IP Control Plane
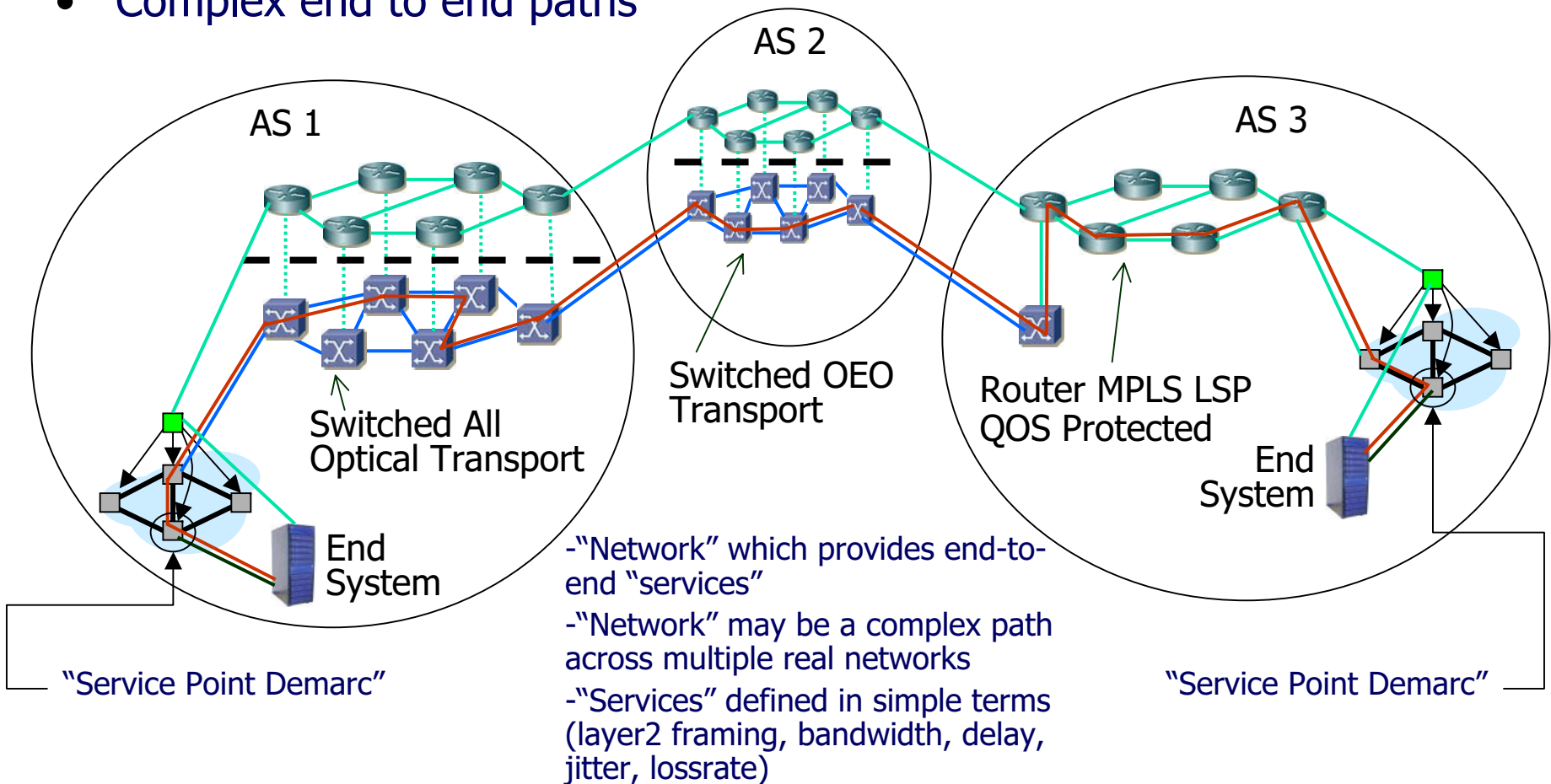# (GMPLS, MPLS, RSVP, QOS, Inter-domain Signaling/Routing)

Application to Next Generation Peering and Disaster Recovery

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The Big Picture – Why do we want a unified IP Control Plane?

- Deterministic paths across heterogeneous network technologies
- Multiple administrative domains with AAA
- Complex end to end paths

AS 1

AS 2

AS 3

Switched All Optical Transport

Switched OEO Transport

Router MPLS LSP QOS Protected

End System

End System

End System

"Service Point Demarc"

-"Network" which provides end-to-end "services"

-"Network" may be a complex path across multiple real networks

-"Services" defined in simple terms (layer2 framing, bandwidth, delay, jitter, lossrate)

"Service Point Demarc"

IP Control Plane applied to Next Generation Peering and Disaster Recovery

- Many applications for a unified IP Control Plane which provides:
  - rapid provisioning of dedicated resource paths
  - across administrative domains
  - with level of Authentication, Authorization, Accounting (AAA) people trusted
- Peering between routers not directly connected
- "Link" protection at lambda, layer 2, or layer 3
- Backup paths
  - Provisioned in advance or in a realtime response to an event
- Confidence to use dedicated resource paths for mission critical/emergency communications
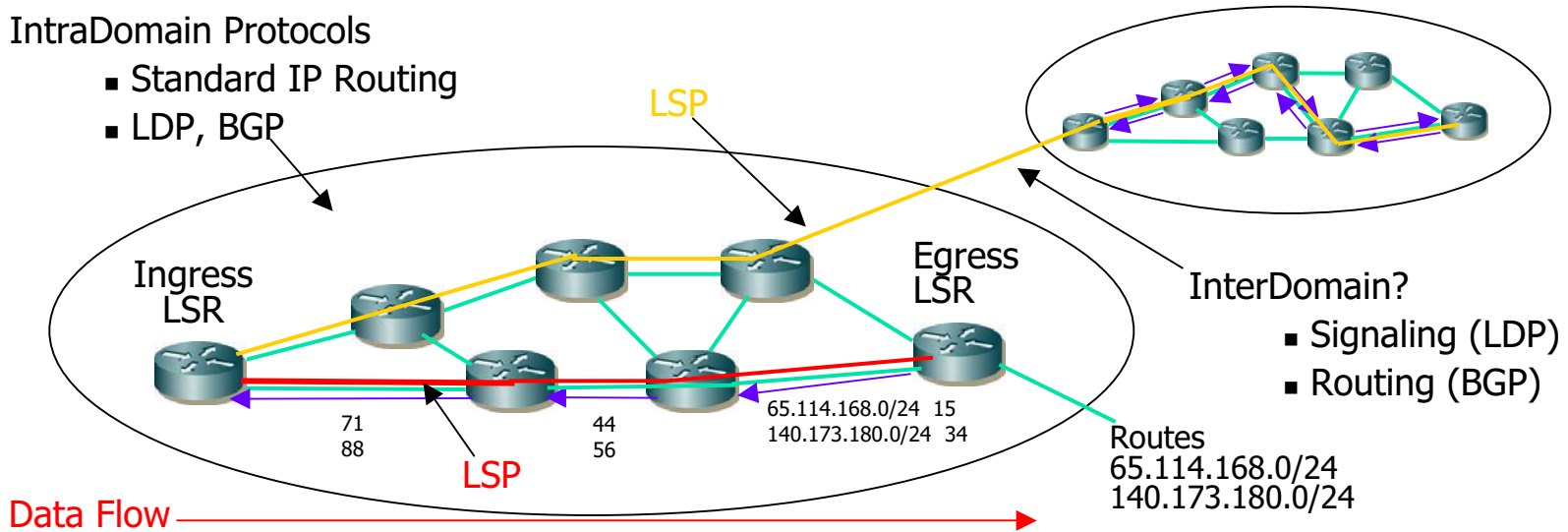
MPLS Control Plane

- MPLS Control Plane
  - LSP Signaling
    - LDP, BGP
  - Traffic Engineered LSP Signaling
    - RSVP-TE
  - TE-Routing
    - OSPF-TE, ISIS-TE

MPLS LSP

IntraDomain Protocols
- Standard IP Routing
- LDP, BGP

LSP

Ingress LSR

Egress LSR

InterDomain?
- Signaling (LDP)
- Routing (BGP)

71
88

44
56

65.114.168.0/24 15
140.173.180.0/24 34
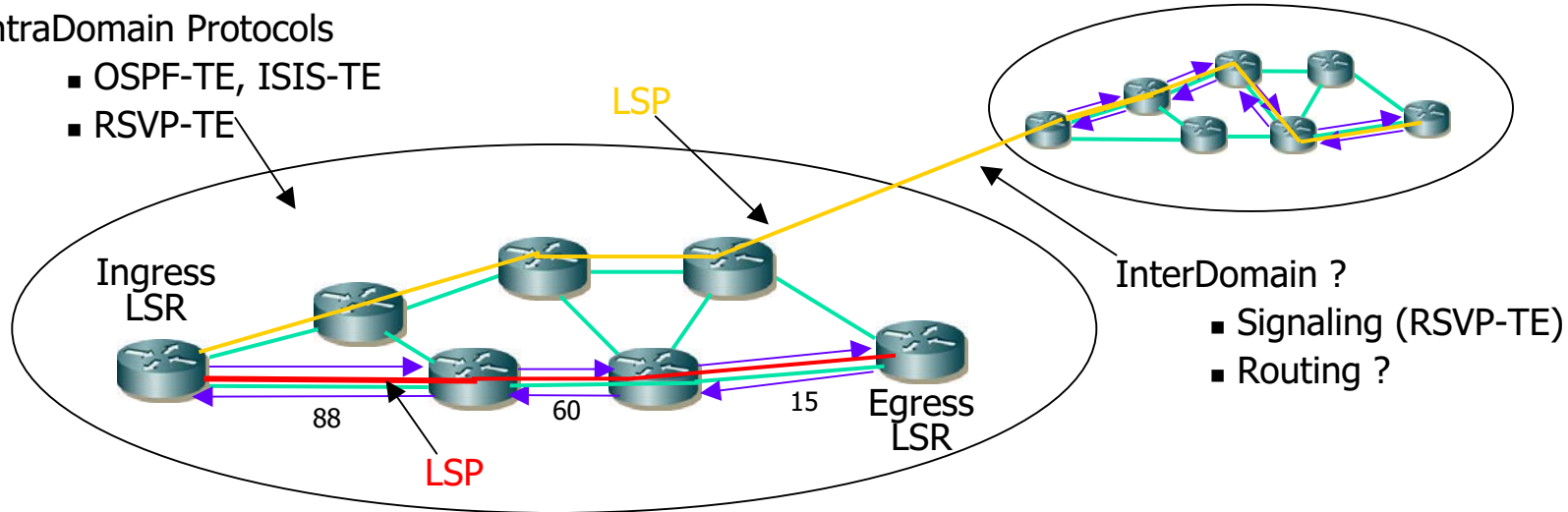
Routes
65.114.168.0/24
140.173.180.0/24

LSP

Data Flow

- Upstream LSRs send Label Request Messages
- Downstream LSRs advertise associated label mappings upstream

MPLS TE LSP

IntraDomain Protocols
- OSPF-TE, ISIS-TE
- RSVP-TE

LSP

Ingress
LSR

88   60   15   Egress
LSR

LSP

InterDomain ?
- Signaling (RSVP-TE)
- Routing ?

- Ingress initiates path setup, request propagates to egress
- Egress responds with label, propagates back to ingress
- QOS resource reservations can be made as part of process

MPLS TE Link Information

- TE Link State Advertisement
  - Link Type
    - Point-to-point or multi-point
  - Link ID
    - Router ID or DR
  - Local interface IP address
  - Remote interface IP address
  - Traffic engineering metric
  - Maximum bandwidth
  - Maximum reservable bandwidth
  - Unreserved Bandwidth
  - Administrative Group

MPLS Applications

- Traffic Engineering
- QOS provisioned LSPs
- Core Routing (turning off BGP)
- VPN/VPWS/VPLS services
- L3 VPNs
  - draft-ietf-ppvpn-rfc2457bis
- L2 VPNs(VPWS)
  - draft-kompella-pppvn-l2vpn
  - draft-ietf-pwe2-control-protocol (martini)
- L2 VPNs(VPLS)
  - draft-lassserre-vkompella-ppvpn-vpls
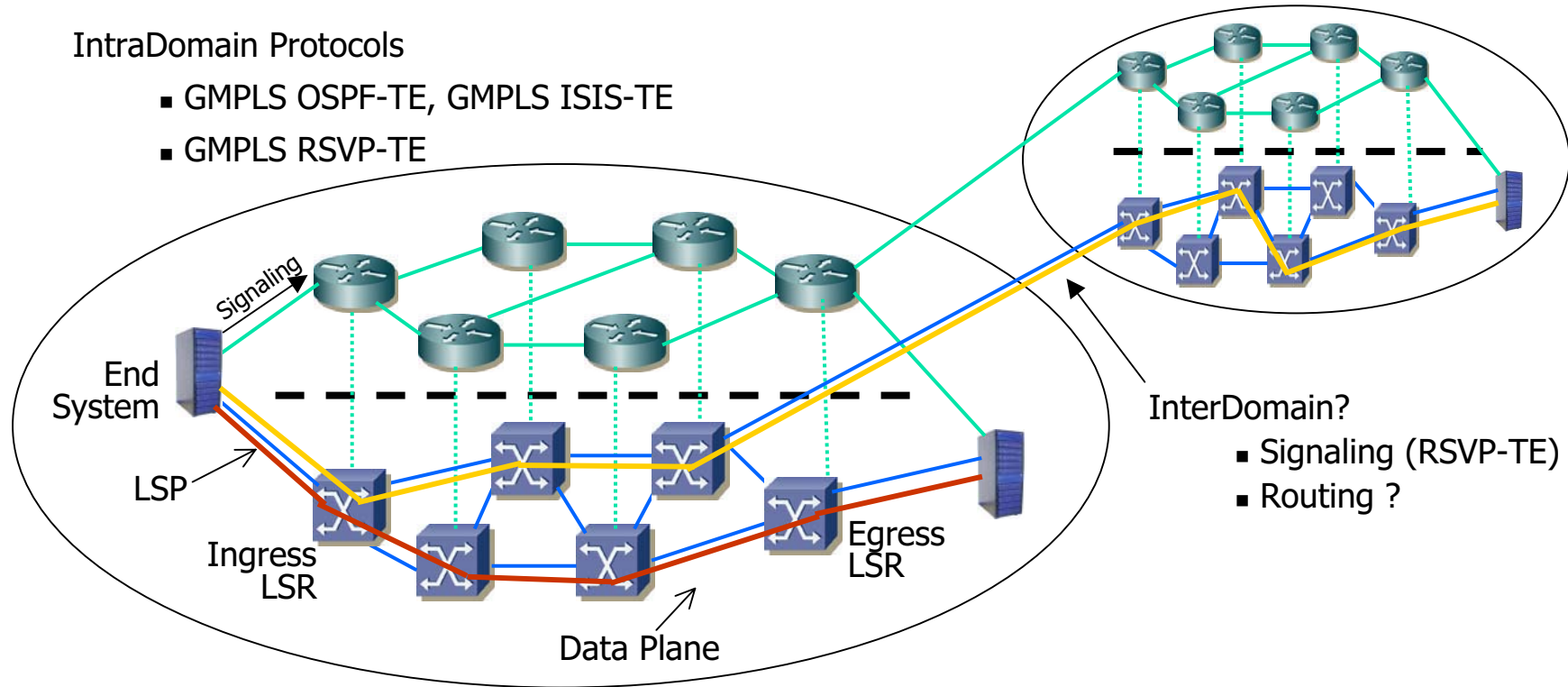- Foundation for GMPLS

GMPLS Control Plane

- GMPLS Extensions
  - GMPLS Signaling
    - GMPLS RSVP-TE
  - GMPLS Routing
    - GMPLS OSPF-TE, GMPLS ISIS-TE
  - Link Management
    - LMP, LMP-WDM, LMP-SONET

GMPLS

IntraDomain Protocols
- GMPLS OSPF-TE, GMPLS ISIS-TE
- GMPLS RSVP-TE

Signaling

End System

LSP

Ingress LSR

Data Plane

Egress LSR

InterDomain?
- Signaling (RSVP-TE)
- Routing ?
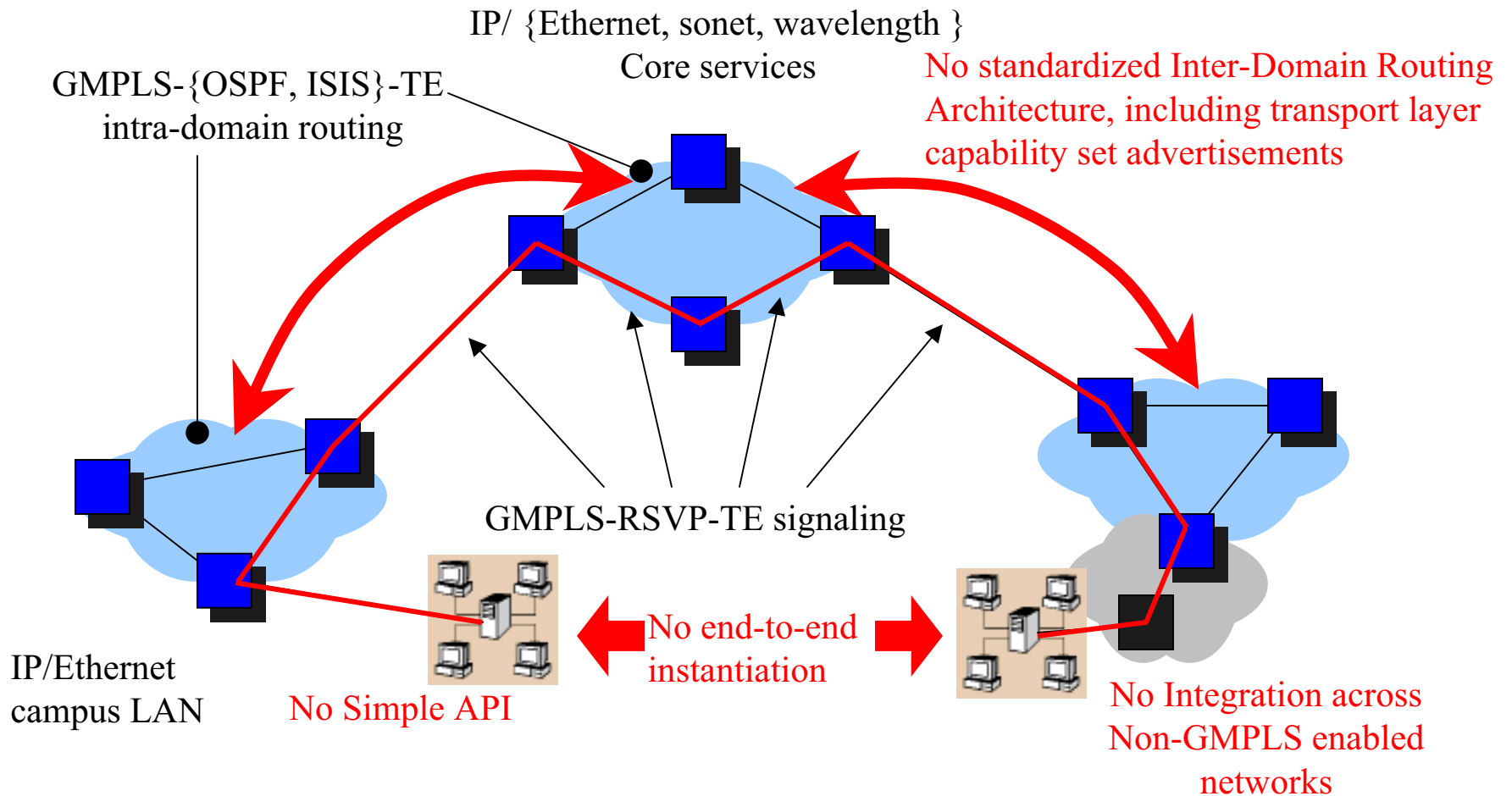
- GMPLS adds support for Lambdas, SONET/SDH, Ports

GMPLS Routing Extensions

- Extensions to OSPF and ISIS to supply required information in opaque LSAs for
  - Sonet/SDH
  - Lambdas
  - Fiber port switching
- Resource availability already covered TE extensions for MPLS
- Other Features (unnumbered interfaces, link protection type, srlg, interface switching type, graceful restart)

End to End GMPLS Transport
What is missing?

IP/ {Ethernet, sonet, wavelength }
Core services

GMPLS-{OSPF, ISIS}-TE
intra-domain routing

No standardized Inter-Domain Routing
Architecture, including transport layer
capability set advertisements

GMPLS-RSVP-TE signaling

IP/Ethernet
campus LAN

No Simple API

No end-to-end
instantiation

No Integration across
Non-GMPLS enabled
networks

Inter-domain Routing and Signaling Research/Standards Activities

- IETF CCAMP
  - draft-vasseur-ayyangar-ccamp-inter-area-AS-TE-00.txt
    - Multiple TE LSP Types (contiguous, stitched, nested)
    - Two inter-area/AS path computation methods (per area/AS, distributed path computation element)
    - Path Computation Element (lsr which computes inter-area/AS path for a TE LSP for which it is not the head-end)
    - Traffic Engineering Database (TED)
    - Little about routing protocols
- IETF TEWG
  - MPLS Inter-AS Traffic Engineering requirements (draft-ietf-tewg-interas-mpls-te-req-06.txt)
  - MPLS Inter-Area Traffic Engineering requirements (draft-ietf-tewg-interarea-mpls-te-req-06.txt)

Inter-domain Routing and Signaling Research/Standards Activities

- OIF
  - intra-carrier E-NNI routing, hierarchical link state based on OSPF modifications
    - DDRP (Domain to Domain Routing Protocol)
  - "Experimental" work for Supercomm demo June in Chicago
- Various Research Projects
  - Canarie
    - Optical BGP, User Controlled LightPaths
  - CHETTAH
  - DRAGON
  - OMNInet

Inter-domain Routing and Signaling Research/Standards Activities

- Issues/Considerations
  - Overlay (OIF) vs Peer-to-Peer (IETF)
  - Inter-domain routing "style"
    - OSPF link state multi-area
    - BGP path vector
    - PNNI hierarchical link state

Control Plane Standards

- IETF GMPLS
  - RSVP-TE (signaling)
  - OSPF-TE (Intra-Domain Routing)
  - ISIS-TE (Intra-Domain Routing
  - LMP (Link Management Protocol)
- ITU ASON (Architecture for Automatically Switched Optical Networks)
  - PNNI
  - RSVP-TE
  - CR-LDP
  - Discovery for SONET/SDH

Control Plane Standards

- OIF (Optical Internetworking Forum)
  - UNI (User Network Interface)
  - OSPF-TE based hierarchical link state routing protocol – DDRP (Domain to Domain Routing Protocol)

Control Plane Status Summary

- Intra Domain
  - Standards available
    - IETF, OIF, ITU
    - Not all in agreement/compatible
  - Dynamic provisioning can be accomplished (with correct equipment)
  - Much work still required on Scheduling and AAA
- Inter Domain
  - No mature standards
  - Several efforts in early stages in IETF and OIF
  - Much work still required on Scheduling and AAA

Resource Scheduling

- Separate path computation and resource reservation for scheduling vs instantiation
  - How do we reserve resources for future timeslot?
  - How do we implement AAA?
  - How do we monitor/enforce resource utilization?
  - How do we integrate instantiation/scheduling activities
  - Design work underway

Authentication, Authorization, Accounting

- How do we accomplish AAA for network resources? Including across domains?
- Related areas?
  - Open Grid Service Architecture (OSGA)
  - RFC 2903 (Generic AAA Architecture)
  - RFC 2904 (Authorization Framework)
  - Global Grid
    - Grid Security Infrastructure (GSI)
    - Generic Security Service API (GSS-API), RFC 2078
  - Java/Jini

Summary

- Many applications for a unified IP Control Plane related to next generation peering and disaster recovery
- Significant research/work still required in the InterDomain routing, signaling, and AAA
- How can LSN/JET help
  - Encourage agencies/networks to work together on these interoperation issues

The End