DEPLOYMENT GUIDE

Version 1.1

Hybrid Cloud Application Architecture for Elastic Java-Based Web Applications

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Introducing the Hybrid Cloud Application Architecture

Welcome to the Hybrid Cloud Application Architecture guide for F5 and VMware® vCloud™ systems. This guide has been prepared as an illustration of an architecture that can be adapted to suit the needs of your particular application. Using F5, VMware, and other freely available components, we have prepared an example infrastructure for a retail e-commerce application. In this guide, F5 BIG-IP® products are used in conjunction with VMware vCloud Director to achieve the cloud bursting action, scaling out and scaling back in of an application delivered using a hybrid cloud computing approach.

For a complete list of hardware, software, and infrastructure components used in this implementation, see *Hardware, software and infrastructure components*, on page 4

For more information on the F5 products described in this guide, see ***http://www.f5.com/products/big-ip/***.

This guide is broken up into the following main sections:

- *Configuring the infrastructure*, on page 7
- *Configuring the BIG-IP LTM*, on page 12
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- *Appendix A: Orchestration*, on page 40

To provide feedback on this deployment guide or other F5 solution documents, contact us at ***solutionsfeedback@f5.com***.

Implementation notes

Applications that work best with a hybrid cloud application architecture are multi-tiered applications; where the application components can be scaled based on one or more key metrics. In our example we selected a Java application serviced by an Apache Tomcat server, where the web and application tiers are collapsed into a single layer, connected to a database with in-built caching and replication capabilities.

The components we selected allow for scaling the application components together, caching shared application data on each node and replicating dynamic data to and from each site. We structured the application and database tables to be compatible with asynchronous replication. BIG-IP Local Traffic Manager™ (LTM), BIG-IP LTM VE (Virtual Edition) and BIG-IP Global Traffic Manager™ (GTM) comprise the application delivery and WAN optimization infrastructure that arbitrate the client connections and ensure that application clients are connected to the right site, based on the application's state.

When adapting the architecture and workflow process described in this guide to fit the specific needs of your application, your infrastructure must contain vCloud Director, vSphere®, BIG-IP LTM, and BIG-IP GTM components at a minimum. You need to determine if vFabric SQLFire is the right technology for your application, the right table structure, replication scheme, and identify your key scaling metrics.

◆ **Note**

In this guide, we refer to VMware's vFabric SQLFire, however at the time of our testing it was branded as GemStone SQL Fabric.

Revision history

The following table contains the document revision history. For a list of specific products and versions of devices and software used in this guide, see *Hardware and software components*, on page 4.

Revision history:

Version	Description
1.0	New deployment guide
1.1	• Changed *GemStone SQL Fabric* to *vFabric SQLFire* to reflect the change in the product name. • Clarifed the scenerio description in Configuration Example section. We modified the JPetStore configuration and not the application itself.

Configuration example

In the example scenario detailed in this guide, we use two instances of vCloud Director in our lab; one represents a private cloud, and the other represents a service provider's public cloud. The two environments are connected via a WAN emulator. Our example application is the JPetStore demonstration application, together with VMware vCloud Director, vFabric SQLFire®, BIG-IP LTM, BIG-IP GTM, and F5 iControl®. Necessary application templates and virtualized infrastructure components have been pre-positioned at a cloud provider in a dormant state, and are activated and cloned as needed.

We used JPetStore, a freely available Java e-commerce application. In our example we have modified the configuration to use the database caching and replication technologies provided by the vFabric SQLFire product. We also partitioned the database table-space to allow inter-site data replication for order history and to maintain accurate inventory levels for order processing at locations throughout the application infrastructure. This deployment uses a hybrid cloud computing model to dynamically scale out the application in response to elevated levels of application clients.

Our infrastructure scales out and back in based on business rules and the performance characteristics of the application. We measure the application response time in the private cloud, and begin to consume cloud provider resources in response to increased application latency. As load continues to increase, we programmatically deploy additional application servers in the public cloud and update the requisite infrastructure components to ensure the application continues to perform according to our defined profile.

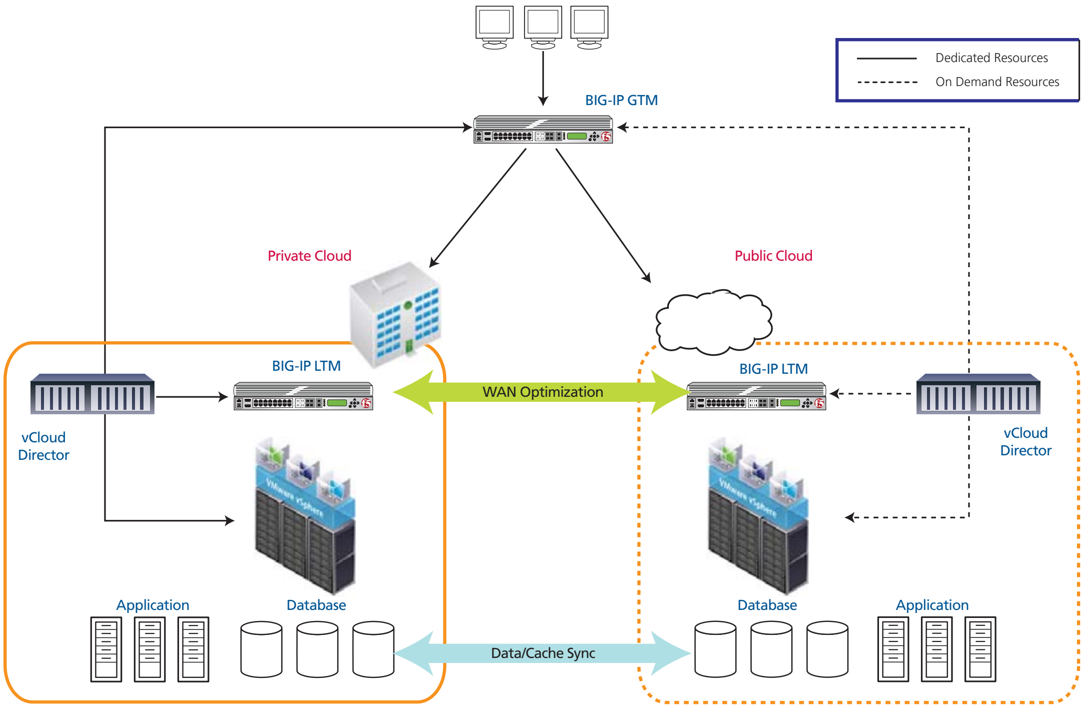


Figure 1 *Logical configuration example*

Hardware, software and infrastructure components

The following is a list of hardware, software and infrastructure components we used to perform the tasks in this deployment guide. These components will be used in any implementation (with the exception of WAN emulation), however, they do not need to be dedicated to this scenario.

Hardware and software components

The following is a list of the software and hardware components used for this implementation:

Role	What we used	Platform
Application Traffic Management	**F5** BIG-IP Global Traffic Manager (GTM) v10.2 **F5** BIG-IP Local Traffic Manager (LTM) v10.2 **F5** iControl SDK	- Appliance for GTM running on the 1600 platform at a minimum) - Appliance for LTM + iSessions (current packaging prevents iSessions and GTM on the same platform (3600 platform at a minimum) - BIG-IP LTM Virtual Edition (VE)
Application Server	**Apache** Tomcat	Cent OS 5.4 virtual machine
Application Environment	**Sun** Java Development Kit (JDK)	Cent OS 5.4 virtual machine
Example application	JPetstore application	Java
Admin clients	**Microsoft** Windows 7	Windows OS virtual machines
Server Operating System	**Microsoft** Windows 2008R2 server	Windows OS virtual machines
Database	- **Oracle** database (per vCloud Director release notes) - **Microsoft** SQL Server 2008	Oracle Enterprise Linux and Microsoft Windows virtual machines
Storage	- Open Solaris - NetApp Data OnTAP NFS server	- Sun Fire x4150 with Sun StorageTek J4200 array - NetApp FAS3160
WAN emulation (only necessary if you are deploying in a lab environment. Other WAN emulators can be used)	**Candela** LANforge 5.14 (can run in a VM, but dedicated hardware strongly recommended)	x86 server hardware with 4 ethernet interfaces
Cloud Services	- **VMware** vCloud Service Director - vCloud SDK - **VMware** vShield - vSphere 4.0U1 - vCenter Server - ESX - ESXi - vSphere Client	- At least 2 server hosts for each vCloud Director cell as per vCloud Director documentation. We used 2 x Dell 2970 each with 16 GB RAM for the Public Cloud and 2 x HP DL 385 servers with 16GB RAM for the Private Cloud - One chassis for VMware management services (running ESXi, vCenter Server, vCloud Director systems and Oracle Databases) these were all running in VMs in a third vSphere environment, not connected to either cloud
Database Cache and Replication	- **vFabric SQLFire** Database	CentOS 5.4 virtual machine

Role	What we used	Platform
Domain Name Resolution	BIND 9	Ubuntu 8 virtual machine
Accurate Network Time	NTP Server	Ubuntu 8 virtual machine
Browser plug-in for admin client	**Adobe** Flash	Administrative console

Infrastructure components

The following is a list of infrastructure components.

What We Used: Network Connections	Description
VMware - ESX & ESXi - vCenter - vCloud Director - vShield - vMotion	A distinct network to coalesce management for infrastructure components. This network should be composed of an assigned VLAN and IP subnet. In testing VLAN 100 and the IP network of 10.1.100.0/255.255.252.0 was used. We label this tc_admin in our vSphere environments.
Oracle 11gR2 database servers	
F5 BIG-IP GTM Appliance management interface F5 BIG-IP LTM Appliance management interface	
LANforge management interface	
Ethernet switches	
VMware - vSphere (vCenter and ESX configured) - vCloud Director network mappings at site 1 (Private cloud) > Direct Organization Network connected to an external network which is backed by a dvPort Group. In our testing we used VLAN 1057 and 10.133.57.0/24 for the direct connect external network. In VSphere, we label this network "dvPG_vm_vcloud_private_external." > Internal Organization vCNI network which is backed by an vCNI Network Pool. We used VLAN 1058 and 10.133.58.0/24 for the isolated network. In vSphere, we label this network "dvPG_vm_vcloud_private_internal." - vCloud Director network mappings at site 2 (Public cloud) > Internal Organization vCNI network which is backed by an vCNI Network Pool. In our testing we used VLAN 1059 and 10.133.59.0/24 for this network. In VSphere, we label this network "dvPG_vm_vcloud_public_external." > Internal Organization vCNI network which is backed by an vCNI Network Pool. In our testing we used VLAN 1060 and 10.133.60.0/24 for this network. In VSphere, we label this network "dvPG_vm_vcloud_public_internal.	Networks for application traffic at each site: At least two VLANs are required at each cloud site. One VLAN and IP network tuple will be assigned for inbound traffic to the cloud and one VLAN and IP network tuple will be assigned for private-internal cloud application traffic.
- VLAN - IPSubnet	A network is required for clients, and in our example for load generation. The VLAN and IP Subnet selected must also be made available to and configured on the LANforge. This allows the client WAN profile to be managed and configured independently of the WAN emulation settings used between the 2 cloud sites. In our testing we used VLAN 1061 and 10.133.61.0/24 for the client network.

Additional components and recommendations

You should also have an orchestration tool, or implement a custom monitoring and execution tool. This solution requires a process to map business requirements to application performance. You need to establish baselines for your application and adapt orchestration as suitable for your environment.

In our deployment, we wrote a custom workflow process in Java. See *Appendix A: Orchestration*, on page 40 for more information.

Configuring the infrastructure

In this section, we provide guidance on how to provision and allocate network, security, database, core services such as NTP and DNS, and perform the essential vCloud Director configuration tasks.

◆ **Important**

It is outside the scope of this document to provide step-by-step procedures for the following tasks. Refer to the vendor's documentation, online help, or support services offered by your cloud provider to supplement these steps.

Configuring NTP and DNS

Use the following guidance when configuring NTP and DNS:

- **DNS**
  - Configure forward name resolution for all management systems.
  - Configure reverse name resolution for all IP addresses (vCloud Director).
- **NTP**
  - Configure NTP accessible by both sites.
  - NTP needs to be accessed by vCloud Director, vCenter, Oracle DB, and vShield manager in each cloud.
  - All clocks within each cloud environment must be within 2 seconds of each other.

Configuring the databases

Use the following guidance when configuring the databases:

- Configure the vCenter database for two vSphere vCenter servers at Version 4.0 U1 or higher (if using a Service Provider, only one is necessary at your private site).
  - Microsoft SQL server is recommended over the embedded database. The Microsoft SQL Server can be installed on the same system as the vCenter server.
- vCloud Director database
  1. Install the Oracle database system(s) (the required version can be found in the VMware vCloud Director documentation).

     a) We recommend one server for each vCloud Director site.

     b) Create a new, empty, namespace for each database, as per the vCloud Director documentation.

     c) The Oracle system needs to be accessible from the vCloud Director management interfaces.

d) The Oracle database login account must have the following privileges: connect, grant resource, create trigger, create procedure, create sequence, and execute any procedure.

- Logon to your Oracle instance as SYSTEM and execute the following SQL commands to create the vCloud Director user
    - ◆Create a user (we use **vcloudusername)** identified by a password (we use **vclouduserpassword)**.
    - ◆Grant **RESOURCE**, **DBA**, **CONNECT** to the user name you created.

Note: *Do not use the Oracle system account to connect vCloud Director hosts to the database*

vCloud Director will create the necessary database schema on the first connect.

Configuring management

This section contains management guidance for ESX/ESXi, vCenter, and vCloud Director.

Configuring ESX/ESXi and vCenter management

Use the following guidance when configuring ESX/ESXi and vCenter:

1. Install the management PC for running the vSphere client - and install the vSphere client.
2. Install ESX/ESXi version 4.0 U1 at each cloud site - ESX/ESXi must be activated with an Enterprise Plus license.
3. Install and configure vCenter to manage the ESX/ESXi hosts at each cloud site.
4. Configure the following items in each vCenter:

a) Cluster for each site

b) Two resource pools in each cluster at each site. One to be used by vCloud Director, and another to be used when creating multiple VM vApps.

c) Datastores.

d) Configure the ESX/ESXi cluster to use Automated DRS.

e) Create a vNetwork Distributed Switch at each site. In our example, we used **dvSW-priv-01** in the Private Cloud and **dvSW_01** in the Public Cloud.

Configuring vCloud Director management

Use the following guidance for configuring vCloud Director management:

1. Install vCloud Director nodes for each site
   a) Each needs at least two IP addresses - though three is preferable.
      - One for Service access.
      - One for vSphere proxy.
      - One for management.
2. Configure vCloud Director for each site's provider resources.
   a) Create a Provider vDC. In our example, we named this provider **Public_provider** for the Public Cloud and **Private_provider** in the Private Cloud.

   b) Add the vCenter to the vCloud Director as appropriate.

   c) Prepare the ESX/ESXi hosts with the vCloud Director agent.

   d) Map the vCenter resources to provider-side objects in the Public vCloud Director.
      - Provider DC to resource pool.
      - Two Provider level vCloud external networks:
        - ◆One connected to vNetwork Distributed Switch dvPort Group. In our example, we created a Provider vDC level External Network connected to an external network which is backed by a dvPort Group for access to and from the application environment. We labeled this **red_public**. This network is connected to the vSphere network labeled **dvPG_vm_vcloud_public_external**.
        - ◆One connected to a vNetwork Distributed Switch dvPort Group. IN our example, we created another Provider vDC level External Network which is backed by a dvPort Group for access to the LTM-VE management interface. We labeled this **Ext_Net_to_tc_admin**. This network is connected to the vSphere network we labeled **tc_admin**.
      - One Provider vCloud Network Pool:
        - ◆A network pool of type VCD Cloud Network Isolation. In our example, we assigned this network a VLAN ID of 1060 and attached it to the dvSW_01. We labeled this network pool as **blue_vCNI_dvPG_vm_vcloud_Public_internal**.

   e) Map the vCenter resources to provider-side objects in the Private vCloud Director.
      - One Provider level vCloud external network.

- ◆ One connected to vNetwork Distributed Switch dvPort Group. In our example, we created a Provider vDC level External Network connected to an external network which is backed by a dvPort Group for access to and from the application environment. We labeled this **red_private**. This network is connected to the vSphere network labeled **dvPG_vm_vcloud_private_external**.

- One Provider vCloud Network Pool:
  - ◆ A network pool of type VCD Cloud Network Isolation. In our example, we assigned this network a VLAN ID of 1058 and attached it to the dvSW-priv-01. WE labeled this network pool as **blue_vCNI_dvPG_vm_vcloud_private_internal**.

3. Datastores need to be provisioned for the vCloud Director.

Configuring the vSphere and physical networks

Use the following guidance for configuring the vSphere and physical network devices:

- ◆ vNetwork Distributed Switches for ESX/ESXi networking.
- ◆ The following tasks are per vCloud Director site:
  1. Provision VLANs and IP subnets as needed.
  2. Configure Ethernet switching:
     a) Interconnect external VLANs with LANForge (if using WAN emulation) and ESX/ESXi hosts.
     b) Interconnect all management interfaces
  3. Install the two vSphere vCenter servers at Version 4.0 U1 or higher
     Note: *If using a Service Provider, only one is necessary.*

Configuring security

Use the following guidance for configuring security:

- ◆ Install vShield managers for each site and configure ESX/ESXi networking as per the vCloud Director documentation- vShield manager configuration only needs an IP address and DNS resolver configured. All other configuration is done automatically using reverse DNS and vCloud Director.

Configuring the vCloud Director

In this section, we configure the vCloud Director. You must have administrative access to complete these tasks.

Completing the Guided Tasks

Log into the vCloud Director web GUI as a *Provider Administrator* and complete all of the **Guided Tasks** as applicable for your configuration, using the networks that were mapped in *Configuring management*, on page 8. Consult the VMware documentation for specific information on configuring the vCloud Director.

◆ **Note**

Many of the tasks will vary based on site conditions; you must configure these as applicable for your configuration or consult your cloud provider. And some of the tasks may be performed by your cloud/service provider.

You need to create a new Organization, and add the appropriate Provider vDC Network Pools to the Organization vDC.

You must then create the Provider Networks - you need two External Organization Network - Direct Connections (note: do not choose NAT-routed connection as this will create a vShield Edge device for this network. The LTM -VE will be performing these functions) and one Internal Organization Network.

In our example, we created the following:

Network Type	Provider Network Names	Organizational Network Names
External Direct	Ext_Net_to_tc_Admin	pub_org_ext_to_tc_admin
External Direct	red_public	pub_org_ext_pub
Internal Organization Network	blue_vCNI_dvPG_vm_vcloud_public_internal	pub_org_blue_int*

* Note: Provide the appropriate Network Mask, Default Gateway, DNS and Static IP Pool information. In our case we used 255.255.255.0 as Network Mask, 10.133.60.1 as Default Gateway, 10.133.61.240 as Primary DNS, and created a Static IP Pool as 10.133.60.101 - 10.133.60.150. (It is important to note the Default Gateway entered here. This IP will be used as a SeflIP on the LTM-VE).

Deploying the application in the private cloud

The final task in this section is to deploy the application in the private cloud. If the application is already a VM running in the vSphere 4 environment backing the vCloud Director installation, you may import from vCenter to vCloud Director. If not, create a vApp that contains the application. The vApp has to be exported to the .ovf format. Once in the .ovf format, the vApp can be transferred to the vCloud Director catalog.

For more information, refer to the VMware vCloud Director documentation.

Configuring the BIG-IP LTM

In this section, we configure the BIG-IP LTM devices. First, we configure the physical BIG-IP LTM appliance on site at the private location. Later in this section, we configure the LTM Virtual Edition (VE) for each organization's virtual data center in the public cloud.

This section contains the following subsections:

- *Configuring the physical BIG-IP LTM in the private cloud*
- *Deploying the BIG-IP LTM as a vApp in the public cloud*, on page 19
- *Configuring the BIG-IP LTM for the vFabric SQLFire locator and WAN gateway services*, on page 27

Prerequisites

The following are prerequisites and configuration notes for this section:

- ◆ Deploy the BIG-IP LTM in fixed infrastructure connected to the private cloud network (where the servers are located), and connected to the external network (where clients are located).
- ◆ Activate the device license and provision LTM for nominal and WOM for WOM lite.
- ◆ Configure all VLANs and self IP addresses to connect so that internal and external networks are connected.

Configuring the physical BIG-IP LTM in the private cloud

In this section, we configure the physical BIG-IP LTM appliance that resides in the private location for application traffic. In our example, we use Apache Tomcat and JPetStore as our application.

Creating the health monitor

The first task is to set up a health monitors for the servers. This procedure is optional, but very strongly recommended. In our example, we create a monitor that uses Send and Receive Strings to ensure the servers are delivering the proper content.

To create a health monitor

1. On the Main tab, expand **Local Traffic**, and then click **Monitors**.
2. Click the **Create** button. The New Monitor screen opens.
3. In the **Name** box, type a name for the Monitor.
   In our example, we type **Tomcat-http-monitor**.
4. From the **Type** list, select **http**.

5. In the Configuration section, in the **Interval** and **Timeout** boxes, type an Interval and Timeout. We recommend at least a (1:3) +1 ratio between the interval and the timeout. In our example, we use a **Interval** of **30** and a **Timeout** of **91**.

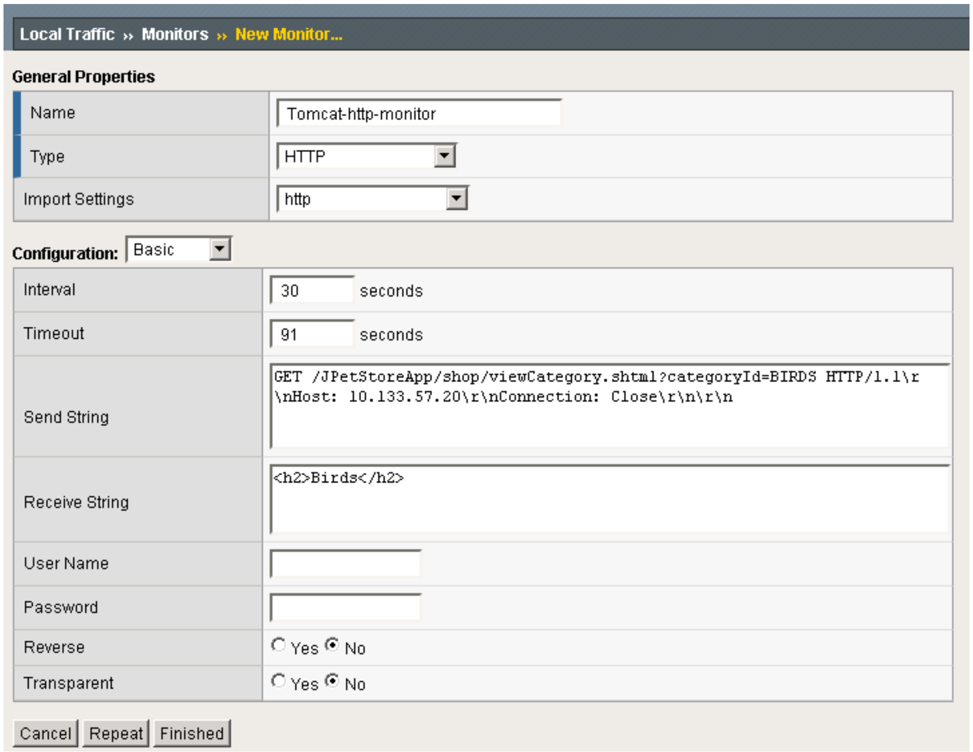
6. In the **Send String** box, you can optionally type a Send string. In our example for JPetStore, we type the following (as a single line):

```
GET /JPetStoreApp/shop/viewCategory.shtml?categoryId=BIRDS HTTP/1.1\r\nHost:
    10.133.57.20\r\nConnection: Close\r\n\r\n
```

7. In the Receive String box, type the response you expect from the Send String. In our example, we type:

   `<h2>Birds</h2>`

8. Click the **Finished** button. The new monitor is added to the list.



General Properties

Name	Tomcat-http-monitor
Type	HTTP
Import Settings	http

Configuration: Basic

Interval	30 seconds
Timeout	91 seconds
Send String	GET /JPetStoreApp/shop/viewCategory.shtml?categoryId=BIRDS HTTP/1.1\r \nHost: 10.133.57.20\r\nConnection: Close\r\n\r\n
Receive String	`<h2>Birds</h2>`
User Name	
Password	
Reverse	○ Yes ● No
Transparent	○ Yes ● No

Figure 2 New health monitor page

Creating the pool

The next step is to define a load balancing pool for the servers. A BIG-IP pool is a set of devices grouped together to receive traffic according to a load balancing method. This pool uses the monitor you just created.

To create the pool

1. On the Main tab, expand **Local Traffic**, and then click **Pools**. The Pool screen opens.

2. Click the **Create** button.
   The New Pool screen opens.
3. From the Configuration list, select **Advanced**.
4. In the **Name** box, type a name for your pool.
   In our example, we use **Tomcat-app-pool**.
5. In the **Health Monitors** section, select the name of the monitor you created in *Creating the health monitor*, and click the Add (<<) button. In our example, we select **Tomcat-http-monitor**.
6. In the **Slow Ramp Time** box, type a number of seconds that corresponds to the expected number of requests per second.
   For example, if the server farm is receiving 2000 requests per second, and there are 5 servers, each device receives approximately 400 requests per second.   When a server that has been offline comes back online, we don't want the BIG-IP to immediately send 400 requests to that device. In our example, we set the Slow Ramp Time to **30** seconds.

   Note: *The* ***Slow Ramp Time*** *option does not appear unless you have selected* ***Advanced*** *from the Configuration list.*

7. From the **Load Balancing Method** list, choose your preferred load balancing method (different load balancing methods may yield optimal results for a particular network).
   In our example, we select **Least Connections (Node)**
8. In this pool, we leave the Priority Group Activation **Disabled**.
9. In the New Members section, make sure the **New Address** option button is selected.
10. In the **Address** box, add the first Apache server to the pool. In our example, we type **10.133.58.101**.
11. In the **Service Port** box, type **80** or select **HTTP** from the list.
12. Click the **Add** button to add the member to the list.
13. Repeat steps 8-10 for each server you want to add to the pool.
    In our example, we repeat these steps again adding **10.133.58.102**.
14. Click the **Finished** button.

Creating profiles

The BIG-IP system uses configuration objects called profiles. A ***profile*** is an object that contains user-configurable settings for controlling the behavior of a particular type of network traffic, such as HTTP connections. Using profiles enhances your control over managing network traffic, and makes traffic-management tasks easier and more efficient.

Although it is possible to use the default profiles, we strongly recommend you create new profiles based on the default parent profiles, even if you do not change any of the settings initially. Creating new profiles allows you to easily modify the profile settings specific to this deployment, and ensures you do not accidentally overwrite the default profile.

Creating an HTTP profile

The first new profile we create is an HTTP profile. The HTTP profile contains numerous configuration options for how the BIG-IP LTM system handles HTTP traffic. In the following example, we base our HTTP profile off of the **http-wan-optimized-compression-caching** parent.

To create a new HTTP profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**.
   The HTTP Profiles screen opens.
2. Click the **Create** button. The New HTTP Profile screen opens.
3. In the **Name** box, type a name for this profile. In our example, we type **Tomcat-app-opt**.
4. From the **Parent Profile** list, select **http-wan-optimized-compression-caching**.
5. *Optional:* If you using the BIG-IP LTM to offload SSL, in the Settings section, check the Custom box for **Redirect Rewrite**, and from the **Redirect Rewrite** list, select **Match**. See *Configuring the WAN emulator*, on page 31 for more information.
6. Modify any of the other settings as applicable for your network. In our example, we leave the settings at their default levels.
7. Click the **Finished** button.

Creating the TCP profile

The next profile we create are the TCP profile. In our example, we create a LAN optimized TCP profile.

To create a new TCP profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**.
   The HTTP Profiles screen opens.
2. On the Menu bar, from the **Protocol** menu, click **tcp**.
3. Click the **Create** button.
   The New TCP Profile screen opens.
4. In the **Name** box, type a name for this profile. In our example, we type **Tomcat-tcp-lan**.
5. From the **Parent Profile** list, select **tcp-lan-optimized**.
6. Modify any of the settings as applicable for your network. In our example, we leave the settings at their default levels.

7. Click the **Finished** button.

Optional: Creating persistence profile

Persistence is essential in an application server environment, especially in Java environments managed by Tomcat. For every user session, memory space is allocated on a particular server, so returning a user to the same machine, creates efficiency for both the server and the user.

For Tomcat persistence, there are two options. If the only persistence being used by your application is based on jSession cookie, the BIG-IP system's built-in cookie hash method can be used to maintain persistence. If URI based session persistence is also used, then it is our recommendation to use the BIG-IP system’s Universal Inspection Engine.

To create a new cookie persistence profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**.
   The HTTP Profiles screen opens.
2. On the Menu bar, click **Persistence**.
   The Persistence Profiles screen opens.
3. Click the **Create** button.
   The New Persistence Profile screen opens.
4. In the **Name** box, type a name for this profile. In our example, we type **Tomcat-cookie**.
5. From the **Persistence Type** list, select **Cookie**.
   The configuration options for cookie persistence appear.
6. From the **Cookie Method** row, click the **Custom** box and then select **Cookie Hash**.
7. In the Cookie Name box, type **JSESSIONID**.
8. Click the **Finished** button

◆ **Important**

If your application only uses JSession cookie, it is safe to use the built-in cookie persistence profile which yields the fastest persistence results.

If using persistence, it is a good idea to have a backup persistence method. In this example, we use Source Address Affinity.

To create a Source Address Affinity persistence profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**.
   The HTTP Profiles screen opens.
2. On the Menu bar, click **Persistence**.
   The Persistence Profiles screen opens.
3. Click the **Create** button.
   The New Persistence Profile screen opens.

4. In the **Name** box, type a name for this profile. In our example, we type **Tomcat-source**.
5. From the **Persistence Type** list, select **Source Address Affinity**. The configuration options appear.
6. Modify any of the settings as applicable for your network. In our example, we leave the settings at their default levels.
1. Click the **Finished** button.

Creating a OneConnect profile

The final profile we create is a OneConnect profile. With OneConnect enabled, client requests can utilize existing, server-side connections, thus reducing the number of server-side connections that a server must negotiate to service those requests. This can provide significant performance improvements for Apache implementations. For more information on OneConnect, see the BIG-IP LTM documentation.

In our example, we leave all the options at their default settings. You can configure these options as appropriate for your network.

To create a new OneConnect profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**. The HTTP Profiles screen opens.
2. On the Menu bar, from the **Other** menu, click **OneConnect**. The Persistence Profiles screen opens.
3. Click the **Create** button. The New HTTP Profile screen opens.
4. In the **Name** box, type a name for this profile. In our example, we type **Tomcat-oneconnect**.
5. From the **Parent Profile** list, ensure that **oneconnect** is selected.
6. Modify any of the other settings as applicable for your network. In our example, we leave the settings at their default levels.
7. Click the **Finished** button.

Creating the virtual server

Next, we configure a virtual server that references the profiles and pool you created in the preceding procedures.

To create the virtual server

1. On the Main tab, expand **Local Traffic**, and then click **Virtual Servers**. The Virtual Servers screen opens.
2. Click the **Create** button. The New Virtual Server screen opens.

3. In the **Name** box, type a name for this virtual server. In our example, we type **jpetstore-vs**.
   Note: *We recommend naming your pool with function of the Tomcat server being load balanced, which makes administration and debugging simpler.*
4. In the **Destination** section, select the **Host** option button.
5. In the **Address** box, type the IP address of this virtual server. In our example, we use **10.133.57.20.**
6. In the **Service Port** box, type **80**, or select **HTTP** from the list.
7. From the Configuration list, select **Advanced**.
   The Advanced configuration options appear.
8. Leave the **Type** list at the default setting: **Standard**.
9. From the **Protocol Profile (Client)** list select the name of the profile you created in the *Creating the TCP profile* section. In our example, we select **Tomcat-tcp-lan**.
10. From the **Protocol Profile (Server)** list, select the name of the profile you created in the *Creating the TCP profile* section. In our example, we select **Tomcat-tcp-lan**.
11. From the **OneConnect Profile** list, select the name of the profile you created in *Creating a OneConnect profile*. In our example, we select **Tomcat-oneconnect**.
12. From the **HTTP Profile** list, select the name of the profile you created in the *Creating an HTTP profile* section. In our example, we select **Tomcat-app-opt**.
13. In the Resources section, from the **Default Pool** list, select the pool you created in the *Creating the pool* section. In our example, we select **Tomcat-app-pool**.
14. From the **Default Persistence Profile** list, select the persistence profile you created in the *Optional: Creating persistence profile* section. In our example, we select **Tomcat-cookie**.
15. From the **Fallback Persistence Profile** list, select the fallback persistence profile you created in the *Optional: Creating persistence profile* section. In our example, we select **Tomcat-source**.
16. Click the **Finished** button.

The BIG-IP LTM HTTP configuration for Apache Tomcat application is complete. If you are using the BIG-IP system to offload SSL, see *Appendix C: Configuring the BIG-IP LTM to offload SSL*, on page 60.

Deploying the BIG-IP LTM as a vApp in the public cloud

The next task is to deploy BIG-IP LTM Virtual Edition(s) as a vApp in the public cloud environment.

You need make sure of the following before beginning the procedures in this section.

- Activate the device license and provision LTM for nominal and WOM for WOM Lite
- Configure all VLANs and self IP addresses to connect so that the direct access network is the “external” network on the LTM and the “internal” network is connected to the isolated network.

Before beginning the BIG-IP LTM configuration, you need to upload and instantiate the BIG-IP LTM VE in the public cloud. Use the following procedures.

Uploading and instantiating the BIG-IP LTM VE in the public cloud

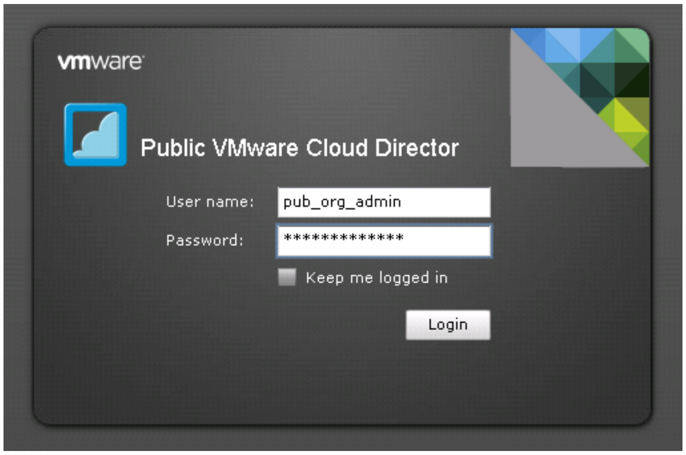
Use the following procedure to upload and instantiate the BIG-IP LTM Virtual Edition in the public cloud.

To upload and instantiate the BIG-IP LTM in the public cloud

1. Download the latest BIG-IP LTM Virtual Edition from ***https://downloads.f5.com/esd/index.jsp*** to a computer which has the ability to upload to the Public cloud.
   In our example, we download **BIGIP-10.2.0.1707.0.ova.zip**.
2. Check MD5.
3. Unzip the file you downloaded to a temporary directory.

   Note: *VMware Cloud Director transfer service allows for the upload of .ovf files and their associated .vmdk files. Uploading .ova files is not yet supported. An .ova file is simply an uncompressed archive of the .ovf and associated files. This archive must be unpacked out to its five constituent files. (F5_icon, .cert, .ovf, .mf, and .vmdk).*

4. Log into the Public vCloud Organization URL as a user with catalog upload permissions.



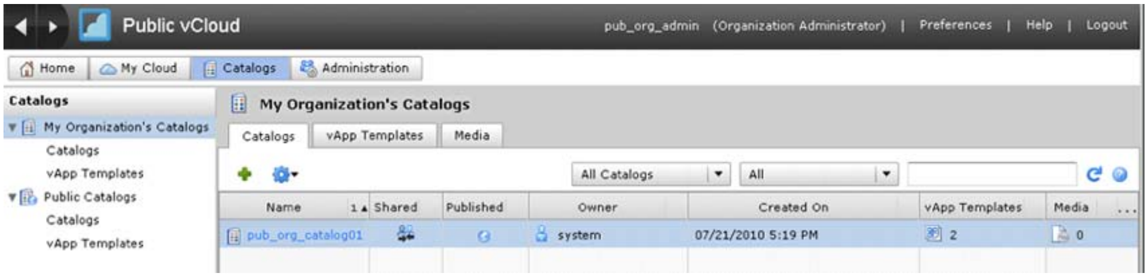
User name: pub_org_admin

Password: *************

□ Keep me logged in

Figure 3   Logon page of the VMware Public Cloud Director

5. Click the Catalogs tab.
6. Click the name of the catalog into which you would like to upload the LTM-VE. In our example, we click **pub_org_catalog01**.

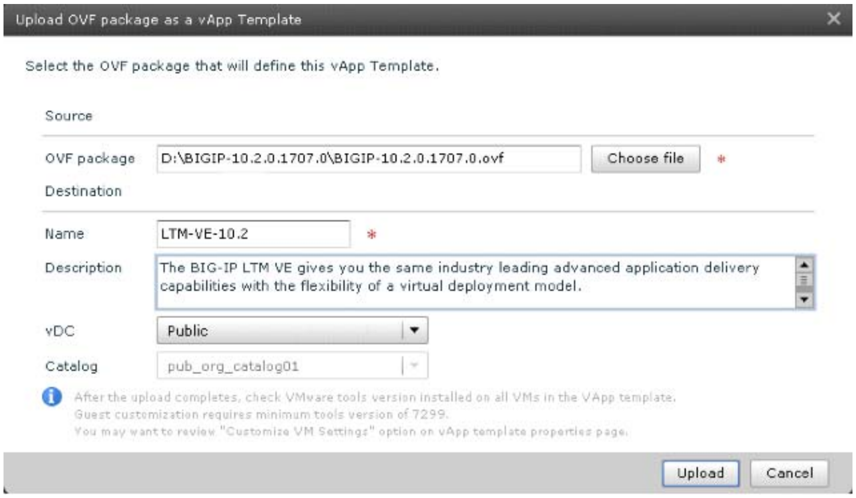


Name	Shared	Published	Owner	Created On	vApp Templates	Media
pub_org_catalog01			system	07/21/2010 5:19 PM	2	0

Figure 4 VMware Public vCloud Catalogs tab

7. Click the **Upload** icon. The Upload OVF package as a vApp Template dialog box opens.
8. Click the **Choose file** button, and then browse to the **BIGIP-10.2.0.1707.0.ovf** file that you unzipped and unpacked in Step 3.
9. From the **vDC** list, select the vDC for which this .ovf will be made available. In our example, we chose **Public**.
10. In the **Name** box, type a name. In our example, we type **LTM-VE-10.2**. You can optionally type a description in the **Description** box.
11. Choose to accept the certificates.

12. Click **Upload**.



Upload OVF package as a vApp Template

Select the OVF package that will define this vApp Template.

Source

OVF package: D:\BIGIP-10.2.0.1707.0\BIGIP-10.2.0.1707.0.ovf [Choose file] *

Destination

Name: LTM-VE-10.2 *

Description: The BIG-IP LTM VE gives you the same industry leading advanced application delivery capabilities with the flexibility of a virtual deployment model.

vDC: Public

Catalog: pub_org_catalog01

After the upload completes, check VMware tools version installed on all VMs in the VApp template.
Guest customization requires minimum tools version of 7299.
You may want to review "Customize VM Settings" option on vApp template properties page.

Figure 5 *Upload OVF package dialog box*

Once the file is uploaded it is available as a vApp template within the catalog to which it was uploaded.

13. Right click the vApp template you just uploaded and then click **Add to My Cloud**. The Add to My Cloud dialog box opens.

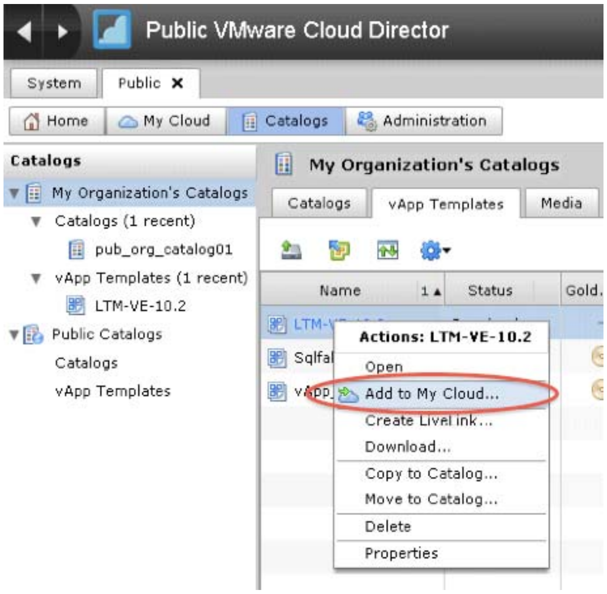


Figure 6 *Right-click menu from the Catalog tab*

14. In the **Name** box, type a name. This is the name used to refer to the vApp in vCD. (vCD will prepend a unique identifier to this name in vCenter). You can optionally type a description.
    In our example, we type **F5_LTM-VE_10-2**.

15. In the Leases section, select times from the **Runtime lease** and **Storage lease** boxes appropriate for your environment. In our example, we choose **Never Expires** for both.

16. Click **Next**. The Configure Virtual Machines page opens.

17. On the Configure Virtual Machines page, configure the following:

    a) In the **Full Name** box, type a name. In our example, we type **LTM-VE-10-2**.

    b) In the **Computer Name** box, type the name that the VM is identified as in the Cloud. In our example, we type **LTM-VE-10-2**.
    Important: *Do NOT use guest customization - it will invalidate your BIG-IP LTM VE license*

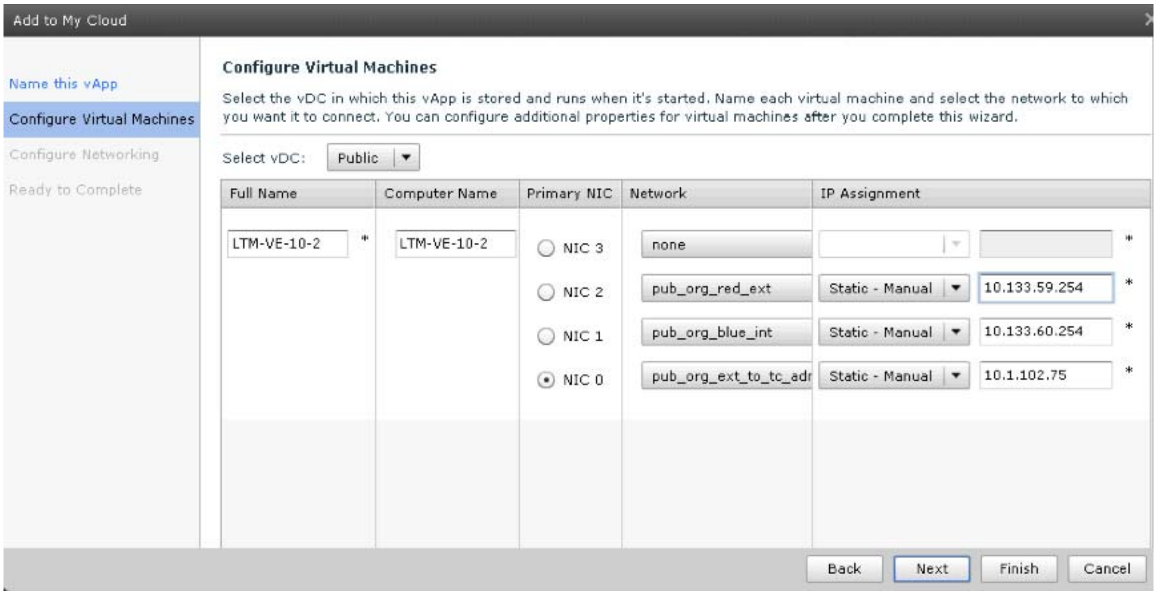
    c) Click the **NIC 0** option button to designate it as the primary NIC. This will be the management NIC.
    From the **Network** list, select the appropriate network label which connects to your management network. In our example, we choose **pub_org_ext_to_tc_admin**.
    From the **IP assignment** list, select **Static - Manual**, and then type an appropriate static IP address for your network. In our example, we type **10.1.102.75**.

    d) In the **NIC 1** row, from the **Network** list, select the appropriate network label which connects to your organization's vCNI internal network. In our example, we select **pub_org_blue_int**.
    From the **IP assignment** list, select **Static - Manual**, and then type an appropriate static IP address for your network. In our example, we type **10.133.50.254**.

    e) In the **NIC 2** row, from the **Network** list, select the appropriate network label which connects to your organization's direct connected external network. In our example, we select **pub_org_red_ext**.
    From the **IP assignment** list, select **Static - Manual**, and then type an appropriate static IP address for your network. In our example, we type **10.133.59.254**.

    f) In the **NIC 3** row, from the **Network** list, select the appropriate network. In our example, we leave this NIC undefined.

18. Click the **Next** button.



Configure Virtual Machines

Select the vDC in which this vApp is stored and runs when it's started. Name each virtual machine and select the network to which you want it to connect. You can configure additional properties for virtual machines after you complete this wizard.

Select vDC: Public ▾

Full Name	Computer Name	Primary NIC	Network	IP Assignment	
LTM-VE-10-2 *	LTM-VE-10-2	○ NIC 3	none		*
		○ NIC 2	pub_org_red_ext	Static - Manual ▾	10.133.59.254 *
		○ NIC 1	pub_org_blue_int	Static - Manual ▾	10.133.60.254 *
		● NIC 0	pub_org_ext_to_tc_adr	Static - Manual ▾	10.1.102.75 *

Figure 7 *Configure the Virtual Machines page of the Add to My Cloud dialog box*

19. On the Configure Networking page, it is very important that you ***DO NOT*** check the **Fence vAPP** box. You can check the **Show networking details** box to double check the networking details.

20. Click **Next**.

21. Click **Finish**.

Configuring the BIG-IP LTM VE to support the application

In this section, we configure the BIG-IP LTM VE to support the application. Because many of the following procedures are the same for VE as the physical BIG-IP LTM you just configured, we refer back to those procedures instead of repeating the same information. Full procedures are included for the new objects, such as the iRule and Statistics profile. Note that this section does not include configuring members in the load balancing pool. Pool members will be added programmatically (the workflow engine uses iControl to add pool members).

Creating the health monitor

To create the health monitor, use the procedure *Creating the health monitor*, on page 12. Give the monitor a unique name.

Creating the pool

To create the pool, use the procedure *Creating the pool*, on page 13. Give the pool a unique name. In our example we used **petshop_http**. ***Important:*** Do NOT add any members to this pool. After Step 7, click the **Finished** button.

Creating the profiles

To create the profiles, use the following procedures. Note that we configure an new Statistics Profile.

- *Creating an HTTP profile*, on page 15
- *Creating the TCP profile*, on page 15
- *Optional: Creating persistence profile*, on page 16
- *Creating a OneConnect profile*, on page 17

Creating the Statistics profile

In this procedure, we create a Statistics profile. In our deployment scenario there are two distinct scaling actions that take place and are initiated by our workflow process according to our established business rules. We define the vertical scaling action as an event that our workflow process executes to initially activate and begin consuming public cloud resources. We define the horizontal scaling action as an event that our workflow process executes to deploy additional application capacity in the public cloud. These state changes and capacity operations are affected using the VMware vCloud API and the F5 iControl API.

The two rules governing our infrastructure operations are:

1. When 40% of the orders confirmed in the system over a one minute period exceed 15ms of processing time activate public cloud resources.
2. vApp systems running in the public cloud shall accept a maximum number of 30 connections at any given time.

In measuring application response time, we build a histogram using a Statistics profile and an iRule, then our workflow process periodically retrieves the values using iControl. The Statistics profile is composed of fields for response time ranges, each with a counter in it. The rages are <5ms, 5-7ms, 7-12ms, 12-15ms, and >15ms. The iRule to appropriately increment these counters according to the order confirmation page latency is in the following procedure.

◆ **Important**

You must follow this procedure exactly as described below, including all names and fields. If you do not, the iRule you create in the following section will not work correctly.

To create the Statistics profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**.
2. On the Menu bar, from the **Other** menu, select **Statistics**.
3. Click the **Create** button.
4. In the **Name** box, type **responseHistogram**.
   Important: *You* ***must*** *use this name, as this profile is referenced from the iRule you create in the next section.*
5. Click the Custom box above the Settings box to check all of the Custom boxes.
6. In the **Field 1** box, type **zeroToFive**.
7. In the **Field 2** box, type **fiveToSeven**.
8. In the **Field 3** box, type **sevenToThirteen**.
9. In the **Field 4** box, type **thirteenToFifteen**.
10. In the **Field 5** box, type **greaterThanFifteen**.
11. Click the **Finished** button.

Creating the iRule

In this section, we create the iRule that references the Statistics profile you just created.

To create the iRule

1. On the Main tab, expand **Local Traffic**, and then click **iRules**.
2. Click the **Create** button.
3. In the **Name** box, type a name for this rule. In our example, we type **increment-irule**.
4. In the **Definition** box, copy and paste the iRule on the following page, omitting the line numbers.

```
when HTTP_REQUEST {
     if { [HTTP::uri] starts_with "/JPetStoreApp/shop/newOrder.shtml?" } {
          set http_request_time [clock clicks -milliseconds]
          set isCheckout "true"
     }

     else {
          set isCheckout "false"
     }
}

when HTTP_RESPONSE {
     if { $isCheckout eq "true" } {
          #if it's not coming from the local LTM monitoring or GTM self IP record the statistic
          set response_time [expr [clock clicks -milliseconds] - $http_request_time]
          log local0. "response time: $response_time ms for [IP::client_addr]"
          if { $response_time < 5 } {
               STATS::incr responseHistogram zeroToFive 1
          }
          elseif { $response_time < 7 } {
               STATS::incr responseHistogram fiveToSeven 1
          }
          elseif { $response_time < 13 } {
               STATS::incr responseHistogram sevenToThirteen 1
          }
          elseif { $response_time < 15} {
               STATS::incr responseHistogram thirteenToFifteen 1
          }
          else {
               STATS::incr responseHistogram greaterThanFifteen 1
          }
     }
}
```

5. Click **Finished**.

Creating the virtual server

To create the virtual server, use the procedure *Creating the virtual server*, on page 17, using the BIG-IP LTM objects you created in this section, with the following exceptions:

- After Step 12, from the **Statistics Profile** list, select the name of the Statistics profile you created in *Creating the Statistics profile*, on page 24.
- After selecting the Statistics profile, in the Resources section, from the **iRules** row, in the **Available** box, select the iRule you created in *Creating the iRule*, on page 25, and the click the Add (**<<**) button to move it to the **Enabled** list. In our example, we select **increment-irule**.

Configuring the BIG-IP LTM for the vFabric SQLFire locator and WAN gateway services

Next, we configure the BIG-IP LTM for the vFabric SQLFire locator and WAN gateway services in each location.

Creating the pool

In this procedure, we create the load balancing pool.

To create the pool

1. On the Main tab, expand **Local Traffic**, and then click **Pools**.
2. Click the **Create** button. The New Pool screen opens.
3. In the **Name** box, type a name for your pool. We type **vfabric-pool**.
4. In the **Health Monitors** section, **gateway_icmp**, and click the Add (<<) button.
5. From the **Load Balancing Method** list, choose your preferred load balancing method (different load balancing methods may yield optimal results for a particular network).
   In our example, we select **Least Connections (node)**.
6. In this pool, we leave the Priority Group Activation **Disabled**.
7. In the New Members section, make sure the **New Address** option button is selected.
8. In the **Address** box, type the IP address of one of the servers. In our example, we use **10.133.58.51**.
9. In the **Service Port** box, type **9001**.
10. Click the **Add** button to add the member to the list.
11. Repeat steps 8-10 for each server you want to add to the pool.
12. Click the **Finished** button.

Creating the TCP profiles

The next task is to create the TCP profiles. We recommend configuring LAN and WAN optimized TCP profiles.

To create a new TCP profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**. The HTTP Profiles screen opens.
2. On the Menu bar, from the **Protocol** menu, click **tcp**.
3. Click the **Create** button.
4. In the **Name** box, type a name for this profile. In our example, we type **tcp-wan-vfabric**.

5. From the **Parent Profile** list, select **tcp-wan-optimized**.
6. Configure any of the other settings as applicable for your network.
7. ***Important:*** Click the **Repeat** button.
8. In the **Name** box, type a name for the LAN optimized profile. In our example, we type **tcp-lan-vfabric**.
9. From the **Parent Profile** list, select **tcp-lan-optimized**.
10. Configure any of the other settings as applicable for your network.
11. Click the **Finished** button.

Configuring iSessions between the Private Cloud LTM and the LTM-VE in the Public Cloud

The next task is to configure iSessions between the BIG-IP LTM and the vApp, for optimizing database cache and replication traffic. The following procedures should be performed on each BIG-IP LTM (and VE).

Configuring the Remote Endpoint

In this procedure, we create the remote end of the WOM tunnel and point it to the BIG-IP in the other data center.

1. On the Main tab, expand **WAN Optimization**, then click **Remote Endpoints**.
2. Click the **Create** button.
3. In the **Remote Endpoint IP Address** box, type the address of the other BIG-IP's WAN Self-IP address.
4. Modify any of the options as applicable for your configuration. In our example, we leave the settings at the default.
5. Click **Finished**.

Running the WOM Quick Start Wizard

The WOM Quick Start Wizard is used to configure the initial parameters.

To run the WOM Quick Start Wizard

1. On the Main tab, expand **WAN Optimization**, and then click **Quick Start**.
2. In the **WAN Self IP Address** box, type the appropriate IP address.
3. Leave the **Discovery** list set to **Enabled**.
4. In the Select VLANs section, from the **LAN VLANs** row, select the appropriate VLAN and click the Add (<<) button to move it **Selected** box.
5. From the **WAN VLANs** row, select the appropriate VLAN and click the Add (<<) button to move it **Selected** box.

6. Leave **Outbound iSession to WAN** set to **serverssl**.
7. Leave **Inbound iSession from WAN** set to **wom-default-clientssl**.
8. Leave **Application Data Encryption** set to **Disabled**.
9. In the **Create Optimized Applications** section, do NOT check any applications. We create applications this later in the guide.
10. ***Important:*** Click the **Apply** button at this step. If you do not, the WOM tunnel is not set up properly.

Creating the iSession Profile

The next task is to create the iSession profile.

To create the iSession profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**
2. On the Menu bar, from the **Services** menu, click **iSession**.
3. Click the **Create** button.
4. In the **Name** box, give the profile a name. In our example, we use **application-isession**.
5. In the Compression Settings section, from the **Deduplication** row, click the **Custom** button, and then from the list, select **Disabled**.
6. Leave the settings at the defaults.
7. Click the **Finished** button.

Creating the optimized applications

The next task is to create the optimized applications. For this procedure, you return to the WAN Optimization Quick Start. In our example, we use port 0 to capture all ports. You can also make this more specific by configuring individual ports. For instructions, see the BIG-IP documentation.

To create the optimized applications

1. On the Main tab, expand **WAN Optimization**, and then click **Quick Start**.
2. At the bottom of the page, in the Other Applications section, click **Click this link to create other optimized applications**.
3. In the **Name** box, type a name for this application.
4. In the Port box, type **0.**
5. In the Enabled LAN VLANs section, from the Available list, select the appropriate VLAN and click the Add (<<) button.
6. From the **iSession Profile** list, select the profile you created in *Creating the iSession Profile*, on page 29.
7. Click **Finished**.

8. ***Important:*** Repeat this entire procedure on the peer BIG-IP LTM in the private cloud.

Creating the wildcard virtual server

The next task is to create a wildcard virtual server. Use the following procedure.

To create the wildcard virtual server

1. On the Main tab, expand **Local Traffic**, and then click **Virtual Servers**.
2. Click the **Create** button.
3. In the **Name** box, type a name for this virtual server. In our example, we type **vfabric_wildcard**.
4. In the **Address** box, type **0.0.0.0**.
5. In the **Service Port** box, type * or select ***All Ports** from the list.
6. From the **Configuration** list, select **Advanced**.
7. From the **Protocol Profile (Client)** list, select the profile you created in *Creating the TCP profiles*, on page 27. In our example, we select **tcp-wan-vfabric**.
8. From the **Protocol Profile (Server)** list, select the profile you created in *Creating the TCP profiles*, on page 27. In our example, we select **tcp-lan-vfabric**.
9. From the **SNAT Pool** list, select **Automap**.
10. From the **Source Port** list, select **Change**.
11. In the WAN Optimization section, from the **iSession Profile** list, select the profile you created in *Creating the iSession Profile*, on page 29
12. In the Resources section, from the **Default Pool** list, select the pool you created in the *Creating the pool* section. In our example, we select **vfabric-pool**.
13. Click **Finished**.

◆ **Important**

Return to Creating the pool, on page 1-27 and repeat all the procedures for the vFabric SQLFire locator and the WAN gateway services in each location.

Configuring the WAN emulator

If staged in a lab environment or when WAN emulation is required, the next task is to configure your WAN emulator. In our example, we use LANForge. You can use other commercial WAN emulators such as Shunra, or open source ones such as Dummynet.

The following diagram shows our LANForge configuration.

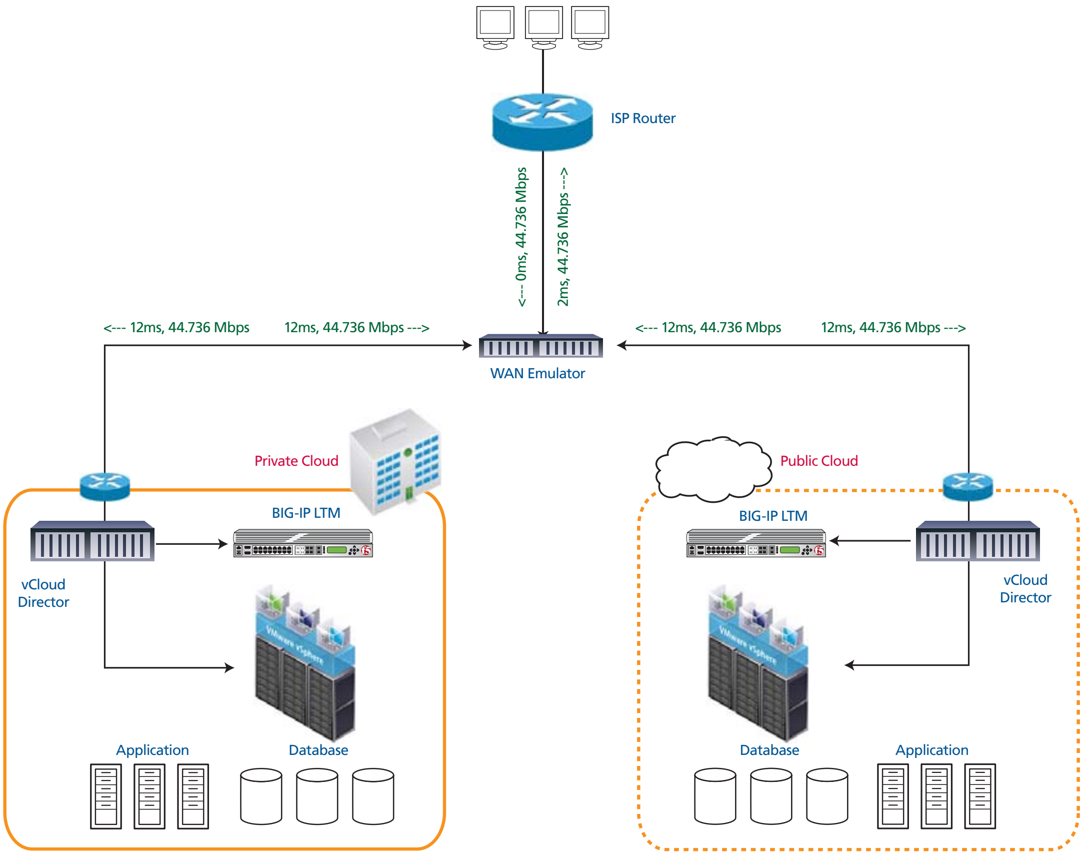


Figure 8 LANForge WAN emulation diagram

If configuring LANForge, keeping in mind the following:

1. Needs to access four networks and VLANs

   a) Management

   b) Private site (public side)

   c) Public site (public side)

   d) Client site

2. Configure virtual routers and establish connectivity among the three IP subnets in use.

    a) One virtual router for each cloud site, interconnected

    b) One virtual router connected to the client site, interconnected with the private site

3. Configure WAN emulation parameters

    a) In our setup we use 45Mb/s bandwidth between the public and private cloud sites. 12ms each way on each link = 48ms RTT. 0.10% packet loss

    b) In our setup we use 1.544 Mb/s bandwidth for the client connection. 5ms each way = 34ms to each site. 0.10% packet loss

Configuring vFabric SQLFire

The following are the vFabric SQLFire configuration tasks. For more information on vFabric SQLFire, see ***http://communities.vmware.com/community/vmtn/appplatform/vfabric_sqlfire***

Configuring vFabric SQLFire locator nodes

Configure vFabric SQLFire locator nodes in each cloud environment. The locator node must be reachable and known before the first application instance comes up. This allows locator and WAN gateway services to be deployed independently of the vFabric SQLFire application services. The remote site knows where to find the service, and queues changes until the service is reachable (this should be abstracted to cover an arbitrary database technology).

Installing and configuring vFabric SQLFire and the application in the private cloud

In this section, you install and configure the vFabric SQLFire and the application. Use the following tasks and guidance when installing and configuring vFabric SQLFire and the application.

◆ **Tip**

We include the scripts we used in this section in ***Appendix B: vFabric SQLFire scripts****, on page 48.*

You must perform the following tasks:

1. Install Apache Tomcat server.
2. Install JDK.
3. Install vFabric SQLFire.
4. Download and deploy JPetStore version from VMware community site.
5. Modify the schema SQL to include a WAN Gateway.
   The **gatewayI.sql** file points to the hub at the other cloud. See *Appendix B: vFabric SQLFire scripts*, on page 48 *for our example*
   a) Modify tables to use the gateway.
      To point the tables to the hub, you have to add "HUB(ALL)" at the end of their table creation DDLs. This was done to the line item and orders tables. Ensure that **/etc/hosts** has an entry for the IP address and hostname that is used on the private network
   b) Create startup scripts - no IP addresses needed, use DNS or **/etc/hosts** instead.

c) On the infrastructure node (locator and WAN gateway)
Kill processes and cleanup the old database.

d) Startup vFabric SQLFire - set properties for forcing use of IP addresses.

e) Bootstrap the application database tables

f) Setup autostarting for tomcat/sqlfabric in rc.local using startup scripts.

Configuring the Application server nodes

Use the following guidance to configure the application server nodes.

1. **clean** - kills all jvms that happen to be running and deletes all persistence files (this includes the data dictionary, so the schema can be fetched from INF node) go - starts sqlfabric, then starts tomcat.
2. **go** - see *Appendix B: vFabric SQLFire scripts*, on page 48 *for our example*
3. **go.init** - see *Appendix B: vFabric SQLFire scripts*, on page 48 *for our example*
4. Setup autostarting for tomcat/sqlfabric in rc.local using startup scripts.

Copying the private cloud configuration to the public cloud

Use the following guidance to copy the private cloud configuration to the public cloud:

1. Copy private cloud vFabric SQLFire configuration to the public cloud systems and reserve the IPs in the WAN gateway configuration.
2. Modify the schema bootstrap on the public cloud to use a negative order ID (UPDATE SEQUENCE SET NEXTID=-2000000).

Configuring Routes

The next task is to create the Routes on the BIG-IP system. Each BIG-IP LTM needs to be able to route to the other BIG-IP LTM, as well as have a route for the remote network where application services reside. We assume that the firewall is the default route (.1).

For WAN optimization to occur properly between sites, each BIG-IP LTM will also need a route to the remote networks via the appropriate next hop gateway. In our example, we add a route for 10.10.2.0/24 via 192.168.2.1 in Datacenter 1.

To create the routes

1. On the Main tab, expand **Network**, and then click **Routes**.
2. Click the Create button.

3. From the **Type** list, select **Route**.
4. In the **Destination** box, type the IP network address of the remote network you wish to reach.
5. In the **Netmask** box, type the associated Netmask.
6. From the **Resource** list, make sure **Use Gateway** is selected.
7. From the Gateway Address list, select **IP Address**, and then type the IP address of the remote internal network via the next hop gateway.
8. Click **Repeat**. Repeat this procedure to add a route so that the device can reach the peer LTM.
9. Click **Finished**.

Configuring the BIG-IP GTM

The next task is to deploy BIG-IP GTM in the fixed infrastructure connected to the external private network.

◆ **Note**

Before starting the following procedures, you should already have configured the appropriate VLANs, self IP addresses and listeners. For specific instructions how to configure these objects, see the BIG-IP documentation, available on Ask F5.

Configuring the BIG-IP GTM from the command line

The first task in this section is to configure the following from the BIG-IP command line. For additional information, refer to the BIG-IP documentation.

- From the GTM command line, run the **bigip_add** command to exchange security information with each LTM.
- From the GTM command line, run **big3d_install** on the GTM to ensure matching big3d_agents between the GTM and each LTM.
- On each BIG-IP LTM, run **bigip_add** to exchange security information with the GTM.
- On each BIG-IP LTM, run **bigip_add** on each LTM to exchange security information with the peer LTM.

Configure the GTM for the application

We configure GTM to use the global availability load balancing method for the wide IP. Virtual servers in the public cloud are configured at a higher priority than those in the private cloud; for ease of deployment and minimizing configuration changes during the cloud burst action. This ensures that when public cloud resources are activated and deactivated GTM does not need to be reconfigured.

We use application QoS and Global Availability to set connection limits on the virtual server in each data center to ensure that global availability.

Creating the data centers

In this task you need to create two data centers, called Public and Private respectively, that correspond to your physical data centers.

To create the data centers

1. On the Main tab of the navigation pane, expand **Global Traffic** and click **Data Centers**. The main screen for data centers opens.

2. Click the **Create** button. The New Data Center screen opens.
3. In the **Name** box, type a name for this data center. In our example, we type **Public**.
4. Complete the rest of the configuration as applicable for your deployment.
5. Click the **Repeat** button. Repeat this procedure for the Private data center.
6. Click **Finished**.

Creating the GTM servers

The next task is to create servers on the BIG-IP GTM system. In this configuration, we create a two servers for the BIG-IP LTM (one in the private network and one in the public, and one for the GTM in the private network

To create the GTM servers

1. On the Main tab of the navigation pane, expand **Global Traffic** and click **Servers**. The main screen for servers opens.
2. Click the **Create** button. The New Server screen opens.
3. In the **Name** box, type a name that identifies the Local Traffic Manager. In our example, we type **Public-BIG-IP**.
4. Configure the General properties of the server as applicable for your deployment.
5. In the Resources section, from the **Virtual Server Discovery** list, select Enabled.
6. Click the **Repeat** button.
7. Repeat this entire procedure to create a GTM server for the BIG-IP LTM in the Public network.
8. Click **Repeat** and then repeat this procedure for the other BIG-IP LTM.
9. Click **Repeat** again, configure the virtual server for the GTM in the private network, and then click the **Finished** button.

Creating the GTM pools

The next task is to create a pools on the BIG-IP GTM system.

To create a GTM pool

1. On the Main tab of the navigation pane, expand **Global Traffic** and click **Pools** (located under **Wide IPs**).
2. Click the **Create** button. The New Pool screen opens.

3. In the **Name** box, type a name for the pool. In our example, we type **Public_pool**.
4. In the Load Balancing Method section, from the **Preferred** list, select **Global Availability**. We recommend using Round Robin as a fallback.
5. In the Member List section, from the **Virtual Server** list, select one of the virtual servers you created in preceding procedure, and click the **Add** button. Note that you must select the virtual server by IP Address and port number combination. In our example, we select **10.133.39.51:80**.

   Repeat this step to add the other virtual server.
6. Configure the other settings as applicable for your deployment
7. Click the **Repeat** button, and repeat this procedure to create a pool for the virtual server in the public data center.
   Important: For this pool, in the **Fallback IPv4** box, type the IP address of the Private datacenter virtual server.
8. Click **Finished**.

Creating a wide IP on the GTM

The final step in the GTM configuration is to create a wide IP that includes both newly-created pools, and uses the fully qualified domain name (FQDN) you wish to use for your applications.

To create a wide IP

1. On the Main tab of the navigation pane, expand **Global Traffic** and click **Wide IPs**.
2. Click the **Create** button. The New Wide IP screen opens.
3. In the **Name** box, type a name for the Wide IP. In our example, we type **cloud.example.com**.
4. From the **State** list, ensure that **Enabled** is selected.
5. From the Pools section, from the **Load Balancing Method** list, select **Global Availability**.
6. From the **Persistence** list, select **Enabled**.
7. In the Pool List section, from the **Pool** list, select the name of the pool you created in *Creating the GTM pools*, on page 37, and then click the **Add** button. In our example, we select **Public_pool**. Repeat this step for the Private pool. The Private pool must be last in the list.
8. From the **Last Resort Pool** list, select the pool in the private data center.
9. Click the **Finished** button.

Uploading your application as a vApp to the public cloud

The next task is to upload your application as a vApp to the public cloud and register it in the catalog as a template. You need to log on to the vClould Director web UI as an Organizational Administrator, and create a catalog to which you will upload vApps.

Refer to your Service Provider or VMware documentation on how to upload the application.

Appendix A: Orchestration

In our deployment we use a custom application for our orchestration process. We use Java versions of the vCloud Director API and iControl libraries and have written specific functions that match our defined business rules for the application.

Orchestration configuration and main functions

In a hybrid cloud application architecture, an application is already running in one or more locations, each with a maximum capacity. We define the cloud bursting action as activating additional resources at a cloud provider site; increasing the overall number of clients that can access the application.

This section of our workflow triggers resource activation at the cloud provider site. The requirements for consuming cloud resources have been met and bootstrapping the application infrastructure in the cloud begin.

1. Read configuration parameters and threshold values. These include:
   - vCloud Endpoint in Public Cloud, Public Cloud deployment details e.g. Organization Name, vDC Name, vApp (Pet Store application and the vFabric SQLFire Infrastructure).
   - BIG-IP LTM Configuration details in Private and Public cloud (for example, iControl URL, Virtual Server Name and so on).
   - Threshold definitions.
2. Periodically call the ReadyToBurst() function to see if the thresholds have been met. When ReadyToBurst() returns TRUE perform the cloud bursting action.
3. Perform Cloud Bursting action.
4. Configure newly added vApp node in public cloud with public LTM Pool.
   - Get the IP address of the newly started 'Pet Store' VM.
   - Get list of LTM pools in the public cloud and reference **petshop_http** pool.
   - Add the 'Pet Store' VM as member to the 'petshop_http' pool.

ReadyToBurst() function

The ReadyToBurst section of our orchestration process polls the BIG-IP LTM controllers for data about current application response time, and for connection counts. When the identified thresholds are met this method will return TRUE to the caller, indicating that it's time to burst to the cloud.

◆ **Note**

Two main thresholds used when monitoring the LTM in Private Cloud are:
***Statistics Profile** for reading response times,*
***Connection Threshold** to make sure enough connections are made in the private cloud to sample the response time data. '*
***RespPercentageThreshold** to determine the percentage of slow response times recorded out of total response times samples to determine overall slowness of the system.*

1. Initialize the BIG-IP Interface and get access to User statistics Binding Stubs (LocalLBProfileUserStatisticBindingStub).
2. Get statistics for the User Defined Statistics ('responseHistogram').
3. Read the value for the user statistics mapping to all the counters (that represents total number of requests with various response time ranges such as <5ms, 5-7 ms, 7-12 ms, 12-15 ms, >15 ms).
4. Read the value of the counter representing the slowest response times.

```
for(All the user stats entries) {
  // Every User stats entry corresponds to the counter
  // Get total number of requests by adding all the counter values.
  totalRequests += userStat.getValue();
  if(Stat Name corresponds to counter for >15 ms response) {
     slowRequests = usrStats.getValue();
  }
}
```

5. Check if Total number of requests are more than the 'Connection Threshold'.
6. Check if the percentage of slowRequests counter out of total requests in greater then the threshold ('RespPercentageThreshold') definition.
7. If both the above conditions are satisfied then we are ready to burst.

```
    if(totalRequests > 'Connection Threshold) &&
      slowRequests > (totalRequests * 'RespPercentageThreshold' / 100) {
     // We are ready to perform cloud bursting action (provisioning in public cloud)
     return TRUE
   }
```

cloudBurstingAction() function

Steps in this section define the actions taken to achieve a cloud bursted state. The specific vApps and infrastructure components are determined and powered on.

1. Get the Reference to the vApp (This has two VM configured for Pet Store Application and vFabric SQLFire Infrastructure)
2. Get list of CHild VM(s)
3. Power on the vFabric SQLFire Infrastructure VM first.
4. Wait for the above VM to power on and boot (approximate time of wait is 45-50 sec).
5. Power on the Pet Store VM.
6. Wait for the 'Power On' Task to complete.

scaleInAction() function for resources in the public cloud

Once resources in the public cloud have been activated, they are monitored to determine if the currently allocated resource quantity is sufficient for the current application load. If the currently deployed resources exceed the number required, determine the best resource to release and then de-provision it.

1. Read configuration parameters and threshold values. These include
   - vCloud Endpoint in Public Cloud, Public Cloud deployment details e.g. Organization Name, vDC Name
   - LTM Configuration details in Private and Public cloud. e.g. iControl URL, Virtual Server Name etc.
   - Threshold definitions.

◆ **Note**

Two main thresholds used for scale out operations are:
Total Node Connections *this threshold defines total number of connections per node that should be dropped to in public cloud before the scale in operation can happen.*
time *This threshold indicates that the total number of connections for the node must drop for at least this duration contiguously to trigger the scale in operation.*

2. wait till ReadyToScaleIn() is TRUE

```
if(readyToScaleIn is TRUE) {
     perfrom ScaleIn();
  }
```

3. Remove the identified Pet Store Application Node from the Public LTM Pool.

scaleIn() function

This operation releases an indicated excess resource in the public cloud.

1. Get list of all pool members in the **pool_GemPet_http** in Public Cloud LTM
2. Get 'session enabled status' for all the pool members
3. // disable the node from the LTM pool that is marked in the nodeTrigger list:

```
for(all the nodes in the pool memberlist) {
  // Skip the one with SQL Fabric Infrastructure node
  if(poolMemberIP == Pet Store IP (part of the SQL Infrastructure vApp) {
     // ignore
     continue;
  }
  if(hitList.contains(pool-member IP) {
     // set the pool member session state to disabled
     memSessionState.setSession_state(sessionState._STATE_DISABLED));

    // Find the vApp reference to the one matching this IP address
    undeploy the vApp
  }
}
```

readyToScaleIn() function

In this section of the orchestration process, application performance attributes are monitored and assigned to a queue of resources to deprovision if they are not needed. readyToScaleIn() will then call the scaleIn() function to do the work of deactivation.

1. Get Total Number of connections for every node ('Petstore Application'):

```
readyToScaleIn = FALSE
for(every Node in the connectionMap) {
If (total number of connections < 'Total Node Connections' Threshold) {
    if(node is already part of trigger list) {
        start timer if not started already. and add to trigger list.
    }  else if ( (current time - start time for the node)  > 'time' threshold) {
        // Mark this node for removal since it has
        // less conections than threshold for time duration more than the 'time threshold'
        hitList.add(node);
        // hit list contains all the nodes that can be disabled from the LTM pool and
    shutdown.
        readyToScaleIn = TRUE
    }

  } else {
  // This node is active again with connections
  // do not consider for removal so remove from the trigger list.
  nodeTriggers.remove(nodeIp);
  }
}
 return ReadyToSCaleIn;
```

Retrieving pool member connection counts

1. Get all the pool members in the “petshop_http” pool in the Public Cloud LTM.
2. Get statistics for every pool member using Poll Member Stub:

```
   for(all the pool members) {
      for (all the stat entries for the given pmember) {
          // Now look fo only the server side open conection statistic entry
          if(Statistic Type ==
    CommonStatisticType.STATISTIC_SERVER_SIDE_CURRENT_CONNECTIONS) {
               numberOfConnectios = stat Entry.value();

              // Connetion Map stores the node and number od connections using the Node IP
    as the key.
               connectionMap.add(Node IP Address, No of connections);
          }
      }
   }

return the connectionMap
```

scaleOutAction() function for increasing resources in the Public Cloud

This action initializes the procedure for adding vApp resources to the application running in the public cloud. The cloud application performance metric is read in from the orchestration configuration and the process waits to deploy resources until the readyToScaleOut() function returns a TRUE.

1. Read configuration parameters and threshold values. These include:

- vCloud Endpoint in Public Cloud, Public Cloud deployment details e.g. Organization Name, vDC Name, vApp Template for the Pet Store Application
- LTM Configuration details in Private and Public cloud. e.g. iControl URL, Virtual Server Name etc.
- Threshold definitions.

◆ **Note**

Note: Two main thresholds used for scale out operations are:
***Total Connections** this threshold defines total number of connections that should be exceeded in public cloud before the scale out operation can happen.*
***time** This threshold indicates that the total number of connections must exceed for at least this duration contiguously to trigger the scale out operation. Including the time component results in a slight smoothing effect, so that new resources are not provisioned for a momentary increase in the key metric.*

2. Prepare for Scale Out operation by Deploying the vApp for Pet Store application

   ```
   deploy vApp()
   ```

3. wait till ReadyToScaleOut() is TRUE

   ```
   if(readyToScaleOut is TRUE) {
         perfrom ScaleOut();
      }
   ```

4. Add the newly provisioned Pet Store Application Node to the Public LTM Pool.

Deploy vApp

1. Get reference to the **PubOrg** Organization in public vCloud.
2. Get access to the Catalog “pub_org_catalog01” that contains the vApp Template for the Pet Store application.
3. Get access to the vDC where the vApp is to be deployed
4. Create new vApp from the vApp Template **vApp_petstore** in the vDC
5. Configure IP Addressing mode for the provisioned VM in the vApp.
   - Get list of child Virtual Machines for the 'Pet Store' vApp.
   - There is only one VM configured in the vApp so access the first and only child VM from the list.
   - Get network Connection section for the VM.

- Set Network Name to **pub_org_blue_int**
- set the IP Address allocation Mode to **IpAddressAllocationModeType.POOL**
- Set the connected status to TRUE

Now update the Network Config Section on the vAPP and wait for the task to complete.

```
childVm.updateSection(networkConnectionSectionType)
```

6. Perform guest customization to change the password for the 'admin' user on the VM
   - Get the Guest Customization section \
   - Set the Admin Password on the section.
   - Update the Guest customization section and wait for the task to complete.

```
Task task = childVm.updateSection(guestCustSec);
waitForTaskCompletion(task);
```

7. Deploy the vApp in the vDC.

Scale Out Operation

1. Power on the vApp which was previously positioned in a dormant state
2. Get the IP Address for the vApp
3. Configure newly added vApp node in public cloud with public LTM Pool.
   - Get the IP address of the newly started 'Pet Store' VM.
   - Get list of LTM pools in the public cloud and reference 'petshop_http' pool.
   - Add the 'Pet Store' VM as member to the 'petshop_http' pool.
4. Deploy new vApp as preparation for next Scale Out action.

Ready to Scale Out?

1. Get Total Number of connections for the given virtual Server

```
If (total number of connections > 'Total Connections' Threshold)
{
       start timer if not started already.
       if ( (current time - start time)  > 'time' threshold) {
           // Ready to scale out
           return TRUE
```

```
            }

        } else {
          // We are dropped below the threshold
          stop the timer
          return FALSE
        }
```

Get total number of connections

1. Get list of Virtual Servers configured in the Public LTM using the Virtual Server Binding Stub

```
     LocalLBVirtualServerLocator().getLocalLBVirtualServerPort('URL to Public LTM POrtal')
```

2. Get List of virtual Servers and statistics.

```
stats = stub.get_statistics(virtual Server List);


   for(all the statistics entries) {
      // We are only interested in the "vs_GemPet_http" Virtual Server that receives the
    traffic for the Pet Store Application in the
      // Public Cloud
      if(Stat Entry.Server Name == "vs_GemPet_http") {
          // Now look fo ronly the cline tside open conection statistic entry
          if(Statistic Type ==
    CommonStatisticType.STATISTIC_CLIENT_SIDE_CURRENT_CONNECTIONS) {
               numberOfConnectios = stat Entry.value();
          }
      }
   }
```

Appendix B: vFabric SQLFire scripts

This appendix contains the vFabric SQLFire scripts we used for the WAN Gateway and Locator, as well as for the Jpetstore application referenced in *Configuring vFabric SQLFire*, on page 33.

These scripts may be different in your implementation.

This section is broken up into the following sections:

- *Infrastructure node WAN Gateway and Locator Scripts*
- *Jpetstore application node Scripts*, on page 49
- *SQL scripts*, on page 50

Infrastructure node WAN Gateway and Locator Scripts

This section contains the infrastructure node WAN Gateway and Locator scripts.

go.init script

The following script is called **go.init**.

```
#!/bin/bash
export JAVA_HOME=/usr/lib/jvm/jdk1.6.0/jre
export
PATH=${PATH}:JAVA_HOME/bin:/usr/local/petstore/SQLFabric10Beta2/bin
cd /usr/local/petstore/app
./clean
./go
./bootstrap
```

clean script

The following script is called **clean**, and is used to clean up the POC environment prior to each run.

```
killall -9 java
rm -rf dsI/serverI/* dsI/serverI/.fab*
rm -rf dsI/locatorI/* dsI/locatorI/.lo*
```

go script

The following script is called **go**.

```
#!/bin/bash
sqlf start-locator -port=9091 -dir=dsI/locatorI -server=false
-Dgemfire.enable-network-partition-detection=true

sqlf fabricserver start -dir=dsI/serverI -port=1521 -serverGroups=all,primary
-Plocators="virtualserver[9091]" -Pmcast-port=0 -Penable-network-partition-detection=true
```

bootstrap script

The following script is called bootstrap.

```
#!/bin/bash
export JAVA_HOME=/usr/lib/jvm/jdk1.6.0/jre
export
PATH=${PATH}:JAVA_HOME/bin:/usr/local/petstore/SQLFabric10Beta2/bin
sqlf ij < dsI/bootI.sql
```

Jpetstore application node Scripts

This section contains the infrastructure node Jpetstore application scripts.

go.init script

The following script is called **go.init**.

```
#!/bin/bash
export JAVA_HOME=/usr/lib/jvm/jdk1.6.0/jre
export
PATH=${PATH}:JAVA_HOME/bin:/usr/local/petstore/SQLFabric10Beta2/bin
cd /usr/local/petstore/app
./clean
./go
```

clean script

The following script is called **clean**, and is used to clean up the POC environment prior to each run.

```
killall -9 java
rm -rf ds1/server1/* ds1/server1/.fab*
```

go script

The following script is called **go**.

```
#!/bin/bash
#sqlf start-locator -port=9191 -dir=tmp
cd ds1
./ds1s1
cd ..

export JAVA_OPTS="-Xmx256m"
ds1/tomcat1/bin/startup.sh
```

SQL scripts

This section contains the SQL scripts.

gatewayI.sql

We modify the schema SQL to include a WAN Gateway. The **gatewayI.sql** file points to the hub at the other cloud. The following is our example **gatewayI.sql** file:

```
CALL SYS.ADD_GATEWAY_HUB('primary',
'private2public',
9001,
null,
null,
null,
null,
0);

CALL SYS.ADD_GATEWAY('private2public', 'pubcloud');
CALL SYS.ADD_GATEWAY_ENDPOINT('private2public', 'pubcloud', '10.133.60.51',9001);
CALL SYS.START_GATEWAY_HUB('private2public', 1);
```

bootl.sql

The following is our bootl.sql file.

```
connect 'jdbc:sqlfabric://virtualserver:1521';
run 'jpetstore-derby-schema.sql';
run 'dsI/gatewayI.sql';
run 'jpetstore-derby-dataload.sql';
```

jpetstore-derby-schema.sql

This is the database setup in vFabric SQLFire before inventory data is loaded. This needs to be run on each DB node before the application starts, and after the database has started. The following script accomplishes this. These statements initialize the structures and setup the partitioning.

We modify tables to use the gateway. To point the tables to the hub, you have to add “HUB(ALL)” at the end of their table creation DDLs. This was done to the line item and orders tables. The following is our example of the **lineitem** table from **jpetstore-derby-schema.sql**:

```
-- identity column ordernum increment by 1 start 1000;
-- identity column linenum increment by 1 start 1000;
-- change datatype bool to smallint table: profile -- remove null declarations

DROP TABLE lineitem;
DROP TABLE orderstatus;
DROP TABLE orders;
DROP TABLE bannerdata;
DROP TABLE profile;
DROP TABLE signon;
DROP TABLE inventory;
DROP TABLE item;
DROP TABLE product;
DROP TABLE account;
DROP TABLE category;
DROP TABLE supplier;
DROP TABLE sequence;

create table supplier (
    suppid int not null,
    name varchar(80) ,
    status varchar(2) not null,
    addr1 varchar(80) ,
    addr2 varchar(80) ,
    city varchar(80) ,
    state varchar(80) ,
    zip varchar(5) ,
    phone varchar(80) ,
    constraint pk_supplier primary key (suppid)
)
REPLICATE
;

create table signon (
    --username varchar(25) not null,
    username varchar(80) not null,
    password varchar(25)  not null,
    constraint pk_signon primary key (username)
)
REPLICATE
;

create table account (
    userid varchar(80) not null,
    email varchar(80) not null,
    firstname varchar(80) not null,
    lastname varchar(80) not null,
    status varchar(2) ,
    addr1 varchar(80) not null,
    addr2 varchar(40) ,
    city varchar(80) not  null,
    state varchar(80) not null,
    zip varchar(20) not null,
    country varchar(20) not null,
    phone varchar(80) not null,
    constraint pk_account primary key (userid)
)
REPLICATE
;

create table profile (
    userid varchar(80) not null,
    langpref varchar(80) not null,
    favcategory varchar(30),
    mylistopt smallint,
    banneropt smallint,
    constraint pk_profile primary key (userid)
)
REPLICATE
;

create table bannerdata (
    favcategory varchar(80) not null,
    bannername varchar(255) ,
    constraint pk_bannerdata primary key (favcategory)
)
REPLICATE;
```

```
create table orders (
      orderid int not null,
      userid varchar(80) not null,
      orderdate date not null,
      shipaddr1 varchar(80) not null,
      shipaddr2 varchar(80) ,
      shipcity varchar(80) not null,
      shipstate varchar(80) not null,
      shipzip varchar(20) not null,
      shipcountry varchar(20) not null,
      billaddr1 varchar(80) not null,
      billaddr2 varchar(80) ,
      billcity varchar(80) not null,
      billstate varchar(80) not null,
      billzip varchar(20) not null,
      billcountry varchar(20) not null,
      courier varchar(80) not null,
      totalprice decimal(10,2) not null,
      billtofirstname varchar(80) not null,
      billtolastname varchar(80) not null,
      shiptofirstname varchar(80) not null,
      shiptolastname varchar(80) not null,
      creditcard varchar(80) not null,
      exprdate varchar(7) not null,
      cardtype varchar(80) not null,
      locale varchar(80) not null,
      constraint pk_orders primary key (orderid)
) HUB(ALL);

create table orderstatus (
      orderid int not null,
      linenum int not null,
      timestamp date not null,
      status varchar(2) not null,
      constraint pk_orderstatus primary key (orderid, linenum)
)
HUB(ALL)
PARTITION BY column(orderid) COLOCATE WITH (orders);

create table lineitem (
      orderid int not null,
      linenum int not null,
      itemid varchar(10) not null,
      quantity int not null,
      unitprice decimal(10,2) not null,
      constraint pk_lineitem primary key (orderid, linenum)
)
HUB(ALL)
PARTITION BY column(orderid) COLOCATE WITH (orders);

create table category (
        catid varchar(10) not null,
        name varchar(80) ,
        descn varchar(255) ,
        constraint pk_category primary key (catid)
)
REPLICATE;

create table product (
    productid varchar(10) not null,
    category varchar(10) not null,
    name varchar(80) ,
    descn varchar(255) ,
    constraint pk_product primary key (productid),
        constraint fk_productCat foreign key (category)
        references category (catid)
)
REPLICATE;

-- create index productCat on product (category);
create index productName on product (name);

create table item (
    itemid varchar(10) not null,
    productid varchar(10) not null,
    listprice decimal(10,2) ,
    unitcost decimal(10,2) ,
    supplier int ,
    status varchar(2) ,
    attr1 varchar(80) ,
    attr2 varchar(80) ,
    attr3 varchar(80) ,
    attr4 varchar(80) ,
    attr5 varchar(80) ,
    constraint pk_item primary key (itemid),
        constraint fk_itemProd foreign key (productid)
        references product (productid),
        constraint fk_itemSup foreign key (supplier)
        references supplier (suppid)
);

-- create index itemProd on item (productid);

create table inventory (
    itemid varchar(10) not null,
    qty int not null,
    constraint pk_inventory primary key (itemid)
)
REPLICATE
;

CREATE TABLE sequence
(
    name               varchar(30)  not null,
    nextid             int          not null,
    constraint pk_sequence primary key (name)
);
```

jpetstore-derby-dataload.sql

This section contains the data to place in the tables at startup, after the tablespace has been setup:

```
INSERT INTO sequence VALUES('ordernum', 1000);
INSERT INTO sequence VALUES('linenum', 1000);

INSERT INTO signon VALUES('j2ee','j2ee');
INSERT INTO signon VALUES('ACID','ACID');

INSERT INTO account VALUES('j2ee','yourname@yourdomain.com','ABC', 'XYX', 'OK', '901 San
    Antonio Road', 'MS UCUP02-206', 'Palo Alto', 'CA', '94303', 'USA',  '555-555-5555');
INSERT INTO account VALUES('ACID','acid@yourdomain.com','ABC', 'XYX', 'OK', '901 San
    Antonio Road', 'MS UCUP02-206', 'Palo Alto', 'CA', '94303', 'USA',  '555-555-5555');

INSERT INTO profile VALUES('j2ee','english','DOGS',1,1);
INSERT INTO profile VALUES('ACID','english','CATS',1,1);

INSERT INTO bannerdata VALUES ('FISH','<image src="../images/banner_fish.gif">');
INSERT INTO bannerdata VALUES ('CATS','<image src="../images/banner_cats.gif">');
INSERT INTO bannerdata VALUES ('DOGS','<image src="../images/banner_dogs.gif">');
INSERT INTO bannerdata VALUES ('REPTILES','<image src="../images/banner_reptiles.gif">');
INSERT INTO bannerdata VALUES ('BIRDS','<image src="../images/banner_birds.gif">');

INSERT INTO category VALUES ('FISH','Fish','<image src="../images/fish_icon.gif"><font
    size="5" color="blue"> Fish</font>');
INSERT INTO category VALUES ('DOGS','Dogs','<image src="../images/dogs_icon.gif"><font
    size="5" color="blue"> Dogs</font>');
INSERT INTO category VALUES ('REPTILES','Reptiles','<image
    src="../images/reptiles_icon.gif"><font size="5" color="blue"> Reptiles</font>');
INSERT INTO category VALUES ('CATS','Cats','<image src="../images/cats_icon.gif"><font
    size="5" color="blue"> Cats</font>');
INSERT INTO category VALUES ('BIRDS','Birds','<image src="../images/birds_icon.gif"><font
    size="5" color="blue"> Birds</font>');

INSERT INTO product VALUES ('FI-SW-01','FISH','Angelfish','<image
    src="../images/fish1.jpg">Salt Water fish from Australia');
INSERT INTO product VALUES ('FI-SW-02','FISH','Tiger Shark','<image
    src="../images/fish4.gif">Salt Water fish from Australia');
INSERT INTO product VALUES ('FI-FW-01','FISH', 'Koi','<image
    src="../images/fish3.gif">Fresh Water fish from Japan');
INSERT INTO product VALUES ('FI-FW-02','FISH', 'Goldfish','<image
    src="../images/fish2.gif">Fresh Water fish from China');
INSERT INTO product VALUES ('K9-BD-01','DOGS','Bulldog','<image
    src="../images/dog2.gif">Friendly dog from England');
INSERT INTO product VALUES ('K9-PO-02','DOGS','Poodle','<image
    src="../images/dog6.gif">Cute dog from France');
INSERT INTO product VALUES ('K9-DL-01','DOGS', 'Dalmation','<image
    src="../images/dog5.gif">Great dog for a Fire Station');
INSERT INTO product VALUES ('K9-RT-01','DOGS', 'Golden Retriever','<image
    src="../images/dog1.gif">Great family dog');
INSERT INTO product VALUES ('K9-RT-02','DOGS', 'Labrador Retriever','<image
    src="../images/dog5.gif">Great hunting dog');
INSERT INTO product VALUES ('K9-CW-01','DOGS', 'Chihuahua','<image
    src="../images/dog4.gif">Great companion dog');
INSERT INTO product VALUES ('RP-SN-01','REPTILES','Rattlesnake','<image
    src="../images/lizard3.gif">Doubles as a watch dog');
INSERT INTO product VALUES ('RP-LI-02','REPTILES','Iguana','<image
    src="../images/lizard2.gif">Friendly green friend');
INSERT INTO product VALUES ('FL-DSH-01','CATS','Manx','<image
    src="../images/cat3.gif">Great for reducing mouse populations');
INSERT INTO product VALUES ('FL-DLH-02','CATS','Persian','<image
    src="../images/cat1.gif">Friendly house cat, doubles as a princess');
INSERT INTO product VALUES ('AV-CB-01','BIRDS','Amazon Parrot','<image
    src="../images/bird4.gif">Great companion for up to 75 years');
INSERT INTO product VALUES ('AV-SB-02','BIRDS','Finch','<image
    src="../images/bird1.gif">Great stress reliever');

INSERT INTO supplier VALUES (1,'XYZ Pets','AC','600 Avon Way','','Los
    Angeles','CA','94024','212-947-0797');
INSERT INTO supplier VALUES (2,'ABC Pets','AC','700 Abalone Way','','San Francisco
    ','CA','94024','415-947-0797');
```

```
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-1','FI-SW-01',16.50,10.00,1,'P','Large');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-2','FI-SW-01',16.50,10.00,1,'P','Small');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-3','FI-SW-02',18.50,12.00,1,'P','Toothless');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-4','FI-FW-01',18.50,12.00,1,'P','Spotted');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-5','FI-FW-01',18.50,12.00,1,'P','Spotless');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-6','K9-BD-01',18.50,12.00,1,'P','Male Adult');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-7','K9-BD-01',18.50,12.00,1,'P','Female Puppy');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-8','K9-PO-02',18.50,12.00,1,'P','Male Puppy');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-9','K9-DL-01',18.50,12.00,1,'P','Spotless Male Puppy');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-10','K9-DL-01',18.50,12.00,1,'P','Spotted Adult Female');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-11','RP-SN-01',18.50,12.00,1,'P','Venomless');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-12','RP-SN-01',18.50,12.00,1,'P','Rattleless');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-13','RP-LI-02',18.50,12.00,1,'P','Green Adult');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-14','FL-DSH-01',58.50,12.00,1,'P','Tailless');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-15','FL-DSH-01',23.50,12.00,1,'P','With tail');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-16','FL-DLH-02',93.50,12.00,1,'P','Adult Female');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-17','FL-DLH-02',93.50,12.00,1,'P','Adult Male');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-18','AV-CB-01',193.50,92.00,1,'P','Adult Male');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-19','AV-SB-02',15.50, 2.00,1,'P','Adult Male');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-20','FI-FW-02',5.50, 2.00,1,'P','Adult Male');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-21','FI-FW-02',5.29, 1.00,1,'P','Adult Female');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-22','K9-RT-02',135.50, 100.00,1,'P','Adult Male');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-23','K9-RT-02',145.49, 100.00,1,'P','Adult Female');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-24','K9-RT-02',255.50, 92.00,1,'P','Adult Male');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-25','K9-RT-02',325.29, 90.00,1,'P','Adult Female');
```

```
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-26','K9-CW-01',125.50, 92.00,1,'P','Adult Male');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-27','K9-CW-01',155.29, 90.00,1,'P','Adult Female');
INSERT INTO  item (itemid, productid, listprice, unitcost, supplier, status, attr1)
    VALUES('EST-28','K9-RT-01',155.29, 90.00,1,'P','Adult Female');


INSERT INTO inventory (itemid, qty ) VALUES ('EST-1',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-2',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-3',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-4',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-5',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-6',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-7',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-8',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-9',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-10',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-11',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-12',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-13',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-14',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-15',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-16',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-17',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-18',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-19',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-20',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-21',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-22',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-23',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-24',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-25',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-26',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-27',10000000);
INSERT INTO inventory (itemid, qty ) VALUES ('EST-28',10000000);
```

gateway1.sql

```
CALL SYS.ADD_GATEWAY_HUB('primary',
        'private2public',
        9001,
        null,
        null,
        null,
        null,
        0);


CALL SYS.ADD_GATEWAY('private2public', 'pubcloud');
CALL SYS.ADD_GATEWAY_ENDPOINT('private2public', 'pubcloud', '10.133.60.51',9001);
CALL SYS.START_GATEWAY_HUB('private2public', 1);

CALL SYS.ADD_LISTENER
('lineItemListener','app','lineitem','com.gemstone.petstore.InventoryCompensationCallback',null);
```

Appendix C: Configuring the BIG-IP LTM to offload SSL

If you are using the BIG-IP LTM system to offload SSL from the Apache devices, there are additional configuration procedures you must perform on the BIG-IP LTM system.

◆ **Important**

Offloading SSL is not typically required inside of the firewall(s). We are including the instructions here for reference.

This section is optional, and only necessary if you are using the BIG-IP LTM system for offloading SSL.

In the following configuration, the BIG-IP LTM redirects all incoming traffic to the HTTP virtual server to the HTTPS virtual server. This is useful if a user types a URL in a browser, but forgets to change the protocol to HTTPS.

If your deployment does not require ***all*** traffic to be redirected to HTTPS, you do not need to configure the iRule or modify the HTTP virtual server as described below, nor configure the Rewrite Redirect setting in the HTTP profile in Step 5 of *Creating an HTTP profile*. You can have both an HTTP and HTTPS virtual server on the same address with the appropriate ports.

Using SSL certificates and keys

Before you can enable the BIG-IP LTM system to act as an SSL proxy, you must install a SSL certificate on the virtual server that you wish to use for Apache connections on the BIG-IP LTM device. For this Deployment Guide, we assume that you already have obtained an SSL certificate, but it is not yet installed on the BIG-IP LTM system. For information on generating certificates, or using the BIG-IP LTM to generate a request for a new certificate and key from a certificate authority, see the **Managing SSL Traffic** chapter in the ***Configuration Guide for Local Traffic Management***.

Importing keys and certificates

Once you have obtained a certificate, you can import this certificate into the BIG-IP LTM system using the Configuration utility. By importing a certificate or archive into the Configuration utility, you ease the task of managing that certificate or archive. You can use the Import SSL Certificates and Keys screen only when the certificate you are importing is in Privacy Enhanced Mail (PEM) format.

To import a key or certificate

1. On the Main tab, expand **Local Traffic**.
2. Click **SSL Certificates**. The list of existing certificates displays.

3. In the upper right corner of the screen, click **Import**.
4. From the **Import Type** list, select the type of import (Certificate or Key).
5. In the **Certificate** (or **Key**) **Name** box, type a unique name for the certificate or key.
6. In the **Certificate** (or **Key**) **Source** box, choose to either upload the file or paste the text.
7. Click **Import**.

If you imported the certificate, repeat this procedure for the key.

Creating a Client SSL profile

The next step in this configuration is to create a Client SSL profile. This profile contains the SSL certificate and Key information for decrypting the SSL traffic on behalf of the servers.

To create a new Client SSL profile

1. On the Main tab, expand **Local Traffic**, and then click **Profiles**.
   The HTTP Profiles screen opens.
2. On the Menu bar, from the SSL menu, select **Client**.
   The Client SSL Profiles screen opens.
3. Click the **Create** button.
   The New Client SSL Profile screen opens.
4. In the **Name** box, type a name for this profile. In our example, we type **Tomcat-clientssl**.
5. In the Configuration section, check the **Certificate** and **Key Custom** boxes.
6. From the **Certificate** list, select the name of the Certificate you imported in the *Importing keys and certificates* section.
7. From the **Key** list, select the key you imported in the *Importing keys and certificates* section.
8. Click the **Finished** button.

Creating the Redirect iRule

The Redirect iRule takes incoming HTTP requests (non-secure) and redirects them to the correct HTTPS (secure) virtual server, without user interaction.

To create the Redirect iRule

1. On the Main tab, expand **Local Traffic**, and then click **iRules**.
   The iRule screen opens.

2. Click the **Create** button.
   The New iRule screen opens.
3. In the **Name** box, enter a name for your iRule.
   In our example, we use **Tomcat-httptohttps**.
4. In the Definition section, copy and paste the following iRule:

```
when HTTP_REQUEST {
   HTTP::redirect https://[HTTP::host][HTTP::uri]
}
```

5. Click the **Finished** button

Modifying the HTTP virtual server

The next task is to modify the HTTP virtual server you created in *Creating the virtual server*, on page 1-17 to use the iRule you just created.

To modify the existing Tomcat virtual server

1. On the Main tab, expand **Local Traffic**, and then click **Virtual Servers**. The Virtual Servers screen opens.
2. From the Virtual Server list, click the Apache virtual server you created in the *Creating the virtual server* section.
   In our example, we click **Tomcat-bookstore-vs**.
3. On the menu bar, click **Resources**.
4. From the **Default Pool** list, select **None**.
   This virtual server no longer requires the load balancing pool, as traffic is redirected to the HTTPS virtual server we create in the following procedure.
5. Click the **Update** button.
6. In the iRules section, click the **Manage** button.
   The Resource Management screen opens.
7. From the **Available** list, select the iRule you created in the *Creating the Redirect iRule* section, and click the Add (<<) button.
   In our example, we select **Tomcat-httptohttps**.
8. Click the **Finished** button.

Creating the HTTPS virtual server

The final task in this section is to create a HTTPS virtual server.

To create a new HTTPS virtual server

1. On the Main tab, expand **Local Traffic**, and then click **Virtual Servers**. The Virtual Servers screen opens.
2. Click the **Create** button.

3. In the **Name** box, type a name for this virtual server. In our example, we type **Tomcat-bookstore-ssl-vs**.
4. In the **Destination** section, select the **Host** option button.
5. In the **Address** box, type the IP address of this virtual server. In our example, we use **192.168.104.146**.
6. In the **Service Port** box, type **443** or select **HTTPS** from the list.
7. From the Configuration list, select **Advanced**.
8. Leave the **Type** list at the default setting: **Standard**.
9. From the **Protocol Profile (Server)** list, select the name of the profile you created in the *Creating the TCP profile* section. In our example, we select **Tomcat-tcp-lan**.
10. From the **OneConnect Profile** list, select the name of the profile you created in *Creating a OneConnect profile*. In our example, we select **Tomcat-oneconnect**.
11. From the HTTP Profile list, select the name of the profile you created in the *Creating an HTTP profile* section. In our example, we select **Tomcat-http-opt**.
    Make sure you have the Rewrite Redirect box checked in the HTTP profile as described in Step 5 of *Creating an HTTP profile*.
12. From the **SSL Profile (Client)** list, select the name of the SSL profile you created in the *Creating a Client SSL profile* section. In our example, we select **Tomcat-clientssl**.
13. From the **Default Pool** list, select the pool you created in the *Creating the pool* section. In our example, we select **Tomcat-app-pool**.
14. From the **Default Persistence Profile** list, select the persistence profile you created in the *Optional: Creating persistence profile*. In our example, we select **Tomcat-cookie**.
15. From the **Fallback Persistence Profile** list, select the fallback persistence profile you created in the *Optional: Creating persistence profile*. In our example, we select **Tomcat-source**.
16. Click the **Finished** button.