Cisco Validated Profile (CVP)

Cisco ASR 9000 Series Carrier Ethernet Profile

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1. Profile Introduction

The Cisco® ASR 9000 Series is a true carrier-class solution. It features the modular, microkernel-based Cisco IOS® XR Software operating system, comprehensive system redundancy, and a full complement of network resiliency schemes. Cisco ASR 9000 Series Routers also offer the services and application-level intelligence you need for optimized video delivery and mobile aggregation.

ASR9000 intelligently blends with the following technology/deployment solutions:

- Cable/MSO
- Carrier Ethernet
- Mobile backhaul
- Web OTT
- Multiservice edge
- DCI gateway
- Broadband gateway
- Large enterprise WAN

This document is intended as a reference for an example of the ASR9K carrier Ethernet deployment profile with a focus on dual-home access L2 resiliency. Dual-home access is becoming more and more popular to provide access network resiliency. In ASR9k, an access dual-homing solution can be achieved through various technologies, including MSTAG, REPAG, MCLAG, HSRP/VRRP, PW redundancy, G8032, and PBB-EVPN. As part of this profile analysis, this document provides a representative feature mix most commonly used in such a deployment role, the associated scale of these features, and an analysis of the router health and performance.

Table 1 summarizes the key areas on which this profile focuses.

Table 1. ASR9K Carrier Ethernet Profile Feature Summary

Deployment areas	Features
Access	MSTAG, REPAG, MCLAG, G8032, PBB, PWHE, vxLAN, BVI
Core	PBB, MPLS, VPLS, VPWS, BGP, BGP-AD, VRRP, EVPN
Network monitoring and troubleshooting	Smart license, netflow, SPAN, MAC accounting, E-OAM, CFM, Y.1731
Network management	SNMP, Telnet, SSH, PAM, CSM

2. Network Profile

2.1 Topology Diagram

Figure 1 shows the basic topology used in a carrier Ethernet profile.

Figure 2 shows the PWHE topology used in a carrier Ethernet profile.

Figure 3 shows the PBB-related topology used in a carrier Ethernet profile.

Figure 1. ASR9k Carrier Ethernet Profile: Basic Topology Overview

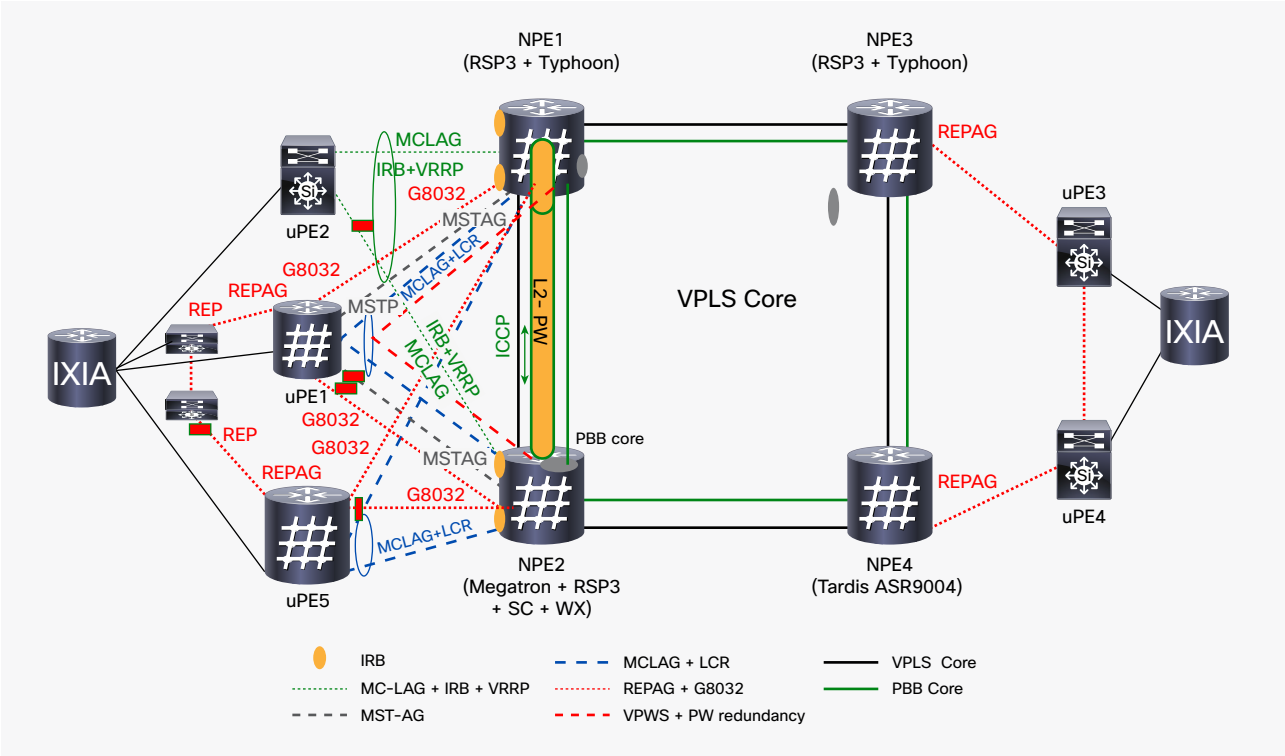


Figure 2. ASR9k Carrier Ethernet Profile: PWHE Topology Overview

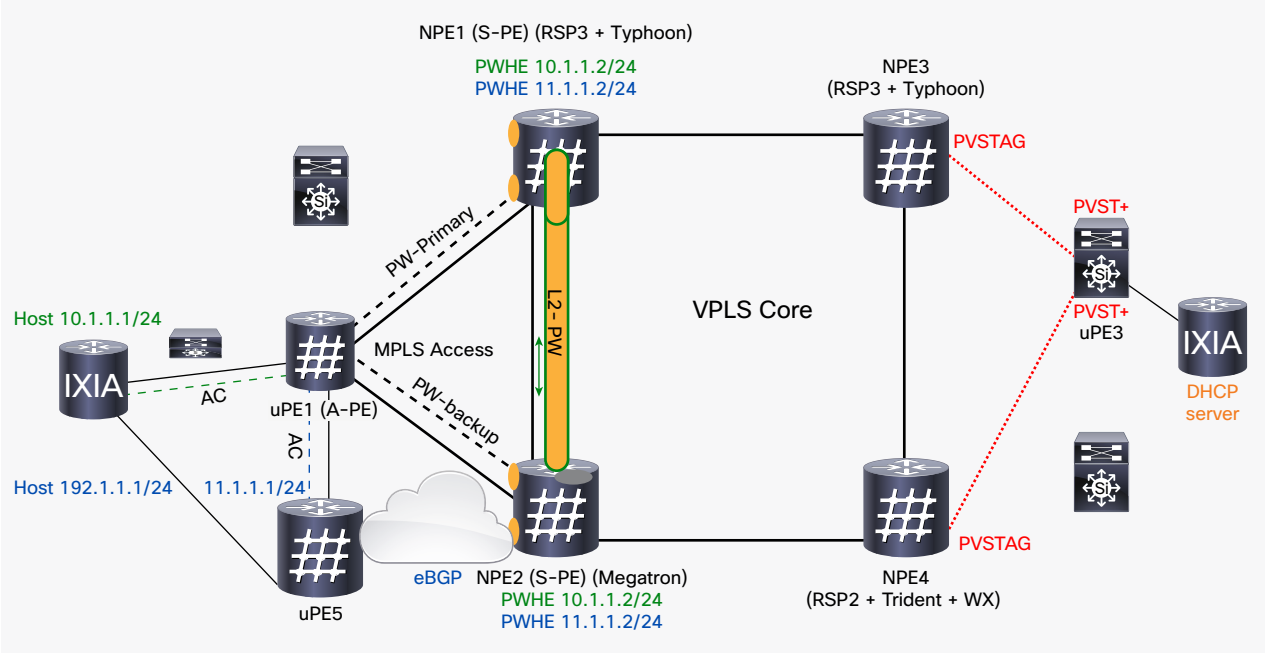
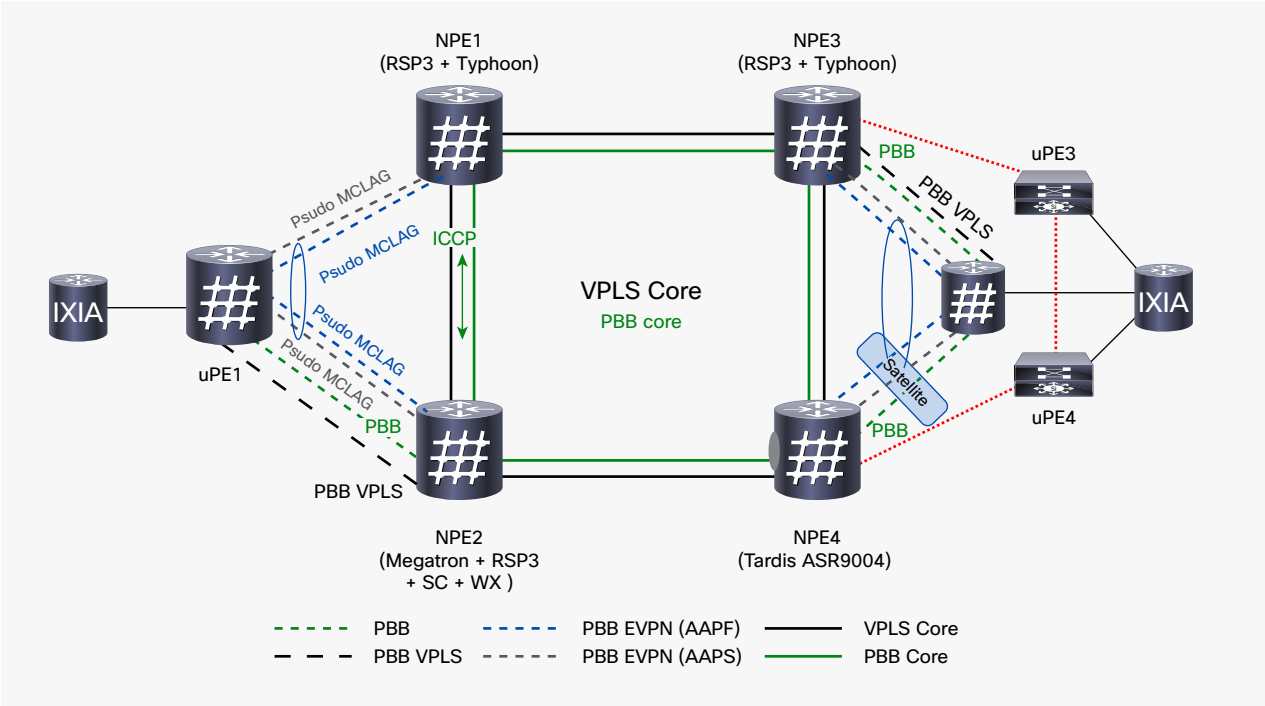


Figure 3. ASR9k Carrier Ethernet Profile: PBB-Related Topology Overview



2.2 Hardware and Feature Specifications

Network devices for L2 resiliency PE as shown in Figures 1, 2, and 3 mainly consist of ASR9000 and C7600 platforms in various roles. The ASR9000 platform is tested as both uPE and nPE devices, which provide both L2 aggregation and redundant access gateway solutions to customers.

Following are the roles for which the ASR9000 platform was tested and characterized for carrier Ethernet L2 resiliency PE profile testing for release 6.1.3:

- nPE roles for REP access gateway
- nPE roles for MST access gateway
- nPE roles for MCLAG points of attachment (PoAs)
- nPE roles for integrated routing and bridging (IRB) functionality
- SPE and APE roles for pseudowire headend functionality
- uPE roles for purely L2 aggregation running MSTP
- uPE roles for purely L2 aggregation running LACP (as DHD)

For dual-homing access deployment using a REPAG solution, ASR9000 can only serve the roles as a REP access gateway; it cannot serve as a REP access switch because the ASR9000 does not yet support the REP protocol. In our solution testbed, we used the C7600 platform to be the access devices running REP.

For dual-homing access deployment using a MSTAG or MCLAG solution, ASR9000 can serve as both access devices and gateway devices. We use ASR9000 to be both access and gateway devices in our MSTAG and PBB-EVPN solution testbed. We use C7600 as the access dual-home device (DHD) and ASR9000 as the PoA devices in our MCLAG + VPLS as well as MCLAG + BVI + VRRP solution testbed.

More specifically, as seen in the following topology depicted in section 2.1:

- ASR9000 platforms are uPE-1, uPE-5, nPE-1, nPE-2, nPE-3, and nPE-4.
- C7600 platforms are uPE-2, uPE-3, uPE-4, uPE-6, and uPE-7.
- Core: NPE1, NPE2, NPE3, and NPE4 form a VPLS ring.
- MSTAG dual-home access: uPE1 dual homed to nPE1 and nPE2.
- MCLAG dual-home access: uPE2 dual homed to nPE1 and nPE2.
- REPAG dual-home access: uPE3 and uPE4 REP segment dual homed to nPE3 and nPE4.
- PWHE access: uPE1 as A-PE, nPE1 and nPE2 as S-PE.

2.2.1 Hardware Profile

Table 2 defines the set of relevant hardware used to complete the end-to-end carrier Ethernet profile deployment.

Table 2. Access and Core Device Hardware Profiles

Hardware	Software Versions	Description
ASR 9K	XR 06.01.03	For aggregation and core functionality
C7600	IOS 15.1S	For dual-home switch (MST, REP) functionality

2.3 Test Environment

This section describes the features and the relevant scales at which the features are deployed across the physical topology. Table 3 lists the scale for each respective feature.

Table 3. Carrier Ethernet Profile: Feature Scale Validated in This Profile

Feature	Scale
BVI	2000
BVI+VRRP	2000
Bridge-domains	40K
VPWS-PW	32K
VPLS-PW	90K
PWHE (L3)	5592
PWHE (L2)	20K
MCLAG + LCR (bundle/local connect/EFP)	2/4000/12000
MAC scale	2M
PBB (I-SID)	11200
PBB (BD edge/core)	4000/1
PBB-VPLS (BD edge/core)	4000/1000
MCLAG (bundle/EFP)	20/4000
MSTAG (instance/EFP)	2/4000
G8032 (BD/EFP)	4000/8000
REPAG (EFP)	1
CFM physical	4000
CFM bundle sw-offload	8000
CFM hw-offload	1000
vxLAN L2GW VNI	4K
BFD hwoffload	5

3. Use Case Scenarios

3.1 Test Methodology

The use cases listed in Table 4 will be executed using the topology defined in Figure 1, Figure 2, and Figure 3 along with the test environment, already explained in this document.

With respect to the longevity for this profile setup, the CPU and memory usage would be monitored during overnight as well as during the weekends along with any mem-leak checks. In order to test the robustness, certain negative and HA events would be triggered during the use case testing.

3.2 Use Cases

Table 4 describes the use cases that were executed on the carrier Ethernet profile. These use cases are divided into buckets of technology areas to provide the complete coverage of the deployment scenarios.

Table 4. List of Use Case Scenarios

Number	Focus Area	Use Cases
Bootup and Management		
1	Bootup	Service provider should be able to boot up ASR9k nodes via TURBOBOOT as well as PIE upgrade to the targeted IOXR images successfully. The following scenarios are validated in this profile: ▪ Turboboot ▪ PIE upgrade (upgrade, downgrade, FPD, config backup/restore) ▪ -SMU activation ▪ nV satellite upgrade
2	System infra/ management	Validate that syslog, SNMP, SSH, Telnet, NTP are functioning well after node bootup.
3	Smart licensing	Validate that the smart licenses client on the node is registered with the node and the correct number and type of the licenses are being consumed.
Carrier Ethernet Solution		
4	MSTAG + VPLS	In this L2 service, DHD running MSTP is dual homed to both ASR9k MST access gateways (primary and backup) running VPLS service. This profile verifies the system-level resiliency during the following events: ▪ L2 service failover from primary gateway to backup gateway ▪ L2 service fallback from backup gateway to primary gateway
5	MCLAG+VPLS	In this L2 service, DHD running LACP is dual homed to both ASR9k PoAs (primary and standby) running VPLS service. This profile verifies the system-level resiliency during the following events: ▪ L2 service failover from primary to standby PoA ▪ L2 service fallback from standby to primary PoA

Number	Focus Area	Use Cases
6	MCLAG + BVI + VRRP	In this L2/L3 service, DHD running LACP is dual homed to both ASR9k PoAs (primary and standby). Both PoAs will provide L3 service redundant termination on BVI/VRRP. This profile verifies the system-level resiliency during the following events: ▪ L3 service failover when MCLAG L2 transport path changes from primary to standby PoA, while VRRP master stays unchanged ▪ L3 service fallback when MCLAG L2 transport path changes from standby back to primary PoA, while VRRP master stays unchanged ▪ L3 service failover when both MCLAG and VRRP mastership change from primary to standby PoA ▪ L3 service fallback when both MCLAG and VRRP mastership change from standby back to primary PoA
7	REPAG + G.8032 + VPLS	In this L2 service, three-node G8032 open ring is connected to VPLS on the core side and connected to the REP ring on the access side. The G8032 switching node is running both G8032 and REPAG; the G8032 interconnect node is running G8032 and VPLS. This profile verifies the system-level resiliency during the following events: ▪ L2 service failover and fallback when topology changes in the REP access ring ▪ L2 service failover and fallback when topology changes in the G8032 open ring
8	PWHE with PW redundancy	In this L2/L3 service, A-PE has VPWS with PW redundancy connected to both primary and backup ASR9k SPEs. SPE provides both L3 termination over PWHE main interface and L2 switching via PWHE L2 subinterface toward VPLS core. This profile verifies the system-level resiliency during the following events: ▪ L2 service failover from primary SPE to backup SPE ▪ L2 service fallback from backup SPE to primary SPE ▪ L3 service failover from primary SPE to backup SPE ▪ L3 service fallback from backup SPE to primary SPE
9	VxLAN L2 gateway	In this VxLAN L2 service, traffic is flowing from non-VxLAN segment via L2 EFP and into VxLAN domain via PIM SM core. This profile verifies the system-level functionality, including: ▪ L2 unicast traffic ▪ L2 broadcast, unknown unicast, and multicast (BUM) traffic

Number	Focus Area	Use Cases
Convergence, HA, and Network Resiliency		
10	Process start	This profile verifies that during process restart, the carrier Ethernet services mentioned earlier in numbers 4 through 10 are recovered with minimal system effect.
11	Link flap	This profile verifies that during link flap event (link down and link up), the carrier Ethernet services mentioned earlier in numbers 4 through 10 are recovered with minimal system effect.
12	LC OIR	This profile verifies that during LC OIR (soft OIR or physical plug out and plug back in), the carrier Ethernet services mentioned earlier in numbers 4 through 10 are recovered with minimal system effect.
13	RSP FO	This profile verifies that during redundant RSP/RP failover, the carrier Ethernet services mentioned earlier in numbers 4 through 10 are recovered with minimal system effect.
14	Node failure	This profile verifies that during node failure (soft reload or physical power off and power back on), the carrier Ethernet services mentioned earlier in numbers 4 through 10 are recovered with minimal system effect.
System Health Monitoring		
15	System health	Monitor system health for CPU usage, memory consumption, and memory leaks during longevity.

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