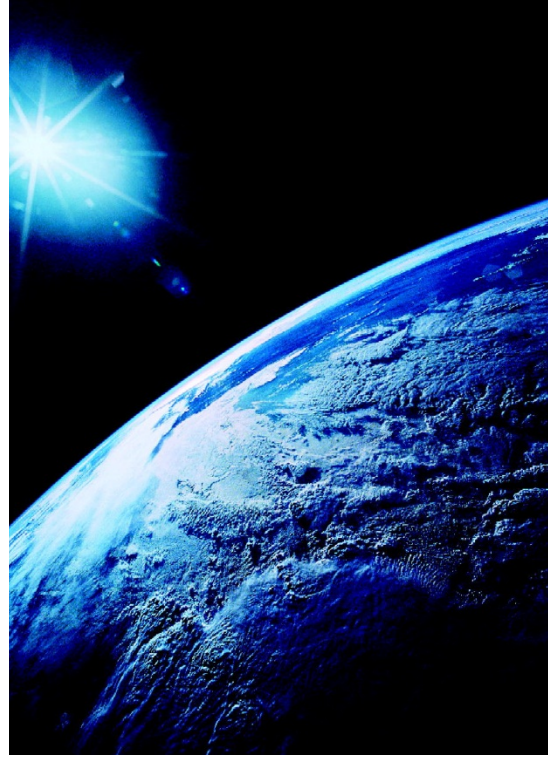
Cisco Connect

Praha, hotel Clarion
10. – 11. dubna 2013

Efektivní aktivace a měření L2 a L3 služeb

T-SP3 / L2

Martin Slinták - Cisco

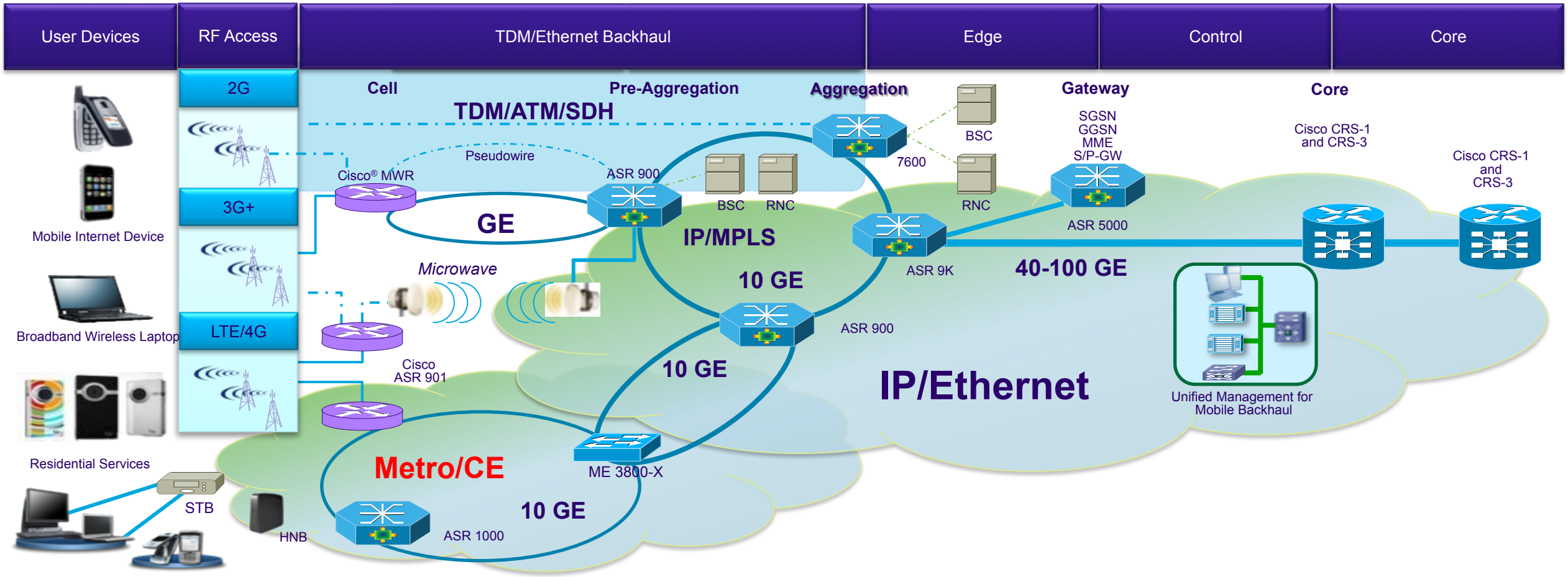


Agenda

- Ethernet performance management
  - Service Activation
  - ITU-T Y.1564
  - ITU-T Y.1731
- Feature Overview
  - Ethernet Data plane Loopback
  - IP SLA Service Performance Probe
- Cisco Integrated Service Performance Testing (SPT) Framework
  - SPT on ASR901 Live Demo

Mobile Backhaul & Carrier Ethernet Operations

Development& Production → Turn Up & Installation → Troubleshooting & Maintenance → Service Assurance

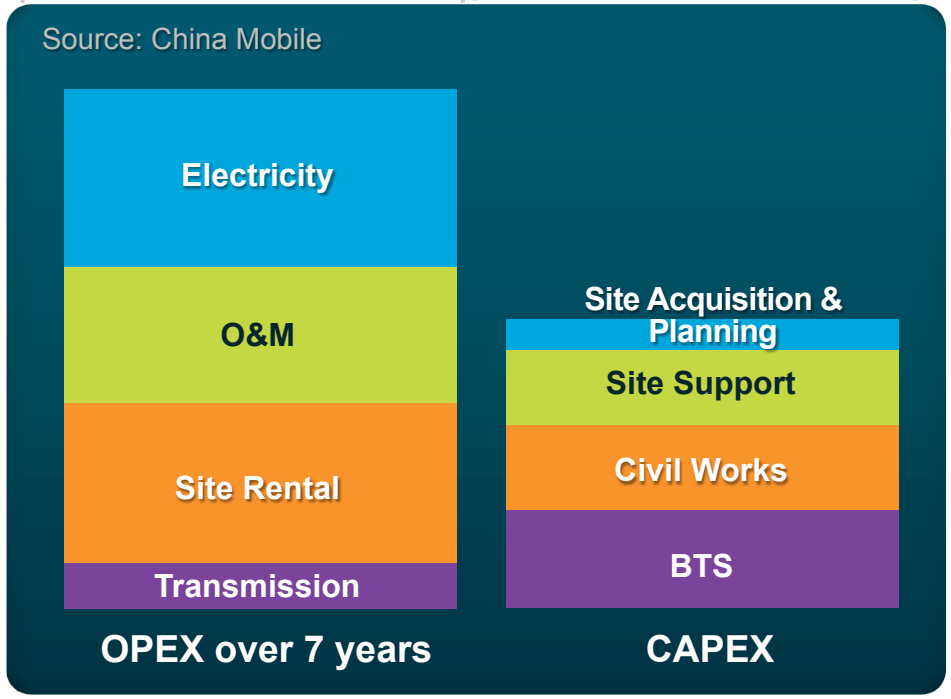


Reduce Truck Roll, CAPEX,OPEX

TCO Distribution

60% TCO | 40% TCO

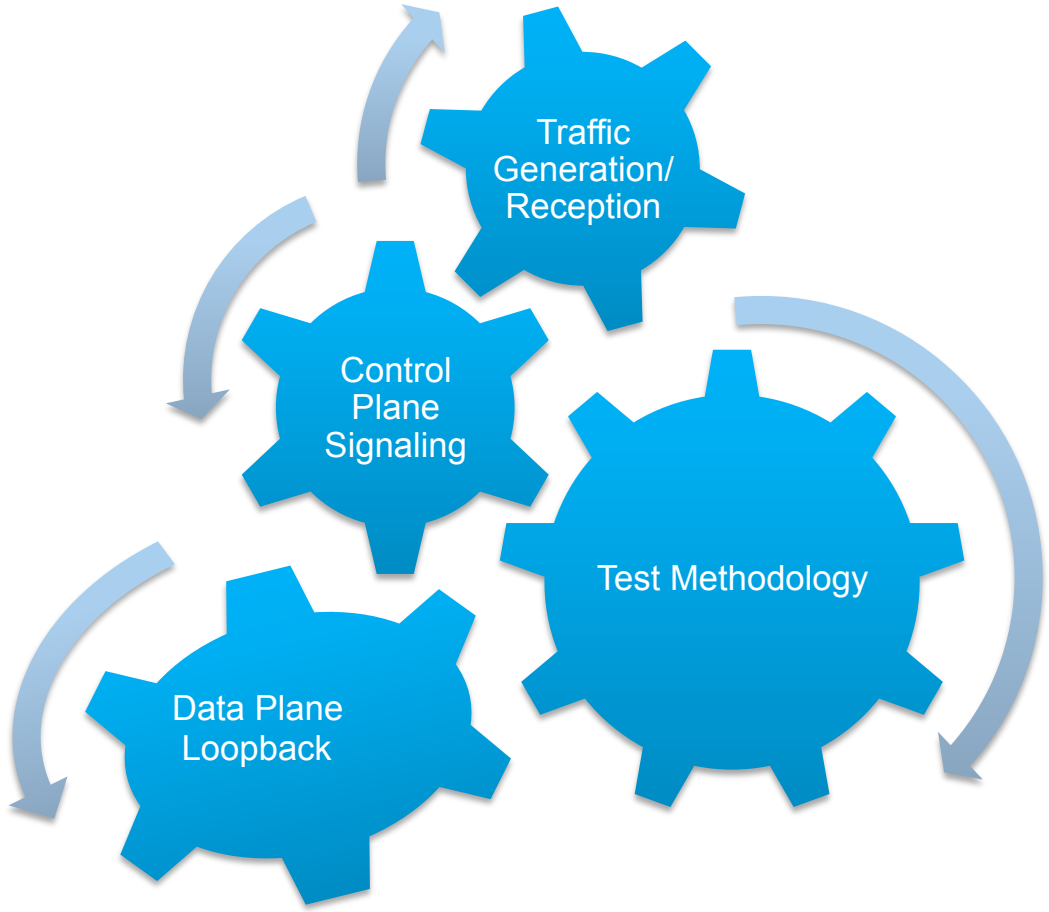
Source: China Mobile



Service Activation

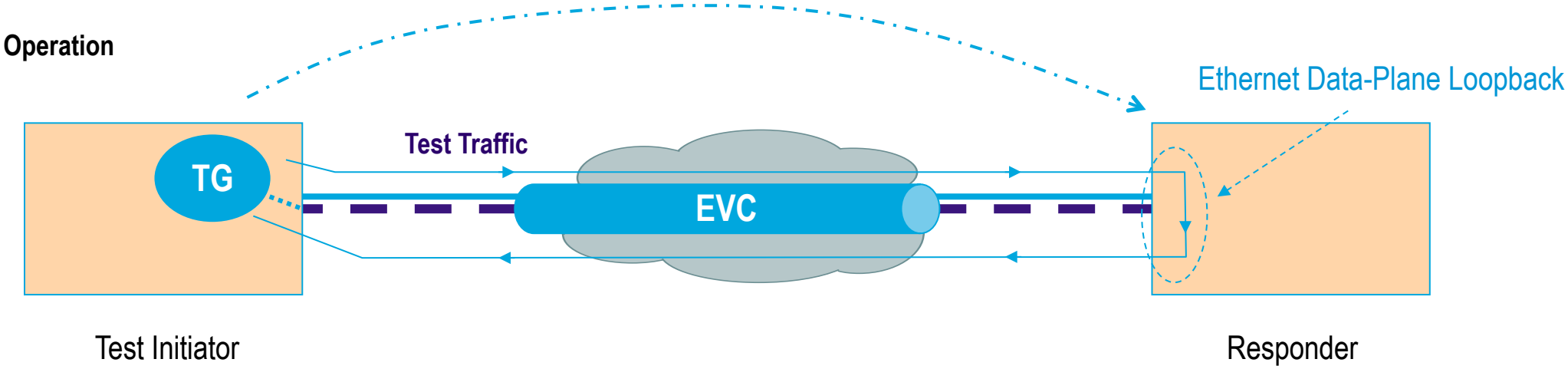
Service Activation Testing (SAT)

- Issuance of ‘Birth Certificate’
- Validation of Service Configuration
- Validation of SLA
  - Throughput
  - Latency
  - Loss
  - Jitter

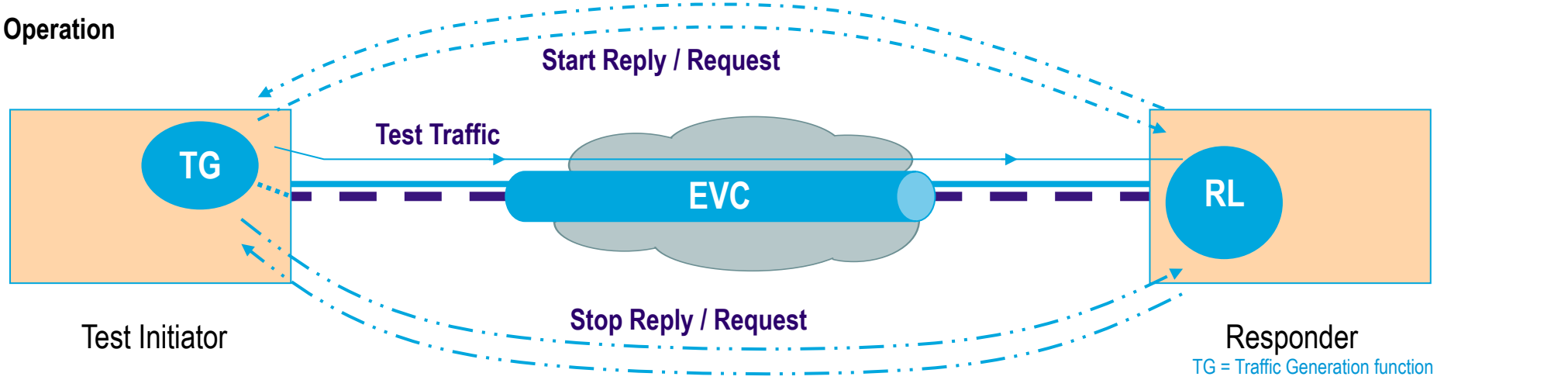


SAT Concepts

Bi-directional Test Operation



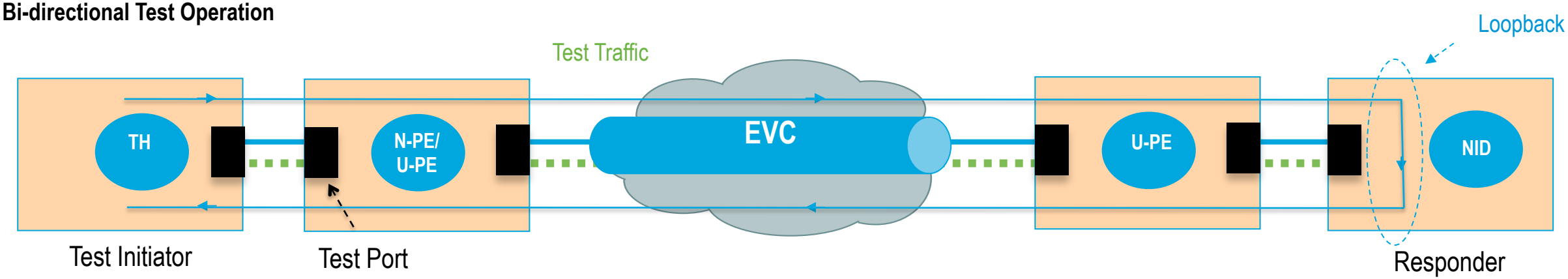
Uni-directional Test Operation



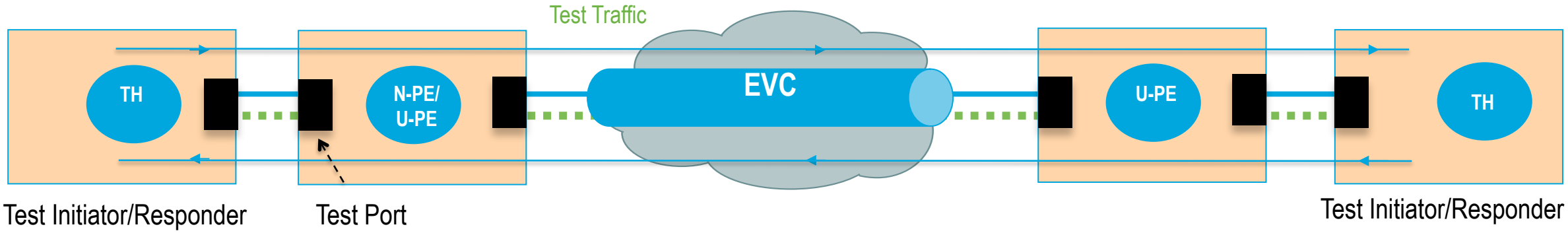
TG = Traffic Generation function
HW-accelarated (Platform-Dependent)
RL=Responder Logic

SAT Use Case - Offnode function

Bi-directional Test Operation



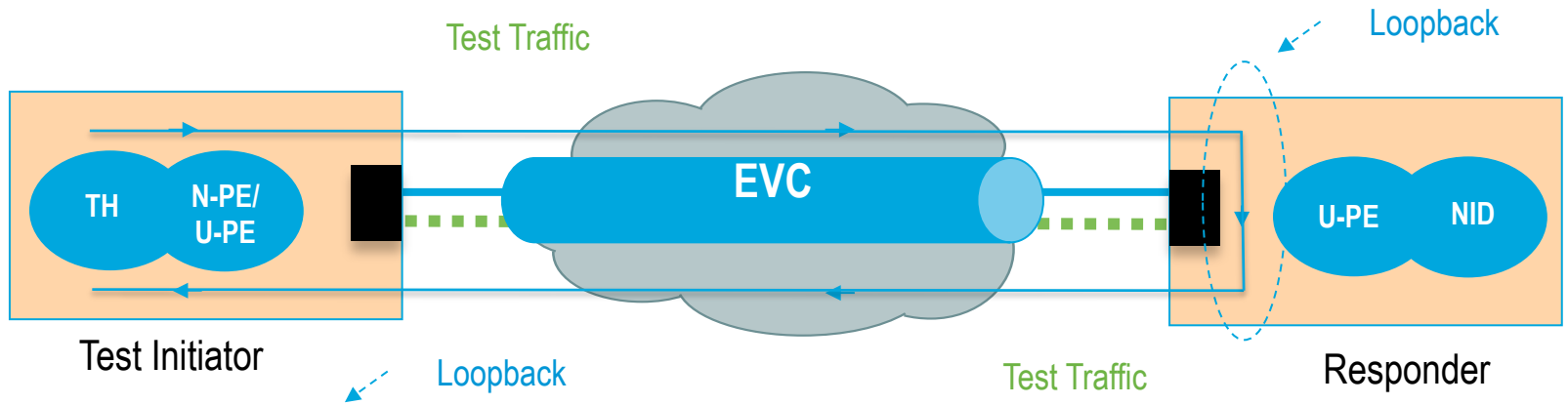
Uni-directional Test Operation



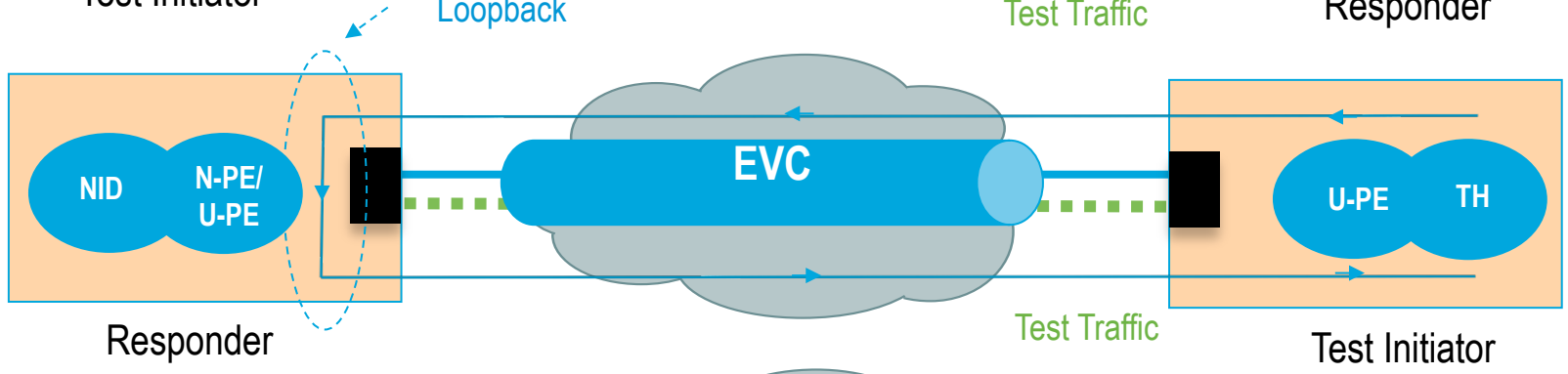
TH = Test Head NID = Network interface Device

SAT Use Case - Onboard function

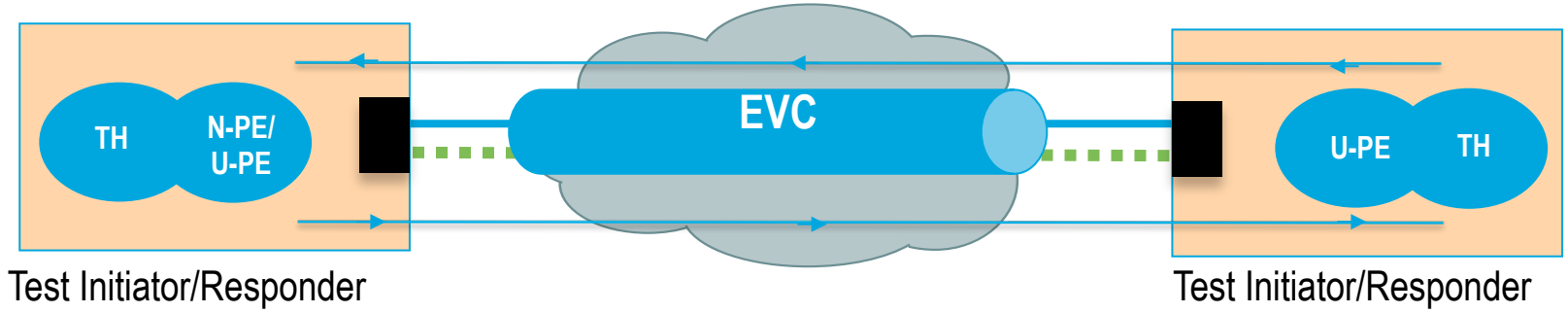
Bi-directional Test Operation



Bi-directional Test Operation



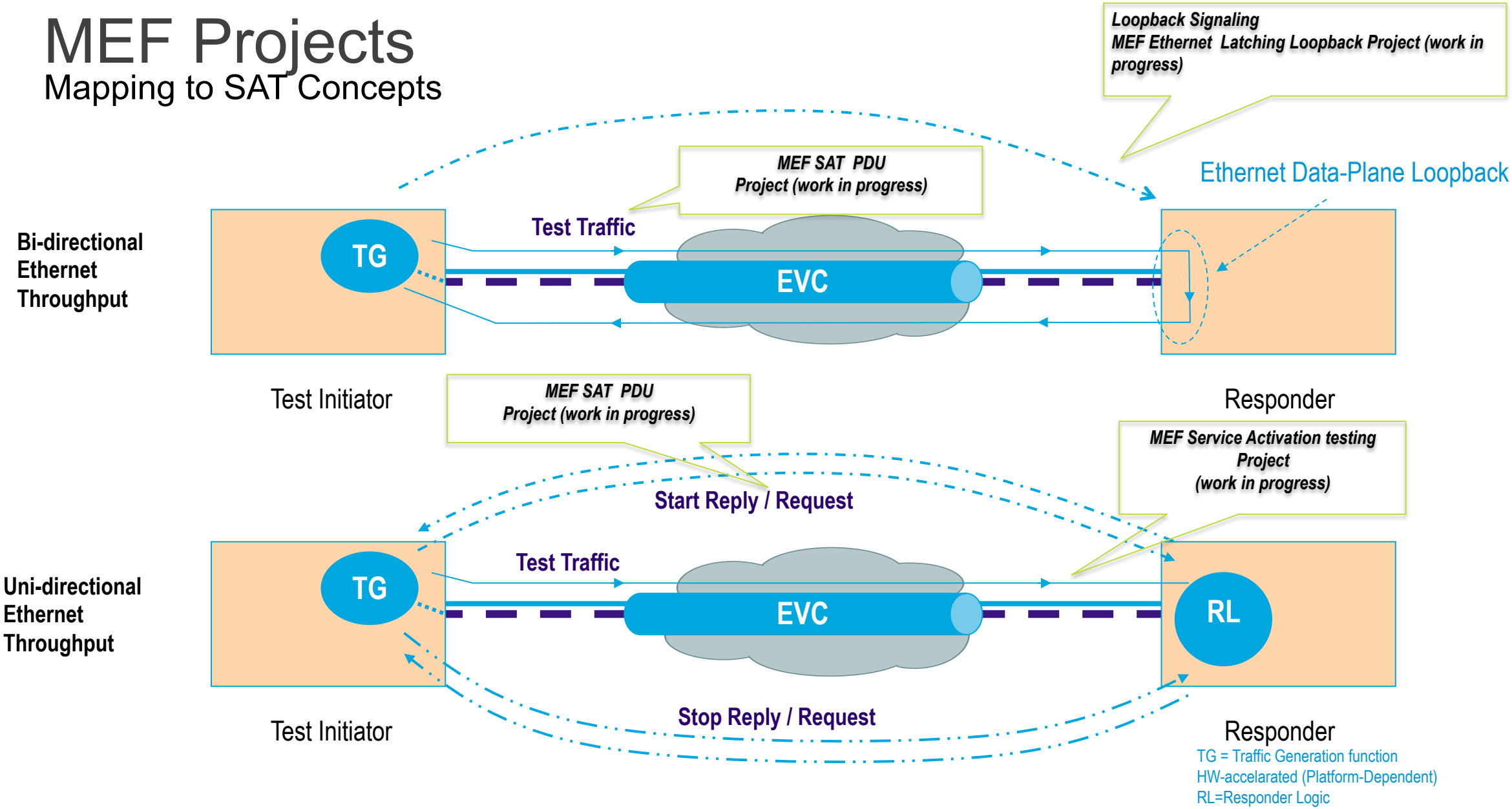
Uni-directional Test Operation



TH = Test Head NID = Network interface Device

MEF Projects

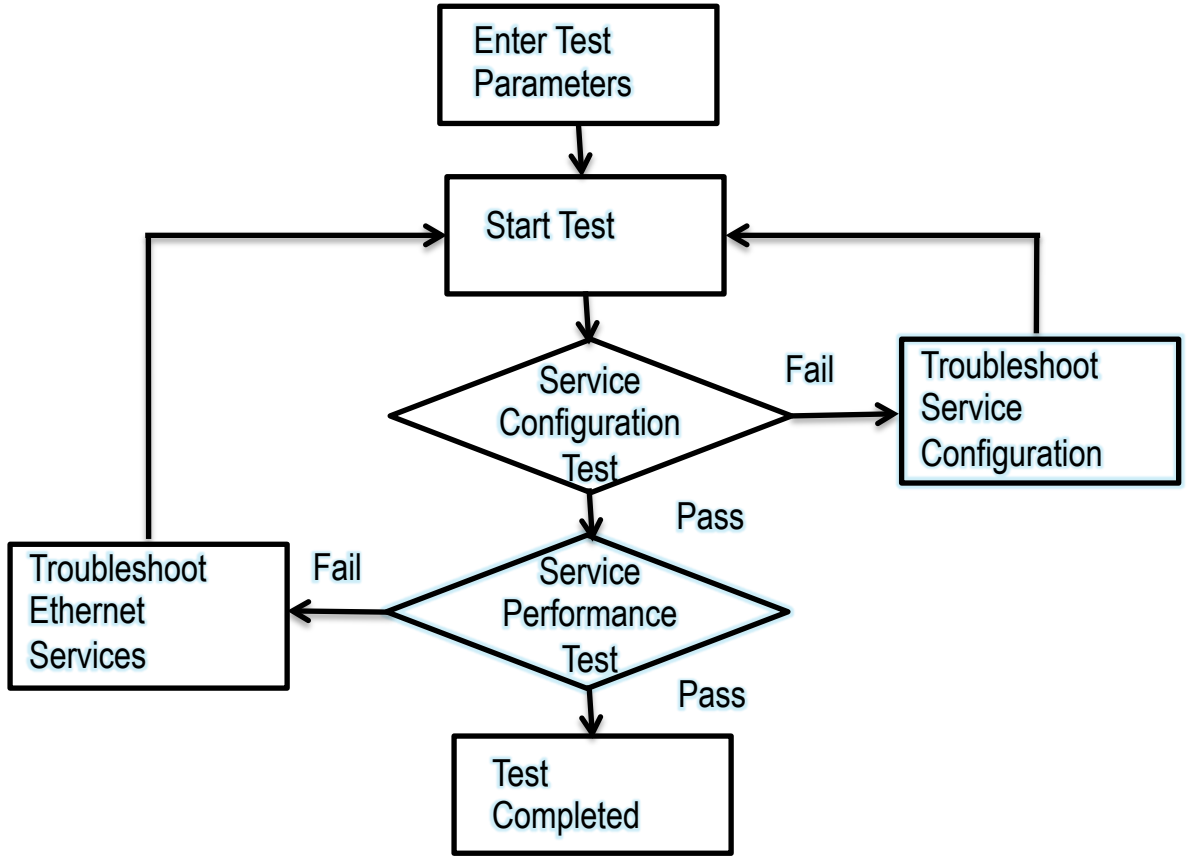
Mapping to SAT Concepts



ITU-T Y.1564

ITU-T Y.1564

- Out of Service Methodology to verify
  - proper Configuration of Service
  - Performance of Service
- Recommends
  - One way tests
  - (no signaling/test PDU specified)
- Assumes
  - External test head
- Acknowledges
  - Test functionality may be onboard Network Element
  - Loopback on responder as an alternative
- Claims
  - To address the gaps of RFC2544



High Level Service Activation Test Methodology

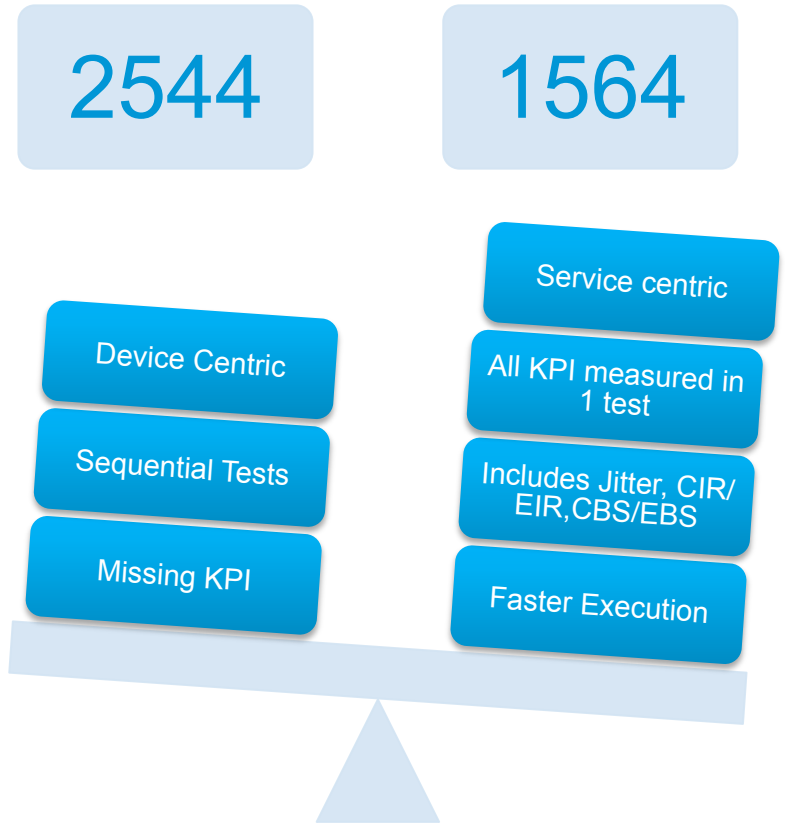
ITU-T Y.1564

RFC2544 methodology shortcomings (as stated by Y.1564)

- Not Ethernet service aware
- Tests run as a single flow at a time
- Tests are performed sequentially
- Does not measure Frame Delay Variation
- Does not verify CIR, CBS, EIR, EBS and CM

Y.1564 advantages

- Tests all KPIs at same time
- Test to CIR to verify SLA performance (FD, FDV, FLR)
- Tests to EIR limit and just beyond to verify policing behavior (no SLA performance expected for yellow frames (above CIR and below CIR+EIR)



ITU-T Y.1564 - Service Attributes

- Ethernet Service Attributes
  - Connection Type
  - QoS
  - Bandwidth Profile
    - CIR,CBS,EIR,EBS,CM,CF
  - Performance Criteria
    - FTD, FDV, FLR, Availability

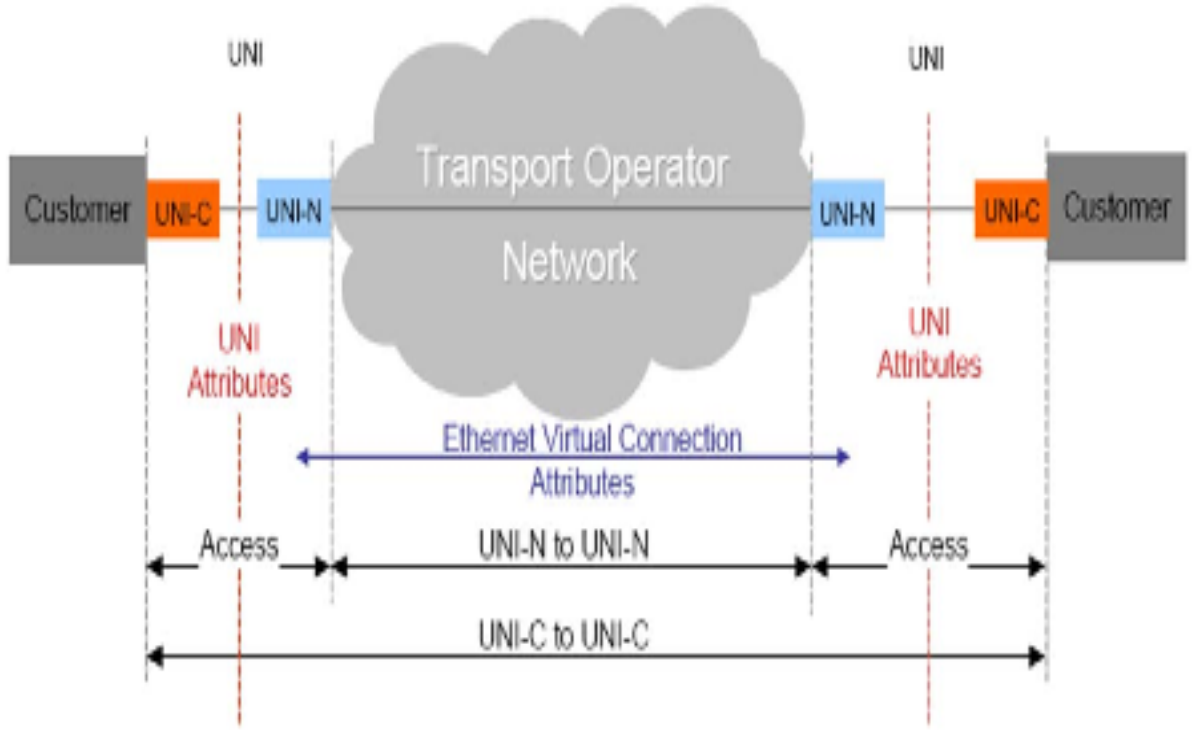


Figure 2 (from G.8011/Figure 6-1) - Single Provider view of Ethernet Service Areas

ITU-T Y.1564 - Test Methodology

Service Configuration Test

- Step load test MAY be used to reach and exceed CIR
- For each step up to CIR – IR, FD, FDV and FLR MUST be measured simultaneously
- Next step is to validate total IR of the service (EIR and Traffic policing tests) (only FLR is observed)
- CBS/EBS bursting tests MAY be executed (normative methodology is for further study)

Service Performance Test

- Executed after Service Configuration test
- Medium to long duration (15min, 2h, 24h)

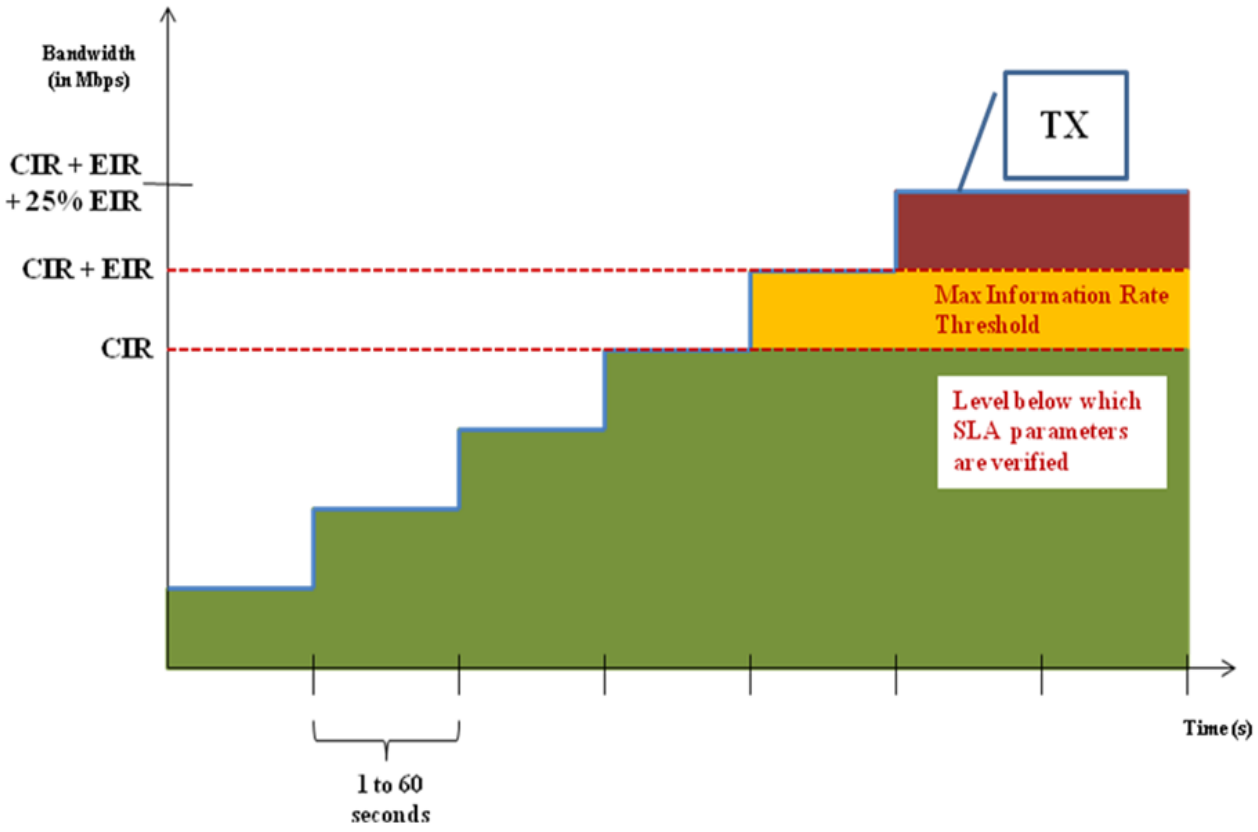


Figure 6 Step Load test used in Service Configuration Test

Ethernet Data plane Loopback

Ethernet Dataplane Loopback

Ethernet data traffic can be looped back on a per flow basis

Use cases:

- Service turn-up
- Post service turn-up troubleshooting
- Out-of-service throughput testing

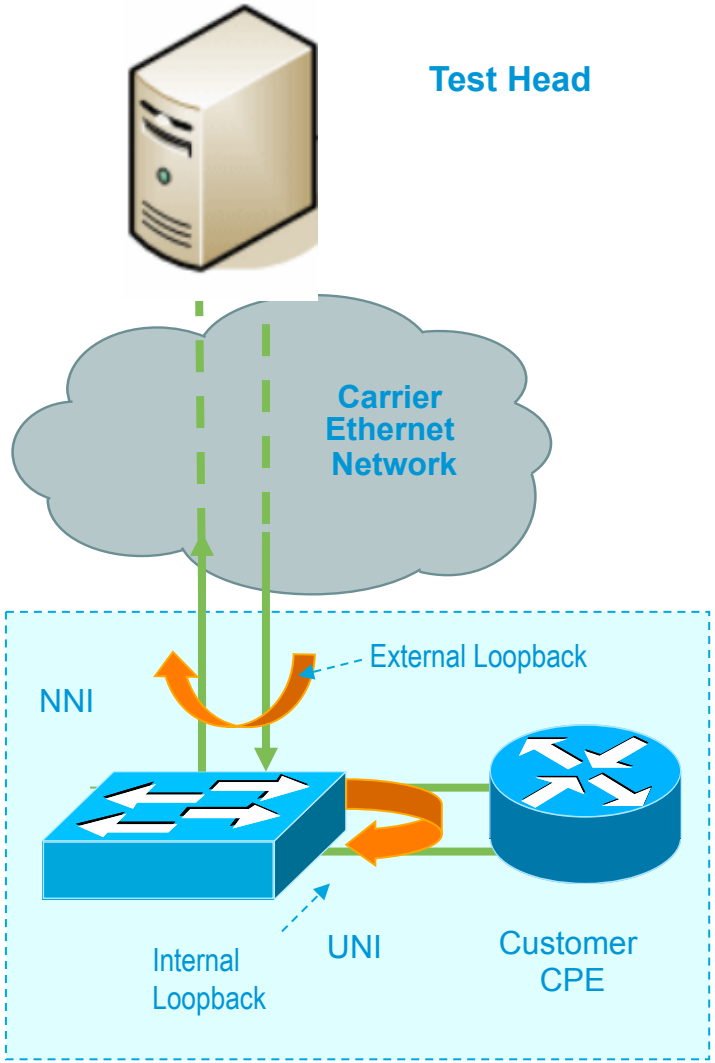
Enabled via CLI or could be signaled in future

MAC Swap

Configurable direction:

- **External** Loopback (facing wire)
- **Internal** Loopback (facing bridge)

External central Test Head allows for flexible and sophisticated test traffic patterns



*Note: External=Facility Internal=Terminal

Ethernet Loopback Comparison

Functionality	IEEE 802.1ag / ITU-T Y.1731 Loopback	IEEE 802.3ah Remote Loopback	Dataplane Loopback
Triggering Mechanism	CLI	CLI / In-Band (OAMPDUs) signal from Master NE	CLI/Signal in future
Loopback Type	Per-Port / Per-VLAN (according to initiator MEP configuration)	Per-Port	Granular Filter (per port/per VLAN/per MAC)
Test Intrusiveness	In-Service and Out-of-Service	Out-of-Service	Out-of-Service
Looped Frames	OAM frames (LBM/LBR)	Data frames	Data frames
SA and DA MAC swap	YES	NO	YES
Loopback Direction	Follows direction of responding MEP: External / Internal (down / up mep respectively)	External	Configurable (External / Internal)
Test Head to Test Point connectivity	Single-Hop / Multi-Hop bridged networks	Single-Hop bridged network (between Master - Slave)	Single-Hop / Multi-Hop bridged networks

*Note: External=Facility Internal=Terminal

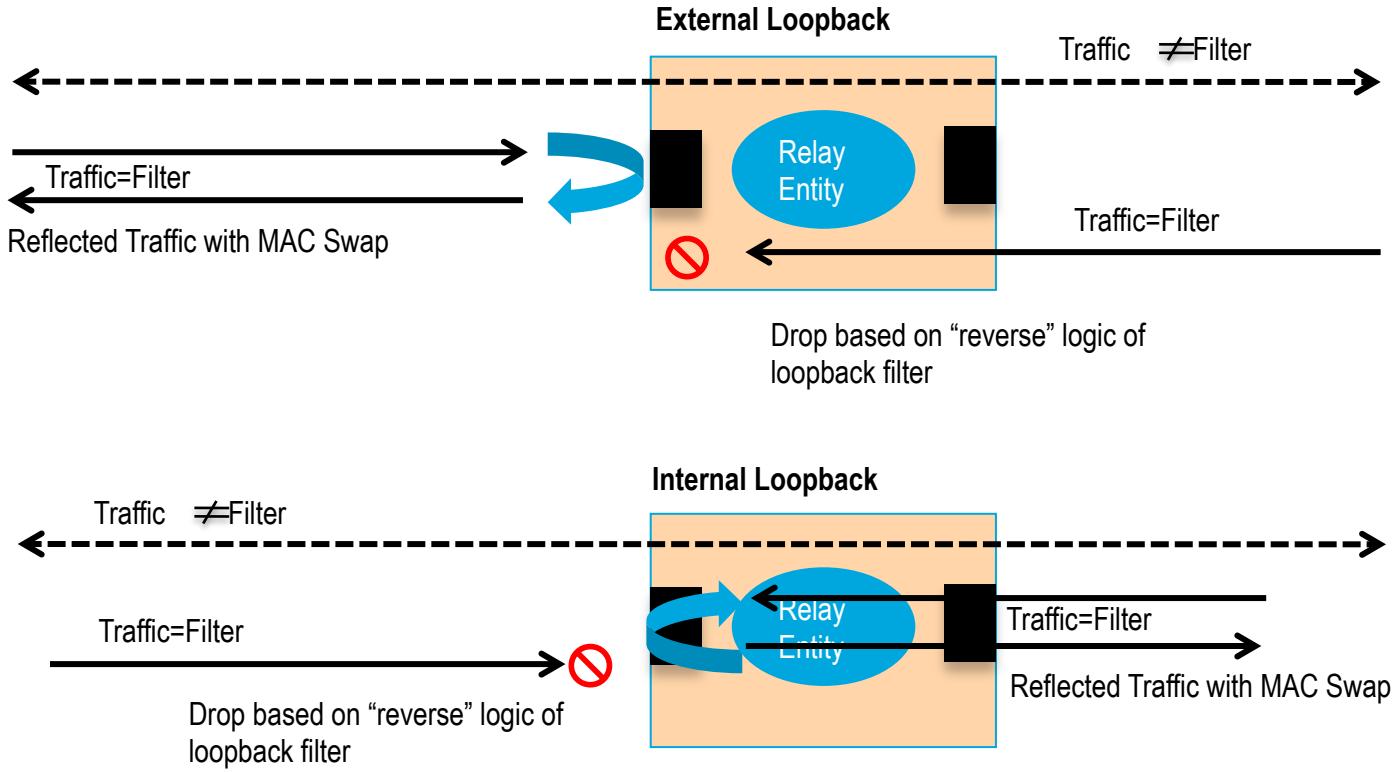
Ethernet Dataplane Loopback

Platform Implementation

Traffic matching the filter is reflected

Traffic matching the filter but arriving from the opposite side is dropped

Traffic not matching the filter undergoes regular forwarding

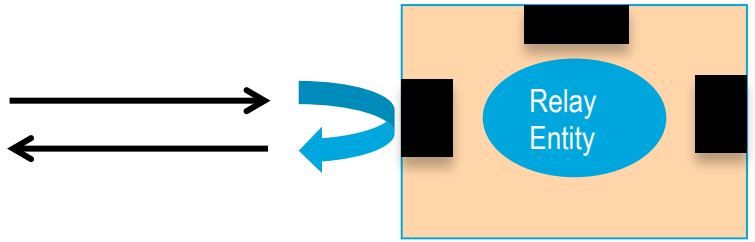


Ethernet Dataplane Loopback

Platform Implementation

With External Loopback SMAC is not learnt for traffic that matches the filter

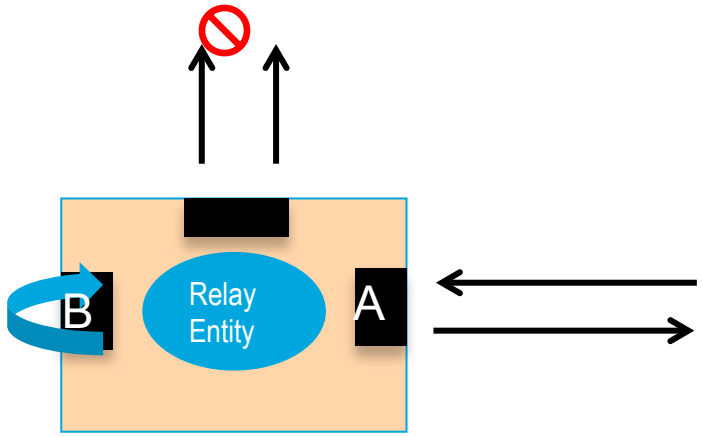
With Internal Loopback SMAC is learnt on the incoming interface while the DMAC is learnt on the interface where the loopback is active



External Loopback

MAC	Interface
-	-

No entries learnt in MAC table for facility loopback case



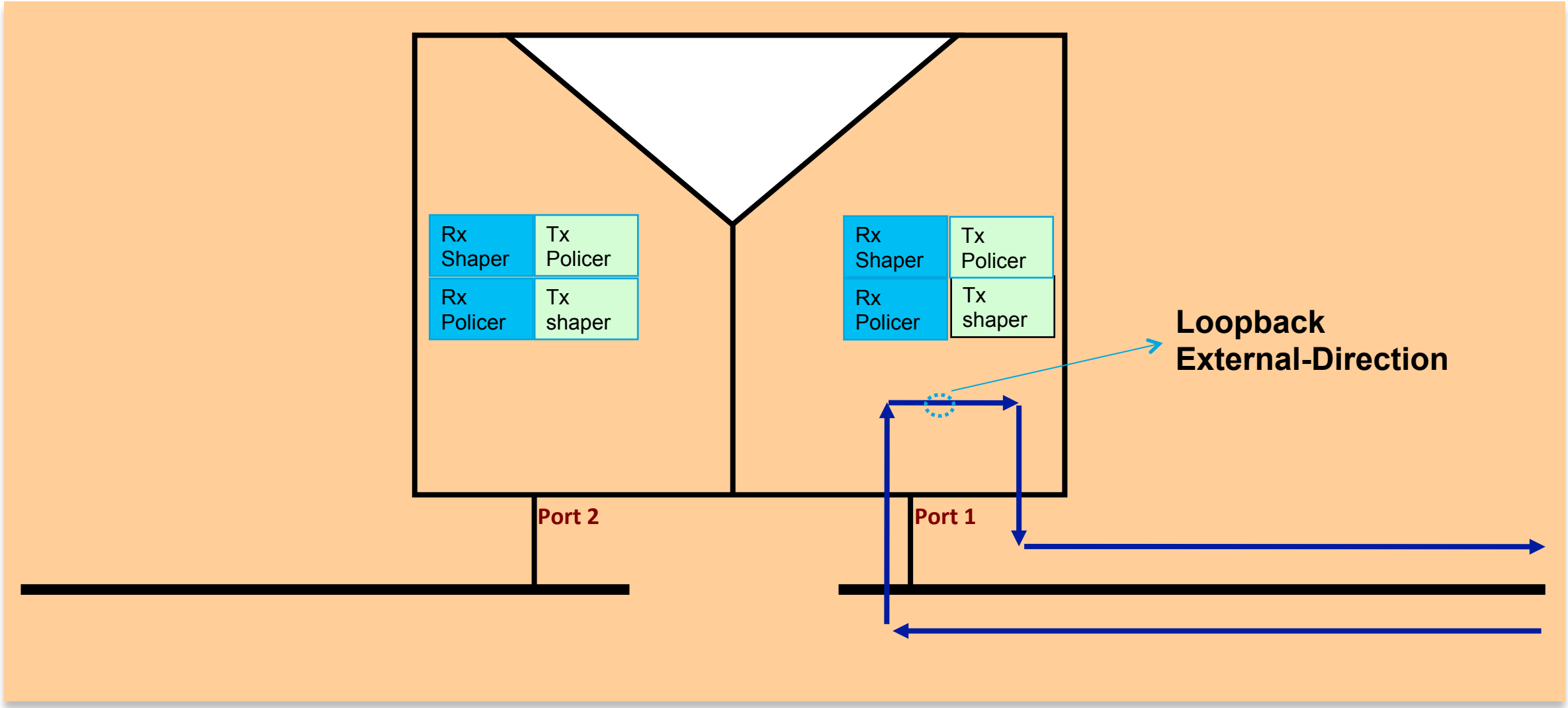
Internal Loopback

MAC	Interface
SMAC	A
DMAC	B

DMAC learnt on port B for internal loopback case to prevent flooding in multipoint scenario

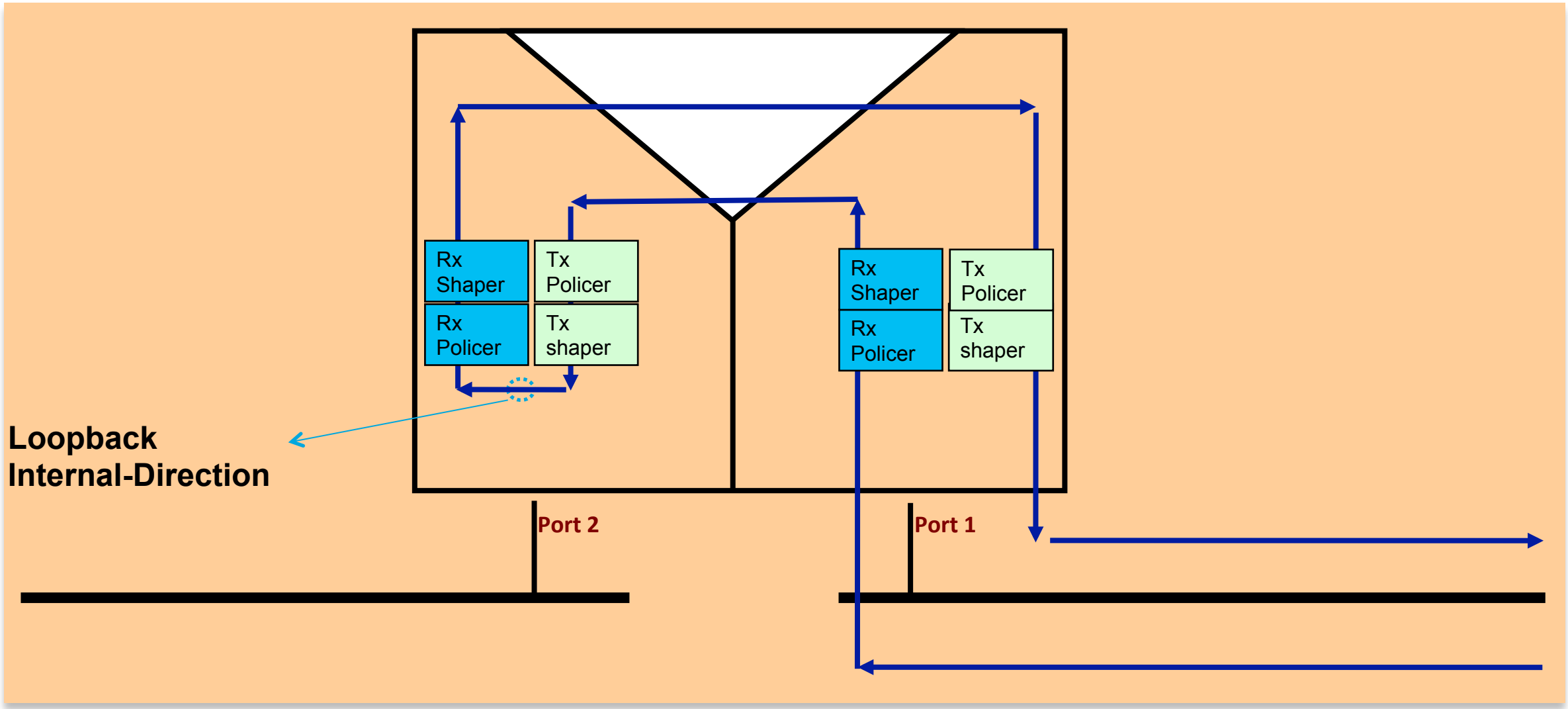
Ethernet Dataplane Loopback

Platform Implementation



Ethernet Dataplane Loopback

Platform Implementation



IP SLA Ethernet Service Performance Probe

IP SLA SP Probe

- Service Acceptance Criteria
  - Information Rate (IR) or Throughput
  - Frame Transfer Delay (FTD)
  - Frame Loss Ratio (FLR)
  - Frame Delay Variation (FDV) or Jitter
- Service Performance test
  - Phase 1 – Minimum data rate to CIR
  - Phase 2 – CIR to EIR
  - Phase 3 – Discard testing

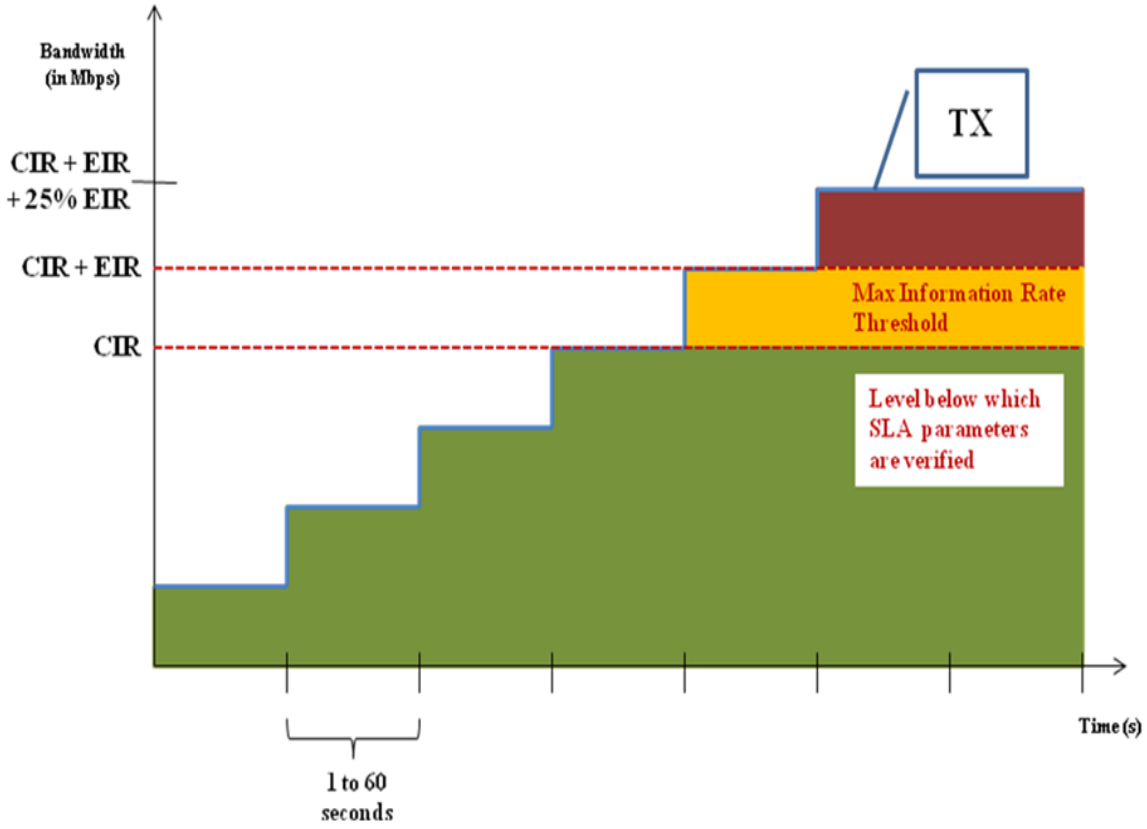


Figure 6 Step Load test used in Service Configuration Test

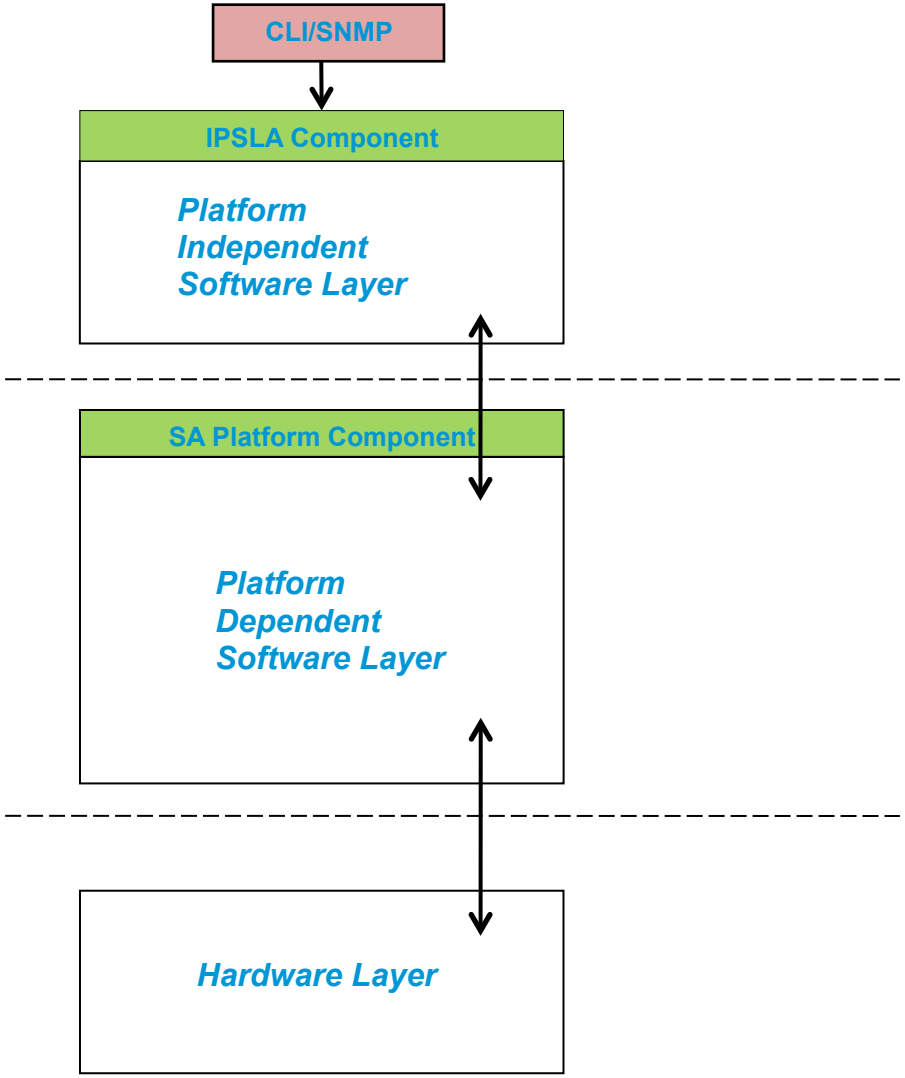
IP SLA SP Probe

Operational Modes

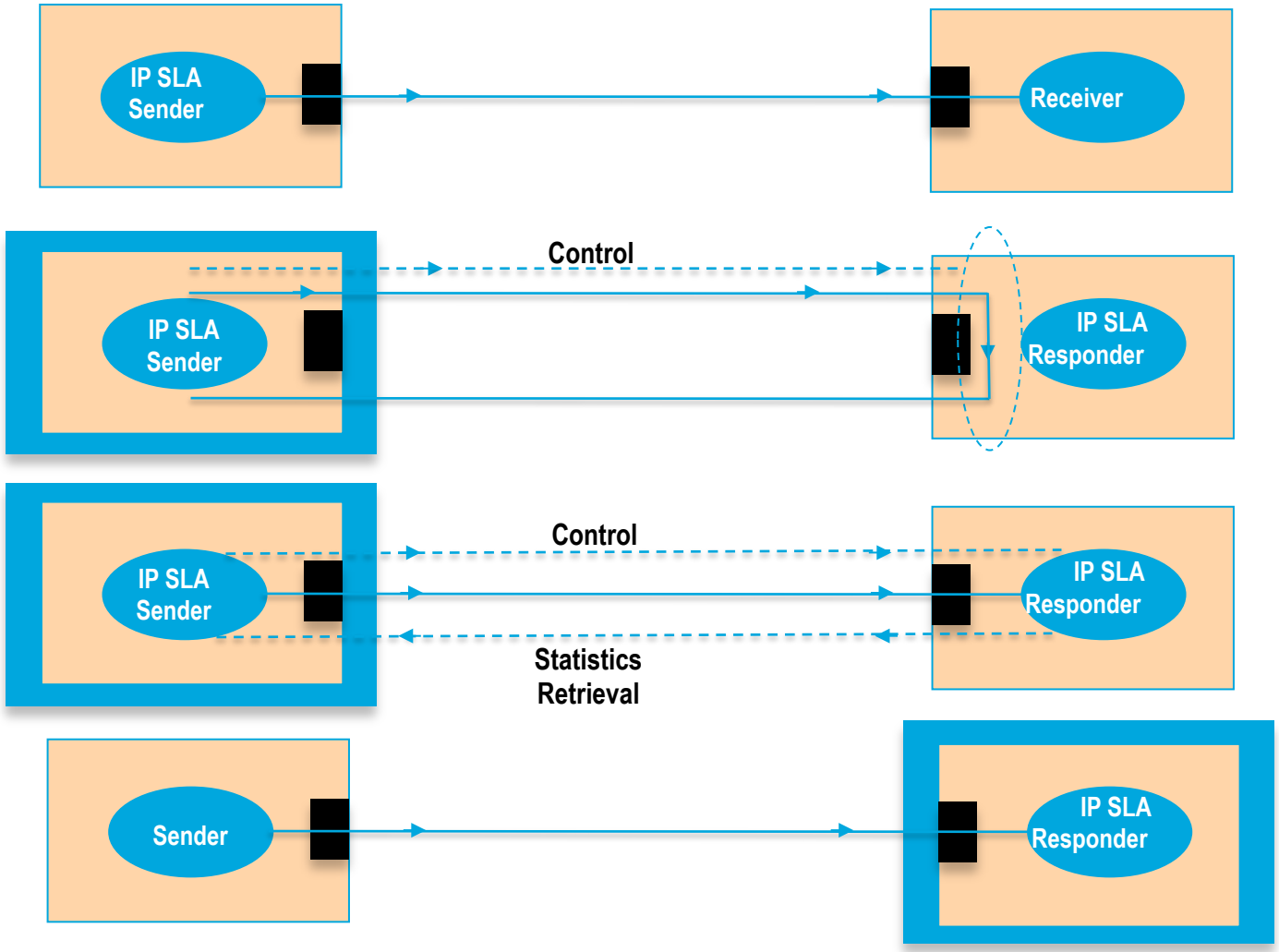
- Traffic Generator Mode
- Two Way Statistics Collection
- One Way Statistics Collection
- Passive Measurement Mode

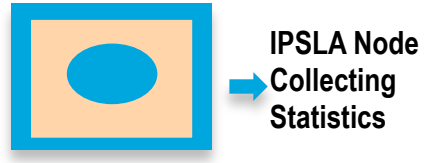
Statistics Collected

- Throughput Min/Max/Avg
- Loss Count/Ratio
- Out of Sequence Packets/Events/Count
- Availability
- Delay Min/Max/Avg
- Delay variation Min/Max/Avg



IP SLA SP Probe





Traffic Generator mode
- Traffic generated by sender

Two Way Statistics Collection
- Traffic generated by sender
- Sender collects stats
- Remote loopback signaled or manual

One Way Statistics Collection
- IP SLA session creation in responder triggered by control message
- Traffic generated by sender
- Responder collects stats
- Responder ships stats back to sender

Passive Measurement mode
- Traffic generated by sender
- Responder collects stats for configured operation

Technical Overview
ITU-T Y.1731
Performance Monitoring

ITU-T Y.1731 – OAM Functions for Performance Management

- Frame Loss Ratio – percentage (%) of service frames not delivered / Total number of service frames delivered in T time interval
- Frame Delay – round-trip/one-way delay for a service frame
- Frame Delay Variation – Variation in frame delay between a pair of service frame
- Service frames (Green) are frames that conform to agreed upon level of bandwidth profile conformance

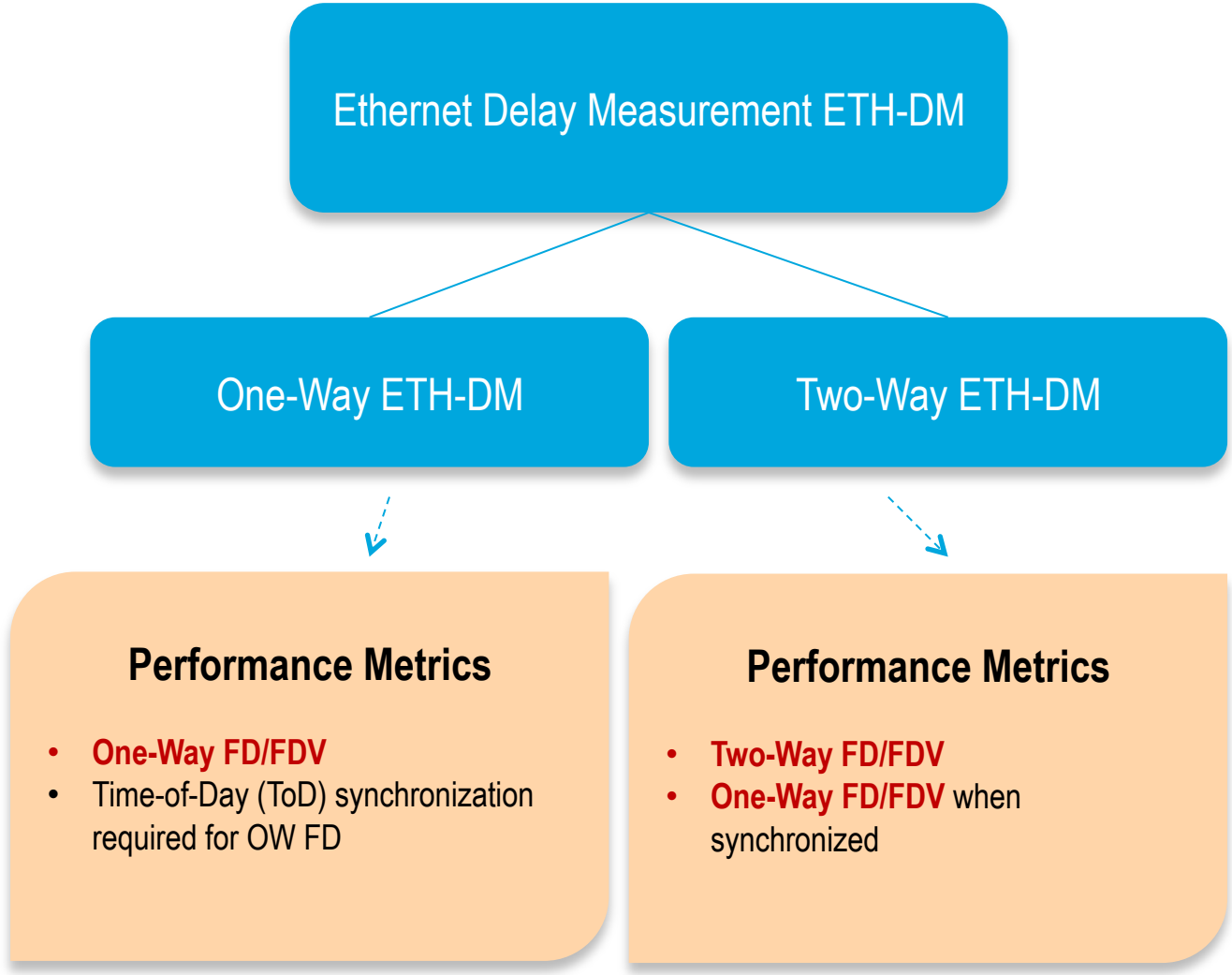
Y.1731 – Frame Delay Measurement

Frame Delay calculated based on timestamps applied to synthetic traffic

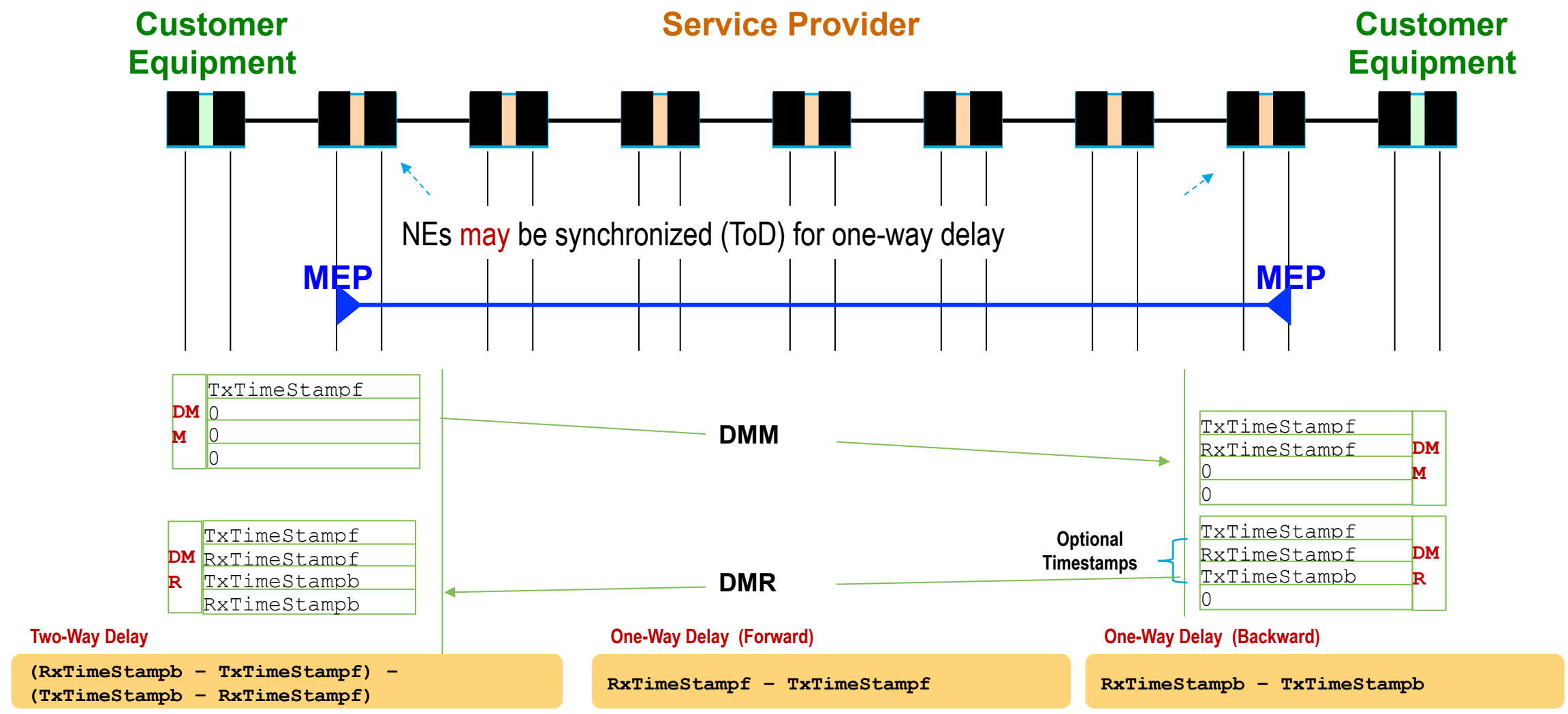
Applicable to point-to-point and multipoint services

Two (2) mechanisms defined

- One-Way ETH-DM
- Two-Way ETH-DM



ITU-T Y.1731 Overview
Two-Way ETH-DM



DMM – Delay Measurement Message
DMR – Delay Measurement Reply

Y.1731 – Frame Loss Measurement

Frame Loss calculated based on actual in-profile service counters

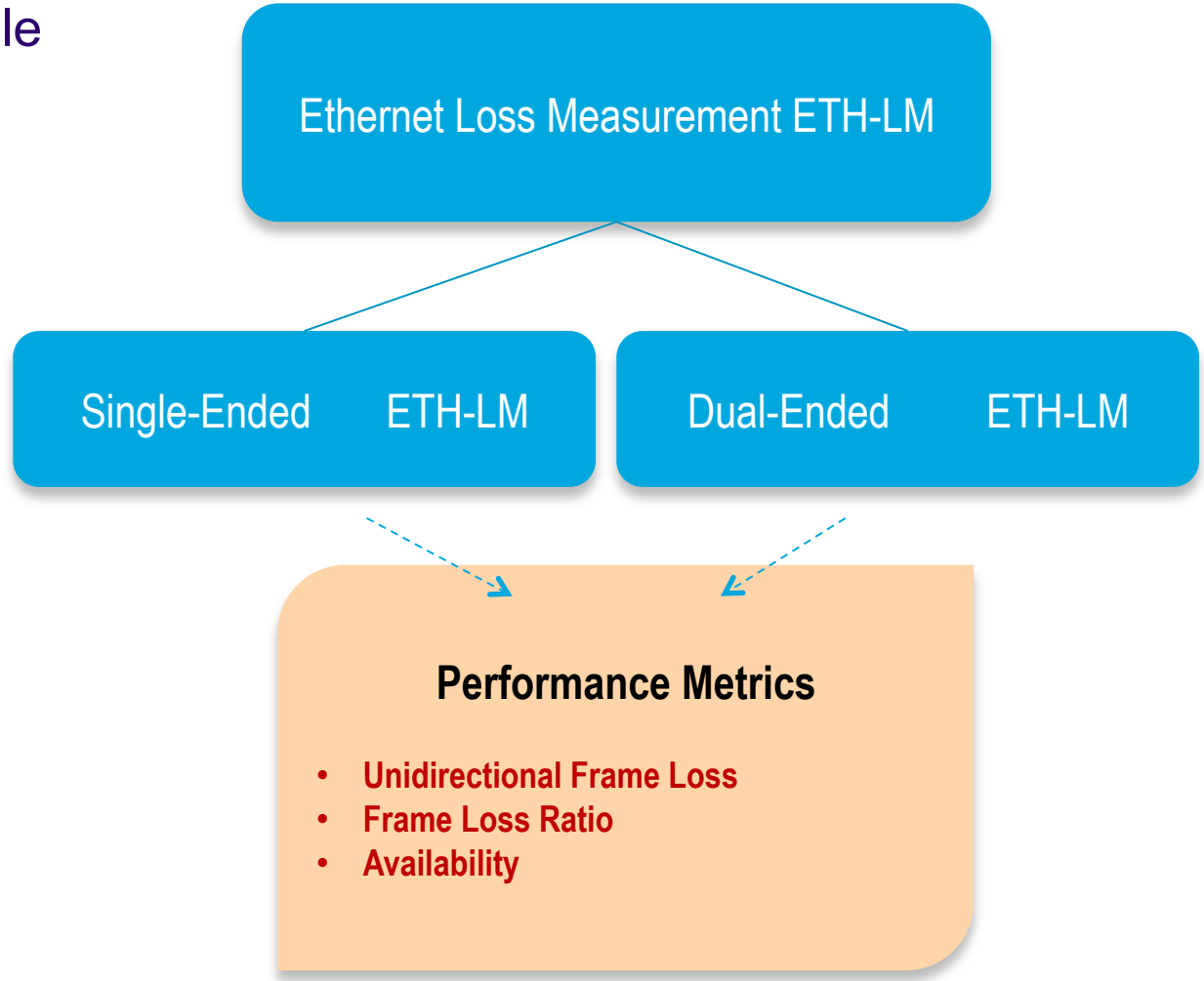
Applicable to point-to-point services only

Near-End Frame Loss measurement

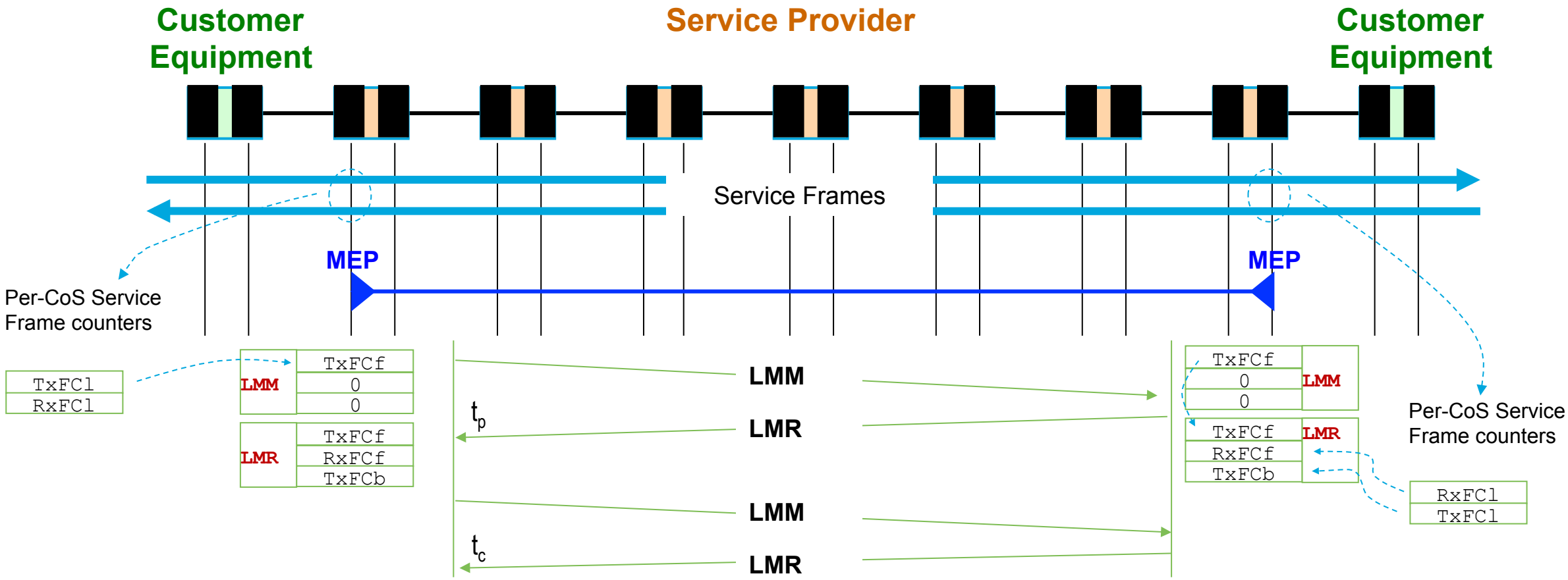
Far-End Frame Loss measurement

Per-CoS counters maintained per MEP

- TxFCl – in-profile data frames transmitted towards the peer MEP
- RxFCl – in-profile data frames received from the peer MEP



ITU-T Y.1731 Overview
Single-Ended (On-demand) ETH-LM



Frame Loss (Far-end)

$(TxFCf[t_c] - TxFCf[t_p]) - (RxFCf[t_c] - RxFCf[t_p])$

Frame Loss (Near-end)

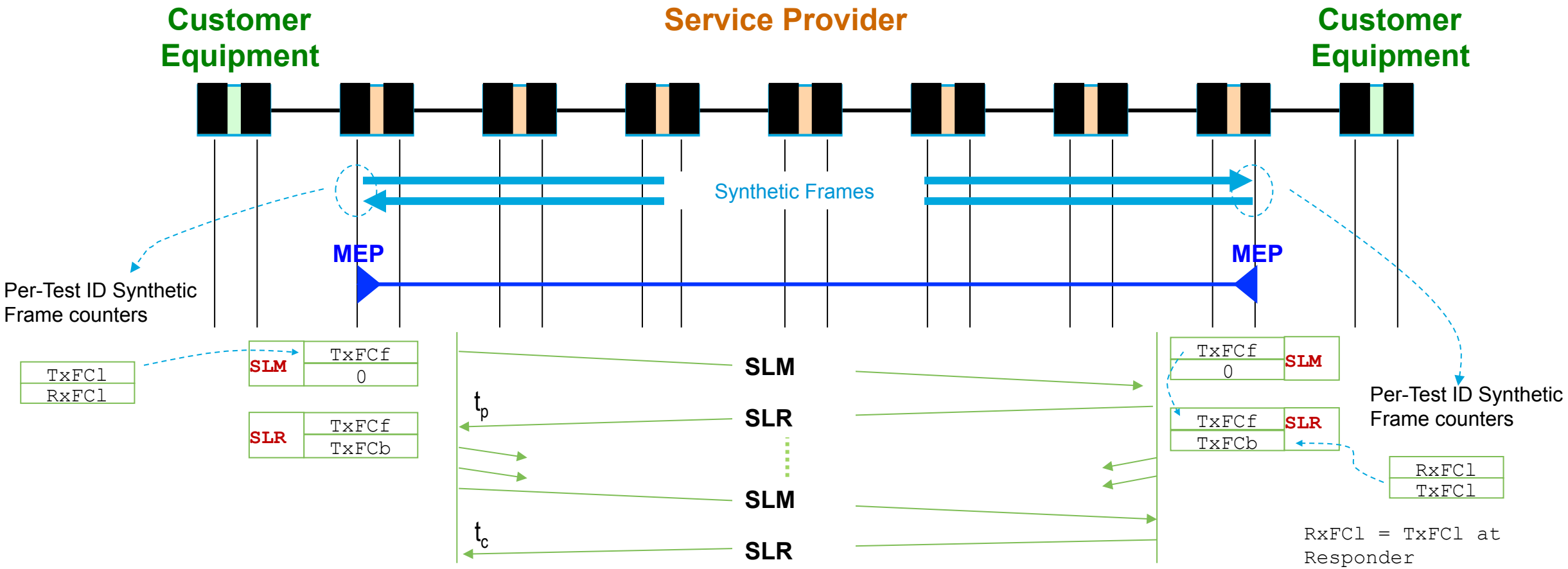
$(TxFCb[t_c] - TxFCb[t_p]) - (RxFCl[t_c] - RxFCl[t_p])$

t_p – Time Previous
t_c – Time Current

LMM – Loss Measurement Message
LMR – Loss Measurement Reply

ITU-T Y.1731 Overview

Single-Ended ETH-SLM



Frame Loss (Far-end)

$(TxFCf[t_c] - TxFCf[t_p]) - (TxFCb[t_c] - TxFCb[t_p])$

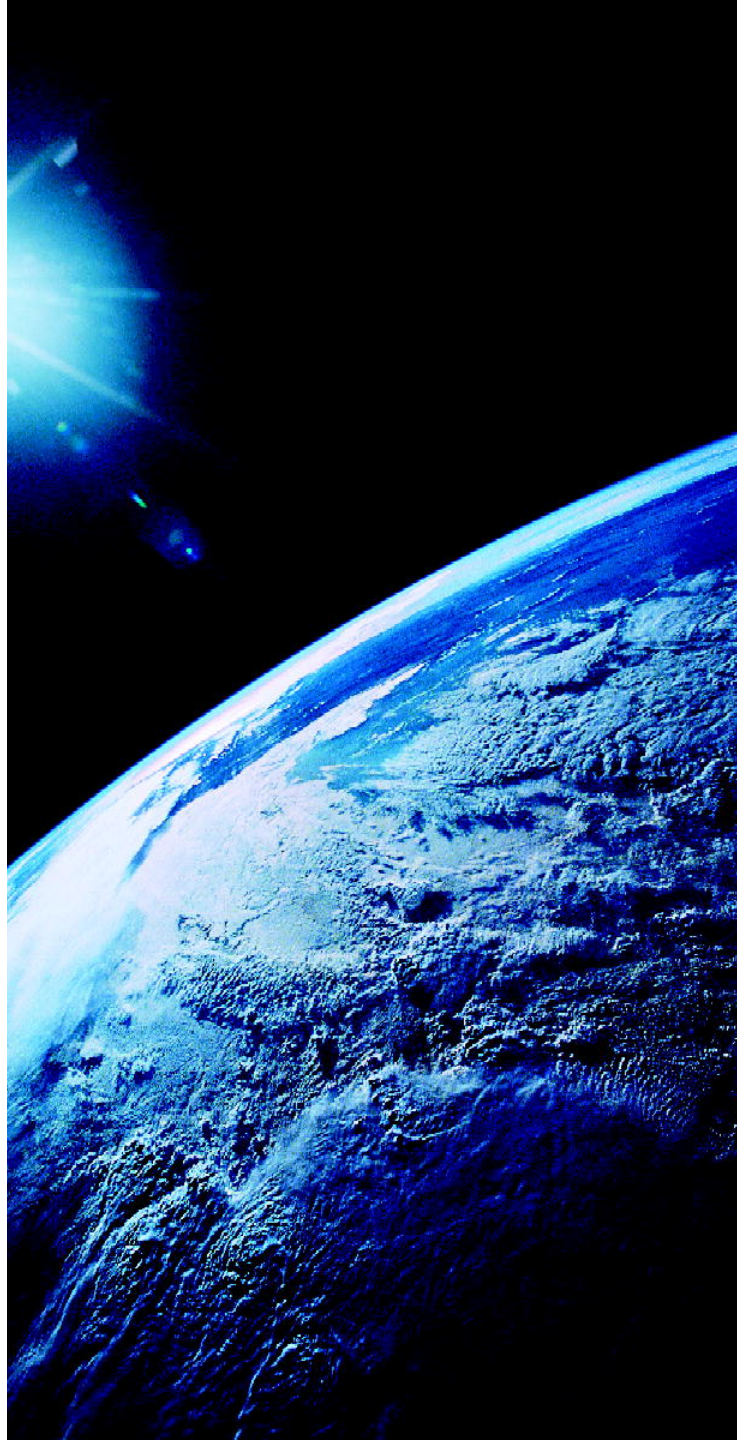
Frame Loss (Near-end)

$(TxFCb[t_c] - TxFCb[t_p]) - (RxFCl[t_c] - RxFCl[t_p])$

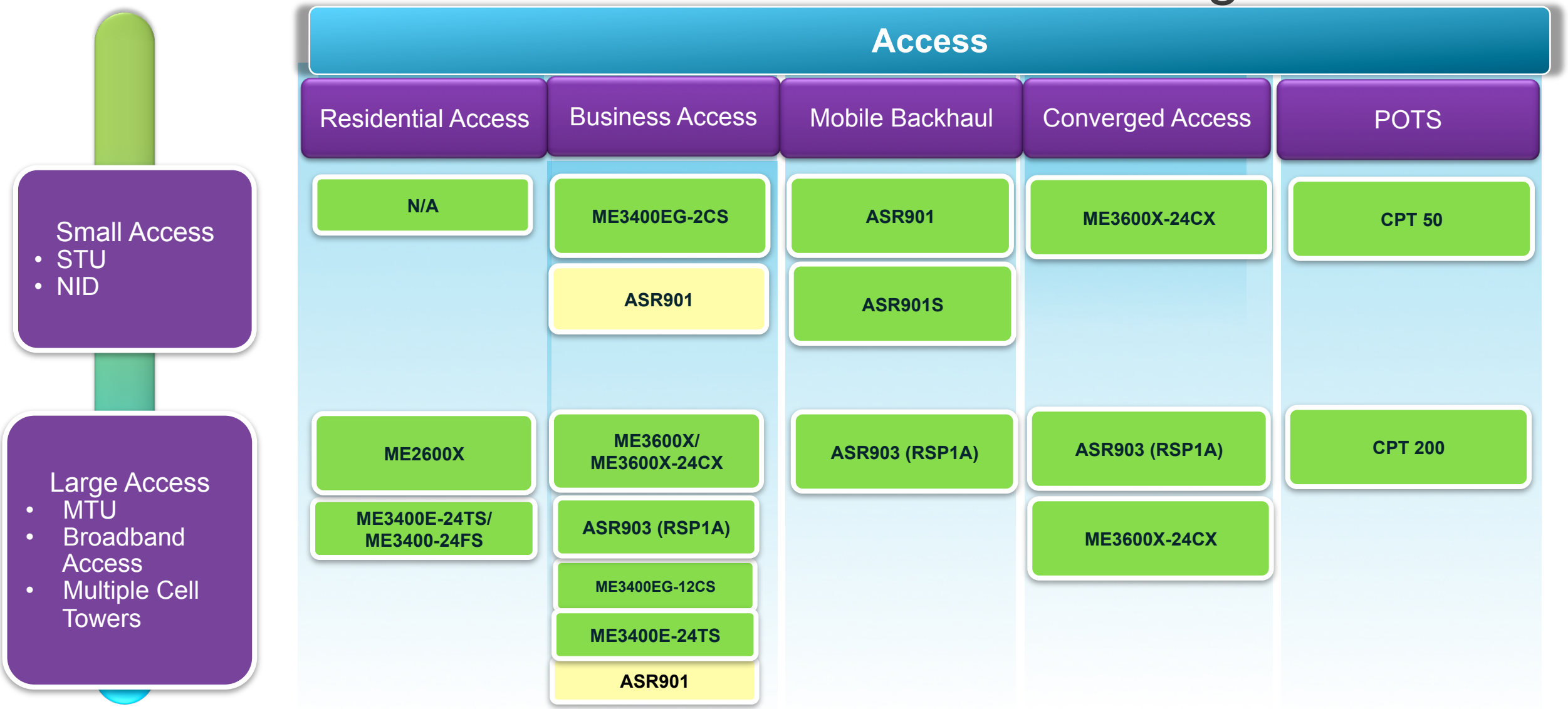
t_p – Time Previous – Start of Measurement Period
t_c – Time Current – End of Measurement Period

SLM – Synthetic Loss Message
SLR – Synthetic Loss Reply

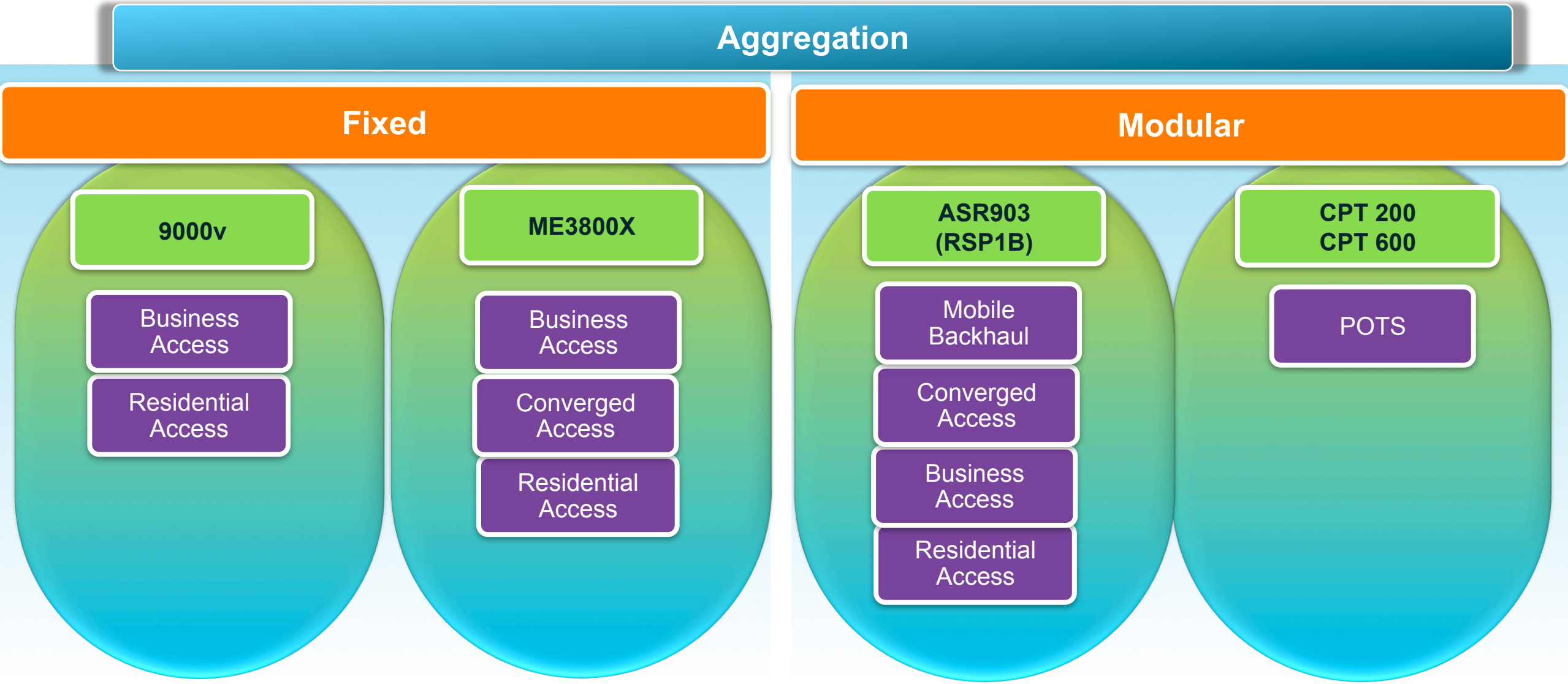
Cisco SP Access Group (SPAG) Integrated SPT Framework



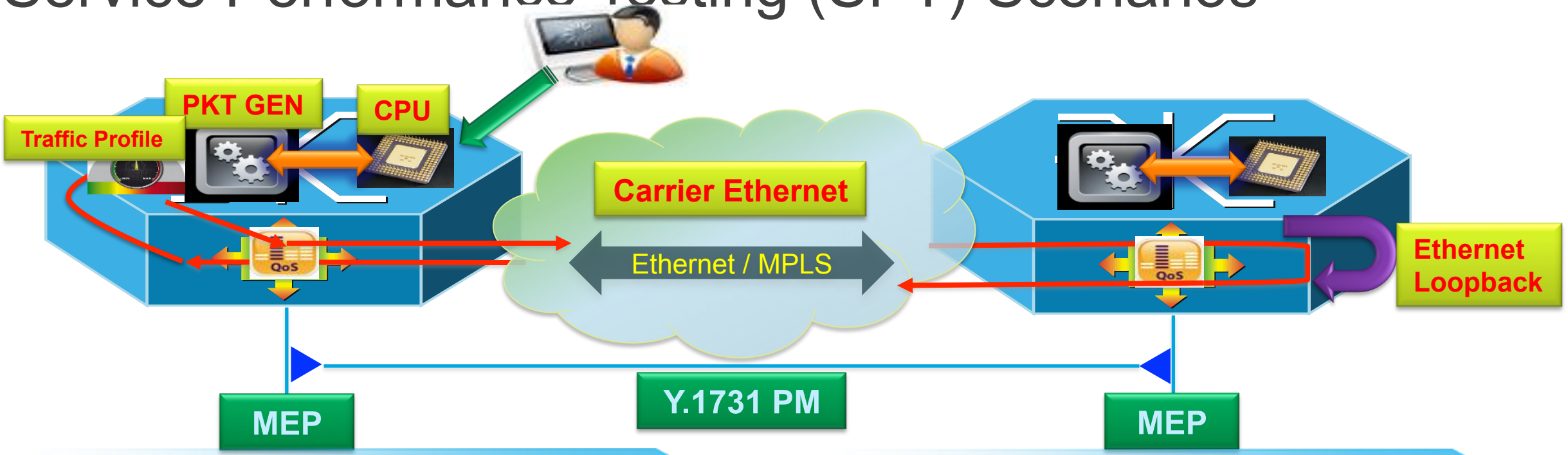
Cisco SPAG Access Portfolio and Positioning



Cisco SPAG Aggregation Portfolio and Positioning

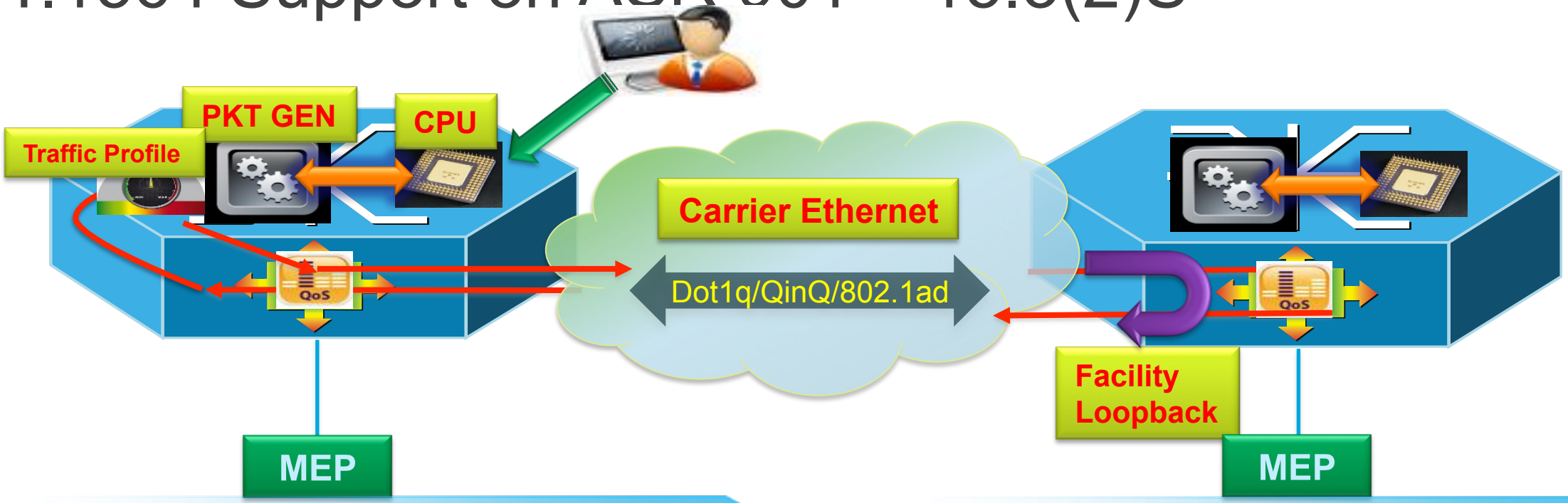


Service Performance Testing (SPT) Scenarios



1. Traffic Generator Replacement
2. Configurable Traffic Profile
3. Ingress/Egress QoS
4. Ethernet Loopback
5. Throughput Measurement
6. Jitter/Latency (Road-map)
7. Y.1731 PM control-plane (Roadmap)
8. Mgt. control-plane (Road-map)

Y.1564 Support on ASR 901 – 15.3(2)S



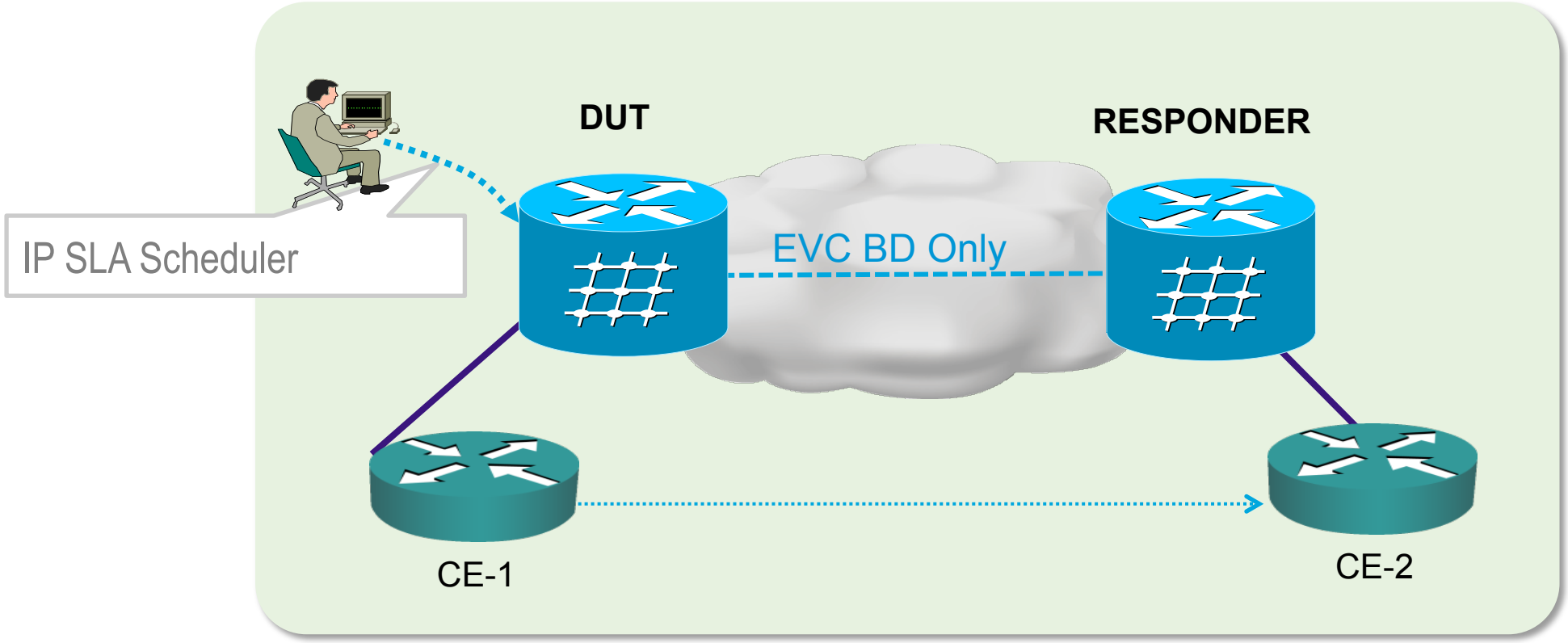
1. Traffic Generator Replacement
2. Ingress and Egress Traffic Profile
3. QoS – Egress Profile Direction
4. Dot1q, QinQ and 802.1ad
5. Throughput Measurement
6. Loss
7. Availability
8. Facility Loopback

Network Performance on ASR 901 with 15.3(2)S

Loss , Throughput and Availability

IP SLA Probes using Trafic Generated Traffic Profile

Maximum Line Rate – 1 Gbps



Traffic Generation Profile Details in IOS 15.3(2)S

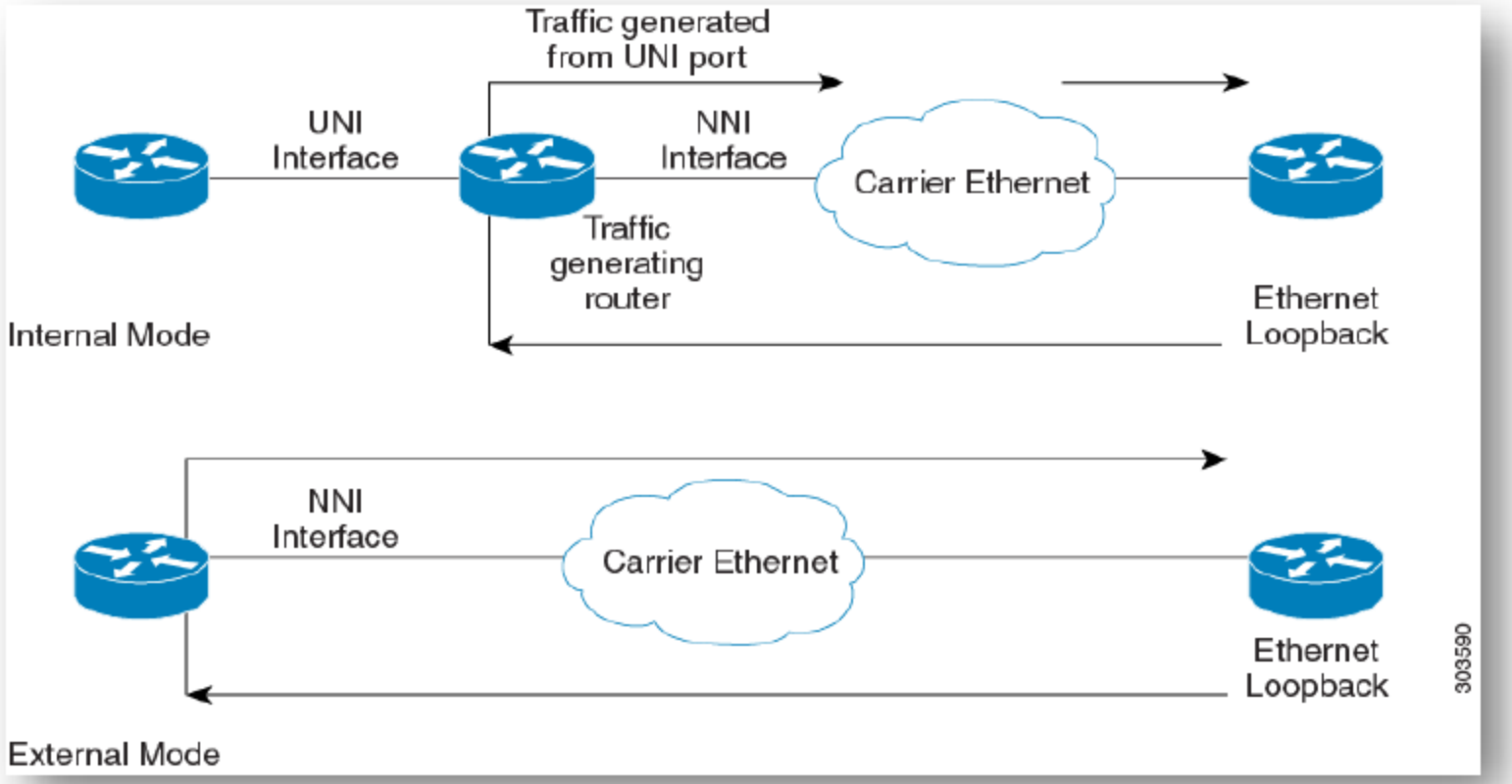
Traffic Profile Direction : Initiated by Traffic Generation from

- Internal : Uni Port
- External : NNI port

Measurement Direction

- External : NNI port
- Internal : UNI Port

Traffic Profile Direction	Measurement Direction
External	External
Internal	External
Internal	Internal



Traffic Generation Profile Details in IOS 15.3(2)S

Packet Size in Bytes

64 (Default) , 128 , 256 , 512 , 1280 and 1518

Supported Encapsulations on EVC

- Untagged
- Dot1q with/out POP1
- QinQ with POP1
- QinQ with POP2
- Dot1ad with POP2/POP1
- Default Encap

Egress QOS

- COS Marking on Outer S-Tag
- Queuing on Egress

Trafic Gen Statistics

Frame Loss(FL) = Tx Packets – Rx Packets

Frame Loss Ratio(FLR) =

{(Tx Packets – Rx Packets) /Tx Packets} %

Information Rate(IR) = Traffic Rate – (Traffic Rate * FLR/100)

Availability = (100 – FLR)%

SPAG SPT Example

Step-1:

```
DUT#sh run | begin ip sla
ip sla 5
service-performance type ethernet dest-mac-addr aaaa.bbbb.cccc interface GigabitEthernet0/0 service instance 2
                                        / * EFP-UNDER-TEST */
 duration time 20                       /* TEST DURATION IS  = 20 seconds. Default is 30 if not specified */
frequency time 95                       /*  Test will restart after 95 Seconds*/
description 64b-1Mbit-EFP
measurement-type direction internal     /*  MEASURING THROUGHPUT AND LOSS */
  loss
  throughput
profile traffic direction internal      /* TRAFFIC GENERATOR TO CONDUCT  TEST AT 500M*/
  rate-step kbps 500000
profile packet                          /* CONFIGURING PACKET-PARAMETERS. 128-BYTE PACKET. */
  outer-vlan 10
  outer-cos 7
  packet-size  1518
  src-mac-addr d48c.b544.9600
```

SPAG SPT Example – cont'd

Step-2:

DUT#sh ip sla statistics 1

IPSLAs Latest Operation Statistics

IPSLA operation id: 5
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 500000
Test duration: 30 seconds

Latest measurement: *00:00:00.000 UTC Mon Jan 1 1900
Latest return code: Unknown

Step 1 (500000 kbps):

SPAG SPT Example – cont'd

Step-3: Start the test

```
DUT#config t
Enter configuration commands, one per line.  End with CNTL/Z.
DUT(config)#ip sla schedule 1 start-time now          /* Test will run to completion, 30 secs. */
```

Step-4: While the test is running, you can do the following to see instantaneous metrics:

```
DUT#sh ip sla statistics 5
IPSLAs Latest Operation Statistics
IPSLA operation id: 5
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 500000
Test duration: 30 seconds
Latest measurement:  *04:26:47.285 UTC Fri Mar 1 2013
Latest return code:  OK
Overall Throughput: In Progress
Step 1 (500000 kbps):
Stats:
IR(kbps)  FL        FLR      Avail
500000    0         0.00%    100.00%
Tx Packets: 1272200  Tx Bytes: 1931199600
Rx Packets: 1272200  Rx Bytes: 1931199600
Step Duration: 30 seconds                  /* TEST COMPLETED. There was no LOSS and TX-RATE = RX-RATE
```

SPAG SPT Example – cont'd

Step-5: Stop the test

DUT(config)#no ip sla schedule 5 start-time now
DUT(config)#end

Metrics come back to default empty state:

DUT#sh ip sla statistics 5
IPSLAs Latest Operation Statistics

IPSLA operation id: 5
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 500000
Test duration: 30 seconds

Latest measurement: *00:00:00.000 UTC Mon Jan 1 1900
Latest return code: Unknown

Step 1 (500000 kbps):

Service Performance Testing Live Demo

Summary

- Ethernet Dataplane loopback allows for bidirectional throughput measurements
- IP SLA Service Performance probe enables onboard traffic generation
- Imminent support for Dataplane loopback and IP SLA Service Performance probe in Cisco's SPAG product line

Links

- Configuring IP SLA - Service Performance Testing
  http://www.cisco.com/en/US/docs/ios-xml/ios/ipsla/configuration/15-s/sla_y1564.html
- Configuring Ethernet OAM
  http://www.cisco.com/en/US/docs/wireless/asr_901/Configuration/Guide/oam.html

IOS 15S Release map

IOS XE 3S	IOS RIs	CCO date	Maintenance
3.4.0S	15.1(3)S	07/29/2011	Extended
3.4.4S	15.1(3)S4	03/08/2012	Extended
3.4.5S	15.1(3)S5	(02/13/2013)	Extended
3.5.0S	15.2(1)S	11/28/2011	Standard
3.5.1S	15.2(1)S1	02/09/2012	Standard
3.5.2S	15.2(1)S2	04/19/2012	Standard
3.6.0S	15.2(2)S	03/29/2012	Standard
3.7.0S	15.2(4)S	07/26/2012	Extended
3.7.1S	15.2(4)S1	10/08/2012	Extended
3.7.2S	15.2(4)S2	12/13/2012	Extended
3.7.3S	15.2(4)S3	(04/23/2013)	Extended
3.8.0S	15.3(1)S	11/28/2012	Standard
3.8.1S	15.3(1)S1	2/12/2013	Standard
3.8.2S	15.3(1)S2	(4/30/2013)	Standard
3.9.0S	15.3(2)S	3/29/2013	Standard
3.10S	15.3(3)S	(7/31/2013)	Extended
3.11S	15.4(1)S	(11/29/2013)	Standard
3.12S	15.4(2)S	(Q1 CY14)	Standard
3.13S	15.4(3)S	(Q3 CY14)	Extended

Acronyms

Acronym	
AIS	Alarm Indication Signal
CCM	Continuity Check Message
CCMDB	CCM Data Base (see CCM)
CE	Customer Edge
CFM	Connectivity Fault Management
EFM	Ethernet in the First Mile
E-LMI	Ethernet LMI (see LMI)
E-OAM	Ethernet OAM (see OAM)
EVC	Ethernet Virtual Connection
IEEE	Institute of Electrical and Electronics Engineers
ITU	International Telecommunication Union
LBM	Loopback Message
LBR	Loopback Reply
LMI	Local Management Interface
LTM	Linktrace Message
LTR	Linktrace Reply
MA	Maintenance Association
MAID	MA Identifier (see MA)
MD	Maintenance Domain

Acronym	
MEF	Metro Ethernet Forum
MEN	Metro Ethernet Network
MEP	Maintenance Association End Point
MEPID	MEP Identifier (see MEP)
MHF	MIP Half Function (see MIP)
MIB	Management Information Base
MIP	Maintenance Domain Intermediate Point
MP	Maintenance Point
OAM	Operations, Administration and Maintenance
PDU	Protocol Data Unit
PE	Provide Edge
RDI	Remote Defect Indicator
RFI	Remote Failure Indicator
TLV	Type, Length, Value
UNI	User to Network Interface
UNI-C	Customer side of UNI (see UNI)
UNI-N	Network side of UNI (see UNI)
VID	VLAN Identifier
VLAN	Virtual LAN

Otázky a odpovědi

Zodpovíme též v “Ptali jste se” v sále LEO v 17:45 – 18:30

e-mail: connect-cz@cisco.com

Prosíme, ohodnoťte tuto přednášku.

Děkujeme za pozornost.