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# **NSFOCUS WAF V6.0**

## **Deployment Guide**

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# Preface

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## Scope

This document mainly describes deployment modes of NSFOCUS Web Application Firewall (WAF) V6.0 and details bypass deployment modes.

The product information involved in this document may slightly differ from your product to be installed because of version upgrades or other reasons.

## Audience

This document is intended for the following users:

- Users who wish to know main features and usage of this product.
- System administrator.
- Network administrator.

This document assumes that you have knowledge of the following areas:





- Network security
- Linux and Windows operating systems
- TCP/IP protocols

## Organization

Chapter	Description
<a href="#">1 Deployment Modes</a>	Describes four deployment modes of WAF.
<a href="#">2 Deployment Principles</a>	Describes basic principles of bypass deployment modes and the reverse proxy deployment mode.
<a href="#">3 Configuration Examples</a>	Describes typical configuration examples of bypass deployment modes, the reverse proxy deployment mode, and the mirroring deployment mode.
<a href="#">4 HA Configuration</a>	Describes configuration examples of the HA active-active mode and master/slave mode.
<a href="#">5 VRRP Configuration</a>	Describes how to configure VRRP on WAFs.
<a href="#">A Default Parameters</a>	Describes default parameters of WAF.



## Conventions

Convention	Description
Bold font	Keywords, names of screen elements like buttons, drop-down lists or fields, and user-entered text appear in bold font.
Italic font	Document titles, new or emphasized terms.
A > B	Selection of menu options.
 <b>Note</b>	Means reader take note.
 <b>Tip</b>	Means tips for easy operation.
 <b>Caution</b>	Means reader be careful. In this situation, you might take an action that could result in equipment damage or loss of data.
 <b>Warning</b>	Means reader be warned. In this situation, you might take an action that could result in body injury.

## Customer Support

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- Japan: +81 3-4510-8673 or +81 3-4510-8NSF
- Singapore: +65 3158 3757
- Hong Kong +852 5803 2673 or +852 5803 2NSF
- Middle East: +973 1619 7607

# 1 Deployment Modes

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WAF can be deployed in the following ways based on its working mode in the network:

- In-path mode
- Out-of-path mode
- Reverse proxy mode
- Mirroring mode

## 1.1 In-Path Deployment

The in-path deployment mode is implemented in two ways: out-of-band management and in-band management. This mode features simple configuration and requires no major network adjustments, but problems on WAF may affect the customer's network.



Note

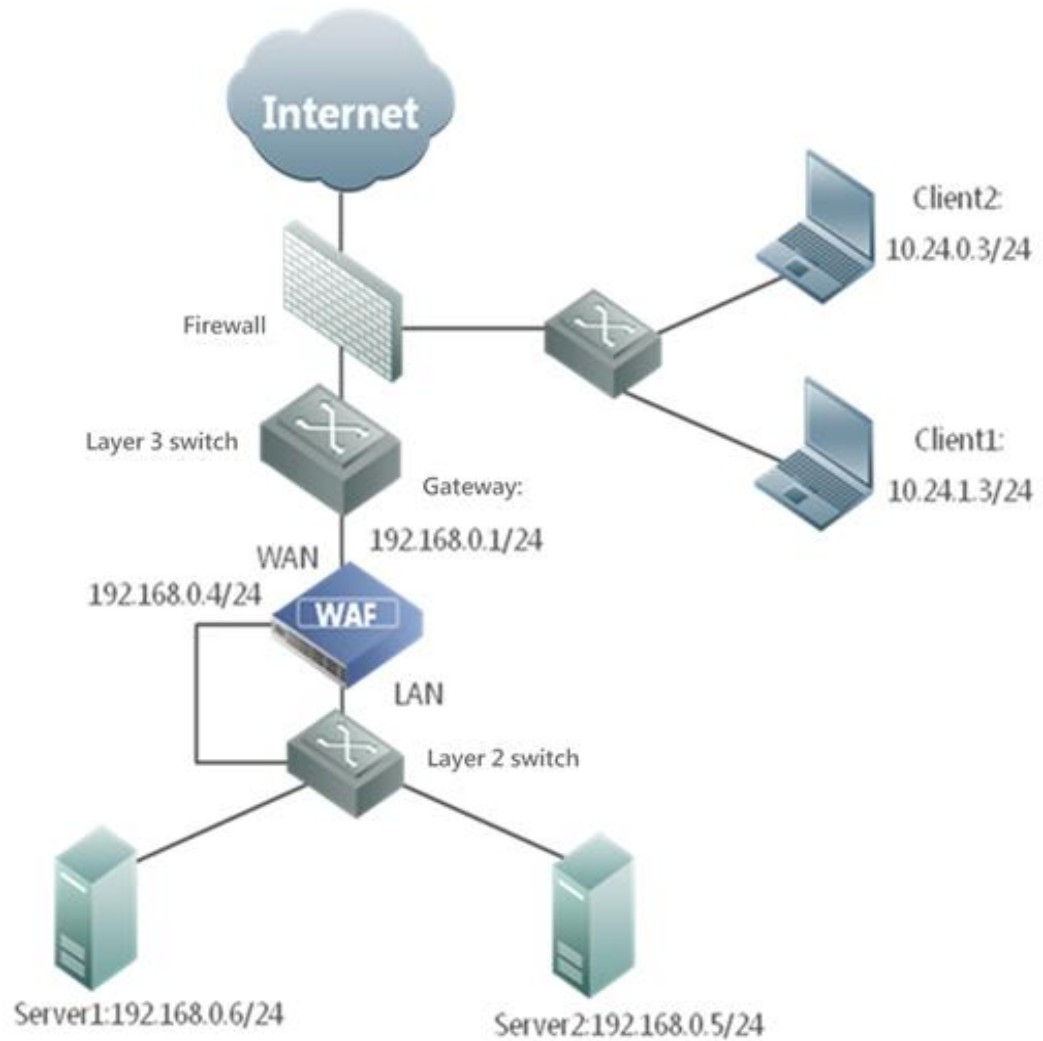
When configuring interfaces on WAF, note the following:

- Configure the IP address of the LAN interface prior to enabling the anti-defacement function and performing scanning protection.
- IP addresses in the same network segment cannot be configured for different interfaces on the same WAF.

### 1.1.1 In-Path Deployment with Out-of-Band Management

In this mode, the out-of-band management interface of WAF is connected to a device (usually, switch or router) on the same side as the WAN or LAN interface of WAF. [Figure 1-1](#) shows the out-of-band management topology.

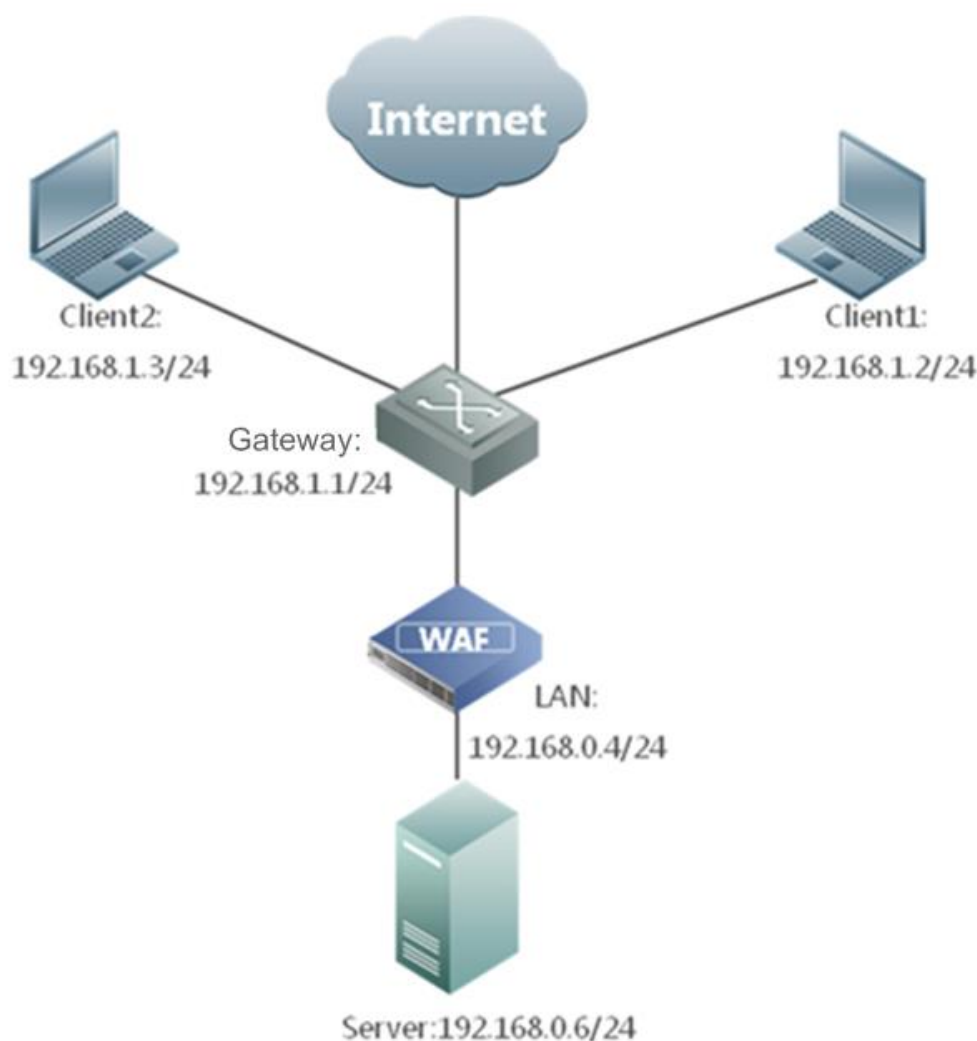
Figure 1-1 In-Path deployment — out-of-band management topology



### 1.1.2 In-Path Deployment with In-Band Management

In this mode, a WAN interface or LAN interface is configured as the management interface of WAF, and its IP address is managed from the same side of the WAN or LAN interface. [Figure 1-2](#) shows the in-band management deployment topology.

Figure 1-2 In-Path Deployment — in-band management topology



## 1.2 Out-of-Path Deployment

In out-of-path deployment mode, WAF, connected to the network in an out-of-path way, diverts traffic destined for the server for cleaning, and then injects the processed traffic back to the network. Responses from the server are forwarded by WAF to the client. In this mode, WAF is physically deployed in an out-of-path way, while logically all bidirectional traffic between the web server and clients passes through WAF. [Figure 1-3](#) shows the deployment topology.

The major advantages of out-of-path deployment are as follows:

- WAF can detect and handle traffic only destined to the server to be protected.
- If WAF fails or reaches the upper performance limit, in the worst situation, it only affects the traffic passing through WAF, but has no impact on other systems or applications in the network.

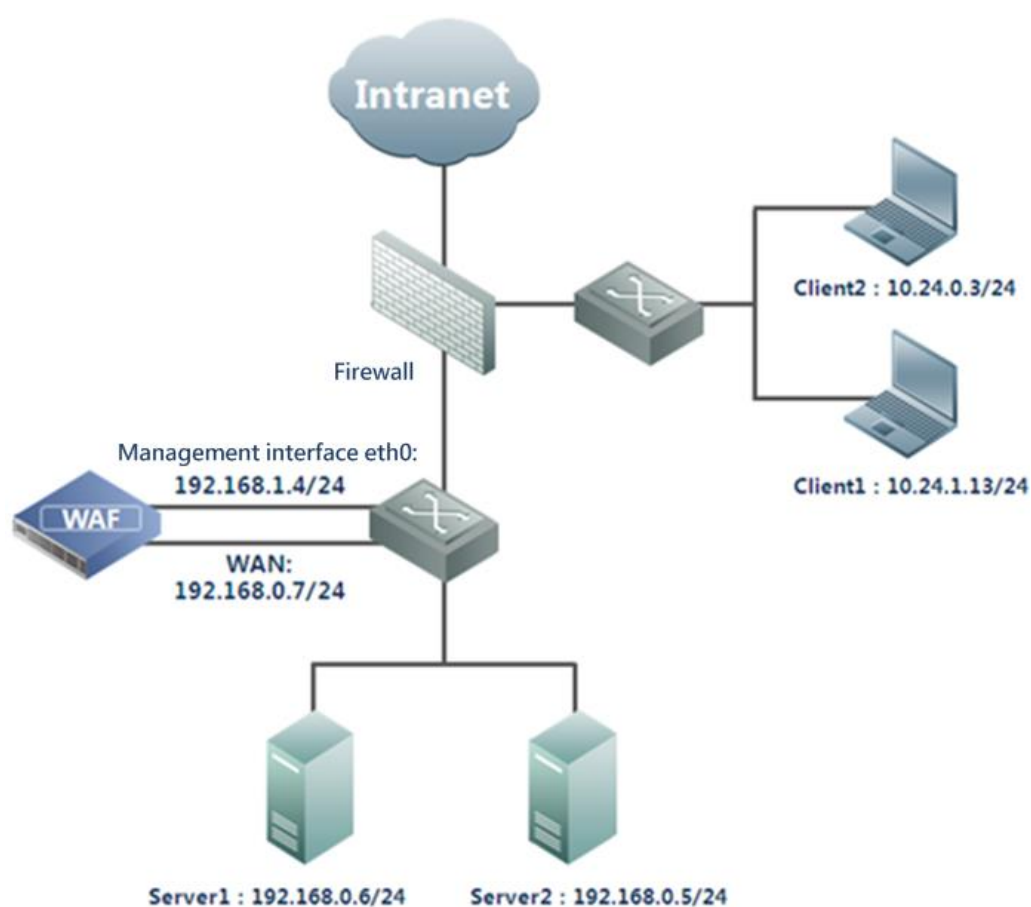
In out-of-path deployment mode, WAF is transparent to clients. Therefore, this mode is also known as the semi-transparent proxy mode. WAF is transparent to the clients. The routing device diverts the request traffic to WAF by modifying the route to the destination.

server, while it appears to client-side devices (client hosts and firewall residing before WAF) that requests destined for the server are still using the IP address and port of the destination server.

For the server side, however, WAF works as the proxy in this mode. To ensure that HTTP responses pass through WAF, WAF changes the source IP address of the received requests to the IP address of its own working interface. Therefore, it seems to server-side devices (server and firewall residing behind WAF) that all requests come from the IP address of the working interface on WAF.

WAF, like a standard proxy server, uses the "X-Forwarded-For" field in the HTTP header to identify the actual source IP address (client IP address) of requests and indicate it to web services and web applications.

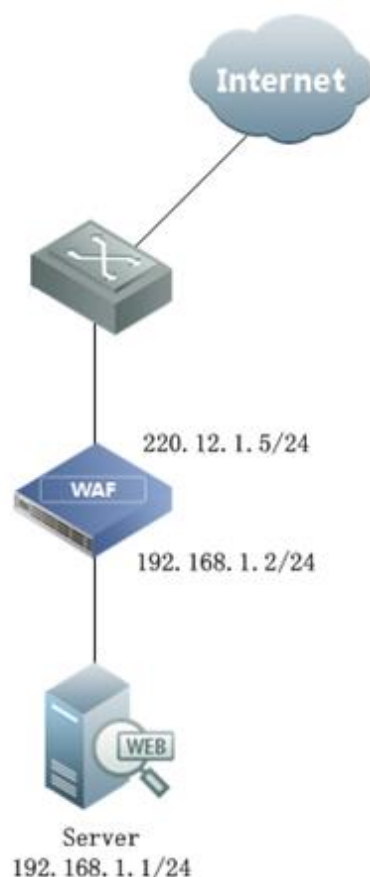
Figure 1-3 Out-of-path deployment topology



## 1.3 Reverse Proxy Mode

In reverse proxy mode, WAF is deployed in front of the server to receive connection requests from Internet clients, apply policies to them, and pass compliant requests to the server. Also, WAF forwards the server's responses to Internet clients. To Internet clients, WAF acts as the server. [Figure 1-4](#) shows the deployment topology.

Figure 1-4 Reverse proxy deployment topology



In this mode, the client sends requests to WAF, and then WAF handles the requests and passes them to the server. Therefore, the server views WAF as the source of requests. In other words, both the client and server are invisible to each other in this mode.

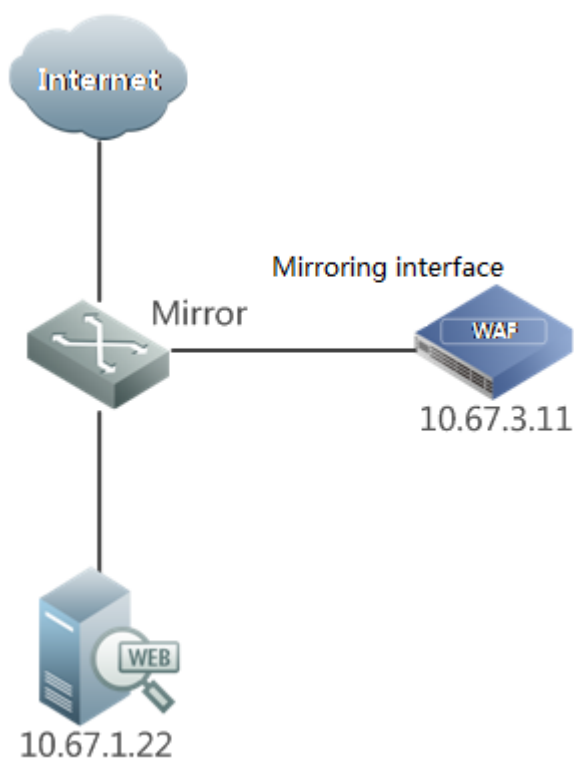
In this mode, WAF forwards only HTTP traffic that matches its policies, and drops mismatched traffic.

WAF, like a standard proxy server, uses the "X-Forwarded-For" field in the HTTP header to identify the actual source IP address (client IP address) of requests and indicate it to web services and web applications.

## 1.4 Mirroring Deployment

In mirroring deployment mode, WAF connects to the switch via a mirroring interface. After WAF and the switch are configured accordingly, the traffic passing through the web server can be mirrored to WAF with the mirroring interface for analysis and detection. [Figure 1-5](#) shows the deployment topology.

Figure 1-5 Mirroring deployment topology



The traffic can be mirrored in one of the following ways:

- Configure the switch to mirror the uplink and downlink traffic of the LAN interface to the mirroring interface, which directly connects to the mirroring interface of WAF with a network cable.
- Configure the switch to mirror the uplink and downlink traffic of the WAN interface to the mirroring interface, which directly connects to the mirroring interface of WAF with a network cable.
- Configure the switch to mirror the uplink traffic of the LAN interface and the downlink traffic of the WAN interface to the mirroring interface, which directly connects to the mirroring interface of WAF with a network cable.

## 1.5 Comparison Among Deployment Modes

Deployment Mode	Strength	Weakness
In-path deployment	<ul style="list-style-type: none"> <li>• Easy deployment.</li> <li>• No major changes to the customer's network.</li> </ul>	<p>The customer's network is not immune to problems on WAF.</p> <p>All traffic in the network passes through WAF, greatly increasing the load on WAF.</p>

Deployment Mode	Strength	Weakness
Out-of-path deployment	<ul style="list-style-type: none"> <li>High resource utilization as WAF only handles traffic of the web server.</li> <li>No single point of failures (SPOFs).</li> </ul>	The deployment is complex as it requires configurations of layer 2 or layer 3 traffic diversion.
Reverse proxy	<ul style="list-style-type: none"> <li>Easy deployment.</li> <li>High resource utilization as WAF only handles HTTP traffic.</li> <li>No SPOFs.</li> </ul>	<p>This deployment mode brings great impacts on the customer's business logic as certain information needs to be changed, including the customer's public IP address, server IP address, and DNS parsing configurations.</p> <p>The server side and client side are invisible to each other.</p>
Mirroring	<ul style="list-style-type: none"> <li>No changes to the customer's network topology.</li> <li>No impact on customer services.</li> <li>Big throughput.</li> </ul>	In this mode, WAF only detects attacks against customer's business, without provide protection.



# 2 Deployment Principles

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This chapter describes the principles for out-of-path and one-arm reverse proxy deployment.

## 2.1 Out-of-Path Deployment

This section describes principles of traffic diversion and injection in out-of-path deployment mode:

- [Traffic Diversion](#)
- [Layer 2 Injection](#)
- [Crossover Injection](#)
- [PBR Injection](#)

### 2.1.1 Traffic Diversion

Traffic diversion here means to divert the traffic destined for a protected server to WAF for processing. To achieve this purpose, you need to configure a high-priority route on the router or switch that is directly connected to WAF. Based on the longest prefix matching principle, the high-priority route needs to be a static route that ends at the IP address of the target server and uses the IP address of a working interface of WAF as the next-hop IP address.

### 2.1.2 Layer 2 Injection

Assume the following scenario:

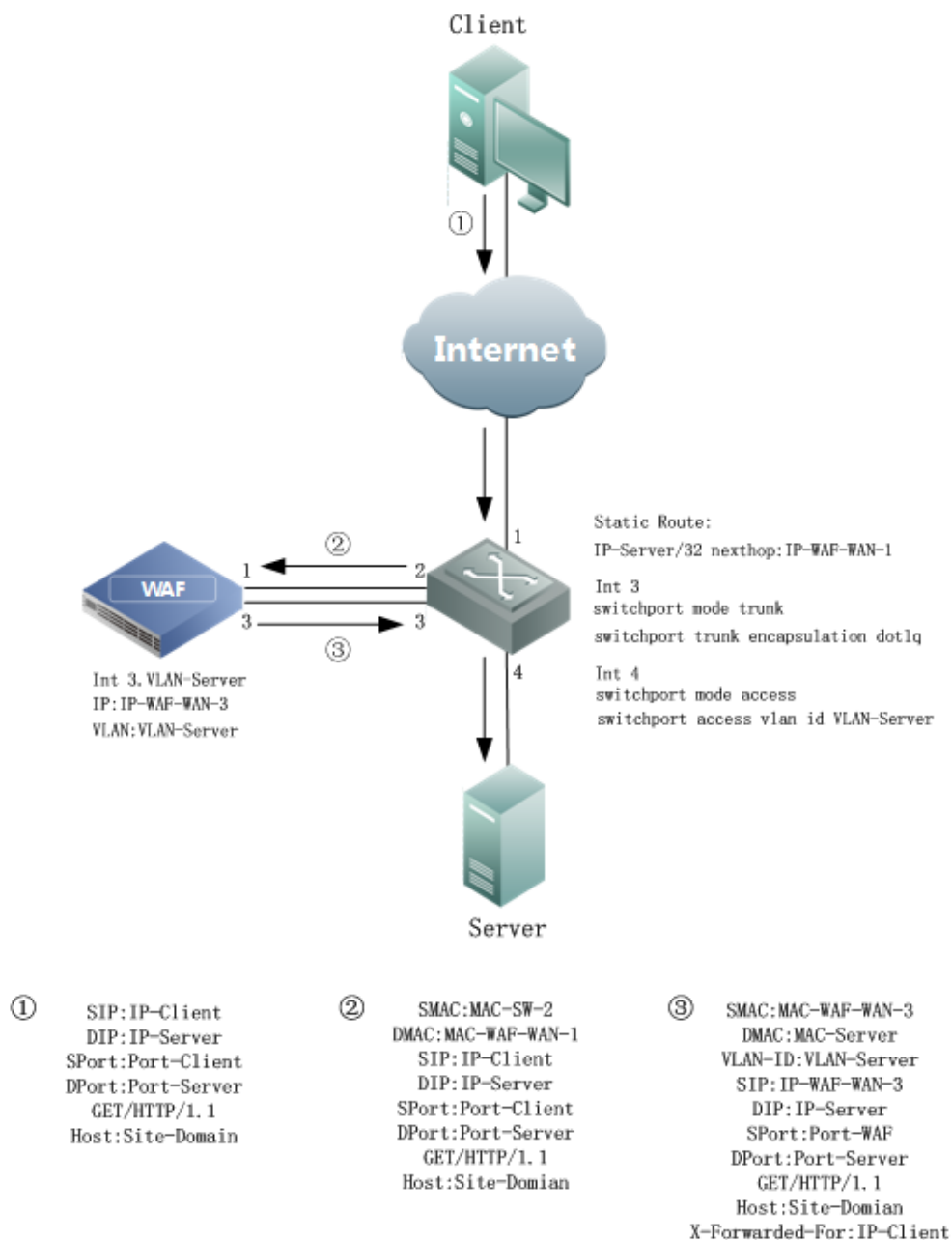
1. The diversion interface and injection interface on WAF are connected to the same layer 3 switch.
2. The layer 3 switch connects to the server via an interface that belongs to a specific VLAN or is configured as a trunk interface encapsulated with dot1q.

If the layer 3 switch acts as the server gateway, it fails to specify the next-hop IP address for injected traffic via PBR. To solve this problem, the switch sends the traffic to the target server via the layer 2 forwarding mechanism, that is, it sends injected traffic to the broadcast domain to which the target server belongs, using the MAC address of the NIC of the target server as the target MAC address of packets.

## Downlink Traffic

[Figure 2-1](#) shows the forwarding paths and packet header changes of downlink traffic (client-to-server requests) during diversion and PBR injection.

Figure 2-1 Layer 2 injection — downlink traffic



The trunk encapsulation dot1q is enabled between interface 3 on WAF and interface 3 on the switch. Interface 3 on WAF needs to be configured with a subinterface, with the IP address of the subinterface set to an idle IP address in the network segment of the server to be protected and the dot1q value specified as the VLAN ID of this network segment. The downlink traffic is processed as follows:

1. The client sends a request to the layer 3 switch via the Internet.
2. The switch forwards the request to interface 1 on WAF for processing along the configured diversion route (32-bit static route).
3. WAF first handles the request.

4. WAF sends the handled request to the switch. To ensure that the server's response to the handled request can reach WAF, WAF uses its own interface IP address and TCP port as the source IP address and source port of the handled request. Meanwhile, WAF records the mapping between the source information (source IP address and port) in the handled request and that in the original request. Also, WAF uses the "X-Forwarded-For" field in the HTTP header to identify the actual source IP address (client IP address) of requests and indicate it to web services and web applications. According to the interface configuration (direct route and VLAN ID), WAF encapsulates the request packet with the dot1q value set to VLAN-Server and sends the packets over interface 3, that is, using the IP address of interface 3 as the source IP address.
5. After the request arrives at interface 3 on the switch, the switch attempts to send the request via layer 2 forwarding because the destination MAC address of this request is not the MAC address of interface 3 of the switch. According to the CAM table, the switch sends the request to the server via interface 4.



Note

On the switch, you need to disable the ARP proxy function of the VLAN where the server resides. Otherwise, when WAF queries the MAC address of the server, the switch may return its own MAC address to WAF. To disable the ARP proxy function on a Cisco switch, run the following commands (replacing <VLAN-Server> with the actual VLAN ID of the server):

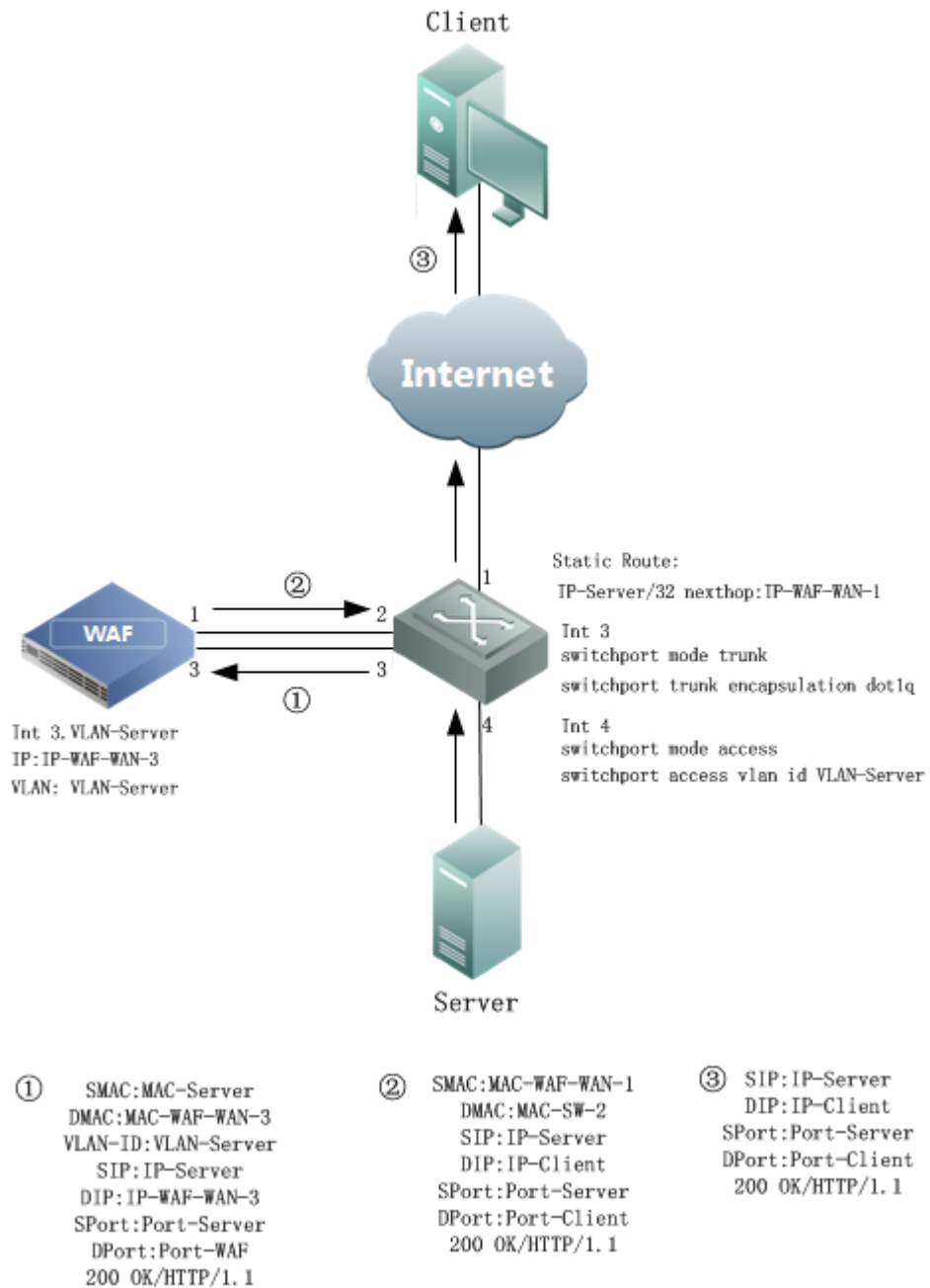
```
(config)# interface vlan <VLAN-Server>
```

```
(config-if)# no ip proxy-arp
```

## Uplink Traffic

Figure 2-2 shows the forwarding paths and packet header changes of uplink traffic (server-to-client responses) during diversion and layer 2 injection.

Figure 2-2 Layer 2 injection — uplink traffic



The uplink traffic is handled as follows:

- The server sends HTTP responses whose destination MAC address and destination IP address are respectively the MAC address and IP address of the injection interface on WAF.
- After receiving HTTP responses from the server, the switch queries the CAM table for the destination IP address based on the destination MAC address and forwards responses to WAF via interface 3.

- c. WAF handles the received HTTP responses and then encapsulates the handled response packets, using the IP address and the TCP port of the client as the destination IP address and destination port according to the mapping recorded previously.
- d. WAF sends encapsulated response packets to the switch via the diversion interface (interface 1).
- e. After querying the routing table, the switch sends the received response packets to the client via the Internet.

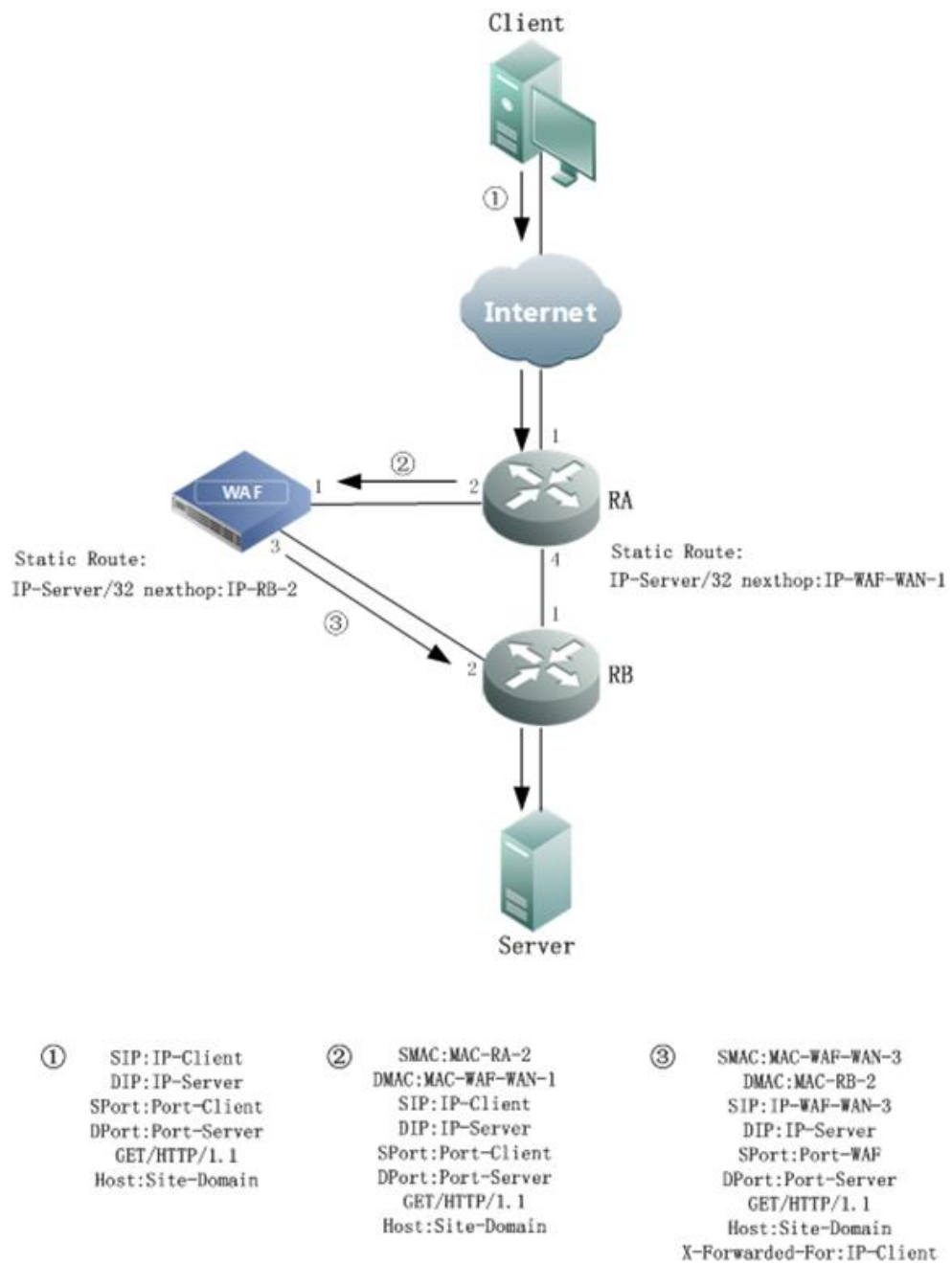
### 2.1.3 Crossover Injection

In crossover injection mode, the router connecting to the injection interface on WAF resides in the downlink of the router connecting to the diversion interface on WAF. As no diversion route exists in the router connecting to the injection interface on WAF, the router sends the injection traffic to the next-hop IP address along a normal route, without traffic diversion.

#### Downlink Traffic

[Figure 2-3](#) shows the forwarding paths and packet header changes of downlink traffic (client-to-server requests) during diversion and crossover injection.

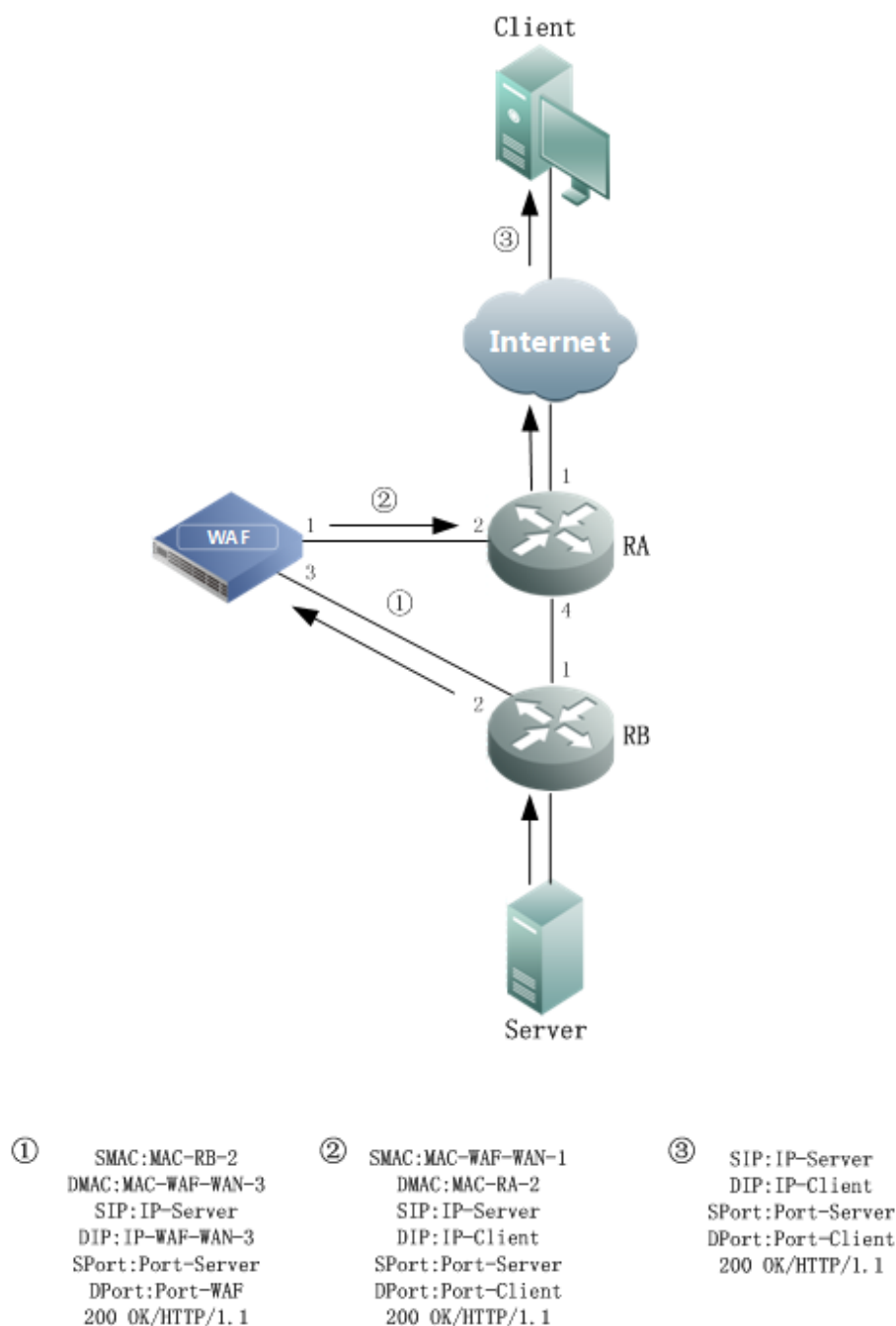
Figure 2-3 Crossover injection — downlink traffic



## Uplink Traffic

Figure 2-4 shows the forwarding paths and packet header changes of uplink traffic (server-to-client responses) during diversion and crossover injection.

Figure 2-4 Crossover injection — uplink traffic



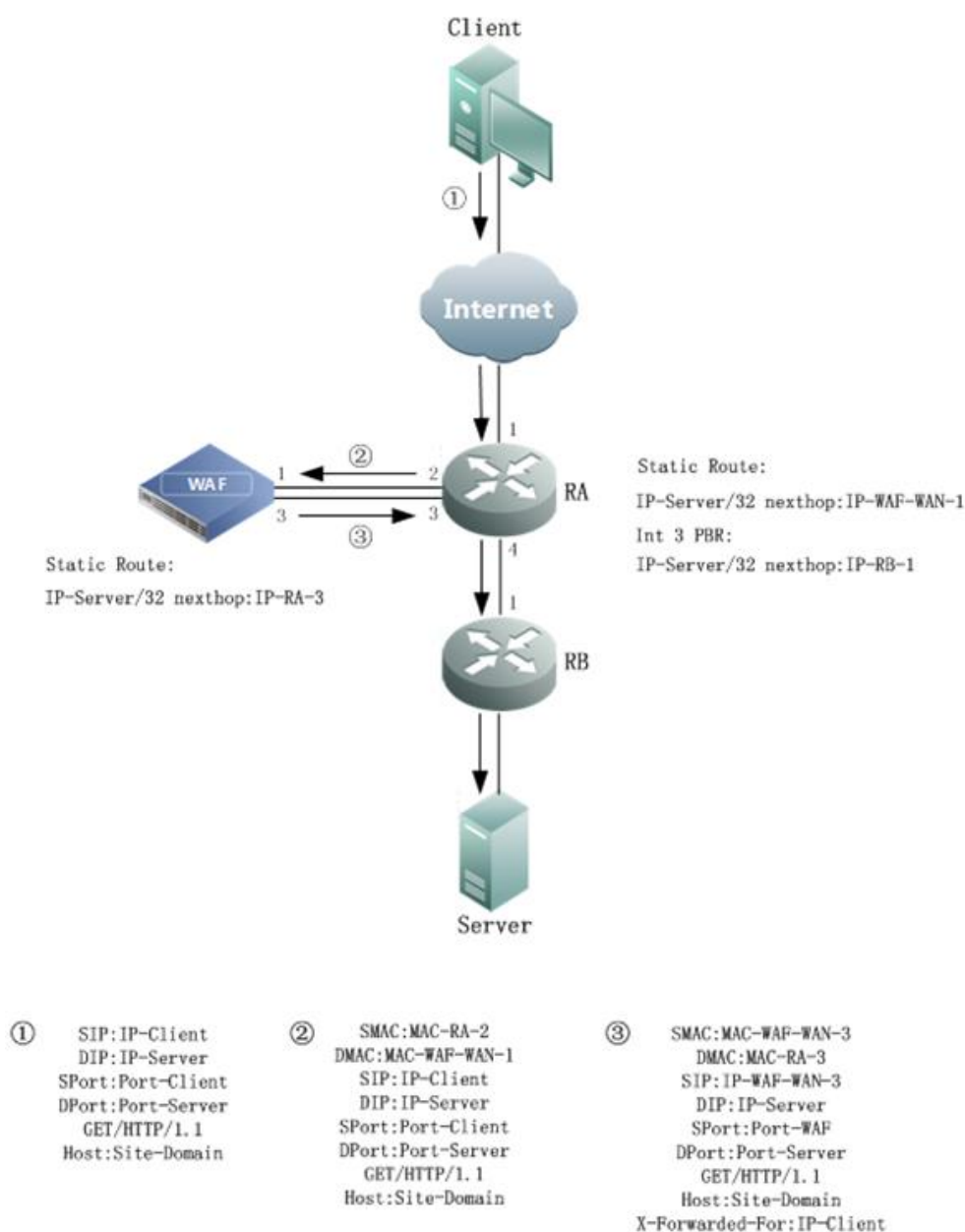
## 2.1.4 PBR Injection

Assume that the injection interface and diversion interface on WAF connect to the same router. In this case, if the gateway exists between the router and the server, you need to configure a policy-based route (PBR) on the injection interface of the router. As the interface-based PBR has a higher priority than global routes (in the routing table including the diversion route), the router forwards injection traffic along the PBR to the proper next-hop IP address. This avoids a routing loop due to injection traffic diversion by the router.

## Downlink Traffic

Figure 2-5 shows the forwarding paths and packet header changes of downlink traffic (client-to-server requests) during diversion and PBR injection.

Figure 2-5 PBR injection — downlink traffic



In the preceding topology, interface 1 on WAF and interface 2 on Router A are in the same network segment; interface 3 on WAF is in the same network segment as interface 3 on Router A. The downlink traffic is processed as follows:

1. The client sends a request to Router A via the Internet.
2. Router A forwards the request along the configured diversion route (32-bit static route) to interface 1 on WAF for processing.



3. WAF handles this request. To ensure that the server's response to the handled request can reach WAF, WAF uses the IP address of its injection interface (interface 3) and its TCP port as the source IP address and source port of requests when sending the handled request to the server. Meanwhile, WAF records the mapping between the source information (source IP address and port) in the handled request and that in the original request. Also, WAF uses the "X-Forwarded-For" field in the HTTP header to identify the actual source IP address (client IP address) of requests and indicate it to web services and web applications.
4. WAF, along the configured static route, sends the injection traffic via its interface 3 to interface 3 on Router A.
5. Router A, along the configured PBR, forwards the traffic via interface 3 to interface 1 on Router B.
6. After receiving the injection traffic, Router B forwards it to the server.



- The diversion interface and injection interface on WAF should come from different bypass interface pairs.
- If WAF is directly connected to a layer 3 switch, you are advised to configure the diversion interface of the switch as a layer 3 interface. The following is the configuration command for a Cisco switch:  

```
(config)# interface GigabitEthernet0/2
(config-if)# no switchport
```

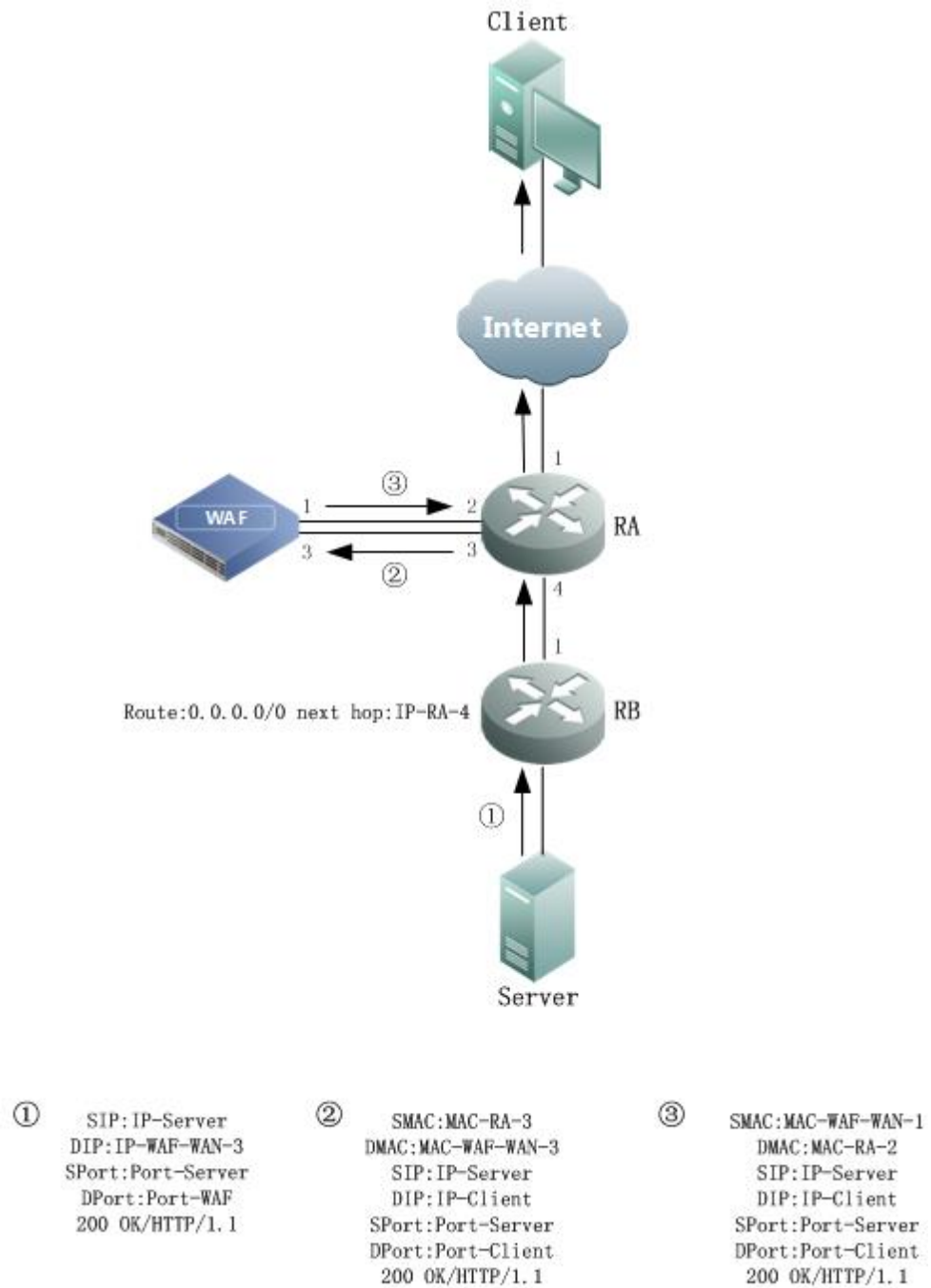
Traffic diversion and injection can also be achieved in one-arm mode:

- WAF connects to a router in one-arm mode. In this case, traffic diversion and injection can be achieved via one or two pairs of interconnected IP addresses. If two pairs of interconnected IP addresses are used, you need to configure subinterfaces on the router interface.
- WAF connects to a layer 3 switch. As most interfaces of a layer 3 switch do not support subinterfaces, you are advised to use one pair of interconnected IP addresses to achieve diversion and injection.

## Uplink Traffic

Figure 2-6 shows the forwarding paths and packet header changes of uplink traffic (server-to-client responses) during diversion and PBR injection.

Figure 2-6 PBR injection — uplink traffic



The uplink traffic is handled as follows:

- a. The server sends an HTTP response, with the destination IP address being the IP address of the injection interface of WAF.
- b. After receiving the response from the server, Router B forwards it to Router A along the default route to Router A, instead of the route to the injection interface of WAF.
- c. Router A forwards the response to the injection interface (interface 3) on WAF along a direct route.

- d. WAF first handles the received response and then encapsulates the response, using the IP address and the TCP port of the client as the destination IP address and destination port according to the correspondence recorded previously.
- e. WAF sends the encapsulated response packet to Router A via the diversion interface (interface 1).
- f. After querying the routing table, Router A sends the received response packet to the client via the Internet.

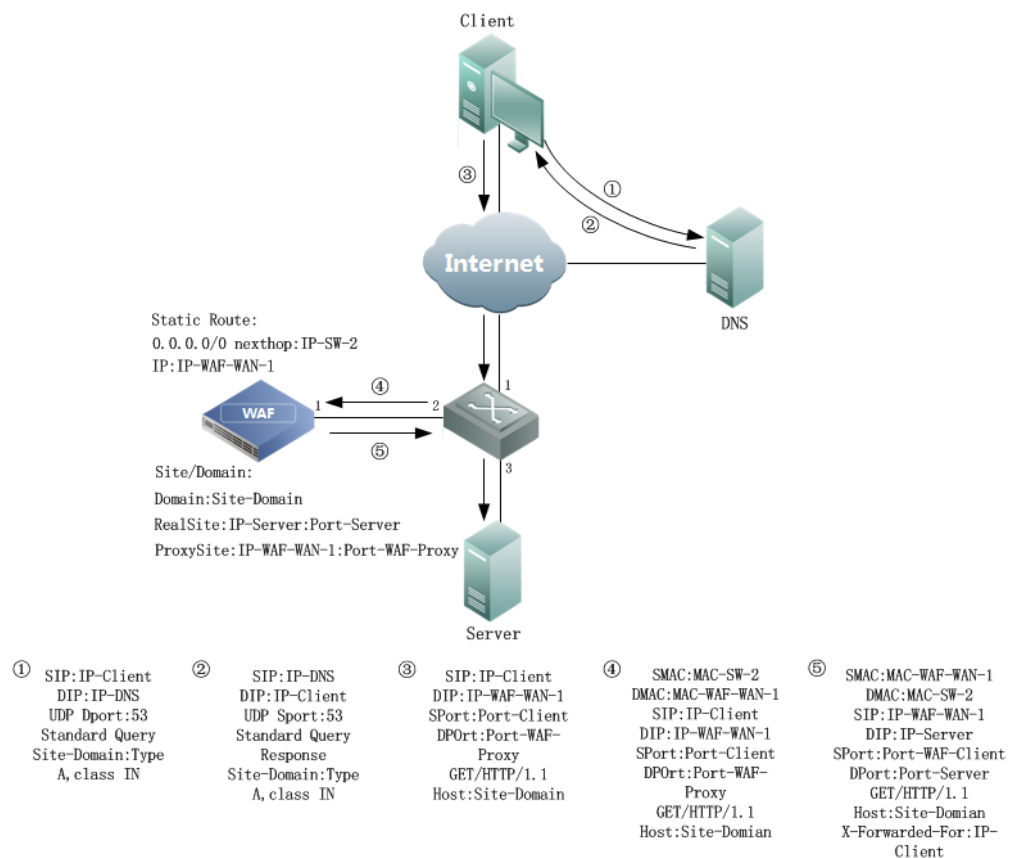
## 2.2 One-Arm Reverse Proxy Deployment

The reverse proxy deployment mode applies if you would rather change the DNS parsing configuration or the IP address of the server than alter the router configuration when deploying WAF. To minimize changes to your network, you can employ the flexible one-arm reverse proxy deployment mode in which WAF is deployed like a reverse proxy server.

### Downlink Traffic

Figure 2-7 shows the forwarding paths and packet header changes of downlink traffic (client-to-server requests) in one-arm reverse proxy mode.

Figure 2-7 One-arm reverse proxy mode — downlink traffic



The downlink traffic is handled as follows:

1. The client queries the DNS server for the domain name of the website.
2. The DNS server returns the client the IP address of WAN-1 interface as the IP address of the site.
3. The client establishes TCP connections with the IP address (proxied IP address) of WAN-1 interface on WAF and service port (proxied port) and sends an HTTP request. In this phase, WAF appears as a web server.
4. WAF handles the HTTP request from the client.
5. WAF sends the HTTP request, using the IP address of WAN-1 interface and its port as the source IP address and source port. Also, WAF records the mapping between the source information (source IP address and port) in the handled request and that in the original request.
6. WAF uses the "X-Forwarded-For" field in the HTTP header to identify the actual source IP address (client IP address) of requests and indicate it to web services and web applications.

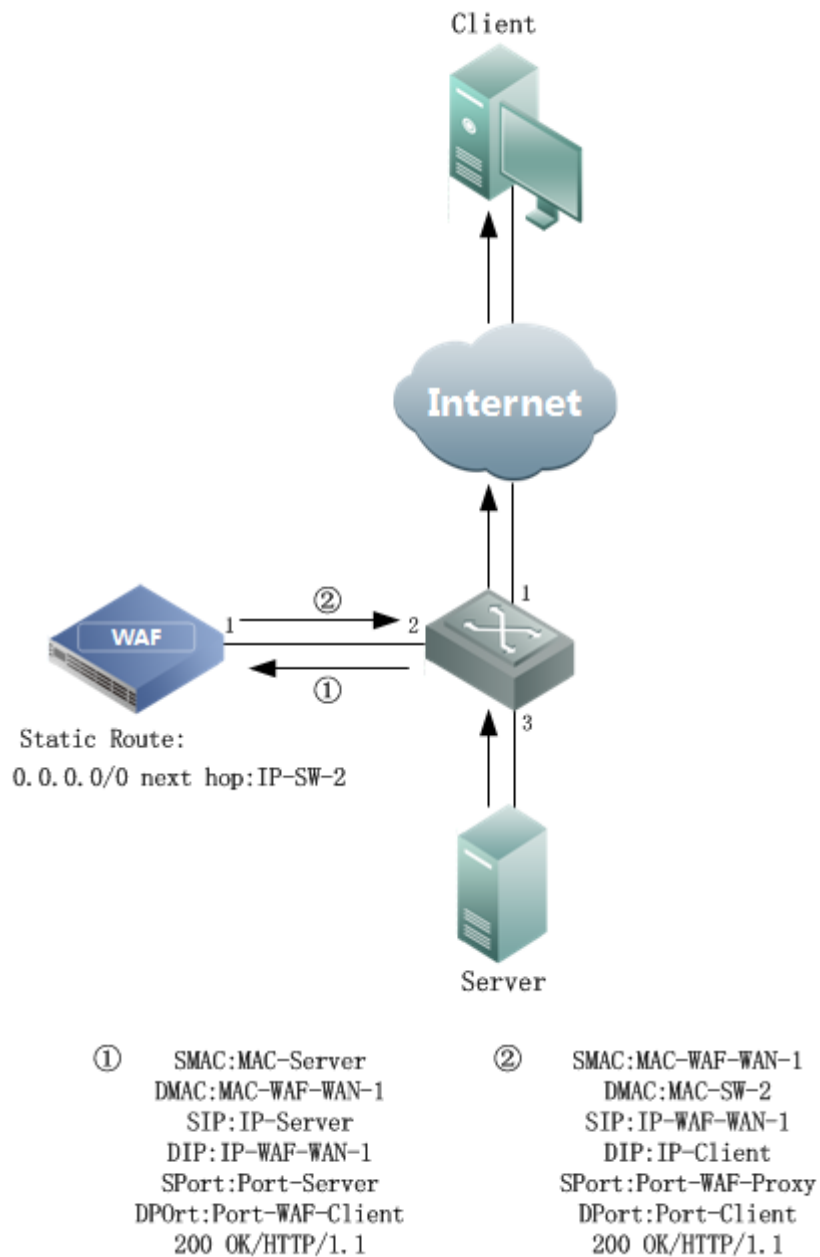


- WAF needs to be configured with a correct default route (the next hop is the IP address of interface 2 on the switch) to the client and server. Otherwise, WAF may fail to properly communicate with the client or server.
- In the preceding deployment example, you need to modify DNS parsing configuration, that is, changing the website's IP address to WAF's IP address when the client accesses the website or changing the server's IP address, and configuring WAF with the original IP address of the server.

## Uplink Traffic

Figure 2-8 shows the forwarding paths and packet header changes of uplink traffic (server-to-client responses) in one-arm reverse proxy mode.

Figure 2-8 One-arm reverse proxy mode — uplink traffic



The uplink traffic is handled as follows:

1. The server sends an HTTP response to the WAN-1 interface of WAF.
2. WAF handles the received HTTP response.
3. Based on the mapping between the original request and proxied request, WAF sends the handled response, using the IP address (proxied IP address) of the WAN-1 interface and its service port (proxied port) as the source IP address and source port.

# 3 Configuration Examples

This chapter describes configuration examples for out-of-path, one-arm reverse proxy deployment, and mirroring deployment.



Note

- Switches in all configuration examples in this chapter refer to Cisco 3750 series switches.
- WAF V6.0R04F00 and later support both IPv4 and IPv6 deployment. This chapter uses IPv4 as examples. To perform IPv6 deployment, add IPv6-related configurations.
- The default management interface is M or H1, and working interface names are in the format of G plus interface board number/interface number, for example G1/1 and G1/2.

## 3.1 Out-of-Path Deployment

This section presents configuration examples of the following out-of-path deployment modes:

- [Diversion via Static Route](#)
- [Layer 2 Injection](#)
- [Crossover Injection](#)
- [PBR Injection](#)

### 3.1.1 Diversion via Static Route

Configure a static route from the switch directly to a working interface on WAF.

#### Switch Configuration

Configuration Command	Description
#interface GigabitEthernet 0/1 # ip address 3.3.3.2 255.255.255.252 # no shutdown #ip route 1.1.1.10 255.255.255.255 3.3.3.1	These commands configure a static route from the switch directly to a working interface on WAF.

## WAF Configuration

Perform the following operations to change the IP address of a working interface of WAF:

**Step 1** Choose **System Management > Network Configuration > Work Group Management**.

Figure 3-1 Diversion via static route — Work Group Management page

Network Configuration
System Deployment
System Tools
Test Tools
ESPC
User Management

Work Group Management
Route Configuration
DNS Configuration

**Available Interfaces**

G1/3
G2/1
G2/2
G2/3
G2/4

**Management Interfaces**

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

**Work Group**

default

View Forwarding Table
View Forwarding Routing Table
Edit
Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	

**Step 2** Click in the row of interface **G1/1** in the **default** group and edit interface parameters in the **Edit Interface** dialog box, as shown in [Figure 3-2](#).

Figure 3-2 Diversion via static route — editing interface G1/4 configuration

**Edit Interface**

Name: G1/1

Media: Copper

☒ IPv4 Address: 3.3.3.1 Mask: 255.255.255.252 ☐ Web Access ☐ SSH Login

☐ IPv6 Address: Mask:  ☐ Web Access ☐ SSH Login

Subinterface Configuration: [Add Subinterface](#) + All subinterfaces use the 802.1q protocol for encapsulation.

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPv4: 1.1.1.2 x IPv6:

☐ Advanced

OK Reset Cancel

**Step 3** Click **OK** to complete the configuration.

Run the following command on the switch to check whether the configuration takes effect:

```
#show ip route 1.1.1.10
Routing entry for 1.1.1.10/32
  Known via "static", distance 1, metric 0
  Routing Descriptor Blocks:
    * 3.3.3.1
      Route metric is 0, traffic share count is 1
```

The command output shows that only one route entry involves the IP address of interface G1/1 on WAF.

----End

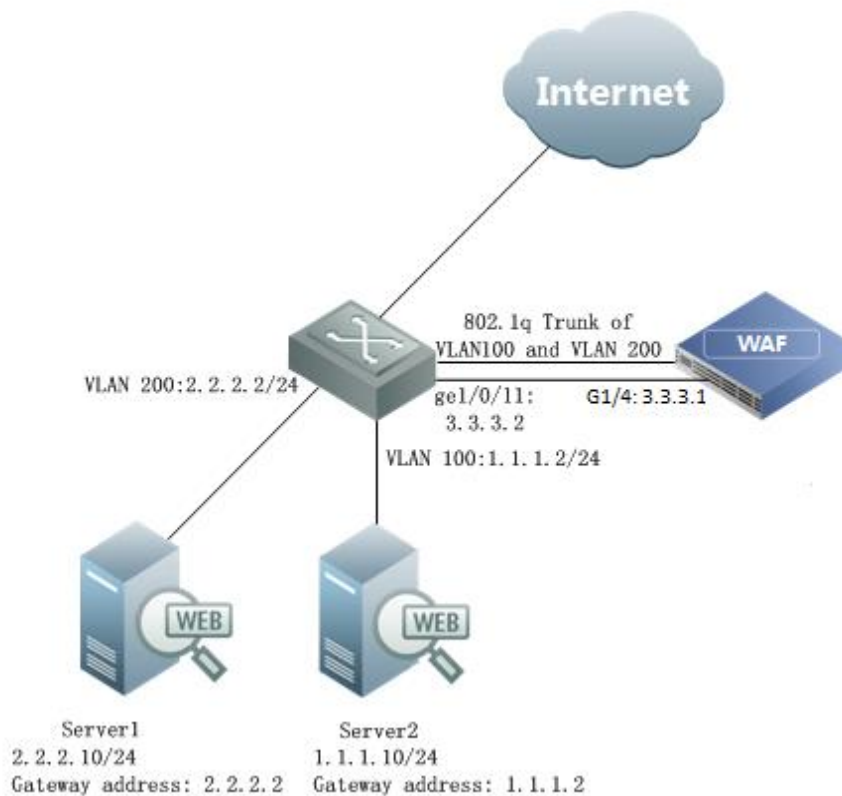
## 3.1.2 Layer 2 Injection

### Scenario

WAF protects multiple VLANs simultaneously and proxies the access to two servers, 1.1.1.10 and 2.2.2.10. Therefore, for the server 1.1.1.10, access requests appear to come from the IP address (1.1.1.1) of VLAN 100 on WAF; for the server 2.2.2.10, access requests seem to come from the IP address (2.2.2.1) of VLAN 200 on WAF. WAF uses interface G1/4 as the diversion interface and uses interface G1/2 as the injection interface. [Figure 3-3](#) shows the topology.



Figure 3-3 Layer 2 injection — topology




## Switch Configuration

Configuration Command	Description
<pre>interface GigabitEthernet1/0/11 description Connect-To-WAF-Diversion no switchport ip address 3.3.3.2 255.255.255.252 !</pre>	These commands configure the diversion interface as a layer 3 interface that directly connects to interface G1/4 on WAF.
<pre>interface GigabitEthernet1/0/13 switchport trunk encapsulation dot1q switchport trunk allowed vlan 100,200 switchport mode trunk !</pre>	These commands configure an injection interface that: <ul style="list-style-type: none"> <li>• Directly connects to interface G1/2 on WAF.</li> <li>• Works in trunk mode and uses dot1q encapsulation.</li> <li>• Allows traffic from VLAN 200 to pass through.</li> </ul>
<pre>interface GigabitEthernet1/0/15 switchport access vlan 200 switchport mode access !</pre>	These commands configure the interface used by the switch to connect to server 1.

Configuration Command	Description
interface GigabitEthernet1/0/21 switchport access vlan 100 switchport mode access !	These commands configure the interface used by the switch to connect to server 2.
interface Vlan100 ip address 1.1.1.2 255.255.255.0 no ip proxy-arp !	These commands achieve the following: <ul style="list-style-type: none"> <li>• Configure VLAN 100 to which server 2 belongs and the IP address of server 2.</li> <li>• Disable proxy ARP in VLAN 100.</li> </ul>
interface Vlan200 ip address 2.2.2.2 255.255.255.0 no ip proxy-arp	These commands achieve the following: <ul style="list-style-type: none"> <li>• Configure VLAN 200 to which server 1 belongs and the IP address of server 1.</li> <li>• Disable proxy ARP in VLAN 200.</li> </ul>
ip route 1.1.1.10 255.255.255.255 1.1.1.1 ip route 2.2.2.10 255.255.255.255 2.2.2.1	These commands are used to configure a static route that diverts traffic destined for the server to the diversion interface on WAF.

## WAF Configuration

 Note	<ul style="list-style-type: none"> <li>• Both the diversion interface and the injection interface on WAF need to be configured as WAN interfaces that are in different network segments.</li> <li>• The injection interface needs to be configured with two subinterfaces.</li> </ul>
---	---

### Configuring the Diversion Interface and Injection Interface

**Step 1** Create a work group.

- a. Choose **System Management > Network Configuration > Work Group Management**.

Figure 3-4 Layer 2 injection — Work Group Management page

WAF System Monitoring Security Management Logs & Reports System Management Hello\_admin ENGLISH Upgrade About 退出

Network Configuration System Deployment System Tools Test Tools ESPC User Management

Work Group Management Route Configuration DNS Configuration

**Available Interfaces**

G1/2 G1/3 G1/4 G2/1 G2/2 G2/3 G2/4

**Management Interfaces** Add

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

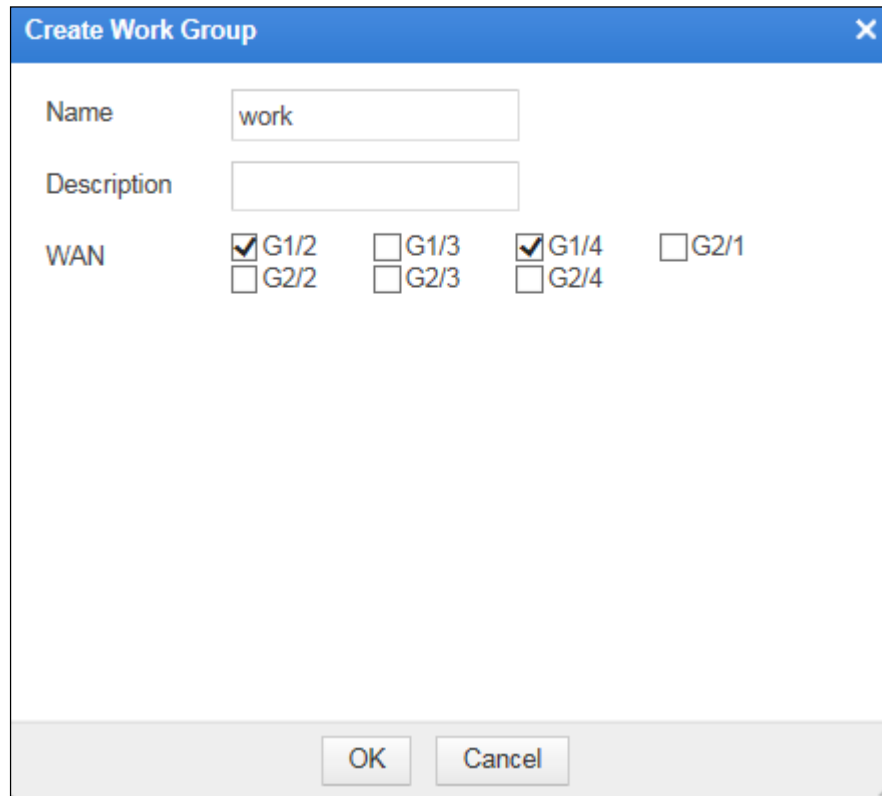
**Work Group** Add

default View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	

- b. In the lower-right corner of the work group list, click **Add** to add a work group (called **work** for example), using interfaces G1/2 and G1/4 as the injection interface and diversion interface respectively, as shown in [Figure 3-5](#).

Figure 3-5 Layer 2 injection — creating a work group



The image shows a 'Create Work Group' dialog box with a blue title bar and a close button (X) in the top right corner. The dialog contains the following fields and options:

- Name:** A text input field containing the text 'work'.
- Description:** An empty text input field.
- WAN:** A section with several checkboxes:
  - ☒ G1/2
  - ☐ G1/3
  - ☒ G1/4
  - ☐ G2/1
  - ☐ G2/2
  - ☐ G2/3
  - ☐ G2/4

At the bottom of the dialog are two buttons: 'OK' and 'Cancel'.

- c. Click **OK** to return to the **Work Group Management** page.  
The new work group, **work**, appears on the page, as shown in [Figure 3-6](#).

Figure 3-6 Layer 2 injection — new work group on the Work Group Management page

WAF System Monitoring Security Management Logs & Reports System Management Hello\_admin ENGLISH Upgrade About

Network Configuration System Deployment System Tools Test Tools ESPC User Management

**Available Interfaces**

G1/3 G2/1 G2/2 G2/3 G2/4

**Management Interfaces** Add

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

**Work Group** Add

default View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	

work View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/2	WAN	Copper	Unknown/Unknown		Auto	Auto	1500Byte	
G1/4	WAN	Copper	Unknown/Unknown		Auto	Auto	1500Byte	

**Step 2** Configure a diversion interface.

- In the work group table shown in Figure 3-6, click in the row of interface G1/4 to configure interface parameters in the **Edit Interface** dialog box, as shown in Figure 3-7.
- Click **OK** to complete the configuration.

Figure 3-7 Layer 2 injection — editing diversion interface configuration

**Edit Interface**

Name: G1/4

Media: Copper

☒ IPv4 Address: 3.3.3.1 Mask: 255.255.255.252 ☐ Web Access ☐ SSH Login

☐ IPv6 Address: Mask: ☐ Web Access ☐ SSH Login

Subinterface Configuration: [Add Subinterface](#) All subinterfaces use the 802.1q protocol for encapsulation.

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPv4: 1.1.1.2  
IPv6:

☐ Advanced

OK Reset Cancel

**Step 3** Configure the injection interface.

- a. In the work group table shown in [Figure 3-6](#), click in the row of interface G1/2 and configure interface parameters in the **Edit Interface** dialog box, as shown in [Figure 3-8](#).

Figure 3-8 Layer 2 injection — editing injection interface configuration

The 'Edit Interface' dialog box displays the following configuration for interface G1/2:

- Name:** G1/2
- Media:** Copper
- IPv4 Address:**  **Mask:**  ☐ Web Access ☐ SSH Login
- IPv6 Address:**  **Mask:**  ☐ Web Access ☐ SSH Login
- Subinterface Configuration:** [Add Subinterface](#) All subinterfaces use the 802.1q protocol for encapsulation.
- Rate:**
- Duplex Mode:**
- MTU(Byte):**  Please enter a number ranging from 512 to 1500.
- Default Gateway:** IPv4  x IPv6
- ☐ Advanced

Buttons at the bottom: OK, Reset, Cancel.

- b. In the **Edit Interface** dialog box shown in Figure 3-8, click the **Add Subinterface** link to add a subinterface for interface G1/2, for example VLAN 100, as shown in Figure 3-9.

Figure 3-9 Layer 2 injection — adding subinterface 1

The 'Edit Interface' dialog box displays the configuration for adding a new subinterface:

- VLAN:**  Please enter a number ranging from 2 to 4094.
- IPv4 Address:**  **Mask:**  ☐ Web Access ☐ SSH Login
- IPv6 Address:**  **Mask:**  ☐ Web Access ☐ SSH Login

Buttons at the bottom: Add, Return.

- c. Click **Add** to successfully add VLAN 100 and return to the **Edit Interface** dialog box of interface G1/2.
- d. Re-click the **Add Subinterface** link to add the second subinterface, VLAN 200.

Figure 3-10 Layer 2 injection — adding subinterface 2

The screenshot shows a web-based dialog box titled "Edit Interface". It contains the following fields and options:

- VLAN:** A text input field containing "200". To its right is a hint: "Please enter a number ranging from 2 to 4094."
- IPv4 Address:** A text input field containing "2.2.2.1".
- Mask:** A text input field containing "255.255.255.0".
- IPv6 Address:** An empty text input field.
- Mask:** An empty text input field.
- Web Access:** A checkbox that is currently unchecked.
- SSH Login:** A checkbox that is currently unchecked.
- Web Access:** A second checkbox, also unchecked.
- SSH Login:** A second checkbox, also unchecked.

At the bottom of the dialog, there are two buttons: "Add" and "Return".

- e. Click **Add** to successfully add VLAN 200 and return to the **Edit Interface** dialog box of interface G1/2.



Figure 3-11 Layer 2 injection — two subinterfaces of the injection interface

**Edit Interface**

Name: G1/2

Media: Copper

☐ IPv4 Address: [ ] Mask: [ ] ☐ Web Access ☐ SSH Login

☐ IPv6 Address: [ ] Mask: [ ] ☐ Web Access ☐ SSH Login

Subinterface Configuration: [Add Subinterface](#) + All subinterfaces use the 802.1q protocol for encapsulation.

VLAN	IP/MASK	Operation
100	<input checked="" type="checkbox"/> 1.1.1.1/255.255.255.0 SSH Login:Prohibited	Web Access:Prohibited
200	<input checked="" type="checkbox"/> 2.2.2.1/255.255.255.0 SSH Login:Prohibited	Web Access:Prohibited

Rate: Auto ▾

Duplex Mode: Auto ▾

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPV4 1.1.1.2 x IPV6 [ ]

☐ Advanced

OK Reset Cancel

f. Click **OK** to complete the configuration.

----End

## Configuring an Injection Route

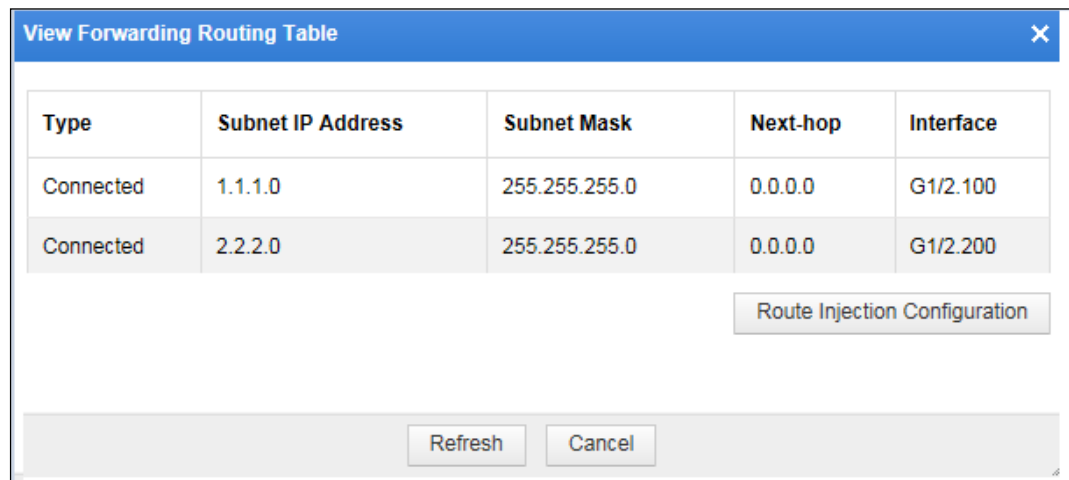


**Note**

After you configure IP addresses of injection subinterfaces, WAF has a direct route to the network segment of the server. You can check this route from the routing table, without configuring an injection route manually.

In the work group table shown in [Figure 3-6](#), click the **View Forwarding Routing Table** link to view injection routes in the routing table, as shown in [Figure 3-12](#).

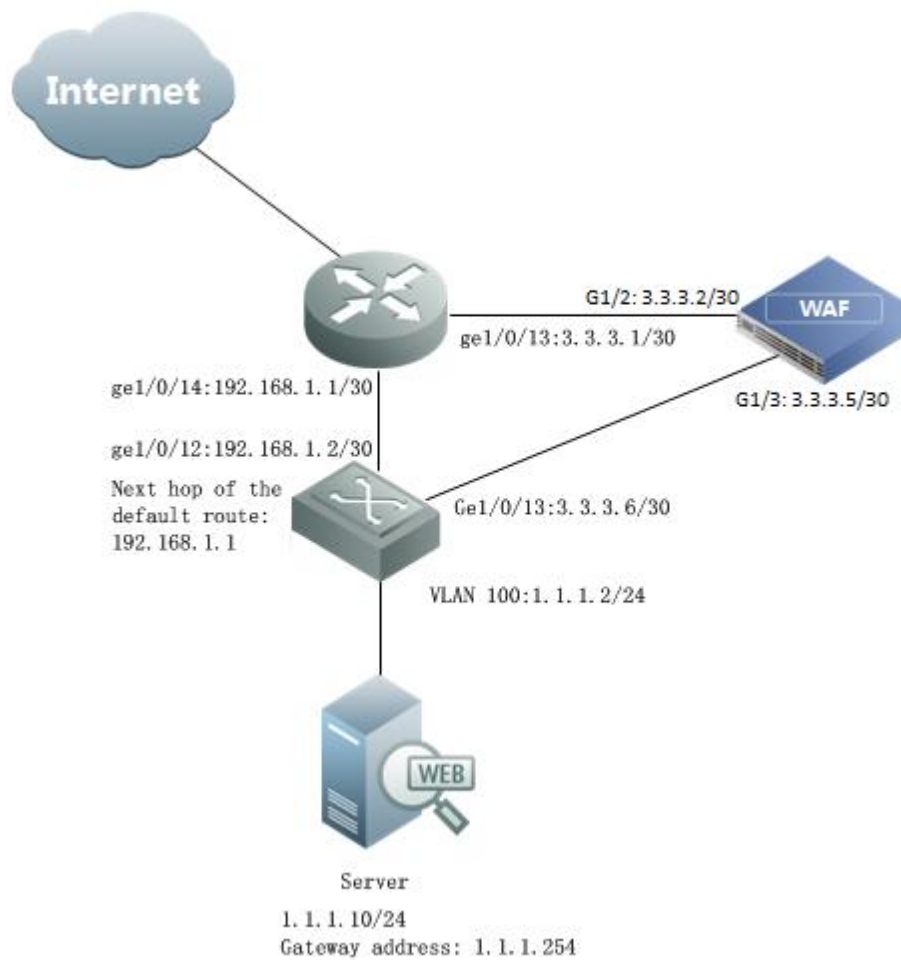
Figure 3-12 Layer 2 injection — View Forwarding Routing Table dialog box



### 3.1.3 Crossover Injection

Figure 3-13 shows the crossover injection deployment topology.

Figure 3-13 Crossover injection — topology



## Router and Switch Configuration

### Router Configuration

Configuration Command	Description
<pre>interface GigabitEthernet1/0/11 description Connect-To-Internet no switchport ip address 10.10.10.1 255.255.255.0 !</pre>	These commands configure the interface used by the router to connect to the client (Internet).
<pre>interface GigabitEthernet1/0/13 description Connect-To- WAF-Diversion no switchport ip address 3.3.3.1 255.255.255.252 !</pre>	These commands configure the diversion interface as a layer 3 interface that directly connects to interface G1/2 on WAF.

Configuration Command	Description
interface GigabitEthernet1/0/14 no switchport ip address 192.168.1.1 255.255.255.0 !	These commands configure the IP address of the interface used by the router to connect to the downstream switch.
ip route 1.1.1.10 255.255.255.255 3.3.3.2 !	This command configures a static route from the server directly to the diversion interface on WAF.

## Switch Configuration

Configuration Command	Description
interface GigabitEthernet1/0/12 no switchport ip address 192.168.1.2 255.255.255.252 !	These commands configure the IP address of the interface used by the switch to connect the router.
interface GigabitEthernet1/0/13 no switchport ip address 3.3.3.6 255.255.255.252 !	These commands configure the IP address of the injection interface connecting to WAF.
interface Vlan100 ip address 1.1.1.2 255.255.255.0 !	These commands configure VLAN 100.
interface GigabitEthernet1/0/21 switchport access vlan 100 switchport mode access !	These commands specify that the server's interface that connects to the switch belongs to VLAN 100.
ip route 0.0.0.0 0.0.0.0 192.168.1.1 !	This command configures a default route.

## WAF Configuration

You need to configure the diversion interface, injection interface, and an injection route on WAF. The configuration method is the same as that in layer 2 injection mode. For details, see [WAF Configuration](#) in section 3.1.2 Layer 2 Injection.

### 3.1.4 PBR Injection

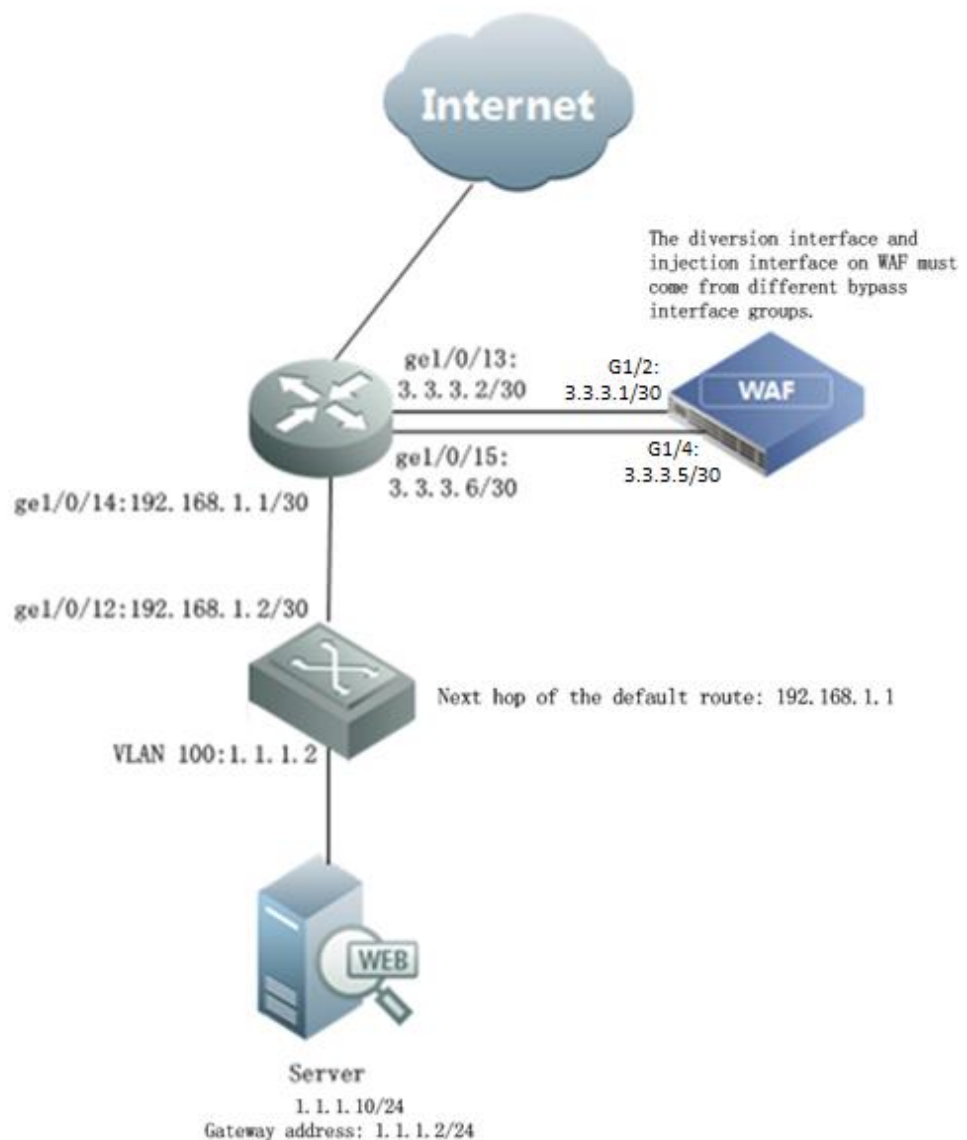
PBR injection include the following:

- [Layer 3 Interface Injection](#)
- [Layer 3 Trunk Injection](#)
- [One-Arm Layer 3 Injection](#)

### 3.1.4.1 Layer 3 Interface Injection

Figure 3-14 shows the layer 3 interface injection topology. On this topology, WAF uses interface G1/2 as the diversion interface and interface G1/4 as the injection interface.

Figure 3-14 Layer 3 interface injection — topology



## Switch and Router Configuration

### Router Configuration


Configuration Command	Description
<pre>interface GigabitEthernet1/0/11 description Connect-To-Internet no switchport ip address 10.10.10.1 255.255.255.0 !</pre>	These commands configure the interface used by the router to connect the client (Internet).
<pre>interface GigabitEthernet1/0/14 description Connect-To-Below-Router no switchport ip address 192.168.1.1 255.255.255.252 !</pre>	These commands configure the interface used by the router to connect to the downstream switch.
<pre>interface GigabitEthernet1/0/13 description Connect-To- WAF-Diversion no switchport ip address 3.3.3.2 255.255.255.252 !</pre>	These commands configure the diversion interface as a layer 3 interface that directly connects to interface G1/2 on WAF.
<pre>interface GigabitEthernet1/0/15 description Connect-To- WAF-Injection no switchport ip address 3.3.3.6 255.255.255.252 ip policy route-map waf !</pre>	<p>These commands achieve the following:</p> <ul style="list-style-type: none"> <li>• Configure the injection interface that directly connects to interface G1/4 on WAF.</li> <li>• Apply the PBR (route-map named <b>WAF</b>) on the injection interface.</li> </ul>
<pre>ip route 1.1.1.10 255.255.255.255 3.3.3.1 !</pre>	This command configures a static route from the server directly to the diversion interface of WAF.
<pre>access-list 100 permit ip any 1.1.1.0 0.0.0.255</pre>	This command configures an access control policy that only matches packets destined for 1.1.1.0/24, the network segment of the server.
<pre>route-map waf permit 10 match ip address 100 set ip next-hop 192.168.1.2 !</pre>	These commands configure a PBR. For packets destined for the network segment (access-list 100) of the server, the next-hop IP address is the IP address (192.168.1.2) of an interface on the router.

## Switch Configuration

Configuration Command	Description
<pre>interface GigabitEthernet1/0/12 no switchport ip address 192.168.1.2 255.255.255.252 !</pre>	These commands configure the IP address of the interface used by the switch to connect to the upstream router.

Configuration Command	Description
<pre>interface Vlan100 ip address 1.1.1.2 255.255.255.0  !</pre>	These commands configure VLAN 100.
<pre>interface GigabitEthernet1/0/21 switchport access vlan 100 switchport mode access  !</pre>	These commands specify that the server's interface that connects to the switch belongs to VLAN 100.
<pre>ip route 0.0.0.0 0.0.0.0 192.168.1.1  !</pre>	This command configures a default route.

## WAF Configuration

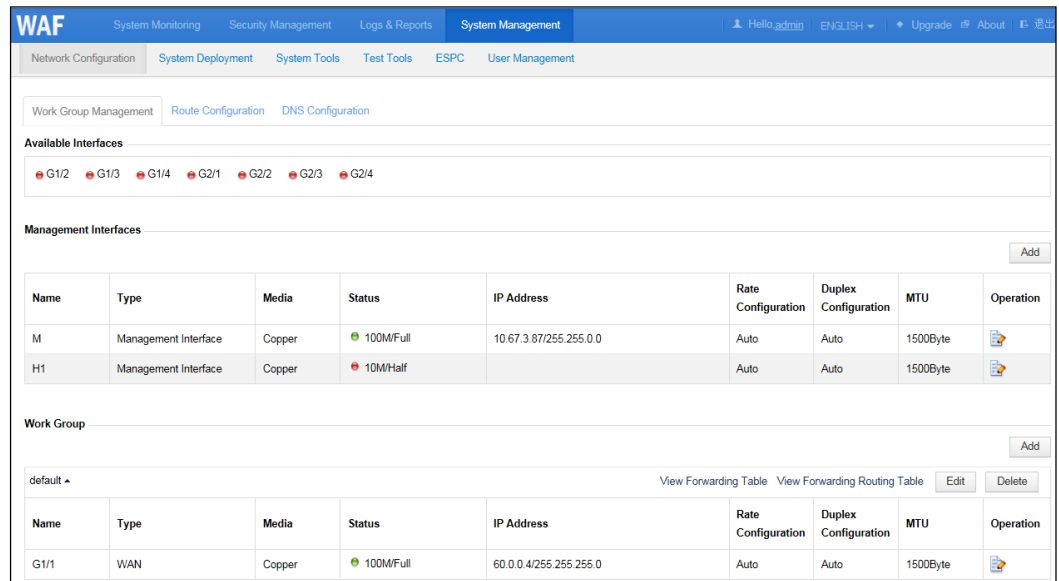
	<ul style="list-style-type: none"> <li>Both the diversion interface and injection interface on WAF need to be configured as WAN interfaces that are in different network segments.</li> <li>No subinterface needs to be configured on the injection interface.</li> </ul>
--	---

### Configuring the Diversion Interface and Injection Interface

**Step 1** Create a work group.

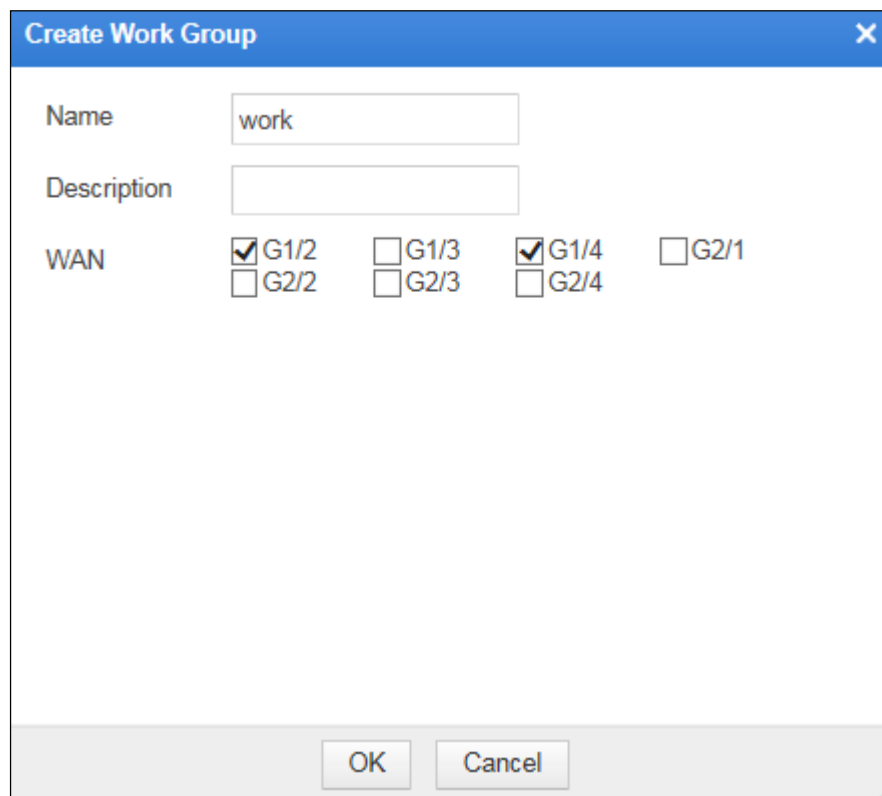
- a. Choose **System Management > Network Configuration > Work Group Management**.

Figure 3-15 Layer 3 interface injection — Work Group Management page



- b. In the lower-right corner of the work group list shown in Figure 3-15, click **Add** to add a work group, using interface G1/2 and G1/4 as the diversion interface and injection interface respectively, as shown in Figure 3-16.

Figure 3-16 Layer 3 interface injection — Create Work Group dialog box





- c. Click **OK** to return to the **Work Group Management** page, as shown in [Figure 3-17](#).

Figure 3-17 Layer 3 interface injection — new work group on the Work Group Management page

**WAF** System Monitoring Security Management Logs & Reports System Management Hello admin ENGLISH Upgrade About

Network Configuration System Deployment System Tools Test Tools ESPC User Management

**Available Interfaces**

G1/3 G2/1 G2/2 G2/3 G2/4

**Management Interfaces** Add

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

**Work Group** Add

default View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	

work View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/2	WAN	Copper	Unknown/Unknown		Auto	Auto	1500Byte	
G1/4	WAN	Copper	Unknown/Unknown		Auto	Auto	1500Byte	

## Step 2 Configure the diversion interface.

- Click in the row of interface G1/2 and configure interface parameters in the **Edit Interface** dialog box, as shown in [Figure 3-18](#).
- Click **OK** to complete the configuration.

Figure 3-18 Layer 3 interface injection — editing diversion interface configuration

**Edit Interface**

Name: G1/2

Media: Copper

☒ IPv4 Address: 3.3.3.1 Mask: 255.255.255.252 ☐ Web Access ☐ SSH Login

☐ IPv6 Address: Mask: ☐ Web Access ☐ SSH Login

Subinterface Configuration: [Add Subinterface](#) All subinterfaces use the 802.1q protocol for encapsulation.

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPv4: 1.1.1.2 IPv6:

☐ Advanced

OK Reset Cancel

**Step 3** Configure the injection interface.

- a. Click in the row of interface G1/4 and configure interface parameters in the **Edit Interface** dialog box, as shown in Figure 3-19.

Figure 3-19 Layer 3 interface injection — editing injection interface configuration

**Edit Interface**

Name: G1/4

Media: Copper

☒ IPv4 Address: 3.3.3.5 Mask: 255.255.255.252 ☐ Web Access ☐ SSH Login

☐ IPv6 Address: Mask: ☐ Web Access ☐ SSH Login

Subinterface Configuration: [Add Subinterface](#) All subinterfaces use the 802.1q protocol for encapsulation.

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPv4: 1.1.1.2 IPv6:

☐ Advanced

OK Reset Cancel

- b. Click **OK** to complete the configuration and return to the **Work Group Management** page, as shown in [Figure 3-20](#).

Figure 3-20 Layer 3 interface injection — interface configuration on the Work Group Management page

The screenshot displays the 'Work Group Management' page in the NSFOCUS WAF V6.0 interface. The page is divided into several sections:

- Available Interfaces:** A list of available interfaces: G1/3, G2/1, G2/2, G2/3, and G2/4.
- Management Interfaces:** A table listing configured management interfaces.
- Work Group:** A section for configuring work groups, including a 'default' group and a 'work' group.

**Management Interfaces Table:**

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

**Work Group Configuration:**

The 'work' group is expanded, showing the following interfaces:

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/2	WAN	Copper	1000M/Full	3.3.3.1/255.255.255.252	Auto	Auto	1500Byte	
G1/4	WAN	Copper	Unknown/Unknown	3.3.3.5/255.255.255.252	Auto	Auto	1500Byte	

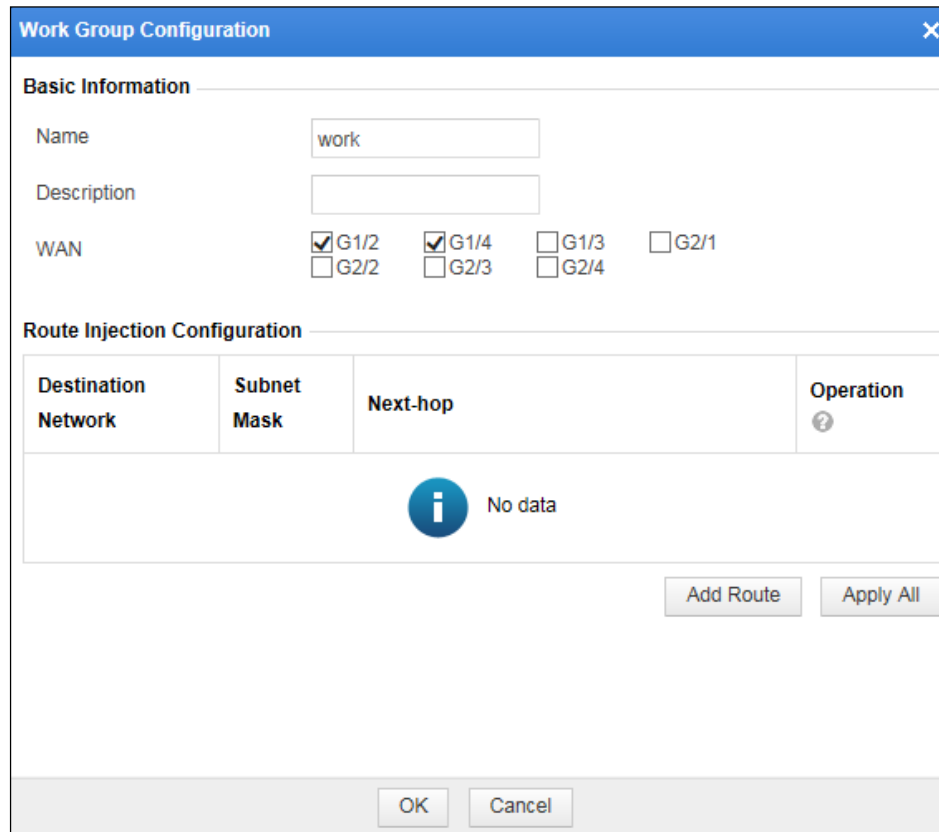
----End

## Configuring an Injection Route

**Step 1** On the **Work Group Management** page shown in [Figure 3-20](#), click **Edit** in the upper-right corner of the **work** group.

The **Work Group Configuration** dialog box appears, as shown in [Figure 3-21](#).

Figure 3-21 Layer 3 interface injection — editing a work group




The dialog box is titled "Work Group Configuration" and contains two main sections: "Basic Information" and "Route Injection Configuration".

**Basic Information**

- Name:** A text input field containing the value "work".
- Description:** An empty text input field.
- WAN:** A group of checkboxes for interface selection:
  - ☒ G1/2
  - ☒ G1/4
  - ☐ G1/3
  - ☐ G2/1
  - ☐ G2/2
  - ☐ G2/3
  - ☐ G2/4

**Route Injection Configuration**

Destination Network	Subnet Mask	Next-hop	Operation ?
 No data			

At the bottom right of the table area are two buttons: "Add Route" and "Apply All".

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

**Step 2** In the lower-right corner of the injection route list, click **Add Route** to add an injection route, as shown in [Figure 3-22](#).

Figure 3-22 Layer 3 Interface injection — adding an injection route

**Work Group Configuration** [X]

**Add Injection Route**

Destination Network: 1.1.1.10

Subnet Mask: 255.255.255.255

Next-Hop IP Address: 3.3.3.6 [X] (+)

OK Cancel

**Note**

**Destination Network** (1.1.1.10) is the IP address of the server, and **Next-Hop IP Address** (3.3.3.6) is the IP address of the injection interface on the switch directly connected to WAF.

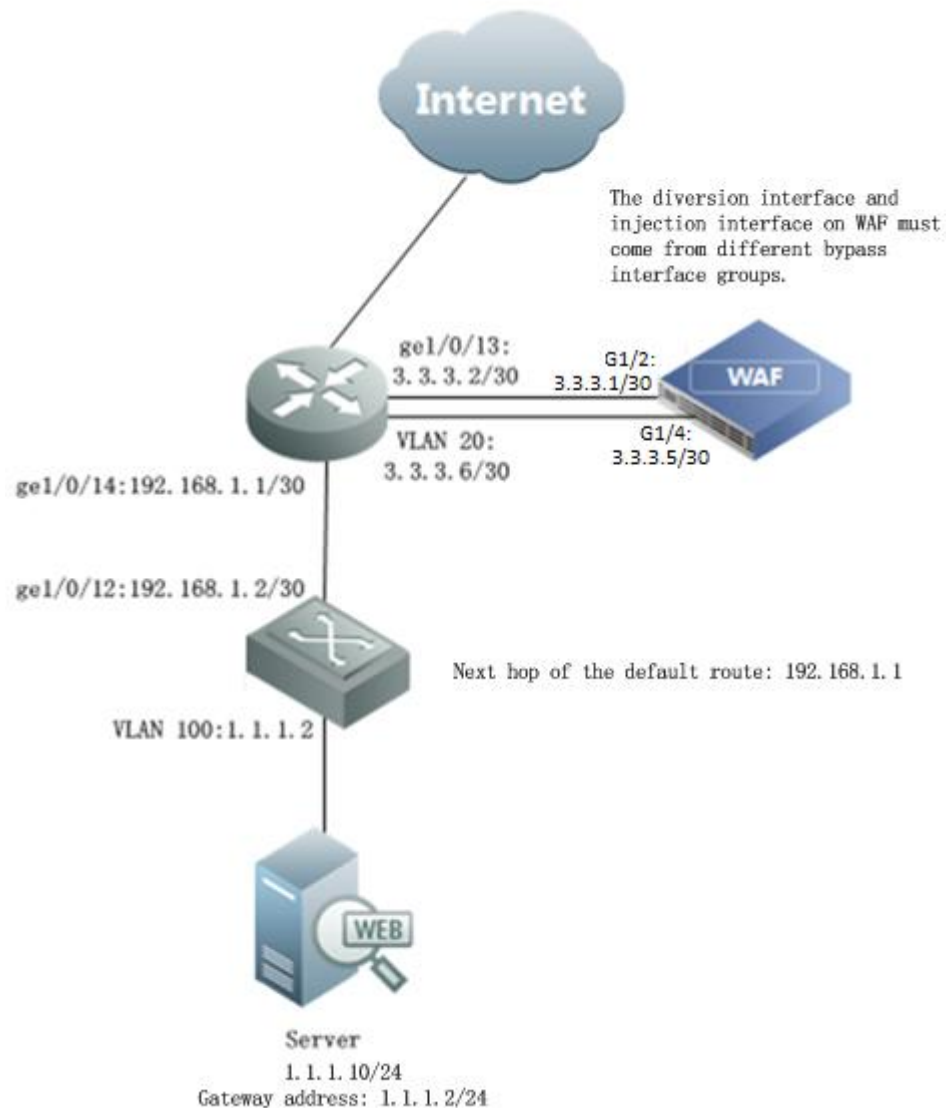
**Step 3** Click **OK** to complete the configuration.

----End

### 3.1.4.2 Layer 3 Trunk Injection

As shown in [Figure 3-23](#), the router directly connects to WAF and the Internet, and the switch connects to the server. The router directly connecting to WAF uses a layer 3 interface as the diversion interface and uses a trunk interface as the injection interface. WAF uses interface G1/2 as the diversion interface and interface G1/4 as the injection interface.

Figure 3-23 Layer 3 trunk injection — topology



## Router and Switch Configuration

### Router Configuration


Configuration Command	Description
<pre>interface GigabitEthernet1/0/11 description Connect-To-Internet no switchport ip address 10.10.10.1 255.255.255.0 !</pre>	These commands configure the interface used by the router to connect to the client (Internet).

Configuration Command	Description
<pre>interface GigabitEthernet1/0/14 description Connect-To-Below-Router no switchport ip address 192.168.1.1 255.255.255.252 !</pre>	These commands configure the interface used by the router to connect to the downstream switch.
<pre>interface GigabitEthernet1/0/13 description Connect-To- WAF-Diversion no switchport ip address 3.3.3.2 255.255.255.252 !</pre>	These commands configure the diversion interface as a layer 3 interface that directly connects to interface G1/2 on WAF
<pre>interface GigabitEthernet1/0/15 description Connect-To-Inject-WAF switchport trunk encapsulation dot1q switchport trunk allowed vlan 20 switchport mode trunk !</pre>	<p>These commands configure an injection interface that:</p> <ul style="list-style-type: none"> <li>• Directly connects to interface G1/4 on WAF.</li> <li>• Works in trunk mode and uses dot1q encapsulation.</li> <li>• Allows traffic from VLAN 20 to pass through.</li> </ul>
<pre>ip route 1.1.1.10 255.255.255.255 3.3.3.1 !</pre>	This command configures a static route from the server directly to the diversion interface of WAF.
<pre>access-list 100 permit ip any 1.1.1.0 0.0.0.255 !</pre>	This command configures an access control policy that only matches packets destined for 1.1.1.0/24, the network segment of the server.
<pre>route-map waf permit 10 match ip address 100 set ip next-hop 192.168.1.2 !</pre>	These commands configure a PBR. For packets destined for the network segment (access-list 100) of the server, the next-hop IP address is the IP address (192.168.1.2) of an interface on the router.
<pre>interface Vlan20 description Injection ip address 3.3.3.6 255.255.255.252  ip policy route-map waf !</pre>	These commands configure VLAN 20 and apply the PBR (route-map named <b>waf</b> ) on it.

## Switch Configuration

Configuration Command	Description
<pre>interface GigabitEthernet1/0/12 no switchport ip address 192.168.1.2 255.255.255.252 !</pre>	These commands configure the IP address of the interface used by the switch to connect to the router.
<pre>interface Vlan100 ip address 1.1.1.2 255.255.255.0 no ip proxy-arp !</pre>	This command configures VLAN 100.
<pre>interface GigabitEthernet1/0/21 switchport access vlan 100 switchport mode access !</pre>	These commands specify that the server's interface that connects to the switch belongs to VLAN 100.
<pre>ip route 0.0.0.0 0.0.0.0 192.168.1.1 !</pre>	This command configures a default route.

## WAF Configuration

	<ul style="list-style-type: none"> <li>Both the diversion interface and injection interface on WAF need to be configured as WAN interfaces that are in different network segments.</li> <li>The injection interface (G1/4) is deployed in trunk mode and needs subinterfaces only.</li> </ul>
---	---

### Configuring the Diversion Interface and Injection Interface

#### Step 1 Create a work group.

- a. Choose **System Management > Network Configuration > Work Group Management**.



Figure 3-24 Layer 3 trunk injection — Work Group Management page

WAF System Monitoring Security Management Logs & Reports System Management Hello admin ENGLISH Upgrade About 退出

Network Configuration System Deployment System Tools Test Tools ESPC User Management

Work Group Management Route Configuration DNS Configuration

Available Interfaces

G1/2 G1/3 G1/4 G2/1 G2/2 G2/3 G2/4

Management Interfaces

Add

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

Work Group

Add

default View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	

- b. In the lower-right corner of the work group list, click **Add** to add a work group, using interfaces G1/2 and G1/4 as the diversion interface and injection interface respectively, as shown in Figure 3-25.

Figure 3-25 Layer 3 trunk injection — Create Work Group dialog box

Create Work Group

Name work

Description

WAN ☒ G1/2 ☐ G1/3 ☒ G1/4 ☐ G2/1  
☐ G2/2 ☐ G2/3 ☐ G2/4

OK Cancel

- c. Click **OK** to return to the **Work Group Management** page, as shown in [Figure 3-26](#).

Figure 3-26 Layer 3 trunk injection — new work group on the Work Group Management page

**WAF** System Monitoring Security Management Logs & Reports System Management Hello admin ENGLISH Upgrade About

Network Configuration System Deployment System Tools Test Tools ESPC User Management

**Available Interfaces**

G1/3 G2/1 G2/2 G2/3 G2/4

**Management Interfaces** Add

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

**Work Group** Add

default View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	

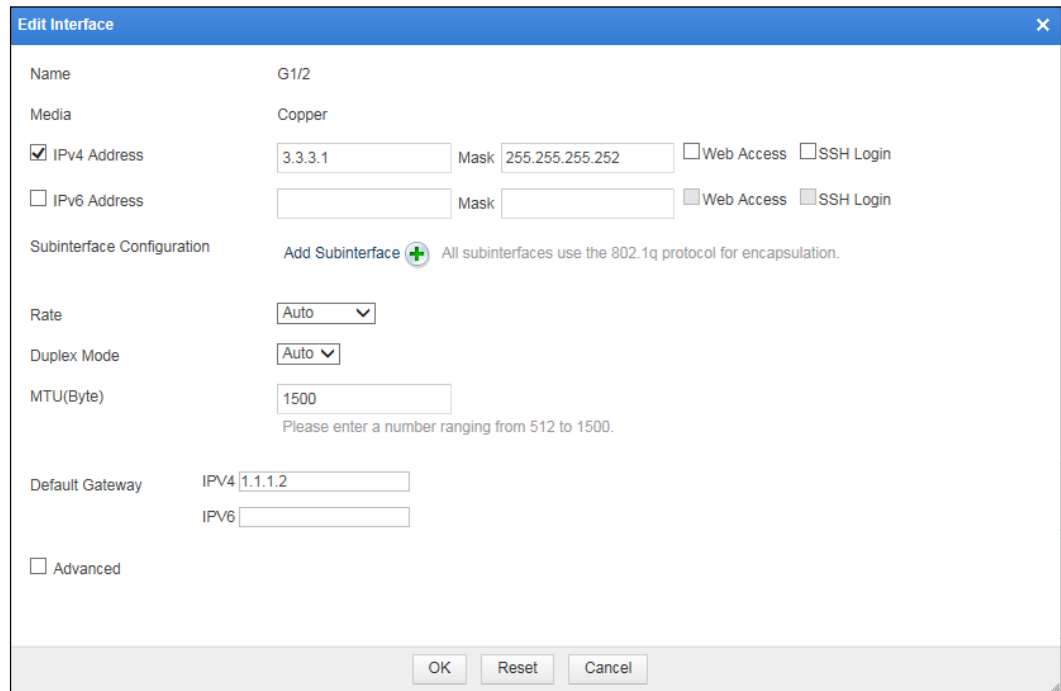
work View Forwarding Table View Forwarding Routing Table Edit Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/2	WAN	Copper	Unknown/Unknown		Auto	Auto	1500Byte	
G1/4	WAN	Copper	Unknown/Unknown		Auto	Auto	1500Byte	

## Step 2 Configure the diversion interface.

- Click in the row of interface G1/2 to edit interface parameters in the **Edit Interface** dialog box, as shown in [Figure 3-27](#).
- Click **OK** to complete the configuration.

Figure 3-27 Layer 3 trunk injection — editing the diversion interface



**Edit Interface**

Name: G1/2

Media: Copper

☒ IPv4 Address: 3.3.3.1 Mask: 255.255.255.252 ☐ Web Access ☐ SSH Login

☐ IPv6 Address: Mask:  ☐ Web Access ☐ SSH Login

Subinterface Configuration: [Add Subinterface](#) (+) All subinterfaces use the 802.1q protocol for encapsulation.

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPV4: 1.1.1.2  
IPV6:

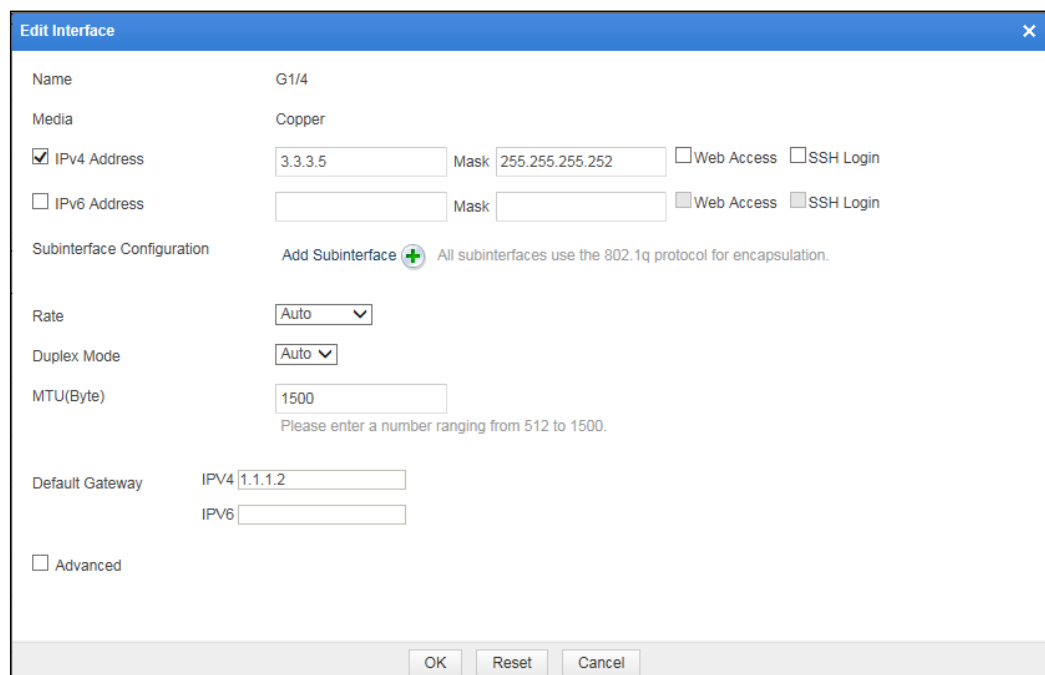
☐ Advanced

OK Reset Cancel

**Step 3** Configure the injection interface.

- a. In the work group table shown in [Figure 3-26](#), click  in the row of interface G1/4 to edit interface parameters in the **Edit Interface** dialog box, as shown in [Figure 3-28](#).

Figure 3-28 Layer 3 trunk injection — editing the injection interface



**Edit Interface**

Name: G1/4

Media: Copper

☒ IPv4 Address: 3.3.3.5 Mask: 255.255.255.252 ☐ Web Access ☐ SSH Login

☐ IPv6 Address: Mask:  ☐ Web Access ☐ SSH Login

Subinterface Configuration: [Add Subinterface](#) (+) All subinterfaces use the 802.1q protocol for encapsulation.

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPV4: 1.1.1.2  
IPV6:

☐ Advanced

OK Reset Cancel

- b. Click the **Add Subinterface** link to add a subinterface, for example, VLAN 20, as shown in [Figure 3-29](#).

Figure 3-29 Layer 3 trunk injection — adding a subinterface

The screenshot shows a web-based configuration window titled "Edit Interface". It contains the following fields and options:

- VLAN:** A text box containing "20". To its right is a note: "Please enter a number ranging from 2 to 4094."
- IPv4 Address:** A text box containing "3.3.3.5".
- Mask:** A text box containing "255.255.255.0".
- IPv6 Address:** An empty text box.
- Mask:** An empty text box.
- Web Access:** A checkbox, currently unchecked.
- SSH Login:** A checkbox, currently unchecked.
- Web Access:** A checkbox, currently unchecked.
- SSH Login:** A checkbox, currently unchecked.

At the bottom of the window, there are two buttons: "Add" and "Return".

- c. Click **Add** to complete the configuration.

----End

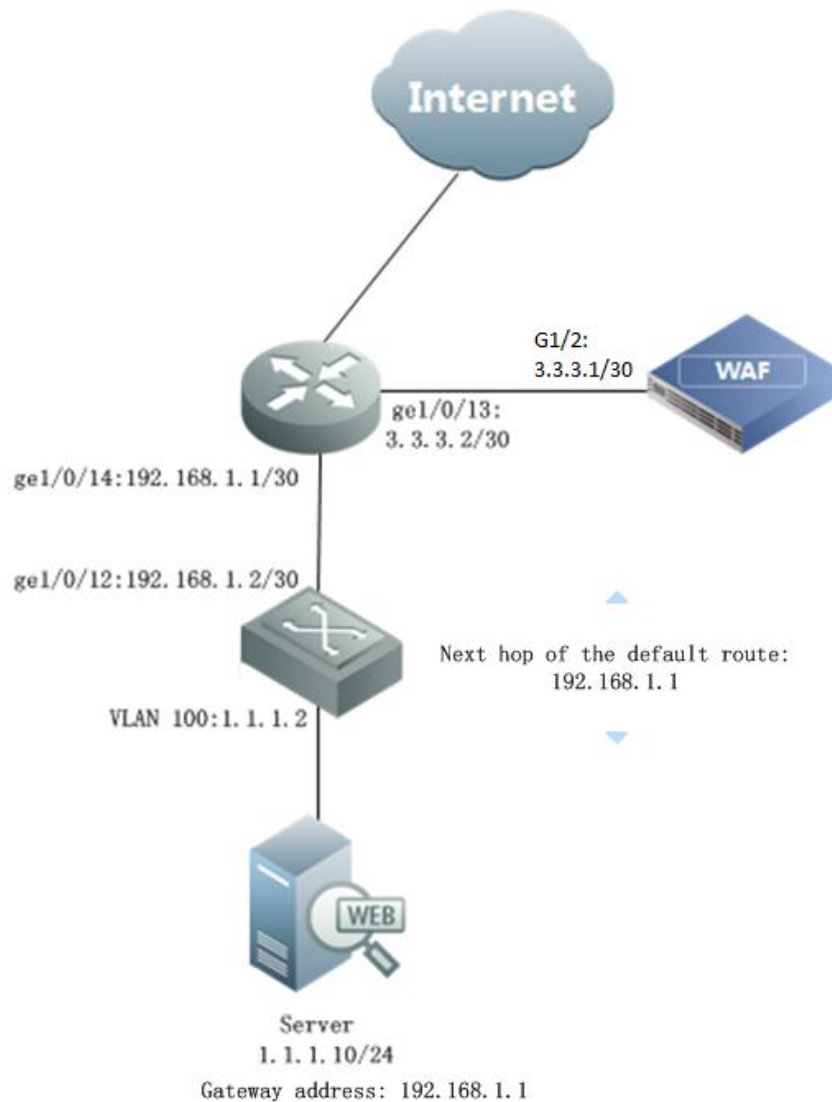
### Configuring an Injection Route

In this mode, the injection route is configured in the same way as the layer 3 interface injection mode. For details, see [Configuring an Injection Route](#) in section 3.1.4.1 Layer 3 Interface Injection.

### 3.1.4.3 One-Arm Layer 3 Injection

[Figure 3-30](#) shows the one-arm layer 3 injection topology. In this mode, both the diversion interface and injection on WAF are interface G1/2.

Figure 3-30 One-Arm layer 3 injection — topology



## Router and Switch Configuration

### Router Configuration

Configuration Command	Description
<pre>interface GigabitEthernet1/0/11 description Connect-To-Internet no switchport ip address 10.10.10.1 255.255.255.0 !</pre>	These commands configure the interface used by the router to connect the client (Internet).

Configuration Command	Description
<pre>interface GigabitEthernet1/0/14 description Connect-To-Below-Router no switchport ip address 192.168.1.1 255.255.255.252 !</pre>	These commands configure the interface used by the router to connect to the downstream switch.
<pre>interface GigabitEthernet1/0/13 description Connect-To- WAF-Diversion no switchport ip address 3.3.3.2 255.255.255.252 ip policy route-map waf !</pre>	<p>These commands achieve the following:</p> <ul style="list-style-type: none"> <li>• Configure a diversion interface as a layer 3 interface that connects to interface G1/2 on WAF.</li> <li>• Apply the PBR (route-map named <b>WAF</b>) on the diversion interface.</li> </ul>
<pre>ip route 1.1.1.10 255.255.255.255 3.3.3.1 !</pre>	This command configures a static route that diverts traffic destined for the server to the diversion interface on WAF.
<pre>access-list 100 permit ip any 1.1.1.0 0.0.0.255 !</pre>	This command configures an access control policy that only matches packets destined for 1.1.1.0/24, the network segment of the server.
<pre>route-map waf permit 10 match ip address 100 set ip next-hop 192.168.1.2 !</pre>	These commands configure a PBR. For packets destined for the network segment (access-list 100) of the server, the next-hop IP address is the IP address (192.168.1.2) of an interface on the router.

## Switch Configuration

Configuration Command	Description
<pre>interface GigabitEthernet1/0/12 no switchport ip address 192.168.1.2 255.255.255.252 !</pre>	These commands configure the IP address of the interface used by the switch to connect to the router.
<pre>interface Vlan100 ip address 1.1.1.2 255.255.255.0 !</pre>	This command configures VLAN 100.
<pre>interface GigabitEthernet1/0/21 switchport access vlan 100 switchport mode access !</pre>	These commands specify that the server's interface that connects to the switch belongs to VLAN 100.

Configuration Command	Description
ip route 0.0.0.0 0.0.0.0 192.168.1.1 !	This command configures a default route.

## WAF Configuration



Interface G1/2 (a WAN interface) is configured as both the diversion interface and injection interface.

### Configuring the Interface

**Step 1** Create a work group.

- a. Choose **System Management > Network Configuration > Work Group Management**.

Figure 3-31 One-arm layer 3 injection — Work Group Management page

WAF

System Monitoring

Security Management

Logs & Reports

System Management

Network Configuration

System Deployment

System Tools

Test Tools

ESPC

User Management

Work Group Management

Route Configuration

DNS Configuration

Available Interfaces

G1/2

G1/3

G1/4

G2/1

G2/2

G2/3

G2/4

Management Interfaces

Add

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	<div></div> 100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	<div></div>
H1	Management Interface	Copper	<div></div> 10M/Half		Auto	Auto	1500Byte	<div></div>

Work Group

Add

default

View Forwarding Table

View Forwarding Routing Table

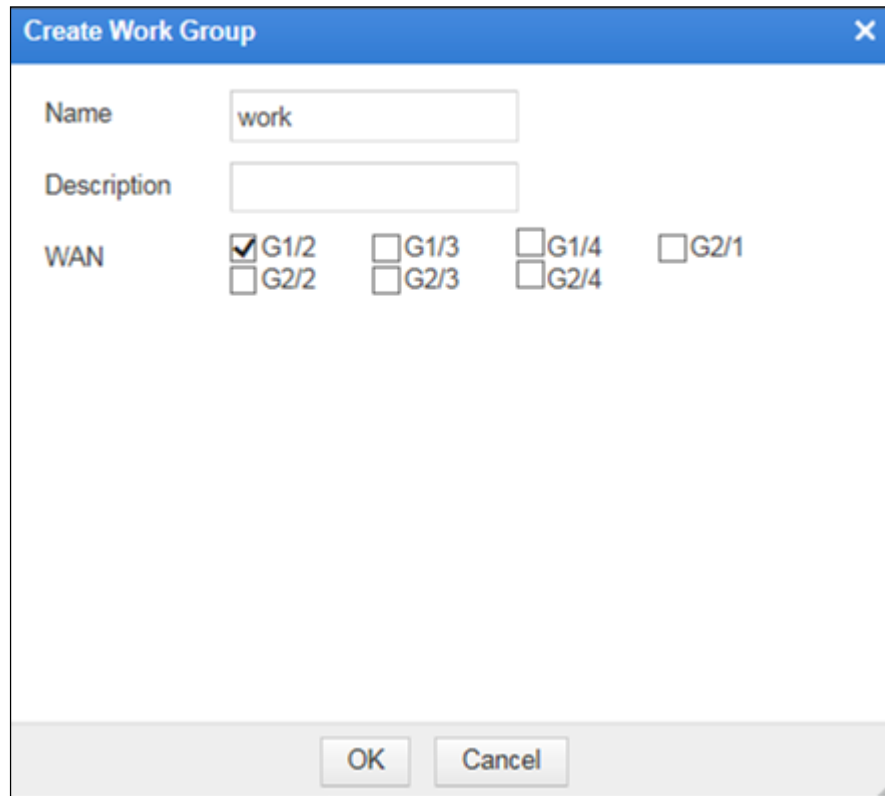
Edit

Delete

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	<div></div> 100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	<div></div>

- b. In the lower-right corner of the work group list, click **Add** to add a work group, using interface G1/2 as both the diversion interface and injection interface, as shown in [Figure 3-32](#).

Figure 3-32 One-arm layer 3 injection — Create Work Group dialog box



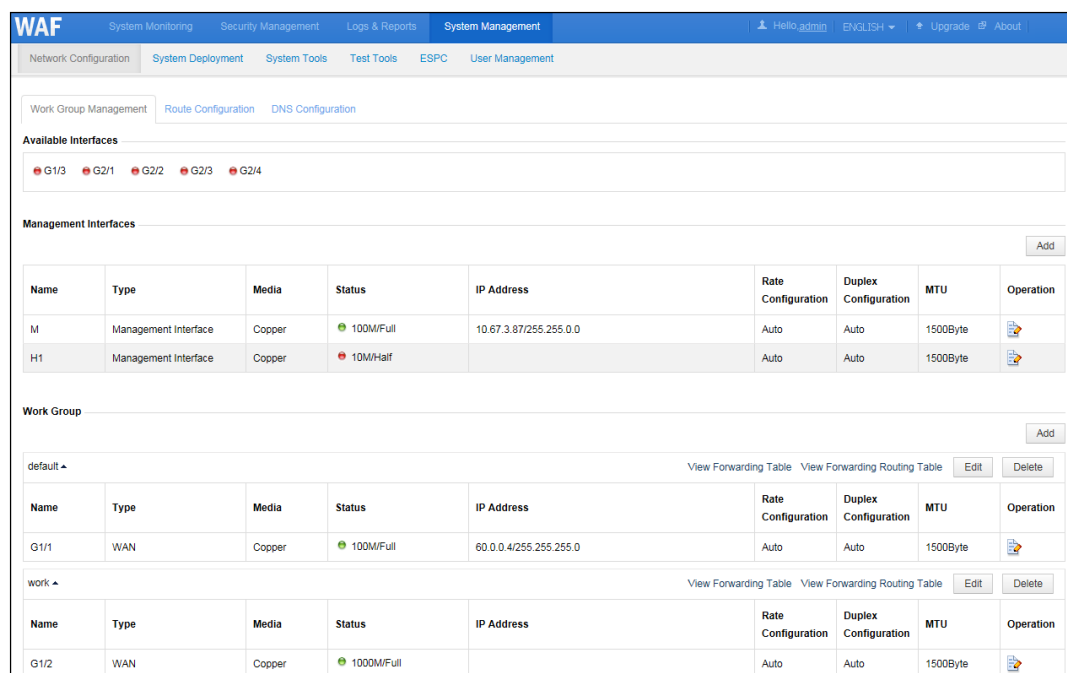
The dialog box titled "Create Work Group" has a blue header bar with a close button (X). It contains the following fields and options:

- Name:** A text input field containing the text "work".
- Description:** An empty text input field.
- WAN:** A section with two columns of checkboxes.
  - Column 1: ☒ G1/2 and ☐ G2/2.
  - Column 2: ☐ G1/3 and ☐ G2/3.
  - Column 3: ☐ G1/4 and ☐ G2/4.
  - Column 4: ☐ G2/1.

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

- c. Click **OK** to return to the **Work Group Management** page, as shown in [Figure 3-33](#).

Figure 3-33 One-arm layer 3 injection — new work group on the Work Group Management page



The screenshot shows the "Work Group Management" page in the NSFOCUS WAF V6.0 interface. The page has a blue header bar with the "WAF" logo and navigation tabs: System Monitoring, Security Management, Logs & Reports, System Management (selected), and a user profile section (Hello admin, ENGLISH, Upgrade, About). Below the header, there are sub-tabs: Network Configuration, System Deployment, System Tools, Test Tools, ESPC, and User Management. The "Work Group Management" sub-tab is active.

The page displays the following sections:

- Available Interfaces:** A list of interfaces: G1/3, G2/1, G2/2, G2/3, and G2/4.
- Management Interfaces:** A table with columns: Name, Type, Media, Status, IP Address, Rate Configuration, Duplex Configuration, MTU, and Operation.
 

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	
- Work Group:** A section with a table showing the configuration for the "work" group.
 

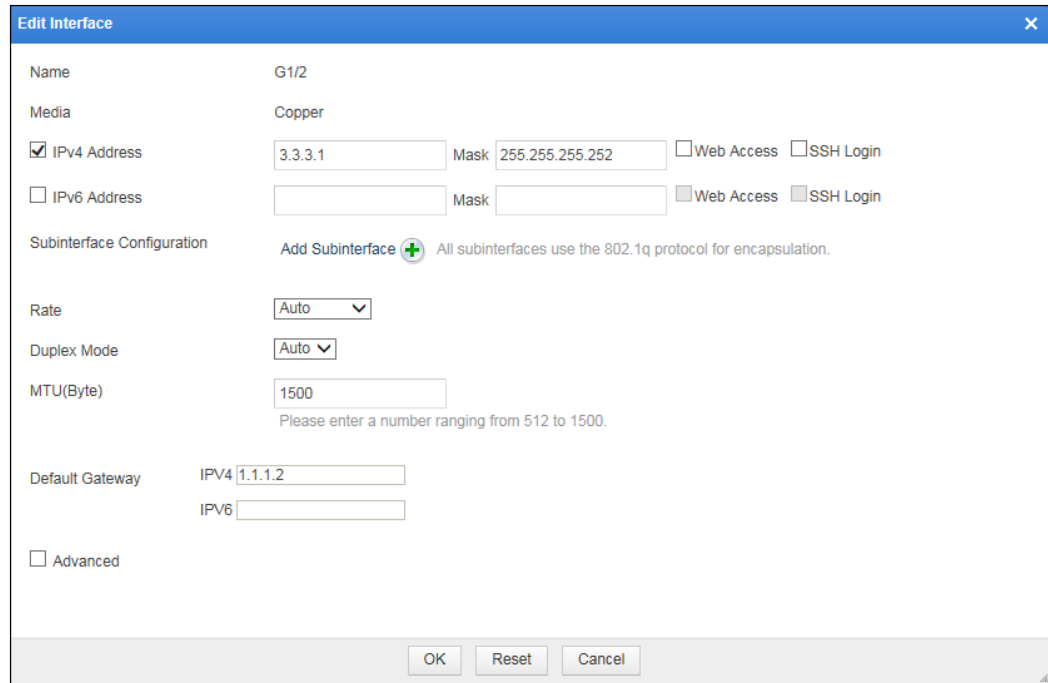
Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/2	WAN	Copper	100M/Full		Auto	Auto	1500Byte	



**Step 2** Configure the interface.

- a. In the work group table shown in [Figure 3-33](#), click  in the row of interface G1/2 to edit interface parameters in the **Edit Interface** dialog box, as shown in [Figure 3-34](#).

Figure 3-34 One-arm layer 3 injection — editing interface configuration




**Edit Interface**

Name: G1/2

Media: Copper

☒ IPv4 Address: 3.3.3.1 Mask: 255.255.255.252 ☐ Web Access ☐ SSH Login

☐ IPv6 Address: Mask: ☐ Web Access ☐ SSH Login

Subinterface Configuration: Add Subinterface  All subinterfaces use the 802.1q protocol for encapsulation.

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPv4: 1.1.1.2  
IPv6:

☐ Advanced

OK Reset Cancel

- b. Click **OK** to complete the configuration and return to the **Work Group Management** page, as shown in [Figure 3-35](#).

Figure 3-35 One-arm layer 3 injection — interface configuration

The screenshot shows the NSFOCUS WAF System Management interface. The top navigation bar includes System Monitoring, Security Management, Logs & Reports, System Management, and a user profile. The left sidebar shows Network Configuration, System Deployment, System Tools, Test Tools, ESPC, and User Management. The main content area is titled 'Work Group Management' and includes tabs for Route Configuration and DNS Configuration.

**Available Interfaces**

G1/3 G2/1 G2/2 G2/3 G2/4

**Management Interfaces**

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.87/255.255.0.0	Auto	Auto	1500Byte	
H1	Management Interface	Copper	10M/Half		Auto	Auto	1500Byte	

**Work Group**

default

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/1	WAN	Copper	100M/Full	60.0.0.4/255.255.255.0	Auto	Auto	1500Byte	

work

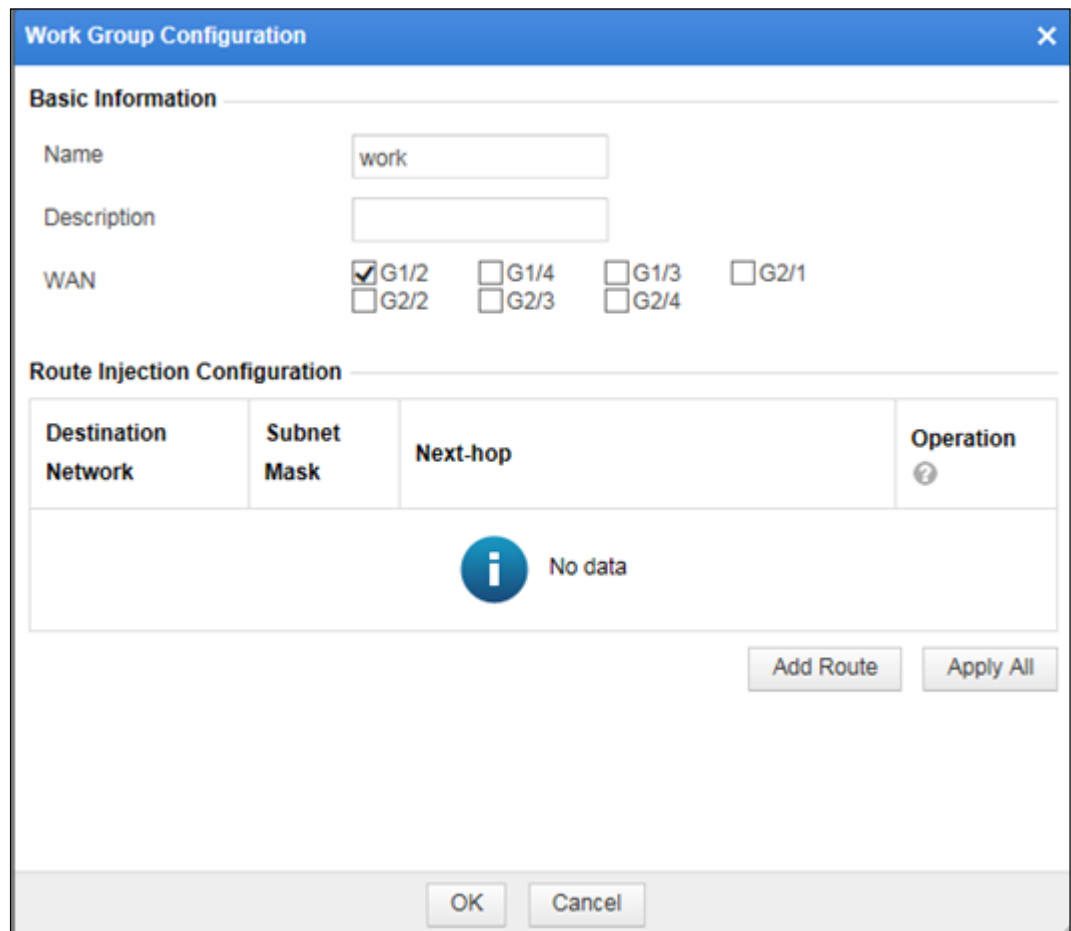
Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/2	WAN	Copper	1000M/Full	3.3.3.1/255.255.255.252	Auto	Auto	1500Byte	

## Configuring an Injection Route

**Step 1** On the **Work Group Management** page shown in [Figure 3-35](#), click **Edit** in the upper-right corner of the work group table.

The **Work Group Configuration** dialog box appears, as shown in [Figure 3-36](#).

Figure 3-36 One-arm layer 3 injection — editing a work group




The dialog box is titled "Work Group Configuration" and contains two main sections: "Basic Information" and "Route Injection Configuration".

**Basic Information**

- Name:** A text field containing the value "work".
- Description:** An empty text field.
- WAN:** A group of checkboxes for network interfaces:
  - ☒ G1/2
  - ☐ G1/4
  - ☐ G1/3
  - ☐ G2/1
  - ☐ G2/2
  - ☐ G2/3
  - ☐ G2/4

**Route Injection Configuration**

Destination Network	Subnet Mask	Next-hop	Operation ?
 No data			

At the bottom right of the table area are two buttons: "Add Route" and "Apply All".

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

**Step 2** In the lower-right corner of the injection route list, click **Add Route** to add an injection route, as shown in [Figure 3-37](#).

Figure 3-37 One-arm layer 3 injection — adding an injection route

**Work Group Configuration** [X]

**Add Injection Route**

Destination Network: 1.1.1.10

Subnet Mask: 255.255.255.255

Next-Hop IP Address: 3.3.3.2 [X] (+)

OK Cancel



**Destination Network** (1.1.1.10) is the IP address of the server, and **Next-Hop IP Address** (3.3.3.2) is the IP address of the injection interface on the switch directly connected to WAF.

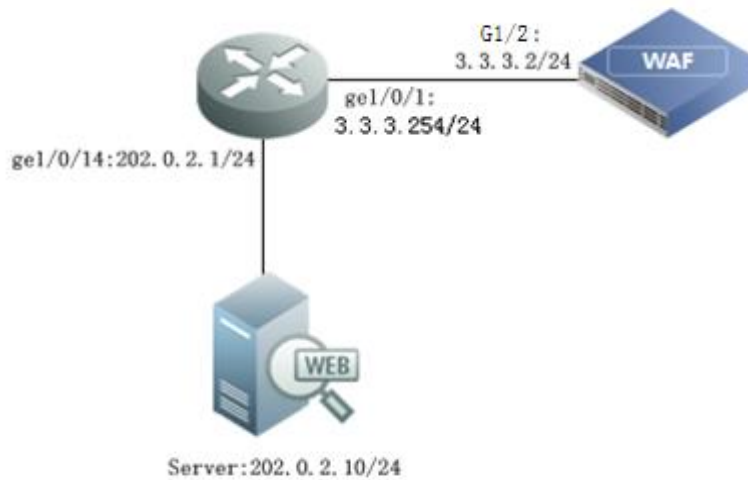
**Step 3** Click **OK** to complete the configuration.

----End

## 3.2 One-Arm Traditional Reverse Proxy

Figure 3-38 shows the one-arm traditional reverse proxy topology of WAF.


Figure 3-38 One-arm traditional reverse proxy — topology



## Router Configuration

Configuration Command	Description
<pre>interface GigabitEthernet1/0/1 description Connect-To-WAF no switchport ip address 3.3. 3.254 255.255.255.0 !</pre>	These commands configure an interface used by the router to connect to a WAN interface on WAF.
<pre>interface GigabitEthernet1/0/14 description Connect-To-Service no switchport ip address 202.0.2.1 255.255.255.0 !</pre>	These commands configure an interface used by the router to connect to the server.

## WAF Configuration

	The IP address of a WAN interface on WAF is configured as the proxied IP address.
---	---

## Configuring a Reverse Proxy Interface

A reverse proxy interface is configured in the same way as the interface configured in one-arm layer 3 injection mode. For details, see [Configuring the Interface](#) in section 3.1.4.3 [One-Arm Layer 3 Injection](#).

## Configuring the Default Route

**Step 1** Choose **System Management > Network Configuration > Route Configuration**.

The **Route Configuration** page appears. Change the IP address of the default gateway to **3.3.3.254**, as shown in [Figure 3-39](#).

Figure 3-39 One-arm traditional reverse proxy — configuring the default route

The screenshot displays the 'Route Configuration' page in the NSFOCUS WAF interface. The top navigation bar includes 'Network Configuration', 'System Deployment', 'System Tools', 'Test Tools', 'ESPC', and 'User Management'. The 'Route Configuration' tab is active. Below the navigation bar, there are three sub-tabs: 'Work Group Management', 'Route Configuration', and 'DNS Configuration'. The 'Default Gateway' section contains an 'IPV4' input field with the value '3.3.3.254', an empty 'IPV6' input field, and an 'OK' button. The 'Static Route' section features an 'Add' button and a table with the following structure:

Destination Network	Gateway	Operation
No data		

**Step 2** Click **OK** to complete the configuration.

----End

## Configuring the Proxied Server

**Step 1** In reverse proxy mode, when adding a website, configure the proxied server and parameters of the proxy server and proxied server, as shown in [Figure 3-40](#).

Figure 3-40 One-arm traditional reverse proxy — adding a website

**Step 2** Click **Complete** to complete the configuration.

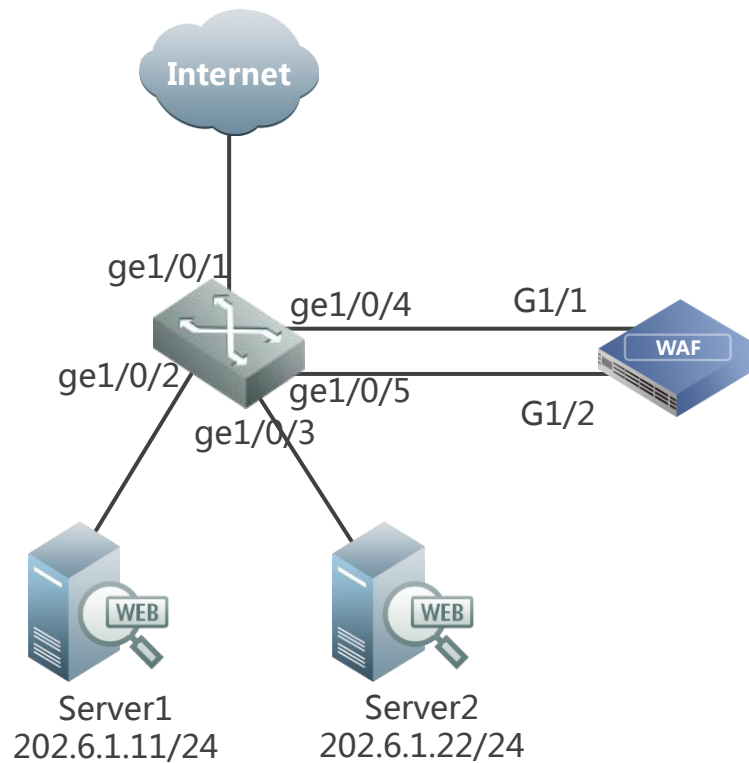
----End

### 3.3 Mirroring Deployment

In the mirroring deployment topology of WAF shown in [Figure 3-41](#), interfaces G1/1 and G1/2 on WAF and ge1/0/4 and ge1/0/5 on the switch are mirroring interfaces.

- Interface ge1/0/4 serves as a mirroring interface of the switch and connects to interface G1/1 of WAF. It is used to mirror data traffic between interface ge1/0/2 and Server1.
- Interface ge1/0/5 serves as the other mirroring interface of the switch and connects to interface G1/2 of WAF. It is used to mirror data traffic between interface ge1/0/3 and Server2.

Figure 3-41 Mirroring deployment topology

**Legend:**

- ge1/0/1: connects to the Internet.
- ge1/0/2: 10.67.1.101/24, connects to Server1.
- ge1/0/3 : 202.6.1.202/24, connects to Server2.

**Switch Configuration**

Configuration Command	Description
<pre>interface GigabitEthernet1/0/2 description Connect-To-Service no switchport ip address 202.6.1.11 255.255.255.0 !</pre>	Connects Server1.
<pre>interface GigabitEthernet1/0/3 description Connect-To-Service no switchport ip address 202.6.1.22 255.255.255.0 !</pre>	Connects Server2.
<pre>monitor session 1 source interface GigabitEthernet1/0/2</pre>	Mirrors data of interface ge1/0/2 to



Configuration Command	Description
monitor session 1 destination interface GigabitEthernet1/0/4	interface ge1/0/4.
monitor session 2 source interface GigabitEthernet1/0/3 monitor session 2 destination interface GigabitEthernet1/0/5	Mirrors data of interface ge1/0/3 to interface ge1/0/5.

## WAF Configuration

### Step 1 Configure the deployment mode of WAF.

- Log in to the web-based manager of WAF.
- Choose **System Management > System Deployment > Running Mode**.
- Set **Deployment Topology** to **Mirroring** and click **OK**.

Figure 3-42 Running Mode page

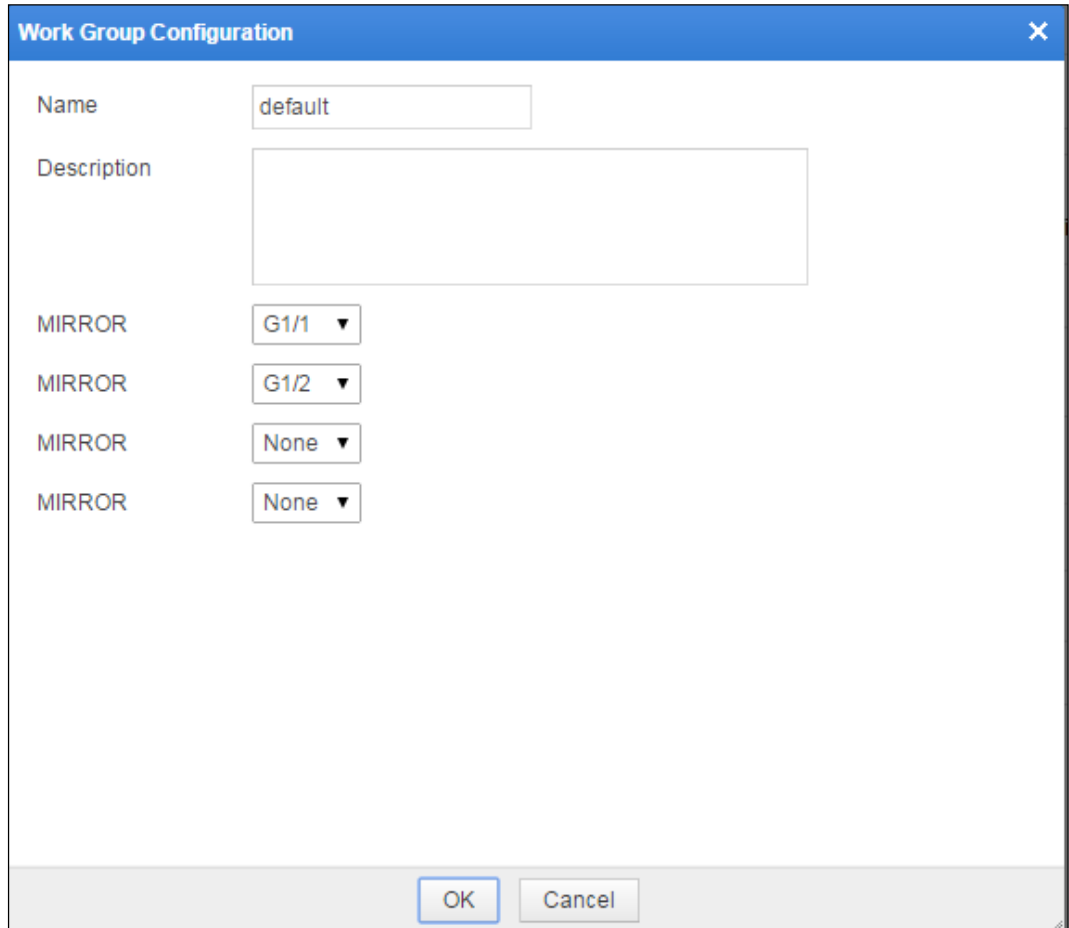
### Step 2 Configure the mirroring interface.

- Choose **System Management > Network Configuration > Work Group Management**.

Figure 3-43 Mirroring mode — Work Group Management page

- b. Click **Edit** in the upper-right corner of the **Work Group** area and then add the mirroring interface G1/2. Interface G1/1 is the default mirroring interface. See [Figure 3-44](#).

Figure 3-44 Editing mirroring interfaces



The image shows a 'Work Group Configuration' dialog box. It has a blue title bar with the text 'Work Group Configuration' and a close button (X) in the top right corner. The main area contains the following fields:

- Name:** A text box containing the word 'default'.
- Description:** A large empty text box.
- MIRROR:** Four rows, each with a label 'MIRROR' on the left and a dropdown menu on the right.
  - Row 1: Dropdown menu shows 'G1/1'.
  - Row 2: Dropdown menu shows 'G1/2'.
  - Row 3: Dropdown menu shows 'None'.
  - Row 4: Dropdown menu shows 'None'.

At the bottom of the dialog box, there are two buttons: 'OK' and 'Cancel'.

- c. Click **OK** to save the settings.
- G1/2 is added and displayed on the **Work Group Management** page in the **default** work group. See [Figure 3-45](#).

Figure 3-45 New mirroring interface

Work Group Management   Route Configuration   DNS Configuration

**Available Interfaces**

G1/3   G1/4   G1/5   G1/6

**Management Interfaces**

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.94/255.255.0.0	Auto	Auto	1500Byte	

**Work Group**

default ▾   Edit   Delete

Name	Type	Media	Status
G1/1	MIRROR	Copper	
G1/2	MIRROR	Copper	

----End

# 4 HA Configuration

---

This chapter describes WAF's HA deployment in the following in-path modes:

- [Active-Active Mode via Port Channel](#)
- [Active-Active Mode via OSPF](#)
- [Master/Slave Mode](#)

## 4.1 Active-Active Mode via Port Channel

### Scenario

In the network environment shown in [Figure 4-1](#), two WAFs (WAF A and WAF B) are deployed, and switch 1 (SW1) and switch 2 (SW2) are connected via a port channel.

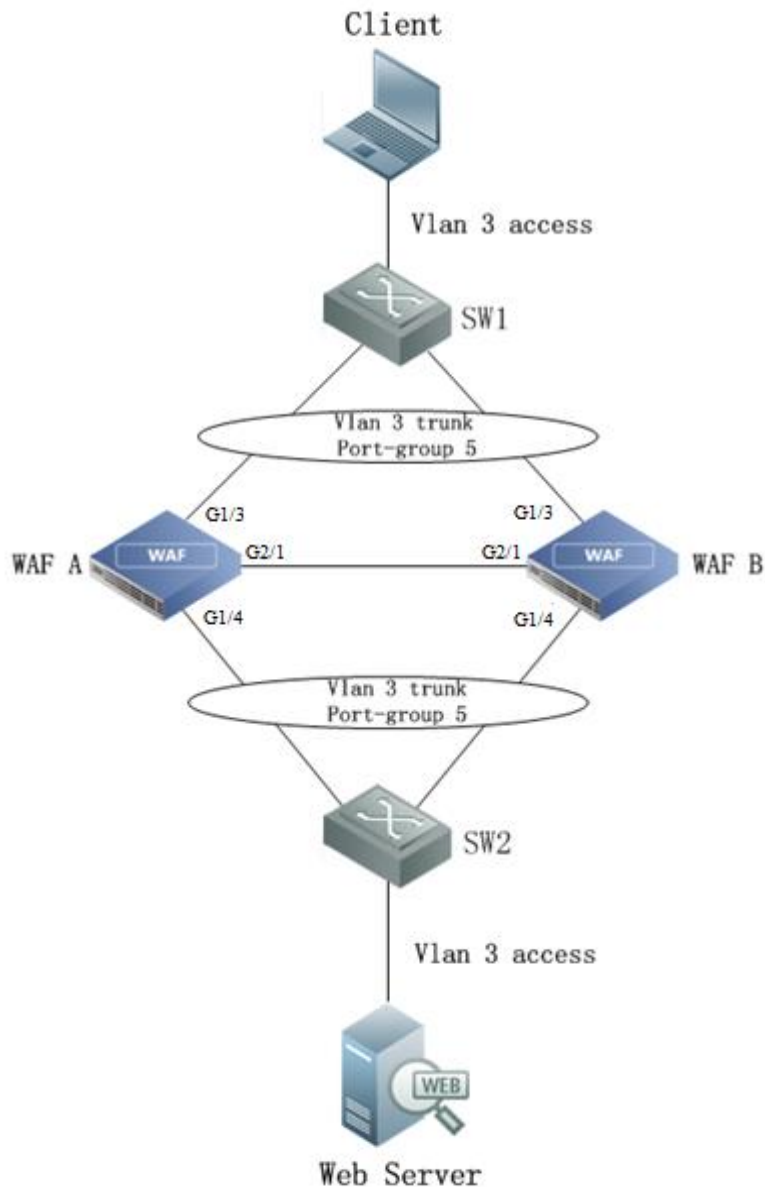
As SW1 and SW2 adopt different load balancing algorithms, asymmetrical traffic occurs when the client accesses the web server, that is, the client's request and the server's response are transmitted along different paths. Network disconnection may occur in the following process:

- A client request reaches the server after passing through SW1, WAF A, and SW2.
- A server response to the request reaches WAF B after passing through SW2.

This is because WAF B cannot find the corresponding session and discards the response.

To ensure smooth network communication, the HA active-active mode is configured on both WAFs in this scenario.

Figure 4-1 Active-active mode via port channel — topology



## Preparation

Prepare the following:

- Two WAFs that can ping each other.
- Administrator account **admin**.

## Configuration Roadmap

The configuration roadmap is as follows:

1. Perform the following configuration on both WAF A and WAF B as administrator **admin**:

- Enable HA, set the working mode, and configure the HA interface.
  - Create a work group and specify the WAN interface and LAN interface.
2. Verify the configuration result.

----End

## Configuration Procedure

Perform the following steps to configure HA on WAF A and WAF B as administrator **admin**:

**Step 1** Perform the HA configuration on WAF A.

Choose **System Management > System Deployment > HA Configuration**. On the **HA Configuration** page that is displayed shown in [Figure 4-2](#), select the **Enable HA** check box, set **Work Mode** to **Active-Active**, and click **OK**.

Figure 4-2 Active-active mode via port channel — HA configuration

The screenshot displays the WAF configuration interface. The top navigation bar includes 'System Monitoring', 'Security Management', 'Logs & Reports', and 'System Management'. Under 'System Management', 'Network Configuration', 'System Deployment', 'System Tools', 'Test Tools', 'ESPC', and 'User Management' are listed. The 'System Deployment' section is active, showing 'Running Mode', 'HA Configuration', 'Built-in Bypass Configuration', and 'External Bypass Configuration'. The 'HA Configuration' tab is selected. The configuration fields are as follows:

Enable HA	<input checked="" type="radio"/> Yes <input type="radio"/> No
Work Mode	Active-Active
Heartbeat Port	G2/1
Peer IP Address	0.0.0.0
Configuration Synchronization Port	60000

Buttons: Synchronize Configuration, OK.

**Step 2** Create a work group on WAF A.

Choose **System Management > Network Configuration > Work Group Management**. On the **Work Group Management** page that is displayed, click **Add** to add a work group, for example, **test**, as shown in [Figure 4-3](#).

Figure 4-3 Active-active mode via port channel — creating a work group

**Create Work Group**

Name: test

Description:

WAN: G1/3

LAN: G1/4

HA: G2/1

OK Cancel

**Step 3** Repeat steps 1 and 2 on WAF B to perform the same configuration.

----End

## Verification

After the preceding configurations are completed, smooth network communication is ensured in the following process:

- A client request reaches the server after passing through SW1, WAF A, and SW2.
- A server response to the request reaches WAF B after passing through SW2.

This is because WAF B forwards the response to WAF A via the HA (G2/1) interface, and WAF A forwards the response to the client through SW1. The pair of request and response is transmitted along the same path.

## 4.2 Active-Active Mode via OSPF

### Scenario

In the network environment shown in [Figure 4-4](#), two WAFs (WAF A and WAF B) are deployed and three routers (R1, R2, and R3) belong to OSPF area 100. R3 announces that the routes from both R1 and R2 to the network segment where the web server resides have the same cost, that is, the two routes are equivalent. Also, R3 learns that routes from R1 and R2 to the client are equivalent.

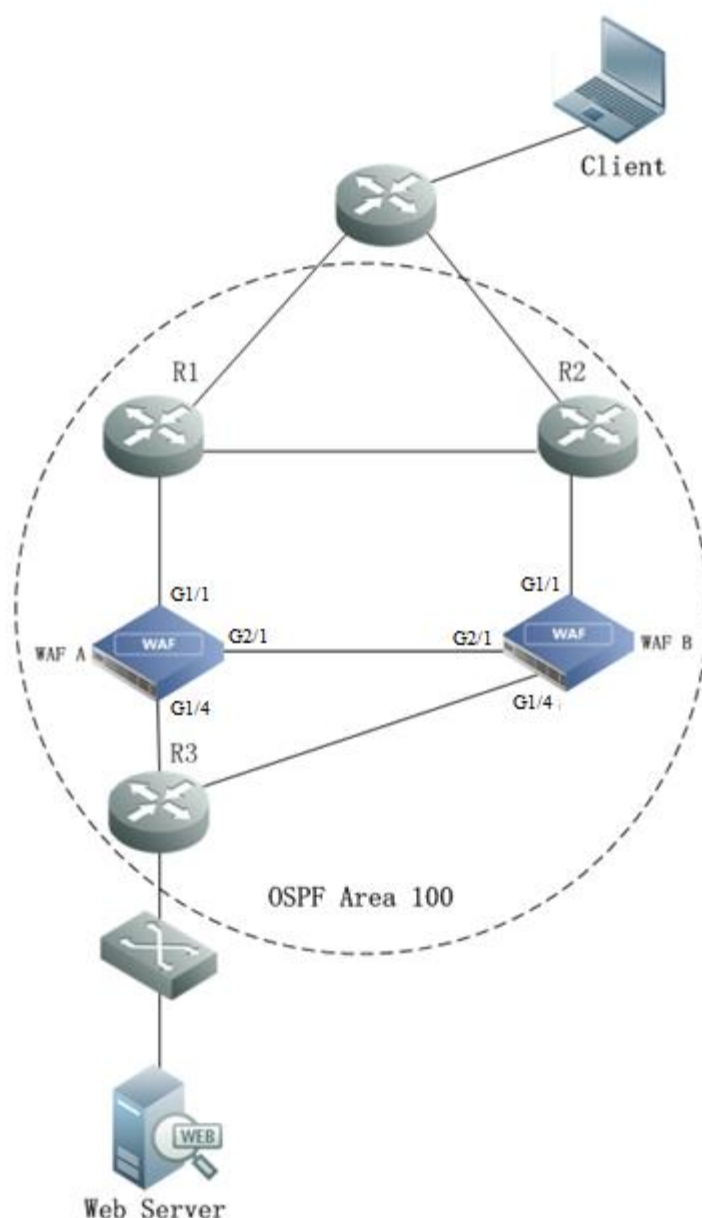
When the client accesses the web server, asymmetrical traffic occurs, that is, the client's request and the server's response are transmitted along different paths. Network disconnection may occur in the following process:

- A client request reaches the server after passing through R1, WAF A, and R3.
- A server response to the request reaches WAF B after passing through R3.

This is because WAF B cannot find the corresponding session and discards the response.

To ensure smooth network communication, the HA active-active mode is configured on two WAFs.

Figure 4-4 Active-active mode via OSPF — topology







Note

For the preceding topology, assume the following:

- The IP address of the default gateway of WAF A is 10.30.255.254.
- The peer MAC address of interface G1/1 on WAF A is 5C-F9-DD-73-94-DE.
- The IP address of the default gateway of WAF B is 10.31.255.254.
- The peer MAC address of interface G1/1 on WAF B is 5C-F9-DE-53-62-AE.

## Preparation

Prepare the following:

- Two WAFs that can ping each other.
- Administrator account **admin**.

## Configuration Roadmap

The configuration roadmap is as follows:

1. Perform the following configuration on both WAF A and WAF B as administrator **admin**:
  - Enable HA and set the working mode.
  - Create a work group and specify the WAN interface, LAN interface, and HA interface.
  - Edit the configuration of interface G1/1 in the work group and bind the peer MAC address.
2. Verify the configuration result.

----End

## Configuration Procedure


- Step 1** Perform HA configuration and create a work group named **test** by repeating [Step 1](#) to [Step 3](#) in [Configuration Procedure](#) in section [4.1 Active-Active Mode via Port Channel](#).
- Step 2** Edit the configuration in interface G1/1 in the new work group in WAF A.
- a. Choose **System Management > Network Configuration > Work Group Management**.
  - b. On the **Work Group Management** page, click  in the row of interface G1/1 on the table of the work group **test**.
  - c. Edit interface configuration in the displayed **Edit Interface** dialog box, as shown in [Figure 4-5](#).
  - d. Click **OK** to complete the configuration.

Figure 4-5 Active-active mode via OSPF — editing interface G1/1 configuration in the work group on WAF A

**Edit Interface**

Name: G1/1

Media: Copper

Manageable: ☐ Yes ☒ No ?

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPv4: 10.30.255.254  
IPv6:

☒ Advanced

Binding Peer MAC: 5C-F9-DD-73-94-DE ?

Enable Source MAC Replacement: ☐ Yes ☒ No ?

OK Reset Cancel

**Step 3** Repeat [Step 2](#) to edit interface G1/1 configuration on WAF B.

Figure 4-6 Active-active mode via OSPF — editing interface G1/1 configuration in the work group on WAF B

**Edit Interface**

Name: G1/1

Media: Copper

Manageable: ☐ Yes ☒ No ?

Rate: Auto

Duplex Mode: Auto

MTU(Byte): 1500  
Please enter a number ranging from 512 to 1500.

Default Gateway: IPv4: 10.31.255.254  
IPv6:

☒ Advanced

Binding Peer MAC: 5C-F9-DE-53-62-AE ?

Enable Source MAC Replacement: ☐ Yes ☒ No ?

OK Reset Cancel

----End

## Verification

After the preceding configurations are completed, smooth network communication is ensured in the following process:

- A client request reaches the server after passing through R1, WAF A, and R3.
- A server response to the request reaches WAF B after passing through R3.

This is because WAF B forwards the response to WAF A via the HA (G2/1) interface, and WAF A forwards the response to the client through R1. The pair of request and response is transmitted along the same path.

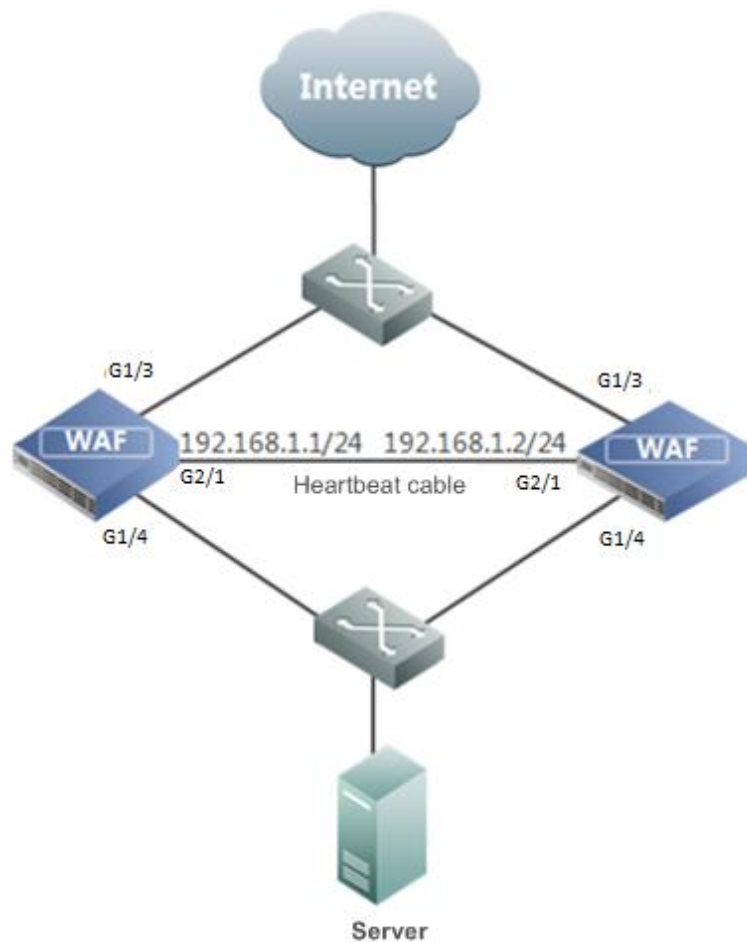
## 4.3 Master/Slave Mode

Two WAFs can work in master/slave mode to meet the security protection requirement of a network where redundant links are available, implementing hot standby. In master/slave mode, once the master WAF fails, the slave WAF takes over all traffic from the master WAF to ensure proper network communication.

### Scenario

Each of the master and slave WAFs has a pair of interfaces to connect to switches on both ends. The two WAFs connect to each other via a working interface (heartbeat interface) that is used to exchange heartbeat information and synchronize configuration files and session information. The working interfaces on the master WAF are in Up state, through which network traffic is transmitted. The working interfaces on the slave WAF is in Down state, acting as standby interfaces for traffic transmission. [Figure 4-7](#) shows the master/slave topology.

Figure 4-7 Master/Slave mode — topology



## Preparation

Prepare two WAFs, each with three working interfaces. Among the three interfaces, two (G1/3 and G1/4 in group1) are used to connect to switches, forward data, and perform failover; the other (G2/1) serves as the heartbeat interface.



**Caution**

- In master/slave mode, the model and software version of the master and slave WAFs must be the same. Otherwise, the synchronization configuration may fail.
- The two WAFs usually use a working interface, rather than the default management interface, as the heartbeat interface to connect to each other.
- Switches that are connected to both ends of WAFs must be in the same VLAN.

## Configuration Roadmap

Perform the following configuration on both the master and slave WAFs:

1. Configure working interfaces.
2. Configure HA parameters.
3. Synchronize configuration files.

## Configuration Procedure

**Step 1** Configure working interfaces on both the master and slave WAFs:

- a. Choose **System Management > Network Configuration > Work Group Management**.
- b. On the **Work Group Management** page that appears, click **Add** in the lower-right corner of the **Work Group** area to add a work group by setting **Name** to **group1**, **WAN** to **G1/3**, **LAN** to **G1/4**, **HA** to **G2/1**, and leaving **Description** blank, as shown in [Figure 4-8](#).

Figure 4-8 Master/Slave mode — adding a work group




- c. Click **OK** to complete the configuration.

**Step 2** Configure HA parameters on both WAFs.

On both WAFs, choose **System Management > System Deployment > HA Configuration**. The **HA Configuration** page appears.

- a. On the master WAF, select the **Enable HA** check box, set **Work Mode** to **Master**, **Work Group** to **group1**, **Heartbeat Port** to **G2/1**, **Peer IP Address** to **192.168.1.1**, and leave other parameters at their default values, as shown in [Figure 4-9](#).

Figure 4-9 Master/Slave mode — HA configuration on the master WAF

Running Mode	HA Configuration	Built-in Bypass Configuration	External Bypass Configuration						
Enable HA <input checked="" type="radio"/> Yes <input type="radio"/> No									
Work Mode <span>Master</span> <span>! Status: Master ?</span>									
Work Group <span>group1</span>									
Heartbeat Port <span>G2/1</span>									
Peer IP Address <span>192.168.1.1</span> <span>Synchronize Configuration ?</span>									
Heartbeat Protocol Port <span>60001</span>									
Heartbeat Interval (ms) <span>1000 ?</span>									
Lost Heartbeats(times) <span>3</span>									
Configuration Synchronization Port <span>60000</span>									
Synchronization Interval (sec) <span>3600</span>									
Gateway Info <table border="1"> <thead> <tr> <th>Interface Name</th> <th>Peer IP Address</th> <th>Operation</th> </tr> </thead> <tbody> <tr> <td colspan="3"> <div>  No data               </div> </td> </tr> </tbody> </table> <div>Add Gateway Info</div>				Interface Name	Peer IP Address	Operation	<div>  No data               </div>		
Interface Name	Peer IP Address	Operation							
<div>  No data               </div>									
<div>OK</div>									

- b. Click **OK** to complete the configuration.
- c. On the slave WAF, select the **Enable HA** check box, set **Work Mode** to **Slave**, **Work Group** to **group1**, **Heartbeat Port** to **G2/1**, **Peer IP Address** to **192.168.1.2**, and leave other parameters at their default values, as shown in [Figure 4-10](#).

Figure 4-10 Master/Slave mode — HA configuration on the standby WAF

Running Mode HA Configuration Built-in Bypass Configuration External Bypass Configuration

Enable HA ☒ Yes ☐ No

Work Mode Slave ! Status: Slave ?  
☒ Start SLAVE after losing MASTER heartbeats.

Work Group group1

Heartbeat Port G2/1

Peer IP Address 192.168.1.2 Synchronize Configuration ?

Heartbeat Protocol Port 60001

Heartbeat Interval (ms) 1000 ?

Lost Heartbeats(times) 3

Configuration Synchronization Port 60000

Synchronization Interval (sec) 3600

Gateway Info

Interface Name	Peer IP Address	Operation
<span>i</span> No data		

Add Gateway Info

OK

d. Click **OK** to complete the configuration.



**Note**

On the **HA Configuration** page on WAF, you are advised to select the check box preceding **Start SLAVE after losing MASTER heartbeats** when configuring **Work Mode**.

**Step 3** Synchronize configuration files between master and slave WAFs.

- a. On the master WAF, choose **System Management > System Deployment > HA Configuration**.
- b. On the **HA Configuration** page that appears, click **Synchronize Configuration** to synchronize configuration files from the master WAF to the slave WAF.

**Step 4** Click **OK** to complete the configuration.

----End



In master/slave mode, the status is displayed as **Master** for the master WAF and **Slave** for the slave WAF.

Once an working interface on the master WAF is down, all interfaces in the HA working group on the master WAF will be down, and the slave WAF takes traffic over from the master WAF. In this case, the status of the master WAF changes to **Slave**, and that of the slave WAF changes to **Master**.



# 5 VRRP Configuration

---

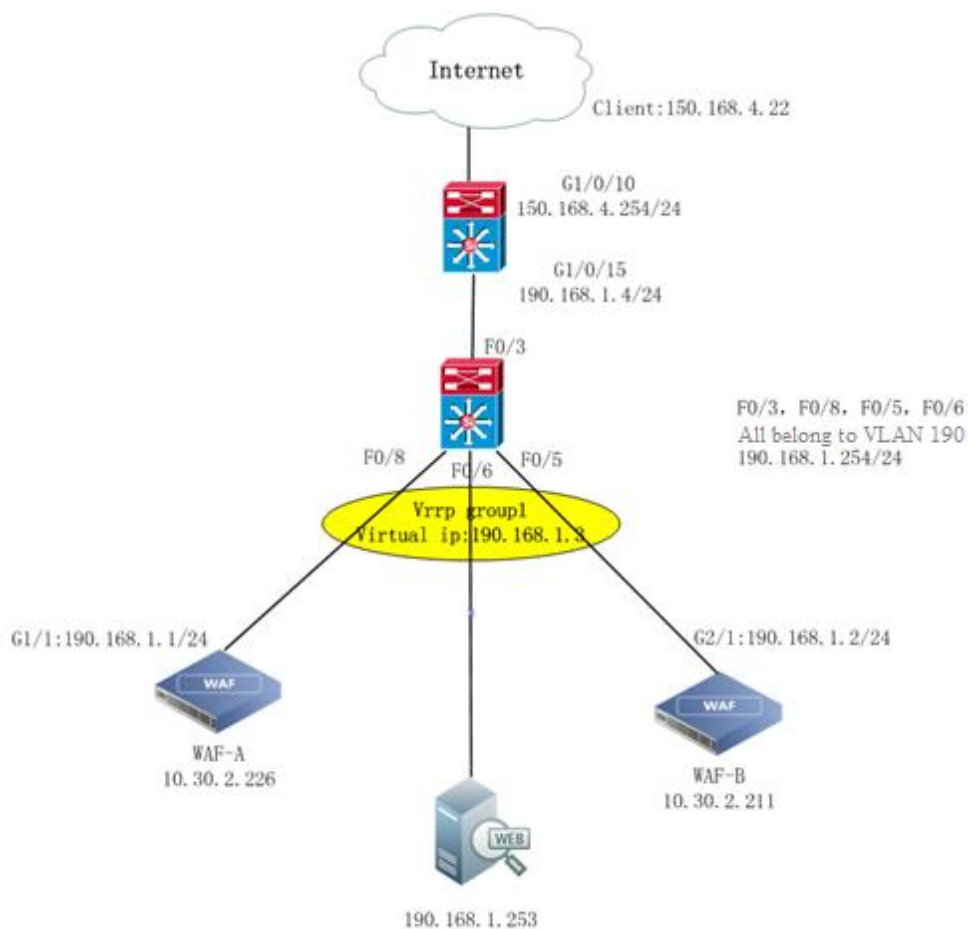
This chapter describes how to configure VRRP on WAFs deployed in reverse proxy mode.

## 5.1 Configuring a Single VRRP Group

### Scenario

As shown in [Figure 5-1](#), two WAFs are deployed on the network: WAF A and WAF B, which are in the same VRRP group. The virtual IP address and the IP addresses of the two WAFs are in the same network segment. To ensure uninterrupted network communications, it is necessary to configure VRRP on the two WAFs, one as the master and the other as the backup. In this manner, when the master WAF fails, the slave WAF automatically takes over traffic from the master WAF.

Figure 5-1 Deployment of WAFs in reverse proxy mode (a single VRRP group)



## Preparation

Prepare the following:

- Two connected WAF devices
- Administrator account **admin**

## Configuration Roadmap

The configuration roadmap is as follows:

1. Perform the following configuration on both WAF A and WAF B as administrator **admin**:
  - Configure a working interface respectively on WAF A and WAF B.
  - Configure VRRP on WAF A and WAF B.
2. Verify the configuration.

## Configuration Procedure on WAF A

Do as follows to configure VRRP on WAF A as administrator **admin**:

**Step 1** Choose **System Management > Network Configuration > Work Group Management**. Specify a working interface, for example, G1/1, as shown in [Figure 5-2](#).

Figure 5-2 Configuring working interface G1/1

**Step 2** Choose **System Management > System Deployment > VRRP Configuration**.

Figure 5-3 VRRP Configuration page

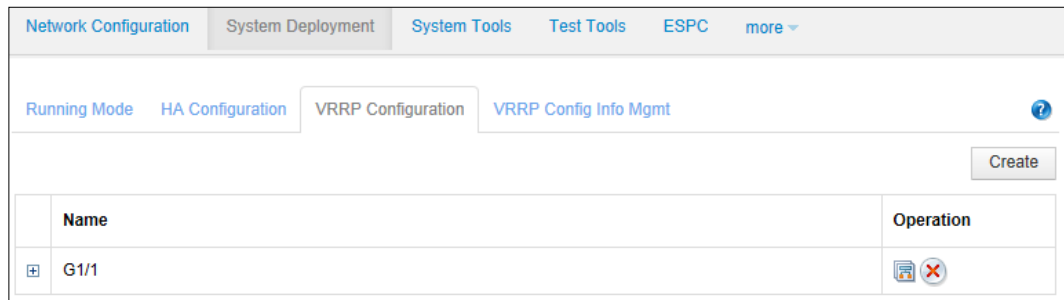
**Step 3** Click **Create** to add interface G1/1.

Figure 5-4 Adding interface G1/1

**Step 4** Click **OK**.

Then interface G1/1 appears on the **VRRP Configuration** page, as shown in [Figure 5-5](#).

Figure 5-5 VRRP Configuration page after interface G1/1 is added




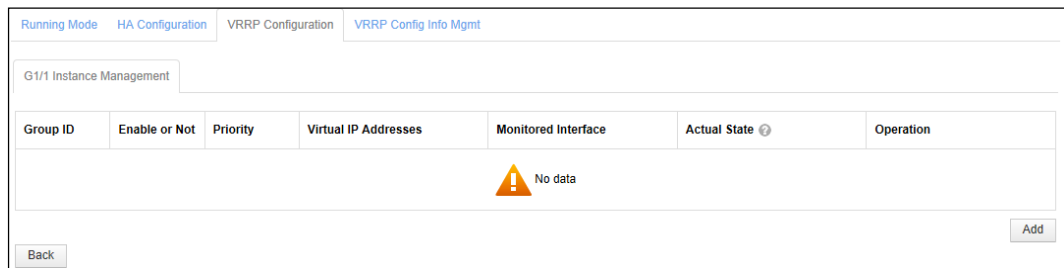
**Step 5** Click the VRRP instance management icon  in the **Operation** column of interface G1/1. The **G1/1 Instance Management** page appears, as shown in [Figure 5-6](#).

Figure 5-6 G1/1 Instance Management page



**Step 6** Click **Add**.

The **Add G1/1 VRRP Instance** page appears, as shown in [Figure 5-7](#).


 <b>Note</b>	<ul style="list-style-type: none"> <li>VRRP instance parameters (such as <b>Group ID</b>, <b>Virtual IP Address</b>, and <b>Transfer Interval</b>) must be set to the same values on the master WAF and slave WAF.</li> <li>When the virtual IP address and the server IP address are in different network segments, a route is required to ensure the connectivity between clients and the VRRP group.</li> </ul>
--	--

Figure 5-7 G1/1 VRRP Instance Add page

Add G1/1 VRRP Instance	
Group ID	<input type="text"/> * ?
Priority	100 * ?
Virtual IP Addresses	<input type="button" value="+"/> ?
Enable or Not	<input checked="" type="radio"/> Yes <input type="radio"/> No ?
Allow Preemption	<input checked="" type="radio"/> Yes <input type="radio"/> No ?
Initial State	Master ▼ ?
Transfer Interval	1 *seconds ?
Primary IP Address	172.16.12.94 ▼ ?
Monitored Interface	<input checked="" type="checkbox"/> G1/1 <input type="checkbox"/> G1/2 <input type="checkbox"/> G1/3 <input type="checkbox"/> G1/4 <input type="checkbox"/> G1/5 <input type="checkbox"/> G1/6
Routes	<input type="button" value="+"/>
Description	<input type="text"/>
<input type="button" value="Save"/> <input type="button" value="Reset"/> <input type="button" value="Back"/>	

**Step 7** Configure parameters and click **Save** to commit the settings.

----End

## Configuration Procedure on WAF B

Do as follows to configure VRRP on WAF B as administrator **admin**:

**Step 1** Choose **System Management > Network Configuration > Work Group Management**. Specify a working interface, G1/2, as shown in [Figure 5-8](#).

Figure 5-8 Configuring working interface G1/2

Network Configuration | **System Deployment** | System Tools | Test Tools | ESPC | User Management | Traffic Control Mgmt

Work Group Management | **Route Configuration** | DNS Configuration

Available Interfaces

G1/1 G1/3 G1/4 G1/5 G1/6

Management Interfaces

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
M	Management Interface	Copper	100M/Full	10.67.3.94/255.255.0.0	Auto	Auto	1500Byte	

Work Group

VRRP\_M

Name	Type	Media	Status	IP Address	Rate Configuration	Duplex Configuration	MTU	Operation
G1/2	WAN	Copper	100M/Full		Auto	Auto	1500Byte	

**Step 2** Choose **System Management > System Deployment > VRRP Configuration**.

Figure 5-9 VRRP Configuration page

Running Mode | HA Configuration | **VRRP Configuration** | VRRP Config Info Mgmt

Create

Name	Operation
No VRRP instance	

**Step 3** Click **Create** to add interface G1/2.

Figure 5-10 Adding interface G1/2

Create

Interface G1/2

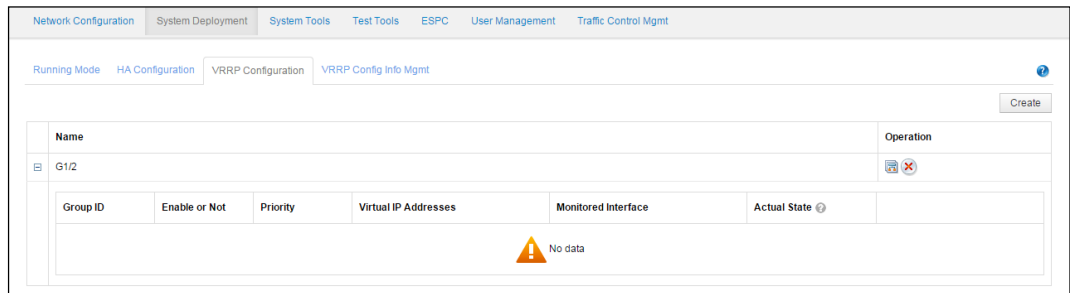
Name

OK Cancel

**Step 4** Click **OK**.

Then interface G1/2 appears on the **VRRP Configuration** page, as shown in [Figure 5-11](#).

Figure 5-11 VRRP Configuration page after interface G1/2 is added




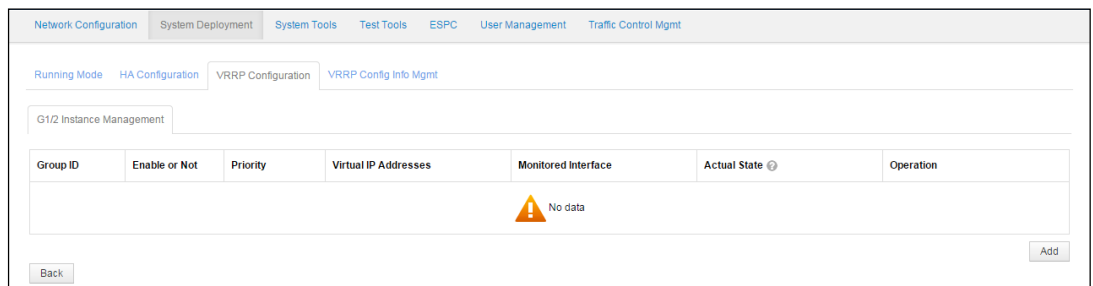
**Step 5** Click the VRRP instance management icon  in the **Operation** column of interface G1/2. The **G1/2 Instance Management** page appears, as shown in [Figure 5-12](#).

Figure 5-12 G1/2 Instance Management page



**Step 6** Click **Add**.

The **Add G1/2 VRRP Instance** page appears, as shown in [Figure 5-13](#).



**Note**

- VRRP instance parameters (such as **Group ID**, **Virtual IP Address**, and **Transfer Interval**) must be set to the same values on the master WAF and slave WAF.
- When the virtual IP address and the server IP address are in different network segments, a route is required to ensure the connectivity between clients and the VRRP group.

Figure 5-13 G1/2 VRRP Instance Add page

Running Mode	HA Configuration	VRRP Configuration	VRRP Config Info Mgmt
Add G1/1 VRRP Instance			
Group ID	1 * ?		
Priority	100 * ?		
Virtual IP Addresses	<div>+ ?</div> <div> <input checked="" type="checkbox"/> Enable or Not    IP Address 190.168.1.3    Subnet Mask 255.255.255.0 <span>✕</span> </div>		
Enable or Not	<input checked="" type="radio"/> Yes <input type="radio"/> No		
Allow Preemption	<input checked="" type="radio"/> Yes <input type="radio"/> No ?		
Initial State	Master ?		
Transfer Interval	1 *seconds ?		
Primary IP Address	192.168.1.2 ?		
Monitored Interface	<input checked="" type="checkbox"/> G1/1 <input type="checkbox"/> G1/2 <input type="checkbox"/> G1/3 <input type="checkbox"/> G1/4 <input type="checkbox"/> G1/5 <input type="checkbox"/> G1/6		
Routes	<div>+ ?</div>		
Description	<div></div>		
<div>Save    Reset    Back</div>			

**Step 7** Configure parameters and click **Save** to commit the settings.

----End

## Verification

After the preceding operations, WAF A and WAF B have been configured to negotiate with each other via VRRP. WAF A has a higher priority than WAF B, thus becoming the master device. Traffic from clients to the server is first diverted to WAF A for cleaning before reaching the destination.

When the monitoring interface of WAF A, that is G1/1, fails, or WAF B cannot receive VRRP packets from WAF A, WAF B automatically switches to the active state. Then traffic from clients to the server is diverted to WAF B for cleaning. In this manner, network communications can proceed properly without being interrupted.

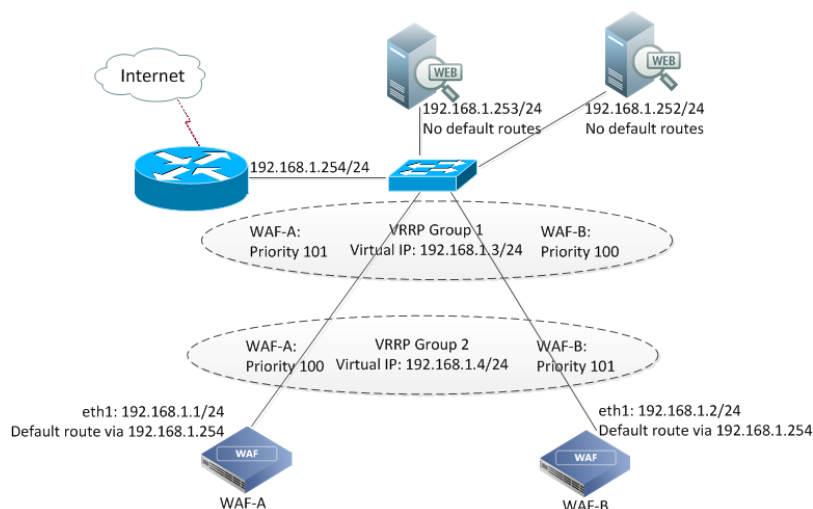
## 5.2 Configuring Multiple VRRP Groups

### Scenario

As shown in [Figure 5-14](#), two WAF devices are deployed on the network, with multiple VRRP instances configured. The two devices work in master/slave mode, jointly handling service traffic destined for servers. When the master device in a VRRP instance becomes faulty, the slave device will take over all the traffic, thereby ensuring business continuity.



Figure 5-14 Deployment of WAF devices in reverse proxy mode (multiple VRRP groups)



## Preparation

Prepare the following:

- Two WAF devices (WAF A and WAF B) that interconnect with each other and connect to the same switch, working in reverse proxy mode
- Protected server, with one-to-many or many-to-many mapping between the domain name and IP address
- Administrator account **admin**

## Configuration Roadmap

The configuration roadmap is as follows:

1. Perform the following configuration on both WAF A and WAF B as administrator **admin**:
  - Configure a working interface respectively on WAF A and WAF B.
  - Configure two VRRP instances respectively on WAF A and WAF B.
2. Verify the configuration.

## Configuration Procedure on WAF A

Do as follows to configure VRRP on WAF A as administrator **admin**:

**Step 1** Specify a working interface on WAF A.

For details, see steps 1 to 5 in [Configuration Procedure on WAF A](#) in section 5.1 [Configuring a Single VRRP Group](#).

**Step 2** On the page shown in [Figure 5-12](#), click **Add** to create the first VRRP instance.

Figure 5-15 Creating the first VRRP instance on WAF A

Running Mode		HA Configuration		VRRP Configuration		VRRP Config Info Mgmt	
Add G1/1 VRRP Instance							
Group ID	1 *						
Priority	101 *						
Virtual IP Addresses	+ ?						
	<input checked="" type="checkbox"/> Enable or Not	IP Address	192.168.1.3		Subnet Mask	255.255.255.0	
Enable or Not	<input checked="" type="radio"/> Yes <input type="radio"/> No						
Allow Preemption	<input checked="" type="radio"/> Yes <input type="radio"/> No ?						
Initial State	Master ?						
Transfer Interval	1 *seconds ?						
Primary IP Address	192.168.1.1 ?						
Monitored Interface	<input checked="" type="checkbox"/> G1/1 <input type="checkbox"/> G1/2 <input type="checkbox"/> G1/3 <input type="checkbox"/> G1/4 <input type="checkbox"/> G1/5 <input type="checkbox"/> G1/6						
Routes	+ ?						
Description							
<div>Save Reset Back</div>							

**Step 3** Configure parameters and click **Save** to commit the settings.

**Step 4** On the page shown in [Figure 5-12](#), click **Add** to create the second VRRP instance.

Figure 5-16 Creating the second VRRP instance on WAF A

Running Mode	HA Configuration	VRRP Configuration	VRRP Config Info Mgmt
Add G1/1 VRRP Instance			
Group ID	2 *		
Priority	100 *		
Virtual IP Addresses	+ ?		
	<input checked="" type="checkbox"/> Enable or Not	IP Address 192.168.1.4	Subnet Mask 255.255.255.0 ✖
Enable or Not	<input checked="" type="radio"/> Yes <input type="radio"/> No		
Allow Preemption	<input checked="" type="radio"/> Yes <input type="radio"/> No ?		
Initial State	Master ▼ ?		
Transfer Interval	1 *seconds ?		
Primary IP Address	192.168.1.1 ▼ ?		
Monitored Interface	<input checked="" type="checkbox"/> G1/1 <input type="checkbox"/> G1/2 <input type="checkbox"/> G1/3 <input type="checkbox"/> G1/4 <input type="checkbox"/> G1/5 <input type="checkbox"/> G1/6		
Routes	+ ?		
Description	<div></div>		
<div>Save</div> <div>Reset</div> <div>Back</div>			

**Step 5** Configure parameters and click **Save** to commit the settings.

----End

## Configuration Procedure on WAF B

Do as follows to configure VRRP on WAF B as administrator **admin**:

**Step 1** Specify a working interface on WAF B.

For details, see steps 1 to 5 in [Configuration Procedure on WAF A](#) in section 5.1 [Configuring a Single VRRP Group](#).

**Step 2** On the page shown in [Figure 5-12](#), click **Add** to create the first VRRP instance.

Figure 5-17 Creating the first VRRP instance on WAF B

Running Mode	HA Configuration	VRRP Configuration	VRRP Config Info Mgmt
Add G1/1 VRRP Instance			
Group ID	1 * ?		
Priority	100 * ?		
Virtual IP Addresses	+ ?		
	<input checked="" type="checkbox"/> Enable or Not	IP Address 192.168.1.3	Subnet Mask 255.255.255.0 X
Enable or Not	<input checked="" type="radio"/> Yes <input type="radio"/> No		
Allow Preemption	<input checked="" type="radio"/> Yes <input type="radio"/> No ?		
Initial State	Master v ?		
Transfer Interval	1 *seconds ?		
Primary IP Address	192.168.1.2 v ?		
Monitored Interface	<input checked="" type="checkbox"/> G1/1 <input type="checkbox"/> G1/2 <input type="checkbox"/> G1/3 <input type="checkbox"/> G1/4 <input type="checkbox"/> G1/5 <input type="checkbox"/> G1/6		
Routes	+ ?		
Description	<div></div>		
<div>Save</div> <div>Reset</div> <div>Back</div>			

**Step 3** Configure parameters and click **Save** to commit the settings.

**Step 4** On the page shown in [Figure 5-12](#), click **Add** to create the second VRRP instance.

Figure 5-18 Creating the second VRRP instance on WAF B

Running Mode	HA Configuration	VRRP Configuration	VRRP Config Info Mgmt
Add G1/1 VRRP Instance			
Group ID	2 *		
Priority	101 *		
Virtual IP Addresses	+ ?		
	<input checked="" type="checkbox"/> Enable or Not	IP Address 192.168.1.4	Subnet Mask 255.255.255.0 ✖
Enable or Not	<input checked="" type="radio"/> Yes <input type="radio"/> No		
Allow Preemption	<input checked="" type="radio"/> Yes <input type="radio"/> No ?		
Initial State	Master ▼ ?		
Transfer Interval	1 *seconds ?		
Primary IP Address	192.168.1.2 ▼ ?		
Monitored Interface	<input checked="" type="checkbox"/> G1/1 <input type="checkbox"/> G1/2 <input type="checkbox"/> G1/3 <input type="checkbox"/> G1/4 <input type="checkbox"/> G1/5 <input type="checkbox"/> G1/6		
Routes	+ ?		
Description	<div></div>		
<div>Save</div> <div>Reset</div> <div>Back</div>			

**Step 5** Configure parameters and click **Save** to commit the settings.



You must ensure that configuration information of the protected website on WAF A is the same as that on WAF B.

----End

## Verification

On the upstream network of WAF, the F5 load balancing device evenly divides traffic destined for the server under WAF's protection and distributes it to the virtual IP addresses 192.168.1.3 and 192.168.1.4. Normally, traffic to 192.168.1.3 is handled by WAF A (master) and traffic to 192.168.1.4 is handled by WAF B (master).

During this process, WAF A and WAF B work simultaneously. In the two VRRP instances configured, the two devices work in master/slave mode to share the load. When one device becomes faulty, the other device takes up all the load, thereby ensuring business continuity.

# A Default Parameters

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## A.1 Default Settings of the Management Interface

IP Address	eth0:192.168.0.1
Subnet Mask	255.255.255.0

## A.2 Default Accounts

	User Name	Password
Web Administrator	admin	admin
Web Auditor	auditor	auditor
System Maintainer	maintainer	maintainer
Console Administrator	nsadmin	nsadmin

## A.3 Communication Parameters of Console Port

Baud Rate	115200
Data Bit	8
Parity	None
Stop Bit	1
Data Flow Control	None