Configuring Direct Server Return

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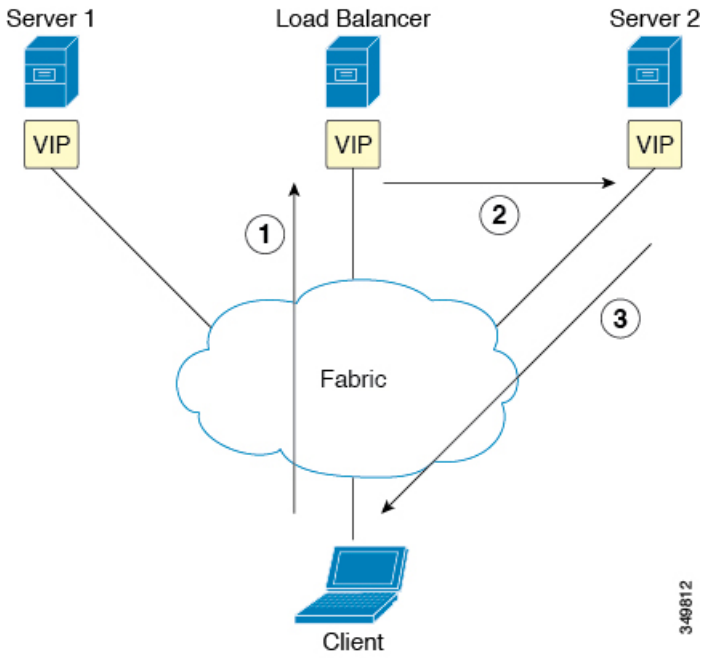
About Direct Server Return

The direct server return feature enables a server to respond directly to clients without having to go through the load balancer, which eliminates a bottleneck in the server-to-client path. In traditional load balancer deployments, the load balancer is in the path of the client-to-server communication: both the client-to-server request path and the server-to-client response path. While the amount of data in the requests from the client-to-server direction are relatively small, the server-to-client response traffic is much higher: approximately 10 times that of client-to-server request data. The load balancer in the path of this high volume response traffic becomes a bottleneck and adversely affects the communication.

For direct server return deployments, a virtual IP address is shared by the load balancer and server. Clients always address their request to the virtual IP address that is intended to reach the load balancer, and the direct response from the server-to-client use this virtual IP address as the source address. Cisco Application Centric Infrastructure (ACI) enabled with data-path learning of the IP source address poses problems when it learns the virtual IP address from the server-to-client traffic, leading to the disruption of Client-to-load balancer request traffic. To allow for the proper operation of a direct server return deployment, the ACI fabric must ensure that the request-response traffic between the communicating endpoints are delivered to their intended destination correctly. This requires that the data-path IP address learning on the leaf switches must be controlled in such a way that there is no interruption to client-to-load balancer, load balancer-to-server, and server-to-client traffic.

The following figure illustrates the data path in a direct server return deployment:

Figure 1: Direct Server Return High-Level Flow



1. The load balancer and all of the back-end servers are configured with the virtual IP address. The load balancer alone responds to Address Resolution Protocol (ARP) requests for this virtual IP address. After load balancing the client request, the load balancer re-writes the destination MAC address in the packet and forwards the MAC address to one of the back-end servers.
2. The virtual IP address is configured on the back-end server, but ARP is disabled to prevent back-end servers from responding to ARP requests for this virtual IP address.
3. The server sends the return traffic directly to the client, by-passing the load-balancer.

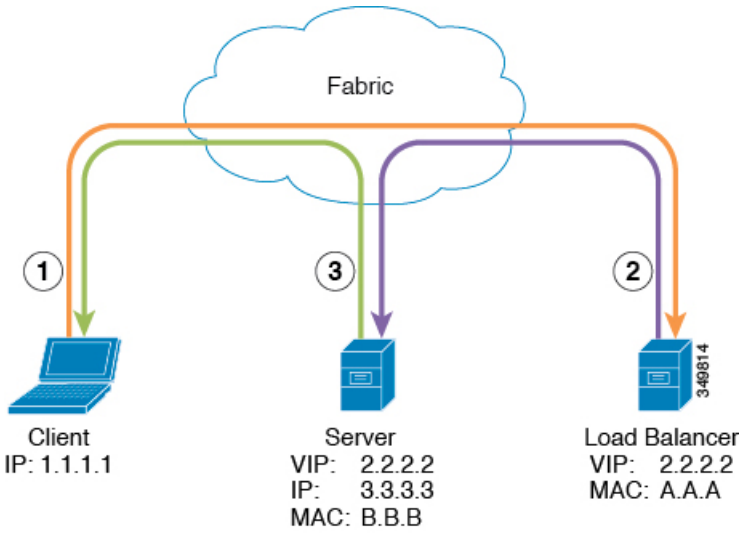
Layer 2 Direct Server Return

Layer 2 direct server return is the common or traditional deployment, also known as direct routing, SwitchBack, or nPath. In this deployment, the virtual IP address is shared by the load balancer and server. The load balancers and servers must be layer 2 adjacent. A layer 2 direct server return deployment has the following limitations:

- You lose flexibility in server placement
- You need an extra server configuration to suppress Address Resolution Protocol (ARP) responses to client virtual IP address requests
- Port selection is layer 3 and protocol dependent; port selection cannot happen at layer 2 (load balancer to server communication)

A layer 2 direct server return deployment has the following traffic flow:

Figure 2: Layer 2 Direct Server Return Traffic Flow



1. Client to load balancer

Source IP Address	1.1.1.1
Destination IP Address	2.2.2.2
Destination MAC Address	A.A.A

2. Load balancer to server

Source IP Address	1.1.1.1
Destination IP Address	2.2.2.2
Destination MAC Address	B.B.B

3. Server to client

Source IP Address	2.2.2.2
Destination IP Address	1.1.1.1
Destination MAC Address	MAC address of the default gateway

About Deploying Layer 2 Direct Server Return with Cisco Application Centric Infrastructure

The following information applies to deploying layer 2 direct server return with Cisco Application Centric Infrastructure (ACI):

- The virtual IP address (2.2.2.2) moves within the ACI fabric

    - The load balancer-to-server and server-to-client traffic with the same source virtual IP address (2.2.2.2)
    - The server-to-client traffic is routed; the traffic is addressed to the gateway MAC address in the fabric
    - The data-path learning of the source IP address from the server moves to the virtual IP address within the fabric

- There are no issues for the client IP address (1.1.1.1) appearing from difference sources
    - The client IP address appears as the source IP address from both the client and the load balancer in the fabric
    - The load balancer and server are layer 2 adjacent and the load balancer-to-server traffic is layer 2 forwarded
    - There is no data-path IP address learning from layer 2 forwarded traffic in the fabric
    - Even if the client IP address appears as the source IP address from the load balancer in the fabric, the client IP address is not learned

Guidelines and Limitations for Configuring Direct Server Return

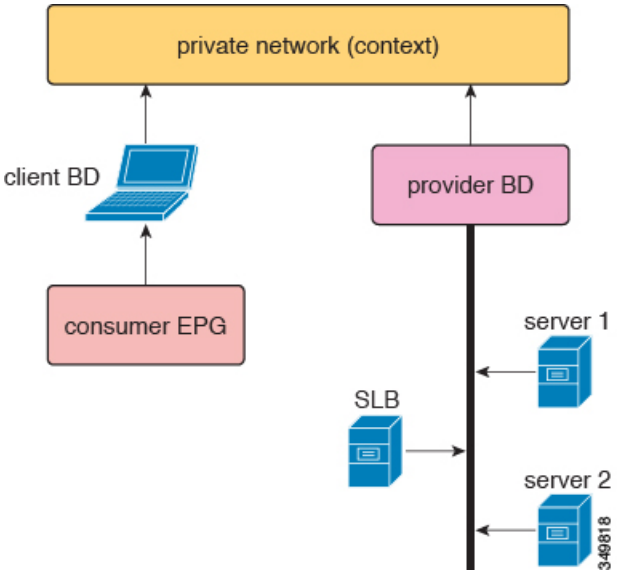
Follow these guidelines and limitations when deploying Direct Server Return:

- The VRF where the VIP is deployed must be set to "enforced" mode.
- The VRF must be set to "ingress" enforcement.
- Shared services are not supported for this configuration.
- EP Move Detection Mode: GARP-based Detection must be enabled for the bridge domain.
- Unicast routing must be enabled for the bridge domain.
- The EPG where the VIP is located must have a contract associated with it (the contract drives the configuration in hardware).
- The Layer 4 to Layer 7 VIP option is configurable only under EPG but not under the EPG collection for VRF (also known as vzAny).
- Client to VIP traffic must always go through the proxy spine.
- The load balancer must be in one-armed mode.
- The server and load balancer EPG must be the same device or the load balancer EPG must be deployed on all server EPG ToRs.
- The server EPG and load balancer EPG must be in the same bridge domain.
- Configuring a Layer 4 to Layer 7 virtual IP (VIP) address under microsegmented EPGs or their corresponding Base EPGs is not supported.

Supported Direct Server Return Configuration

The following figure illustrates the supported direct server return configuration:

Figure 3: Supported Direct Server Return Configuration



The following information applies to the supported configuration:

- The server load balancer and servers are in the same subnet and bridge domain
- The server load balancer should operate in 1 ARM mode; the inside and outside legs of server load balancer should point to the same bridge domain
- The consumer and provider endpoint groups should be under the same private network; no shared service configuration is supported

Example XML POST of Direct Server Return for Static Service Deployment

The following XML POST is an example of a direct server return (DSR) static service deployment:

```
<fvAp name="dev">
      <fvAEPg name="loadbalancer">
        <fvRsDomAtt tDn="uni/phys-{{tenantName}}"/>
        <fvRsBd tnFvBDName="lab"/>
        <fvVip addr="121.0.0.{{net}}" />
        <fvRsPathAtt tDn="topology/pod-1/paths-104/pathep-[eth1/1]" encap="vlan-33" />
        <fvRsProv tnVzBrCPName="loadBalancer"/>
        <fvRsCons tnVzBrCPName="webServer"/>
      </fvAEPg>
        <fvAEPg name="webServer">
          <fvRsDomAtt tDn="uni/phys-{{tenantName}}"/>
            <fvRsBd tnFvBDName="lab"/>
          <fvRsPathAtt tDn="topology/pod-1/paths-101/pathep-[eth1/1]" encap="vlan-34"/>
            <fvRsProv tnVzBrCPName="webServer"/>
        </fvAEPg>
      <fvAEPg name="client">
```

```
        <fvRsDomAtt tDn="uni/phys-{{tenantName}}"/>
        <fvRsBd tnFvBDName="lab"/>
        <fvRsPathAtt tDn="topology/pod-1/paths-103/pathep-[eth1/4]" encap="vlan-1114"/>
        <fvRsCons tnVzBrCPName="loadBalancer"/>
      </fvAEPg>
</fvAp>
```

The DSR configuration is downloaded to all top-of-rack switches (ToRs) where the EPG with a Layer 4 to Layer 7 virtual IP address is deployed or an EPG that has a contract with the EPG with a Layer 4 to Layer 7 virtual IP address is deployed, regardless of the contract direction. In the example, the DSR virtual IP address configuration is downloaded to the ToR nodes 101, 103, and 104. Node 104 has a load balancer EPG with a Layer 4 to Layer 7 virtual IP address configured. Nodes 101 and 103 have a webserver or client EPG, which has a contract to the load balancer EPG.

All ToRs that downloaded the DSR configuration do not learn the Layer 4 to Layer 7 virtual IP address from the datapath. Such ToRs also do not learn the Layer 4 to Layer 7 virtual IP address from the other EPGs. This is true even if you use Address Resolution Protocol (ARP), Gratuitous Address Resolution Protocol (GARP), or IPv6 Neighbor Discovery (ND). For example, the ToRs only learn the Layer 4 to Layer 7 virtual IP address from a load balancer EPG by way of the control plane. This restriction helps to prevent the erroneous learning of the Layer 4 to Layer 7 virtual IP address from a web server EPG, such as if you forgot to suppress ARP on a web server.

Direct Server Return for Static Service Deployment

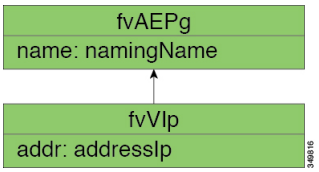
In the static service deployment mode, you configure the service flow by creating the appropriate application endpoint groups and contracts on a hop-by-hop basis.

Direct Server Return for Static Service Deployment Logical Model

You can configure the virtual IP addresses that are used by the load balancers by using the `fvVip` object under an application endpoint group (`fvAEPg`).

The following figure illustrates the logical model for static service deployment:

Figure 4: Static Service Deployment Logical Model



Direct Server Return for Service Graph Insertion

The Cisco Application Centric Infrastructure (ACI) provides automated service insertion by using vendor packages and service graphs. In this mode, the endpoint groups that are created for the service device legs, such as inside and outside endpoint groups, are created by the ACI without the operator configuration.

For service graph insertion, you must configure the virtual IP addresses under the appropriate logical interface context for the service device, as shown in the following example XML POST:

```
<vnsLDevCtx ctrctNameOrLbl="webCtrct"
  graphNameOrLbl="G1"
  nodeNameOrLbl="SLB">
    <vnsRsLDevCtxToLDev tDn="uni/tn-t1/lDevVip-InsiemeCluster"/>
    <vnsLIfCtx connNameOrLbl="inside">
        <vnsRsLIfCtxToBD tDn="uni/tn-t1/BD-t1BD1"/>
        <vnsRsLIfCtxToLIf tDn="uni/tn-t1/lDevVip-InsiemeCluster/lIf-inside"/>
    </vnsLIfCtx>
    <vnsLIfCtx connNameOrLbl="outside">
        <vnsRsLIfCtxToBD tDn="uni/tn-t1/BD-t1BD1"/>
        <vnsRsLIfCtxToLIf tDn="uni/tn-t1/lDevVip-InsiemeCluster/lIf-outside"/>
        <vnsSvcVip addr="9.9.9.9" />
        <vnsSvcVip addr="11.11.11.11" />
    </vnsLIfCtx>
</vnsLDevCtx>
```

The sample request configures two virtual IP addresses (9.9.9.9 and 11.11.11.11) on the outside leg of the server load balancer. The virtual IP address definition is under `LIfCtx` instead of being under an endpoint group as it is with a static direct server return configuration. This is because in the service graph case, operators do not have direct access to an endpoint group for the device legs, unlike with a static service deployment.

Direct Server Return Shared Layer 4 to Layer 7 Service Configuration

When the service device is configured in the common tenant or management tenant, the implicit model differs slightly. Instead of `vnsEPpInfo`, the service virtual IP address update managed object is created as a child of `vnsREPpInfo`. One `vnsSvcEpgCont` managed object is created per `vnsRsEPpInfo` to keep track of shared `SvcVip`s across tenants.

Configuring the Citrix Server Load Balancer for Direct Server Return

The following procedure provides an overview of how to configure the Citrix server load balancer for direct server return.

Procedure

Step 1 Configure the virtual IP address on the backend server's loopback so that the backend server accepts the packets.

Step 2 Disable Address Resolution Protocol (ARP) reply for the virtual IP address on backend server.

Step 3 If necessary, disable the proxy port on services that are bound to the load balancing virtual server. The proxy port is disabled by default.

Step 4 Set the m parameter to "MAC" on the load balancing virtual server.

Step 5 Enable the USIP mode either globally or for each service.

Step 6 Enable the "L3", "USNIP", and "MBF" modes.

Step 7 Configure a route on the backend servers so that they can reach the Internet directly.

Configuring a Linux Server for Direct Server Return

The following procedure provides an overview of how to configure a Linux server for direct server return.

Procedure

Step 1 Configure the virtual IP addresses on the loopback interfaces by creating the `/etc/sysconfig/network-scripts/ifcfg-lo` file in Centos with the following contents:

```
DEVICE=lo:1
IPADDRESS=10.10.10.99
NETMASK=255.255.255.255
NETWORK=10.10.10.99
BROADCAST=10.10.10.99
ONBOOT=yes
NAME=loopback
```

In this example, 10.10.10.99 is the virtual IP address.

Step 2 Set the arp_ignore and arp_announce settings in the server interface that is used to reply to client request:

```
echo 1 > /proc/sys/net/ipv4/conf/eth1/arp_ignore
echo 2 > /proc/sys/net/ipv4/conf/eth1/arp_announce
```

In this example, `eth1` is the server interface used to respond to client requests.

For more information about the ARP settings, see the following Linux Virtual Server wiki page:

http://kb.linuxvirtualserver.org/wiki/Using_arp_announce/arp_ignore_to_disable_ARP