Advanced Data Transport in GMPLS

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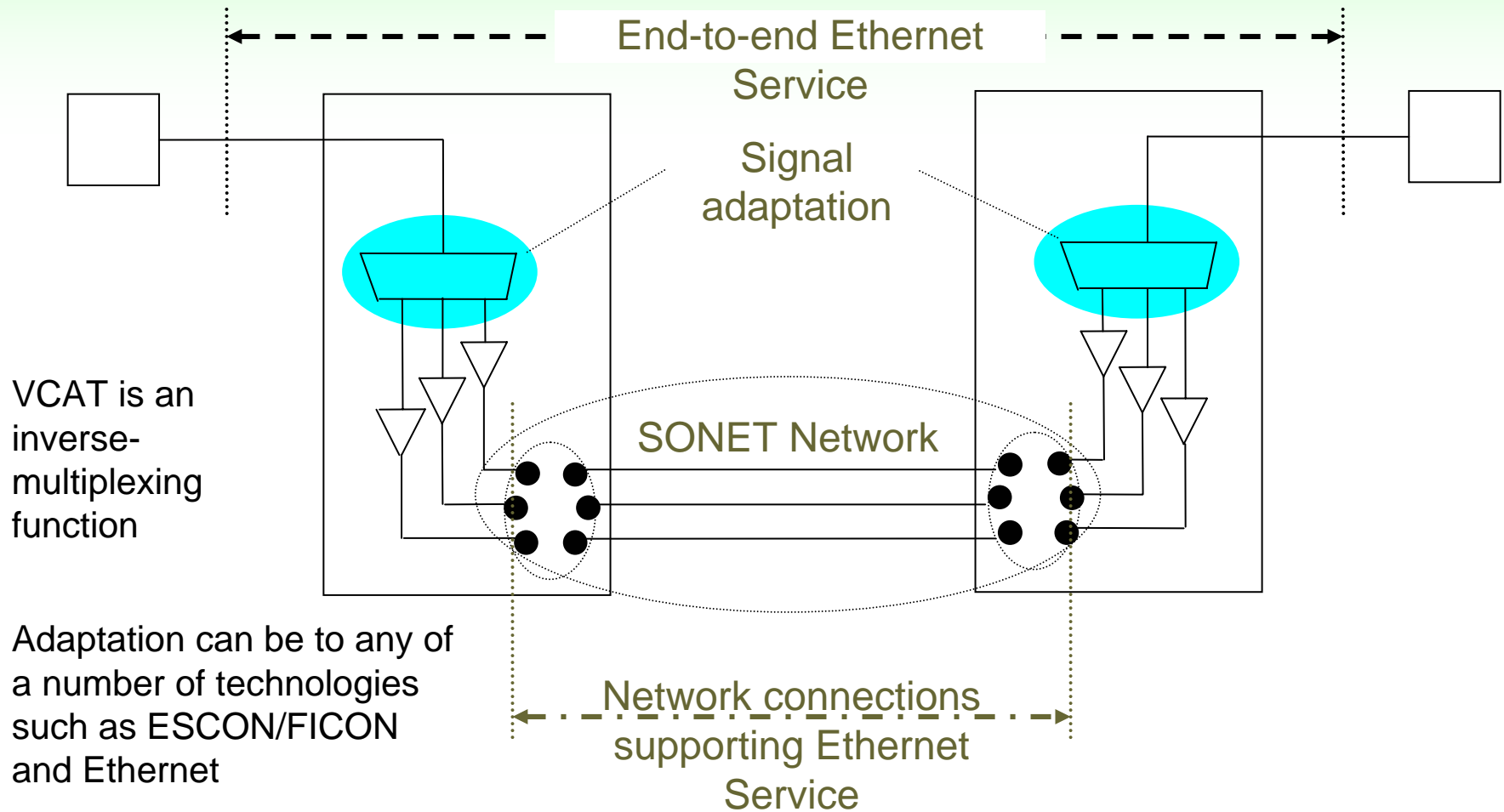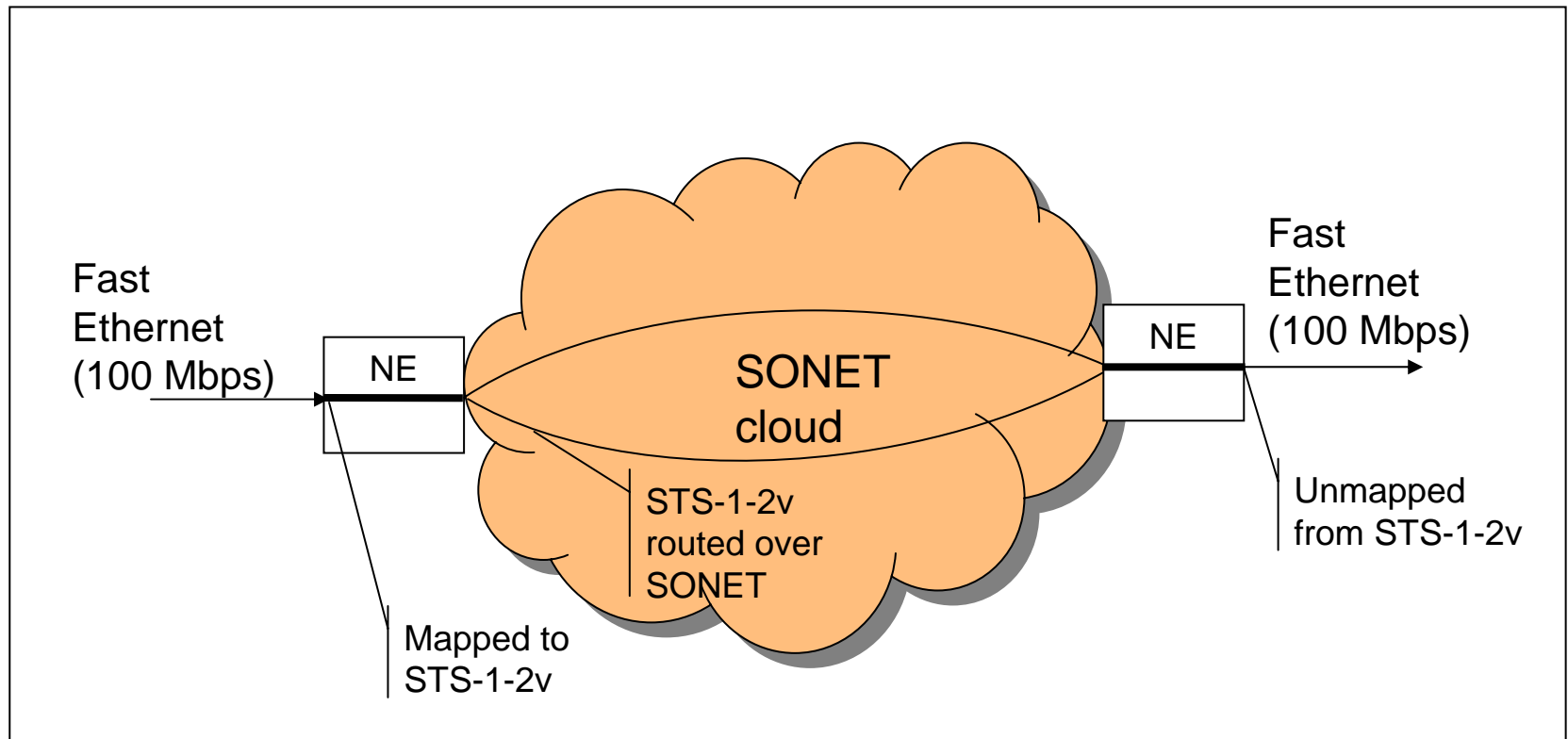
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Introduction

- Development of GMPLS to support data and transport service
- Starting in the past few years, Ethernet has become the service of choice to carry data
- Transport (SONET/SDH) networks have started supporting Ethernet services, while providing the reliability and robustness of SONET that carriers require
- To carry Ethernet over SONET, an adaptation layer was inserted between SONET and Ethernet
- There was a mismatch between Ethernet bandwidth and size of SONET circuits (e.g. 100 Mbps Ethernet is carried in 155 Mbps OC-3 circuit), resulting in inefficiencies
- Virtual concatenation (VCAT) developed to solve this problem
- GMPLS had good support for VCAT
- New advances in data transport such as diversely routed VCAT and the LCAS protocol require new features in GMPLS

A View of Ethernet over SONET using VCAT

End-to-end Ethernet Service

Signal adaptation

VCAT is an inverse-multiplexing function

SONET Network

Adaptation can be to any of a number of technologies such as ESCON/FICON and Ethernet

Network connections supporting Ethernet Service

Diversely Routed VCAT in Support of Ethernet

- Ability to increase network efficiency
- Added complexity with respect to timing

Fast Ethernet (100 Mbps) — NE — SONET cloud — NE — Fast Ethernet (100 Mbps)

STS-1-2v routed over SONET

Mapped to STS-1-2v

Unmapped from STS-1-2v

New Challenge from Diversely Routed VCAT

- Note that no intermediate node needs to be aware of the concatenation (no Ethernet in the transport network)
- In GMPLS, no method to associate the different LSPs
- No method to make sure that an ingress/egress supports the same adaptation at a specific interface
  - An adaptation capability is not node-specific but interface-specific
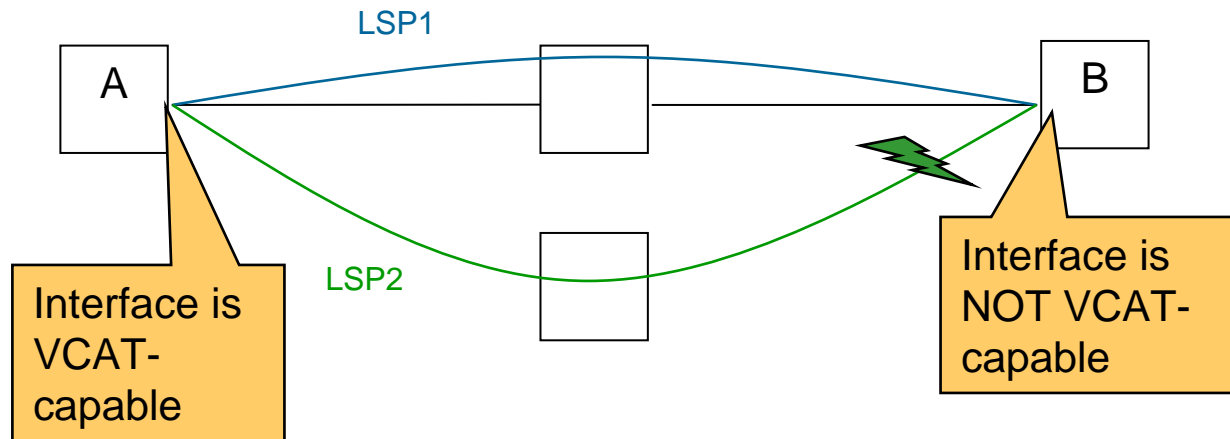
LSP1 is set up but LSP2 setup fails as the interface at B does not support VCAT, so LSP1 must be deleted

A

B

LSP1

LSP2

Interface is VCAT-capable

Interface is NOT VCAT-capable
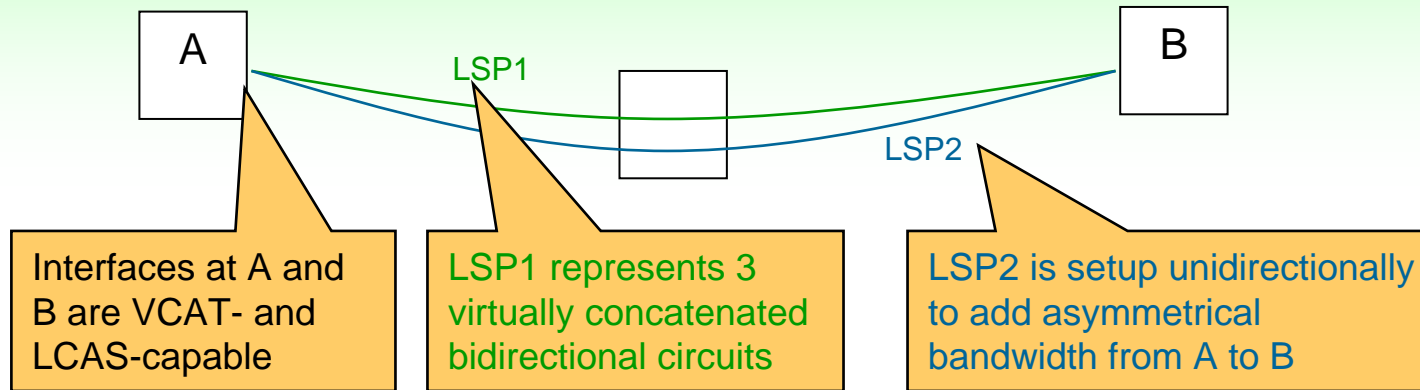
Link Capacity Adjustment Scheme (LCAS)

- Adaptation is invoked at ingress and egress to properly assemble inversely multiplexed data

- Previously, VCAT offered no capability to change the bandwidth available at the SONET layer after traffic starts being carried

- LCAS changes the paradigm and allows the transport network to increase and decrease the number of constituent circuits in the VCAT group

- For example, the operator can start with STS-1-5v and increase to STS-1-7v when bandwidth needs in the data network increase

- Graceful degradation fully supported using LCAS

Challenges with LCAS (1/2)

A — LSP1 — B

Interfaces at A and B are VCAT-capable

LSP2

LSP3

Interface is NOT LCAS-capable
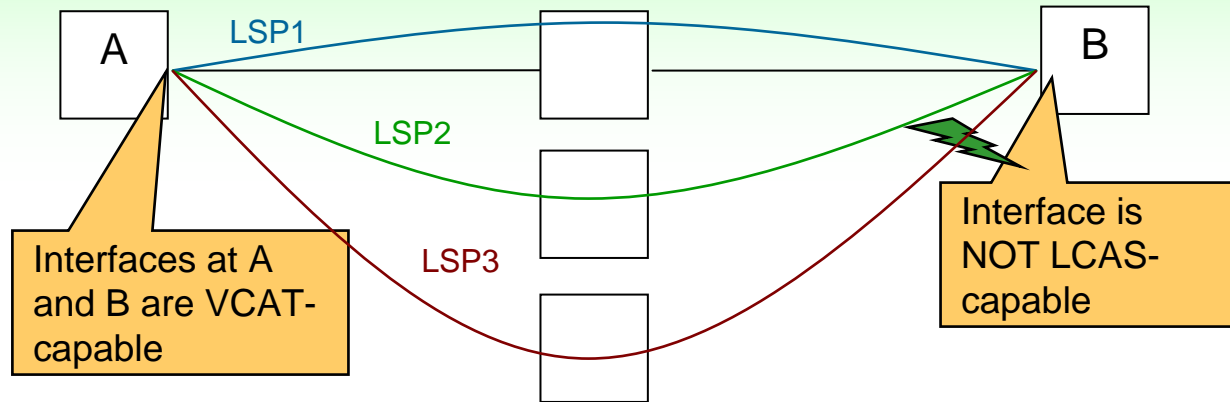
- LSP1 and LSP2 are successfully set up
- Adaptation is invoked and they carry Ethernet traffic
- Due to increased demand for bandwidth, operator tries to add a new SONET circuit (by signaling LSP3) but fails as the interface at B is not LCAS-capable
- Any approach to add the circuit is not hitless
- It is important therefore to know whether the interfaces being paired have the same capability

Challenges with LCAS (2/2)

A   LSP1   B

LSP2

Interfaces at A and B are VCAT- and LCAS-capable

LSP1 represents 3 virtually concatenated bidirectional circuits

**LSP2 is setup unidirectionally to add asymmetrical bandwidth from A to B**

- LCAS allows capacity adjustment in either or both directions
- SONET circuits historically have been setup bidirectionally
- Whereas in the past we could change the NVC field to update the bandwidth on one LSP subtending several SONET circuits, we now have to maintain separate unidirectional LSPs
- Do we change ownership of the circuits in each direction to each of the unidirectional LSPs?

VCAT/LCAS and GMPLS

- GMPLS is not supposed to automate the whole process of setting up SONET circuits, executing the adaptation, setting up the Ethernet connectivity, monitoring the use of the Ethernet connection and invoking LCAS
- Instead, GMPLS and the NMS should cooperate to keep network management in charge of decision-making and achieve the required automation in signaling and advertising
- NMS
    - Decides the number and size of circuits to set up at the SONET/SDH layer and asks GMPLS to signal them
    - Invokes the adaptation function when the lower layer circuits have been cross-connected
    - Decides the size of the LSP at the Ethernet layer and asks GMPLS to signal it
    - May monitor utilization of Ethernet LSP based on policy
    - Invokes the LCAS protocol to add/remove lower-layer circuits
    - Asks GMPLS to signal the change in cooperation with LCAS
- GMPLS
    - Advertises interface capability (adaptation, VCAT, LCAS)
    - Signals LSPs being set up, torn down and resized
    - Associates diversely routed LSPs to allow the adaptation function to pick the correct circuits at the interface

Status of Proposal at IETF CCAMP

- Vendors: Ciena, Fujitsu, Marconi-Ericsson, Huawei
- Service Providers: NTT, France Telecom
- Consultant: Grotto
- Advisor: Old Dog Consulting
- Currently finalizing requirements
- Proposed use of Association object to associate diversely routed circuits based on recommendation from WG chair Adrian Farrel
- Looking at the advertising aspects to minimize crankback in some situations (VCAT) and unacceptable failure to resize after service setup (mismatch between LCAS-capable and non-LCAS capable interfaces)
- Aim is to produce a cookbook to help implementers and extensions to signaling and routing to support advanced data transport features

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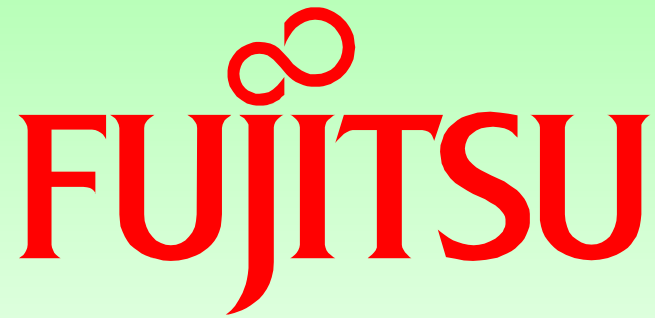
THE POSSIBILITIES ARE INFINITE