

IPsec Tunneling

Feature Description

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1 Introduction

Internet Protocol Security (IPsec) is designed and used to provide secure connections between nodes and networks throughout the internet. IPsec has become the standard for most of the IP Virtual Private Network (VPN) technology.

> This document covers both the policy-based and route-based VPN functionality supported on LoadMaster. Policy-based VPNs are supported in the base LoadMaster system in LMOS 7.2.48.x and subsequent releases. Support for route-based VPNs was added in LMOS 7.2.53.0 via an add-on package that can be installed separately, as explained later in this document in the section **Configure the LoadMaster using Route Based VPN**.

IPsec can operate in a point-to-point (aka host-to-host) configuration or in a site-to-site (aka network-to-network) configuration. An IPsec implementation operates in a host, as a Security Gateway (SG), or as an independent device, affording protection to IP traffic for both IPv4 and IPv6. (A security gateway is an intermediate system implementing IPsec, for example a firewall, router or gateway which has been IPsec-enabled.)

A suite of protocols are utilized to implement IPsec. These include Authentication Header (AH) and Encapsulating Security Payload (ESP). Handshaking and exchanging session keys is implemented using the Internet Key Exchange (IKE) protocol.

IPsec also has several Hashed Message Authentication Codes (HMAC) from which to choose, each giving different levels of protection for attacks such as man-in-the-middle, packet replay (anti-replay), and data integrity attacks.

There are many benefits of using IPsec. These include, but are not limited to:

- Secure connectivity provided across distributed enterprises
- Bandwidth benefits over traditionally expensive Wide Area Network (WAN) infrastructure
- Cost benefits over traditionally expensive WAN infrastructure
- Security - IPsec VPNs inherently provide a high degree of data security
- Flexibility - IPsec VPNs can be established and be available using the internet

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- Resilience and High Availability (HA) for critical and sensitive applications available over the internet

1.1 Document Purpose

The purpose of this document is to explain how to set up and configure IPsec tunneling on the Kemp LoadMaster.

1.2 Intended Audience

This document is intended to be used by anyone who is interested in setting up IPsec tunneling on the LoadMaster.

1.3 Prerequisites

If needed, please obtain an externally-facing IPv4 address for the VPN device. This IP address may be required for a site-to-site configuration. Please refer to the **Limitations** section below to find out what is supported for what platforms in relation to using a public IP address.

> The VPN device will either be a LoadMaster or a Network Address Translation (NAT)/firewall device.

> The externally-facing public IPv4 address will either be the externally accessible public IP address which is directly available on the LoadMaster or a public IP address on a NAT/firewall device which will be NATed from the LoadMaster's internal IP address.

1.4 Limitations

1.4.1 Limitations Relating to the Cloud Platform Used

Microsoft Azure and Amazon Web Services (AWS) are currently the only supported platforms that VPN tunneling on the LoadMaster works with. There are some limitations depending on the cloud platform being used. These limitations are outlined in the table below.

Architecture	Connection	Azure	AWS
Perfect Forward Secrecy		Unsupported	Supported

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Architecture	Connection	Azure	AWS
No Perfect Forward Secrecy		Supported	Unsupported
LoadMaster behind a Gateway		Supported	Unsupported
LoadMaster with a public IP address	Private subnets	Unsupported	Unsupported
	Public subnets	Unsupported	Supported

As indicated by the table above, only a public interface tunnel is supported on AWS. This is because Network Address Translation Traversal (NAT-T) is not supported on AWS.

In Azure - multiple remote and private subnets are supported. So, it is possible to have multiple IPsec connections between Azure and the LoadMaster - each connection can connect a certain LoadMaster's private subnet with a certain Azure subnet. It is also possible to connect to multiple tunnels within the one connection.

1.4.2 LoadMaster Clustering

IPsec tunneling is not enabled or supported on a system which is configured for LoadMaster clustering.

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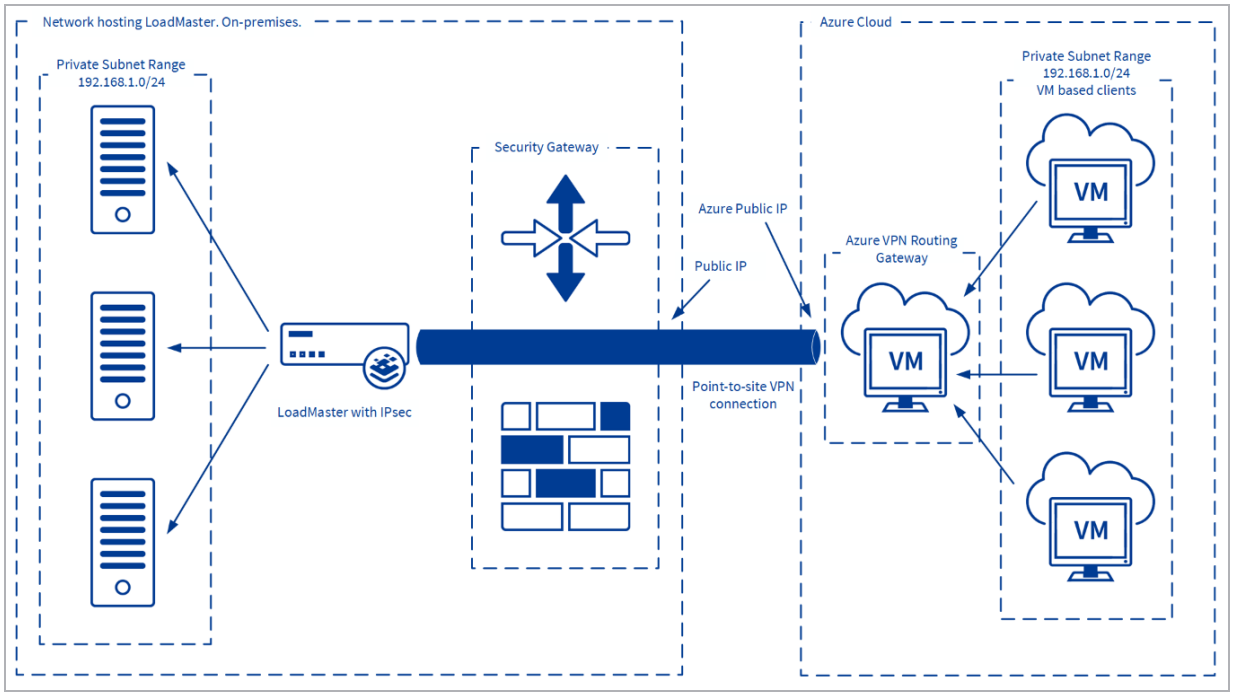
2 Site-To-Site Tunneling

IPsec is most widely used in the context of configuring a secure connection between an entire network (such as a Local Area Network (LAN)) and a remote network using a site-to-site (network-to-network) connection. This document focuses on the setting up and configuring site-to-site tunneling. However, point-to-site and host-to-host (point-to-point) will also work. Please consult the third party documentation or contact Kemp Support for further assistance.

A site-to-site connection requires the setup of IPsec routers/gateways on each side of the connecting networks to transparently process and route information from one node on a LAN to a node on a remote LAN. For example, hosts on the 192.168.1.0/24 IP range can communicate with hosts on the 192.168.2.0/24 IP range.

These LANs use IPsec routers to authenticate and initiate a connection using a secure tunnel through the internet. The process of communicating from one node in the 192.168.1.0/24 IP range to another in the 192.168.2.0/24 range is completely transparent to the nodes as the processing, encryption/decryption and routing of the IPsec packets are completely handled by the IPsec routers.

The following diagram outlines a potential deployment scenario in Microsoft Azure.



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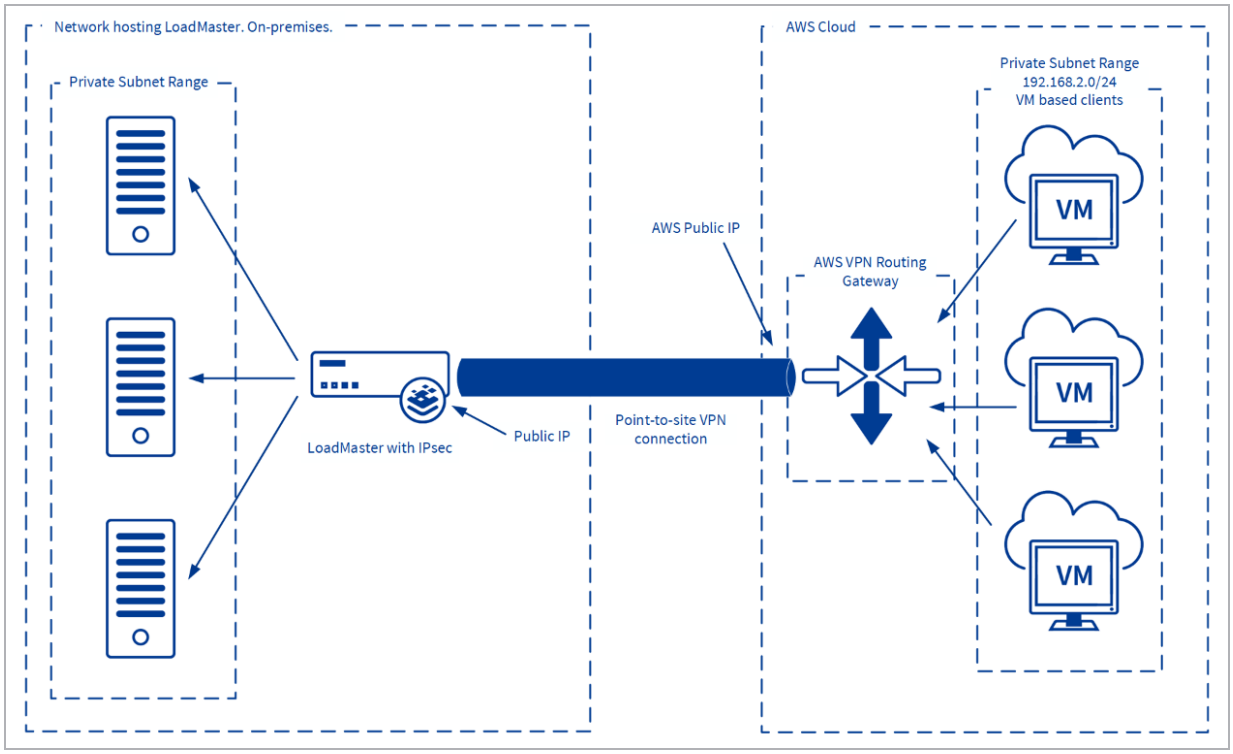
The following diagram outlines a potential deployment scenario in AWS. In this case, the firewall and Public IP address are on the LoadMaster and the LoadMaster acts as the security gateway.



2.1 Configure the Cloud Platform

IPsec tunnelling using the LoadMaster is currently supported on these cloud platforms:

- Microsoft Azure
- Amazon Web Services (AWS)

Steps on how to set up a VPN connection on each of these cloud platforms are provided in the sections below.

> These steps are correct at the time of writing this document. These steps may change without our knowledge. Please consult the relevant third party cloud platform documentation for the latest steps.

2.1.1 Configure Microsoft Azure

There are two options for creating and configuring a virtual network:

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- Configure the network manually by using a network configuration file
- Use the wizard in the Azure Management Portal

It is recommended to use the wizard the first time a virtual network is created. The wizard creates a network configuration file (.xml file) for the virtual network. After creating the first virtual network using the Management Portal, the network configuration file can be exported and used as a template to create additional virtual networks.

Follow the steps below to configure a site-to-site VPN in the Azure Management Portal:

> These steps are correct at the time of writing this document. These steps may change without our knowledge. Please consult the Microsoft documentation for the latest steps.

1. Log in to the Azure Management portal.
2. Click **New**.
3. Click **Network Services** and then click **Virtual Network**.
4. Click **Custom Create**.
5. Enter the **Name** of the virtual network, for example **EastUSVNet**.

> This network name will be used when deploying the Virtual Machines and Platform as a Service (PaaS) instances so it is recommended to not enter a complicated name here.

6. Specify the **Location**.

> The location is directly related to the physical location (region) where the resources (Virtual Machines) will reside. For example, if the Virtual Machines that will be deployed to this network will be physically located in East US, select that location. The region associated with the virtual network cannot be changed after it is created.

7. On the **DNS Servers and VPN Connectivity** page, enter the following information and then click the **Next** arrow:

   a) **DNS Servers:** Enter the DNS server name and IP address, or select a previously registered DNS server from the drop-down menu.

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> This setting does not create a DNS server. It allows the specification of the DNS servers to be used for name resolution for this virtual network.

b) Configure Site-To-Site VPN: Select the check box called Configure a site-to-site VPN.

c) **Local Network:** A local network represents the physical on-premises location. Select a local network that has previously been created, or create a new local network.

> If an existing local network was selected, go to the **Local Networks** configuration page and ensure that the VPN Device IP address (public-facing IPv4 address for the VPN device) is accurate for this local network.

8. If an existing local network was selected, skip this step. If creating a new local network, the **Site-To-Site Connectivity** page will appear. Enter the following information and then click the **Next** arrow:

a) **Name:** The name of the local (on-premises) network site.

b) **VPN Device IP Address:** This is the public-facing IPv4 address of the on-premises VPN device used to connect to Azure.

c) **Address Space:** Specify the address range(s) (including starting IP and CIDR) to be sent through the virtual network gateway to the local on-premises location. If a destination IP address falls between the ranges specified here, it will be routed through the virtual network gateway.

d) **Add address space:** If there are multiple address ranges to be sent through the virtual network gateway, this is where each additional address range is specified. Ranges can be added or removed later as needed, on the **Local Network** page.

9. On the **Virtual Network Address Spaces** page, specify the address range to be used for the virtual network. Enter the following information, and then click the checkmark to configure the network:

> These are the Dynamic IP addresses (DIPS) that will be assigned to the Virtual Machines and other role instances that are deployed to this virtual network. There are a few rules regarding the virtual network address space - please refer to the Microsoft - Virtual Network Address Spaces page for more

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> information. It is particularly important to select a range that does not overlap with any of the ranges that are in use for the on-premises network. A range of IP addresses might need to be carved out from the on-premises network address space to be used for the virtual network.

a) **Address Space:** Include the starting IP address and the address count.

> Verify that the address spaces specified do not overlap with any of the address spaces on the on-premises network.

b) **Add subnet:** Include the starting IP address and address count.

> Additional subnets are not required, but a separate subnet may be needed for Virtual Machines that will have static DIPS. Or the Virtual Machines might need to be in a subnet that is separate from the other role instances.

c) **Add gateway subnet:** Click to add the gateway subnet. The gateway subnet is used only for the virtual network gateway and is required for this configuration.

10. Click the checkmark on the bottom of the page and the virtual network will begin to create. When it completes, **Created** will be shown under **Status** on the **Networks** page in the Azure Management Portal.

11. Next, configure the virtual network gateway to create a secure site-to-site connection. Refer to Microsoft - Configure a Virtual Network Gateway in the Management Portal for instructions on how to do this.

12. When you get to the **Configure your VPN Device** section, refer to the section below for instructions on how to configure the LoadMaster.

2.1.2 Configure AWS

Follow the steps below to set up a VPN connection on the AWS platform:

1. Log in to the AWS console.
2. Click **VPC**.
3. Click **Virtual Private Gateways**.
4. Click **Create Virtual Private Gateway**.

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5. Enter a **Name tag**.

6. Click the **Yes, Create** button.

7. Select the Virtual Private Gateway that was just created and click the **Attach to VPC** button.

8. Select the relevant Virtual Private Cloud (VPC) from the list.

9. Click **Yes, Attach**.

10. Click **Customer Gateways** in the menu.

11. Click the **Create Customer Gateway** button.

12. Enter a recognizable **Name tag** for the LoadMaster.

13. Enter the **IP address** of the LoadMaster.

14. Click the **Yes, Create** button.

15. Click **VPN Connections** in the menu.

16. Click **Create VPN Connection**.

17. Enter a recognizable **Name tag** for the VPN connection.

18. In the **Virtual Private Gateway** drop-down list, select the Virtual Private Gateway which was created earlier.

19. Select **Static** in the **Routing Options** section.

20. Enter the LoadMaster-side network IP address followed by the CIDR in the **Static IP Prefixes** field.

21. Click the **Yes, Create** button.

22. Wait for the VPN status to become available.

23. Click **Download Configuration**.

24. Select **Generic** as the **Vendor**.

25. Select **Generic** as the **Platform**.

26. Select **Vendor Agnostic** as the **Software**.

27. Click the **Yes, Download** button.

28. Save the text file.

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The text file contains the Pre-Shared Key which will be needed when configuring the LoadMaster side.

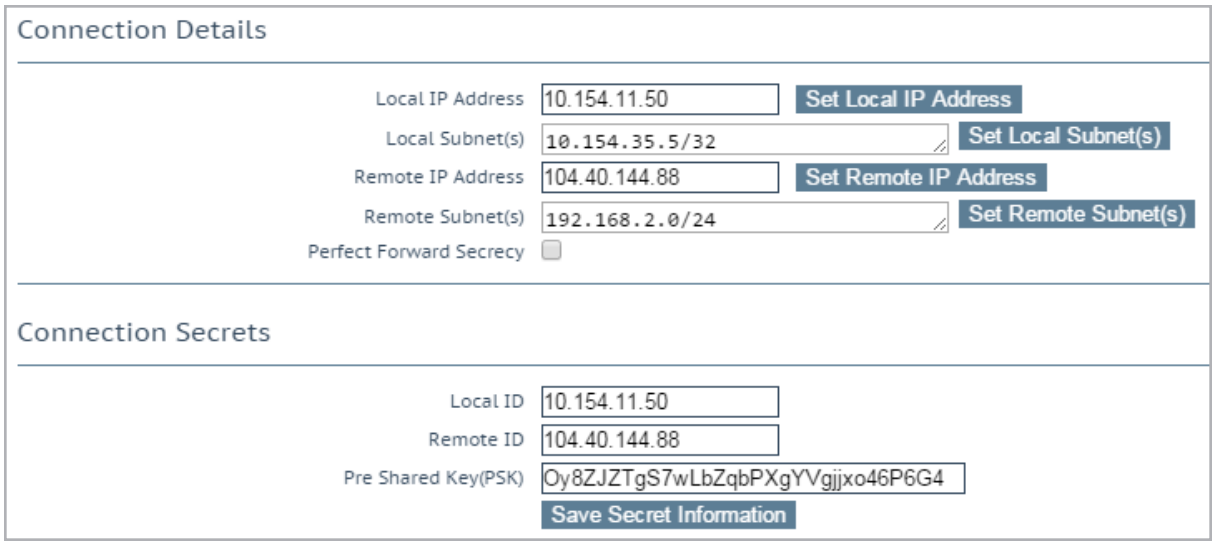
2.2 Configure the LoadMaster

A connection end point must be added in the LoadMaster for tunneling to work. Follow the steps below to configure the LoadMaster settings:

1. In the main menu of the LoadMaster Web User Interface (WUI), go to **System Configuration > Route Management > VPN Management**.



2. Enter a unique and recognizable **Connection Name** and click **Create**.



3. Enter the IP address for the local side of the connection in the **Local IP Address** text box and click **Set Local IP Address**.

> In non-HA mode, the **Local IP Address** should be the LoadMaster IP address, that is, the IP address of the default gateway interface.

> In HA-mode, the **Local IP Address** should be the shared IP address. This will be automatically populated if HA has already

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> been configured. For more information on setting up tunneling in a HA configuration, refer to the next section.

4. When the **Local IP Address** is set, the **Local Subnet Address** will be automatically populated. Review the **Local Subnet Address** and update it if needed. Ensure to click **Set Local Subnet Address** to apply the setting, whether the address has been changed or not. Multiple local subnets can be specified using a comma-separated list. Up to 10 IP addresses can be specified.

5. The local IP can be the only participant if applicable, given the /32 CIDR. Enter the IP address of the remote side of the connection in the **Remote IP Address** text box and click **Set Remote IP Address**.

> In the context of an Azure endpoint, this IP address is expected to be the public-facing IP address for the VPN Gateway device. For instructions on how to get this IP address, refer to Microsoft - Configure a Virtual Network Gateway in the Management Portal.

6. Enter the **Remote Subnet Address** and click **Set Remote Subnet Address**. Multiple remote subnets can be specified using a comma-separated list. Up to 10 IP addresses can be specified.

7. Either enable or disable **Perfect Forward Secrecy**.

> The cloud platform being used will determine what the **Perfect Forward Secrecy** option should be set to. **Perfect Forward Secrecy** is needed for some platforms but is unsupported on others. To find out what will work with your cloud platform, refer to the **Prerequisites** section.

8. By default, the **Local ID** text box is populated with the **Local IP Address** when the **Set Local IP Address** button is clicked. Review and update this address, if needed.

> This may be the local IP address.

> If the LoadMaster is in HA mode, the **Local ID** field will be automatically set to **%any**. This value cannot be updated when the LoadMaster is in HA mode.

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9. Enter identification for the remote side of the connection.

> This may be the remote IP address.

10. Enter the pre-shared key string in the **Pre-Shared Key (PSK)** text box.

> This is the **Shared key** which is generated and managed on the Azure side, as outlined in Microsoft - Configure a Virtual Network Gateway in the Management Portal. It must be taken from Azure and entered in the **Pre-Shared Key (PSK)** text box in the LoadMaster WUI.

> If you are upgrading the LoadMaster firmware from a version older than 7.2.41 to version 7.2.41 or above, Kemp recommends re-entering the PSK to encrypt it.

11. Click **Save Secret Information** to generate and save the connection identification and secret information.

12. Go back to the **VPN Management** screen.

2.2.1 Virtual Service Configuration

Refer to the sections below for information on how to configure certain Virtual Service options.

> The **Subnet Originating Requests** (SOR) option is not relevant in the context of IPsec virtual Real Server resources.

2.2.1.1 Enable Non-Local Real Servers

Real Servers that are cloud-based must be specified/configured as non-local for the Virtual Services that require remote resources. The **Enable Non-Local Real Servers** option must be enabled globally in order for IPsec tunneling to work.

To enable non-local Real Servers globally, follow the steps below in the LoadMaster WUI:

1. In the main menu, go to **System Configuration > Miscellaneous Options > Network Options**.

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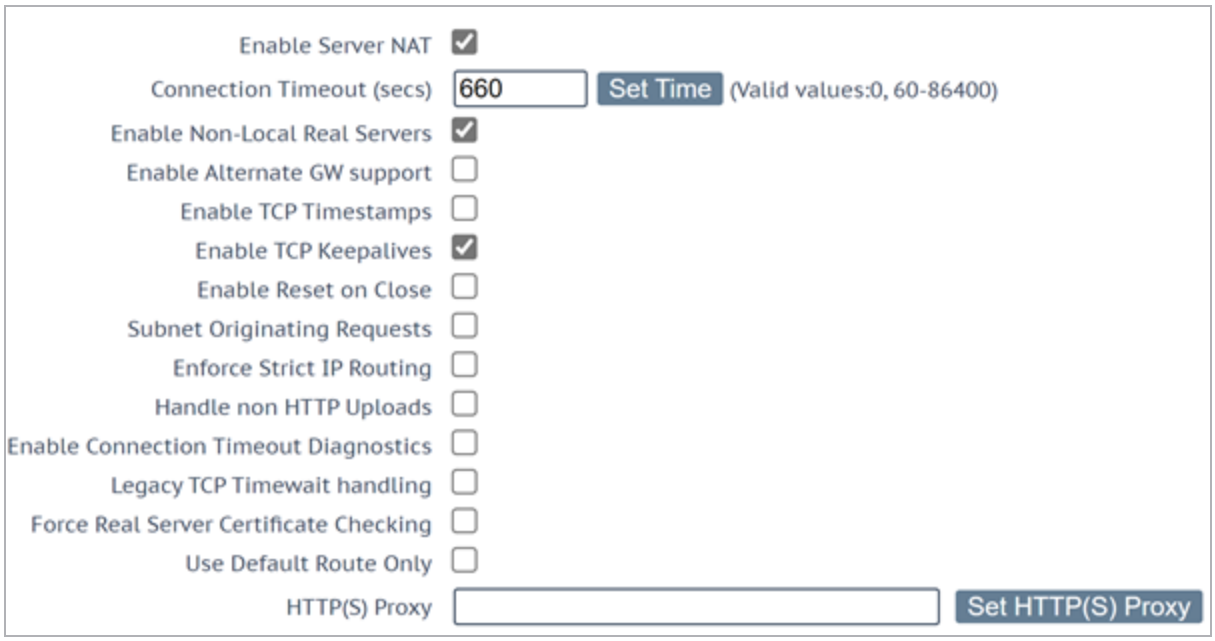
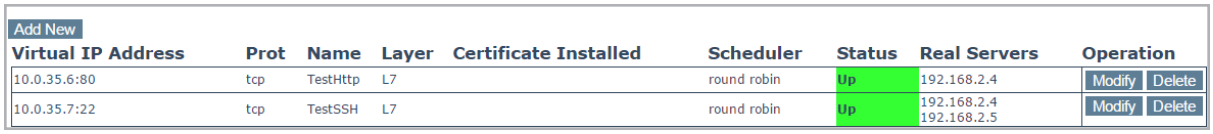


2. Select the Enable Non-Local Real Servers check box.

2.2.1.2 Disable Transparency

Due to the use of non-local Real Servers, the **Transparency** option must be disabled in the relevant Virtual Services. To disable transparency, follow the steps below:

1. In the main menu, go to Virtual Services > View/Modify Services.



2. Click **Modify** on the relevant Virtual Service.
3. Expand the **Standard Options** section.

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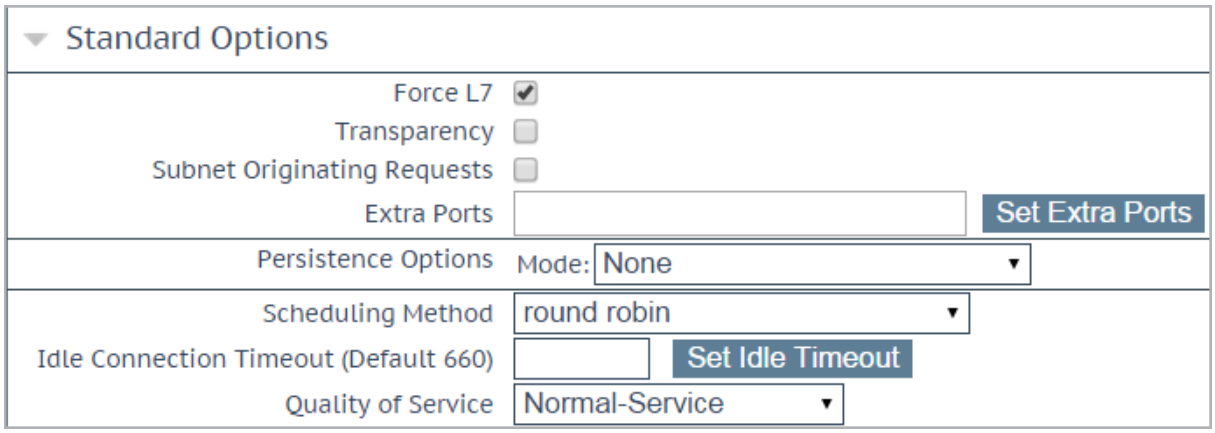


4. Remove the tick from the **Transparency** text box.

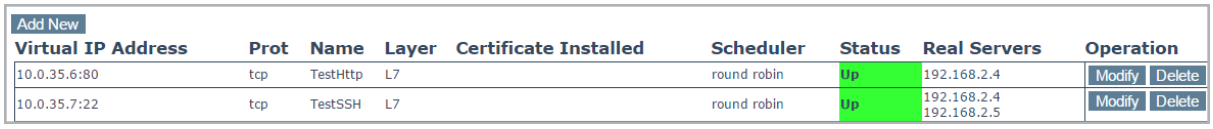
2.2.1.3 Allow Remote Addresses

When adding a Real Server, ensure the **Allow Remote Addresses** option is enabled.

> This option will only be visible when adding a Real Server if **Enable Non-Local Real Servers** has been enabled and **Transparency** has been disabled on the relevant Virtual Service. For instructions on how to configure these options, refer to the **Enable Non-Local Real Servers** and **Disable Transparency** sections.

To do this, follow the steps below in the LoadMaster WUI:

1. In the main menu, go to **Virtual Services > View/Modify Services**.



2. Click **Modify** on the relevant Virtual Service.
3. Expand the **Real Servers** section.
4. Click **Add New**.

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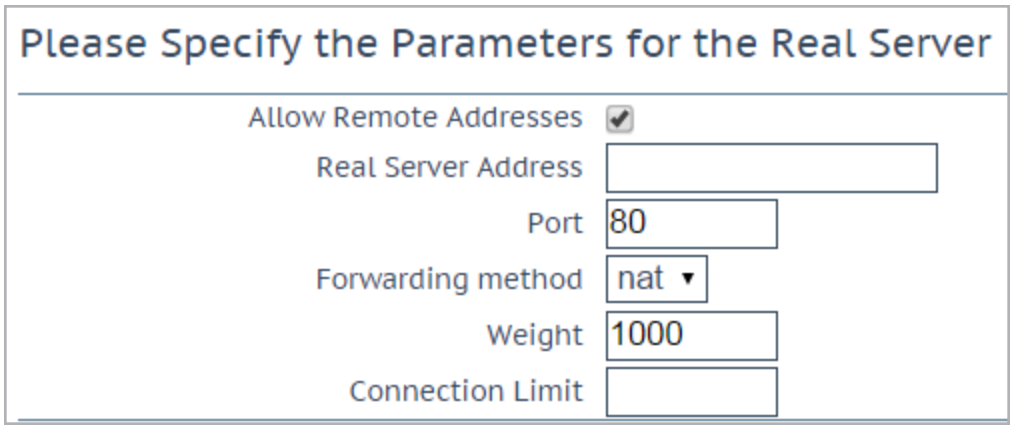

5. Enable the **Allow Remote Addresses** option.
6. Fill out the other details as needed.

   > Kemp recommends using static IP addresses for the Real Servers on the Azure side.

7. Click **Add This Real Server**.

2.3 Configure the LoadMaster using Route Based VPN

Prior to LoadMaster firmware version 7.2.53, the LoadMaster only supported policy-based Virtual Private Networks (VPNs). As of LoadMaster version 7.2.53, route-based VPN support has been introduced. The route-based VPN functionality is available as an add-on pack which you can download from the Kemp Support Site. When you have the add-on file, install it in **System Configuration > System Administration > Update Software**. Reboot the LoadMaster after installing the add-on to activate it (**System Configuration > System Administration > System Reboot**).

> The route-based VPN add-on is only supported in firmware version 7.2.53 and above.

> The LoadMaster route-based VPN functionality is based on the strongSwan IPsec VPN solution. For more details on strongSwan documentation, refer to the strongSwan website link https://www.strongswan.org/.

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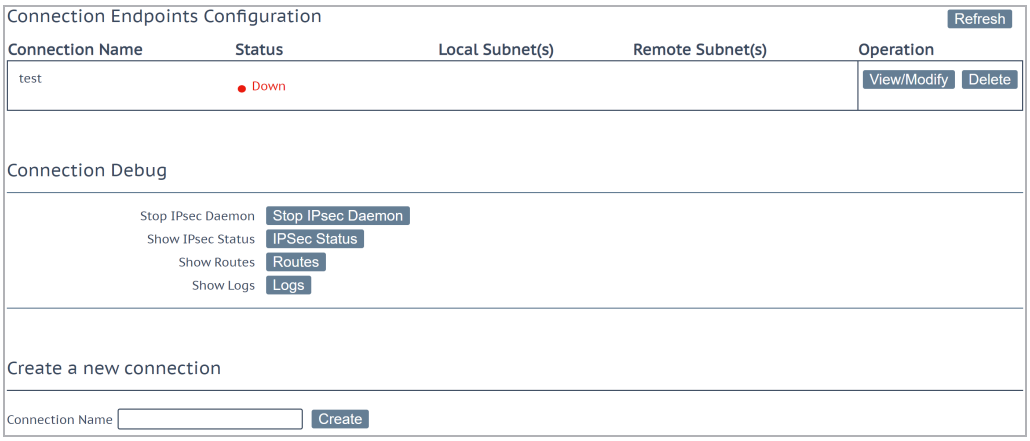
After installing the add-on and rebooting the LoadMaster, a new main menu option becomes available: **System Configuration > Network Setup > Route Based VPN**. Specify a unique name to identify the connection and click **Create**.

After configuring the details of the VPN connection, you can also see the **Connection Debug** options:

- Stop and start the IPsec daemon on the LoadMaster.
- Display the connection status.
- Display routes.
- Show logs.



Connection Name

Specify a unique name to identify the connection.

Create

Create a uniquely identifiable connection with the specified name.

View/Modify

View or modify the configuration parameters for this connection.

Delete

Delete this connection.

> Ensure the **Connection Name** is the same as the connection name in the **ipsec.conf** file you will be uploading.

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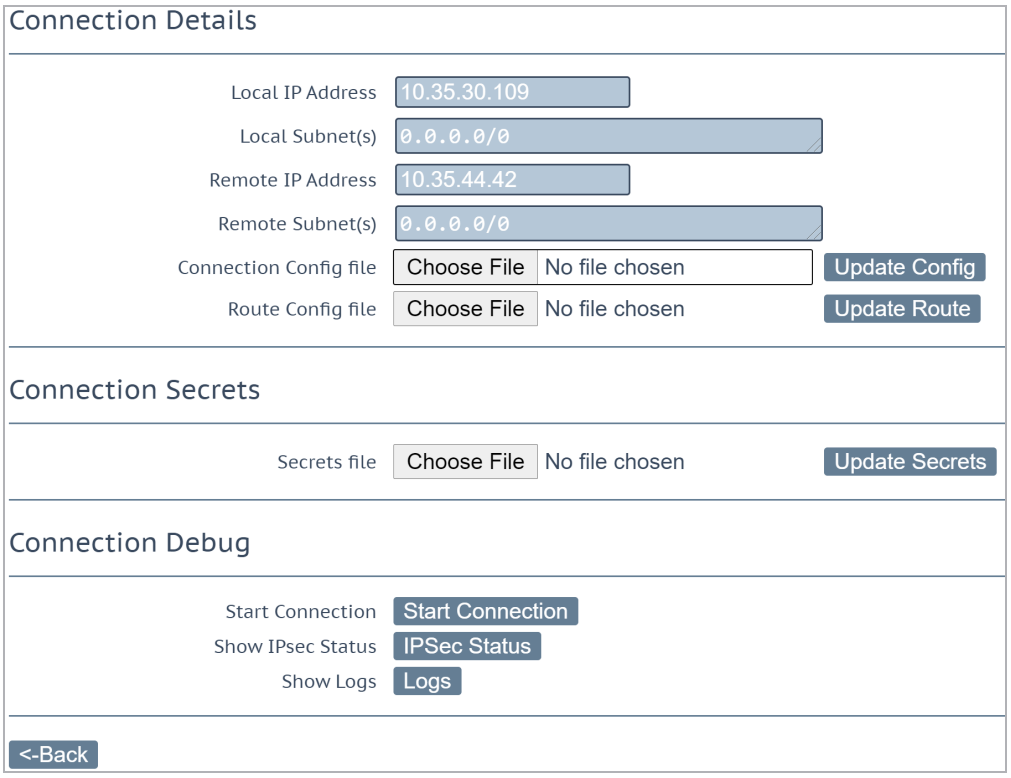
> The **Connection Name** must be at least three and at most 20 characters in length. Valid characters are **a-z, A-Z, 0-9, _,** and **-**.

After creating the connection initially, you must upload the connection configuration, route configuration, and secrets files based on the strongSwan standard format. These files provide support for multiple configuration option which user can configure strongswan IPsec based on their requirement.

> Ensure to set the left IP address in the ipsec.conf file to your LoadMaster IP address (eth0).

Once the files have been uploaded and validated, the **Connection Details** are shown in the fields on the **View/Modify** VPN Connection screen.

2.3.1 View/Modify VPN Connection



Local IP Address

Display the IP address for the local side of the connection.

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In non-HA mode, the **Local IP Address** should be the LoadMaster IP address, that is, the IP address of the default gateway interface.

In HA-mode, the **Local IP Address** should be the shared IP address. This will be automatically populated if HA has already been configured. For more information on setting up tunneling in a HA configuration, refer to the next section.

Local Subnet(s)

Display the **Local Subnet(s)** for the local side of the connection.

Remote IP Address

Display the IP address for the remote side of the connection. In the context of an Azure endpoint, this IP address is expected to be the public-facing IP address for the Virtual Private Network (VPN) Gateway device.

Remote Subnet(s)

Display the subnet for the remote side of the connection.

Connection Config file

Click the **Choose File**, browse to and select the file and click **Update Config**. The configuration file contains default value **conn %deafult** for all the IPsec connection configured. This configuration is given directly to the strongswan IPsec engine. . The format of Connection Config file contains following parameters:

conn %default

dpddelay=30

dpdtimeout=120

dpdaction=restart

ikelifetime=28800s

#keylife=20m

keylife=1d

rekeymargin=3m

keyingtries=1

authby=secret

keyexchange=ikev2

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mobike=yes

ike=aes256-sha384-ecp384

esp=aes256-sha384-ecp384,aes256gcm16

conn routevpn

left=10.35.45.170

leftsubnet=10.35.99.170/32

right=65.51.241.146

rightsubnet=10.0.70.1/32

leftid=78.56.45.56

rightid=%any

mark=1

auto=start

ikelifetime=1h

lifetime = 1h

margintime = 9m

rekeyfuzz = 100%

ike=aes256gcm16-sha384-modp2048

esp=aes256gcm16-sha384-modp2048

Route Config file

Click the **Choose File**, browse to and select the file and click **Update Route**. The Route Config file contains routing information to route packet to specific remote network using the IPsec tunnel created. The format of Route Config file contains following parameters:

<LEFT IP> <RIGHT IP> <REMOTE NETWORK> <SOURCE IP>

Secrets file

Click the **Choose File**, browse to and select the file and click **Update Secrets**. The Secrets file contains the remote and local endpoint address and the secrets to communicate with the remote endpoint. The format example of Secret file is:

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10.35.45.170 65.51.241.146 %any: PSK "fE31$I#%w&"

Show IPsec Status

You can display the connection status by clicking **IPSec Status**.

Show Logs

You can display the connection logs by clicking **Logs**.

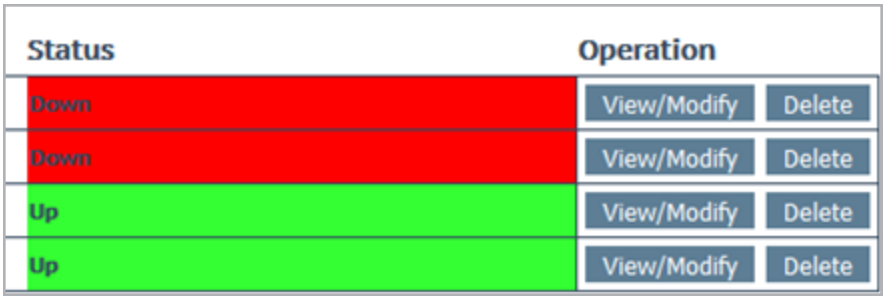
2.4 Configuring IPsec Tunneling in a HA Setup

When configuring IPsec tunneling in a HA setup, ideally HA should be configured first. For instructions on how to configure HA, refer to the High Availability (HA), Feature Description.

When HA is configured - to set up tunneling, follow the steps in the **Configure the Cloud Platform** and **Configure the LoadMaster** sections above. Ensure to configure IPsec tunneling on the master HA unit. If HA is configured, the **Local IP Address** will be automatically populated with the HA shared IP address. Also, the **Local ID** field will be automatically set to **%any**. This value cannot be updated when the LoadMaster is in HA mode.

> If the HA shared IP address is changed after the VPN tunnel connection has been established, the tunnel connection will break. Please ensure to update the **Local IP Address** if the shared IP address changes.

2.5 Delete the Connection



To delete a VPN connection, go to **System Configuration > Route Management > VPN Management** and click **Delete**. Then, click **OK** to the warning.

> All associated configuration will be permanently deleted.

A connection can be deleted at any time, even if it is running.

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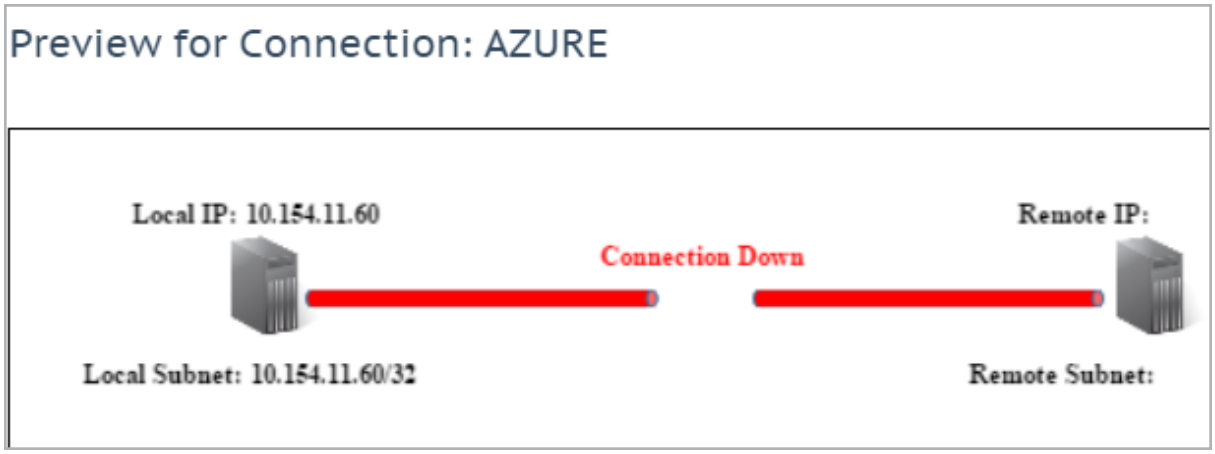
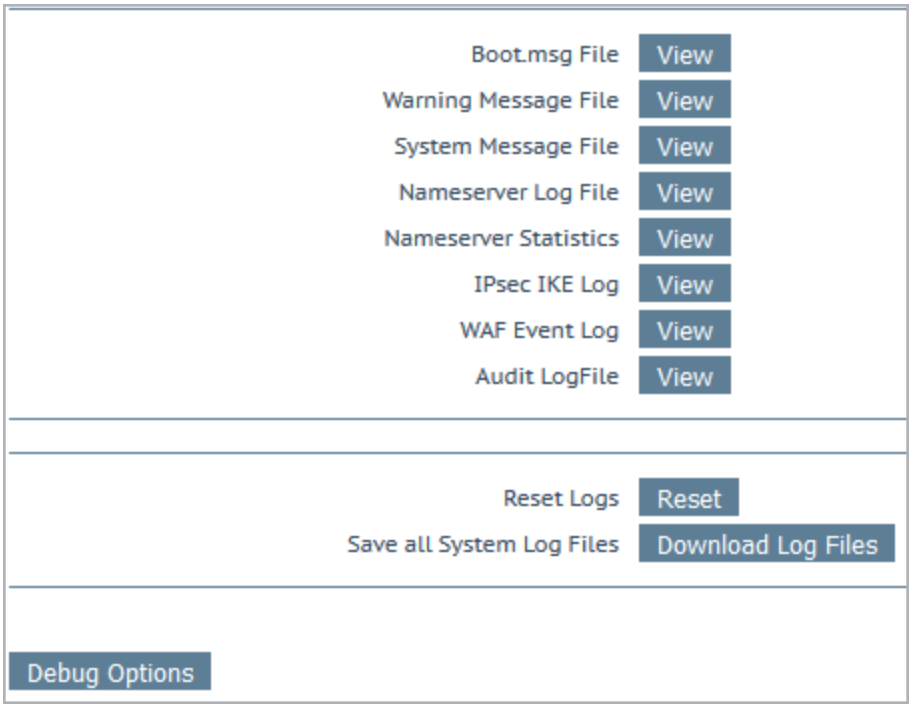
3 IPsec Debug Options



If the connection is down, the diagram on the **VPN Management** page will say **Connection Down** and the tunnel will be red.



To view the IPsec IKE Log, go to **Logging Options > System Log Files** and click **View** next to **IPsec IKE Log**.

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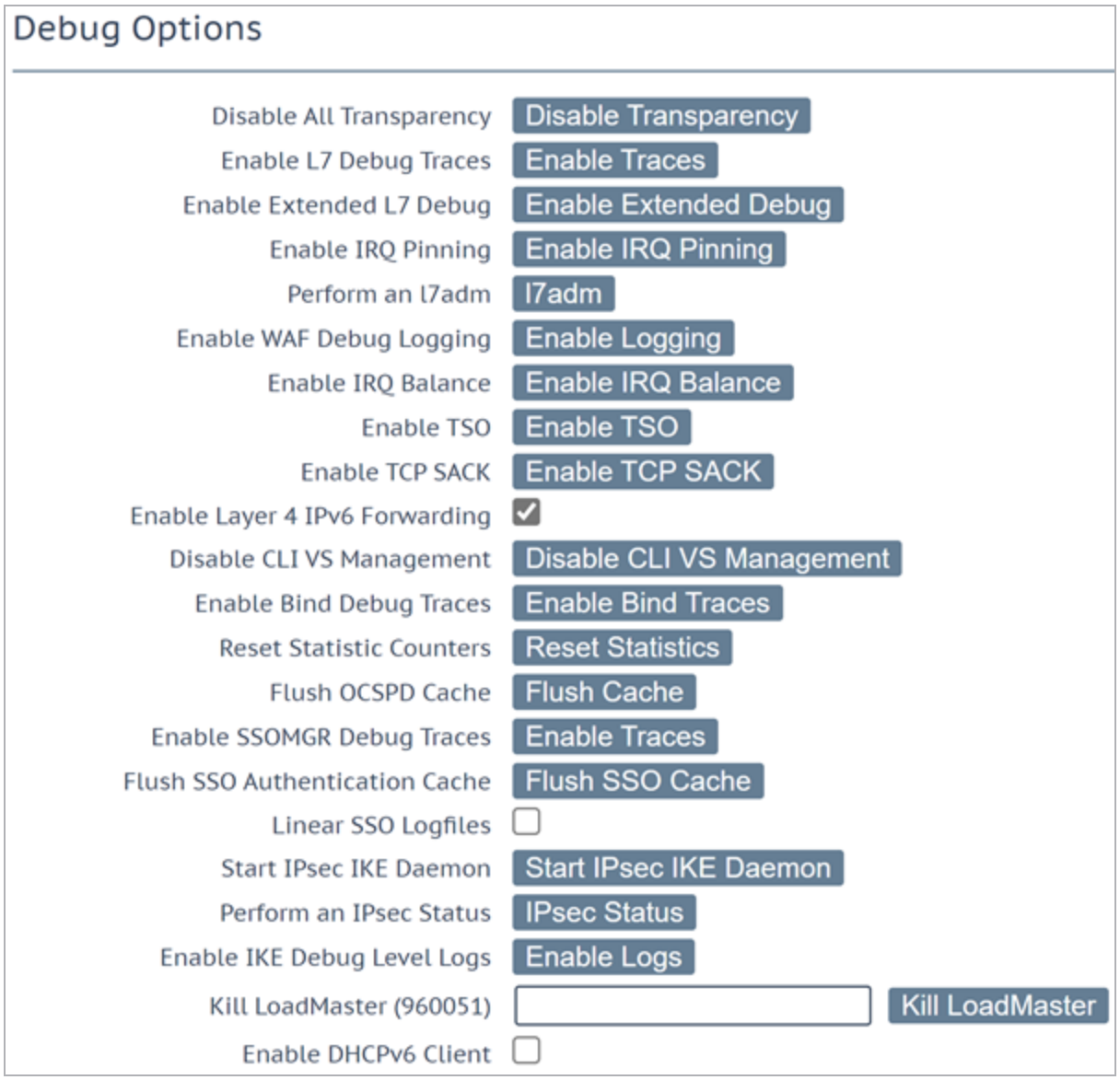

There are debug options that can help when troubleshooting problems with IPsec tunneling. To see these options, go to **System Configuration > Logging Options > System Log Files > Debug Options** in the main menu of the LoadMaster WUI.

Stop IPsec IKE Daemon

Stop the IPsec IKE daemon on the LoadMaster.

> If this button is clicked, the connection for all tunnels will go down.

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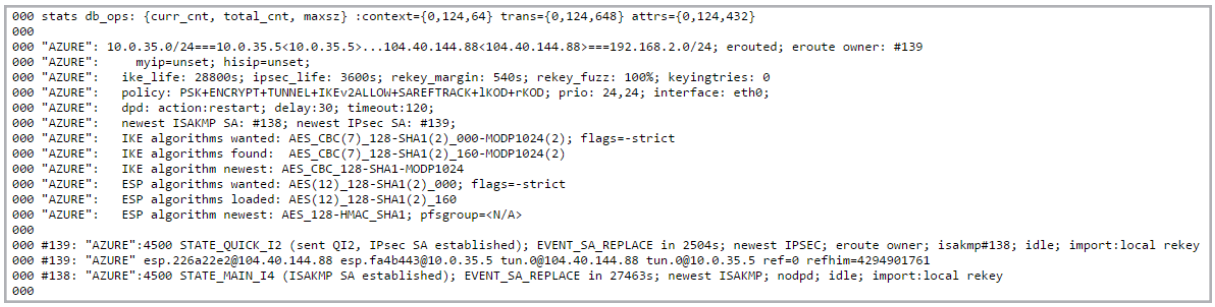
Perform an IPsec Status

Display the raw IPsec status output.



```
000 stats db_ops: {curr_cnt, total_cnt, maxsz} :context={0,124,64} trans={0,124,648} attrs={0,124,432}
000
000 "AZURE": 10.0.35.0/24===10.0.35.5<10.0.35.5>...104.40.144.88<104.40.144.88>===192.168.2.0/24; erouted; eroute owner: #139
000 "AZURE":     myip=unset; hisip=unset;
000 "AZURE":   ike_life: 28800s; ipsec_life: 3600s; rekey_margin: 540s; rekey_fuzz: 100%; keyingtries: 0
000 "AZURE":   policy: PSK+ENCRYPT+TUNNEL+IKEv2ALLOW+SAREFTRACK+lKOD+rKOD; prio: 24,24; interface: eth0;
000 "AZURE":   dpd: action:restart; delay:30; timeout:120;
000 "AZURE":   newest ISAKMP SA: #138; newest IPsec SA: #139;
000 "AZURE":   IKE algorithms wanted: AES_CBC(7)_128-SHA1(2)_000-MODP1024(2); flags=-strict
000 "AZURE":   IKE algorithms found:  AES_CBC(7)_128-SHA1(2)_160-MODP1024(2)
000 "AZURE":   IKE algorithm newest: AES_CBC_128-SHA1-MODP1024
000 "AZURE":   ESP algorithms wanted: AES(12)_128-SHA1(2)_000; flags=-strict
000 "AZURE":   ESP algorithms loaded: AES(12)_128-SHA1(2)_160
000 "AZURE":   ESP algorithm newest: AES_128-HMAC_SHA1; pfsgroup=<N/A>
000
000 #139: "AZURE":4500 STATE_QUICK_I2 (sent QI2, IPsec SA established); EVENT_SA_REPLACE in 2504s; newest IPSEC; eroute owner; isakmp#138; idle; import:local rekey
000 #139: "AZURE" esp.226a22e2@104.40.144.88 esp.fa4b443@10.0.35.5 tun.0@104.40.144.88 tun.0@10.0.35.5 ref=0 refhim=4294901761
000 #138: "AZURE":4500 STATE_MAIN_I4 (ISAKMP SA established); EVENT_SA_REPLACE in 27463s; newest ISAKMP; nodpd; idle; import:local rekey
000
```

Connection information for each tunnel in the output is prefixed with **“**<ConnectionName>**”** (for example **AZURE** in the screenshot above).

Enable IKE Debug Level Logs

Control the IPsec IKE log level. When this option is enabled, additional logs will be shown in the **IPsec IKE Log** and the **IPsec Status**.

> This debug option can be useful when setting up the connection initially. However, please use extreme caution if enabling this option - enabling this option will restart the daemon which will drop any connections and reestablish them.

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References

Some useful links containing further information are provided below:

High Availability (HA), Feature Description

http://kemptechnologies.com/documentation/

Microsoft - Virtual Network Address Spaces page

http://msdn.microsoft.com/en-us/library/azure/09926218-92ab-4f43-aa99-83ab4d355555 **- Virtual Network Address Spaces page section**

Microsoft - Configure a Virtual Network Gateway in the Management Portal
http://msdn.microsoft.com/en-us/library/azure/jj156210.aspx

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