PTN (Packet Transport Network) Interoperability Test ——ITU-T G.8113.1 OAM

Part 2 Test methods for ITU-T G.8113.1 C&I

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Course content

- Part 1 ITU-T PTN technology and OAM mechanism
- **Part 2 Test methods for ITU-T G.8113.1 C&I**
- Part 3 Summary and Question time

Course Objectives(Part 2)

Upon completion of this course, you will be able to:

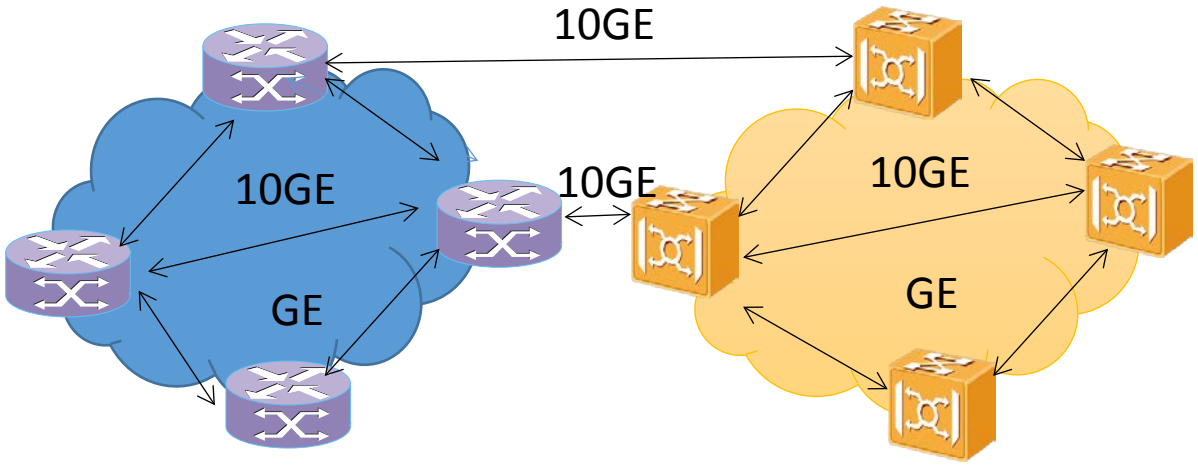
- Know the scope and purpose of PTN C&I Test
- Understand the Key features, functions specification， packet formats ,working principles of ITU-T G.8113.1 MPLS-TP OAM for PTN
- Learn the test methods for ITU-T G.8113.1 C&I test

Part 2 Test methods for ITU-T G.8113.1 C&I

- Test devices & instruments in the test
- Overview of PTN C&I Test Items
- Test principles of G.8113.1
- Test methods of G.8113.1

Test devices and instruments in the test

PTN C&I test scenario in the lab



- PTN devices in metro core and aggregation layer: 4
- PTN devices in metro access layer: 4
- Network management system: 2

PTN C&I test devices in the lab

Optical packet network Lab

Optical packet network Lab

Test devices and instruments in the test

PTN C&I test instruments:

- Network simulator : 10GE/GE interface
- work in pass through mode
- Insert packet loss & delay & jitter

PTN C&I test instruments:

- Network Analyzer : 100GE/10GE/GE interface
- generate service traffic
- monitor the service traffic: bandwidth & packet loss & delay

Part 2 Test methods for ITU-T G.8113.1 C&I

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Overview of PTN C&I Test Items

- Multi-service Bearer Interoperability test
  - E1 Service
  - STM-1 Service
  - Ethernet Service
- OAM functional Interoperability test
  - IEEE 802.3ah
  - Y.1731 ETH-OAM
  - G.8113.1 LSP OAM★
  - G.8113.1 PW OAM
  - G.8113.1 Section-layer OAM
- QOS functional Interoperability test
  - Priority Mapping
  - Priority scheduling
- Network Protection Interoperability test
  - LSP 1+1/1:1 Linear Protection
  - LAG Protection
  - MSP1+1/1:1 Linear Protection
- Clock / Time Synchronization Interoperability test
  - CES service frequency Synchronization
  - frequency Synchronization on synchronous Ethernet
  - IEEE1588V2 time Synchronization

Referenced standard of PTN C&I Test

Multi-service Bearer Interoperability test

- IETF RFC 4197
- IETF RFC 4553
- IETF RFC 5086
- IETF RFC 4448

OAM functional Interoperability test

- IEEE 802.3ah
- ITU-T Y.1731
- ITU-T G.8113.1 ★

QOS functional Interoperability test

- IETF RFC 3289
- IETF RFC 3644

Network Protection Interoperability test

- ITU-T G.8131
- IEEE 802.3 (Clause43）
- TU-T G.841

Clock / Time Synchronization Interoperability test

- ITU-T G.823
- ITU-T G.8261
- IEEE 1588V2

Part 2 Test methods for ITU-T G.8113.1 C&I

- Test devices & instruments in the test
- Overview of PTN C&I Test Items
- **Test principles of G.8113.1**
- Test methods of G.8113.1

Principles and mechanism of G.8113.1

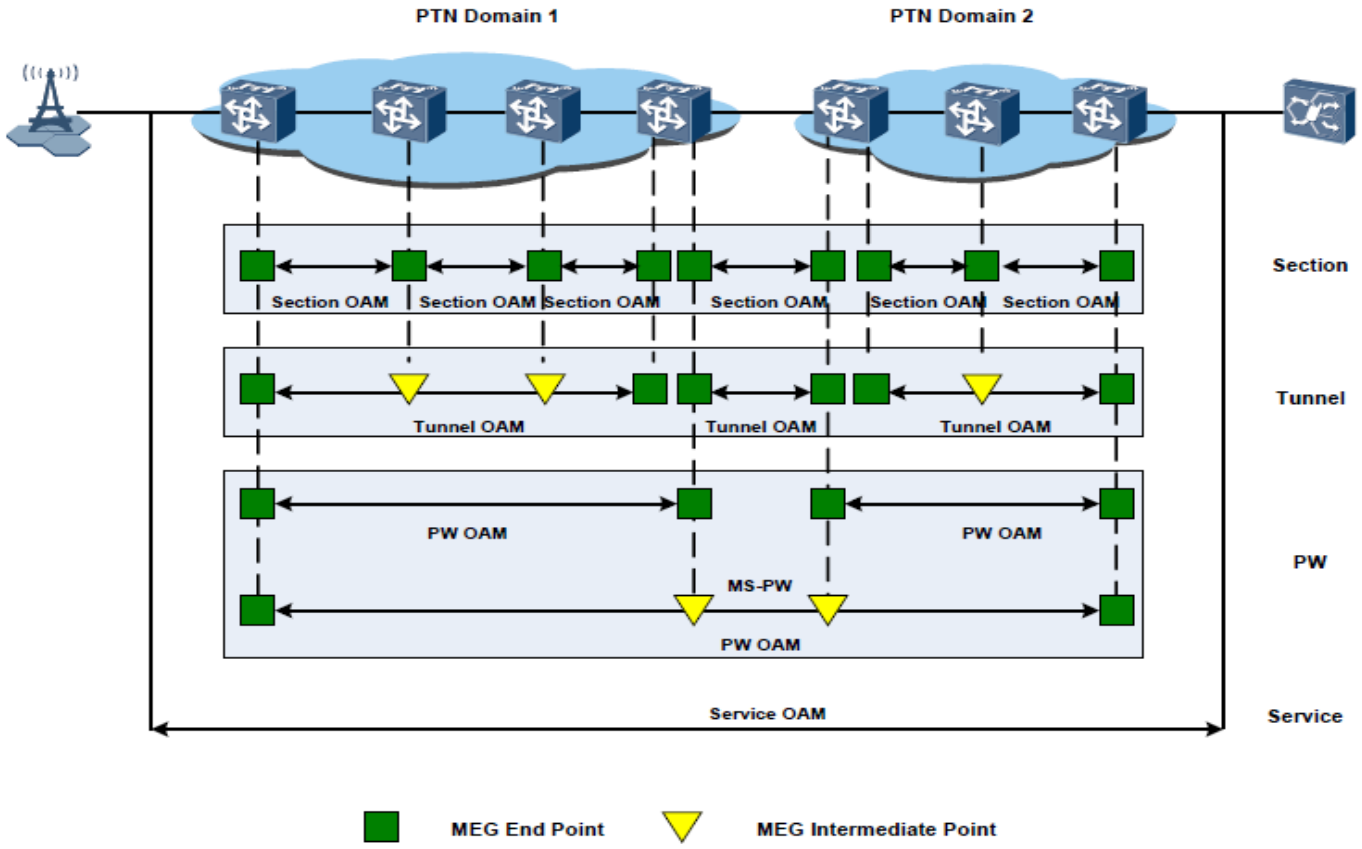
1.What is G.8113.1 ?

- used for operation, administration and management (OAM) of MPLS-TP network
- detects, identifies, and locates faults on an MPLS-TP network
- triggers protection switching

2.Key functions of G.8113.1 ?

- provides comprehensive OAM capabilities that cover the following aspects:
  - Fault management
  - Performance monitoring
  - Protection switching

Application on MPLS-TP network



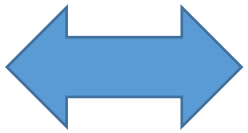
- MPLS-TP network consists of the section layer, LSP layer, and PW layer
- G.8113.1 is applied at the section, LSP, and PW layers

OAM Functional components

MEs and MEGs

►The MPLS-TP OAM operations are performed based on MEs(Maintenance Entity)

►One or more MEs on the same transport path form an MEG (Maintenance Entity Group)



MEPs and MIPs

►MEPs are source and sink points of an MEG.

►An MIP is the intermediate node between two MEPs of an MEG.

Function list of G.8113.1

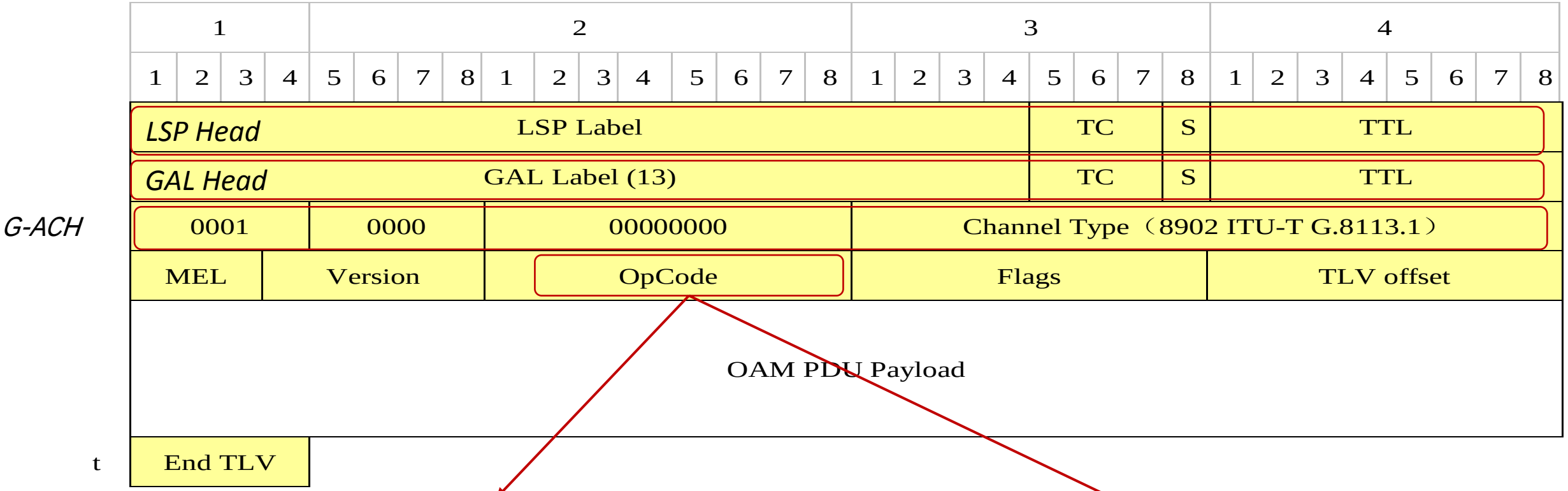
- G.8113.1 provides multiple fault detection and Performance monitoring functions：

Application	OAM function	
Fault management	Pro-active	*Continuity check and connectivity verification (CC/CV)
		*Remote defect indication (RDI)
		*Alarm indication signal (AIS)
	On-demand	connectivity verification (CV)
		*loopback
		Locked signal (LCK)
Performance management	On-demand	*Loss measurement (LM)
		*Delay measurement (DM)
Protection switching		Automatic protection switching (APS)

*: G.8113.1 C&I test focuses on items

G.8113.1 OAM common capsulation

LSP OAM Frame Format

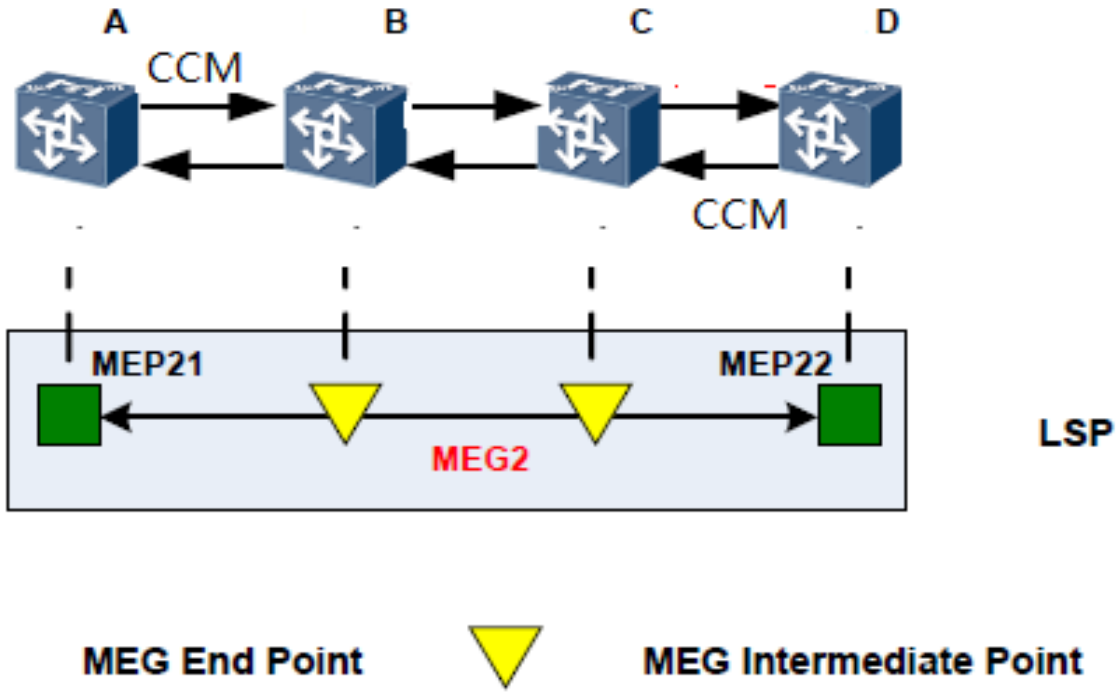


OpCode value	OAM PDU type	OpCode relevance for MEPs/MIPs
1	CCM	MEPs
3	LBM	MEPs and MIPs (CV)
2	LBR	MEPs and MIPs (CV)
33	AIS	MEPs
35	LCK	MEPs
37	TST	MEPs

OpCode value	OAM PDU type	OpCode relevance for MEPs/MIPs
39	APS	MEPs
43	LMM	MEPs
42	LMR	MEPs
45	1DM	MEPs
47	DMM	MEPs
46	DMR	MEPs
52	CSF	MEPs

Principles and mechanism of Continuity check (CC)

Application scenario of the CC function



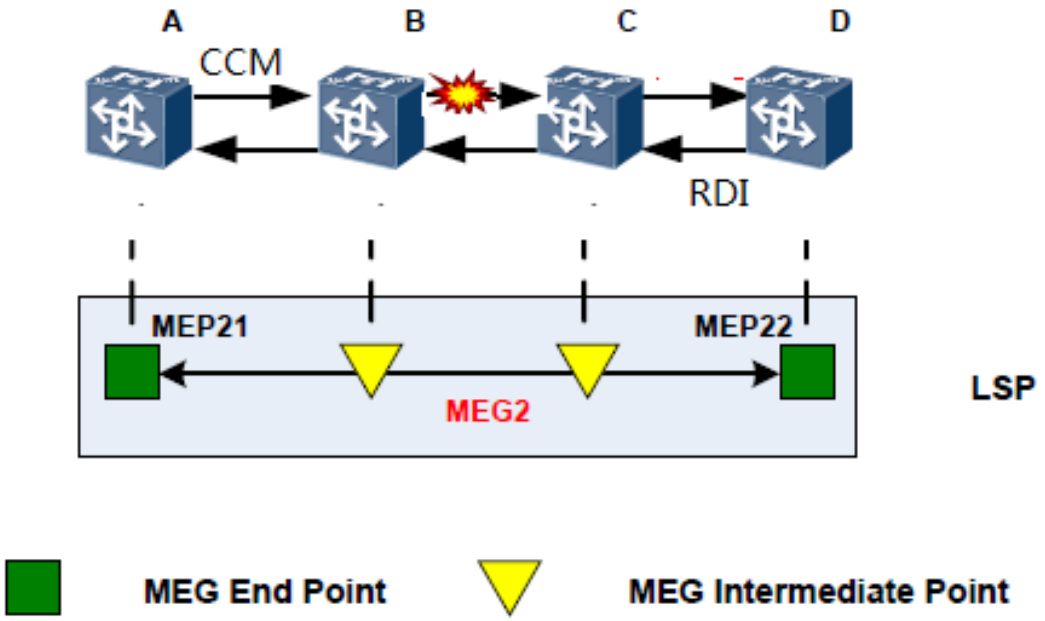
Working mechanism of the CC function

- source MEP periodically transmits CCMs.
- not receive any CCMs , reports an alarm.
- destination MEP receives CCMs, terminates the alarm.

- CC: Continuity check (CC) is used for proactive monitoring. It detects connectivity between two MEPs of a PW, LSP, or section.

Principles and mechanism of remote defect indication (RDI)

Application scenario of the RDI function



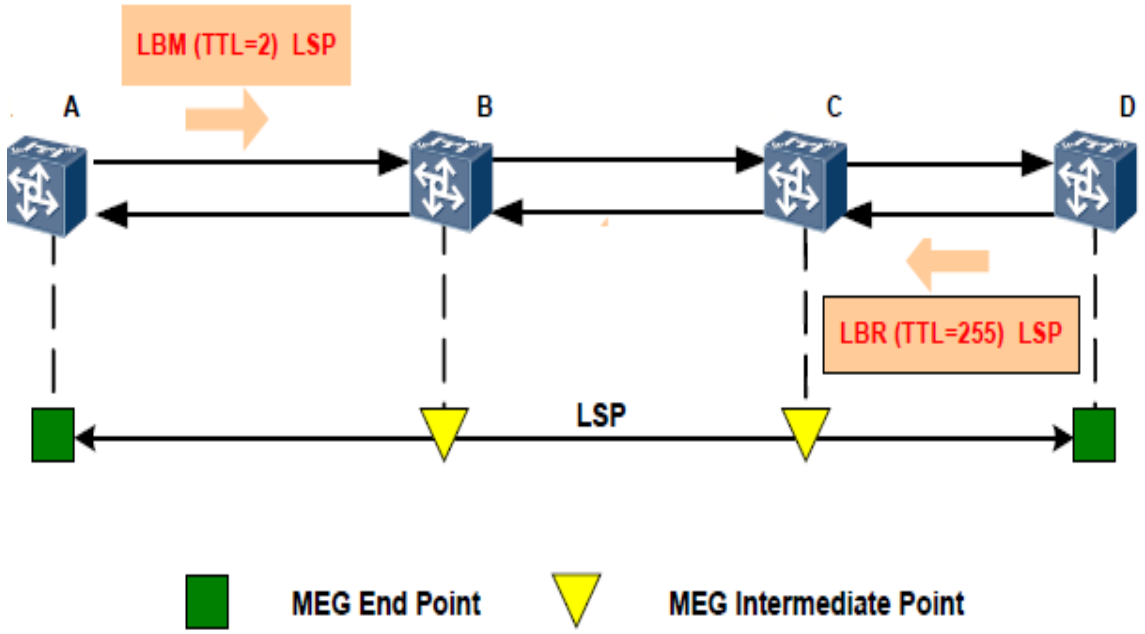
Working mechanism of the RDI function

- local MEP detects a link fault.
- sets the RDI field to 1 in the CCMs, transmits the CCMs to the peer MEP
- local fault is removed, local MEP sets the RDI field to 0 in the CCMs.

- **RDI: remote defect indication (RDI) function is used by a local MEP to inform the peer MEP of a local fault or defect.**

Principles and mechanism of loopback (LB)

Application scenario of the LB function



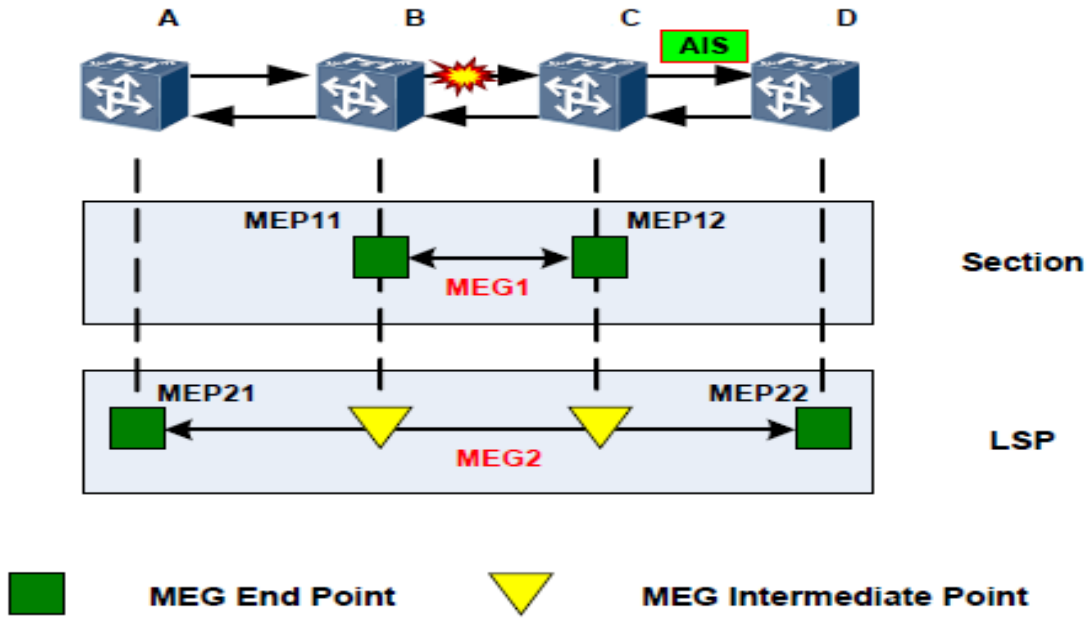
Working mechanism of the LB function

- The source MEP transmits a LBM to the destination
- destination node receive the LBM, checks target MIP or MEP ID.
- destination node transmits a loopback reply (LBR) message.

- **LB: The loopback (LB) function verifies bidirectional connectivity between two MEPs or between an MEP and an MIP.**

Principles and mechanism of alarm indication signal (AIS)

Application scenario of the AIS function



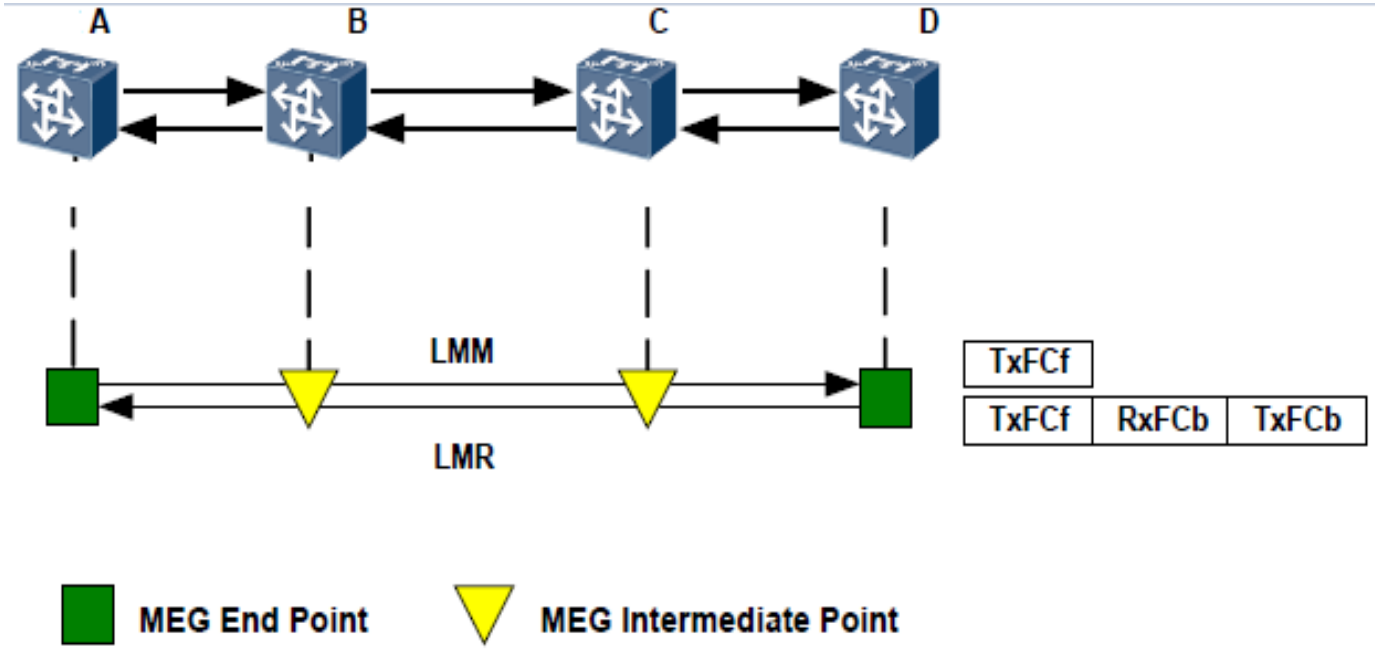
Working mechanism of the AIS function

- detect the connectivity fault, reports an alarm.
- starts to periodically insert AIS frames .
- Receive the AIS frames, reports an AIS alarm.

AIS: The alarm indication signal (AIS) function suppresses alarms at the upper layer when a fault is detected at the lower layer.

Principles and mechanism of Frame loss measurement (LM)

Application scenario of the LM function



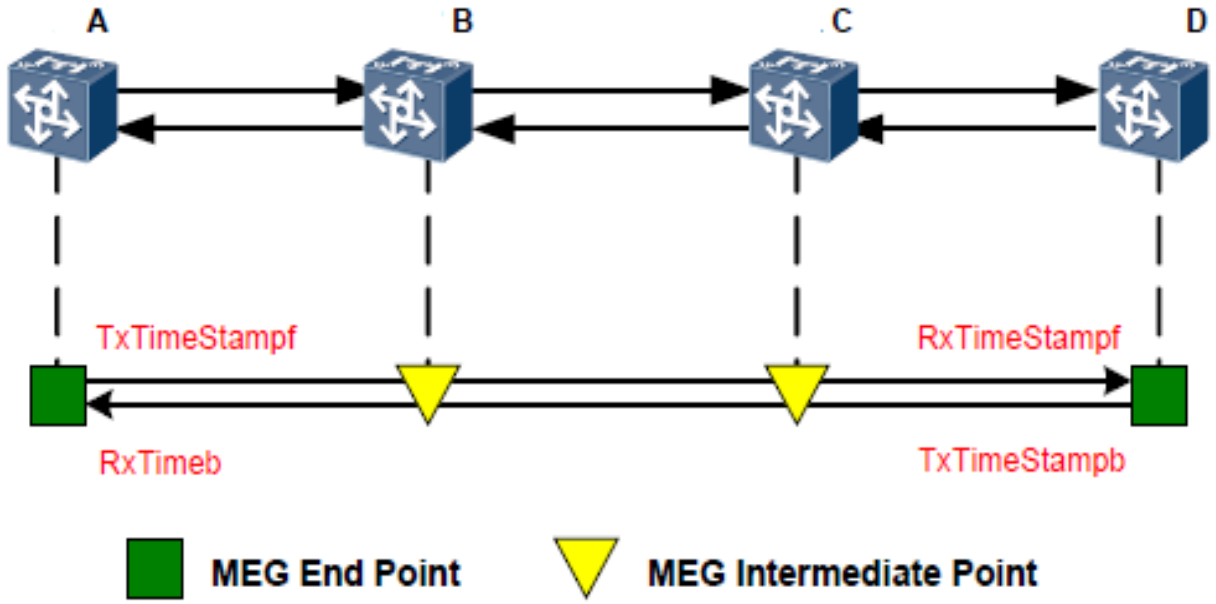
Working mechanism of the LM function

- local MEP periodically transmits LMM frames.
- Receive a correct LMM frame, the peer MEP transmits an LMR frame.
- receive LMR frames. local MEP compares the data to perform frame loss measurements.

LM: Frame loss measurement (LM) is a function for performance monitoring of an MPLS-TP network. It measures the frame loss between a pair of MEPs.

Principles and mechanism of frame delay measurement (DM)

Application scenario of the DM function



Operation mechanism of the DM function

- source MEP periodically transmits DMM frames.
- Receive the DMM frames, sink MEP transmits DMR frames.
- receives the DMR frames, source MEP calculates frame delay.

- DM: The frame delay measurement (DM) function measures frame delay and frame delay variation between a pair of MEPs.

Part 2 Test methods for ITU-T G.8113.1 C&I

- Test devices & instruments in the test
- Overview of PTN C&I Test Items
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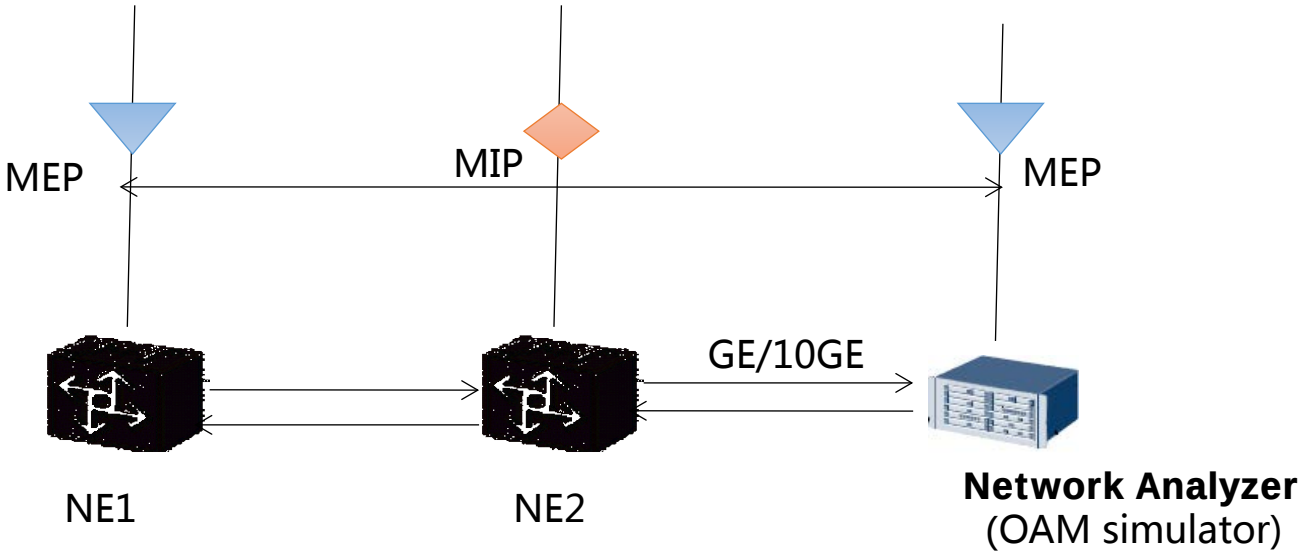
- **Test methods of G.8113.1**

Test case of CC&RDI

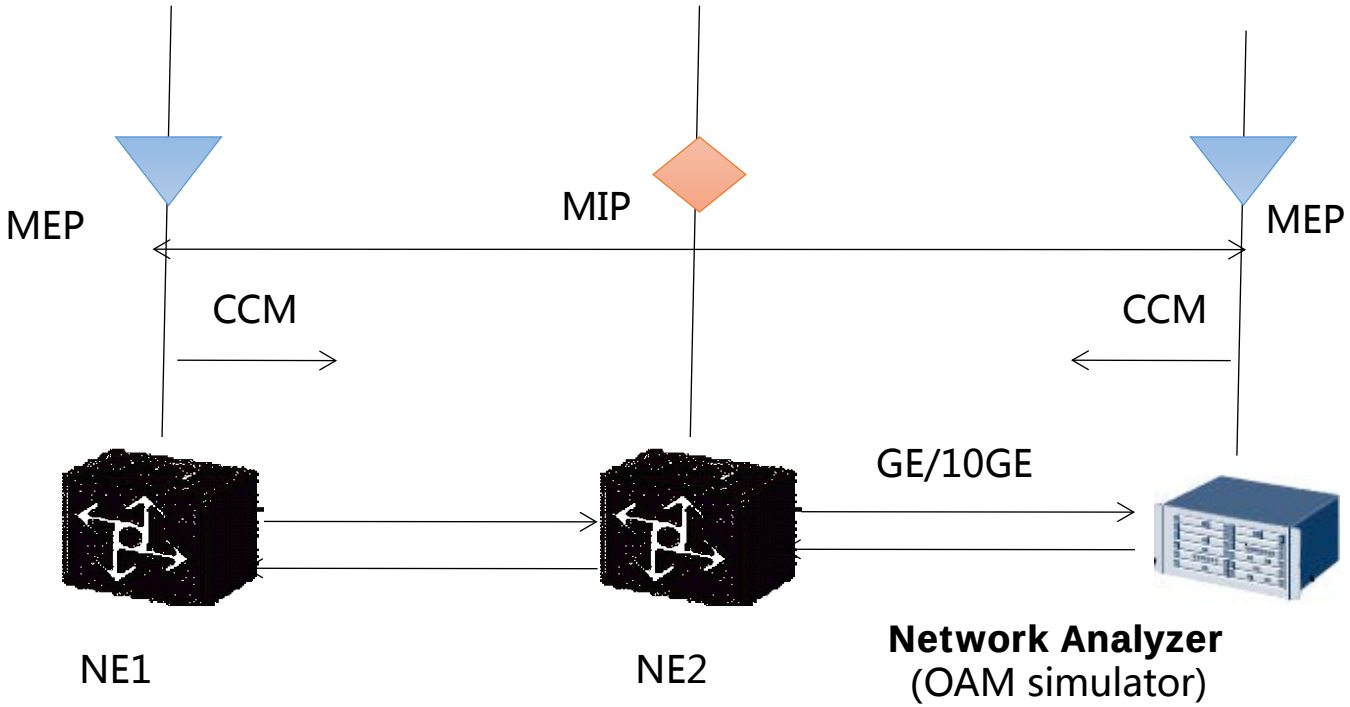
1.Test configuration

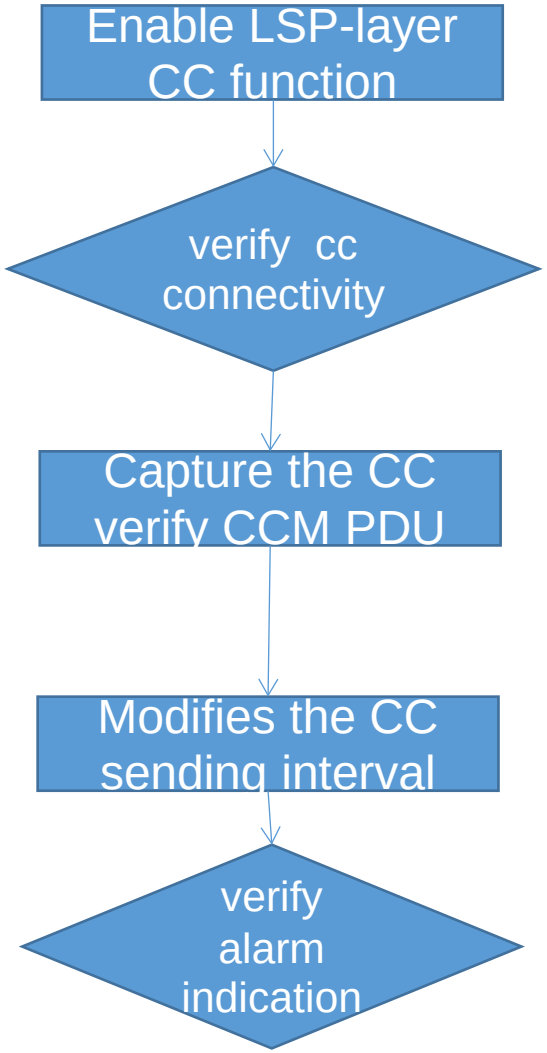


- Network Analyzer interconnects with NE2 by GE/10OGE port .
- Create a bidirectional LSP
- Configure the LSP-layer CC, Both NE1 and Network Analyzer are set to MEP , NE2 is set to MIP.
- Set the CC message sending interval to 3.3 ms, MEG Id to MEG_LSP.

Test case of CC&RDI

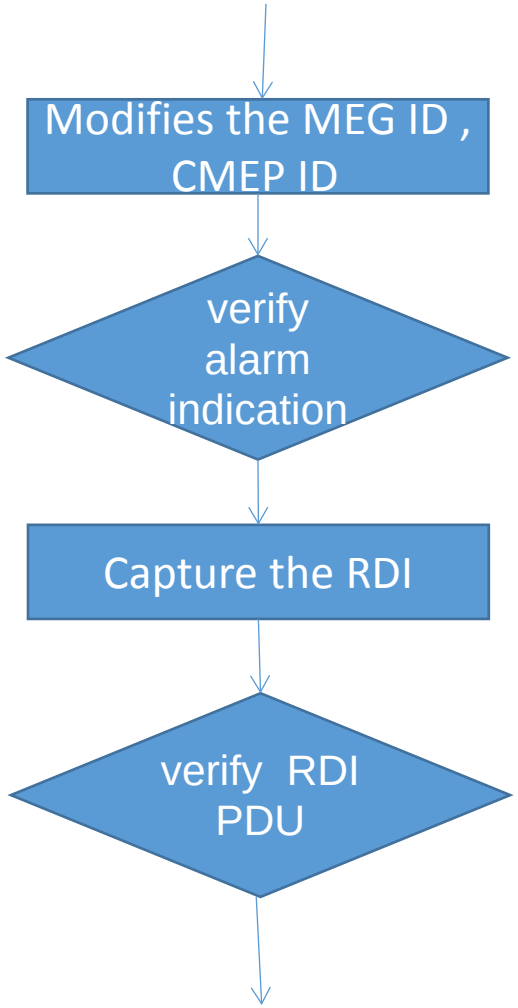
2.Test Procedure

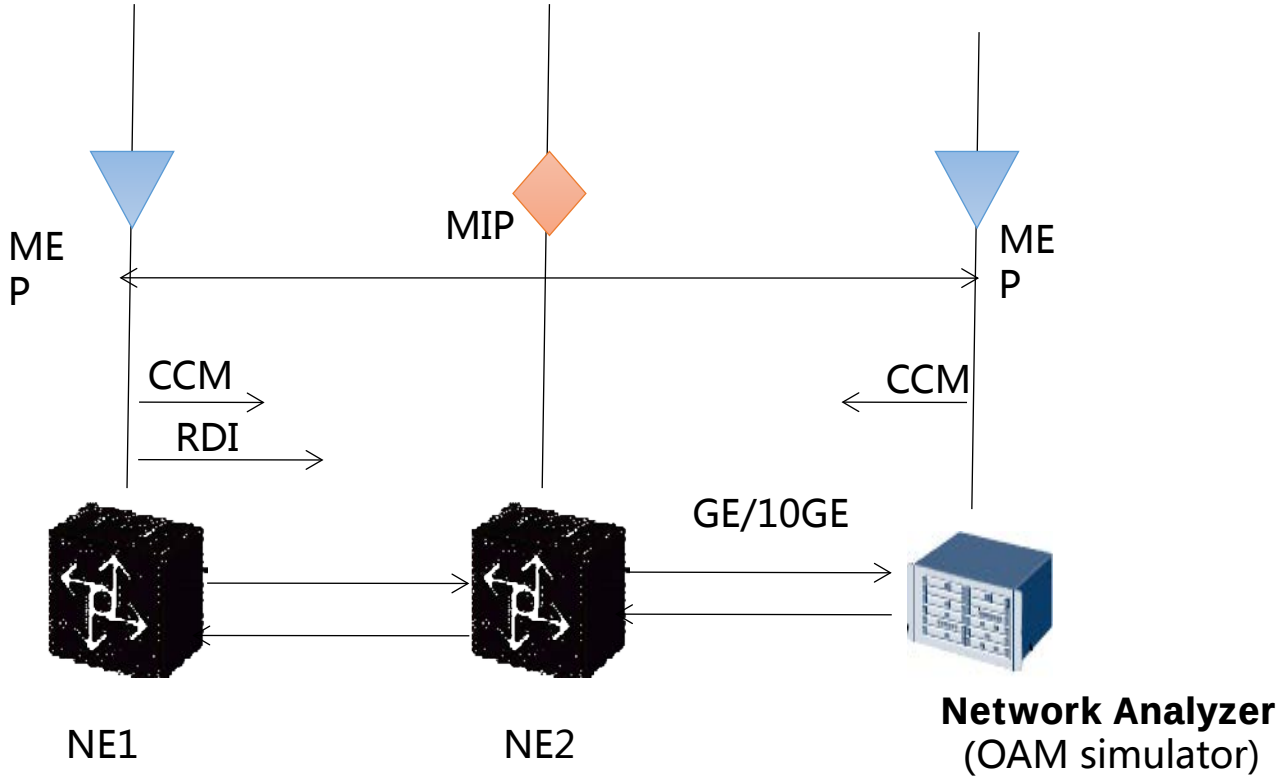




Test case of CC&RDI

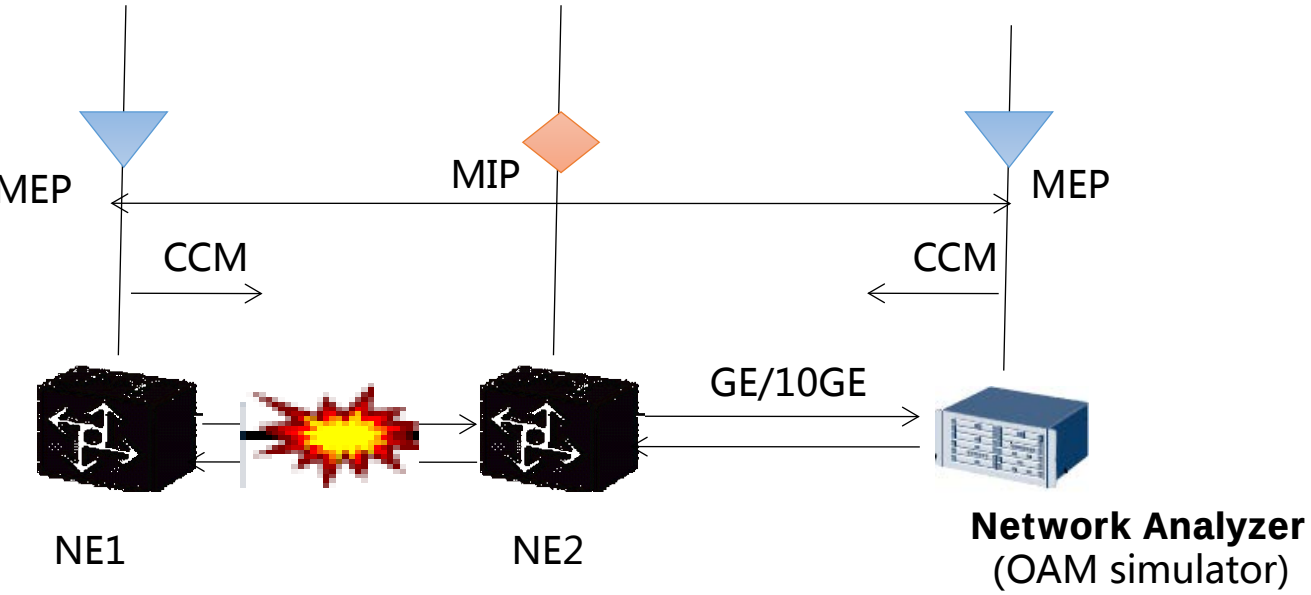
2.Test Procedure

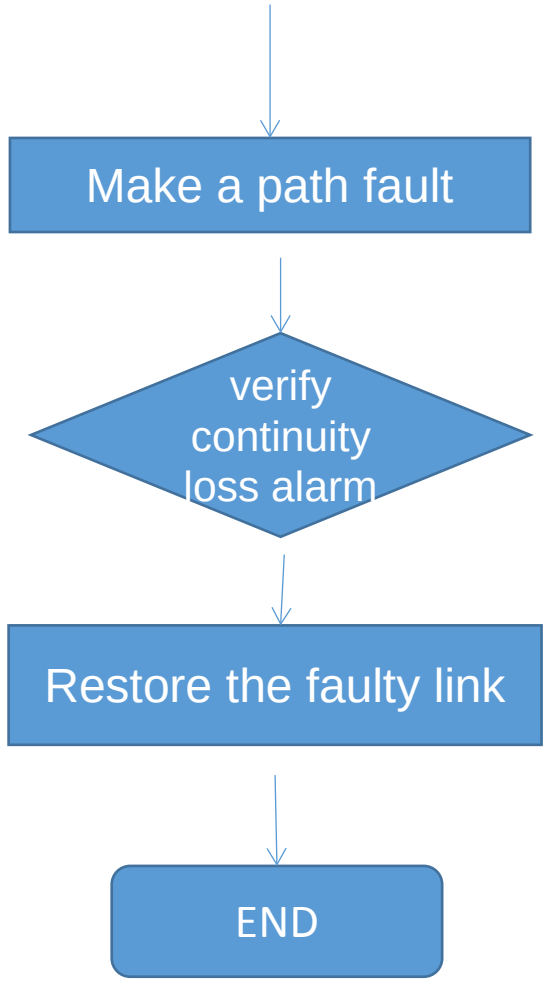




Test case of CC&RDI

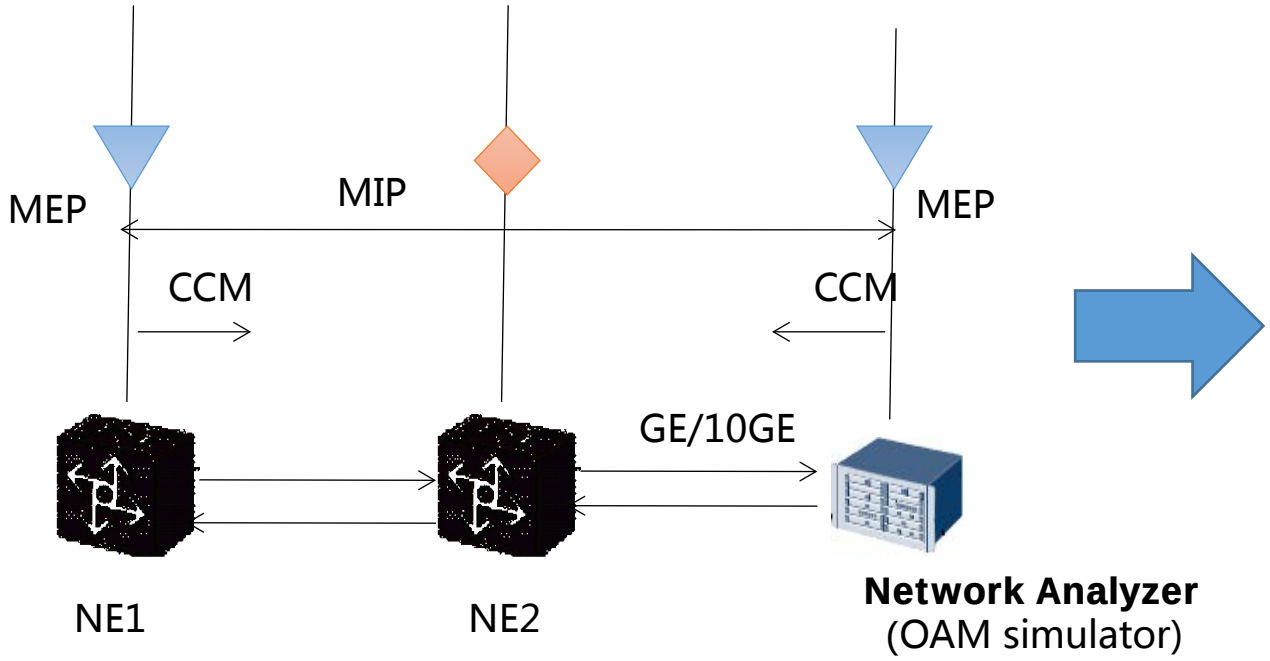
2.Test Procedure





Test case of CC&RDI

3.Test Results



items		Step no.
CC connectivity	Remote MEPs is up on network analyzer	1
CCM/RDI PDU format	LSP label /PW label 、OpCode=1、channel type =0x8902、MEP ID、MEG ID、CC Period, RDI bit=1	2
Alarms	Loss of connectivity、Unexpected Period 、Unexpected MEP ID、MEG ID Mismerged	3，4，5，6

Test case of CC&RDI

3.Test Results

Routing and MPLS > MPLS-TP Y1731 OAM > MEG Results | Change Result View

Port Name	MEG ID	ME Level	CC Tx State	CC Rx State	# MEPs
Port //2/1	test1	7	Up	Up	1

CC results on network analyzer

Routing and MPLS > MPLS-TP Y1731 OAM > CC Results | Change Result View

MP Name	LCK Rx State	AIS Rx State	RDI Tx State	RDI Rx State	CC Message Tx Count	CC Message Rx Count	#
MP 2	Off	Off	Off	Off	4,664	4,146	1

# Unexpected MEPs	# Unexpected MA/MEG IDs	# Unexpected MD/ME Levels	# Timeouts	# Unexpected Period Values
326	574	63	10	125

Alarm state on network analyzer

Test case of LB,AIS,LM,DM

Show on video……

Summary

- The MPLS-TP OAM detects, identifies, and locates faults on an MPLS-TP network and triggers protection switching in a timely manner in case of a link fault.
- The MPLS-TP OAM functions that are available on Fault management, Performance Management and Protection switching.
- MPLS-TP network consists of the section layer, LSP layer, and PW layer.

  G.8113.1 is applied at the section, LSP, and PW layers
- Fault management function consists of CC/RDI、LB and AIS as well.
- Performance Management function consists of LM and DM.

Exam questions:

1) What are the main functions of ITU-T G.8113.1 OAM?

2) What is the generation principle of alarm indication signal (AIS) in ITU-T G.8113.1 ?

3) What is the working mechanism of frame loss measurements (LM) in ITU-T G.8113.1 ?

(Trainer information)

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Thanks for Your Attentions

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