

## Configuring Triple Play Services with CLI

This section provides information to configure Residential Broadband Aggregation services using the command line interface. It is assumed that the reader is familiar with basic configuration of VPLS, IES and VPRN services.

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## Configuring VPLS Residential Split Horizon Groups

To configure a group of SAPs in a VPLS service as a Residential Split Horizon Group (RSHG), add the residential-group parameter when creating the split horizon group. Traffic arriving on a SAP within an RSHG will not be copied to other SAPs in the same split horizon group. Note that the split horizon group must be created before it can be applied.

The following example displays a VPLS configuration with split horizon enabled:

```
*A:ALA-48>config>service>vpls# info
-----
split-horizon-group "DSL-group2" residential-group create
    description "split horizon group for DSL - no broadcast supported"
exit
stp
    shutdown
exit
sap 2/1/4:100 split-horizon-group "DSL-group2" create
    description "SAP in RSHG"
exit
sap 2/1/4:200 split-horizon-group "DSL-group2" create
    description "another SAP in the RSHG"
exit
no shutdown
-----
*A:ALA-48>config>service>vpls#
```

## Configuring Static Hosts

In order for the static host to be operational, forwarding traffic bi-directional, the mac address of the host must be learned or configured. Learning the MAC of the static host is different for IPv4 or IPv6.

If an IPv4 static host MAC is not specified

- The system will learn respective MAC address dynamically from ARP packets (arp-request or gratuitous-arp) generated by the host with the specified IP address.
- On a VPLS service, this can occur if arp-reply-agent function is enabled on a given SAP. On Layer 3 services, such as IES or VPRN, the ARP packets are always examined so no further conditions are applicable.

If an IPv6 static host MAC is not specified

- The system learns the MAC address depending on the type of host configured such as: IPv6 prefix host or IPv6 address host.
  - A SAP can be specified as a single-MAC and it implies that there is only a single device attached to the SAP. It changes the MAC learning behavior on the SAP for IPv6 host only. Firstly, all IPv6 hosts will share the same learned MAC. Secondly, the MAC address is learned from the host's router solicits and neighbor discoveries.
  - For static host with an address, upon shutdown, a RS for the clients IPv6 address is sent towards the host and the MAC is learned upon the RA reply
  - For static host with an address, SHCV will send the RS, and the MAC is learned from the RA
  - For static host with an address, the OAM command can trigger a RS and the MAC is learned from the RA
  - For static host with either a prefix or an address, linking the IPv6 host to an IPv4 host will copy the IPv4 host MAC address to the IPv6 host and vice versa.

The learned MAC address will be handled as a MAC address of static host with explicitly defined mac-address. Meaning:

- The MAC address will not be aged by the mac-aging or any other aging timers.
- The MAC address will not be moved to another SAP as a consequence of re-learning event (= event when learning request for the same MAC address comes from another SAP).
- The MAC address will not be flushed from FDB due to SAP failure or STP flush messages.

Every time the given static-host uses different MAC address in its ARP request, the dynamic MAC learning process will be performed. The old MAC address will be overwritten by a new MAC address.

The learned MAC address will not be made persistent (a static host is not a part of the persistency file). A service discontinuity of such a host could be proportional to its arp-cache timeout.

The following interactions are described:

- Antispoof (all services) — In case a static IP-only host is configured on a given SAP, anti-spoof types, IP, NH MAC, and IP MAC are supported. Static hosts for which MAC address is not known will not have any antispoof entry. This will be added only after the corresponding MAC has been learned. As a consequence, all traffic generated by the host before the MAC is learned are dropped.
- MAC-linking (IES and VPRN service only) — the MAC address can be learned from either the IPv4 or IPv6 host. Once learned it is copied over to the host of the other address family
- Single-MAC (IES and VPRN service only) — This specifies that there is only one single subscriber (MAC) on the SAP and any ICMP6 message from the SAP can be assumed to be the subscriber MAC address. This does not apply to IPv4 host.
- Enhanced subscriber management (all services) — ESM is supported in a combination with a static ip-only host. It is assumed that ip-mac antispoofing is enabled. The resources (queues, etc.) are allocated at the time such a host is configured, although they will be effectively used only after antispoof entry has been installed.
- Dual-homing (for IPv4 host only) — It is assumed that static host is configured on both chassis. The dynamic mac-address learning event will be then synchronized (also, if the members are on two different nodes) and corresponding anti-spoof entries will be installed on both chassis.
- MAC-pinning (for VPLS services only) — The dynamically learned MAC address of the static-host will be considered as a static-mac and is not affected by the no mac-pinning command.
- ARP-reply-agent (VPLS services only) — It is possible to enable arp-reply-agent on a SAP where static host with ip-only configured. Besides the regular arp-reply-agent functionality (reply to all arp-requests targeting the given host's IP address) learning of the host's MAC address will be performed. As long as no MAC address have been learned no ARP replies on behalf of such host should be expected. Enabling of arp-reply-agent is optional for SAP with ip-only static hosts.

## BNG Learning IP-Only Static Host’s MAC Address

Before an IP-only static host can forward or receive traffic, the MAC of the host must be learned by the BNG. The learned MAC is used to fill in the anti-spoof entry for the static host. Table 6 summarizes the different methods that the BNG could use to learn the IP only static host MAC address.

**Table 6: Methods to Learn IP-Only Static Host MAC Addresses**

Number of Host(s) on SAP	IPv4 Static Host	IPv6 Numbered Static Host	IPv6 Prefix Only Host (unnumbered)	Dual Stack Host
1	Host’s ARP Triggered SHCV Data packet OAM SHCV	Auto populate RS/NS MAC GUA based NS Triggered SHCV Data packet OAM SHC V	Auto populate RS/NS MAC GUA based NS Data packet	IPv4: Via IPv6 static host MAC (if available) and mechanisms listed for IPv4 static host  IPv6 numbered host: Via IPv4 static host MAC (if available) and mechanisms listed for IPv6 numbered static host  IPv6 prefix only host: Via IPv4 static host MAC (if available) and mechanism listed for IPv6 prefix only host
N	Host’s ARP Triggered SHCV Data packet OAM SHCV	GUA based NS SHCV Data packet OAM SHCV	GUA based NS Data packet	IPv4 Via IPv6 static host MAC (if available) and mechanism listed for IPv4 static host  IPv6 numbered host: Via IPv4 static host MAC (if available) and mechanism listed for IPv6 numbered static host  IPv6 prefix only host: Via IPv4 static host MAC (if available) and mechanism listed for IPv6 prefix only host

IP-only static hosts without a MAC address are put into a “non-forwarding” state and are not be able to send or receive traffic. The BNG must populate the MAC address using the methods described in the table above to put the host into a “forwarding” state. If the IPv4 static host sends an ARP, then the IPv4 address along with Ethernet header source MAC can populate the IP-only host MAC address. For IPv6, the subscriber must send in a NS using the GUA to allow the BNG to resolve the MAC address. If the IP-only host is an IPv6 prefix, NS using the GUA can also resolve

the static host MAC address, provided that the GUA is within the subnet of the prefix. n IPv6 prefix host can only have one MAC association, multiple bridged hosts using a single IPv6 prefix is not supported. To support multiple bridge hosts on a SAP, individual /128 host must be configured along with enabling **ipoe-bridge-mode**.

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## Static Host Learning the IPv6 Default Gateway Address

Static hosts also need to resolve the default gateway and MAC in order to forward traffic. Static hosts can learn the BNG MAC using the following methods.

1. If the static host can use the BNG link-local as the default gateway, then the exchange of router solicit and advertisement should be able to populate the default route for the static host.
2. If the static host can use the BNG link-local as the default gateway but only through neighbor solicit, the BNG will respond to NS only if the source address is the GUA of the host.
3. If the static host can only use a GUA as the default gateway, then the subscriber interface must be configured with an IPv6 address instead of a prefix.

A host's RS/NS messages might use link-local as the source address. The host's link-local addresses are unknown to the BNG, since the BNG only knows static hosts by their GUA. By default, unknown host's RS/NS messages are dropped. Therefore, static hosts cannot resolve their default gateway/MAC address. There are two different methods to enable the BNG to respond to static host's RS/NS messages. The first solution is to declare the SAP as a single-mac. When a SAP is configured as a "single-mac", it is declaring that only a single host is expected on the SAP and any RS/NS sent by the host will automatically populate the MAC table. The BNG in return will also respond to the static host's RS/NS. The second solution is for cases where multiple hosts are on the SAP. RS/NS might not provide enough information to populate the subscriber host's MAC because the source IP are link-local addresses. The BNG anti-spoof will only reply to known hosts RS/NS; therefore, these static hosts' RS/NS are dropped. The group interface has a configuration option to auto-reply to any RS/NS, which will allow the static host to resolve their default gateway/route. Afterwards, the static host can send traffic to the BNG, which the BNG can use for MAC learning. To use data packets for MAC learning, the BNG has a "data-trigger" learning option for static hosts.

### Configuring Static Hosts on an VPLS SAP

The following example displays a static host on a VPLS SAP configuration:

```
*A:ALA-48>config>service# info
-----
vpls 800 customer 6001 create
  description "VPLS with residential split horizon for DSL"
  stp
    shutdown
  exit
  sap 1/2/7:100 split-horizon-group "DSL-group2" create
    description "SAP for RSHG"
    static-host ip 10.1.1.1
  exit
  no shutdown
-----
*A:ALA-48>config>service#
```

---

### Configuring Static Hosts on an IES SAP

The following displays a static host on an IES SAP:

```
*A:ALA-49>config>service>ies>sub-if>grp-if# info
-----
  sap 7/1/5 create
  description "IES with static host"
    static-host ip 10.1.1.1 create
    static-host ip 2001::1/128 create
    static-host ip 2001:1::/64 create
  exit
-----
*A:ALA-49>config>service>ies#
```

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### Configuring Static Hosts on an VPRN SAP

The following displays a static host on a VPRN SAP:

```
*A:ALA-49>config>service>vprn>sub-if>grp-if# info
-----
  description "VPRN service with static host"
  sap 7/1/5 create
    description "IES with static host"
    static-host ip 10.1.1.1 create
    static-host ip 2001::1/128 create
    static-host ip 2001:1::/64 create
  exit
-----
*A:ALA-49>config>service>vprn#
```