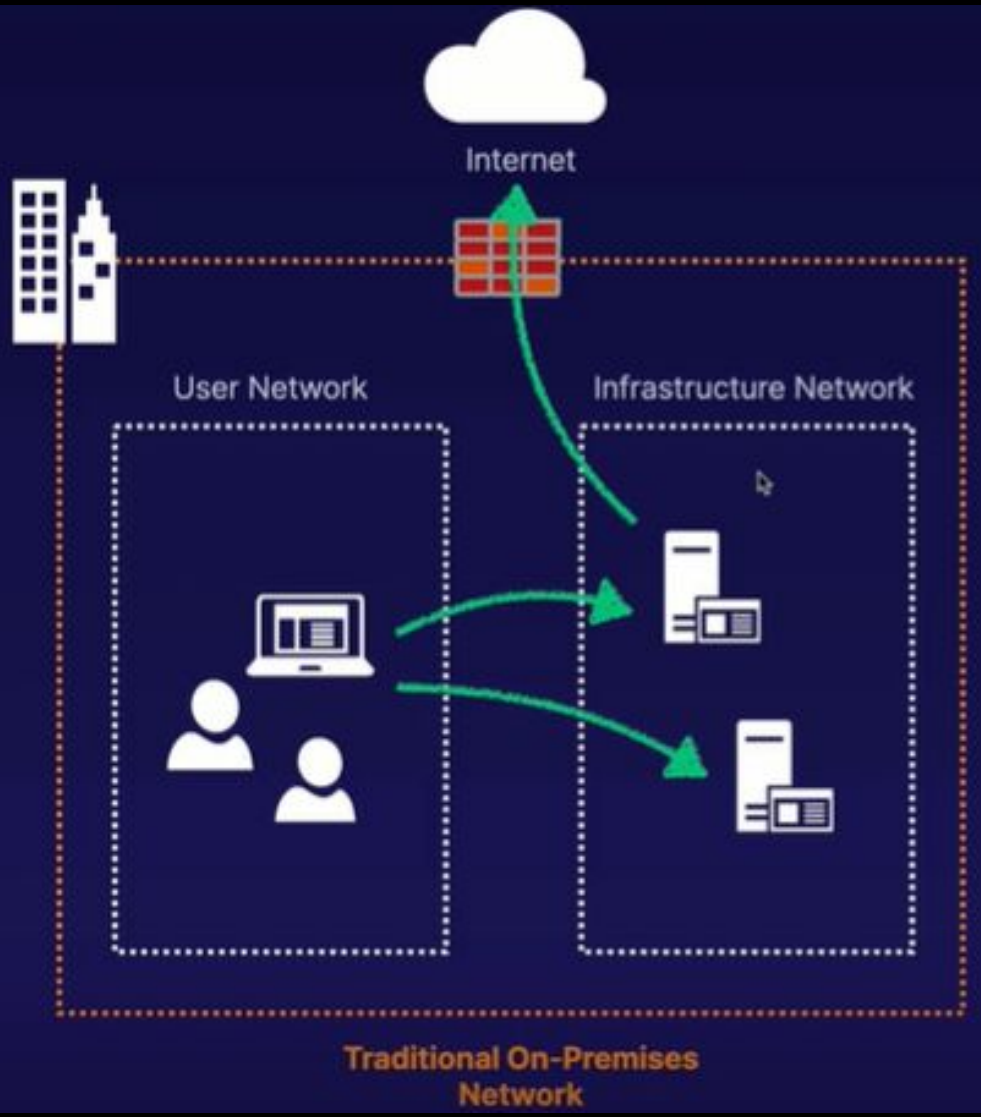
AZURE 104

Implement Infrastructure

Virtual Networking

The purpose of a Network



Communication:
Connectivity between resources.

Networks are crucial; they help users access resources that exist somewhere other than their personal devices.

For example:

- Users in an office accessing files on a server
- Remote staff accessing a web server
- Application servers accessing data on the Internet

The purpose of a Network

Virtual Network (VNet)

The VNet is an isolated container within Azure, which provides network connectivity for resources.

Subnet

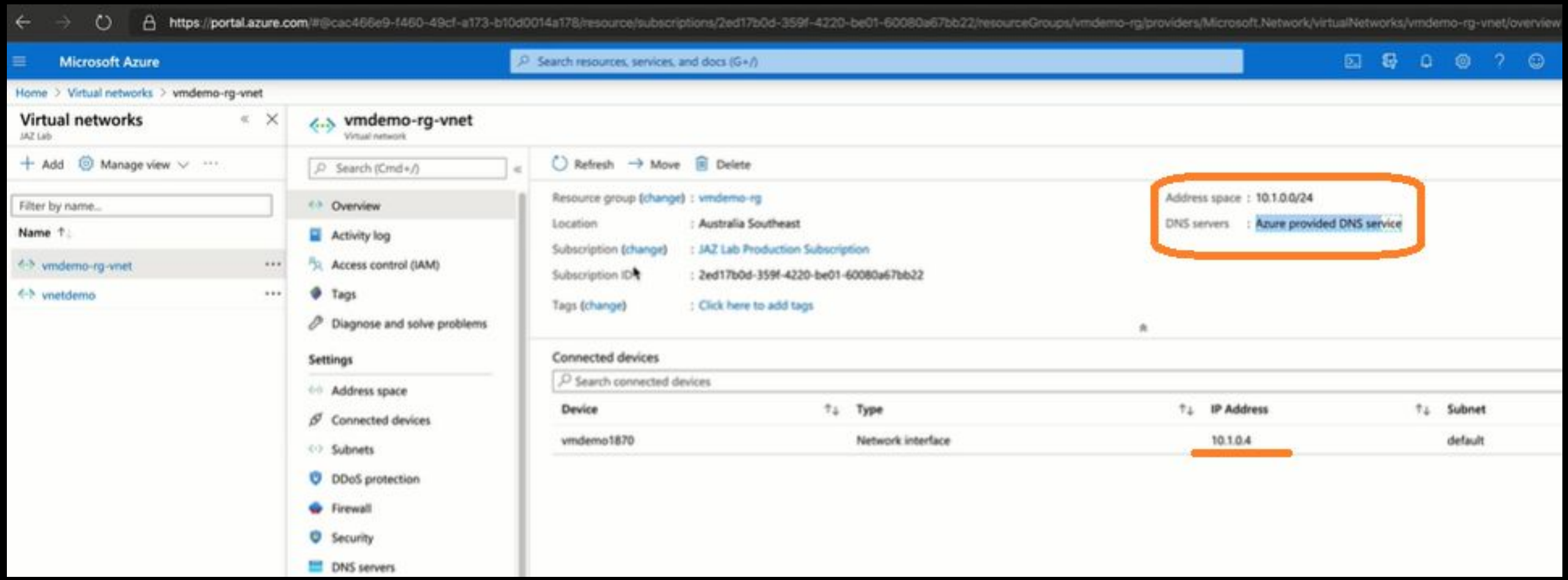
A virtual network has one or more subnets. Resources that require network connectivity must reside in a subnet.

Address Space

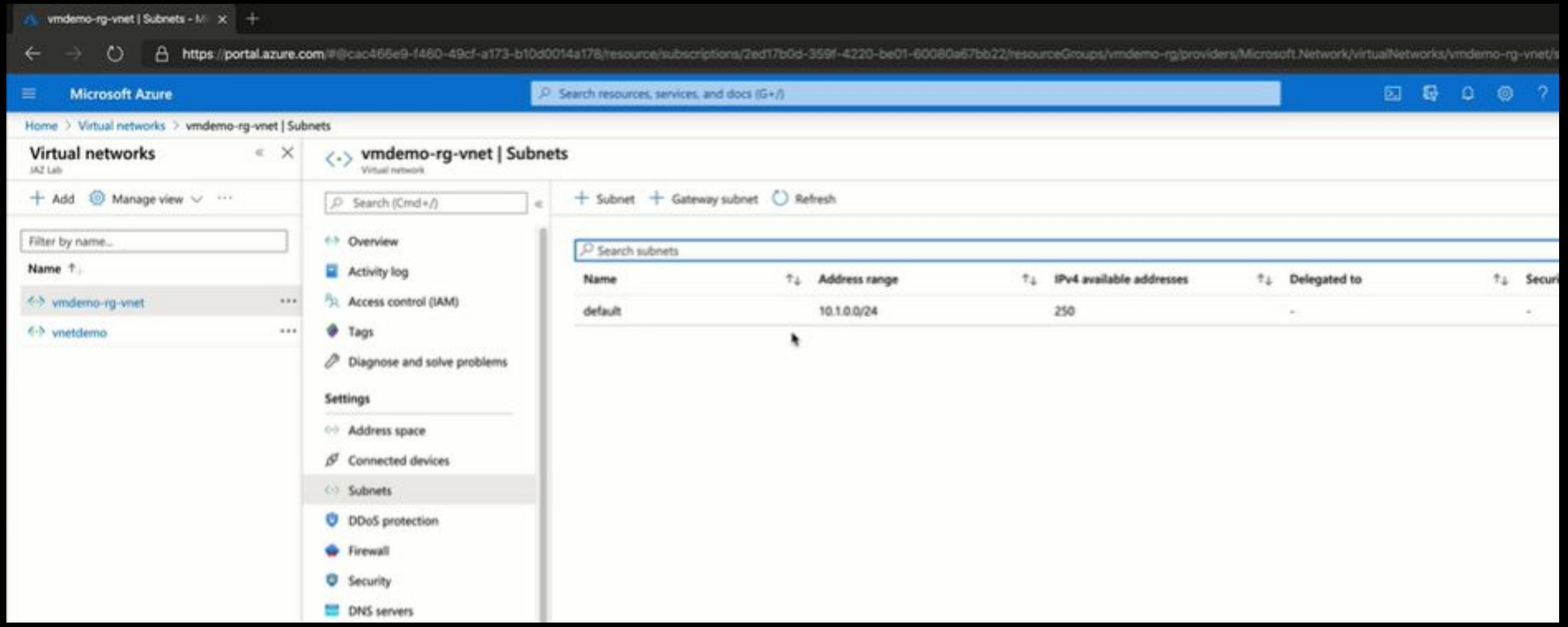
10.0.0.0

Virtual networks require one or more address spaces to provide private IP addresses to resources.

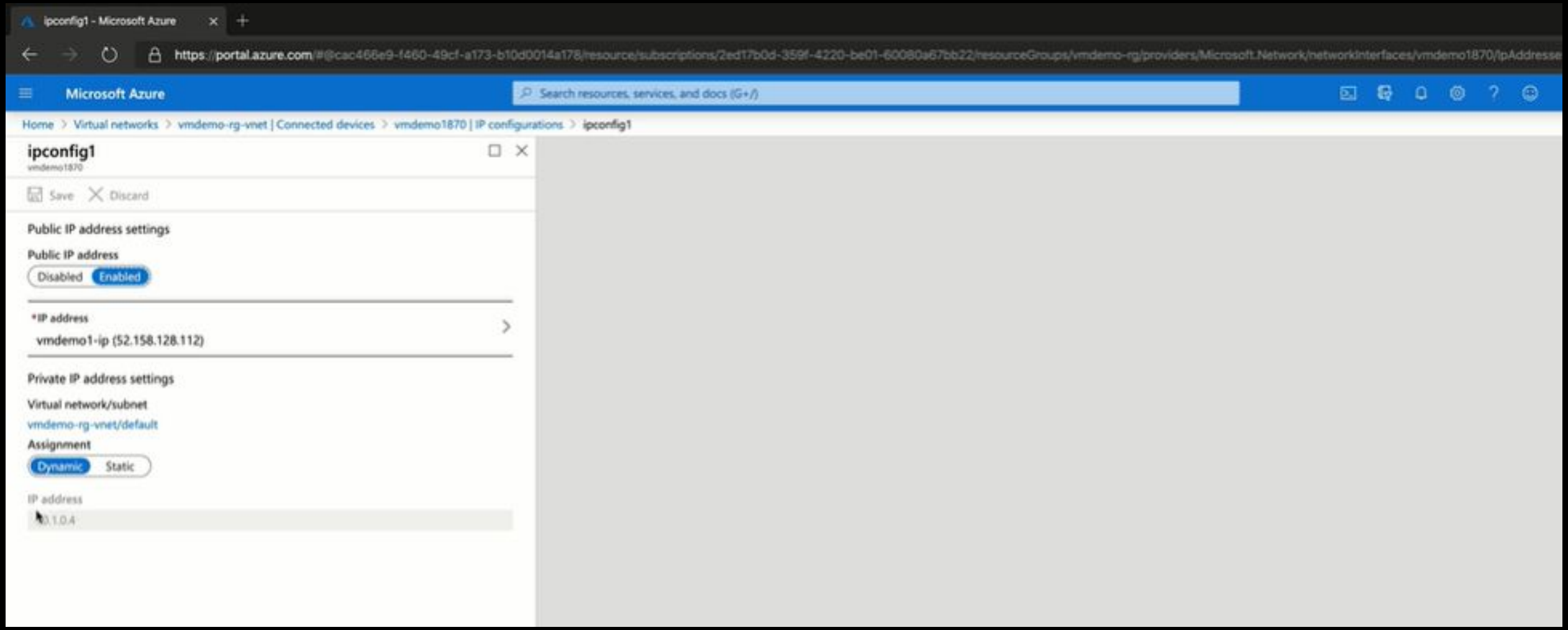
Virtual Networks in Azure



Virtual Networks in Azure



Virtual Networks in Azure | Subnets



Virtual Networks in Azure | ipconfig

Important Considerations

1. **Default Connectivity**

   After creating a virtual network, some connectivity is enabled by default (e.g., Internet access, inter-subnet access).

2. **Address Range Restrictions**

   Private IP address ranges (as per RFC 1918) are allowed. The smallest allowed VNet/subnet is /29, and the largest is /8.

3. **Reserved IP Addresses**

   5 IP addresses are reserved in each subnet. This includes the first three and last one (e.g. x.x.x.0-3, x.x.x.255).

4. **DNS and DHCP**

   Custom DNS can be configured for your VNet. DHCP is built-in, however, and custom DHCP cannot be deployed.

5. **Supported Protocols**

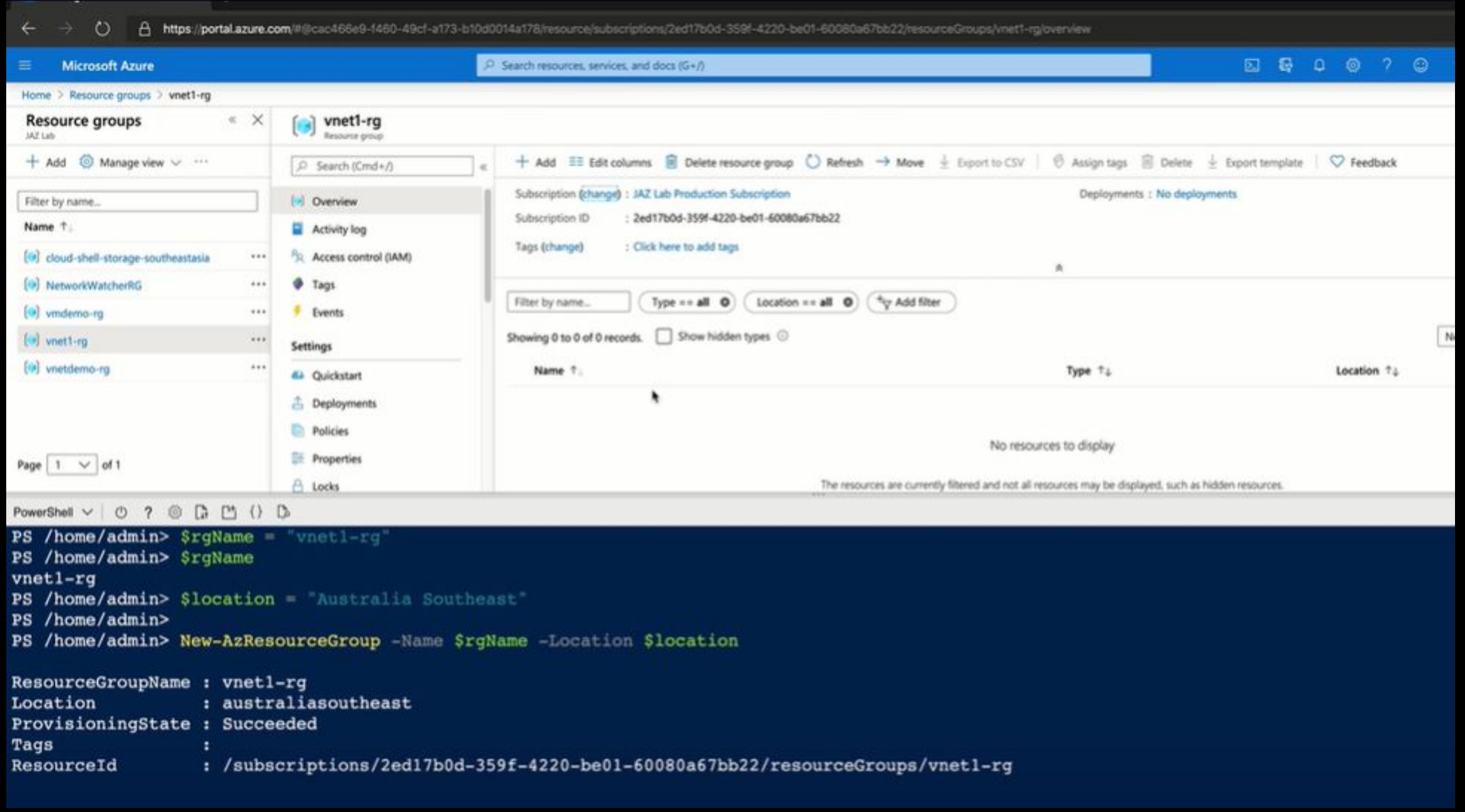
   VNets support TCP, UDP, and ICMP TCP/IP protocols. Some common protocols such as multicast and GRE are blocked.

6. **Integrated Connectivity**

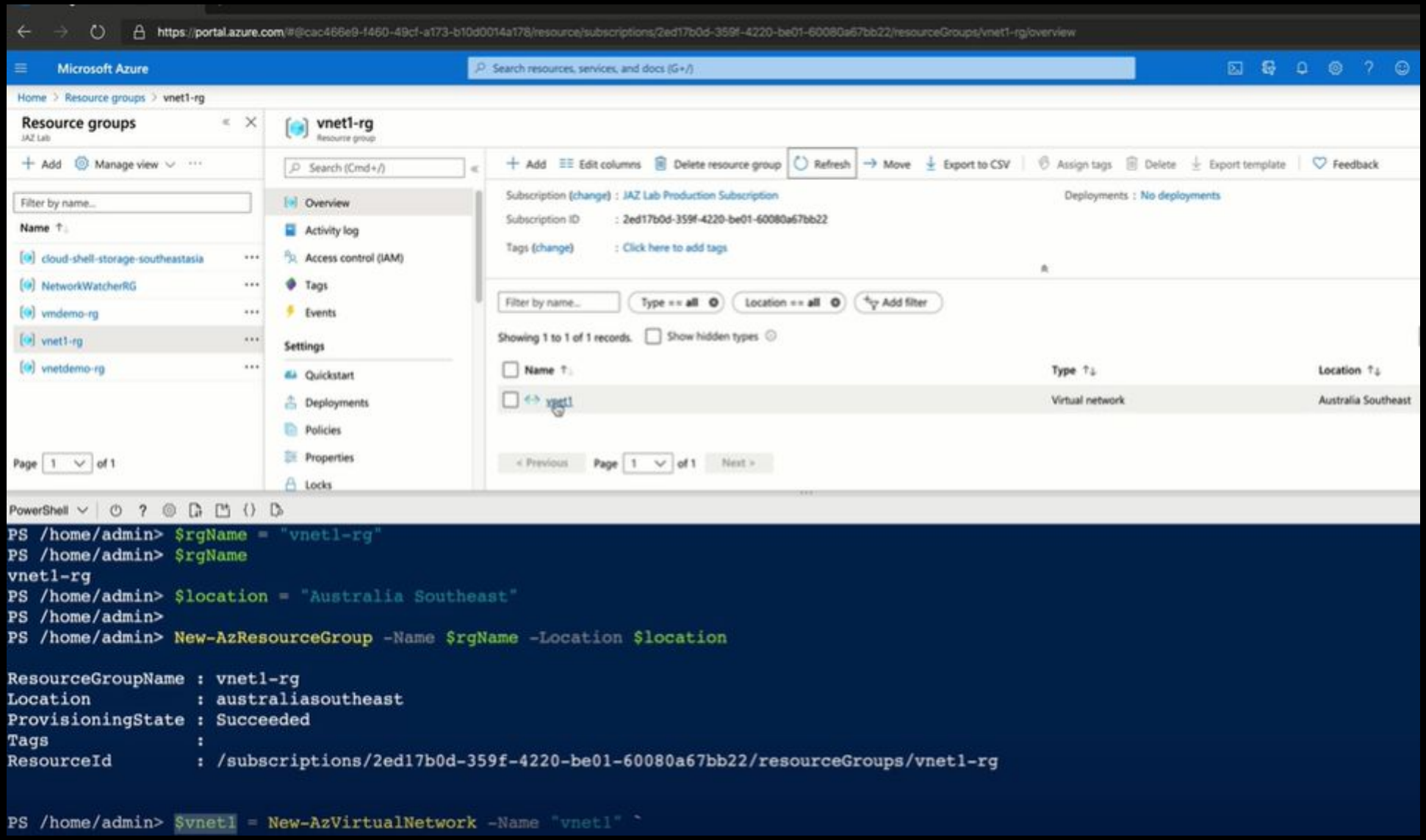
   VNets are also built for various forms of integration, including ExpressRoute, Private Link, VPN, and more.

```powershell
$rgName = "vnet1-rg"
$location = "Australia Southeast"

# Create a resource group
New-AzResourceGroup -Name $rgName -Location $location

# Create the virtual network
$vnet1 = New-AzVirtualNetwork -Name "vnet1" `
    -ResourceGroupName $rgName `
    -Location $location `
    -AddressPrefix "10.1.0.0/16"

# Create a subnet, and add it to the new virtual network
Add-AzVirtualNetworkSubnetConfig -Name "subnet1" `
    -AddressPrefix "10.1.1.0/24" `
    -VirtualNetwork $vnet1

Set-AzVirtualNetwork -VirtualNetwork $vnet1
```

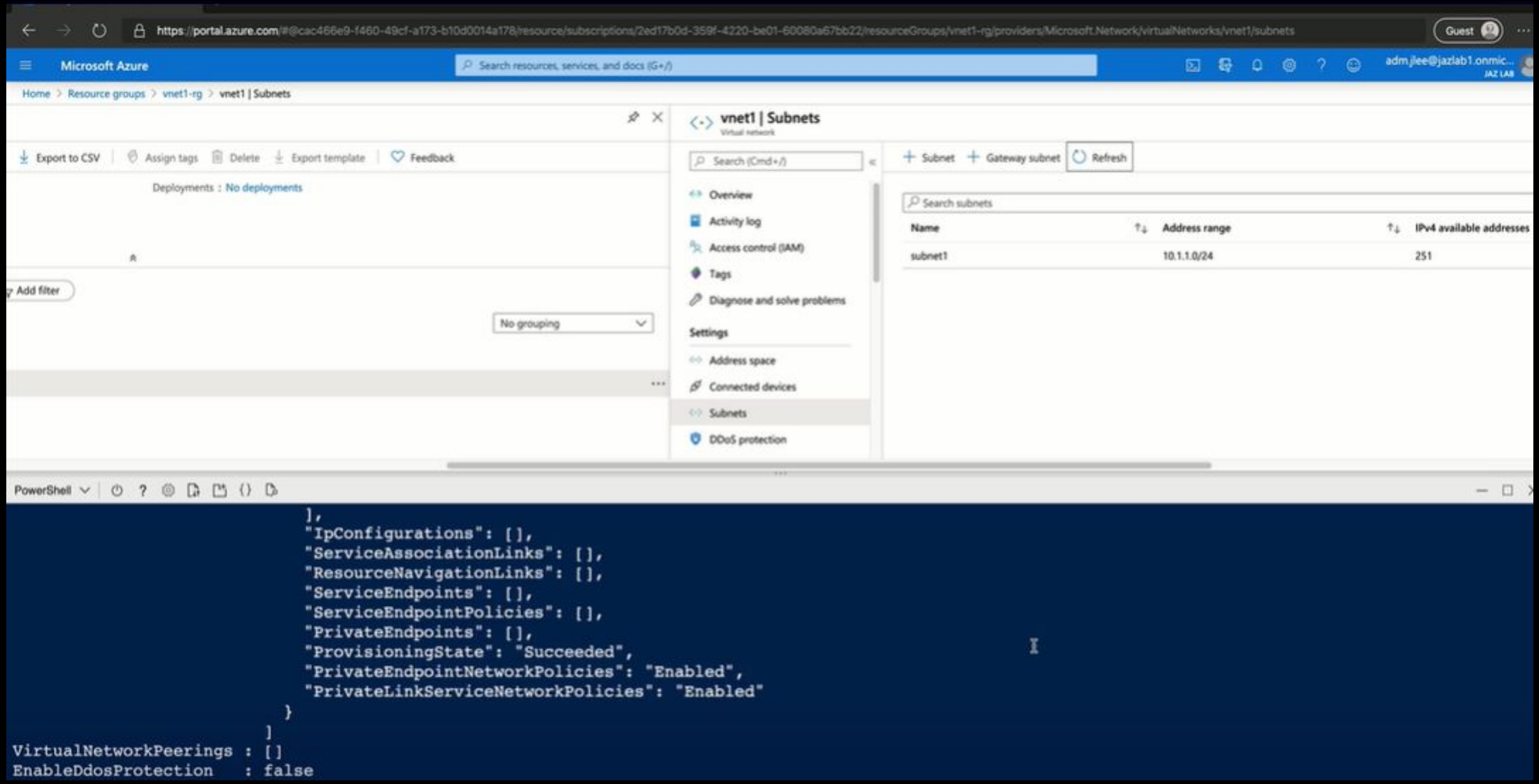
Configuring Virtual Networks



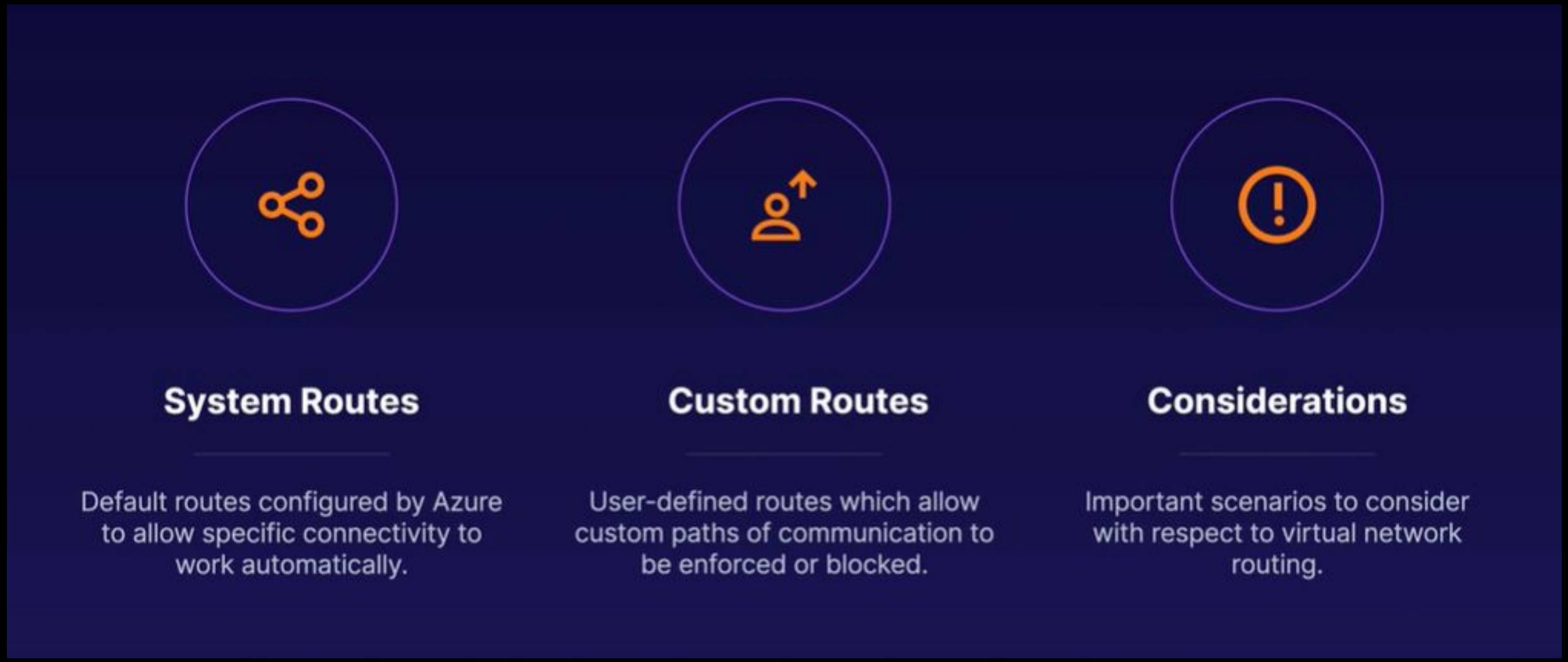
Configuring Virtual Networks



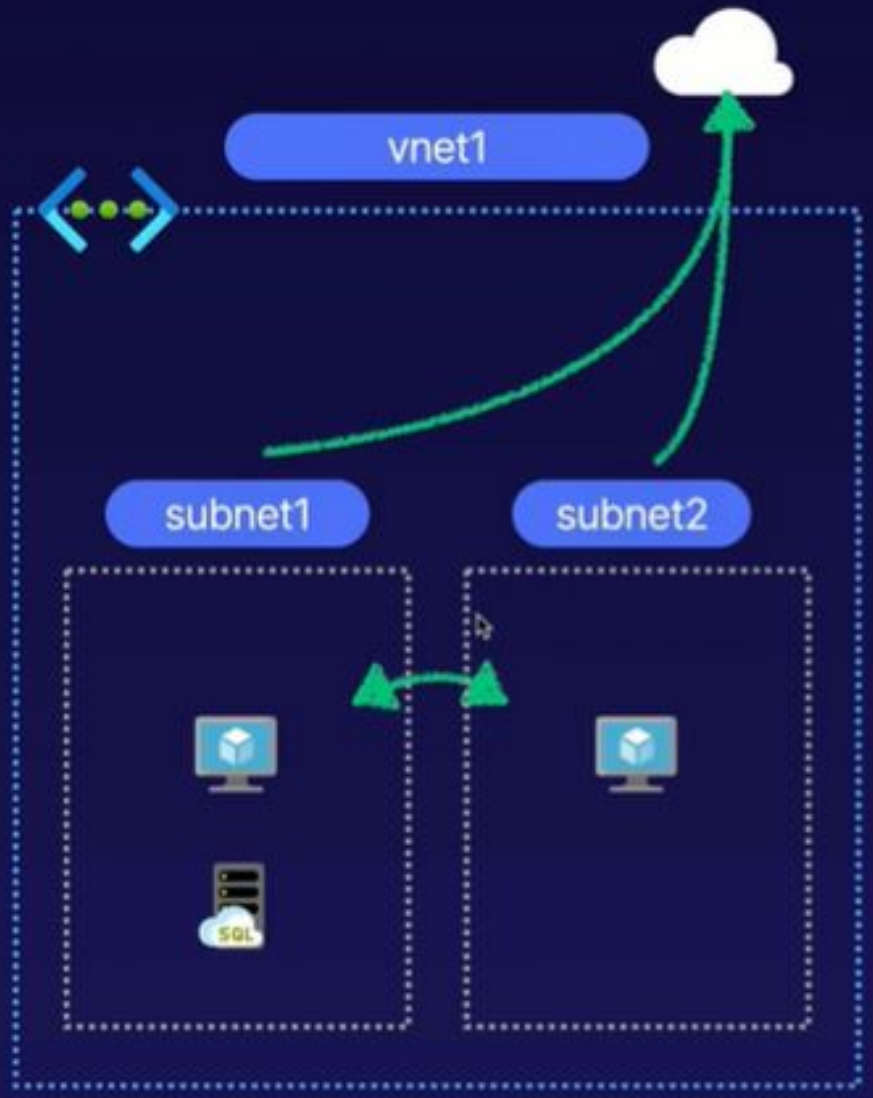
Configuring Virtual Networks



Configuring Virtual Networks



Virtual Networks Routing And Connectivity



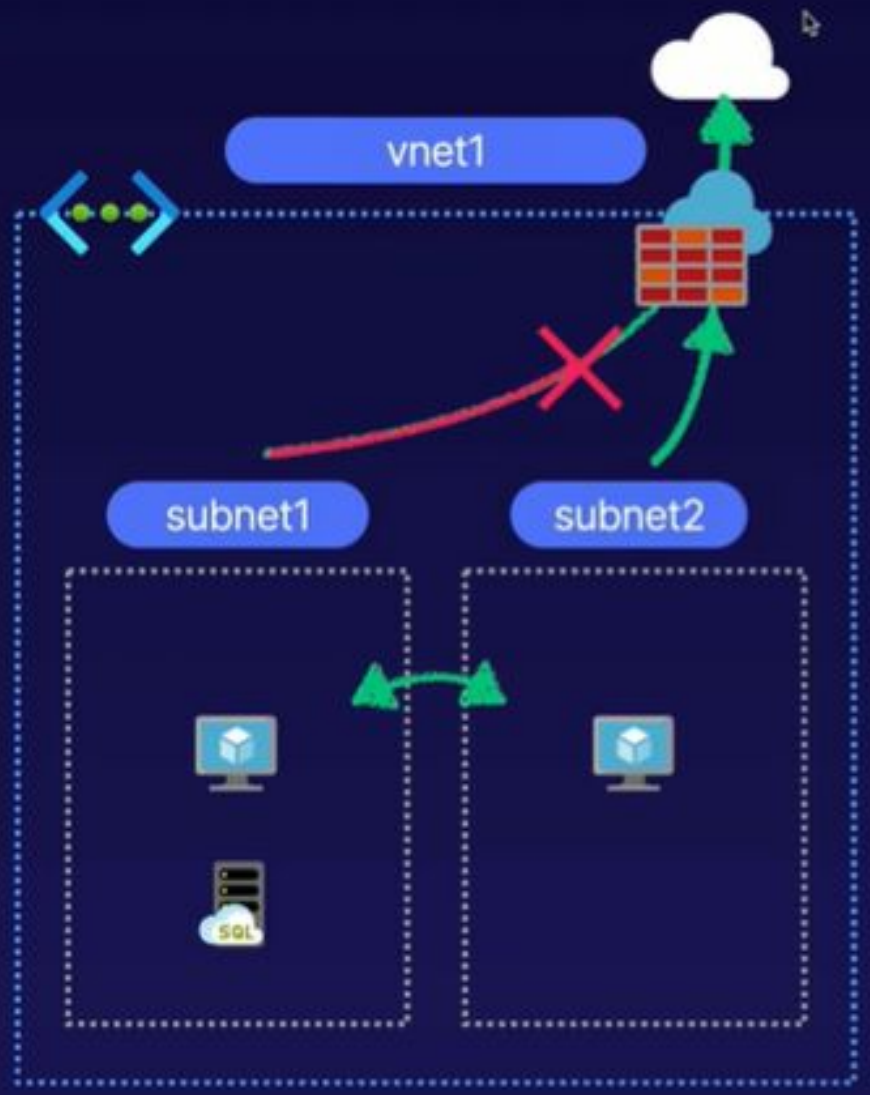
Default Connectivity

Virtual Networks come pre-configured with a range of "paths" already allowed.

The following routes are allowed:

- Outbound access to the Internet
- Subnet to subnet connectivity
- Other default routes to support advanced connectivity (e.g., peering)

Virtual Networks Routing And Connectivity



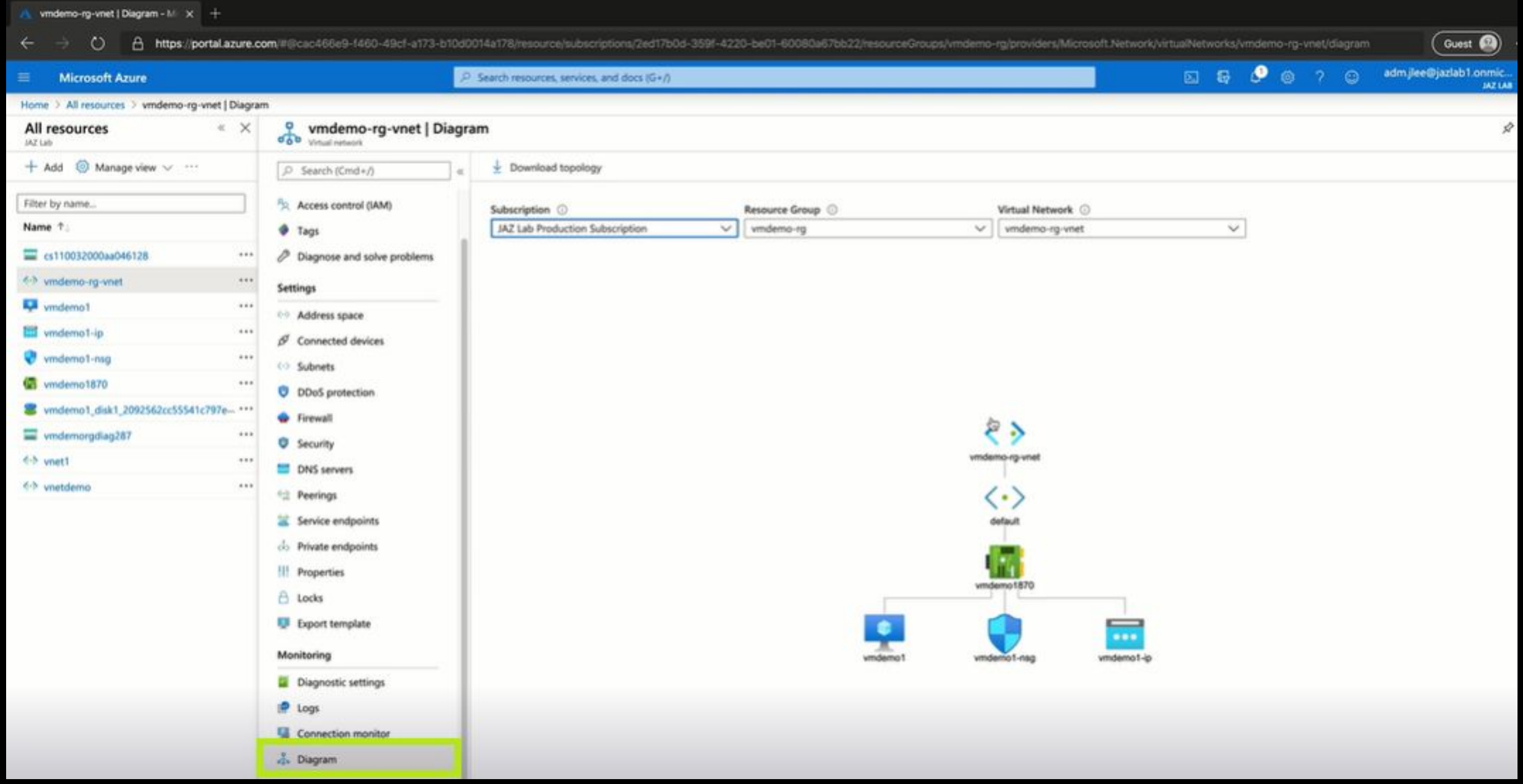
Custom Routes

Custom Routes allow us to change the default routing behavior.

For example:

- Blocking all access to the Internet
- Forcing traffic via another address (e.g., all traffic via a network virtual appliance, or Azure Firewall)

Virtual Networks Routing And Connectivity



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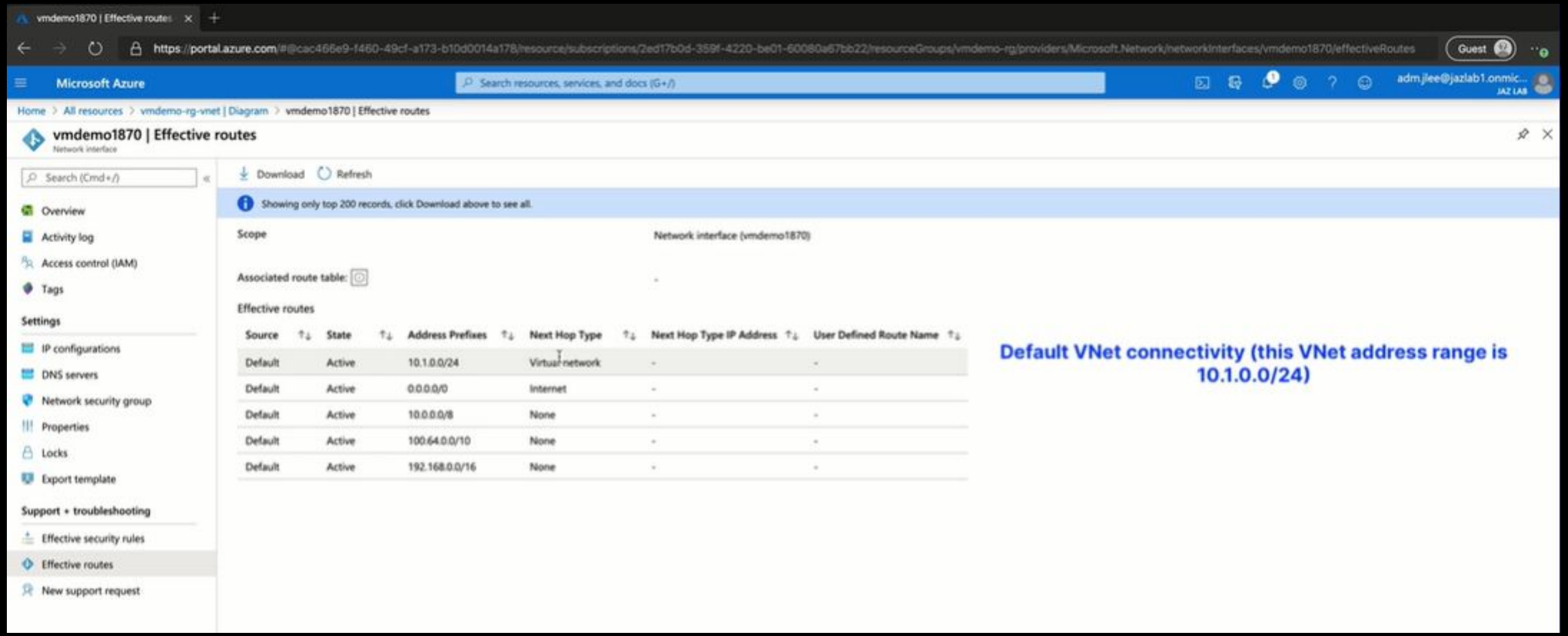
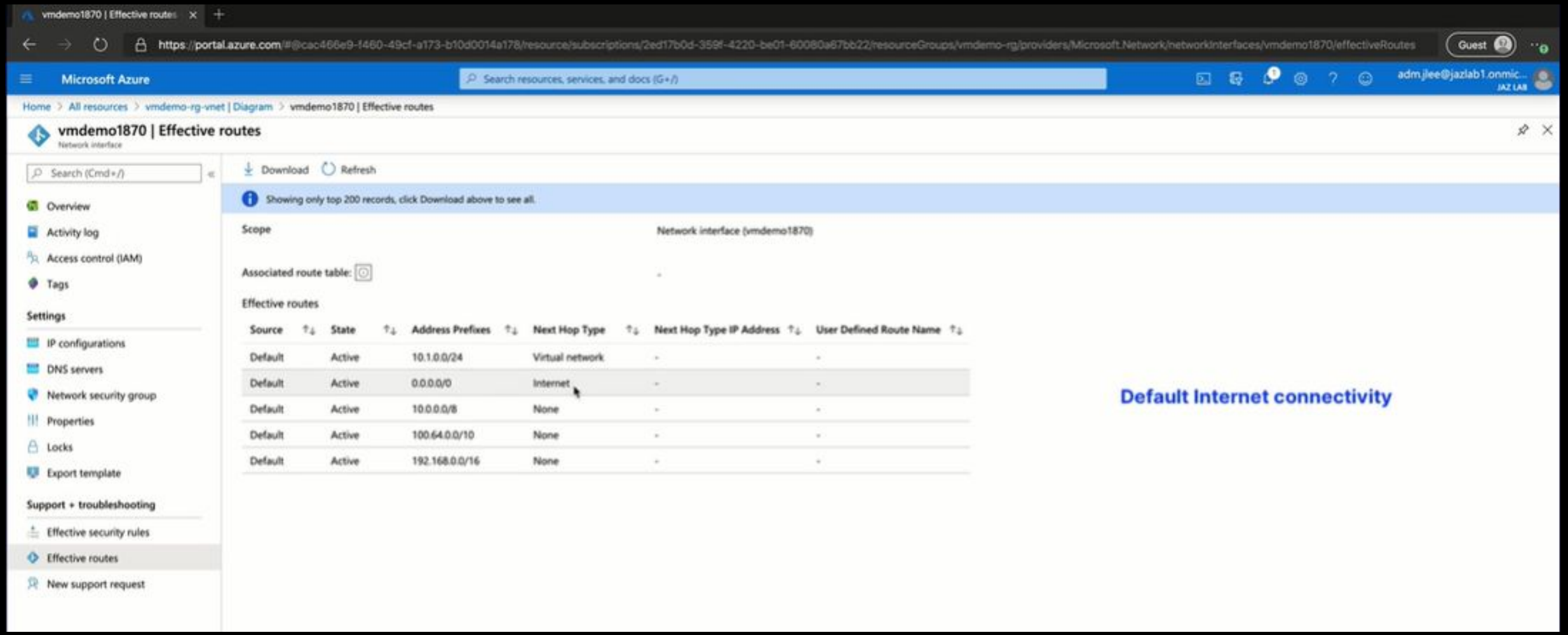
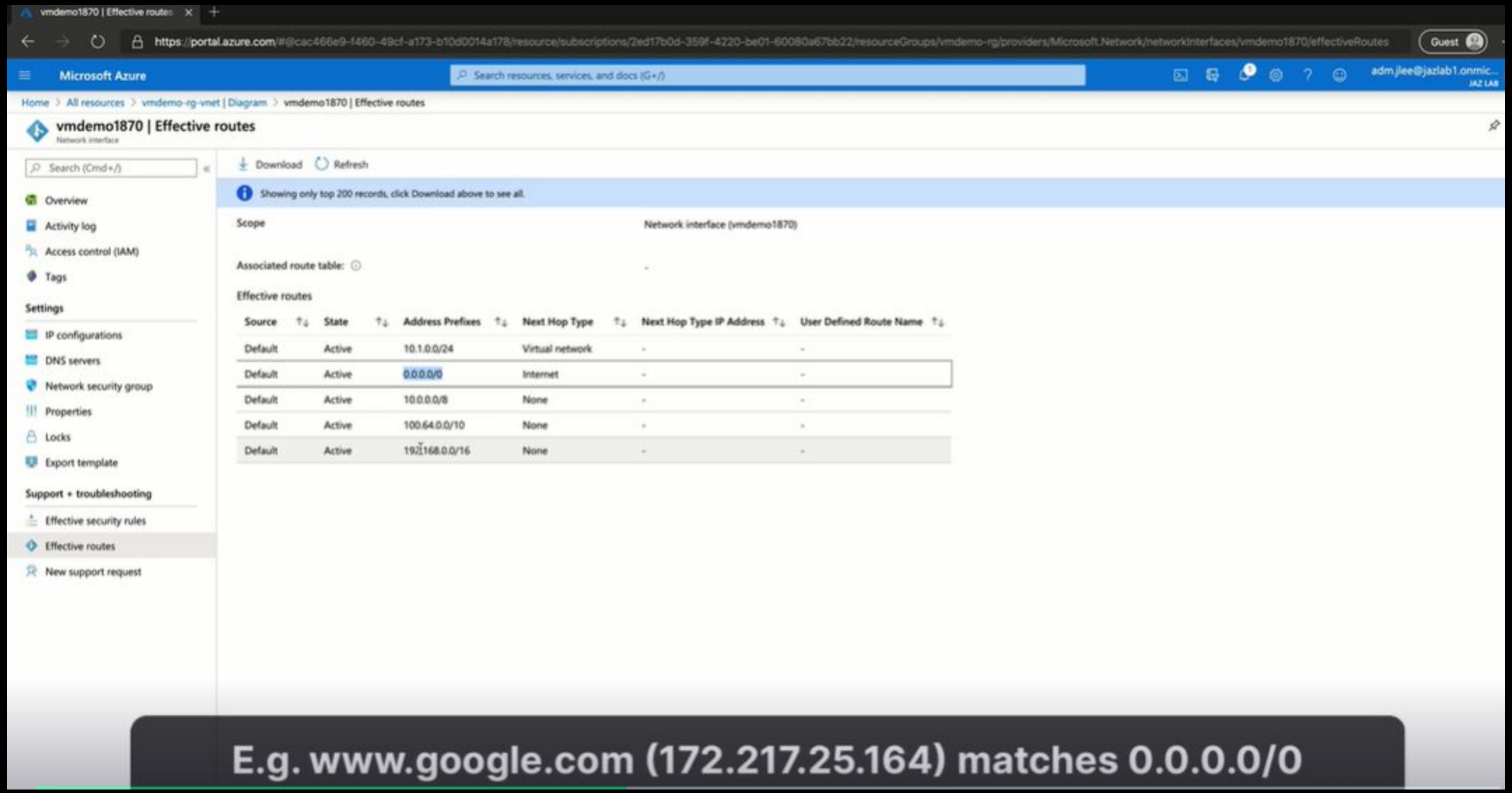


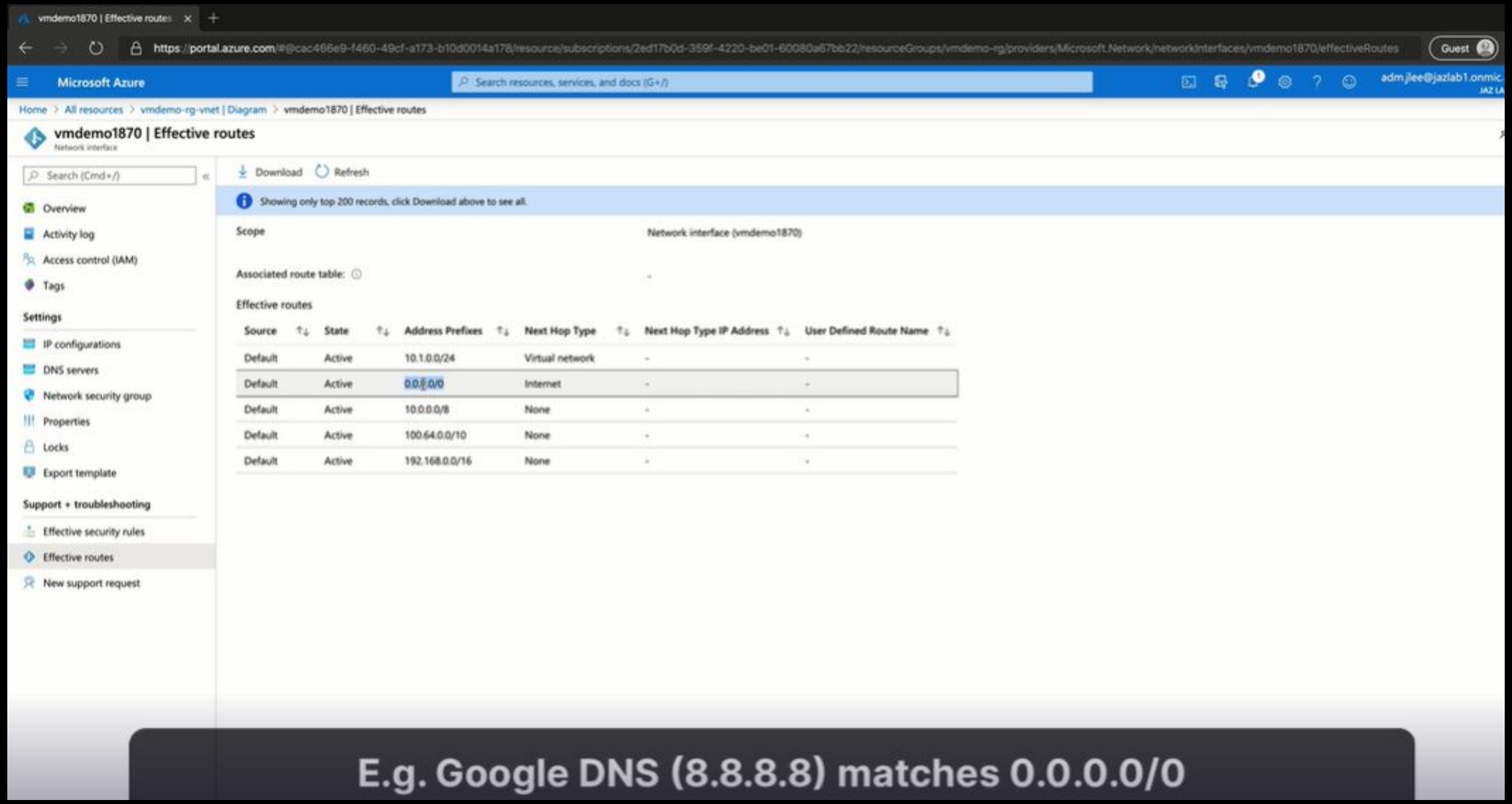
Virtual Networks Routing And Connectivity



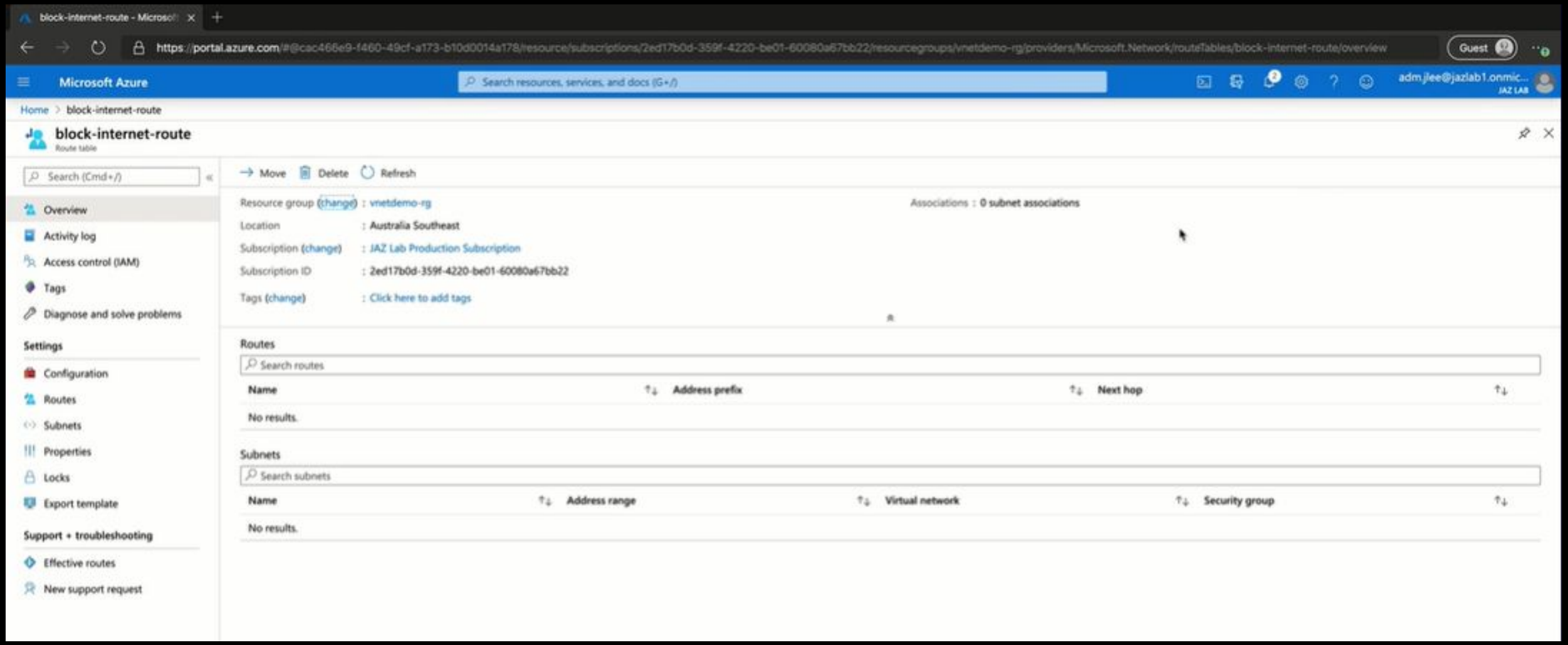
Virtual Networks Routing And Connectivity



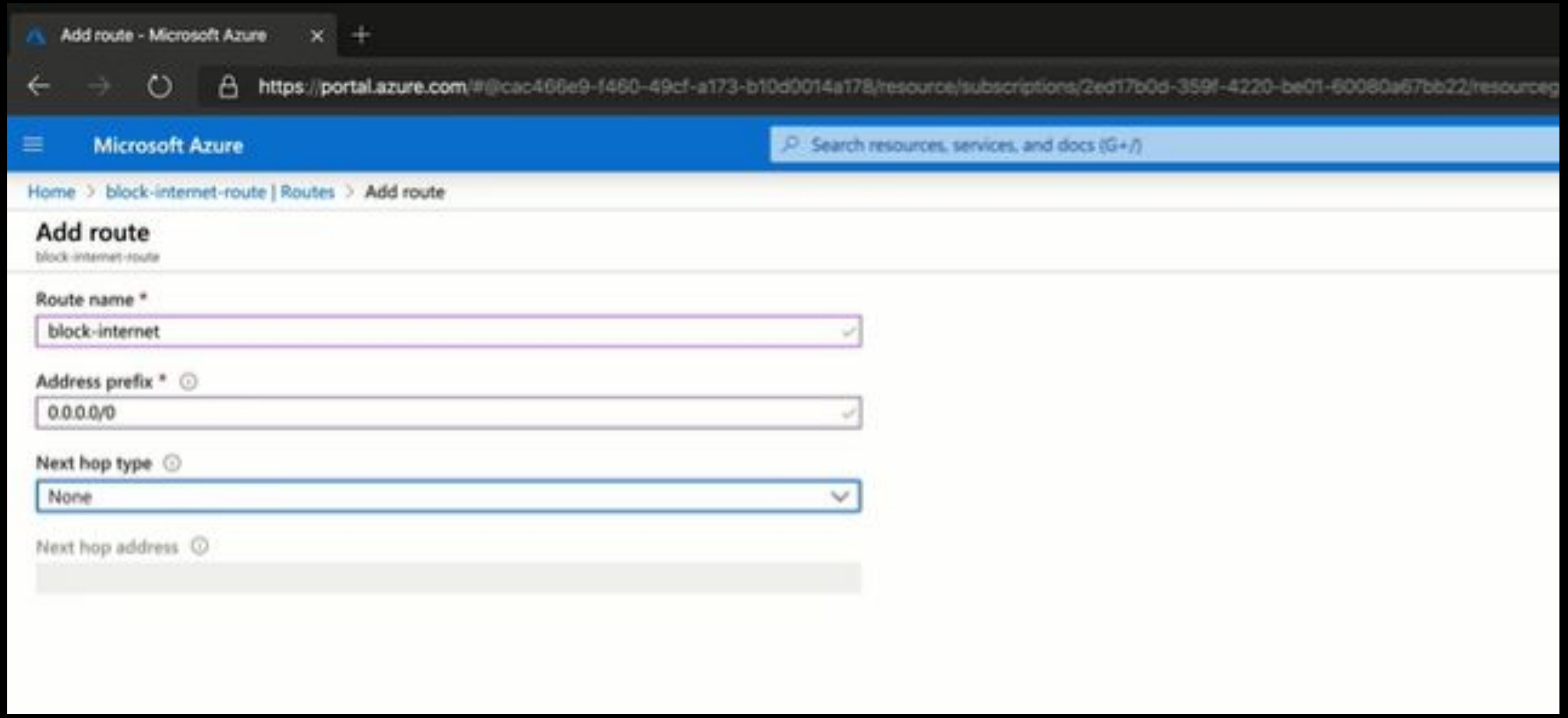
Effective routes



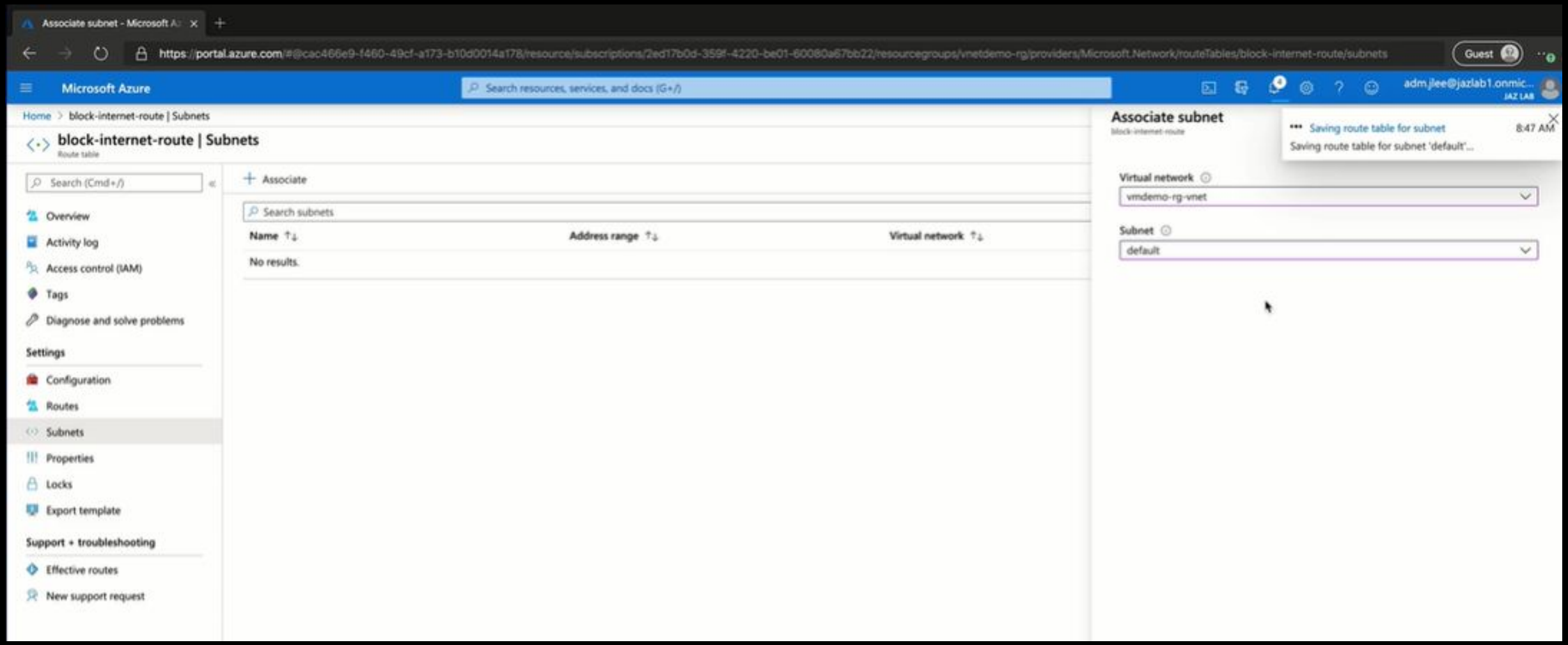
Effective routes



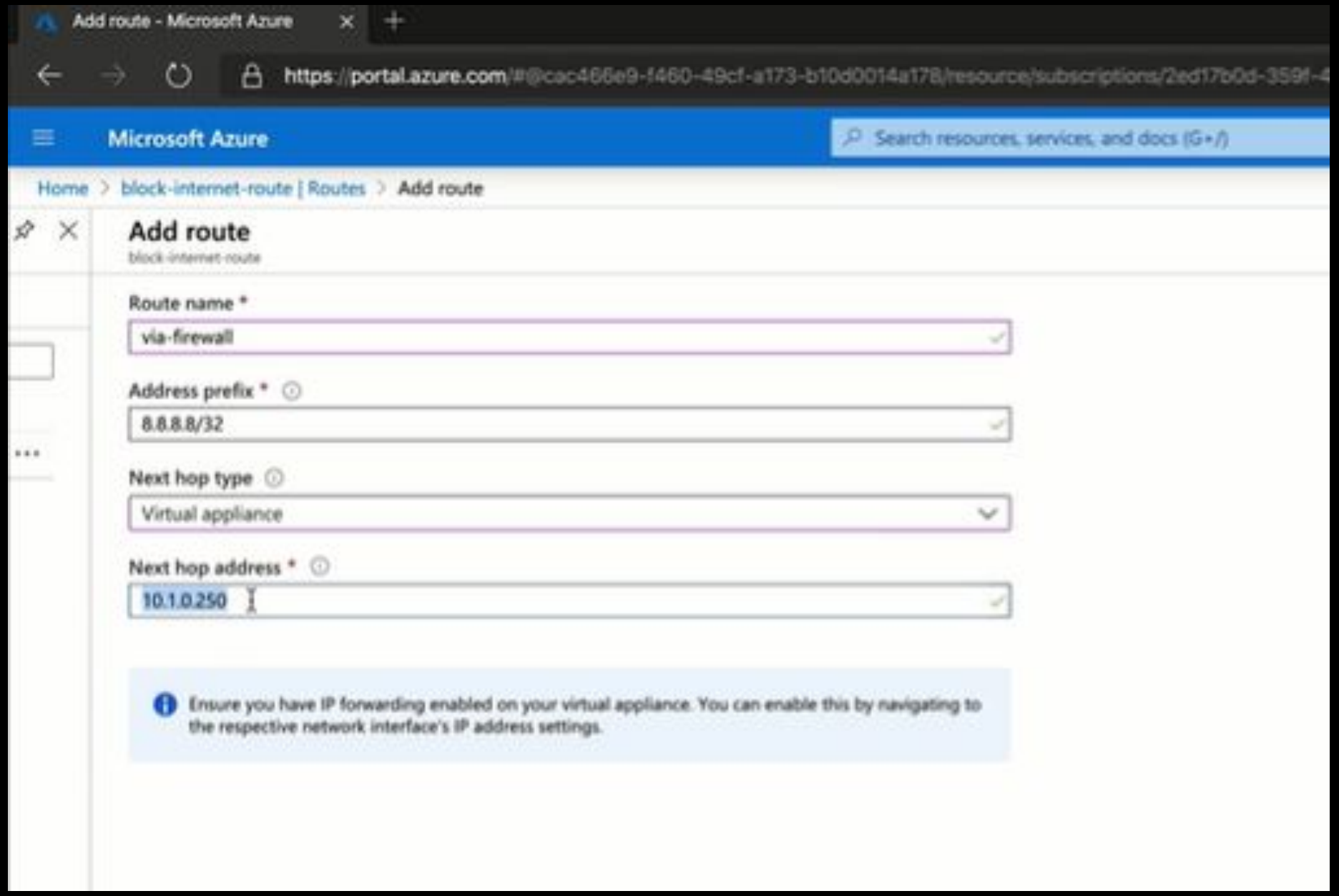
Create a custom route table



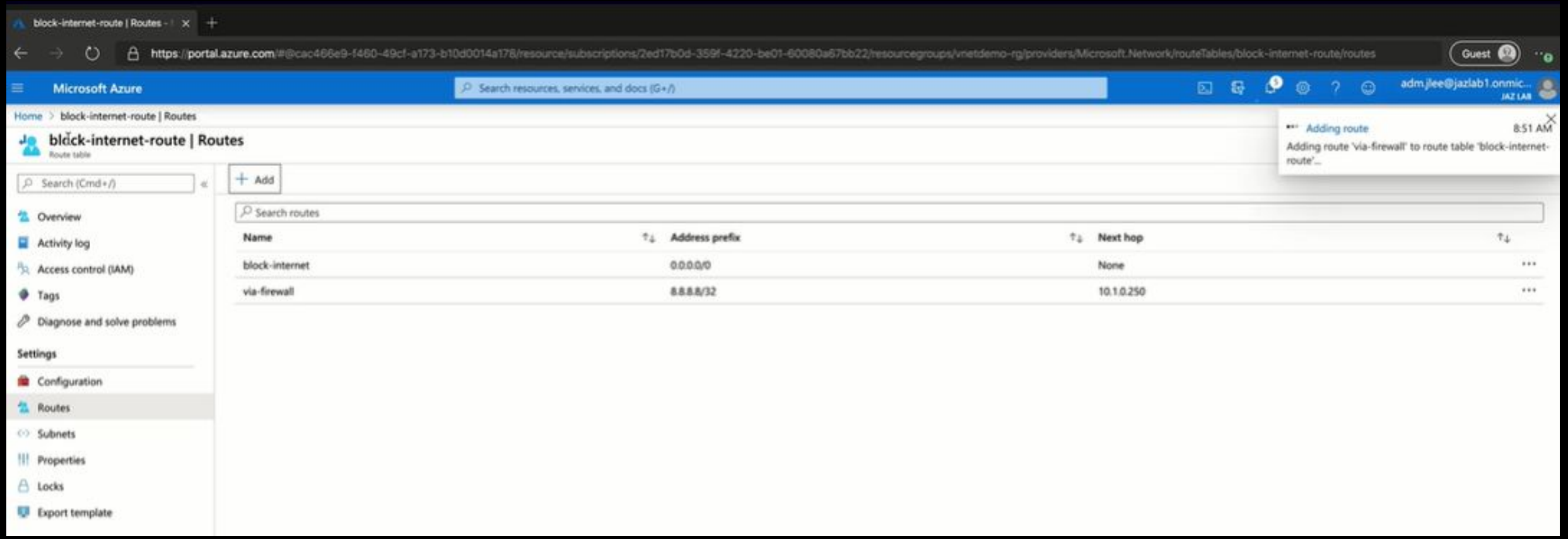
Create a new route



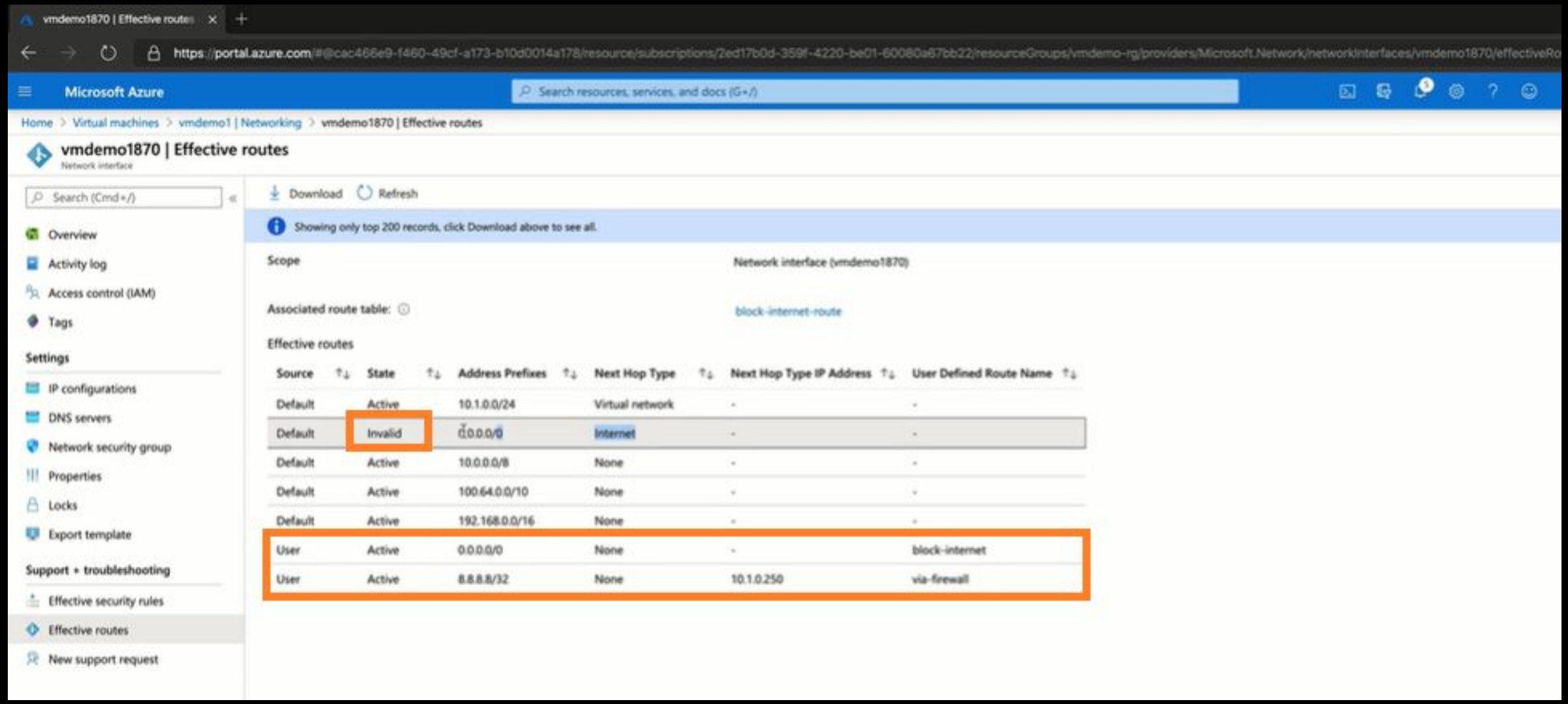
Associate subnet to the new route



Adding a new route to a virtual applicance

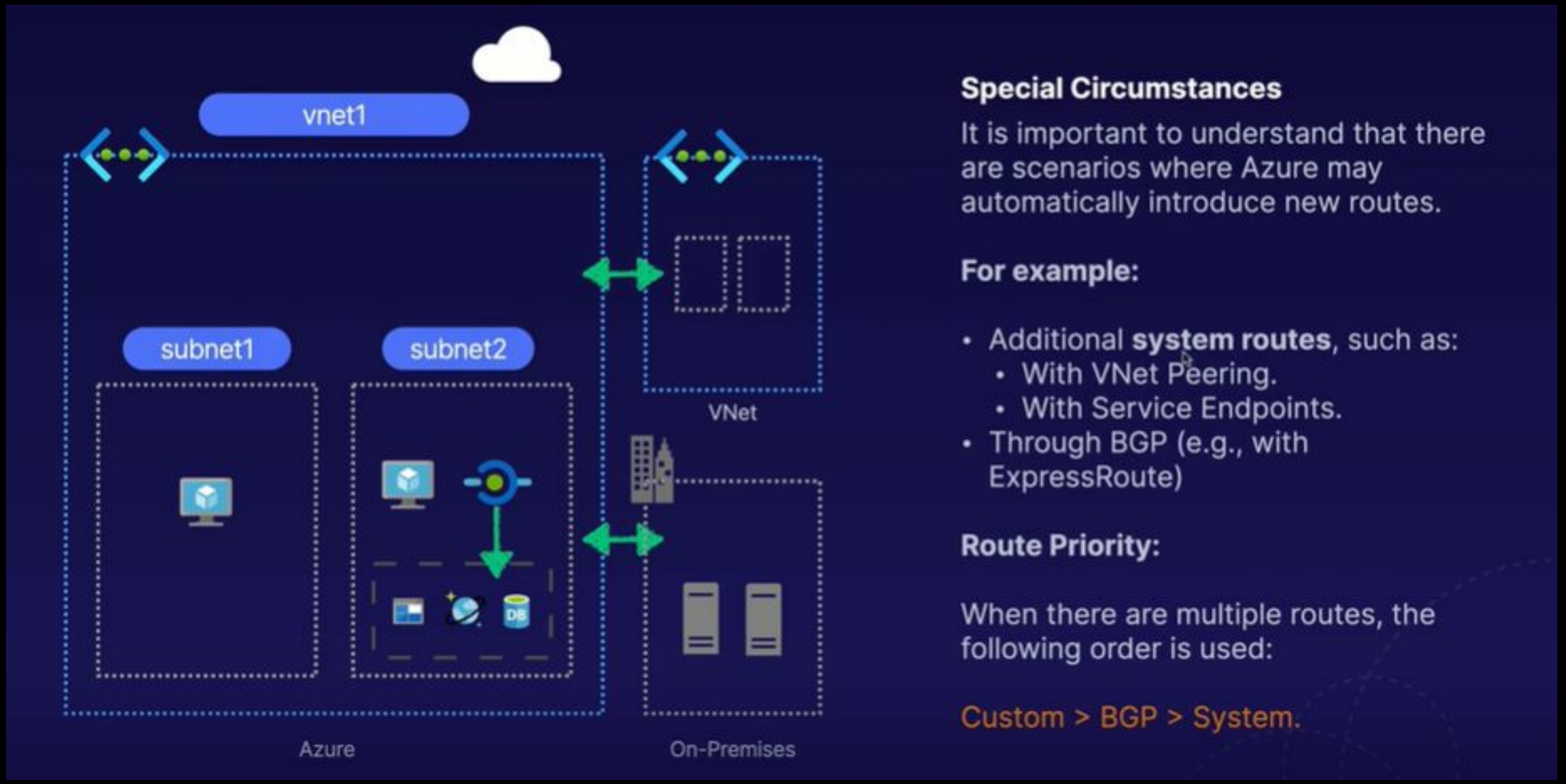


Adding a new route to a virtual appliance



Updated effective routes in my VM

E.g: a 10.0.0.0/32 will match more closely than 10.0.0.0/24



Important considerations

Virtual Machines

Purpose of Virtual Machines

1. **Windows and Linux Compute**

   Deploy virtualized Windows or Linux virtual machines.

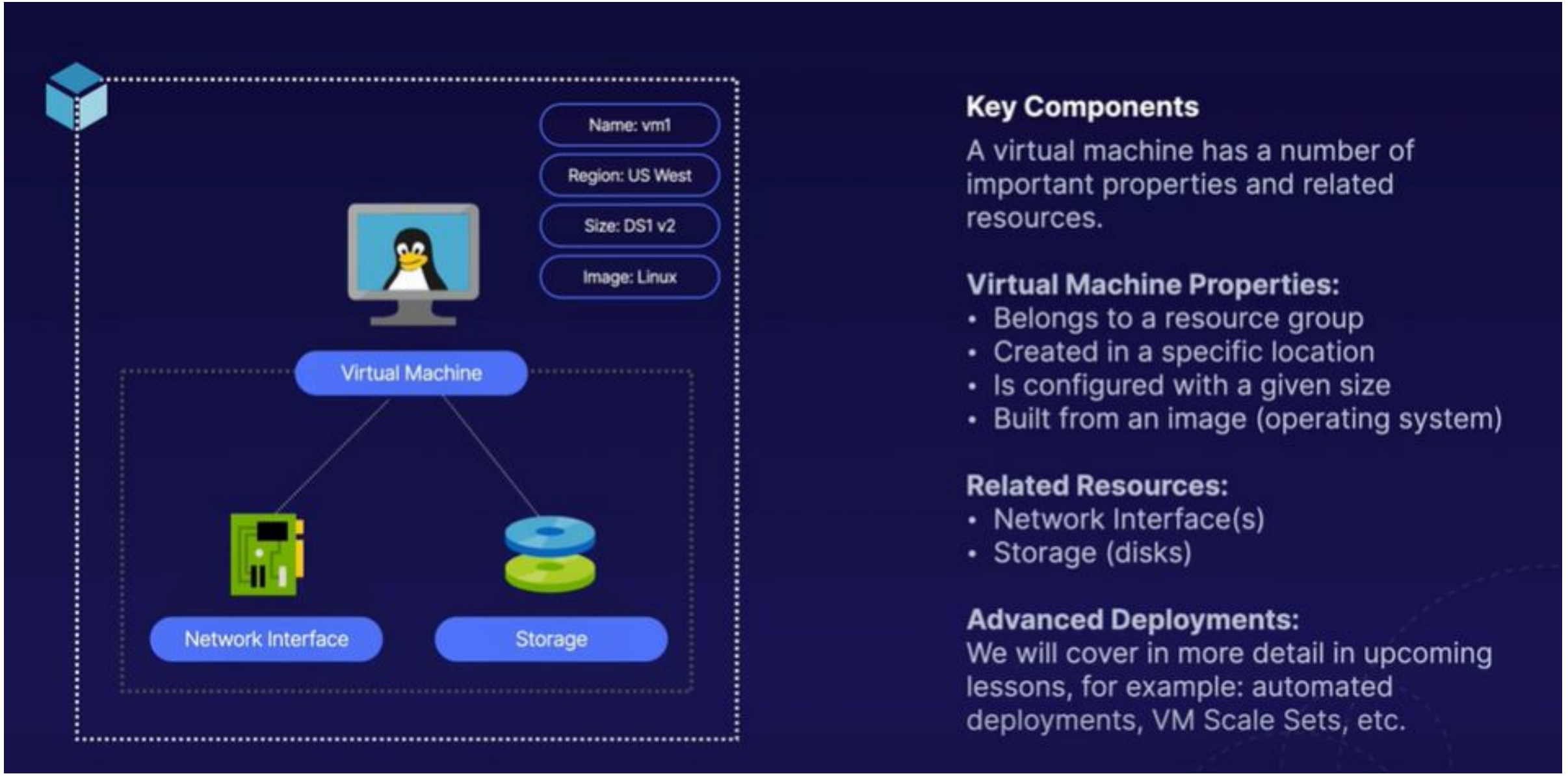
2. **Migrate Existing Workloads**

   Migrate existing compute workloads to Azure, where other services are not yet viable.

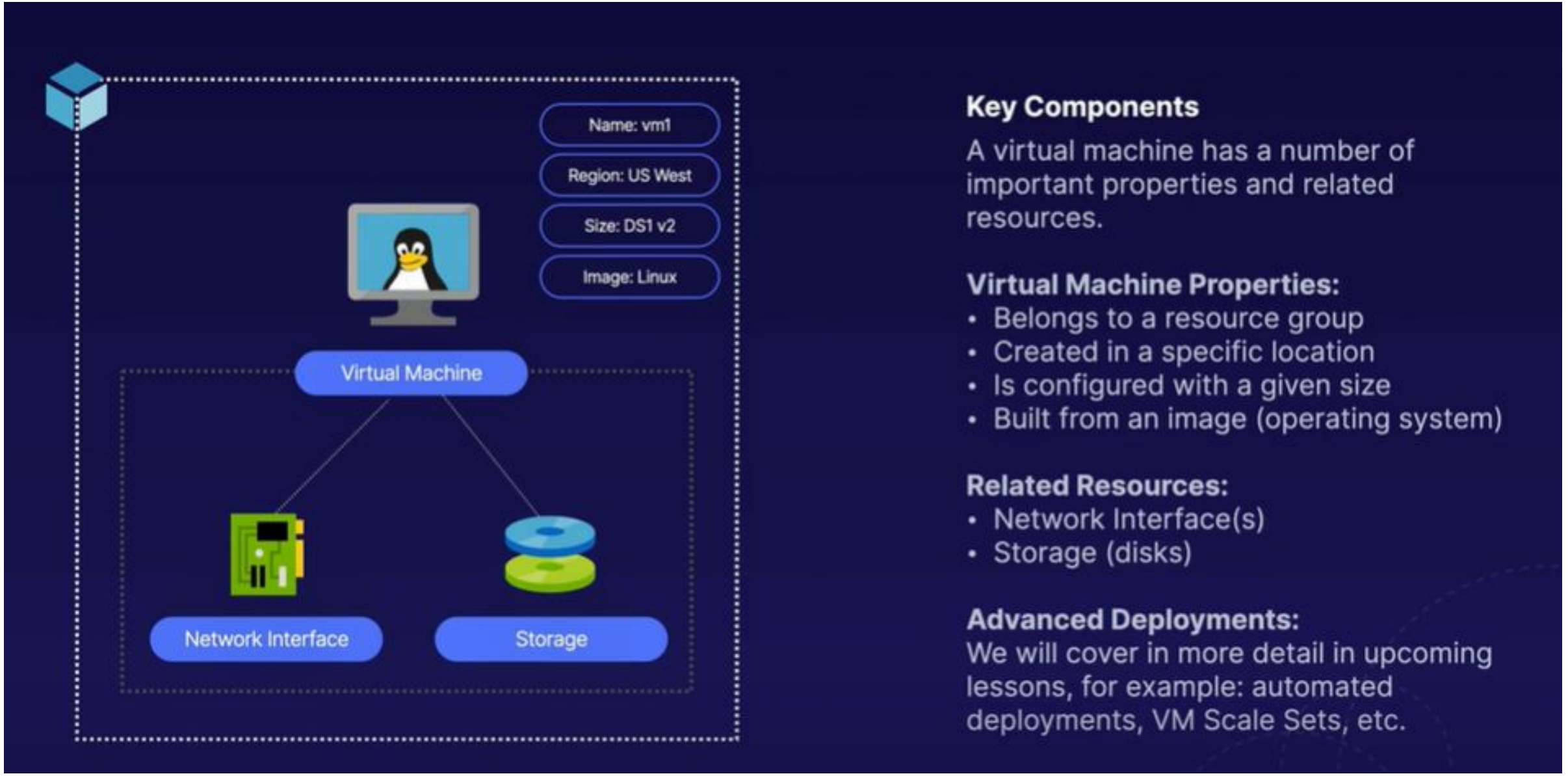
3. **Deploy Advanced Compute Solutions**

   Virtual Machines provide a foundation for advanced solutions such as high performance compute, decoupled, and scalable applications.

Purpose of Virtual Machines



Creating a Virtual Machine



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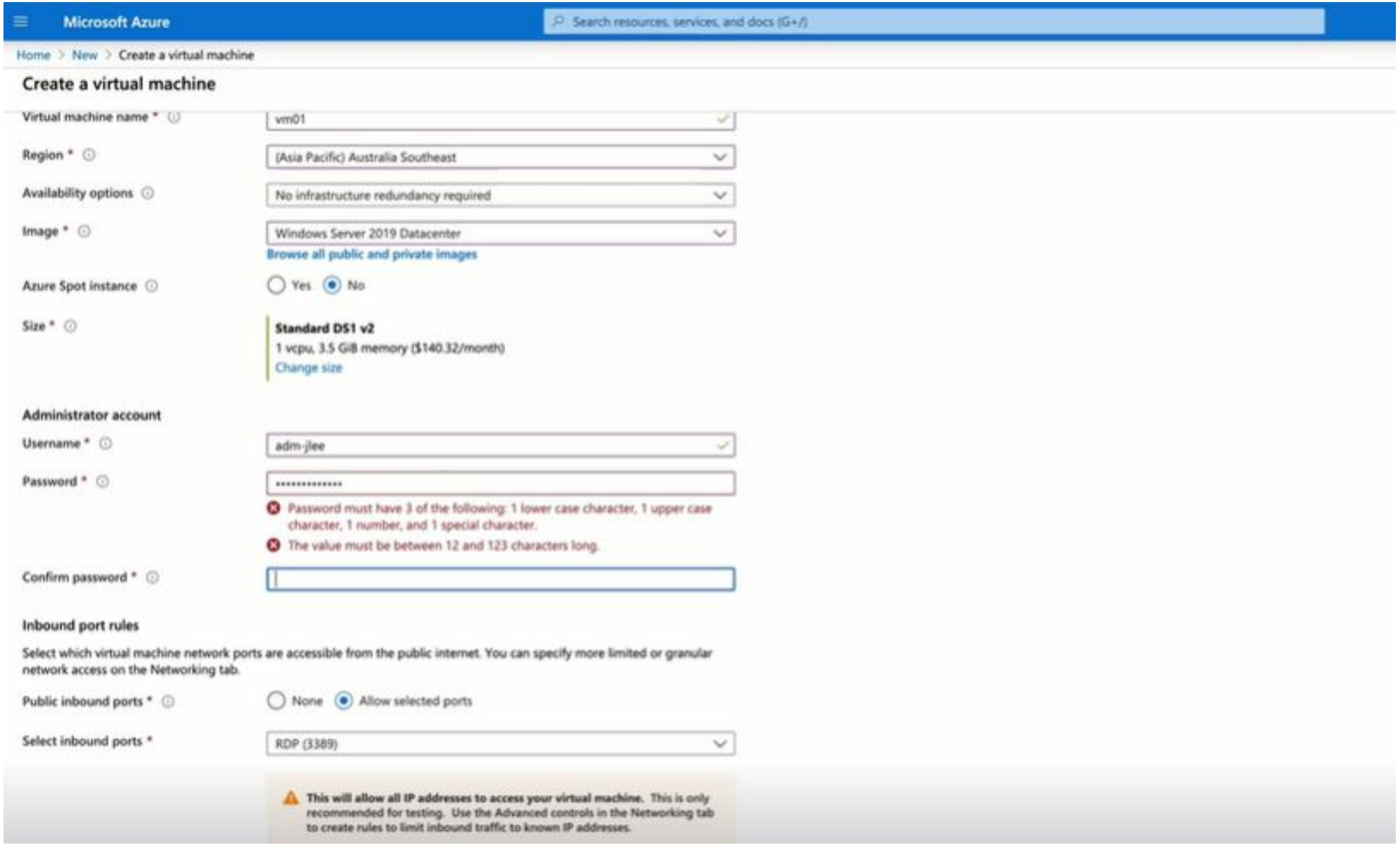

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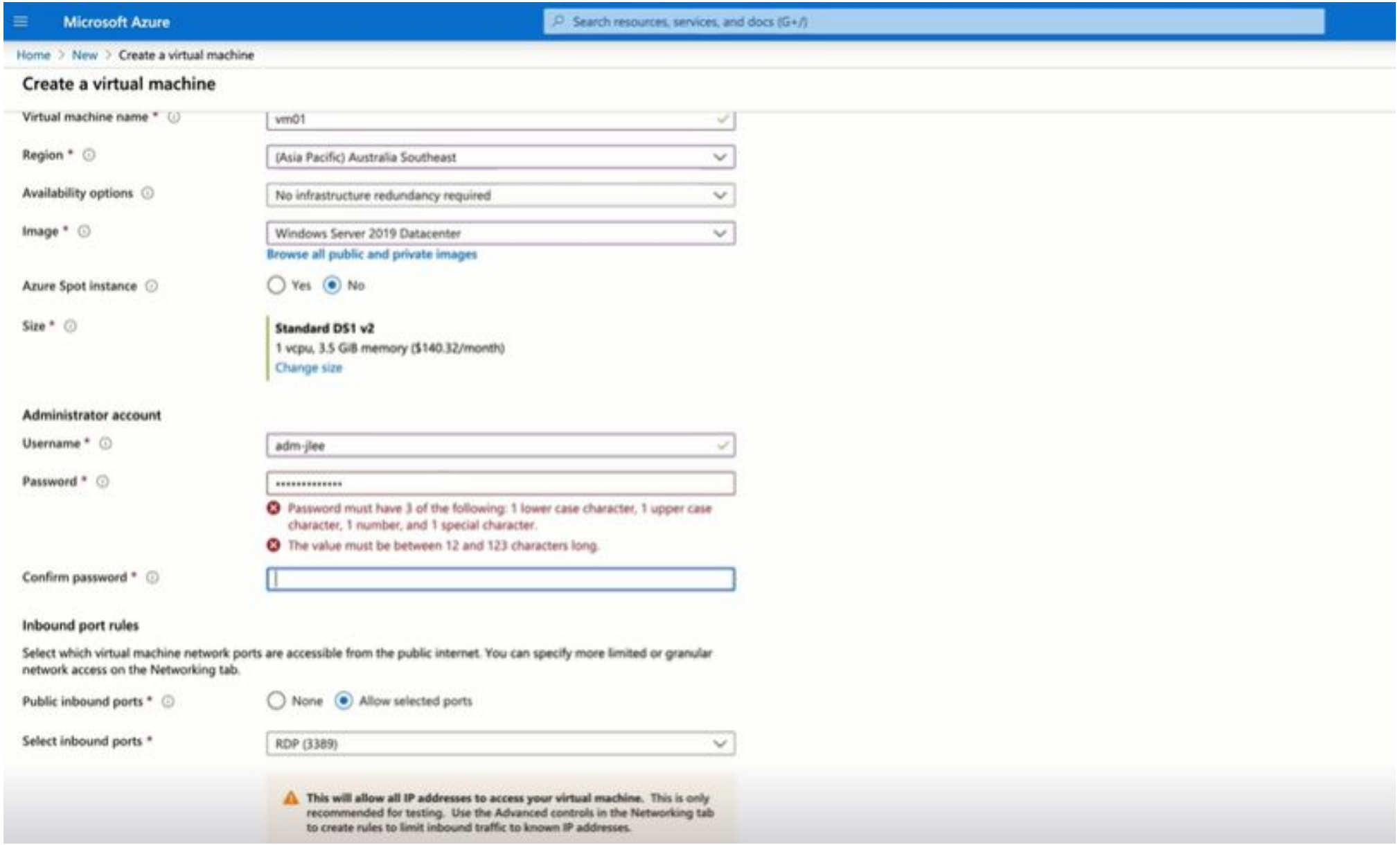

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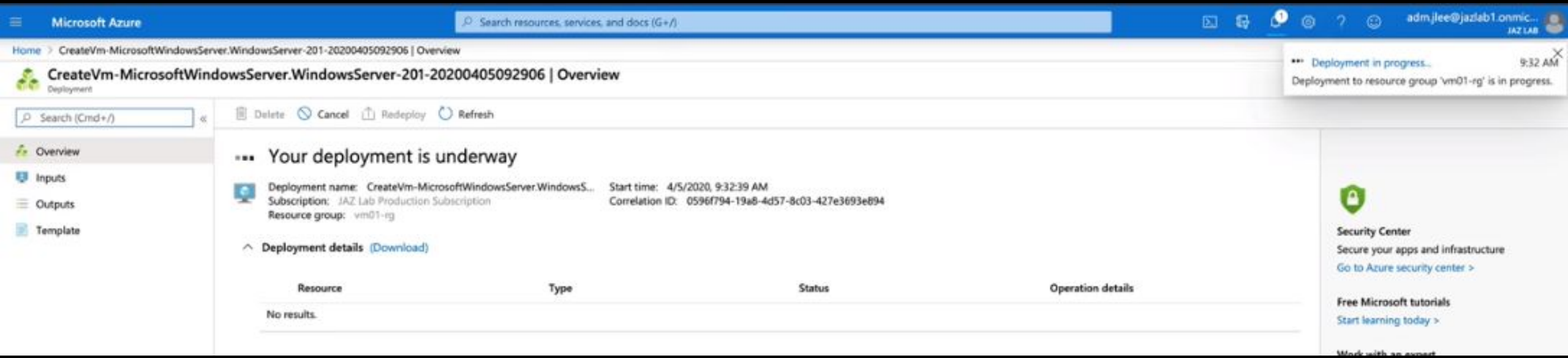
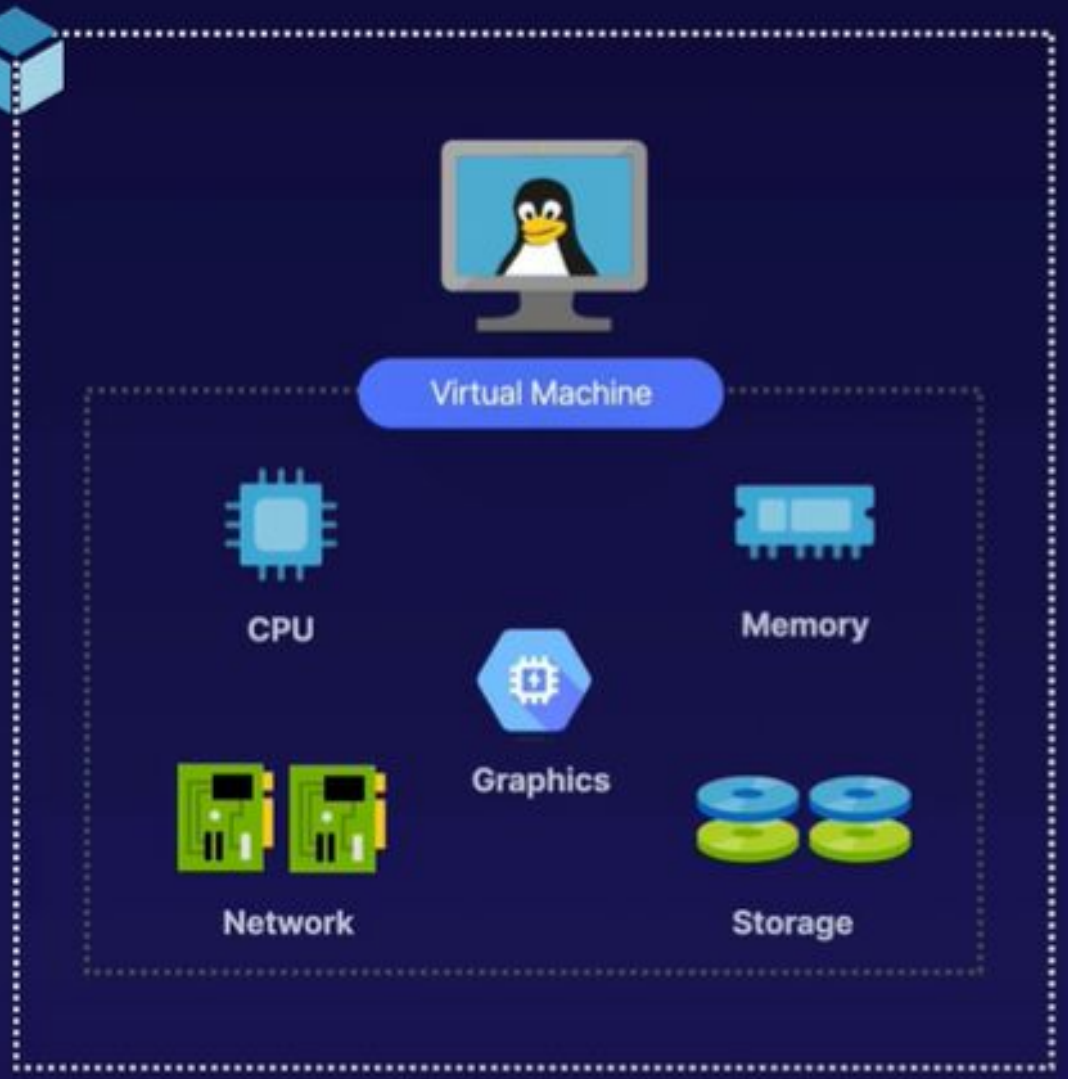


Creating a Virtual Machine



Virtual Machine Size

The size of a virtual machine influences several characteristics.

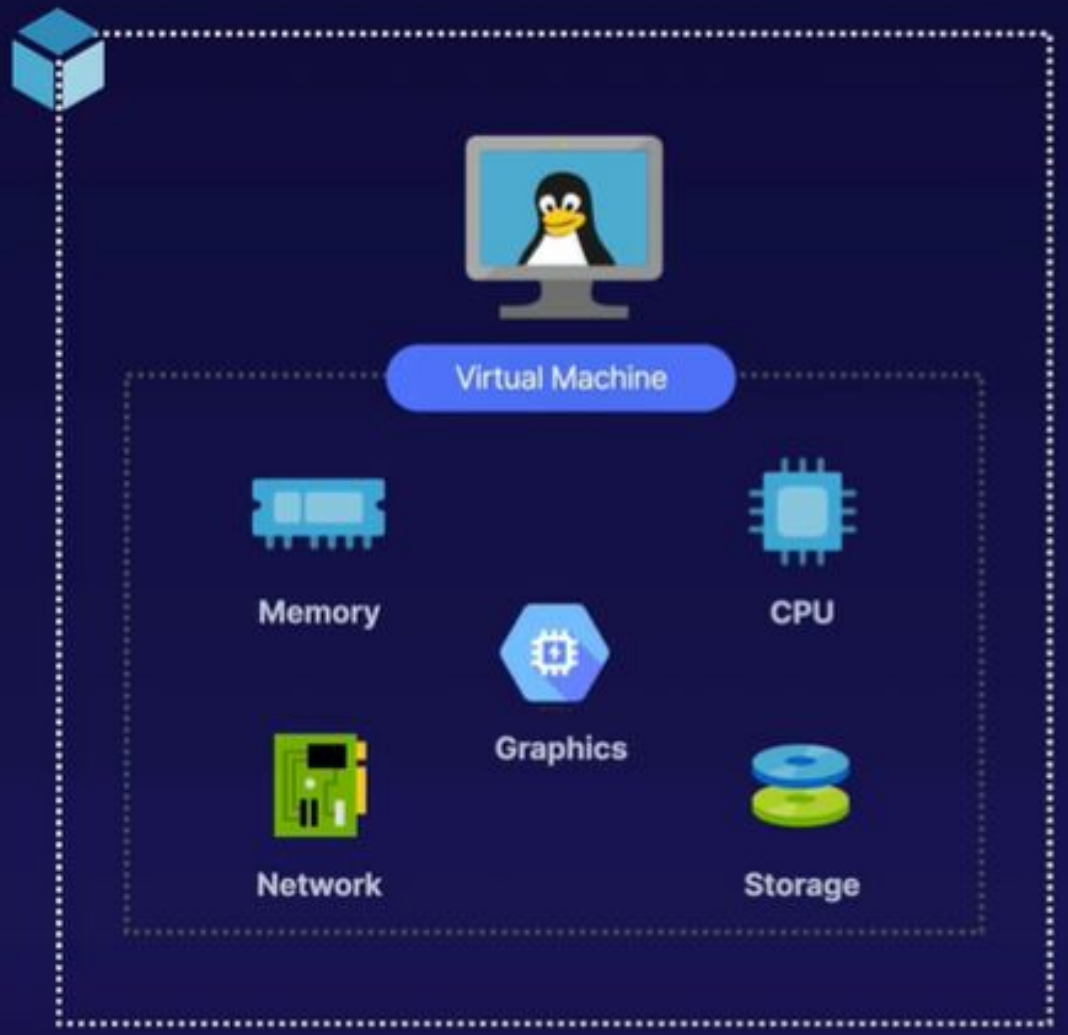
Important Considerations:

- CPU resource allocation
- Available total memory
- Graphics capabilities
- Network interface card (NIC) performance
- Storage (Azure Disks) performance
- Influences limits (maximum NICs, disks)

Configuring Virtual Machine Size:

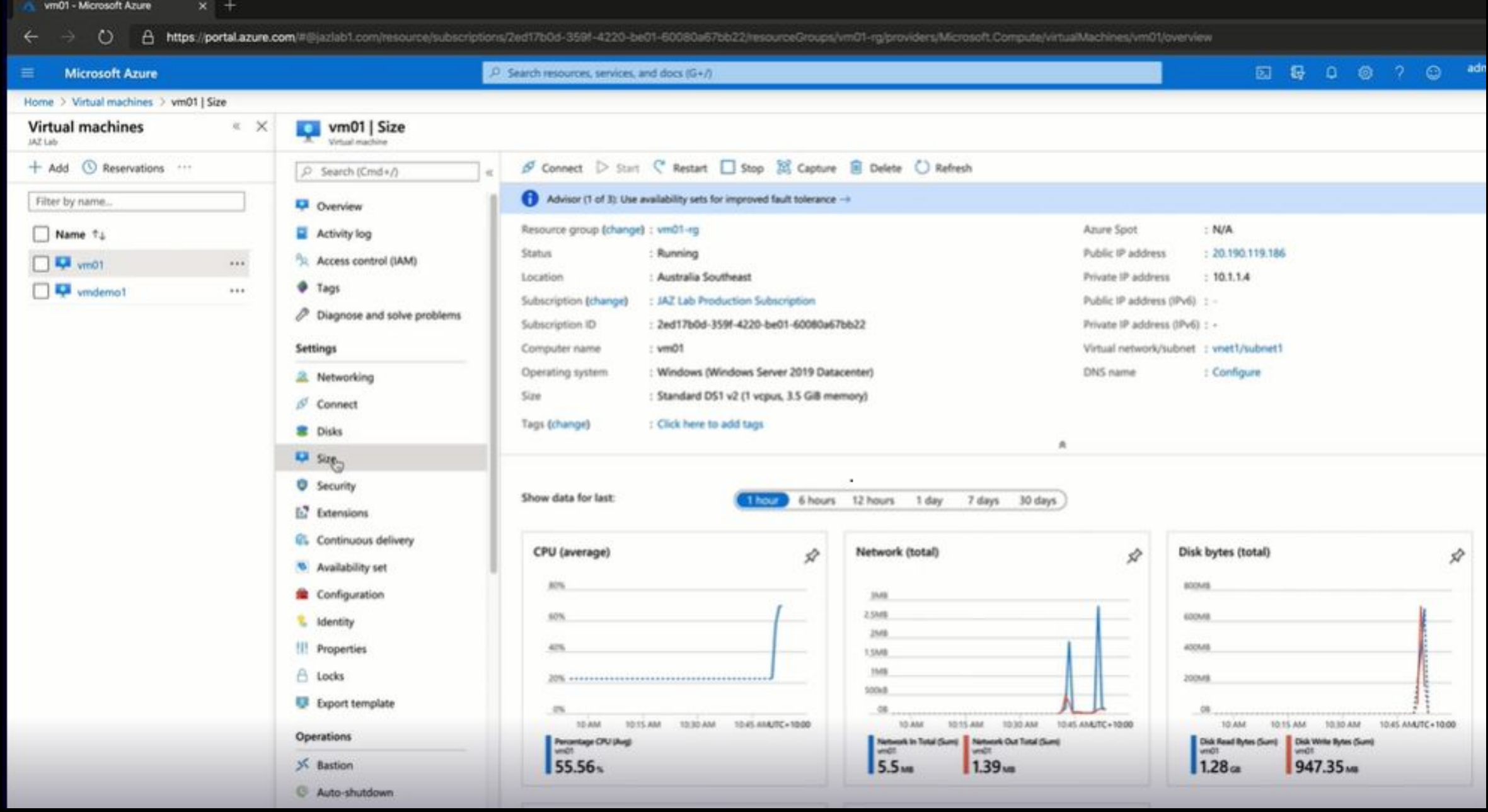
- Can be configured at time of creation
- Can be changed (requires a restart)
- Available sizes depends on:
  - Whether the virtual machine is running
  - The location of the virtual machine

Virtual Machine Size

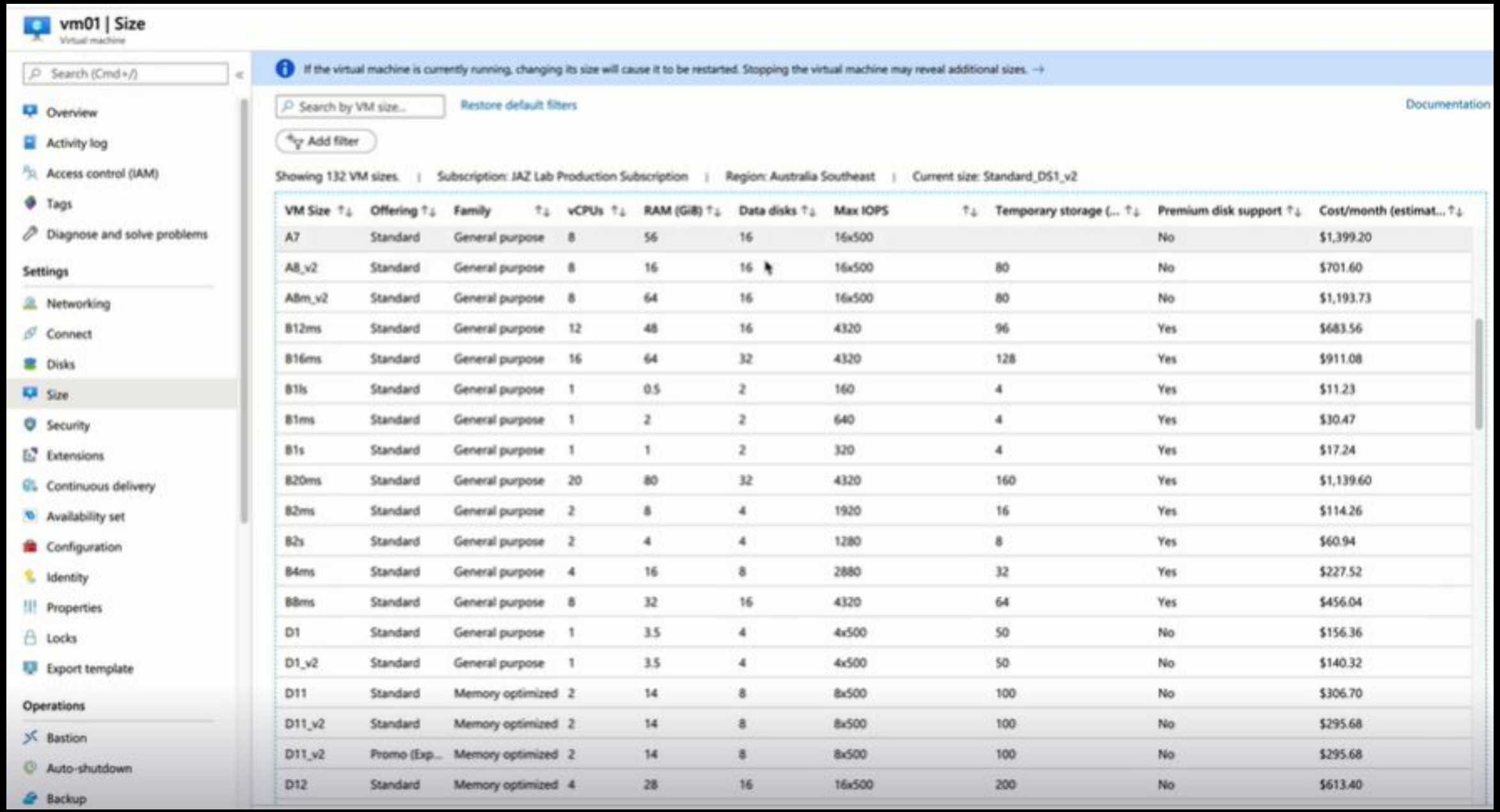


VM Size Type	Description
General Purpose	Balanced CPU-to-memory ratio. Ideal for testing and development, small to medium databases, and low to medium traffic web servers.
Compute Optimized	High CPU-to-memory ratio. Good for medium traffic web servers, network appliances, batch processes, and application servers.
Memory Optimized	High memory-to-CPU ratio. Great for relational database servers, medium to large caches, and in-memory analytics.
Storage Optimzed	High disk throughput and IO ideal for Big Data, SQL, NoSQL databases, data warehousing and large transactional databases.
GPU	Specialized virtual machines targeted for heavy graphic rendering and video editing, as well as model training and inferencing (ND) with deep learning. Available with single or multiple GPUs.
HPC	Our fastest and most powerful CPU virtual machines with optional high-throughput network interfaces (RDMA).

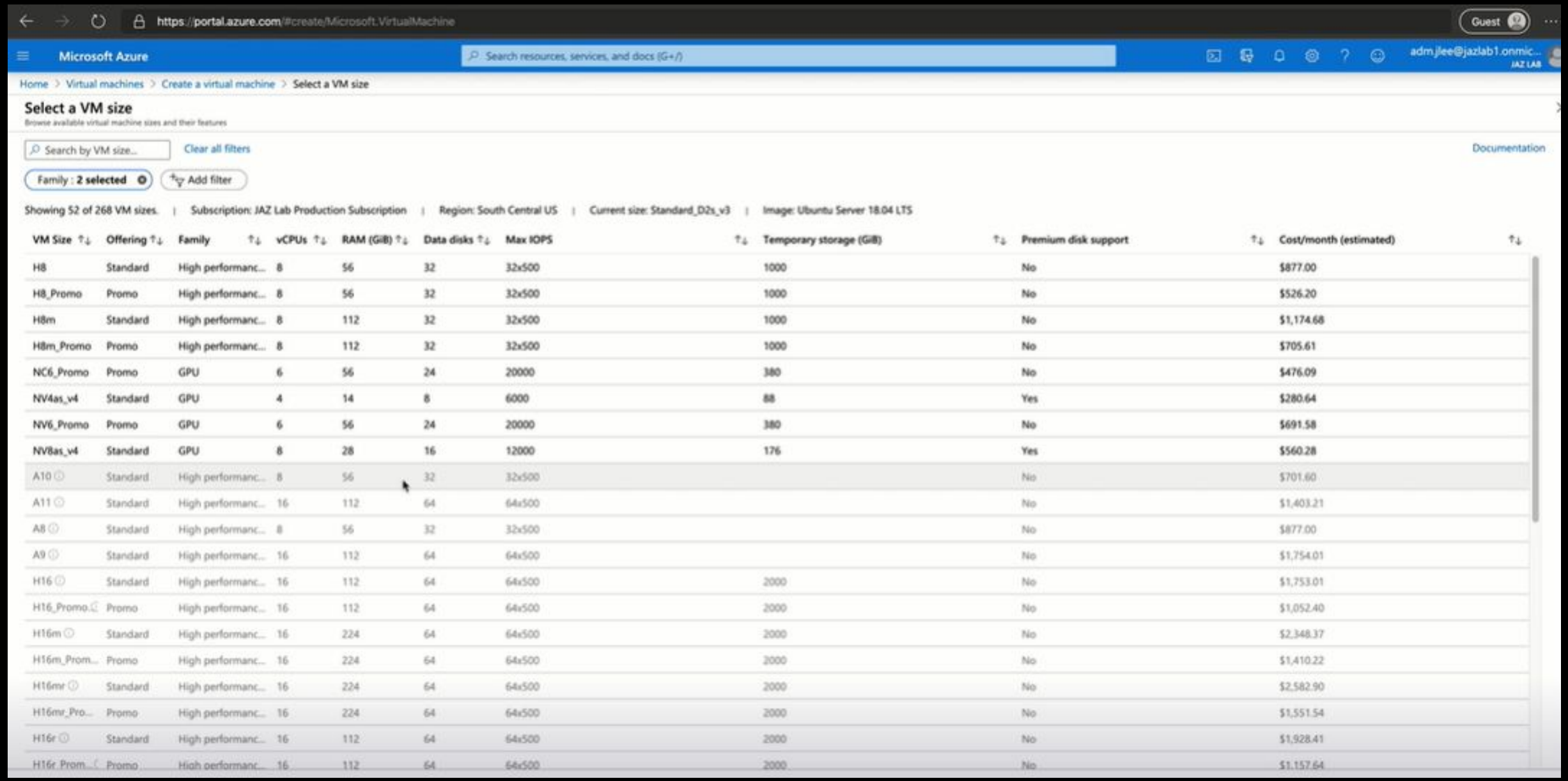
Creating a Virtual Machine



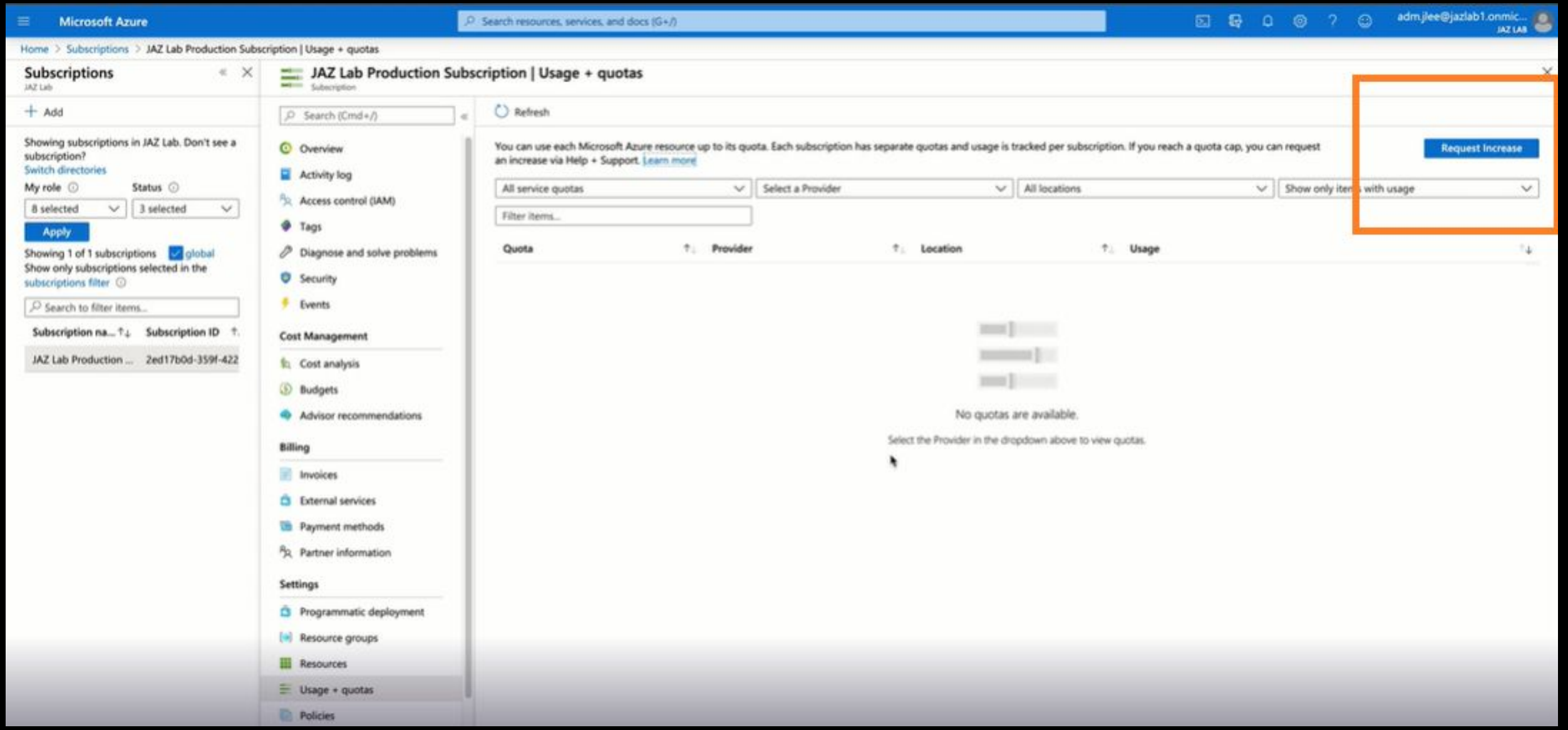
Virtual Machine size



Virtual Machine size



Quotas for Virtual Machine Sizes



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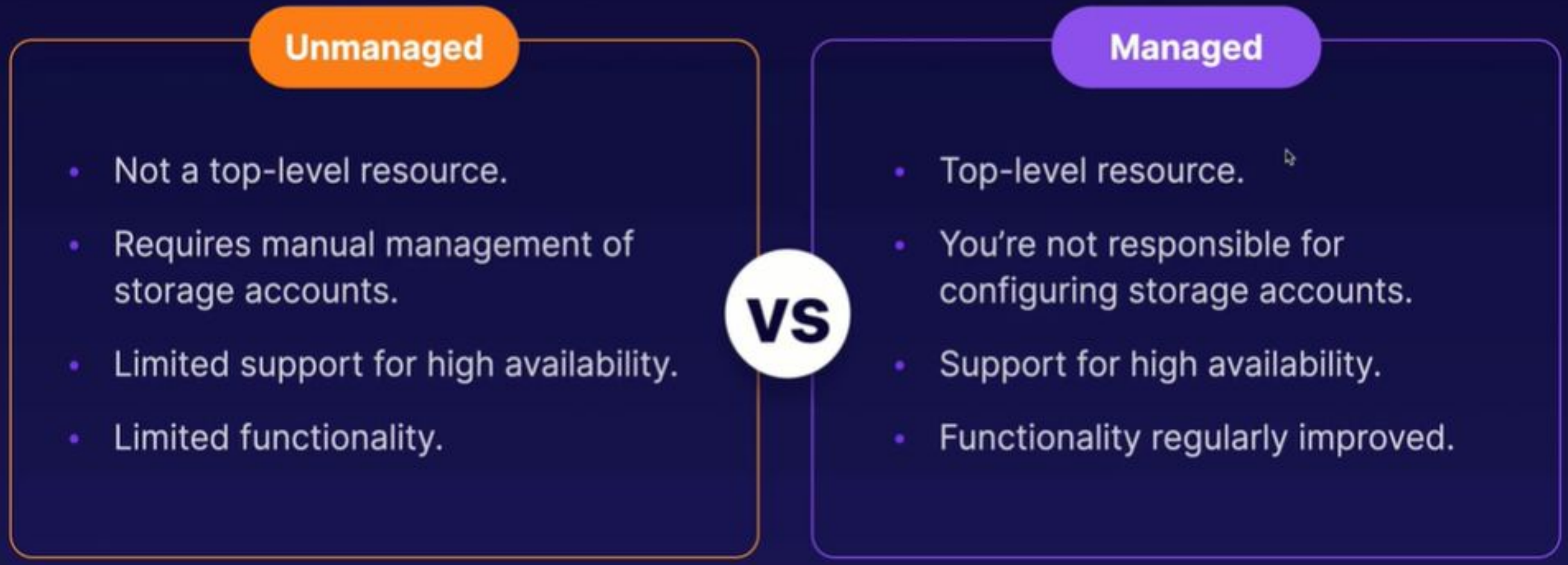
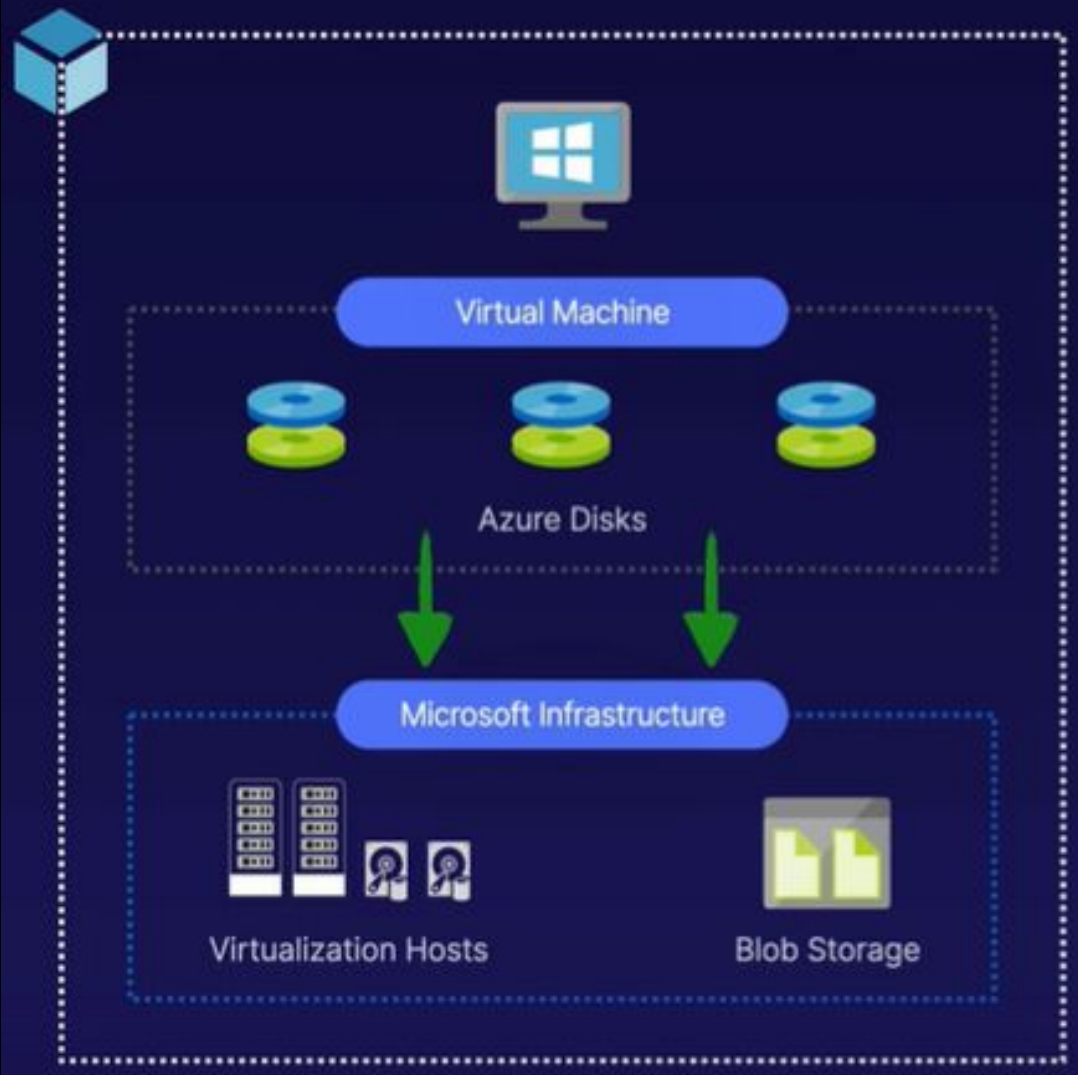


Virtual Machine storage

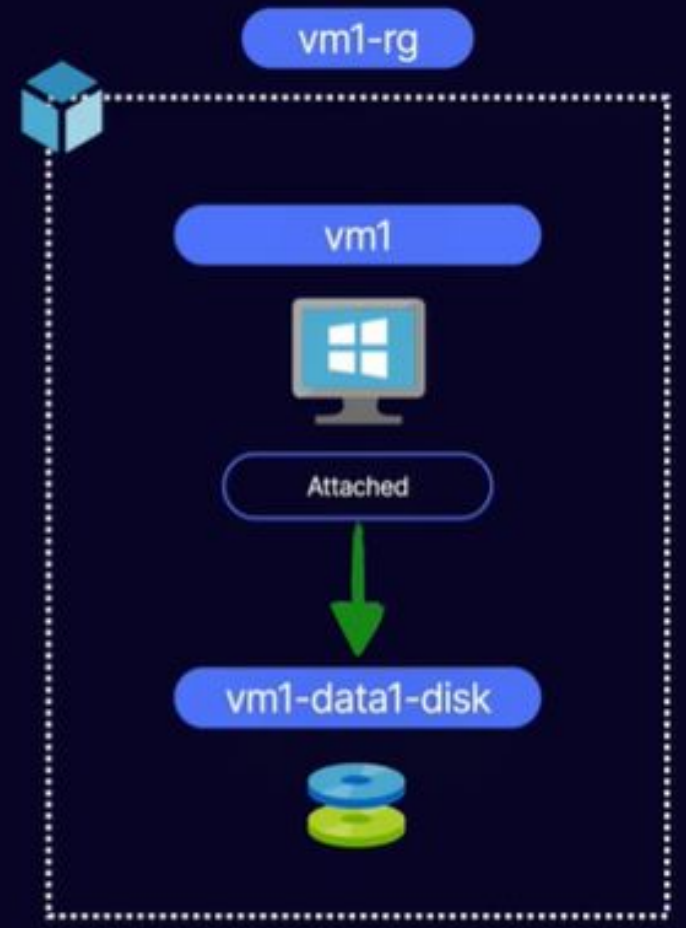
Unmanaged vs Managed Disks



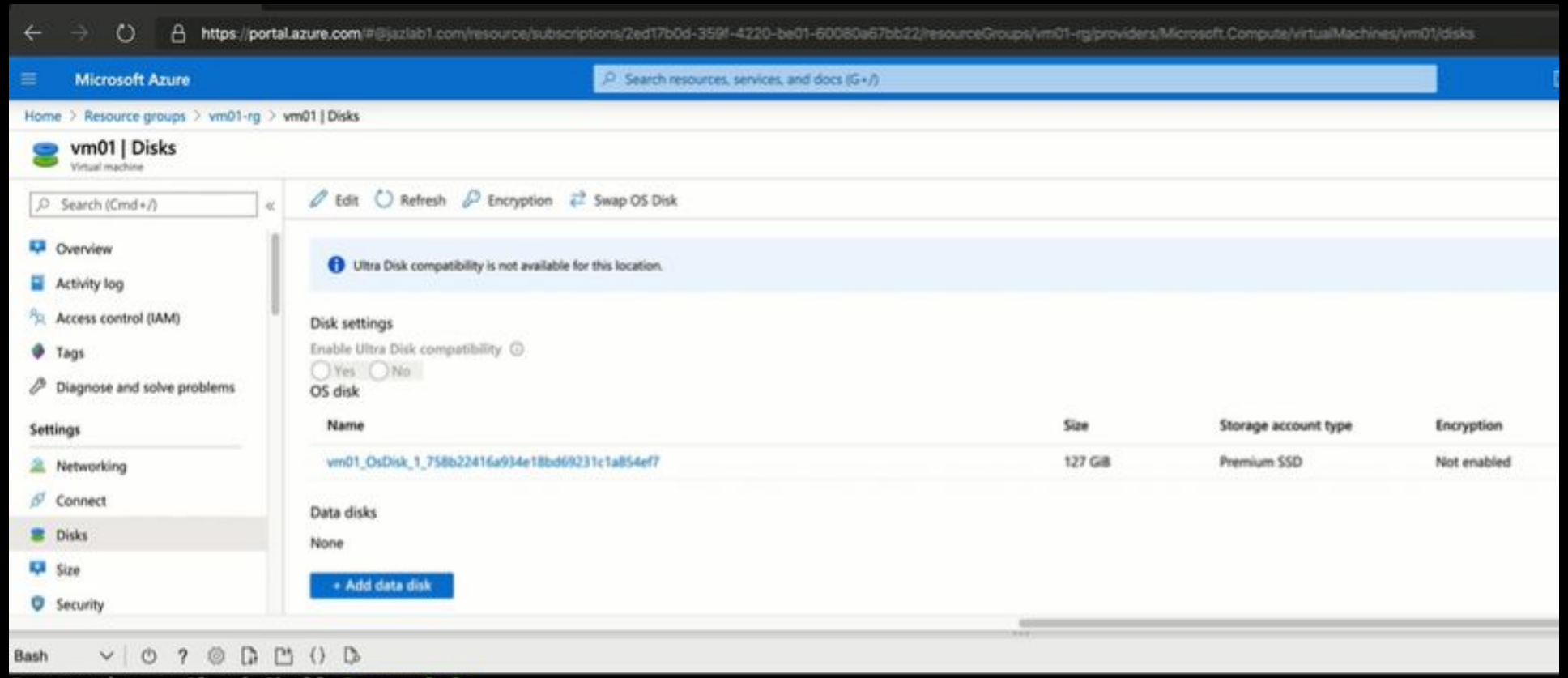
Disk Type	Description
OS Disk	Required by all virtual machines, the OS disk is built from an image containing a pre-installed operating system (OS). **OS disks are a default disk.**
Temporary Disk	A local disk (local to the underlying Microsoft host infrastructure which is hosting the virtual machine) that is NOT persistent. **Temporary disks are a default disk.**
Data Disk	A disk used to store information persistently, such as application data, etc.
Ephemeral OS Disk	A special type of OS Disk which contains an operating system installation, but where data cannot be changed.

Disk Types

```bash
# Add a data disk to an existing VM using Azure CLI

rgName="vm1-rg"
vmName="vm1"
diskName="vm1-data1-disk"

# Create a new disk
az disk create --name "vm1-data1-disk" \
    --resource-group $rgName \
    --location "Australia Southeast" \
    --size-gb 10

# Add disk to existing VM
az vm disk attach --vm-name $vmName \
    --name $diskName \
    --resource-group $rgName
```

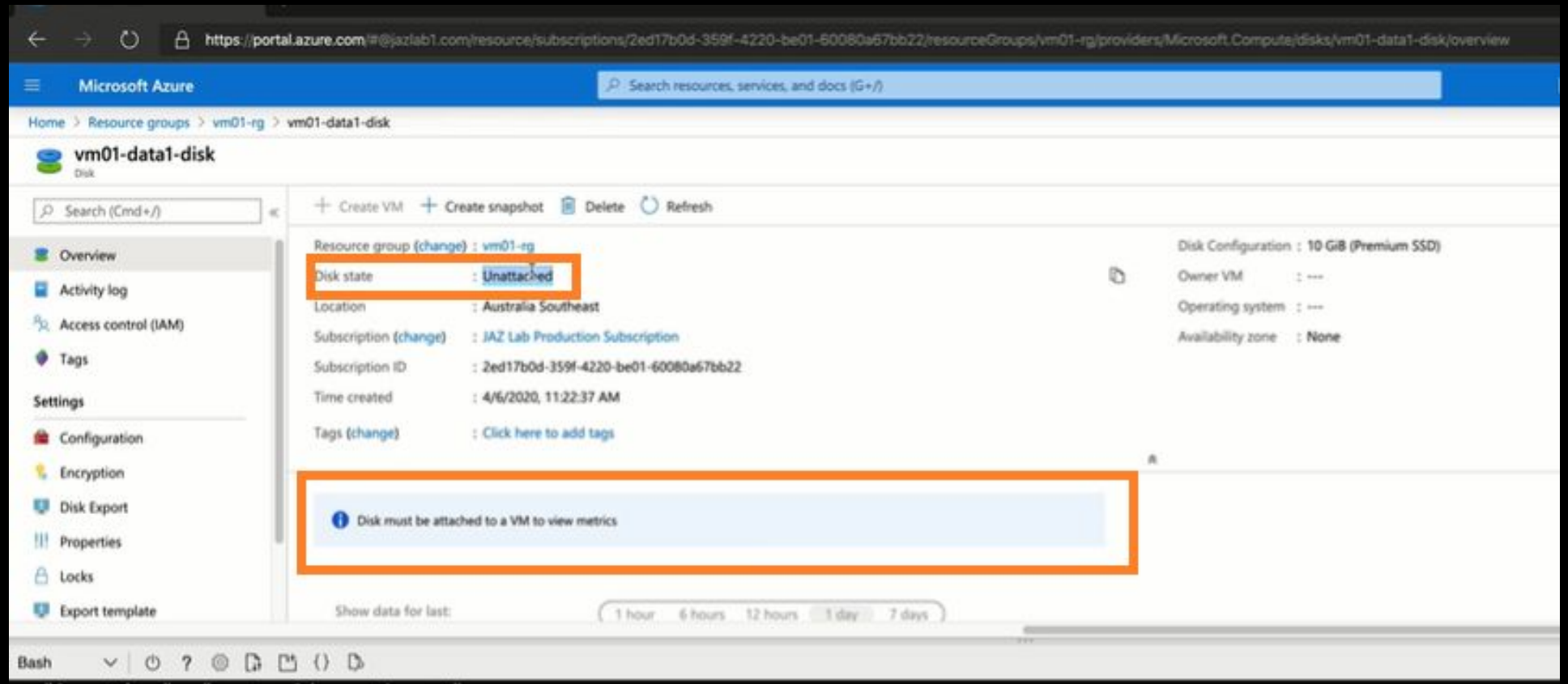


Adding a Data Disk to a VM



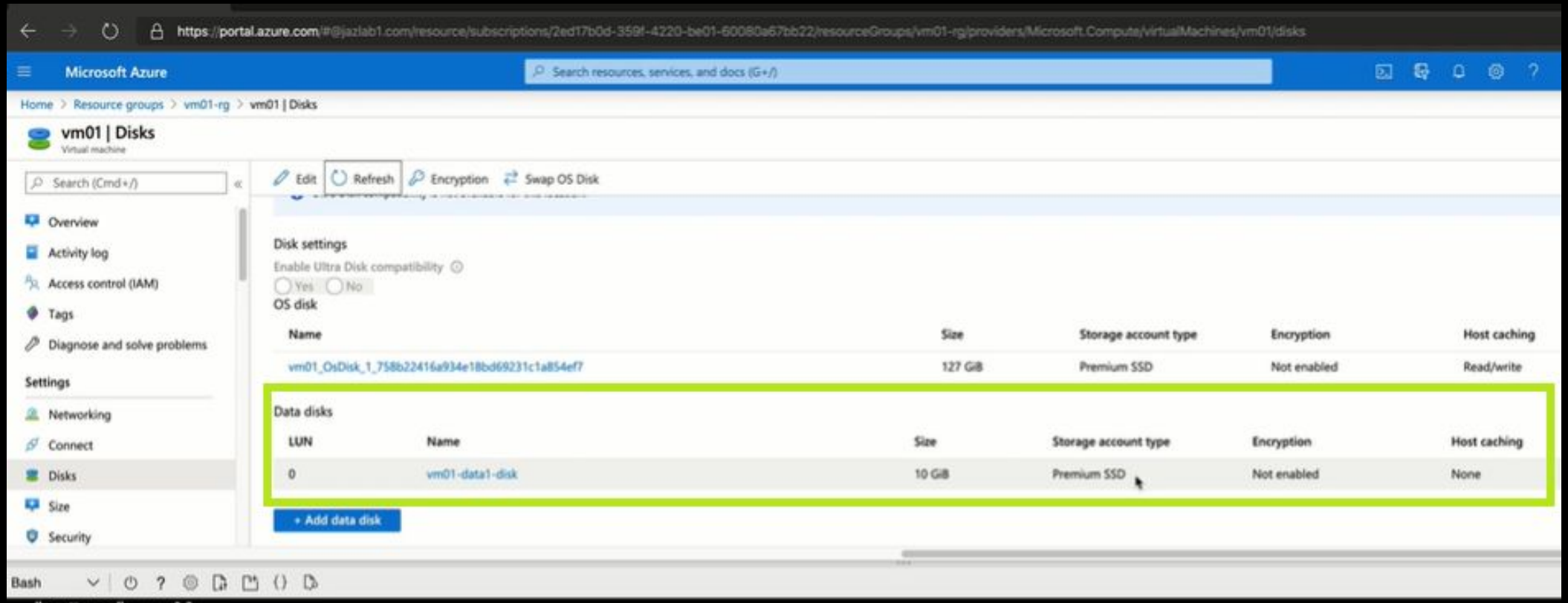

```
Requesting a Cloud Shell.Succeeded.
Connecting terminal...

admin@Azure:~$ rgName="vm01-rg"
admin@Azure:~$ vmName="vm01"
admin@Azure:~$ diskName="vm01-data1-disk"
admin@Azure:~$
admin@Azure:~$ az disk create --name $diskName \
> --resource-group $rgName \
> --location "Australia Southeast" \
> --size-gb 10
```

Adding a Data Disk to a VM



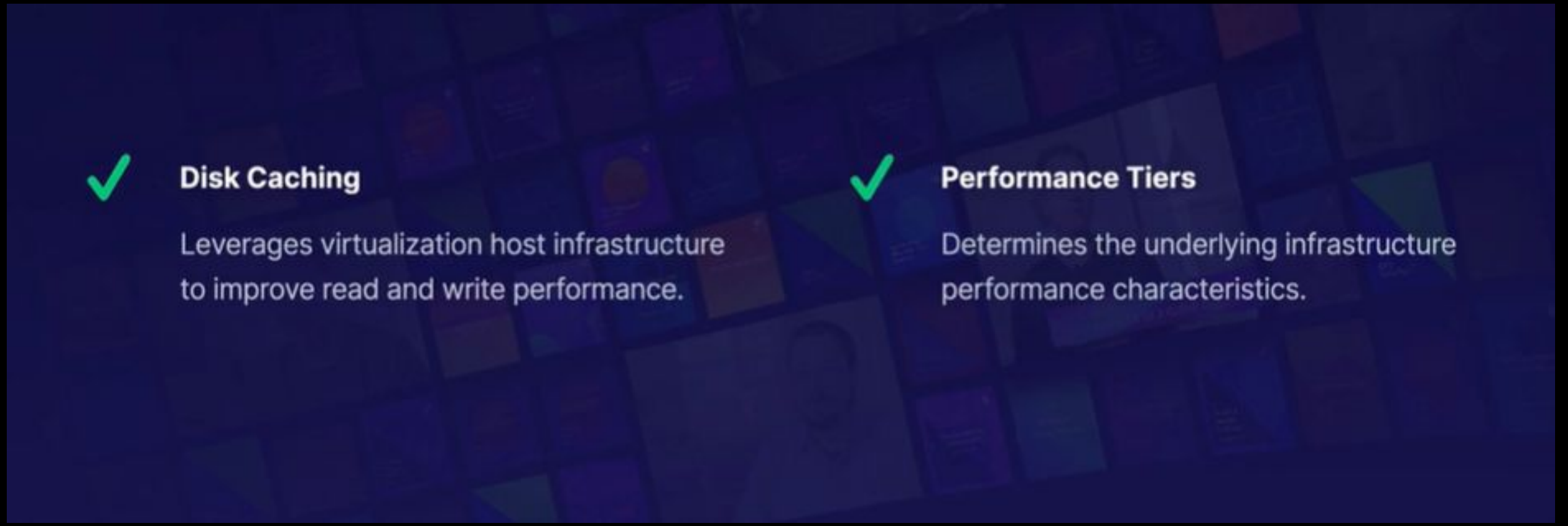

```
"location": "australiasoutheast",
"managedBy": null,
"name": "vm01-data1-disk",
"osType": null,
"provisioningState": "Succeeded",
"resourceGroup": "vm01-rg",
"sku": {
  "name": "Premium_LRS",
  "tier": "Premium"
},
"tags": {},
"timeCreated": "2020-04-06T01:22:37.625757+00:00",
"type": "Microsoft.Compute/disks",
"uniqueId": "27aa018c-739c-4704-8926-6af2f3f155c7",
```


Adding a Data Disk to a VM

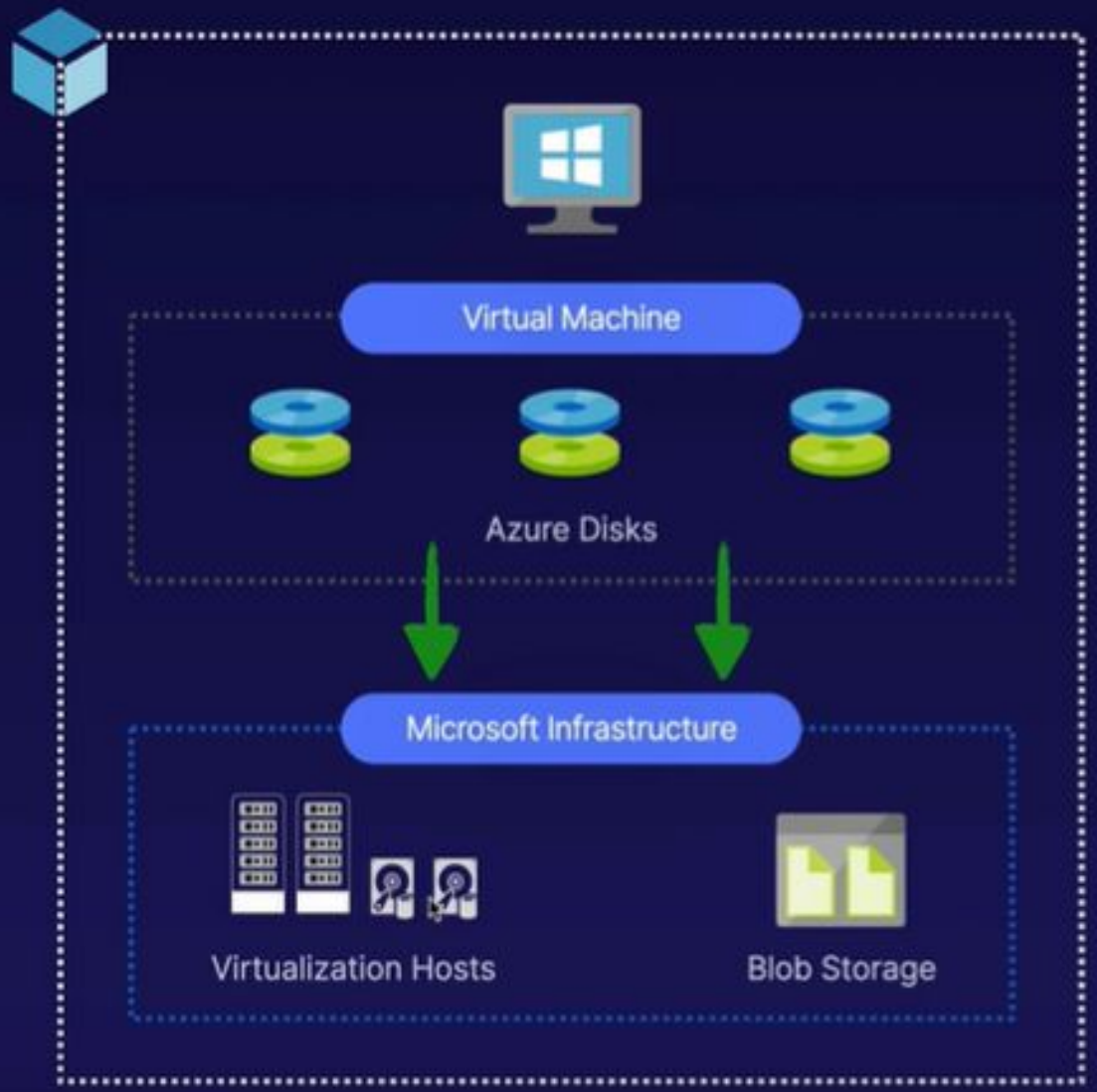



```
  "osType": null,
  "provisioningState": "Succeeded",
  "resourceGroup": "vm01-rg",
  "sku": {
    "name": "Premium_LRS",
    "tier": "Premium"
  },
  "tags": {},
  "timeCreated": "2020-04-06T01:22:37.625757+00:00",
  "type": "Microsoft.Compute/disks",
  "uniqueId": "27aa018c-739c-4704-8926-6af2f3f155c7",
  "zones": null
}
admin@Azure:~$ az vm disk attach --vm-name $vmName \
```

Adding a Data Disk to a VM



Azure Disk Performance



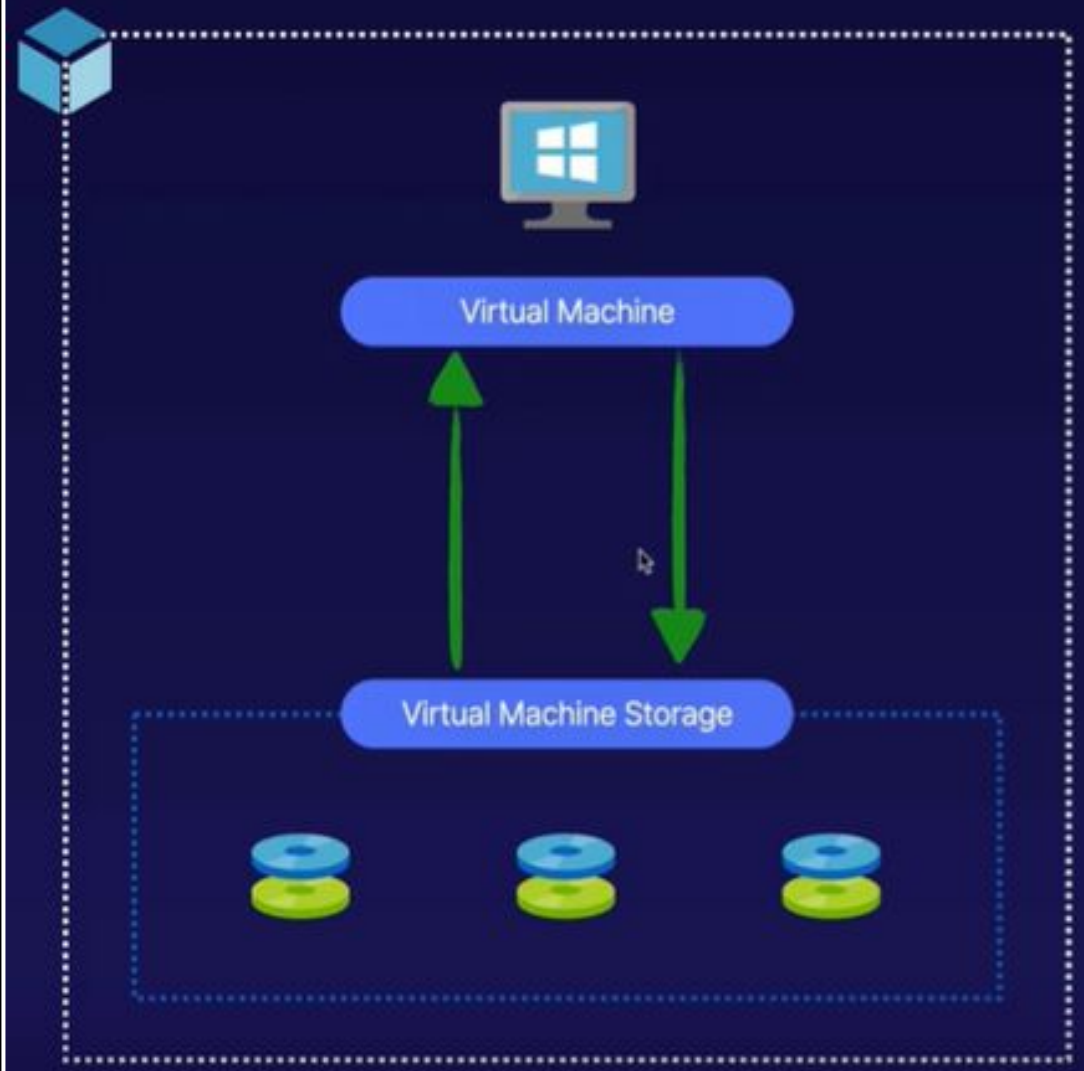
Disk Caching

Disk caching (also referred to as **host caching**) is a feature that leverages specialised high-performance (read and write) storage systems to ensure data can be accessed **very fast**.

BlobCache

Disk caching in Azure leverages a technology referred to as BlobCache, which uses a combination of host SSDs and memory to provide each to virtual machines.

Disk Caching



Cache Option	Description
Read/Write	Leverages a cache for both reads and writes. This MUST have proper support from applications on the VM to ensure data is correctly persisted from cache to storage. This type of cache is often referred to as "write-back caching". Note: this option is enabled by default for OS disks, and also supports Data disks.
Read-Only	Improves read performance (throughput and latency) by reading data from the cache, with all writes going direct to storage. This is often referred to as "read-through caching".
None	Both read and write operations do not use a cache and are instead directed to the storage backend.

Disk Caching

Azure Disk Performance Tiers

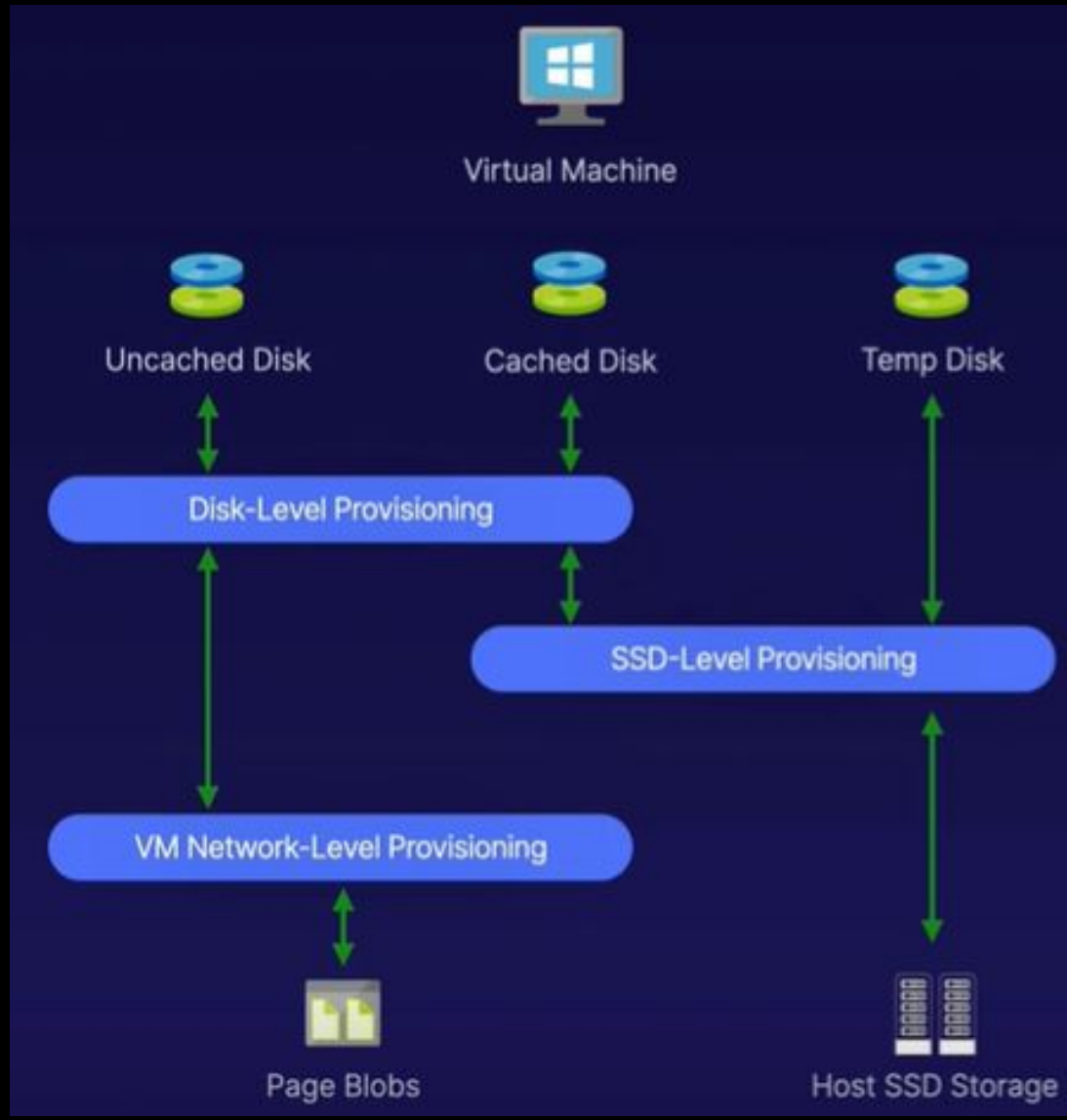
Microsoft provide several options to cater to the various performance requirements of different workloads.

Important Considerations:

- Different performance have different:
  - Maximum disk sizes.
  - Maximum throughput.
  - Maximum IOPS.
- Note, not all VM sizes support all performance tiers

Tier	Description
Ultra	Designed for extremely input/output intensive workloads (for example, SAP HANA, top-tier databases, etc.).
Premium SSD	Intended for production workloads with high-performances requirements.
Standard SSD	Built for light-usage applications, or development and testing workloads.
Standard HDD	Only intended for backup or non-critical workloads.

Disk Caching



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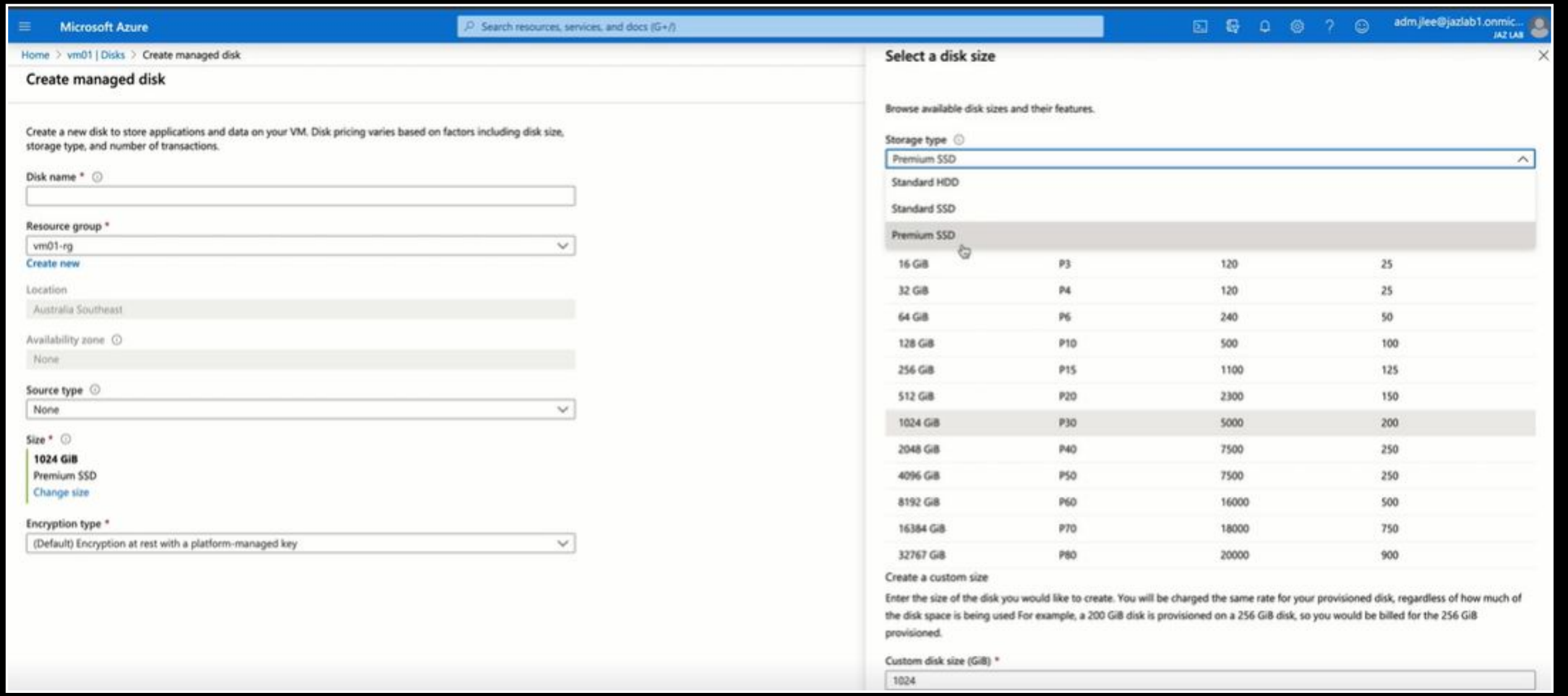
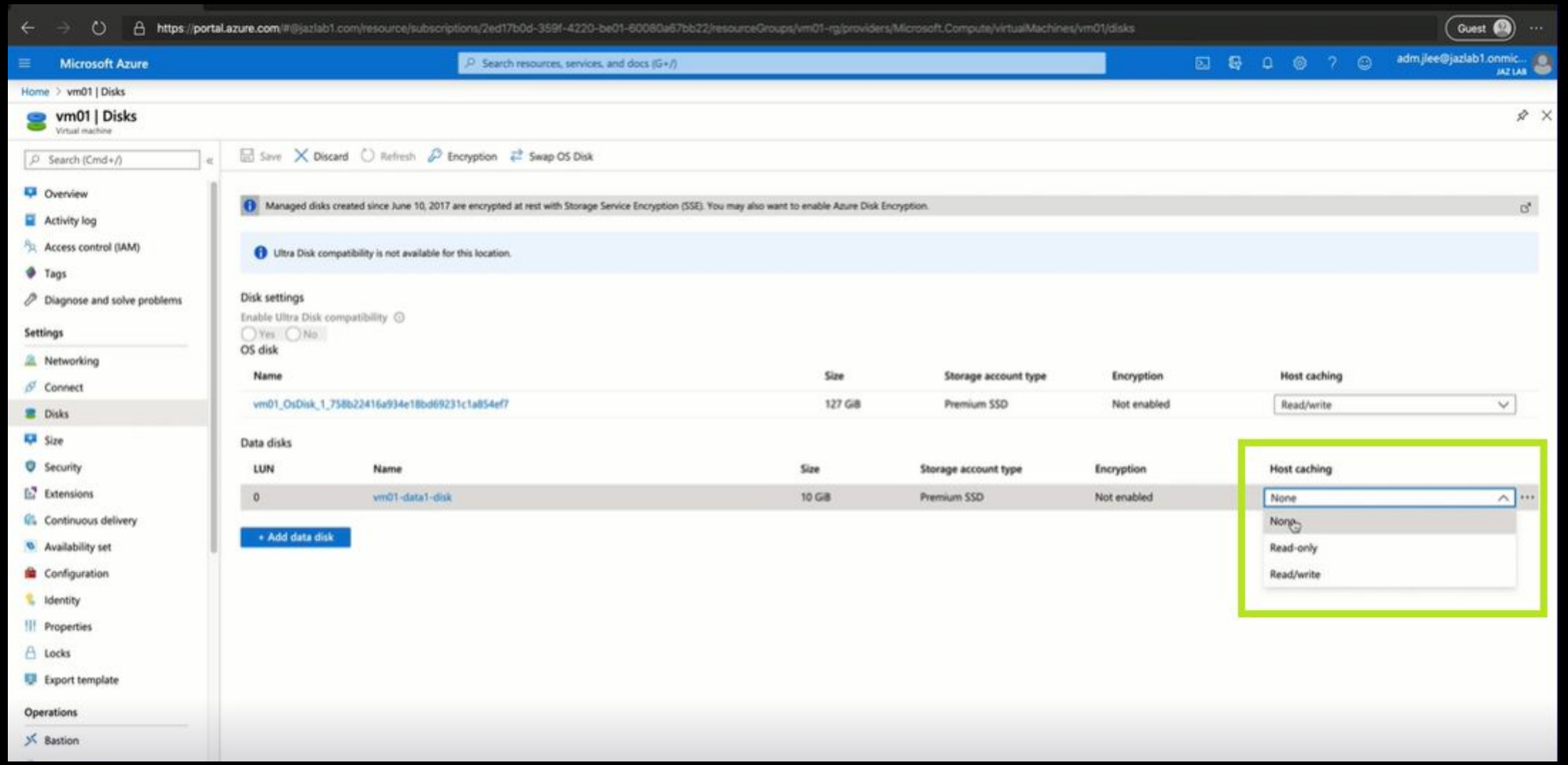
Performance Tiers



Performance Tiers



Disk Caching

Thank You