
TECHNICAL WHITEPAPER

VXLAN INTEROPERABILITY

ARUBAOS-SWITCH CONFIGURATION GUIDE



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INTRODUCTION

Virtual eXtensible LAN (VXLAN) is a MAC-in-UDP technology that provides Layer 2 connectivity between distant network sites across an IP network. VXLAN is typically used in data centers for multitenant services.

VXLAN provides the following benefits:

- Support for more virtual switched domains than VLANs. Each VXLAN is uniquely identified by a 24-bit VXLAN ID. The total number of VXLANs can reach 16777216 (2^{24}). This specification makes VXLAN a better choice than 802.1Q VLAN to isolate traffic for virtual machines (VMs).
- Easy deployment and maintenance. VXLAN requires deployment only on the edge devices of the transport network. Devices in the transport network perform Layer 3 forwarding.

The VXLAN tunnel endpoints (VTEP) performs Layer 2 or Layer 3 forwarding for VXLANs depending on your configuration:

- In Layer 3 forwarding mode, the VTEP uses the ARP table to forward traffic for VXLANs. Use Layer 3 forwarding mode if you want to use the VTEP as a VXLAN IP gateway.
- In Layer 2 forwarding mode, the VTEP uses the MAC address table to forward traffic for VXLANs.

This whitepaper describes the Layer 2 forwarding processes. It describes how to configure a VXLAN tunnel between an HPE FlexFabric 12900 and an Aruba 3810M, supporting VXLAN. Please note that only FC, FE, and FX cards on the 12900 support VXLAN.

Note: The configuration examples in this document should be limited to very small deployments, considering the large amount of configuration required to configure the static VXLAN tunnels.

LOGICAL NETWORK DIAGRAM

As shown in the figure below, the end devices are Aruba 2540 and 2930M switches. The VTEPs are the VXLAN tunnel endpoints. For this document, we use the HPE 12900 and the Aruba 3810M Switch Series as VTEPs.

A VTEP uses Virtual Switch Instances (VSIs) and VXLAN tunnels to provide VXLAN services.

- Virtual Switch Instance (VSI) – A VSI is a virtual Layer 2 switched domain. Each VSI provides switching services only for one VXLAN. VSIs learn MAC addresses and forward frames independently of one another. VMs in different sites have Layer 2 connectivity if they are in the same VXLAN.
- VXLAN tunnel – VXLAN tunnels are logical point-to-point tunnels between VTEPs over the transport network. Each VXLAN tunnel can trunk multiple VSLANs. VTEPs encapsulate VXLAN traffic in the VXLAN, outer UDP, and outer IP headers. The devices in the transport network forward VXLAN traffic only based on the outer IP header.

VTEPs encapsulate VXLAN traffic in the VXLAN, outer UDP and outer IP headers. The devices in the transport network forward VXLAN traffic only based on the outer IP header.

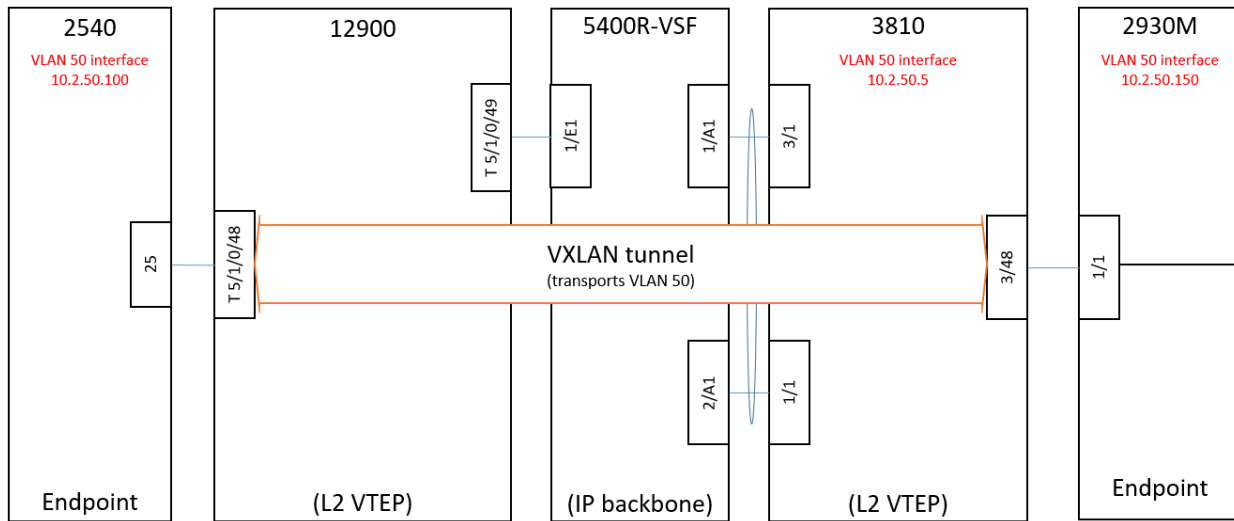


Figure 1: Logical Network Diagram

WORKING MECHANISMS

The VTEP uses the following process to forward an inter-site frame:

- Assigns the frame to its matching VXLAN if the frame is sent between sites.
- Performs MAC learning on the VXLANs VSI.
- Forwards the frame.

VXLAN tunnel establishment and assignment

To provide Layer 2 connectivity for a VXLAN between two sites, you must create a VXLAN tunnel between the sites and assign the tunnel to the VXLAN.

Traffic from the local site to a remote site

The VTEP uses an Ethernet service instance to match a list of VLANs on a site-facing interface. The VTEP assigns customer traffic from the VLANs to a VXLAN by mapping the Ethernet service instance to a VSI.

Traffic from a remote site to the local site

When a frame arrives at a VXLAN tunnel, the VTEP uses the VXLAN ID in the frame to identify its VXLAN.

MAC Learning

The VTEP performs source MAC learning on the VSI as a Layer 2 switch.

- For traffic from the local site to the remote site, the VTEP learns the source MAC address before VXLAN encapsulation.
- For traffic from the remote site to the local site, the VTEP learns the source MAC address after removing the VXLAN header.

Traffic Forwarding

The VTEP performs Layer 2 or Layer 3 forwarding for VXLANs depending on your configuration:

- In Layer 3 forwarding mode, the VTEP uses the ARP table to forward traffic for VXLANs. Use Layer 3 forwarding mode if you want to use the VTEP as a VXLAN IP gateway.

- In Layer 2 forwarding mode, the VTEP uses the MAC address table to forward traffic for VXLANs.

HARDWARE AND SOFTWARE REQUIREMENTS

For this document, the following hardware and software versions were used in order to implement this specific VXLAN solution:

- Aruba 3810M Switch Series – KB.16.08.0001
- HPE 12900 and FX Module (JH359A) – version 7.1.070, Release 2712

CONFIGURATION

The following steps are to configure VXLAN on the HPE FlexFabric 12900 and on the Aruba 3810M. The prerequisites are to configure IP addresses and unicast routing settings on all transport switches:

- Assign IP addresses to the interfaces
- Configure OSPF on all transport network switches
- Configure OSPF to advertise routes

HPE FlexFabric 12900 Configuration

Create a VLAN for the endpoint devices

```
vlan 50
interface Vlan-interface50
 ip address 10.2.50.10 255.255.255.0
```

Enable L2VPN

```
system-view
l2vpn enable
```

Enable Layer 2 Forwarding

```
undo vxlan ip-forwarding
```

Create the VSI vni200 and VXLAN 200

```
vsi vni200
 vxlan 200
 quit
 quit
```

Assign an IP address to Loopback 0. The IP address will be used as the source IP address of the VXLAN tunnels to Switch B and Switch C.

```
interface LoopBack0
 ip address 5.8.1.10 255.255.255.255
 ospf 1 area 0.0.0.0
```

Create a VXLAN tunnel to the 3810M. The tunnel interface name is Tunnel 13

```
interface Tunnel13 mode vxlan
 source 5.8.1.10
 destination 5.8.1.2
 quit
```

Assign Tunnel 13 to VXLAN 200.

```
vsi vni200
 vxlan 200
 tunnel 13
 quit
 quit
```

On the uplink to the 3810M create Ethernet service instance 2.

```
interface Ten-GigabitEthernet5/1/0/48
 port link-mode bridge
 port access vlan 50
 service-instance 2
 encapsulation untagged
```

Map Ethernet service instance 2 to the VSI vni200.

```
interface Ten-GigabitEthernet4/0/1
 service-instance 2
 xconnect vsi vni200
 quit
 quit
```

Configure the uplink to the endpoint device

```
interface Ten-GigabitEthernet5/1/0/49
 port link-mode route
 ip address 10.220.0.2 255.255.255.252
 ospf network-type p2p
 ospf 1 area 0.0.0.0
```

Aruba 3810 configuration

Enable VXLAN

```
vxlan enable
```

Create Virtual Network and associate Virtual Network ID to VLAN

```
virtual-network 200 50 "vni200"
```

Create VXLAN tunnel between the two switches

```
interface tunnel 13
 tunnel name "VXLAN_Tunnel02"
 tunnel mode vxlan
 tunnel source 5.8.1.2
 tunnel destination 5.8.1.10
 exit
```

Map Overlay-VLAN (VLAN 50) to Tunnel 13

```
vxlan tunnel 13 overlay-vlan 50
```

VERIFICATION

As mentioned in the introduction, the VXLAN tunnel endpoints are HPE 5700 and Aruba 2920 switches. Below are the details of the endpoints.

Table 1: VXLAN tunnel endpoints

Model	IP Address	MAC Address
Aruba 2540	10.2.50.100	98:f2:b3:c0:a5:00
Aruba 2930M	10.2.50.150	F4:03:43:de:27:47

The commands to determine the information in Table 1 above are:

```
2540Switch(config)# show arp
```

```
IP ARP table
```

```

IP Address      MAC Address      Type      Port
-----
10.2.50.150    f40343-de2747   dynamic

```

```
2930MSwitch(config)# show arp
```

```
IP ARP table
```

```

IP Address      MAC Address      Type      Port
-----
10.2.50.100    98f2b3-c0a500   dynamic

```

To confirm that the above data is correct, issue the following commands on both endpoints to find out the MAC address for each interface:

```
2930MSwitch(config)# show system
```

```
Status and Counters - General System Information
```

```

System Name      : Aruba-Stack-2930M
System Contact   :
System Location  :
MAC Age Time (sec) : 300
Time Zone       : 0
Daylight Time Rule : None

```

```

Software revision : WC.16.08.0001
Base MAC Addr     : f40343-de2747

```

```
Member :1
```

```

ROM Version      : WC.17.02.0006
Up Time         : 2 days
CPU Util (%)     : 0
MAC Addr        : f40343-de2740
Serial Number    : SG7ZJQP03Y

```

```
Memory - Total : 340,857,344
        Free   : 180,406,648
2540Switch(config)# show system
```

Status and Counters - General System Information

```
System Name       : Aruba-2540-24G-PoEP-4SFPP
System Contact    :
System Location   :
```

```
MAC Age Time (sec) : 300
```

```
Time Zone        : 0
Daylight Time Rule : None
```

```
Software revision : YC.16.08.0002      Base MAC Addr   : 98f2b3-c0a500
ROM Version       : YC.16.01.0002      Serial Number   : CN77JYK05S
```

```
Up Time          : 2 days              Memory - Total  : 360,047,104
CPU Util (%)     : 2                   Free           : 258,874,500
```

```
IP Mgmt - Pkts Rx : 8284              Packet - Total  : 6600
          Pkts Tx : 8272              Buffers Free   : 4859
                                          Lowest        : 4853
                                          Missed       : 0
```

To verify the correct neighbor information, issue the following LLDP commands:

```
<12904-2>dis lldp neighbor-information list
Chassis ID : * -- -- Nearest nontpmr bridge neighbor
             # -- -- Nearest customer bridge neighbor
             Default -- -- Nearest bridge neighbor
Local Interface Chassis ID      Port ID      System Name
XGE5/1/0/3      943f-c206-dfbb Ten-GigabitEthernet1/0/18 5940-4
XGE5/1/0/4      d894-0322-1e30 Ten-GigabitEthernet1/1/18 5940-3
XGE5/1/0/7      d894-03f8-8baa Ten-GigabitEthernet1/2/18 5940-6
XGE5/1/0/48     98f2-b3c0-a500 25                Aruba-2540-24G-PoEP-4SFPP
XGE5/1/0/49     5820-b1b2-9b3f 129               M1st-Core
3810(config)# show lldp info remote-device
```

LLDP Remote Devices Information

LocalPort	ChassisId	PortId	PortDescr	SysName
1/1	5820b1-b29b3f	1	1/A1	M1st-Core
1/23	40e3d6-c42964	40 e3 d6 c4 29 64	eth0	40:e3:d6:c4:29:64
1/24	d4c9ef-f81b0d	d4 c9 ef f8 1b 0d		
3/1	5820b1-b29b3f	193	2/A1	M1st-Core
3/24	10604b-471e6a	10 60 4b 47 1e 6a		
3/24	0.0.0.0	2c 41 38 7f a8 d5		
3/48	f40343-de2747	1	1/1	Aruba-Stack-2930M

Now traffic can be passed between the two endpoints:

```
2540Switch(config)# ping 10.2.50.150
10.2.50.150 is alive, time = 3 ms
```

```
2930MSwitch(config)# ping 10.2.50.100
10.2.50.100 is alive, time = 2 ms
```

Besides pinging the two endpoint devices, in order to verify the correct functionality, the status of the tunnels and MAC learning, issue the following commands:

On the 12900

```
<12904-2>display interface tunnel 13
Tunnell13
Current state: UP
Line protocol state: UP
Description: Tunnell13 Interface
Bandwidth: 64 kbps
Maximum transmission unit: 1464
Internet protocol processing: Disabled
Last clearing of counters: Never
Tunnel source 5.8.1.10, destination 5.8.1.2
Tunnel protocol/transport UDP_VXLAN/IP
```

Verify that the VXLAN tunnels have been assigned:

```
<12904-2>display l2vpn vsi verbose
VSI Name: vni200
VSI Index          : 0
VSI State          : Up
MTU                : 1500
Bandwidth          : Unlimited
Broadcast Restrain : Unlimited
Multicast Restrain : Unlimited
Unknown Unicast Restrain: Unlimited
MAC Learning       : Enabled
MAC Table Limit    : -
MAC Learning rate  : -
Drop Unknown       : -
Flooding           : Enabled
Statistics         : Disabled
VXLAN ID           : 200
Tunnels:
  Tunnel Name      Link ID   State   Type      Flood proxy
  Tunnell13       0x500000d UP       Manual    Disabled
ACs:
  AC                Link ID   State   Type
  XGE5/1/0/48 srv2  0         Up      Manual
```

Verify that the VTEP has learned the MAC addresses of remote devices:

```
<12904-2>display l2vpn mac-address
MAC Address      State      VSI Name      Link ID/Name    Aging
98f2-b3c0-a500  Dynamic   vni200        XGE5/1/0/48    Aging
f403-43de-2747  Dynamic   vni200        Tunnel13        Aging
--- 2 mac address(es) found ---
```

On the 3810M

Verify the interface tunnel

```
3810(config)# show interface tunnel
```

Tunnel Configuration :

```
Tunnel           : 251659491
Tunnel Name      : VXLAN_Tunnel02
Tunnel Status    : Enabled
Source Address   : 5.8.1.2
Destination Address : 5.8.1.10
Mode             : VXLAN Tunnel
TOS              : -1
TTL              : 64
IPv6             : n/a
MTU              : 1450
```

Current Tunnel Status :

```
Tunnel State           : Up
Destination Address Route : 5.8.1.10/32
Next Hop IP           : 10.30.1.254
Next Hop Interface     : vlan-30
Next Hop IP Link Status : Up
Source Address        : 5.8.1.2
```

Verify that the VXLAN tunnels have been assigned

```
3810(config)# show virtual-network
```

```
Max. Supported Virtual Networks : 64
Virtual Networks Configured      : 1
```

VN-ID	VN-Name	VLAN-ID	VLAN-Name
200	vni200	50	VLAN50

APPENDIX A - SWITCH CONFIGURATIONS

3810 configuration

```

; hpStack_KB Configuration Editor; Created on release #KB.16.08.0001
; Ver #0c:01.7c.59.f4.7b.ff.ff.fc.ff.ff.3f.ef:
stacking
  member 1 type "JL074A" mac-address 70106f-8fa780
  member 1 priority 255
  member 2 type "JL076A" mac-address 1c98ec-9e0f80
  member 2 priority 200
  member 3 type "JL076A" mac-address 1c98ec-9e4d00
  member 3 priority 150
  member 3 flexible-module A type JL083A
  exit
hostname "3810"
no rest-interface
vxlan enable
vxlan tunnel 13 overlay-vlan 50
trunk 1/1,3/1 trk1 lacp
max-vlans 4000
ip routing
interface loopback 0
  ip address 5.8.1.2
  ip ospf 5.8.1.2 area backbone
  exit
interface tunnel 13
  tunnel name "VXLAN_Tunnel02"
  tunnel mode vxlan
  tunnel source 5.8.1.2
  tunnel destination 5.8.1.10
  exit
snmp-server community "public" operator unrestricted
snmp-server community "private"
oobm
  ip address dhcp-bootp
  ipv6 enable
  ipv6 address dhcp full
  member 1
    ip address dhcp-bootp
    ipv6 enable
    ipv6 address dhcp full
    exit
  member 2

```

```
        ip address dhcp-bootp
        ipv6 enable
        ipv6 address dhcp full
        exit
    member 3
        ip address dhcp-bootp
        ipv6 enable
        ipv6 address dhcp full
        exit
    exit
router ospf
    area backbone
    enable
    exit
vlan 1
    name "DEFAULT_VLAN"
    no untagged 1/D4,2/D4,Trk1-Trk2
    untagged 1/D2-1/D3,1/D6-1/D7,1/F1-1/F24,2/D2-2/D3,2/D6-2/D7
    ip address dhcp-bootp
    exit
vlan 10
    name "VLAN10"
    untagged 1/11
    ip address 10.5.8.4 255.255.255.0
    ip ospf 10.5.8.4 area backbone
    jumbo
    exit
vlan 20
    name "VLAN20"
    no ip address
    exit
vlan 30
    name "VLAN30"
    untagged Trk1
    ip address 10.30.1.4 255.255.255.0
    ip ospf 10.30.1.4 area backbone
    exit
vlan 40
    name "VLAN40"
    ip address 10.2.40.5 255.255.255.0
    ip ospf 10.2.40.5 area backbone
    exit
vlan 50
    name "VLAN50"
    untagged 3/48
```

```
ip address 10.2.50.5 255.255.255.0
exit
spanning-tree Trk1 priority 4
virtual-network 200 50 "vni200"
password manager
```

12900 Switch Configuration

```
#
version 7.1.070, Release 2712
#
mdc Admin id 1
#
mdc Production-MDC id 2
mdc start
#
sysname 12900
#
telnet server enable
#
undo vxlan ip-forwarding
#
ospf 1
non-stop-routing
area 0.0.0.0
network 1.220.0.2 0.0.0.0
network 5.8.1.10 0.0.0.0
network 10.2.10.0 0.0.0.255
network 10.220.0.0 0.0.0.3
#
lldp global enable
#
mvrp global enable
#
reserve-vlan-interface 3000 to 3100
reserve-vlan-interface 200 global
#
system-working-mode standard
password-recovery enable
lpu-type f-series
#
vlan 1
#
vlan 50
#
vlan 129
#
```

```
stp global enable
#
l2vpn enable
#
vsi vni200
vxlan 200
tunnel 13
#
interface NULL0
#
#
interface LoopBack0
ip address 5.8.1.10 255.255.255.255
ospf 1 area 0.0.0.0
#
interface Vlan-interface1
mtu 9008
#
interface Vlan-interface50
ip address 10.2.50.10 255.255.255.0
#
interface FortyGigE5/0/1
port link-mode route
#
interface FortyGigE5/0/13
#
# ... other interfaces ...
#
interface M-GigabitEthernet0/0/0
ip address 10.10.10.44 255.255.255.0
#
interface Ten-GigabitEthernet5/1/0/48
port link-mode bridge
port access vlan 50
#
service-instance 2
encapsulation untagged
xconnect vsi vni200
#
interface Ten-GigabitEthernet5/1/0/49
port link-mode route
ip address 10.220.0.2 255.255.255.252
ospf network-type p2p
ospf 1 area 0.0.0.0
#
```

```
interface Ten-GigabitEthernet4/0/3
  port link-mode bridge
#
interface Ten-GigabitEthernet4/0/4
  port link-mode bridge
#
interface Ten-GigabitEthernet4/0/5
  port link-mode bridge
#
interface Ten-GigabitEthernet4/0/6
  port link-mode bridge
#
interface Ten-GigabitEthernet4/0/7
  port link-mode bridge
#
interface Ten-GigabitEthernet4/0/8
  port link-mode bridge
#
# ... other interfaces ...
#
#
interface Tunnel13 mode vxlan
  source 5.8.1.10
  destination 5.8.1.2
#
interface Blade-Aggregation1
#
  scheduler logfile size 16
#
line class aux
  user-role network-admin
#
line class vty
  user-role network-operator
#
line aux 0 1
  user-role network-admin
#
#
line vty 0 15
  authentication-mode scheme
  user-role network-operator
#
line vty 16 63
  user-role network-operator
```

```
#
ip route-static 0.0.0.0 0 10.10.10.254
#
snmp-agent
snmp-agent local-engineid 800063A28080F62E82C30700000001
snmp-agent community write private
snmp-agent community read public
snmp-agent sys-info version all
snmp-agent target-host trap address udp-domain 10.10.10.10 params
securityname public v2c
snmp-agent target-host trap address udp-domain 10.3.10.220 params
securityname public v2c
#
acl number 2000
#
acl number 3000
#
acl number 4000
domain system
#
domain default enable system
#
role name level-0
description Predefined level-0 role
#
role name level-1
description Predefined level-1 role
#
role name level-2
description Predefined level-2 role
#
role name level-3
description Predefined level-3 role
#
role name level-4
description Predefined level-4 role
#
role name level-5
description Predefined level-5 role
#
role name level-6
description Predefined level-6 role
#
role name level-7
description Predefined level-7 role
```



```
#
role name level-8
  description Predefined level-8 role
#
role name level-9
  description Predefined level-9 role
#
role name level-10
  description Predefined level-10 role
#
role name level-11
  description Predefined level-11 role
#
role name level-12
  description Predefined level-12 role
#
role name level-13
  description Predefined level-13 role
#
role name level-14
  description Predefined level-14 role
#
user-group system
#
local-user admin class manage
  password hash
  $h$6$ucKzWby6Pa3zRhCP$uCDJbw5pvcGP9gIFXP0I4++QDxc9sXvPK8WrwhpwbgK976oHF5r06yL
  mvdzUcJwOxz6PxxwgKu/MRapealGtgsA==
  service-type telnet
  authorization-attribute user-role network-admin
  authorization-attribute user-role network-operator
#
return
```

For more information

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