IETF Standards Activities in Optical Networking

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Why Standards

- Internet and optical bubble burst in 2001
- Carrier and service provider build-up dried out
- Carriers are now very concerned about their bottom line
- Moving away from proprietary and vendor-specific solution
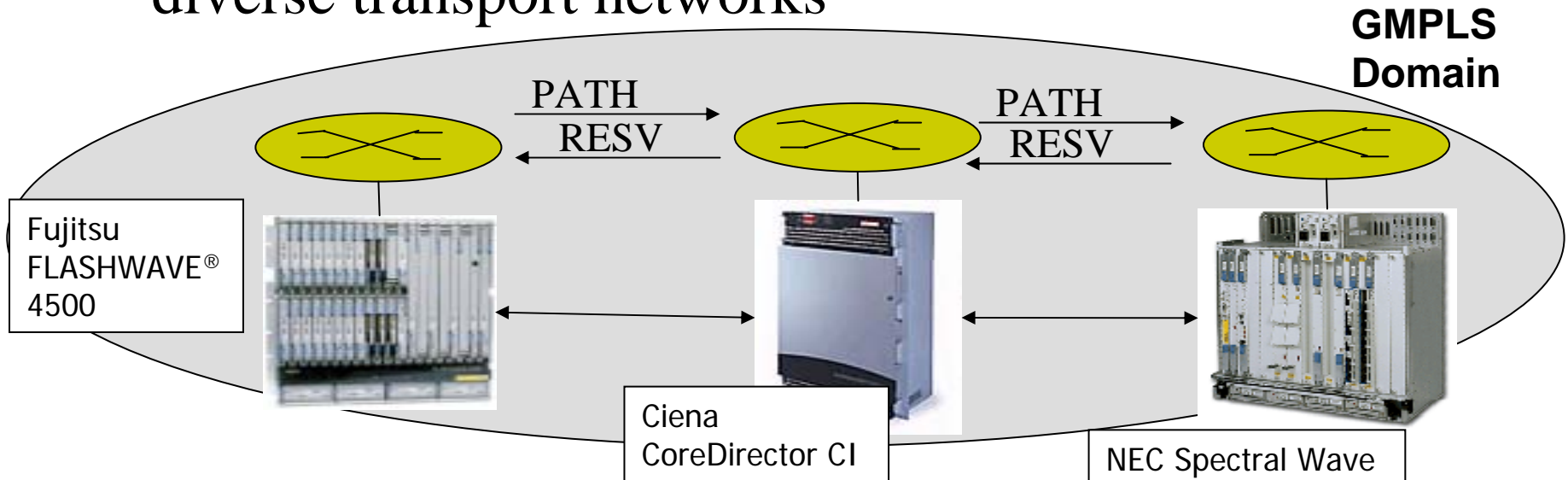- Vendors need to develop standards-based solutions that interoperate with each other

Internet Engineering Task Force

- IETF became involved in several avenues of optical networking
- Not looking to standardize layer 2 or layer 1 technologies
- Focuses on layer 3 (and 2.5) protocols for optical and transport networks
- Work started during the bubble
- Now much more realistic goals
  - Focus on elegant solutions to simple problems

Common Control and Measurement Plane: CCAMP Working Group (1)

- One of the major outputs of the working group was GMPLS control plane (Generalized Multi-Protocol Label Switching)

- Develop IP-based solution for path setup across diverse transport networks

GMPLS Domain

PATH
RESV

PATH
RESV

Fujitsu FLASHWAVE® 4500

Ciena CoreDirector CI

NEC Spectral Wave

CCAMP Working Group (2)

- Topology discovery and link management
  - Link Management Protocol
- Routing
  - Based on OSPF and extended for Traffic Engineering (OSPF-TE)
  - IP traffic over separate channel most of the time
- Signaling
  - RSVP extended to support Traffic Engineering (RSVP-TE)
  - Soft state: needs constant refreshing

CCAMP Working Group (3)

- Optical network restoration
  - No time bounds; we had a proposal for abiding to time constraints but that was considered radical as it focused on shared mesh restoration
  - No perceived demand for mesh
- Currently pursuing work on addressing architecture
  - Joint work between NTT, Fujitsu and Isocore (interop lab)
  - The GMPLS architecture is complex
  - May have one routing controller in charge of a routing domain that includes many nodes
  - May have one similarly a signaling controller in charge of a signaling domain that includes many nodes
  - Much confusion in setting up the network during interoperability tests

Layer 1 Virtual Private Network: L1VPN Working Group

- New working group

- Work spearheaded by NTT Laboratories

- Initially Proposed to CCAMP

- Became its own working group

- Objective is to specify mechanisms necessary for providing a Virtual Private Network (VPN) service over a GMPLS transport network

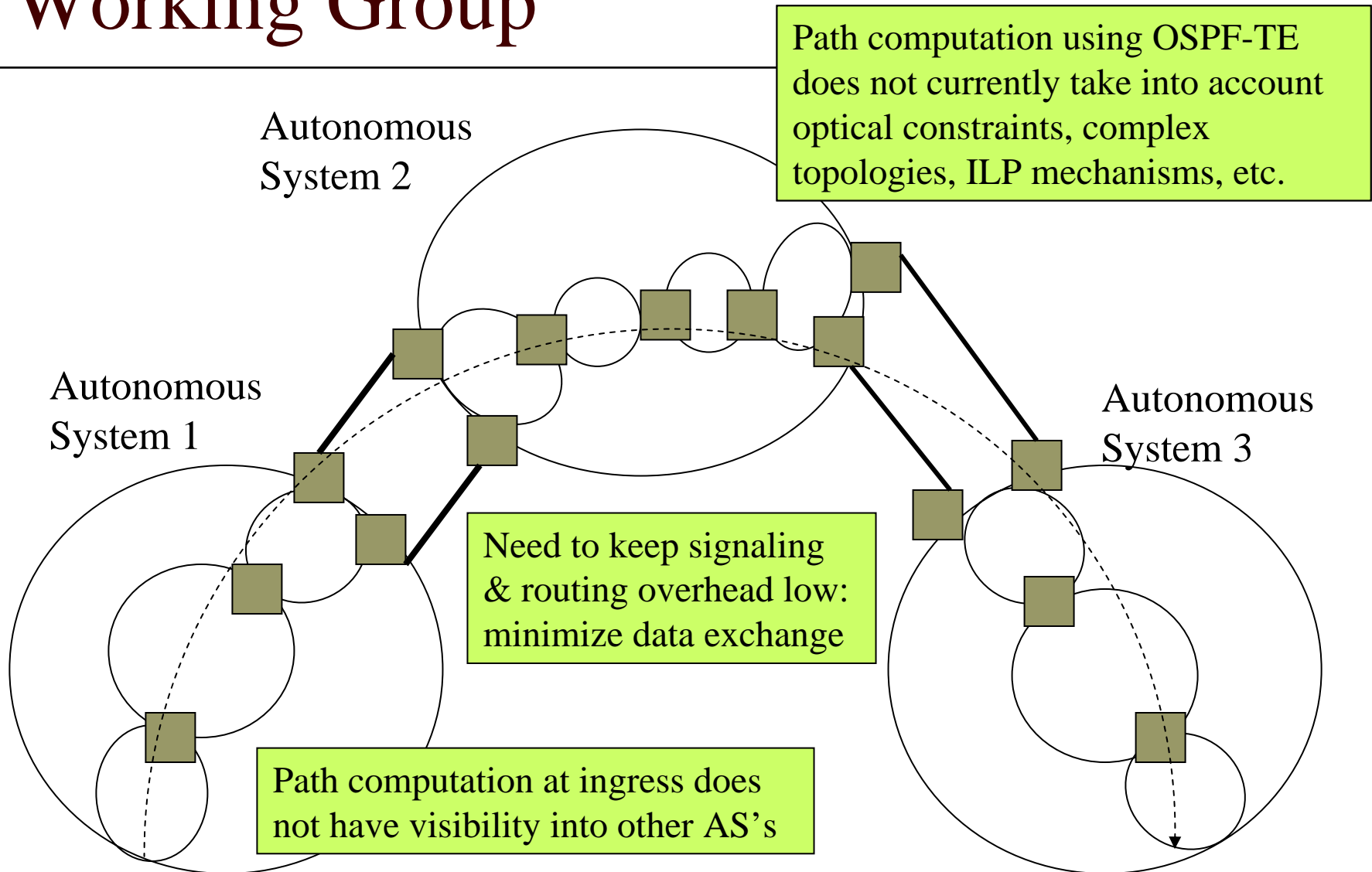 - SONET service
  - Wavelength service

L1VPN Working Group (2)

- Two service models to be addressed

  - Basic mode: the CE-PE (Customer Equipment-Provider Equipment) interface's functional repertoire is limited to path setup signalling only. The GMPLS network is not involved in distribution of user's routing information.

  - Enhanced mode: the CE-PE interface provides the signaling capabilities as in the Basic mode, plus permits limited exchange of information between the control planes of the provider and the user to help such functions as discovery of reachability information in remote sites, or parameters of the part of the provider's network dedicated to the user.

Path Computation Element: PCE Working Group

Autonomous System 2

Autonomous System 1

Autonomous System 3

Path computation using OSPF-TE does not currently take into account optical constraints, complex topologies, ILP mechanisms, etc.

Need to keep signaling & routing overhead low: minimize data exchange

Path computation at ingress does not have visibility into other AS's

PCE Working Group (2)

- PCE: entity capable of computing a (partial/full) route of a TE Label Switched Path

- The PCE may or may not be the head-end router

- PCE is not centralized path computation

  - Includes both distributed and centralized path computation models

- PCE may be stateless or stateful

PCE High-Level Requirements (3)

- Reliable client-PCE signaling
- Automatic discovery of PCEs and their capabilities
- Scalability
  - Load Balancing across PCEs
  - Distributed PCE function
    - For backup path computation, a PCE can be the protected node
- High availability and redundancy
  - Backup PCEs
  - PCE load balancing
- Robustness
  - Controlled computation delays to allow for rapid convergence in case of topology change
  - Controlled tradeoff between computation time and optimality

Standards Activities and ONTC

- Work takes a long time and feels inefficient
- Most of the work done behind the scenes
  - Convincing key people of the suitability of the solution
  - Getting support for Working Group chairs
- IETF strives to reach "reasonable consensus"
- Suggestion to work with industry on identifying work topics
- Research topics often not suitable
- Studies of protocols proposed at IETF of interest
  - Scalability, security, problems