Transit VNet with the VM-Series .1

Deployment Guide

How to deploy a Transit VNet solution in Azure

http://www.paloaltonetworks.com

Last Update: June 2018

Table of Contents

Version History

Version number	Comments
0.1	Panorama is required for this deployment. Adds Bootstrapping to the Hub, Spoke and Autoscaling to the Spoke.

1. About

This document will guideline how to deploy a Transit VNet solution on Azure with the VM-Series. The Transit VNet uses a hub and spoke architecture to centralize commonly used services such as security and connectivity. For more details about the advantages of the hub and spoke topology please refer to this link:

https://docs.microsoft.com/en-us/azure/architecture/reference-architectures/hybrid-networking/hub-spoke

Note: The Transit VNet with the VM-Series solution is considered advanced. It requires familiarity with Azure and the VM-Series next generation firewall. This deployment has NOT been tested in Government.

The deployment guide walks through the Palo Alto Networks ARM Templates to deploy a Transit VNet solution with the VM-Series firewalls in conjunction with, Application Gateways, Standard Load Balancers, Basic Load Balancers, and User Defined Route Tables. Version .1 now includes support for Virtual Machine Scale Sets and native bootstrapping. You will need to follow the instructions in the VM-Series deployment guide on how to bootstrap in Azure Cloud.

Bootstrap the VM-Series Firewall on Azure
https://www.paloaltonetworks.com/documentation/81/virtualization/virtualization/bootstrap-the-vm-series-firewall/bootstrap-the-vm-series-firewall-in-azure#idd51f75b8-e579-44d6-a809-2fafcfe4b3b6

Transit VNet .1 requires a previously deployed, physical or virtual Panorama. Panorama will be used for the spoke deployment to manage the VM-Series firewalls in the Virtual Machine Scale Set. Panorama will also be used for license deactivation, as well as logging and reporting. For more information on Panorama please see the Panorama admin guide. **See Prerequisites.**

Panorama Administration Guide
https://www.paloaltonetworks.com/documentation/81/panorama

The Transit VNet provides centralized secured outbound internet access and connectivity for all your Azure VNets. This secured outbound internet access is provided by two VM-Series firewall pairs positioned behind an Azure Standard any port load balancer in the Hub VNet. All outbound traffic originating from your Azure VNets will be provided with a secure single point of exit from your cloud architecture by way of the Hub VNet. User Define Routes are used to route spoke traffic to the Hub internal load balancer for packet forwarding to the Hub VM-Series Firewalls. Traffic flowing through the VM-Series is protected from inbound threats, outbound command-and-control and data exfiltration security becomes complex and cumbersome, oftentimes slowing deployments.

2. Topology

The Transit VNet solution deploys a classic hub-and-spoke architecture where the Hub and each spoke are deployed in separate VNets.

VNet Peering

For the different VNets to talk to each other, they must be peered in both the directions. VNet Peering works under the assumption that the peering networks **do not have overlapping subnets.** In this topology, when a VNet spoke is deployed, we will dynamically peer the spoke's VNet and the hub's VNet enabling traffic to flow between them. For additional information on VNet Peering please reference the link below

https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-peering-overview

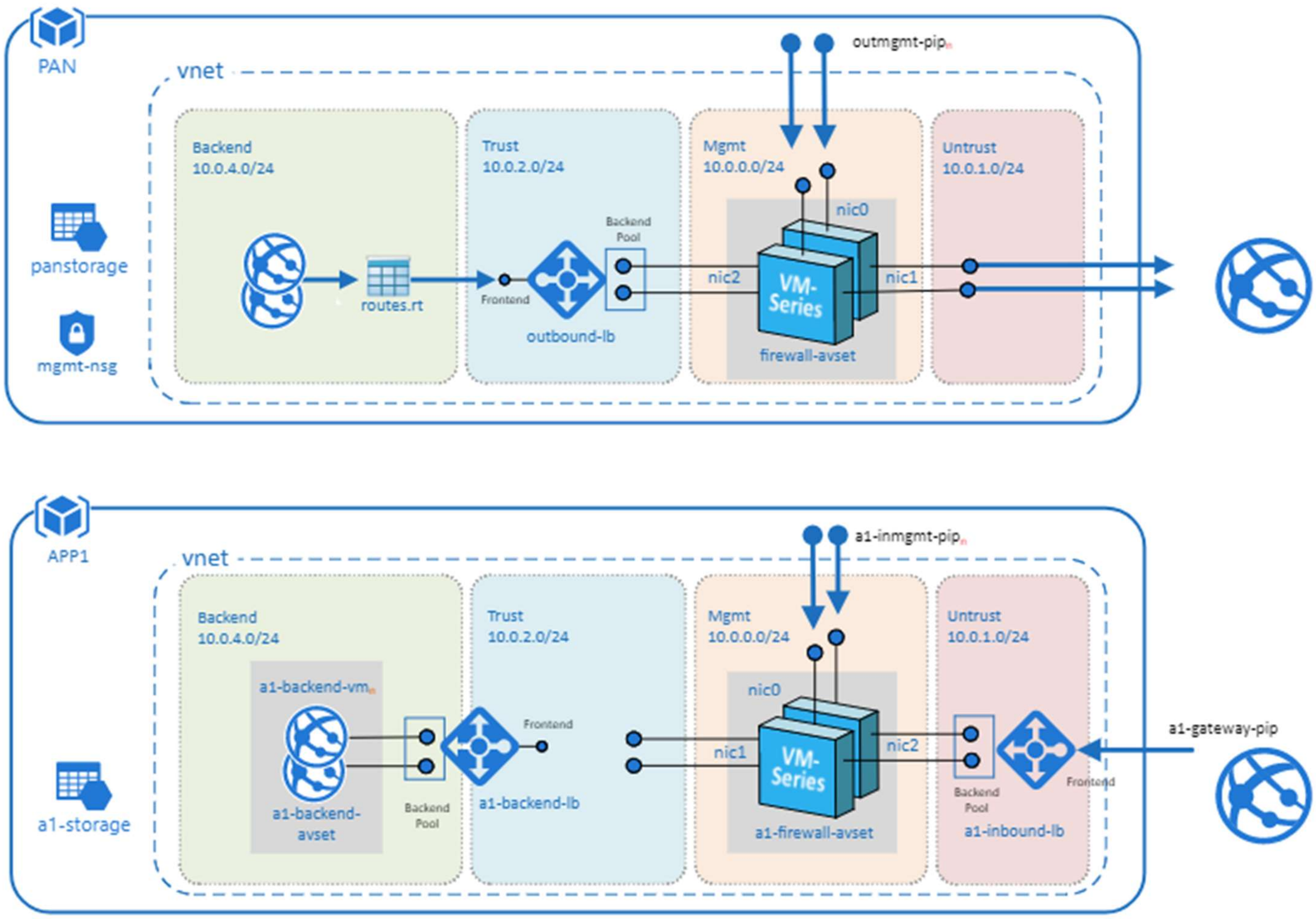


Figure 1

Hub Topology

In Figure 1 **PAN** represents the Hub VNet. The Hub VNet consists of Mgmt , Untrust and Trust subnets. An Azure internal LB[Outbound-LB] used for outbound traffic and a pair of VM-Series FWs in an availability set. The Hub topology serves as the exit point of all non-return traffic for the Hub and Spoke topology.

The Hub topology consists of

- 2 VM-Series Firewalls
- 1 Standard internal Load Balancer
- Linux Worker Node
    - Worker node uses the Tabular storage table to keep track of the Azure VMSS table and Panorama device list. During a scale down event the worker node will deactivate the license in the Support Portal and remove the firewall from Panorama.
    - The worker node updates the NAT address object in the Spoke VM-series with the correct IP address of the spoke ILB.
    - The worker node will add the Azure instrumentation key for application insights into the Panorama template for reach new spoke deployment.
- 1 Tabular Storage Table
    - Stores VMSS device list data

Spoke Topology

In Figure 1 **APP1** represents the Spoke VNet. The spoke VNet allows an ingress point for all traffic destined to public facing resources. The subnets consist of Mgmt, Untrust, Trust and Backend Subnets for the application servers. An Application Gateway doubles as a public facing load balancer and sits on the front end. VM-Series firewalls in a Virtual Machine Scale Set receive traffic from the public facing LB. An Internal LB sits behind the firewalls and sends traffic to the backend application servers. All return traffic egresses this same path. When a spoke subscribes to a hub, a UDR is also defined which has a default route to the Hub's Interal Load Balancer. This is so all packets that are not destined to the spoke's VNet gets forwarded to the Hub Internal LB for routing.

The Spoke topology consists of

- 1 Application Gateway functioning as an external load balancer listening on port 80.
- Spoke subnets are 192.168.0.0/21 Spoke1, 192.168.8.0/21 Spoke2 and so on.
- Virtual Machine Scale Set with a VM-Series
- Availability Set for VM-Series
- 1 Internal Load Balancer
- 2 Linux Web servers
- 1 UDR sending all default route traffic to the Hub VNet Standard Load Balancer.

- 1 Bastion host
    - Used to connect to VM-Series firewalls in the VMSS via private Mgmt interface IP
- Application insights
    - Used to process VM-Series metrics used to determine scale in & scale out events

Hub & Spoke Topology

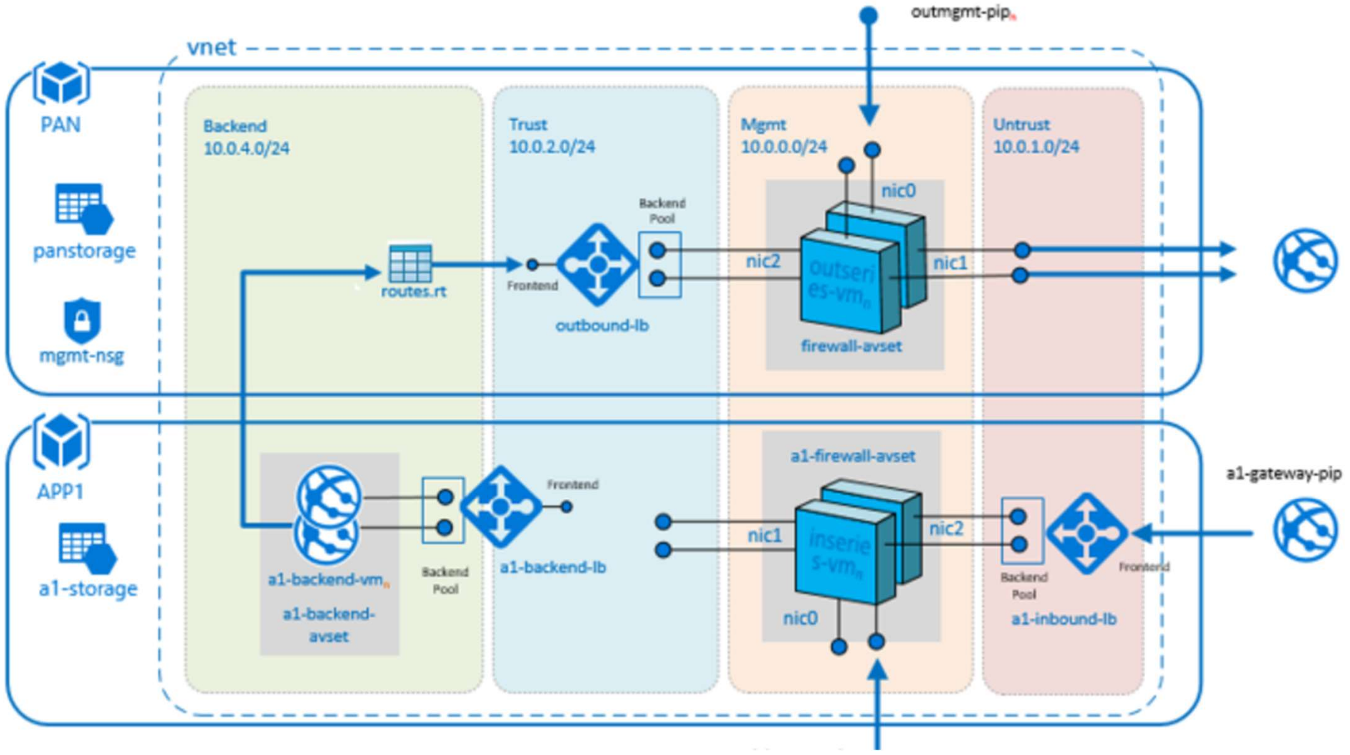


Figure 2

3. Support Policy

Community Supported

This solution is released under an as-is, best effort, support policy. These scripts should be 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.

4. Prerequisites

Here are the prerequisites required to successfully launch this template:

1. **Permissions**
   AZURE account with appropriate permissions.
2. **Download appropriate files**
   Clone or download the files from the following GitHub repository on to your local machine:
   https://github.com/PaloAltoNetworks/Azure-transit-VNet

3. **Valid License**
   Without a valid VM-Series Firewall license you will not see any data in the traffic logs. If you don't have a license provided by Palo Alto Networks, please select **bundle1** or **bundle2** in the template parameters for licensing. For more information on licensing please see the link below.
   https://www.paloaltonetworks.com/documentation/80/virtualization/virtualization/license-the-vm-series-firewall/license-typesvm-series-firewalls/vm-series-firewall-in-amazon-web-services-aws-and-azure-licenses

4. **Service Principal and Active Directory Application Setup**
   You will need to set up an Azure Active Directory application and service principal account. Follow the link below for details. Make note of your Subscription ID, Azure Application ID, Application Secret Key, and Tenant ID.
   https://docs.microsoft.com/en-us/azure/azure-resource-manager/resource-group-create-service-principal-portal#check-azure-subscription-permissions

   Retrieve Azure Tenant ID
   https://docs.microsoft.com/en-us/azure/active-directory/develop/active-directory-howto-tenant

5. **Bootstrap Storage Account**
   Storage accounts setup for bootstrapping in the spoke. Bootstrapping in the Hub is optional. Be sure to take the .xml configuration files from the Hub and spoke GitHub repo and change them to bootstrap.xml for bootstrapping. It is recommended to create a separate resource group for your bootstrap storage account. See bootstrap instructions below.

https://www.paloaltonetworks.com/documentation/81/virtualization/virtualization/bootstrap-the-vm-series-firewall/bootstrap-the-vm-series-firewall-in-azure#idd51f75b8-e579-44d6-a809-2fafcfe4b3b6

Creating the bootstrap package
https://www.paloaltonetworks.com/documentation/71/virtualization/virtualization/bootstrap-the-vm-series-firewall/prepare-the-bootstrap-package#_38054

6. Bootstrap init-cfg.txt for Spoke VM-Series

A sample init-cfg.txt is provided below with explanation –

```
type=dhcp-client
ip-address=
default-gateway=
netmask=
ipv6-address=
ipv6-default-gateway=
hostname=
vm-auth-key=PanoramaVmAuthKey
panorama-server=PanoramaIP
panorama-server-2=
tplname=<spoke_name> + ”-tmplstk”
dgname=<spoke_name> + ”-dg”
dns-primary=8.8.8.8
dns-secondary=208.67.222.222
op-command-modes=
dhcp-send-hostname=yes
dhcp-send-client-id=yes
dhcp-accept-server-hostname=yes
dhcp-accept-server-domain=yes
```

7. Panorama Setup

Panorama 8.1 is a requirement for Transit VNet .1 and is only used to manage VM-Series firewalls deployed in the spoke Virtual Machine Scale Set. You must allow access to port 3978 to the Mgmt interface of the Panorama for any device security the Panorama. Port 443 and SSH can be locked down to the IP you will manage your Panorama from.
https://www.paloaltonetworks.com/documentation/71/panorama/panorama_adminguide/set-up-panorama/set-up-the-panorama-virtual-appliance#55656

8. Panorama VM Auth Key

To authenticate the API, we need a Panorama API Key. The following link will walk you through generating an API Key.
https://www.paloaltonetworks.com/documentation/71/pan-os/xml-api/get-started-with-the-pan-os-xml-api/get-your-api-key

9. Enabling XML API access in Panorama

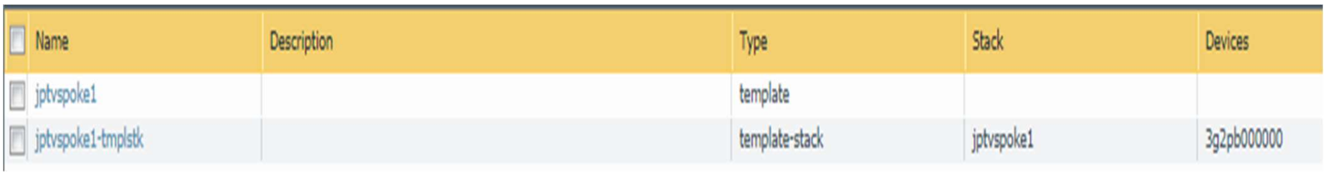
To program Panorama and deactivate VM Licenses, you need to enable XML API access in Panorama. As a best practice, create a new role with just API access to perform this. The steps to do this can be found here.
https://www.paloaltonetworks.com/documentation/71/pan-os/xml-api/get-started-with-the-pan-os-xml-api/enable-api-access

10. License Deactivation Key

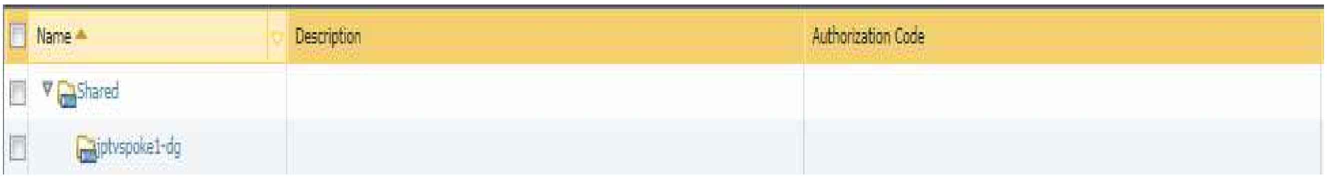
We require a License Deactivation API Key and the "Verify Update Server Identity" to be enabled to deactivate the license keys from Panorama. The License Deactivation Key should be obtained from Palo Alto Customer Support Portal. Steps on how to activate this can be found below.
https://www.paloaltonetworks.com/documentation/71/virtualization/virtualization/license-the-vm-series-firewall/install-a-license-deactivation-api-key

11. Panorama Template and Device Group Name

For every spoke that is launched, a corresponding Device Group, Template and Template Stack needs to be created in Panorama. Use the name of your Azure Spoke resource group to name your template and Device Group. For example, if the resource group of your spoke in Azure is named jptvspoke1, then name your device group jptvspoke1-dg and name your template stack jptvspoke1-tmplstk. The template should have all the configuration and added to the template stack.



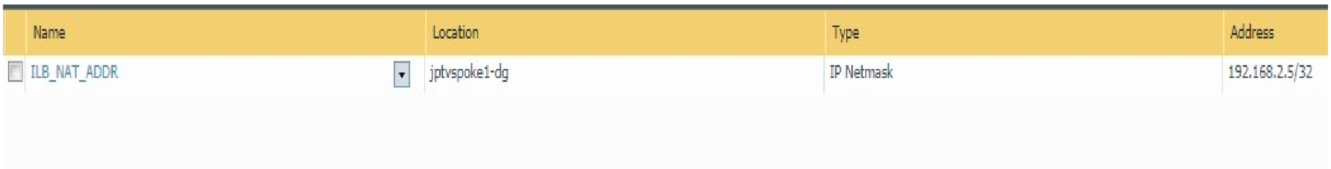
□	Name	Description	Type	Stack	Devices
□	jptvspoke1		template		
□	jptvspoke1-tmplstk		template-stack	jptvspoke1	3g2pb000000



□	Name ▲	Description	Authorization Code
□	▽ Shared		
□	jptvspoke1-dg		

12. Panorama Device Group NAT Object

The Device Group should also have an address object called **ILB_NAT_ADDR** created with a random IP address which will be re-programmed by the worker node monitoring script.



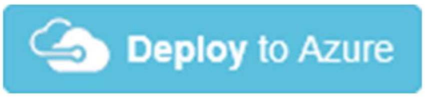
Name	Location	Type	Address
☐ ILB_NAT_ADDR	jptvspoke1-dg	IP Netmask	192.168.2.5/32

13. Panorama Template and Device Group Configuration

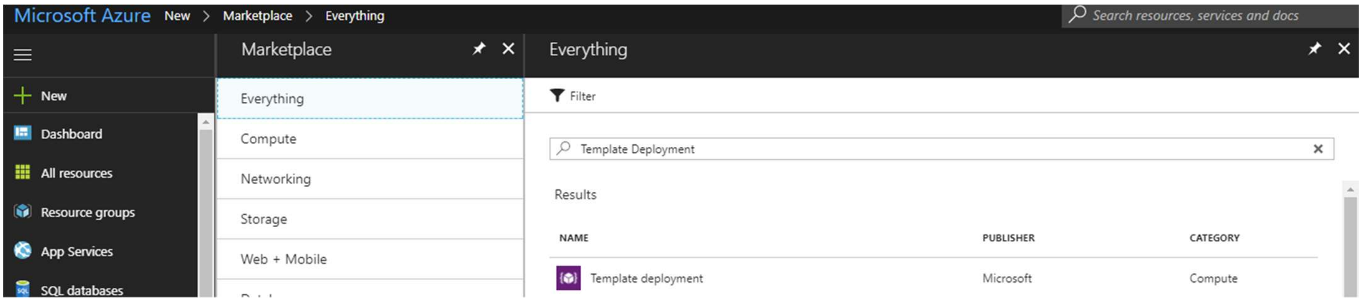
You can use the **appgw-sample.xml** snapshot configuration in the GitHub spoke folder as an example of how to configure your device group and template in Panorama. Load this configuration on to a firewall without committing to view the settings while you configure your Panorama. To avoid issues always validate your configuration prior to attempting a push or bootstrap. See **Gotchas** section below.

5. Launch the Transit VNet Hub Template

There are multiple ways to deploy your template. You can use Azure CLI, PowerShell, Deploy to Azure button or you can deploy the template manually. If the GitHub Repository has a **Deploy to Azure** button you can deploy the template by clicking the deploy button for each template. Before launching be sure to take the **working_hub_config.xml** and rename it bootstrap.xml for use when bootstrapping VM-Series in the Hub. The steps below will walk you through how to launch the ARM template manually.



In the Azure Resource Manager console you can launch the **azureDeployInfra.json** file directly from the Azure Portal. To do this click **"New"** then search **"Template Deployment"**, click the Template Deployment icon an select **"Create".**

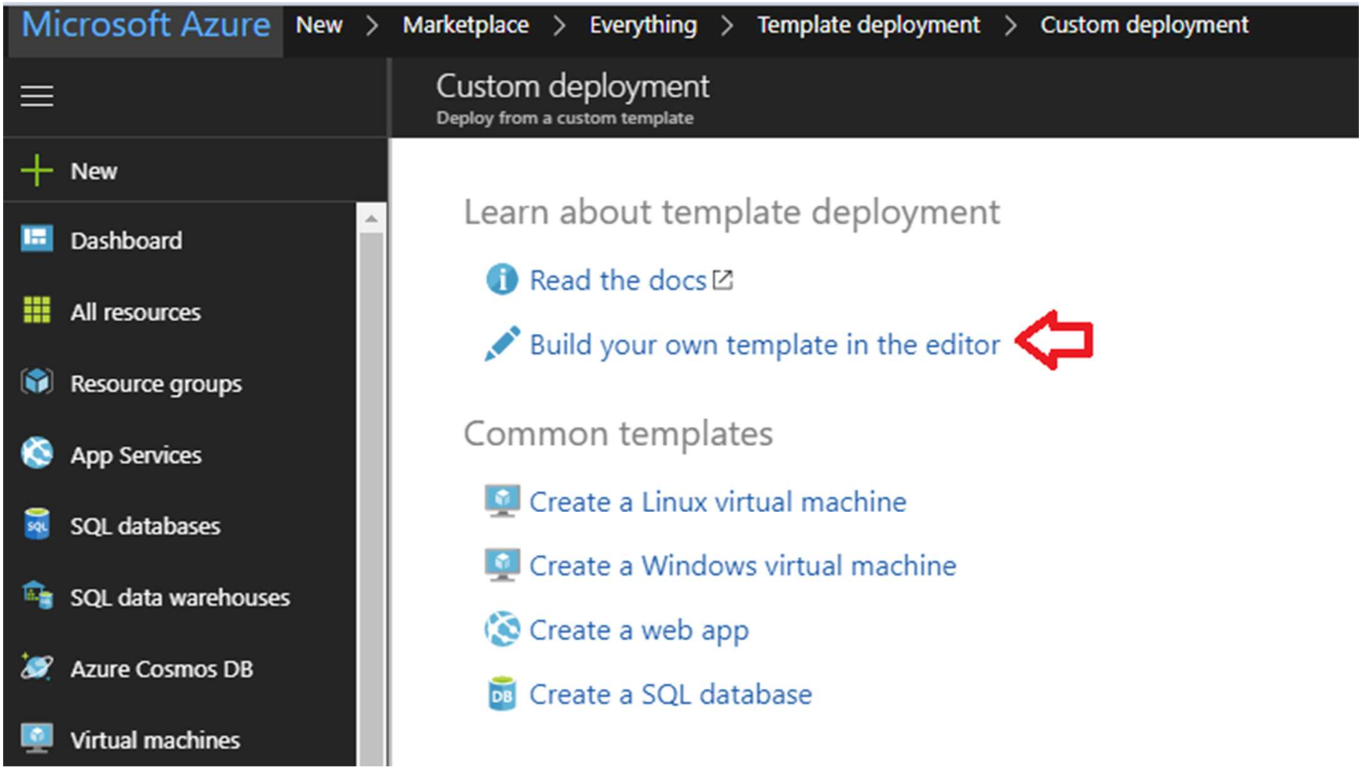


Template Deployment

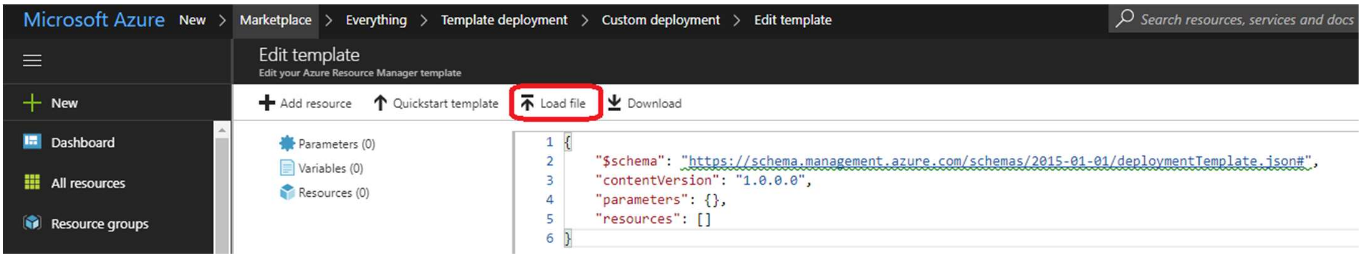
Results

NAME	PUBLISHER	CATEGORY
Template deployment	Microsoft	Compute

In the next screen click **“Build your own template in the editor”**

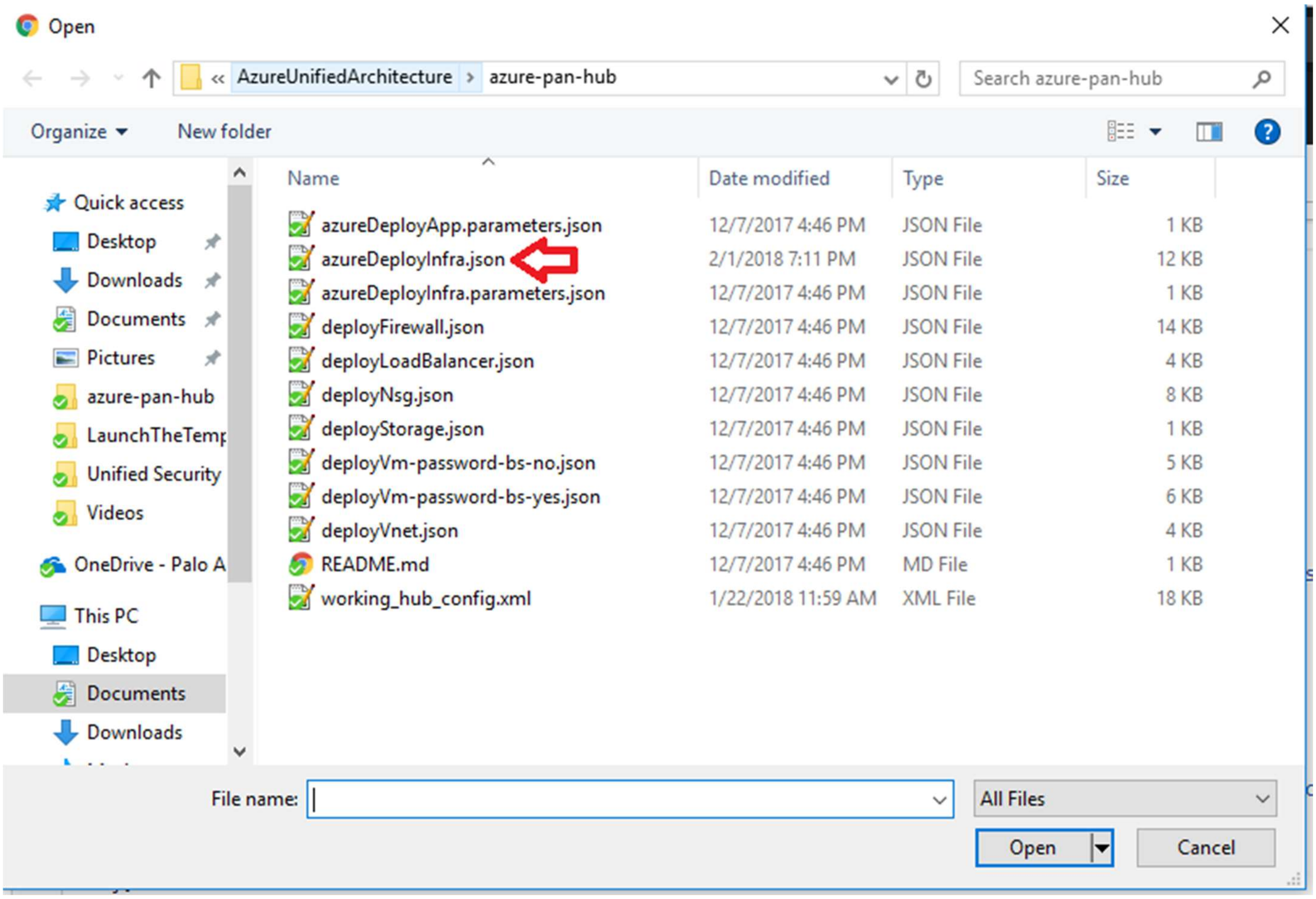

Microsoft Azure
New > Marketplace > Everything > Template deployment > Custom deployment
Custom deployment
Deploy from a custom template
New
Dashboard
All resources
Resource groups
App Services
SQL databases
SQL data warehouses
Azure Cosmos DB
Virtual machines
Learn about template deployment
Read the docs
Build your own template in the editor
Common templates
Create a Linux virtual machine
Create a Windows virtual machine
Create a web app
Create a SQL database

Select **“Load File”**


Microsoft Azure
New > Marketplace > Everything > Template deployment > Custom deployment > Edit template
Search resources, services and docs
Edit template
Edit your Azure Resource Manager template
New
Dashboard
All resources
Resource groups
Add resource
Quickstart template
Load file
Download
Parameters (0)
Variables (0)
Resources (0)

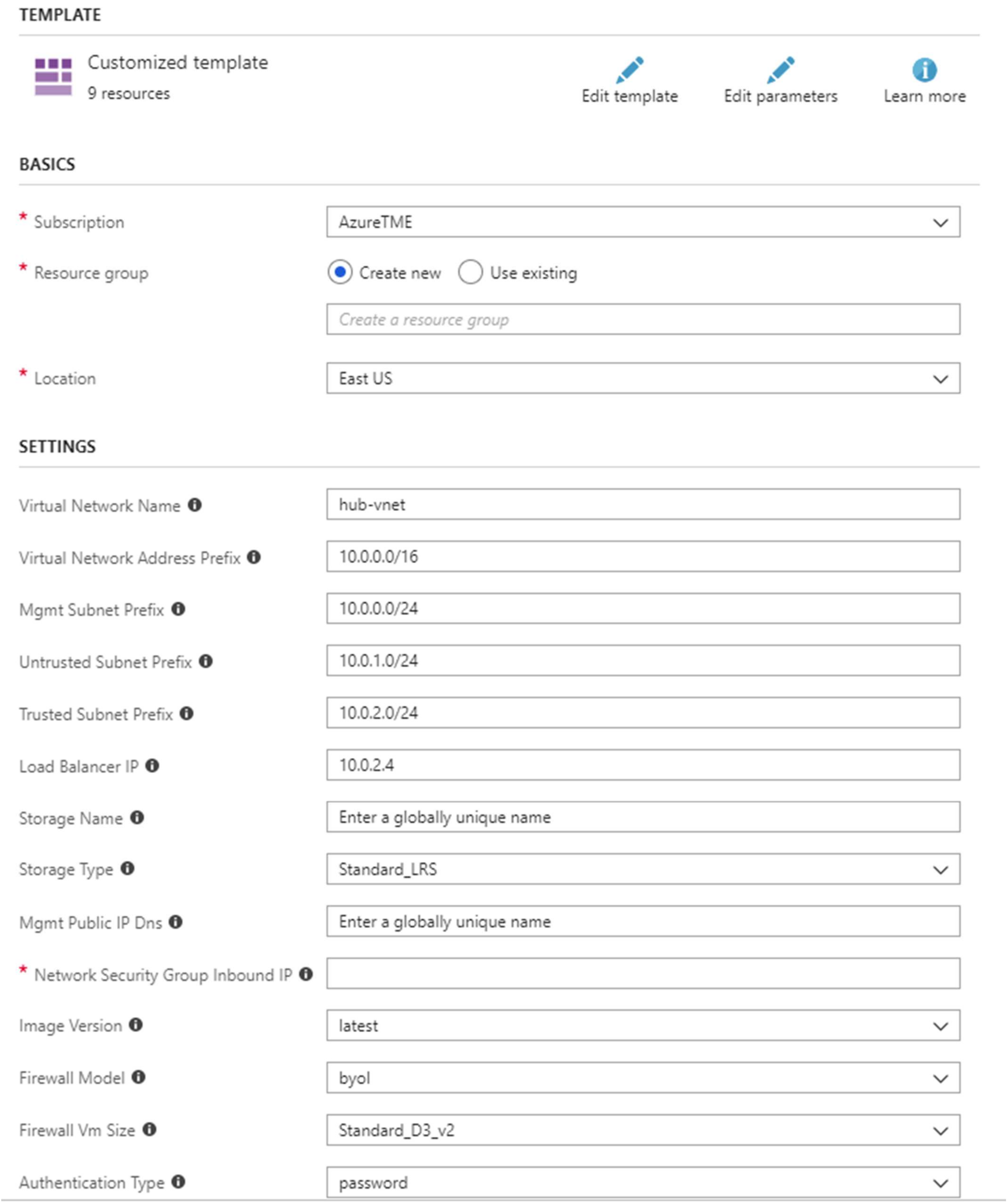
```
{
    "$schema": "https://schema.management.azure.com/schemas/2015-01-01/deploymentTemplate.json#",
    "contentVersion": "1.0.0.0",
    "parameters": {},
    "resources": []
}
```

Select **“azureDeployInfra.json“** file from the Azure-Transit-VNet/azure-pan-hub directory that you cloned from GitHub, then click **“Save”** to bring up the parameters.



Name	Date modified	Type	Size
azureDeployApp.parameters.json	12/7/2017 4:46 PM	JSON File	1 KB
azureDeployInfra.json	2/1/2018 7:11 PM	JSON File	12 KB
azureDeployInfra.parameters.json	12/7/2017 4:46 PM	JSON File	1 KB
deployFirewall.json	12/7/2017 4:46 PM	JSON File	14 KB
deployLoadBalancer.json	12/7/2017 4:46 PM	JSON File	4 KB
deployNsg.json	12/7/2017 4:46 PM	JSON File	8 KB
deployStorage.json	12/7/2017 4:46 PM	JSON File	1 KB
deployVm-password-bs-no.json	12/7/2017 4:46 PM	JSON File	5 KB
deployVm-password-bs-yes.json	12/7/2017 4:46 PM	JSON File	6 KB
deployVnet.json	12/7/2017 4:46 PM	JSON File	4 KB
README.md	12/7/2017 4:46 PM	MD File	1 KB
working_hub_config.xml	1/22/2018 11:59 AM	XML File	18 KB

a. Most of the **parameters** are self-explanatory and should be left at the defaults
b. **Resource Group** – Always create a new resource Group. The hub template does not work in an existing resource group
c. **Location** – Use the location where your bootstrap storage account is created.
d. **Virtual Network Name** – This will be the name of the hub VNet
e. **Virtual Network Address Prefix** – Use a network address which will not be used in the spoke deployment. The defaults should suffice.
f. **Load Balancer IP** – Use a static IP for Load Balancer in the Trust network. Remember this address since it is used as an input parameter for the spoke template.
g. **Network Security Group Inbound Src IP** – This is the IP you will allow explicit access to the management interface of the virtual machines. For security purposes be sure to set **Security Group Inbound IP** for mgmt access to the firewall.
h. **Image Version** – For image version you must use at minimum PAN-OS 8.1 so select latest.
i. **Firewall Model** – If you select BYOL you must receive licensing directly from Palo Alto Networks or reseller.
j. **Username** and **password** that is entered by default for the devices is:
user:pandemo **password:**Dem0pa$$w0rd
k. **Subscription ID** – See Step 4 listed in prerequisites
l. **App ID** – See Step 4 listed in prerequisites
m. **Tenant ID** – See Step 4 listed in prerequisites
n. **Panorama IP** – IP address for the previously deployed Panorama
o. **Panorama API Key** – See step 9 listed in prerequisites
p. **Bootstrap Storage Account** – See step 5 listed in prerequisites
q. **Storage Account Access Key** – See step 5 listed in prerequisites
r. **Storage Account File Share** – See step 5 listed in prerequisites
s. **Storage Account File Share Directory** – See step 5 listed in prerequisites
t. It could take up to 10 minutes to complete the launch or longer depending on Azure.



TEMPLATE

Customized template
9 resources

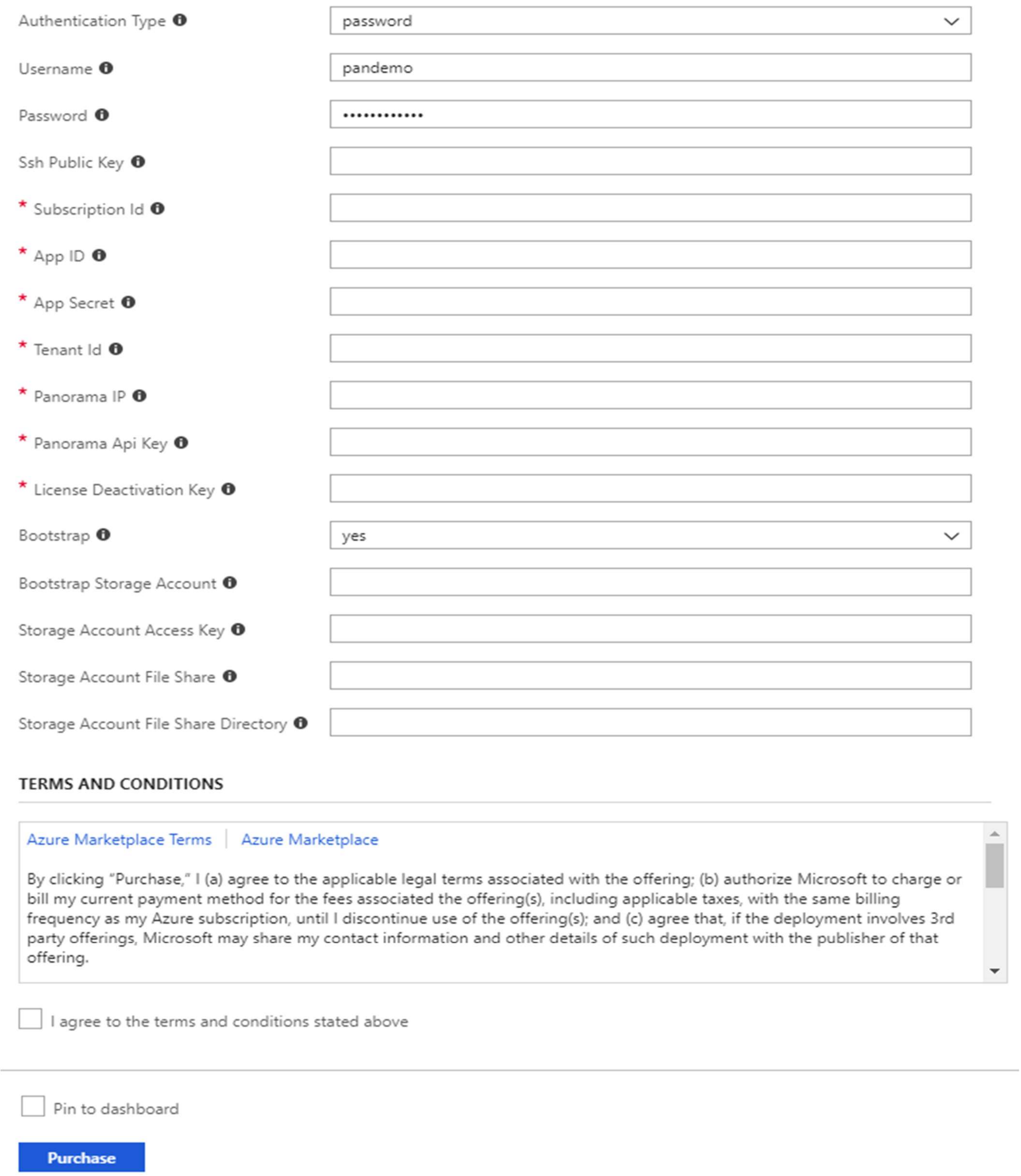
BASICS

* Subscription	AzureTME
* Resource group	● Create new ○ Use existing
	Create a resource group
* Location	East US

SETTINGS

Virtual Network Name	hub-vnet
Virtual Network Address Prefix	10.0.0.0/16
Mgmt Subnet Prefix	10.0.0.0/24
Untrusted Subnet Prefix	10.0.1.0/24
Trusted Subnet Prefix	10.0.2.0/24
Load Balancer IP	10.0.2.4
Storage Name	Enter a globally unique name
Storage Type	Standard_LRS
Mgmt Public IP Dns	Enter a globally unique name
* Network Security Group Inbound IP	
Image Version	latest
Firewall Model	byol
Firewall Vm Size	Standard_D3_v2
Authentication Type	password

Acknowledge the terms and conditions and click “**Purchase**”



Authentication Type	password
Username	pandemo
Password	•••••••••••••
Ssh Public Key	
* Subscription Id	
* App ID	
* App Secret	
* Tenant Id	
* Panorama IP	
* Panorama Api Key	
* License Deactivation Key	
Bootstrap	yes
Bootstrap Storage Account	
Storage Account Access Key	
Storage Account File Share	
Storage Account File Share Directory	

TERMS AND CONDITIONS

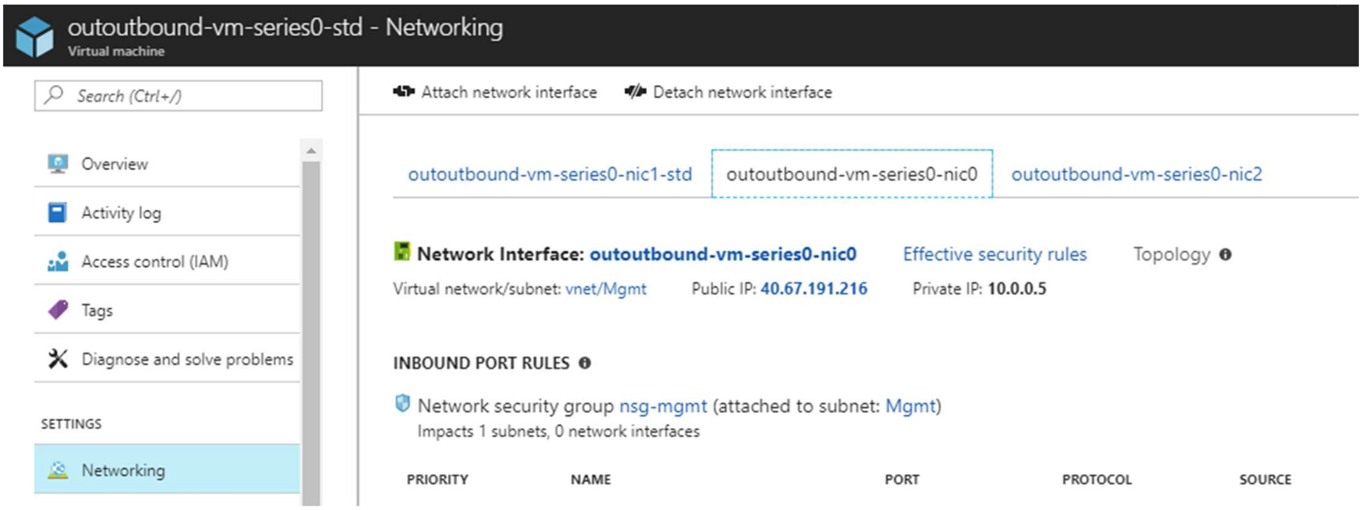
Azure Marketplace Terms | Azure Marketplace

By clicking “Purchase,” I (a) agree to the applicable legal terms associated with the offering; (b) authorize Microsoft to charge or bill my current payment method for the fees associated the offering(s), including applicable taxes, with the same billing frequency as my Azure subscription, until I discontinue use of the offering(s); and (c) agree that, if the deployment involves 3rd party offerings, Microsoft may share my contact information and other details of such deployment with the publisher of that offering.

☐ I agree to the terms and conditions stated above

☐ Pin to dashboard

Once the firewalls have launched, locate the **Management** interface public IP address in Azure.



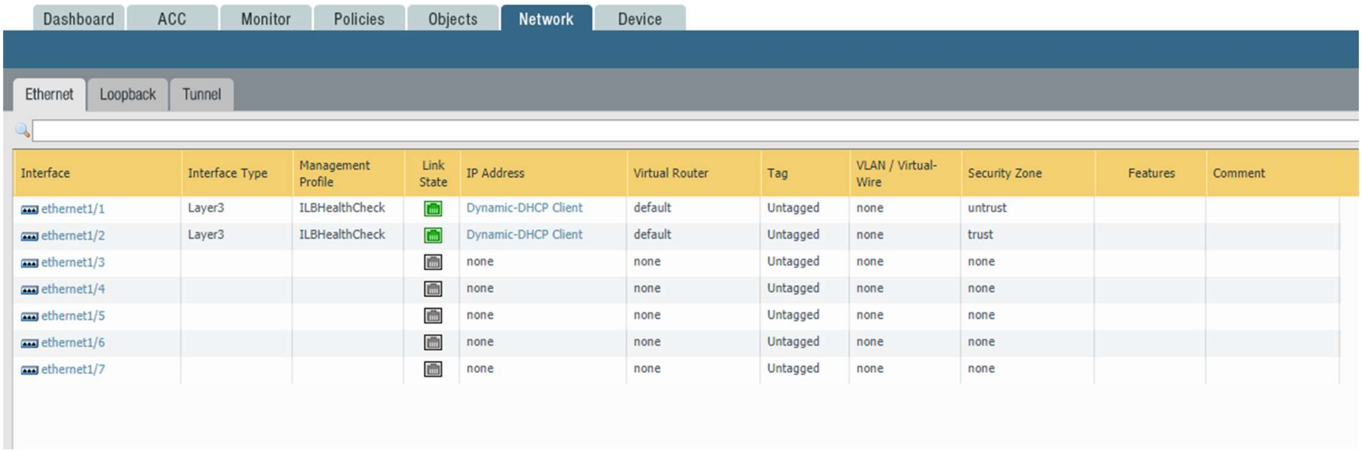
Network Interface: outoutbound-vm-series0-nic0

Virtual network/subnet: vnet/Mgmt   Public IP: 40.67.191.216   Private IP: 10.0.0.5

Network security group nsg-mgmt (attached to subnet: Mgmt)

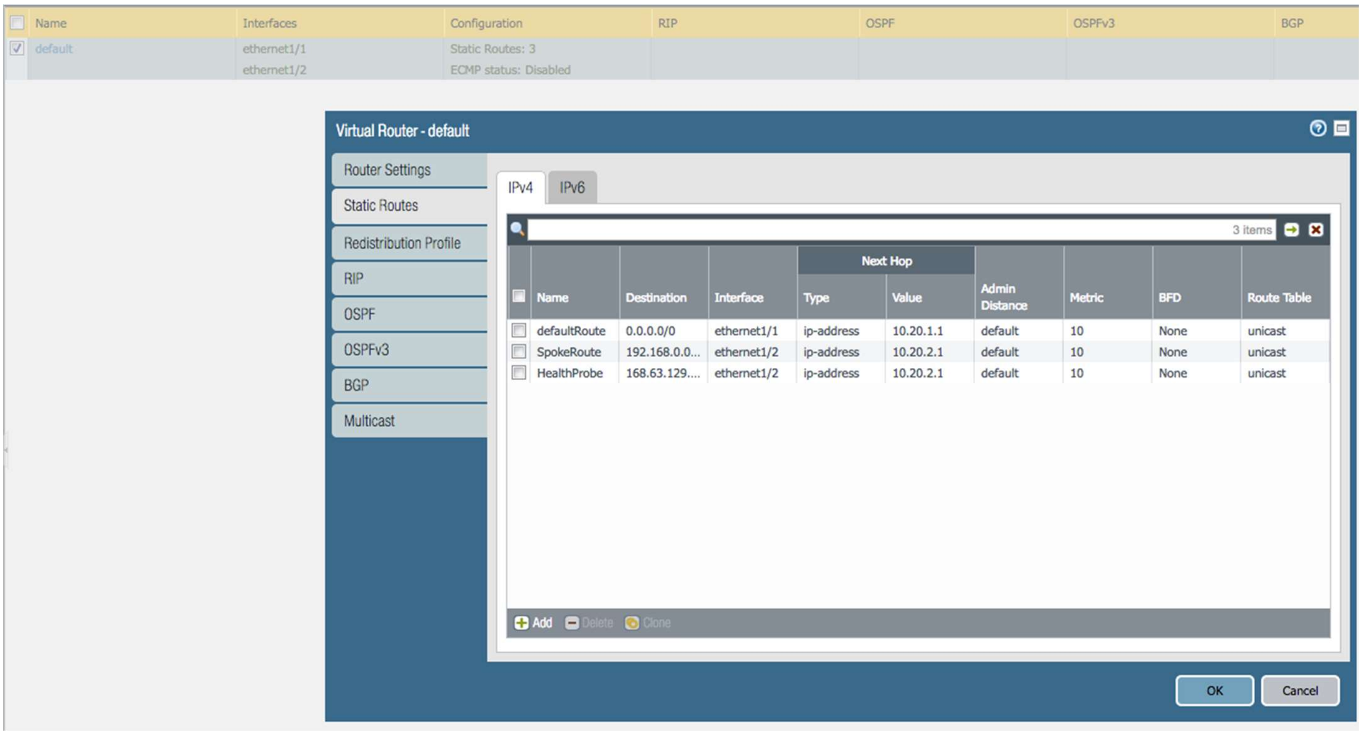
Impacts 1 subnets, 0 network interfaces

Log into the hub firewalls using **HTTPS.** Make sure your ethernet1/1 and Ethernet1/2 interfaces now show green.



Interface	Interface Type	Management Profile	Link State	IP Address	Virtual Router	Tag	VLAN / Virtual-Wire	Security Zone	Features	Comment
ethernet1/1	Layer3	ILBHealthCheck	🟩	Dynamic-DHCP Client	default	Untagged	none	untrust		
ethernet1/2	Layer3	ILBHealthCheck	🟩	Dynamic-DHCP Client	default	Untagged	none	trust		
ethernet1/3			▨	none	none	Untagged	none	none		
ethernet1/4			▨	none	none	Untagged	none	none		
ethernet1/5			▨	none	none	Untagged	none	none		
ethernet1/6			▨	none	none	Untagged	none	none		
ethernet1/7			▨	none	none	Untagged	none	none		

Verify the **virtual router** has the following configuration.



☐	Name	Interfaces	Configuration	RIP	OSPF	OSPFv3	BGP
☑	default	ethernet1/1 ethernet1/2	Static Routes: 3 ECMP status: Disabled				

Virtual Router - default

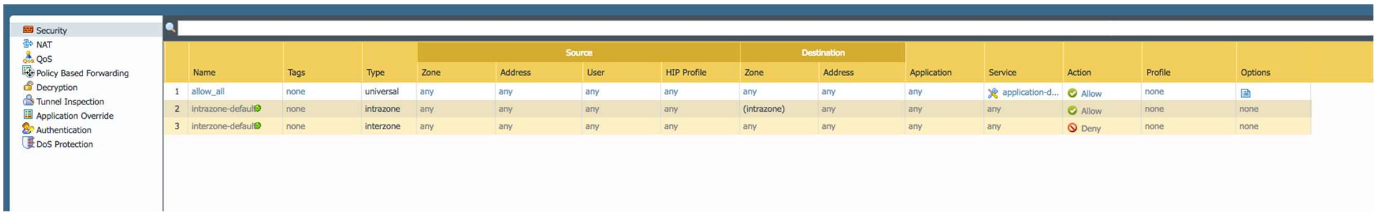
☐	Name	Destination	Interface	Next Hop		Admin Distance	Metric	BFD	Route Table
				Type	Value				
☐	defaultRoute	0.0.0.0/0	ethernet1/1	ip-address	10.20.1.1	default	10	None	unicast
☐	SpokeRoute	192.168.0.0...	ethernet1/2	ip-address	10.20.2.1	default	10	None	unicast
☐	HealthProbe	168.63.129....	ethernet1/2	ip-address	10.20.2.1	default	10	None	unicast

DefaultRoute: is to forward all outbound traffic to the untrust interface so that it egresses out of the Azure network.

SpokeRoute: is to forward all the inbound traffic and inter-spoke traffic back to the Trust interface so that it reaches the appropriate Spoke (application server). Note that the Network address of the all the spokes VNets should be part of this network address. If a new spoke is added whose network address is not part of this network address, then a new route needs to be added in the config to forward that traffic to the Trust interface.

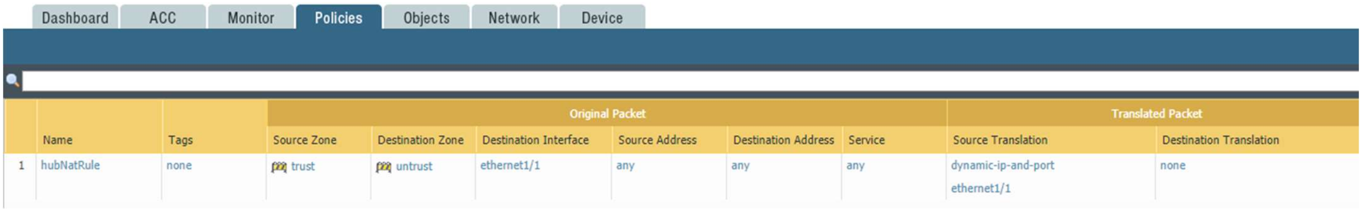
HealthProbe: is to respond to the health probe packets generated by the Internal Load Balancer. For this lab the health check is configured to port 22 on the firewall Trust interface.

An **allow-all** security policy is created to forward all traffic. This should be modified to accommodate your policy preferences.



				Source				Destination						
	Name	Tags	Type	Zone	Address	User	HIP Profile	Zone	Address	Application	Service	Action	Profile	Options
1	allow_all	none	universal	any	any	any	any	any	any	any	application-d...	Allow	none	
2	intrazone-default	none	intrazone	any	any	any	any	(intrazone)	any	any	any	Allow	none	none
3	interzone-default	none	interzone	any	any	any	any	any	any	any	any	Deny	none	none

Verify that you have a **NAT rule** on the hub firewall for outbound traffic



			Original Packet						Translated Packet	
	Name	Tags	Source Zone	Destination Zone	Destination Interface	Source Address	Destination Address	Service	Source Translation	Destination Translation
1	hubNatRule	none	trust	untrust	ethernet1/1	any	any	any	dynamic-ip-and-port ethernet1/1	none

6. Launch the Transit VNet Spoke Template

Spoke Template Options

Azuredeploy.json – This launches the spoke template with VM-Series firewalls sandwiched between an external and internal load balancer. This provides secured external access to public facing workloads with return traffic egressing the spoke VNet. All internal originating traffic will be forwarded to the Hub VNet as the exit route to provide secure outbound access.

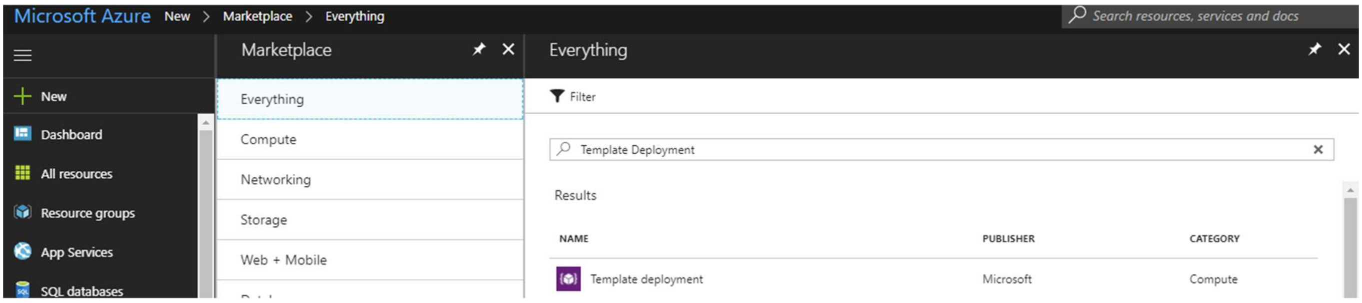
Azuredeploy-no-firewall.json – Launches the spoke template with no firewalls but still launches application servers. This scenario would NOT provide security using the VM-Series for public facing workloads. All internal originating traffic will be forwarded to the Hub VNet as the exit route to provide secure outbound access. This template will be available soon.

There are multiple ways to deploy your template. You can use Azure CLI, PowerShell, Deploy to Azure button or you can deploy the template manually. If the GitHub Repository has a **Deploy to Azure** button you can deploy your template by clicking the deploy button for each template. Before launching be sure to take the **appgw-sample.xml** and rename it bootstrap.xml for use when bootstrapping VM-Series in the

Hub. For Spoke2 use the **appgw-sample2.xml** configure file. Below I will walk you through how to launch your ARM template manually.

Deploy to Azure

From the Azure-Transit-VNet/azure-pan-spoke GitHub repository that you cloned, launch the **azuredeploy.json** file directly from the Azure Portal. You may need to bring up two azure portal browsers in order to locate information needed to fill out the parameters when launching this template. To do this click **“New”** then search **“Template Deployment”**, click the Template Deployment icon an select **“Create”.**

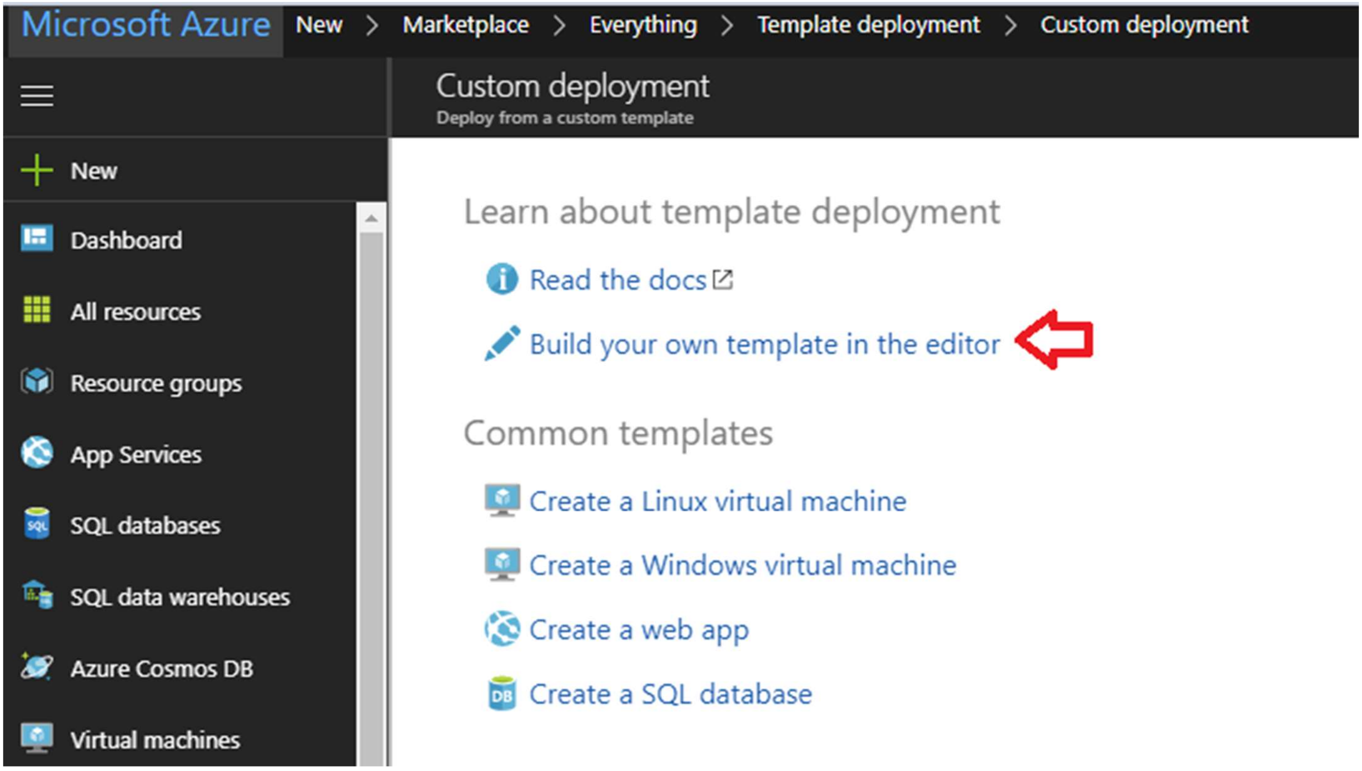


Template Deployment

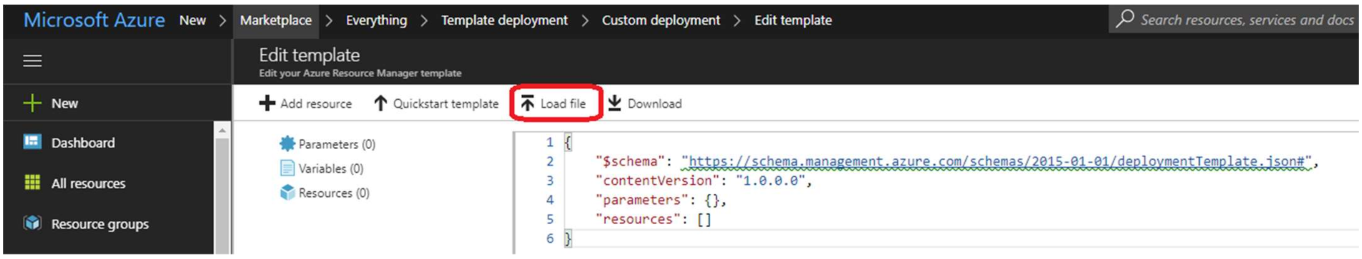
Results

NAME	PUBLISHER	CATEGORY
Template deployment	Microsoft	Compute

In the next screen click **“Build your own template in the editor”**

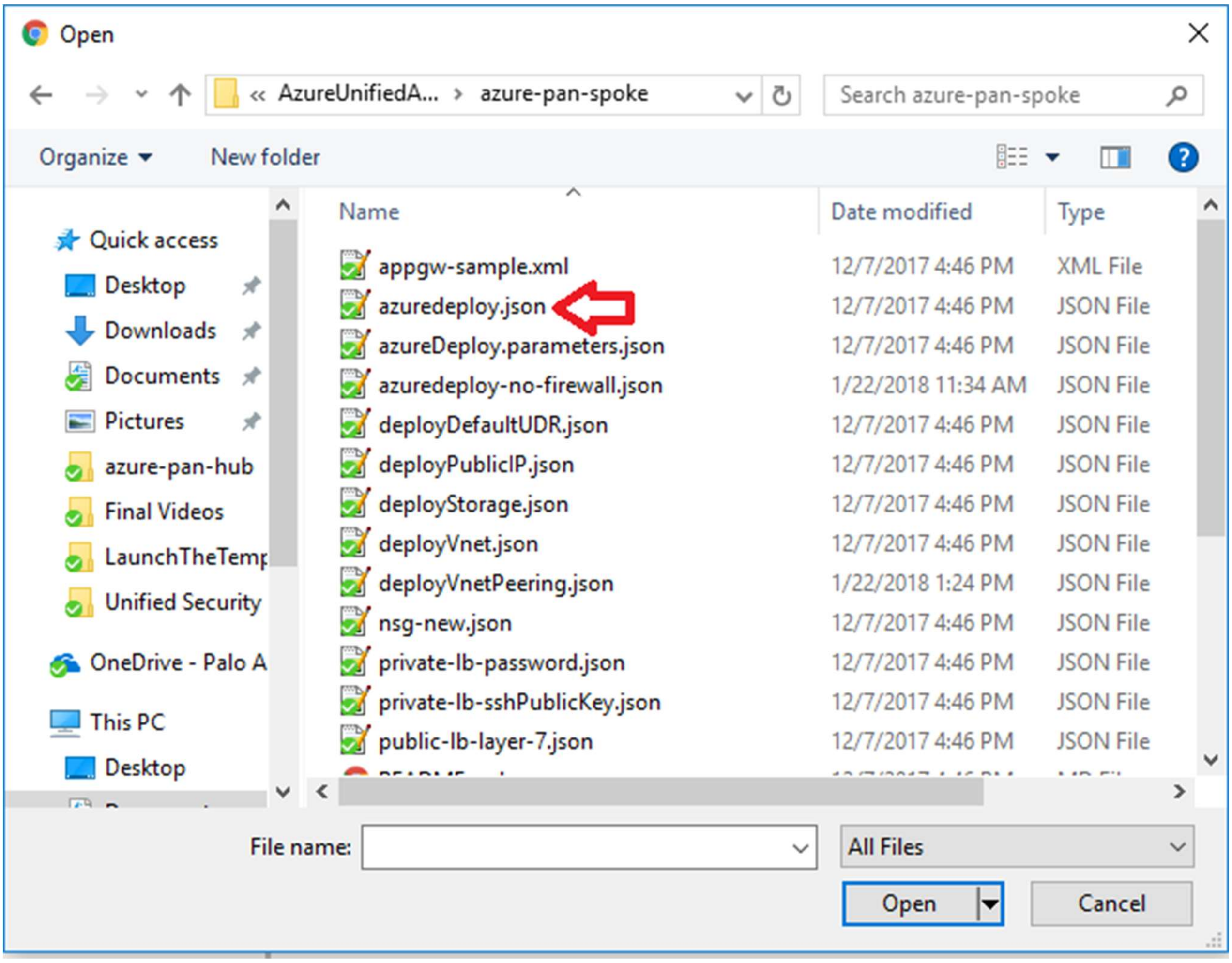

Microsoft Azure
New > Marketplace > Everything > Template deployment > Custom deployment
Custom deployment
Deploy from a custom template
New
Dashboard
All resources
Resource groups
App Services
SQL databases
SQL data warehouses
Azure Cosmos DB
Virtual machines
Learn about template deployment
Read the docs
Build your own template in the editor
Common templates
Create a Linux virtual machine
Create a Windows virtual machine
Create a web app
Create a SQL database

Select **"Load File"**


Microsoft Azure
New > Marketplace > Everything > Template deployment > Custom deployment > Edit template
Search resources, services and docs
Edit template
Edit your Azure Resource Manager template
New
Dashboard
All resources
Resource groups
Add resource
Quickstart template
Load file
Download
Parameters (0)
Variables (0)
Resources (0)

```
{
    "$schema": "https://schema.management.azure.com/schemas/2015-01-01/deploymentTemplate.json#",
    "contentVersion": "1.0.0.0",
    "parameters": {},
    "resources": []
}
```

Select **"azuredeploy.json"** file from the Azure-Transit-VNet/azure-pan-spoke directory that you cloned from GitHub, then click **"Save"** to bring up the parameters.



Name	Date modified	Type
appgw-sample.xml	12/7/2017 4:46 PM	XML File
azuredeploy.json	12/7/2017 4:46 PM	JSON File
azureDeploy.parameters.json	12/7/2017 4:46 PM	JSON File
azuredeploy-no-firewall.json	1/22/2018 11:34 AM	JSON File
deployDefaultUDR.json	12/7/2017 4:46 PM	JSON File
deployPublicIP.json	12/7/2017 4:46 PM	JSON File
deployStorage.json	12/7/2017 4:46 PM	JSON File
deployVnet.json	12/7/2017 4:46 PM	JSON File
deployVnetPeering.json	1/22/2018 1:24 PM	JSON File
nsg-new.json	12/7/2017 4:46 PM	JSON File
private-lb-password.json	12/7/2017 4:46 PM	JSON File
private-lb-sshPublicKey.json	12/7/2017 4:46 PM	JSON File
public-lb-layer-7.json	12/7/2017 4:46 PM	JSON File

a. Most of the **parameters** are self-explanatory and should be left at the defaults

b. **Resource Group** – Create a new Resource Group. This template does not work with existing resource groups.

c. **Location** – It should be the same location as the hub since VNet peering does not work well across regions.

d. **Hub Resource Group Name** – Give the Resource Group name of the hub created resource group.

e. **Hub VNet Name** – Use the exact VNet name of the hub created earlier.

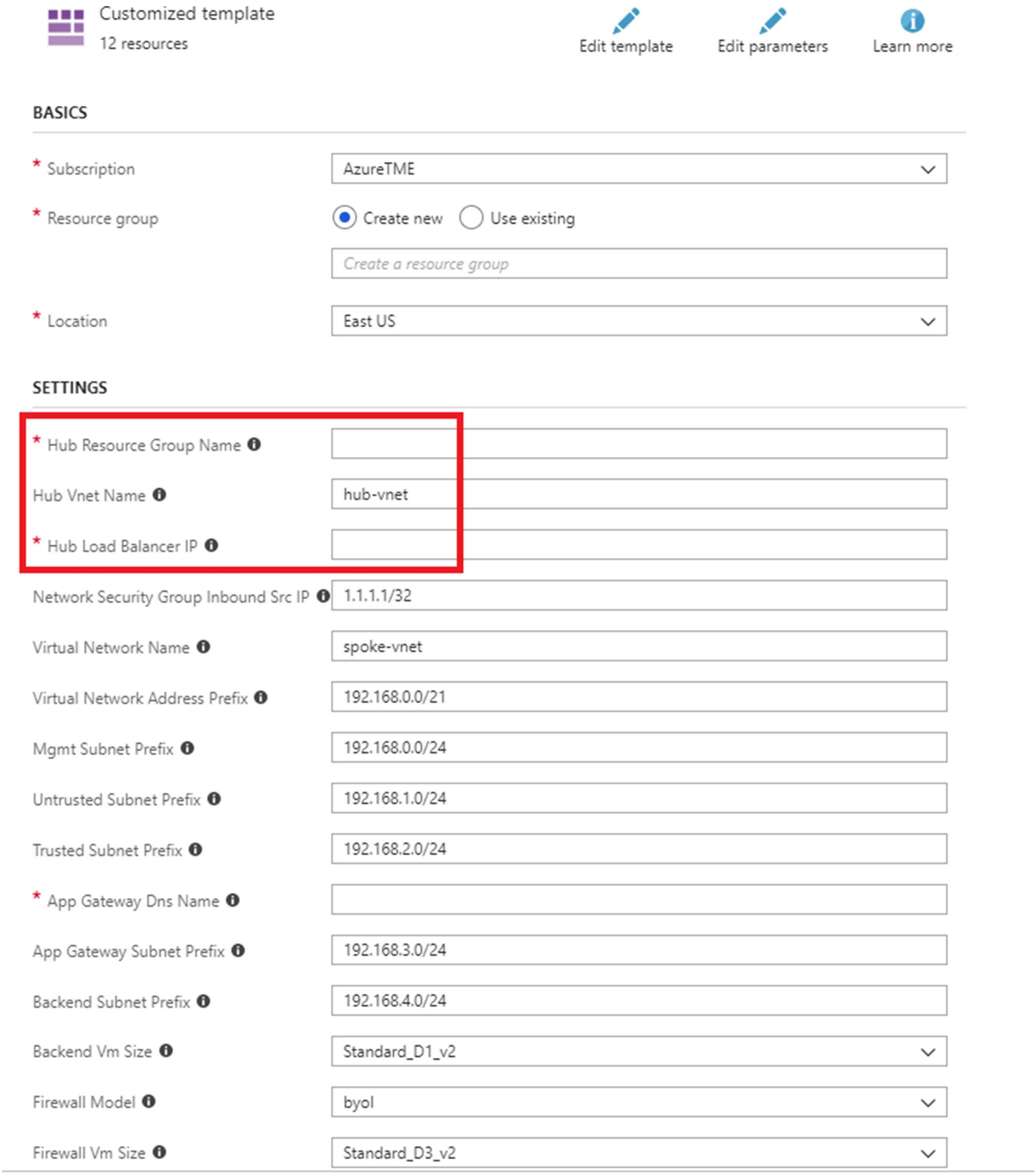
f. **Hub Load Balancer IP** – Use the static IP given to the Load Balancer in the created in the hub template. You can find this information in the load balancer settings

g. **Network Security Group Inbound Src IP** – This is the IP you will allow explicit access to the management interface of the virtual machines.

h. **Virtual Network Address Prefix** – This network address should be the subnet of the network address given in the "SpokeRoute" in the hub's firewall configuration.

i. **Mgmt, Trust and Untrust** subnets should be subnets of the VNet subnet created in the previous step.

j. **Firewall VM Size** - Choose the Firewall Model and Size based on requirements. Use Standard D3 or D3 v2.
k. **SSH Public Key** – If using a password then leave this section blank.
l. **Bootstrap Storage Account** – See step 5 listed in prerequisites
m. **Storage Account Access Key** – See step 5 listed in prerequisites
n. **Storage Account File Share** – See step 5 listed in prerequisites
o. **Storage Account File Share Directory** – See step 5 listed in prerequisites
p. **VM Scale Set Min Count** – Customize based on preference
q. **VM Scale Set Max Count** – Customize based on preference
r. **Scale In Threshold** – Customize based on preference
s. **Scale Out Threshold** – Customize based on preference
t. **Auto Scale Metric** – Customize based on preference
For more information on Azure Virtual Machine Scale Sets please see the following link
https://docs.microsoft.com/en-us/azure/virtual-machine-scale-sets/overview



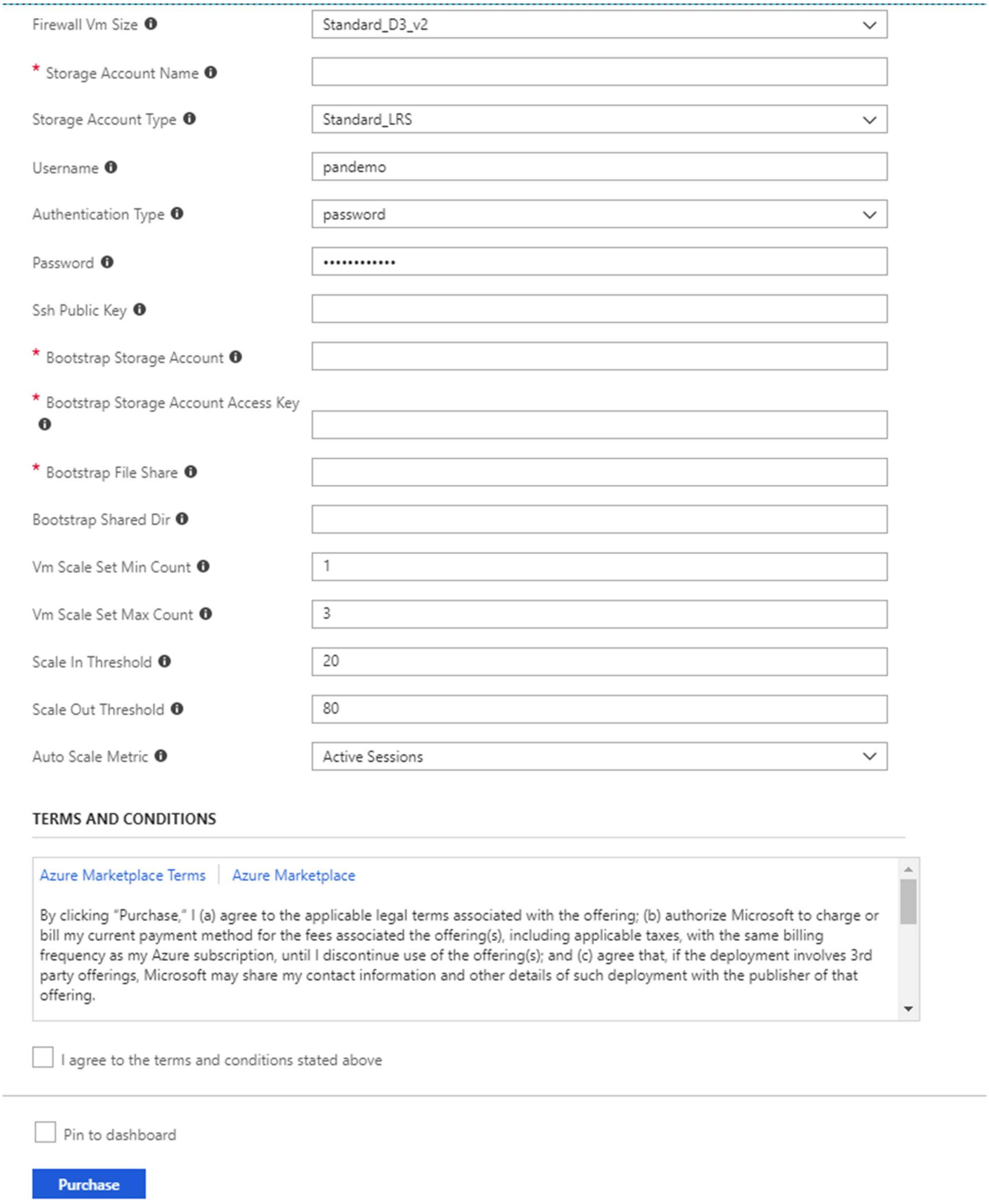
Customized template
12 resources

BASICS

* Subscription	AzureTME
* Resource group	● Create new ○ Use existing
	Create a resource group
* Location	East US

SETTINGS

* Hub Resource Group Name	
Hub Vnet Name	hub-vnet
* Hub Load Balancer IP	
Network Security Group Inbound Src IP	1.1.1.1/32
Virtual Network Name	spoke-vnet
Virtual Network Address Prefix	192.168.0.0/21
Mgmt Subnet Prefix	192.168.0.0/24
Untrusted Subnet Prefix	192.168.1.0/24
Trusted Subnet Prefix	192.168.2.0/24
* App Gateway Dns Name	
App Gateway Subnet Prefix	192.168.3.0/24
Backend Subnet Prefix	192.168.4.0/24
Backend Vm Size	Standard_D1_v2
Firewall Model	byol
Firewall Vm Size	Standard_D3_v2



Firewall Vm Size	Standard_D3_v2
* Storage Account Name	
Storage Account Type	Standard_LRS
Username	pandemo
Authentication Type	password
Password	•••••••••••••
Ssh Public Key	
* Bootstrap Storage Account	
* Bootstrap Storage Account Access Key	
* Bootstrap File Share	
Bootstrap Shared Dir	
Vm Scale Set Min Count	1
Vm Scale Set Max Count	3
Scale In Threshold	20
Scale Out Threshold	80
Auto Scale Metric	Active Sessions

TERMS AND CONDITIONS

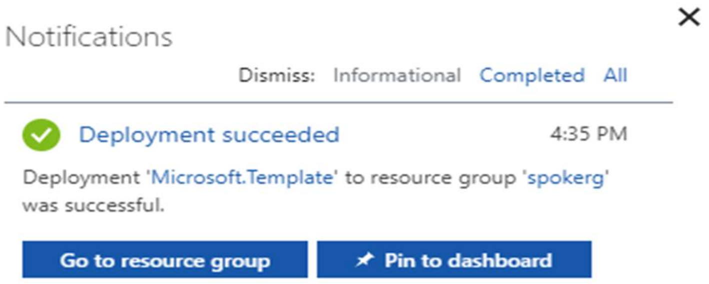
Azure Marketplace Terms | Azure Marketplace

By clicking "Purchase," I (a) agree to the applicable legal terms associated with the offering; (b) authorize Microsoft to charge or bill my current payment method for the fees associated the offering(s), including applicable taxes, with the same billing frequency as my Azure subscription, until I discontinue use of the offering(s); and (c) agree that, if the deployment involves 3rd party offerings, Microsoft may share my contact information and other details of such deployment with the publisher of that offering.

□ I agree to the terms and conditions stated above

□ Pin to dashboard

Once the Spoke template has successfully launched you will see Deployment succeeded.



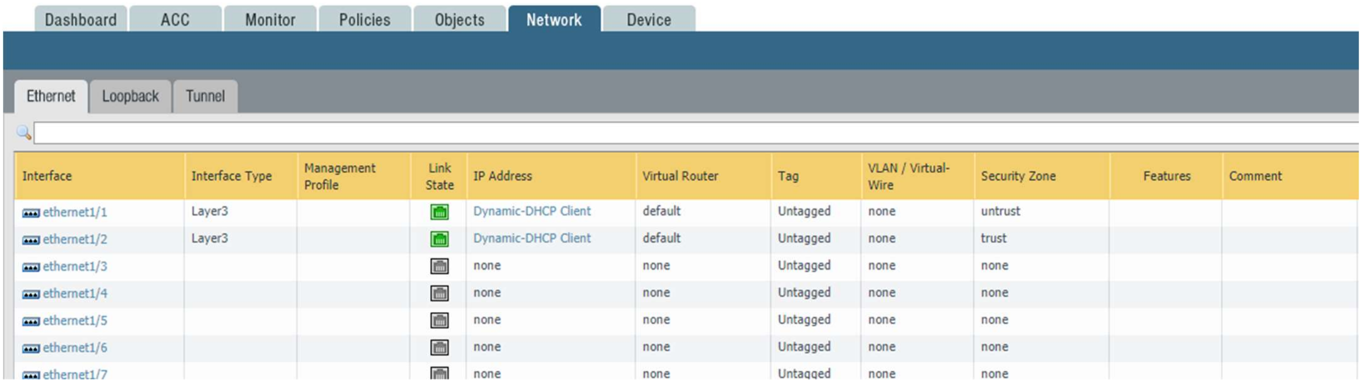
Notifications

Dismiss: Informational Completed All

Deployment succeeded 4:35 PM

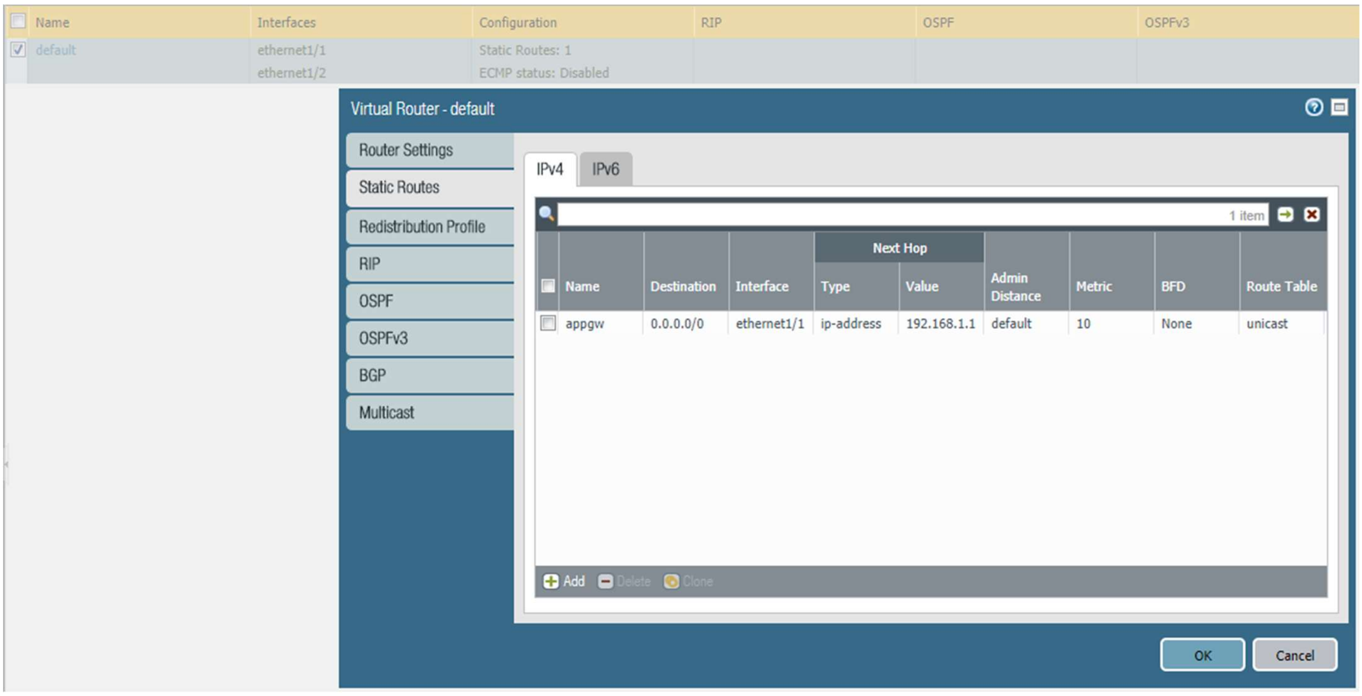
Deployment 'Microsoft.Template' to resource group 'spokerg' was successful.

Log into the spoke firewalls using **HTTPS.** Make sure your ethernet1/1 and Ethernet1/2 interfaces now show green



Interface	Interface Type	Management Profile	Link State	IP Address	Virtual Router	Tag	VLAN / Virtual-Wire	Security Zone	Features	Comment
ethernet1/1	Layer3		🟩	Dynamic-DHCP Client	default	Untagged	none	untrust		
ethernet1/2	Layer3		🟩	Dynamic-DHCP Client	default	Untagged	none	trust		
ethernet1/3			▨	none	none	Untagged	none	none		
ethernet1/4			▨	none	none	Untagged	none	none		
ethernet1/5			▨	none	none	Untagged	none	none		
ethernet1/6			▨	none	none	Untagged	none	none		
ethernet1/7			▨	none	none	Untagged	none	none		

Verify the spoke firewall **virtual router** has the following configuration.



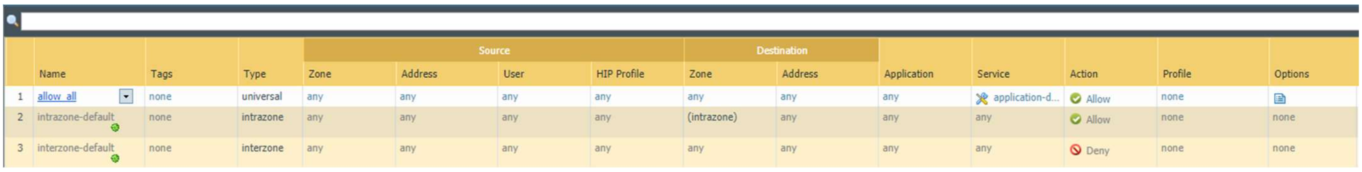
□ Name	Interfaces	Configuration	RIP	OSPF	OSPFv3
☑ default	ethernet1/1 ethernet1/2	Static Routes: 1 ECMP status: Disabled			

Virtual Router - default

			Next Hop					
□ Name	Destination	Interface	Type	Value	Admin Distance	Metric	BFD	Route Table
□ appgw	0.0.0.0/0	ethernet1/1	ip-address	192.168.1.1	default	10	None	unicast

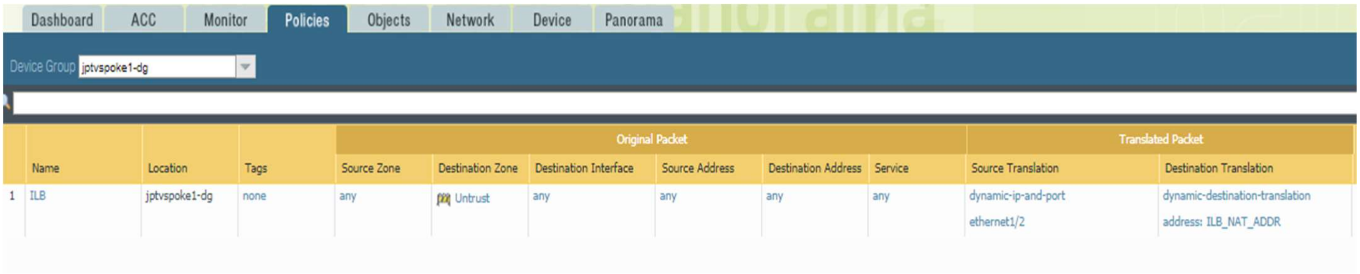
appgw: is to forward all traffic originating from the firewall to the untrust interface. Traffic originating from spoke resources behind the firewall will egress through the Hub VNet.

An **allow-all** security policy on the firewall is created to receive all traffic although the application gateway load balancer only listens for port 80. This should be modified to accommodate your policy preferences.



				Source				Destination						
	Name	Tags	Type	Zone	Address	User	HIP Profile	Zone	Address	Application	Service	Action	Profile	Options
1	allow_all	none	universal	any	any	any	any	any	any	any	application-d...	Allow	none	
2	intrazone-default	none	intrazone	any	any	any	any	(intrazone)	any	any	any	Allow	none	none
3	interzone-default	none	interzone	any	any	any	any	any	any	any	any	Deny	none	none

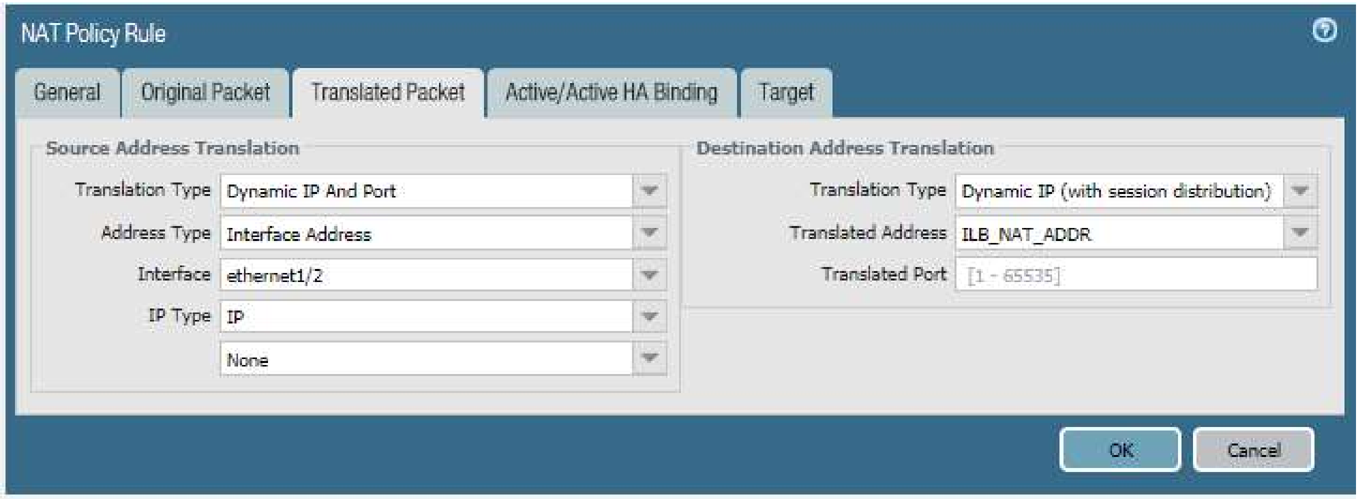
Verify that you have a **NAT rule** on the spoke firewall for inbound traffic



Device Group jptvspoke1-dg

				Original Packet						Translated Packet	
	Name	Location	Tags	Source Zone	Destination Zone	Destination Interface	Source Address	Destination Address	Service	Source Translation	Destination Translation
1	ILB	jptvspoke1-dg	none	any	Untrust	any	any	any	any	dynamic-ip-and-port ethernet1/2	dynamic-destination-translation address: ILB_NAT_ADDR

In order for your NAT policy to work your translated packet for source and destination should be configured as follows. Do NOT use Static IP



NAT Policy Rule

Source Address Translation

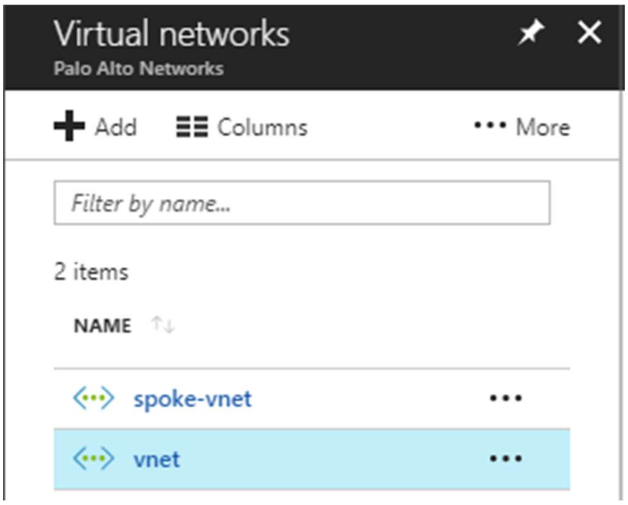
Translation Type: Dynamic IP And Port
Address Type: Interface Address
Interface: ethernet1/2
IP Type: IP
None

Destination Address Translation

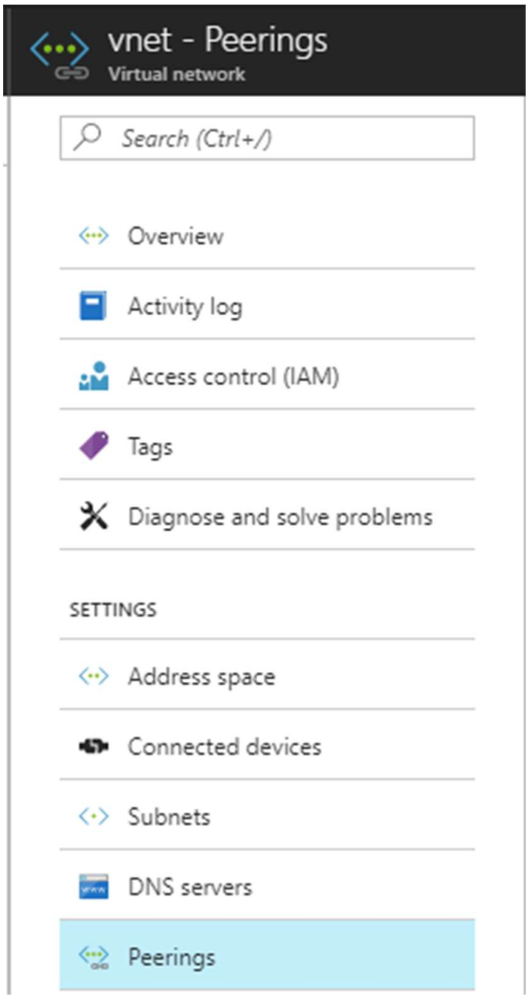
Translation Type: Dynamic IP (with session distribution)
Translated Address: ILB_NAT_ADDR
Translated Port: [1 - 65535]

7. VNet Peering Verification

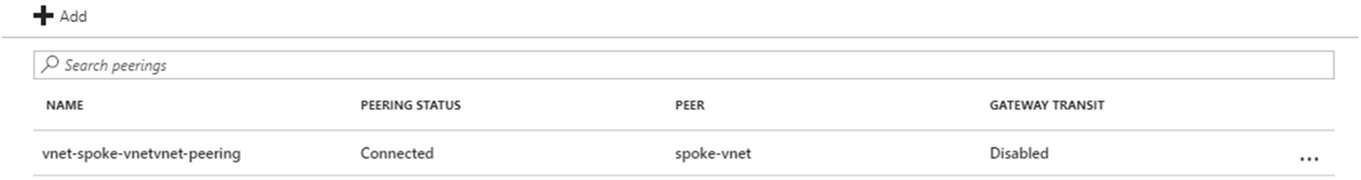
Within Azure Portal verify that **VNet Peering** has been configured automatically between the Hub VNet and Spoke VNet. To check this in Azure navigate to Virtual Networks > select the VNet **name.**



Then select **Peerings**



Here you should see the name of the peer **VNet** with a status of connected. **Gateway Transit** should be disabled. Check this on both the hub and spoke VNet.



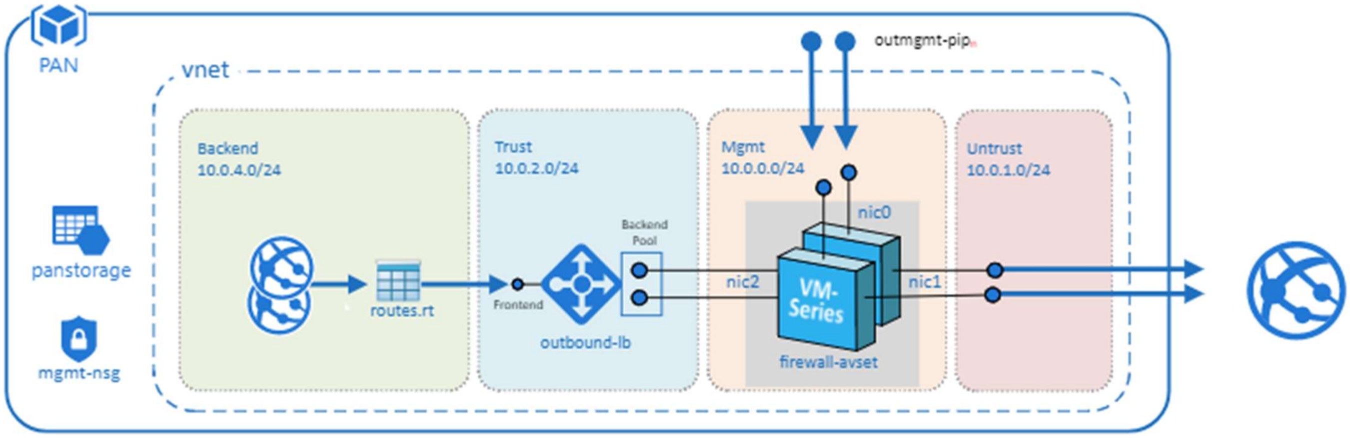
NAME	PEERING STATUS	PEER	GATEWAY TRANSIT
vnet-spoke-vnetvnet-peering	Connected	spoke-vnet	Disabled

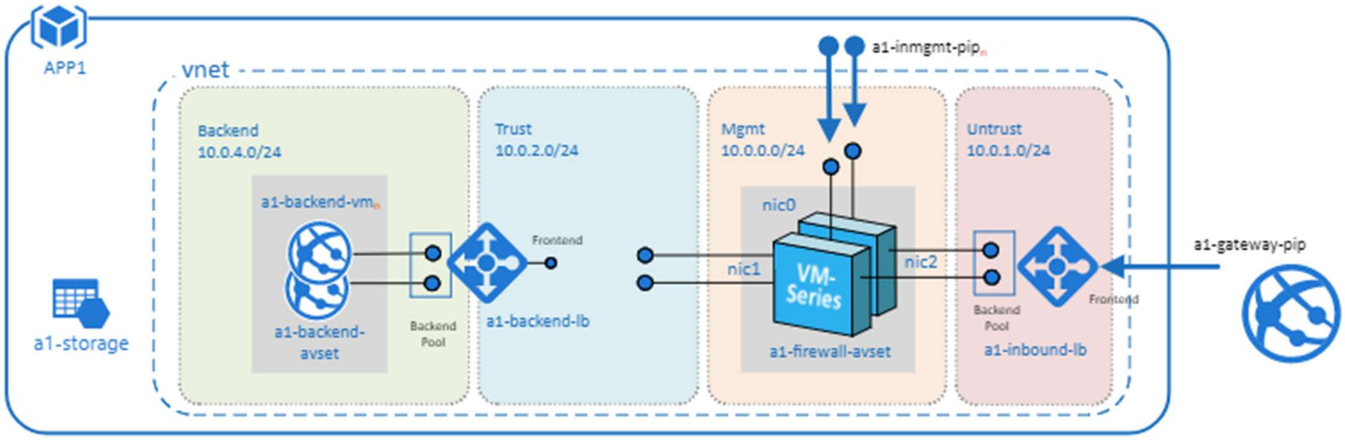
8. Inbound and Outbound Traffic Tests

Once you have confirmed that both the Hub and Spoke templates were successfully deployed, you have imported and loaded the firewall configuration and confirmed VNet Peering, you will want to test your proof of concept with live traffic.

Outbound Traffic Test

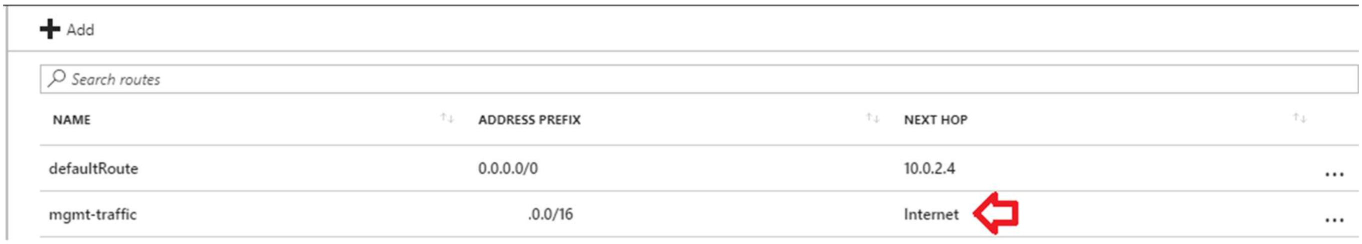
As per the diagram all traffic originating from within the Azure VNets will exit through the Hub VNet.





One way to test this setup is to originate traffic from a backend Linux VM deployed in the spoke to www.google.com by using wget www.google.com. From there check the traffic logs of the Hub firewalls for www.google.com traffic or web-browsing traffic if using another port 80 based website for wget tests. You will need a license to see logs in the traffic logs or you can edit the template to use PAYG1 or PAYG2.

By default you will not be able to access the Linux servers in the spoke. To access the Linux devices you will need to add a public IP address to one of the Spoke backend Linux servers. Then add a route on the UDR named “**defaultBackendUDR**” for mgmt traffic, that will allow your public IP address with a next hop of “**Internet**”



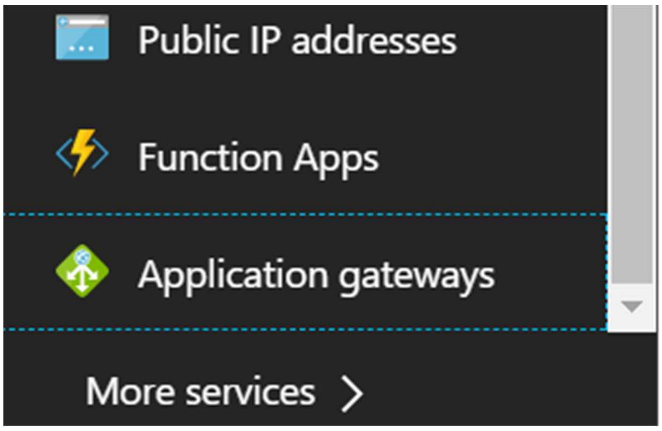
NAME	ADDRESS PREFIX	NEXT HOP	
defaultRoute	0.0.0.0/0	10.0.2.4	...
mgmt-traffic	.0.0/16	Internet	...

Another way to accomplish this would be to install a **Bastion Host** or **Jump Box** into the Backend Subnet and SSH from that device.

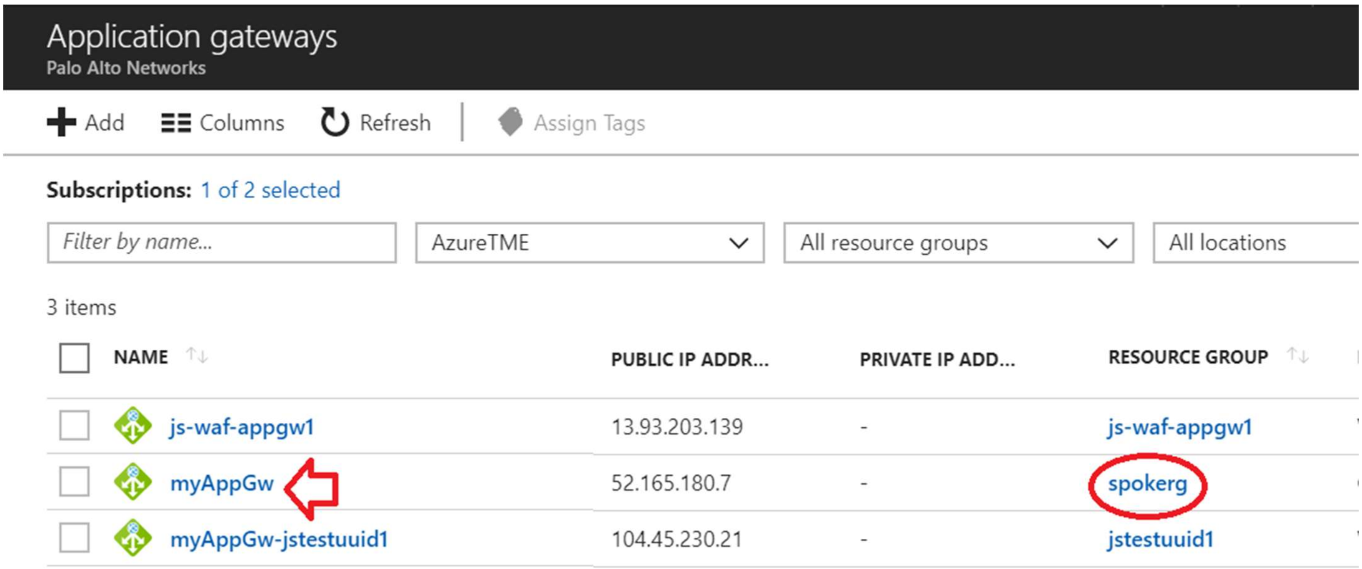
Inbound Traffic Test

When launching the spoke template with firewalls, the spoke VNet will have an Application Gateway (External LB), A set of firewalls and an internal Load balancer. This allows the spoke to host its own public facing workloads. Once you have launched the Spoke template with firewalls you can test access to the public facing workload by

Navigating to **“Application gateways”** within the Azure Portal



Selecting the name of your **Application Gateway** that was created when you launched the Transit VNet Spoke template. You can find the name of your **Resource Group** to help you differentiate from any other Application Gateways.



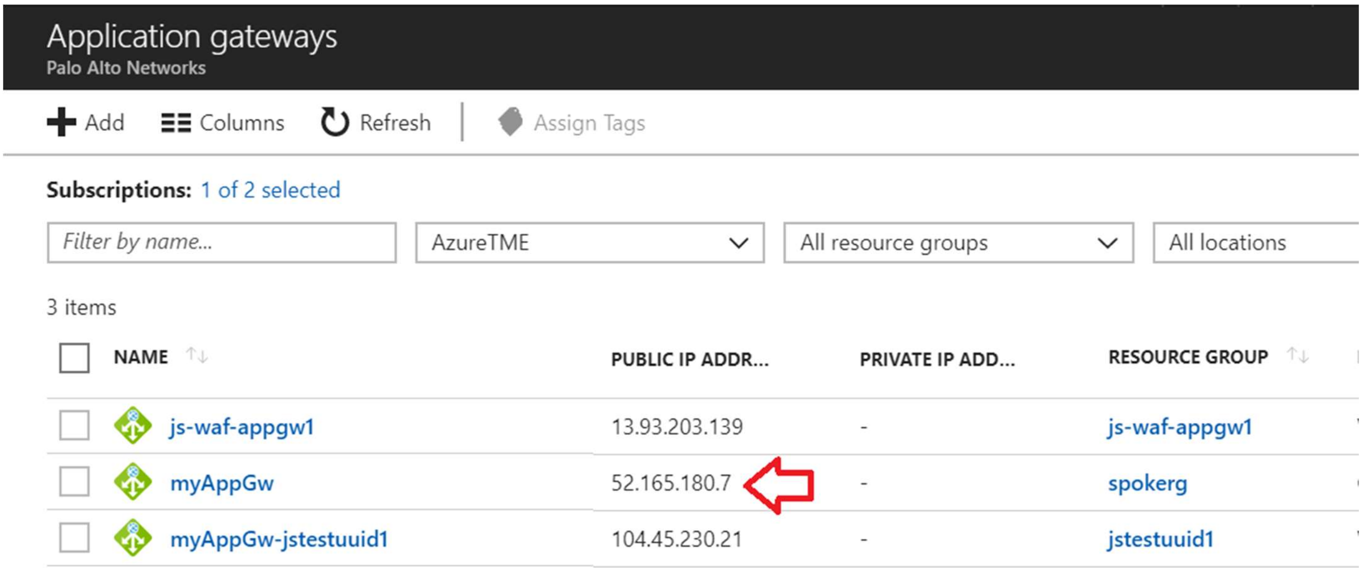
Subscriptions: 1 of 2 selected

Filter by name... | AzureTME | All resource groups | All locations

3 items

NAME	PUBLIC IP ADDR...	PRIVATE IP ADD...	RESOURCE GROUP
js-waf-appgw1	13.93.203.139	-	js-waf-appgw1
myAppGw	52.165.180.7	-	spokerg
myAppGw-jstestuuid1	104.45.230.21	-	jstestuuid1

Locale the **Public IP address** for your Application Gateway.



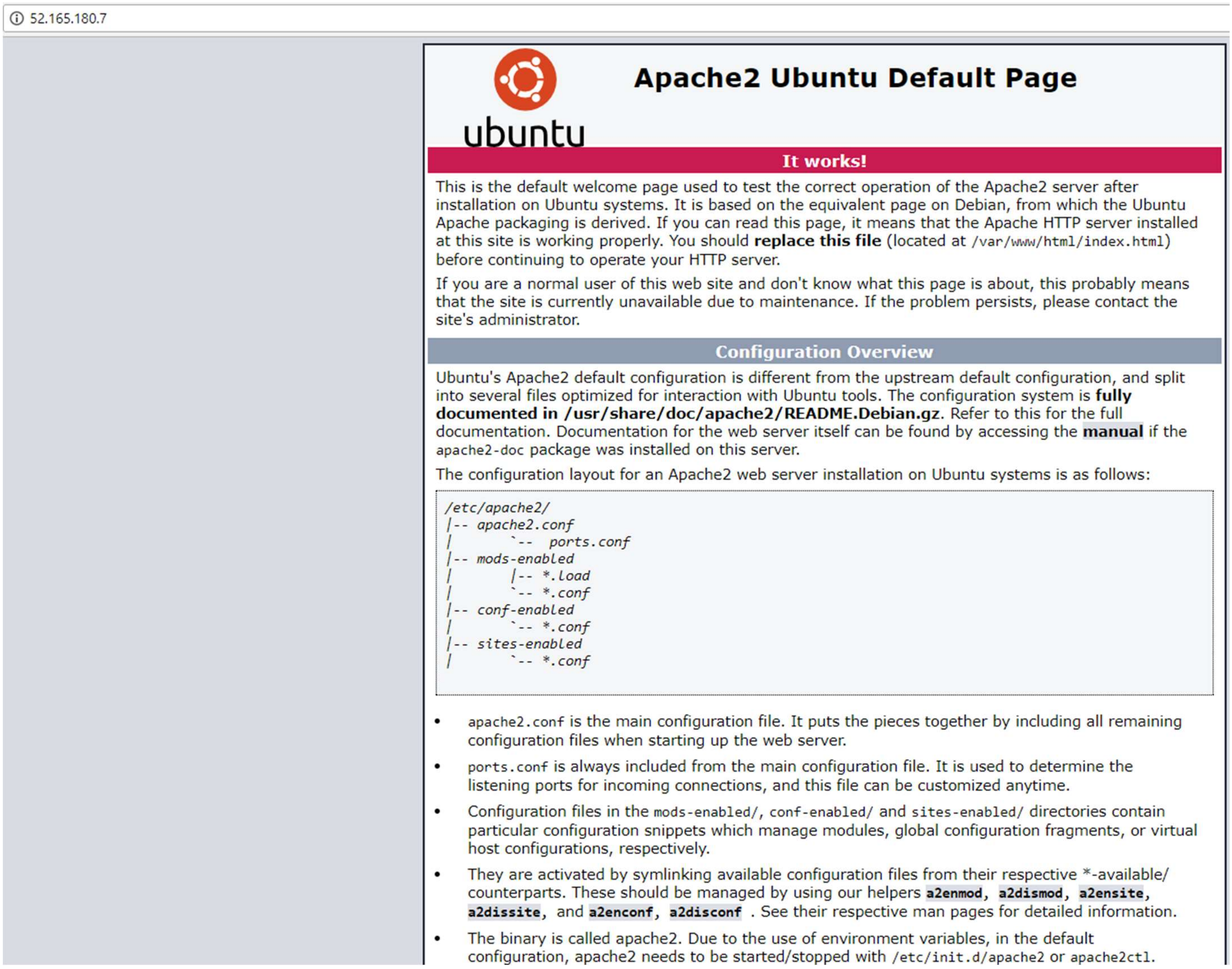
Subscriptions: 1 of 2 selected

Filter by name... | AzureTME | All resource groups | All locations

3 items

NAME	PUBLIC IP ADDR...	PRIVATE IP ADD...	RESOURCE GROUP
js-waf-appgw1	13.93.203.139	-	js-waf-appgw1
myAppGw	52.165.180.7	-	spokerg
myAppGw-jstestuuid1	104.45.230.21	-	jstestuuid1

Place the **Public IP address** in your web browser. This IP address is the public facing IP of the Application Gateway Load Balancer. You will see the default Ubuntu Page.



Apache2 Ubuntu Default Page

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

Configuration Overview

Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the `apache2-doc` package was installed on this server.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:

```
/etc/apache2/
|-- apache2.conf
|       `--  ports.conf
|-- mods-enabled
|       |-- *.load
|       `-- *.conf
|-- conf-enabled
|       `-- *.conf
|-- sites-enabled
|       `-- *.conf
```

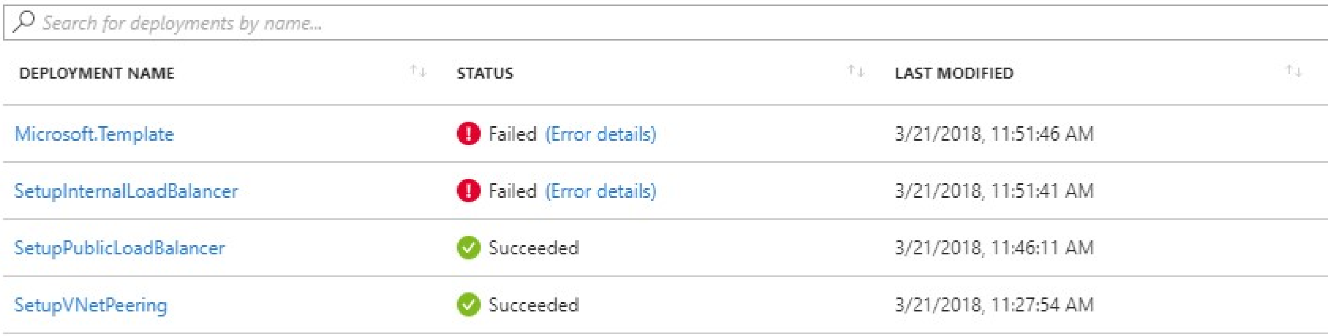
- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.
- `ports.conf` is always included from the main configuration file. It is used to determine the listening ports for incoming connections, and this file can be customized anytime.
- Configuration files in the `mods-enabled/`, `conf-enabled/` and `sites-enabled/` directories contain particular configuration snippets which manage modules, global configuration fragments, or virtual host configurations, respectively.
- They are activated by symlinking available configuration files from their respective *-available/ counterparts. These should be managed by using our helpers **`a2enmod`**, **`a2dismod`**, **`a2ensite`**, **`a2dissite`**, and **`a2enconf`**, **`a2disconf`** . See their respective man pages for detailed information.
- The binary is called apache2. Due to the use of environment variables, in the default configuration, apache2 needs to be started/stopped with `/etc/init.d/apache2` or `apache2ctl`.

9. Cleanup

You can clean up the setup by deleting the **resource groups** for both the hub and spoke deployments. Once you have deleted the resource groups for both the hub and spoke you will have successfully deleted all resources created in this deployment.

10. Gotchas

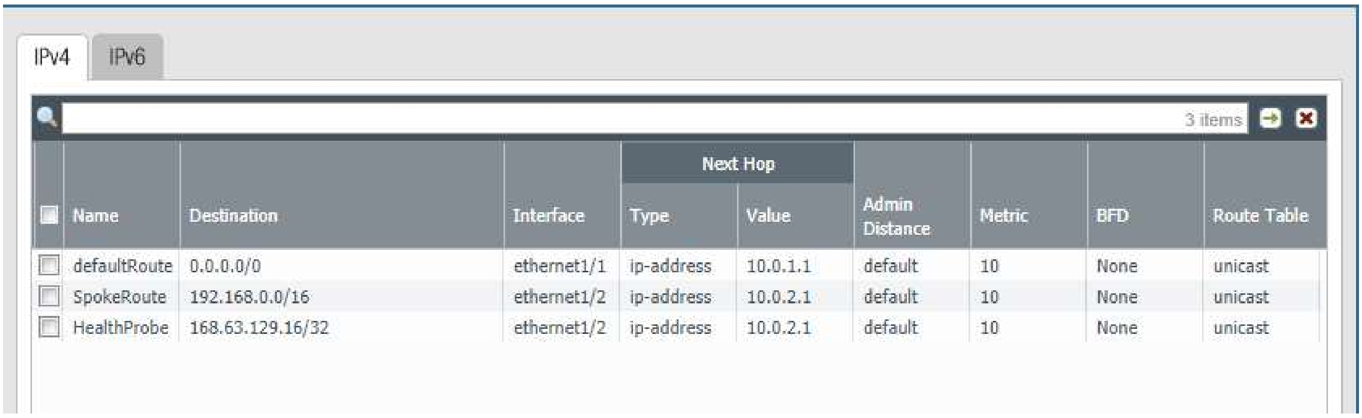
1. To successfully deploy your **spoke template**, the hub **VM-Series** firewalls must but up, running and configured or the deployment will fail. This means you must import your configuration snapshot file before launching your spoke template.



Search for deployments by name...

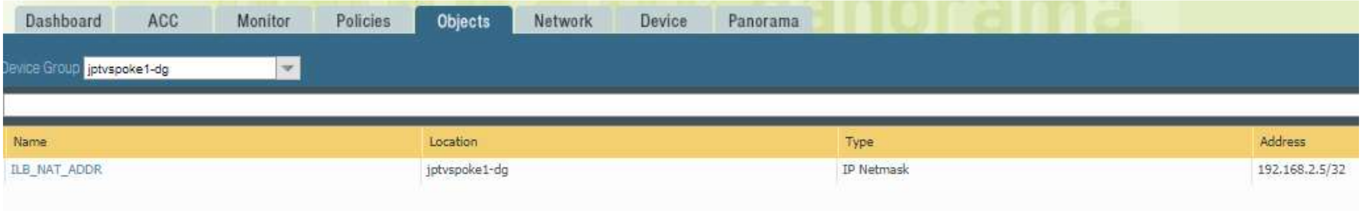
DEPLOYMENT NAME	STATUS	LAST MODIFIED
Microsoft.Template	! Failed (Error details)	3/21/2018, 11:51:46 AM
SetupInternalLoadBalancer	! Failed (Error details)	3/21/2018, 11:51:41 AM
SetupPublicLoadBalancer	✓ Succeeded	3/21/2018, 11:46:11 AM
SetupVNetPeering	✓ Succeeded	3/21/2018, 11:27:54 AM

2. **When adding a new spoke**, if the subnet does not fall within the 192.168.0.0/16 pre-configured route, be sure to add the new spoke subnet to the hub firewall VM-Series static route table. Clone the spoke route configuration and change the destination route



				Next Hop					
□	Name	Destination	Interface	Type	Value	Admin Distance	Metric	BFD	Route Table
□	defaultRoute	0.0.0.0/0	ethernet1/1	ip-address	10.0.1.1	default	10	None	unicast
□	SpokeRoute	192.168.0.0/16	ethernet1/2	ip-address	10.0.2.1	default	10	None	unicast
□	HealthProbe	168.63.129.16/32	ethernet1/2	ip-address	10.0.2.1	default	10	None	unicast

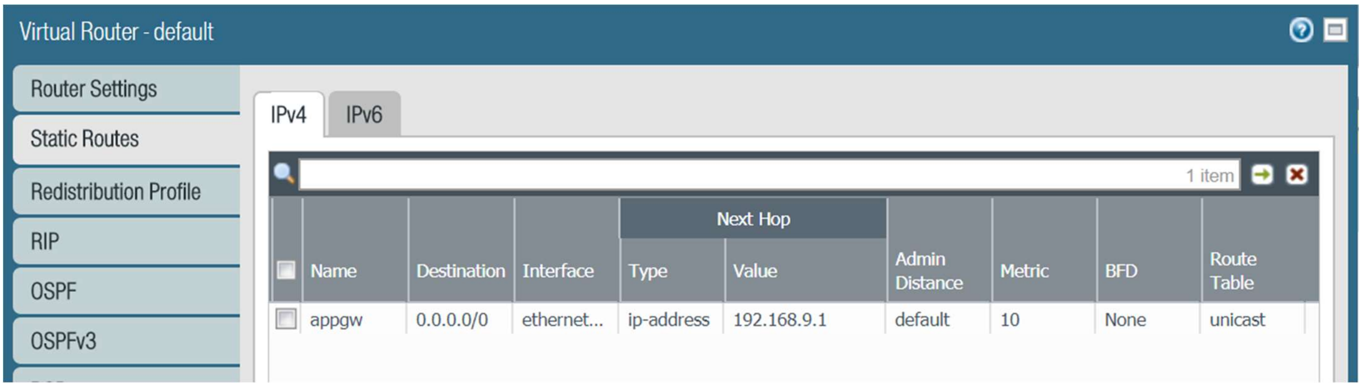
3. **Address objects** are statically defined in the configuration snapshot file. After the deployment of the spoke, the worker node will populate this object with the correct address.



Device Group jptvspoke1-dg

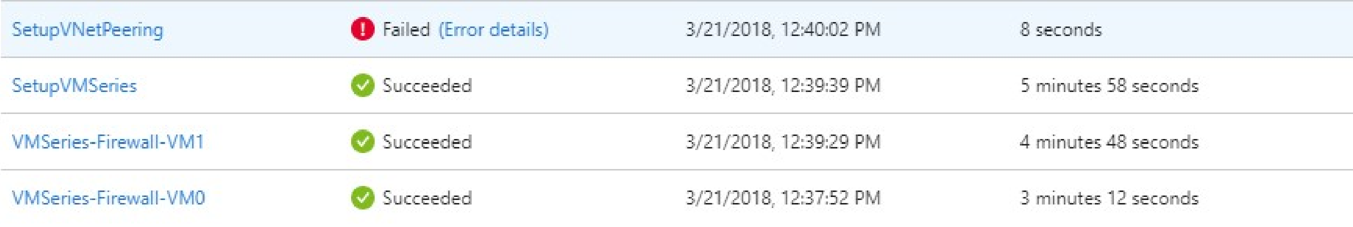
Name	Location	Type	Address
ILB_NAT_ADDR	jptvspoke1-dg	IP Netmask	192.168.2.5/32

4. When adding additional spokes using the firewall template you must change the spoke firewall **Default Route** to point to the untrust Azure system gateway for the subnet of the Untrust Interface.



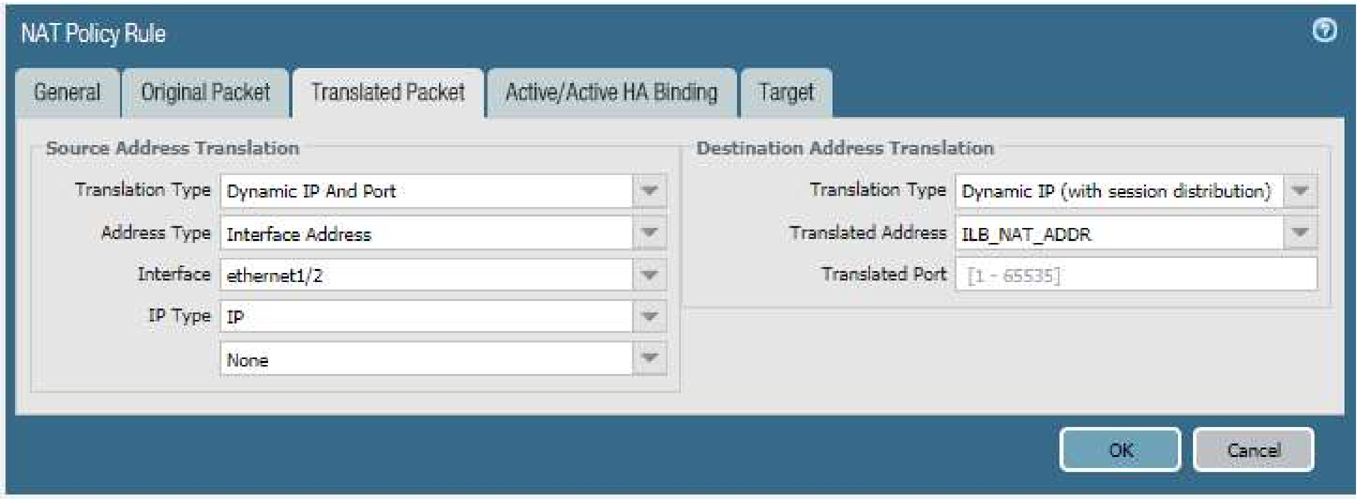
□	Name	Destination	Interface	Next Hop		Admin Distance	Metric	BFD	Route Table
				Type	Value				
□	appgw	0.0.0.0/0	ethernet...	ip-address	192.168.9.1	default	10	None	unicast

5. Anytime you delete and redeploy a spoke **VNet**, it’s always best practice to delete the peering configuration from within the hub VNet. The Azure system route table re-calculates after peering is established. To add new routes, you must remove the peering association, add the new routes then recreate the peering association.



SetupVNetPeering	Failed (Error details)	3/21/2018, 12:40:02 PM	8 seconds
SetupVMSeries	Succeeded	3/21/2018, 12:39:39 PM	5 minutes 58 seconds
VMSeries-Firewall-VM1	Succeeded	3/21/2018, 12:39:29 PM	4 minutes 48 seconds
VMSeries-Firewall-VM0	Succeeded	3/21/2018, 12:37:52 PM	3 minutes 12 seconds

6. Your **NAT policy** in Panorama will fail to push to the firewall unless your translated packet for source and destination looks like the screenshot below. For Destination do NOT use static.



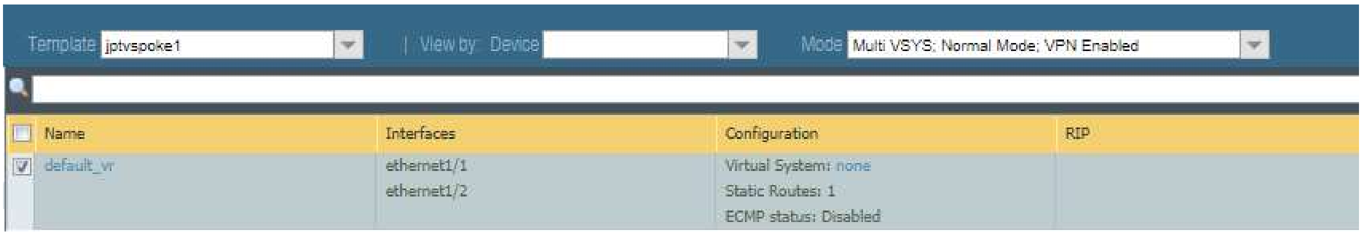
Source Address Translation

Translation Type: Dynamic IP And Port
Address Type: Interface Address
Interface: ethernet1/2
IP Type: IP
None

Destination Address Translation

Translation Type: Dynamic IP (with session distribution)
Translated Address: ILB_NAT_ADDR
Translated Port: [1 - 65535]

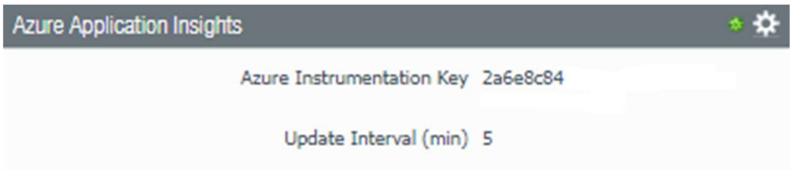
7. Be sure to **never** name something on Panorama the same as what is already configured locally on the firewall. For example if you name your virtual route in the Panorama Template “default”, your Panorama push to devices will fail because the local firewall has a default virtual route. Use something like default_vr instead.



Template: jptvspoke1 | View by: Device | Mode: Multi VSYS; Normal Mode; VPN Enabled

□ Name	Interfaces	Configuration	RIP
☑ default_vr	ethernet1/1 ethernet1/2	Virtual System: none Static Routes: 1 ECMP status: Disabled	

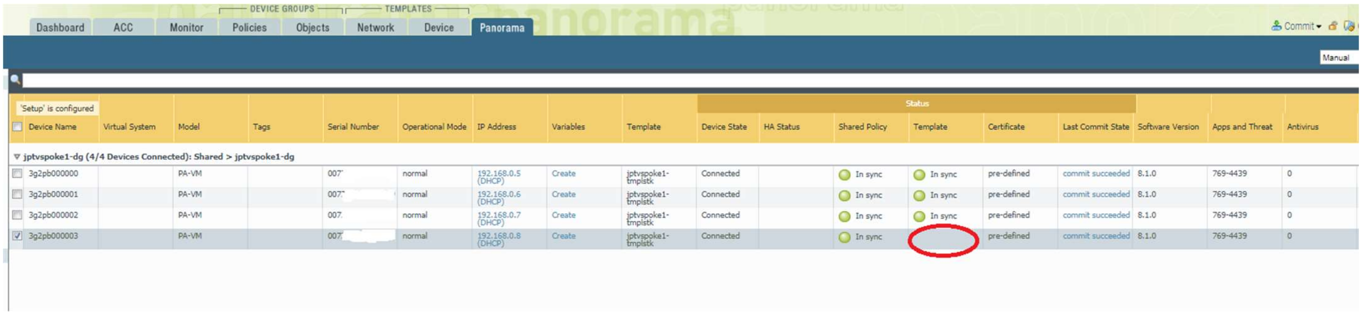
8. If you are not seeing any **Metrics** being populated within the Metric view within application insights double check your instrumentation key within the Panorama Template Configuration.



Azure Instrumentation Key: 2a6e8c84

Update Interval (min): 5

9. After the VM-Series in the VMSS bootstraps it will receive the settings to connect to Panorama. Once connected the device group and template configuration will be pushed to the firewall. After this takes place it is important to note that Panorama does NOT commit. What this means is that after your bootstrap firewall receives its device group and template configuration it will work as designed HOWEVER a commit will still need to take place on Panorama to preserve the firewall in the device list. If a scale event takes place and a firewall is added you will know because, although the template has been pushed to the firewall it will not show in sync in panorama. See below.



									Status								
□	Device Name	Virtual System	Model	Tags	Serial Number	Operational Mode	IP Address	Variables	Template	Device State	HA Status	Shared Policy	Template	Certificate	Last Commit State	Software Version	Apps and Threat	Antivirus
▽ jptvspoke1-dg (4/4 Devices Connected): Shared > jptvspoke1-dg																		
□	3g2pb000000		PA-VM		007[redacted]	normal	192.168.0.5 (DHCP)	Create	jptvspoke1-tmplstk	Connected		● In sync	● In sync	pre-defined	commit succeeded	8.1.0	769-4439	0
□	3g2pb000001		PA-VM		007[redacted]	normal	192.168.0.6 (DHCP)	Create	jptvspoke1-tmplstk	Connected		● In sync	● In sync	pre-defined	commit succeeded	8.1.0	769-4439	0
□	3g2pb000002		PA-VM		007[redacted]	normal	192.168.0.7 (DHCP)	Create	jptvspoke1-tmplstk	Connected		● In sync	● In sync	pre-defined	commit succeeded	8.1.0	769-4439	0
☑	3g2pb000003		PA-VM		007[redacted]	normal	192.168.0.8 (DHCP)	Create	jptvspoke1-tmplstk	Connected		● In sync		pre-defined	commit succeeded	8.1.0	769-4439	0

You will want to perform a Panorama commit to avoid an unexpected reboot which will then cause the Panorama to lose its candidate configuration.

10. **When issue #9 happens**, you can check the worker node logs to see data. From the Hub resource group locate the worker node public IP address and log in using the pandemo user account and password.
Type $sudo bash
Type # cd /root
Type cat worker.log | grep boot
You will see output like the following.

```
[2018-06-22 02:45:07,716] [INFO] (MainThread) VM 3g2pb000003 found in VMSS but not in Panorama. May be not yet booted.
```

11. **The worker node handles delicensing.** You can check the /root/worker.log for information on delicensed VM's

```
[2018-06-19 21:20:13,324] [INFO] (MainThread) The following VMs need to be delicensed [{'serial': u'007xxxxxxxxxxxx', 'hostname': u'3g2pb000001', 'name': u'007xxxxxxxxxxxx '}]
```

12. You can check the worker.log for issues with **API calls** to Panorama as well.

13. The following output in the worker.log would signify that Panorama is not accessible or the **API key used is incorrect**

    ```
    [2018-06-27 06:05:08,661] [INFO] (MainThread) Executed URL
    https://23.99.134.105/api/?type=config&action=get&key=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx=&xpath=/config/devices/entry[@name='localhost.loc
    aldomain']/device-group/entry[@name='jptvspoke1-dg']/devices
    [2018-06-27 06:07:18,818] [ERROR] (MainThread) Execution of cmd failed with <urlopen
    error [Errno 110] Connection timed out>
    [2018-06-27 06:07:18,819] [INFO] (MainThread) Getting device list from DG jptvspoke1-dg
    failed <urlopen error [Errno 110] Connection timed out>
    ```