

GCP Transit VPC

VPC Peering & Internal Load Balancer as Next Hop

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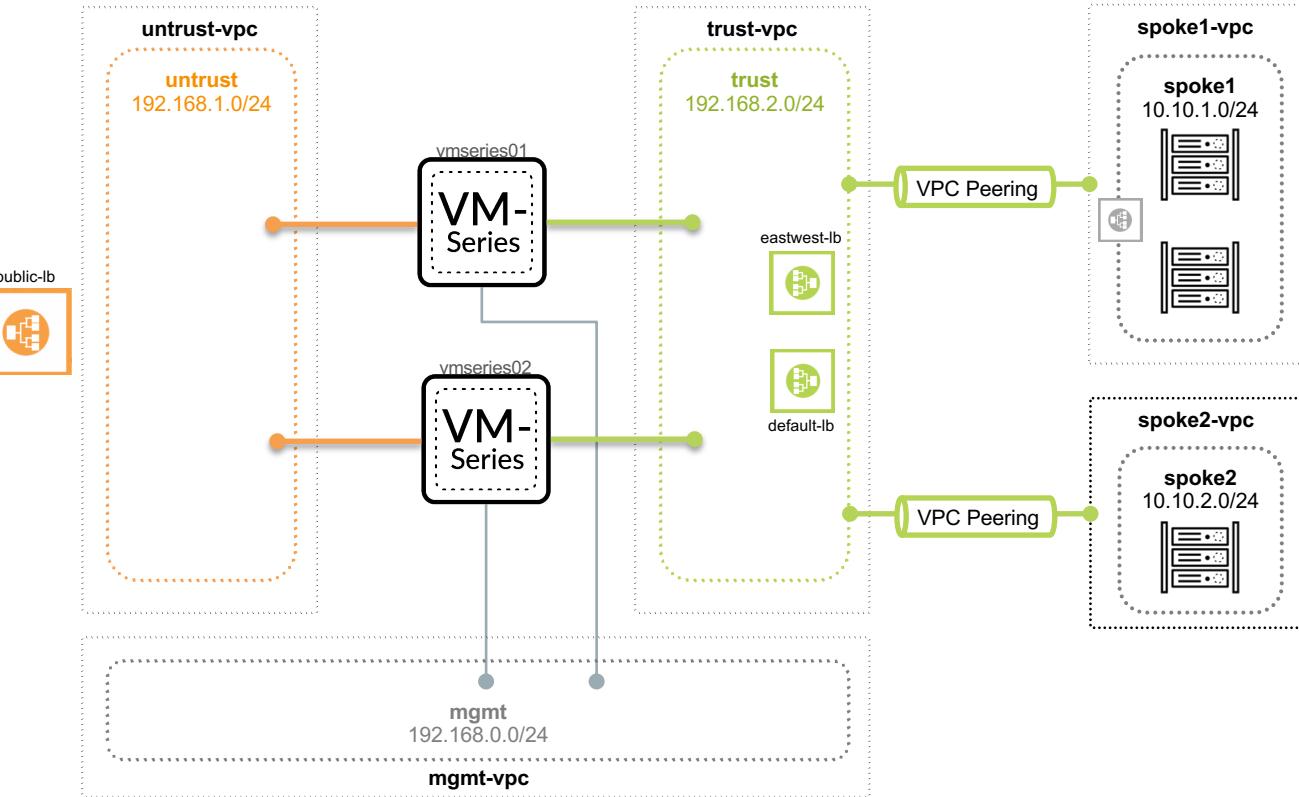


SUPPORT POLICY

This is released under an as-is, best effort, support policy. These scripts should be seen as community supported and Palo Alto Networks will contribute our expertise as and when possible. We do not provide technical support or help in using or troubleshooting the components of the project through our normal support options such as Palo Alto Networks support teams, or ASC (Authorized Support Centers) partners and backline support options. The underlying product used (the VM-Series firewall) by the scripts or templates are still supported, but the support is only for the product functionality and not for help in deploying or using the template or script itself. Unless explicitly tagged, all projects or work posted in our GitHub repository (at <https://github.com/PaloAltoNetworks>) or sites other than our official Downloads page on <https://support.paloaltonetworks.com> are provided under the best effort policy.

OVERVIEW

- 2 x VM-Series deployed between public & internal load balancers to secure inbound, outbound, and east-west traffic between two spoke VPCs.
- The spoke VPCs connect to the trust VPC via VPC peering.
- Spoke1 contains 2 x Web VMs with an internal load balancer.
- Spoke2 contains 1 x Ubuntu VM.
- Outbound and East-West traffic flows over the peer link to internal load balancers in the trust VPC.



PART 1

SETUP PROJECT

& BUILD ENVIRONMENT

STEP 1. CREATE A PROJECT

1. Log into GCP console & create a project
2. Record project ID before proceeding

The screenshot shows the Google Cloud Platform homepage. The top navigation bar has a blue header with the text "Google Cloud Platform". Below it, there's a dropdown menu labeled "My First Project" with a downward arrow. A red box highlights this dropdown. A modal window titled "Select a project" is overlaid on the page. It contains a search bar with the placeholder "Search projects and folders" and a "NEW PROJECT" button with a gear icon. The "NEW PROJECT" button is also highlighted with a red arrow. On the left side of the screen, there's a sidebar with various icons and links: Home, Marketplace, Billing, APIs & Services, Support, IAM & Admin, and Getting Started. The "RECENT" tab is selected in the sidebar. A table lists recent projects: "My First Project" (ID: sonic-falcon-256618). The "My First Project" link in the main navigation bar is also highlighted with a red box.

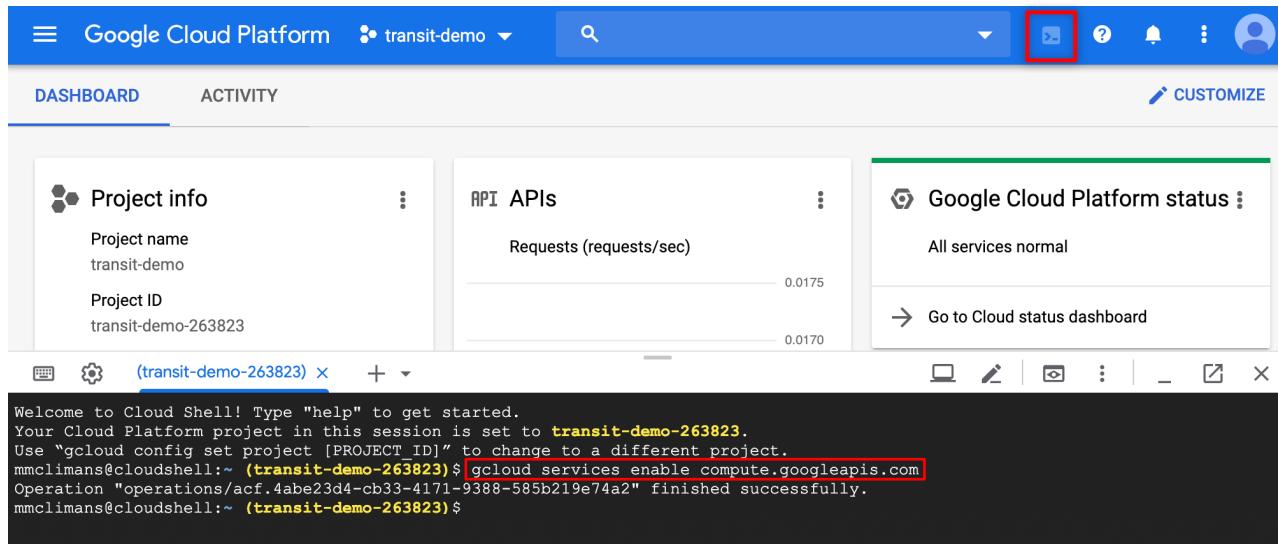
The screenshot shows the "New Project" dialog box. At the top, it says "Project name * transit-demo". Below that, it says "Project ID: transit-demo-263823. It cannot be changed later." with a blue "EDIT" link. Under "Location *", it says "No organization" with a "BROWSE" button. There's also a "Parent organization or folder" field. At the bottom are "CREATE" and "CANCEL" buttons. Red arrows point from the "Project ID" field and the "Location" field to the corresponding sections in the "Select a project" dialog on the left.

Record your Project ID

STEP 2. ENABLE COMPUTE ENGINE API

1. Inside your project, open a cloud shell terminal
2. Enable the Compute Engine API

```
$ gcloud services enable compute.googleapis.com
```



STEP 3. DOWNLOAD REPO

1. Create an SSH key to enable user authentication to the VMs (password protected key is optional)

```
$ ssh-keygen -f ~/.ssh/gcp-demo -t rsa -C demo
```

```
mmclimans@cloudshell:~ (transit-demo-263823)$  
mmclimans@cloudshell:~ (transit-demo-263823)$ ssh-keygen -f ~/.ssh/gcp-demo -t rsa -C demo  
Generating public/private rsa key pair.  
Enter passphrase (empty for no passphrase):  
Enter same passphrase again:  
Your identification has been saved in /home/mmclimans/.ssh/gcp-demo.  
Your public key has been saved in /home/mmclimans/.ssh/gcp-demo.pub. ←  
The key fingerprint is:  
SHA256:8FrpSUW3V2ZaP5umXAWLEI/EYZlnECwEjlibJEtYJjo demo  
The key's randomart image is:  
+---[RSA 2048]---+  
| .o= +o.oXB. . =|  
| ..+ * =.+==oo O.|  
|E o = ..oo+ +.o|  
| . o o . =|  
| S = |  
| = . . + |  
| . o o |  
| |  
+---[SHA256]---+  
mmclimans@cloudshell:~ (transit-demo-263823)$
```

Record the
public key's
full path

STEP 4. DOWNLOAD REPO

1. Clone the Github repo & change directories to adv_peering_2fw_2spoke_common/

```
$ git clone https://github.com/wwce/terraform; cd terraform/gcp/adv_peering_2fw_2spoke_common
```

```
mmclimans@cloudshell:~ (transit-demo-263823)$ git clone https://github.com/wwce/terraform; cd terraform/gcp/adv_peering_2fw_2spoke_common
Cloning into 'terraform'...
remote: Enumerating objects: 214, done.
remote: Counting objects: 100% (214/214), done.
remote: Compressing objects: 100% (138/138), done.
remote: Total 5184 (delta 153), reused 131 (delta 75), pack-reused 4970
Receiving objects: 100% (5184/5184), 32.77 MiB | 41.71 MiB/s, done.
Resolving deltas: 100% (3108/3108), done.
mmclimans@cloudshell:~/terraform/gcp/adv peering 2fw 2spoke common (transit-demo-263823)$
```

STEP 5. UPDATE TERRAFORM.TFVARS

1. Open the terraform.tfvars file

```
$ nano terraform.tfvars
```

2. Uncomment (delete # at line start) & set values for **project_id**, **public_key_path**, & **fw_panos**

```
GNU nano 2.7.4                                File: terraform.tfvars                                Modified

project_id      = "transit-demo-263823"    ← Project ID from Step 1
public_key_path = "~/.ssh/gcp-demo.pub"   ← SSH public key path from Step 3

#fw_panos      = "byol-904"
fw_panos        = "bundle1-904"           ← Uncomment only 1 line for VM-Series license option
#fw_panos      = "bundle2-904"

#---
```

3. Save file and exit: `ctrl-x` → `y` → `enter`



BYOL LICENSES ONLY

To license the firewall's during deployment perform the following. You can also manually license later.

1. Ensure authcode is registered with the Palo Alto Networks support site.
2. Open bootstrap_files/authcodes & enter your authcode.

```
$ nano bootstrap_files/authcodes
```



GNU nano 2.7.4 File: bootstrap_files/authcodes Modified

I01234AH ← Your authcode

^G Get Help ^O Write Out ^W Where Is ^L Cut Text ^J Justify ^C Cur Pos ^Y Prev Page
^X Exit ^R Read File ^V Replace ^U Uncut Text ^T To Spell ^_ Go To Line ^V Next Page

3. Save file and exit: `ctrl-x` → `y` → `enter`

STEP 6. DEPLOY BUILD

Initialize and apply the Terraform

```
$ terraform init
```

```
mmclimans@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)$ terraform init
Initializing modules...
```

```
Terraform has been successfully initialized!
```

```
You may now begin working with Terraform. Try running "terraform plan" to see
any changes that are required for your infrastructure. All Terraform commands
should now work.
```

```
If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
```

```
mmclimans@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)
```

```
$ terraform apply
```

```
mmclimans@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)$ terraform apply
data.google_compute_zones.available: Refreshing state...
```

```
Plan: 50 to add, 0 to change, 0 to destroy.
```

```
Do you want to perform these actions?
```

```
Terraform will perform the actions described above.
Only 'yes' will be accepted to approve.
```

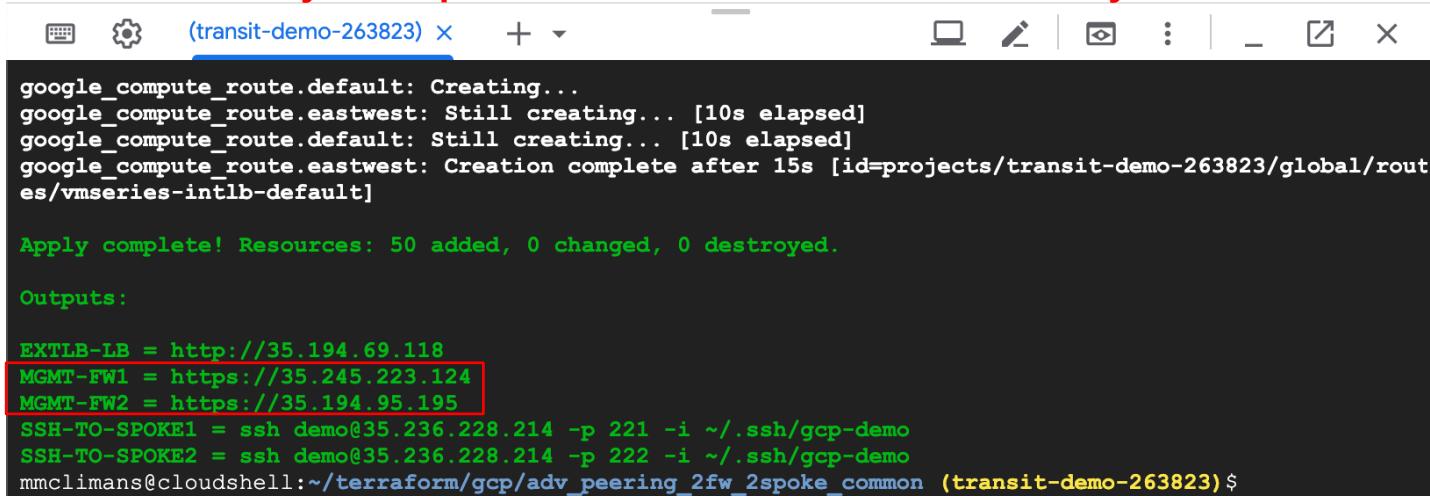
```
Enter a value: yes ← Enter yes to confirm
```



STEP 7. BUILD OUTPUT

- Once the build completes, the following output will be displayed
- Log into each firewall by pasting the **MGMT-FW1** & **MGMT-FW2** outputs into a web-browser.
 - UN:** paloalto
 - PW:** Pal0Alt0@123

It may take up to 15 minutes for the firewalls to fully boot.



```
google_compute_route.default: Creating...
google_compute_route.eastwest: Still creating... [10s elapsed]
google_compute_route.default: Still creating... [10s elapsed]
google_compute_route.eastwest: Creation complete after 15s [id=projects/transit-demo-263823/global/routes/vmseries-intlb-default]

Apply complete! Resources: 50 added, 0 changed, 0 destroyed.

Outputs:

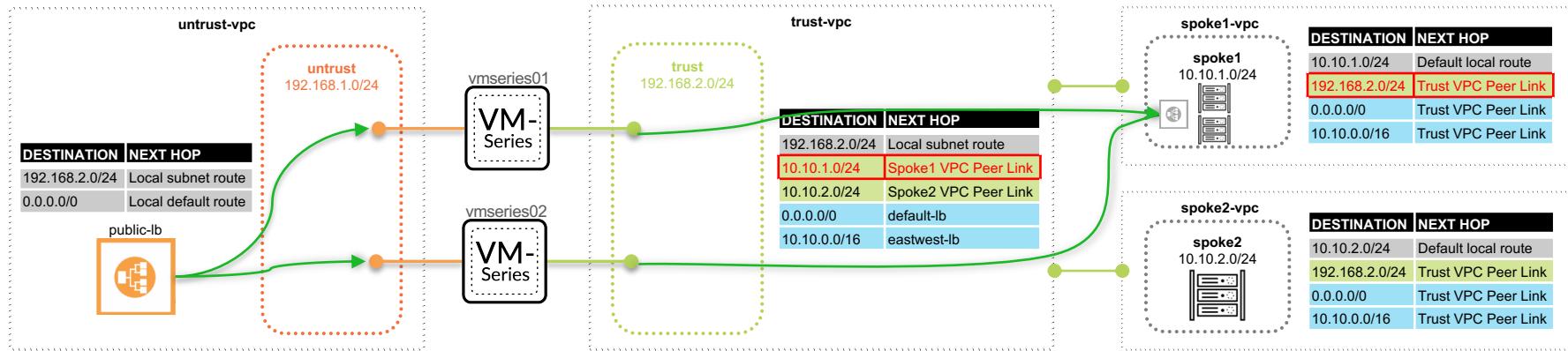
EXTLB-LB = http://35.194.69.118
MGMT-FW1 = https://35.245.223.124
MGMT-FW2 = https://35.194.95.195
SSH-TO-SPOKE1 = ssh demo@35.236.228.214 -p 221 -i ~/.ssh/gcp-demo
SSH-TO-SPOKE2 = ssh demo@35.236.228.214 -p 222 -i ~/.ssh/gcp-demo
mmclimans@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)$
```



PART 2

TEST ENVIRONMENT

INBOUND FLOW



1. A request from the internet hits the public-lb's frontend.
2. The LB forwards the traffic to the firewall's untrust NICs.
3. The firewall's inspect and perform SNAT to trust interface and DNAT to spoke1's internal LB (**10.10.1.100**).
4. When the traffic leaves the trust interface, the spoke1-vpc peering route is taken.
5. The response back from spoke1 uses the trust-vpc peer route.

TEST INBOUND FLOW

1. Copy the **GLB-ADDR** output into a web browser.
2. Observe inbound load balancing by refreshing the page. The value of **LOCAL IP** and **VM NAME** will change between the web VMs in spoke1.

```
(transit-demo-263823) x + - x
google_compute_route.default: Creating...
google_compute_route.eastwest: Still creating... [10s elapsed]
google_compute_route.default: Still creating... [10s elapsed]
google_compute_route.eastwest: Creation complete after 15s [id=projects/transit-demo-263823/global/routes/vmseries-intlb-default]

Apply complete! Resources: 50 added, 0 changed, 0 destroyed.

Outputs:
EXTLB-LB = http://35.194.69.118
MGMT-FW1 = https://35.245.223.124
MGMT-FW2 = https://35.194.05.195
SSH-TO-SPOKE1 = ssh demo@35.236.228.214 -p 221 -i ~/.ssh/gcp-demo
SSH-TO-SPOKE2 = ssh demo@35.236.228.214 -p 222 -i ~/.ssh/gcp-demo
mmcliams@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)$
```

35.194.69.118

http://35.194.69.118

SOURCE & DESTINATION ADDRESSES

INTERVAL: 0.00019192695617676

SOURCE IP: 192.168.2.3

LOCAL IP: 10.10.1.2

VM NAME: spoke1-vm1

HEADER INFORMATION

HTTP_HOST: 35.194.69.118

HTTP_CONNECTION: keep-alive

HTTP_CACHE_CONTROL: max-age=0

HTTP_UPGRADE_INSECURE_REQUESTS: 1

spoke1-vm1

35.194.69.118

http://35.194.69.118

SOURCE & DESTINATION ADDRESSES

INTERVAL: 0.0001990795135498

SOURCE IP: 192.168.2.3

LOCAL IP: 10.10.1.3

VM NAME: spoke1-vm2

HEADER INFORMATION

HTTP_HOST: 35.194.69.118

HTTP_CONNECTION: keep-alive

HTTP_CACHE_CONTROL: max-age=0

HTTP_UPGRADE_INSECURE_REQUESTS: 1

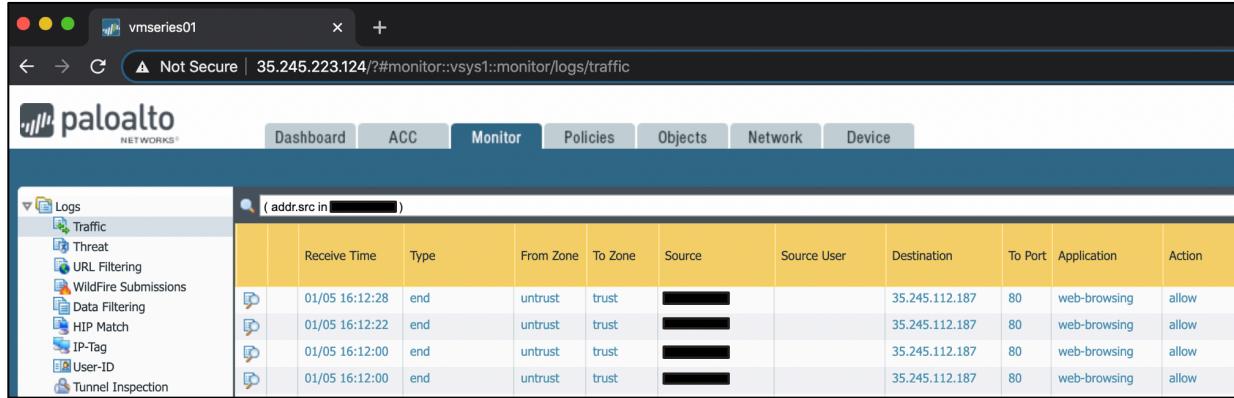
spoke1-vm2



VIEW INBOUND TRAFFIC LOGS

- View the inbound traffic on both firewalls (Monitor → Traffic)

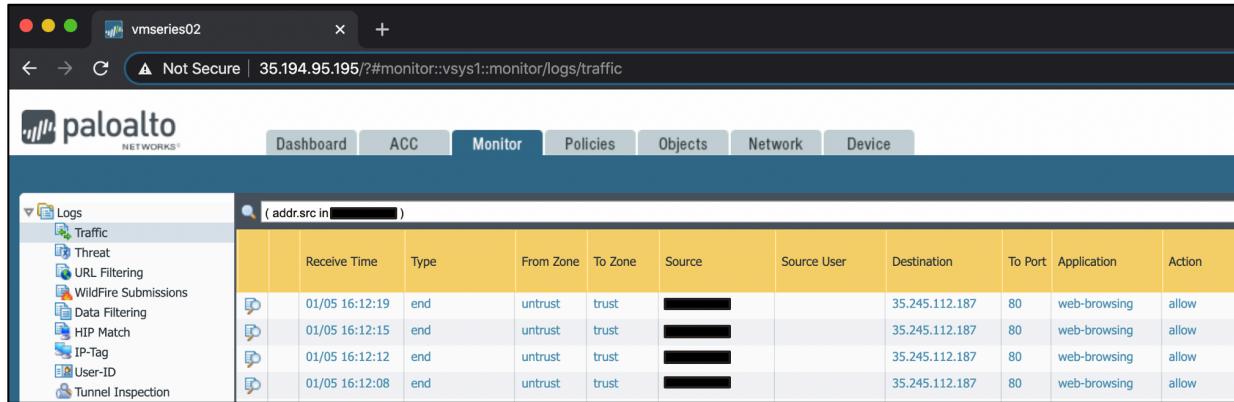
vmseries01



A screenshot of the Palo Alto Networks VM Series 01 web interface. The title bar shows "vmseries01" and the URL "Not Secure | 35.245.223.124/?#monitor::vsys1::monitor/logs/traffic". The navigation bar includes Dashboard, ACC, Monitor (which is selected), Policies, Objects, Network, and Device. On the left, a sidebar under "Logs" shows icons for Traffic, Threat, URL Filtering, WildFire Submissions, Data Filtering, HIP Match, IP-Tag, User-ID, and Tunnel Inspection. The main pane displays a table of traffic logs with the following columns: Receive Time, Type, From Zone, To Zone, Source, Source User, Destination, To Port, Application, and Action. The table contains four rows of log entries.

Receive Time	Type	From Zone	To Zone	Source	Source User	Destination	To Port	Application	Action
01/05 16:12:28	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow
01/05 16:12:22	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow
01/05 16:12:00	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow
01/05 16:12:00	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow

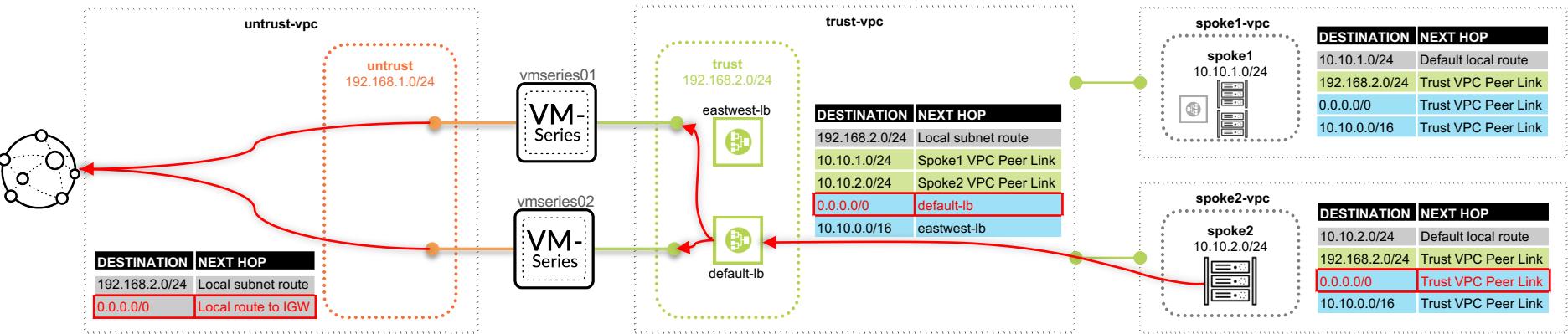
vmseries02



A screenshot of the Palo Alto Networks VM Series 02 web interface. The title bar shows "vmseries02" and the URL "Not Secure | 35.194.95.195/?#monitor::vsys1::monitor/logs/traffic". The navigation bar includes Dashboard, ACC, Monitor (selected), Policies, Objects, Network, and Device. On the left, a sidebar under "Logs" shows icons for Traffic, Threat, URL Filtering, WildFire Submissions, Data Filtering, HIP Match, IP-Tag, User-ID, and Tunnel Inspection. The main pane displays a table of traffic logs with the following columns: Receive Time, Type, From Zone, To Zone, Source, Source User, Destination, To Port, Application, and Action. The table contains four rows of log entries.

Receive Time	Type	From Zone	To Zone	Source	Source User	Destination	To Port	Application	Action
01/05 16:12:19	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow
01/05 16:12:15	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow
01/05 16:12:12	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow
01/05 16:12:08	end	untrust	trust	[REDACTED]		35.245.112.187	80	web-browsing	allow

OUTBOUND FLOW



6. The firewall inspects and SNATs the traffic to the untrust interface.
7. When traffic leaves the untrust interface, it uses the untrust-vpc's default route to its internet gateway.

4. Traffic destined for internet from Spoke2 uses the custom static route to the default-lb.
5. The default-lb sends all TCP/UDP to the FW's trust interfaces (active/active)

1. Spoke2 VM (**10.10.2.4**) makes a request to internet.
2. Spoke2 uses route imported from the trust-vpc's route table.
3. The route's next-hop is to the trust-vpc's peering link.

TEST OUTBOUND FLOW

1. Log into spoke2-vm. Copy the **SSH-TO-SPOKE2** output and paste it into your terminal
2. From the spoke2-vm, test outbound connectivity:

```
$ sudo apt-get update
```

3. View the outbound traffic on both firewalls
(Monitor → Traffic)

```
Apply complete! Resources: 50 added, 0 changed, 0 destroyed.
```

Outputs:

```
EXTLB-LB = http://35.194.69.118
MGMT-FW1 = https://35.245.223.124
MGMT-FW2 = https://35.194.95.195
SSH-TO-SPOKE1 = ssh demo@35.236.228.214 -p 221 -i ~/ssh/gcp-demo
SSH-TO-SPOKE2 = ssh demo@35.236.228.214 -p 222 -i ~/.ssh/gcp-demo
```

```
(transit-demo-263823)$ ssh demo@35.236.228.214 -p 222 -i ~/.ssh/gcp-demo
```

The programs included with the Ubuntu system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.

```
demo@spoke2-vm1:~$ sudo apt-get update
```

vmseries01

This screenshot shows the Palo Alto Networks VM-Series 01 traffic log interface. The monitor tab is selected. A search filter '(zone.src eq trust) and (zone.dst eq untrust)' is applied. The table displays five rows of traffic logs:

	Receive Time	Type	From Zone	To Zone	Source	Source User	Destination	To Port	Application	Action
1	01/01 16:42:02	end	trust	untrust	10.10.2.2		91.189.88.24	80	apt-get	allow
2	01/01 16:40:58	end	trust	untrust	10.10.2.2		91.189.95.15	443	ssl	allow
3	01/01 16:32:21	end	trust	untrust	10.10.1.3		151.101.0.133	443	ssl	allow
4	01/01 16:32:19	end	trust	untrust	10.10.1.2		151.101.0.133	443	ssl	allow

vmseries02

This screenshot shows the Palo Alto Networks VM-Series 02 traffic log interface. The monitor tab is selected. A search filter '(zone.src eq trust) and (zone.dst eq untrust)' is applied. The table displays five rows of traffic logs:

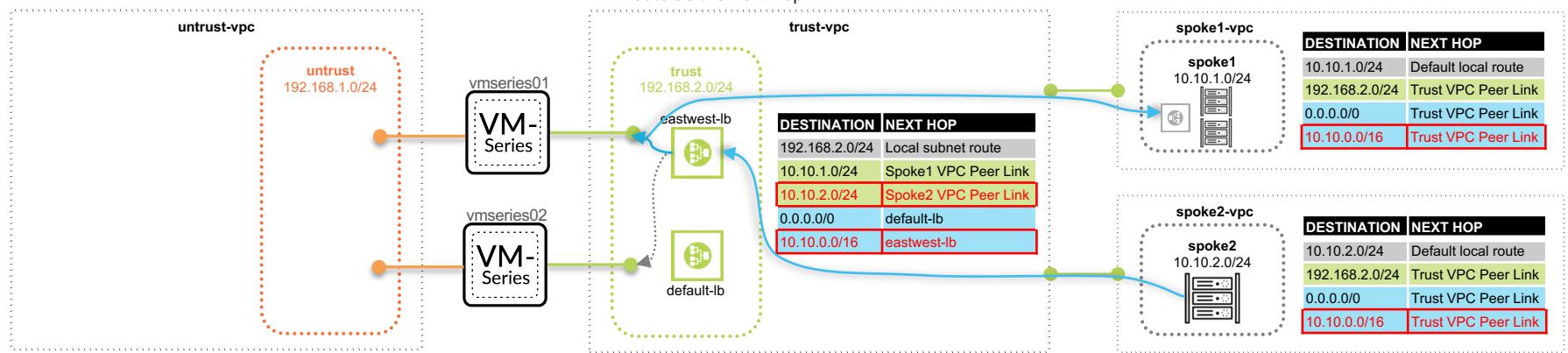
	Receive Time	Type	From Zone	To Zone	Source	Source User	Destination	To Port	Application	Action
1	01/01 16:42:02	end	trust	untrust	10.10.2.2		91.189.92.150	80	apt-get	allow
2	01/01 16:42:02	end	trust	untrust	10.10.2.2		91.189.91.14	80	apt-get	allow
3	01/01 16:32:13	end	trust	untrust	10.10.1.3		91.189.88.31	80	apt-get	allow
4	01/01 16:32:11	end	trust	untrust	10.10.1.2		91.189.88.162	80	apt-get	allow



EAST-WEST FLOW

7. vmseries01 inspects and sends the traffic back out its trust NIC

8. The traffic then uses spoke1-vpc's peering link route as the next hop



4. When traffic arrives in the trust-vpc, the custom route to **10.10.0.0/16** to **eastwest-lb** is taken

5. The eastwest-lb sends all TCP/UDP to vmseries01

Note: The use of active/passive backends avoids SNAT for east/west traffic. The LB uses vmseries02 as a failover device (F/O determined by LB health-check).

1. Spoke2 VM (**10.10.2.4**) makes a request to internal LB in spoke1 (**10.10.1.100**)
2. Spoke2 uses the imported route from the trust-vpc's route table to **10.10.0.0/16**
3. The route's next-hop is to the trust-vpc peering link.

TEST EAST-WEST FLOW

1. Stay inside spoke2-vm1 (**10.10.2.4**)
2. Run a curl command to the web server's internal load balancer in spoke1 (**10.10.1.100**)

```
$ curl http://10.10.1.100/?[1-1000]
```

```
demo@spoke2-vm1:~$ curl http://10.10.1.100/?[1-1000]
```

3. View the east-west traffic on **vmseries01 only** (Monitor → Traffic)

The screenshot shows the Palo Alto Networks VM-Series 01 interface. The browser tab is titled "vmseries01". The URL is "Not Secure | 35.245.223.124/?#monitor::vsys1::monitor/logs/traffic". The navigation bar includes Dashboard, ACC, Monitor (which is selected), Policies, Objects, Network, and Device. On the left, a sidebar under "Logs" has "Traffic" selected, along with other options like Threat, URL Filtering, WildFire Submissions, Data Filtering, HIP Match, IP-Tag, User-ID, and Tunnel Inspection. The main pane displays a table of traffic logs. The table has columns: Receive Time, Type, From Zone, To Zone, Source, Source User, Destination, To Port, Application, and Action. There are four rows of data:

	Receive Time	Type	From Zone	To Zone	Source	Source User	Destination	To Port	Application	Action
1	01/01 16:46:51	end	trust	trust	10.10.2.2		10.10.1.100	80	web-browsing	allow
2	01/01 16:46:51	end	trust	trust	10.10.2.2		10.10.1.100	80	web-browsing	allow
3	01/01 16:46:51	end	trust	trust	10.10.2.2		10.10.1.100	80	web-browsing	allow
4	01/01 16:46:51	end	trust	trust	10.10.2.2		10.10.1.100	80	web-browsing	allow





DESTROY
ENVIRONMENT

DESTROY BUILD

Perform the following to destroy the deployment.

1. Verify you are in the adv_peering_4fw_2spoke directory and run the following. Enter yes to confirm.

```
$ terraform destroy
```

```
mmclimans@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)$  
mmclimans@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)$ terraform destroy  
Plan: 0 to add, 0 to change, 50 to destroy.  
  
Do you really want to destroy all resources?  
Terraform will destroy all your managed infrastructure, as shown above.  
There is no undo. Only 'yes' will be accepted to confirm.  
  
Enter a value: yes
```

2. Once the destroy is complete, you will receive the following output:

```
module.vpc_untrust.google_compute_network.default: Destruction complete after 15s  
module.vpc_mgmt.google_compute_network.default: Destruction complete after 15s  
module.vpc_trust.google_compute_network.default: Still destroying... [id=projects/transit-demo-263823/global/networks/trust-vpc, 20s elapsed]  
module.vpc_trust.google_compute_network.default: Destruction complete after 26s  
  
Destroy complete! Resources: 50 destroyed.  
mmclimans@cloudshell:~/terraform/gcp/adv_peering_2fw_2spoke_common (transit-demo-263823)$
```



DEPLOYMENT CHEAT SHEET

Part 1: Setup Project

```
$ gcloud services enable compute.googleapis.com  
$ ssh-keygen -f ~/.ssh/gcp-demo -t rsa -C demo  
$ git clone https://github.com/wwce/terraform; cd terraform/gcp/adv_peering_2fw_2spoke_common
```

Part 2: Run Build

Edit `terraform.tfvars` to match **project ID**, **SSH key**, and **PAN-OS license**.

```
$ terraform init  
$ terraform apply
```

Part 3: Destroy Build

```
$ terraform destroy  
$ rm ~/.ssh/gcp-demo*
```

