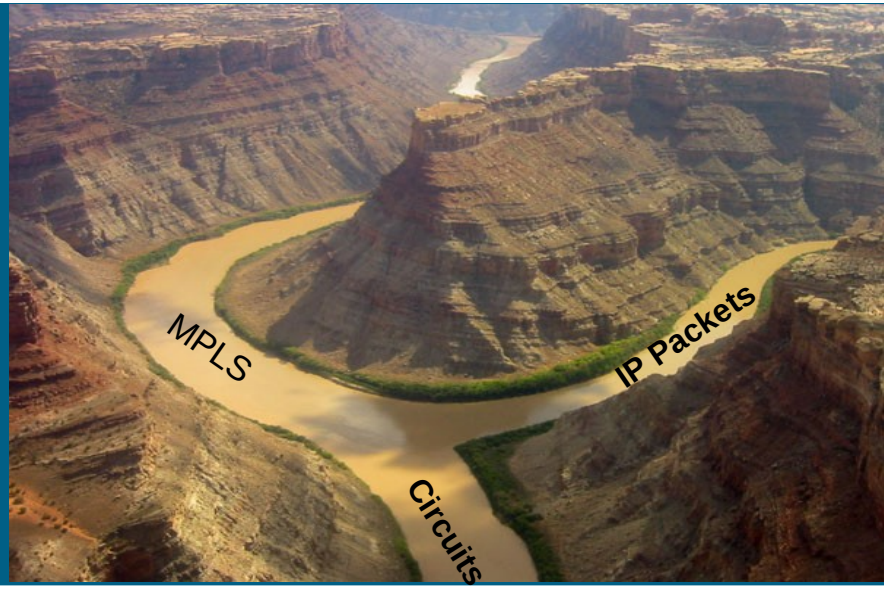
MPLS-TP:
The New Generation of Transport Networks.



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Version2.0

What problem is being solved?

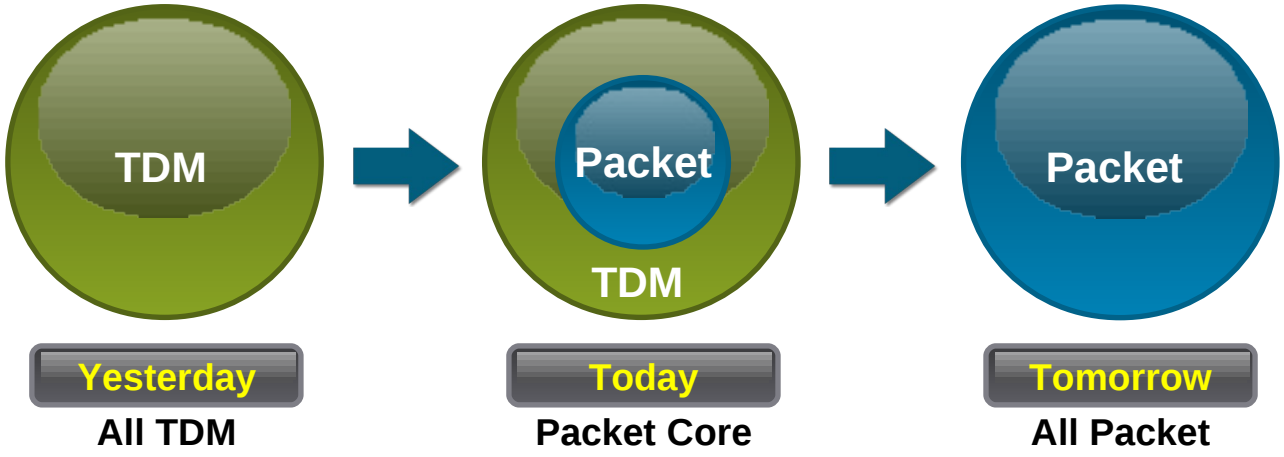
- NGN transport - Moving from SONET/SDH TDM technologies to packet switching
  - Higher bandwidth to support multi-services
  - Lower cost with statistical mixing than fixed bandwidth
- Maintaining transport characteristics through the technology transition
  - Pre-determined path
  - In-band OAM
  - Fast detection and recover time
  - NMS provisioning
  - Tight LSA: BW, QoS, HA

Agenda

- Introduction
- What problem is MPLS-TP solving?
- MPLS-TP overview
- Standards updste
- Customer scenarios

Market Trends in Infrastructure

- Growth of Internet and hence IP traffic
- Ethernet cost points drop
  - Effective technology to carry IP
- Revenue shifts from voice to data
- Video accelerates the problem
  - IP Traffic doubles every year
  - Drives infrastructure migration from TDM to Packet



The Transport Environment

Carrier Ethernet will replace SONET/SDH infrastructure over time

- SONET/SDH infrastructure largely ruled by the transport department
- Transport teams strongly influenced by transport vendors

Transport team metodology

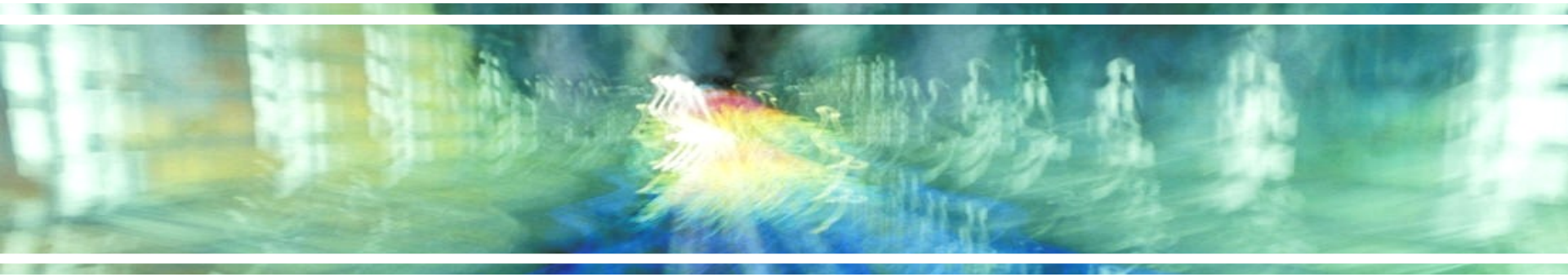
- Long term statically provisioned paths, pre-determined back-up paths
- Highly automated operations environment
- Strong reliance on automated OAM and fault management systems
- Simple static control plane scores well over a complex auto-magic control plane
- Operations staff generally Junior level

Transport teams views / transport vendor positioning on IP/MPLS

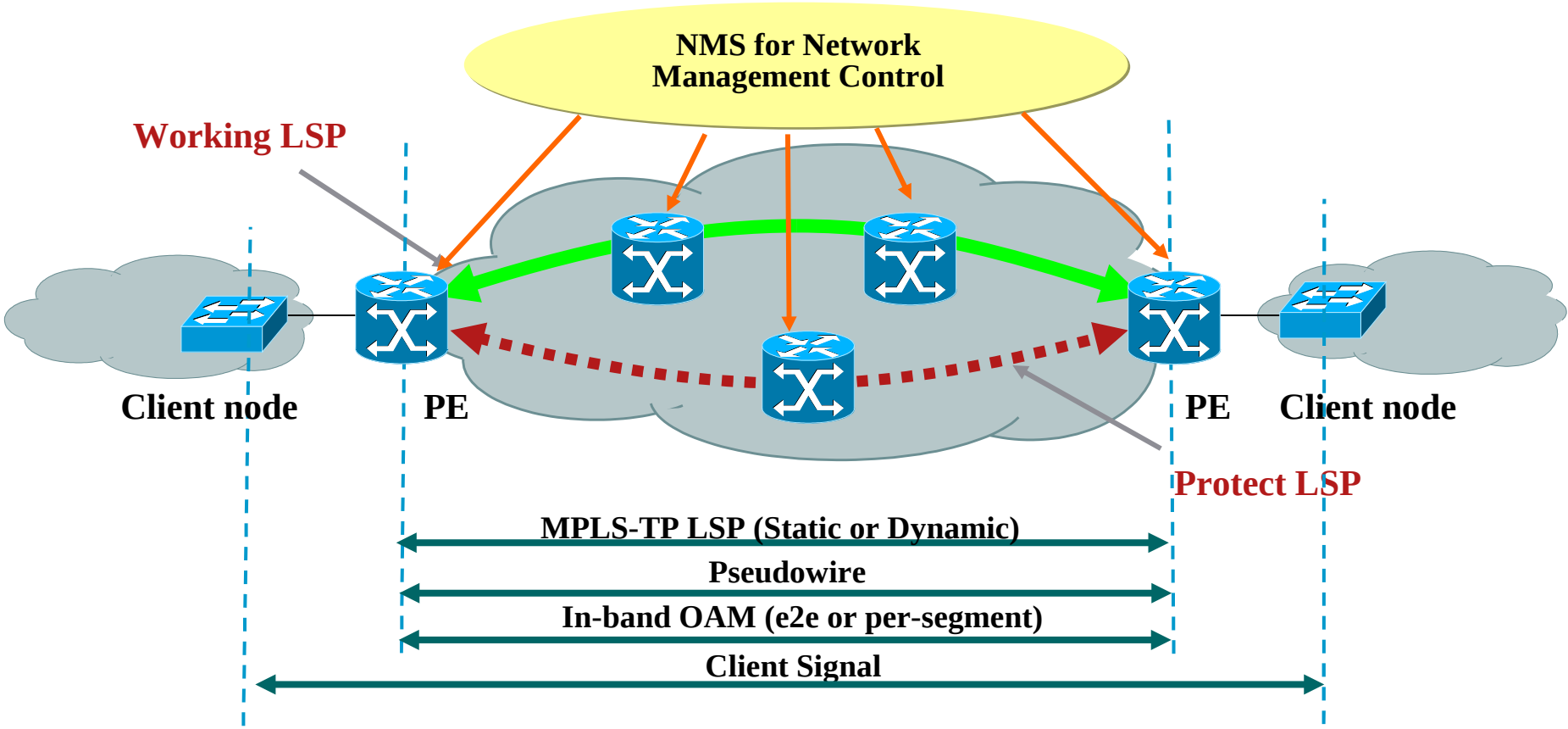
- Don’t understand IP or associated technologies
- Very complex (LDP, IS-IS, OSPF, dLDP, MPLS-TE, MPLS-FRR)
- Don’t need dynamic routing protocols and recovery times too slow
- Poor and inconsistent OAM

Making MPLS more Transport Friendly

- Static configuration LSPs and PWEs
- LSPs and PWEs management via external NMS
- Nesting of LSPs and PWEs similar to SONET/SDH environments
- OAM and data path are congruency
- Simple Transport protection mechanisms within MPLS architecture
- Transport OAM capabilities at LSP and PWE independent of configuration mechanism
- Common and consistent OAM capabilities for L2, PWE, LSP

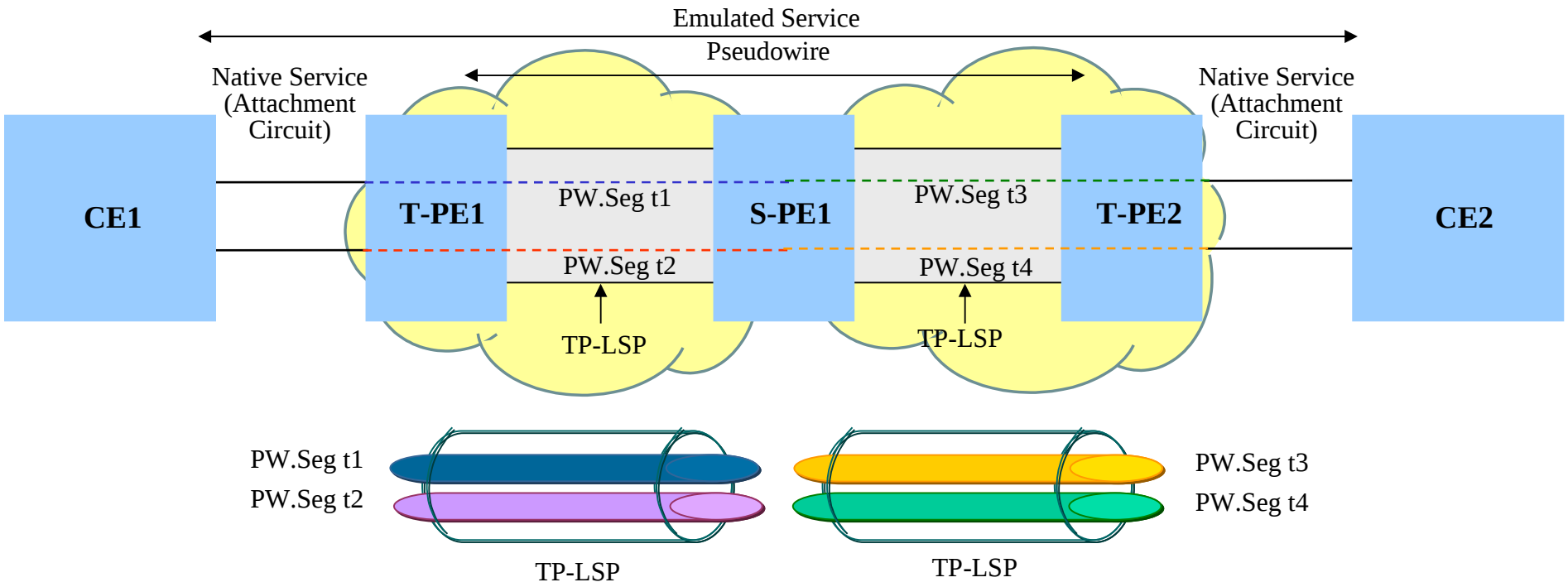


MPLS-TP Concept



Connection Oriented, pre-configured working path and protect path
Transport Tunnel 1:1 protection, switching triggered by in-band OAM
Phase 1: NMS for static provisioning

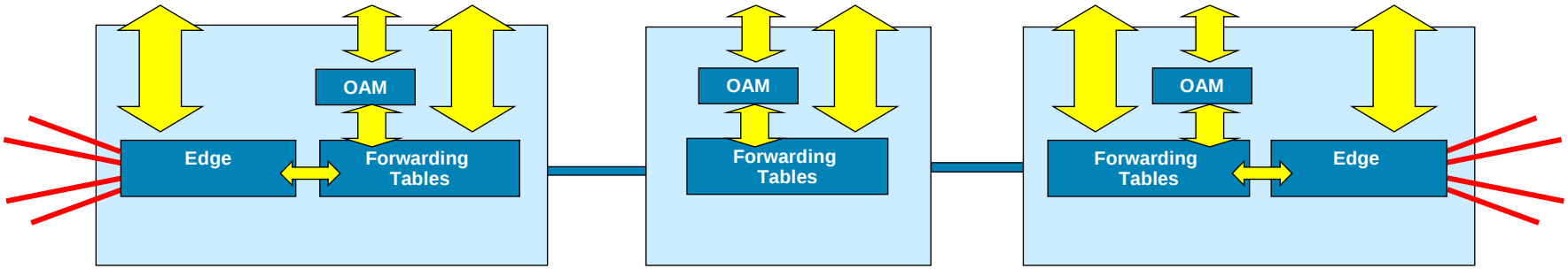
MPLS-TP Architecture



Basic construct of MPLS-TP:

- –MPLS LSPs for transportation (LSPs can be nested)
- –PWs for the client layer (SS-PW and MS-PW)
- –All other types of traffic are carried by PW as client layer

Network Management: MPLS-TP Static Provisioning



- Static provisioning and dynamic control plane
  - Requirements state that the solution must include static only provisioning
  - Any dynamic control plane will be based on IETF solutions (GMPLS, IP/MPLS)
- Control Plane responsible for:
  - End-to-end, segment LSPs and PWE-3 application labels (programming the LFIB)
  - Determining and defining primary and backup paths
  - Configuring the OAM function along the path
  - Others: Defining the UNI…
- OAM responsible for monitoring and driving switches between primary and backup paths for the end-to-end path and path segments

MPLS-TP Major Solution Observations

- Bringing ACH functionality into LSPs begins to blur the architectural line between an MPLS LSP and an MPLS Pseudowire
- The same OAM mechanism (e.g. ACH) can be unified for LSPs and PWs

  Enabling the same functionality for both and ease of implementation

  Avoid breaking anything (e.g. ECMP)

  ACH functionality for LSPs should be limited to only OAM, APS and Performance management data.

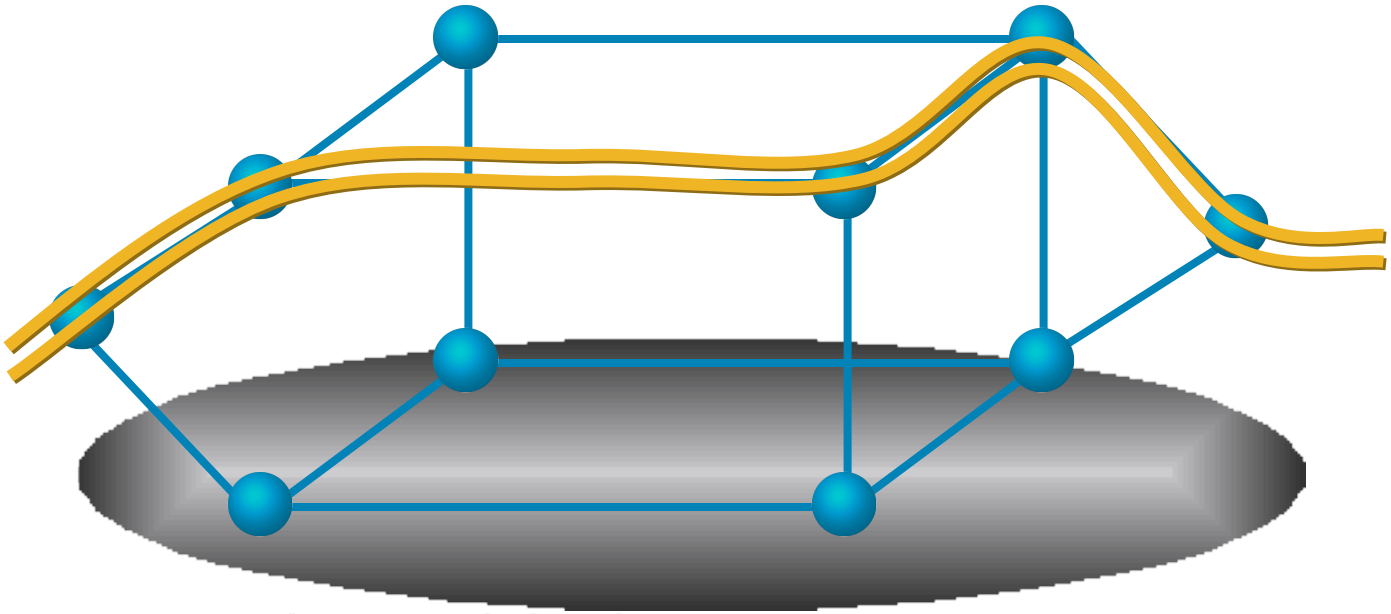
  A great deal of IETF protocol, design and architectural reuse can be employed to solve the requirements

- No change to the IETF MPLS architecture is necessary!

MPLS-TP Major Solution Constructs

- Definition of MPLS-TP general alert label (GAL) and a generic associated channel (GE ACH)
  - Allows OAM packets to be directed to an intermediated node on a LSP/PWE Via label stacking or proper TTL setting
  - Define a new reserved label
- Generic associated channel (GE ACH) functionality supports the FCAPS functions by carrying OAM, APS, ECC packets across the network
  - Use of PW associated channel to carry OAM packets
  - GE ACH are code points from PW ACH space but, not necessarily, for PW purposes
  - GE ACH would be present for OAM of all LSPs

Bidirectional Paths

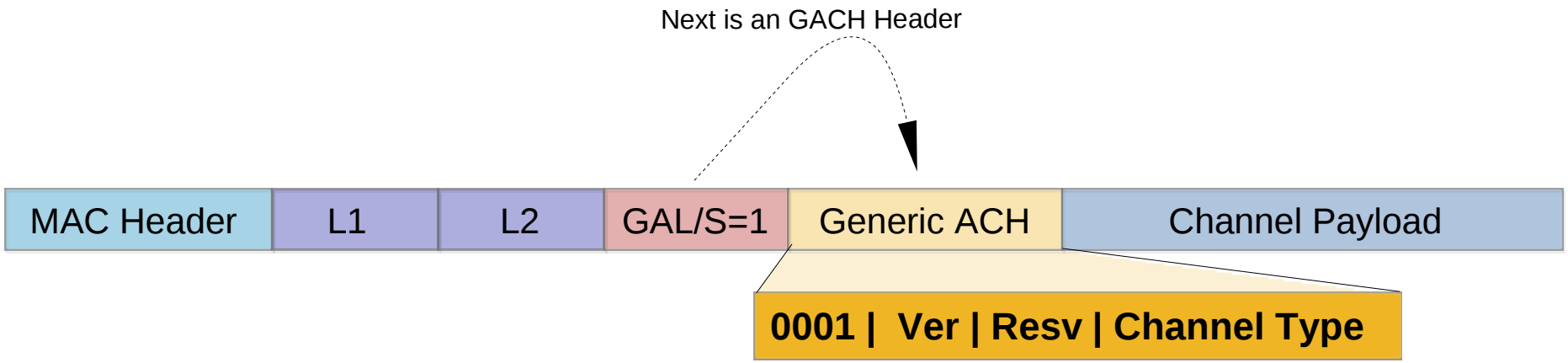


- External Static Provisioning

  NMS responsible for configuration and ensuring bi-direction congruency

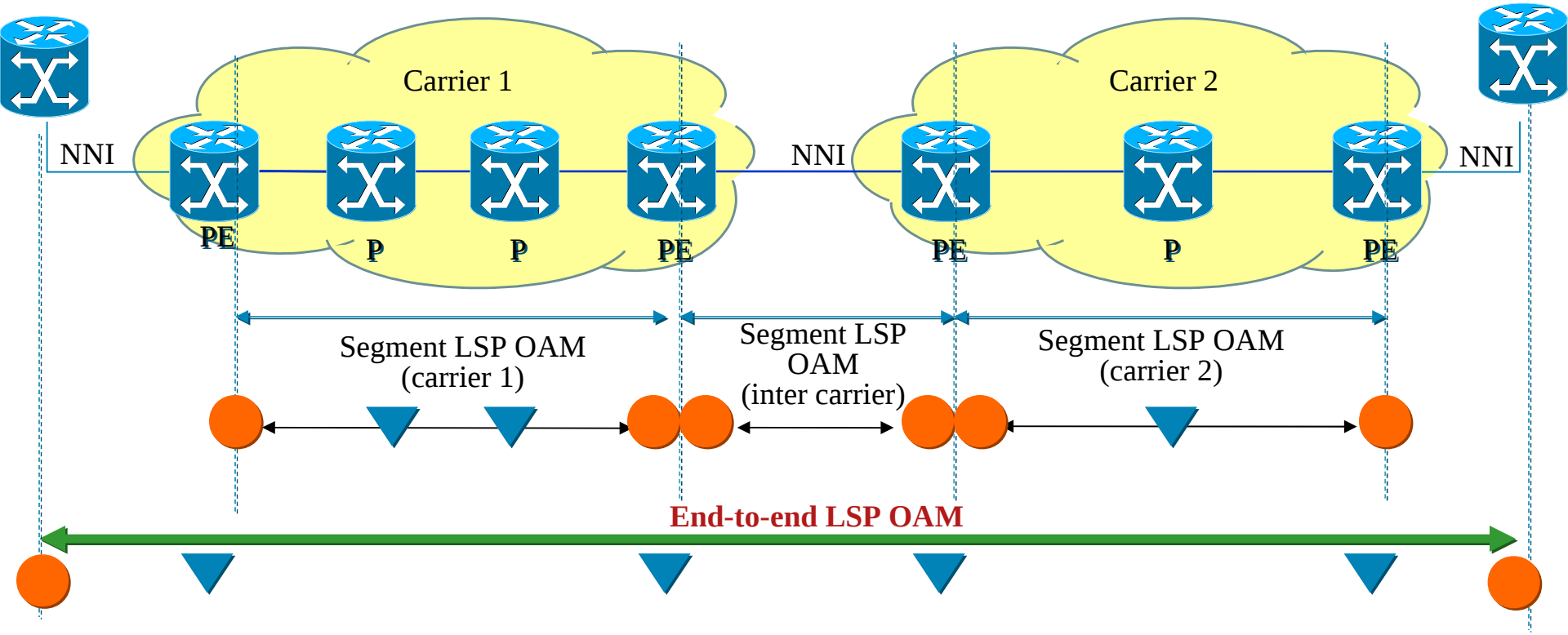
- If Dynamic Control Plane

  GMPLS bidirectional RSVP for LSP path establishment



- Assign a transport alert label as a GAL from reserved label space:
  - Label 13 has been proposed because,
  - Label 14 has been allocated to Y.1711
- Bottom of stack is always set on LFU in the transport profile
- Define a generic associated channel function
  - Similar to the PWE-3 Associated Channel but doesn't have to be associated with a PW
  - Important the first nibble tells system not to load balance (so not 06 or 04)
- Generic associated channel is always under a generic exception label if endpoint (MEP)
- Generalised Associated Channel defines what packet function using "channel type" field
  - Examples : What OAM function is carried, CC

LSP OAM
End-to-End and Per Carrier Monitoring

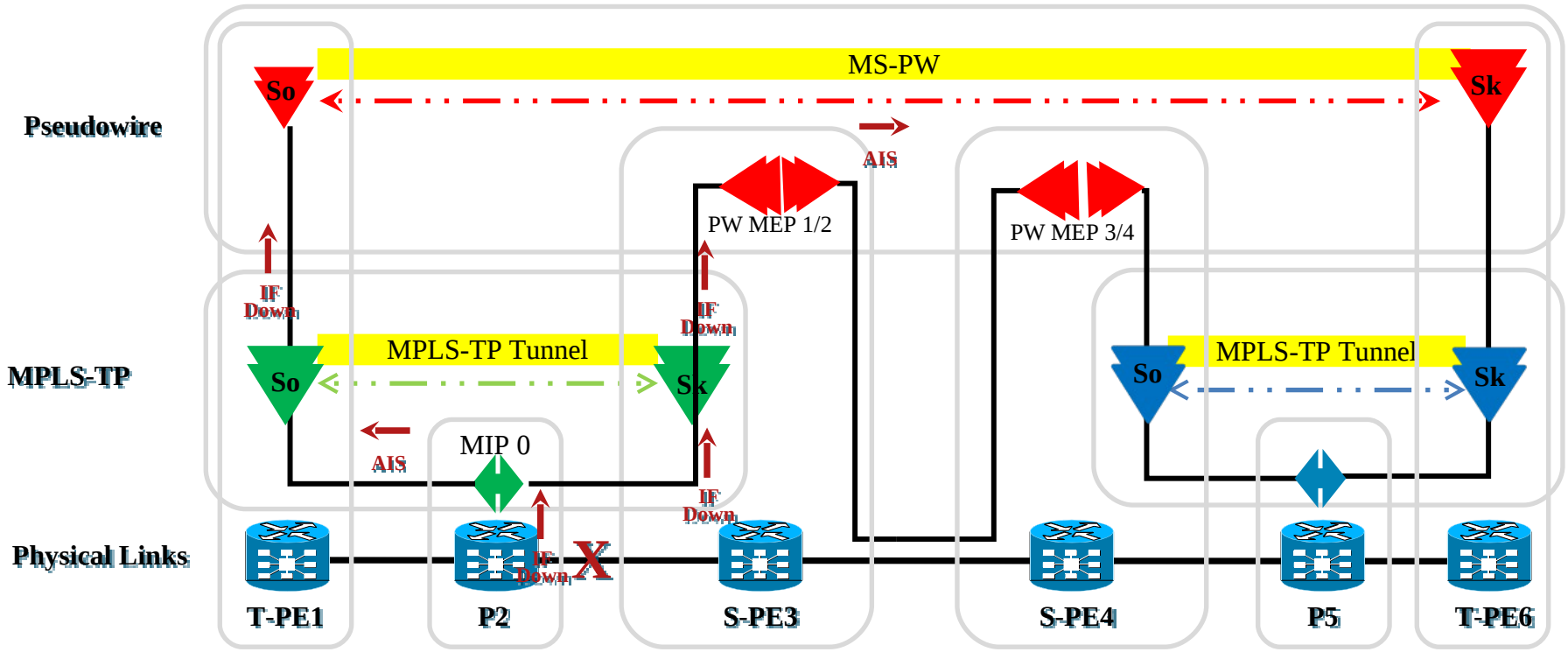


- A segment is between MEPs
- OAM is end-to-end or per segment
  - In SDH/OTN and Ethernet segment OAM is implemented using Tandem Connection Monitoring (TCM)
- The OAM in each segment is independent of any other segment
- Recovery actions (Protection or restoration) are always between MEPs i.e. per segment or end to end

Note: A policing function (traffic management/shaping) is normally co located with a MEP at a business boundary (UNI/NNI)

MEP: Maintenance End Point
MIP: Maintenance Intermediate Point

AIS Alarm Propagation



Link P2 - S-PE3 fails

At P2 IF Down sent to MIP 0; At S-PE3 IF Down sent to MEP Sk

MIP 0 sends AIS to MEP So

MEP So sends IF Down up to MEP So; MEP Sk sends IF Down up to MEP 1

These are IF Down events of TP Tunnel

MEP 1 sends AIS to MEP Sk

MEPs So Sk indicate that MS-PW is down; appropriate Attachment Circuit OAM is sent

MEP

MIP

IETF 76 – Hiroshima , Update

- Lot's of work : 3 WG meetings and 4 breakout sessions.
- New request for unidirectional link protection.
  - –This is not possible, it will break all timing protocols.
- BFD discussion is still ongoing:
  - – Proposal 1: requirement to statically configure packet frequency. (start at 3.3ms interval) No negotiation possible.
  - –Proposal 2: start at a large interval 10s , and quickly negotiate down not required value.
- Static PW status protocol Draft accepted as WG doc.
- New PW MEP definition.

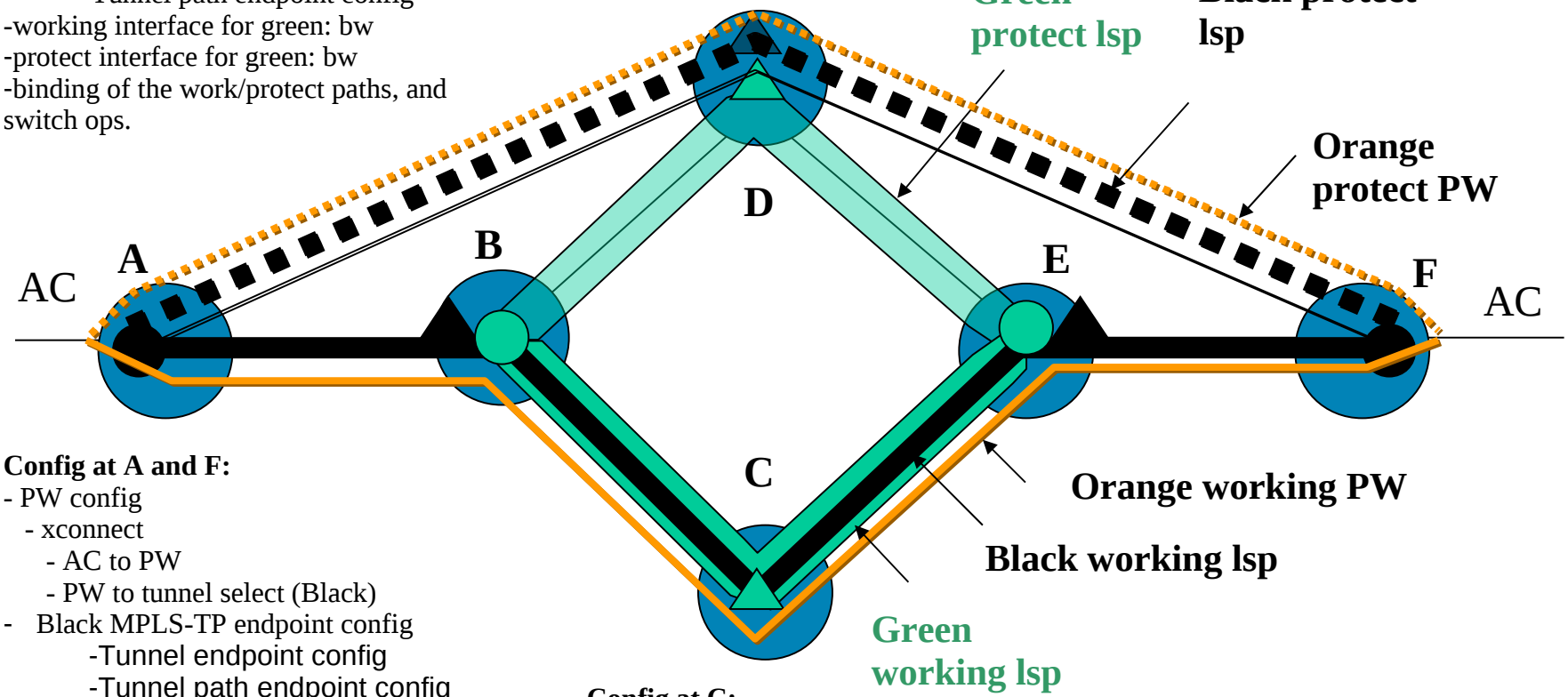
Update Con't

- Ring Protection:
  - –Discussion started.
  - –Many many proposals.
  - –Some initial consolidation int 2 proposals.
- MIP problem:
  - –Requirement from some providers to have one MIP per card in the box. (NTT)
  - –We do not design protocols to fit a specific hardware design.
  - –Settling on ingress , and egress loop function.

MPLS-TP Tunnel Construct Example

Config at B and E:
-Black MPLS-TP midpoint:
Tunnel path midpoint config
-Green MPLS-TP endpoint:
- Tunnel endpoint config
- Tunnel path endpoint config
-working interface for green: bw
-protect interface for green: bw
-binding of the work/protect paths, and switch ops.

Config at D:
- Green MPLS-TP tunnel path midpoint config
- Black MPLS-TP tunnel path midpoint: config



Config at A and F:
- PW config
  - xconnect
    - AC to PW
    - PW to tunnel select (Black)
- Black MPLS-TP endpoint config
  -Tunnel endpoint config
  -Tunnel path endpoint config
- working interface for black: bw
- protect interface for black: bw
- binding of the work/protect paths, and switch ops.

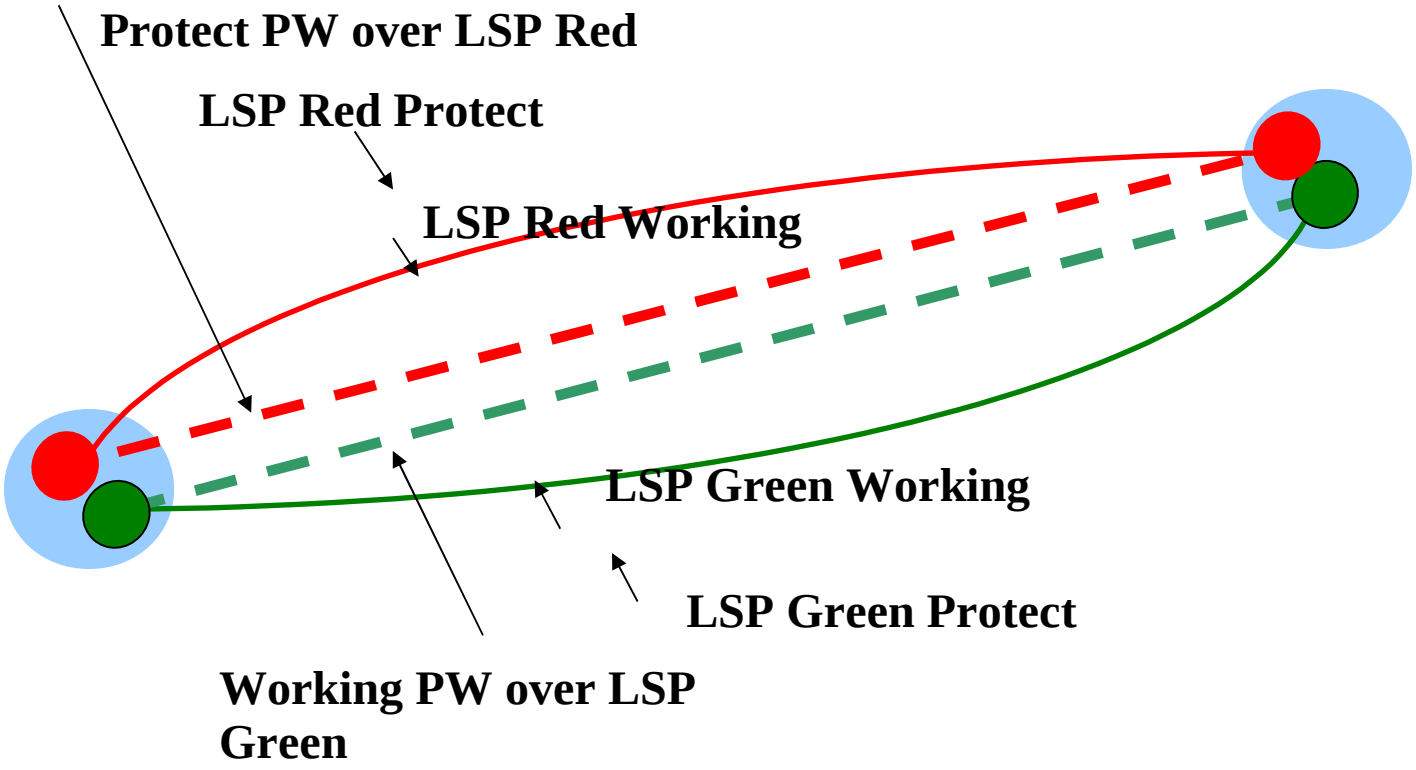
Config at C:
- Green MPLS-TP tunnel midpoint config

Black lsp: working path: A-B-Green LSP-E-F
protect path: A-D-F
Green lsp: working path: B-C-E
protect path: B-D-E

Tunnel Endpoint

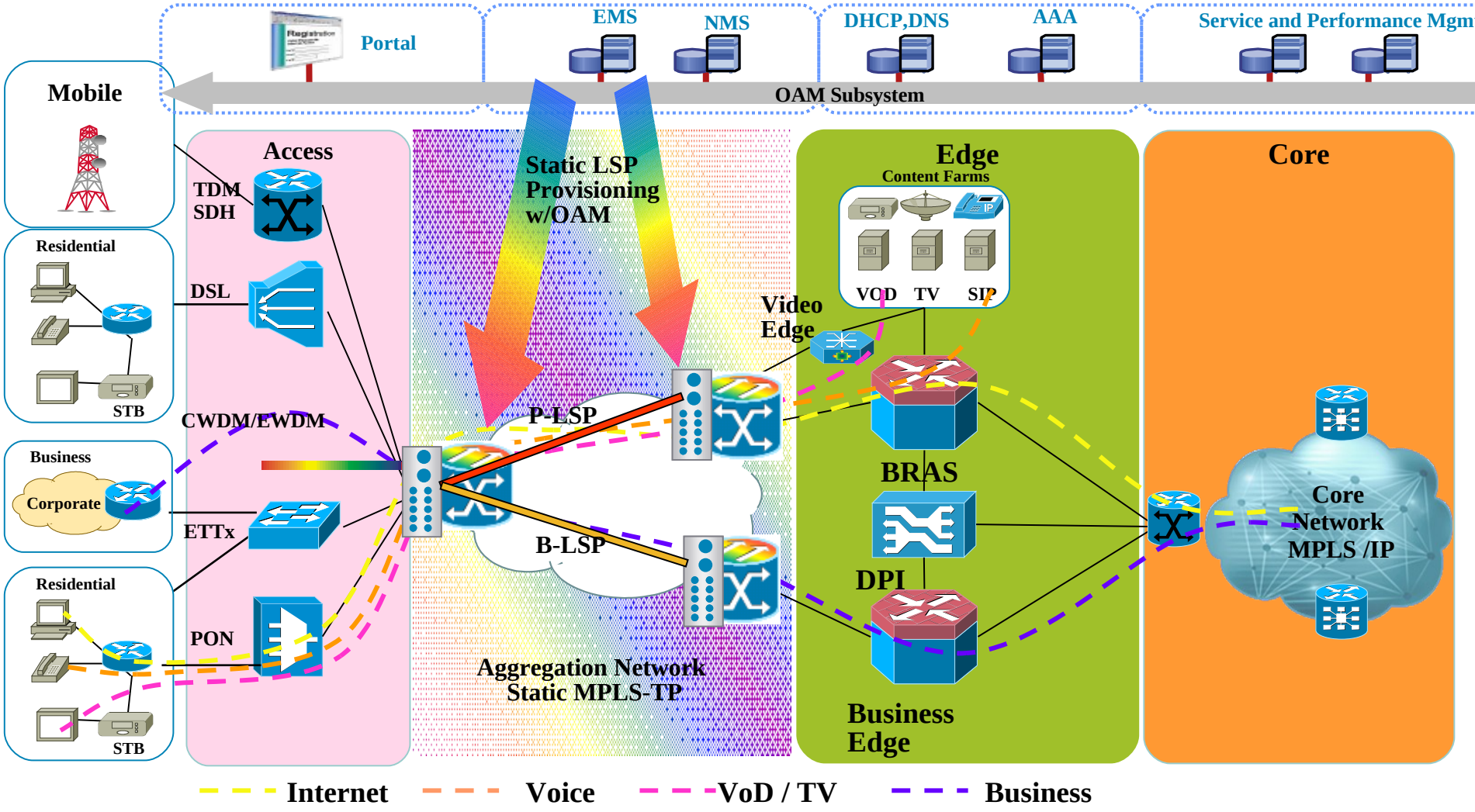
Tunnel Midpoint

LSP and PW working/protect Relationships



- The working PW is configured over lsp Green tunnel interface with working and protect paths.
- When lsp Green working path fails, it switches to lsp Green Protect. No PW switching is needed.
- PW redundancy takes place only when both lsp Green Working and Protect paths fail, in that case, PW will switch to the protect PW which is configured on the lsp Red tunnel interface with working and protect path.

Deployment Scenario: MPLS-TP – deployment example



Summary and Takeaways

- T-MPLS is dead!
  - Making rapid progress in the IETF.
- Industry now behind MPLS-TP
- MPLS-TP is just OEM extensions to MPLS, and a subset of MPLS.
- NO Change to the MPLS base architecture.
- Cisco is leading the effort.


Questions ?
MPLS