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Benchmarking Methodology for EVPN and PBB-EVPN
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Abstract

This document defines methodologies for benchmarking EVPN and PBB-EVPN performance. EVPN is defined in RFC 7432, and is being deployed in Service Provider networks. Specifically this document defines the methodologies for benchmarking EVPN/PBB-EVPN convergence, data plane performance, and control plane performance.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on February 22, 2020.

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1. Introduction

EVPN is defined in RFC 7432, and describes BGP MPLS- based Ethernet VPNs (EVPN). PBB-EVPN is defined in RFC 7623, discusses how Ethernet Provider backbone Bridging can be combined with EVPNs to provide a new/combined solution. This draft defines methodologies that can be used to benchmark both RFC 7432 and RFC 7623 solutions. Further, this draft provides methodologies for benchmarking the performance of

EVPN data and control planes, MAC learning, MAC flushing, MAC ageing, convergence, high availability, and scale.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

1.2. Terminologies

MHPE Multi homed Provide Edge router.

RR Route Reflector.

P Provider Router.

CE Customer Router/Devices/Switch.

MHPE2 Multi homed Provider Edge router 2.

MHPE1 Multi homed Provider Edge router 1.

SHPE3 Single homed Provider Edge Router 3.

AA EVPN Terminologies AA All-Active.

SA EVPN Terminologies SA Single-Active.

RT Router Tester.

Sub Interface Each physical Interfaces is subdivided in to Logical units.

EVI EVPN Instances which will be running on sub interface or physical port of the provider Edge routers.

DF Designated Forwarder.

ESI Ethernet Segment Identifier.

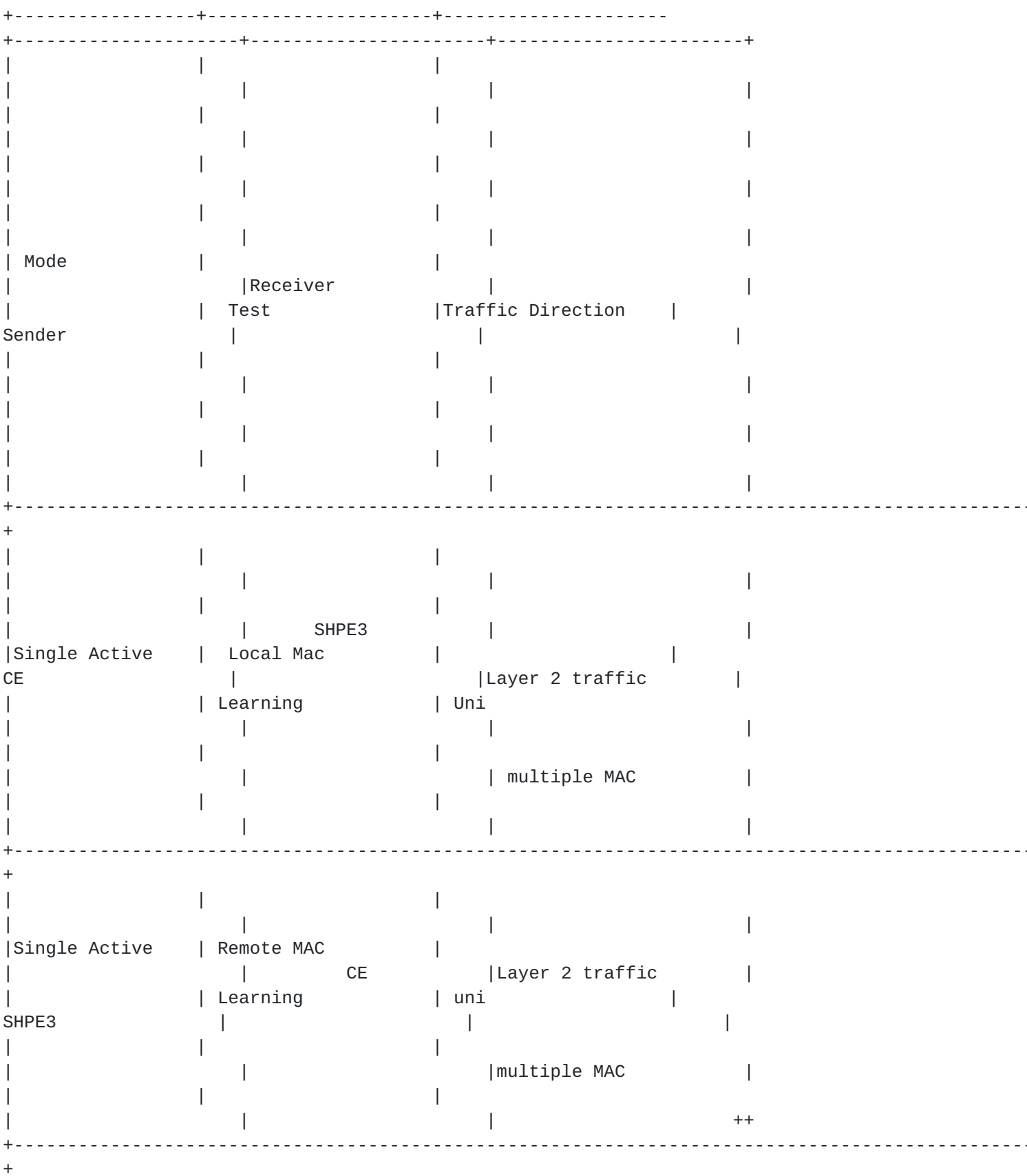
2. Test Topology

EVPN/PBB-EVPN Services running on SHPE3, MHPE1 and MHPE2 in Single Active Mode:

Topology 1

Test Setup

Figure 1


Mode
Receiver
Test
Traffic Direction
Sender
SHPE3
Single Active
Local Mac
Layer 2 traffic
CE
Learning
Uni
multiple MAC
Single Active
Remote MAC
CE
Layer 2 traffic
Learning
uni
SHPE3
multiple MAC

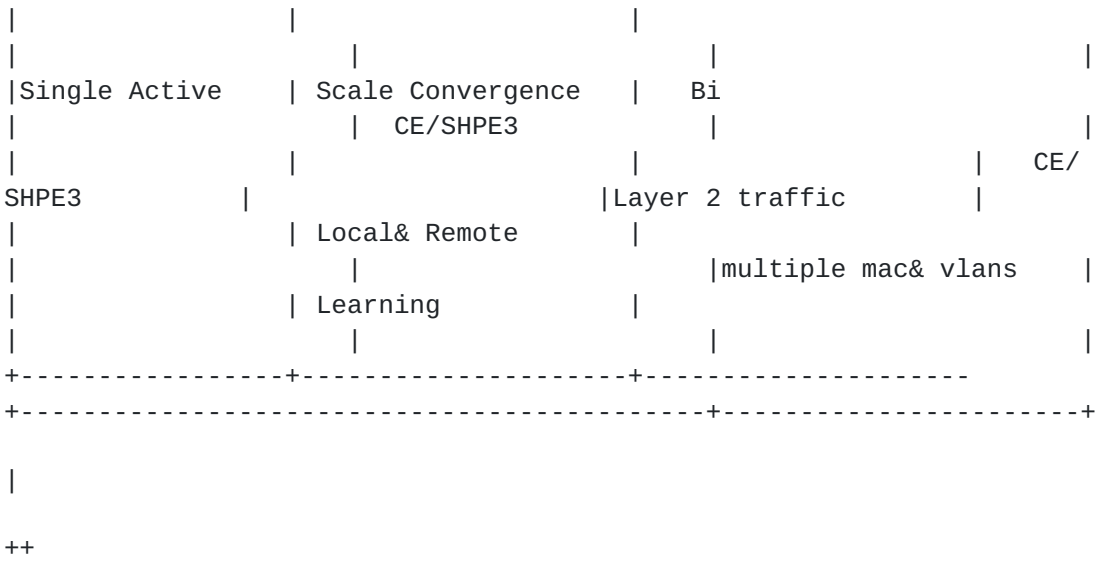


Table showing Traffic pattern for various test

Figure 2

Test Setup Configurations:

There are five routers in the Test setup. SHPE3, RR/P, MHPE1 and MHPE2 emulating a service provider network. CE is a customer device connected to MHPE1 and MHPE2, it is configured with bridge domains in multiple vlans. The router tester is connected to CE and SHPE3.The MHPE1 acts as DUT.The RT will be used as sender and receiver of traffic.The measurement will be taken in DUT.

All routers except CE is configured with OSPF/IS-IS,LDP,MPLS,BGP with EVPN address family.

All routers except CE must have IBGP configured with RR acting as route reflector.

MHPE1,MHPE2,SHPE3 must be configured with "N" EVPN/PBB-EVPN instances depends up on the cases.

MHPE1 and MHEPE2 must be configured with ESI per vlan or ESI on IFD.

MHPE1 and MHEPE2 are running Single Active mode of EVPN.

CE is acting as bridge configured with vlans that is configured on MHPE1,MHPE2,SHPE3.

Depends up on the test traffic will be flowing uni directional or bi directional depends on the test performed.

The above configuration will be serving as the base configuration for all test cases.

3. Test Cases for EVPN Benchmarking

3.1. Local MAC Learning

Objective:

To Record the time taken to learn the MAC address locally in DUT.

Topology : Topology 1

Procedure:

The data plane MAC learning can be measured using the parameters defined in RFC 2889 section 5.8. Send "X" unicast frames from CE to MHPE1(DUT) working in SA mode with "X" different source and destination address from RT. The DUT must learn these "X" macs in data plane.

Measurement :

Measure the time taken to learn "X" MACs in DUT evpn mac table. The data plane measurement is taken by considering DUT as black box the range of X MAC is known from RT and the same must be learned in DUT, the time taken to learn "X" macs is measured.

Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The mac learning time is calculated by averaging the values obtained from "N" samples.

Mac learning in sec = (T1+T2+..Tn/N)

3.2. Remote MAC Learning

Objective:

To Record the time taken to learn the remote macs.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to SHPE3 from RT. SHPE3 will advertise these locally learned macs to MHPE1 and MHPE2 via control plane.Measure the time taken to learn these X MACs from remote peer in DUT EVPN MAC address table.The DUT and MHPE2 are running SA mode.

Measurement :

Measure the time taken by the DUT to learn the "X" MACs in the data plane.Repeat these test and plot the data.The test is repeated for "N" times and the values are collected.The mac learning time is calculated by averaging the values obtained from "N" samples.

Mac learning in sec = (T1+T2+..Tn/N)

3.3. MAC Flush due to local link failure and Relearning

Objective:

To record the time taken to flush the mac learned locally and the time taken to relearn the same amount of macs.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from CE using traffic generator. Wait till the MHPE1 learns all X MAC address. Then fail the MHPE1 CE link and measure the time taken to flush these X MACs from the EVPN MAC table. Bring up the link which was made Down(the

link between MHPE1 and CE).Measure time taken to relearn it. The DUT and MHPE2 are running SA mode.

Measurement :

Measure the time taken for flushing these X MAC address. Measure the time taken to relearn the X MACs in DUT. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The flush and the relearning time is calculated by averaging the values obtained by "N" samples.

Flush time for X Macs in sec = (T1+T2+..Tn/N)

Relearning time for X macs in sec = (T1+T2+..Tn/N)

3.4. MAC Flush due to remote link failure.

Objective:

To record the time taken to flush the remote mac learned in DUT during remote link failure.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from SHPE3 using traffic generator. Bring down the link between SHPE3 and traffic generator. Then measure the time taken to flush the DUT EVPN MAC table. The DUT and MHPE2 are running SA mode.

Measurement :

Measure the time taken to flush X remote MACs from EVPN MAC table of DUT. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The flush rate is calculated averaging the values obtained by "N" samples.

Flush time for X Macs in sec = (T1+T2+..Tn/N)

3.5. MAC Aging

Objective:

To measure the mac aging time.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from CE using traffic generator. Wait till X MAC address are learned. Then stop the traffic. Record the time taken to flush X MACS from DUT EVPN MAC table due to aging. The DUT and MHPE2 are running SA mode

Measurement :

Measure the time taken to flush X MAC address due to aging. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The aging is calculated averaging the values obtained by "N" samples.

Aging time for X Macs in sec = (T1+T2+..Tn/N)

3.6. Remote Mac Aging

Objective:

To measure the remote mac aging time.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from SHPE3 using traffic generator. Stop the traffic at remote PE SHPE3.Due to MAC aging SHPE3 will withdraw its routes from DUT and MHPE2. Measure the time taken to remove these MACs from DUT EVPN MAC table. DUT and MHPE2 are running in SA mode

Measurement :

Measure the time taken to flush X remote MACs learned in DUT EVPN MAC table due to aging. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The aging is calculated by averaging the values obtained by "N" samples.

Aging time for X Macs in sec = (T1+T2+..Tn/N)

3.7. Local and Remote MAC Learning

Objective:

To record the time taken to learn both local and remote macs.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from SHPE3 using traffic generator. Send X frames with different SA and DA from traffic generator connected to CE. The SA and DA of flows must be complimentary to have unicast flows. Measure the time taken by the DUT to learn 2X in EVPN MAC. DUT and MHPE2 are running in SA mode.

Measurement :

Measure the time taken to learn 2X MAC address in DUT EVPN MAC table. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The mac learning time is calculated by averaging the values obtained by "N" samples.

Time to learn 2X Macs in sec = (T1+T2+..Tn/N)

3.8. High Availability.

Objective:

To record traffic loss during routing engine fail over.

Topology : Topology 1

Procedure:

Send X frames from CE to DUT from traffic generator withX different SA and DA. Send X frames from traffic generator to SHPE3 with X different SA and DA so that 2X MAC address will be learned in DUT. There is a bi directional traffic flow with X pps in each direction. Then do a routing engine fail-over.

Measurement :

There should be 0 traffic loss which is the ideal case, No change in the DF role. DUT should not withdraw any routes.Repeat the test "N" times and plot the data.The packet loss is calculated by averaging the values obtained from "N" samples.

Packet loss in sec = (T1+T2+..Tn/N)

3.9. ARP/ND Scale

These tests are conducted to Record the scaling parameter of ARP/ND of the DUT.

Objective:

To Record the ARP/ND scale of the DUT.

Topology : Topology 1

Procedure:

Send X arp/icmpv6 request from RT to DUT with different sender ip/ ipv6 address to the same target gateway ip address. Measure whether X MAC+IPv4 address/MAC+IPv6 address of the hosts are learned in DUT.

Measurement :

The DUT must learn X MAC+IPV4/MAC+IPv6 and it must advertise the X MAC+IPV4/MAC+IPV6 to the remote router.

3.10. Scaling of Services

Objective:

To measure the scale limit of DUT for EVPN.This is to measure the performance of DUT in scaling to "X" EVPN instances.

Topology : Topology 1

Procedure:

The DUT,MHPE2 and SHPE3 are scaled to "N" EVI.Clear BGP neighbors of the DUT. Once adjacency is established in the DUT. Measure the routes received from MHPE2 and SHPE3 for "N" EVI in the DUT.

Measurement :

There should not be any loss of route types 1,2,3 and 4 in DUT. DUT must relearn all type 1,2,3 and 4 from remote routers. The DUT must be subjected to various values of N to find the optimal scale limit

3.11. Scale Convergence

Objective:

To measure the convergence time of DUT when the DUT is scaled with EVPN instance along with traffic.

Topology : Topology 1

Procedure:

Scale N EVIs in DUT,SHPE3 and MHPE2.Send F frames to DUT from CE using traffic generator with X different SA and DA for N EVI's. Send F frames from traffic generator to SHPE3 with X different SA and DA. There will be 2X number of MAC address will be learned in DUT EVPN MAC table. There is a bi directional traffic flow with F pps in each direction. Then clear the BGP neighbors in the DUT. Once the adjacency is restored in DUT. Measure the time taken to learn 2X MAC address in DUT MAC table.

Measurement :

The DUT must learn 2X MAC address. Measure the time taken to learn 2X MAC in DUT. Repeat these test and plot the data.The test is repeated for "N" times and the values are collected.The convergence time is calculated by averaging the values obtained by "N" samples.

Convergence time in sec = (T1+T2+..Tn/N)

3.12. SOAK Test.

Objective:

This test is carried out to measure the stability of the DUT in a scaled environment with traffic over a period of time "T'". In each interval "t1" the DUT CPU usage, memory usage are measured. The DUT is checked for any crashes during this time period.

Topology : Topology 1

Procedure:

Scale N EVI's in DUT,SHPE3 and MHPE2.Send F frames to DUT from CE using traffic generator with different X SA and DA for N EVI's. Send F frames from traffic generator to SHPE3 with X different SA and DA. There will be 2X number of MAC address will be learned in DUT EVPN

MAC table. There is a bi directional traffic flow with F pps in each direction. The DUT must run with traffic for 24 hours, every hour check for memory leak, CPU usage and crash.

Measurement :

Take the hourly reading of CPU, process memory. There should not be any leak, crashes, CPU spikes.

4. Test Cases for PBB-EVPN Benchmarking

4.1. Local MAC Learning

Objective:

To Record the time taken to learn the MAC address locally.

Topology : Topology 1

Procedure:

Send "X" unicast frames from CE to MHPE1(DUT) working in SA mode with "X" different source and destination address from RT. The DUT must learn "X" macs in data plane.

Measurement :

Measure the time taken by the DUT to learn the "X" MACs in the data plane. The data plane measurement is taken by considering DUT as black box the range of "X" MAC is known from RT and the same must be learned in DUT, the time taken to learn "X" MAC is measured. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The mac learning time is calculated by averaging the values obtained from "N" samples.

Mac learning in sec = (T1+T2+..Tn/N)

4.2. Remote Mac Learning

Objective:

To Record the time taken to learn the remote macs.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to SHPE3 from RT.These macs will be flooded to MHPE1 and MHPE2 by SHPE3.The DUT and MHPE2 are running SA mode.

Measurement :

Measure the time taken to learn X mac address in DUT mac table. Repeat these test and plot the data.The test is repeated for "N" times and the values are collected.The mac learning time is calculated by averaging the values obtained by "N" samples.

Mac learning in sec = (T1+T2+..Tn/N)

4.3. MAC Flush due to link failure

Objective:

To record the time taken to flush the mac learned locally and the time taken to relearn the same amount of macs.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from CE using traffic generator. Wait till the MHPE1 learn all X MAC address. Then fail the MHPE1 CE link and measure the time taken to flush these X MACs from the PBB-EVPN MAC table. Then bring up the link. Measure the time taken to relearn X MACS. The DUT and MHPE2 are running SA mode.

Measurement :

Measure the time taken for flushing these X MAC address. Measure the time taken to relearn the X MACs in DUT. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The flush and the relearning time is calculated by averaging the values obtained by "N" samples.

Flush time for X Macs in sec = (T1+T2+..Tn/N)

Relearning time for X macs in sec = (T1+T2+..Tn/N)

4.4. MAC Flush due to remote Failure

Objective:

To record the time taken to flush the remote mac learned in DUT during remote link failure.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from SHPE3 using traffic generator. Bring down the link between SHPE3 and traffic generator. Then measure the time taken to flush the DUT PBB-EVPN MAC address table. The remote MACs will be learned by Data plane, but the B-MAC will be learned by control plane. The DUT and MHPE2 are running SA mode.

Measurement :

Measure the time taken to flush X remote MACs from PBB-EVPN MAC table of DUT. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The flush rate is calculated by averaging the values obtained by "N" samples.

Flush time for X Macs in sec = (T1+T2+..Tn/N)

4.5. MAC aging

Objective:

To measure the mac aging time.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from CE using traffic generator. Wait till X MAC address are learned in DUT PBB- EVPN MAC table. Then stop the traffic. Record the time taken to flush X MAC entries due to aging. The DUT and MHPE2 running in SA mode

Measurement :

Measure the time taken to flush X MAC address due to aging. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The aging is calculated by averaging the values obtained by "N" samples.

Aging time for X Macs in sec = (T1+T2+..Tn/N)

4.6. Remote MAC Aging.

Objective:

To measure the remote mac aging time.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from SHPE3 using traffic generator. Stop the traffic at remote PE(SHPE3).Measure the time taken to remove these remote MACs from DUT PBB-EVPN MAC table. The DUT and MHPE2 are running in SA mode.

Measurement :

Measure the time taken to flush the X remote MACs from DUT PBB-EVPN MAC table due to aging Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The aging is calculated by averaging the values obtained by "N" samples.

Aging time for X Macs in sec = (T1+T2+..Tn/N)

4.7. Local and Remote MAC Learning

Objective:

To record the time taken to learn both local and remote macs.

Topology : Topology 1

Procedure:

Send X frames with X different SA and DA to DUT from SHPE3 using traffic generator. Send X frames with different SA and DA from traffic generator connected to CE. The SA and DA of flows must be complimentary to have unicast flows. Measure the time taken by the DUT to learn 2X in MAC table. DUT and MHPE2 are running in SA mode.

Measurement :

Measure the time taken to learn 2X MAC address table in DUT PBB-EVPN MAC table. Repeat these test and plot the data. The test is repeated for "N" times and the values are collected. The mac

learning time is calculated by averaging the values obtained by "N" samples.

Time to learn 2X Macs in sec = (T1+T2+..Tn/N)

4.8. High Availability

Objective:

To record traffic loss during routing engine failover.

Topology : Topology 1

Procedure:

Send X frames to DUT with X different SA and DA from CE using the traffic generator. Send X frames from traffic generator to SHPE3 with X different SA and DA so that 2X MAC address will be Learned in DUT. There is a bi directional traffic flow with X pps in each direction. Then do a routing engine fail-over.

Measurement :

There should be 0 traffic loss which is the ideal case, No change in the DF role. DUT should not withdraw any routes.Repeat the test "N" times and plot the data.The packet loss is calculated by averaging the values obtained from "N" samples.

Packet loss in sec = (T1+T2+..Tn/N)

4.9. Scale

Objective:

To measure the scale limit of DUT for PBB-EVPN.

Topology : Topology 1

Procedure:

The DUT,MHPE2 and SHPE3 are scaled to "N" PBB-EVPN instances. Clear BGP neighbors in the DUT Once adjacency is established in DUT, check routes received from SHPE3 and MHPE2.

Measurement :

There should not be any loss of route types 2,3 and 4 in DUT. The DUT must relearn all type 2,3 and 4 routes from remote routers. The DUT must be subjected to various values of N to find the optimal scale limit.

4.10. Scale Convergence

Objective:

To measure the convergence time of DUT when the DUT is scaled with EVPN instance along with traffic.

Topology : Topology 1

Procedure:

Scale N PBB-EVIs in DUT,SHPE3 and MHPE2.Send F frames to DUT from CE using traffic generator with X different SA and DA for N PBB-EVI's. Send F frames from traffic generator to SHPE3 with X different SA and DA. There will be 2X number of MAC address will be learned in DUT PBB-EVPN MAC table. There is a bi directional traffic flow with F pps in each direction. Then clear the BGP neighbors in the DUT. Once the adjacency is restored in DUT. Measure the time taken to learn 2X MAC address in DUT MAC table.

Measurement :

The DUT must learn 2X MAC address. Measure the time taken to learn 2X MAC in DUT. Repeat these test and plot the data.The test is repeated for "N" times and the values are collected.The convergence time is calculated by averaging the values obtained by "N" samples.

Convergence time in sec = (T1+T2+..Tn/N)

4.11. Soak Test

Objective:

To measure the stability of the DUT in a scaled environment with traffic.

Topology : Topology 1

Procedure:

Scale N PBB-EVI's in DUT,SHPE3 and MHPE2.Send F frames to DUT from CE using traffic generator with X different SA and DA for N EVI's. Send F frames from traffic generator to SHPE3 with X different SA and DA. There will be 2X number of MAC address will be learned in DUT PBB-EVPN MAC table. There is a bi directional traffic flow with F pps in Each direction. The DUT must run with traffic for 24 hours, every hour check the memory leak, crashes.

Measurement :

Take the hourly reading of CPU process, memory usages. There should not be any memory leak, crashes,CPU spikes.

5. Acknowledgements

We would like to thank Fioccola Giuseppe of Telecom Italia reviewing our draft and commenting it. We would like to thank Sarah Banks for guiding and mentoring us.

6. IANA Considerations

This memo includes no request to IANA.

7. Security Considerations

There is no additional consideration from RFC 6192.

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8.1. Normative References

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Appendix A. Appendix

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