MPLS-TP OAM in Packet Transport Network (PTN)

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Contents



PTN Overview and Technology Advantages

- Why & What is PTN?
- PTN technology and its evolution
- MPLS-TP OAM Overview and standard progress

• MPLS-TP OAM in PTN

- Comprehensive and Hierarchical OAM in PTN
- MPLS-TP OAM Options: GACH+Y.1731 vs. BFD Extension/LSP Ping
- MPLS-TP OAM Implementation in PTN
- Migration to Standard MPLS-TP OAM

PTN Key Application & Case-studies

- Key Applications
- China Operators PTN Case Studies

Conclusion

Mobile Data Growth Drivers





Major Challenges for Service Providers





How to deal with Packet Traffic Growth: Rapid Growth in 3G Mobile and Broadband subscribers worldwide driving the demand for high-speed packet transport



How to improve revenue: Despite the subscriber growth, ARPU is going down. Networks are too complex, difficult to scale, and expensive to maintain. Energy and Realestate are another major challenges



How to offer New Services: Current transport network infrastructure is not adequate to offer evolving mobile services such as LTE and advanced enterprise services (e.g., EPL, EVPL)



Transport Vendors

- Transport based technology
 - Telecom world
 - Connection-oriented, fully controlled by Carrier
- NG-SDH, T-MPLS, RPR
 - Metro aggregation

Router/Switch Vendors

- Router/Switch based technology
 - Internet world
 - Connectionless, loosely controlled, "peer-to-peer", "plug and play"
- IP/MPLS/VPLS
 - Metro core to Metro aggregation

Choices for Service Providers



1	CONTINUE deploying SDH/ SONET for transport	But…	Doesn't scale for packet traffic No support for statistical multiplexing – bandwidth inefficient High CAPEX
2	THINK Switch/Router for data Network	But…	Connection-less approach High OPEX – complex operation Difficult to troubleshoot – weak OAM Doesn't meet 3.5G/4G synchronization requirements
3	DEPLOY Packet Transport Network		Low TCO Connected Oriented Statistical multiplexing; Powerful OAM functions Meets mobile synchronization requirements
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What is **PTN**?





Note: PTN is sometimes also referred to as P-OTS or POTP

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PTN Technology Choices



PTN Technology Choices

T-MPLS

 A new formulation of MPLS, being standardized by ITU-T, and designed specifically for a connection-oriented packet transport network based on well-known and widely deployed IP/MPLS technology and standards

T-MPLS = *MPLS* (*PW/LSP*) + OAM – L3 Complexity

PBB-TE

 A subset of IEEE Provider Backbone Bridging (802.1ah) that turns Ethernet connectionless networking into a provisioned connection-oriented transport network primarily for point-to-point Ethernet virtual connections

PBT = Ethernet (MAC/MAC)+OAM – L2 Complexity



PTN Standards Overview





MPLS-TP Overview





MPLS-TP OAM Overview



- OAM (Operation, Administration, and Maintenance) Basic Roles
 - Fault Detection & diagnostic: Continuity Check/Connectivity Verification (CC/CV), Loopback (LB)
 - Alarm and Alarm suppress: Generate alarm when fault happens but suppress large volume alarm through AIS/RDI (Alarm Correlation Suppression)
 - Performance monitor: packet loss ratio (LM), delay measurement (DM)
 - Maintenance tools: Link track (LT), Lock (LCK)
 - APS OAM: Linear and Ring APS

• MPLS-TP OAM with IETF and ITU-T

 ITU-T and IETF in many technical aspects of the compromise, MPLS-TP OAM inherited the T-MPLS G.8114 part of the agreement, but the rest of codecs and

protocols supplementary part, by the major inheritance from the IETF.



MPLS-TP OAM Standard Progress Update(1)



CLASS	NAME	SOURCE	STATUS	DATE
Requirement	The Requirement of MPLS-TP OAM	A-L/Juniper/M. Betts	RFC5860	2010-05
Framework	MPLS-TP OAM Framework draft-ietf-mpls-tp-oam-framework-09	A-L/BT/Ericsson	Publication Requested	2010-10-07
Concept	"The OAM Acronym Soup" draft-ietf-opsawg-mpls-tp-oam-def-07	Ericsson/ Huawei/Juniper/Avaya	AD is watching	2010-09-27
Analysis	MPLS-TP OAM Analysis draft-ietf-mpls-tp-oam-analysis-02	NSN/Ericsson	I-D Exists	2010-07-04
Allalysis	Telecom operator considerations of MPLS-TP OAM draft-fang-mpls-tp-oam-considerations-00	CATR/CMCC/TI/CT/CU	I-D Exists	2010-06-07
	MPLS Generic Associated Channel	A-L/Cisco	RFC 5586	2009-09
Package	The definition of ACH TLV architecture draft-ietf-mpls-tp-ach-tlv-02	Cisco/Juniper	Expired	2010-3-5
	The package of LSP-Ping and BFD draft-ietf-mpls-tp-lsp-ping-bfd-procedures-00	Juniper/BT/NSN	I-D Exists	2010-08-22
	MPLS-TP Identifiers draft-ietf-mpls-tp-identifiers-02	A-L/Cisco	I-D Exists	2010-07-12
ldentifier	MIP MPLS-TP OAM packet process draft-farrel-mpls-tp-mip-mep-map-03	Huawei/Hitachi	I-D Exists	2010-10-15
	MPLS-TP UAIN maintenance draft-koike-ietf-mpls-tp-oam-maintenance-points- 01	NTT/DT	Expired	2010-03-09
Fault Management	MPLS-TP Fault Management OAM draft-ietf-mpls-tp-fault-02	Cisco/Ericsson/ A- L/Juniper	I-D Exists	2010-07-05

MPLS-TP OAM Standard Progress Update(2)



OAM toolMPLS-TP OAM Primer draft-sprecher-mpls-tp-oam-primer-01NSN/ EricssonI-D Exists2010-07-09OAM Total SolutionMPLS-TP OAM base on Y.1731 draft-bhh-mpls-tp-oam-y1731-05A-L/HuaweiI-D Exists2010-7-12Proactive C/CV/RDIMPLS-TP Proactive CV/CC and RDI draft-ietf-mpls-tp-cc-cv-rdi-01Ericsson/Cisco/ JuniperI-D Exists2010-07-12Proactive C/CV/RDIMPLS-TP Proactive CV/CC and RDI draft-ietf-mpls-tp-cc-cv-rdi-01Ericsson/Cisco/ JuniperI-D Exists2010-07-02MPLS on-demand CV, route trace and NF draft-intinb-mpls-tp-on-demand-cv-00Juniper/Cisco/Ericsson /I-D Exists2010-07-02Don-demand CC/CVMPLS on-demand CV, route trace and NF draft-absw-mpls-tp-ing-mpls-tp-oam-conf-00Line Exists2010-07-02Loopback and Lock IndicatorMPLS-TP LSP loopback draft-boutros-mpls-tp-li-lb-01Ericsson/SExpired2010-07-02Loopback and Lock IndicatorMPLS-TP LSP loopback draft-boutros-mpls-tp-li-lb-01Ericsson/NSExpired2010-07-02LockMPLS-TP LSP loopback draft-boutros-mpls-tp-lailb-01Ericsson/NSExpired2010-07-02Diagnostic toolMPLS-TP diagnostic test tool draft-film-mpls-tp-oam-diagnostic-test-01AL/CMCC/CTCI-D Exists2010-07-02Diagnostic toolMPLS-TP packet loss and delay measurement draft-tieff-mpls-tp-loss-delay-00Exist2010-07-022010-07-02Diagnostic toolMPLS-TP packet loss counting active/de-active Extension of packet loss counting active/de-activeAL/CMCC/CTCI-D Exists20	CLASS	NAME	SOURCE	STATUS	DATE
OAM Total SolutionMPLS-TP OAM base on Y.1731 draft-bhh-mpls-tp-oam-y1731.05A-L/HuaweiI-D Exists2010-7-12Proactive CC/CV/RDIMPLS-TP Proactive CV/CC and RDI draft-ietf-mpls-tp-cc-cv-rdi-01Ericsson/Cisco/ JuniperI-D Exists2010-07-12MPLS on-demand CV, route trace and NF draft-nitinb-mpls-tp-on-demand-cv-00Juniper/Cisco/Ericsson / non-demand CV/ for trace and NF (arft-nitinb-mpls-tp-on-demand-cv-00Juniper/Cisco/Ericsson / I-D Exists2010-07-26Loopback and LockMPLS TP LSP loopback draft-boutros-mpls-tp-ling-mpls-tp-oam-conf-00Ericsson/ JuniperI-D Exists2010-07-02LockMPLS-TP LSP loopback draft-boutros-mpls-tp-linb-01Cisco/Juniper/AL/ ZTEI-D Exists2010-07-02Path traceMPLS-TP diagnostic test tool draft-fil-mpls-tp-oam-diagnostic-test-01CiscoExpired2009-07-02Diagnostic toolMPLS-TP packet loss and delay measurement draft-ietf-mpls-tp-loss-delay-00CiscoI-D Exists2010-07-02Extension of packet loss counting active/de-active Extension of packet loss counting active/de-activeArtI-D Exists2010-07-02	OAM tool	MPLS-TP OAM Primer draft-sprecher-mpls-tp-oam-primer-01	NSN/ Ericsson	I-D Exists	2010-07-05
Proactive CC/CV/RDIMPLS-TP Proactive CV/CC and RDI draft-ietf-mpls-tp-cc-cv-rdi-01Ericsson/Cisco/ JuniperI-D Exists2010-07-11mon-demand CC/CV 	OAM Total Solution	MPLS-TP OAM base on Y.1731 draft-bhh-mpls-tp-oam-y1731-05	A-L/Huawei	I-D Exists	2010-7-12
on-demand CC/CVMPLS on-demand CV, route trace and NF draft-nitinb-mpls-tp-on-demand-cv-00Juniper/Cisco/Ericsson /I-D Exists2010-07-26LSP Ping configuration for Proactive PLS-TP OAM draft-absw-mpls-lsp-ping-mpls-tp-oam-conf-00Ericsson/ 	Proactive CC/CV/RDI	MPLS-TP Proactive CV/CC and RDI draft-ietf-mpls-tp-cc-cv-rdi-01	Ericsson/Cisco/ Juniper	I-D Exists	2010-07-12
On-demand CO/CV draft-absw-mpls-lsp-ping configuration for Proactive PLS-TP OAM draft-absw-mpls-lsp-ping-mpls-tp-oam-conf-00Ericsson/ JuniperI-D Exists2010-07-01Loopback and Lock IndicatorMPLS-TP LSP loopback draft-boutros-mpls-tp-li-lb-01Cisco/Juniper/AL/ ZTEI-D Exists2010-07-06Lockdraft-fulignoli-mpls-tp-ais-lock-tool-01Ericsson/NSExpired2009-07-16Path tracedraft-boutros-mpls-tp-path-trace-00CiscoExpired2009-07-06Diagnostic toolMPLS-TP diagnostic test tool draft-flh-mpls-tp-oam-diagnostic-test-01AL/CMCC/CTCI-D Exists2010-05-11MPLS-TP packet loss and delay measurement draft-ietf-mpls-tp-loss-delay-00CiscoI-D Exists2010-07-26Extension of packet loss counting active/de-activeTTEI-D Exists2010-07-26	on domand COIOV	MPLS on-demand CV, route trace and NF draft-nitinb-mpls-tp-on-demand-cv-00	Juniper/Cisco/Ericsson /	I-D Exists	2010-07-26
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Lockdraft-fulignoli-mpls-tp-ais-lock-tool-01Ericsson/NSExpired2009-07-13Path tracedraft-boutros-mpls-tp-path-trace-00CiscoExpired2009-07-06Diagnostic toolMPLS-TP diagnostic test tool draft-filh-mpls-tp-oam-diagnostic-test-01AL/CMCC/CTCI-D Exists2010-05-13MPLS-TP packet loss and delay measurement draft-ietf-mpls-tp-loss-delay-00CiscoI-D Exists2010-07-26Extension of packet loss counting active/de-activeTTEI-D Exists2010-07-26	Loopback and Lock Indicator	MPLS-TP LSP loopback draft-boutros-mpls-tp-li-lb-01	Cisco/Juniper/AL/ ZTE	I-D Exists	2010-07-06
Path trace draft-boutros-mpls-tp-path-trace-00 Cisco Expired 2009-07-06 Diagnostic tool MPLS-TP diagnostic test tool draft-flh-mpls-tp-oam-diagnostic-test-01 AL/CMCC/CTC I-D Exists 2010-05-16 MPLS-TP packet loss and delay measurement draft-ietf-mpls-tp-loss-delay-00 Cisco I-D Exists 2010-07-26 Extension of packet loss counting active/de-active TTE I-D Exists 2010-07-26	Lock	draft-fulignoli-mpls-tp-ais-lock-tool-01	Ericsson/NS	Expired	2009-07-13
Diagnostic tool MPLS-TP diagnostic test tool AL/CMCC/CTC I-D Exists 2010-05-11 MPLS-TP packet loss and delay measurement Cisco I-D Exists 2010-07-26 Extension of packet loss counting active/de-active TTE I-D Exists 2010-07-26	Path trace	draft-boutros-mpls-tp-path-trace-00	Cisco	Expired	2009-07-06
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Extension of packet loss counting active/de-active		MPLS-TP packet loss and delay measurement draft-ietf-mpls-tp-loss-delay-00	Cisco	I-D Exists	2010-07-26
draft-xiao-mpls-tp-lm-counting-extension-00	Performance	Extension of packet loss counting active/de-active draft-xiao-mpls-tp-lm-counting-extension-00	ZTE	I-D Exists	2010-07-05
MPLS-TP Throughput estimation draft-xiao-mpls-tp-throughput-estimation-01 ZTE I-D Exists 2010-10-15		MPLS-TP Throughput estimation draft-xiao-mpls-tp-throughput-estimation-01	ZTE	I-D Exists	2010-10-15
Client Signal Failure draft-he-mpls-tp-csf-02 Huawei/CMCC I-D Exists 2010-07-12	Client Signal Failure	draft-he-mpls-tp-csf-02	Huawei/CMCC	I-D Exists	2010-07-12

Contents



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Comprehensive & Hierarchical OAM in PTN



- Based on Ethernet, ITU-T, and MPLS-TP standards
- Multi-layer OAM support
 - Client Layer: ATM, SDH/SONET, and Ethernet
 - > <u>MPLS-TP Layer</u>: PW and LSP (*using associated channel mechanism as shown below*)
 - Network Uplink layer: Ethernet and SDH/SONET

LSP monitoring and alarming

Generic Exception Label and Generic Associated Channel Many options including Non IP BFD is an option encapsulation of Y.1731 pdu

Ethernet Header	L2	LFU/BoS	Generic ACH	Channel Payload
			0001 Ver R	esv Channel Type

Pseudo-wire monitoring and alarming PW-Associated Channel

 Ethernet Header
 L1
 L2
 PWL/BoS
 PWE-3 ACH
 Channel Payload

 0001 |
 Ver |
 Resv |
 Channel Type

MPLS-TP OAM Functions and Implementation



Class	Туре	Function	T-MPLS G.8114	MPLS-TP (draft-bhh-Y.1731)	MPLS-TP (9 other drafts)
Multi- ownership	Degree	Network, multi-domain link	n*8	Label stacking	Label stacking
	Statuc	Continuity Check	CV.CC	CCM.CC	BFD async+ext.[WIP]
	Status	Connectivity Verification	CV(TTSI)	CCM(MEG-IG+MEP-ID	BFD extensions[WIP]
	Performa	Broken	CV.CC,CV.RDI	CCM, CC, CCM, RDI	BFD status+ext.[WIP]
Proactive	nce	Frame loss	CV.LM	CCM.LM, LMM/LMR	New PM tool[WIP]
Monitor		Alarm supress	FDI	AIS	New PM tool[WIP]
	Maintena	Lock Indication	LCK	LCK	New PM tool[WIP]
	nce	Remote failure indication	CV.RDI	CCM. RDI	BFD diag extensions[WIP]
		Client signal idication	CSF	CSF	New PM tool[WIP]
	Status	Connectivity Verification	LBM/LBR	LBM/LBR	LSP Ping extensions[WIP]
		Frame loss	LMM/LMR	LMM/LMR	New PM tool[WIP]
	Performa	Frame Delay	DMM/DMR,1DM	DMM/DMR,1DM	New PM tool[WIP]
on-demand Monitor	nce	Frame Delay Variance	DMM/DMR,1DM	DMM/DMR,1DM	New PM tool[WIP]
		Throughput	LBM/LBR,TST	LBM/LBR,TST	New tool[WIP]
	Failure	Path Connectivity	LBM/LBR	LBM/LBR	LSP Ping extensions[WIP]
	Isolation	Stream Connectivity	-	-	LSP Traceroute ext.[WIP]
Communic ation	Protection	head/tail-end sync	APS	APS	New PSC tool[WIP]
Channel	General	ECC for MCN/SCN	MCC,SCC	MCC,SCC[RFC5718]	MCC,SCC[RFC5718]

MPLS-TP Implementation in PTN



- Pre-standard MPLS-TP OAM Implementation in PTN
 - Send OAM packet between MEP/MIP in PTN network. Detect fault and performance through OAM packet exchanges, generate alarm and related process
 - Pre-standard MPLS-TP OAM mechism is implemented in current PTN products like T-MPLS G.8114 or MPLS Y. 1711
 - OAM packet is sent/received/handled by PTN equipment (normally using FPGA Hardware to handle OAM packet). The CV interval can be up to 3.3ms per OAM packet. Fault can be detected within 10ms when 3 packet missed (3*3.3ms=10ms) which trigger protection switch.

MPLS-TP OAM Option 1: GACH+ Y.1731

- Draft-Bhh-mpls-tp-oam-y.1731
- Use RFC 5586 GACH package
- OAM total solution and fulfill operator's requirements
- Support proactive/on-demand CC/CV, AIS, RDI, LB, LCK, TST, APS, LM, DM

🛛 1588 123.809999 Utstarco_83:17:8f Utstarco_83:17:2f MPLS MPLS Label Switched Packet
 B Frame 1588 (66 bytes on wire, 66 bytes captured) Ethernet II, Src: Utstarco_83:17:8f (00:07:ba:83:17:8f), Dst: Utstarco_83:17:2f (00:07:ba:83:17:2f) B Destination: Utstarco_83:17:8f (00:07:ba:83:17:8f) B Source: Utstarco_83:17:8f (00:07:ba:83:17:8f) B Source: Utstarco_83:17:8f (00:07:ba:83:17:8f) B Source: Utstarco_83:17:8f (00:07:ba:83:17:8f) B Source: Utstarco_83:17:8f (00:07:ba:83:17:8f) B MultiProtocol Label switching Header, Label: 102420, Exp: 7, S: 0, TTL: 254 MPLS Label: 102420 MPLS Experimental Bits: 7 MPLS Bottom of Label Stack: 0 MPLS TTL: 254
■ MUltiProtocol Label Switching Header, Label: 14 (OAM Alert), Exp: 0, S: 1, TTL: 1 MPLS Label: 14 (OAM Alert) MPLS Experimental Bits: 0 MPLS Bottom of Label Stack: 1 MPLS TTL: 1 ■ MPLS Operation & Maintenance
Function Type: CV (Connectivity Verification) (0x01) LSR ID: 10.250.10.104 LSP ID: 37 BIP16: 0x48fe
0010 44 f 000 0

Pre-standard OAM: CV – packet capture

MPLS-TP OAM Option 2: BFD/LSP Ping Extension

- 9 other Drafts
- Use RFC 5586 GACH package
- BFD extension supports proactive CC/CV/RDI, LSP Ping support ondemand CC/CV, new tools for other functions

OAM Options: G.Ach+Y.1731 vs. BFD/LSP Ping Extension



							1					
	5 6 7 8	2 1 2 3 4 5 6 7 8	Y.1731 frame format:									
	Т	unnel label (13)	• use MPLS date plane									
0001	0000	00000000	(Label: 13)									
MEL	Version	OpCode	• Use G.ACH									
		OAM PDU payloa	• use OpCode identify OAM type									
End TLV	and TLV											
1		2										
2 3 4	5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4	5 6 7	8	1 2 3 4 5 6 7 8	BFD extensions frame					
		LSP label		TC	S	TTL	format:					
		label (13)		TC	S	TTL	•Use MPLS date plane					
0001	Version	Res		Ch	annel	Туре	(Label: 13)					
		ACH TLV	Header				•Use G.ACH					
		OAM PDU payload area (BI	• use Channel Type identify OAM type									
	and TLV											

■ BFD expansion can support fault detection up to L3 and below

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GACH+Y.1731 and BFD Expansion Standard Progress



	Basic OAM	requirements	GACH+Y.1731	BFD Expansion						
1	Continuity Che Verific	eck/ Connectivity ation (CC/CV)		IETF draft (draft-asm-mpls-tp-bfd-cc (close to complete) draft-ietf-mpls-tp-lsp-ping-bfd-procedures-00) (incomplete)						
2	Connectivity der	Verification on mand (CV)		IETF draft (draft-nitinb-mpls-tp-lsp-ping-						
3	Route	Tracing								
4	Debug test	Debug test		IETF draft(draft-flh-mpls-tp-oam-diagnostic-test) (incomplete)						
	Loopback		(draft-bhh-	IETF draft (draft-boutros-mpls-tp-loopback)						
5	Lock	indicate	mpls-tp-oam- y1731),	(incomplete)						
6	L	ock	(close to	IETF draft (draft-ietf-mpls-tp-fault)						
7	Alarm indicat	tion singal (AIS)	complete)	(close to complete)						
8	Remote Alarm	Indication (RAI)		IETF draft (draft-asm-mpls-tp-bfd-cc-cv) (close to complete)						
9	Client Signa	I Failure (CSF)		IETF draft(draft-he-mpls-tp-csf) (incomplete)						
10	Packet loss	measurement		IETF draft (draft-frost-mpls-tp-loss-delav)						
11	Delay me	easurement		(incomplete)						

G.Ach+Y.1731 OAM Packet Definition



OAM PDIL

	1 2 3 4																													
1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7												7	8	1	2	3	4	5	6	7	8									
	Tunnel label (13) TC S TTL																													
0001 0000 00000000 Channel Type (Y.1731 OAM)													-																	
MEL Version OpCode Flags TLV offset																														
OAM PDU payload area (Y.1731)																														
End	TĽ	V																												

G.Ach MPLS-TP OAM Packet Format Definiation

OAM PDU Frame definitions:

- a. Tunnel label:16 bits, value = 13, GAL
- b. TC: 3 bits, traffic classification;
- c. S: 1 bit, Value=1 means bottom of stack;
- d. TTL: 8 bit, Value=1 or MEP to MEP hops+1;
- e. channel type identify it is an OAM packet;
- f. MEL: Maintenance entity level; configurable, default = "7";
- g. Version: Identify OAM protocol version, set to 0
- h. OpCode define OAM PDU packet type (see right table)
- i. TLV offset: 8 bits, related to OAM PDU type, Value=0 means TLV offset one byte;
- j. OAM PDU payload area: OAM PDU packet content;
- k. End TLV: 8 bit, identify end of OAM PDU packet

	Obcode-	OMM FD0₽
	1.0	CCM PDU ₂
	20	LBR PDU₽
	3₽	LBM PDU
	5₽	LTM PDU $_{e^2}$
	4₽	LTR PDUe
	33₽	FDI (AIS) PDU ₂
-	35₽	LCK PDU
	370	TST PDU₽
	39₽	Linear APS PDU@
	40₽	Ring APS PDU₽
	41 ₽	MCC PDU₽
	44₽	SCC PDUe
	43₽	$LMMPDU_{\ell^2}$
	42 ₽	LMR PDU
	45₽	1DM PDU
	47₽	DMM PDU
	46⊷	DMR PDU
	52+ ²	CSF PD U₽

Orcoderi

OpCode Definition

Select G.ach +Y.1731 as PTN OAM



- CMCC/China CCSA select G.ach +Y.1731 as PTN OAM standard
 - Treat draft-bhh-mpls-tp-oam-y.1731 as option of MPLS-TP OAM
 - Y.1731 Ethernet OAM: 0x8902
 - Select RFC5586 experimental Code Point 32767 (7FFF) as channel type
 - Alliance:
 - PTN vendor: Al-Lu, Huawei, ZTE, Fiberhome, UTStarcom;
 - Operators: China Mobile, China telecom, China Unicom, TI, CJK, telefonica etc.
 - Push the acceptance and standard process in ITU-T and IETF

Option 1: GACH+Y.1731

- Mature, meet all the requirement at technical point of view
- Easy upgrade from existing PTN system to support this Mechanism
- Better availability, Large volume PTN deployed in CMCC and most PTN equipment can upgrade to to support it in short term

Option 2: MPLS-TP & MPLS

- Not complete and not mature, can not meet short term requirements (at least another 2 years to be mature)
- Hard to upgrade from existing PTN system to support this mechanism, hardware upgrade might be necessary
- Consensus and might be final standard at last
- No equipment or vendor declare support it

Migration to MPLS-TP OAM



- MPLS-TP standards Progress
 - Standards still in development by the JWT from ITU-T and IETF.
 - MPLS-TP is based on PWE3 and LSP forwarding architecture which is within IETF MPLS standards. So there are minimal changes in the LSP and PW datastructure
- Upgrading to MPLS-TP OAM
 - More comprehensive OAM features to handle the end-to-end management of network than IP/MPLS.
 - MPLS-TP OAM standards are still under development, hence current installed equipment will have to be upgraded to support the new OAM formats and messages to comply with Standard

UTStarcom will ensure smooth migration to MPLS-TP OAM without any service disruption

TN OAM Upgrade Scenario





- When MPLS-TP OAM standards are finalized, TN series can be upgraded to work on dual OAM formats simultaneously (Dual-Mode): one mode supports the old format, and another one supports the new format that complies with the finalized MPLS-TP standards.
- The whole upgrade process is divided into two steps:
 - 1. upgrade each node to support dual OAM formats
 - 2. activate the LSP to support new OAM format.

Contents



- PTN Overview and Technology Advantages
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 - PTN technology and its evolution
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• MPLS-TP OAM in PTN

- Comprehensive and Hierarchical OAM in PTN
- MPLS-TP OAM Options: GACH+Y.1731 vs. BFD Extension/LSP Ping
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Mobile Backhaul using PTN





SDH/MSTP Replacement





Migrate to PTN at China Operators



China Operators' PTN Market

China Mobile (CMCC)

1. Start PTN research with PTN vendors since Q3/2007.

2. Start PTN equipment and IOP test since Q4/2008;

3. Mobile backhaul by PTN field trial Q1/2009 and 1588v2 test in Q2/09

4. First PTN purchase Q4/2009 and send phase purchase Q2/2010. More than 100K PTN nodes are installed and carrying living traffic.

China Telecom (CTC)

1. Start CE (Carry Ethernet) test at Q4/2006 and switch PTN technology later

2. After PTN investigation and research, start large scale PTN test since Q3/2009

3. PTN field trail since Q1/2010; more than 3000 PTN nodes trial in the network

China Unicom (CUC)

1. Start CE (Carry Ethernet) test since 2008 and did a few trials.

2. Switch to PTN and start PTN test Q4/2009 and finished at Q1/2009

3. Start PTN field trial Q2/2010 and close to 2000 PTN nodes are running in the field.

Orientation has been confirmed that evolution is inevitable



Case Study – Mobile Operator China





Customer Background & Pain-points

- Over 470 million subscribers includes 2G and 3G (400,000+ base stations installed and growing)
- Operates not only basic mobile voice services but also value-added services such as data,IP telephone and multimedia.
- Start to deploy TD-SCDMA 3G network since 2008
- Looking for IP RAN solution scalable to support future data service and at the same time support TDM and other legacy services such as ATM
- Has deployed more than 100K PTN nodes network since 2009
- Start MPLS-TP OAM IOP base on GACh+Y.7131

CMCC 3G (TD-SCDMA) Network Migration



•Current 2G/GSM Networks : TDM based BTS and BSC. E1 at BTS, STM-1 and E1 at BSC

• Current 3G/TD-SCDMA Networks : ATM IMAE1 at Node B, Channelized STM-1 at RNC



Requirement Highlights



•Requirements to PTN:

- -Converged network to support multiple type of services: legacy E1, ATM and future FE
- -Common network for wireless and fixed line broadband service
- -Reliability, QOS, OAM, controllable and manageable
- -Performance including delay, jitter

-Privacy

- -Inter-working with IP/MPLS and SDH/NGSDH
- -Distribute Frequency and time synchronization to Base stations

MPLS-TP PTN solution address these requirements by

- -Multi-service support
- -Carries class design with hardware redundancy and OAM to support <50ms protection switching, fault detection and monitoring of tunnels
- -Use of network management systems to pre-configured CIR, EIR Bandwidth, control how tunnels are configured or provisioned
- -Provide frequency synchronization signal to BTS and Node B (+/- 0.05ppm) and time signal in the future
- -End to end QOS

UTS PTN Value Proposition



Data friendly – statistical multiplexing,	
 flexible transport containers, easy inter- working Advanced QOS control & Multicast Bandwidth Efficient & Scalable 	TN703
 Connection Oriented, end to end QoS High clock accuracy Resiliency on par with TDM network Comprehensive OAM Multi-service support Powerful Network management for e2e service provisioning 	TN705 TN705 TN725
 State-of-art pure-packet architecture Competitive cost Diverse set of interfaces (TDM, ATM, IP) Compact platform MPLS-TP (pre-standard) Compliant 	TN735
	 Data menory – statistical multiplexing, flexible transport containers, easy inter- working Advanced QOS control & Multicast Bandwidth Efficient & Scalable Connection Oriented, end to end QoS High clock accuracy Resiliency on par with TDM network Comprehensive OAM Multi-service support Powerful Network management for e2e service provisioning State-of-art pure-packet architecture Competitive cost Diverse set of interfaces (TDM, ATM, IP) Compact platform MPLS-TP (pre-standard) Compliant Service oriented NMS

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PTN -- The Best choice of Metro Access & Aggregation (1)



Meet New Services' Requirements

- Higher bandwidth: from E1/STM-1 to FE/GE; from dial in to xDSL to xPON; From nx64kbps to nx Mbps;
- Real time: real time application; clock sync; time sync
- Low delay and delay variance: Delay and Jitter sensitivity service
- Higher performance: advanced QoS, CIR/EIR, CBS/EBS
- Higher availability: 99.999% and higher
- Mobility: from fix to mobile
- Resilience: sub 50ms switch time



•	IPTV/Medium stream	VoIP	Enterprise VPN	Live TV Video Phone/ conference
New Services Requirements	 Real-time High bandwidth High performance <50ms protection Multicast supporting P-to-MP Fixed route 	 Real-time High performance <50ms Protection Aggregation to core router Fixed route 	 Committed bandwidth Service isolation Fixed route 	 Real-time Committed bandwidth Protection P-t-P/ MP-t-MP Aggregation to video server Fixed route

Bandwidth • Jitter/latency • protection • Security

PTN -- The Best choice of Metro Access & Aggregation (2)



Meet Network Migration's Requirements

- Multi-services support
 - Support ATM, TDM, Ethernet services in an unified access/aggregation network.
- Topology free:
 - support any topology as the existing fiber network
- Operation continuity:
 - Utilize rich transport operation experience in past decade;
 - Centralized powerful network management system (NMS)
 - Simply training and quick knowledge transfer;
 - Continue to use the existing operation process and can change step by step;
- Hierarchical OAM for quick fault isolation and trouble shooting
- High accuracy sync clock and time delivery
-



TDM • ATM • Ethernet • Topology Free • Operation

PTN -- The Best choice of Metro Access & Aggregation (3)



Lower CAPEX and OPEX

- Network and equipment simplify:
 - Aggregated traffic (from access to core) dominate Metro access & aggregation network
 - Connection oriented and mainly permanent network connection circuit
 - No addressing and routing is required at most of time (fixed route)
 - No full Mesh network existing at Metro access & aggregation
- Reduce the complexity of network operation
 - Hierarchical network structure– Independent packet transport layer; Not peer IP/MPLS Network; avoid large scale of IP/MPLS domain
 - Manage and maintenance much more equipments per engineer simultaneously (hundreds vs. tens)
 - Lower transfer cost
 - Simpler IP address planning; Not touch customer's IP planning
- Smaller footprint
- Lower power consumption
-



Simplify • Reduce complexity • Smaller • Lower

UTStarcom Confidential

NetRing TN – Packet Transport Network Product Portfolio







