

Link Load Balancing

<http://docs.citrix.com/content/docs/en-us/netScaler/11-1/link-load-balancing.html>
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Link Load Balancing

Link load balancing (LLB) balances outbound traffic across multiple Internet connections provided by different service providers. LLB enables the Citrix® NetScaler® appliance to monitor and control traffic so that packets are transmitted seamlessly over the best possible link. Unlike with server load balancing, where a service represents a server, with LLB, a service represents a router or the next hop. A link is a connection between the NetScaler and the router.

To configure link load balancing, many users begin by configuring a basic setup with default settings. Configuring a basic setup involves configuring services, virtual servers, monitors, routes, an LLB method, and, optionally, configuring persistence. Once a basic setup is operational, you can customize it for your environment.

Load balancing methods that are applicable to LLB are round robin, destination IP hash, least bandwidth, and least packets. You can optionally configure persistence for connections to be sustained on a specific link. The available persistence types are source IP address-based, destination IP address-based, and source IP and destination IP address-based. PING is the default monitor but configuring a transparent monitor is recommended.

You can customize your setup by configuring reverse NAT (RNAT) and backup links.

This document includes the following information:

- Configuring a Basic LLB Setup
- Configuring RNAT with LLB
- Configuring a Backup Route
- Resilient LLB Deployment Scenario
- Monitoring an LLB Setup

Configuring a Basic LLB Setup

To configure LLB, you first create services representing each router to the Internet Service Providers (ISPs). A PING monitor is bound by default to each service. Binding a transparent monitor is optional but recommended. Then, you create a virtual server, bind the services to the virtual server, and configure a route for the virtual server. The route identifies the virtual server as the gateway to the physical routers represented by the services. The virtual server selects a router by using the load balancing method that you specify. Optionally, you can configure persistence to make sure that all traffic for a particular session is sent over a specific link.

To configure a basic LLB setup, do the following:

- Configure services
- Configure an LLB virtual server and binding a service
- Configure the LLB method and persistence
- Configure an LLB route
- Create and bind a transparent monitor

Configuring Services

Updated: 2014-10-27

A default monitor (PING) is automatically bound to a service type of ANY when the service is created, but you can replace the default monitor with a transparent monitor, as described in "Creating and Binding a Transparent Monitor."

To create a service by using the command line interface

At the command prompt, type:

- add service <name> <IP> <serviceType> <port>
- show service <name>

Example

```
add service ISP1R_svc_any 10.10.10.254 any *
show service ISP1R_svc_any
    ISP1R_svc_any (10.10.10.254:*) - ANY
    State: DOWN
    Last state change was at Tue Aug 31 04:31:13 2010
    Time since last state change: 2 days, 05:34:18.600
    Server Name: 10.10.10.254
    Server ID : 0    Monitor Threshold : 0
    Max Conn: 0      Max Req: 0          Max Bandwidth: 0 kbits
    Use Source IP: NO
    Client Keepalive(CKA): NO
    Access Down Service: NO
    TCP Buffering(TCPB): YES
    HTTP Compression(CMP): NO
    Idle timeout: Client: 120 sec    Server: 120 sec
    Client IP: DISABLED
    Cacheable: NO
    SC: OFF
    SP: OFF
    Down state flush: ENABLED

1)    Monitor Name: ping
        State: UP          Weight: 1
        Probes: 244705    Failed [Total: 0 Current: 0]
        Last response: Success - ICMP echo reply received.
        Response Time: 1.322 millisec

Done
```

To create services by using the configuration utility

Navigate to Traffic Management > Load Balancing > Services, and create a service.

To create services by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Services.
2. In the details pane, click Add.
3. In the Create Service dialog box, specify values for the following parameters:

- o Service Name*â€"name
- o Serverâ€"IP
- o Protocol*â€"serviceType (Select ANY from the drop-down list.)
- o Port*â€"port

* A required parameter

4. Click Create.
5. Repeat Steps 2-4 to create another service.
6. Click Close.
7. In the Services pane, select the services that you just configured and verify that the settings displayed at the bottom of the screen are correct.

Configuring an LLB Virtual Server and Binding a Service

Updated: 2014-10-28

After you create a service, create a virtual server and bind services to the virtual server. The default LB method of least connections is not supported in LLB. For information about changing the LB method, see "Configuring the LLB Method and Persistence."

To create a link load balancing virtual server and bind a service by using the command line interface

At the command prompt, type:

- o add lb vserver <name> <serviceType>
- o bind lb vserver < name> <serviceName>
- o show lb vserver < name>

Example

```
add lb vserver Router1-vip any
bind lb vserver Router-vip ISPlR_svc_any
sh lb vserver router-vip
Router-vip (0.0.0.0:0) - ANY      Type: ADDRESS
State: DOWN
Last state change was at Thu Sep  2 10:51:32 2010
Time since last state change: 0 days, 17:51:46.770
Effective State: DOWN
Client Idle Timeout: 120 sec
Down state flush: ENABLED
Disable Primary Vserver On Down : DISABLED
No. of Bound Services :  1 (Total)          0 (Active)
Configured Method: ROUNDROBIN
Mode: IP
Persistence: NONE
Connection Failover: DISABLED

1) ISPlR_svc_any (10.10.10.254: *) - ANY State: DOWN      Weight: 1
Done
```

To create a link load balancing virtual server and bind a service by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Virtual Servers, and create a virtual server for link load balancing. Specify **ANY** in the **Protocol** field.
Note: Make sure that **Directly Addressable** is unchecked.
2. Under the **Services** tab, in the **Active** column, select the check box for the service that you want to bind to the virtual server.

Configuring the LLB Method and Persistence

Updated: 2014-10-28

By default, the NetScaler appliance uses the least connections method to select the service for redirecting each client request, but you should set the LLB method to one of the supported methods. You can also configure persistence, so that different transmissions from the same client are directed to the same server.

To configure the LLB method and/or persistence by using the command line interface

At the command prompt, type the following command:

- o set lb vserver <name> -lbMethod <lbMethod> -persistenceType <persistenceType>
- o show lb vserver <name>

Example

```
set lb vserver router-vip -lbmethod ROUNDROBIN -persistencetype SOURCEIP

show lb vserver Router-vip
Router-vip (0.0.0.0:0) - ANY      Type: ADDRESS
State: DOWN
Last state change was at Fri Sep  3 04:46:48 2010
Time since last state change: 0 days, 00:52:21.200
Effective State: DOWN
Client Idle Timeout: 120 sec
Down state flush: ENABLED
Disable Primary Vserver On Down : DISABLED
No. of Bound Services :  0 (Total)      0 (Active)
Configured Method: ROUNDROBIN
Mode: IP
Persistence: SOURCEIP
Persistence Mask: 255.255.255.255      Persistence v6MaskLength: 128      Persistence Tim
Connection Failover: DISABLED
```

To configure the link load balancing method and/or persistence by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Virtual Servers and select the virtual server for which you want to configure the load balancing method and/or persistence settings.
2. In the **Advanced** section, select Method and configure the load balancing method.
3. In the **Advanced** section, select **Persistence** and configure the persistence parameters.

Configuring an LLB Route

Updated: 2014-10-28

After configuring the IPv4 or IPv6 services, virtual servers, LLB methods, and persistence, you configure an IPv4 or IPv6 LLB route for the network specifying the virtual server as the gateway. A route is a collection of links that are load balanced. Requests are sent to the virtual server IP address that acts as the gateway for all outbound traffic and selects the router based on the LLB method configured.

To configure an IPv4 LLB route by using the command line interface

At the command prompt, type:

- o add lb route <network> <netmask> <gatewayName>
- o show lb route [<network> <netmask>]

Example

```
add lb route 0.0.0.0 0.0.0.0 Router-vip
show lb route 0.0.0.0 0.0.0.0
```

	Network	Netmask	Gateway/VIP	Flags
1)	0.0.0.0	0.0.0.0	Router-vip	UP

To configure an IPv6 LLB route by using the command line interface

At the command prompt, type:

- o add lb route6 <network> <gatewayName>
- o show lb route6

```
add lb route6 :::/0 llb6_vs
```

```
show lb route6
```

	Network	VIP	Flags
1)	:::/0	llb6_vs	UP

Example

To configure an LLB route by using the configuration utility

Navigate to System > Network > Routes, and select **LLB**, and configure the LLB route.

Note: Select LLBV6 to configure an IPV6 route.

To configure an LLB route by using the configuration utility

1. Navigate to System > Network > Routes.
2. In the details pane, select one of the following:
 - o Click LLB to configure an IPv4 route.
 - o Click LLBV6 to configure an IPv4 route.
3. In the Create LB Route or Create LB IPV6 Routedialog box, set the following parameters:

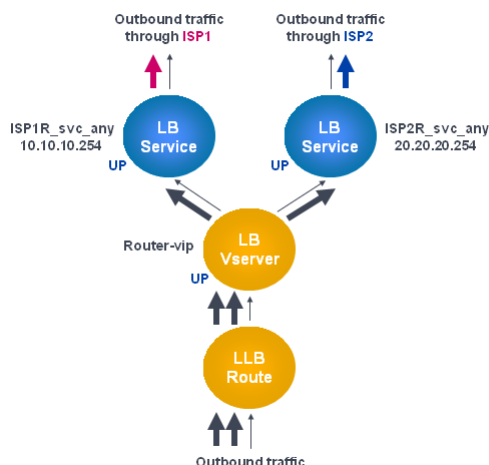
- o Network*
- o Netmask*â€”Required for IPV4 routes.
- o Gateway Name*â€”gatewayName

* A required parameter

4. Click Create, and then click Close. The route that you just created appears on the LLB or the LLB6 tab in the Routes pane.

The following diagram shows a basic LLB setup. A service is configured for each of the two links (ISPs) and PING monitors are bound by default to these services. A link is selected based on the LLB method configured.

Figure 1. Basic LLB Setup



Note: If your Internet service provider has provided an IPv6 address, replace the IPv4 service with an IPv6 service in the above figure.

Creating and Binding a Transparent Monitor

Updated: 2014-10-28

You create a transparent monitor to monitor the health of upstream devices, such as routers. You can then bind the transparent monitor to services. The default PING monitor monitors the connectivity only between the NetScaler appliance and the upstream device. The transparent monitor monitors all the devices existing in the path from the appliance to the device that owns the destination IP address specified in the monitor. If a transparent monitor is not configured and the status of the router is UP but one of the next hop devices from that router is down, the appliance includes the router while performing load balancing and forwards the packet to the router. However, the packet is not delivered to the final destination because one of the next hop devices is down. By binding a transparent monitor, if any of the devices (including the router) are down, the service is marked as DOWN and the router is not included when the appliance performs link load balancing.

To create a transparent monitor by using the command line interface

At the command prompt, type:

- o add lb monitor <monitorName> <type> -destIP <ip_addr|*> -transparent YES
- o show lb monitor [<monitorName>]

Example

```
add lb monitor monitor-1 PING -destIP 10.10.10.11 -transparent YES
> show lb monitor monitor-1
1) Name.....: monitor-1 Type.....: PING State....: ENABLED
Standard parameters:
Interval.....: 5 sec Retries.....: 3
Response timeout.: 2 sec Down time.....: 30 sec
Reverse.....: NO Transparent.....: YES
Secure.....: NO LRTM.....: ENABLED
Action.....: Not applicable Deviation.....: 0 sec
Destination IP...: 10.10.10.11
Destination port.: Bound service
Iptunnel.....: NO
TOS.....: NO TOS ID.....: 0
SNMP Alert Retries.: 0 Success Retries...: 1
Failure Retries...: 0
```

To create a transparent monitor by using the configuration utility

Navigate to Traffic Management > Load Balancing > Monitors and configure a transparent monitor.

To create a transparent monitor by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Monitors.
2. In the Monitors pane, click Add.
3. In the Create Monitor dialog box, set the following parameters:

- o Name*
- o Type*
- o Destination IP
- o Transparent

* A required parameter

4. Click Create, and then click Close.
5. In the Monitors pane, select the monitor that you just configured and verify that the settings displayed in the Details pane are correct.

To bind a monitor to a service by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Services.
2. On the **Monitors** tab, under **Available**, select the monitor that you want to bind to the service, and then click **Add**.

To bind a monitor to a service by using the command line interface

At the command prompt, type:

- o bind lb monitor <monitorName> <serviceName>
- o show service <name>

Example

```
bind lb monitor monitor-HTTP-1 isPlR_svc_any
Done
> show service isPlR_svc_any
ISPlR_svc_any (10.10.10.254:*) - ANY
State: UP
Last state change was at Thu Sep 2 10:51:07 2010
Time since last state change: 0 days, 18:41:55.130
Server Name: 10.10.10.254
```

Server ID : 0 Monitor Threshold : 0
Max Conn: 0 Max Req: 0 Max Bandwidth: 0 kbits
Use Source IP: NO
Client Keepalive(CKA): NO
Access Down Service: NO
TCP Buffering(TCPB): YES
HTTP Compression(CMP): NO
Idle timeout: Client: 120 sec Server: 120 sec
Client IP: DISABLED
Cacheable: NO
SC: OFF
SP: OFF
Down state flush: ENABLED

1) Monitor Name: monitor-HTTP-1
 State: UP Weight: 1
 Probes: 1256 Failed [Total: 0 Current: 0]
 Last response: Success - ICMP echo reply received.
 Response Time: 1.322 milliseC

Done

To bind a monitor to a service by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Services.
2. In the details pane, select a service to which you want to bind a monitor, and then click Open.
3. In the Configure Service dialog box, on the Monitors tab, under Available, select the monitor that you want to bind to the service, and then click Add.
4. Click OK.
5. In the Services pane, select the service that you just configured and verify that the settings displayed in the Details pane are correct.

Configuring RNAT with LLB

To configure RNAT by using the command line interface

You can configure an LLB setup for reverse network address translation (RNAT) for outbound traffic. This ensures that the return network traffic for a specific flow is routed through the same path. First configure basic LLB, as described in ["Configuring a Basic LLB Setup"](#), and then configure RNAT. You must then enable use subnet IP (USNIP) mode.

To add SNIPs for ISP routers by using the command line interface

At the command prompt, type:

- o **Add IP NS** <network><subnet of first ISP in the IP router> <subnet mask> **-type SNIP**
- o **Add IP NS** <in the IP subnet of second ISP router> <subnet mask> **-type SNIP**

Example

```
add ns ip 10.140.23.1 255.255.255.0 -type snip
add ns ip 10.141.23.1 255.255.255.0 -type snip
```

To configure RNAT by using the command line interface

At the command prompt, type:

- o set rnat <network> <netmask>
- o show rnat

Example

```
set rnat 10.102.29.0 255.255.255.0
> show rnat
1)      Network: 10.102.29.0      Netmask: 255.255.255.0
      NatIP: *
```

To configure RNAT by using the configuration utility

1. Navigate to System > Network > Routes.
2. On the **RNAT** tab, from the **Actions** drop-down list, select **Configure RNAT**.
3. Specify the network on which to perform RNAT.

Note

You can also configure RNAT by using Access Control Lists (ACLs). Refer [Configuring RNAT](#) for details.

To enable Use Subnet IP mode by using the command line interface

At the command prompt, type:

- o enable ns mode USNIP
- o show ns mode

Example

```
enable ns mode USNIP
> show ns mode
```

	Mode	Acronym	Status
	-----	-----	-----
1)	Fast Ramp	FR	ON

- | | | | |
|----|---------------|-------|----|
| 2) | â€¦ | | |
| 8) | Use Subnet IP | USNIP | ON |
| 9) | â€¦ | | |

To enable Use Subnet IP mode by using the configuration utility

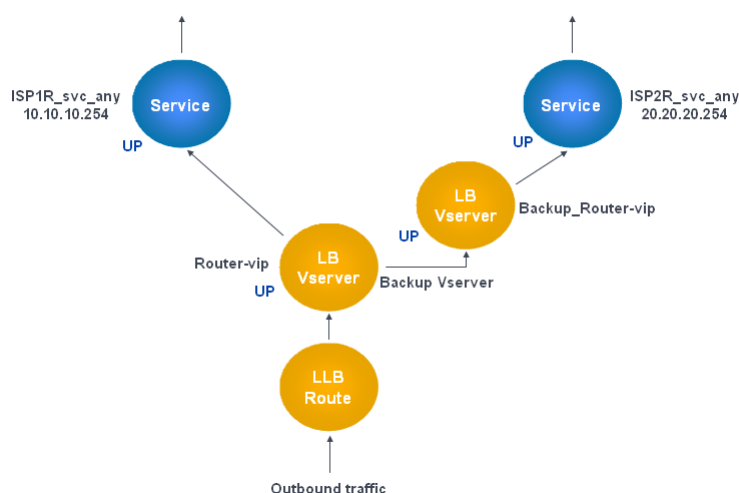
1. Navigate to **System > Settings** and, under **Modes and Features**, click **Configure Modes**.
2. In the **Configure Modes** dialog box, select **Use Subnet IP**, and then click **OK**.

Configuring a Backup Route

To prevent disruption in services when the primary route is down, you can configure a backup route. Once the backup route is configured, the NetScaler appliance automatically uses it when the primary route fails. First create a primary virtual server as described in "Configuring an LLB Virtual Server and Binding a Service." To configure a backup route, create a secondary virtual server similar to a primary virtual server and then designate this virtual server as a backup virtual server (route).

In the following diagram, **Router-vip** is the primary virtual server, and **Backup_Router-vip** is the secondary virtual server designated as the backup virtual server.

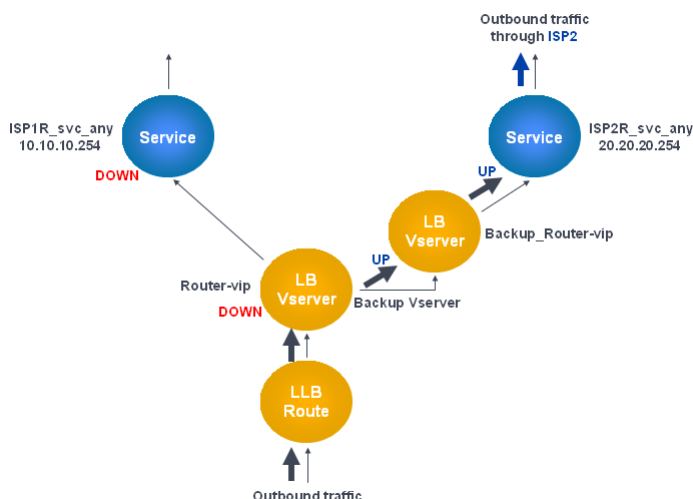
Figure 1. Backup Route Setup



Note: If your Internet service provider has provided an IPv6 address, replace the IPv4 service with an IPv6 service in the above figure.

By default, all traffic is sent through the primary route. However, when the primary route fails, all traffic is diverted to the backup route as shown in the following diagram.

Figure 2. Backup Routing in Operation



Note: If your Internet service provider has provided an IPv6 address, replace the IPv4 service with an IPv6 service in the above figure.

To set the secondary virtual server as the backup virtual server by using the command line interface

At the command prompt, type:

```
set lb vserver <name> -backupVserver <string>
```

Example

```

set lb vserver Router-vip -backupVServer Backup_Router-vip
> show lb vserver Router-vip
Router-vip (0.0.0.0:0) - ANY      Type: ADDRESS
State: UP
Last state change was at Fri Sep  3 04:46:48 2010
Time since last state change: 0 days, 03:09:45.600
Effective State: UP
Client Idle Timeout: 120 sec
Down state flush: ENABLED
Disable Primary Vserver On Down : DISABLED
No. of Bound Services :  1 (Total)      1 (Active)
Configured Method: ROUNDROBIN
Mode: IP
Persistence: DESTIP      Persistence Mask: 255.255.255.255      Persistence v6MaskLe
Backup: Router2-vip
Connection Failover: DISABLED
Done

```

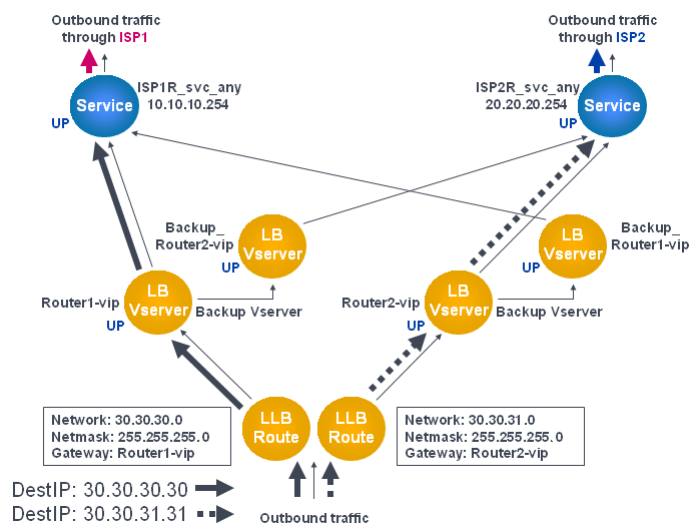
To set the secondary virtual server as the backup virtual server by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Virtual Servers and select the secondary virtual server for which you want to configure the backup virtual server.
2. In the **Load Balancing Virtual Server** dialog box, under **Advanced**, select **Protection**.
3. In the **Backup Virtual Server** drop-down list, select the secondary backup virtual server, and then click **OK**.

Resilient LLB Deployment Scenario

In the following diagram, there are two networks: 30.30.30.0 and 30.30.31.0. Link load balancing is configured based on the destination IP address. Two routes are configured with gateways **Router1-vip** and **Router2-vip**, respectively. **Router1-vip** is configured as a backup to **Router2-vip** and vice versa. All traffic with the destination IP specified as 30.30.30.30 is sent through **Router1-vip** and traffic with the destination IP specified as 30.30.31.31 is sent through **Router2-vip**.

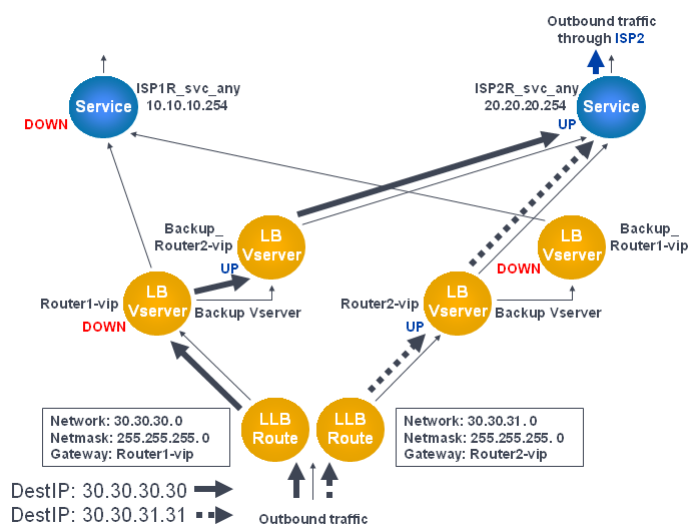
Figure 1. Resilient LLB Deployment Setup



Note: If your Internet service provider has provided an IPv6 address, replace the IPv4 service with an IPv6 service in the above figure.

However, if any one of the gateways (**Router1-vip** or **Router2-vip**) is DOWN, traffic is routed through the backup router. In the following diagram, **Router1-vip** for ISP1 is DOWN, so all traffic with the destination IP specified as 30.30.30.30 is also sent through ISP2.

Figure 2. Resilient LLB Deployment Scenario



Note: If your Internet service provider has provided an IPv6 address, replace the IPv4 service with an IPv6 service in the above figure.

Monitoring an LLB Setup

After the configuration is up and running, you should view the statistics for each service and virtual server to check for possible problems.

Viewing the Statistics of a Virtual Server

Updated: 2013-09-05

To evaluate the performance of virtual servers or to troubleshoot problems, you can display details of the virtual servers configured on the NetScaler appliance. You can display a summary of statistics for all the virtual servers, or you can specify the name of a virtual server to display the statistics only for that virtual server. You can display the following details:

- Name
- IP address
- Port
- Protocol
- State of the virtual server
- Rate of requests received
- Rate of hits

To display virtual server statistics by using the command line interface

To display a summary of the statistics for all the virtual servers currently configured on the NetScaler, or for a single virtual server, at the command prompt, type:

```
stat lb vserver [-detail] [<name>]
```

Example

```
>stat lb vserver -detail
Virtual Server(s) Summary
```

	vsvrIP	port	Protocol	State	Req/s	Hits/s
One	*	80	HTTP	UP	5/s	0/s
Two	*	0	TCP	DOWN	0/s	0/s
Three	*	2598	TCP	DOWN	0/s	0/s
dnsVirtualNS	10.102.29.90	53	DNS	DOWN	0/s	0/s
BRVSERVER	10.10.1.1	80	HTTP	DOWN	0/s	0/s
LBVIP	10.102.29.66	80	HTTP	UP	0/s	0/s
Done						

To display virtual server statistics by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Virtual Servers > Statistics.
2. If you want to display the statistics for only one virtual server, in the details pane, select the virtual server, and click Statistics.

Viewing the Statistics of a Service

Updated: 2013-08-28

You can view the rate of requests, responses, request bytes, response bytes, current client connections, requests in surge queue, current server connections, and so forth using the service statistics.

To view the statistics of a service by using the command line interface

At the command prompt, type:

```
stat service <name>
```

Example

```
stat service Service-HTTP-1
```

To view the statistics of a service by using the configuration utility

1. Navigate to Traffic Management > Load Balancing > Services > Statistics.
2. If you want to display the statistics for only one service, select the service, and click Statistics.

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