MPLS & Transport MPLS
What is the difference?

Marc Lasserre

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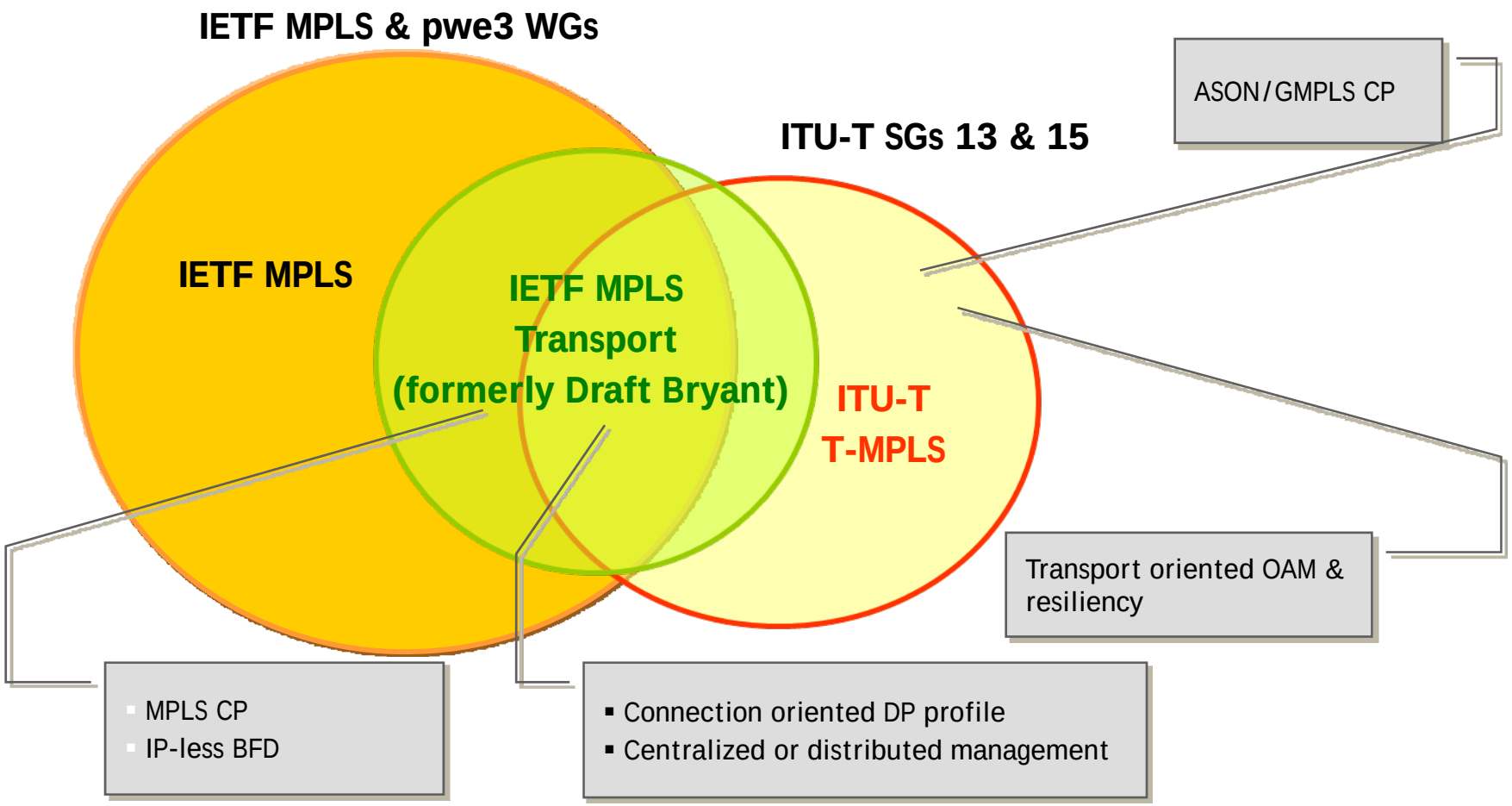
Agenda

- Background
- What is T-MPLS?
- MPLS & T-MPLS Comparison
- MPLS/T-MPLS Interconnection Models
- Summary

MPLS – T-MPLS relationship



While much is in common, there are certain OAM and CP differences

Rationale for Transport MPLS

Transport evolves to support increasingly packet-based Services:

- Past - pure TDM (SONET/SDH)
- Present - MSPP (Ethernet over SONET/SDH)
- Evolving to Packet Transport

IP/MPLS networks perceived by some as expensive and complex

The alternative is combining:

- Architectural, management and operational models of Circuit Switched transport networks with
- Packet switching optimizations

Solution - Transport-optimized MPLS

- MPLS Data Plane
- Extended OAM & Protection capabilities

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What is T-MPLS?

T-MPLS as a subset of MPLS

- MPLS label switching
- No IP routing
- No PHP, no ECMP, no merging
- Bi-dir LSPs (as defined in GMPLS)

Why a “profile” of MPLS?

- Traditional transport networks have strong OAM & resiliency mechanisms
  - Status & perf. monitoring
  - Per-segment monitoring
  - E2e protection (linear & ring)
- Provisioning
  - Centralized management tool and/or CP

T-MPLS = MPLS Subset + Extended OAM/Protection capabilities

Key T-MPLS Characteristics

CO-PS

- TE p2p bi-dir LSPs

  Similar to TDM circuit switching paradigm

  E2e protection

- No support for connectionless mode

Separation of CP and DP

- Ability to use either NMS or GMPLS for connection setup
- Ability to decouple OAM & protection functions from other layers

  E.g. in MPLS, OAM & protection dependent upon IP layer (e.g. LSP ping, VCCV, FRR)

IETF “draft-bryant”

Draft-ietf-pwe3-mpls-transport

- Application of Ethernet PWs to MPLS Transport Networks

Transport of MPLS over MPLS

- MPLS over Ethernet PW over MPLS

Static PWs over static or dynamic LSPs

No merging, PHP, ECMP

Uni & bi-dir LSPs

Use of VCCV/BFD

Summary of MPLS/draft-bryant/T-MPLS Differences: Dataplane

	MPLS	Draft-bryant	T-MPLS
Dataplane			
		Static tunnel LSP	**Static tunnel LSPs**
		Uni-dir LSPs	*Uni-dir LSPs*
		Symetrical bi-dir LSPs	Symetrical bi-dir LSPs
		No ECMP/No PHP/No Merging	No ECMP/No PHP/No Merging
	Dynamic tunnel LSP	**Dynamic tunnel LSP**	
	RSVP-TE for uni-dir LSP	RSVP-TE for uni-dir or GMPLS for bi-dir	GMPLS in future
		No label merging except if FRR is used	
		No ECMP/No PHP	

Summary of MPLS/draft-bryant/T-MPLS Differences: Signaling

	MPLS	Draft-bryant	T-MPLS
PW Signaling	T-LDP	Static	Static T-LDP (Future)
Tunnel Signaling			
	RSVP-TE	RSVP-TE	Static
	LDP	GMPLS for bi-dir tunnels (RFC3471)	GMPLS in future

Summary of MPLS/draft-bryant/T-MPLS Differences: OAM

	MPLS	Draft-bryant	T-MPLS
OAM			
	PW level	**PW level**	
	T-LDP PW status		
	VCCV/BFD	VCCV/BFD with or without IP/UDP	G.8114
	LSP level	**LSP level**	
	LSP ping/traceroute	LSP ping for dynamic LSPs	G.8114
	BFD	Future IP-less BFD (TBD)	
Protection			
	FRR, Active/Standby	FRR for dynamic LSPs	Linear, Ring, DNI

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T-MPLS Applications

Complement Circuit Switching (SDH/OTH/WDM) with Packet Switching in Multi-layer Transport networks

Convey Multi-service traffic:

- Ethernet
  - P2p through PW or direct mapping
  - Mp2mp through VPLS
- Any Layer 2
  - Through PW

MPLS & T-MPLS OAM

MPLS OAM

- PW Connectivity: VCCV
  - Fault Detection & Diagnostics
  - Continuous & on-demand
  - VCCV Flavors
    - VCCV-Ping
    - VCCV-Bfd
      - IP-less BFD
      - BFD with IP/UDP
- LSP connectivity Check
  - LSP Ping/TR
    - Dataplane failure detection
    - Consistency check between data & ctrl planes (ingress/egress FEC checks)
  - BFD
    - Fast dataplane failure detection
    - Fixed frame format

T-MPLS OAM

- Use of Y.1711/G.8114 for both LSP & PW layers
  - CV: Connectivity Verification (heartbeat)
  - Y.17fec-cv
  - FFD: Fast Failure Detection (fast heartbeat)
  - FDI/BDI: Forward & Backward Defect Indication
  - PM: Performance Management

What is different between MPLS & T_MPLS OAM?

- Convergence towards commonality
  - Reliance on IP for some MPLS OAM tools is being addressed
    - PW OAM: e.g. VCCV-BFD
  - Fast heartbeat functions such as CV & FFD can be achieved with BFD
  - Dissimilar OAM tools at tunnel & service layer
    - BFD is applicable for both PW and LSP
- Strong PM capabilities do not exist yet for MPLS
  - Reliance on MIB counters/SAA

Future: Transport OAM principles to be applied to MPLS

T-MPLS vs. MPLS Resilience

Functionality	T-MPLS	MPLS	Remarks
End-to-end 1+1, 1:1, 1:n Protection	APS	Relies on: IP for dynamic LSP Future IP-less BFD for static LSP	Relies on IGP timers Fast if BFD is HW-assisted
Ring Protection	APS, in standardization	None	
Local bypass	APS for section protection	FRR	
Segmented Protection	Segment 1+1, 1:1, 1:n; DNI	None	
Restoration	GMPLS	MPLS Control Plane	

What's different between MPLS & T_MPLS Protection?

- Sub-50 msec protection supported by both
  - MPLS: FRR or e2e protection with h/w assisted IP-less BFD or ECMP
- Local repair useful when LSP span large geographical areas
- IP reliance can be addressed with IP-less BFD
  - Similar e2e protection with MPLS when FRR is not desired

Applicability for both local and e2e protection schemes

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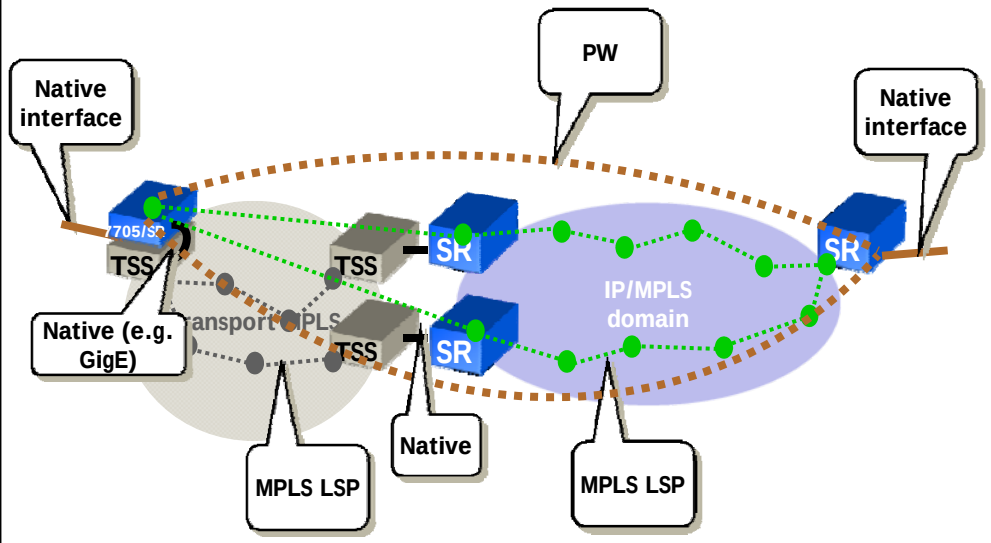
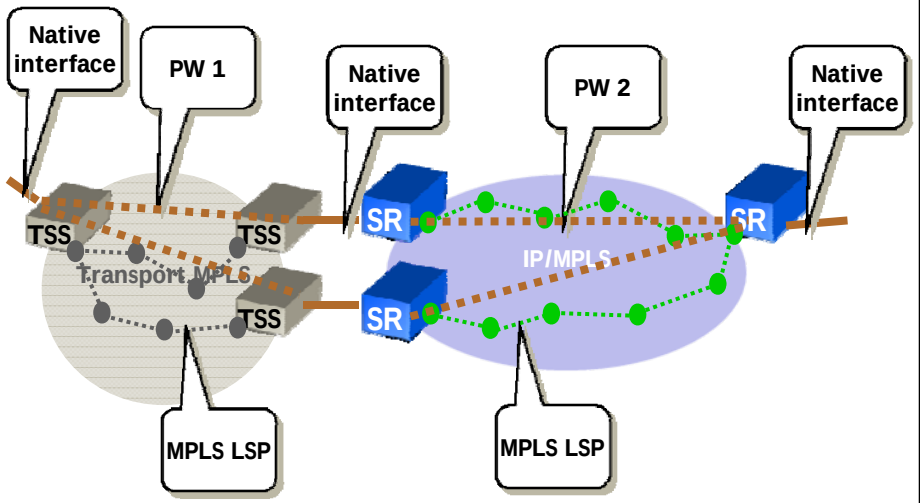
Overlay & Native Models

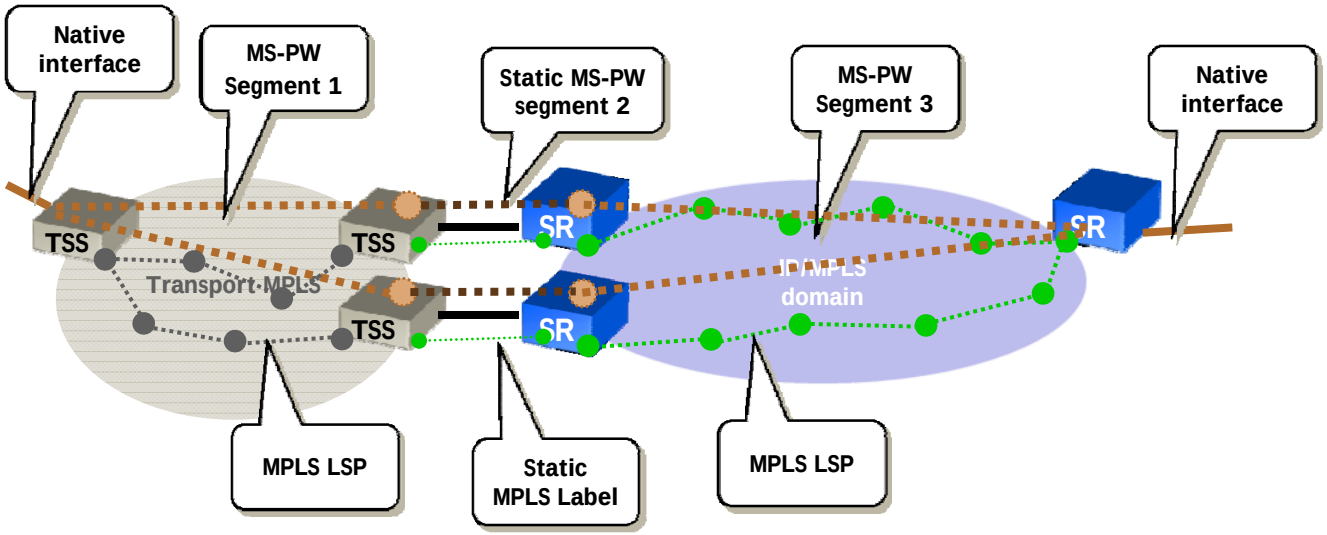




Technical Analysis	
OAM	1. Per domain: VCCV-BFD with G.8114 with G.8114-like extensions 2. E2E: IP/MPLS (e.g. LSP Ping, VCCV-Ping)
Protection	Path protection + FRR in IP/MPLS
Operations	Similar to current network: disjoint layers

Technical Analysis	
OAM	1. Per domain: VCCV-BFD with G.8114-like extensions 2. E2E: client-layer (e.g. Native ATM OAM, 802.1ag)
Protection	1. Path protection + FRR in IP/MPLS 2. E2E: BFD/VCCV-BFD extensions to propagate down events
Operations	Per domain

PW Interconnect

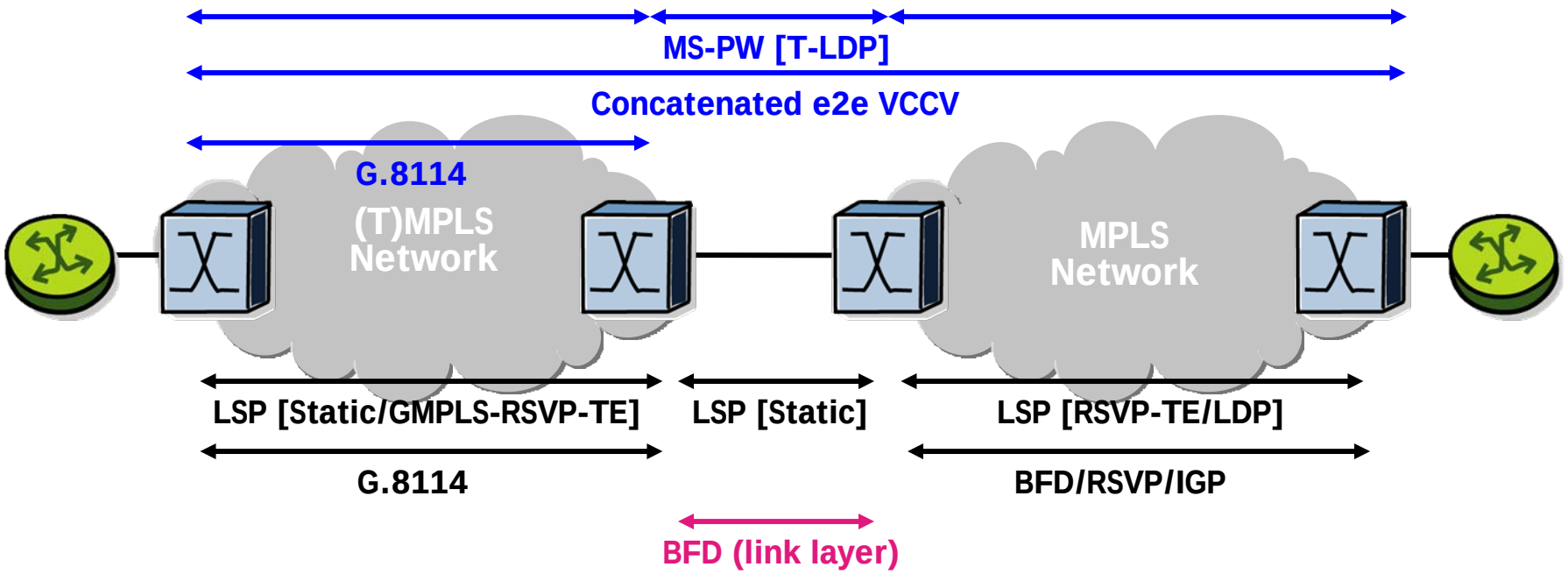


Technical Analysis	
OAM	LSP: BFD-ng (G.8114-like extensions) PW: T-LDP PW Status/VCCV-ng
Protection	PW: Active/standby via PW status, MS-PW based in future LSP: Path Protection(*) and/or FRR
Provisioning	1. Static MS-PW provisioning/stitching 2. e2e MS-PW via T-LDP
Operations	Static LSP: Segment stitching in SR/ TSS border node

PW Options	
Static PW (No T-LDP)	VCCV-BFD for protection/CV PM: TBD (e.g. VCCV-ng)
Dynamic PW (T-LDP FEC 128)	PW status PM: TBD (e.g. VCCV-ng)
Hybrid (Static/Dynamic PW)	VCCV-BFD for protection/CV PM: TBD (e.g. VCCV-ng)

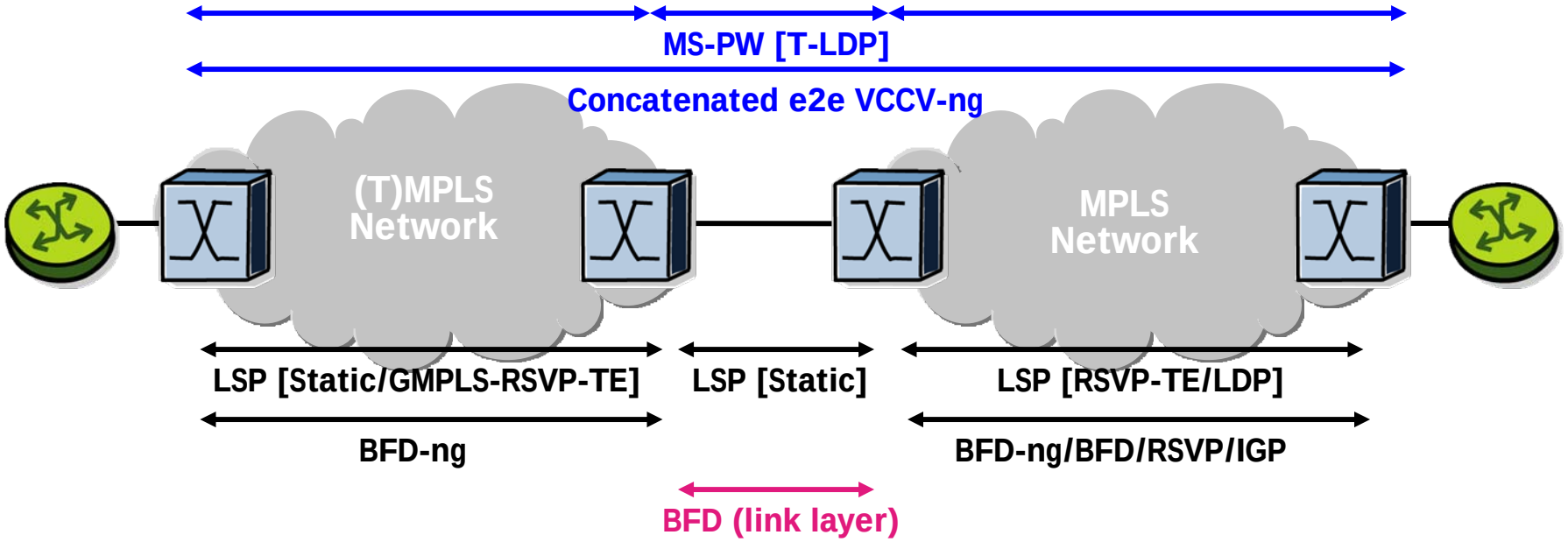
(*) Segment protection
- Pro: preferred by transport people
- Con: does no scale in large environments

PW Interconnect: OAM Model (Current)



PW Interconnect: OAM Model (Future)

VCCV-ng (with G.8114-like capabilities) runs end-to-end -> Common PW OAM and capabilities



BFD-ng (with G.8114-like capabilities) runs independently within each segment

Redundancy at Interconnect points

Failure Propagation

- E-LMI-like protocol

Redundancy

- MC-LAG/MC-APS
- DNI

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T-MPLS is MPLS!

T-MPLS defines extensions to MPLS OAM and Protection

- Per ITU-T Transport practices

Seamless MPLS & T-MPLS inter-working

- Native hand-off/Overlay
- PW interconnect

Future MPLS & T-MPLS standards convergence

Q & A