InterDomain Peering and Provisioning via GMPLS and Web Services

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Control Plane Objectives

- Multi-Service, Multi-Domain, Multi-Layer, Multi-Vendor Provisioning
  - Basic capability is the provision of a “circuit” in above environment
- In addition, need control plane features for:
  - AAA
  - Scheduling
  - Easy APIs which combine multiple individual control plane actions into an application specific configuration (i.e., application specific topologies)

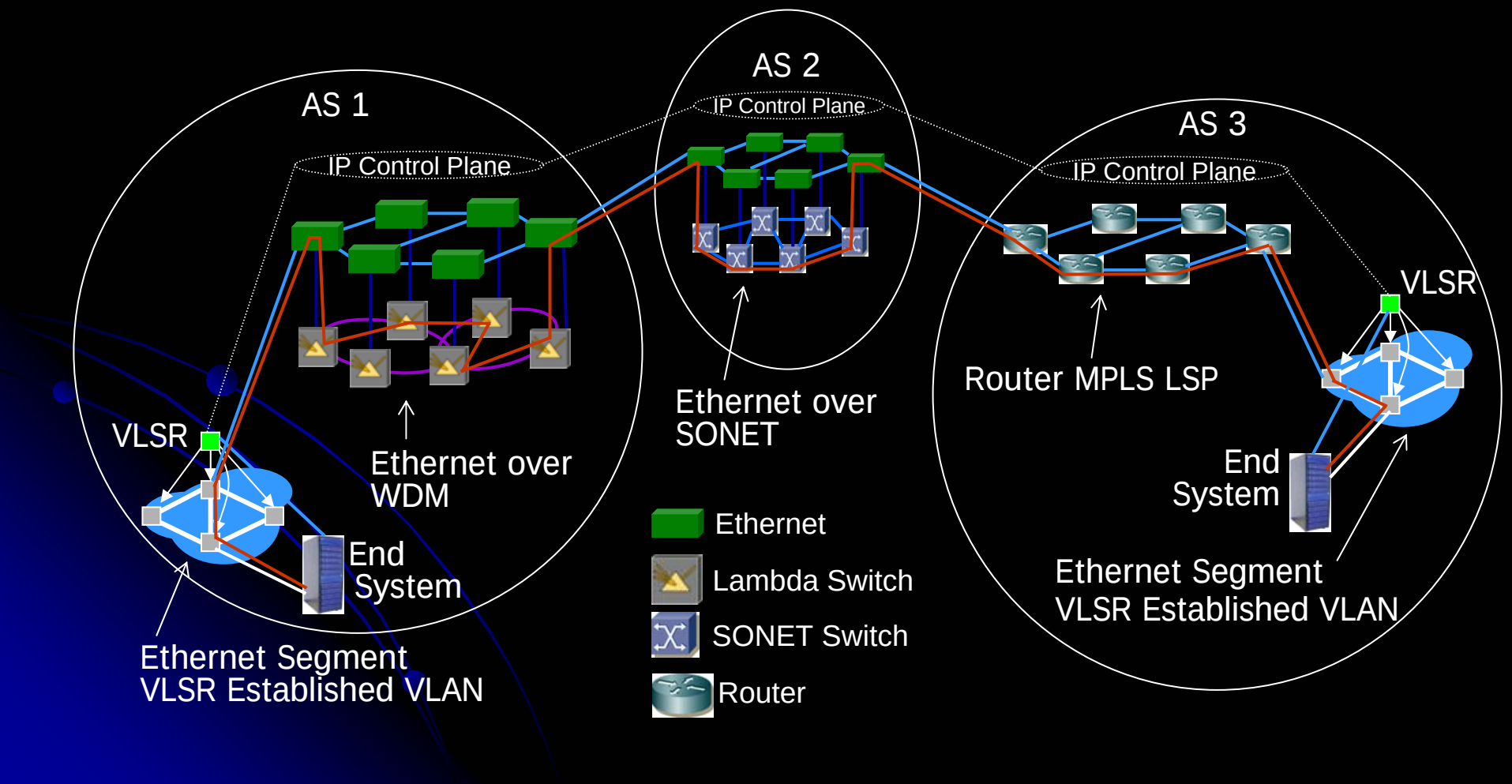
Key Control Plane Features (for Connection Control)

- Routing
  - distribution of "data" between networks. The data that needs to be distributed includes reachability information, resource usages, etc
- Path computation
  - the processing of information received via routing data to determining how to provision an end-to-end path. This is typically a Constrained Shortest Path First (CSPF) type algorithm for the GMPLS control planes. Web services based exchanges might employ a modified version of this technique or something entirely different.
- Signaling
  - the exchange of messages to instantiate specific provisioning requests based upon the above routing and path computation functions. This is typically a RVSP-TE exchange for the GMPLS control planes. Web services based exchanges might employ a modified version of this technique or something entirely different.

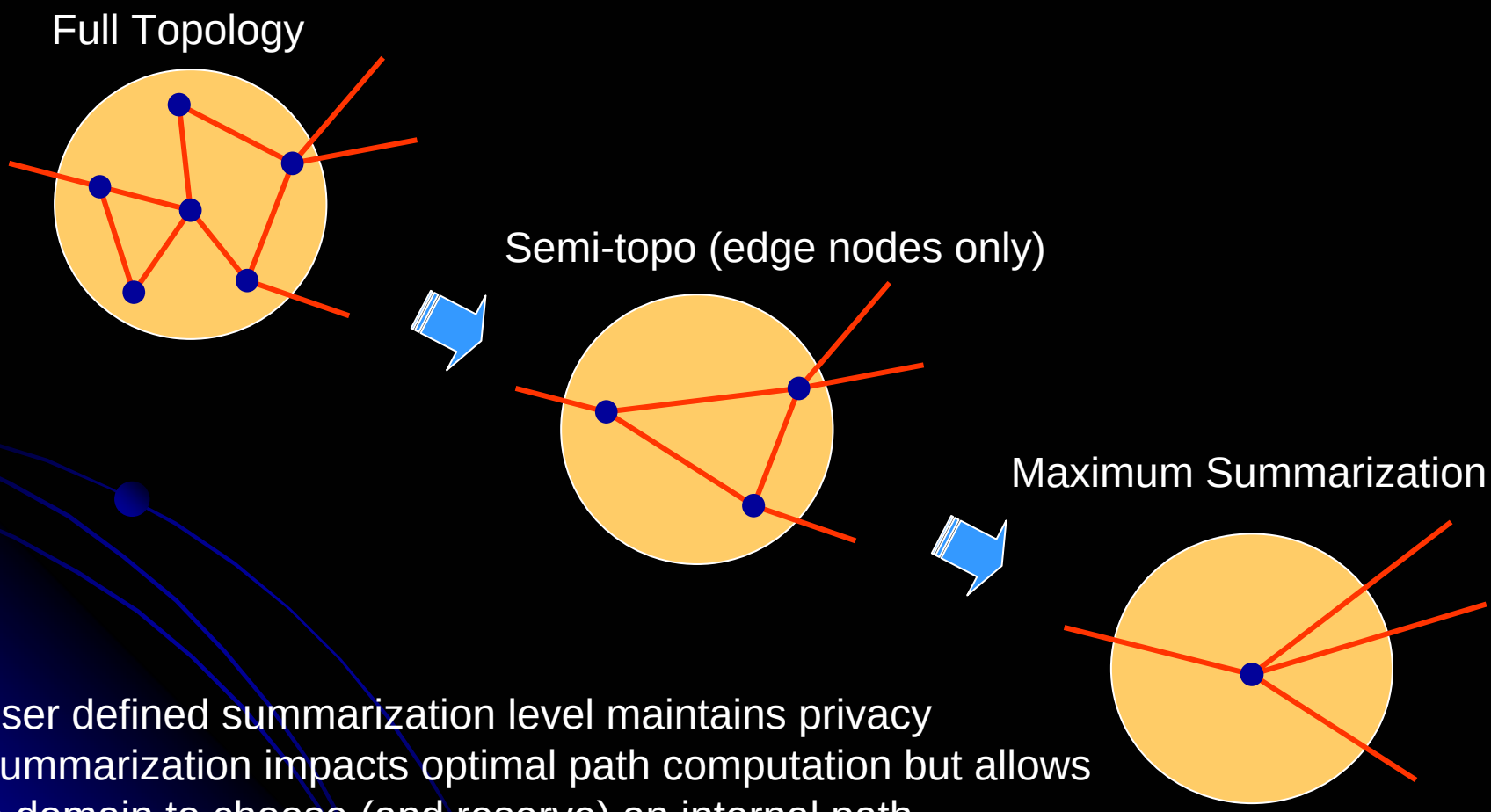
Key Control Plane Key Capabilities

- Domain Summarization
  - Ability to generate abstract representations of your domain for making available to others
  - The type and amount of information (constraints) needed to be included in this abstraction requires discussion.
  - Ability to quickly update this representation based on provisioning actions and other changes
- Multi-layer “Techniques”
  - Stitching: some network elements will need to map one layer into others, i.e., multi-layer adaptation
  - In this context the layers are: PSC, L2SC, TDM, LSC, FSC
  - Hierarchical techniques. Provision a circuit at one layer, then treat it as a resource at another layer. (i.e., Forward Adjacency concept)
- Multi-Layer, Multi-Domain Path Computation Algorithms
  - Algorithms which allow processing on network graphs with multiple constraints
  - Coordination between per domain Path Computation Elements

Heterogeneous Network Technologies Complex End to End Paths

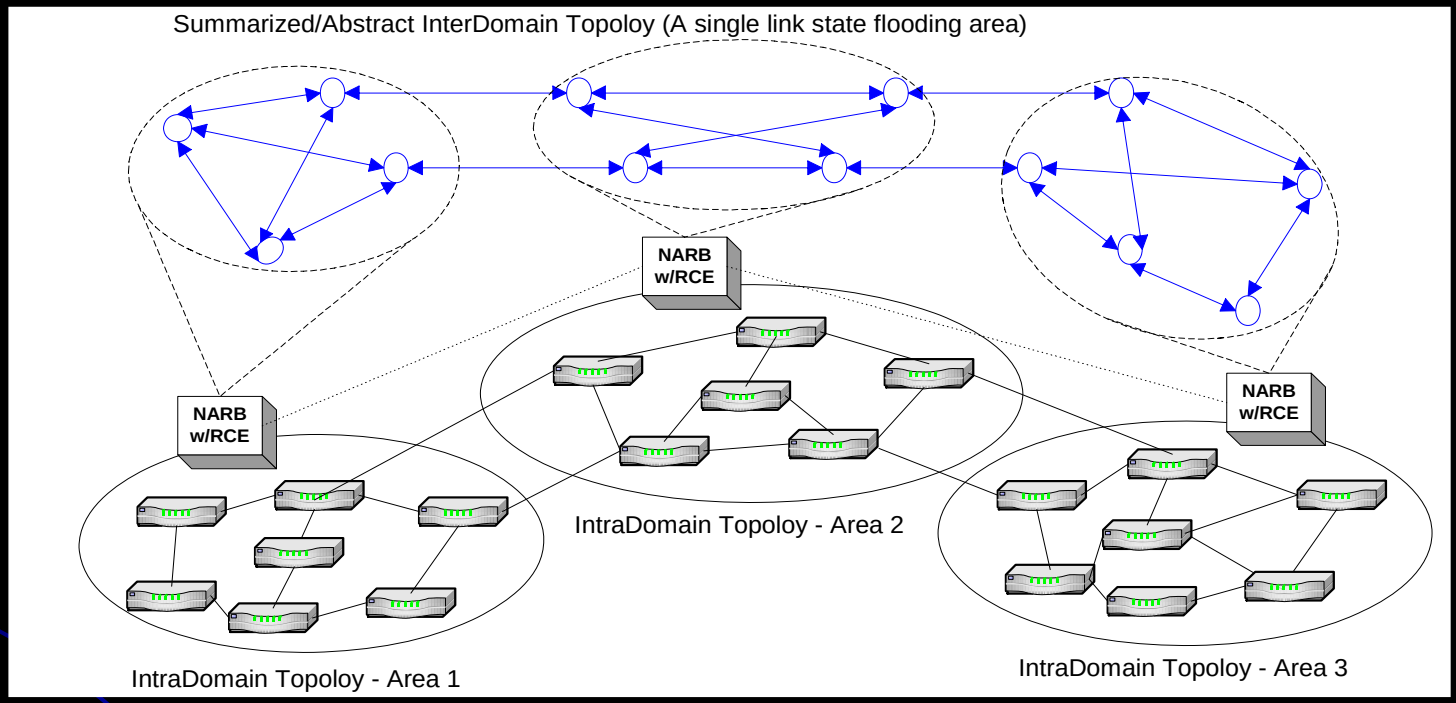


Inter-Domain Topology Summarization



- User defined summarization level maintains privacy
- Summarization impacts optimal path computation but allows the domain to choose (and reserve) an internal path

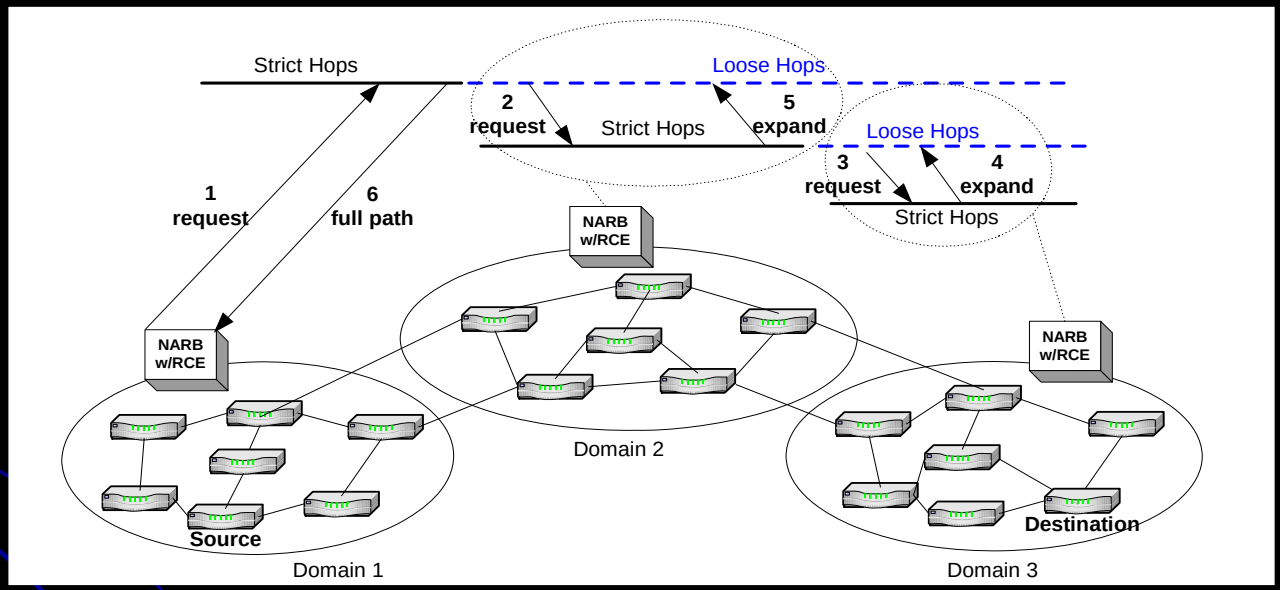
Interdomain Path Computation A Hierarchical Architecture



- NARB summarizes individual domain topology and advertise it globally using link-state routing protocol, generating an abstract topology.
- RCE computes partial paths by combining the abstract global topology and detailed local topology.
- NARB's assemble the partial paths into a full path by speaking to one another across domains.

E2E Multi-Domain Path Computation Scheme

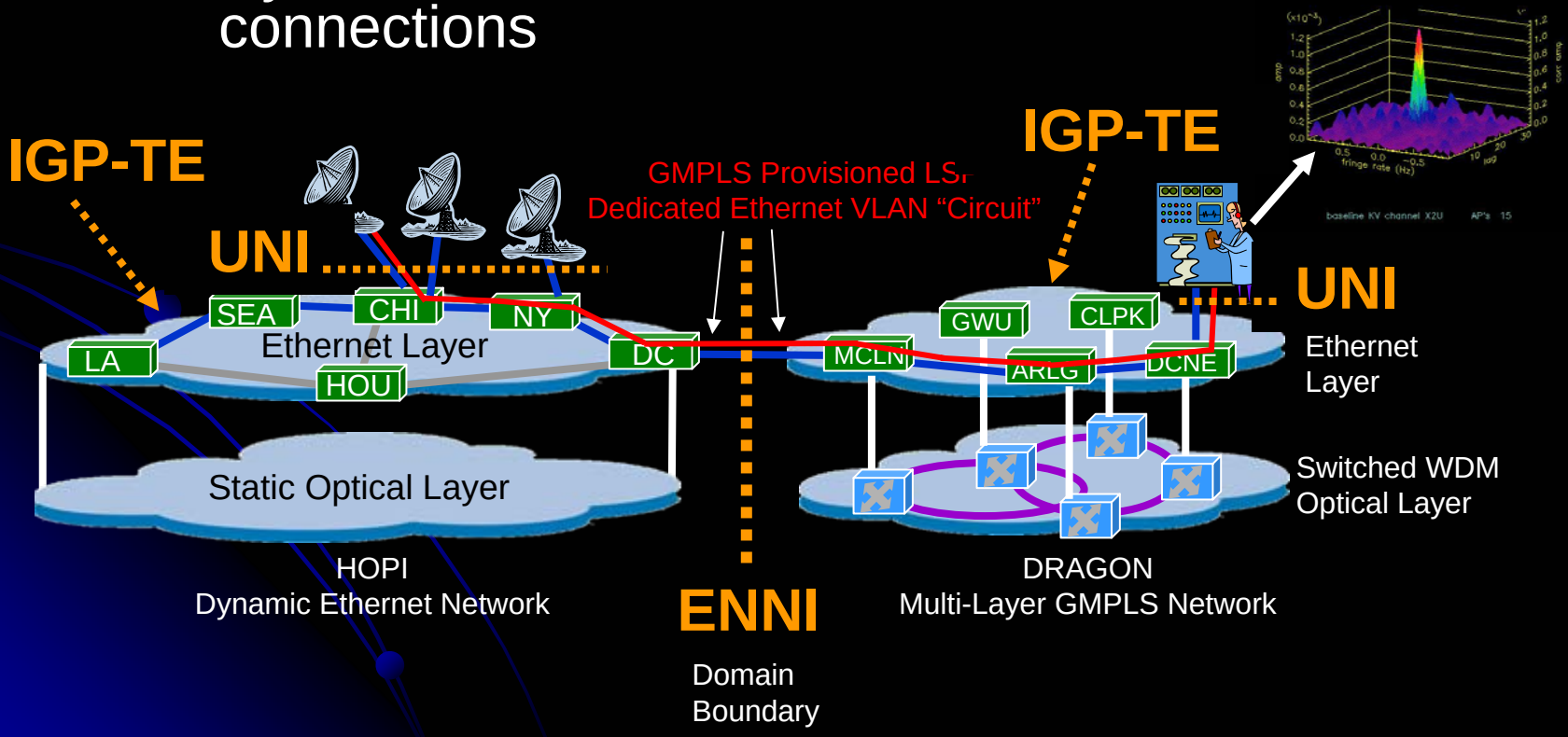
DRAGON mainly uses Recursive Per-Domain (RPD) interdomain path computation



- Full explicit path is obtained before signaling.
- Other supported schemes include Centralized path computation and Forward Per-Domain (FPD) path computation.

GMPLS Approach for DRAGON to HOPI

- GMPLS Multi-layer, Multi-Domain
- Ethernet Service Provisioning
- Dynamic dedicated VLAN based connections



DRAGON Control Plane Key Components

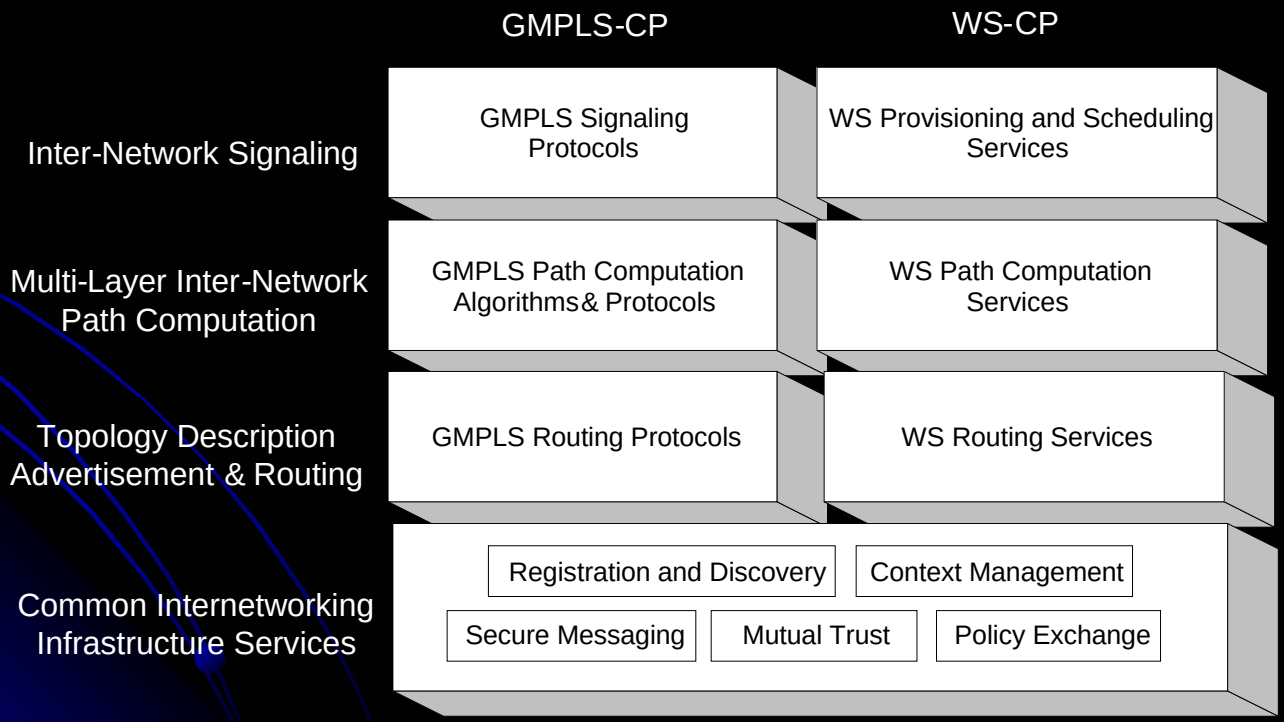
- Network Aware Resource Broker – NARB
  - Intradomain listener, Path Computation, Interdomain Routing
- Virtual Label Swapping Router – VLSR
  - Open source protocols running on PC act as GMPLS network element (OSPF-TE, RSVP-TE)
  - Control PCs participate in protocol exchanges and provisions covered switch according to protocol events (PATH setup, PATH tear down, state query, etc)
- Client System Agent – CSA
  - End system or client software for signaling into network (UNI or peer mode)
- Application Specific Topology Builder – ASTB
  - User Interface and processing which build topologies on behalf of users
  - Topologies are a user specific configuration of multiple LSPs

What About Web Services?

- There is value to capturing some of these control plane functions in the form of Web Services
- For DRAGON, that would mean putting a Web Service interface into our GMPLS control plane
  - Automatically processing of routing protocols
- The most basic web service needed is (abstracted) topology representation
  - Network Description Language (NDL) seems like a good method for topology (network graph) representations
  - Community needs to agree on a schema

GMPLS and WS Control Plane Overlap

- Idea – All participating control planes must have a common set of topology discovery, routing, path computation and signaling functionality.
- Methodology – Translate the “key” GMPLS-CP functions into WS-CP counterparts in web services notations

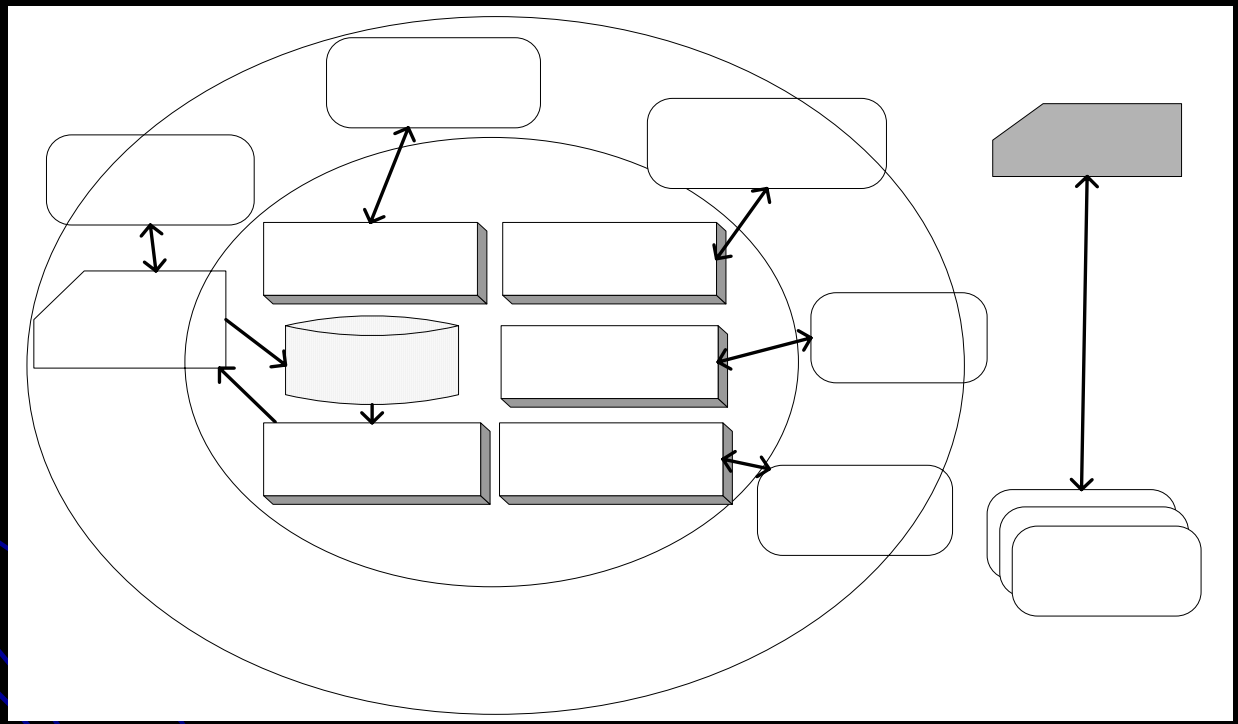


WS-CP Structure
Web Service Wrappers

<*wsdl*:operation name="getNetworkTopology">

<*wsdl*:operation name="getAdjacentNetworkList">

<*wsdl*:operation name="getPathComputationResult">



<*wsdl*:operation name="createInternetworkPathComputationSession">

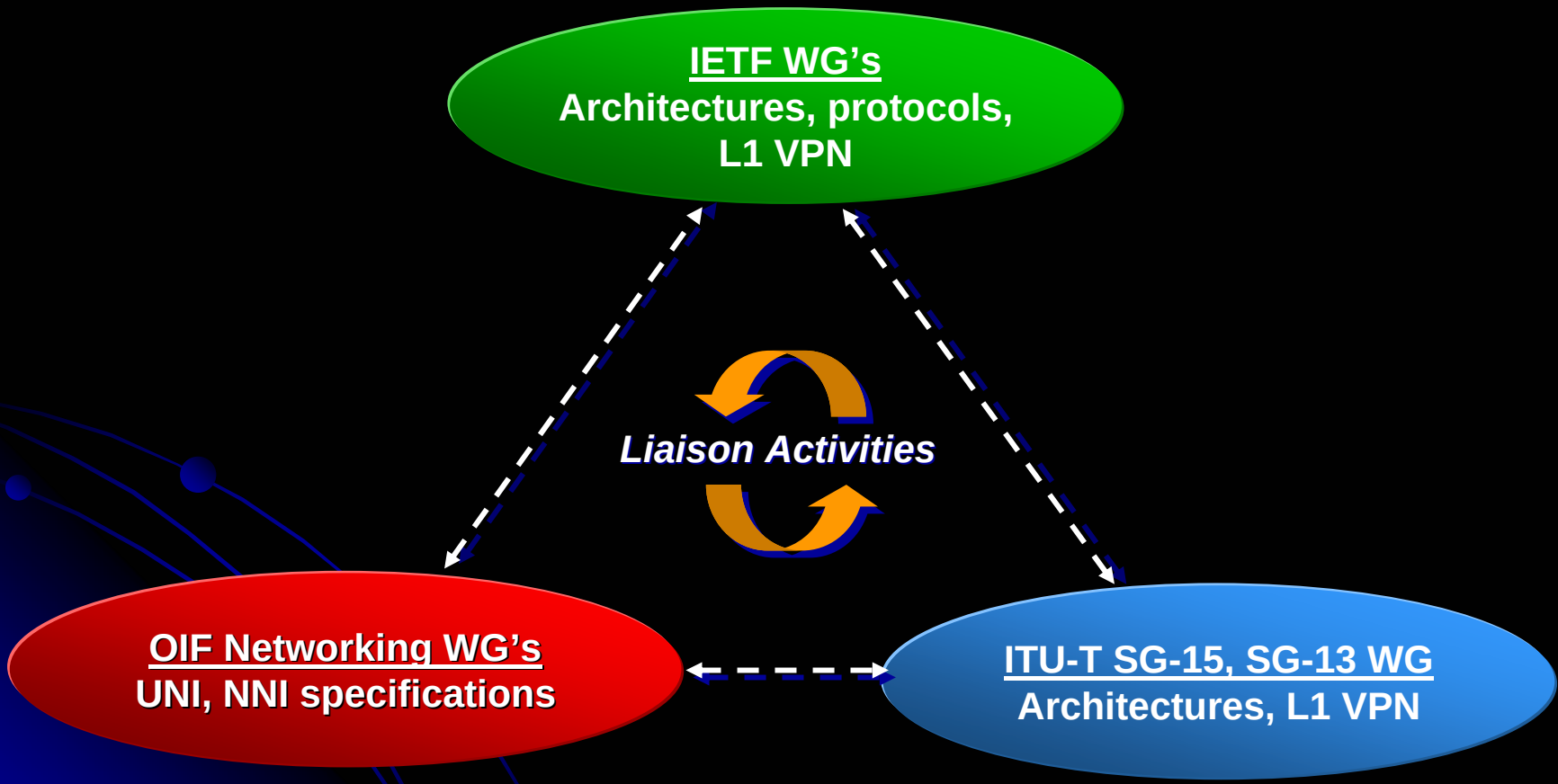
<*wsdl*:operation name="getRecursivePathComputationResult">

<*wsdl*:operation name="createPathReservation">

<*wsdl*:operation name="createAdaptationCrossConnect">

Standards Tracking

Multi-Layer / Multi-Domain Activities



Conclusions

- Any control plane will have to address routing, path computation, and signaling
- GMPLS represents the most advanced set of thinking, concepts, and capabilities in this area
  - Need to track and leverage these concepts, standards activities, and vendor implementations to the maximum extent possible
- There is value in capturing some of these functions via web services
  - Particularly topology descriptions
  - Need to agree on a schema (i.e., NDL)

Conclusions

- Expect a future environment where some peering networks will use GMPLS and some use Web Services
  - Should be able to accomplish multi-domain provisioning in this environment
  - This will allow interoperation between GMPLS and non-GMPLS networks (or Web Service and non-Web Service networks depending on your viewpoint)
- Most participants in this community have a per domain controller/manager
  - We should strive to define the InterDomain communications required for both:
    - GMPLS style control plane
    - Web Service style control plane
  - Future will likely be mixture of both

Thank You

Questions/Comments?:

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