BIG-IP® Global Traffic Manager™: Concepts

Version 11.5

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Chapter 1

About Global Server Load Balancing

Introducing the Global Traffic Manager

BIG-IP® Global Traffic Manager™ (GTM™) is a system that monitors the availability and performance of global resources and uses that information to manage network traffic patterns. BIG-IP GTM uses load balancing algorithms, topology-based routing, and iRules® to control and distribute traffic according to specific policies.

About global server load balancing

BIG-IP® Global Traffic Manager™ (GTM™) provides tiered global server load balancing (GSLB). BIG-IP GTM distributes DNS name resolution requests, first to the best available pool in a wide IP, and then to the best available virtual server within that pool. GTM selects the best available resource using either a static or a dynamic load balancing method. Using a static load balancing method, BIG-IP GTM selects a resource based on a pre-defined pattern. Using a dynamic load balancing method, BIG-IP GTM selects a resource based on current performance metrics collected by the `big3d` agents running in each data center.

Static load balancing methods

This table describes the static load balancing methods available in BIG-IP® Global Traffic Manager™ (GTM™).

Name	Description	Recommended Use	Wide IP Load Balancing	Preferred Method	Alternate Method	Fallback Method
Drop Packet	BIG-IP GTM drops the DNS request.	Use **Drop Packet** for the **Alternate** load balancing method when you want to ensure that GTM does not offer in a response a virtual server that is potentially unavailable.	No	Yes	Yes	Yes
Fallback IP	BIG-IP GTM distributes DNS name resolution requests to a virtual server that you specify. This virtual server is not monitored for availability.	Use **Fallback IP** for the fallback load balancing method when you want GTM to return a disaster recovery site when the preferred and alternate load balancing methods do not return an available virtual server.	No	No	No	Yes
Global Availability	BIG-IP GTM distributes DNS name resolution requests to the first available virtual server in a pool. BIG-IP GTM starts at the top of a manually configured list of virtual servers and sends requests to the first	Use **Global Availability** when you have specific virtual servers that you want to handle most of the requests.	Yes	Yes	Yes	Yes

Name	Description	Recommended Use	Wide IP Load Balancing	Preferred Method	Alternate Method	Fallback Method
	available virtual server in the list. Only when the virtual server becomes unavailable does BIG-IP GTM send requests to the next virtual server in the list. Over time, the first virtual server in the list receives the most requests and the last virtual server in the list receives the least requests.					
None	BIG-IP GTM distributes DNS name resolution requests skipping either the next available pool in a multiple pool configuration or the current load balancing method. If all pools are unavailable, BIG-IP GTM returns an aggregate of the IP addresses of all the virtual servers in the pool using BIND.	Use **None** for the alternate and fallback methods when you want to limit each pool to a single load balancing method. If the preferred load balancing method fails, GTM offers the next pool in a load balancing response.	No	No	Yes	Yes
Ratio	BIG-IP GTM distributes DNS name resolution requests among the virtual servers in a pool or among pools in a multiple pool configuration using *weighted round robin*, a load balancing pattern in which requests are distributed among several resources based on a priority level or weight assigned to each resource.	Use **Ratio** when you want to send twice as many connections to a fast server and half as many connections to a slow server.	Yes	Yes	Yes	Yes
Return to DNS	BIG-IP GTM immediately distributes DNS name resolution requests to an LDNS for resolution.	Use **Return to DNS** when you want to temporarily remove a pool from service. You can also use **Return to DNS** when you want to limit a pool in a single pool configuration to only one or two load balancing attempts.	No	Yes	Yes	Yes
Round Robin	BIG-IP GTM distributes DNS name resolution requests in a circular and sequential pattern among the virtual servers in a pool. Over time each virtual server receives an equal number of requests.	Use **Round Robin** when you want to distribute requests equally among all virtual servers in a pool.	Yes	Yes	Yes	Yes
Static Persist	BIG-IP GTM distributes DNS name resolution requests to the first available virtual server in a pool using the persist mask with the source IP address of the LDNS and a hash algorithm to determine the order of the virtual servers in the list. This	Use **Static Persist** when you want requests from a specific LDNS to resolve to a specific virtual server.	No	Yes	Yes	Yes

Name	Description	Recommended Use	Wide IP Load Balancing	Preferred Method	Alternate Method	Fallback Method
	hash algorithm orders the virtual servers in the list differently for each LDNS that is passing traffic to the system taking into account the specified CIDR of the LDNS. Each LDNS (and thus each client) generally resolves to the same virtual server; however, when the selected virtual server becomes unavailable, BIG-IP GTM sends requests to another virtual server until the original virtual server becomes available. Then BIG-IP GTM again resolves requests to that virtual server.					
Topology	BIG-IP GTM distributes DNS name resolution requests using proximity-based load balancing. BIG-IP GTM determines the proximity of the resource by comparing location information derived from the DNS message to the topology records in a topology statement you have configured.	Use **Topology** when you want to send requests from a client in a particular geographic region to a data center or server located in that region.	Yes	Yes	Yes	Yes

Dynamic load balancing methods

This table describes the dynamic load balancing methods available in BIG-IP® Global Traffic Manager™ (GTM™).

Name	Description	Wide IP load balancing	Preferred method	Alternate method	Fallback method
Completion Rate	BIG-IP® GTM™ distributes DNS name resolution requests to the virtual server that currently maintains the least number of dropped or timed-out packets during a transaction between a data center and the client's LDNS.	No	Yes	No	Yes
CPU	BIG-IP GTM distributes DNS name resolution requests to the virtual server that currently has the most CPU processing time available.	No	Yes	No	Yes
Hops	BIG-IP GTM distributes DNS name resolution requests to a virtual server in the data center that has the fewest router hops from the client's LDNS. BIG-IP GTM uses the traceroute utility to track the number of router hops between a client's LDNS and each data center.	No	Yes	No	Yes
Kilobytes/Second	BIG-IP GTM distributes DNS name resolution requests to the virtual server that is currently processing the fewest number of kilobytes per	No	Yes	No	Yes

Name	Description	Wide IP load balancing	Preferred method	Alternate method	Fallback method
	second. Use **Kilobytes/Second** only with virtual servers for which BIG-IP GTM can collect the kilobytes per second metric.				
Least Connections	BIG-IP GTM distributes DNS name resolution requests to virtual servers on BIG-IP® Local Traffic Manager™ (LTM®) that currently hosts the fewest connections. Use **Least Connections** only with LTM servers.	No	Yes	No	Yes
Packet Rate	BIG-IP GTM distributes DNS name resolution requests to the virtual server that is currently processing the fewest number of packets per second.	No	Yes	Yes	Yes
Quality of Service	BIG-IP GTM distributes DNS name resolution requests to virtual servers based on a score assigned to each virtual server that is calculated from current performance metrics. Use **Quality of Service** only when you have configured BIG-IP GTM to calculate an overall score for each virtual server based on performance metrics.	No	Yes	No	Yes
Round Trip Time	BIG-IP GTM distributes DNS name resolution requests to the virtual server with the fastest measured round trip time between a data center and a client's LDNS.	No	Yes	No	Yes
Virtual Server Score	BIG-IP GTM distributes DNS name resolution requests to virtual servers on LTM based on a user-defined ranking. Use **Virtual Server Score** only with LTM systems on which you have assigned scores to each virtual server.	No	Yes	Yes	Yes
Virtual Server Capacity	BIG-IP GTM distributes DNS name resolution requests to virtual servers in a list that are weighted by the number of available virtual servers in the pool. The pool with the most available virtual servers is sent more requests; however, over time all the virtual servers in all the pools are sent requests. If more than one virtual server has the same weight, then BIG-IP GTM distributes DNS requests among those virtual servers using the round-robin load balancing method.	No	Yes	Yes	Yes

About load balancing and resource availability

BIG-IP® Global Traffic Manager™ (GTM™) load balances DNS name resolution requests to resources based on availability. A resource is available when it meets one or more pre-defined requirements. BIG-IP GTM uses three methods to determine resource availability: a dependency on another resource, limit settings, or a set of values returned by a monitor. When BIG-IP GTM considers a resource unavailable, BIG-IP GTM attempts to select the next resource based on the current load balancing method.

About virtual server dependency

Within BIG-IP® GTM™, you can configure a virtual server to be available based on the availability of other virtual servers.

Consider the fictional company SiteRequest. One of the servers, serverMain, at the Tokyo data center has two virtual servers: vsContact, which points to the contacts page of the web site, and vsMail, which points to the mail system. The vsMail virtual server is in the Dependency List of the vsContact virtual server. As a result, BIG-IP GTM considers the vsContact virtual server available only if the vsMail virtual server is also available.

Configuring virtual server availability to be dependent on the status of other virtual servers

Ensure that multiple virtual servers are configured on the server. Determine the virtual servers upon which you want the availability of a virtual server to be dependent.

Configure a virtual server to be available based on the availability of other virtual servers by configuring a **Dependency List** for the virtual server.

1. On the Main tab, click **DNS** > **GSLB** > **Servers**.
   The Server List screen opens.
2. In the Server List, click a server name.
   The server settings and values display.
3. On the menu bar, click **Virtual Servers**.
   A list of the virtual servers configured on the server displays.
4. In the Virtual Servers list, click a virtual server name.
   The virtual server settings and values display.
5. From the **Configuration** list, select **Advanced**.
   Additional controls display on the screen.
6. In the Dependency List area, from the **Virtual Servers** list, select each virtual server on which you want the virtual server to be dependent, and then click **Add**.
   The virtual servers display in the list as you add them.
7. Click **Finished**.

The virtual server is now available only when the virtual servers on the dependency list are also available.

Limit settings for resource availability

This table describes the limit settings BIG-IP® Global Traffic Manager™ (GTM™) uses to determine resource availability. A *limit setting* is a threshold for a statistic associated with a system.

Limit setting	Server-level	Pool-level	Virtual Server-level	BIG-IP Systems	Other Load Balancers	Hosts
Maximum allowable throughput in bits per second	Y	Y	Y	Y	Y	Y
Packets	Y	Y	Y	Y	Y	Y

Limit setting	Server-level	Pool-level	Virtual Server-level	BIG-IP Systems	Other Load Balancers	Hosts
Current connections	Y	Y	Y	Y	Y	Y
Connection	N	N	Y	Y	N	N
CPU	Y	N	N	N	Y	Y
Memory	Y	N	N	N	Y	Y

About wide IP-level load balancing

BIG-IP® Global Traffic Manager™ (GTM™) selects pools based on the order in which they are listed in a wide IP. When you organize pools in conjunction with the Global Availability, Ratio, Round Robin, and Topology load balancing methods, consider the order in which the pools are listed in the Pool List.

The Global Availability load balancing method instructs BIG-IP GTM to select the first pool in the wide IP pool list until it becomes unavailable, and then to select the next pool in the list until the first pool becomes available again. This ensures that the most robust pool receives DNS name resolution requests, while the other pools act as backups in case the primary pool becomes unavailable.

About the Global Availability load balancing method

The *Global Availability* load balancing method distributes DNS name resolution requests based on the order of resources in a list. Using global availability, BIG-IP® GTM™ sends a request to the first available resource in a list. Only when a resource becomes unavailable does BIG-IP GTM send requests to the next resource in the list. Over time, the first resource in the list receives the most requests and the last resource in the list receives the least requests.

Testing global server load balancing without verifying availability of virtual servers

You can configure BIG-IP GTM load balancing in a staging environment to load balance DNS name resolution requests to virtual servers without verifying the availability of the virtual servers.

1. On the Main tab, click **DNS** > **Settings** > **GSLB** > **Load Balancing**.
   The Load Balancing configuration screen opens.
2. Deselect the **Verify Virtual Server Availability** check box.
3. Click **Update**.

About the Ratio load balancing method

The *Ratio* load balancing method distributes DNS name resolution requests among the virtual servers in a pool or among pools in a multiple pool configuration using *weighted round robin*, a load balancing pattern in which requests are distributed among several resources based on a priority level or weight assigned to each resource.

Using the Ratio method, you can configure BIG-IP GTM to send twice as many connections to a fast, new server, and half as many connections to an older, slower server.

About wide IPs and weighting pools for the Ratio load balancing method

When you configure a wide IP to use the Ratio load balancing method, BIG-IP®GTM™ load balances DNS name resolution requests across the pools in the wide IP based on the weight assigned to each pool. BIG-IP GTM uses pool weight as a percentage of the total of the weights of all the pools in the wide IP to determine the frequency at which a pool receives connection requests.

Consider the fictional company SiteRequest, where the wide IP `www.siterequest.com` contains three pools, with the following weight assignments:

- Pool 1: weight 50
- Pool 2: weight 25
- Pool 3: weight 25

Each time GTM selects this wide IP, it load balances DNS name resolution requests across all three pools. Over time, the load balancing statistics for this wide IP appear as follows:

- Pool 1: selected 50 percent of the time
- Pool 2: selected 25 percent of the time
- Pool 3: selected 25 percent of the time

About pools and weighting pool members for the Ratio load balancing method

When you configure a pool to use the Ratio load balancing method, the Global Traffic Manager™ load balances requests across the pool members based on the weight assigned to each pool member (virtual server). The system uses pool member weight as a percentage of the total of the weights of all the members assigned to the pool to determine the frequency at which a pool member receives connection requests.

Consider the fictional company SiteRequest, where the wide IP `www.siterequest.com` contains a pool named poolMain. This pool contains three members, with the following weight assignments:

- Virtual Server 1: weight 50
- Virtual Server 2: weight 25
- Virtual Server 3: weight 25

Each time the Global Traffic Manager selects this pool, it load balances across all three members. Over time, the load balancing statistics for this pool appear as follows:

- Virtual Server 1: selected 50 percent of the time
- Virtual Server 2: selected 25 percent of the time
- Virtual Server 3: selected 25 percent of the time

About the Round Robin load balancing method

The *Round Robin* load balancing method distributes DNS name resolution requests in a circular and sequential pattern among the virtual servers in a pool. Over time, each virtual server receives an equal number of connections.

About Topology load balancing

Topology load balancing distributes DNS name resolution requests based on the proximity of the client to the data center housing the resource that responds to the request. When Topology load balancing is enabled, the BIG-IP® system uses topology records to make load balancing decisions.

About pool-level load balancing

BIG-IP® Global Traffic Manager™ (GTM™) provides three tiers of pool-level load balancing to identify a virtual server to handle a DNS name resolution request.

Preferred Load Balancing Method
The first load balancing method BIG-IP GTM uses to return the IP address of a virtual server in response to a DNS name resolution request. The preferred method can be either static or dynamic.

Alternate Load Balancing Method
If the preferred load balancing method fails to return a valid resource in response to a DNS name resolution request, it is likely that BIG-IP GTM was unable to acquire the proper metrics to perform load balancing. The alternate method can be only static.

Fallback Load Balancing Method
If the alternate load balancing method fails to return a valid resource in response to a DNS name resolution request, BIG-IP GTM uses the fallback method. To ensure that BIG-IP GTM returns a response to a request, the fallback method ignores the availability status of a resource. The fallback method can be either static or dynamic.

If all of the configured load balancing methods fail to provide a valid resource in response to a DNS name resolution request, either the request fails or BIG-IP GTM uses the local BIND to resolve the request.

About the Drop Packet load balancing method

The *Drop Packet* load balancing method indicates that BIG-IP® Global Traffic Manager™ (GTM™) drops a DNS name resolution request. This load balancing method is most often selected for the Alternate load balancing method to ensure that BIG-IP GTM does note return an IP address for an unavailable resource.

About the Virtual Server Score load balancing method

The *Virtual Server Score* load balancing method distributes DNS name resolution requests to pool members (virtual servers) based on a user-defined ranking system.

Note: *This method can be used only for distributing requests to pool members controlled by BIG-IP® Local Traffic Manager™ (LTM™) systems.*

About the Virtual Server Capacity load balancing method

The *Virtual Server Capacity* load balancing method distributes DNS name resolution requests to pool members (virtual servers) based on a system-generated list of pool members (virtual servers) weighted by capacity. BIG-IP GTM selects the pool member with the greatest capacity most often, but over time, all pool members are returned in responses. When pool members have the same capacity, BIG-IP GTM uses the Round Robin method to select a pool member.

About the Round Trip Times load balancing method

The *Round Trip Times* load balancing method distributes DNS name resolution requests to the pool member (virtual server) with the fastest measured round trip time between a data center and a client's LDNS.

About the Packet Rate load balancing method

The *Packet Rate* load balancing method distributes DNS name resolution requests to the pool member (virtual server) that is currently processing the fewest number of packets per second.

About the Least Connections load balancing method

The *Least Connections* load balancing method distributes DNS name resolution requests to pool members (virtual servers) that are managed by load balancing servers, such as BIG-IP® Local Traffic Manager™ (LTM™). BIG-IP GTM selects a pool member that currently hosts the fewest connections.

About the Kilobyte/Second load balancing method

The *Kilobyte/Second* load balancing method distributes DNS name resolution requests to the pool member (virtual server) that is currently processing the fewest number of kilobytes per second.

Note: *This method can be used only with servers for which BIG-IP GTM can collect the kilobytes per second metric.*

About the Hops load balancing method

The *Hops* load balancing method distributes DNS name resolution requests based on the `traceroute` utility and tracks the number of intermediate system transitions (router hops) between a client's LDNS and each data center. BIG-IP GTM distributes requests to a pool member in the data center that is the fewest router hops from the LDNS.

About the Completion Rate load balancing method

The *Completion Rate* load balancing method distributes DNS name resolution requests to the pool member (virtual server) that currently maintains the least number of dropped or timed-out packets during a transaction between a pool member in a data center and the client's LDNS.

About the CPU load balancing method

The *CPU* load balancing method distributes DNS name resolution requests to the pool member (virtual server) that currently has the most CPU processing time available.

About the Return to DNS load balancing method

The *Return to DNS* load balancing method immediately returns DNS name resolution requests to the LDNS for resolution. When you use this load balancing method, for client queries, the BIG-iP system increments the Return to DNS statistics; otherwise, the system increments the Return from DNS statistics.

Use this method when you want to temporarily remove a pool from service or when you want to limit a pool, in a single pool configuration, to only one or two request attempts.

About Static Persist load balancing

The Static Persist load balancing method uses the persist mask with the source IP address of the LDNS in a deterministic algorithm to send requests to a specific pool member (virtual server). Using this method, BIG-IP® GTM™ sends DNS name resolution requests to the first available pool member based on a hash algorithm that determines the order of the pool members. This algorithm orders the pool members differently for each LDNS that is sending requests to BIG-IP GTM, taking into account the Classless Inter-Domain Routing (CIDR) of the LDNS. As BIG-IP GTM distributes requests across all pool members, requests from each LDNS (and thus, each client) are generally sent to the same pool member. When the selected pool member becomes unavailable, BIG-IP GTM sends requests to another pool member. When the original pool member becomes available again, BIG-IP GTM sends requests to that pool member.

About the Fallback IP load balancing method

The *Fallback IP* load balancing method distributes DNS name resolution requests to a specific user-specified IP address. This IP address is not monitored for availability. Use this load balancing method only for the Fallback IP method and specifically to provide a disaster recovery site.

Verifying the availability of virtual servers when using the fallback load balancing method

You can configure BIG-IP GTM to verify that a virtual server is up before returning the IP address of the virtual server in a response to a DNS name resolution request. Do this when the preferred and alternate load balancing methods assigned to a pool do not return a valid response and BIG-IP GTM begins to use the configured fallback load balancing method.

1. On the Main tab, click **DNS** > **Settings** > **GSLB** > **Load Balancing**.

The Load Balancing configuration screen opens.

2. Select the **Respect Fallback Dependency** check box.
3. Click **Update**.

About the None load balancing method

The *None* load balancing method skips the current load balancing method, distributes DNS name resolution requests to the next available pool in a multi-pool configuration.

If the alternate load balancing method for a pool is None, BIG-IP GTM skips the alternate method and immediately tries the fallback method. If the fallback method is None, and there are multiple pools configured, BIG-IP GTM uses the next available pool. If all pools are unavailable, BIG-IP GTM returns an aggregate of the IP addresses of all pool members using BIND. Alternatively, when the preferred method for all pools is configured, but the alternate and fallback methods are set to None, if the preferred method fails, BIG-IP GTM uses the next available pool.

About the QoS load balancing method

The *Quality of Service (QoS)* dynamic load balancing method uses current performance metrics to calculate an overall QoS score for each pool member (virtual server). When load balancing DNS name resolution requests, BIG-IP GTM selects a virtual server with the best overall QoS score. If virtual servers have identical scores, BIG-IP GTM load balances connections to those virtual servers using the round robin method. If QoS scores cannot be determined, BIG-IP GTM load balances connections across all pool members using the round robin method.

Understanding the QoS equation

The equation for calculating the overall Quality of Service (QoS) score is:

```
POOL_CONFIG->rtt * (GLOBALS->rtt / path->rtt) * 10 +
POOL_CONFIG->hops * (GLOBALS->hops / path->hops) +
POOL_CONFIG->hit_ratio * (path->hit_ratio / GLOBALS->hit_ration+
POOL_CONFIG->packet_rate * (GLOBALS->packet_rate / vs->packet_rate) * 100 +
POOL_CONFIG->bps * (GLOBALS->bps / vs->bps) +
POOL_CONFIG->topology * (topology_match->score / GLOBALS->topology) +
POOL_CONFIG->vs_capacity * vs->cur_serv_cnt +
POOL_CONFIG->vs_score * vs->cur_vs_score +
POOL_CONFIG->lcs * vs->link->lcs * 10
```

Pool members (virtual servers) inherit the QoS settings from the pool. In the equation, the value of POOL_CONFIG->"setting name" can be found in the properties of a pool, the value of GLOBALS->"setting name" in the global BIG-IP GTM setting, and the value of path->"setting name" These are measured values that come from path metrics. If there are no path metrics, the system does not perform path metric calculations and computes the QoS score using the other calculations. vs->"field" These are measured values that come from measurements the system makes on virtual servers. If there are no measurements, the system does not perform these calculations and computes the QoS score using the other calculations. Each QoS coefficient, its scale, default value, upper limit, and whether a higher or lower value is more efficient are defined in the table.

Table 1: QoS coefficients defined

Coefficient	Scale	Default value	Upper limit	Is higher or lower value more efficient?
Round trip time (rtt)	Microseconds	50	2,000,000	L
Completion rate (hit ratio)	Percentage of successfully transferred packets (0-100%)	5	100%	H
Hops	Number of intermediate systems transitions	0	64	L
Packet rate	Packets per second	1	700	L
bits/second	Bits per second throughput	3	15000	L
Topology	Score that defines network proximity by comparing server and LDNS IP addresses (0-2^{32})	0	100	H
Virtual server capacity (vs capacity)	Number of nodes up	0	20	H
Virtual server score (vs score)	User-defined ranking of virtual servers	0	100	H
Link capacity (lcs)	Based on the target dynamic ratio	30	2,000,000	H

About customizing the QoS equation

When you customize the QoS equation, consider these three concepts:

Scale

The raw metrics for the coefficients in the QoS equation are on different scales. For example, completion rate is measured in percentages, while packet rate is measured in packets per second.

Normalization

BIG-IP GTM normalizes the raw metrics to values in the range of 0 - 10.

Emphasis

You can adjust coefficients to emphasize one normalized metric over another.

When you customize the QoS equation configuration using the values in the table, if the completion rates for two virtual servers are close, the system chooses the virtual server with the best packet rate. If both the completion rates and the packet rates are close, the round trip time (RTT) breaks the tie. In this example, BIG-IP GTM does not use the metrics for topology, hops, link capacity, vs capacity, and kilobytes/second to determine how to distribute connections.

Note: *You can set a value for either RTT or hops. If you set both, BIG-IP GTM incorporates the RTT and resets the hops to 0 (zero).*

Coefficient	Value
Round Trip Time	50
Hops	0
Topology	0
Completion Rate	5
Packet Rate	10
VS Capacity	0
Bits/second	35
Link Capacity	30
Virtual Server Score	10
Kilobytes/Second (KBPS)	3

Customizing the QoS equation for load balancing global traffic

Determine the pool to which you want to apply a customized QoS equation.

Customize the QoS equation to load balance the DNS name resolution requests the members of this pool handle.

1. On the Main tab, click **DNS** > **GSLB** > **Pools**.
2. Click the name of the pool for which you want to modify the QoS equation.
   The Pool Properties screen displays.
3. On the menu bar, click **Members**.
   The Members Properties screen displays.
4. Select **Quality of Service** from either the **Preferred** or **Fallback** list.
   The Quality of Service Weights area displays.
5. Define the QoS coefficients for this pool.
6. Click **Update**.

About dynamic ratio load balancing

When you use dynamic ratio load balancing, BIG-IP GTM treats dynamic load balancing values as ratios, and distributes DNS name resolution requests to the virtual servers in the pool in proportion to these ratios.

Consider a pool named primaryOne, which contains two virtual servers: memberOne and memberTwo. primaryOne is configured with the Preferred load balancing method set to **Round Trip Time**. BIG-IP GTM determines that the round trip time for memberOne is 50 microseconds and the round trip time for memberTwo is 100 microseconds. When the **Dynamic Ratio** setting on the primaryOne pool is disabled, BIG-IP GTM always sends DNS name resolution requests to memberOne, because that virtual server has the lowest round trip time value. When the **Dynamic Ratio** setting on the primaryOne pool is enabled, BIG-IP GTM treats the round trip time values as ratios and sends twice as many DNS name resolution

requests to memberOne as it sends to memberTwo, because the round trip time for memberOne is twice as fast as the round trip time for memberTwo.

Distributing DNS requests based on weighted virtual servers

Determine the pool to which you want to apply the dynamic ratio feature.

Configure BIG-IP GTM to use dynamic load balancing values as ratios, and distribute DNS name resolution requests to virtual servers in a pool in proportion to these ratios.

1. On the Main tab, click **DNS** > **GSLB** > **Pools**.
   The Pools list screen opens.
2. Click the name of the pool that you want to modify.
3. From the **Configuration** list, select **Advanced**.
4. Select the **Dynamic Ratio** check box.
5. Click **Update**.

Using the preferred load balancing method when metrics are unavailable

Configure BIG-IP GTM to use the preferred load balancing method assigned to a pool even when metrics for the pool are unavailable. BIG-IP GTM uses old metrics, rather than the alternate load balancing method assigned to the pool.

1. On the Main tab, click **DNS** > **Settings** > **GSLB** > **Load Balancing**.
   The Load Balancing configuration screen opens.
2. Select the **Ignore Path TTL** check box.
3. Click **Update**.

BIG-IP GTM uses path information gathered during metrics collection even if the time-to-live (TTL) value of that information has expired.

Configuring the resources in a pool for manual resume

Determine the pool to which you want to apply the manual resume feature.

When a virtual server goes offline, BIG-IP GTM proceeds to send DNS name resolution requests to other virtual servers, based on the current load balancing method. By default, when the virtual server becomes available again, BIG-IP GTM resumes sending requests to that resource. When you do not want BIG-IP GTM to resume to send requests to the virtual servers in a pool immediately after the resources become available, enable the manual resume feature on the pool.

1. On the Main tab, click **DNS** > **GSLB** > **Pools**.
   The Pools list screen opens.
2. Click the name of the pool that you want to modify.
3. From the **Configuration** list, select **Advanced**.
4. Select the **Manual Resume** check box.
5. Click **Update**.

After a virtual server in this pool goes offline, you must manually enable the virtual server before BIG-IP GTM can resume sending requests to the virtual server.

Restoring availability of a pool member manually

Determine the virtual server that you want to manually enable.

When a virtual server in a pool that is configured for manual resume becomes available, you must manually enable the virtual server before BIG-IP GTM can begin sending DNS name resolution requests to the virtual server.

1. On the Main tab, click **DNS** > **GSLB** > **Pools**.
   The Pools list screen opens.
2. Click the name of the pool to which the virtual server you want to enable belongs.
3. On the menu bar, click **Members**.
4. Select the check box next to the virtual server that you want to enable, and then click **Enable**.

The virtual server is now available to receive DNS name resolution requests.

Chapter 2

Communications Between BIG-IP GTM and Other Systems

About establishing communications between GTM and other systems

Before BIG-IP® GTM™ can operate as an integrated component within your network, communications must be established between BIG-IP GTM and the other BIG-IP systems with which BIG-IP GTM must exchange information. The three scripts described in the table are used to establish these communications in specific instances.

Script name	When to run
`gtm_add`	To install a new BIG-IP GTM on a network that includes a GTM synchronization group that contains at least one other BIG-IP GTM.
`big3d_install`	To install a new BIG-IP GTM on a network that includes BIG-IP systems running earlier versions of the BIG-IP system software.
`bigip_add`	To install a new BIG-IP GTM on a network that includes BIG-IP systems running the same version of the BIG-IP system software.

About iQuery

BIG-IP® systems use an XML protocol named *iQuery*® to communicate with other BIG-IP systems using gzip compression. BIG-IP systems must exchange SSL certificates and be members of the same configuration synchronization group before the systems can share information using iQuery.

Tip: *`iqdump` is a command you can use to view the data transmitted between systems using iQuery.*

Important: *BIG-IP systems send iQuery communications only on the VLAN on which the systems receive incoming messages.*

About iQuery and communications between BIG-IP systems

The `gtmd` agent on BIG-IP® Global Traffic Manager™ (GTM™) uses the iQuery® protocol to communicate with the local `big3d` agent, and the `big3d` agents installed on other BIG-IP systems. The `gtmd` agent monitors both the availability of the BIG-IP systems, and the integrity of the network paths between the systems that host a domain and the local DNS servers that attempt to connect to that domain.

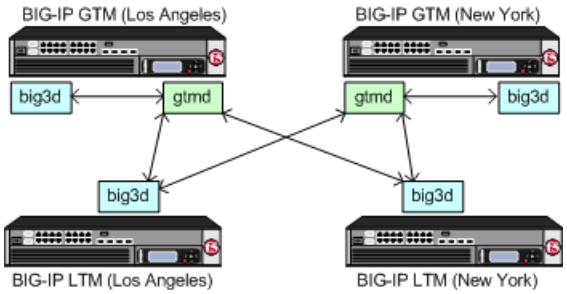


Figure 1: Communications between big3d and gtmd agents using iQuery

Viewing iQuery statistics

Ensure that the BIG-IP® GTM™ configuration contains at least one BIG-IP server object with a self IP address.

To view information about the connections between BIG-IP GTM and other BIG-IP systems, view iQuery® statistics.

1. On the Main tab, click **Statistics** > **Module Statistics** > **DNS** > **GSLB**.
   The Global Traffic statistics screen opens.
2. From the **Statistics Type** list, select **iQuery**.
   Information about the iQuery connections between this system and other BIG-IP systems in your network displays.
3. When you want to estimate iQuery traffic throughput, click **Reset**.
   The following statistics are reset to zero:
   - iQuery Reconnects
   - Bytes In
   - Bytes Out
   - Backlogs
   - Bytes Dropped

To view information about the iQuery® connections between a different BIG-IP GTM and the BIG-IP systems in your network, log in to that BIG-IP GTM and repeat this procedure.

About the gtm_add script

The `gtm_add` script is designed to be run on a BIG-IP® GTM™ you are installing on your network, when you want to integrate the system into a previously created GTM synchronization group that includes at least one other BIG-IP GTM. The script copies the remote BIG-IP GTM configuration to the local BIG-IP GTM system.

Note: *Prior to running the* `gtm_add` *script, the BIG-IP GTM system you are adding to the network must be defined in the configuration of the BIG-IP GTM system in the configuration synchronization group to which you are adding the new system.*

About the big3d_install script

The `big3d_install` script is designed to be run on a BIG-IP® GTM™ you are installing on a network that includes BIG-IP systems of earlier versions. The `big3d_install` script connects to each BIG-IP system on your network, extracts the IP addresses of the devices, and automatically updates the `big3d agents` on all devices.

About the bigip_add script

The `bigip_add` script is designed to run on a BIG-IP® GTM™ you are installing on a network that includes BIG-IP systems of the same version. The `bigip_add` script exchanges SSL certificates with each of the other BIG-IP systems to authorize communication between the devices.

Chapter 3

Configuration Synchronization

About configuration synchronization

Configuration synchronization ensures the rapid distribution of BIG-IP® GTM™ settings to other BIG-IP systems that belong to the same GTM synchronization group. A *GTM synchronization group* might contain both BIG-IP GTM and BIG-IP® Link Controller™ systems.

Configuration synchronization occurs in the following manner:

- When a change is made to a BIG-IP GTM configuration, the system broadcasts the change to the other systems in the GTM synchronization group.
- When a configuration synchronization is in progress, the process must either complete or timeout, before another configuration synchronization can occur.

About NTP servers and GTM configuration synchronization

The Network Time Protocol (NTP) servers that BIG-IP GTM references ensure that each system in a GTM synchronization group is referencing the same time when verifying configuration file timestamps.

Chapter 4

BIG-IP GTM Configuration

About listeners

A *listener* is a specialized virtual server that passively checks for DNS packets on port 53 and the IP address you assign to the listener. When a DNS query is sent to the IP address of the listener, BIG-IP GTM™ either handles the request locally or forwards the request to the appropriate resource.

How listeners process network traffic

You control how BIG-IP GTM responds to DNS queries on a per-listener basis. The number of listeners you create depends on your network configuration and the destinations to which you want to send specific queries. For example, a single BIG-IP GTM can be the primary authoritative server for one domain, while forwarding other DNSqueries to a different DNS server. BIG-IP GTM always manages and responds to DNS queries for the wide IPs that are configured on the system.

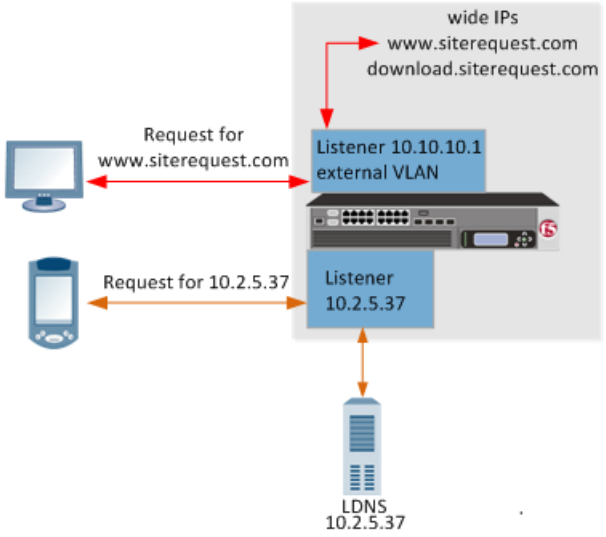
Consider the fictional company SiteRequest, once integrated into the network, BIG-IP GTM is responsible for:

- Managing and responding to requests for two wide IPs configured on the external VLAN:
  - `www.siterequest.com`
  - `downloads.siterequest.com`
- Forwarding DNS traffic destined for a DNS server at IP address `10.2.5.37`

In this scenario, BIG-IP GTM requires two listeners:

- A listener with an IP address that is on an external VLAN to manage DNS traffic destined for the wide IPs.
- A listener with the IP address of the local DNS server `10.2.5.37` to which the system can forward incoming traffic destined for that server.

Figure 2: Listener configuration example



About wildcard listeners

A *wildcard listener* is a special listener that is assigned an IP address of `0.0.0.0` and the DNS query port (port 53). When you want BIG-IP® GTM™ to respond to DNS queries coming into your network, regardless of the destination IP address of the given request, you use a wildcard listener.

About Prober pools

A *Prober pool* is an ordered collection of one or more BIG-IP® systems. BIG-IP Global Traffic Manager™ (GTM™) can be a member of more than one Prober pool, and a Prober pool can be assigned to an individual server or a data center. When you assign a Prober pool to a data center, by default, the servers in that data center inherit that Prober pool.

The members of a Prober pool perform monitor probes of servers to gather data about the health and performance of the resources on the servers. BIG-IP GTM makes load balancing decisions based on the gathered data. If all of the members of a Prober pool are marked down, or if a server has no Prober pool assigned, BIG-IP GTM reverts to a default intelligent probing algorithm to gather data about the resources on the server.

This figure illustrates how Prober pools work. BIG-IP GTM contains two BIG-IP Local Traffic Manager™ (LTM™) systems that are assigned Prober pools and one BIG-IP LTM system that is not assigned a Prober pool:

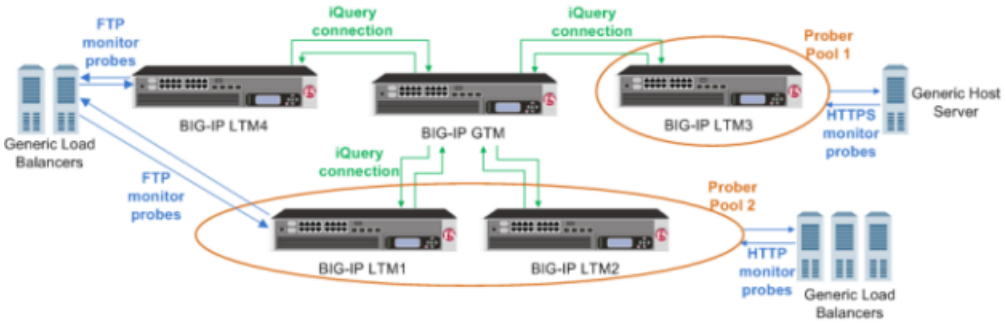


Figure 3: BIG-IP systems with prober pools

Prober Pool 1 is assigned to a generic host server

BIG-IP LTM3 is the only member of Prober Pool 1, and performs all HTTPS monitor probes of the server.

Prober Pool 2 is assigned to generic load balancers

BIG-IP LTM1 and BIG-IP LTM2 are members of Prober Pool 2. These two systems perform HTTP monitor probes of generic load balancers based on the load balancing method assigned to Prober Pool 2.

The generic load balancers on the left side of the graphic are not assigned a Prober pool

BIG-IP GTM can solicit any BIG-IP system to perform FTP monitor probes of these load balancers, including systems that are Prober pool members.

About Prober pool statistics

You can view the number of successful and failed probe requests that the BIG-IP® GTM™ system (on which you are viewing statistics) made to the Prober pools. These statistics reflect only the number of Probe requests and their success or failure. These statistics do not reflect the actual probes that the pool members made to servers on your network.

Prober pool statistics are not aggregated among the BIG-IP GTM systems in a synchronization group. The statistics on one BIG-IP GTM include only the requests made from that BIG-IP GTM system.

In this figure, the Prober pool statistics that display on BIG-IP GTM1 are the probe requests made only by that system.

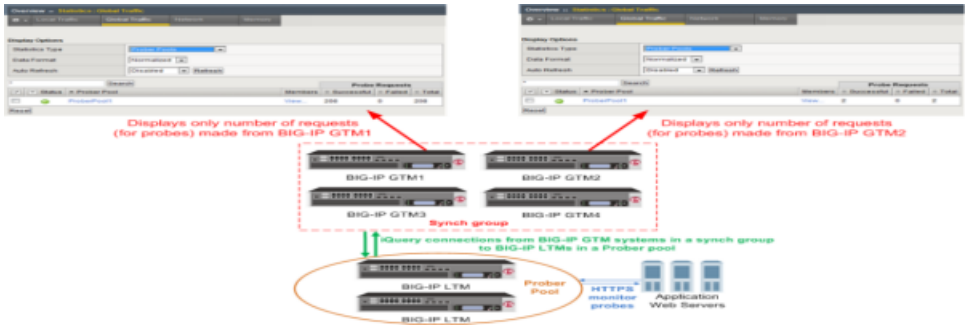


Figure 4: Prober pool statistics displayed per system

About Prober pool status

The status of a Prober pool also indicates the status of the members of the pool. If at least one member of a Prober pool has green status (Available), the Prober pool has green status.

The status of a Prober pool member indicates whether the BIG-IP GTM™ system, on which you are viewing status, can establish an iQuery connection with the member.

Note: *If a Prober pool member has red status (Offline), no iQuery connection exists between the member and the BIG-IP GTM system on which you are viewing status. Therefore, that BIG-IP GTM system cannot request that member to perform probes, and the Prober pool will not select the member for load balancing.*

About probes

A *probe* is an action a BIG-IP® system takes to acquire data from other network resources. BIG-IP Global Traffic Manager™ (GTM™) uses probes to track the health and availability of network resources.

About GTM probes of an LDNS

BIG-IP® Global Traffic Manager™ (GTM™) is responsible for acquiring data from local DNS servers (LDNS) using probes. Unlike probes conducted on internal systems, such as web servers, probes of an LDNS require that BIG-IP GTM verifies data from a resource that exists outside the network. Typically, this data is the

path information BIG-IP GTM requires when conducting Quality of Service, Round Trip Time, Completion Rate, and Hops load balancing methods.

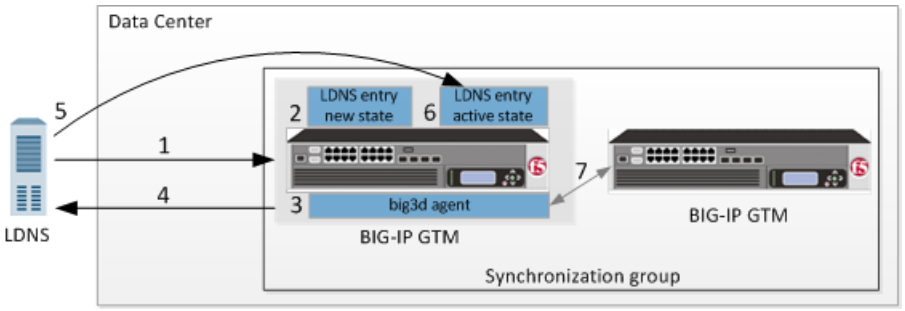


Figure 5: Flow of probe process

The steps in the probe process

1. An LDNS sends a DNS name resolution request to BIG-IP GTM for a wide IP.
2. The specific BIG-IP GTM in a GTM synchronization group that is chosen to manage probing of a resource creates an entry with a state of New (unless an entry for the LDNS already exists).

   Note: *Once a specific BIG-IP GTM system becomes responsible for managing the probing of a resource, that BIG-IP GTM maintains that responsibility until that GTM goes offline, a new BIG-IP GTM is added to the data center, or the configuration of the resource changes.*

3. The BIG-IP GTM that is responsible for managing the probing of the resource, delegates the probe to a BIG-IP GTM that is currently responsible for conducting the fewest number of probes.

   Note: *BIG-IP GTM checks this statistic each time a probe of a specific resource is required; as a result, the BIG-IP GTM that probes the resource can change from one probe instance another.*

4. The `big3d` agent on the BIG-IP GTM that is delegated to probe the resource, sends a probe to the LDNS.
5. The LDNS responds to the probe.
6. BIG-IP GTM updates the LDNS entry, assigning it an Active state.
7. The `big3d` agent then broadcasts the results of the probe to all BIG-IP GTM systems in the GTM synchronization group.

Converting a statistics collection server to a Prober pool automatically

In version 10.2 of BIG-IP® Global Traffic Manager™ (GTM™), you could assign a single BIG-IP® system to probe a server to gather health and performance data. You did this by specifying the IP address of the BIG-IP system (which you chose to perform probes of the server) in the **Statistics Collection Server** field of the server. In version 11.0, this feature was replaced by the Prober pool feature.

When you upgrade from version 10.2.x to version 11.x, if a single BIG-IP system was assigned to probe a server, BIG-IP GTM converts the single server to a Prober pool with one member, and then assigns the Prober pool to the server to which the Statistics Collection server was originally assigned. The name of the new Prober pool is based on the IP address of the original Statistics Collection server. If the original Statistics Collection server had an IP address of `10.10.2.3`, the name of the automatically created Prober pool is `prober_pool_10_10_2_3`.

About delegation of LDNS probes

By default, BIG-IP GTM delegates the probe of a resource to a BIG-IP GTM that is in the same data center as the resource, because the close proximity improves probe response time. However, when more than one BIG-IP GTM in a GTM synchronization group resides in the same data center, an algorithm is used to delegate the probes of resources equally among those BIG-IP GTM systems. This ensures that no BIG-IP GTM becomes overloaded with conducting probes, which can cause a decrease in the performance of the other tasks for which the BIG-IP system is responsible. When a data center does not contain a BIG-IP GTM, an algorithm is used to distribute the actual probes of a resource in that data center equally among the BIG-IP GTM systems in the synchronization group.

About LDNS entries on a GTM

An LDNS entry can be in one of three states: New, Pending, or Active. In general, the New and Pending states are temporary. An LDNS entry remains in one of these states only until the LDNS responds to the first probe request from a BIG-IP GTM.

New
This LDNS has not contacted BIG-IP GTM before.

Pending
This LDNS has contacted BIG-IP GTM before; however, this LDNS has yet to respond to a probe.

Active
BIG-IP GTM has an entry for this LDNS.

Protocols and ports used by big3d during communications with local DNS servers

This table describes the protocols and ports the `big3d` agent uses to communicate with an LDNS when collecting path data for the local DNS servers.

Table 2: Communication between big3d agents and local DNS servers

From	To	Protocol	From port	To port	Purpose
big3d agent	LDNS	ICMP	n/a	n/a	Probe using ICMP pings
big3d agent	LDNS	TCP	>1023	53	Probe using TCP (Cisco® routers: allow establish)
LDNS	big3d agent	TCP	53	1023	Replies using TCP (Cisco® routers: allow establish)
big3d agent	LDNS	UDP	53	33434	Probe using UDP or the traceroute utility
LDNS	big3d agent	ICMP	n/a	n/a	Replies to ICMP, UDP

From	To	Protocol	From port	To port	Purpose
					pings, or traceroute utility probes
big3d agent	LDNS	dns_rev, dns_dot	>1023	53	Probe using DNS rev or DNS dot
big3d agent	LDNS	dns_rev, dns_dot	53	>1023	Replies to DNS rev or DNS dot probes

About wide IPs

A *wide IP* maps a fully-qualified domain name (FQDN) to one or more pools of virtual servers that host the content of a domain. When an LDNS issues a DNS name resolution for a wide IP, the configuration of the wide IP indicates which pools of virtual servers are eligible to respond to the request, and which load balancing methods BIG-IP GTM uses to select the pool.

About wildcard characters in wide IP names

BIG-IP® Global Traffic Manager™ (GTM™) supports these wildcard characters in wide IP names and aliases:

Question mark (?)
Use to replace a single character, except a dot (.).

Asterisk (*)
Use to replace multiple consecutive characters with the exception of dots (.)

You can use one or more question marks or asterisks, or both question marks and asterisks in a wide IP name or alias.

Valid uses of wildcard characters for the wide IP name `www.mydomain.net` include:

- ???.mydomain.net
- www.??.domain.net
- www.my*.net
- www.??*.net
- www.my*.*
- ???.my*.*
- *.*.net
- www.*.??

Using wildcard characters in wide IPs to minimize maintenance tasks

Determine the domain names and aliases for which you want to configure wide IPs.

Create a wide IP using wildcard characters in the name to represent a domain when you have a large quantity of aliases that you want to use for the domain.

1. On the Main tab, click **DNS** > **GSLB** > **Wide IPs**.
   The Wide IP List screen opens.
2. Click **Create**.
   The New Wide IP screen opens.
3. In the **Name** field, type a name for the wide IP.

   Tip: *You can use two different wildcard characters in the wide IP name: asterisk (*) to represent several characters and question mark (?) to represent a single character. This reduces the number of aliases you have to add to the configuration.*

4. From the **Pool** list, select the pools that this wide IP uses for load balancing.

   The system evaluates the pools based on the wide IP load balancing method configured.

   a) From the **Pool** list, select a pool.

      A pool can belong to more than one wide IP.

   b) Click **Add**.

5. Click **Finished**.

About persistence connections

Most load balancing methods divide DNS name resolution requests among available pools or virtual servers. Each time BIG-IP GTM receives a request, it sends that request to the most appropriate resource based on the configuration of your network.

For example, when a user visits a web site, multiple DNS name resolution requests are generated as the user moves from page to page. Depending on the load balancing method configured, BIG-IP GTM sends each request to a different server, virtual server, or data center. In certain circumstances, you might want to ensure that a user remains with a given set of resources throughout the session. For example, a user attempting to conduct on online banking transaction needs to remain with the same set of resources to ensure that the transaction is completed successfully.

Configuring GTM for persistent connections

Configure BIG-IP GTM for persistent connections when you want a user to stay with a specific set or resources during a web transaction.

1. On the Main tab, click **DNS** > **GSLB** > **Wide IPs**.
   The Wide IP List screen opens.
2. Click **Create**.
   The New Wide IP screen opens.
3. In the **Name** field, type a name for the wide IP.

   Tip: *You can use two different wildcard characters in the wide IP name: asterisk (*) to represent several characters and question mark (?) to represent a single character. This reduces the number of aliases you have to add to the configuration.*

4. From the **Load Balancing Method** list, select the load balancing method the wide IP uses to select a pool.
5. On the menu bar, click **Pools**.
6. From the **Persistence** list, select **Enabled**.

7. In the **Persistent TTL** field, type the number of seconds the persistence entry is valid.
   This value can range from `0` to `4294967295` seconds.
8. Click **Finished**.

Once a resource has sent a response to a DNS name resolution request, BIG-IP GTM sends subsequent requests from the same connection to that same resource until the current session is completed.

About wide IPs and a last resort pool

BIG-IP® Global Traffic Manager™ (GTM™) considers any pool associated with a wide IP as a potential resource to which to load balance DNS name resolution requests. A *last resort pool* is a pool of virtual servers to which BIG-IP GTM sends DNS name resolution requests in the event that all other pools associated with the wide IP are unavailable. When you design your network, ensure that this particular pool is kept in reserve and not used as part of the normal global server load balancing.

Configuring a wide IP with a last resort pool

Ensure that a pool of virtual servers that is not part of the normal global server load balancing operations exists in the configuration.

Create a wide IP to map a FQDN to one or more pools of virtual servers that host the content of the domain, and assign a last resort pool to the wide IP.

1. On the Main tab, click **DNS** > **GSLB** > **Wide IPs**.
   The Wide IP List screen opens.
2. Click **Create**.
   The New Wide IP screen opens.
3. In the **Name** field, type a name for the wide IP.

   Tip: *You can use two different wildcard characters in the wide IP name: asterisk (*) to represent several characters and question mark (?) to represent a single character. This reduces the number of aliases you have to add to the configuration.*

4. From the **Pool** list, select the pools that this wide IP uses for load balancing.
   The system evaluates the pools based on the wide IP load balancing method configured.
   a) From the **Pool** list, select a pool.
      A pool can belong to more than one wide IP.
   b) Click **Add**.
5. From the **Last Resort Pool** list, select a pool for the system to use when no other resources are available.
6. Click **Finished**.

BIG-IP GTM uses the resources included in the last resort pool only if no other resources are available to handle DNS name resolution requests for the wide IP.

About data centers

All of the resources on your network are associated with a data center. BIG-IP® Global Traffic Manager™ (GTM™) consolidates the paths and metrics data collected from the servers, virtual servers, and links in the data center. GTM uses that data to conduct load balancing and route client requests to the best-performing resource based on different factors.

GTM might send all requests to one data center when another data center is down. Alternatively, GTM might send a request to the data center that has the fastest response time. A third option might be for GTM to send a request to the data center that is located closest to the client's source address.

Tip: *The resources associated with a data center are available only when the data center is also available.*

About servers

A *server* defines a physical system on the network. Servers contain the virtual servers that are the ultimate destinations of DNS name resolution requests. BIG-IP® Global Traffic Manager™ (GTM™) supports three types of server,s as shown in the table.

BIG-IP® systems
Any member of the BIG-IP system product line.

Third-party load balancing systems
A third-party load balancing system is any system, other than a BIG-IP system, that supports and manages virtual servers on the network.

Third-party host servers
A third-party host server is a resource to which the BIG-IP system load balances DNS traffic, for example, a web server, file server, or SQL server.

About third-party host servers

A *host* is a network resource that is not a part of the BIG-IP® product family and does not provide load balancing. BIG-IP® Global Traffic Manager™ (GTM™) supports these host servers:

- CacheFlow®
- NetApp™
- Sun Solaris™
- Windows 2000 Server (You can monitor the Windows Vista® Enterprise Server using the Windows 2000 Server.)
- Windows NT 4.0™

About third-party load balancing servers

BIG-IP® Global Traffic Manager™ (GTM™) interacts with other load balancing servers to determine availability and assess performance when responding to DNS name resolution requests. BIG-IP GTM supports these load balancing servers:

- Alteon® Ace Director
- Cisco® CSS
- Cisco® LocalDirector v2
- Cisco® LocadDirector v3
- Cisco® SLB
- Extreme
- Foundry® ServerIron
- Radware WSD
- Other generic load balancers

About virtual servers

A *virtual server* is a specific IP address and port number that points to a resource on the network. In the case of host servers, this IP address and port number likely point to the resource itself. With load balancing systems, virtual servers are often proxies that allow the load balancing server to manage a resource request across a multitude of resources.

Configuring virtual server availability to be dependent on the status of other virtual servers

Ensure that multiple virtual servers are configured on the server. Determine the virtual servers upon which you want the availability of a virtual server to be dependent.

Configure a virtual server to be available based on the availability of other virtual servers by configuring a **Dependency List** for the virtual server.

1. On the Main tab, click **DNS** > **GSLB** > **Servers**.
   The Server List screen opens.
2. In the Server List, click a server name.
   The server settings and values display.
3. On the menu bar, click **Virtual Servers**.
   A list of the virtual servers configured on the server displays.
4. In the Virtual Servers list, click a virtual server name.
   The virtual server settings and values display.
5. From the **Configuration** list, select **Advanced**.
   Additional controls display on the screen.
6. In the Dependency List area, from the **Virtual Servers** list, select each virtual server on which you want the virtual server to be dependent, and then click **Add**.
   The virtual servers display in the list as you add them.
7. Click **Finished**.

The virtual server is now available only when the virtual servers on the dependency list are also available.

Configuring virtual server status for clusters

You can configure virtual server status to be dependent only on the timeout value of the monitor associated with the virtual server. This ensures that when the primary blade in a cluster becomes unavailable, the `gtmd` agent on the new primary blade has time to establish new iQuery® connections with and receive updated status from other BIG-IP® systems.

Tip: *The `big3d` agent on the new primary blade must be up and functioning within 90 seconds (the timeout value of the BIG-IP monitor).*

---

1. On the Main tab, click **DNS** > **Settings** > **GSLB** > **General**.
   The General configuration screen opens.
2. Select **Depends on Monitors Only** from the **Virtual Server Status** list.
3. Click **Update**.

About pools and pool members

A *pool* is a collection of virtual servers that can reside on multiple servers. A *virtual server* is a combination of IP address and port number that points to a specific resource on the network. When you add a virtual server to a pool, it becomes a pool member. A *pool member* is a virtual server that has attributes that pertain to the virtual server only in the context of the pool. A virtual server can be a member of multiple pools and have different attributes in each pool. BIG-IP® Global Traffic Manager™ (GTM™) directs traffic to a pool member, based on the attributes of the pool member.

To illustrate the difference between pool members and virtual servers, consider the fictional company SiteRequest. In the London data center, the IT team has a virtual server that acts as a proxy for a BIG-IP Local Traffic Manager™ (LTM™). This virtual server is the primary resource for DNS name resolution requests for the company web page that originate from Europe. This virtual server is also the backup resource for requests that originate from the United States. Because these are two distinctly different roles, the virtual server is a pool member in two different pools. The IT team can use this configuration to customize the virtual server for each pool to which it belongs, without modifying the actual virtual server itself.

About CNAME records

A *CNAME* record specifies that a domain name is an alias of another domain. When you create a pool with a canonical name, BIG-IP® Global Traffic Manager™(GTM™) responds to DNS name resolution requests for the CNAME with the real fully qualified domain name (FQDN).

About links

A *link* is a logical representation of a physical device (router) that connects your network to the Internet. BIG-IP® Global Traffic Manager™ (GTM™) tracks the performance of links, which influence the availability of pools, data centers, wide IPs, and distributed applications.

Defining a link

Ensure that at least one data center exists in the configuration.

Gather information about the routers that you want to define as links, including:

- IP addresses
- Data center location

Define links to aid BIG-IP® Global Traffic Manager™ (GTM™) in determining resource availability.

1. On the Main tab, click **DNS** > **GSLB** > **Links.**.
   The Links list screen opens.
2. Click **Create**.
   The New Link screen opens.
3. Type a name for the link.

   Important: *Link names are limited to* `63` *characters.*

4. Specify whether the link uses address translation when communicating between the network and the Internet.

   Important: *If you enable this setting, the BIG-IP Link monitor cannot monitor outbound traffic through this link.*

5. Type the IP address of a router in the **Address** field, and then click **Add**.
   You can add more than one IP address, depending on how the server on which you are creating the link interacts with the rest of your network.
6. Select the data center where the router that the link represents resides.
7. In the **Uplink Address** field, specify the IP address of the router on the ISP side of the link.
   When you configure an uplink address, the BIG-IP system sends SNMP requests to the IP addresses configured in the **Router Address List**. The system uses the statistics that the router returns to distinguish between internal-only traffic and traffic destined for the Internet.
8. Assign the BIG-IP Link monitor to the link by moving it from the **Available** list to the **Selected** list.
9. Click **Create**.

The `big3d` agent can now gather and analyze path and metrics information about outbound traffic passing through the router the link represents.

Load balancing outbound traffic through links of differing bandwidths

Ensure that at least one data center exists in the configuration.

Gather the following information about the routers that you want to define as links:

- IP addresses
- Data Center location

When you want to avoid sending too much outbound traffic to a router with lower bandwidth, configure the links that represent your routers for ratio weighting.

Important: *You must use the same weighting option for all of the links on your network.*

1. On the Main tab, click **DNS** > **GSLB** > **Links.**.
   The Links list screen opens.
2. Click **Create**.
   The New Link screen opens.
3. Type a name for the link.

   Important: *Link names are limited to 63 characters.*

4. Specify whether the link uses address translation when communicating between the network and the Internet.

   Important: *If you enable this setting, the BIG-IP Link monitor cannot monitor outbound traffic through this link.*

5. Type the IP address of a router in the **Address** field, and then click **Add**.
   You can add more than one IP address, depending on how the server on which you are creating the link interacts with the rest of your network.
6. Select the data center where the router that the link represents resides.
7. In the **Uplink Address** field, specify the IP address of the router on the ISP side of the link.
   When you configure an uplink address, the BIG-IP system sends SNMP requests to the IP addresses configured in the **Router Address List**. The system uses the statistics that the router returns to distinguish between internal-only traffic and traffic destined for the Internet.
8. From the **Configuration** list, select **Advanced**.
   Additional controls display on the screen.
9. Assign the BIG-IP Link monitor to the link by moving it from the **Available** list to the **Selected** list.
10. From the **Weighting** list, select **Ratio**, when you want BIG-IP to continuously check the performance of each link and route outbound traffic through the link with the best performance data.
11. From the **Weighting** list, select the methodology BIG-IP uses to select a link through which to route outbound traffic.

Option	Description
Ratio	Specifies that BIG-IP uses the ratio you specify in the **Link Ratio** field when selecting a link.
Price (Dynamic Ratio)	Specifies that the system uses dynamic ratio methodology when selecting the link.

12. If you selected **Ratio** from the **Weighting** list, in the **Link Ratio** field, type the frequency at which the system sends traffic through the link.
13. Click **Create**.

The BIG-IP system can now load balance outbound traffic through your routers based on bandwidth.

Load balancing outbound traffic over the least expensive link first

Ensure that at least one data center exists in the configuration.

Gather the following information about the routers that you want to define as links:

- IP addresses
- Data Center location

When you want to load balance outbound traffic to a router with the lowest fees first, configure the links that represent your routers for price weighting.

Important: *You must use the same weighting option for all of the links on your network.*

1. On the Main tab, click **DNS** > **GSLB** > **Links.**.
   The Links list screen opens.
2. Click **Create**.
   The New Link screen opens.
3. Type a name for the link.

   Important: *Link names are limited to 63 characters.*

4. Specify whether the link uses address translation when communicating between the network and the Internet.

   Important: *If you enable this setting, the BIG-IP Link monitor cannot monitor outbound traffic through this link.*

5. Type the IP address of a router in the **Address** field, and then click **Add**.
   You can add more than one IP address, depending on how the server on which you are creating the link interacts with the rest of your network.
6. Select the data center where the router that the link represents resides.
7. In the **Uplink Address** field, specify the IP address of the router on the ISP side of the link.
   When you configure an uplink address, the BIG-IP system sends SNMP requests to the IP addresses configured in the **Router Address List**. The system uses the statistics that the router returns to distinguish between internal-only traffic and traffic destined for the Internet.
8. From the **Configuration** list, select **Advanced**.
   Additional controls display on the screen.
9. Assign the BIG-IP Link monitor to the link by moving it from the **Available** list to the **Selected** list.
10. From the **Weighting** list, select **Price**, when you want BIG-IP to direct outbound traffic through the link with the lowest cost first.
11. Click **Create**.

The BIG-IP system can now load balance outbound traffic through your routers based on cost.

Configuring statistics to reflect link bandwidth usage

Your ISP providers must use duplex billing.

When you want the BIG-IP system to display statistics that reflect link bandwidth usage, configure duplex billing.

1. On the Main tab, click **DNS** > **GSLB** > **Links.**.
   The Links list screen opens.
2. Click a link name.
   The Links list screen opens.
3. From the **Configuration** list, select **Advanced**.
   Additional controls display on the screen.

4. Select the **Duplex Billing** check box when the ISP that provides the link bills for bandwidth usage based on a maximum amount of inbound or outbound traffic (whichever is higher), rather than billing for bandwidth usage based on the total inbound and outbound traffic.
5. Click **Create**.
   The Link List screen displays.

About distributed applications

A *distributed application* is a collection of one or more wide IPs, data centers, and links that serve as a single application to a web site visitor. Configuring a distributed application provides several advantages:

- You can organize logical network components into groups that represent a business environment.
- You can configure a distributed application to be dependent upon the availability of a data center, server, or link. This dependency ensures that a user cannot access a distributed application when a portion of the resources are unavailable.
- You can define persistence for the distributed application, ensuring that a user, who accesses the distributed application uses the same resources during a single session.

If the New York data center goes offline, a wide IP in that data center becomes unavailable. A distributed application associated with that wide IP also becomes unavailable. Consequently, the system does not send resolution requests to any of the distributed application resources, until the entire application becomes available again.

About ZoneRunner

You can use the ZoneRunner™ utility to create and manage DNS zone files and configure the BIND instance on BIG-IP® Global Traffic Manager™ (GTM™). With the ZoneRunner utility, you can:

- Import and transfer DNS zone files
- Manage zone resource records
- Manage views
- Manage a local nameserver and the associated configuration file, `named.conf`
- Transfer zone files to a nameserver
- Import only primary zone files from a nameserver

About named.conf

`named.conf` contains the primary operational characteristics of BIND, including DNS views, access control list definitions, and zones. The ZoneRunner™ utility updates `named.conf` when you modify the local BIND instance.

Using ZoneRunner to configure named.conf

Ensure that at least one zone is configured on BIG-IP ®GTM™.

Use ZoneRunner™ to edit `named.conf`, to decrease the risk of a syntax error that prevents the BIND system from performing as expected. Zonerunner provides an automatic syntax check and displays error messages to help you write the correct syntax.

1. On the Main tab, click **DNS** > **Zones** > **ZoneRunner** > **named Configuration**.
   The named Configuration screen opens.
2. In the Options area, type additional configurations per your network design.
3. Click **Update**.

Creating a master DNS zone

A master zone is authoritative. Create a zone when you want to use ZoneRunner™ to manage DNS zones and resource records.

Tip: *The BIG-IP® system can be either a primary or secondary DNS server.*

1. On the Main tab, click **DNS** > **Zones** > **ZoneRunner** > **Zone List**.
   The Zone List screen opens.
2. Click **Create**.
   The New Zone screen opens.
3. From the **View Name** list, select **external**.
   The external view is a default view to which you can assign zones.
4. In the **Zone Name** field, type a period character (`.`).
5. From the **Zone Type** list, select **Master**.
6. Clear the **Zone File Name** field, and type the zone file name.
   `db.external.siterequest.com`

   Note: *Do not include a trailing dot.*
7. In the Records Creation area, type the values for the SOA and NS record parameters.
8. Click **Finished**.

If you want further help creating a custom zone file, see *SOL8380* on `www.askf5.com` for instructions.

Creating a hint zone

Hint zones designate a subset of the root nameservers list. When the local nameserver starts (or restarts), the nameserver queries the root servers in the hint zone for the most current list of root servers. The root hint is built into BIND version 9.0 and later.

Create a zone when you want to use ZoneRunner™ to manage DNS zones and resource records.

Tip: *The BIG-IP® system can be either a primary or secondary DNS server.*

1. On the Main tab, click **DNS** > **Zones** > **ZoneRunner** > **Zone List**.
   The Zone List screen opens.
2. Click **Create**.
   The New Zone screen opens.
3. From the **View Name** list, select **external**.

The external view is a default view to which you can assign zones.

4. In the **Zone Name** field, type a period character (.).
5. From the **Zone Type** list, select **Hint**.
6. Clear the **Zone File Name** field, and type the zone file name.
   `db.external.siterequest.com`

   Note: *Do not include a trailing dot.*

7. Click **Finished**.

If you want further help creating a custom hint file, see *SOL8380* on `www.askf5.com` for instructions.

Configuring GTM to allow zone file transfers

By default, BIG-IP® GTM™ is configured to secure BIND to not allow zone transfers except from the localhost. However, you can configure BIG-IP GTM to allow zone file transfers to other DNS servers.

1. On the Main tab, click **DNS** > **Zones** > **ZoneRunner** > **named Configuration**.
   The named Configuration screen opens.
2. In the **Options** field, modify the allow-transfer statement to include the IP address of the GTM.
   You can modify the following allow-transfer statement to use the IP address of the GTM.

```
allow-transfer {

      localhost;

      192.168.10.105;

      };
```

3. On the menu bar, click **View List**.
   The View List screen opens.
4. Click the name of the view that contains the zone you are configuring.
   The View Configuration screen opens.
5. In the Options area, modify the match-clients statement based on your configuration.

View configuration type	Add to match-clients statement
Single view configuration	`view "external" { match-clients { "zrd-acl-000-000"; any; }; }`

Multiple view configuration, where you want to allow transfers from GTM	Modify the following match-clients statement to use the IP address of the GTM.
	`acl "internal-acl" { <IP address> ; };`
	`view "internal" { match-clients { "zrd-acl-000-001";`

View configuration type	Add to match-clients statement

```
    "internal-acl";
    <IP address> ;
  };

view "external" {
  match-clients {
    "zrd-acl-000-000";
    any;
  };
```

6. Click **Update**.

To verify that zone transfers are working properly, modify this Linux command and run it on an external computer:`dig @<IP address> es.net. axfr`

The command should return a response similar to this:

```
; <<>> DiG? 9.5.0-P2 <<>> @192.17.1.253 es.net. axfr
   ; (1 server found)

   ;; global options: printcmd

   es.net. 500 IN SOA siterequest.com.

   hostmaster.siterequest.com. 6 10800 3600 604800 60

   es.net. 500 IN NS siterequest.com.

   a.es.net. 30 IN A 192.17.1.100

   b.es.net. 30 IN A 192.18.1.100

   es.net. 500 IN SOA siterequest.com.

   hostmaster.siterequest.com. 6 10800 3600 604800 60

   ;; Query time: 6 msec

   ;; SERVER: 192.17.1.253#53(192.17.1.253)

   ;; WHEN: Fri Mar 11 17:20:25 2011

   ;; XFR size: 5 records (messages 1, bytes 180)
```

About DNS views

A DNS *view* is a modification of a nameserver configuration based on the community attempting to access it. Using views, you can build multiple nameserver configurations on the same server, and have those configurations apply dynamically when the request originates from a specified source.

If your DNS handles requests from both inside and outside your company, you can create two views: internal and external.

Creating a DNS view

It is helpful to keep in mind that ZoneRunner™ contains a default view named: external.

Create an additional DNS view to modify the local nameserver configuration to allow a specific community to access it.

1. On the Main tab, click **DNS** > **Zones** > **ZoneRunner** > **View List**.
   The View List screen opens.
2. Click **Create**.
3. In the **View Name** field, type a name for the view.
4. From the **View Order** list, make a selection.

Option	Description
First	In the view hierarchy, this view is listed first.
Last	In the view hierarchy, this view is listed last.
After	In the view hierarchy, this view is listed immediately following the view that you select from the View List.

5. In the Options area, modify the match-clients statement based on your configuration.

View configuration type

Add to match-clients statement

Single view configuration

```
view "external" {
         match-clients {
           "zrd-acl-000-000";
           any;
         };
```

Multiple view configuration, where you want to allow transfers from GTM

Modify the following match-clients statement to use the IP address of the GTM.

```
acl "internal-acl"
     { <IP address> ;
     };

view "internal" {
  match-clients {
    "zrd-acl-000-001";
    "internal-acl";
    <IP address> ;
  };

view "external" {
  match-clients {
    "zrd-acl-000-000";
    any;
  };
```

6. In the Options area, type additional configurations per your network design.
7. Click **Finished**.

Types of DNS zone files

This table describes the types of DNS zone files.

DNS file type	Description
Primary	Zone files for a primary zone contain, at minimum, the start of authority (SOA) and nameserver (NS) resource records for the zone. Primary zones are authoritative, that is,

DNS file type	Description
	they respond to DNS queries for the domain or sub-domain. A zone can have only one SOA record, and must have at least one NS record.
Secondary	Zone files for a secondary zone are copies of the principal zone files. At an interval specified in the SOA record, secondary zones query the primary zone to check for and obtain updated zone data. A secondary zone responds authoritatively for the zone provided that the zone data is valid.
Stub	Stub zones are similar to secondary zones, except that stub zones contain only the NS records for the zone. Note that stub zones are a specific feature of the BIND implementation of DNS. F5 Networks recommends that you use stub zones only if you have a specific requirement for this functionality.
Forward	The zone file for a forwarding zone contains only information to forward DNS queries to another nameserver on a per-zone (or per-domain) basis.
Hint	The zone file for a hint zone specifies an initial set of root nameservers for the zone. Whenever the local nameserver starts, it queries a root nameserver in the hint zone file to obtain the most recent list of root nameservers. Zone file import.

Types of DNS resource records

This table describes the types of DNS resource records that ZoneRunner™ supports.

DNS file type	Description
SOA (Start of authority)	The start of authority resource record, SOA, starts every zone file and indicates that a nameserver is the best source of information for a particular zone. The SOA record indicates that a nameserver is authoritative for a zone. There must be exactly one SOA record per zone. Unlike other resource records, you create a SOA record only when you create a new master zone file.
A (Address)	The Address record, or A record, lists the IP address for a given host name. The name field is the host's name, and the address is the network interface address. There should be one A record for each IP address of the machine.
AAAA (IPv6 Address)	The IPv6 Address record, or AAAA record, lists the 128-bit IPv6 address for a given host name.
CNAME (Canonical Name)	The Canonical Name resource record, CNAME, specifies an alias or nickname for the official, or canonical, host name. This record must be the only one associated with the alias name. It is usually easier to supply one A record for a given address and use CNAME records to define alias host names for that address.
DNAME (Delegation of Reverse Name)	The Delegation of Reverse Name resource record, DNAME, specifies the reverse lookup of an IPv6 address. These records substitute the suffix of one domain name with another. The DNAME record instructs Global Traffic Manager™ (GTM™) (or any DNS server) to build an alias that substitutes a portion of the requested IP address with the data stored in the DNAME record.
HINFO (Host Information)	The Host Information resource record, HINFO, contains information on the hardware and operating system relevant to Global Traffic Manager (or other DNS).
MX (Mail Exchanger)	The Mail Exchange resource record, MX, defines the mail system(s) for a given domain.
NS (nameserver)	The nameserver resource record, NS, defines the nameservers for a given domain, creating a delegation point and a subzone. The first name field specifies the zone

DNS file type	Description
	that is served by the nameserver that is specified in the nameservers name field. Every zone needs at least one nameserver.
PTR (Pointer)	A name pointer resource record, PTR, associates a host name with a given IP address. These records are used for reverse name lookups.
SRV (Service)	The Service resource record (SRV) is a pointer with which an alias for a given service is redirected to another domain. For example, if the fictional company Site Request has an FTP archive hosted on archive.siterequest.com, the IT department can create an SRV record with which the alias ftp.siterequest.com is redirected to archive.siterequest.com.
TXT (Text)	The Text resource record, TXT, allows you to supply any string of information, such as the location of a server or any other relevant information that you want available.

About DNSSEC

Domain Name System Security Extensions (DNSSEC) is an industry-standard protocol that functions as an extension to the Domain Name System (DNS) protocol. BIG-IP® Global Traffic Manager™ (GTM™) uses DNSSEC to guarantee the authenticity of DNS responses, including zone transfers, and to return Denial of Existence responses thus protecting your network against DNS protocol and DNS server attacks.

About DNSSEC keys

BIG-IP® Global Traffic Manager™ (GTM™) uses two types of DNSSEC keys to return DNSSEC-compliant responses: a *zone-signing key* to sign all of the records in a DNSSEC resource record set, and a *key-signing* key to sign only the DNSKEY record (that is the zone-signing key) of a DNSSEC record set.

About enhancing DNSSEC key security

To enhance DNSSEC key security, when automatic key management is configured, BIG-IP® Global Traffic Manager™ (GTM™) uses an automatic key rollover process that uses overlapping generations of a key to ensure that BIG-IP GTM can always respond to queries with DNSSEC-compliant responses. BIG-IP GTM dynamically creates new generations of each key based on the values of the **Rollover Period** and **Expiration Period** of the key.

The first generation of a key has an ID of 0 (zero). Each time BIG-IP GTM dynamically creates a new generation of a key, the ID increments by one. Over time, each generation of a key overlaps the previous generation of the key ensuring that GTM can respond to a DNSSEC query even if one generation of a key becomes unavailable. When a generation of a key expires, BIG-IP GTM automatically removes that generation of the key from the configuration. The value of the **TTL (time-to-live)** of a key specifies how long a client resolver can cache the key.

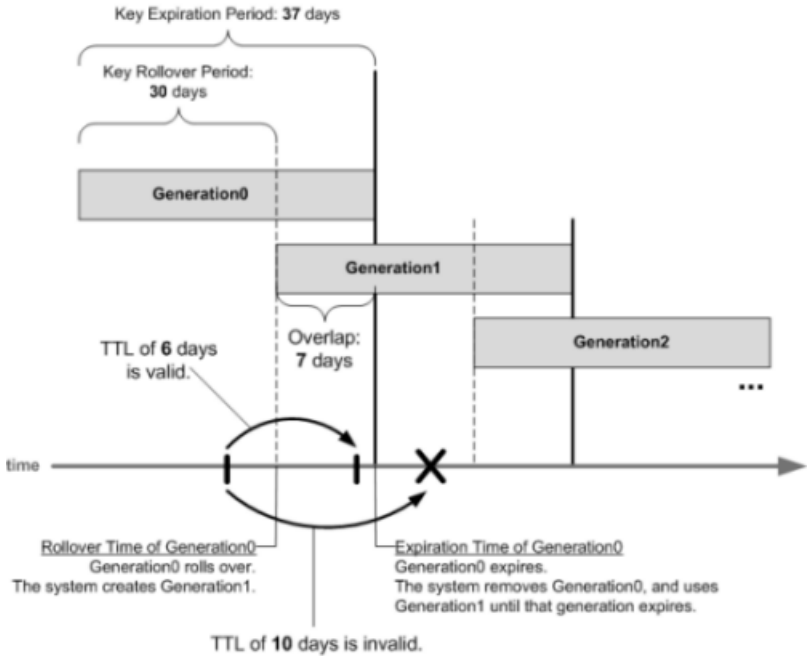


Figure 6: Overlapping generations of a key

Viewing DNSSEC records in ZoneRunner

Ensure that all DNSSEC records are added to the BIND configuration.

View the DNSSEC records using ZoneRunner™ when you want to evaluate how your network is handling DNSSEC traffic.

1. On the Main tab, click **DNS** > **Zones** > **ZoneRunner** > **Resource Record List**.
   The Resource Record List screen opens.
2. From the **View Name** list, select the name of the view that contains the resource records you want to view.
3. From the **Zone Name** list, select the zone for which you want to view resource records.
4. From the **Type** list, select the type of resource records you want to view.
5. Click **Search**.

View the resource records that display.

Protocols supported by the BIG-IP system

This table describes the protocols supported by the BIG-IP® system.

Protocol	Description
iQuery® protocol	The `gtmd` agent on BIG-IP Global Traffic Manager™ (GTM™) uses iQuery® to communicate with the local `big3d` agent and the `big3d` agents installed on other BIG-IP systems.

Protocol	Description
DNS	BIG-IP supports the Domain Name System (DNS) for distribution of DNS name resolution requests from clients and their local DNS servers to resources on your global network.
DNSSEC	BIG-IP GTM supports the DNS Security Extensions for secure zone signing and authentication of DNS responses.
HTTPS	BIG-IP supports Hypertext Transfer Protocol Secure (HTTPS) for secure web browsing.
SSL	The web server, which hosts the web-based Configuration utility, supports Secure Sockets Layer (SSL) connections as well as user authentication.
SNMP	BIG-IP supports the Simple Network Management Protocol (SNMP) for monitoring network resources.
SMTP	BIG-IP supports the Simple Mail Transfer Protocol (SMTP) for email transmission across the Internet.
SSH	BIG-IP supports Secure Shell (SSH) administrative connections for remote administration from the command line.
TCP wrappers	BIG-IP supports the use of TCP wrappers to provide an extra layer of security for network connections.
FTP	BIG-IP supports the File Transfer Protocol (FTP) for secure access to BIG-IP system software downloads from a web server.

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