BIG-IP® CGNAT: Implementations

Version 11.6

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Deploying a Carrier Grade NAT

Overview: The carrier-grade NAT (CGNAT) module

The carrier-grade network address translation (CGNAT) module on the BIG-IP® system supports large groups of translation addresses using large-scale NAT (LSN) pools and grouping of address-translation-related options in an ALG profile, which can be assigned to multiple virtual servers. It also has the ability to match virtual servers based on client address to destination addresses and ports. Other characteristics of the CGNAT module are listed here.

Note: *CGNAT is NAT only. If you want to deploy DNS services, you need a BIG-IP GTM™ license.*

Translation address persistence

The CGNAT module can assign the same external (translation) address to all connections originated by the same internal client. For example, providing endpoint-independent address mapping.

Automatic external inbound connection handling

CGNAT can accept inbound external connections to active translation address/port combinations to facilitate endpoint-independent filtering as described in section 5 of *RFC 4787*. This is also known as a full-cone NAT.

More efficient logging

CGNAT supports log messages that map external addresses and ports back to internal clients for both troubleshooting and compliance with law enforcement/legal constraints.

Network address and port translation

Network address and port translation (NAPT) mode provides standard address and port translation allowing multiple clients in a private network to access remote networks using the single IP address assigned to their router.

Deterministic assignment of translation addresses

Deterministic mode is an option used to assign translation address, and is port-based on the client address/port and destination address/port. It uses reversible mapping to reduce logging, while maintaining the ability for translated IP address to be discovered for troubleshooting and compliance with regulations. Deterministic mode also provides an option to configure backup-members.

Port block allocation of translation addresses

Port block allocation (PBA) mode is an option that reduces logging, by logging only the allocation and release of a block of ports. When a subscriber sends a translation request, the BIG-IP system services the request from a block of ports that is assigned to a single IP address, and only logs the allocation and release of that block of ports. The BIG-IP system applies subsequent requests from the service provider to that block of ports until all ports are used.

Licensing

Designed for service providers, the CGNAT module is offered as a stand-alone license or as an add-on license for Local Traffic Manager™ (LTM®) and Policy Enforcement Manager™ (PEM).

Task summary

Creating an LSN pool
Configuring an ALG profile
Configuring a CGNAT iRule
Creating a virtual server for an LSN pool
Creating a CGNAT tunnel

About ALG Profiles

Application Layer Gateway (ALG) profiles provide the CGNAT with protocol and service functionality that modifies the necessary application protocol header and payload, thus allowing these protocols to seamlessly traverse the NAT. FTP, RTSP, SIP, and PPTP profiles are supported with ALG profiles, and added to the CGNAT configuration as needed.

An FTP, RTSP, or SIP profile can use an Automap, NAPT, DNAT, or PBA address translation mode when providing necessary logging.

About CGNAT translation address persistence and inbound connections

The BIG-IP® system enables you to manage RFC-defined behavior for translation address persistence and inbound connections.

Translation Address Persistence

When you configure an LSN pool, the CGNAT Persistence Mode setting assigns translation endpoints in accordance with the selected configuration mode: NAPT, Deterministic NAT (DNAT), or Port Block Allocation (PBA). It is important to note that this CGNAT translation address persistence is different from the persistence used in the BIG-IP Local Traffic Manager™ (LTM®) load balancing. *CGNAT translation address persistence* uses a selected translation address, or endpoint, across multiple connections from the same subscriber address, or endpoint.

The BIG-IP system provides three Persistence Mode settings (**None**, **Address**, and **Address Port**) for each configuration mode.

Persistence Mode	Description
None	Translation addresses are not preserved for the subscriber. Each outbound connection might receive a different translation address. This setting provides the lowest overhead and highest performance.
Address	CGNAT preserves the translation address for the subscriber. When a connection is established, CGNAT determines if this subscriber already has a translation address. If the subscriber already has a translation address, then CGNAT uses the translation address stored in the persistence record, and locates a port for that connection. If no port is available, then CGNAT selects a different address. This setting provides greater overhead on each connection and less performance. ***Note:*** *DNAT reserves both addresses and ports for a subscriber; however, persistence might still be of value when a subscriber's deterministic mappings span*

Persistence Mode	Description
	two translation addresses. In this instance, persistence prefers the same address each time.
Address Port	CGNAT preserves the translation address and port of the subscriber's connection, so that the endpoint can be reused on subsequent connections. This setting provides Endpoint Independent Mapping (EIM) behavior. Additionally, like the **Address** setting for **Persistence Mode**, this setting provides greater overhead on each connection and less performance.

Inbound Connections

The Inbound Connections setting determines whether the Large Scale NAT (LSN) allows connections to be established inbound to the LSN subscriber or client. This setting provides greater overhead, including a lookup on inbound entries for each connection to prevent endpoint overloading, and a reduction in the use of the translation space.

When you disable inbound connections, the BIG-IP system provides greater efficiency in address space utilization by allowing endpoint overloading, where two different subscribers can use the same translation address and port, as long as each subscriber connects to a different host.

When you enable inbound connections, the BIG-IP system restricts the use of a translation address and port to a single subscriber, and ensures that only one subscriber address and port uses a translation endpoint.

Note: *Because DNAT reserves addresses and ports for a subscriber, no endpoint overloading between subscribers occurs, but a single subscriber's traffic can leverage overloading. Inbound connections restrict this behavior. For DNAT, increased restriction from inbound connections might occur when fewer ports per subscriber are available. With inbound connections enabled, the ratio of subscriber ports to translation endpoints for a subscriber is 1:1.*

About IPv6 prefixes

IPv6 128-bit addresses include a network prefix in the leftmost fields, and subnet in the remaining fields. For example, an IPv6 address of `2001:0db8:0000:0000:0000:0000:0000:0000` with a 32-bit prefix equates to a network of `2001:0db8`, written as `2001:db8::/32`. A network written as `2001:db8::/32` omits leading zeros in four-digit groups, uses `::` to indicate collapsed zero groups, and uses `/32` to indicate the 32-bit prefix.

About IPv4 prefixes

IPv4 32-bit addresses include a network prefix in the leftmost fields, and a host identifier in the remaining fields. For example, an address of `192.168.1.0/24` includes the prefix of the IPv4 network starting at the given address, having 24 bits allocated for the network prefix, and the remaining 8 bits reserved for host addressing.

Creating an LSN pool

The CGNAT module must be enabled through the **System** > **Resource Provisioning** screen before you can create LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.

   If your pool uses deterministic mode, ensure that any address ranges you enter as a member do not overlap another member's prefix address ranges. For example, the address and prefix `10.10.10.0/24` overlaps `10.10.10.0/23`.
5. Click **Finished**.

Your LSN pool is now ready, and you can continue to configure your CGNAT.

Configuring an ALG profile

An ALG profile provides the CGNAT module with protocol and service information to make specified packet modifications to the IP and TCP/UDP headers, as well as the payload during translation.

Important: *Edit only copies of the included ALG profiles to avoid unwanted propagation of settings to other profiles that use the included profiles as parents.*

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles**.
2. In the ALG Profiles menu, click an ALG profile.
3. Click **Create**.
   The New Profile screen opens.
4. Type a name for the new profile.
5. From the **Parent Profile** list, ensure that the correct parent profile is selected as the new profile.
6. Select the **Custom** check box on the right.
7. Configure the profile settings.
8. Click **Finished** to save the new ALG profile.

You now have an ALG profile for use by CGNAT.

Configuring a CGNAT iRule

You create iRules® to automate traffic forwarding for XML content-based routing. When a match occurs, an iRule event is triggered, and the iRule directs the individual request to an LSN pool, a node, or virtual server.

1. On the Main tab, click **Carrier Grade NAT** > **iRules**.
   The iRule List screen opens.
2. Click **Create**.
3. In the **Name** field, type a 1 to 31 character name, such as `cgn_https_redirect_iRule`.
4. In the **Definition** field, type the syntax for the iRule using Tool Command Language (Tcl) syntax.

For complete and detailed information about iRules syntax, see the F5 Networks DevCentral web site (`http://devcentral.f5.com`).

5. Click **Finished**.

You now have an iRule to use with a CGNAT virtual server.

Creating a virtual server for an LSN pool

Virtual servers are matched based on source (client) addresses. Define a virtual server that references the CGNAT profile and the LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Performance (Layer 4)**.
5. For a network, in the **Destination Address** field, type an IPv4 or IPv6 address in CIDR format to allow all traffic to be translated.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `0.0.0.0/0`, and an IPv6 address/prefix is `::/0`.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.
7. From the **VLAN and Tunnel Traffic** list, select **Enabled on**. Then, for the **VLANs and Tunnels** setting, move the VLAN or VLANs on which you want to allow the virtual servers to share traffic from the **Available** list to the **Selected** list.
8. For the **LSN Pool** setting, select the pool that this server will draw on for translation addresses.
9. In the Resources area of the screen, for the **iRules** setting, select the name of the iRule that you want to assign and using the Move button, move the name from the **Available** list to the **Enabled** list.
10. Click **Finished**.

The custom CGNAT virtual server now appears in the CGNAT Virtual Servers list.

Creating a CGNAT tunnel

Many translations use tunneling to move TCP/UDP traffic where the payload is other IP traffic. You can create and configure a tunnel for use with an LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Tunnels**.
   The Tunnels screen opens.
2. Click **Create**.
   The New Tunnel screen opens.
3. In the **Name** field, type a unique name for the tunnel.
4. In the **Local Address** field, type the IP address of the BIG-IP system.
5. From the **Remote Address** list, retain the default selection, **Any**.

   This entry means that you do not have to specify the IP address of the remote end of the tunnel, which allows multiple devices to use the same tunnel.
6. Click **Finished**.

Your CGNAT tunnel is ready to use as an egress interface in an LSN Pool.

Using NAT64 to Map IPv6 Addresses to IPv4 Destinations

Overview: NAT64

For the BIG-IP® system CGNAT module, NAT64 is the NAT type that maps IPv6 subscriber private addresses to IPv4 Internet public addresses. NAT64 translates subscriber IPv6 addresses to public Internet IPv4 addresses and allows Internet traffic from an IPv6 client to reach a public IPv4 server. The CGNAT module processes NAT64 traffic, as defined in *RFC 6146* for TCP and UDP addresses.

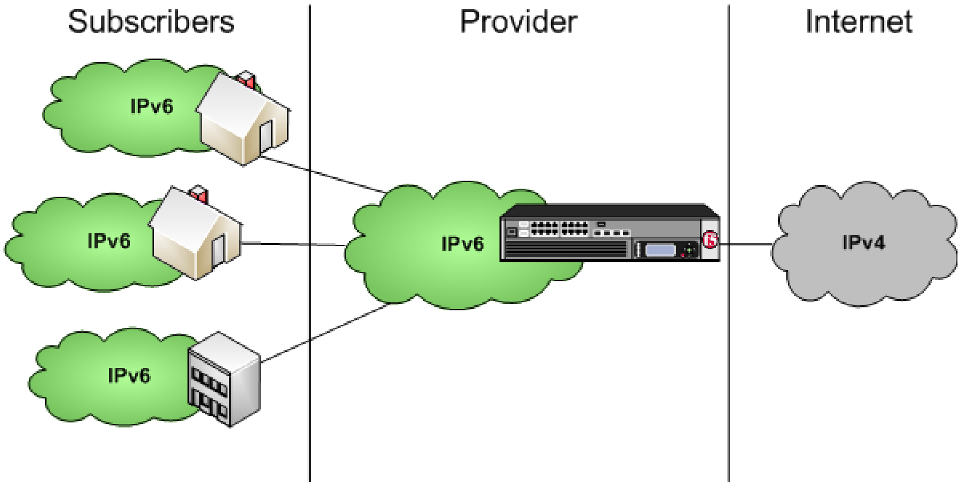


Figure 1: Diagram of a NAT64 network

Task summary

Creating a NAT64 LSN pool
Creating a NAT64 virtual server for an LSN pool
Configuring an ALG profile
Configuring a CGNAT iRule

NAT64 example

This NAT64 example shows the BIG-IP® system CGNAT module mapping of IPv6 subscriber private addresses to IPv4 Internet public addresses.

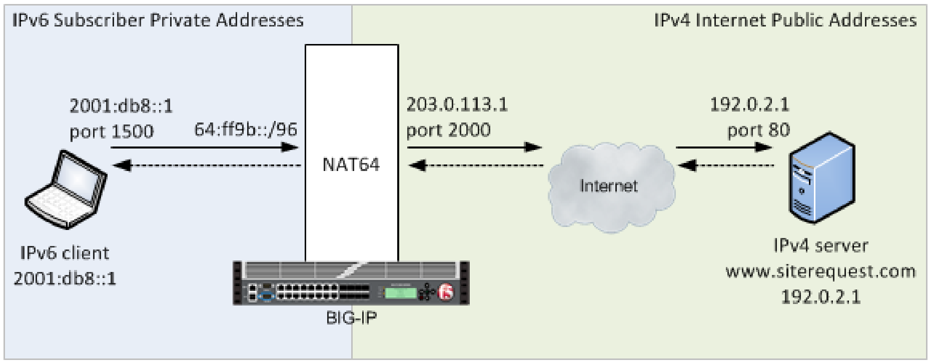


Figure 2: A NAT64 example configuration

In this example, an IPv6 client initiates a request to the IPv4 server, using a source address of `2001:db8::1,1500` and a destination address of `64:ff9b::192.0.2.1,80`. The NAT64 on the BIG-IP® system selects an available port for the IPv4 address `203.0.113.1,2000`, and creates a mapping entry from `2001:db8::1,1500` to `203.0.113.1,2000`. The NAT64 translates the IPv6 header into an IPv4 header, including `203.0.113.1,2000` as the source address and `192.0.2.1,80` as the destination address, and sends the translated packet to the IPv4 server.

The IPv4 server responds with a server packet, which includes a destination address of `203.0.113.1,2000` and source address of `192.0.2.1,80`. Upon receipt of the IPv4 server packet, the NAT64 translates the IPv4 header into an IPv6 header, which includes `2001:db8::1,1500` as the source address, and sends the response to the client.

Creating a NAT64 LSN pool

The CGNAT module must be enabled through **System** > **Resource Provisioning** before you can configure LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. For the **Member List** setting, in the **Address/Prefix Length** field, type an address and a prefix length and click **Add**.

   In a NAT64 implementation, an example of an IPv6 member address and prefix is `64:ff9b::/96`.
5. Click **Finished**.

Your LSN pool is now ready, and you can continue to configure your CGNAT.

Creating a NAT64 virtual server for an LSN pool

Virtual servers are matched based on source (client) addresses. Define a NAT64 virtual server that references the CGNAT profile and the LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.

The Virtual Server List screen opens.

2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Performance (Layer 4)**.
5. In the **Destination Address** field, type the IPv6 address in CIDR format.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv6 address/prefix is `ffe1::0020/64` or `2001:ed8:77b5:2:10:10:100:42/64`.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.
7. From the **Configuration** list, select **Advanced**.
8. From the **Protocol** list, select *** All Protocols**.
9. For the **LSN Pool** setting, select the pool that this server will draw on for translation addresses.
10. For the **Address Translation** setting, select the **Enabled** check box to enable address translation.
11. For the **Port Translation** setting, clear the **Enabled** check box.
12. For the **NAT64** setting, select the **Enabled** check box.
13. In the Resources area of the screen, for the **iRules** setting, select the name of the iRule that you want to assign and using the Move button, move the name from the **Available** list to the **Enabled** list.
14. Click **Finished**.

The custom CGNAT NAT64 virtual server now appears in the CGNAT Virtual Servers list.

Configuring an ALG profile

An ALG profile provides the CGNAT module with protocol and service information to make specified packet modifications to the IP and TCP/UDP headers, as well as the payload during translation.

Important: *Edit only copies of the included ALG profiles to avoid unwanted propagation of settings to other profiles that use the included profiles as parents.*

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles**.
2. In the ALG Profiles menu, click an ALG profile.
3. Click **Create**.
   The New Profile screen opens.
4. Type a name for the new profile.
5. From the **Parent Profile** list, ensure that the correct parent profile is selected as the new profile.
6. Select the **Custom** check box on the right.
7. Configure the profile settings.
8. Click **Finished** to save the new ALG profile.

You now have an ALG profile for use by CGNAT.

Configuring a CGNAT iRule

You create iRules® to automate traffic forwarding for XML content-based routing. When a match occurs, an iRule event is triggered, and the iRule directs the individual request to an LSN pool, a node, or virtual server.

1. On the Main tab, click **Carrier Grade NAT** > **iRules**.
   The iRule List screen opens.
2. Click **Create**.
3. In the **Name** field, type a 1 to 31 character name, such as `cgn_https_redirect_iRule`.
4. In the **Definition** field, type the syntax for the iRule using Tool Command Language (Tcl) syntax.

   For complete and detailed information about iRules syntax, see the F5 Networks DevCentral web site (`http://devcentral.f5.com`).
5. Click **Finished**.

You now have an iRule to use with a CGNAT virtual server.

Using NAT44 to Translate IPv4 Addresses

Overview: NAT44

For the BIG-IP® system CGNAT module, NAT44 is the NAT type that maps IPv4 subscriber private addresses to IPv4 Internet public addresses. Translation addresses and ports are set in LSN pools. The CGNAT module performs NAT44 translations for all IP traffic.

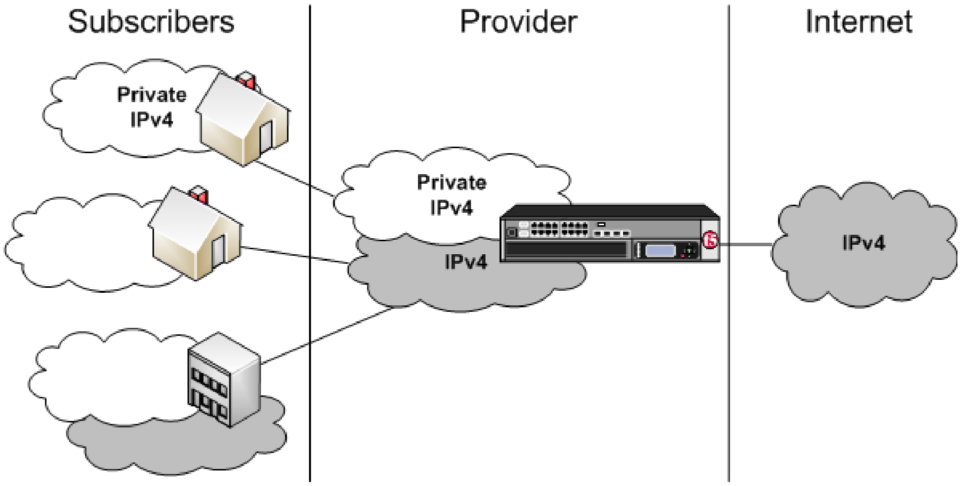


Figure 3: Diagram of a NAT44 network

Task summary

Creating an LSN pool
Creating a virtual server for an LSN pool
Configuring an ALG profile
Configuring a CGNAT iRule

About CGNAT hairpinning

An optional feature on the BIG-IP ®system, *hairpinning* routes traffic from one subscriber's client to an external address of another subscriber's server, where both client and server are located in the same subnet. To each subscriber, it appears that the other subscriber's address is on an external host and on a different subnet. The BIG-IP system can recognize this situation and send, or hairpin, the message back to the origin subnet so that the message can reach its destination.

Note: *At present hairpinning works with all BIG-IP CGNAT scenarios except NAT64.*

Creating an LSN pool

The CGNAT module must be enabled through the **System** > **Resource Provisioning** screen before you can create LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.

   If your pool uses deterministic mode, ensure that any address ranges you enter as a member do not overlap another member's prefix address ranges. For example, the address and prefix `10.10.10.0/24` overlaps `10.10.10.0/23`.
5. Click **Finished**.

Your LSN pool is now ready, and you can continue to configure your CGNAT.

Creating a virtual server for an LSN pool

Virtual servers are matched based on source (client) addresses. Define a virtual server that references the CGNAT profile and the LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Performance (Layer 4)**.
5. For a network, in the **Destination Address** field, type an IPv4 or IPv6 address in CIDR format to allow all traffic to be translated.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `0.0.0.0/0`, and an IPv6 address/prefix is `::/0`.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.
7. From the **VLAN and Tunnel Traffic** list, select **Enabled on**. Then, for the **VLANs and Tunnels** setting, move the VLAN or VLANs on which you want to allow the virtual servers to share traffic from the **Available** list to the **Selected** list.
8. For the **LSN Pool** setting, select the pool that this server will draw on for translation addresses.
9. In the Resources area of the screen, for the **iRules** setting, select the name of the iRule that you want to assign and using the Move button, move the name from the **Available** list to the **Enabled** list.

10. Click **Finished**.

The custom CGNAT virtual server now appears in the CGNAT Virtual Servers list.

Configuring an ALG profile

An ALG profile provides the CGNAT module with protocol and service information to make specified packet modifications to the IP and TCP/UDP headers, as well as the payload during translation.

Important: *Edit only copies of the included ALG profiles to avoid unwanted propagation of settings to other profiles that use the included profiles as parents.*

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles**.
2. In the ALG Profiles menu, click an ALG profile.
3. Click **Create**.
   The New Profile screen opens.
4. Type a name for the new profile.
5. From the **Parent Profile** list, ensure that the correct parent profile is selected as the new profile.
6. Select the **Custom** check box on the right.
7. Configure the profile settings.
8. Click **Finished** to save the new ALG profile.

You now have an ALG profile for use by CGNAT.

Configuring a CGNAT iRule

You create iRules® to automate traffic forwarding for XML content-based routing. When a match occurs, an iRule event is triggered, and the iRule directs the individual request to an LSN pool, a node, or virtual server.

1. On the Main tab, click **Carrier Grade NAT** > **iRules**.
   The iRule List screen opens.
2. Click **Create**.
3. In the **Name** field, type a 1 to 31 character name, such as `cgn_https_redirect_iRule`.
4. In the **Definition** field, type the syntax for the iRule using Tool Command Language (Tcl) syntax.

   For complete and detailed information about iRules syntax, see the F5 Networks DevCentral web site (`http://devcentral.f5.com`).
5. Click **Finished**.

You now have an iRule to use with a CGNAT virtual server.

Using DS-Lite with CGNAT

Overview: DS-Lite Configuration on BIG-IP systems

As IPv4 addresses are becoming depleted, service providers (DSL, cable, and mobile) face the challenge of supplying IP addresses to new customers. Providing IPv6 addresses alone is often not workable, because most of the public Internet still uses only IPv4, and many customer systems do not yet fully support IPv6. The Dual-Stack Lite (DS-Lite) tunneling technology is one solution to this problem. DS-Lite gives service providers the means to migrate to an IPv6 access network without changing end user devices or software.

What is DS-Lite?

DS-Lite is an IPv4-to-IPv6 transition technology, described in RFC 6333, that uses tunneling and network address translation (NAT) to send IPv4 packets over an IPv6 network. This technology makes it possible, for example, for a service provider with an IPv6 backbone to properly route traffic while overlapping IPv4 networks.

How does DS-Lite work?

The customer-premises equipment (CPE), known as the B4 (Basic Bridging BroadBand) device, encapsulates the IPv4 packets inside IPv6 packets, and sends them to the AFTR (Address Family Transition Router) device. The AFTR device includes carrier-grade NAT (CGNAT), which has a global IPv4 address space. The AFTR device decapsulates the IPv4 traffic and performs address translation, as it sends the traffic to the external IPv4 network.

How does F5 implement DS-Lite?

On the BIG-IP® system, a DS-Lite tunnel is a variation of IPIP tunnels that uses augmented flow lookups to route traffic. *Augmented flow lookups* include the IPv6 address of the tunnel to identify the accurate source of packets that might have the same IPv4 address. When the BIG-IP device receives an IPv6 encapsulated packet, the system terminates the tunnel, decapsulates the packet, and marks it for DS-Lite. When the system re-injects the packet into the IP stack, it performs an augmented flow lookup to properly route the response.

Illustration of a DS-Lite deployment

In this example, a service provider transports encapsulated IPv4 traffic over its IPv6 network.

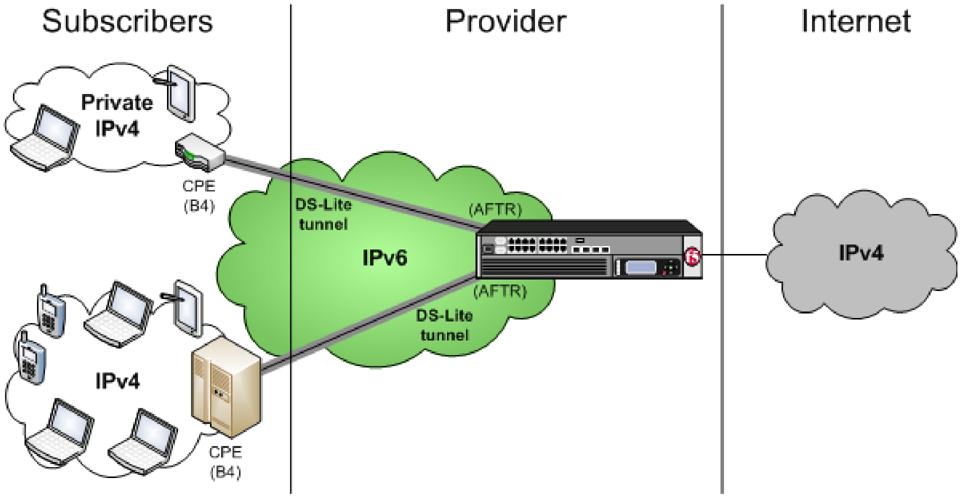


Figure 4: Example of a DS-Lite configuration

Task summary

Creating a DS-Lite tunnel on the BIG-IP device as an AFTR device
Assigning a self IP address to an AFTR device
Configuring CGNAT for DS-Lite
Verifying traffic statistics for a DS-Lite tunnel

About CGNAT hairpinning

An optional feature on the BIG-IP ®system, *hairpinning* routes traffic from one subscriber's client to an external address of another subscriber's server, where both client and server are located in the same subnet. To each subscriber, it appears that the other subscriber's address is on an external host and on a different subnet. The BIG-IP system can recognize this situation and send, or hairpin, the message back to the origin subnet so that the message can reach its destination.

Note: *At present hairpinning works with all BIG-IP CGNAT scenarios except NAT64.*

Creating a DS-Lite tunnel on the BIG-IP device as an AFTR device

Before you configure the tunnel, ensure that the BIG-IP® device you are configuring has an IPv6 address.

You can create a DS-Lite (wildcard) tunnel for terminating IPv4-in-IPv6 tunnels to remote B4 devices, and recycling the IPv4 address space.

1. On the Main tab, click **Network** > **Tunnels** > **Tunnel List** > **Create**.

The New Tunnel screen opens.

2. In the **Name** field, type a unique name for the tunnel.
3. From the **Encapsulation Type** list, select **dslite**.
4. In the **Local Address** field, type the IPv6 address of the local BIG-IP device.
5. For the **Remote Address** setting, retain the default selection, **Any**, which indicates a wildcard IP address.
6. Click **Finished**.

You have now created a DS-Lite tunnel that functions as an AFTR (Address Family Translation Router) device.

Assigning a self IP address to an AFTR device

Ensure that you have created a DS-Lite tunnel before you start this task.

Self IP addresses can enable the BIG-IP® system, and other devices on the network, to route application traffic through the associated tunnel.

1. On the Main tab, click **Network** > **Self IPs**.
2. Click **Create**.
   The New Self IP screen opens.
3. In the **Name** field, type a unique name for the self IP address.
4. In the **IP Address** field, type an IP address.

   This IP address is the IPv4 gateway that the B4 devices use to reach the Internet. F5 recommends using the IP address space that the IANA has specifically allocated for an AFTR device, for example, `192.0.0.1`.
5. In the **Netmask** field, type the full network mask for the specified IP address.

   For example, you can type `ffff:ffff:ffff:ffff:0000:0000:0000:0000` or `ffff:ffff:ffff:ffff::`.
6. From the **VLAN/Tunnel** list, select the tunnel with which to associate this self IP address.
7. Click **Finished**.

Configuring CGNAT for DS-Lite

Before starting this task, ensure that CGNAT is licensed and the feature module enabled on the BIG-IP® system, and you have created at least one LSN pool.

When you are configuring DS-Lite, you must set up a forwarding virtual server to provide the Large Scale NAT (LSN), which is specified by the DS-Lite tunnel as an augmented flow lookup.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Performance (Layer 4)**.
5. In the **Destination Address** field, type `0.0.0.0/0` to translate all IPv4 traffic.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.

7. From the **Configuration** list, select **Advanced**.
8. From the **Protocol** list, select *** All Protocols**.
9. From the **LSN Pool** list, select an LSN pool.
10. Click **Finished**.

This virtual server now intercepts traffic leaving the DS-Lite tunnel, provides the LSN address translation, and forwards the traffic to the IPv4 gateway.

Verifying traffic statistics for a DS-Lite tunnel

After you configure DS-Lite on a BIG-IP® system, you can check the statistics for the tunnel to verify that traffic is passing through it.

1. Log on to the BIG-IP command-line interface.
2. At the command prompt, type `tmsh show sys connection all-properties`.
   The result should show tunnel with `any` as the remote endpoint (on the first line), and `ipencap` as the `Protocol`, as shown in the example.

```
2001:db8::/32.any - 2001:db8::46.any - any6.any - any6.any
---------------------------------------------------------
  TMM           0
  Type          any
  Acceleration  none
  Protocol      ipencap
  Idle Time     1
  Idle Timeout  300
  Unit ID       1
  Lasthop       /Common/wan 00:d0:01:b9:88:00
  Virtual Path  2001:db8::46.any

                     ClientSide  ServerSide
  Client Addr  2001:db8::45.any    any6.any
  Server Addr  2001:db8::46.any    any6.any
  Bits In                171.6K           0
  Bits Out               171.6K           0
```

Using CGNAT Translation Modes

Overview: Using NAPT address translation mode

NAPT mode provides standard address and port translation allowing multiple clients in a private network to access remote networks using the single IP address assigned to their router. For outbound packets, NAPT translates the source IP address and source transport identifier. For inbound packets, NAPT translates the destination IP address, the destination transport identifier, and the IP and transport header checksums. This mode is beneficial for remote access users.

Task summary

Creating a NAPT LSN pool
Creating a VLAN for NAT
Creating a NAT64 virtual server for an LSN pool

NAPT log examples

The following examples describe typical NAPT log messages

NAT44 example

```
Mar 27 11:17:39 10.10.10.200 lsn_event="LSN_ADD",cli="10.10.10.1:
33950",nat="5.5.5.1:10000"
Mar 27 11:17:39 10.10.10.200 "LSN_ADD""10.10.10.1: 33950""5.5.5.1:10000"
Mar 27 11:23:17 localhost info tmm[32683]:
"LSN_ADD""10.10.10.1:33950""5.5.5.1:10000"
Mar 27 11:17:39 10.10.10.200 lsn_event="LSN_DELETE",cli="10.10.10.1:
33950",nat="5.5.5.1:10000"
Mar 27 11:17:39 10.10.10.200 "LSN_DELETE""10.10.10.1: 33950""5.5.5.1:10000"
Mar 27 11:23:17 localhost info tmm[32683]:
"LSN_DELETE""10.10.10.1:33950""5.5.5.1:10000"
```

NAT44 example with route domains

```
Mar 28 08:34:12 10.10.21.200 lsn_event="LSN_ADD",cli="10.10.10.1%11:
59187",nat="5.5.5.1%22:10000"
Mar 28 08:34:12 10.10.21.200 "LSN_ADD""10.10.10.1%11: 59187""5.5.5.1%22:10000"
Mar 28 08:34:12 10.10.21.200 lsn_event="LSN_DELETE",cli="10.10.10.1%11:
59187",nat="5.5.5.1%22:10000"
Mar 28 08:34:12 10.10.21.200 "LSN_DELETE""10.10.10.1%11:
59187""5.5.5.1%22:10000"
```

NAT64 example

```
Mar 27 11:18:20 10.10.10.200 lsn_event="LSN_ADD",cli="2701:
1:12:123:1234:432:43:100.39900",nat="5.5.5.1:10000"
Mar 27 11:18:20 10.10.10.200 "LSN_ADD""2701:
```

```
1:12:123:1234:432:43:100.39900""5.5.5.1:10000"
Mar 27 11:23:57 localhost info tmm[32683]:
"LSN_ADD""2701:1:12:123:1234:432:43:100.39900""5.5.5.1:10000"
Mar 27 11:18:23 10.10.10.200 lsn_event="LSN_DELETE",cli="2701:
1:12:123:1234:432:43:100.39900",nat="5.5.5.1:10000"
Mar 27 11:18:23 10.10.10.200 "LSN_DELETE""2701:
1:12:123:1234:432:43:100.39900""5.5.5.1:10000"
Mar 27 11:24:00 localhost info tmm[32683]:
"LSN_DELETE""2701:1:12:123:1234:432:43:100.39900""5.5.5.1:10000"
```

NAT64 example with route domains

```
Mar 28 14:50:56 10.10.21.200 lsn_event="LSN_ADD",cli="2701:
1:12:123:1234:432:43:100%11.45000",nat="5.5.5.1%22:10000"
Mar 28 14:50:56 10.10.21.200 "LSN_ADD""2701:
1:12:123:1234:432:43:100%11.45000""5.5.5.1%22:10000"
Mar 28 14:50:56 10.10.21.200 lsn_event="LSN_DELETE",cli="2701:
1:12:123:1234:432:43:100%11.45000",nat="5.5.5.1%22:10000"
Mar 28 14:50:56 10.10.21.200 "LSN_DELETE""2701:
1:12:123:1234:432:43:100%11.45000""5.5.5.1%22:10000"
```

NAT DSLITE

```
Mar 27 11:19:14 10.10.10.200 lsn_event="LSN_ADD",cli="10.10.31.4:
52240",nat="5.5.5.1:10000",dslite="2701::200"
Mar 27 11:19:14 10.10.10.200 "LSN_ADD""10.10.31.4:
52240""5.5.5.1:10000""2701::200"
Mar 27 11:24:52 localhost info tmm[32682]:
"LSN_ADD""10.10.31.4:52240""5.5.5.1:10000""2701::200"
Mar 27 11:19:18 10.10.10.200 lsn_event="LSN_DELETE",cli="10.10.31.4:
52240",nat="5.5.5.1:10000",dslite="2701::200"
Mar 27 11:19:18 10.10.10.200 "LSN_DELETE""10.10.31.4:
52240""5.5.5.1:10000""2701::200"
Mar 27 11:24:55 localhost info tmm[32682]:
"LSN_DELETE""10.10.31.4:52240""5.5.5.1:10000""2701::200"
```

NAT DSLITE with route domains

```
Mar 28 15:03:40 10.10.21.200 lsn_event="LSN_ADD",cli="10.10.31.4%11:
51942",nat="5.5.5.1%22:10000",dslite="2701::200%11"
Mar 28 15:03:40 10.10.21.200 "LSN_ADD""10.10.31.4%11:
51942""5.5.5.1%22:10000""2701::200%11"
Mar 28 15:03:40 10.10.21.200 lsn_event="LSN_DELETE",cli="10.10.31.4%11:
51942",nat="5.5.5.1%22:10000",dslite="2701::200%11"
Mar 28 15:03:40 10.10.21.200 "LSN_DELETE""10.10.31.4%11:
51942""5.5.5.1%22:10000""2701::200%11"
```

Creating a NAPT LSN pool

- The CGNAT module must be provisioned before LSN pools can be configured.
- Before associating a LSN pool with a log publisher, ensure that at least one log publisher exists on the BIG-IP system.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.

The LSN Pool List screen opens.

2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the **Description** field, type a description.
5. Select **NAPT** for the pool's translation **Mode**.
6. Click **Finished**.

Your NAPT LSN pool is now ready and you can continue to configure your CGNAT.

Creating a VLAN for NAT

VLANs represent a logical collection of hosts that can share network resources, regardless of their physical location on the network. You create a VLAN to associate physical interfaces with that VLAN.

1. On the Main tab, click **Network** > **VLANs**.
   The VLAN List screen opens.
2. Click **Create**.
   The New VLAN screen opens.
3. In the **Name** field, type a unique name for the VLAN.
4. In the **Tag** field, type a numeric tag, from 1-4094, for the VLAN, or leave the field blank if you want the BIG-IP system to automatically assign a VLAN tag.

   The VLAN tag identifies the traffic from hosts in the associated VLAN.
5. For the **Interfaces** setting:
   a) From the **Interface** list, select an interface number.
   b) From the **Tagging** list, select **Tagged** or **Untagged**.

      Select **Tagged** when you want traffic for that interface to be tagged with a VLAN ID.
   c) If you specified a numeric value for the **Customer Tag** setting and from the **Tagging** list you selected **Tagged**, then from the **Tag Mode** list, select a value.
   d) Click **Add**.
   e) Repeat these steps for each interface that you want to assign to the VLAN.
6. From the **Configuration** list, select **Advanced**.
7. If you want the system to verify that the return route to an initial packet is the same VLAN from which the packet originated, select the **Source Check** check box.
8. In the **MTU** field, retain the default number of bytes (**1500**).
9. If you want to base redundant-system failover on VLAN-related events, select the **Fail-safe** check box.
10. From the **Auto Last Hop** list, select a value.
11. From the **CMP Hash** list, select **Source** if this VLAN is the subscriber side or **Destination Address** if this VLAN is the Internet side.
12. To enable the **DAG Round Robin** setting, select the check box.
13. Click **Finished**.
    The screen refreshes, and displays the new VLAN in the list.

You now have one of two VLANs for your deterministic or PBA NAT. Repeat these steps to create a second VLAN to act as the destination if the first VLAN is the source or vice versa.

Creating a NAT64 virtual server for an LSN pool

Virtual servers are matched based on source (client) addresses. Define a NAT64 virtual server that references the CGNAT profile and the LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Performance (Layer 4)**.
5. In the **Destination Address** field, type the IPv6 address in CIDR format.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv6 address/prefix is `ffe1::0020/64` or `2001:ed8:77b5:2:10:10:100:42/64`.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.
7. From the **Configuration** list, select **Advanced**.
8. From the **Protocol** list, select *** All Protocols**.
9. For the **LSN Pool** setting, select the pool that this server will draw on for translation addresses.
10. For the **Address Translation** setting, select the **Enabled** check box to enable address translation.
11. For the **Port Translation** setting, clear the **Enabled** check box.
12. For the **NAT64** setting, select the **Enabled** check box.
13. In the Resources area of the screen, for the **iRules** setting, select the name of the iRule that you want to assign and using the Move button, move the name from the **Available** list to the **Enabled** list.
14. Click **Finished**.

The custom CGNAT NAT64 virtual server now appears in the CGNAT Virtual Servers list.

Overview: Using PBA mode to reduce CGNAT logging

Port block allocation (PBA) mode is a translation mode option that reduces CGNAT logging, by logging only the allocation and release of each block of ports. When a subscriber first establishes a network connection, the BIG-IP® system reserves a block of ports on a single IP address for that subscriber. The system releases the block when no more connections are using it. This reduces the logging overhead because the CGNAT logs only the allocation and release of each block of ports.

Note: *When a subscriber first connects, the PBA translation mode applies client port block limits, which the subscriber uses as long as it has addresses allocated. For each subscriber, PBA mode compares the subscriber's allocated number of port blocks to the port block limit for the currently connected pool. If the allocated number of port blocks exceeds the port block limit, then the connection is denied. For example, if a subscriber's allocated number of port blocks is 2, and the port block limit for the currently connected pool is 1, then the connection is denied.*

Task summary

Creating a PBA LSN pool
Creating a VLAN for NAT
Creating a virtual server for an LSN pool

About PBA address translation mode

Port Block Allocation (PBA) mode provides you with the ability to log only the allocation and release of port blocks for a subscriber, instead of separately logging each network address translation (NAT) session as a separate translation event, as with network address and port translation (NAPT), thus reducing the number of log entries while maintaining legal mapping and reverse mapping requirements.

Restrictions

Configuration restrictions for PBA mode include these constraints.

- PBA mode is compatible only with SP-DAG. If a VLAN is used that is not compatible with SP-DAG, then NAPT mode becomes active and an error is logged.
- You can configure overlapping LSN prefixes only between pools of the same type, to ensure correct reverse mapping from a translation address and port to a subscriber.
- The system allocates one primary port block for each subscriber, with the allocation of an additional overflow port block, as necessary.
- The Client Connection Limit value constrains the number of subscriber connections, preventing any one subscriber from using an excessive number of connections.
- PBA mode is available with NAT44, NAT64, and DS-Lite.

Behavior Characteristics

PBA mode manages connections by means of the following characteristics.

- A *zombie port block*, which is a port block that has reached the Block Lifetime limit but cannot be released due to active connections, is released when all active connections become inactive, or when the Zombie Timeout value is reached.
- Port allocation within an active port block occurs until all available ports become allocated, or until the Block Lifetime limit is exceeded.
- The Block Idle Timeout value specifies the period between when the last connection using a port block is freed and when the port block can be reused.

Reduced Logging

When you use PBA mode, a log entry is sent when a block of ports is allocated for a subscriber, and again when a block of ports is released. Log entries include the range of ports (that is, the port block) from the start port through the end port. Several logging destinations are available for PBA mode, including Syslog, Splunk, and IPFIX.

About configuring PBA mode with route domains

Port block allocation (PBA) mode can be used with route domains to configure multiple subscriber networks in separate route domains. You can also partition subscriber networks and the Internet by using route domains.

A route domain that is used for the translation entry is not the subscriber route domain. The subscriber route domain is, instead, applied to the egress interface.

In the following configuration, multiple subscribers can connect to servers in Internet route domain 0. The BIG-IP® system allocates, to each subscriber, available port blocks from Internet route domain 0 that include unique addresses and ports.

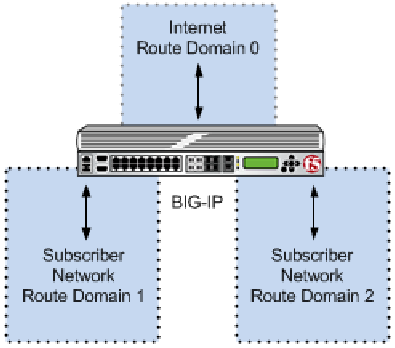


Figure 5: Multiple subscriber networks connecting to Internet servers in Internet Route Domain 0

In the next configuration, multiple subscribers can connect to servers in respective Internet route domains. The BIG-IP system allocates available port blocks from the respective Internet route domain to the corresponding subscriber. Allocated port blocks can differ only by route domain, and use identical address and port ranges; consequently, for this configuration, a service provider must provide a means to distinguish the connections of different route domains, as necessary.

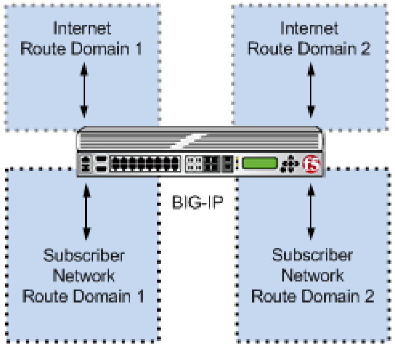


Figure 6: Multiple subscriber networks connecting to Internet servers in separate Internet route domains

PBA log examples

Following are some examples of the elements that comprise a typical Port Block Allocation (PBA) mode log entry.

PBA log messages include several elements of interest. The following examples show typical log messages, and the table describes common information types.

NAT44 HSL example

```
Jul 23 09:33:42 www.siterequest.com "LSN_PB_ALLOCATED""10.10.10.1""5.5.5.9:
5555-6666"
Jul 23 09:33:42 www.siterequest.com "LSN_PB_RELEASED""10.10.10.1""5.5.5.9:
5555-6666"
```

NAT44 HSL with route domains example

```
Jul 23 09:33:42 www.siterequest.com
"LSN_PB_ALLOCATED""10.10.10.1%55""5.5.5.9%22: 5555-6666"
```

```
Jul 23 09:33:42 www.siterequest.com "LSN_PB_RELEASED""10.10.10.1%55""5.5.5.9%22:
 5555-6666"
```

DS-Lite HSL example

```
Jul 23 10:46:31 www.siterequest.com "LSN_PB_ALLOCATED""2701:
:200""5.5.5.9:5555-6666"
Jul 23 10:46:31 www.siterequest.com "LSN_PB_RELEASED""2701:
:200""5.5.5.9:5555-6666"
```

DS-Lite HSL with route domains example

```
Jul 23 09:36:33 www.siterequest.com "LSN_PB_ALLOCATED""2701:
:200%11""5.5.5.9%22:5555-6666"
Jul 23 09:36:33 www.siterequest.com "LSN_PB_RELEASED""2701:
:200%11""5.5.5.9%22:5555-6666"
```

NAT64 HSL example

```
Jul 23 09:36:33 www.siterequest.com "LSN_PB_ALLOCATED""2701:
:200""5.5.5.9:5555-6666"
Jul 23 09:36:33 www.siterequest.com "LSN_PB_RELEASED""2701:
:200"5.5.5.9:5555-6666"
```

NAT64 HSL with route domains example

```
Jul 23 09:36:33 www.siterequest.com "LSN_PB_ALLOCATED""2701:
:200%33""5.5.5.9%22:5555-6666"
Jul 23 09:36:33 www.siterequest.com "LSN_PB_RELEASED""2701:
:200%33""5.5.5.9%22:5555-6666"
```

NAT44 Splunk example

```
Jul 23 10:56:13 www.siterequest.com
lsn_event="LSN_PB_ALLOCATED",lsn_client="10.10.10.1",lsn_pb="5.5.5.9: 5555-6666"
Jul 23 10:56:13 www.siterequest.com
lsn_event="LSN_PB_RELEASED",lsn_client="10.10.10.1",lsn_pb="5.5.5.9: 5555-6666"
```

NAT44 Splunk with route domains example

```
Jul 23 10:56:13 www.siterequest.com
lsn_event="LSN_PB_ALLOCATED",lsn_client="10.10.10.1%55",lsn_pb="5.5.5.9%22:
5555-6666"
Jul 23 10:56:13 www.siterequest.com
lsn_event="LSN_PB_RELEASED",lsn_client="10.10.10.1%55",lsn_pb="5.5.5.9%22:
5555-6666"
```

DS-Lite Splunk example

```
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_ALLOCATED",lsn_dslite_client="2701:
```

```
:200",lsn_pb="5.5.5.9:5555-6666"
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_RELEASED",lsn_dslite_client="2701:
:200",lsn_pb="5.5.5.9:5555-6666"
```

DS-Lite Splunk with route domains example

```
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_ALLOCATED",lsn_dslite_client="2701:
:200%11",lsn_pb="5.5.5.9%22:5555-6666"
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_RELEASED",lsn_dslite_client="2701:
:200%11",lsn_pb="5.5.5.9%22:5555-6666"
```

NAT64 Splunk example

```
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_ALLOCATED",lsn_client="2701: :200",lsn_pb="5.5.5.9:5555-6666"
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_RELEASED",lsn_client="2701: :200",lsn_pb="5.5.5.9:5555-6666"
```

NAT64 Splunk with route domains example

```
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_ALLOCATED",lsn_client="2701:
:200%33",lsn_pb="5.5.5.9%22:5555-6666"
Jul 23 10:57:08 www.siterequest.com
lsn_event="LSN_PB_RELEASED",lsn_client="2701:
:200%33",lsn_pb="5.5.5.9%22:5555-6666"
```

Information Type	Example Value	Description
Timestamp	`Jul 23 10:57:08`	Specifies the time and date that the system logged the event message.
Domain name	`www.siterequest.com`	Specifies the domain name of the client.
LSN event	`lsn_event="LSN_PB_ALLOCATED"`; `lsn_event="LSN_PB_RELEASED"`	Specifies the allocation or release of the port block.
Client address	`10.10.10.1`;`10.10.10.1%55`;`2701: :200`; `2701: :200%33`; `lsn_client="10.10.10.1"`; `lsn_client="10.10.10.1%55"`; `lsn_dslite_client="2701: :200"`; `lsn_dslite_client="2701: :200%11"`	Specifies the address of the client.
Port block address	`5.5.5.9`; `5.5.5.9%22`	Specifies the address of the port block.
Port range start	`5555`	Specifies the start of the port range.
Port range end	`6666`	Specifies the end of the port range.

Creating a PBA LSN pool

- The CGNAT module must be provisioned before LSN pools can be configured.
- Before associating a LSN pool with a log publisher, ensure that at least one log publisher exists on the BIG-IP® system.

You configure *Large Scale NAT* (LSN) pools for the CGNAT module to use in allowing efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the **Description** field, type a description.
5. For the **Mode** setting, select **PBA** for the pool's translation.

   Note that PBA mode for DS-lite is same as for NAT44, except that all clients behind the DS-Lite tunnel are managed as one subscriber. Port block limits are in accordance with each DS-lite tunnel.
6. For the **Port Block Allocation** setting, specify your preferred PBA configuration.
   a) In the **Block Size** field, type the number of ports designated for a block.
   b) In the **Block Lifetime** field, type the number of seconds before a port block times out.

   Note: *If you type a timeout other than `0`, you can also specify a **Zombie Timeout**. A **Block Lifetime** value that is less than the **Persistence Timeout** value minimizes the number of zombie port blocks. The default value of `0` specifies no lifetime limit and indefinite use of the port block.*

   c) In the **Block Idle Timeout** field, enter the timeout (in seconds) for after the port block becomes idle.

   Note: *Typically, you want to use a **Block Idle Timeout** value less than the **Persistence Timeout** value, to minimize the number of zombie port blocks.*

   d) In the **Client Block Limit** field, type the number of blocks that can be assigned to a single subscriber IP address.
   e) In the **Zombie Timeout** field, type the number of seconds before port block times out.

   A *zombie port block* is a timed out port block with one or more active connections. The default value of `0` specifies no timeout and an indefinite zombie state for the port block, as long as connections remain active. A value other than `0` specifies a timeout expiration, upon which existing connections are terminated, and the port block is released and returned to the pool.
7. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.
8. Click **Finished**.

Your PBA LSN pool is now ready, and you can continue to configure your CGNAT.

Creating a VLAN for NAT

VLANs represent a logical collection of hosts that can share network resources, regardless of their physical location on the network. You create a VLAN to associate physical interfaces with that VLAN.

1. On the Main tab, click **Network** > **VLANs**.

The VLAN List screen opens.

2. Click **Create**.
   The New VLAN screen opens.
3. In the **Name** field, type a unique name for the VLAN.
4. In the **Tag** field, type a numeric tag, from 1-4094, for the VLAN, or leave the field blank if you want the BIG-IP system to automatically assign a VLAN tag.

   The VLAN tag identifies the traffic from hosts in the associated VLAN.
5. For the **Interfaces** setting:
   a) From the **Interface** list, select an interface number.
   b) From the **Tagging** list, select **Tagged** or **Untagged**.

      Select **Tagged** when you want traffic for that interface to be tagged with a VLAN ID.
   c) If you specified a numeric value for the **Customer Tag** setting and from the **Tagging** list you selected **Tagged**, then from the **Tag Mode** list, select a value.
   d) Click **Add**.
   e) Repeat these steps for each interface that you want to assign to the VLAN.
6. From the **Configuration** list, select **Advanced**.
7. If you want the system to verify that the return route to an initial packet is the same VLAN from which the packet originated, select the **Source Check** check box.
8. In the **MTU** field, retain the default number of bytes (**1500**).
9. If you want to base redundant-system failover on VLAN-related events, select the **Fail-safe** check box.
10. From the **Auto Last Hop** list, select a value.
11. From the **CMP Hash** list, select **Source** if this VLAN is the subscriber side or **Destination Address** if this VLAN is the Internet side.
12. To enable the **DAG Round Robin** setting, select the check box.
13. Click **Finished**.
    The screen refreshes, and displays the new VLAN in the list.

You now have one of two VLANs for your deterministic or PBA NAT. Repeat these steps to create a second VLAN to act as the destination if the first VLAN is the source or vice versa.

Creating a virtual server for an LSN pool

Virtual servers are matched based on source (client) addresses. Define a virtual server that references the CGNAT profile and the LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Performance (Layer 4)**.
5. For a network, in the **Destination Address** field, type an IPv4 or IPv6 address in CIDR format to allow all traffic to be translated.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `0.0.0.0/0`, and an IPv6 address/prefix is `::/0`.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.

7. From the **VLAN and Tunnel Traffic** list, select **Enabled on**. Then, for the **VLANs and Tunnels** setting, move the VLAN or VLANs on which you want to allow the virtual servers to share traffic from the **Available** list to the **Selected** list.
8. For the **LSN Pool** setting, select the pool that this server will draw on for translation addresses.
9. In the Resources area of the screen, for the **iRules** setting, select the name of the iRule that you want to assign and using the Move button, move the name from the **Available** list to the **Enabled** list.
10. Click **Finished**.

The custom CGNAT virtual server now appears in the CGNAT Virtual Servers list.

Overview: Deterministic address translation mode

Deterministic address translation mode provides address translation that eliminates logging of every address mapping, while still allowing internal client address tracking using only an external address and port, and a destination address and port. Reverse mapping allows BIG-IP® CGNAT operators to respond to legal requests revealing the identity of the originator of a specific communication. A typical example is revealing the identity of file sharers or P2P network users accused of copyright theft.

Deterministic mode allows unique identification of internal client address based on:

- External address and port (the address and port visible to the destination server)
- Destination address and port (the service accessed by the client)
- Time

Restrictions

Deterministic mode has these configuration restrictions:

- Only NAT44 can use deterministic mode.
- The subscriber (client-side) and Internet (server-side) interfaces (VLANs) must be set either as a source or destination address in the **CMP Hash** setting.
- The complete set of all internal client addresses that will ever communicate through the CGNAT must be entered at configuration time.

  Note: *This means that all virtual servers referring to an LSN pool through deterministic NAT mode must specify the source attribute with a value other than 0.0.0.0/0 or ::/0 (any/0, any6/0).*

- Use only the most specific address prefixes covering all customer addresses.
- Members of two or more deterministic LSN pools must not overlap; in other words, every external address used for deterministic mapping must occur in only one LSN pool.
- Deterministic mode does not support IPFIX.

Simplified logging

As an alternative to per-connection logging, deterministic mode maps internal addresses to external addresses algorithmically to calculate the mapping without relying on per-connection logging. Deterministic mode significantly reduces the logging burden while mapping a subscriber's inside IP address with an outside Internet address and port.

To decipher mapping generated by LSN pools using deterministic mode, you must use the DNAT utility that can be run from the system's `tmsh` command prompt.

Task summary

Creating a deterministic LSN pool
Creating a VLAN for NAT
Creating a virtual server for an LSN pool

Creating a deterministic LSN pool

The CGNAT module must be provisioned before you can configure LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. For the **Mode** setting, select **Deterministic** for the pool's translation.

   Note that deterministic mode does not support *DS-lite* tunneling or *NAT64*.
5. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.

   If your pool uses deterministic mode, ensure that any address ranges you enter as a member do not overlap another member's prefix address ranges. For example, the address and prefix `10.10.10.0/24` overlaps `10.10.10.0/23`.
6. For deterministic mode, the **Backup Member List** must have at least one member, so type an address in the **Address/Prefix Length** field and click **Add**.
7. Click **Finished**.

Your deterministic LSN pool is now ready, and you can continue to configure your CGNAT.

Creating a VLAN for NAT

VLANs represent a logical collection of hosts that can share network resources, regardless of their physical location on the network. You create a VLAN to associate physical interfaces with that VLAN.

1. On the Main tab, click **Network** > **VLANs**.
   The VLAN List screen opens.
2. Click **Create**.
   The New VLAN screen opens.
3. In the **Name** field, type a unique name for the VLAN.
4. In the **Tag** field, type a numeric tag, from 1-4094, for the VLAN, or leave the field blank if you want the BIG-IP system to automatically assign a VLAN tag.

   The VLAN tag identifies the traffic from hosts in the associated VLAN.
5. For the **Interfaces** setting:
   a) From the **Interface** list, select an interface number.
   b) From the **Tagging** list, select **Tagged** or **Untagged**.

      Select **Tagged** when you want traffic for that interface to be tagged with a VLAN ID.

c) If you specified a numeric value for the **Customer Tag** setting and from the **Tagging** list you selected **Tagged**, then from the **Tag Mode** list, select a value.
d) Click **Add**.
e) Repeat these steps for each interface that you want to assign to the VLAN.

6. From the **Configuration** list, select **Advanced**.
7. If you want the system to verify that the return route to an initial packet is the same VLAN from which the packet originated, select the **Source Check** check box.
8. In the **MTU** field, retain the default number of bytes (**1500**).
9. If you want to base redundant-system failover on VLAN-related events, select the **Fail-safe** check box.
10. From the **Auto Last Hop** list, select a value.
11. From the **CMP Hash** list, select **Source** if this VLAN is the subscriber side or **Destination Address** if this VLAN is the Internet side.
12. To enable the **DAG Round Robin** setting, select the check box.
13. Click **Finished**.
    The screen refreshes, and displays the new VLAN in the list.

You now have one of two VLANs for your deterministic or PBA NAT. Repeat these steps to create a second VLAN to act as the destination if the first VLAN is the source or vice versa.

Creating a virtual server for an LSN pool

Virtual servers are matched based on source (client) addresses. Define a virtual server that references the CGNAT profile and the LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Performance (Layer 4)**.
5. For a network, in the **Destination Address** field, type an IPv4 or IPv6 address in CIDR format to allow all traffic to be translated.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `0.0.0.0/0`, and an IPv6 address/prefix is `::/0`.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.
7. From the **VLAN and Tunnel Traffic** list, select **Enabled on**. Then, for the **VLANs and Tunnels** setting, move the VLAN or VLANs on which you want to allow the virtual servers to share traffic from the **Available** list to the **Selected** list.
8. For the **LSN Pool** setting, select the pool that this server will draw on for translation addresses.
9. In the Resources area of the screen, for the **iRules** setting, select the name of the iRule that you want to assign and using the Move button, move the name from the **Available** list to the **Enabled** list.
10. Click **Finished**.

The custom CGNAT virtual server now appears in the CGNAT Virtual Servers list.

Overview: The DNAT utility

BIG-IP® deterministic NAT (DNAT) mode allows conservation of log storage for service providers by mapping subscribers to public translation addresses and ports algorithmically so that very little data needs to be stored in logs. The DNAT utility (`dnatutil`) is necessary for identifying subscribers through calculation of reverse source address and port mapping of deterministic-mode LSN pools, by using the states stored in the log files.

It can interpret logs from version 11.4.0 and later, correctly reverse mapping subscribers or forward mapping possible end-points of the subscriber. DNAT, as of version 11.5 of the BIG-IP system, supports multiple log destinations including, LTM®, Remote Syslog, and Splunk. The DNAT utility can parse logs from any supported DNAT log destination.

The DNAT utility binary can be run either on the BIG-IP system or on any supported Linux host. The DNAT utility package currently supports CentOS 64 and Ubuntu 64 for deployment on Linux systems to support reverse mappings on archived logs. The package is available from the F5® Downloads site (`http://support.f5.com/kb/en-us.html`).

Task summary

Downloading the DNAT utility external tool
Using the DNAT utility external tool for reverse mappings
Using DNAT utility to look up deterministic NAT mappings on the BIG-IP system

DNAT utility example commands

This list provides examples of the syntax used in commands for `dnatutil`.

Command	Response
`dnatutil 10.0.0.1 --action forward`	Shows a list of translation address/port pairs that might be used for a subscriber at 10.0.0.1, using the DNAT states contained in /var/log/ltm.
`dnatutil 173.240.102.139:5678`	Performs a reverse mapping back to the subscriber address for the connection from 173.240.102.139:5678, using the DNAT states contained in /var/log/ltm.
`dnatutil --start_time ’2012-09-27 06:30:00’ --end_time ’2012-09-27 12:10:00’ 173.240.102.139:5678`	Performs a reverse mapping back to the subscriber address for the connection from 173.240.102.139:5678, but only shows the subscriber addresses that used the translation within the specified time range.
`dnatutil --start_time ’2012-09-27 06:30:00’ --end_time ’2012-09-27 12:10:00’ --file ltmlog-21102013 173.240.102.139:5678`	Performs a reverse mapping back to the subscriber address for the connection from 173.240.102.139:5678, showing the subscriber addresses that used the translation within the specified time range, and using the DNAT states contained in /var/log/test.
`dnatutil --file /var/log/test`	Shows summary information, using the DNAT states contained in /var/log/test.

Command	Response
`dnatutil --action summary --start_time '2012-09-27 06:30:00' --end_time '2012-09-27 12:10:00'`	Shows summary information, using the DNAT states within the specified time range.
`dnatutil --action reverse_addr 1.2.3.4`	Shows a list of possible subscriber addresses for the provided client address.
`dnatutil --help | grep DAG_ID`	Provides version information for the utility.

Downloading the DNAT utility external tool

The deterministic NAT (DNAT) reverse mapping tool can run independently from the BIG-IP® system. Follow these steps to download the `dnatutil` RPM or Debian file from the F5® Downloads site.

1. Access the F5 Downloads site at `http://downloads.f5.com`.
2. From the Downloads Overview page, click **Find a Download**.
   The Select a Product Line page displays.
3. Under **Product Line**, click the BIG-IP software branch **BIG-IP v11.x**.
4. Select **BIG-IP version 11.5** from the drop-down menu.

   The system selects the most recent version of software, by default.
5. From the Name column, select **dnatutil**.
   A Software Terms and Conditions page appears.
6. Read the End User Software License Agreement (EULA) and either accept the license by clicking **I Accept**, or cancel the process by clicking **Cancel**.

   If you accept the EULA, the Select a Download page appears with a table detailing the file name, product description, and size of the file. You should see three files:

   - dnatutil.rpm
   - dnatutil.deb
   - readme.txt
7. Select the file you would like to download.

Now that you have downloaded the DNAT utility RPM/Debian package, you can now use `dnatutil` for forward and reverse mappings.

Using the DNAT utility external tool for reverse mappings

To discover the subscriber address, you need to have at least the NAT/public address you would like to translate. It is preferable to have the date, time, and NAT/public address, port, and the archived logs with the state information you wish to use.

Deterministic NATs (DNATs) can reduce total log file size but require use of the DNAT utility (`dnatutil`) to decipher the mapping. With `dnatutil`, you can calculate forward end-points and reverse client address and port mapping of an LSN pool using deterministic mode based on the state stored in the specified log file.

1. Download the BIG-IP® version 11.x RPM or Debian file from the F5® Downloads web site (`https://downloads.f5.com`) to a preferred location.
2. Using the command line, type `install -Uvh <rpm>` to install the RPM file.

3. Type `dnatutil` with the date, time, NAT/public address, and port that you want to translate.

   ```
   dnatutil --file /var/log/messages  --start_time "2013-10-02 15:21:12"
   --end_time "2013-10-02 15:22:42" 1.1.1.1:1234
   ```

4. Press enter.

   If the BIG-IP platform is located in a different time zone than the receiving log server, messages might not be correctly interpreted. `TZ` is an environmental variable that specifies the timezone. If not specified, the local timezone is used.

   ```
   # dnatutil  --file ltm 1.1.7.1:1025
   From (1365014711): 2013-04-03 18:45:11 GMT
   Reverse mapping for ::,80 -> 1.1.7.1,1025
   Using cmp-hash 'dst-ip' and TMM 1:10.10.10.11
   ```

   The log entry will show the source prefix, destination prefix (public address), and the subscriber IP address for the time range.

You now have the basic details for deciphering deterministic log files using the DNAT utility.

Using DNAT utility to look up deterministic NAT mappings on the BIG-IP system

You should have a knowledge of navigating in `tmsh` before using the DNAT utility (`dnatutil`). For detailed information about navigating in `tmsh`, see the *Traffic Management Shell (tmsh) Reference Guide*.

Deterministic NATs can reduce total log file size but require use of the `dnatutil` (available in `tmsh`) to decipher the mapping. With the `dnatutil`, you can calculate forward and reverse source address and port mapping of an LSN pool using deterministic mode based on the state stored in the specified TMM log file.

1. Use an SSH tool to access the BIG-IP® system from the command line.
2. At the command line, type: `tmsh`.
   This starts `tmsh` in interactive shell mode and displays the prompt: `(tmos)#`.
3. ***Note:** If you do not provide a file and you are on a BIG-IP system, it will default to the LTM® log.*

   To show a list of translation address/port pairs used for a subscriber at `10.0.0.1:4321` connecting to `65.61.115.222:80`, using the deterministic NAT states contained in `/var/log/ltm`, type the command: `run util dnat --file /var/log/ltm --client_addr 10.0.0.1 --client_port 4321 --server_addr 65.61.115.222 --action forward`

   Replace these example addresses with your actual client and server.

   This displays a list of the address/port pairs.
4. To calculate a reverse mapping back to the subscriber address for the connection between 173.240.102.139:5678 and 65.61.115.222:80, using the DNAT states contained in `/var/log/ltm.1`, type the command: `run util dnat --file /var/log/ltm.1 --server_addr 65.61.115.222 --client_addr 173.240.102.139 --client_port 5678 --action reverse`
   This displays the reverse mapping.
5. For more information about the DNAT utility, type the command: `help util dnat` at the `tmsh` prompt.
   The help file for the DNAT utility is displayed.

You now have the basic details for deciphering deterministic log files using the DNAT utility in `tmsh`.

Overview: PCP client address translation

Port Control Protocol (PCP) clients can request specific NAT/CGNAT mappings for themselves and/or for third-party devices. This allows the PCP clients to set their own public-side IP addresses (also called *translation addresses*) in a network that uses CGNAT. In cases where the BIG-IP® system assigns a translation address or port other than the one requested, the client is at least aware of their assigned address or port.

You apply a PCP profile to a Large Scale NAT (LSN) pool of translation addresses. A client that uses the LSN pool can also send PCP requests to the BIG-IP system to request a particular address/port from the pool. RFC 6887 defines PCP.

Note: *The port block allocation (PBA) translation mode is not supported for PCP client address translation.*

Task summary

Creating a PCP profile
Configuring an LSN pool with a PCP profile

Creating a PCP profile

Someone must license the CGNAT module through **System** > **License**, and enable it through **System** > **Resource Provisioning** before you can create a PCP profile.

A PCP profile defines limitations for PCP-client requests.

1. On the Main tab, click **Carrier Grade NAT** > **PCP Profiles** > +.
   The New PCP Profile screen opens.
2. In the **Name** field, type a unique name.
3. You can accept the defaults in this profile, or you can select the check box next to any setting that you want to change.

   The online help describes each field.
4. Click **Finished**.

Your PCP profile is now ready to be used in one or more LSN pools.

Configuring an LSN pool with a PCP profile

An *LSN Pool* is a group of addresses and ports to be used as translation addresses by a virtual server's clients. If one of those clients sends a PCP request (for example, to map the client's private IP address to a particular translation address), the LSN pool's PCP profile determines the ranges and limits allowed for the request.

You assign a PCP profile to an LSN pool in the pool's configuration screen. You also designate the IP address and/or DS-Lite tunnel to which the virtual server's clients can send their PCP requests.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click the name of an LSN pool.
3. From the **PCP Profile** list, select a pre-created PCP profile.

   If you have not yet created a customized profile, you can use the default PCP profile **pcp**.

The other two PCP-related settings become active.

4. Type a self IP address or a DS-Lite tunnel where the virtual server's clients can send their PCP requests. You can use either field:

   - Use the **PCP Server IP** list to select one of the existing self IP addresses on the system, or
   - Use the **PCP DS-LITE Tunnel Name - IPv6** list to select an existing DS-Lite tunnel

   The virtual server's clients can send PCP requests to the self-IP address or through the DS-Lite tunnel you selected.

After you perform this task, any virtual server with this LSN pool can support PCP. The virtual server's clients can send PCP MAP requests to the address or tunnel you specified here.

No client can use this PCP configuration unless the LSN pool is assigned to at least one virtual server. Go to **Carrier Grade NAT** > **Virtual Servers** > **Virtual Server List** for a list of servers. Look for the LSN pool's name in the **LSN Pool** column. Confirm that at least one virtual server uses this LSN pool.

Using ALG Profiles

Overview: Using the FTP ALG Profile to Transfer Files

The File Transfer Protocol (FTP) application layer gateway (ALG) profile enables you to transfer files between a client and server. The FTP ALG profile supports both active and passive modes, where data connections are initiated either from an FTP server (active mode) or from a client (passive mode). You can transfer files using the FTP protocol by configuring an LSN pool, configuring an FTP profile, and then assigning the LSN pool and FTP profile to a virtual server. The FTP protocol is described in RFC 959.

Task summary

Creating an LSN pool
Creating an FTP profile
Configuring a CGNAT iRule
Creating a virtual server using an FTP ALG profile
Creating an FTP ALG logging profile
Configuring an FTP ALG profile

About the FTP profile

The *File Transfer Protocol* (*FTP*) profile enables you to transfer files between a client and server, using FTP connections over TCP. The FTP application layer gateway (ALG) supports the FTP protocol's active and passive modes, where data connections are initiated either from an FTP server (active mode) or from a client (passive mode).

You can configure the FTP profile settings, as needed, to ensure compatibility between IPv4 and IPv6 clients and servers, to enable the FTP data channel to inherit the TCP profile used by the FTP control channel, and to use a port other than the default port (`20`). Additionally, when used with Application Security Manager™ (ASM™), this profile enables the BIG-IP® system to inspect FTP traffic for security vulnerabilities by using an FTP security profile.

FTP Control Channels

Once established, the FTP control channel remains open throughout the FTP session. The FTP control channel and the FTP data channel must both originate from the same IP address.

FTP Data Channels

In *active mode*, the FTP server initiates data connections. A client informs the server as to what port the client is listening on, and the server connects to the client by using that port.

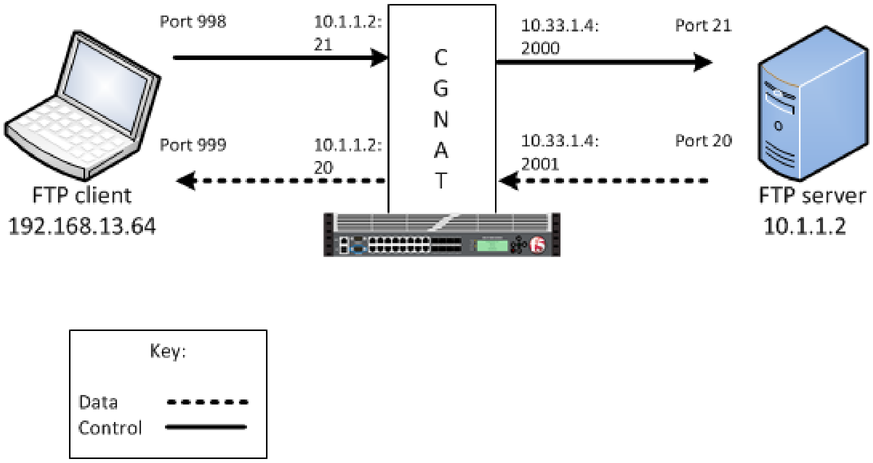


Figure 7: An example FTP active mode configuration

In this example, an LSN pool is configured with a translation IP address and prefix length of `10.33.1.0/24`. The virtual server is configured with an FTP control port using a wildcard address and a specific port: `0.0.0.0:21`. The FTP data port is configured to use port `20`. The configured translation mode uses the values of the respective port range.

Translation mode	Port range
NAPT	2000-3000
DNAT	2000-2200
PBA	2000-2150

In *passive mode*, the FTP client initiates data connections. The FTP server informs the client as to what port the server is listening on, and the client connects to the server by using that port.

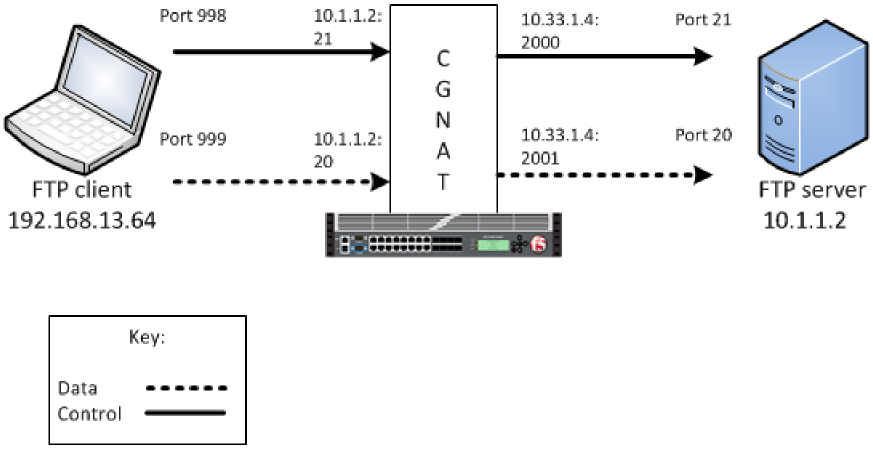


Figure 8: An example FTP passive mode configuration

In this example, an LSN pool is configured with a translation IP address and prefix length of `10.33.1.0/24`. The virtual server is configured with an FTP control port using a wildcard address and a specific port: `0.0.0.0:21`. The FTP data port is configured to use port `20`. In this example, the configured translation mode uses the values of the respective port range.

Translation mode	Port range
NAPT	2000-3000

Translation mode	Port range
DNAT	2000-2200
PBA	2000-2150

Creating an LSN pool

The CGNAT module must be enabled through the **System** > **Resource Provisioning** screen before you can create LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.

   If your pool uses deterministic mode, ensure that any address ranges you enter as a member do not overlap another member's prefix address ranges. For example, the address and prefix `10.10.10.0/24` overlaps `10.10.10.0/23`.
5. Click **Finished**.

Your LSN pool is now ready, and you can continue to configure your CGNAT.

Creating an FTP profile

You can configure a file transfer protocol (FTP) profile on the BIG-IP® system that transfers files, either in an active or passive mode, and logs related messages.

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles** > **FTP**.
   The FTP screen opens and displays a list of available FTP ALG profiles.
2. Click **Create**.
3. Type a name for the profile.
4. From the **Parent Profile** list, select a parent profile.
5. Select the **Custom** check box.
6. Select the **Translate Extended** check box to ensure compatibility between IPv4 and IPv6 clients and servers when using the FTP protocol. The default is selected.
7. Select the **Inherit Parent Profile** check box to enable the FTP data channel to inherit the TCP profile used by the control channel. The default is cleared.

   Note: *If disabled, the data channel uses FastL4 (BigProto) only.*
8. In the **Data Port** field, type a number for an alternate port. The default value for the FTP data port is `20`.
9. Click **Finished**.

An FTP profile is configured on the BIG-IP® system that transfers files, either in an active or passive mode, and logs related messages.

Configuring a CGNAT iRule

You create iRules® to automate traffic forwarding for XML content-based routing. When a match occurs, an iRule event is triggered, and the iRule directs the individual request to an LSN pool, a node, or virtual server.

1. On the Main tab, click **Carrier Grade NAT** > **iRules**.
   The iRule List screen opens.
2. Click **Create**.
3. In the **Name** field, type a 1 to 31 character name, such as `cgn_https_redirect_iRule`.
4. In the **Definition** field, type the syntax for the iRule using Tool Command Language (Tcl) syntax.

   For complete and detailed information about iRules syntax, see the F5 Networks DevCentral web site (`http://devcentral.f5.com`).
5. Click **Finished**.

You now have an iRule to use with a CGNAT virtual server.

Creating a virtual server using an FTP ALG profile

Virtual servers are matched based on source (client) addresses. Define a virtual server in order to reference an FTP profile and LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, retain the default setting **Standard.**
5. In the **Destination Address** field, type the IP address in CIDR format.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `10.0.0.1` or `10.0.0.0/24`, and an IPv6 address/prefix is `ffe1::0020/64` or `2001:ed8:77b5:2:10:10:100:42/64`. When you use an IPv4 address without specifying a prefix, the BIG-IP® system automatically uses a `/32` prefix.

   Note: *The IP address you type must be available and not in the loopback network.*
6. In the **Service Port** field, type `21` or select **FTP** from the list.
7. From the **Protocol** list, select **TCP**.
8. From the **Protocol Profile (Client)** list, select a predefined or user-defined TCP profile.
9. From the **Protocol Profile (Server)** list, select a predefined or user-defined TCP profile.
10. From the **FTP Profile** list, select an FTP ALG profile for the virtual server to use.
11. For the **LSN Pool** setting, select the pool that this server will draw on for addresses.
12. Locate the Resources area of the screen; for the **Related iRules** setting, from the **Available** list, select the name of the iRule that you want to assign and move the name to the **Enabled** list.

This setting applies to virtual servers that reference a profile for a data channel protocol, such as FTP or RTSP.

13. Click **Finished**.

The custom CGNAT virtual server appears in the CGNAT Virtual Servers list.

Creating an FTP ALG logging profile

You can create an ALG logging profile, and associate it with one or more FTP ALG profiles, to allow you to configure logging options for various events that apply to high-speed logging (HSL) destinations. A logging profile decreases the need to maintain a number of customized profiles where the events are very similar.

1. On the Main tab, click **Carrier Grade NAT** > **Logging Profiles** > **ALG**.
   The ALG logging profiles screen opens.
2. Click **Create**.
   The New ALG Logging Profile screen opens.
3. In the **Name** field, type a unique name for the logging profile.
4. From the **Parent Profile** list, select a profile from which the new profile inherits properties.
5. Select the **Custom** check box for the Log Settings area.
6. For the Log Settings area, select **Enabled** for the following settings, as necessary.

Setting	Description
Start Control Channel	Generates event log entries at the start of a control channel connection for an ALG client.
End Control Channel	Generates event log entries at the end of a control channel connection for an ALG client.
Start Data Channel	Generates event log entries at the start of a data channel connection for an ALG client.
End Data Channel	Generates event log entries at the end of a data channel connection for an ALG client.
Inbound Transaction	Generates event log entries at the start of an inbound connection to the BIG-IP® system.

7. Click **Finished**.

Configuring an FTP ALG profile

You can associate an FTP ALG profile with a log publisher and logging profile that the BIG-IP® system uses to send log messages to a specified destination.

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles** > **FTP**.
   The FTP screen opens and displays a list of available FTP ALG profiles.
2. Click the name of an FTP profile.
3. From the **Log Publisher** list, select the log publisher that the BIG-IP system uses to send log messages to a specified destination.

__Important:__ If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the `logpublisher.atomic` *db key to* `false`*. If all the remote high-speed log (HSL) destinations are down (unavailable), setting the* `logpublisher.atomic` *db key to* `false` *will not work to allow the logs to be written to local-syslog. The* `logpublisher.atomic` *db key has no effect on local-syslog.*

4. From the **Logging Profile** list, select the logging profile the BIG-IP system uses to configure logging options for various ALG events.

   __Note:__ If you configure a Logging Profile, you must also configure a Log Publisher.

5. Click **Finished**.

Overview: Using the SIP ALG Profile for Multimedia Sessions

The Session Initiation Protocol (SIP) application layer gateway (ALG) profile enables you to manage peer-to-peer connections through a CGNAT, permitting a client on an external network to initiate and establish a multimedia session with a user on an internal network. You can enable SIP multimedia sessions by configuring an LSN pool, configuring a SIP profile, and then assigning the LSN pool and SIP profile to a virtual server. The SIP protocol is described in RFC 3261.

Task summary

Creating an LSN pool
Creating a SIP profile
Creating a virtual server using a SIP ALG profile
Creating an empty LSN pool
Creating a virtual server using a SIP ALG profile and empty LSN pool
Creating an SIP ALG logging profile
Configuring an SIP ALG profile

About the SIP ALG profile

The *Session Initiation Protocol* (*SIP*) profile establishes connections over TCP, UDP, and SCTP through a CGNAT. It creates the connections by establishing flows for multimedia traffic, and by translating IP addresses included in SIP messages into external IP addresses. As a result, these can be reached by means of a public network. Once a call is established, the SIP ALG creates flows for multimedia traffic (as determined by the advertised address and port combinations on either side of a call), and tears down the flow when the call ends.

You can configure the SIP profile settings, as needed, to provide the following functionality.

- A maximum message size
- Closed connection when a BYE transaction completes
- Use of SIP dialog information
- High-speed logging (HSL) security checking
- Association of a SIP virtual server-profile pairing with a SIP proxy functional group

- Via headers
- Record-Route headers
- Real-Time Transport (RTP) proxy style for media relaying
- Timing for dialog establishment or SIP session tunnel
- Definition of maximum media sessions, sessions per registration, or registrations

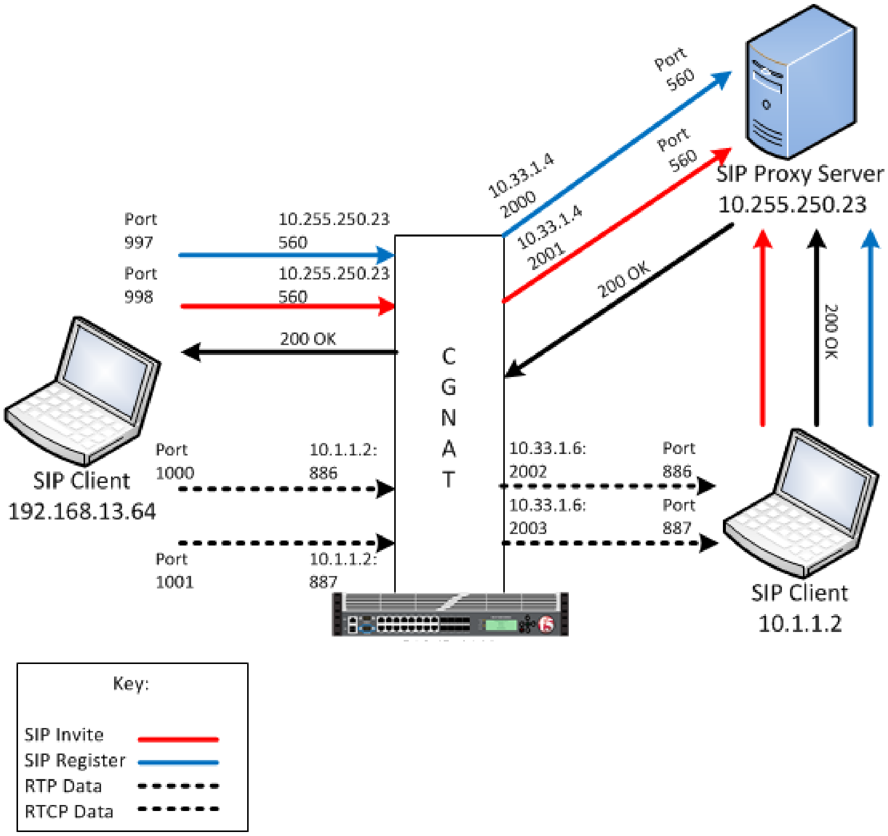


Figure 9: An example SIP ALG configuration

In this example, an LSN pool is configured with a translation IP address and prefix length of `10.33.1.0/24`. The virtual server is configured with a register and invite port that use a wildcard destination address and a specific port: `0.0.0.0:560`. The SIP RTP data port is configured to use port `886` and the RTCP data port is configured to use port `887`. The configured translation mode uses the values of the respective port range.

Translation mode	Port range
NAPT	2000-3000
DNAT	2000-2200
PBA	2000-2150

Creating an LSN pool

The CGNAT module must be enabled through the **System** > **Resource Provisioning** screen before you can create LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.

   If your pool uses deterministic mode, ensure that any address ranges you enter as a member do not overlap another member's prefix address ranges. For example, the address and prefix `10.10.10.0/24` overlaps `10.10.10.0/23`.
5. Click **Finished**.

Your LSN pool is now ready, and you can continue to configure your CGNAT.

Creating a SIP profile

You can configure a session initiation protocol (SIP) profile on the BIG-IP® system that manages peer-to-peer connections through a CGNAT.

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles** > **SIP**.
   The SIP screen opens and displays a list of available SIP ALG profiles.
2. Click **Create**.
3. Type a name for the profile.
4. From the **Parent Profile** list, select a parent profile.
5. Select the **Custom** check box.
6. In the **Maximum Size (Bytes)** field, type a number to specify the maximum size, in bytes, for a SIP message. The default is `65535` bytes.
7. Clear the **Terminate on BYE** check box.

   Important: *You must clear the* ***Terminate on BYE*** *check box for a TCP or UDP connection when the BIG-IP system functions as a SIP proxy, configuring the inbound SNAT and consolidating multiple calls into one server-side connection. You should select the* ***Terminate on BYE*** *check box to improve performance only for a UDP connection if each client call comes from a unique IP address and no inbound SNATs are configured.*
8. Select the **Dialog Aware** check box to gather SIP dialog information, and automatically forward SIP messages belonging to the known SIP dialog. The default is cleared.
9. Select the **Security** check box to enable the use of enhanced HSL security checking. The default is cleared.
10. With the **Dialog Aware** check box selected, in the **Community** field, type a string to indicate whether the SIP virtual server-profile pair belongs to the same SIP proxy functional group.
11. Configure the **Insert Via Header** settings.
    a) From the **Insert Via Header** list, select **Enabled** to insert a Via header in the forwarded SIP request. The default is **Disabled**.
    b) With the **Insert Via Header** setting enabled, in the **User Via** field type a value that the system inserts as the top Via header in a SIP `REQUEST` message.
12. Select the **Secure Via Header** check box to insert a secure Via header in the forwarded SIP request. The default is cleared.

13. Select the **Insert Record-Route Header** check box to insert a Record-Route SIP header, which indicates the next hop for the following SIP request messages. The default is cleared.
14. Configure the **Application Level Gateway** settings.
    a) From the **Application Level Gateway** list, select **Enabled** to provide options for defining ALG settings. The default is **Disabled**.
    b) From the **RTP Proxy Style** list, select **Symmetric**.
    c) In the **Dialog Establishment Timeout** field, type an interval, in seconds, during which the system attempts to establish a peer-to-peer SIP relationship between two user agents, which facilitates sequencing of messages and proper routing of requests between two user agents. The default is `10`.
    d) In the **Registration Timeout** field, type a time, in seconds, that elapses before the SIP registration process expires. The default is `3600`.

    Note: *When configuring a SIP profile for use with Port Block Allocation (PBA), the* ***Registration Timeout*** *value must be less than the PBA* ***Block Lifetime*** *value.*

    e) In the **SIP Session Timeout** field, type an idle time, in seconds, after which the SIP session times out. The default is `300`.
    f) In the **Maximum Media Sessions** field, type a maximum number of allowable sessions. The default is `6`.
    g) In the **Maximum Sessions Per Registration** field, type a maximum number of allowable sessions per registration. The default is `50`.
    h) In the **Maximum Registrations** field, type a maximum number of allowable registrations. The default is `100`.
15. Select the **SIP Firewall** check box to indicate that SIP firewall capability is enabled. The default is cleared.
16. Click **Finished**.

A SIP profile is configured on the BIG-IP® system that manages peer-to-peer connections through a CGNAT.

Creating a virtual server using a SIP ALG profile

Virtual servers are matched based on source (client) addresses. Here are the steps to define a virtual server that references a SIP profile and LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, retain the default setting **Standard.**
5. For a network, in the **Destination Address** field, type an IPv4 or IPv6 address in CIDR format to allow all traffic to be translated.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `0.0.0.0/0`, and an IPv6 address/prefix is `::/0`.
6. In the **Service Port** field, type `5060`.
7. From the **Configuration** list, select **Advanced**.
8. From the **Protocol** list, select one of the following:
   - **UDP**

- **TCP**
- *** All Protocols**

9. From the **Protocol Profile (Client)** list, select a predefined or user-defined profile.
10. From the **Protocol Profile (Server)** list, select a predefined or user-defined profile.
11. From the **SIP Profile** list, select a SIP ALG profile for the virtual server to use.
12. For the **LSN Pool** setting, select the LSN pool that this server uses for addresses.
13. From the **Source Port** list, select **Change**.
14. Click **Finished**.

The custom CGNAT virtual server appears in the CGNAT Virtual Servers list.

Creating an empty LSN pool

The CGNAT module must be enabled through the **System** > **Resource Provisioning** screen before you can create LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. From **Persistence Mode**, select to persist on **Address Port**.

   This is the address mode the CGNAT module uses to track and store connection data.
5. From the **Log Publisher** list, select the log publisher the BIG-IP system uses to send log messages to a specified destination.

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the `logpublisher.atomic` db variable to `false`.*
6. Click **Finished**.

Your empty LSN pool is now ready.

Creating a virtual server using a SIP ALG profile and empty LSN pool

Virtual servers are matched based on source (client) addresses. Here are the steps to define a virtual server that references a SIP profile and LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.

4. From the **Type** list, retain the default setting **Standard.**
5. In the **Source** field, type `0.0.0.0/0`.
6. For a host, in the **Destination Address** field, type an IPv4 or IPv6 address in CIDR format to allow all traffic to be translated.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `0.0.0.0/0`, and an IPv6 address/prefix is `::/0`.
7. In the **Service Port** field, type the port number `5060` for the service.
8. From the **Configuration** list, select **Advanced**.
9. From the **Protocol** list, select one of the following:
   - **UDP**
   - **TCP**
   - *** All Protocols**
10. From the **Protocol Profile (Client)** list, select a predefined or user-defined profile.
11. From the **Protocol Profile (Server)** list, select a predefined or user-defined profile.
12. From the **SIP Profile** list, select the same SIP ALG profile for this virtual server to use as the other virtual server.
13. For the **LSN Pool** setting, select the empty pool that this server will use for addresses.
14. Click **Finished**.

The custom CGNAT virtual server appears in the CGNAT Virtual Servers list.

Creating an SIP ALG logging profile

You can create an ALG logging profile, and associate it with one or more SIP ALG profiles, to allow you to configure logging options for various events that apply to high-speed logging (HSL) destinations. A logging profile decreases the need to maintain a number of customized profiles where the events are very similar.

1. On the Main tab, click **Carrier Grade NAT** > **Logging Profiles** > **ALG**.
   The ALG logging profiles screen opens.
2. On the Main tab, click **Local Traffic** > **Profiles** > **Other** > **ALG Logging**.
   The ALG Logging screen opens.
3. Click **Create**.
   The New ALG Logging Profile screen opens.
4. In the **Name** field, type a unique name for the logging profile.
5. From the **Parent Profile** list, select a profile from which the new profile inherits properties.
6. Select the **Custom** check box for the Log Settings area.
7. For the Log Settings area, select **Enabled** for the following settings, as necessary.

Setting	Description
Start Control Channel	Generates event log entries at the start of a control channel connection for an ALG client.
End Control Channel	Generates event log entries at the end of a control channel connection for an ALG client.
Start Data Channel	Generates event log entries at the start of a data channel connection for an ALG client.

Setting	Description
End Data Channel	Generates event log entries at the end of a data channel connection for an ALG client.
Inbound Transaction	Generates event log entries at the start of an inbound connection to the BIG-IP® system.

8. Click **Finished**.

Configuring an SIP ALG profile

You can associate an SIP ALG profile with a log publisher and logging profile that the BIG-IP® system uses to send log messages to a specified destination.

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles** > **SIP**.
   The SIP screen opens and displays a list of available SIP ALG profiles.
2. Click the name of an SIP profile.
3. From the **Log Publisher** list, select the log publisher that the BIG-IP system uses to send log messages to a specified destination.

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the `logpublisher.atomic` db key to `false`. If all the remote high-speed log (HSL) destinations are down (unavailable), setting the `logpublisher.atomic` db key to `false` will not work to allow the logs to be written to local-syslog. The `logpublisher.atomic` db key has no effect on local-syslog.*

4. From the **Logging Profile** list, select the logging profile the BIG-IP system uses to configure logging options for various ALG events.

   Note: *If you configure a Logging Profile, you must also configure a Log Publisher.*

5. Click **Finished**.

Overview: Using the RTSP ALG Profile to Stream Media

The Real Time Streaming Protocol (RTSP) application layer gateway (ALG) profile enables you to establish streaming multimedia sessions between a client and a server. You can stream multimedia sessions by configuring an LSN pool, configuring an RTSP profile, and then assigning the LSN pool and RTSP profile to a virtual server. The RTSP protocol is described in RFC 2326.

Task summary

Creating an RTSP ALG logging profile
Configuring an RTSP ALG profile

About the RTSP ALG profile

The *Real Time Streaming Protocol* (RTSP) profile enables you to stream multimedia content between a client and server, using RTSP connections over TCP. The RTSP application layer group (ALG) supports the RTSP protocol's control channel to an RTSP server, through which the client requests a file for the server to stream (and controls the streaming of that file with commands like play or pause). The client can request streaming over UDP and provide two listening ports for the server response. The RTSP server responds with a Real-Time Transport Protocol (RTP) data channel port, to stream the requested file, and a Real-Time Control Protocol (RTCP) control channel port, which provides a stream description and status.

Note: *You can specify RTP and RTCP port numbers in the RTSP profile, which only apply when a client connects to a Windows Media server. If you configure RTP and RTCP port numbers, both values must be nonzero.*

You can configure the RTSP profile settings, as needed.

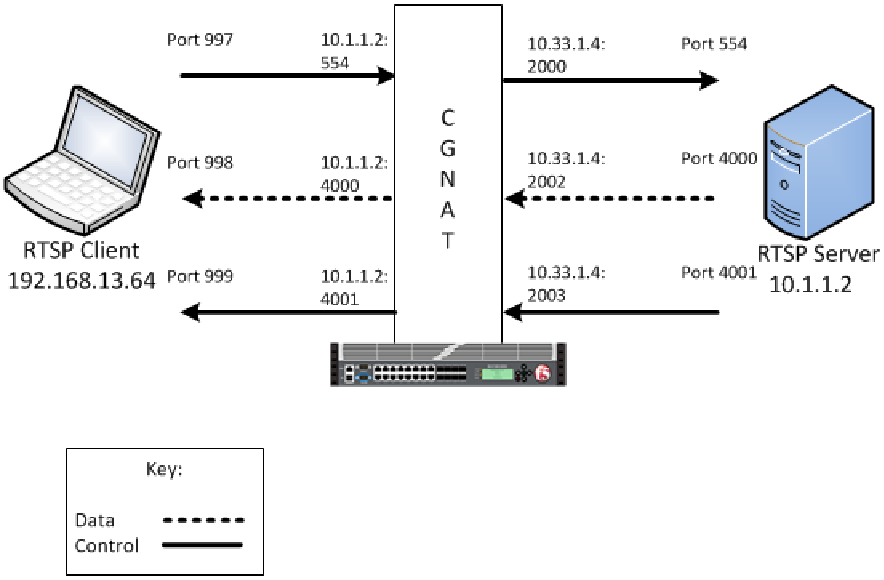


Figure 10: An example RTSP ALG configuration

In this example, an LSN pool is configured with a translation IP address and prefix length of `10.33.1.0/24`. The virtual server is configured with an RTSP control port using a wildcard address and a specific port: `0.0.0.0:554`. The configured translation mode uses the values of the respective port range.

Translation mode	Port range
NAPT	2000-3000
DNAT	2000-2200
PBA	2000-2150

Creating an LSN pool

The CGNAT module must be enabled through the **System** > **Resource Provisioning** screen before you can create LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.

   If your pool uses deterministic mode, ensure that any address ranges you enter as a member do not overlap another member's prefix address ranges. For example, the address and prefix `10.10.10.0/24` overlaps `10.10.10.0/23`.
5. Click **Finished**.

Your LSN pool is now ready, and you can continue to configure your CGNAT.

Creating an RTSP profile

You can configure a real time streaming protocol (RTSP) profile on the BIG-IP® system that streams multimedia content between a client and server.

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles** > **RTSP**.
   The RTSP screen opens and displays a list of available RTSP ALG profiles.
2. Click **Create**.
3. Type a name for the profile.
4. From the **Parent Profile** list, select a parent profile.
5. Select the **Custom** check box.
6. In the **RTP Port** field, type the port number that a Microsoft Media Services server uses. The default is `0`.

   Note: *You can specify Real-Time Transport Protocol (RTP) and Real-Time Control Protocol (RTCP) port numbers in the RTSP profile, which only apply when a client connects to a Windows Media® server. If you configure RTP and RTCP port numbers, both values must be nonzero.*
7. In the **RTCP Port** field, type the port number that a Microsoft Media Services server uses. The default is `0`.

   Note: *You can specify Real-Time Transport Protocol (RTP) and Real-Time Control Protocol (RTCP) port numbers in the RTSP profile, which only apply when a client connects to a Windows Media® server. If you configure RTP and RTCP port numbers, both values must be nonzero.*
8. Click **Finished**.

An RTSP profile is configured on the BIG-IP® system that streams multimedia content between a client and server.

Configuring a CGNAT iRule

You create iRules® to automate traffic forwarding for XML content-based routing. When a match occurs, an iRule event is triggered, and the iRule directs the individual request to an LSN pool, a node, or virtual server.

1. On the Main tab, click **Carrier Grade NAT** > **iRules**.
   The iRule List screen opens.
2. Click **Create**.
3. In the **Name** field, type a 1 to 31 character name, such as `cgn_https_redirect_iRule`.
4. In the **Definition** field, type the syntax for the iRule using Tool Command Language (Tcl) syntax.

   For complete and detailed information about iRules syntax, see the F5 Networks DevCentral web site (`http://devcentral.f5.com`).
5. Click **Finished**.

You now have an iRule to use with a CGNAT virtual server.

Creating a virtual server using an RTSP ALG profile

Virtual servers are matched based on source (client) addresses. Here are the steps to define a virtual server that references an RTSP profile and LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, retain the default setting **Standard.**
5. In the **Destination Address** field, type the IP address in CIDR format.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `10.0.0.1` or `10.0.0.0/24`, and an IPv6 address/prefix is `ffe1::0020/64` or `2001:ed8:77b5:2:10:10:100:42/64`. When you use an IPv4 address without specifying a prefix, the BIG-IP® system automatically uses a `/32` prefix.

   Note: *The IP address you type must be available and not in the loopback network.*
6. In the **Service Port** field, type `554` for the service.
7. From the **Protocol** list, select **TCP**.
8. From the **Protocol Profile (Client)** list, select a predefined or user-defined TCP profile.
9. From the **Protocol Profile (Server)** list, select a predefined or user-defined TCP profile.
10. From the **RTSP Profile** list, select an RISP ALG profile for the virtual server to use.
11. For the **LSN Pool** setting, select the pool that this server will draw on for addresses.
12. Locate the Resources area of the screen; for the **Related iRules** setting, from the **Available** list, select the name of the iRule that you want to assign and move the name to the **Enabled** list.

    This setting applies to virtual servers that reference a profile for a data channel protocol, such as FTP or RTSP.
13. Click **Finished**.

The custom CGNAT virtual server appears in the CGNAT Virtual Servers list.

Creating an RTSP ALG logging profile

You can create an ALG logging profile, and associate it with one or more RTSP ALG profiles, to allow you to configure logging options for various events that apply to high-speed logging (HSL) destinations. A logging profile decreases the need to maintain a number of customized profiles where the events are very similar.

1. On the Main tab, click **Carrier Grade NAT** > **Logging Profiles** > **ALG**.
   The ALG logging profiles screen opens.
2. On the Main tab, click **Local Traffic** > **Profiles** > **Other** > **ALG Logging**.
   The ALG Logging screen opens.
3. Click **Create**.
   The New ALG Logging Profile screen opens.
4. In the **Name** field, type a unique name for the logging profile.
5. From the **Parent Profile** list, select a profile from which the new profile inherits properties.
6. Select the **Custom** check box for the Log Settings area.
7. For the Log Settings area, select **Enabled** for the following settings, as necessary.

Setting	Description
Start Control Channel	Generates event log entries at the start of a control channel connection for an ALG client.
End Control Channel	Generates event log entries at the end of a control channel connection for an ALG client.
Start Data Channel	Generates event log entries at the start of a data channel connection for an ALG client.
End Data Channel	Generates event log entries at the end of a data channel connection for an ALG client.
Inbound Transaction	Generates event log entries at the start of an inbound connection to the BIG-IP® system.

8. Click **Finished**.

Configuring an RTSP ALG profile

You can associate an RTSP ALG profile with a log publisher and logging profile that the BIG-IP® system uses to send log messages to a specified destination.

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles** > **RTSP**.
   The RTSP screen opens and displays a list of available RTSP ALG profiles.
2. Click the name of an RTSP profile.
3. From the **Log Publisher** list, select the log publisher that the BIG-IP system uses to send log messages to a specified destination.

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one* *or more destinations become unavailable, you must set the `logpublisher.atomic` db key to `false`. If all the remote high-speed log (HSL) destinations are down (unavailable), setting the `logpublisher.atomic` db key to `false` will not work to allow the logs to be written to local-syslog. The `logpublisher.atomic` db key has no effect on local-syslog.*

4. From the **Logging Profile** list, select the logging profile the BIG-IP system uses to configure logging options for various ALG events.

   Note: *If you configure a Logging Profile, you must also configure a Log Publisher.*

5. Click **Finished**.

Overview: Using the PPTP ALG profile to create a VPN tunnel

The point-to-point tunneling protocol (PPTP) profile enables you to configure the BIG-IP® system to support a secure virtual private network (VPN) tunnel that forwards PPTP control and data connections. You can create a secure VPN tunnel by configuring a PPTP Profile, and then assigning the PPTP profile to a virtual server. The PPTP protocol is described in RFC 2637.

Important: *You cannot combine or use the PPTP Profile with another profile other than a TCP Profile. The PPTP Profile must be used separately and independently.*

Task summary

Creating an LSN pool

Creating a PPTP profile

Adding a static route to manage GRE traffic

Creating a virtual server using a PPTP ALG profile

About the PPTP ALG profile

The *point-to-point tunneling protocol* (PPTP) profile enables you to configure the BIG-IP® system to support a secure virtual private network (VPN) tunnel. A PPTP application layer gateway (ALG) forwards PPTP client (also known as PPTP Access Concentrator [PAC]) control and data connections through the BIG-IP system to PPTP servers (also known as PPTP Network Servers [PNSs]), while providing source address translation that allows multiple clients to share a single translation address.

The PPTP profile defines a Transmission Control Protocol (TCP) control connection and a data channel through a PPTP Generic Routing Encapsulation (GRE) tunnel, which manages the PPTP tunnels through CGNAT for NAT44 and DS-Lite, as well as all translation modes, including Network Address Port Translation (NAPT), Deterministic, and Port Block Allocation (PBA) modes.

PPTP control channels

The BIG-IP system proxies PPTP control channels as normal TCP connections. The PPTP profile translates outbound control messages, which contain Call Identification numbers (Call IDs) that match the port that is selected on the outbound side. Subsequently, for inbound control messages containing translated Call IDs, the BIG-IP system restores the original client Call ID. You can use a packet tracer to observe this translation on the subscriber side or on the Internet side. You can also use iRules® to evaluate and manage any headers in the PPTP control channel.

PPTP GRE data channels

The BIG-IP system manages the translation for PPTP GRE data channels in a manner similar to that of control channels. The BIG-IP system replaces the translated Call ID from the Key field of the GRE header with the inbound client's Call ID. You can use a packet tracer to observe this translation, as well.

Important: *A PPTP ALG configuration requires a route to the PPTP client in order to return GRE traffic to the PPTP client. A route to the PPTP client is required because GRE traffic (in both directions) is forwarded based on standard IP routing, unlike TCP control connections, which are automatically routed because of the default* `auto-lasthop=enabled` *setting.*

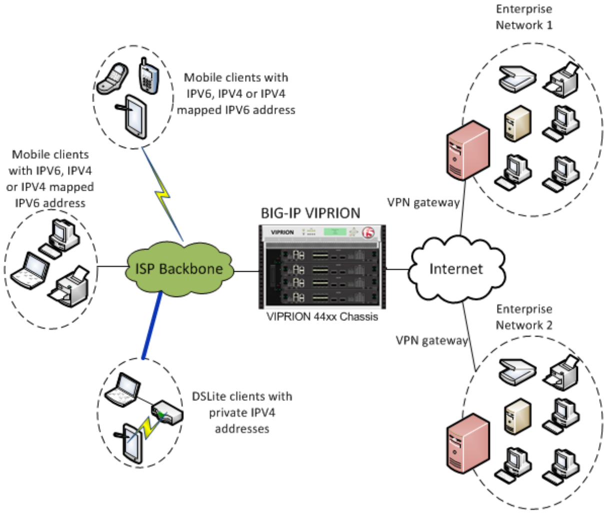

Enterprise Network 1
Mobile clients with IPV6, IPV4 or IPV4 mapped IPV6 address
Mobile clients with IPV6, IPV4 or IPV4 mapped IPV6 address
BIG-IP VIPRION
VPN gateway
ISP Backbone
Internet
VIPRION 44xx Chassis
Enterprise Network 2
VPN gateway
DSLite clients with private IPV4 addresses

Figure 11: An example PPTP ALG configuration

Log messages

The PPTP profile enables you to configure Log Settings, specifically the Publisher Name setting, which logs the name of the log publisher, and the Include Destination IP setting, which logs the host IP address of the PPTP server, for each call establishment, call failure, and call teardown.

Note: *If a client, for example, a personal computer (PC) or mobile phone, attempts to create a second concurrent call, then an error message is logged and sent to the client.*

PPTP profile log example

This topic includes examples of the elements that comprise a typical log entry.

Description of PPTP log messages

PPTP log messages include several elements of interest. The following examples describe typical log messages.

```
"Mar 1 18:46:11:PPTP CALL-REQUEST id;0 from;10.10.10.1 to;20.20.20.1
nat;30.30.30.1 ext-id;32456"
"Mar 1 18:46:11:PPTP CALL-START id;0 from;10.10.10.1 to;20.20.20.1
nat;30.30.30.1 ext-id;32456"
"Mar 1 18:46:11:PPTP CALL-END id;0 reason;0 from;10.10.10.1 to;20.20.20.1
nat;30.30.30.1 ext-id;32456"
```

Information Type	Example Value	Description
Timestamp	`Mar 1 18:46:11`	The time and date that the system logged the event message.
Transformation mode	`PPTP`	The logged transformation mode.

Command	`CALL-REQUEST,`
	`CALL-START,`
	`CALL-END`
		The type of command that is logged.

Client Call ID	`id;0`	The client Call ID received from a subscriber.
Client IP address	`from;10.10.10.1`	The IP address of the client that initiated the connection.
Reason	`reason;0`	A code number that correlates the reason for terminating the connection. The following reason codes apply: • `0`. The client requested termination, a normal termination. • `1`. The server requested termination, a normal termination. • `2`. The client unexpectedly disconnected, where TCP shut down or reset the connection. • `3`. The server unexpectedly disconnected, where TCP shut down or reset the connection. • `4`. The client timed out. • `5`. The server timed out.
Server IP address	`to;20.20.20.1`	The IP address of the server that established the connection. ***Note:*** *If Include Destination IP is set to Disabled, then the Server IP address uses the value of* `0.0.0.0`.
NAT	`nat;30.30.30.1`	The translated IP address.
Translated client Call ID	`ext-id;32456`	The translated client Call ID from the GRE header of the PPTP call.

Creating an LSN pool

The CGNAT module must be enabled through the **System** > **Resource Provisioning** screen before you can create LSN pools.

Large Scale NAT (LSN) pools are used by the CGNAT module to allow efficient configuration of translation prefixes and parameters.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique name.
4. In the Configuration area, for the **Member List** setting, type an address and a prefix length in the **Address/Prefix Length** field, and click **Add**.

   If your pool uses deterministic mode, ensure that any address ranges you enter as a member do not overlap another member's prefix address ranges. For example, the address and prefix `10.10.10.0/24` overlaps `10.10.10.0/23`.
5. Click **Finished**.

Your LSN pool is now ready, and you can continue to configure your CGNAT.

Creating a PPTP profile

You can configure a point-to-point tunneling protocol (PPTP) profile on the BIG-IP® system to support a secure virtual private network (VPN) tunnel that forwards PPTP control and data connections, and logs related messages.

1. On the Main tab, click **Carrier Grade NAT** > **ALG Profiles** > **PPTP**.
   The PPTP screen opens and displays a list of available PPTP ALG profiles.
2. Click **Create**.
3. Type a name for the profile.
4. From the **Parent Profile** list, select a parent profile.
5. Select the **Custom** check box.
6. From the **Publisher Name** list, select a log publisher for high-speed logging of messages.

   If **None** is selected, the BIG-IP system uses the default syslog.

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the* `logpublisher.atomic` *db variable to* `false`.
7. (Optional) From the **Include Destination IP** list, select whether to include the PPTP server's IP address in log messages.

Option	Description
Enabled	Includes the PPTP server's IP address in log messages for call establishment or call disconnect.
Disabled	Default. Includes `0.0.0.0` as the PPTP server's IP address in log messages for call establishment or call disconnect.

8. Click **Finished**.

The PPTP profile displays in the ALG Profiles list on the PPTP screen.

Adding a static route to manage GRE traffic

Perform this task when you want to explicitly add a route for a destination client that is not on the directly-connected network. Depending on the settings you choose, the BIG-IP system can forward packets to a specified network device, or the system can drop packets altogether.

1. On the Main tab, click **Network** > **Routes**.
2. Click **Add**.
   The New Route screen opens.
3. In the **Name** field, type a unique user name.

   This name can be any combination of alphanumeric characters, including an IP address.
4. In the **Description** field, type a description for this route entry.

   This setting is optional.

5. In the **Destination** field, type the destination IP address for the route.
6. In the **Netmask** field, type the network mask for the destination IP address.
7. From the **Resource** list, specify the method through which the system forwards packets:

Option	Description
Use Gateway	Select this option when you want the next hop in the route to be a network IP address. This choice works well when the destination is a pool member on the same internal network as this gateway address.
Use Pool	Select this option when you want the next hop in the route to be a pool of routers instead of a single next-hop router. If you select this option, verify that you have created a pool on the BIG-IP system, with the routers as pool members.
Use VLAN/Tunnel	Select this option when you want the next hop in the route to be a VLAN or tunnel. This option works well when the destination address you specify in the routing entry is a network address. Selecting a VLAN/tunnel name as the resource implies that the specified network is directly connected to the BIG-IP system. In this case, the BIG-IP system can find the destination host simply by sending an ARP request to the hosts in the specified VLAN, thereby obtaining the destination host's MAC address.
Reject	Select this option when you want the BIG-IP system to reject packets sent to the specified destination.

8. In the **MTU** field, specify in bytes a maximum transmission unit (MTU) for this route.
9. Click **Finished**.

A static route is defined to manage GRE traffic to a client.

Creating a virtual server using a PPTP ALG profile

Be sure to disable `translate-address` and `translate-port` before creating a PPTP virtual server.

Virtual servers are matched based on source (client) addresses. You define a virtual server that references the CGNAT profile and the LSN pool.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, retain the default setting **Standard.**
5. For a network, in the **Destination Address** field, type an IPv4 or IPv6 address in CIDR format to allow all traffic to be translated.

   The supported format is address/prefix, where the prefix length is in bits. For example, an IPv4 address/prefix is `0.0.0.0/0`, and an IPv6 address/prefix is `::/0`.
6. In the **Service Port** field, type `1723` or select **PPTP** from the list.
7. From the **PPTP Profile** list, select a PPTP ALG profile for the virtual server to use.
8. From the **VLAN and Tunnel Traffic** list, select **Enabled on**. Then, for the **VLANs and Tunnels** setting, move the VLAN or VLANs on which you want to allow the virtual servers to share traffic from the **Available** list to the **Selected** list.
9. For the **LSN Pool** setting, select the pool that this server will draw on for translation addresses.

10. Click **Finished**.

The custom CGNAT virtual server appears in the CGNAT Virtual Servers list.

Using CGNAT Logging and Subscriber Traceability

Overview: Configuring local logging for CGNAT

You can configure the BIG-IP® system to send log messages about carrier grade network address translation (CGNAT) processes to the local Syslog database on the BIG-IP system.

Note: *Enabling logging impacts BIG-IP system performance.*

When configuring local logging of CGNAT processes, it is helpful to understand the objects you need to create and why:

Object	Reason
Destination (formatted/local)	Create a formatted log destination to format the logs in human-readable name/value pairs, and forward the logs to the local-syslog database.
Publisher (local-syslog)	Create a log publisher to send logs to the previously created destination that formats the logs in name/value pairs, and forwards the logs to the local Syslog database on the BIG-IP system.
LSN pool	Associate a large scale NAT (LSN) pool with a log publisher in order to log messages about the traffic that uses the pool.

Task summary

Creating a formatted local log destination for CGNAT
Creating a publisher to send log messages to the local Syslog database
Configuring an LSN pool with a local Syslog log publisher

Creating a formatted local log destination for CGNAT

Create a formatted logging destination to specify that log messages about CGNAT processes are sent to the local Syslog database in a format that displays name/value pairs in a human-readable format.

1. On the Main tab, click **System** > **Logs** > **Configuration** > **Log Destinations**.
   The Log Destinations screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique, identifiable name for this destination.
4. From the **Type** list, select **Splunk**.

   The Splunk format is a predefined format of key value pairs.
5. From the **Forward To** list, select **local-syslog**.
6. Click **Finished**.

Creating a publisher to send log messages to the local Syslog database

Create a publisher to specify that the BIG-IP® system sends formatted log messages to the local Syslog database, on the BIG-IP system.

1. On the Main tab, click **System** > **Logs** > **Configuration** > **Log Publishers**.
   The Log Publishers screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique, identifiable name for this publisher.
4. For the **Destinations** setting, select the previously created destination from the **Available** list (which formats the logs in the Splunk format and forwards the logs to the local Syslog database) and move the destination to the **Selected** list.
5. Click **Finished**.

Configuring an LSN pool with a local Syslog log publisher

Before associating a large scale NAT (LSN) pool with a log publisher, ensure that at least one log publisher exists that sends formatted log messages to the local Syslog database on the BIG-IP® system.

Associate an LSN pool with the log publisher that the BIG-IP system uses to send formatted log messages to the local Syslog database.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools**.
   The LSN Pool List screen opens.
2. Click the name of an LSN pool.
3. From the **Log Publisher** list, select the log publisher that sends formatted log messages to the local Syslog database on the BIG-IP system.
4. Click **Finished**.

Overview: Configuring remote high-speed logging for CGNAT

You can configure the BIG-IP® system to log information about carrier grade network address translation (CGNAT) processes and send the log messages to remote high-speed log servers.

When configuring remote high-speed logging (HSL) of CGNAT processes, it is helpful to understand the objects you need to create and why, as described here:

Object	Reason
Pool of remote log servers	Create a pool of remote log servers to which the BIG-IP system can send log messages.
Destination (unformatted)	Create a log destination of Remote High-Speed Log type that specifies a pool of remote log servers.
Destination (formatted)	If your remote log servers are the Splunk, IPFIX, or Remote Syslog type, create an additional log destination to format the logs in the required format and forward the logs to a remote high-speed log destination.

Object	Reason
Publisher	Create a log publisher to send logs to a set of specified log destinations.
Logging Profile (optional)	Create a logging profile to configure logging options for various large scale NAT (LSN) events. The options apply to all HSL destinations.
LSN pool	Associate an LSN pool with a logging profile and log publisher in order to log messages about the traffic that uses the pool.

This illustration shows the association of the configuration objects for remote high-speed logging of CGNAT processes.

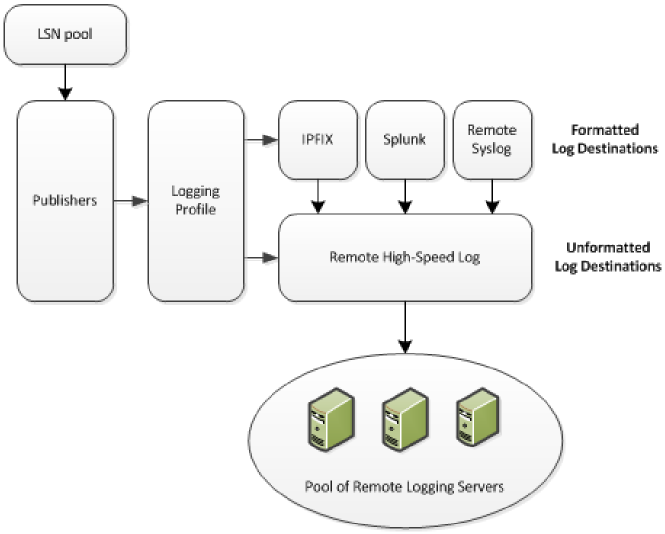

LSN pool
Publishers
Logging Profile
IPFIX
Splunk
Remote Syslog
Formatted Log Destinations
Remote High-Speed Log
Unformatted Log Destinations
Pool of Remote Logging Servers

Figure 12: Association of remote high-speed logging configuration objects

Task summary

Perform these tasks to configure remote high-speed logging of CGNAT processes on the BIG-IP® system.

Note: *Enabling remote high-speed logging impacts BIG-IP system performance.*

Creating a pool of remote logging servers
Creating a remote high-speed log destination
Creating a formatted remote high-speed log destination
Creating a publisher
Creating an LSN logging profile
Configuring an LSN pool

Creating a pool of remote logging servers

Before creating a pool of log servers, gather the IP addresses of the servers that you want to include in the pool. Ensure that the remote log servers are configured to listen to and receive log messages from the BIG-IP® system.

Create a pool of remote log servers to which the BIG-IP system can send log messages.

1. On the Main tab, click the applicable path.
   - **DNS** > **Delivery** > **Load Balancing** > **Pools**
   - **Local Traffic** > **Pools**

   The Pool List screen opens.
2. Click **Create**.
   The New Pool screen opens.
3. In the **Name** field, type a unique name for the pool.
4. Using the **New Members** setting, add the IP address for each remote logging server that you want to include in the pool:
   a) Type an IP address in the **Address** field, or select a node address from the **Node List**.
   b) Type a service number in the **Service Port** field, or select a service name from the list.

   Note: *Typical remote logging servers require port* `514`.

   c) Click **Add**.
5. Click **Finished**.

Creating a remote high-speed log destination

Before creating a remote high-speed log destination, ensure that at least one pool of remote log servers exists on the BIG-IP® system.

Create a log destination of the **Remote High-Speed Log** type to specify that log messages are sent to a pool of remote log servers.

1. On the Main tab, click **System** > **Logs** > **Configuration** > **Log Destinations**.
   The Log Destinations screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique, identifiable name for this destination.
4. From the **Type** list, select **Remote High-Speed Log**.

   Important: *If you use log servers such as Remote Syslog, Splunk, or IPFIX, which require data be sent to the servers in a specific format, you must create an additional log destination of the required type, and associate it with a log destination of the* ***Remote High-Speed Log*** *type. This allows the BIG-IP system to send data to the servers in the required format.*

   The BIG-IP system is configured to send an unformatted string of text to the log servers.
5. From the **Pool Name** list, select the pool of remote log servers to which you want the BIG-IP system to send log messages.
6. From the **Protocol** list, select the protocol used by the high-speed logging pool members.
7. Click **Finished**.

Creating a formatted remote high-speed log destination

Ensure that at least one remote high-speed log destination exists on the BIG-IP® system.

Create a formatted logging destination to specify that log messages are sent to a pool of remote log servers, such as Remote Syslog, Splunk, or IPFIX servers.

1. On the Main tab, click **System** > **Logs** > **Configuration** > **Log Destinations**.
   The Log Destinations screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique, identifiable name for this destination.
4. From the **Type** list, select a formatted logging destination, such as **Remote Syslog**, **Splunk**, or **IPFIX**.

   The Splunk format is a predefined format of key value pairs.

   The BIG-IP system is configured to send a formatted string of text to the log servers.
5. If you selected **Remote Syslog**, from the **Syslog Format** list, select a format for the logs, and then from the **High-Speed Log Destination** list, select the destination that points to a pool of remote Syslog servers to which you want the BIG-IP system to send log messages.

   Important: *For logs coming from Access Policy Manager® (APM®), only the BSD Syslog format is supported.*
6. If you selected **Splunk** or **IPFIX**, from the **Forward To** list, select the destination that points to a pool of high-speed log servers to which you want the BIG-IP system to send log messages.
7. Click **Finished**.

Creating a publisher

Ensure that at least one destination associated with a pool of remote log servers exists on the BIG-IP® system.

Create a publisher to specify where the BIG-IP system sends log messages for specific resources.

1. On the Main tab, click **System** > **Logs** > **Configuration** > **Log Publishers**.
   The Log Publishers screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique, identifiable name for this publisher.
4. For the **Destinations** setting, select a destination from the **Available** list, and move the destination to the **Selected** list.

   Note: *If you are using a formatted destination, select the destination that matches your log servers, such as Remote Syslog, Splunk, or IPFIX.*

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the* `logpublisher.atomic` *db key to* `false`*. If all the remote high-speed log (HSL) destinations are down (unavailable), setting the* `logpublisher.atomic` *db key to* `false` *will not work to allow the logs to be written to local-syslog. The* `logpublisher.atomic` *db key has no effect on local-syslog.*
5. Click **Finished**.

Creating an LSN logging profile

You can create an LSN logging profile to allow you to configure logging options for various LSN events that apply to high-speed logging destinations.

Note: *For configuring remote high-speed logging of CGNAT processes on the BIG-IP® system, these steps are optional.*

1. On the Main tab, click **Carrier Grade NAT** > **Logging Profiles** > **LSN**.
   The LSN logging profiles screen opens.
2. Click **Create**.
   The New LSN Logging Profile screen opens.
3. In the **Name** field, type a unique name for the logging profile.
4. From the **Parent Profile** list, select a profile from which the new profile inherits properties.
5. Select the **Custom** check box for the Log Settings area.
6. For the Log Settings area, select **Enabled** for the following settings, as necessary.

Setting	Description
Start Outbound Session	Generates event log entries at the start of a translation event for an LSN client.
End Outbound Session	Generates event log entries at the end of a translation event for an LSN client.
Start Inbound Session	Generates event log entries at the start of an incoming connection event for a translated endpoint.
End Inbound Session	Generates event log entries at the end of an incoming connection event for a translated endpoint.
Quota Exceeded	Generates event log entries when an LSN client exceeds allocated resources.
Errors	Generates event log entries when LSN translation errors occur.

7. Click **Finished**.

Configuring an LSN pool

You can associate an LSN pool with a log publisher and logging profile that the BIG-IP® system uses to send log messages to a specified destination.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools** > **LSN Pool List**.
   The LSN Pool List screen opens.
2. Select an LSN pool from the list.
   The configuration screen for the pool opens.
3. From the **Log Publisher** list, select the log publisher that the BIG-IP system uses to send log messages to a specified destination.

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the* `logpublisher.atomic` *db key to* `false`*. If all the remote high-speed log (HSL) destinations are down (unavailable), setting the* `logpublisher.atomic` *db key to* `false` *will not work to allow the logs to be written to local-syslog. The* `logpublisher.atomic` *db key has no effect on local-syslog.*

4. Optional: From the **Logging Profile** list, select the logging profile the BIG-IP system uses to configure logging options for various LSN events.
5. Click **Finished**.

You now have an LSN pool for which the BIG-IP system logs messages using the specified logging profile.

Overview: Configuring IPFIX logging for CGNAT

You can configure the BIG-IP® system to log information about carrier grade network address translation (CGNAT) processes and send the log messages to remote IPFIX collectors.

IPFIX is a set of IETF standards described in RFCs 5101 and 5102. The BIG-IP system supports logging of CGNAT translation events over the IPFIX protocol. IPFIX logs are raw, binary-encoded strings with their fields and field lengths defined by IPFIX templates. *IPFIX collectors* are external devices that can receive IPFIX templates, and use them to interpret IPFIX logs.

The configuration process involves creating and connecting the following configuration objects.

Object	Reason
Pool of IPFIX collectors	Create a pool of IPFIX collectors to which the BIG-IP system can send IPFIX log messages.
Destination	Create a log destination to format the logs in IPFIX templates, and forward the logs to the IPFIX collectors.
Publisher	Create a log publisher to send logs to a set of specified log destinations.
Logging Profile (optional)	Create a logging profile to configure logging options for various large scale NAT (LSN) events. The options apply to all HSL destinations.
LSN pool	Associate an LSN pool with a logging profile and log publisher in order to log messages about the traffic that uses the pool.

This illustration shows the association of the configuration objects for IPFIX logging of CGNAT processes.

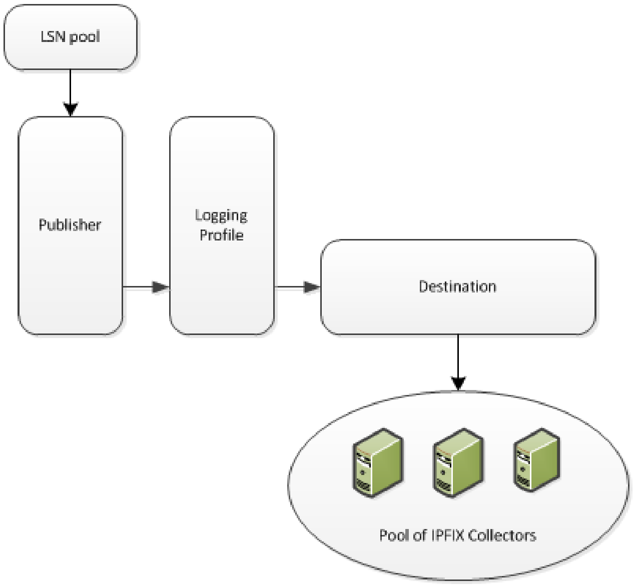


Figure 13: Association of logging configuration objects

Task summary

Perform these tasks to configure IPFIX logging of CGNAT processes on the BIG-IP system.

Note: *Enabling IPFIX logging impacts BIG-IP system performance.*

Assembling a pool of IPFIX collectors
Creating an IPFIX log destination
Creating a publisher
Creating an LSN logging profile
Configuring an LSN pool

Assembling a pool of IPFIX collectors

Before creating a pool of IPFIX collectors, gather the IP addresses of the collectors that you want to include in the pool. Ensure that the remote IPFIX collectors are configured to listen to and receive log messages from the BIG-IP® system.

These are the steps for creating a pool of IPFIX collectors. The BIG-IP system can send IPFIX log messages to this pool.

1. On the Main tab, click **Local Traffic** > **Pools**.
   The Pool List screen opens.
2. Click **Create**.
   The New Pool screen opens.
3. In the **Name** field, type a unique name for the pool.
4. Using the **New Members** setting, add the IP address for each IPFIX collector that you want to include in the pool:
   a) Type the collector's IP address in the **Address** field, or select a node address from the **Node List**.
   b) Type a port number in the **Service Port** field.

      By default, IPFIX collectors listen on UDP or TCP port `4739` and Netflow V9 devices listen on port `2055`, though the port is configurable at each collector.

c) Click **Add**.

5. Click **Finished**.

Creating an IPFIX log destination

A log destination of the **IPFIX** type specifies that log messages are sent to a pool of IPFIX collectors. Use these steps to create a log destination for IPFIX collectors.

1. On the Main tab, click **System** > **Logs** > **Configuration** > **Log Destinations**.
   The Log Destinations screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique, identifiable name for this destination.
4. From the **Type** list, select **IPFIX**.
5. From the **Protocol** list, select **IPFIX** or **Netflow V9**, depending on the type of collectors you have in the pool.
6. From the **Pool Name** list, select an LTM® pool of IPFIX collectors.
7. From the **Transport Profile** list, select **TCP**, **UDP**, or any customized profile derived from TCP or UDP.
8. The **Template Retransmit Interval** is the time between transmissions of IPFIX templates to the pool of collectors. The BIG-IP system only retransmits its templates if the **Transport Profile** is a **UDP** profile.

   An *IPFIX template* defines the field types and byte lengths of the binary IPFIX log messages. The logging destination sends the template for a given log type (for example, NAT44 logs or customized logs from an iRule) before sending any of those logs, so that the IPFIX collector can read the logs of that type. The logging destination assigns a template ID to each template, and places the template ID into each log that uses that template.

   The log destination periodically retransmits all of its IPFIX templates over a UDP connection. The retransmissions are helpful for UDP connections, which are lossy.
9. The **Template Delete Delay** is the time that the BIG-IP device should pause between deleting an obsolete template and re-using its template ID. This feature is helpful for systems that can create custom IPFIX templates with iRules.
10. The **Server SSL Profile** applies Secure Socket Layer (SSL) or Transport Layer Security (TLS) to TCP connections. You can only choose an SSL profile if the **Transport Profile** is a **TCP** profile. Choose an SSL profile that is appropriate for the IPFIX collectors' SSL/TLS configuration.

    SSL or TLS requires extra processing and therefore slows the connection, so we only recommend this for sites where the connections to the IPFIX collectors have a potential security risk.
11. Click **Finished**.

Creating a publisher

A publisher specifies where the BIG-IP® system sends log messages for IPFIX logs.

1. On the Main tab, click **System** > **Logs** > **Configuration** > **Log Publishers**.
   The Log Publishers screen opens.
2. Click **Create**.
3. In the **Name** field, type a unique, identifiable name for this publisher.

4. Use the Log Destinations area to select an existing IPFIX destination (perhaps along with other destinations for your logs): click any destination name in the **Available** list, and move it to the **Selected** list.

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging will occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the* `logpublisher.atomic` *db variable to* `false`*. If all the remote high-speed log (HSL) destinations are down (unavailable), setting the* `logpublisher.atomic` *db key to* `false` *will not work to allow the logs to be written to local-syslog. The* `logpublisher.atomic` *db key has no effect on local-syslog.*

5. Click **Finished**.

Creating an LSN logging profile

You can create an LSN logging profile to allow you to configure logging options for various LSN events that apply to IPFIX logging destinations.

Note: *For configuring IPFIX logging of CGNAT processes on the BIG-IP® system, these steps are optional.*

1. On the Main tab, click **Carrier Grade NAT** > **Logging Profiles** > **LSN**.
   The LSN profile list screen opens.
2. Click **Create**.
   The New LSN Logging Profile screen opens.
3. In the **Name** field, type a unique name for the logging profile.
4. From the **Parent Profile** list, select a profile from which the new profile inherits properties.
5. Select the **Custom** check box for the Log Settings area.
6. For the Log Settings area, select **Enabled** for the following settings, as necessary.

Setting	Description
Start Outbound Session	Generates event log entries at the start of a translation event for an LSN client.
End Outbound Session	Generates event log entries at the end of a translation event for an LSN client.
Start Inbound Session	Generates event log entries at the start of an incoming connection event for a translated endpoint.
End Inbound Session	Generates event log entries at the end of an incoming connection event for a translated endpoint.
Quota Exceeded	Generates event log entries when an LSN client exceeds allocated resources.
Errors	Generates event log entries when LSN translation errors occur.

7. Click **Finished**.

Configuring an LSN pool

You can associate an LSN pool with a log publisher and logging profile that the BIG-IP® system uses to send log messages to a specified destination.

1. On the Main tab, click **Carrier Grade NAT** > **LSN Pools** > **LSN Pool List**.
   The LSN Pool List screen opens.
2. Select an LSN pool from the list.
   The configuration screen for the pool opens.
3. From the **Log Publisher** list, select the log publisher that the BIG-IP system uses to send log messages to a specified destination.

   Important: *If you configure a log publisher to use multiple logging destinations, then, by default, all logging destinations must be available in order to log to each destination. Unless all logging destinations are available, no logging can occur. If you want to log to the available logging destinations when one or more destinations become unavailable, you must set the `logpublisher.atomic` db key to `false`. If all the remote high-speed log (HSL) destinations are down (unavailable), setting the `logpublisher.atomic` db key to `false` will not work to allow the logs to be written to local-syslog. The `logpublisher.atomic` db key has no effect on local-syslog.*

4. Optional: From the **Logging Profile** list, select the logging profile the BIG-IP system uses to configure logging options for various LSN events.
5. Click **Finished**.

You now have an LSN pool for which the BIG-IP system logs messages using the specified logging profile.

Deploying Stateless Network Address Translation

Overview: 6rd configuration on BIG-IP systems

The *6rd* (rapid deployment) feature is a solution to the IPv6 address transition. It provides a stateless protocol mechanism for tunneling IPv6 traffic from the IPv6 Internet over a service provider's (SP's) IPv4 network to the customer's IPv6 networks. As specified in RFC5969, 6rd uses an SP's own IPv6 address prefix rather than the well-known IPV6 in IPv4 prefix (2002::/16), which means that the operational domain of 6rd is limited to the SP network, and is under the SP's control.

Fully compliant with RFC5969, the BIG-IP® system supports the border relay (BR) functionality by automatically mapping the tunnel's IPv4 address at the customer premises to IPv6 address spaces using the 6rd domain configuration information. Using a BIG-IP system, an SP can deploy a single 6rd domain or multiple 6rd domains. When supporting multiple 6rd domains, a separate tunnel is required to accommodate each 6rd domain, which is specified in the associated 6rd tunnel profile.

When you deploy 6rd using a BIG-IP system as the BR device, you need to create 6rd tunnels using wildcard remote addresses. This implementation documents the configuration of a BIG-IP device as a BR device.

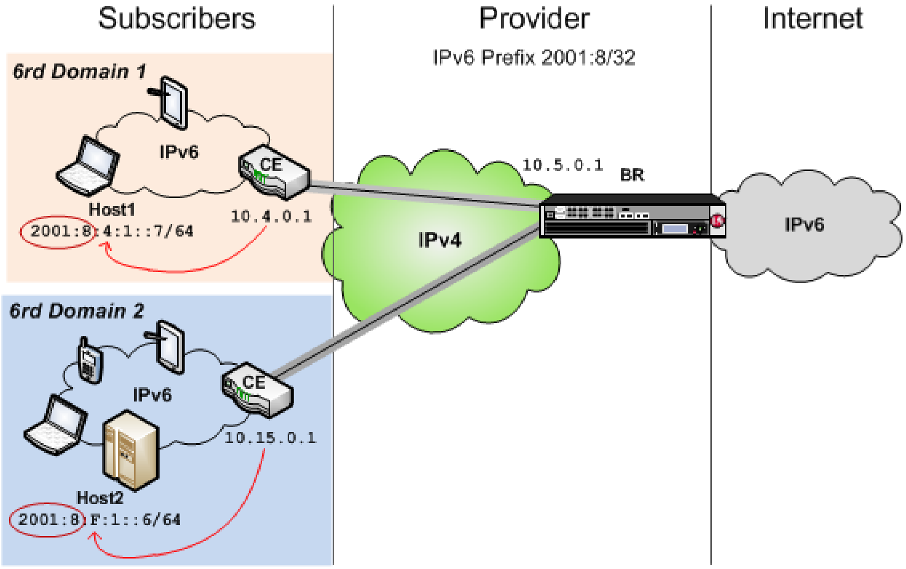


Figure 14: Example of a 6rd configuration

This table shows examples of 6rd parameter values, based on the illustration. You set these values in the v6rd profile you create.

Setting	Value
IPv4 Prefix	10
IPv4 Prefix Length	8
IPv6 Prefix	2001:8:4:1
IPv6 Prefix Length	64

Task summary

Before you configure a 6rd network, ensure that you have licensed and provisioned CGNAT on the BIG-IP® system. Also, the BIG-IP system must have an IPv6 address and an IPv6 default gateway.

Using a profile to define a 6rd domain
Configuring a BIG-IP system as a border relay (BR) device
Creating a forwarding virtual server for a tunnel
Assigning a self IP address to an IP tunnel endpoint
Routing traffic through a 6rd tunnel interface

Using a profile to define a 6rd domain

You must create a new v6rd profile to specify the parameters for a 6rd tunnel. The system-supplied v6rd profile, `v6rd` provides the defaults, but does not suffice as a 6rd profile, as configured. For example, the required 6rd prefix is not specified.

1. On the Main tab, click **Network** > **Tunnels** > **Profiles** > **v6rd** > **Create**.
   The New 6RD Profile screen opens.
2. In the **Name** field, type a unique name for the profile.
3. Select the **Custom** check box.
4. For the **IPv4 Prefix** setting, type the IPv4 prefix that is assumed to be the customer edge (CE) device's IPv4 address, which is not included in the customer's IPv6 6rd prefix. A value of `0.0.0.0` indicates that all 32 bits of the CE's IPv4 address are to be extracted from its 6rd IPv6 prefix.

   Note: *If you do not provide an IPv4 prefix, the system derives it from the tunnel local address you specify when creating the tunnel.*

5. For the **IPv4 Prefix Length** setting, type the number of identical high-order bits shared by all CE and BR IPv4 addresses in the 6rd domain you are configuring.
6. For the **6rd Prefix** setting, type the IPv6 prefix for the 6rd domain you are configuring.
7. For the **6rd Prefix Length** setting, type the length of the IPv6 prefix for the 6rd domain you are configuring.
8. Click **Finished**.

To apply this profile to traffic, you must associate it with a tunnel.

Configuring a BIG-IP system as a border relay (BR) device

Before creating a 6rd tunnel on a BIG-IP® system, you must have configured a v6rd tunnel profile.

You can create a 6rd tunnel on a BIG-IP® system to carry IPv6 traffic over an IPv4 network, allowing your users to seamlessly access the IPv6 Internet.

1. On the Main tab, click **Network** > **Tunnels** > **Tunnel List** > **Create**.
   The New Tunnel screen opens.
2. In the **Name** field, type a unique name for the tunnel.
3. From the **Encapsulation Type** list, select **v6rd**.

4. In the **Local Address** field, type the IPv4 address of the BIG-IP device you are configuring.
5. For the **Remote Address** list, retain the default selection, **Any**.
6. Click **Finished**.

After you create the 6rd tunnel at the BR, you must configure your network routing to send remote traffic through the tunnel.

Creating a forwarding virtual server for a tunnel

You can create a forwarding virtual server to intercept IP traffic and direct it to a tunnel.

1. On the Main tab, click **Local Traffic** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Forwarding (IP)**.
5. In the **Destination Address** field, type `::/0` to accept any IPv6 traffic.
6. In the **Service Port** field, type `*` or select *** All Ports** from the list.
7. From the **Protocol** list, select *** All Protocols**.
8. Click **Finished**.

Now that you have created a virtual server to intercept the IP traffic, you need to create a route to direct this traffic to the tunnel interface.

Assigning a self IP address to an IP tunnel endpoint

Ensure that you have created an IP tunnel before starting this task.

Self IP addresses can enable the BIG-IP® system, and other devices on the network, to route application traffic through the associated tunnel, similar to routing through VLANs and VLAN groups.

Note: *If the other side of the tunnel needs to be reachable, make sure the self IP addresses that you assign to both sides of the tunnel are in the same subnet.*

1. On the Main tab, click **Network** > **Self IPs**.
2. Click **Create**.
   The New Self IP screen opens.
3. In the **Name** field, type a unique name for the self IP address.
4. In the **IP Address** field, type the IP address of the tunnel.

   The system accepts IPv4 and IPv6 addresses.

   Note: *This is not the same as the IP address of the tunnel local endpoint.*

5. In the **Netmask** field, type the full network mask for the specified IP address.

   For example, you can type `ffff:ffff:ffff:ffff:0000:0000:0000:0000` or `ffff:ffff:ffff:ffff::`.

6. From the **VLAN/Tunnel** list, select the tunnel with which to associate this self IP address.

7. Click **Finished**.
   The screen refreshes, and displays the new self IP address.

Assigning a self IP to a tunnel ensures that the tunnel appears as a resource for routing traffic.

To direct traffic through the tunnel, add a route for which you specify the tunnel as the resource.

Routing traffic through a 6rd tunnel interface

Before starting this task, ensure that you have created a 6rd tunnel, and have assigned a self IP address to the tunnel.

You can route traffic through a tunnel interface, much like you use a VLAN or VLAN group.

1. On the Main tab, click **Network** > **Routes**.
2. Click **Add**.
   The New Route screen opens.
3. In the **Name** field, type a unique user name.

   This name can be any combination of alphanumeric characters, including an IP address.
4. In the **Destination** field, type the 6rd IPv6 network address.
5. In the **Netmask** field, type the network mask for the destination IP address.
6. From the **Resource** list, select **Use VLAN/Tunnel**.
7. From the **VLAN/Tunnel** list, select the name of the v6rd tunnel you created.
8. Click **Finished**.

The system now routes traffic destined for the IP address you specified through the tunnel you selected.

Overview: MAP configuration on BIG-IP systems

Mapping of Address and Port (MAP) is an IPv4 to IPv6 transition technology. The BIG-IP® system plays the role of the border relay (BR) in a MAP deployment. At the time of this writing, the implementation of MAP on the BIG-IP system complies with the IETF Standards Track draft *Mapping of Address and Port with Encapsulation (MAP) draft-ietf-software-map-10.*

Note: *You must configure the customer edge (CE) functionality of the MAP solution on the CE device, not on the BIG-IP system.*

This illustration shows the position of a BIG-IP system in a MAP configuration. As the BR device, the BIG-IP system decapsulates the encapsulated IPv6 traffic and forwards it to the public IPv4 Internet.

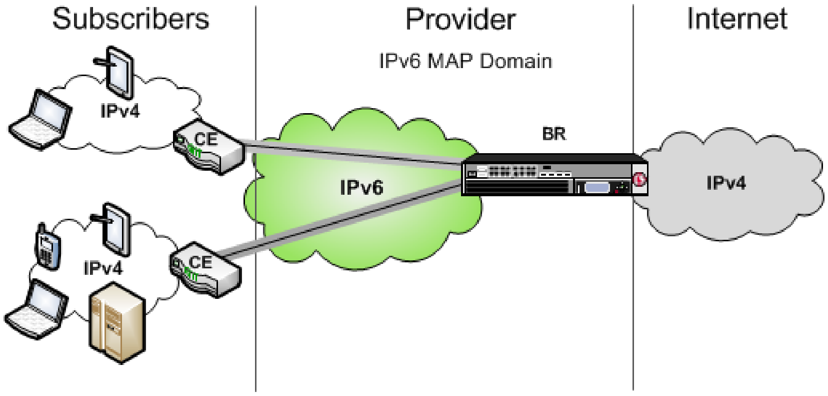


Figure 15: Example of a MAP configuration

About Mapping of Address and Port (MAP)

MAP is a deterministic algorithm that uses MAP-domain configuration information to map between IPv4 and IPv6 addresses to transport IPv4 traffic over the IPv6 infrastructure. MAP is nearly stateless, and it does not require the border relay (BR) device to perform NAT on the traffic. Instead, the translation of private to public IPv4 addresses is delegated to the customer edge (CE) devices, such as customer-premises equipment (CPEs). Mapping of Address and Port (MAP) uses a port mapping algorithm to provide IPv4 connectivity over an IPv6 network. The MAP implementation has two variants, which share the same architecture.

- MAP-E (Encapsulated), which uses the IPv4-in-IPv6 tunneling approach, is on the IETF standards track, and is now referred to as simply MAP.
- MAP-T (Translated), which uses the IPv4-from/to-IPv6 address translation approach, is on the IETF experimental track. MAP-T is not supported on the BIG-IP® system in this release.

Both MAP and MAP-T assume that the service provider internal network has already been migrated to IPv6, but the CE is still running dual stack. IPv6 subscribers behind the CE can use regular addressing methods to reach the public IPv6 Internet. MAP focuses on how the CEs should forward IPv4 subscriber traffic to and from the Internet.

About Mapping of Address and Port with Translation (MAP-T)

In a MAP-T deployment, the customer edge (CE) device implements a combination of stateful NAPT44 translation and stateless MAP translation, using source IPv4 address and port number, to forward IPv4 traffic across the upstream IPv6 network. The BR (border relay) is responsible for connecting one or more MAP domains to external IPv4 networks. It converts the inbound IPv6 packet from the CEs back to NAT'd IPv4, using the corresponding MAP configurations.

Note: *MAP-T is not supported on the BIG-IP® system in this release.*

About Mapping of Address and Port with Encapsulation (MAP)

In a MAP (formerly MAP-E) deployment, the customer edge (CE) device implements a combination of NAPT44 followed by IPv4-in-IPv6 encapsulation. The source IPv6 address of the encapsulating header is derived from the source IPv4 address and port number, according to MAP configurations. At the border relay (BR), the IPv6 traffic is decapsulated to recover the NAT'd IPv4 packet, which the system then forwards to the Internet.

The MAP CE devices and BRs form a MAP domain. The MAP domain is defined by the algorithms and parameters for mapping IPv4 address and port numbers to a subscriber. All CE nodes within the same MAP domain must use the same subnet ID, as configured in the ip4-prefix attribute of the BR configuration, to correctly synthesize the MAP IPv6 address.

MAP relies on port sharing, which means that it supports only ICMP and port-based transport protocols. This excludes PPTP (which uses GRE) and any transports other than TCP, UDP, or ICMP. Because the port sharing ratio and IPv6 prefix are mathematically interdependent, you must correctly size your IPv6 network to ensure that your implementation of MAP accommodates enough subscribers.

The BR handles traffic between itself and a given MAP domain, which means that it has at least one IPv4 interface and one IPv6 interface. Its job is to aggregate the MAP tunnels. Within the MAP Domain, IPv4 traffic follows IPv6 routing, and the BR is reachable using IPv6 anycast addressing for load balancing and resiliency.

The port set ID (PSID) algorithmically represents different groups of non-overlapping, contiguous L4 ports that a CE device can use for port translation, allowing different CE devices to share the same source IPV4 address. As an anti-spoofing measure, the PSID is embedded within the IPv6 address for validation at the BR.

A MAP Domain encapsulates and decapsulates IPv4 traffic using a Basic Mapping Rule (BMR) specified in the MAP draft. The objective of a BMR is to provision a source IPv6 address that generates sets of source IPv4 translation endpoints. The embedded address (EA) bits serve to uniquely identify these endpoints.

- The BMR enables the CE to provision multiple sets of IPv4 ports (NAT pools) for subscribers to use.
- The BMR allows the CE to construct the associated upstream source MAP IPv6 address;
- The BMR must be applied consistently to all CEs and BRs within a given MAP domain.

Due to the deterministic mapping of IPv4 address and port numbers to subscribers, MAP may originate tunnels heading toward subscribers given the IPv4 flow information.

Task summary

Before you configure the BIG-IP® system as a BR device for a MAP domain, ensure that you have licensed and provisioned CGNAT on the BIG-IP system. Also, the BIG-IP system must have an IPv6 self IP address, an IPv6 default gateway, and an IPv4 self IP address on the side of the BIG-IP system that faces the Internet.

Make sure that the CE devices are configured for MAP. For instructions on configuring a CE device, consult the manufacturer's documentation.

Task summary

Using a profile to define a MAP domain

You must create a new MAP profile to specify the parameters for a MAP tunnel, by customizing the system-supplied MAP profile, `map`.

1. On the Main tab, click **Network** > **Tunnels** > **Profiles** > **MAP** > **Create**.
   The New MAP Profile screen opens.
2. In the **Name** field, type a unique name for the profile.
3. From the **Parent Profile** list, select **map**.
4. Select the **Custom** check box.
5. For the **IPv6 Prefix** setting, type the IPv6 prefix of the MAP domain.
6. For the **IPv4 Prefix** setting, type the IPv4 prefix of the MAP domain.
7. For the **Embedded Address Bits Length** setting, type the length, in bits, of the Embedded Address (EA) of the MAP domain.
8. For the **Port Offset** setting, type the length, in bits, of the port offset of the MAP domain.

   This value must be less than `16`.
9. Click **Finished**.

The MAP profile you created now appears in the **Encapsulation Type** list on the New Tunnel and Tunnel Properties screens.

Configuring a tunnel for Mapping Address and Port

Before creating a MAP tunnel on a BIG-IP® system, you must have configured a MAP tunnel profile.

You create a MAP tunnel on a BIG-IP® system to carry IPv4 traffic over an IPv6 network, allowing users to seamlessly access the IPv4 Internet.

1. On the Main tab, click **Network** > **Tunnels** > **Tunnel List** > **Create**, or **Carrier Grade NAT** > **Tunnels** > **Create**
   The New Tunnel screen opens.
2. In the **Name** field, type a unique name for the tunnel.
3. From the **Encapsulation Type** list, select the MAP profile you created previously.
4. In the **Local Address** field, type the IPv6 address of the local BIG-IP device.
5. For the **Remote Address** list, retain the default selection, **Any**.
6. Click **Finished**.

After you create a MAP tunnel, you must create two virtual servers to forward IPv4 and IPv6 traffic.

Creating a forwarding virtual server for IPv4 traffic

After you configure a MAP tunnel to transport IPv4 traffic over an IPv6 network, you need to create a virtual server to intercept the IPv4 traffic and forward the packets to their destinations.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.

3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Forwarding (IP)**.
5. In the **Destination Address** field, type `0.0.0.0/0` to accept any IPv4 traffic.
6. Click **Finished**.

Creating a forwarding virtual server for IPv6 traffic

After you configure a MAP tunnel to transport IPv4 and IPv6 traffic over an IPv6 network, you need to create a virtual server to intercept the IPv6 traffic and forward the packets to their destinations.

1. On the Main tab, click **Carrier Grade NAT** > **Virtual Servers**.
   The Virtual Server List screen opens.
2. Click the **Create** button.
   The New Virtual Server screen opens.
3. In the **Name** field, type a unique name for the virtual server.
4. From the **Type** list, select **Forwarding (IP)**.
5. In the **Destination Address** field, type `::/0` to accept any IPv6 traffic.
6. Click **Finished**.

Assigning a self IP address to a MAP tunnel endpoint

Before starting this task, ensure that you have created a MAP tunnel.

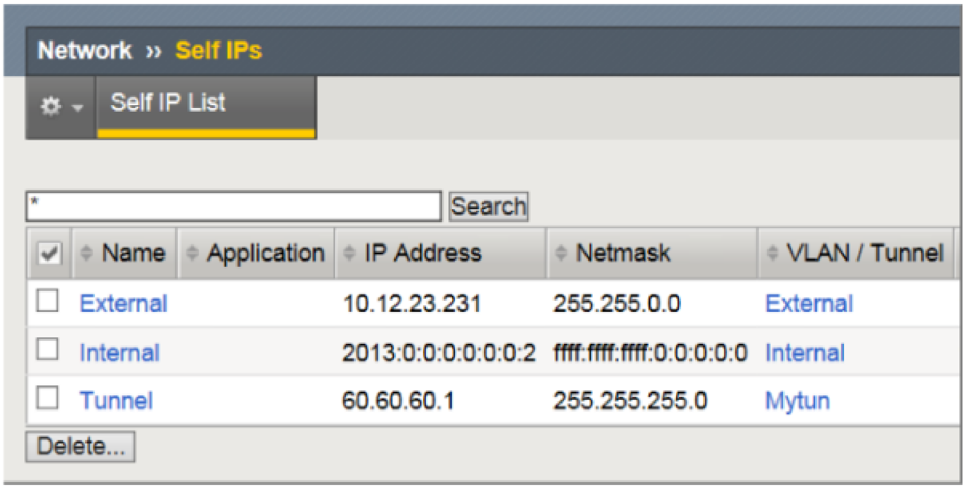
Self IP addresses can enable the BIG-IP® system, and other devices on the network, to route application traffic through the associated tunnel, similar to routing through VLANs and VLAN groups. If you specify a public IPv4 address in the same range as the CE devices, the system automatically creates a connected route on the BIG-IP platform, which can be used to route back IPv4 traffic to this MAP domain. The alternative is to add a static route manually.

1. On the Main tab, click **Network** > **Self IPs**.
2. Click **Create**.
   The New Self IP screen opens.
3. In the **Name** field, type a unique name for the self IP address.
4. In the **IP Address** field, type the IPv4 address of the tunnel, which is an IP address that belongs to the network of the CE devices.

   Note: *This is not the same as the IP address of the tunnel local endpoint.*

5. In the **Netmask** field, type the network mask for the specified IP address.
6. From the **VLAN/Tunnel** list, select the tunnel with which to associate this self IP address.
7. Click **Finished**.
   The screen refreshes, and displays the new self IP address.

Assigning a self IP address to a tunnel ensures that the tunnel appears as a resource for routing traffic. This screen snippet shows a sample list of the self IP addresses required on the BIG-IP system for a MAP configuration, including the self IP address of the tunnel.



☑	Name	Application	IP Address	Netmask	VLAN / Tunnel
□	External		10.12.23.231	255.255.0.0	External
□	Internal		2013:0:0:0:0:0:0:2	ffff:ffff:ffff:0:0:0:0:0	Internal
□	Tunnel		60.60.60.1	255.255.255.0	Mytun

Figure 16: Self IP addresses required for a MAP configuration

- The `External` self IP address is an IPv4 address on the side of the BIG-IP system that faces the Internet.
- The `Internal` self IP address is an IPv6 address on the BIG-IP system, which is configured as a BR device.
- The `Tunnel` self IP address is the one you just created in this task.

Viewing MAP tunnel statistics

Using the `tmsh` command-line interface, you can view statistics to help you diagnose issues with MAP tunnels.

1. Access the `tmsh` command-line utility.
2. Type this command at the prompt.

   `tmsh show net tunnels map` *`profile`*

This example shows the statistics displayed for the MAP tunnel using the profile `map-profile`.

```
tmsh show net tunnels map map-profile
-------------------------------------------------
Net::MAP Profile: map-profile
-------------------------------------------------
Spoof Packets                                   0
Misdirected Packets                             4
Address Sharing Ratio                         256
Ports per User                                256
```

- Spoof Packets: The number of IPv4 packets that fail MAP self-consistency checks.
- Misdirected Packets: The number of IPv4 packets sent to the wrong MAP domain or wrong protocol number.
- Address Sharing Ratio: The number of users sharing one IP address.
- Ports per user: The number of ports each user behind the CE can use.

IPFIX Templates for CGNAT Events

Overview: IPFIX logging templates

The IP Flow Information Export (IPFIX) Protocol is a logging mechanism for IP events. This appendix defines the IPFIX information elements (IEs) and templates used to log the F5 CGNAT events. An *IE* is the smallest form of useful information in an IPFIX log message, such as an IP address or a timestamp for the event. An *IPFIX template* is an ordered collection of specific IEs used to record one IP event, such as the establishment of an inbound NAT64 session.

IPFIX information elements for CGNAT events

Information elements (IEs) are individual fields in an IPFIX template. An IPFIX template describes a single CGNAT event. These tables list all the IEs used in F5 CGNAT events, and differentiate IEs defined by IANA from IEs defined by F5 products.

IANA-Defined IPFIX information elements

Information Elements

IANA maintains a list of standard IPFIX information elements (IEs), each with a unique element identifier, at *http://www.iana.org/assignments/ipfix/ipfix.xml*. The F5 CGNAT implementation uses a subset of these IEs to publish CGNAT events. This subset is summarized in the table below. Please refer to the IANA site for the official description of each field.

Information Element (IE)	ID	Size (Bytes)
destinationIPv4Address	12	4
destinationTransportPort	11	2
egressVRFID	235	4
flowDurationMilliseconds	161	4
flowStartMilliseconds	152	8
ingressVRFID	234	4
natEvent	230	1
natOriginatingAddressRealm	229	1
natPoolName	284	Variable
observationTimeMilliseconds	323	8
portRangeEnd	362	2
portRangeStart	361	2

Information Element (IE)	ID	Size (Bytes)
postNAPTDestinationTransportPort	228	2
postNAPTSourceTransportPort	227	2
postNATDestinationIPv4Address	226	4
postNATDestinationIPv6Address	282	16
postNATSourceIPv4Address	225	4
protocolIdentifier	4	1
sourceIPv4Address	8	4
sourceIPv6Address	27	16
sourceTransportPort	7	2

Note: *IPFIX, unlike NetFlow v9, supports variable-length IEs, where the length is encoded within the field in the Data Record. NetFlow v9 collectors (and their variants) cannot correctly process variable-length IEs, so they are omitted from logs sent to those collector types.*

IPFIX enterprise information elements

Description

IPFIX provides specifications for enterprises to define their own Information Elements. F5 currently does not use any non-standard IEs for CGNAT Events.

Individual IPFIX templates for each event

These tables specify the IPFIX templates used by F5 to publish CGNAT Events.

Each template contains a *natEvent* information element (IE). This element is currently defined by IANA to contain values of 1 (Create Event), 2 (Delete Event) and 3 (Pool Exhausted). In the future, it is possible that IANA will standardize additional values to distinguish between NAT44 and NAT64 events, and to allow for additional types of NAT events. For example, the *http://datatracker.ietf.org/doc/draft-ietf-behave-ipfix-nat-logging* Internet Draft proposes additional values for this IE for such events.

F5 uses the standard Create and Delete *natEvent* values in its IPFIX Data Records, rather than new (non-standard) specific values for NAT44 Create, NAT64 Create, and so on.

You can infer the semantics of each template (for example, whether or not the template applies to NAT44 Create, NAT64 Create, or DS-Lite Create) from the template's contents rather than from distinct values in the natEvent IE.

F5 CGNAT might generate different variants of NAT Session Create/Delete events, to cater to customer requirements such as the need to publish destination address information, or to specifically omit such information. Each variant has a distinct template.

The “Pool Exhausted” *natEvent* value is insufficiently descriptive to cover the possible NAT failure cases. Therefore, pending future updates to the *natEvent* Information Element, F5 uses some non-standard values to cover the following cases:

- 10 – Translation Failure
- 11 – Session Quota Exceeded
- 12 – Port Quota Exceeded
- 13 - Port Block Allocated
- 14 - Port Block Released
- 15 - Port Block Allocation (PBA) Client Block Limit Exceeded
- 16 - PBA Port Quota Exceeded

The following tables enumerate and define the IPFIX templates, and include the possible *natEvent* values for each template.

NAT44 session create – outbound variant

Description

This event is generated when a NAT44 client session is received from the subscriber side and the LSN process successfully translates the source address/port.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The "LSN" routing-domain ID.
sourceIPv4Address	8	4	
postNATSourceIPv4Address	225	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
postNAPTSourceTransportPort	227	2	
destinationIPv4Address	12	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natOriginatingAddressRealm	229	1	1 (private/internal realm, subscriber side).
natEvent	230	1	1 (for Create event).

NAT44 session delete – outbound variant

Description

This event is generated when a NAT44 client session is received from the subscriber side and the LSN process finishes the session.

By default, the BIG-IP® system does not record "delete session" events like this one. This default exists to improve performance, but it prevents the system from ever sending IPFIX logs matching this template. To enable "delete session" events and IPFIX logs matching this template, use the following `tmsh` command:

```
modify sys db log.lsn.session.end value enable
```

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The "LSN" routing-domain ID.
sourceIPv4Address	8	4	
postNATSourceIPv4Address	225	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
postNAPTSourceTransportPort	227	2	
destinationIPv4Address	12	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natOriginatingAddressRealm	229	1	1 (private/internal realm, subscriber side).
natEvent	230	1	2 (for Delete event).
flowStartMilliseconds	152	8	Start time, in ms since Epoch (1/1/1970).
flowDurationMilliseconds	161	4	Duration in ms.

NAT44 session create – inbound variant

Description

This event is generated when an inbound NAT44 client session is received from the internet side and connects to a client on the subscriber side.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "LSN" routing-domain ID.
egressVRFID	235	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
destinationIPv4Address	12	4	
postNATDestinationIPv4Address	226	4	

Information Element (IE)	ID	Size (Bytes)	Notes
destinationTransportPort	11	2	
postNAPTDestinationTransportPort	228	2	
natOriginatingAddressRealm	229	1	2 (public/external realm, Internet side).
natEvent	230	1	1 (for Create event).

NAT44 session delete – inbound variant

Description

This event is generated when an inbound NAT44 client session is received from the internet side and connects to a client on the subscriber side. This event is the deletion of the inbound connection.

By default, the BIG-IP® system does not record "delete session" events like this one. This default exists to improve performance, but it prevents the system from ever sending IPFIX logs matching this template. To enable "delete session" events and IPFIX logs matching this template, use the following `tmsh` command:

```
modify sys db log.lsn.session.end value enable
```

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "LSN" routing-domain ID.
egressVRFID	235	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
destinationIPv4Address	12	4	
postNATDestinationIPv4Address	226	4	
destinationTransportPort	11	2	
postNAPTDestinationTransportPort	228	2	
natOriginatingAddressRealm	229	1	2 (public/external realm, Internet side).
natEvent	230	1	2 (for Delete event).
flowStartMilliseconds	152	8	Start time, in ms since Epoch (1/1/1970).
flowDurationMilliseconds	161	4	Duration in ms.

NAT44 translation failed

Description

This event reports a NAT44 Translation Failure. The failure does not necessarily mean that all addresses or ports in the translation pool are already in use; the implementation may not be able to find a valid translation within the allowed time constraints or number of lookup attempts, as may happen if the pool has become highly fragmented.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
destinationIPv4Address	12	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natEvent	230	1	10 for Transmission Failed.
natPoolName	284	Variable	This IE is omitted for NetFlow v9.

NAT44 quota exceeded

Description

This event is generated when an administratively configured policy prevents a successful NAT44 translation.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
natEvent	230	1	11 for Session Quota Exceeded, 12 for Port Quota Exceeded, 15 for PBA client block limit Exceeded, 16 for PBA Port Quota Exceeded.
natPoolName	284	Variable	This IE is omitted for NetFlow v9.

NAT44 port block allocated or released

Description

This event is generated when the BIG-IP software allocates or releases a block of ports for a NAT44 client. The event only occurs when port-block allocation (PBA) is configured for the LSN pool. When an LSN pool uses PBA, it only issues an IPFIX log for every block of CGNAT translations. This reduces IPFIX traffic for CGNAT.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The egress routing-domain ID.
sourceIPv4Address	8	4	
postNATSourceIPv4Address	225	4	
portRangeStart	361	2	
portRangeEnd	362	2	
natEvent	230	1	13 for PBA, block Allocated, 14 for PBA, block released.

NAT64 session create – outbound variant

Description

This event is generated when a NAT64 client session is received from the subscriber side and the LSN process successfully translates the source address/port.

Note: *The* `destinationIPv6Address` *is not reported, since the* `postNATdestinationIPv4Address` *value is derived algorithmically from the IPv6 representation in* `destinationIPv6Address`*, as specified in RFC 6146 and RFC 6502.*

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The "LSN" routing-domain ID.
sourceIPv6Address	27	16	
postNATSourceIPv4Address	225	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
postNAPTSourceTransportPort	227	2	
postNATDestinationIPv4Address	226	4	0 (zero) if obscured.

Information Element (IE)	ID	Size (Bytes)	Notes
destinationTransportPort	11	2	0 (zero) if obscured.
natOriginatingAddressRealm	229	1	1 (private/internal realm, subscriber side).
natEvent	230	1	1 (for Create event).

NAT64 session delete – outbound variant

Description

This event is generated when a NAT64 client session is received from the subscriber side and the LSN process finishes the outbound session.

By default, the BIG-IP® system does not record "delete session" events like this one. This default exists to improve performance, but it prevents the system from ever sending IPFIX logs matching this template. To enable "delete session" events and IPFIX logs matching this template, use the following `tmsh` command:

```
modify sys db log.lsn.session.end value enable
```

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The "LSN" routing-domain ID.
sourceIPv6Address	27	16	
postNATSourceIPv4Address	225	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
postNAPTSourceTransportPort	227	2	
postNATDestinationIPv4Address	226	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natOriginatingAddressRealm	229	1	1 (private/internal realm, subscriber side).
natEvent	230	1	2 (for Delete event).
flowStartMilliseconds	152	8	Start time, in ms since Epoch (1/1/1970).
flowDurationMilliseconds	161	4	Duration in ms.

NAT64 session create – inbound variant

Description

This event is generated when a client session comes in from the internet side and successfully connects to a NAT64 client on the subscriber side.

Note: *`postNATSourceIPv6Address` is not reported since this value can be derived algorithmically from by appending the well-known NAT64 prefix 64:ff9b:: to `sourceIPv4Address`.*

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "LSN" routing-domain ID.
egressVRFID	235	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
destinationIPv4Address	12	4	
postNATDestinationIPv6Address	282	16	
destinationTransportPort	11	2	
postNAPTDestinationTransportPort	228	2	
natOriginatingAddressRealm	229	1	2 (public/external realm, Internet side).
natEvent	230	1	1 (for Create event).

NAT64 session delete – inbound variant

Description

This event is generated when a client session comes in from the internet side and successfully connects to a NAT64 client on the subscriber side. This event is the deletion of the inbound connection.

Note: *`postNATSourceIPv6Address` is not reported since this value can be derived algorithmically from by appending the well-known NAT64 prefix 64:ff9b:: to `sourceIPv4Address`.*

By default, the BIG-IP® system does not record "delete session" events like this one. This default exists to improve performance, but it prevents the system from ever sending IPFIX logs matching this template. To enable "delete session" events and IPFIX logs matching this template, use the following `tmsh` command:

```
modify sys db log.lsn.session.end value enable
```

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	

Information Element (IE)	ID	Size (Bytes)	Notes
ingressVRFID	234	4	The "LSN" routing-domain ID.
egressVRFID	235	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
destinationIPv4Address	12	4	
postNATDestinationIPv6Address	282	16	
destinationTransportPort	11	2	
postNAPTDestinationTransportPort	228	2	
natOriginatingAddressRealm	229	1	2 (public/external realm, Internet side).
natEvent	230	1	2 (for Delete event).
flowStartMilliseconds	152	8	Start time, in ms since Epoch (1/1/1970).
flowDurationMilliseconds	161	4	Duration in ms.

NAT64 translation failed

Description

This event reports a NAT64 Translation Failure. The failure does not necessarily mean that all addresses or ports in the translation pool are already in use; the implementation may not be able to find a valid translation within the allowed time constraints or number of lookup attempts, as may happen if the pool has become highly fragmented.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
sourceIPv6Address	27	16	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
destinationIPv4Address	12	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natEvent	230	1	10 for Transmission Failed.
natPoolName	284	Variable	This IE is omitted for NetFlow v9.

NAT64 quota exceeded

Description

This event is generated when an administratively configured policy prevents a successful NAT64 translation.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
sourceIPv6Address	27	16	
natEvent	230	1	11 for Session Quota Exceeded, 12 for Port Quota Exceeded, 15 for PBA client block limit Exceeded, 16 for PBA Port Quota Exceeded.
natPoolName	284	Variable	This IE is omitted for NetFlow v9.

NAT64 port block allocated or released

Description

This event is generated when the BIG-IP software allocates or releases a block of ports for a NAT64 client. The event only occurs when port-block allocation (PBA) is configured for the LSN pool. When an LSN pool uses PBA, it only issues an IPFIX log for every block of CGNAT translations. This reduces IPFIX traffic for CGNAT.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The egress routing-domain ID.
sourceIPv6Address	27	16	
postNATSourceIPv4Address	225	4	
portRangeStart	361	2	
portRangeEnd	362	2	
natEvent	230	1	13 for PBA, block Allocated, 14 for PBA, block released.

DS-Lite session create – outbound variant

Description

This event is generated when a DS-Lite client session is received on the subscriber side and the LSN process successfully translates the source address/port. The client's DS-Lite IPv6 remote endpoint address is reported using IE `lsnDsLiteRemoteV6asSource`.

Note: *The* `sourceIPv6Address` *stores different information in this template from the equivalent NAT64 template. In the NAT64 create and delete templates,* `sourceIPv6Address` *holds the client's IPv6 address. In this DS-Lite template, it holds the remote endpoint address of the DS-Lite tunnel.*

Note: *The VRFID (or routing domain ID) for the DS-Lite tunnel is not currently provided; this attribute may be added in the future.*

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The "LSN" routing-domain ID.
sourceIPv4Address	8	4	
postNATSourceIPv4Address	225	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
postNAPTSourceTransportPort	227	2	
sourceIPv6Address	27	16	DS-Lite remote endpoint IPv6 address.
destinationIPv4Address	12	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natOriginatingAddressRealm	229	1	1 (private/internal realm, subscriber side).
natEvent	230	1	1 (for Create event).

DS-Lite session delete – outbound variant

Description

This event is generated when a DS-Lite client session is received from the subscriber side and the LSN process finishes with the outbound session.

Note: *The* `sourceIPv6Address` *stores different information in this template from the equivalent NAT64 template. In the NAT64 create and delete templates,* `sourceIPv6Address` *holds the client's IPv6 address. In this DS-Lite template, it holds the remote endpoint address of the DS-Lite tunnel.*

***Note:** The VRFID (or routing domain ID) for the DS-Lite tunnel is not currently provided; this attribute may be added in the future.*

By default, the BIG-IP® system does not record "delete session" events like this one. This default exists to improve performance, but it prevents the system from ever sending IPFIX logs matching this template. To enable "delete session" events and IPFIX logs matching this template, use the following `tmsh` command:

```
modify sys db log.lsn.session.end value enable
```

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The "LSN" routing-domain ID.
sourceIPv4Address	8	4	
postNATSourceIPv4Address	225	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
postNAPTSourceTransportPort	227	2	
sourceIPv6Address	27	16	DS-Lite remote endpoint IPv6 address.
destinationIPv4Address	12	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natOriginatingAddressRealm	229	1	1 (private/internal realm, subscriber side).
natEvent	230	1	2 (for Delete event).
flowStartMilliseconds	152	8	Start time, in ms since Epoch (1/1/1970).
flowDurationMilliseconds	161	4	Duration in ms.

DS-Lite session create – inbound variant

Description

This event is generated when an inbound client session comes in from the internet side and connects to a DS-Lite client on the subscriber side.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "LSN" routing-domain ID.
egressVRFID	235	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
protocolIdentifier	4	1	

Information Element (IE)	ID	Size (Bytes)	Notes
sourceTransportPort	7	2	
destinationIPv4Address	12	4	
postNATDestinationIPv6Address	282	16	DS-Lite remote endpoint IPv6 address.
postNATDestinationIPv4Address	226	4	
destinationTransportPort	11	2	
postNAPTDestinationTransportPort	228	2	
natOriginatingAddressRealm	229	1	2 (public/external realm, Internet side).
natEvent	230	1	1 (for Create event).

DS-Lite session delete – inbound variant

Description

This event is generated when an inbound client session comes in from the internet side and connects to a DS-Lite client on the subscriber side. This event marks the end of the inbound connection, when the connection is deleted.

By default, the BIG-IP® system does not record "delete session" events like this one. This default exists to improve performance, but it prevents the system from ever sending IPFIX logs matching this template. To enable "delete session" events and IPFIX logs matching this template, use the following `tmsh` command:

```
modify sys db log.lsn.session.end value enable
```

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "LSN" routing-domain ID.
egressVRFID	235	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
protocolIdentifier	4	1	
sourceTransportPort	7	2	
destinationIPv4Address	12	4	
postNATDestinationIPv6Address	282	16	
postNATDestinationIPv4Address	226	4	
destinationTransportPort	11	2	
postNAPTDestinationTransportPort	228	2	
natOriginatingAddressRealm	229	1	2 (public/external realm, Internet side).
natEvent	230	1	2 (for Delete event).
flowStartMilliseconds	152	8	Start time, in ms since Epoch (1/1/1970).

Information Element (IE)	ID	Size (Bytes)	Notes
flowDurationMilliseconds	161	4	Duration in ms.

DS-Lite translation failed

Description

This event reports a DS-Lite Translation Failure. The failure does not necessarily mean that all addresses or ports in the translation pool are already in use; the implementation may not be able to find a valid translation within the allowed time constraints or number of lookup attempts, as may happen if the pool has become highly fragmented.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	IPv4 address used by F5 CGNAT in the IPv4-mapped IPv6 format, for the DS-Lite tunnel terminated on the BIG-IP.
protocolIdentifier	4	1	
sourceTransportPort	7	2	
sourceIPv6Address	27	16	IPv6 address for remote endpoint of the DS-Lite tunnel.
destinationIPv4Address	12	4	0 (zero) if obscured.
destinationTransportPort	11	2	0 (zero) if obscured.
natEvent	230	1	10 for Transmission Failed.
natPoolName	284	Variable	This IE is omitted for NetFlow v9.

DS-Lite quota exceeded

Description

This event is generated when an administratively configured policy prevents a successful NAT translation in a DS-Lite context.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
sourceIPv4Address	8	4	
sourceIPv6Address	27	16	DS-Lite remote endpoint IPv6 address.
natEvent	230	1	11 for Session Quota Exceeded, 12 for Port Quota Exceeded, 15 for PBA client

Information Element (IE)	ID	Size (Bytes)	Notes
			block limit Exceeded, 16 for PBA Port Quota Exceeded.
natPoolName	284	Variable	This IE is omitted for NetFlow v9.

DS-Lite port block allocated or released

Description

This event is generated when the BIG-IP software allocates or releases a block of ports for a DS-Lite client. This event only occurs when port-block allocation (PBA) is configured for the LSN pool. When an LSN pool uses PBA, it issues an IPFIX log for every block of CGNAT translations rather than each individual translation. This reduces IPFIX traffic for CGNAT.

Information Element (IE)	ID	Size (Bytes)	Notes
observationTimeMilliseconds	323	8	
ingressVRFID	234	4	The "client" routing-domain ID.
egressVRFID	235	4	The egress routing-domain ID.
sourceIPv6Address	27	16	
postNATSourceIPv4Address	225	4	
portRangeStart	361	2	
portRangeEnd	362	2	
natEvent	230	1	13 for PBA, block Allocated, 14 for PBA, block released.

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