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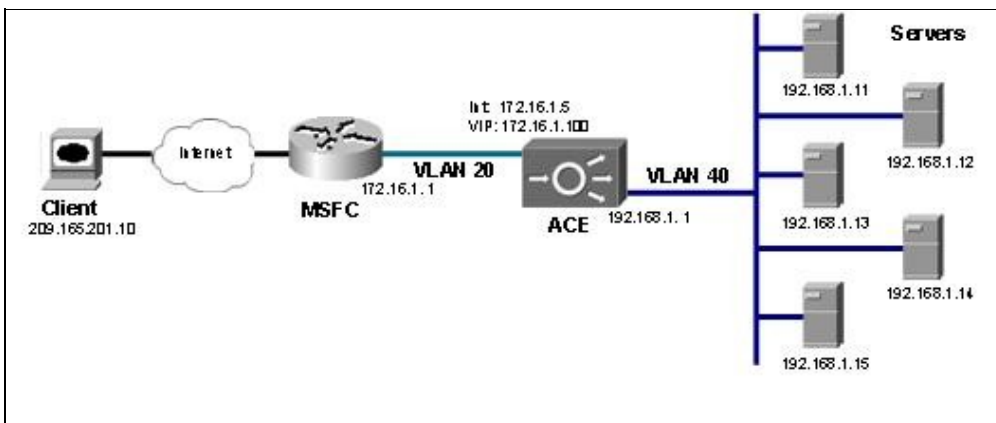
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Goal

Configure basic load balancing where client traffic enters on one network and is directed to servers residing on a second network. The server farm for each request will be chosen based on the URL being requested.

Design

Clients will send application requests through the multilayer switch feature card (MSFC), which routes them to a virtual IP address (VIP) within the Cisco® Application Control Engine (ACE). The VIP used in this example resides in an ACE context, which is configured with a client VLAN and a server VLAN (Figure 1). Client requests will arrive at the VIP, and the ACE will pick the appropriate server and then use the destination Network Address Translation (NAT) to send the client request to the server. The server will respond using the interface VLAN of the ACE as its default gateway to the client. The ACE will then change the source IP to be the VIP and forward the response to the client via the MSFC.



Configuration


The Cisco ACE needs to be configured via access control lists (ACLs) to allow traffic into the ACE data plane. After the ACL checks are made, a service policy, which is applied to the interface, is used to classify traffic destined for the VIP. The VIP is associated with a load-balancing action within the multimatch policy. The load-balancing action tells the ACE how to handle traffic that has been directed to a VIP. In this example, all traffic is sent to a server farm, where it is distributed in round-robin fashion to one of five real servers. The ACE configuration occurs in layers, such that it builds from the real IPs to applying the VIP on an interface. Due to this layered structure, it is optimal to create the configuration by working backward from the way the flow is processed. Thus, to enable server load balancing you need to do the following:

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- Enable ACLs to allow data traffic through the ACE device, as it is denied by default.
- Configure the IPs of the servers (define rservers).
- Group the real servers (create a server farm).
- Define the virtual IP address (VIP).
- Define how traffic is to be handled as it is received (create a policy map for load balancing).
- Associate a VIP to a handling action (create a multimatch policy map [a service policy])
- Create client- and server-facing interfaces.
- Apply the VIP and ACL permitting client connections to the interface (apply access group and service policy to interface).

To begin the configuration, create an access list for permitting client connections.

```
ACE-1/routed(config)# access-list everyone extended permit ip any any
ACE-1/routed(config)# access-list everyone extended permit icmp any any
```

 **Note:** Although this example shows a ?permit any any,? it is recommended that ACLs be used to permit only the traffic you want allow through the Cisco ACE. In the past, server load-balancing (SLB) devices have used the VIP and port alone to protect servers. Within the ACE, ACLs are processed first, and thus dropping traffic using an ACL requires fewer resources than dropping it once it passes the ACLs and reaches the VIP.

The Cisco ACE needs to know the IP address of the servers available to handle client connections. The rserver command is used to define the IP address of the service. In addition, each rserver must be place in service for it to be used. The benefit of this design is that no matter how many applications or services an rserver hosts, the entire real server can be completely removed from the load-balancing rotation by issuing a single ?no inservice? or ?no inservice-standby? command at the rserver level. This is very beneficial for users needing to upgrade or patch an rserver, because they no longer have to go to each application and remove each instance of the rserver.

```
ACE-1/routed(config)# rserver lnx1
ACE-1/routed(config-rserver-host)# ip add 192.168.1.11
ACE-1/routed(config-rserver-host)# inservice
ACE-1/routed(config-rserver-host)# rserver lnx2
ACE-1/routed(config-rserver-host)# ip add 192.168.1.12
ACE-1/routed(config-rserver-host)# inservice
ACE-1/routed(config-rserver-host)# rserver lnx3
ACE-1/routed(config-rserver-host)# ip add 192.168.1.13
ACE-1/routed(config-rserver-host)# inservice
ACE-1/routed(config-rserver-host)# rserver lnx4
ACE-1/routed(config-rserver-host)# ip add 192.168.1.14
ACE-1/routed(config-rserver-host)# inservice
ACE-1/routed(config-rserver-host)# rserver lnx5
ACE-1/routed(config-rserver-host)# ip add 192.168.1.15
ACE-1/routed(config-rserver-host)# inservice
```

Now group the rservers to be used to handle client connections into a server farm. Again, the rserver must be placed in service. This allows a single instance of an rserver to be manually removed from rotation.

```
ACE-1/routed(config-cmap)# serverfarm web
ACE-1/routed(config-sfarm-host)# rserver lnx1
ACE-1/routed(config-sfarm-host-rs)# inservice
ACE-1/routed(config-sfarm-host-rs)# rserver lnx2
ACE-1/routed(config-sfarm-host-rs)# inservice
ACE-1/routed(config-sfarm-host-rs)# rserver lnx3
ACE-1/routed(config-sfarm-host-rs)# inservice
ACE-1/routed(config-sfarm-host-rs)# rserver lnx4
ACE-1/routed(config-sfarm-host-rs)# inservice
ACE-1/routed(config-sfarm-host-rs)# rserver lnx5
ACE-1/routed(config-sfarm-host-rs)# inservice
```

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Use a class map to define the VIP to which clients will send their requests. In this example, the VIP is considered L3 (Layer 3) because there is a match on any port. If the VIP were to match only HTTP traffic, the match would be bound to port 80 and considered an L4 (Layer 4) VIP. (For example, ?match virtual-address 172.16.1.101 tcp eq 80?).

```
ACE-1/routed(config)# class-map slb-vip
ACE-1/routed(config-cmap)# match virtual-address 172.16.1.101 any
```

Next define an http class to match URLs requesting images. This is done using a simple HTTP URL match on the ?/image/? directory name. The wildcard allows for any image filename to be matched.

```
ACE-1/routed(config-cmap-http-lb)# class-map type http loadbalance match-all images
ACE-1/routed(config-cmap-http-lb)# match http url /images/.*
```

Next define the action to take when a new client request arrives. In this case we have two possible actions. Based on the http matching class defined above, requests for images will be sent to the imagefarm, while all other requests will be sent to the web servers in the webfarm.

```
ACE-1/routed(config)# policy-map type loadbalance http first-match slb-logic
ACE-1/routed(config-pmap-lb)# class images
ACE-1/routed(config-pmap-lb-c)# serverfarm imagefarm
ACE-1/routed(config-pmap-lb-c)# class class-default
ACE-1/routed(config-pmap-lb-c)# serverfarm webfarm
```

Since the VIPs and load-balancing actions are defined independently, they must be associated so that the Cisco ACE knows how to handle traffic destined for a VIP. The association is made using a multimatch policy map. Keep in mind that multimatch policy maps are applied to interfaces as service policies.

```
ACE-1/routed(config)# policy-map multi-match client-vips
ACE-1/routed(config-pmap)# class slb-vip
ACE-1/routed(config-pmap-c)# loadbalance policy slb
ACE-1/routed(config-pmap-c)# loadbalance vip inservice
```


At this point the interface VLANs can be created to interconnect the Cisco ACE to the client side of the network and to the servers.

```
ACE-1/routed(config)# interface vlan 20
ACE-1/routed(config-if)# description ?Client Side?
ACE-1/routed(config-if)# ip address 172.16.1.5 255.255.255.0
ACE-1/routed(config-if)# no shutdown

ACE-1/routed(config-if)# interface vlan 40
ACE-1/routed(config-if)# description ?Default gateway of real servers?
ACE-1/routed(config-if)# ip address 192.168.1.1 255.255.255.0
ACE-1/routed(config-if)# no shutdown
```

The last step is to apply the ACL and service policy (?policy-map multi-match?) to the client-side interface. Both the access group and service policy are applied on the input side of the interface.

```
ACE-1/routed(config)# interface vlan 20
ACE-1/routed(config-if)# access-group input everyone
ACE-1/routed(config-if)# service-policy input client-vips
```

 **Note:** There is no need to add an access group to the server side, as the Cisco ACE automatically creates pinholes to allow server response traffic to pass back to the client.

When a client connects to the VIP, it downloads the index.html page from the web servers and all the embedded images from the imagefarm servers. This can be verified using the detailed output of the ?show

service-policy? command:

```
ACE-1/routed(config-if)# do show service-policy client-vips detail
```

```
Status      : ACTIVE
Description: -
-----
Interface: vlan 20
  service-policy: client-vips
  class: slb-vip
  VIP Address:   Protocol:  Port:
  172.16.1.101  tcp          eq      80
  loadbalance:
    L7 loadbalance policy: slb-logic
    VIP Route Metric      : 77
    VIP Route Advertise   : DISABLED
    VIP ICMP Reply        : DISABLED
    VIP State: INSERVICE
    curr conns            : 0          , hit count            : 10
    dropped conns         : 0
    client pkt count      : 84          , client byte count: 6070
    server pkt count      : 112         , server byte count: 89359
    max-conn-limit        : 0          , drop-count : 0
    conn-rate-limit       : 0          , drop-count : 0
    bandwidth-rate-limit : 0          , drop-count : 0
    L7 Loadbalance policy : slb-logic
    class/match : images
    LB action :
      primary serverfarm: imagefarm
      state: UP
      backup serverfarm : -
      hit count          : 9
      dropped conns      : 0
    class/match : class-default
    LB action :
      primary serverfarm: webfarm
      state: UP
      backup serverfarm : -
      hit count          : 1
      dropped conns      : 0
```

Related show Commands

This section provides information you can use to confirm your configuration is working properly.

Certain show commands are supported by the [Output Interpreter Tool \(registered customers only\)](#), which allows you to view an analysis of show command output.

```
ACE-1/routed #show arp
ACE-1/routed #show acl
ACE-1/routed #show service-policy client-vips
ACE-1/routed #show service-policy client-vips detail
ACE-1/routed #show serverfarm
ACE-1/routed #show rserver
ACE-1/routed #show stats
```

Comments

Once you've completed the configuration, verify that the Cisco ACE has an Address Resolution Protocol (ARP) response for each rserver and the default route to the client. Check the ACL hits to ensure that client

connections are being accepted. Check the service policy output to see the client connection hits, and verify that the server is responding with response packets. The ?show? command for serverfarm and rserver can be used to display the exact rserver handling the connection and the amount of work the entire server farm has handled. The ?show stats? command provides a higher level of monitoring of ACE load balancing, inspection, probes, and other important metrics.

show running-config

```
ACE-1/routed# show run

access-list everyone line 8 extended permit ip any any
access-list everyone line 16 extended permit icmp any any

rserver host lnx1
  ip address 192.168.1.11
  inservice
rserver host lnx2
  ip address 192.168.1.12
  inservice
rserver host lnx3
  ip address 192.168.1.13
  inservice
rserver host lnx4
  ip address 192.168.1.14
  inservice
rserver host lnx5
  ip address 192.168.1.15
  inservice

serverfarm host imagefarm
  rserver lnx3
    inservice
  rserver lnx4
    inservice
serverfarm host webfarm
  rserver lnx1
    inservice
  rserver lnx2
    inservice

class-map type http loadbalance match-all images
  2 match http url /images/*

class-map match-all slb-vip
  2 match virtual-address 172.16.1.101 any

policy-map type management first-match remote-access
  class class-default
    permit

policy-map type loadbalance http first-match slb
  class images
    serverfarm imagefarm
  class class-default
    serverfarm web

policy-map multi-match client-vips
  class slb-vip
    loadbalance vip inservice
    loadbalance policy slb

interface vlan 20
```

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```
description "Client Side"  
ip address 172.16.1.5 255.255.255.0  
access-group input everyone  
service-policy input client-vips  
no shutdown
```

```
interface vlan 40  
description "Default gateway of real servers"  
ip address 192.168.1.1 255.255.255.0  
service-policy input remote-access  
no shutdown
```

```
ip route 0.0.0.0 0.0.0.0 172.16.1.1
```

Related Information

[Technical Support & Documentation - Cisco Systems](#)