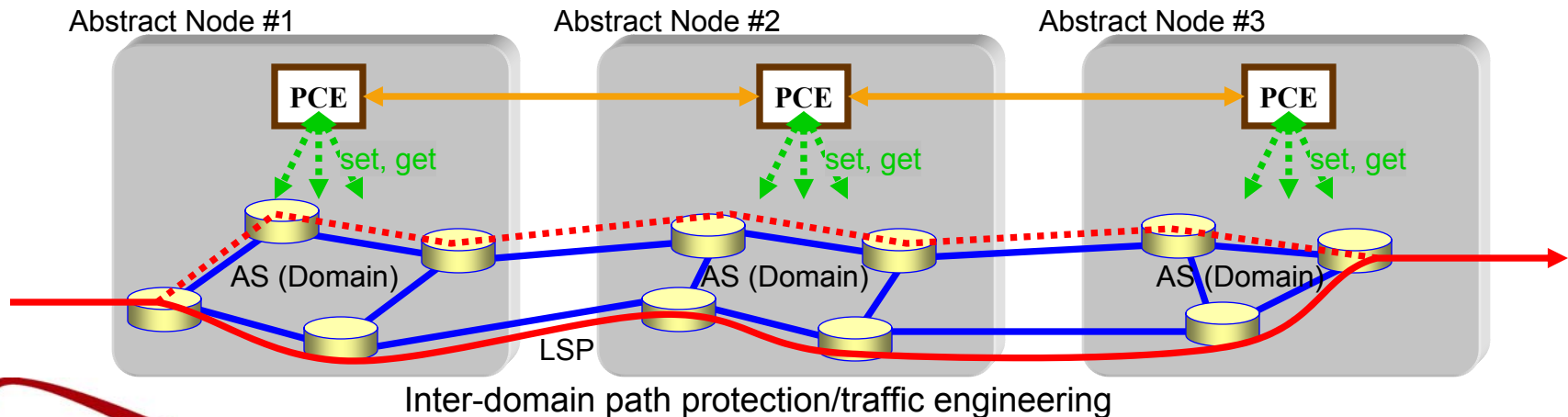When we expand the L2-MPLS network to GC tier, inter-AS issues will occur...

➤ Large single domain network will be unstable.
 (No more expansion with single domain)
➤ Multi domain network can separate influence of failure.
➤ End-to-end QoS issue in multi domain network
➤ End-to-end path protection/traffic engineering
➤ End-to-end management/OAM function (ex. LSP ping)

Effective solution as soon as possible!!

Abstract Node Approach in Multi Domain Network

AS (Domain) should be treated as Abstract Node.
  - Abstract Node looks like an LSR.
  - The member in the domain is concealed from outside.
  - Access to the member from outside is possible through PCE.
  - Existing protocols can be apply to the protocol between PCEs.

Abstract Node #1   Abstract Node #2   Abstract Node #3

PCE   PCE   PCE

'set, get   'set, get   'set, get

AS (Domain)   AS (Domain)   AS (Domain)

LSP

Inter-domain path protection/traffic engineering

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NTT Communications

Inter-Carrier MPLS Issues
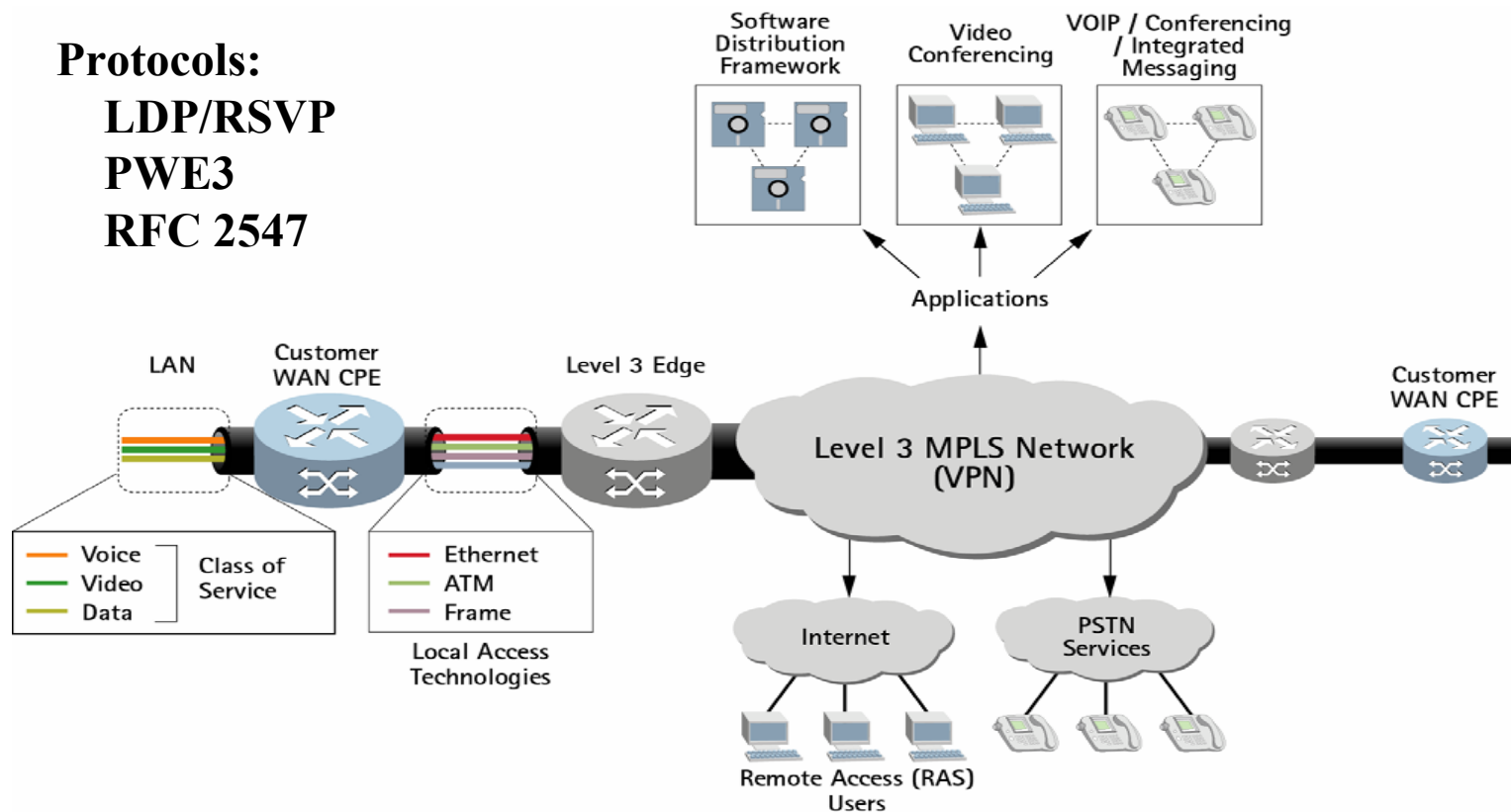## Andrew Dugan
Andrew.Dugan@Level3.com

Level(3) MPLS Network

Protocols:
   LDP/RSVP
   PWE3
   RFC 2547

Level(3) Services Offered Over a Converged MPLS Core Network

- Internet
- Layer 2 Services
  - ATM
  - Frame
  - Ethernet
- IP VPN
- Internet Dial
- Voice over IP
  - IP – IP
  - IP – PSTN
  - PSTN – IP

Inter-Carrier Connection Issues

- Peering vs service relationship between carriers?
- SLA Reporting
- QOS Mapping
- Network Management
- Customer Ownership
- Capacity Management
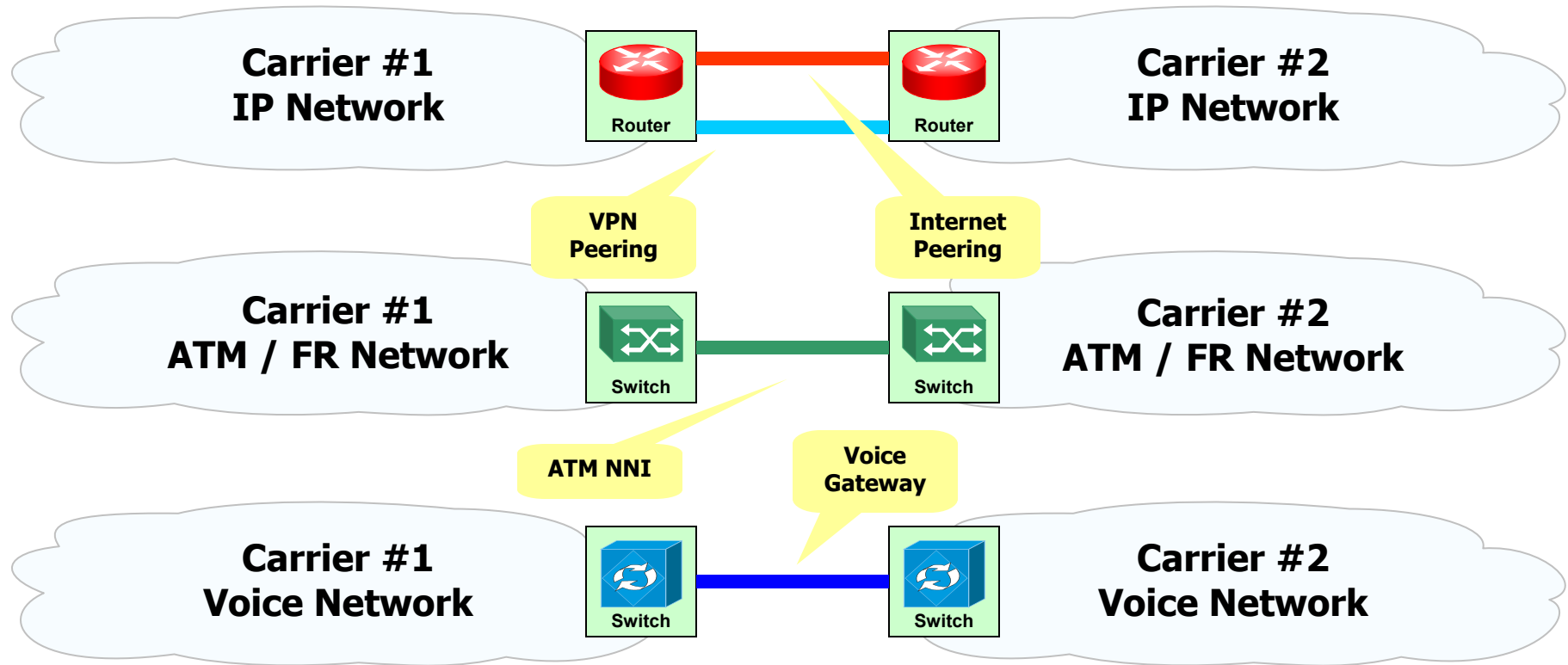
Inter-Carrier MPLS Issues
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Qwest Communication
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Today's Interconnection Architecture

Carrier #1 IP Network — Router ↔ Router — **Carrier #2 IP Network**

VPN Peering

Internet Peering

Carrier #1 ATM / FR Network — Switch ↔ Switch — **Carrier #2 ATM / FR Network**

ATM NNI

Voice Gateway

Carrier #1 Voice Network — Switch ↔ Switch — **Carrier #2 Voice Network**

Technology based interconnect using multiple circuits and networks

The Future

VPN LSP
(L2 & L3)

Carrier #1
IP/MPLS Network

Router

Router

Carrier #2
IP/MPLS Network

Voice
LSP

Internet
LSP
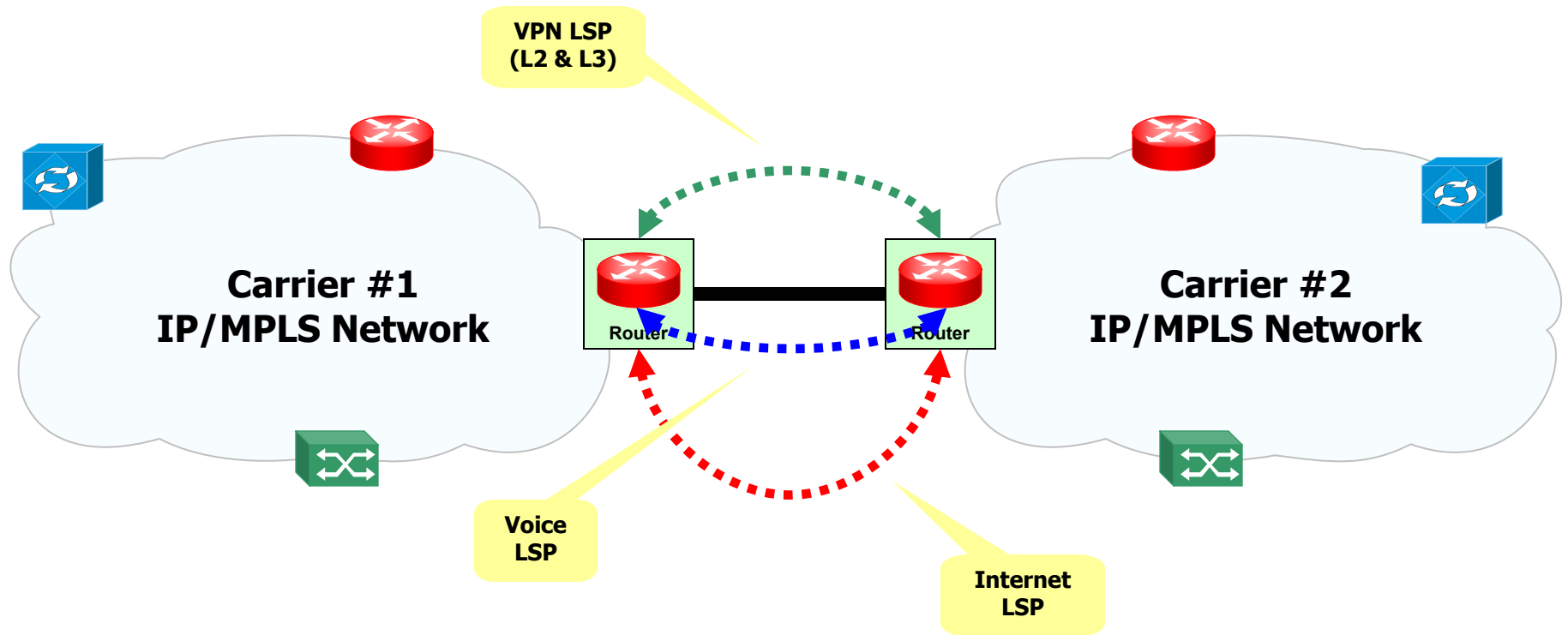
**Application based logical interconnect
using one physical circuit**

Service Provider Issues/Requirements Summary

- Some of the Inter-AS issues/requirements described in the following IETF draft.
  - http://www.ietf.org/internet-drafts/draft-ietf-tewg-interas-mpls-te-req-09.txt
- Performance
  - Optimal E2E Path Computation
    - Security vs Functionality. What is the happy medium?
  - Reoptimization
    - Should a partner have the ability to cause state changes in your network?
  - DS-TE Support
    - How many Service Classes?
    - Best Practice or per-partner agreement?
- High Availability
  - Fast ReRoute and Diverse Path Support
    - One for the vendors !!

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Issues and Requirements

- ## Scalability
  - ### Aggregation and Hierarchy
    - Let's plan for the future !!

- ## Management
  - ### E2E Monitoring and Provisioning
    - What can you see and do on someone else's network?
  - ### Measurements
    - Consistent E2E model, possibly a 3rd party?
    - SLA metrics, best practice?
  - ### Interoperability
    - Not only vendor equipment but carrier architectures.
  - ### Confidentiality
    - Securing a network without compromising functionality.
  - ### Policy Control
    - Attack mitigation, protecting the control/data planes

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Issues and Requirements

- Business Issues
  - Settlements
  - Transit Arrangements