THE MPLS JOURNEY

FROM CONNECTIVITY TO FULL SERVICE NETWORKS

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Cisco Systems

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Agenda

- Introducing the Full Service Network
- The MPLS Journey
- From Connectivity to Full Service
  - MPLS VPNs
  - MPLS L2VPNs (AToM)
  - MPLS Traffic Engineering
- Summary: Full Convergence for Full Service

Benefits of An Integrated MPLS Full Service Network

- Deliver the richest set of business generating services on a single network infrastructure
- Minimize Capital and Operational expenditures while delivering these service
- Maximize network and service availability
- Enable new services such as Voice VPNs and Video on Demand
- Ease deployment and maintenance by combining resources and offerings

MPLS: The Key to Full Service Delivery

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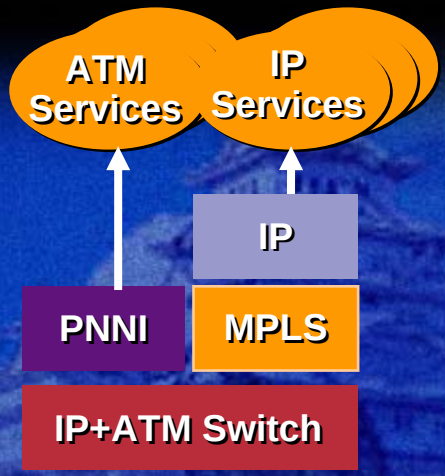
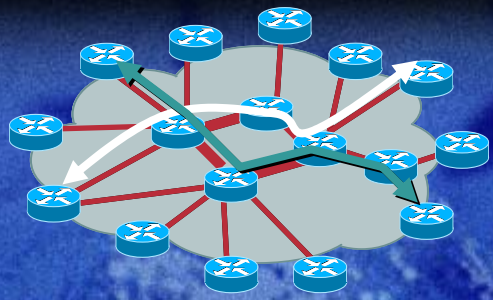
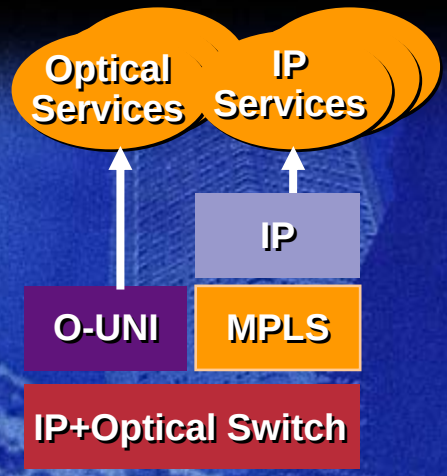


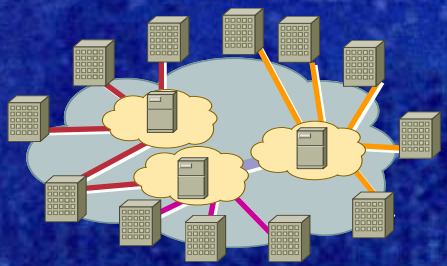
L2VPN Integration:
ATM/FR/Eth Transport and Interworking



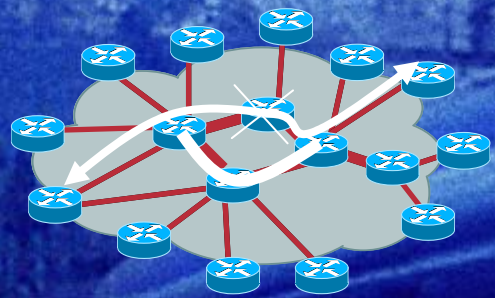
Traffic Engineering: Bandwidth
Optimization of traffic



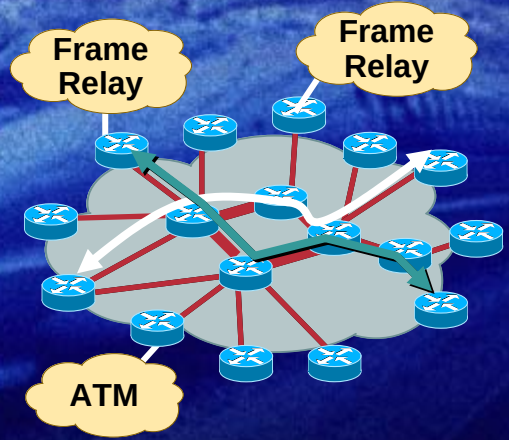
IP+Optical Integration



MPLS VPNs: Scalable
Network based VPNs



Bandwidth Protection and Resiliency
Reduction in CAPEX & OPEX



Layer 2 Integration for
a single converged
Network Infrastructure

The MPLS Journey
From Connectivity to Full Service

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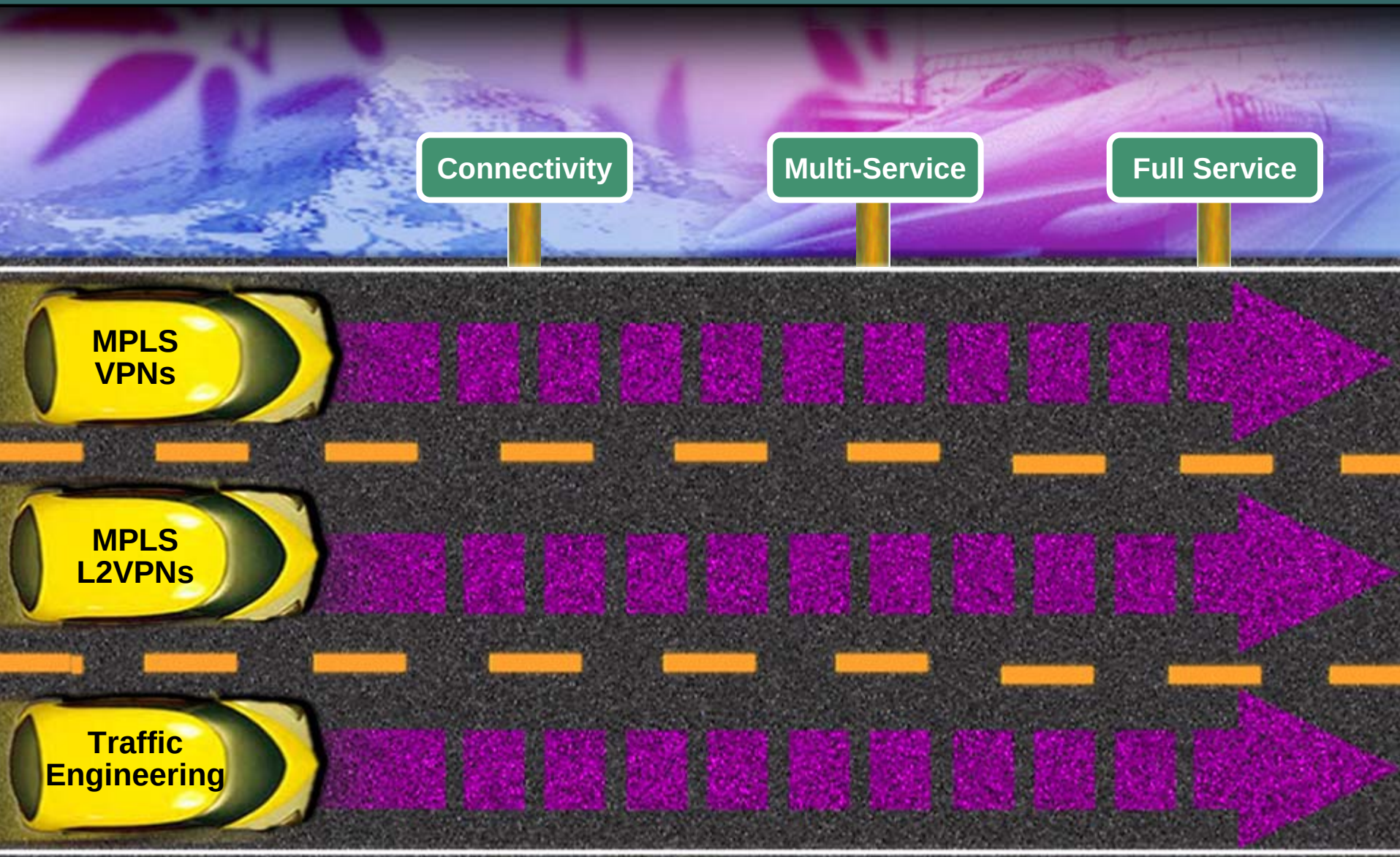

The Promise of an MPLS Full Service Network

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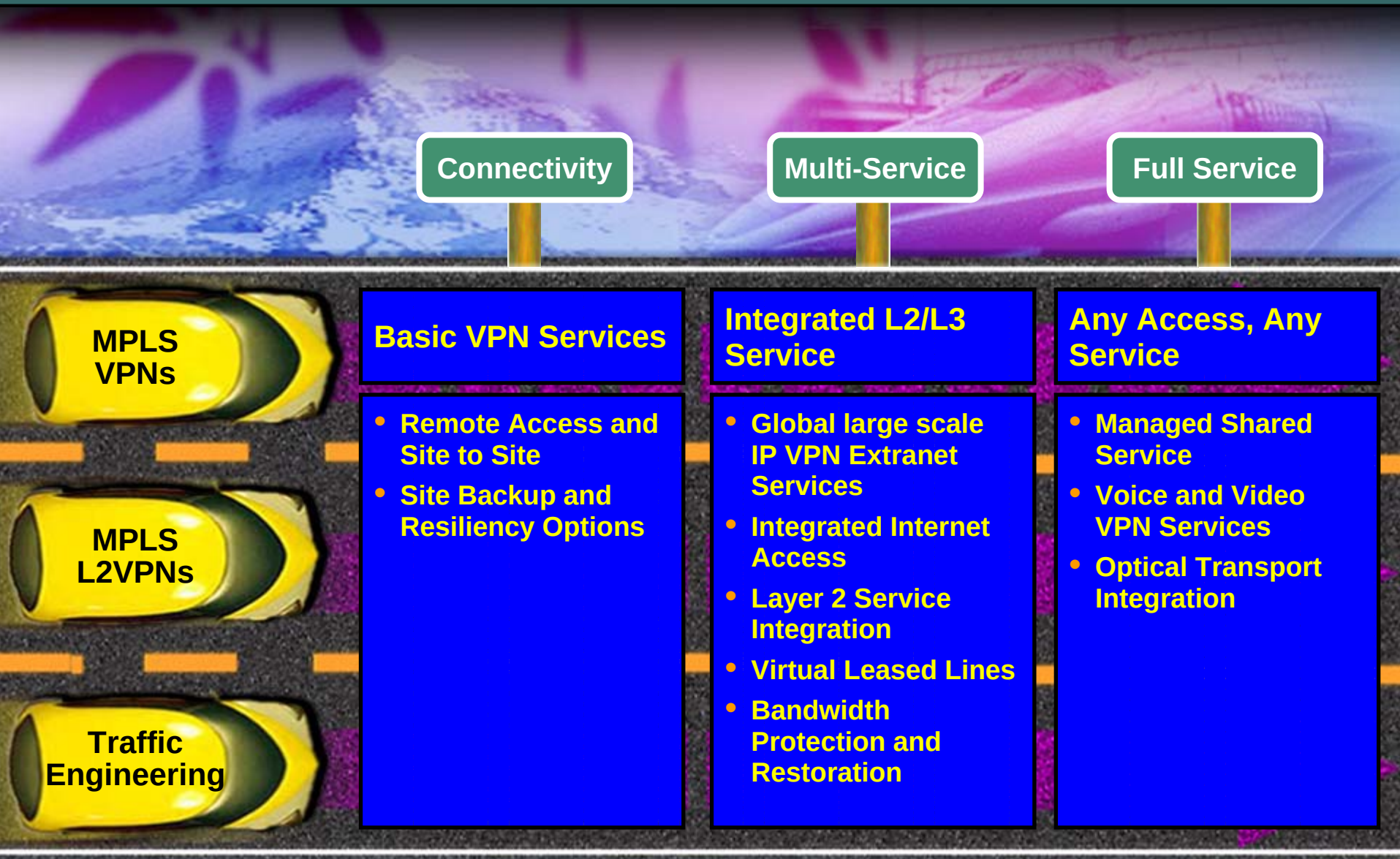
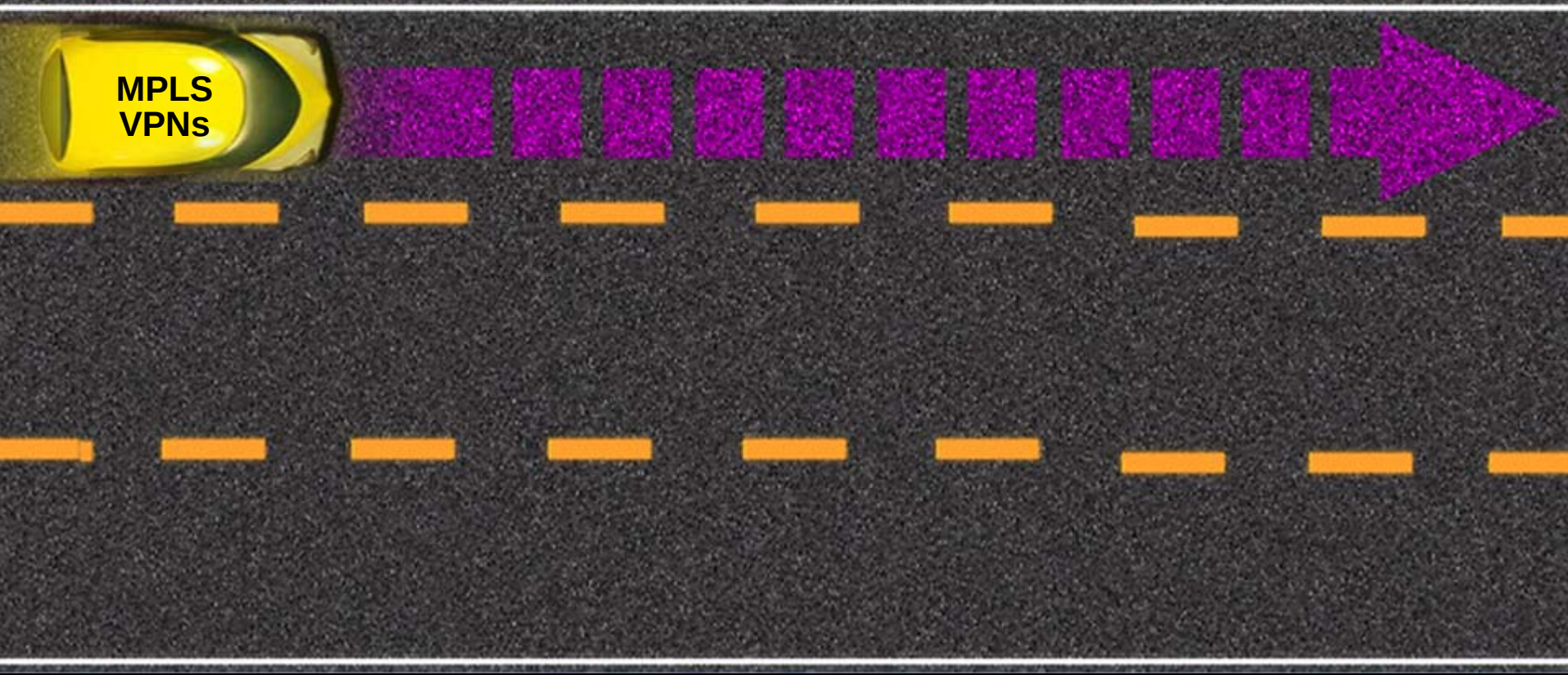


MPLS VPNs



MPLS VPNs:
The Drive to Full Service

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- Beyond connectivity – Deliver value-add IP services
- Consolidate network core into one infrastructure
- Ease Deployment, Provisioning and Maintenance
- Offer unified VPN choice for L2 or L3 based on service needs
- Provide flexible demarcation - Customer/subscriber managed, Managed CPE, Provider Edge
- Provision Managed Shared Services per customer

MPLS VPNs – The Journey

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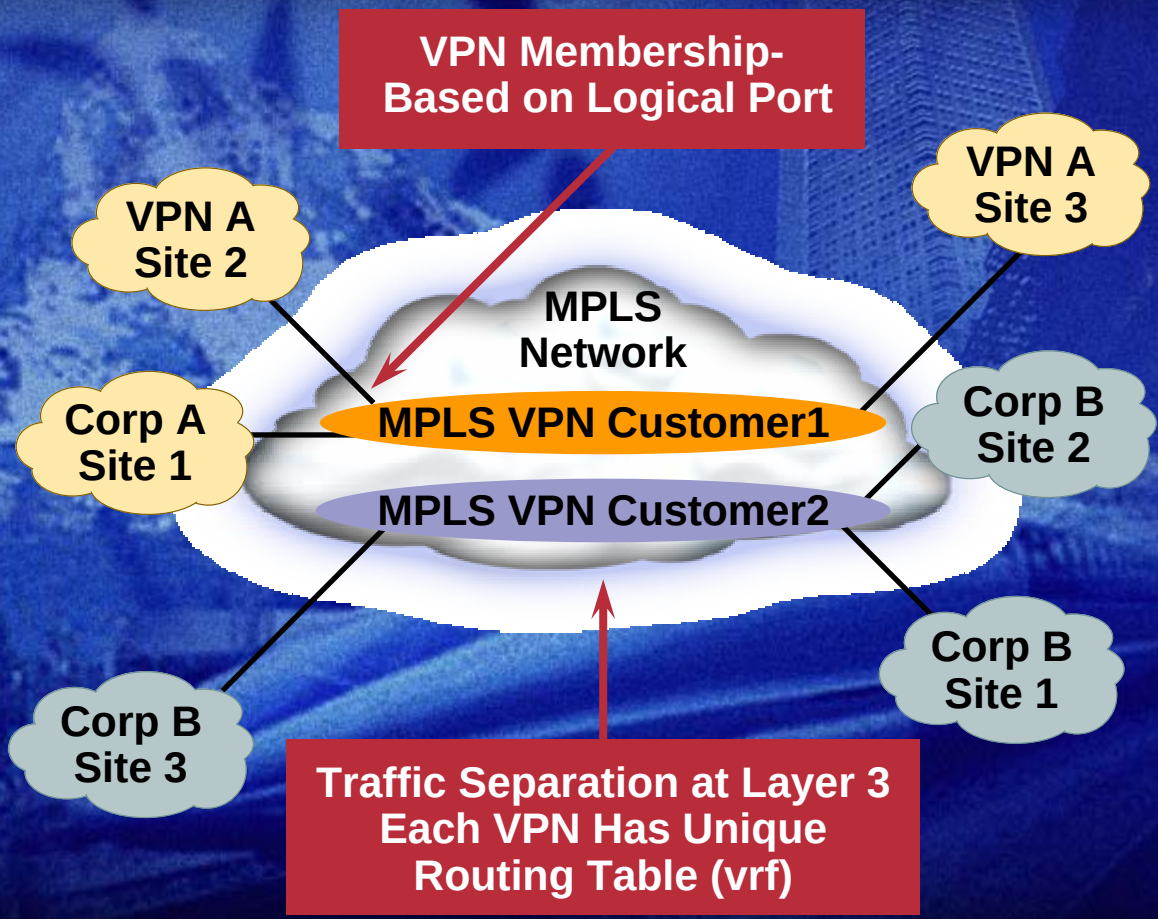
	Connectivity	Multi-Service	Full Service
Business Drivers	IP VPN service Internet Connectivity Simplifying full-mesh VC provisioning	CAPEX, OPEX reduction Network L2/L3 convergence Scalable IP VPN service Remote Access Integration Service Differentiation	Further CAPEX, OPEX reduction Transport Independent VPNs Value Add services beyond Multi-service connectivity
Services and Enabling Technologies	Full Mesh Connectivity: IP/MPLS VPNs Regional IP VPNs: IP/MPLS VPNs	Global VPN Extranet Srvs: Inter-AS, CSC, mcast VPN Remote Access VPN Integration: IPsec with MPLS VPN Traffic Prioritization for Data, Voice, and Video: MPLS QoS	Integrated IPv6: IPv6 VPN, IPv6-PE Many-to-Many Secure VPNs: Multi-point IPsec VPN Managed Shared Services: VRF-aware NAT, Firewall, DHCP, HSRP, AAA, H.323 Any access Any service: AToM, VPN, TE, and QoS integration

What are MPLS-based IP-VPNs?

- Scalable VPNs
- IP QoS and traffic engineering
- Easy to manage and No VC provisioning required
- Provides a level of Security equivalent to Frame-relay and ATM
- Supports the deployment of new value-added applications
- Customer IP address freedom



MPLS VPN Services:
Global IP VPN Extranet Services

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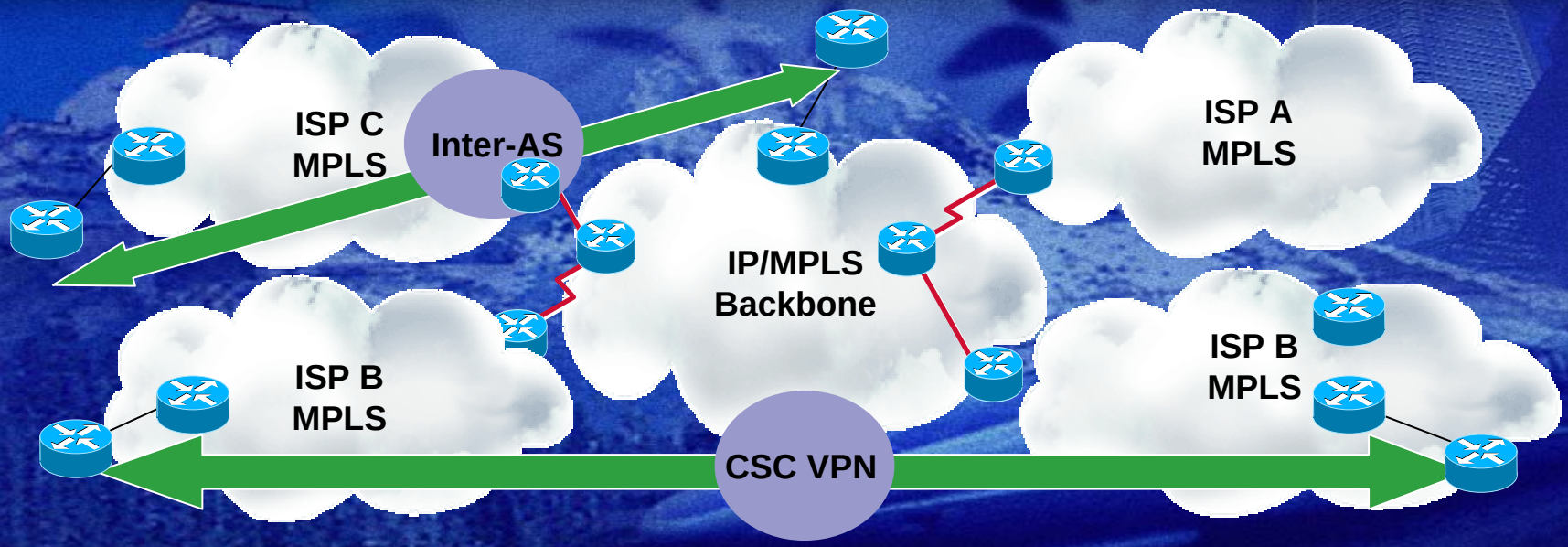

Requirement: Scale to large networks and multiple providers

Solution: Use MPLS Inter-AS and CSC

Benefits: Time-to-Service, Global Reach, Reduced Cost

MPLS VPN Services:
Managed Shared Services

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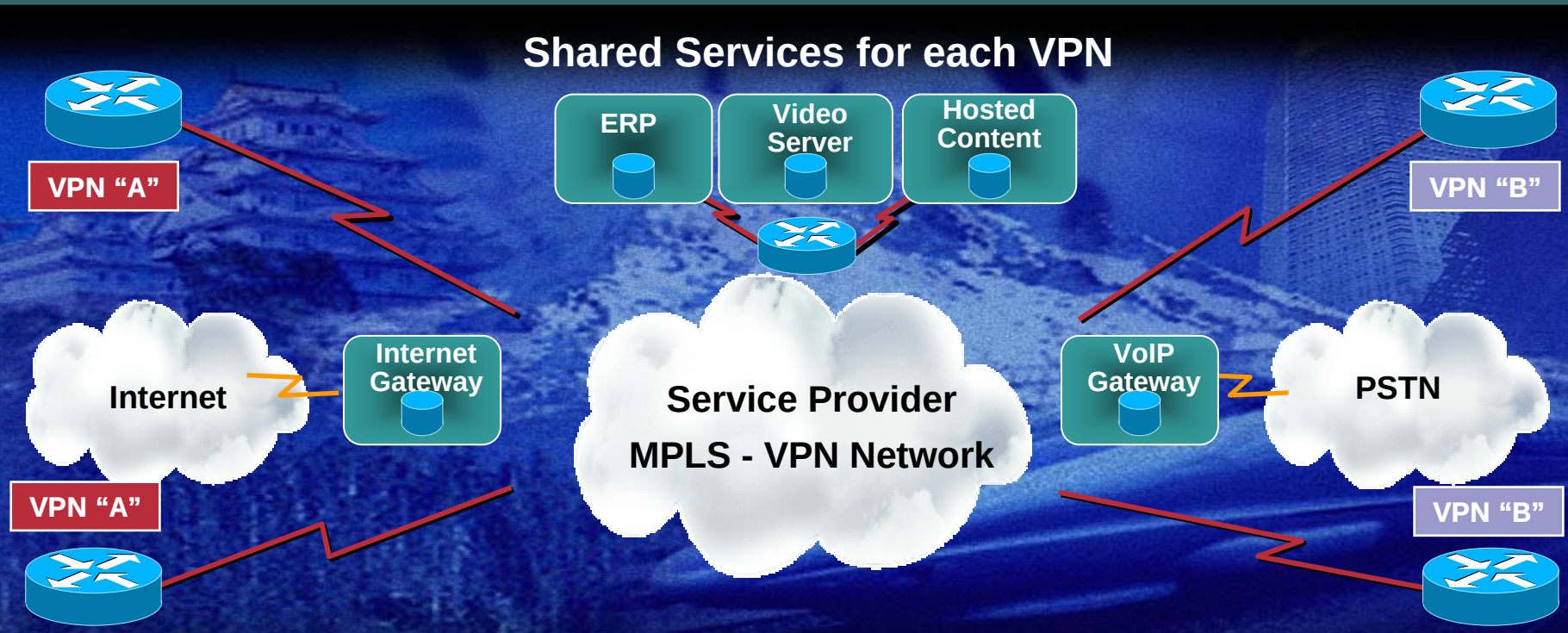

Requirement: Value-add Shared Services beyond Connectivity

Solution: VRF-aware Features such as NAT, DHCP, H.323, AAA

Benefits: Additional revenue sources, Shared Resources, Reduced Cost

MPLS VPN Services:
Remote Access VPN Integration

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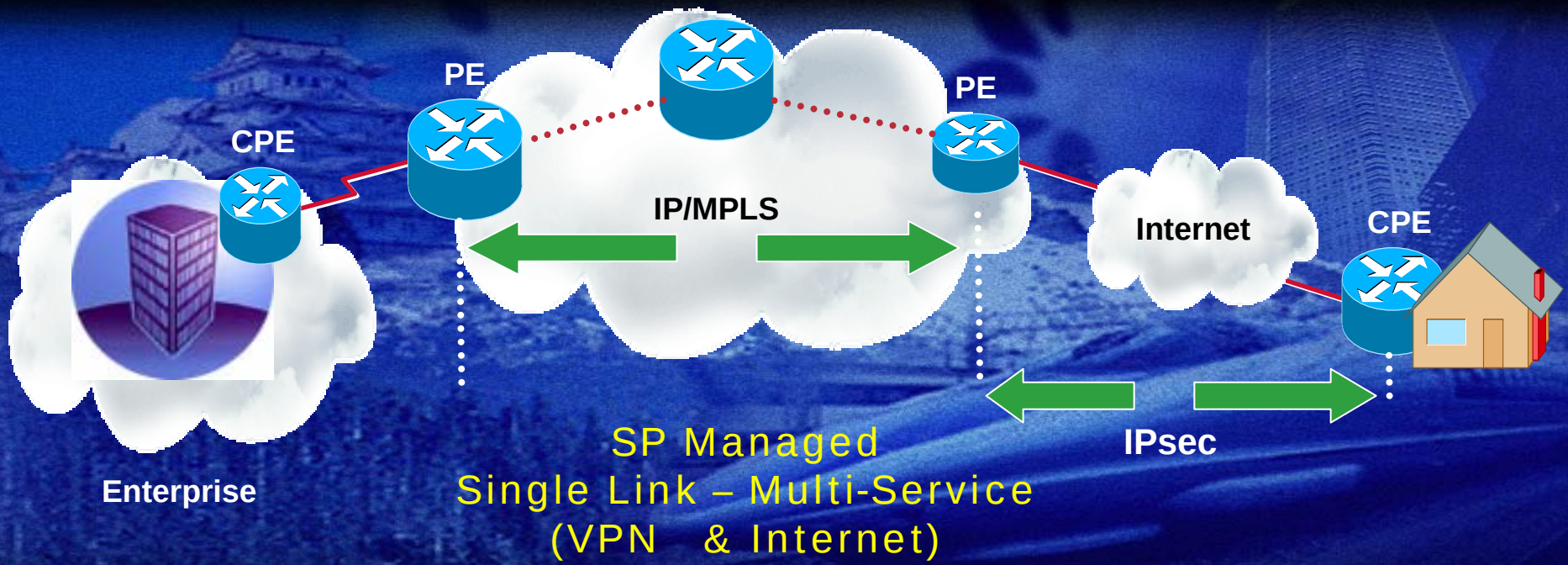

Requirement: Establish secure connections between sites over public network

Solution: MPLS connectivity combined with IPsec

Benefits: Time-to-Service, Global Reach, Security, Flexibility

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MPLS VPN Services:
Traffic Prioritization for Data, Voice, and Video

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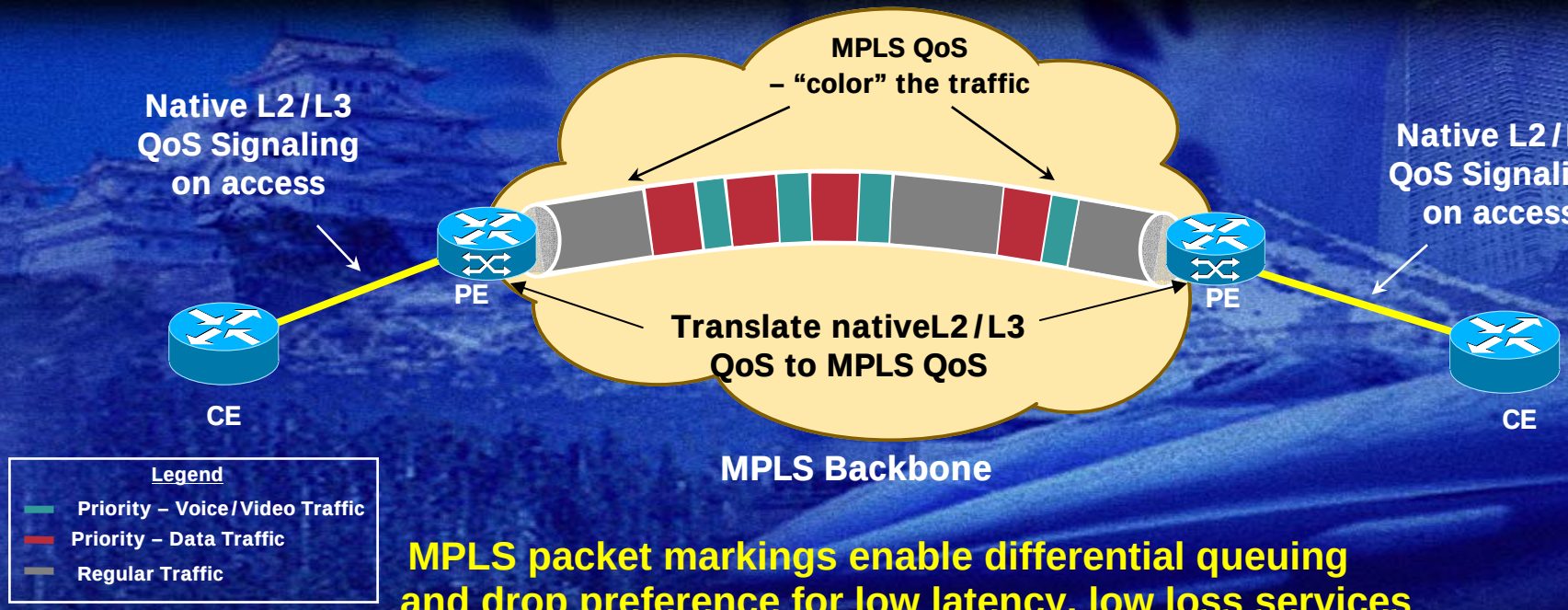


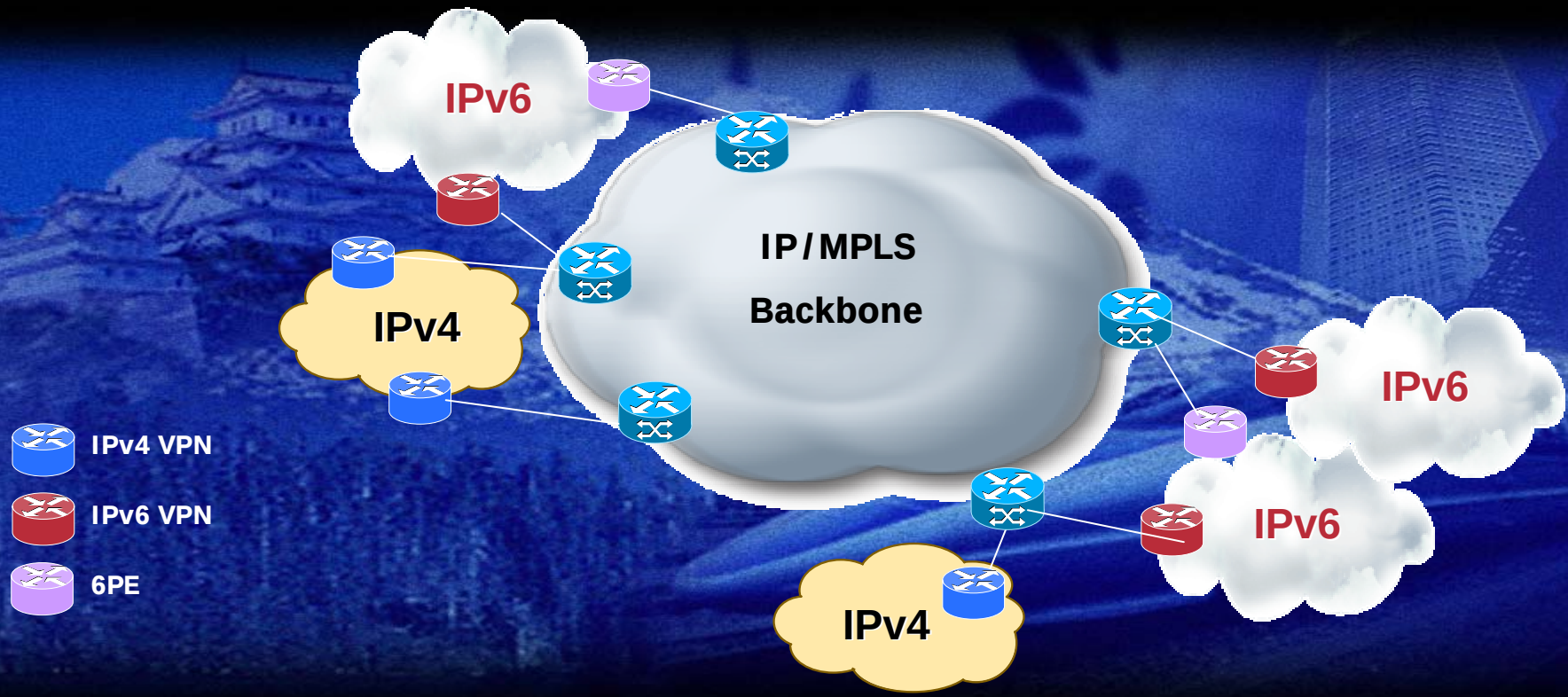
MPLS packet markings enable differential queuing and drop preference for low latency, low loss services

Requirement: Service Differentiation for different types of traffic within VPN

Solution: CoS/ToS to MPLS QoS Mapping

Benefits: Improved response for prioritized traffic (Voice/Video)

MPLS VPN Full Service:
Integrated Native IPv6 VPNs



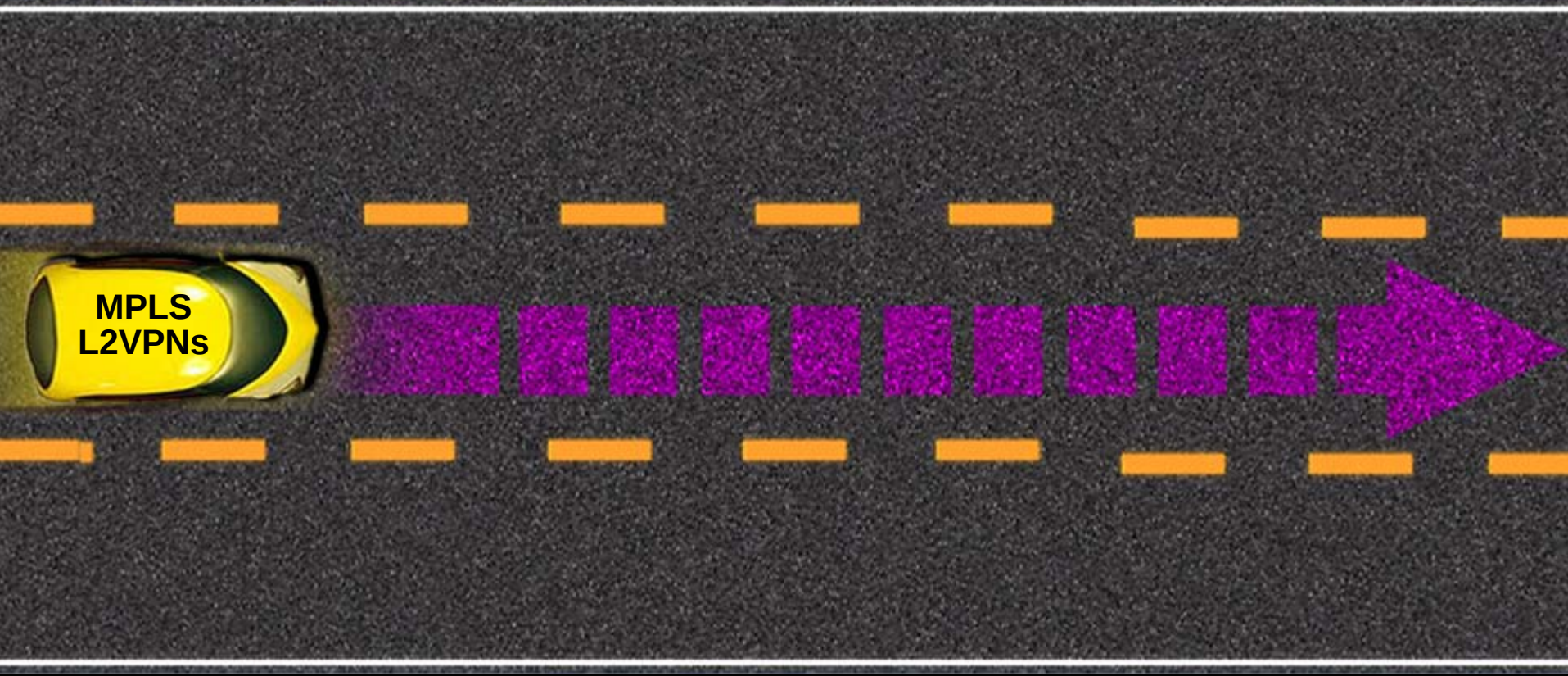
Requirement: Offer IPv6 (along with IPv4) VPN Support through MPLS Backbone

Solution: Integrated IPv6 Transport (6PE) and IPv6 VPN

Benefits: Support for IPv6 applications, addressing space, etc.

MPLS L2VPNs

Layer 2 Service Delivery through Any Transport over MPLS



MPLS L2VPNs:
The Drive to Full Service

- Market Drivers
  - Services are more distributed and competitive
  - Technology transitions from TDM to ATM to IP/MPLS
  - Seamless service transition and transparency
- Service Provider Drivers
  - Sustain existing business (ATM/FR) while rolling out new services
  - Move from single service networks to single network offering multiple services
  - Network price/performance profitability
  - Service breadth and flexibility
- Single network for layer 2 and Layer 3 services needs
- Leverage high speed packet core (OC-192 and beyond) for all applications

L2VPNs – The Journey

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	Connectivity	Multi-Service	Full Service
Business Drivers	Point to Point connectivity Leased Line Connectivity	OPEX, CAPEX Reduction Network L2/L3 Convergence Ethernet-based connectivity across MAN	Migration of Existing installed based to converged network Ease of provisioning Further OPEX, CAPEX Reduction
Services and Enabling Technologies	Independent Transports Separate Networks: ATM, Frame Relay Services IP Network overlay: IP-over-ATM	L2VPN Service: Any Transport Over MPLS (AToM) Metro Ethernet Service: EoMPLS, VPLS Transport Independent Layer 2 Service: L2 Interworking	Simple provisioning of services across existing networks: ATM-MPLS Signaling Interworking Any access Any service: AToM, VPN, TE, and QoS integration

What is ATOM – Any Transport Over MPLS?

ATM, Frame Relay & Ethernet *Transport* over MPLS Infrastructure

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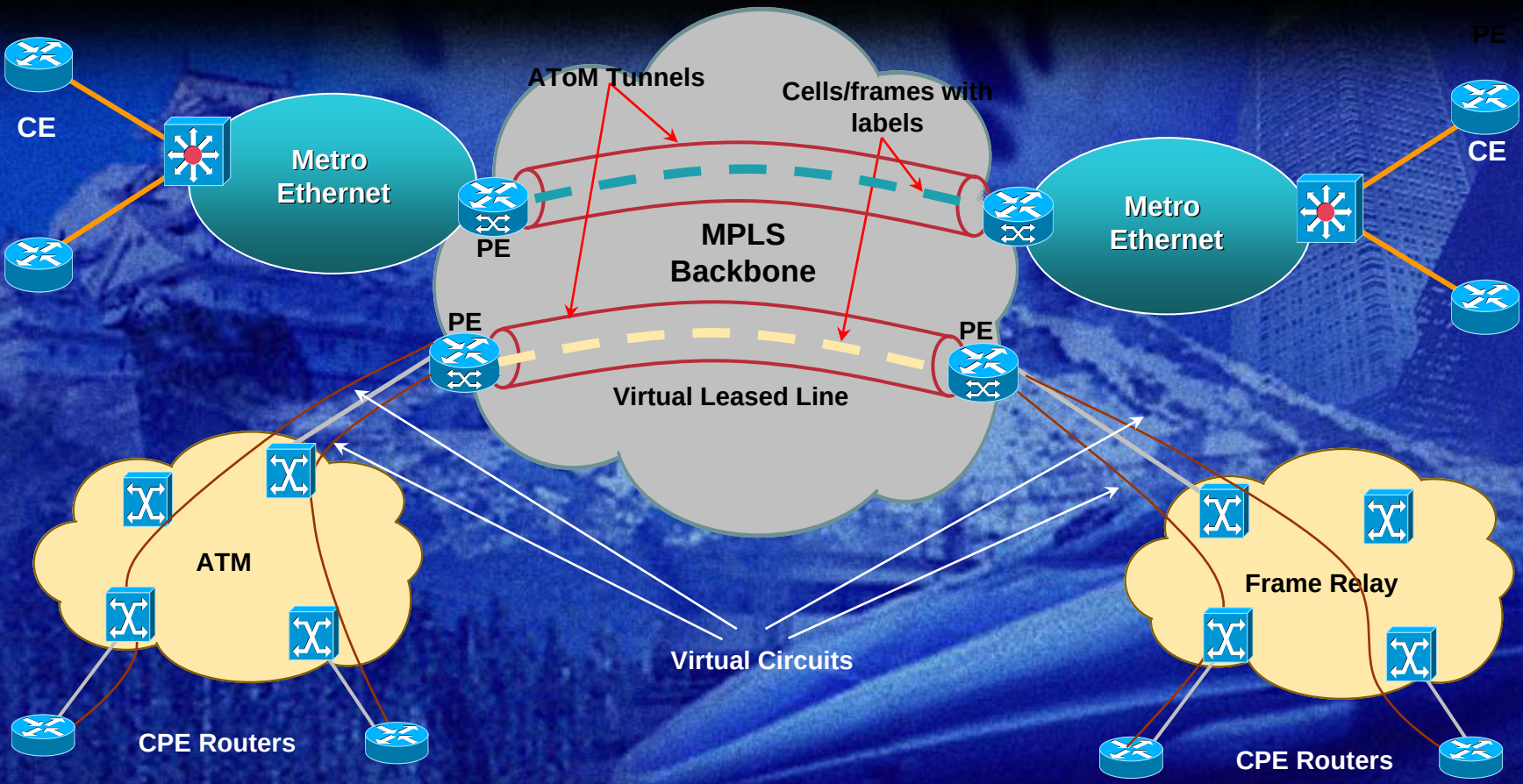

One network any access

Layer 2 VPNs – Integrating Packet & Circuit Networks

Like to Like – Transport of L2 (Ethernet, Frame Relay, ATM, PPP, HDLC)

L2 VPN Services:
AToM L2 Transport Interworking

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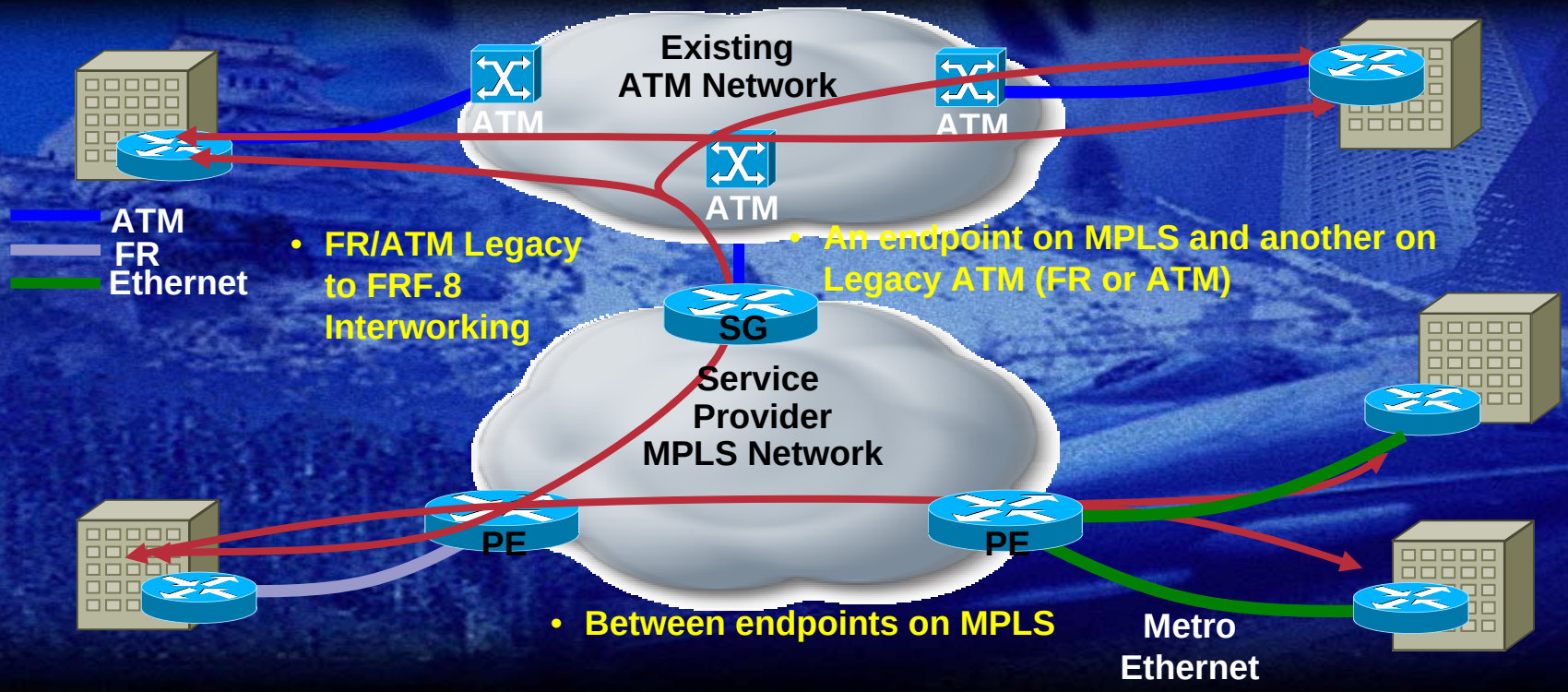
ATM, Frame Relay & Ethernet *Interworking* over MPLS Infrastructure



Requirement: Transport Independent L2 Service w/full Interoperability

Solution: L2 (AToM) Interworking

Benefits: Most Flexible Layer 2 Transport Service Offering

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L2 VPN Services:
Metro Ethernet over MPLS

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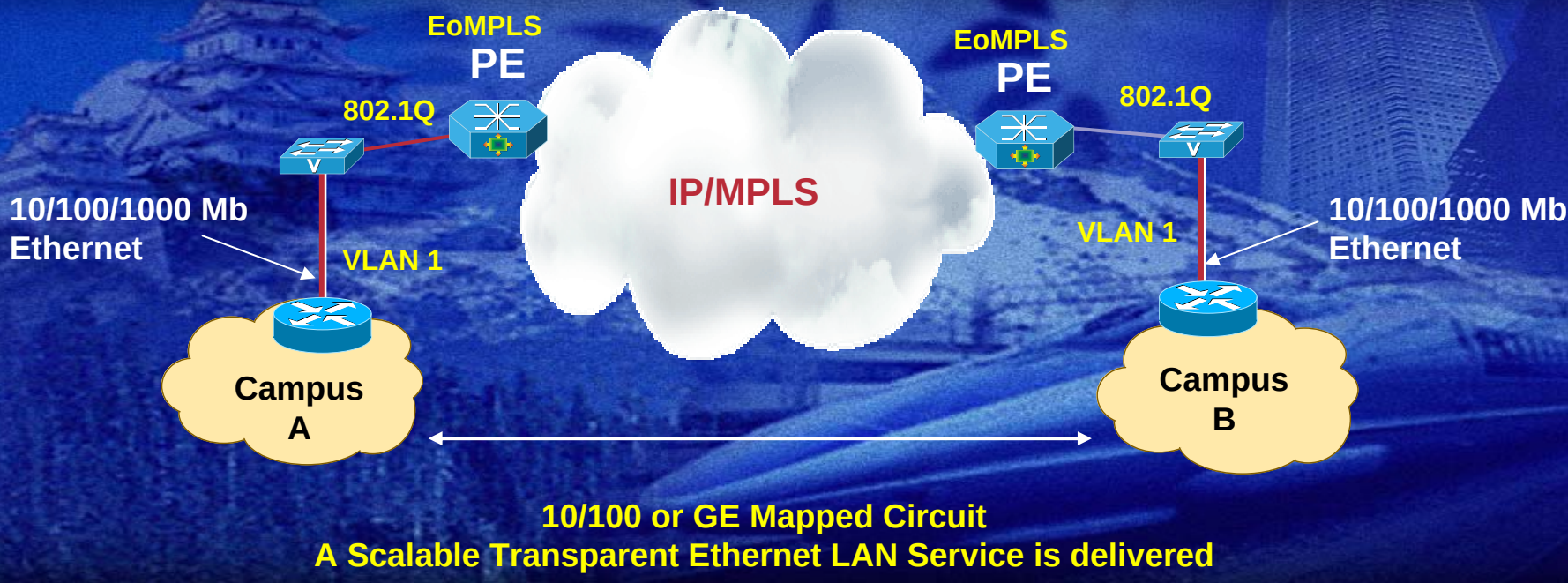

Requirement: Ethernet-based VLAN Service across MAN

Solution: AToM Ethernet-over-MPLS

Benefits: High Bandwidth, low cost properties of Ethernet for VPN Service

L2 VPN Full Service:
ATM – MPLS Signal Interworking

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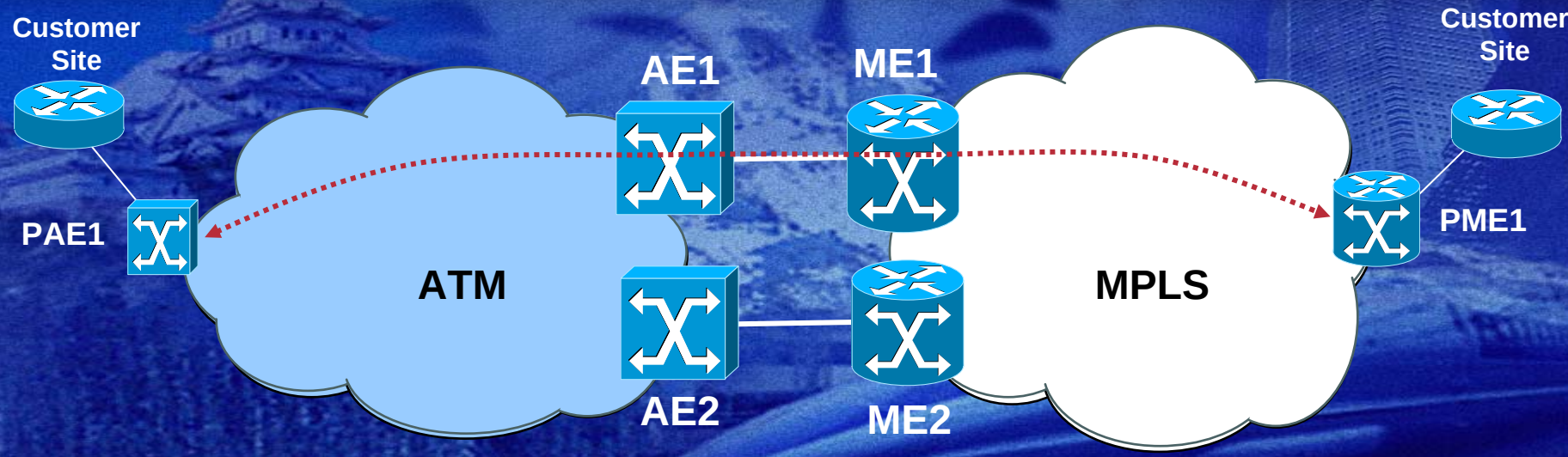
ATM UNI to MPLS Signal mapping



Requirement: Simple provisioning across MPLS and existing ATM networks

Solution: Signal Interworking – ATM UNI to MPLS

Benefits: Easy migration from existing to new network services

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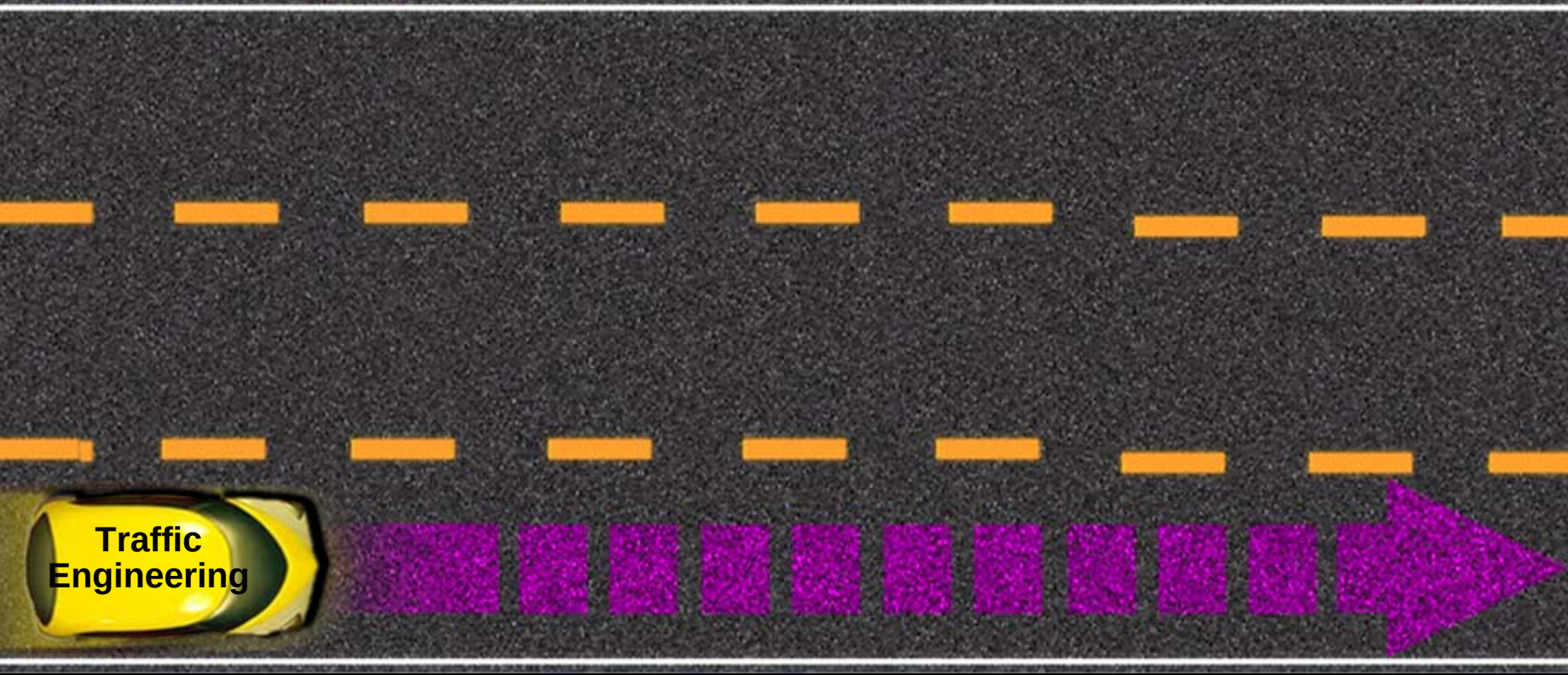
MPLS Traffic Engineering

Managing Bandwidth Protection, Optimization, and Restoration



MPLS Traffic Engineering:
The Drive to Full Service

- Congestion in the network due to changing traffic patterns
  - Election news, online trading, major sports events
- Better utilization of available bandwidth
  - Intelligently spread traffic across non-equal paths
- Route around failed links/nodes
  - Fast rerouting around failures, transparently to users
  - Like SONET APS (Automatic Protection Switching)
- Build new services—Virtual leased line services
  - VoIP toll-bypass applications, point-to-point bandwidth guarantees
- Capacity planning
  - TE improves aggregate availability of the network

MPLS Traffic Engineering – The Journey

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	Connectivity	Multi-Service	Full Service
Business Drivers	Address bandwidth pressure on DS3 backbones due to Broadband deployments Improve network link utilization Traffic Prioritization	Network Element Protection for better SLA delivery Guaranteed Bandwidth Further improvement in network link utilization	Rapid service provisioning over combined optical and IP/MPLS core Single managed infrastructure
Services and Enabling Technologies	Network choke point relief: MPLS Traffic Engineering, QoS Manual diverse routing: ATM VCs mapping, Routing protocol metric manipulation Initial QoS delivery: CoS, Priority queuing	Network Protection and Restoration: MPLS TE Fast Re-route Bandwidth Guarantees: DiffServ Aware TE Bandwidth Provisioning: MPLS TE w/RSVP, Global Inter-Area TE	Optical Integration: GMPLS and OUNI with TE Voice Trunking/VPN: VPN, QoS, DiffServ Aware TE

What is MPLS Traffic Engineering?
Explicitly Managing the Data Flow

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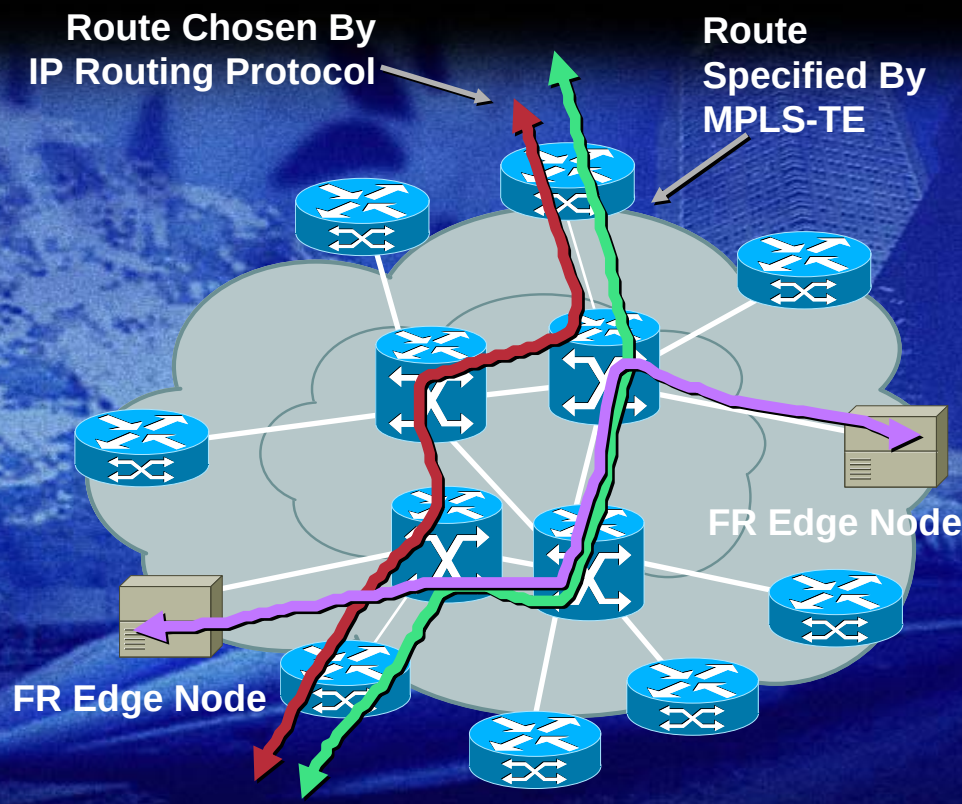
- **Traffic engineering**
  - Aligning traffic flows to resources
  - Optimize link utilization
- **Fast reroute**
  - Fast, local, link and node protection
- **Guaranteed bandwidth**
  - Hard end-to-end bandwidth and delay guarantees



Conventional IP Routing is destination based and is based on simple link costs.
- Bandwidth availability is not taken into account
- Some links may be underutilized while others are congested

MPLS-TE supports explicit routing
- Lets you use paths other than IGP shortest path
- Allows unequal-cost load sharing

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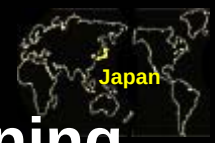
MPLS TE Services:
MPLS Traffic Engineering for Bandwidth Provisioning



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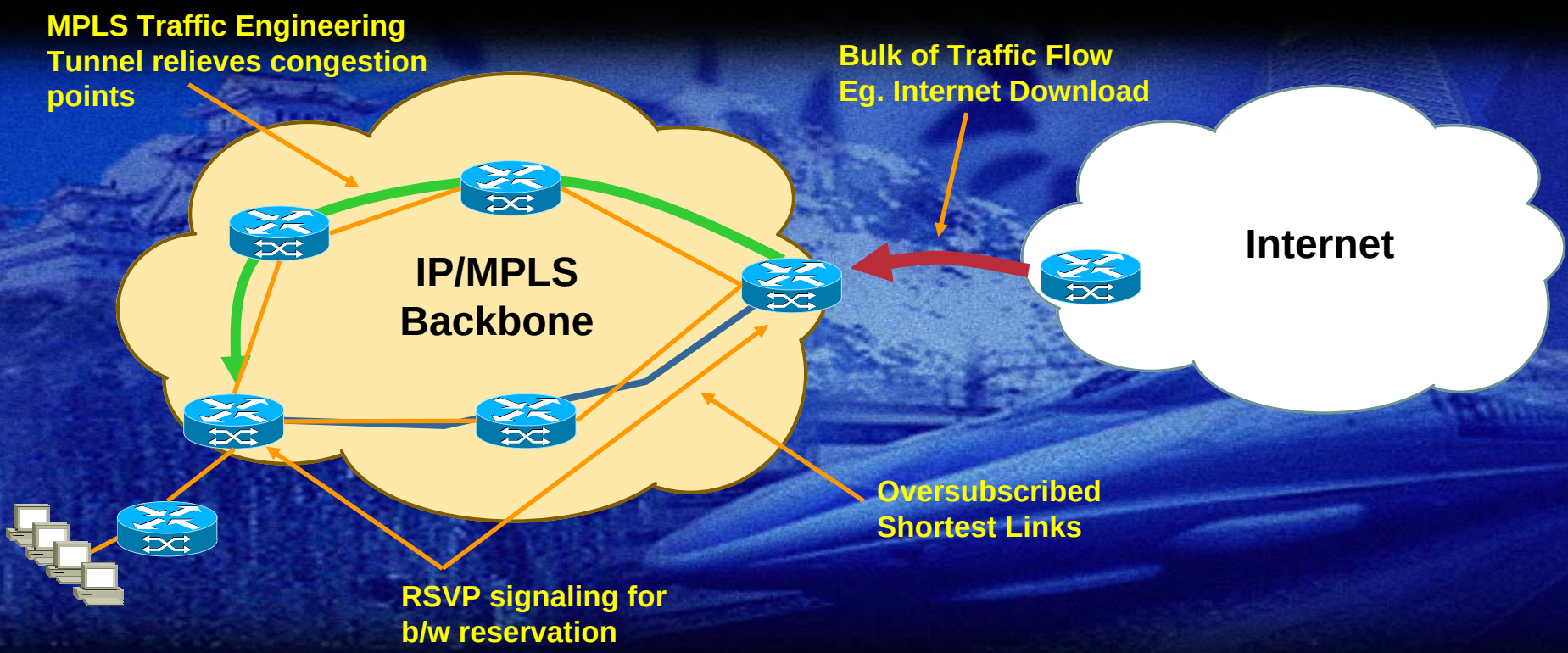

Requirement: Better QoS and Bandwidth deliveries for prioritized traffic

Solution: MPLS TE in MPLS core, combined with MPLS QoS

Benefits: Improved Bandwidth Inventory

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MPLS TE Services:
Diffserv-Aware Traffic Engineering

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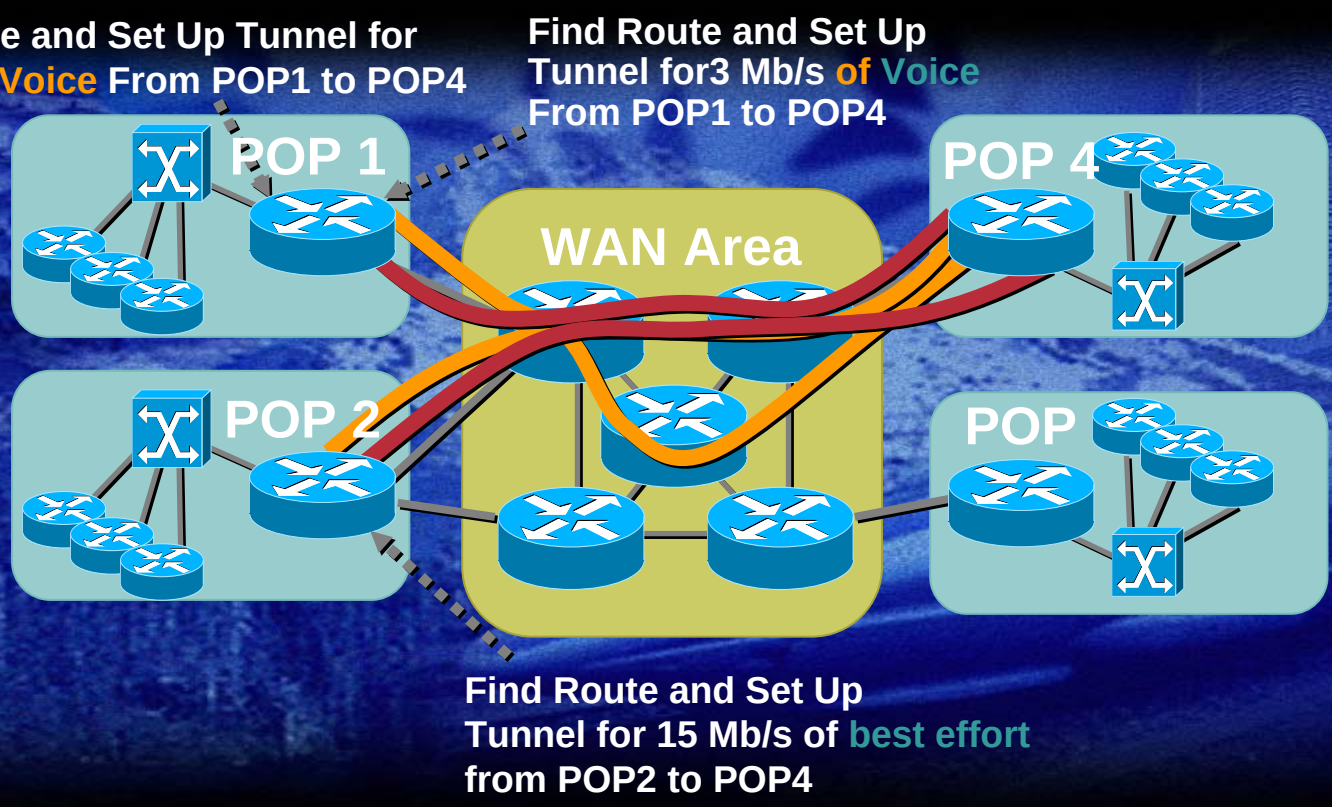

Requirement: Bandwidth Guarantees for time/latency critical traffic

Solution: Diffserv-Aware MPLS Traffic Engineering

Benefits: Better service differentiation

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MPLS TE Services:
Network Protection and Restoration

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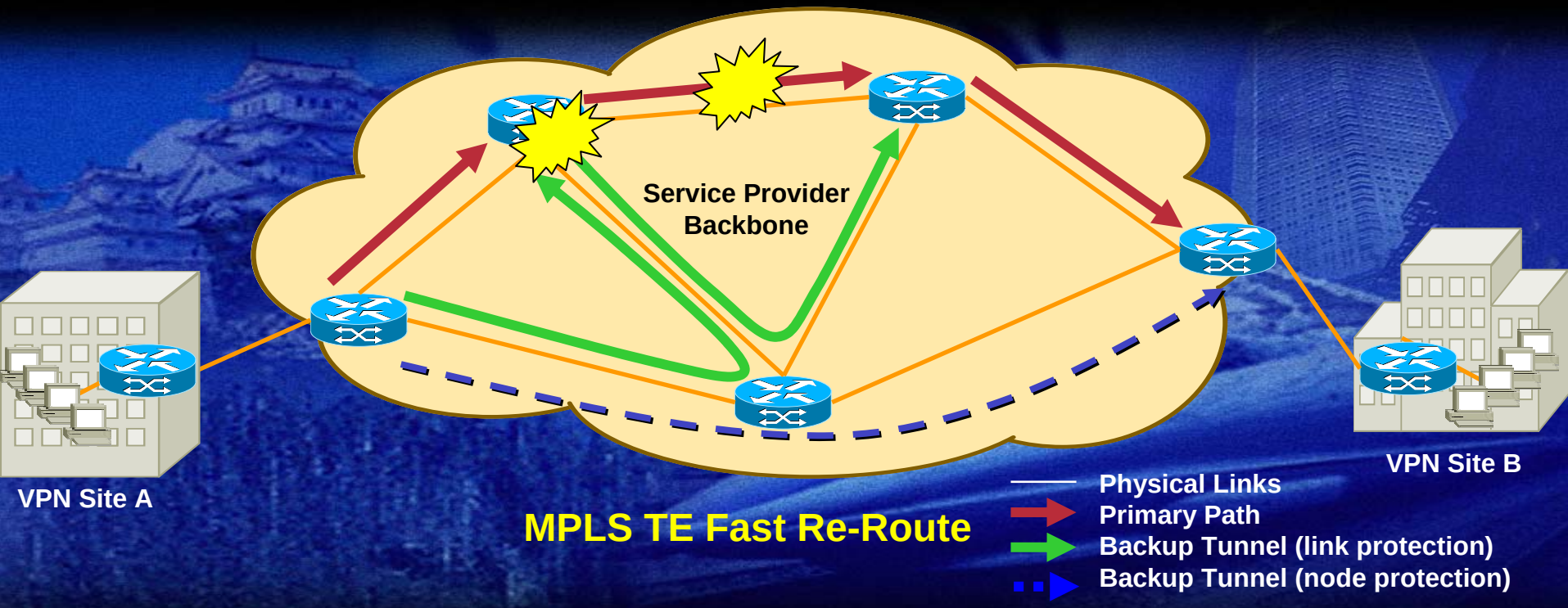

Requirement: SONET-like Network Protection and restoration over MPLS network

Solution: MPLS TE Fast Reroute

Benefits: ~50msec failover with both link and node protection

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MPLS TE Full Service:
Optical Integration

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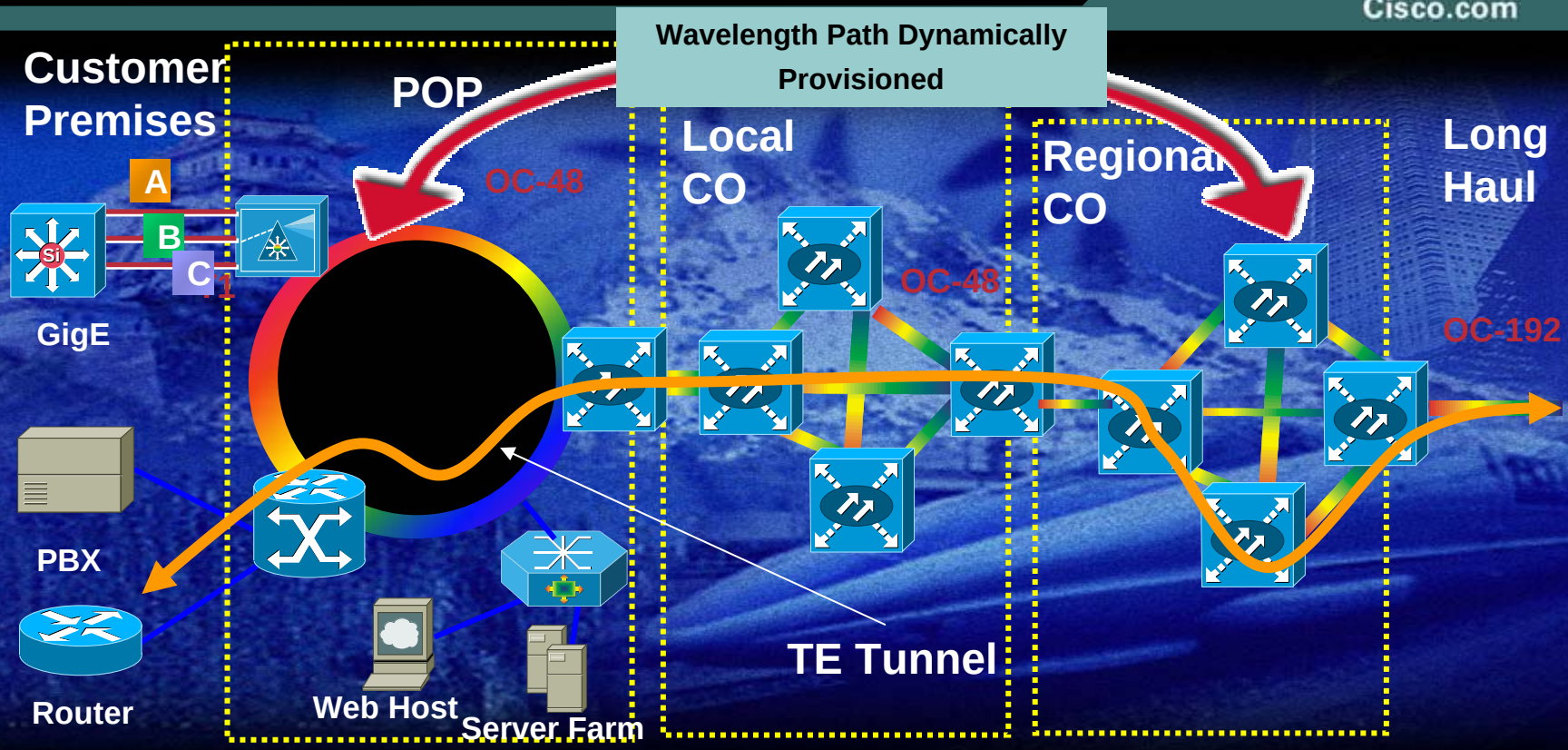


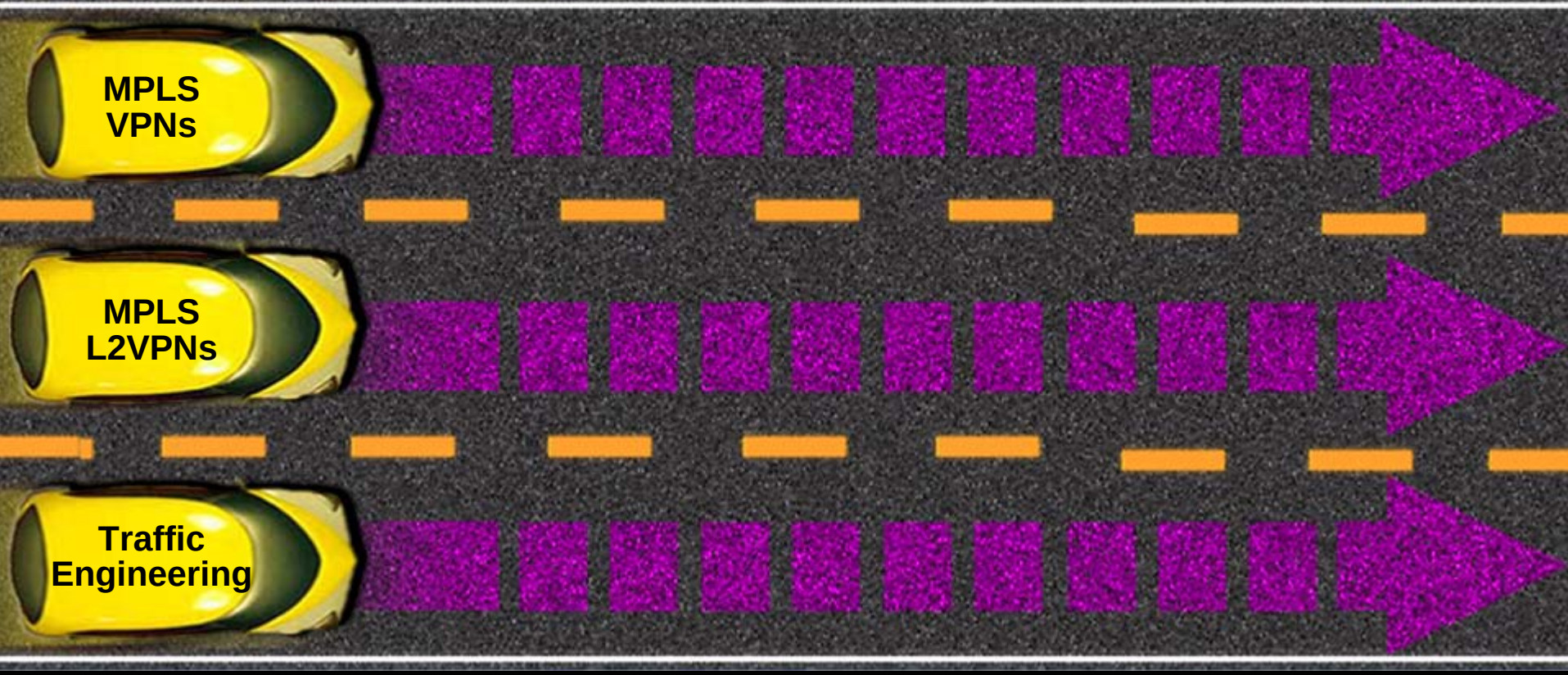
Requirement: Quick circuit provisioning over combined Optical/MPLS network

Solution: GMPLS with MPLS Traffic Engineering

Benefits: Unified control plane, maximizes service delivery

Summary

Full Convergence for Full Service



The Full Service Network:
Integrated MPLS Technologies

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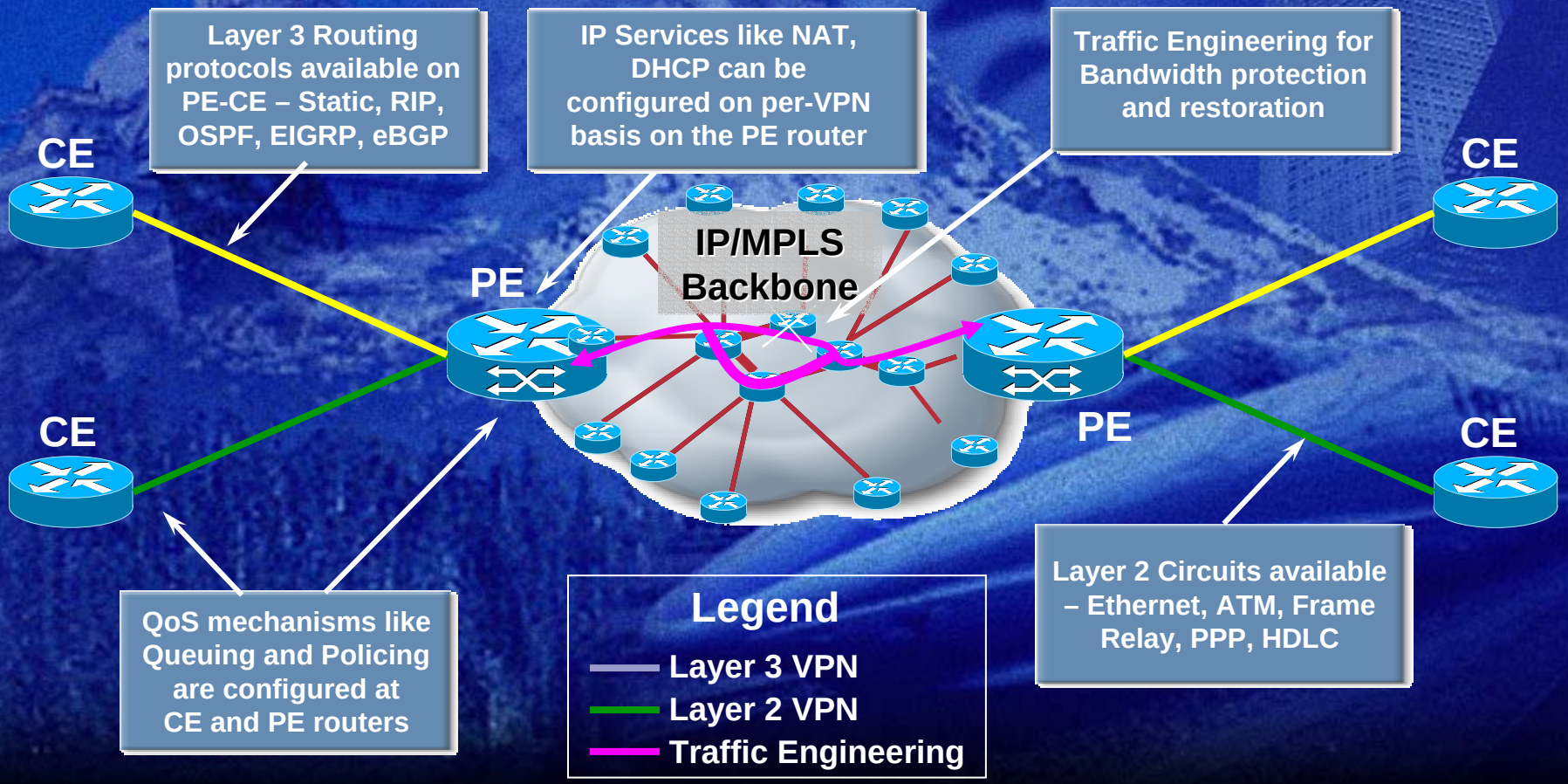
Layer 3 VPNs & Layer 2 VPNs
Traffic Engineering + QoS + IP Services



The Full Service Network with MPLS: Ready - Today!

- Over 200 active Cisco IOS-based MPLS networks
- Supports legacy and new advanced services
- infrastructure consolidation reduces OpEx/CapEx
- Additional revenue opportunity for Service Providers
- Increased productivity and lower cost for users
- You can deploy MPLS full service networks – Today!

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