Microsoft

AZ-700

Module 01

Introduction to Azure Virtual Networks

AZ-700 Agenda

Module 01: Introduction to Azure Virtual Networks ←

Module 02: Designing and Implementing Hybrid Networking

Module 03: Designing and Implementing Azure ExpressRoute

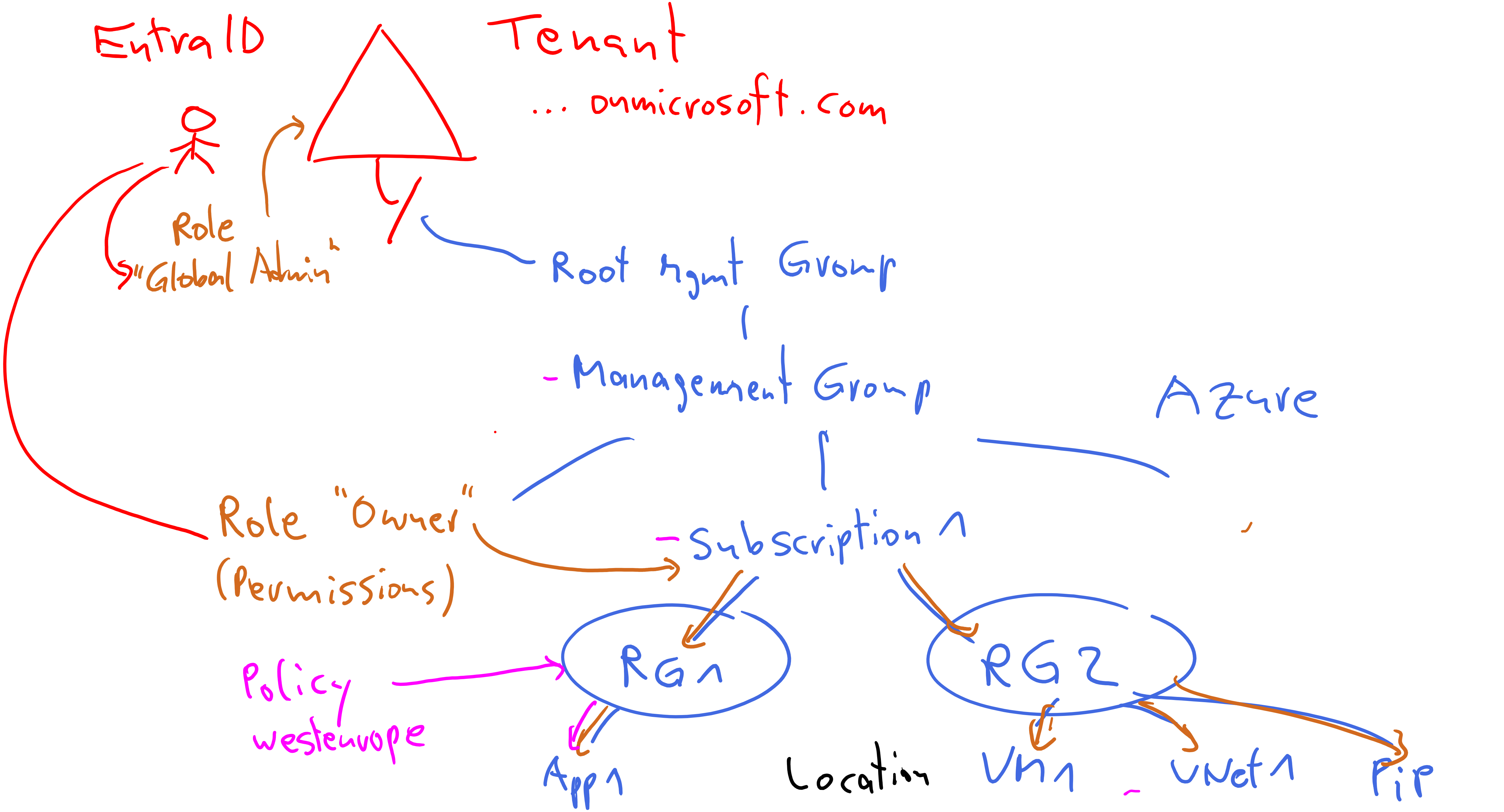
Module 04: Load balance non-HTTP(S) traffic in Azure

Module 05: Load balance HTTP(S) traffic in Azure

Module 06: Design and Implement Network Security

Module 07: Design and Implement private access to Azure Services

Module 08: Design and Implement Network Monitoring


Entra ID
Tenant
... onmicrosoft.com
Role
"Global Admin"
Root Mgmt Group
Management Group
Azure
Role "Owner"
(Permissions)
Subscription 1
RG1
RG2
Policy
westeurope
App1
Location
VM1
vNet1
Pip

Module Overview

Vint Cerf

- Explore Azure Virtual Networks
- Configure Public IP addresses
- Design name resolution for your Virtual Network
- Enable Cross-VNet connectivity with peering
- Implement virtual network traffic routing
- Configure internet access with Azure Virtual NAT

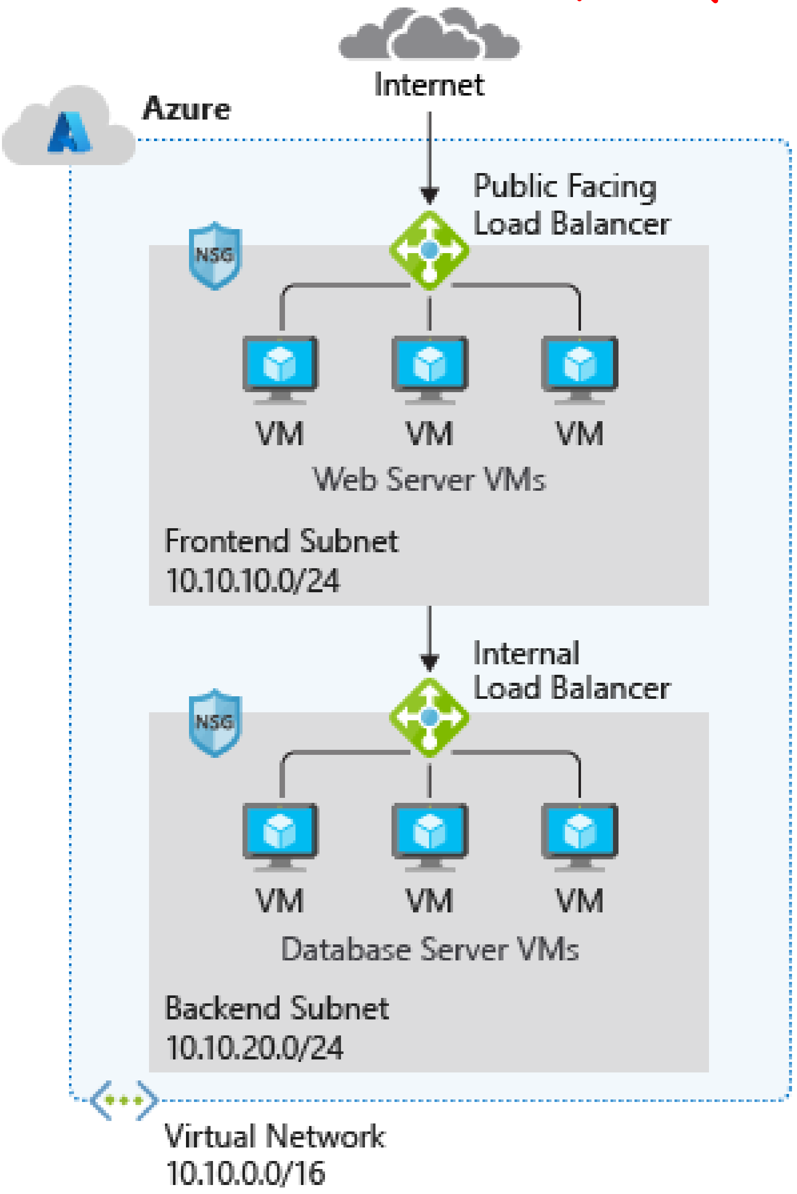
VNet 1 ═══ VNet 2

Explore Azure Virtual Networks

Capabilities of Azure Virtual Networks

IANA

- Communication with the Internet
- Communication between Azure resources
- Communication between on-premises resources
- Filtering network traffic
- Routing network traffic



Virtual Network address space

RFC 1918

10.0.0.0 - 10.255.255.255 (10/8 prefix)
172.16.0.0 - 172.31.255.255 (172.16/12 prefix)
192.168.0.0 - 192.168.255.255 (192.168/16 prefix)

Azure reserves 5 IP addresses

- x.x.x.0: Network address
- x.x.x.1: Reserved by Azure for the default gateway
- x.x.x.2, x.x.x.3: Reserved by Azure to map the Azure DNS IPs to the VNet space
- x.x.x.255: Network broadcast address

Unavailable address ranges:

- 224.0.0.0/4 (Multicast)
- 255.255.255.255/32 (Broadcast)
- 127.0.0.0/8 (Loopback)
- 169.254.0.0/16 (Link-local)
- 168.63.129.16/32 (Internal DNS)

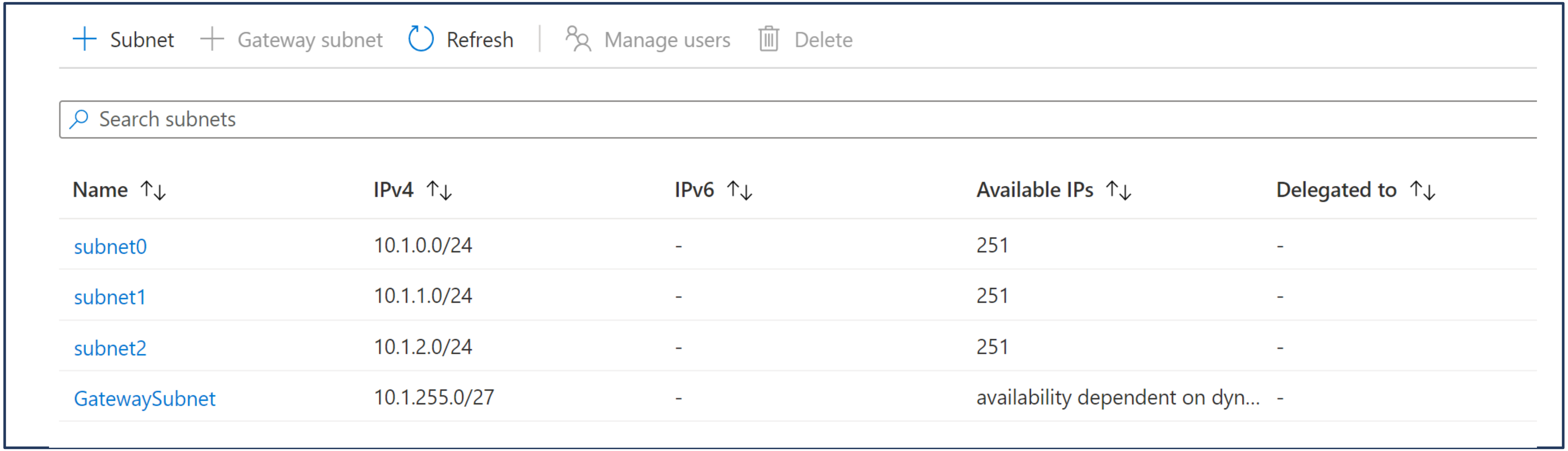
Logical representation of your own network

Create a dedicated private cloud-only virtual network

Securely extend your datacenter with virtual networks

Enable hybrid cloud scenarios

Subnets



Name ↑↓	IPv4 ↑↓	IPv6 ↑↓	Available IPs ↑↓	Delegated to ↑↓
subnet0	10.1.0.0/24	-	251	-
subnet1	10.1.1.0/24	-	251	-
subnet2	10.1.2.0/24	-	251	-
GatewaySubnet	10.1.255.0/27	-	availability dependent on dyn...	-

A virtual network can be segmented into one or more subnets

Subnets provide logical divisions within your network

Subnets can help improve security, increase performance, and make it easier to manage the network

Each subnet must have a unique address range – cannot overlap with other subnets in the virtual network in the subscription

Private IP Addresses allocation

Private IP Addresses	IP address association
Virtual Machine	NIC
Internal Load Balancer	Front-end configuration
Application Gateway	Front-end configuration

Dynamic (default). Azure assigns the next available unassigned or unreserved IP address in the subnet’s address range

Static. You select and assign any unassigned or unreserved IP address in the subnet's address range

Understand Regions and Subscriptions

Regions: VNet is scoped to a single region/location; however, multiple virtual networks from different regions can be connected using Virtual Network Peering.

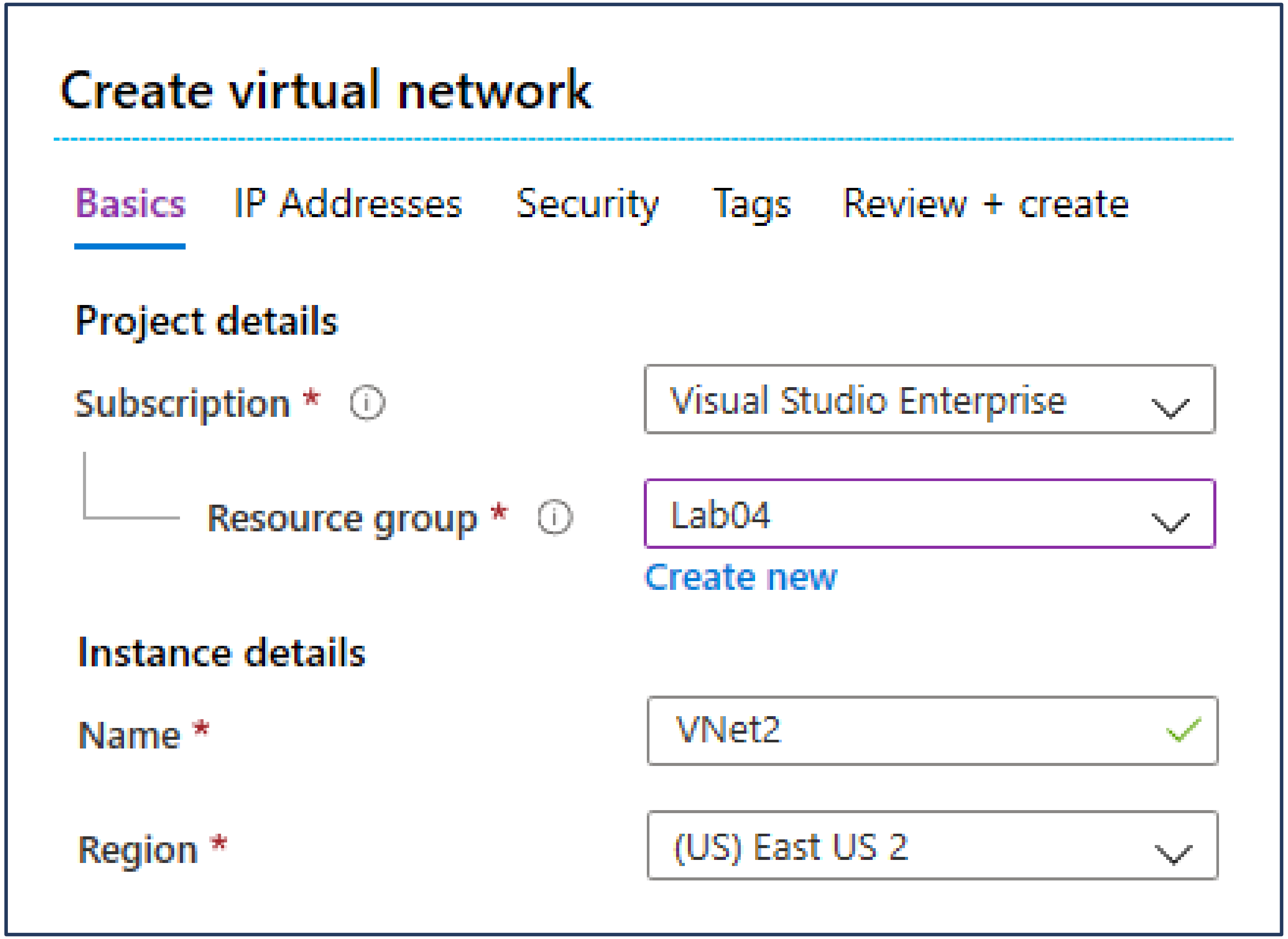
Create a Virtual Network

Create new virtual networks at any time

Add virtual networks when you create a virtual machine

Need to define the address space, and at least one subnet

Ensure non-overlapping address spaces



Create virtual network

Project details

Subscription * : Visual Studio Enterprise

Resource group * : Lab04

Instance details

Name * : VNet2 ✓

Region * : (US) East US 2

Configure Public IP addresses

Public IP Addresses

Public IP addresses	IP address association	Dynamic	Static
Virtual Machine	NIC	Yes	Yes
Load Balancer	Front-end configuration	Yes	Yes
VPN Gateway	Gateway IP configuration	Yes (non-AZ only)	Yes
Application Gateway	Front-end configuration	Yes (V1 only)	Yes (V2 only)
Azure Firewall	Front-end configuration	No	Yes
NAT gateway	Gateway IP configuration	No	Yes

A public IP address resource can be associated with resources such as virtual machine network interfaces, internet-facing load balancers, VPN gateways, and Application Gateways

Choose the appropriate SKU for a public IP

Basic SKU

- Assigned with the static or dynamic allocation method
- Open by default. NSGs are recommended but optional
- Assigned to network interfaces, VPN gateway, public load balancers, or Application Gateways
- Don’t support availability zone scenarios

Standard SKU

- Always use static allocation method
- Secure by default and closed to inbound traffic
- Allow inbound traffic with NSG
- Assigned to network interfaces, standard public load balancers, or Application Gateways
- Can be zone-redundant, zonal, or no-zone

Creating Public IP Addresses

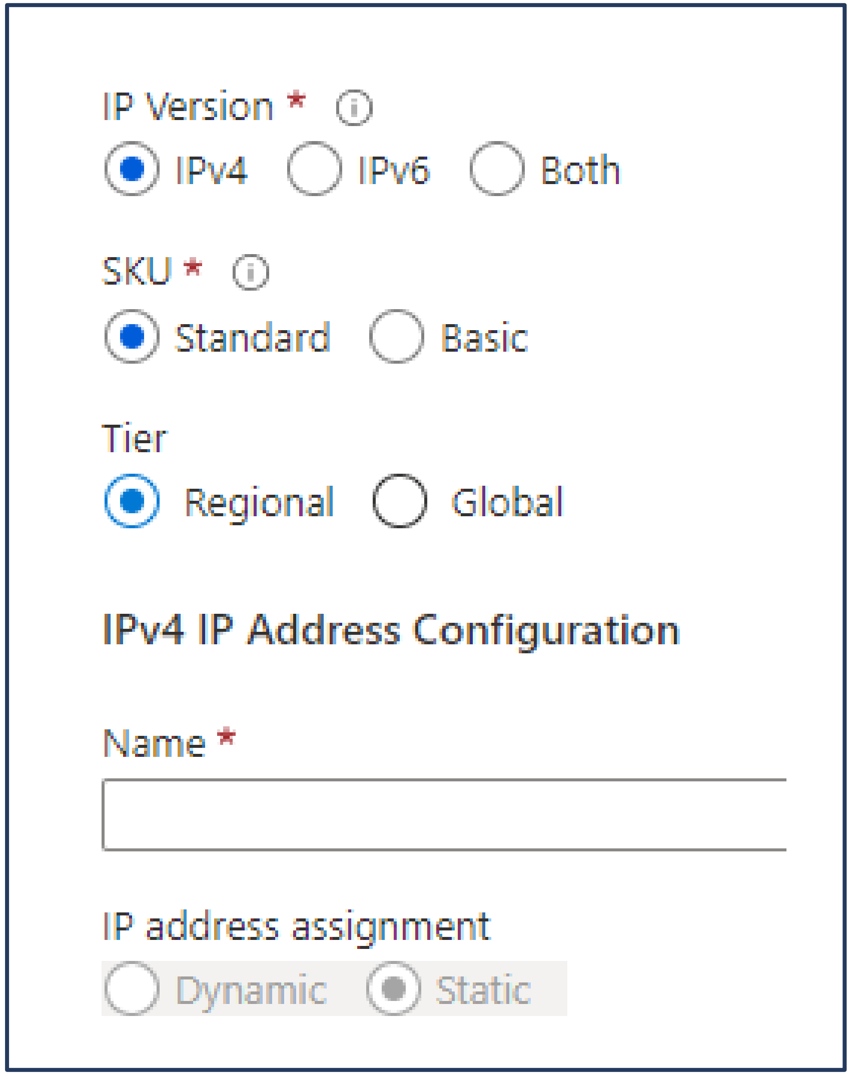
Available in IPv4 or IPv6 or both

Basic vs Standard SKU

Regional vs Global

Dynamic vs Static

Range of contiguous addresses available as a prefix



IP Version *

● IPv4 ○ IPv6 ○ Both

SKU *

● Standard ○ Basic

Tier

● Regional ○ Global

IPv4 IP Address Configuration

Name *

IP address assignment

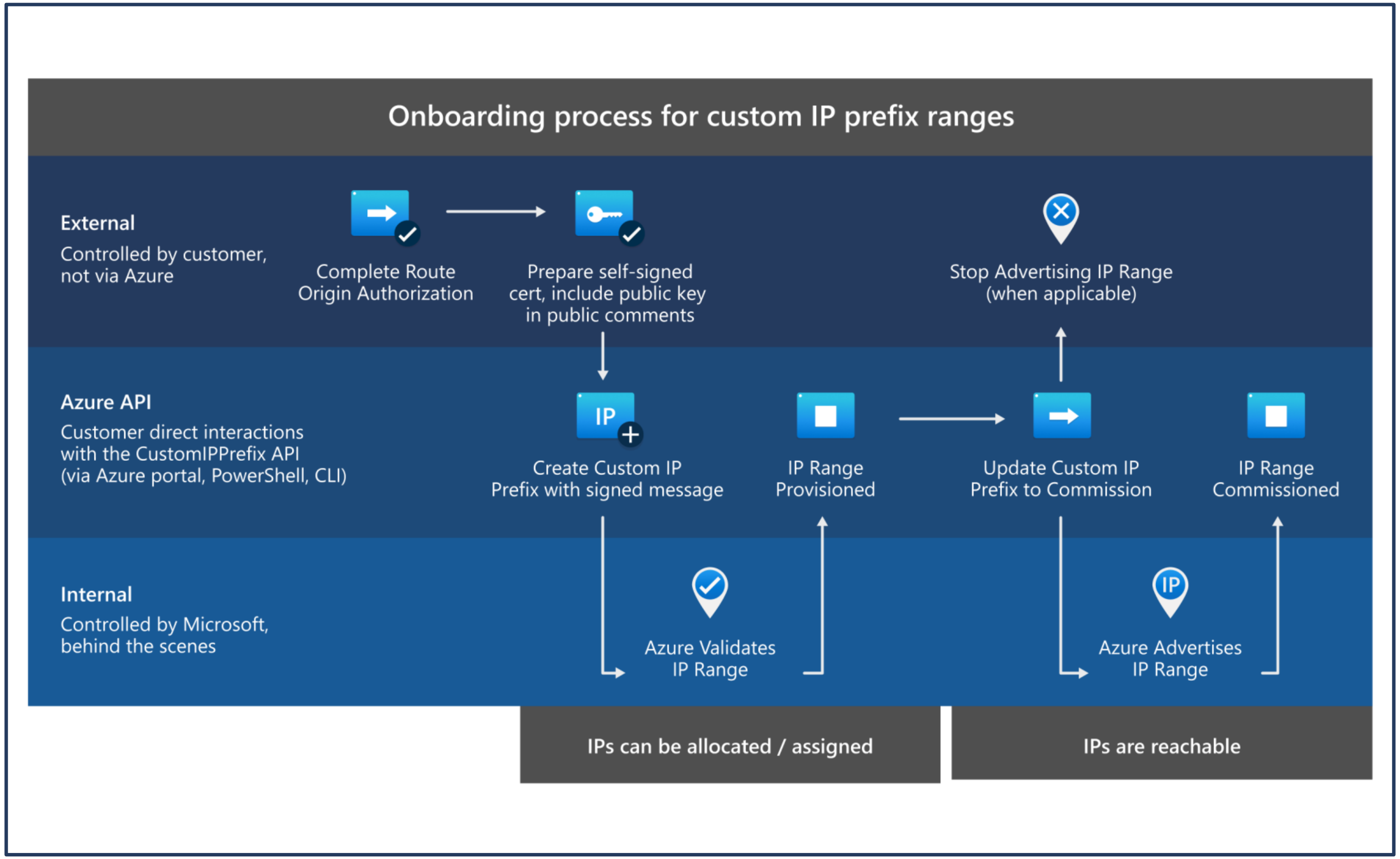
○ Dynamic ● Static

Custom IP address prefix (Bring your own IP)

Retain IP ranges (BYOIP) to maintain established reputation and continue to pass through externally controlled allowlists.

Three phase process to bring an IP prefix to Azure:

- Validation
- Provision
- Commission


Onboarding process for custom IP prefix ranges
External
Controlled by customer, not via Azure
Complete Route Origin Authorization
Prepare self-signed cert, include public key in public comments
Stop Advertising IP Range (when applicable)
Azure API
Customer direct interactions with the CustomIPPrefix API (via Azure portal, PowerShell, CLI)
IP
Create Custom IP Prefix with signed message
IP Range Provisioned
Update Custom IP Prefix to Commission
IP Range Commissioned
Internal
Controlled by Microsoft, behind the scenes
Azure Validates IP Range
IP
Azure Advertises IP Range
IPs can be allocated / assigned
IPs are reachable

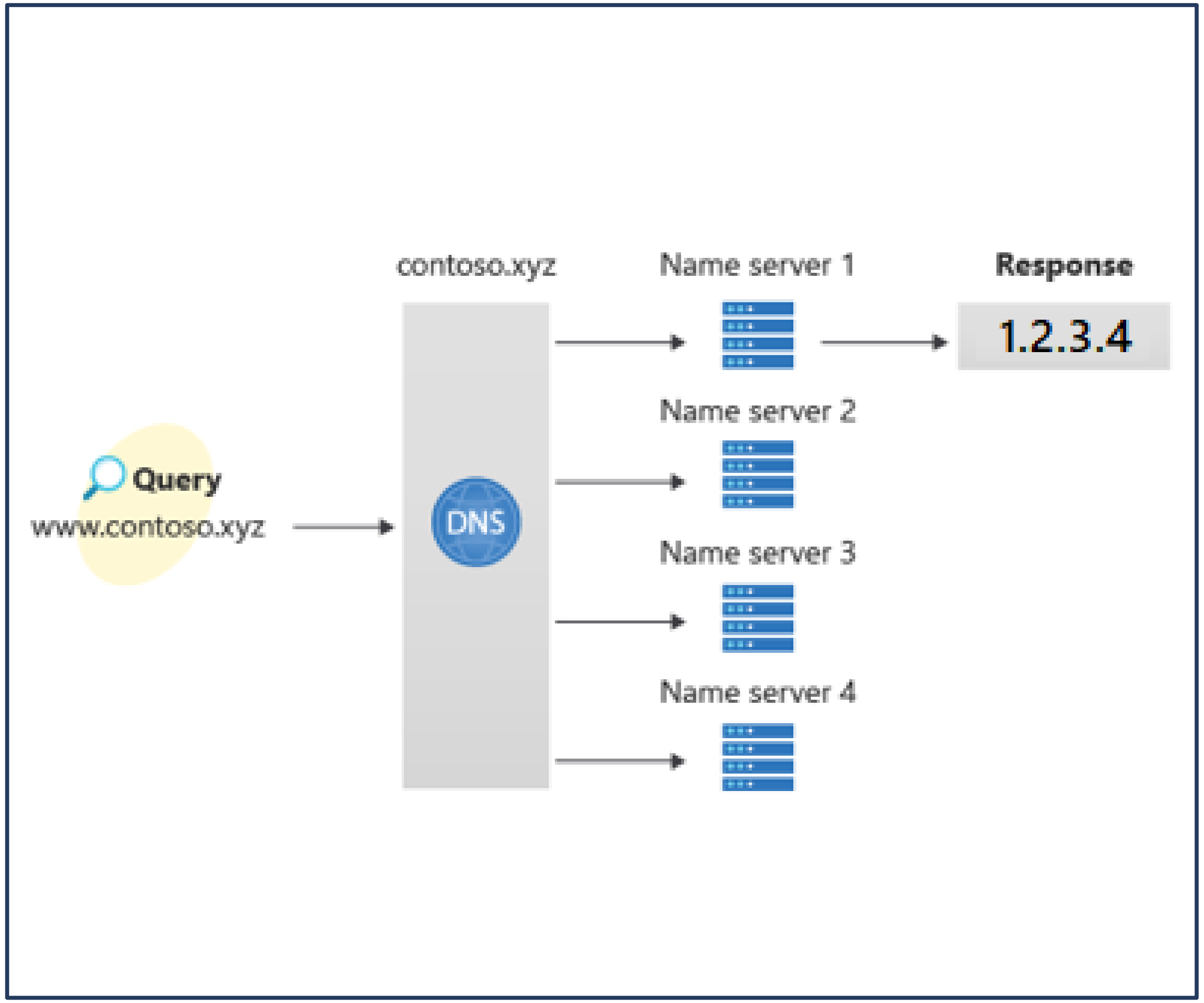
Design Name Resolution for Azure Virtual Network

Public DNS

Public DNS services resolve names and IP addresses for resources and services accessible over the internet such as web servers. Azure DNS is a hosting service for DNS domain that provides name resolution by using Microsoft Azure infrastructure

In Azure DNS, you can create address records manually within relevant zones. The records most frequently used will be:

- Host records: A/AAAA (IPv4/IPv6)
- Alias records: CNAME



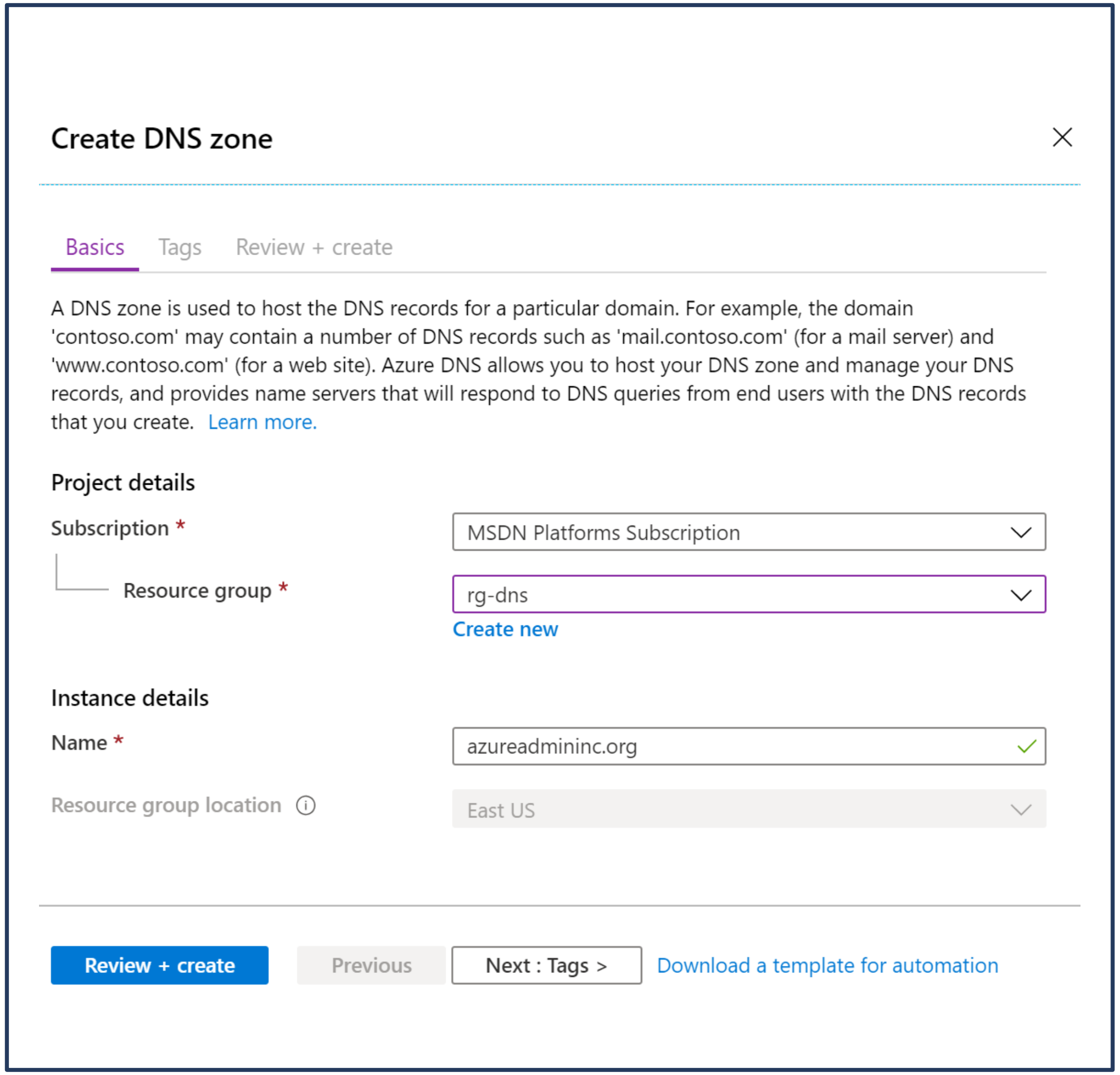
Azure DNS Zones

A DNS zone hosts the DNS records for a domain

The same zone name can be reused in a different resource group or a different Azure subscription

Where multiple zones share the same name, each instance is assigned different name server addresses

Root/Parent domain is registered at the registrar and pointed to Azure NS



Create DNS zone

A DNS zone is used to host the DNS records for a particular domain. For example, the domain 'contoso.com' may contain a number of DNS records such as 'mail.contoso.com' (for a mail server) and 'www.contoso.com' (for a web site). Azure DNS allows you to host your DNS zone and manage your DNS records, and provides name servers that will respond to DNS queries from end users with the DNS records that you create. Learn more.

Project details

Subscription * MSDN Platforms Subscription

Resource group * rg-dns

Create new

Instance details

Name * azureadmininc.org ✓

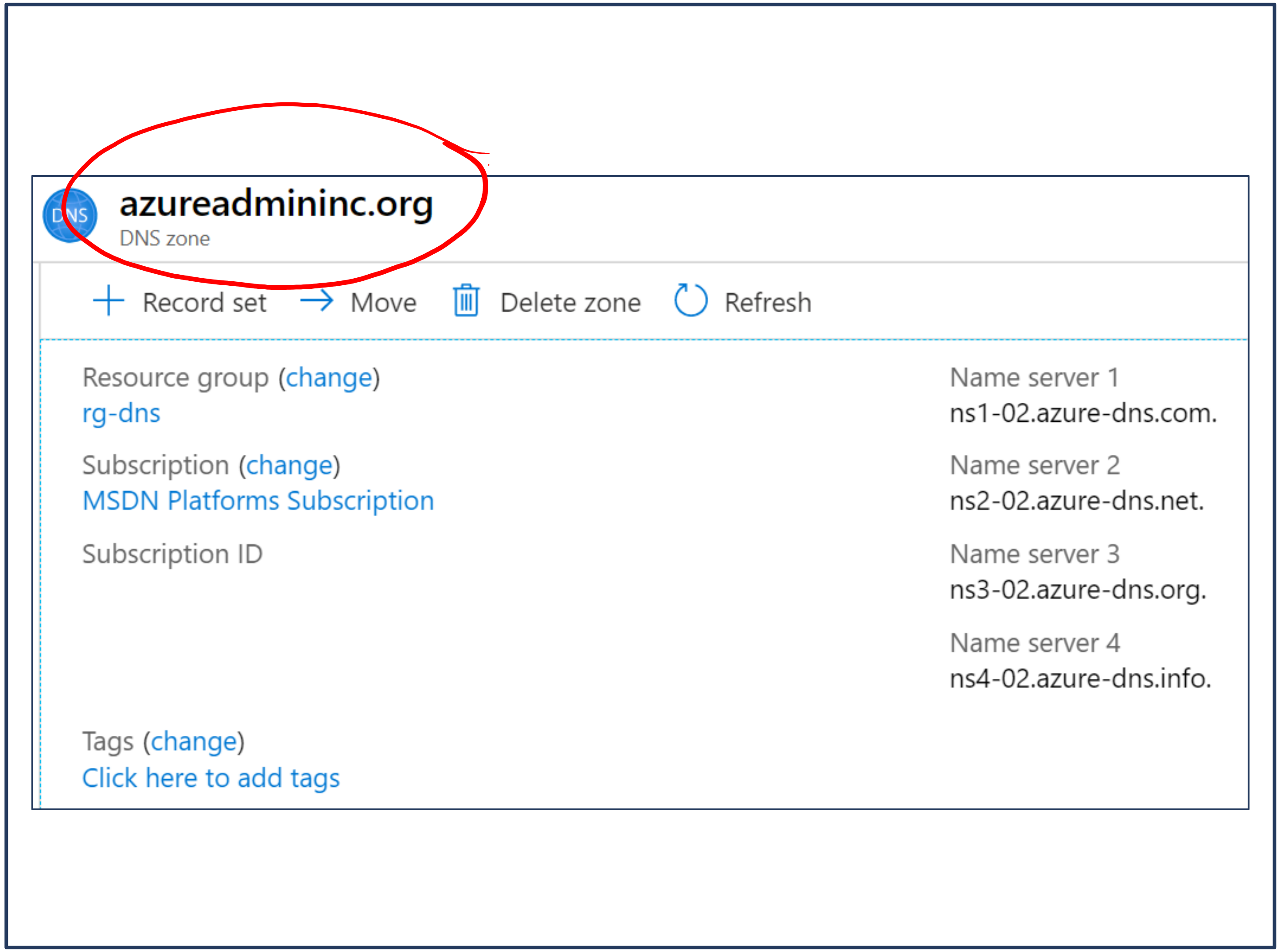
Resource group location ⓘ East US

DNS Delegation

When delegating a domain to Azure DNS, you must use the name server names provided by Azure DNS – use all four

Once the DNS zone is created, update the parent registrar

For child zones, register the NS records in the parent domain



azureadmininc.org

DNS zone

Resource group (change)
rg-dns

Subscription (change)
MSDN Platforms Subscription

Subscription ID

Tags (change)
Click here to add tags

Name server 1
ns1-02.azure-dns.com.

Name server 2
ns2-02.azure-dns.net.

Name server 3
ns3-02.azure-dns.org.

Name server 4
ns4-02.azure-dns.info.

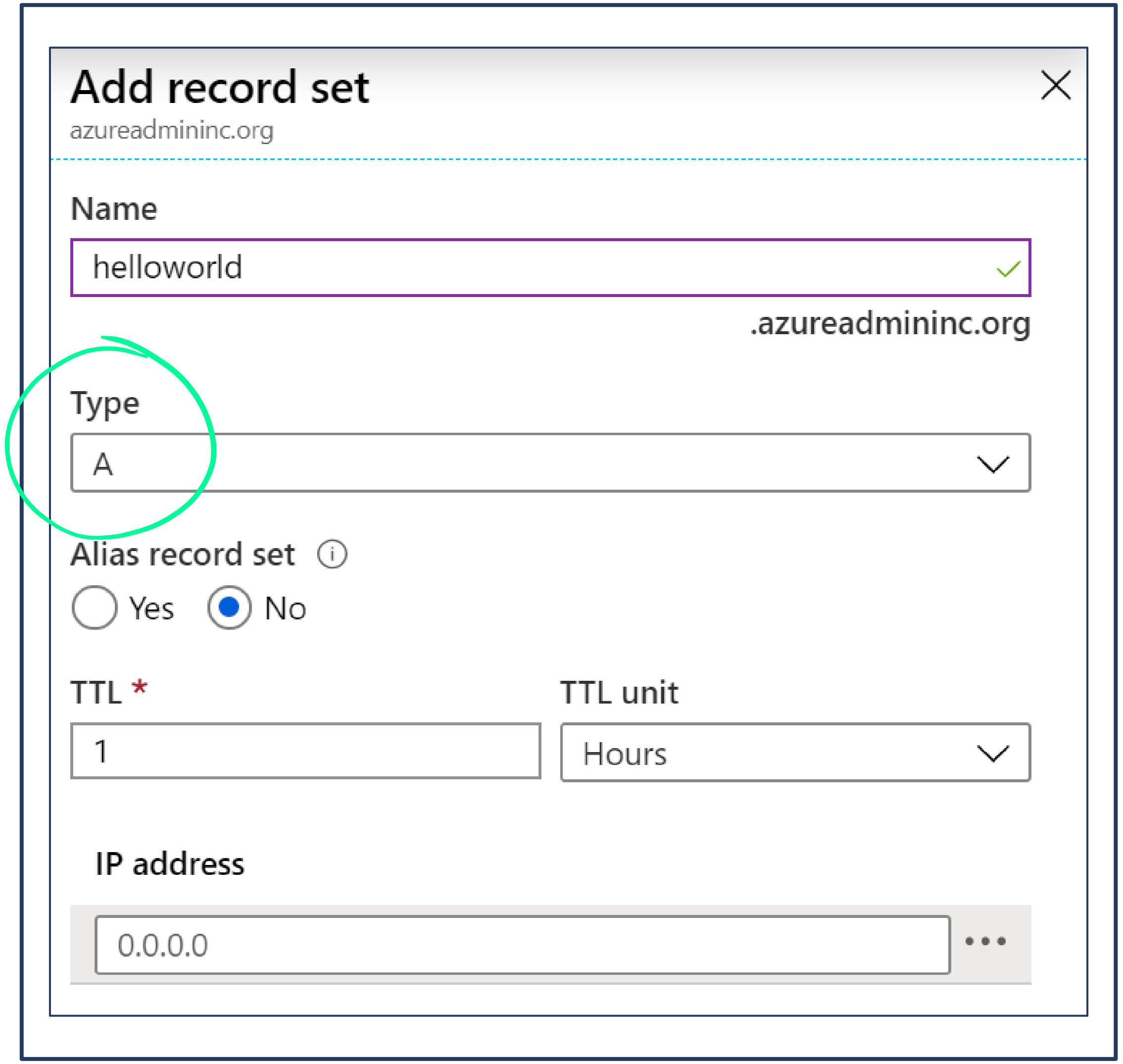
DNS Record Sets

A record set is a collection of records in a zone that have the same name and are the same type

Azure DNS supports all common DNS record types: A, AAAA, CAA, CNAME, MX, NS, PTR, SOA, SRV, and TXT

A record set cannot contain two identical records

Changing the drop-down Type, changes the information required



Add record set

azureadmininc.org

Name: helloworld .azureadmininc.org

Type: A

Alias record set: ○ Yes ● No

TTL *: 1

TTL unit: Hours

IP address: 0.0.0.0

DNS for Private Domains

Use your own custom domain names

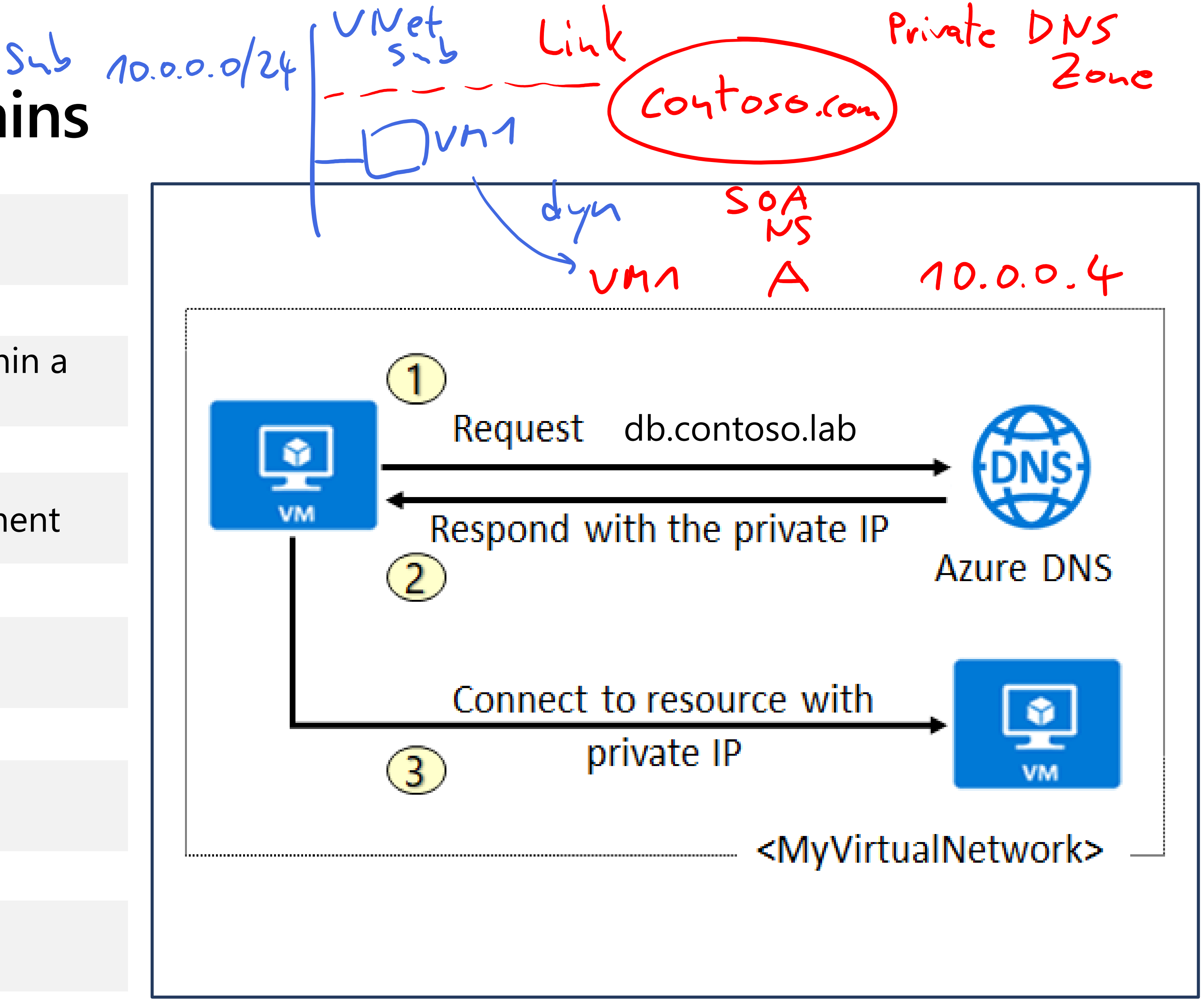
Provides name resolution for VMs within a VNet and between VNets

Automatic hostname record management

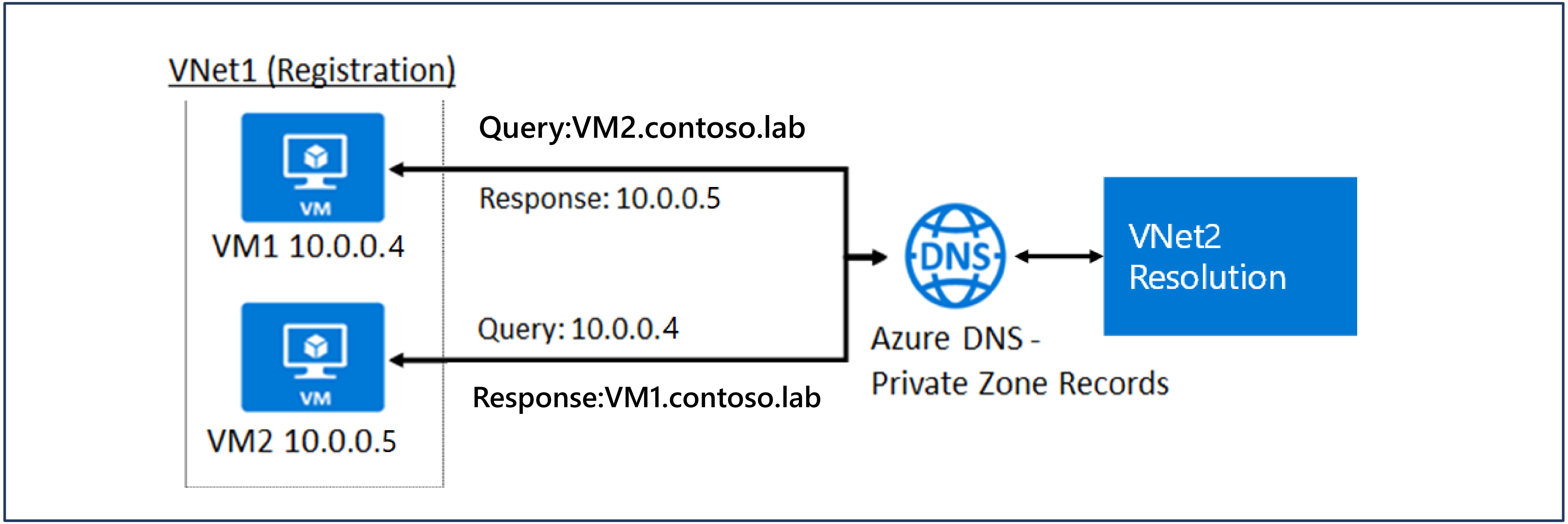
Removes the need for custom DNS solutions

Use all common DNS records types

Available in all Azure regions



Private Zone Scenarios



DNS queries across the linked virtual networks are resolved

DNS resolution in VNet1 is private and not accessible from the Internet

Significance of IP address 168.63.129.16

Magic

Enables the VM Agent to communicate with the Azure platform to signal that it is in a "Ready" state

Enables communication with the DNS virtual server to provide filtered name resolution to the resources (such as VM) that do not have a custom DNS server.

Enables health probes from Azure load balancer to determine the health state of VMs

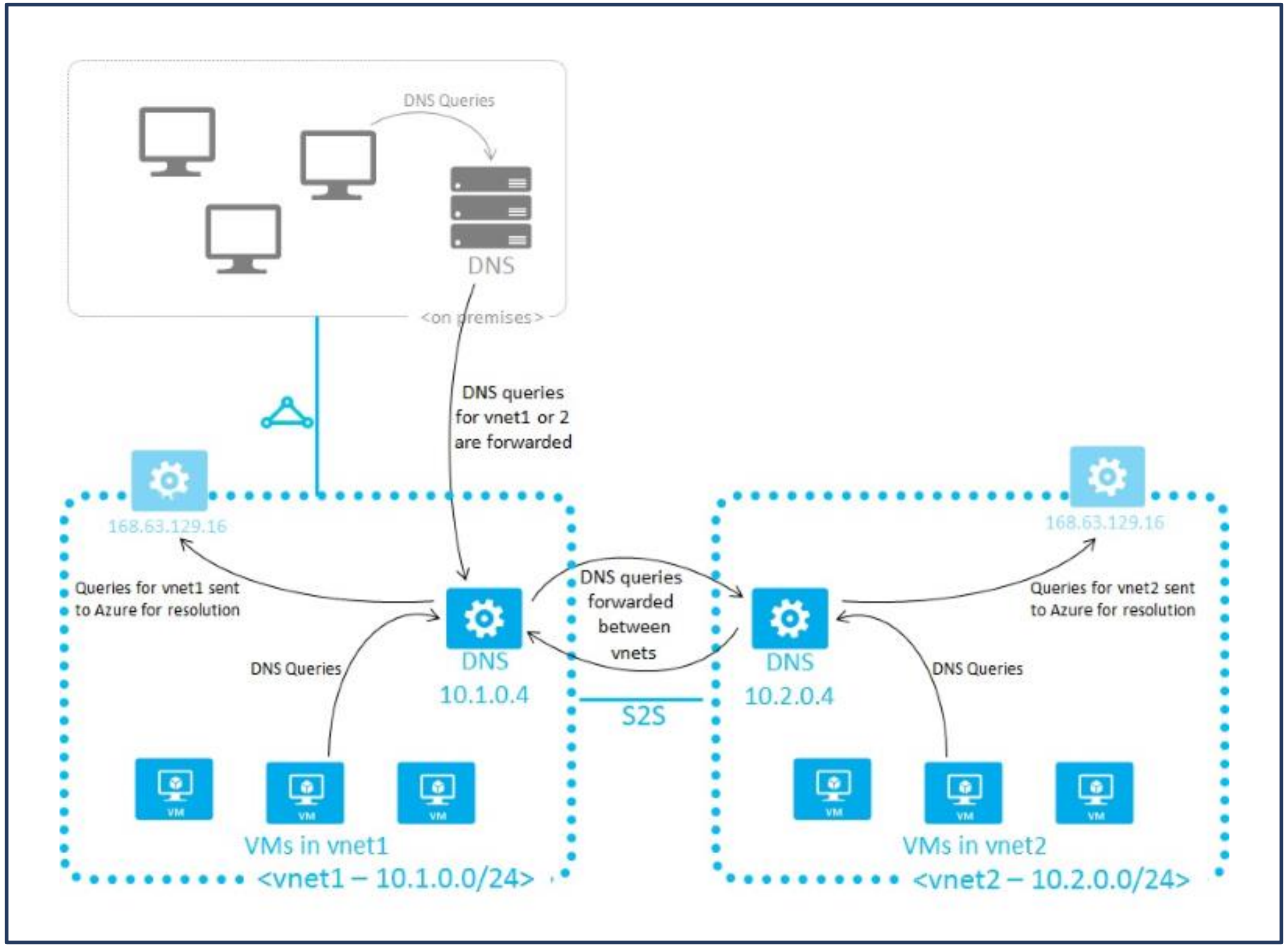
Enables the VM to obtain a dynamic IP address from the DHCP service in Azure

Enables Guest Agent heartbeat messages for the PaaS role

Configure DNS settings inside a VNet

Provide your own DNS solution:

- Provide appropriate host name resolution.
- Provide appropriate recursive resolution to allow resolution of external domain names.
- Be accessible (TCP and UDP on port 53) - NSG rules must allow access to your DNS listeners endpoint.
- Be secured against access from the internet, to mitigate threats posed by external agents.



Enable Cross-VNet Connectivity with Peering

Learning Objectives - Enable Cross-VNet Connectivity with Peering

- VNet Peering
- Gateway Transit and Connectivity
- Service Chaining
- Configure VNet Peering
- Demonstration
- Learning Recap

VNet Peering

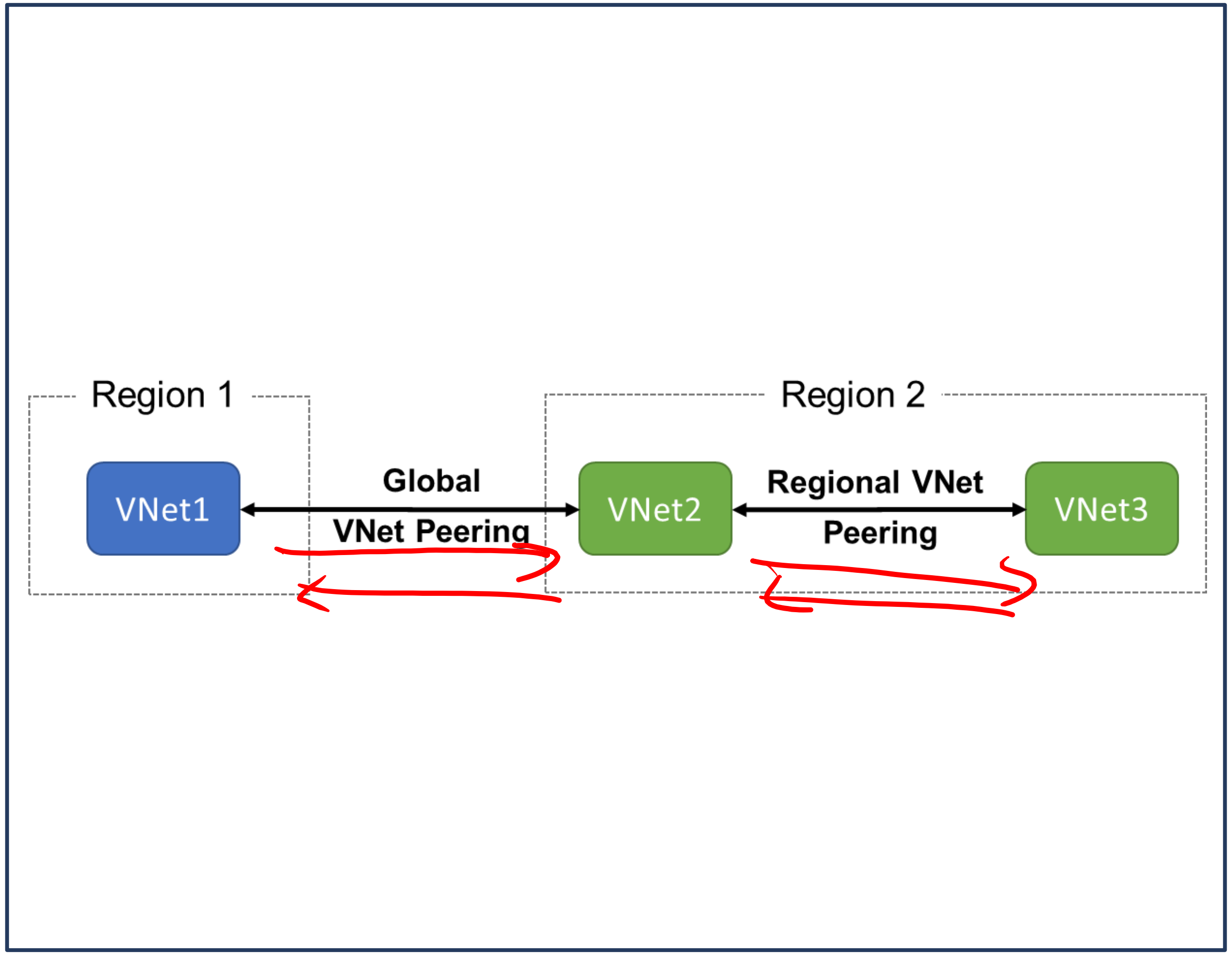
VNet peering connects two Azure virtual networks

Two types of peering: Regional and Global

Peered networks use the Azure backbone for privacy and isolation

You can peer across subscriptions and tenants

VNet peering is not transitive



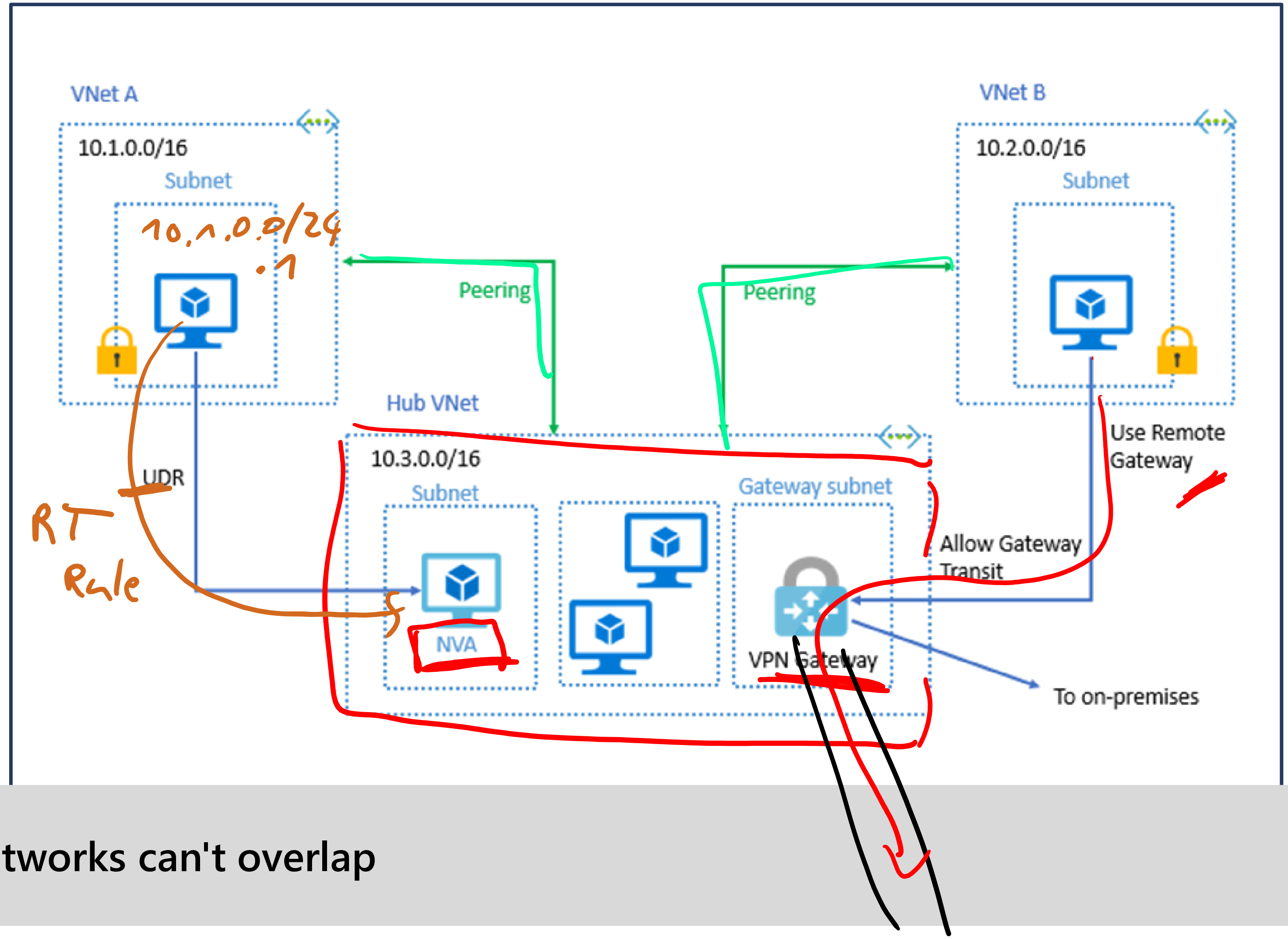
UDR User defined Route
NVA Net virtual Appliance

Implementing VNet Peering

Gateway transit allows peered virtual networks to share the gateway and get access to resources

No VPN gateway is required in the peered virtual network

Default VNet peering provides full connectivity

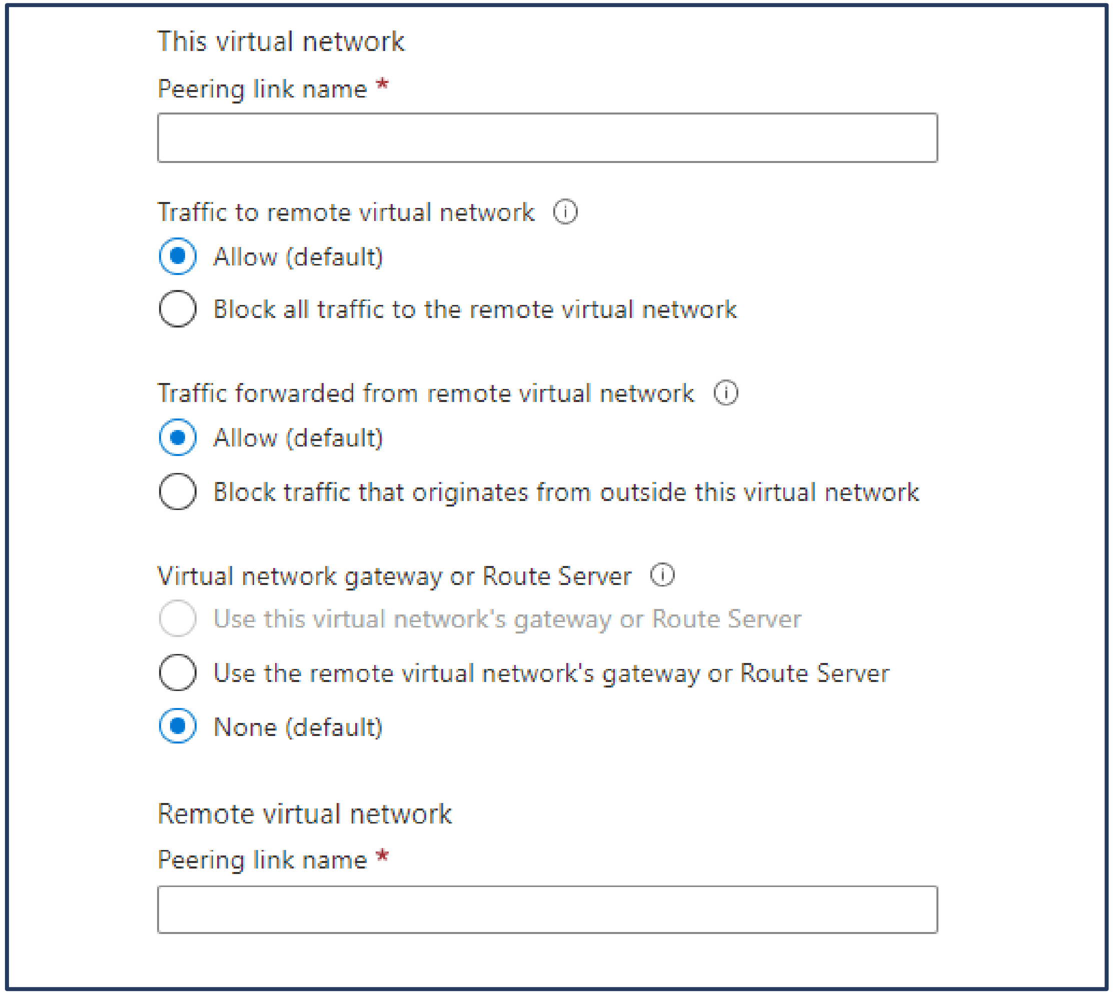


✓ IP address spaces of connected networks can't overlap

Configure VNet Peering

Allow virtual network access settings

Configure forwarded traffic settings



This virtual network

Peering link name *

Traffic to remote virtual network ⓘ

● Allow (default)

○ Block all traffic to the remote virtual network

Traffic forwarded from remote virtual network ⓘ

● Allow (default)

○ Block traffic that originates from outside this virtual network

Virtual network gateway or Route Server ⓘ

○ Use this virtual network's gateway or Route Server

○ Use the remote virtual network's gateway or Route Server

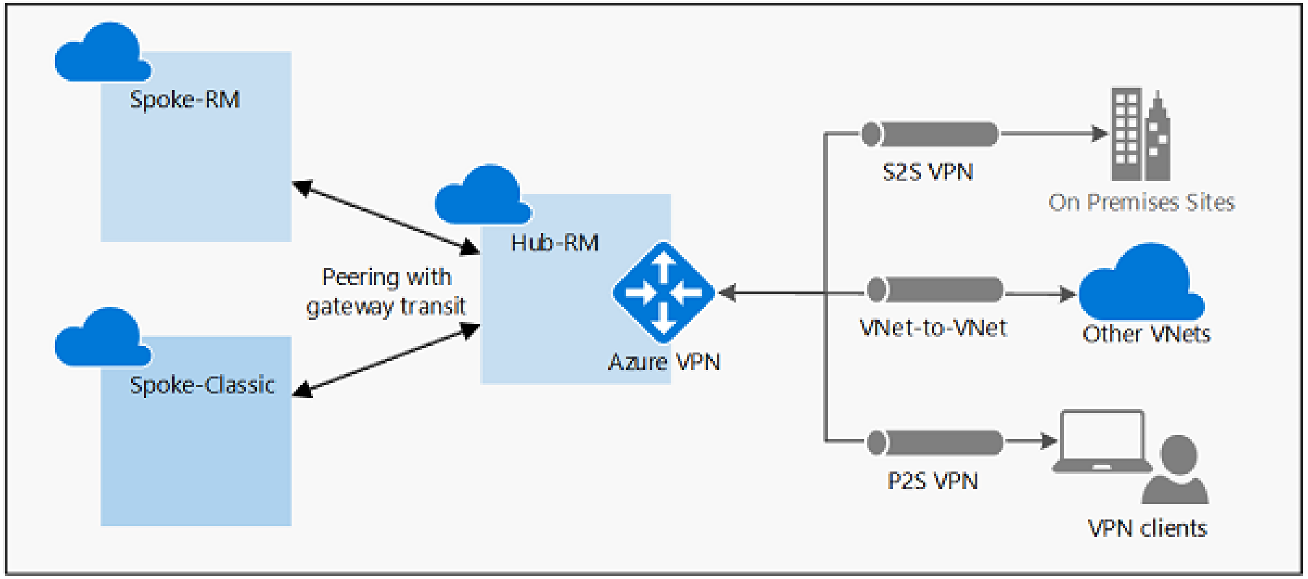
● None (default)

Remote virtual network

Peering link name *

Configure VNet peering – Gateway Transit

Gateway transit allows spoke virtual networks to share the VPN gateway in the hub

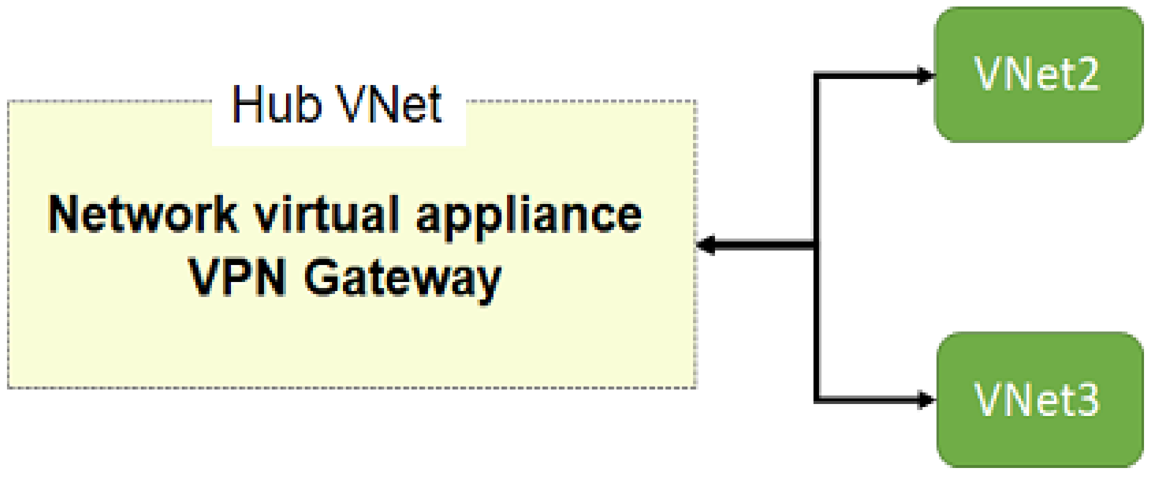


Service Chaining

Leverage user-defined routes and service chaining to implement custom routing

Implement a VNet hub with a network virtual appliance or a VPN gateway

Service chaining enables you to direct traffic from one virtual network to a virtual appliance, or virtual network gateway, in a peered virtual network, through user-defined routes



Implement virtual network traffic routing

Learning Objectives - Implement Virtual Network Traffic Routing

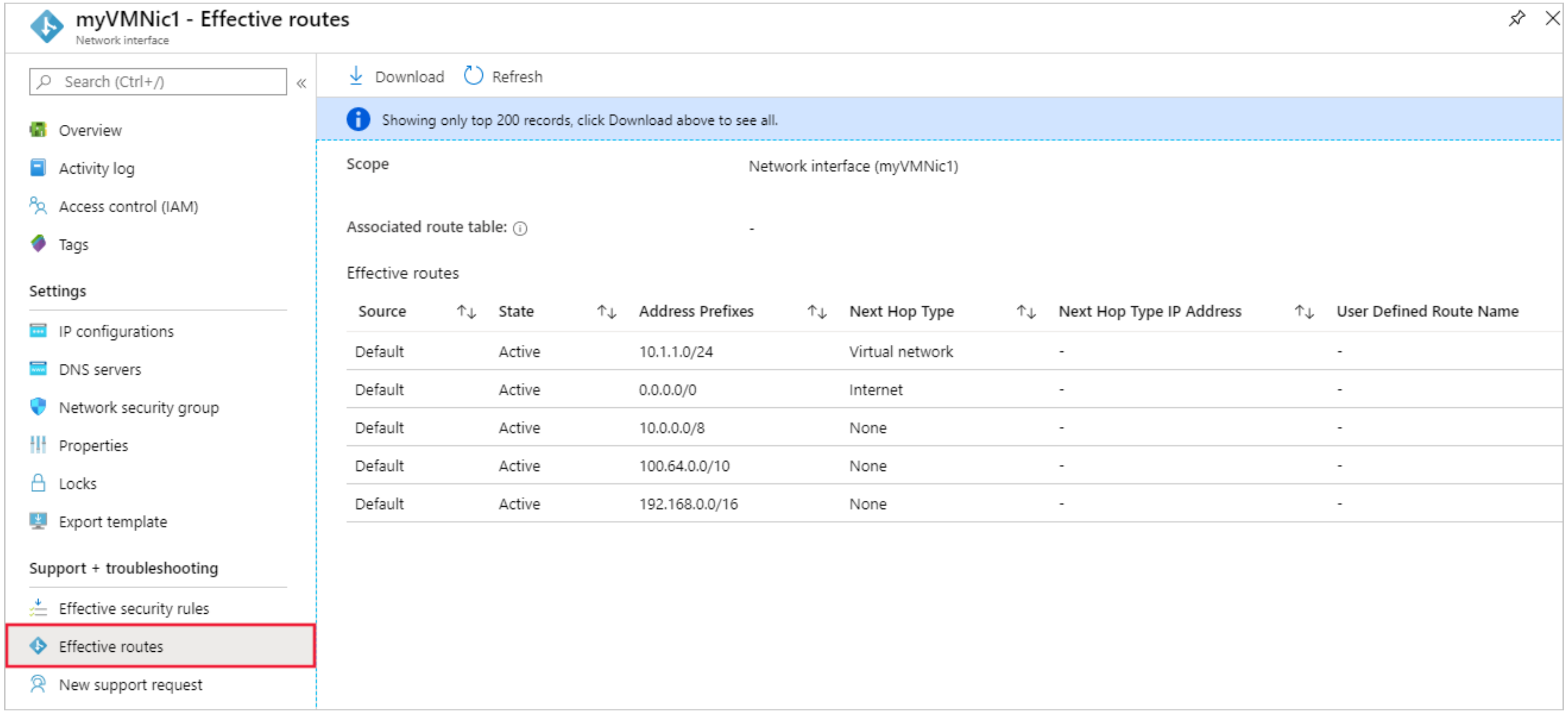
- Virtual network traffic routing
- Configure User-defined routes (UDRs)
- Configure forced tunneling
- Configure Azure Route Server
- Diagnose a routing problem
- Demonstration
- Learning Recap

Virtual network traffic routing

System routes

Default routes

Custom routes



Showing only top 200 records, click Download above to see all.

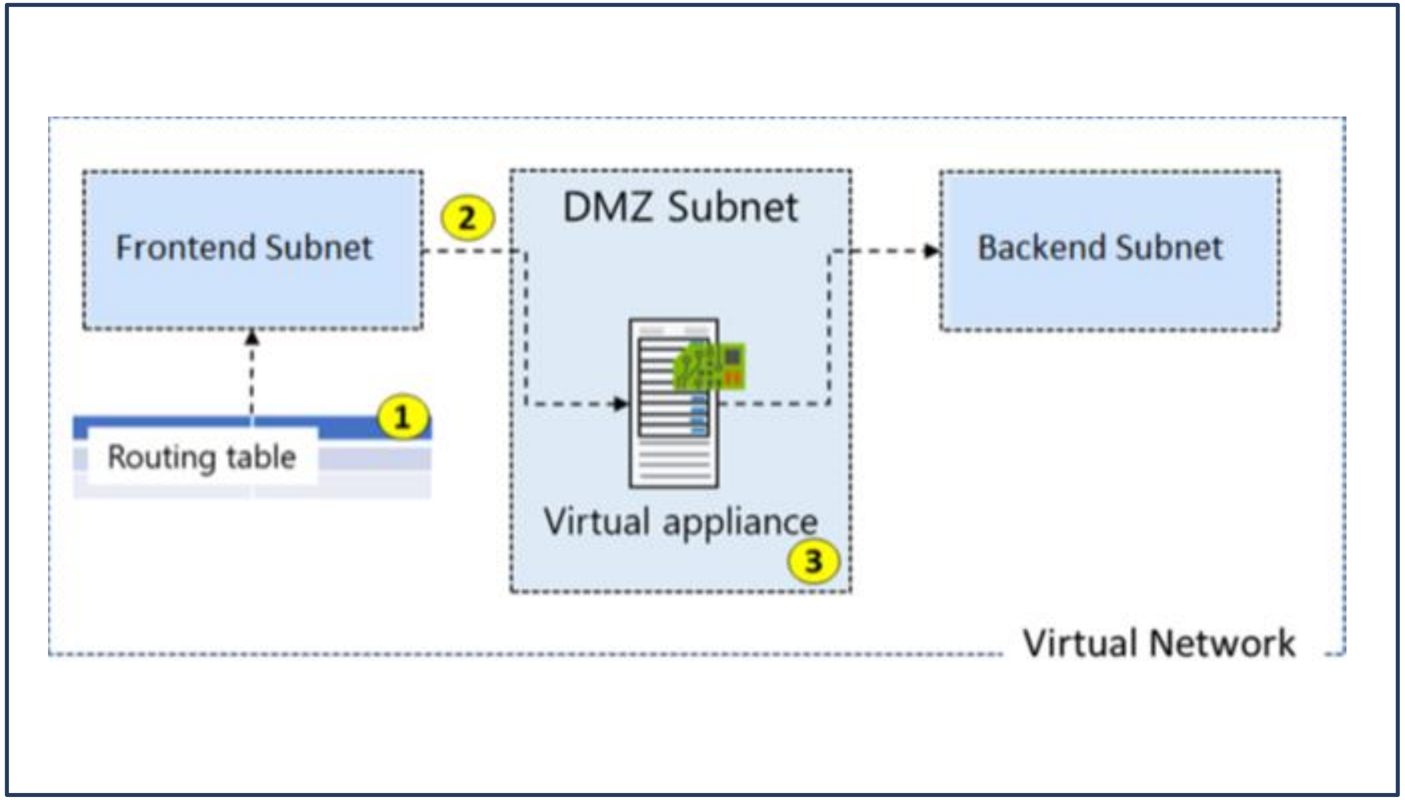
Scope Network interface (myVMNic1)

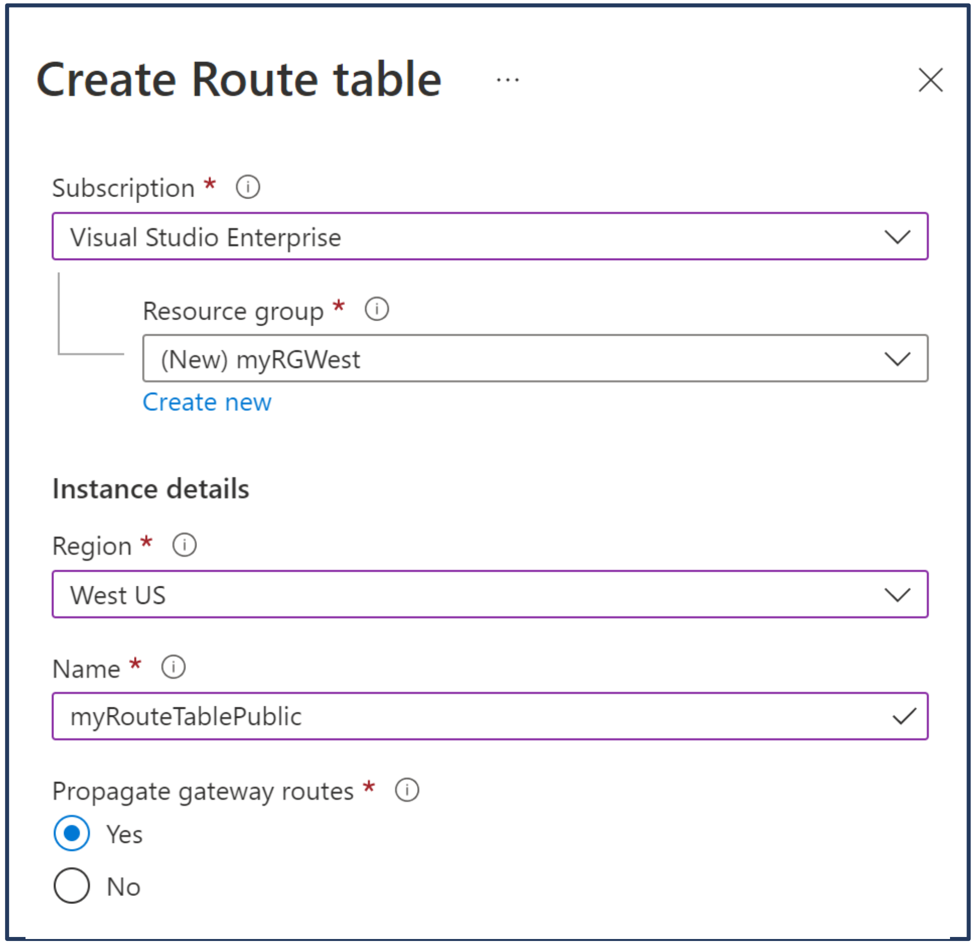
Associated route table: -

Effective routes

Source	State	Address Prefixes	Next Hop Type	Next Hop Type IP Address	User Defined Route Name
Default	Active	10.1.1.0/24	Virtual network	-	-
Default	Active	0.0.0.0/0	Internet	-	-
Default	Active	10.0.0.0/8	None	-	-
Default	Active	100.64.0.0/10	None	-	-
Default	Active	192.168.0.0/16	None	-	-

Configure User-defined routes





Create Route table

Subscription * ⓘ

Visual Studio Enterprise

Resource group * ⓘ

(New) myRGWest

Create new

Instance details

Region * ⓘ

West US

Name * ⓘ

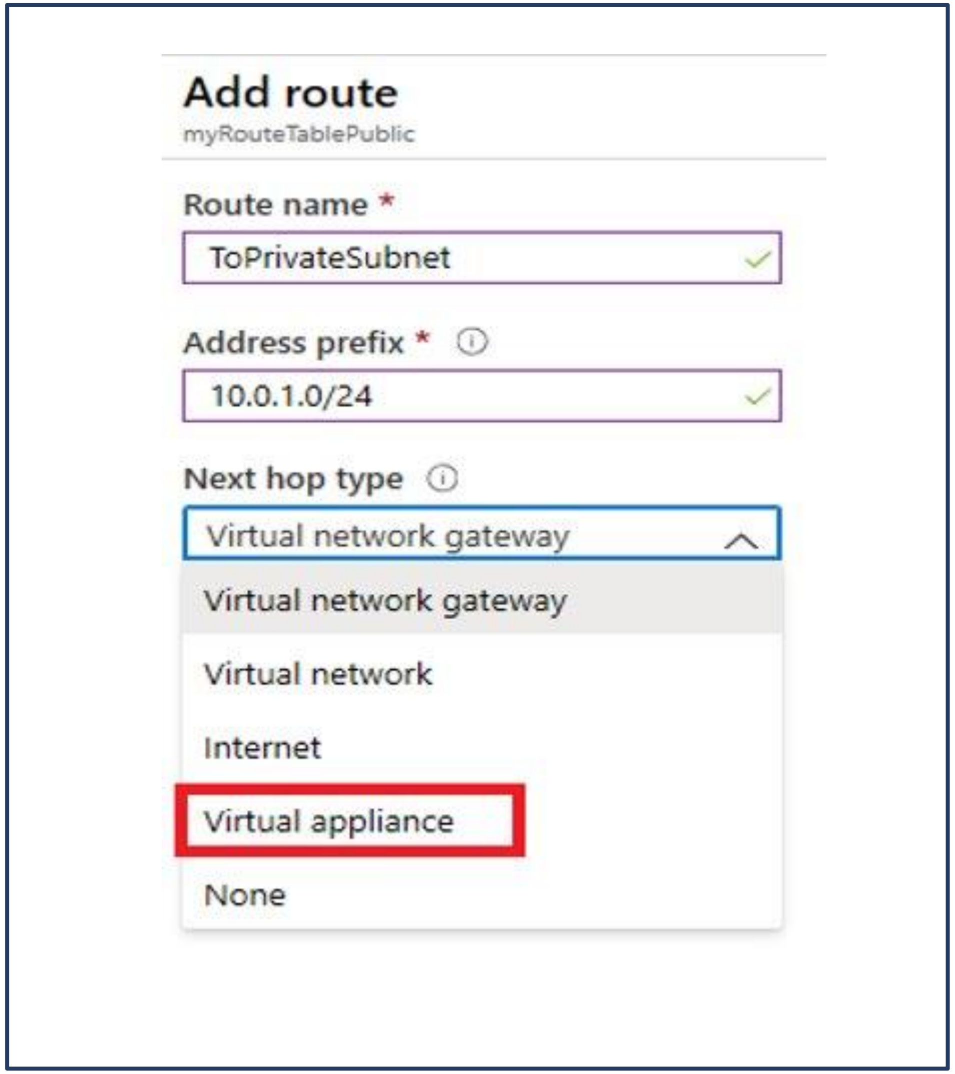
myRouteTablePublic ✓

Propagate gateway routes * ⓘ

● Yes

○ No

Create a Custom Route and associate route table to subnet

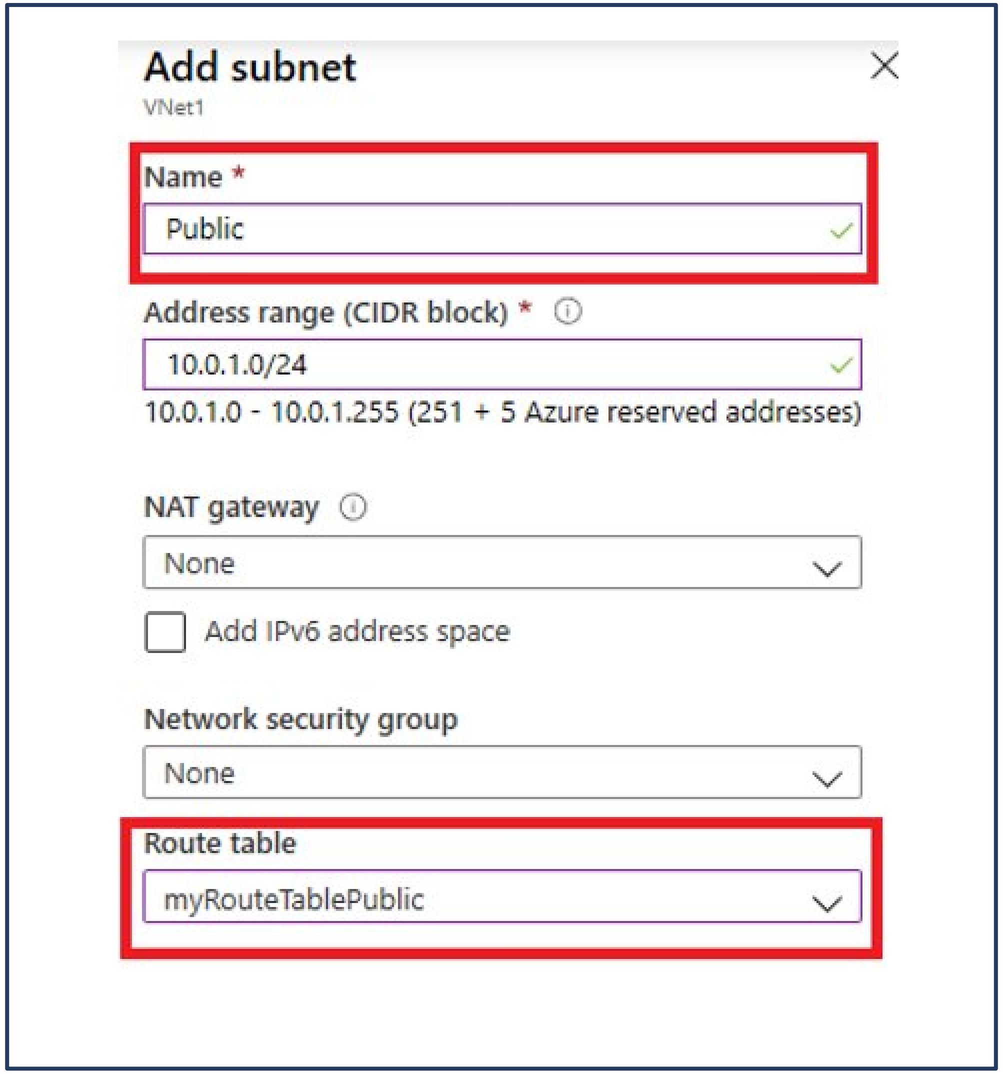


Add route
myRouteTablePublic

Route name * ToPrivateSubnet

Address prefix * 10.0.1.0/24

Next hop type: Virtual network gateway



Add subnet
VNet1

Name * Public

Address range (CIDR block) * 10.0.1.0/24

10.0.1.0 - 10.0.1.255 (251 + 5 Azure reserved addresses)

NAT gateway: None

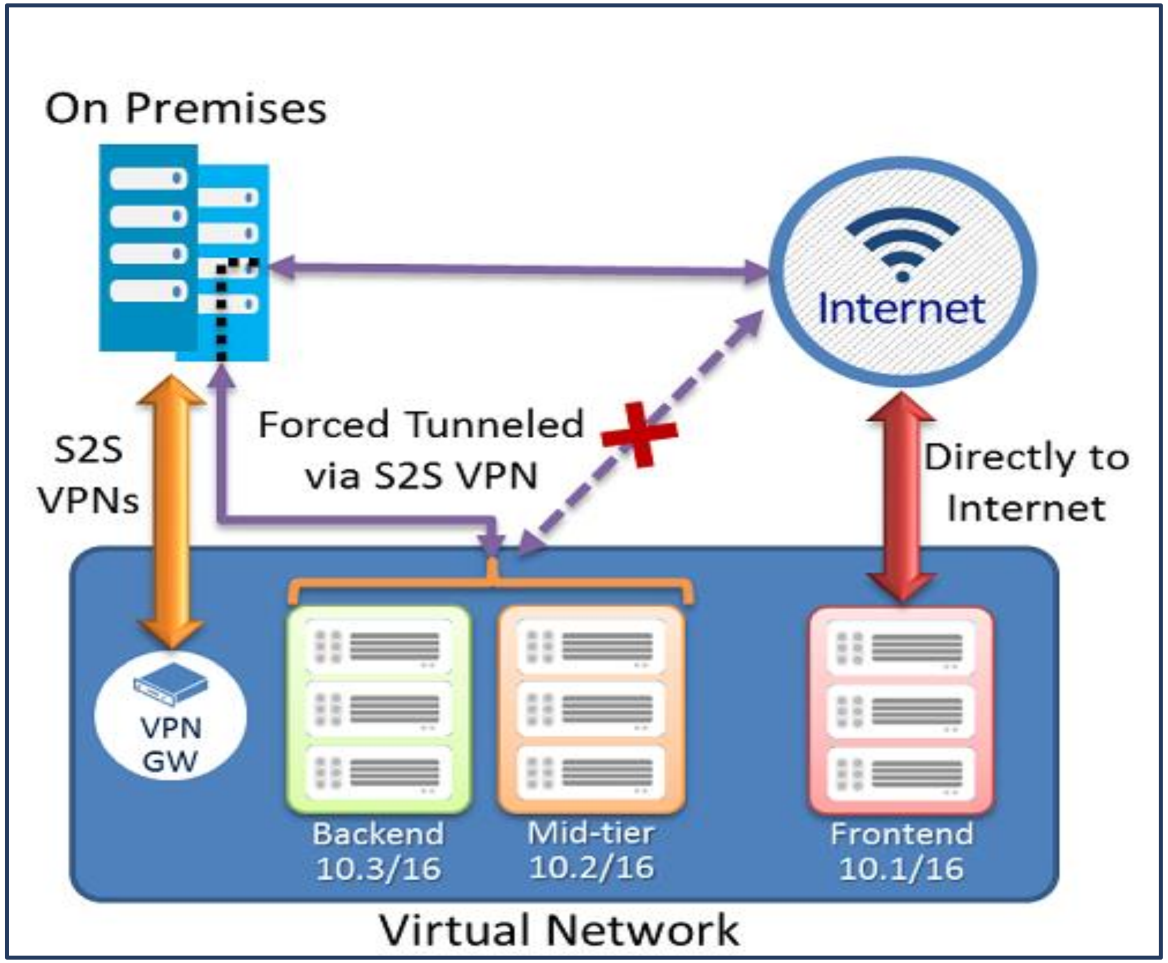
□ Add IPv6 address space

Network security group: None

Route table: myRouteTablePublic

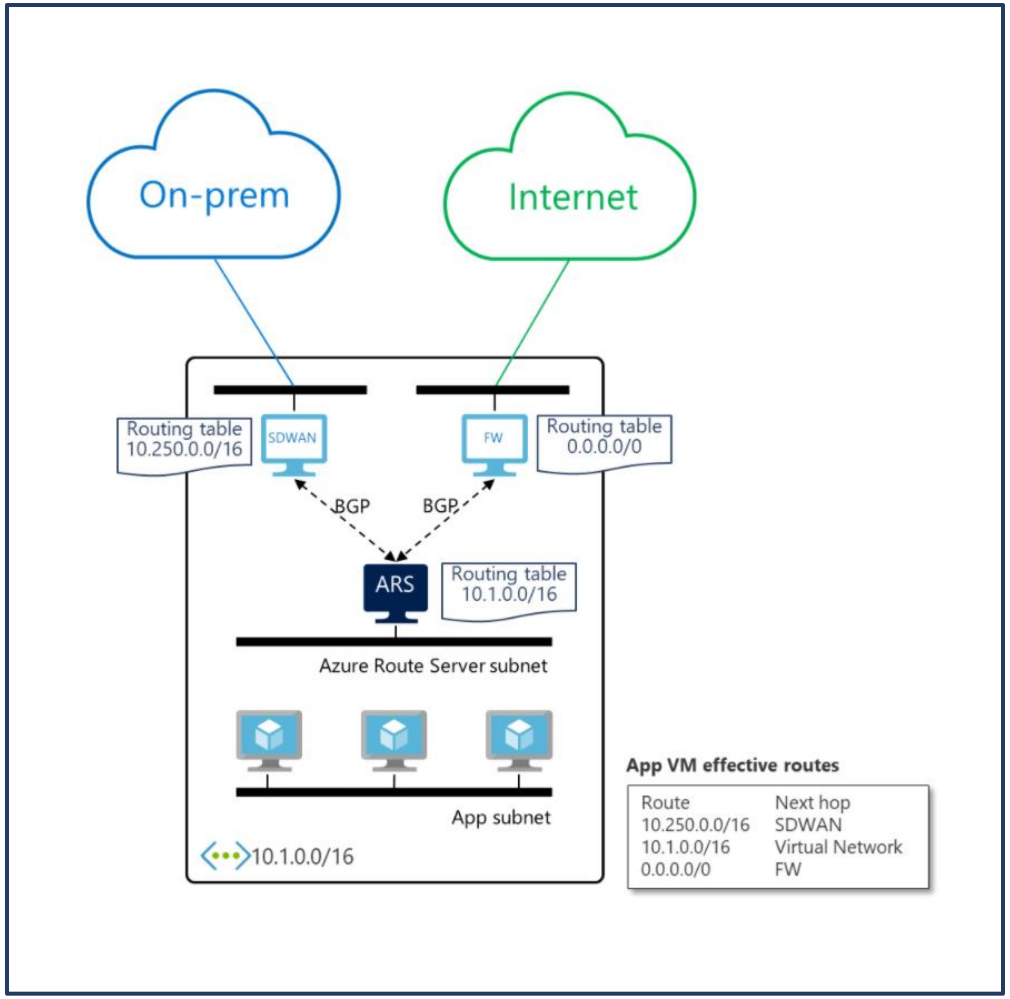
Configure forced tunneling

- Create a routing table.
- Add a user-defined default route to the VPN Gateway.
- Associate the routing table to the appropriate VNet subnet(s).
- Forced tunneling must be associated with a VNet that has a route-based VPN gateway.
- You must set a default site connection among the cross-premises local sites connected to the virtual network.
- The on-premises VPN device must be configured using 0.0.0.0/0 as traffic selectors.



Configure Azure Route Server

- Fully managed service that simplifies dynamic routing between NVA and the VNet
- NVA needs to support BGP
- You no longer need to manually update the routing table on your NVA whenever your virtual network addresses are updated.
- You no longer need to update User-Defined Routes manually whenever your NVA announces new routes or withdraw old ones.
- Needs a RouteServerSubnet



App VM effective routes

Route	Next hop
10.250.0.0/16	SDWAN
10.1.0.0/16	Virtual Network
0.0.0.0/0	FW

Diagnose a routing problem

View effective routes in the Azure portal, PowerShell or CLI

Use Azure Network Watcher to troubleshoot

Resolve Issues:

- Add a custom route to override a default route.
- Change or remove a custom route that causes traffic to be routed to an undesired location.
- Ensure that the route table is associated to the correct subnet (the one that contains the network interface).
- Ensure that devices such as Azure VPN gateway or network virtual appliances you've deployed are operating as intended.

Configure internet access with Azure Virtual NAT

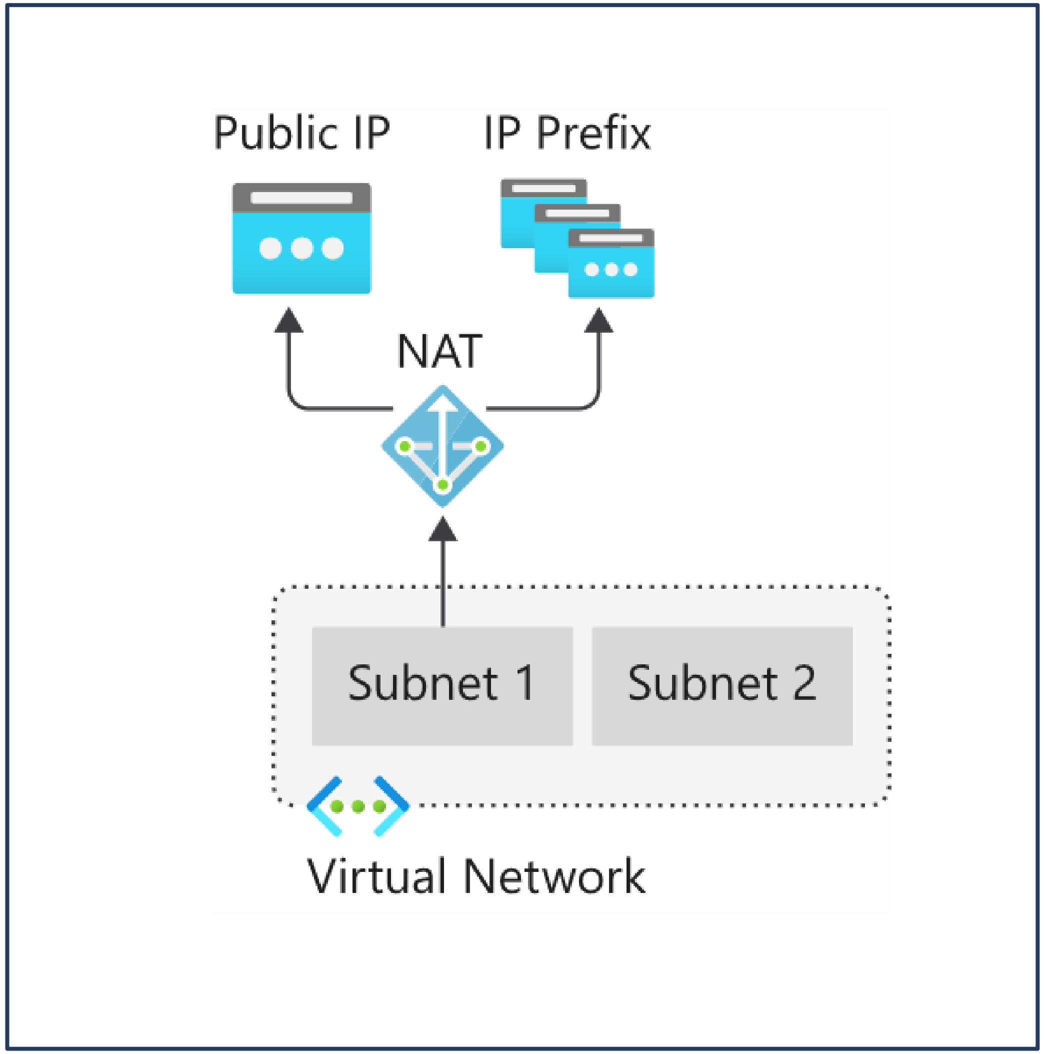
Azure Virtual Network NAT

Virtual Network NAT (network address translation) simplifies outbound-only Internet connectivity for virtual networks

Is a fully managed and highly resilient service that supports dynamic workloads by scaling NAT

When configured on a subnet, all outbound connectivity uses your specified static public IP addresses

Outbound connectivity is possible without a load balancer or public IP addresses directly attached to virtual machines

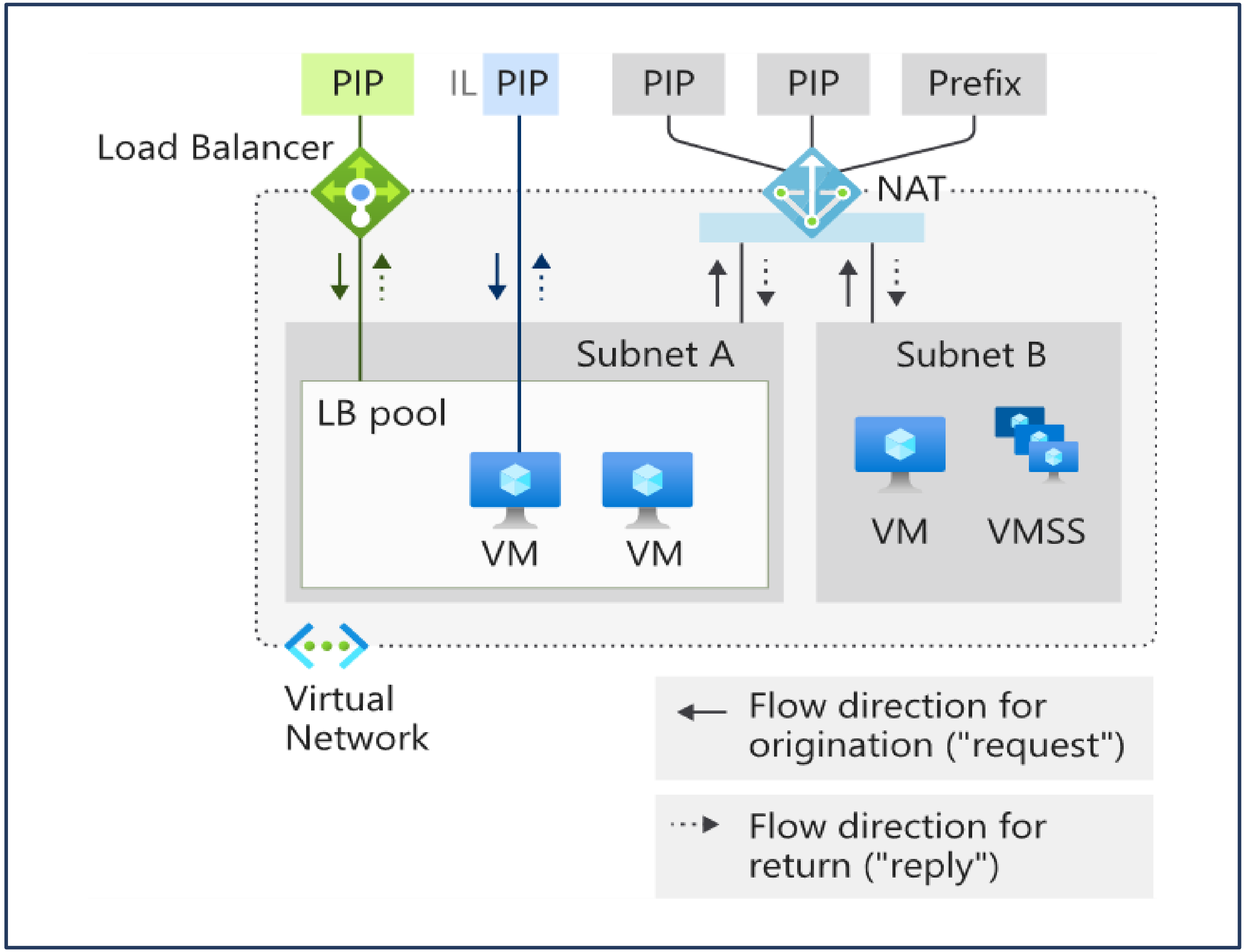


Coexistence of inbound and outbound

NAT and compatible Standard SKU features are aware of the direction the flow was started.

Inbound and outbound scenarios can coexist.

These scenarios will receive the correct network address translations because these features are aware of the flow direction.



← Flow direction for origination ("request")

···▸ Flow direction for return ("reply")

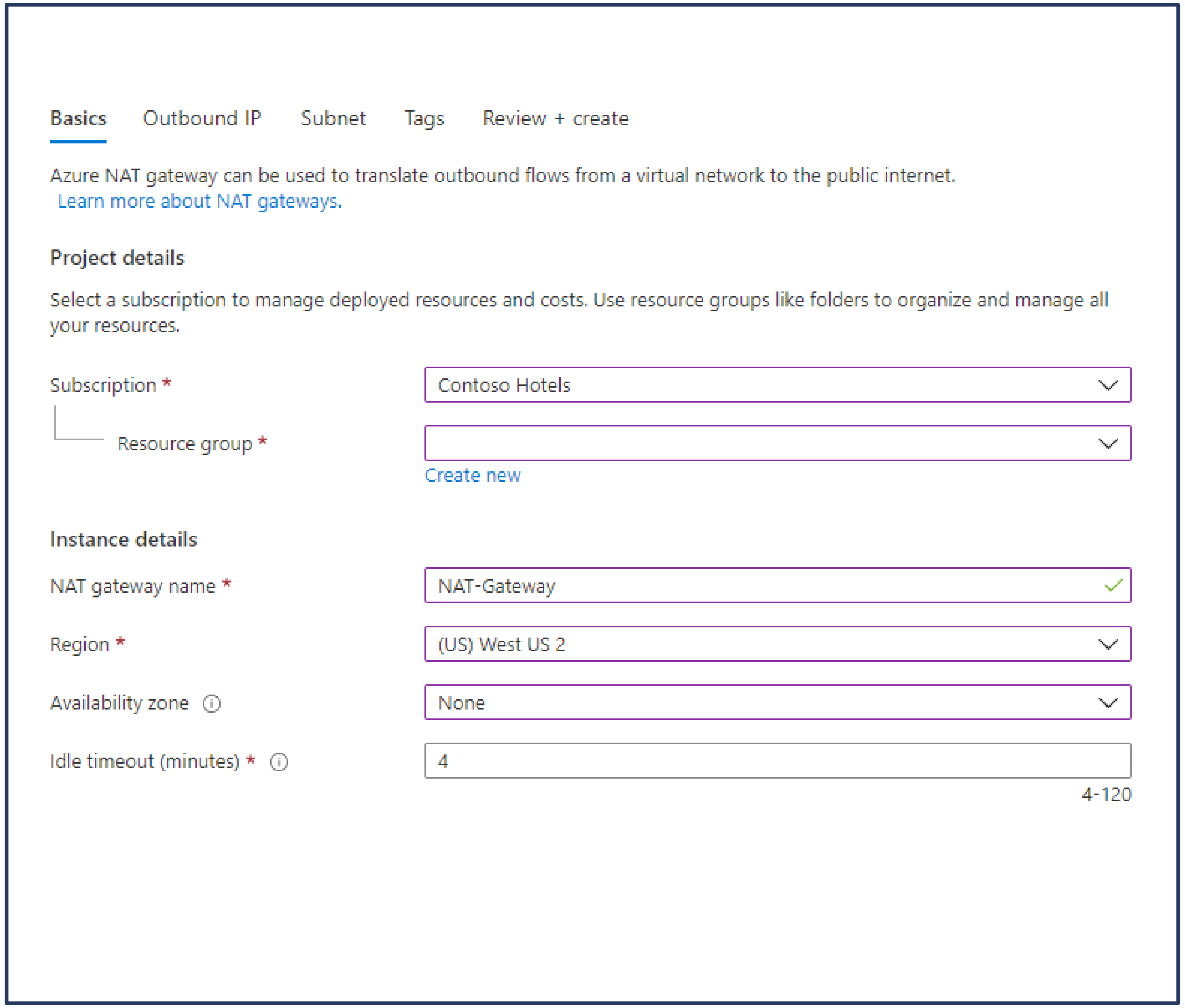
How to deploy NAT

NAT gateway resource:

1. Create regional or zonal (zone-isolated) NAT gateway resource
2. Assign IP addresses
3. If necessary, modify TCP idle timeout

Virtual network:

- Configure virtual network subnet to use a NAT gateway.
- User-defined routes are not necessary.



Azure NAT gateway can be used to translate outbound flows from a virtual network to the public internet.
Learn more about NAT gateways.

Project details

Select a subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription *	Contoso Hotels
Resource group *	 Create new

Instance details

NAT gateway name *	NAT-Gateway ✓
Region *	(US) West US 2
Availability zone ⓘ	None
Idle timeout (minutes) * ⓘ	4 4-120

Exercise: Design and implement a Virtual Network in Azure

Design and Implement a Virtual Network in Azure

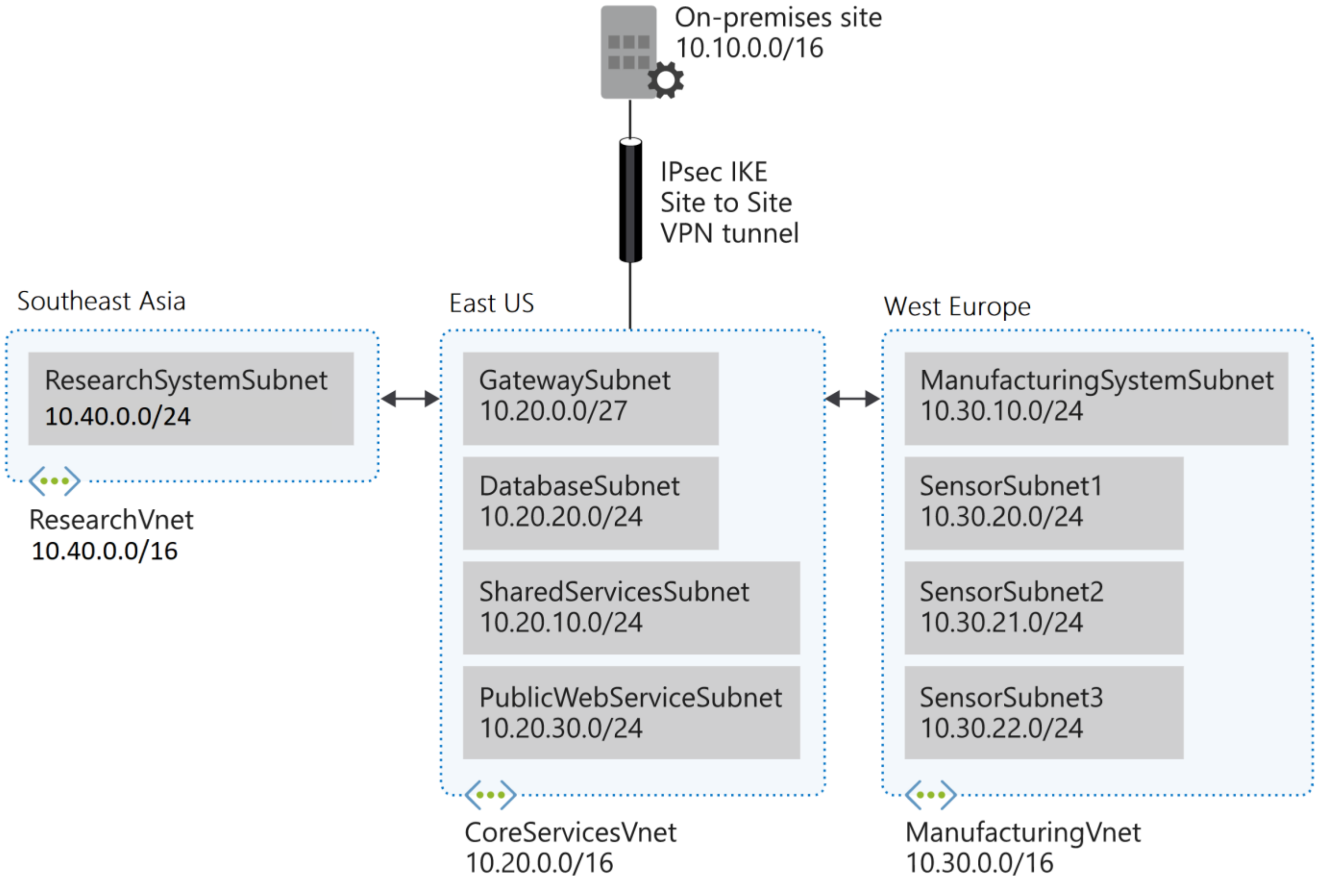
Task 1: Create the Contoso resource group

Task 2: Create the CoreServicesVnet virtual network and subnets

Task 3: Create the ManufacturingVnet virtual network and subnets

Task 4: Create the ResearchVnet virtual network and subnets

Task 5: Verify the creation of VNets and Subnets



Exercise: Configure DNS settings in Azure

Exercise – Configure DNS Settings in Azure

- Create a private DNS Zone
- Link subnet for auto registration
- Create Virtual Machines to test the configuration
- Verify records are present in the DNS zone

Exercise: Connect two Azure virtual networks using global VNet peering

Connect Two Azure Virtual Networks Using Global VNet Peering

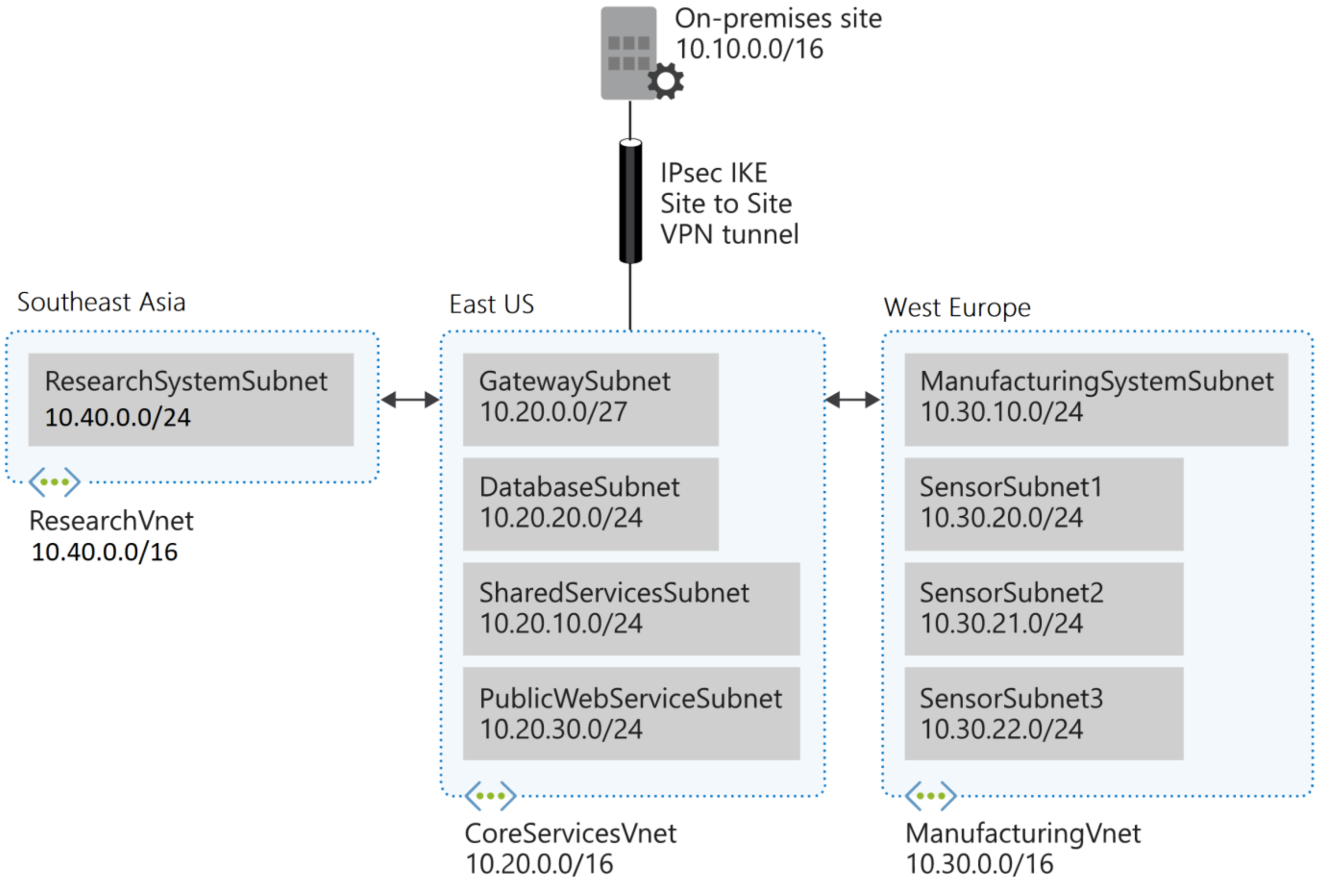
Task 1: Create a Virtual Machine to test the configuration

Task 2: Connect to the Test VMs using RDP

Task 3: Test the connection between the VMs

Task 4: Create VNet peerings between CoreServicesVnet and ManufacturingVnet

Task 5: Test the connection between the VMs



End of presentation