Microsoft

AZ-700

Design and implement Azure ExpressRoute

AZ-700 Agenda

Module 01: Introduction to Azure Virtual Networks

Module 02: Designing and Implementing Hybrid Networking

Module 03: Designing and Implementing Azure ExpressRoute

VPN $

ER $$

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

Explore Azure ExpressRoute

ExpressRoute Capabilities

Layer 3 connectivity with redundancy

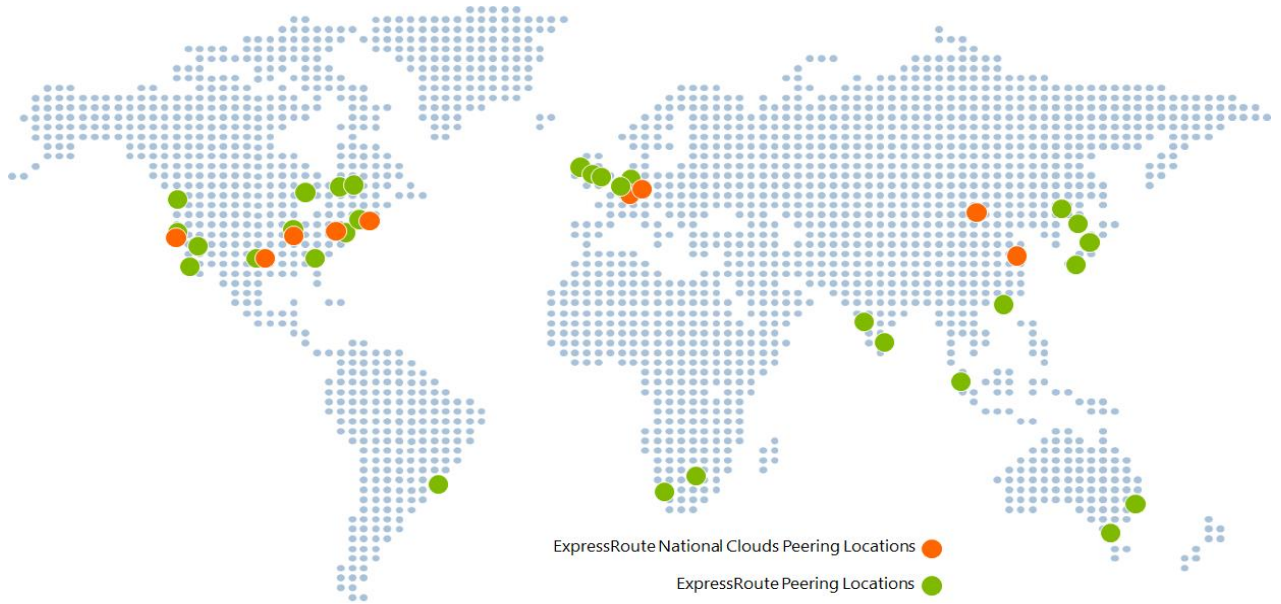
Connectivity to all regions within a geography

Global connectivity with ExpressRoute premium add-on

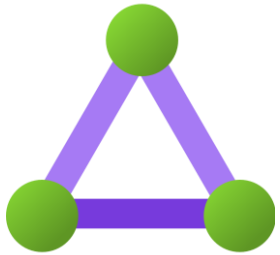
Across on-premises connectivity with ExpressRoute Global Reach

Bandwidth options – 50 Mbps to 100 Gbps

Billing models – Unlimited, metered



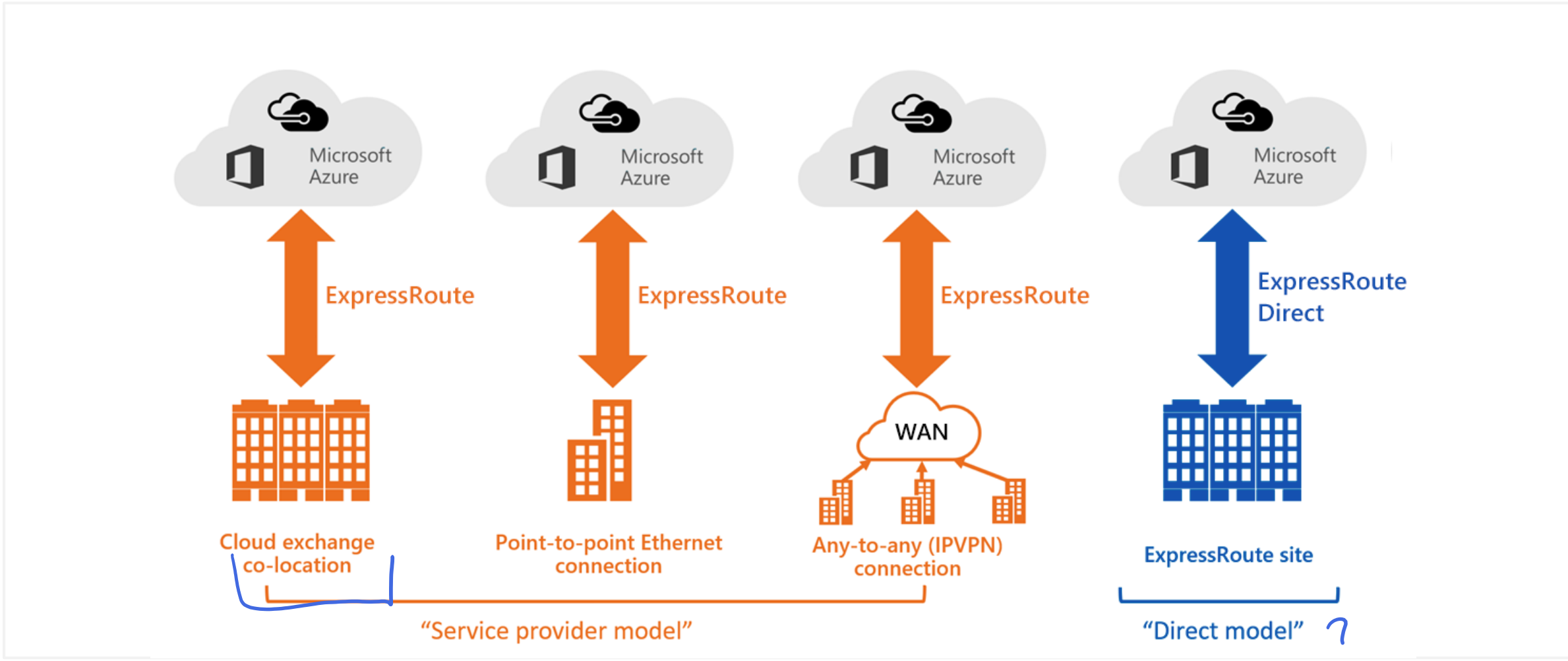
Understand use cases for Azure ExpressRoute



- Faster and Reliable connection to Azure services
- Storage, backup, and Recovery
- Extends Data center capabilities
- Predictable, reliable, and high-throughput connections
- SLA
- Built in redundant circuits
- Border Gateway Protocol (BGP)
- Integrates with existing Multiprotocol Label Switching (MPLS)
- Private connection to Microsoft cloud

Leased Line
not encrypted

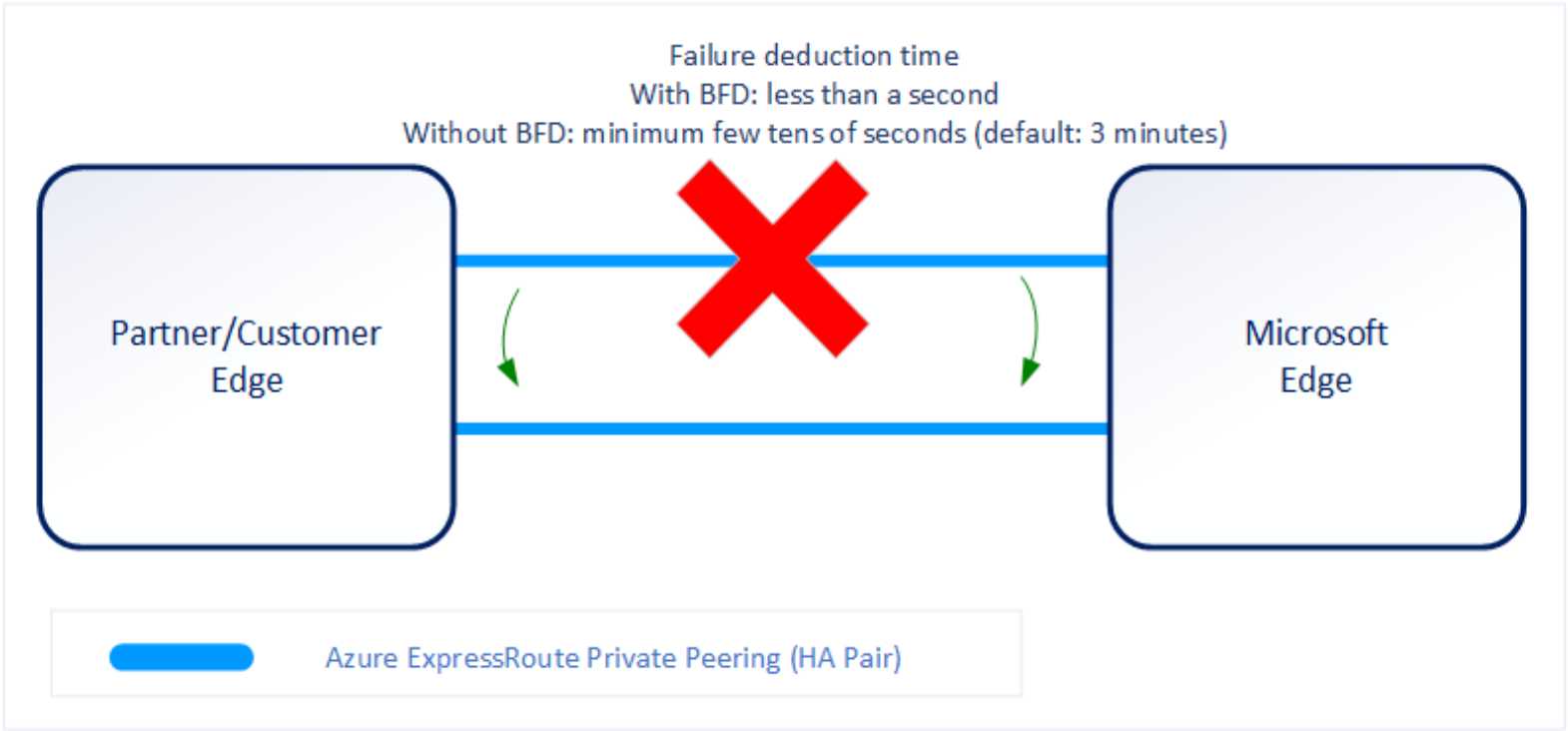
ExpressRoute connectivity models



Design considerations for ExpressRoute deployments

ExpressRoute using a Service Provider	ExpressRoute Direct
Uses service providers to enable fast onboarding and connectivity into existing infrastructure	Requires 100 Gbps/10 Gbps infrastructure and full management of all layers
Integrates with hundreds of providers including Ethernet and MPLS	Direct/Dedicated capacity for regulated industries and massive data ingestion
Circuits SKUs from 50 Mbps to 10 Gbps	Customer may select a combination of the following circuit SKUs on 100-Gbps ExpressRoute Direct: (5 Gbps, 10 Gbps, 40 Gbps, 100 Gbps) Customer may select a combination of the following circuit SKUs on 10-Gbps ExpressRoute Direct: (1 Gbps, 2 Gbps, 5 Gbps, 10 Gbps)
Optimized for single tenant	Optimized for single tenant with multiple business units and multiple work environments

Bidirectional Forwarding Detection (BFD) with ExpressRoute Private Peering



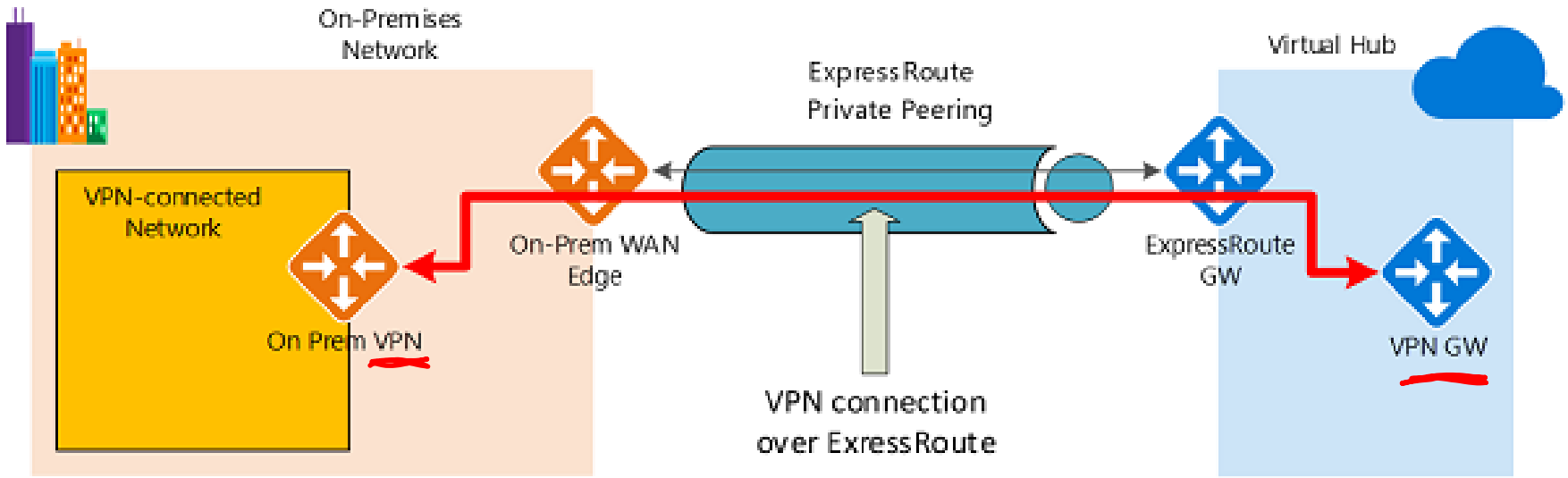
BFD is configured by default

You only need to configure BFD on both your primary and secondary devices

You configure the BFD on the interface and then link it to the BGP session.

Configure encryption over ExpressRoute

RSA
Quantum Computing

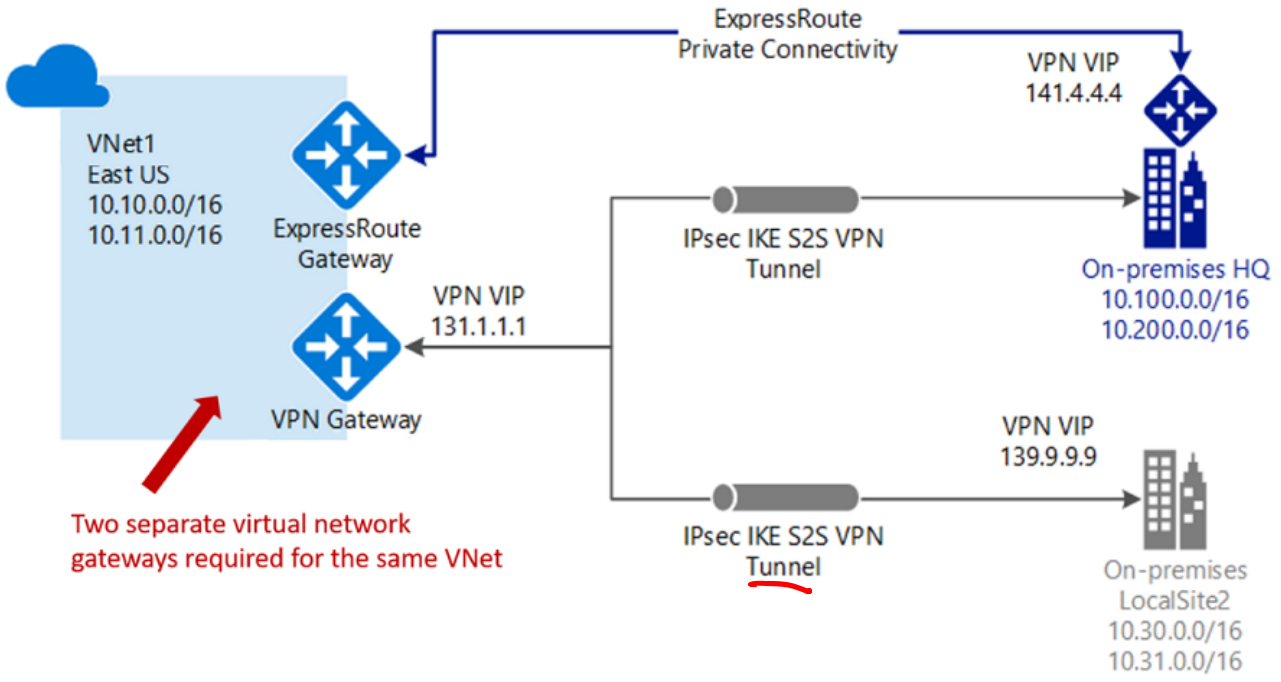


Establish ExpressRoute connectivity with an ExpressRoute circuit and private peering

Establish the VPN connectivity over ExpressRoute

Routing between the on-premises networks and Azure over both the ExpressRoute and VPN paths

Coexisting Site-to-Site and ExpressRoute



Use S2S VPN as a secure failover path for ExpressRoute

Use S2S VPNs to connect to sites that are not connected with ExpressRoute

Notice two VNet gateways for the same virtual network

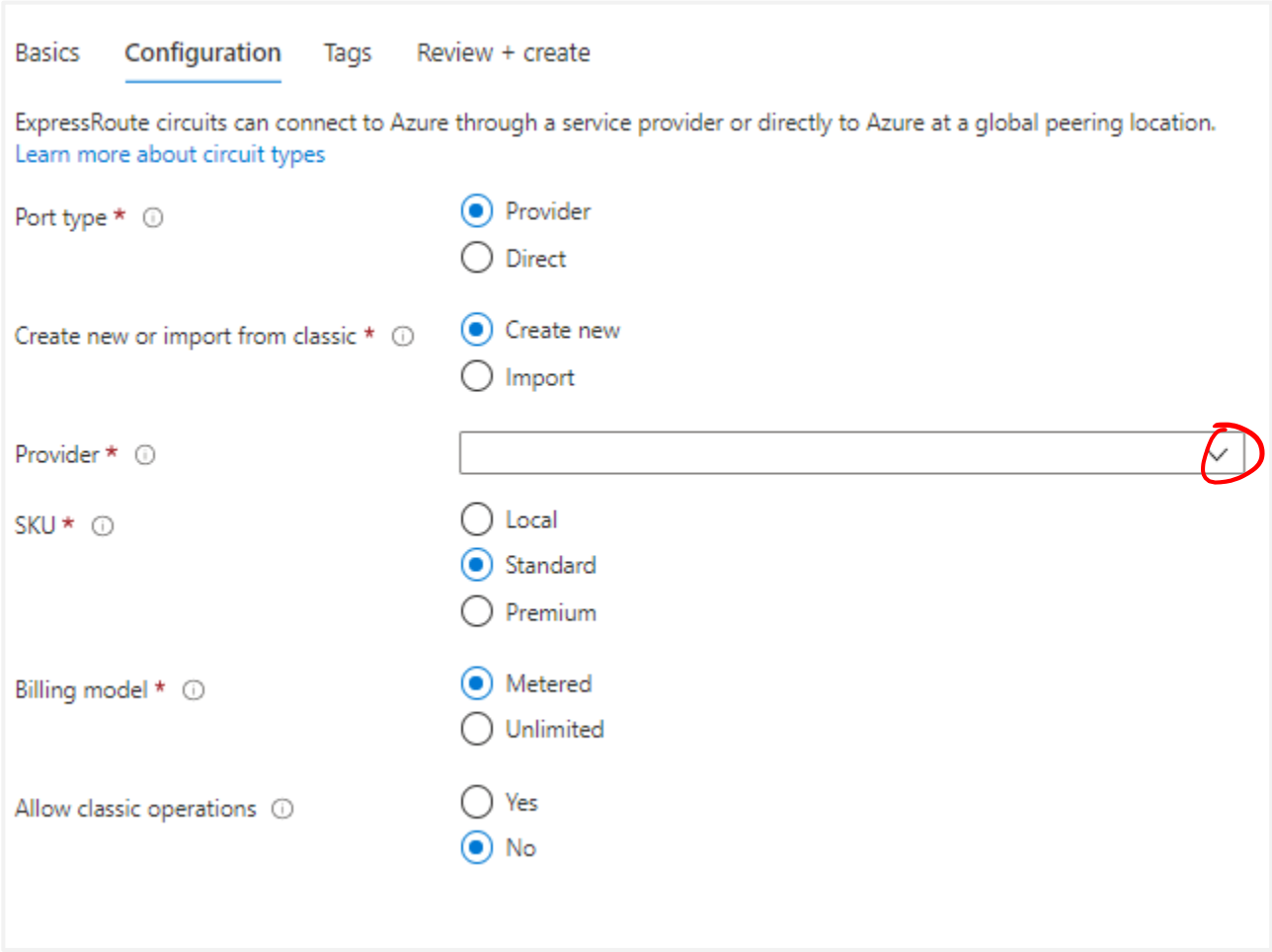
Design an ExpressRoute deployment

ExpressRoute SKUs

Local (if available) - provides free egress data transfer and gives you access to only 1-2 Azure regions in the same area as your circuit

Standard SKU - gives you access to all Azure regions in a geopolitical area

Premium SKU - provides support for more than 4K routes, ability to connect to more than 10 virtual networks, and global connectivity



Choose a peering location

Choose the right ExpressRoute Circuit and billing model

Choose Metered or unlimited data plan

Choose Bandwidth

You can increase gateway size but not decrease without service outage

Pricing varies by region and zone

Unlimited data. Billing is based on a monthly fee; all inbound and outbound data transfer is included free of charge.

Metered data. Billing is based on a monthly fee; all inbound data transfer is free of charge. Outbound data transfer is charged per GB of data transfer. Data transfer rates vary by region.

ExpressRoute premium add-on.
ExpressRoute premium is an add-on to the ExpressRoute circuit.

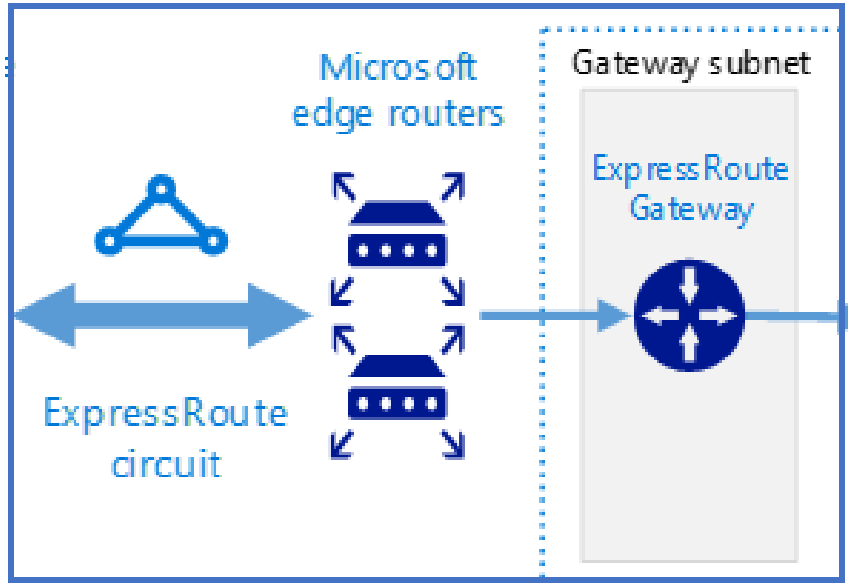
Exercise – Configure an ExpressRoute Gateway

Exercise - Configure an ExpressRoute Gateway

In this exercise, you learn how to:

Task 1: Create the VNet and gateway subnet

Task 2: Create the virtual network gateway

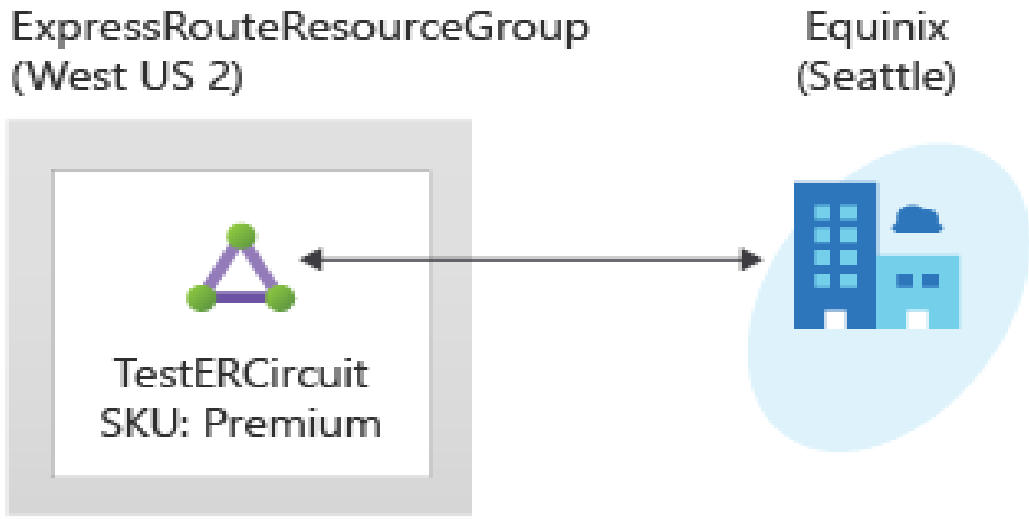


Exercice – Provision an ExpressRoute circuit

Exercise

In this exercise, you learn how to:

Task 1: Create and provision an ExpressRoute circuit
Task 2: Retrieve your Service key
Task 3: Deprovisioning an ExpressRoute circuit



Configure peering for an ExpressRoute deployment

Learning Objectives - Peering for an ExpressRoute

- Configure Private peering
- Configure Microsoft peering
- Choose between private peering only, Microsoft peering only, or both
- Route filters
- Learning Recap

Configure Private peering

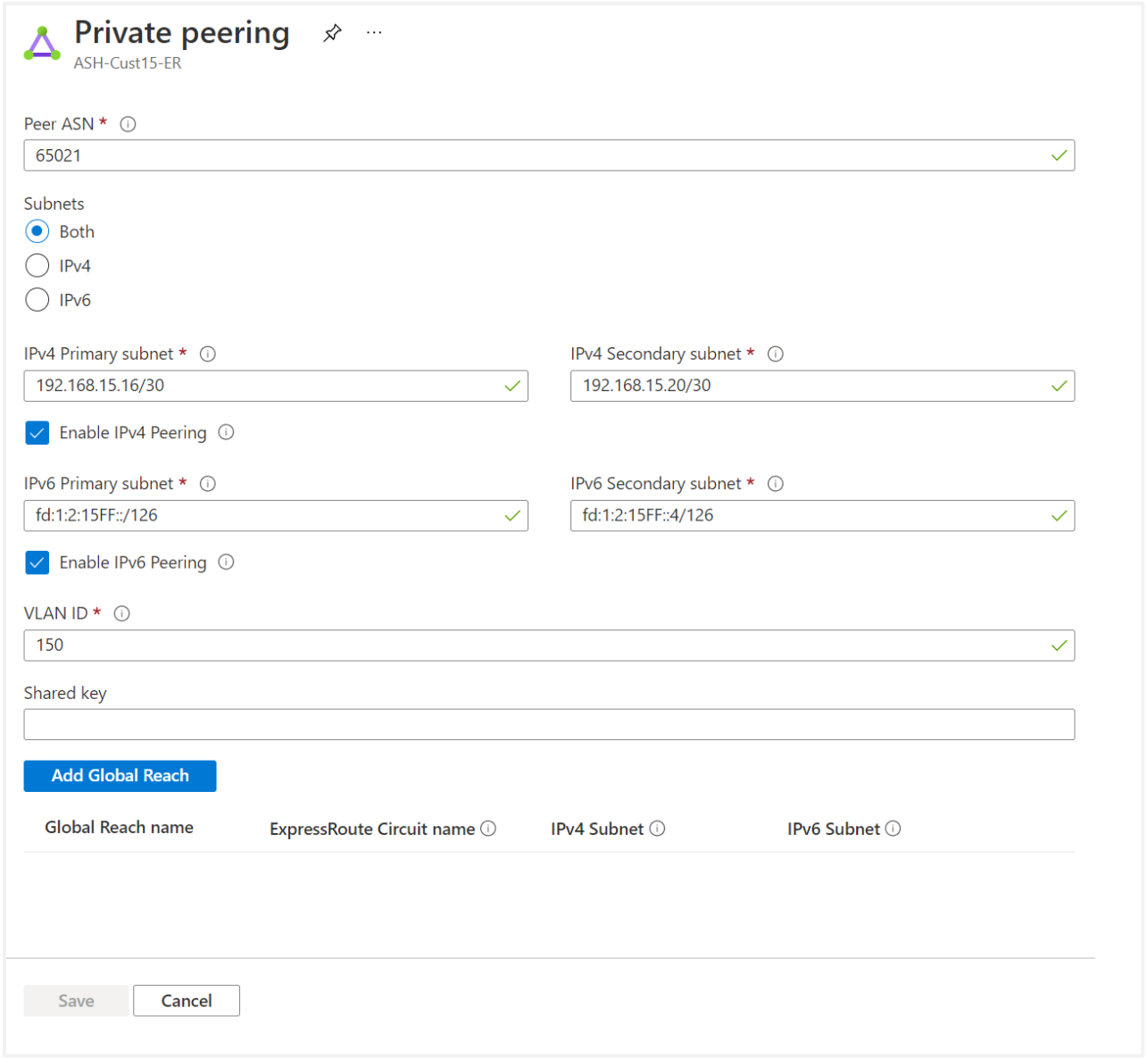
A pair of subnets that are not part of any address space reserved for virtual networks. One subnet will be used for the primary link, while the other will be used for the secondary link

A valid on-prem VLAN ID to establish this peering on

AS number for peering

Advertise the routes from your on-premises Edge router to Azure via BGP

Optional - An MD5 hash if you choose to use one



Configure Microsoft peering

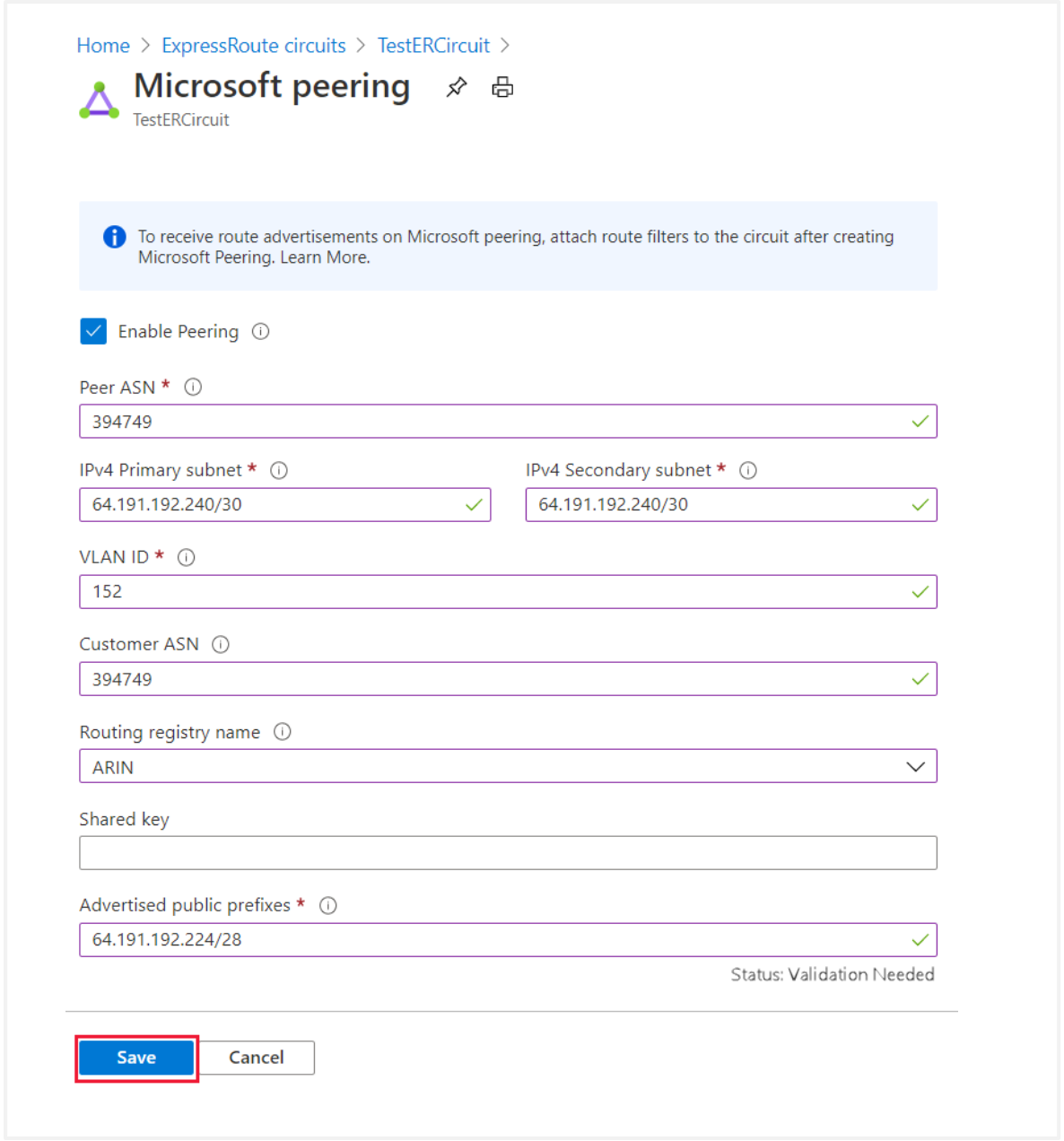
A pair of subnets owned by you and registered in an RIR/IRR. One subnet will be used for the primary link, while the other will be used for the secondary link.

A valid on-prem VLAN ID to establish this peering on

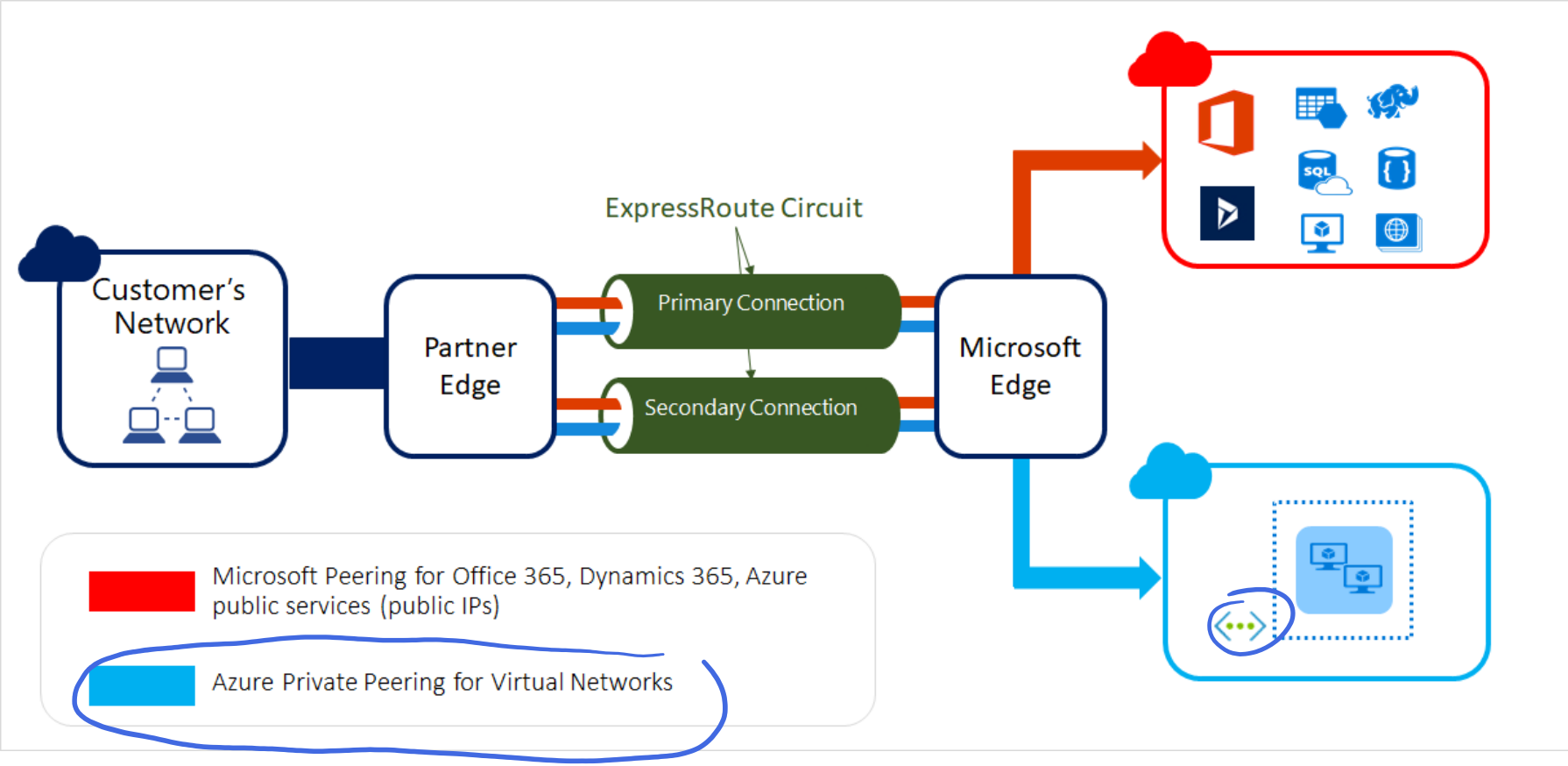
AS number for peering

Advertised prefixes: You provide a list of all prefixes you plan to advertise over the BGP session

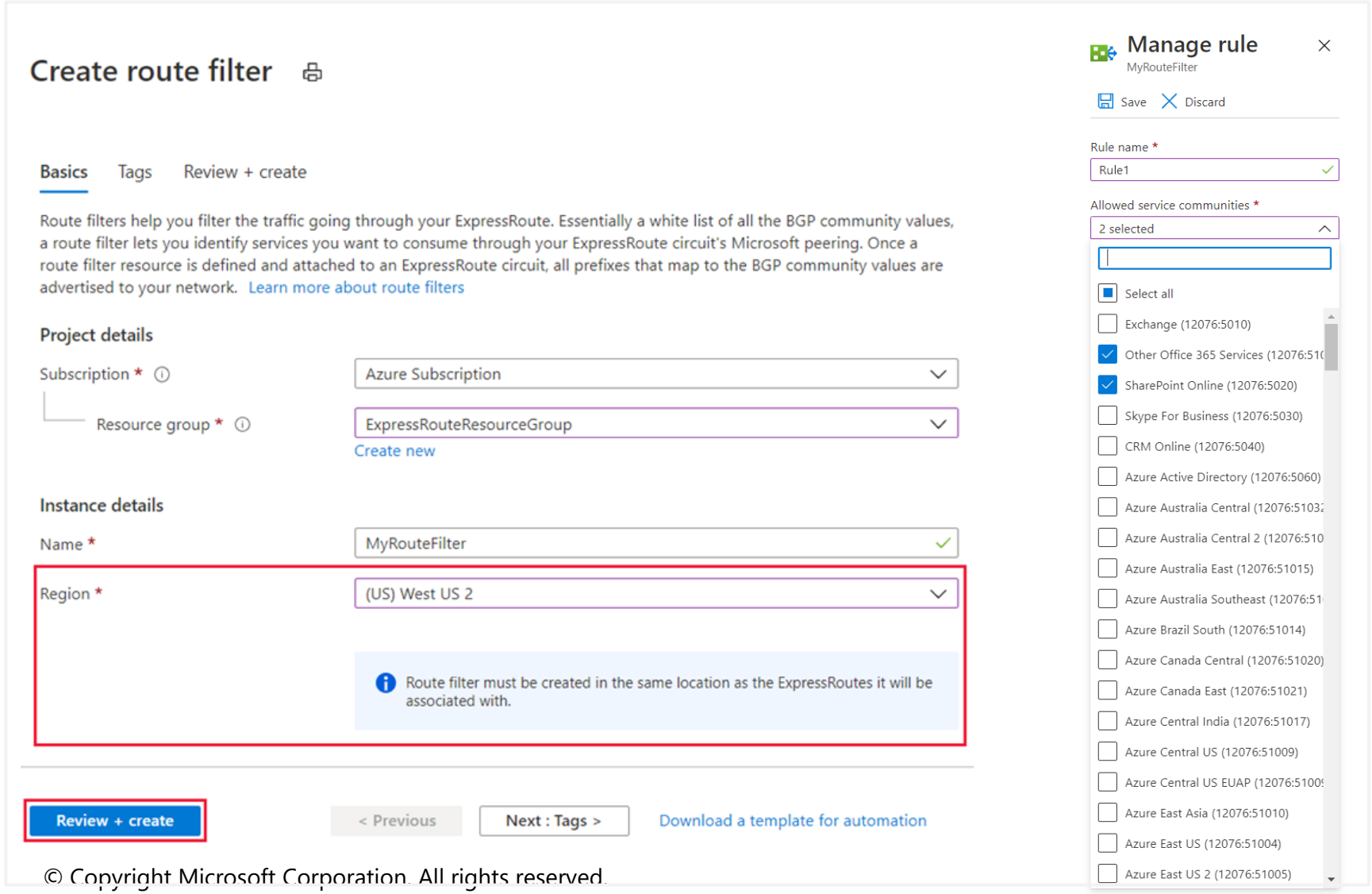
Routing Registry Name



Choose between private peering only, Microsoft peering only, or both



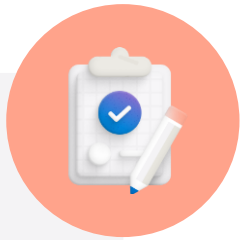
Route filters



Create route filter and create route filter rules

Attach the route filter to an ExpressRoute circuit

Learning Recap – Peering ExpressRoute



Check your knowledge questions and additional study

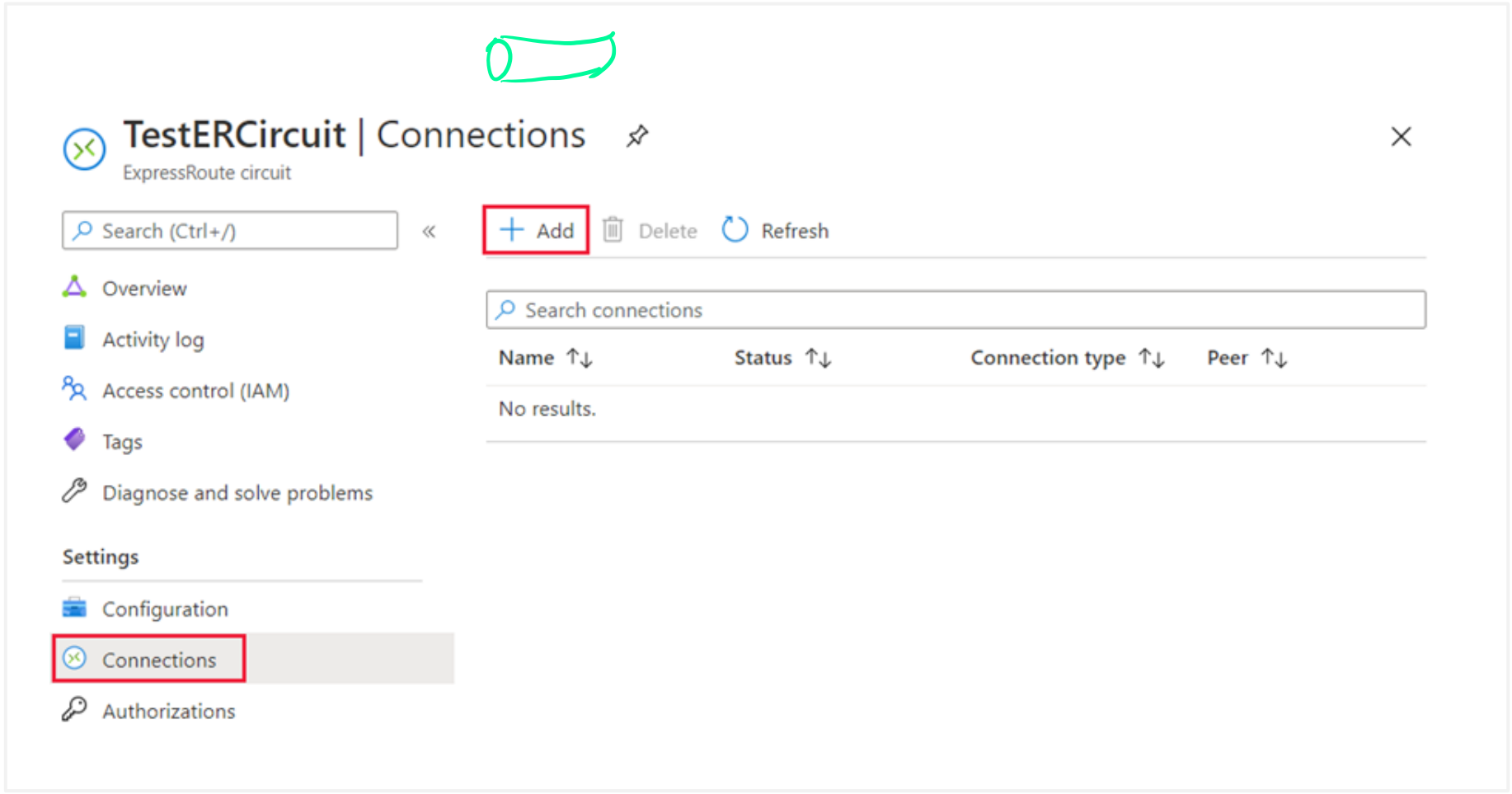
[Azure ExpressRoute: Circuits and peering | Microsoft Docs]

Connect an ExpressRoute circuit to a VNet

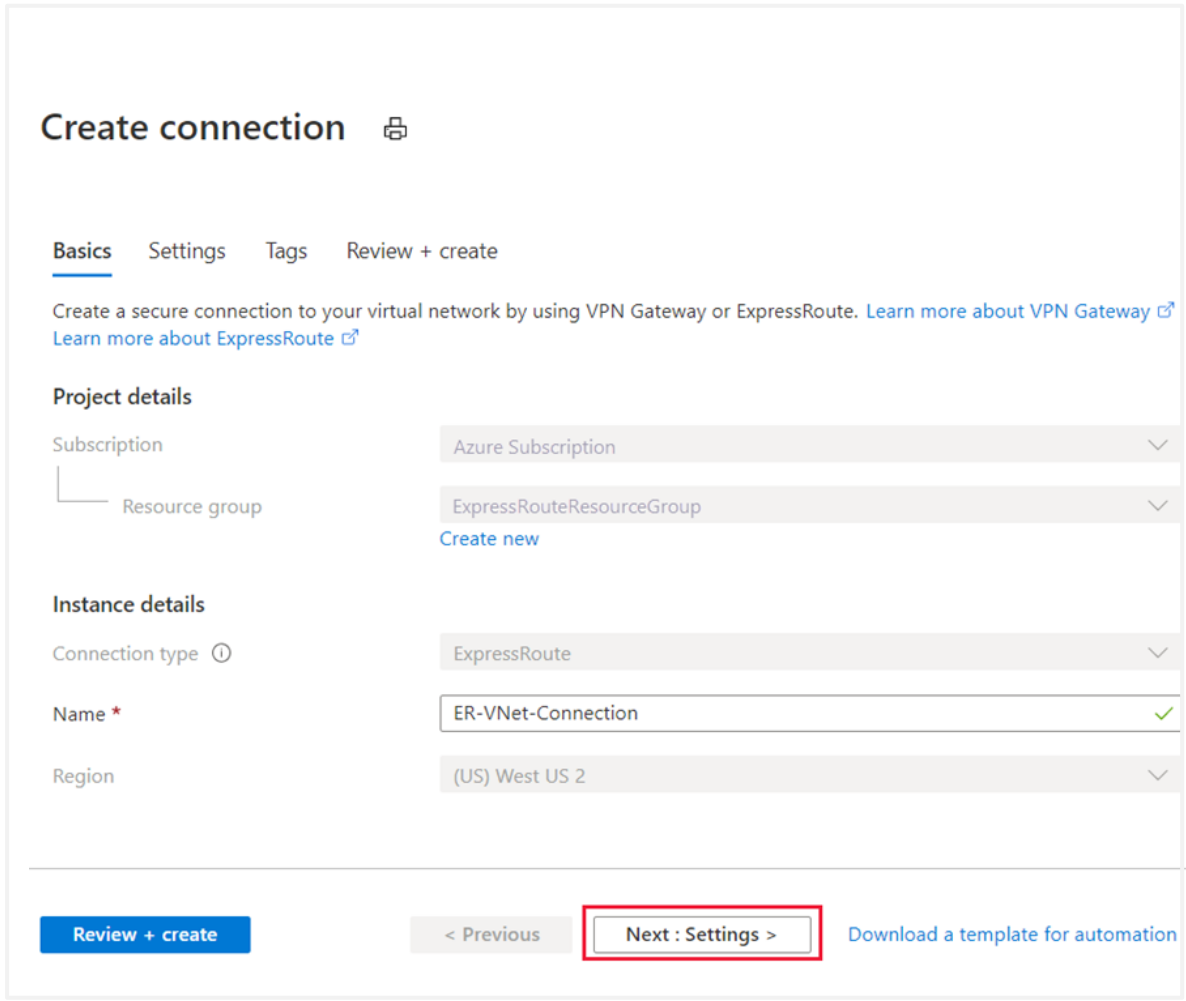
Learning Objectives - Connect an ExpressRoute Circuit to a VNet

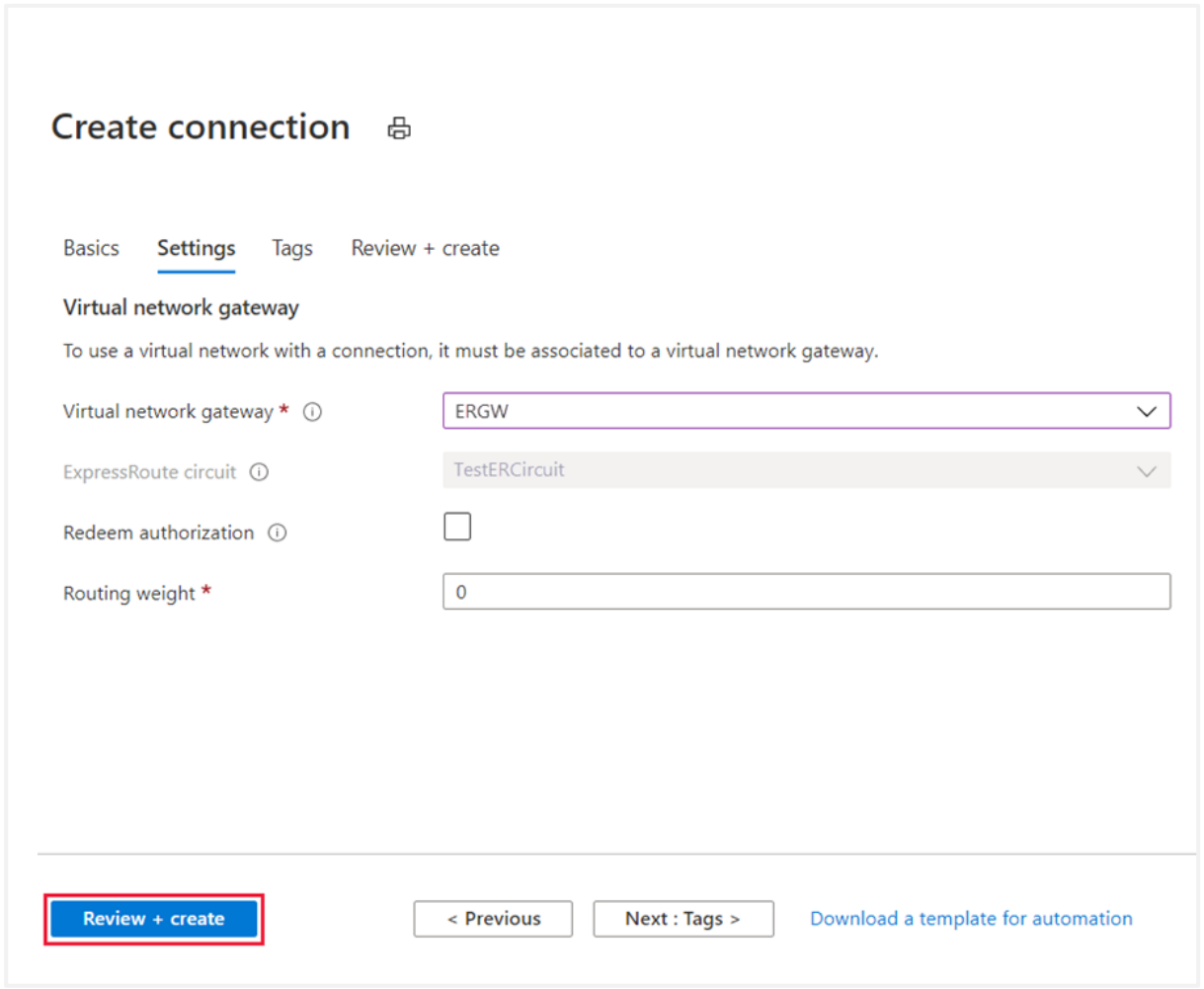
- Connect virtual network to an ExpressRoute circuit
- Learning Recap

Connect virtual network to an ExpressRoute circuit

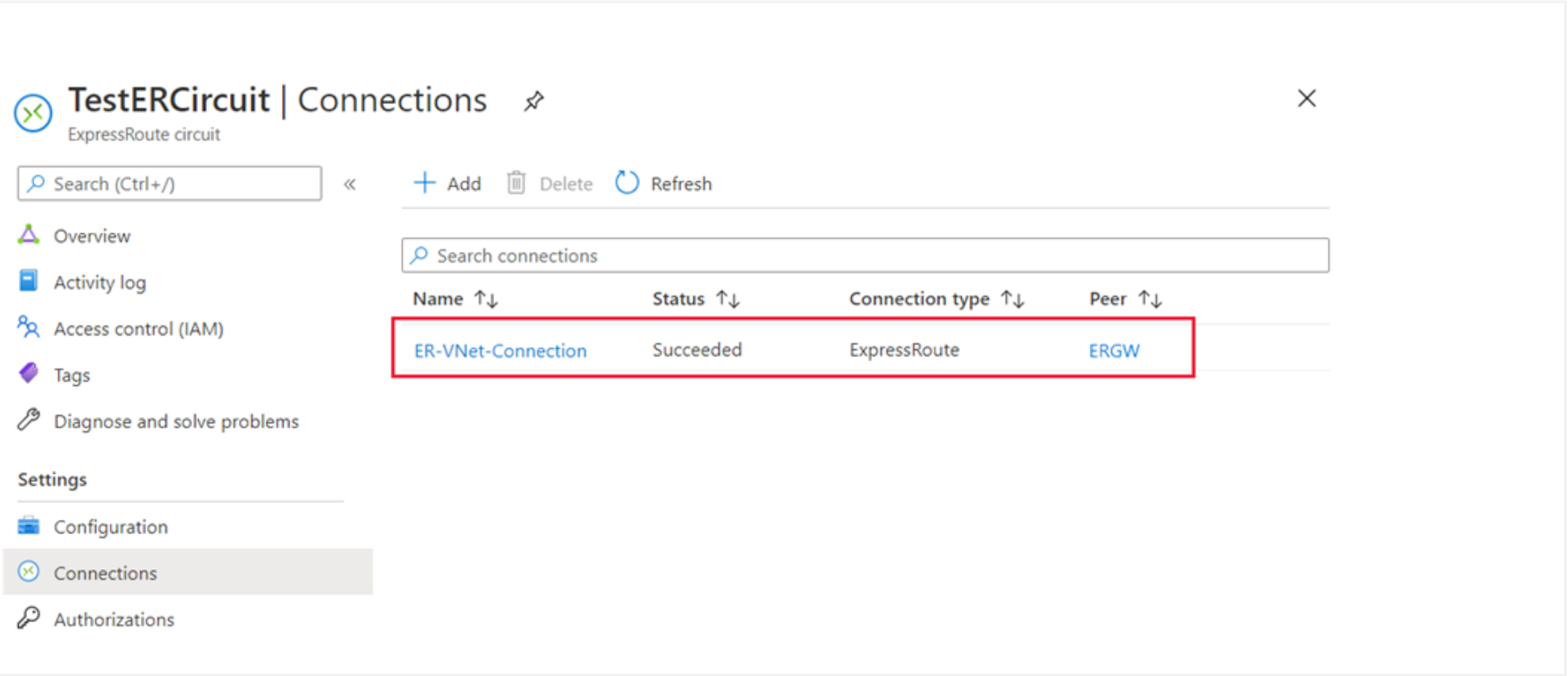


Connect virtual network to an ExpressRoute circuit – continued

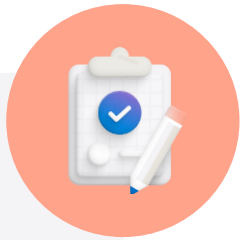




Verify connection



Learning Recap – Connect an ExpressRoute Circuit to a VNet



Check your knowledge questions and additional study

[Azure ExpressRoute: Circuit configuration workflow | Microsoft Docs]

Connect geographically dispersed networks with ExpressRoute Global Reach

Learning Objectives - ExpressRoute Global Reach

- Use Cross-region connectivity to link multiple ExpressRoutes
- Choose when to use ExpressRoute Global Reach
- Configure ExpressRoute Global Reach
- Learning Recap

Use Cross-region connectivity to link multiple ExpressRoutes

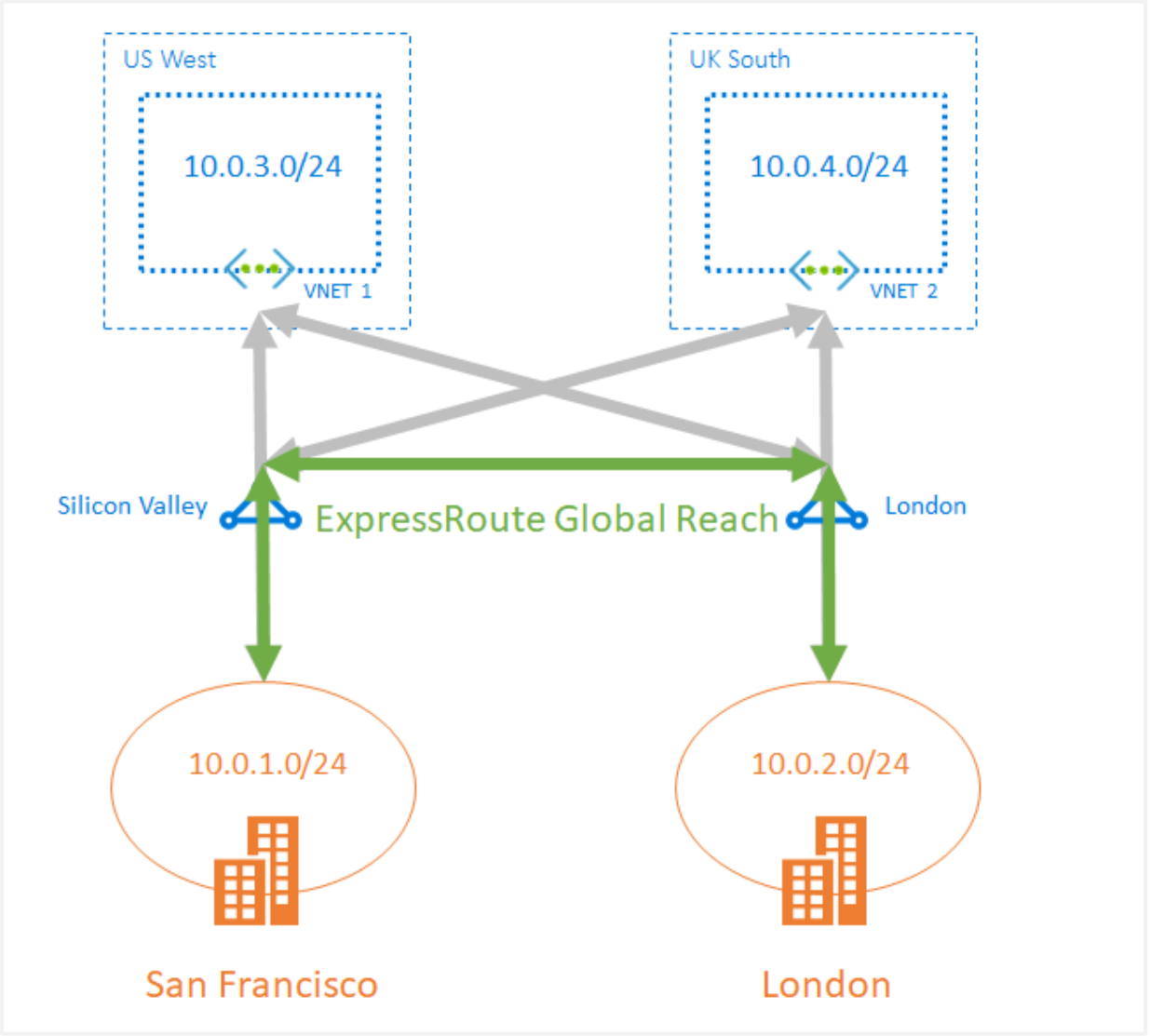
Connectivity to all regions within a geopolitical region

Global connectivity with ExpressRoute Premium

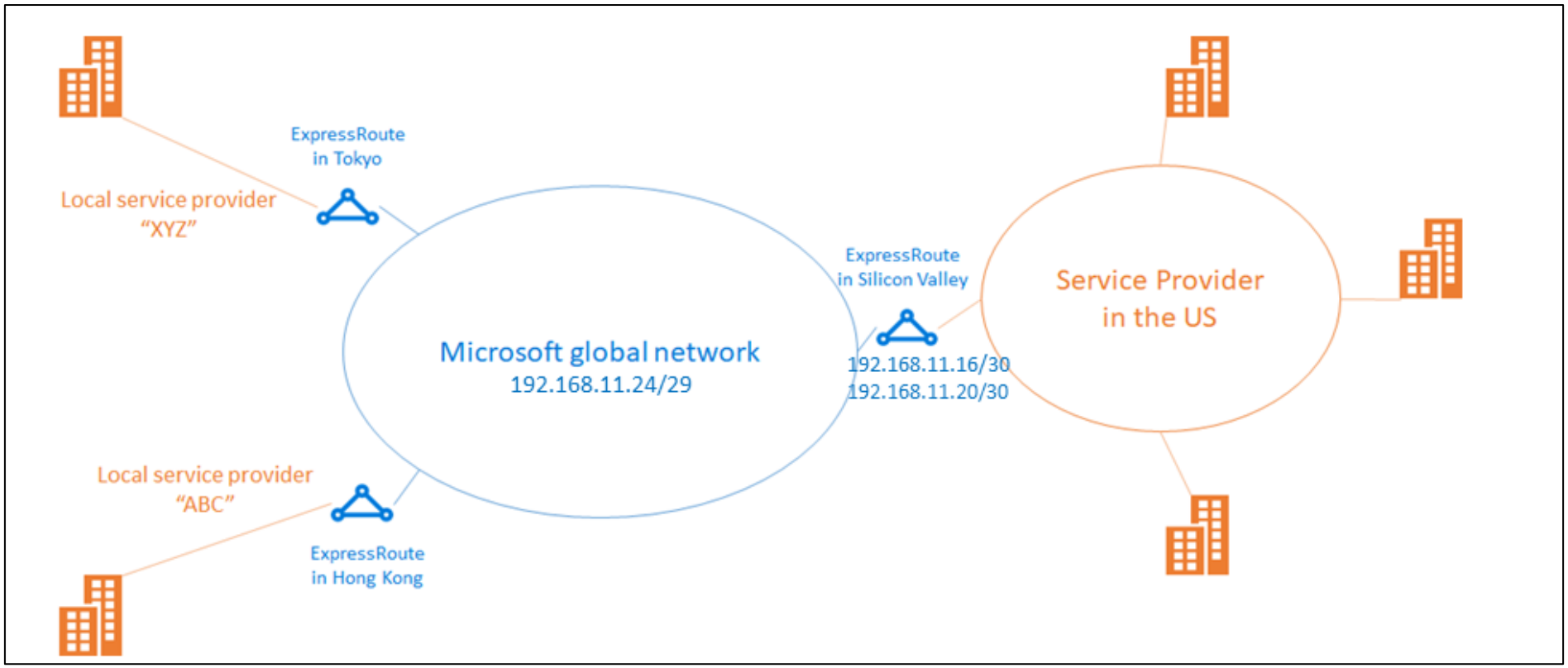
Local connectivity with ExpressRoute Local

Across on-premises connectivity with ExpressRoute Global Reach

ExpressRoute Direct



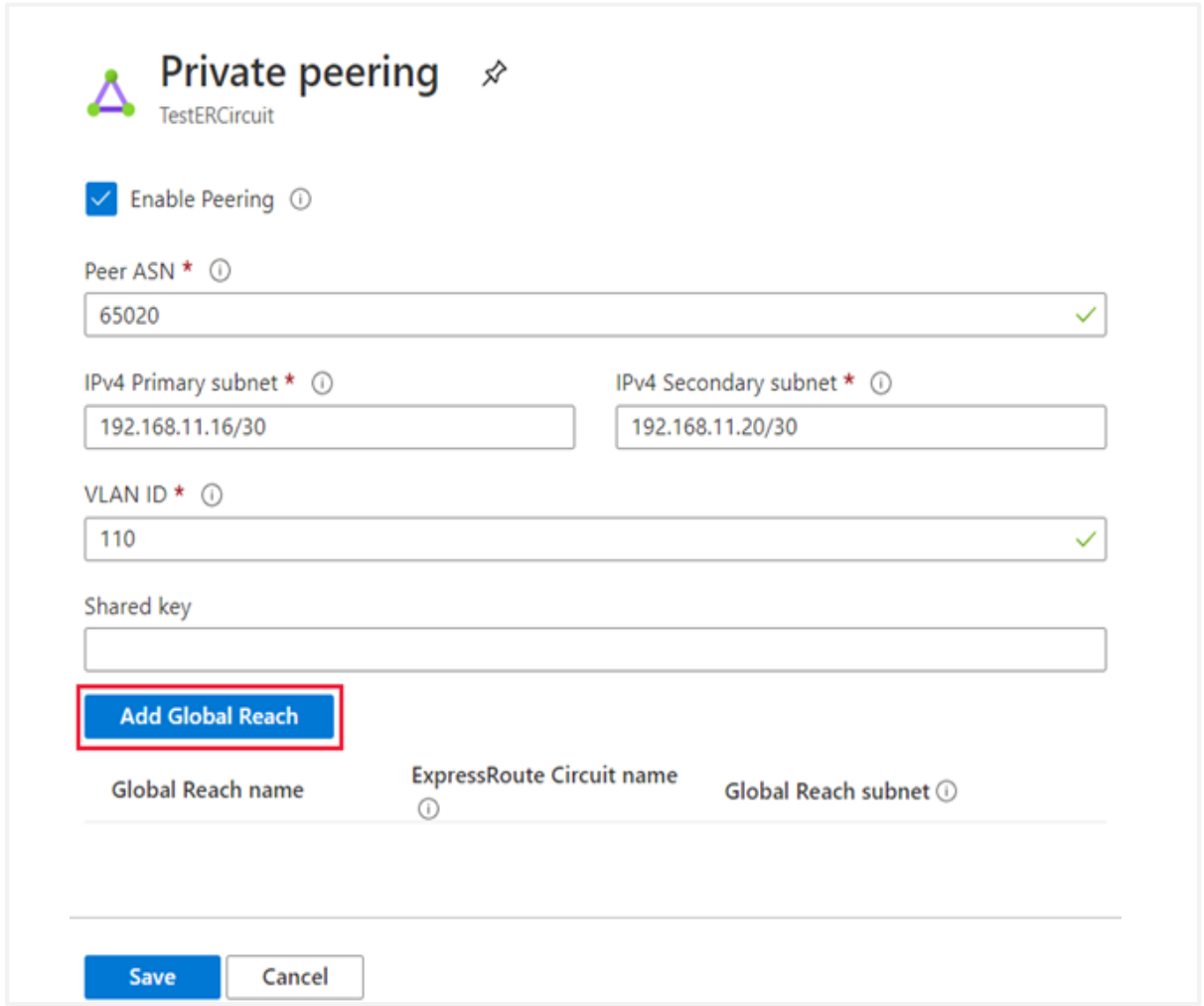
ExpressRoute Global Reach

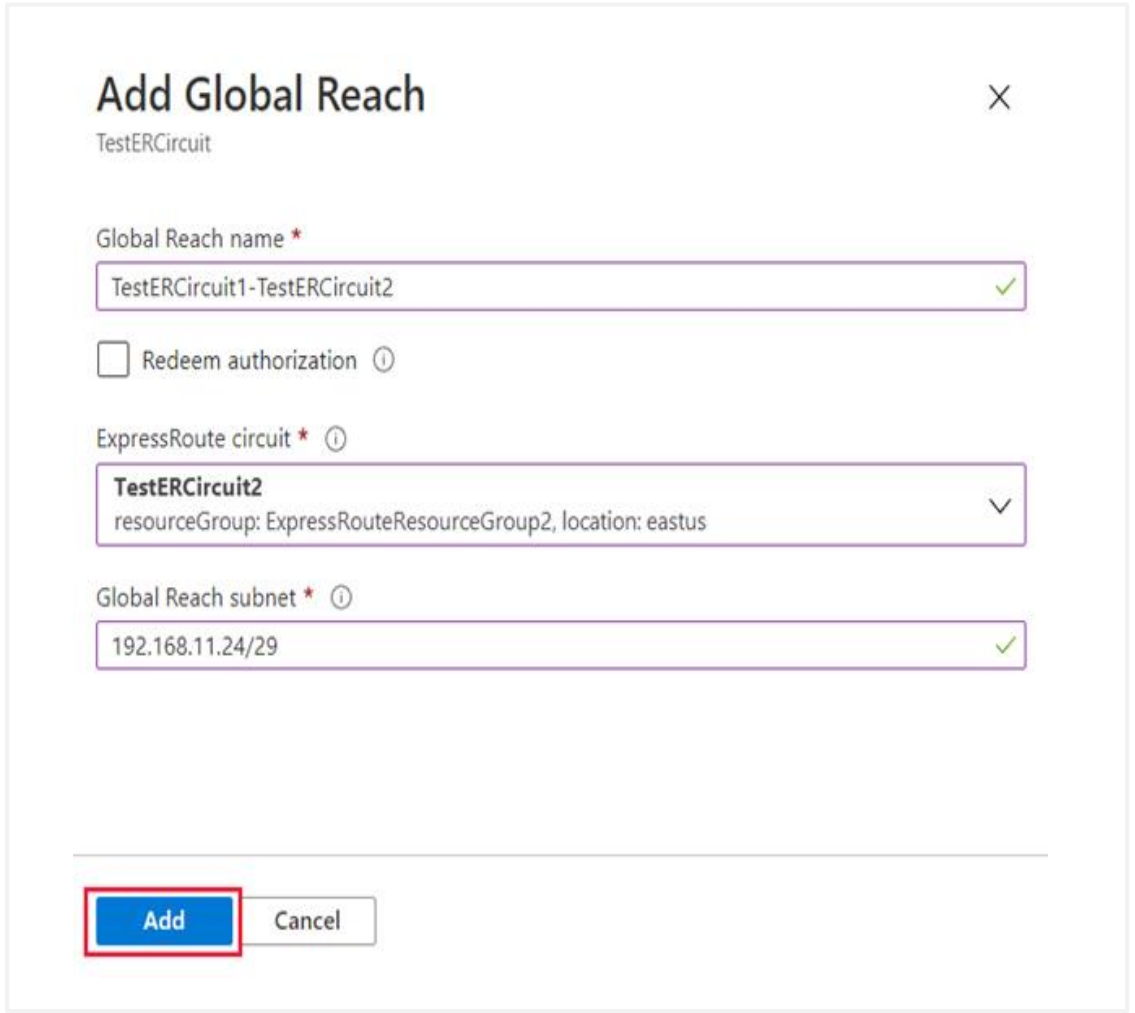


Designed to complement your service provider's WAN implementation and connect your branch offices across the world

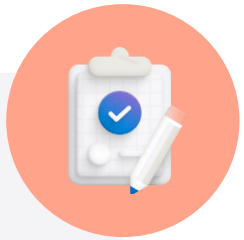
You can link ExpressRoute circuits together to make a private network between your on-premises networks

Configure ExpressRoute Global Reach





Learning Recap – ExpressRoute Global Reach



Check your knowledge questions and additional study

[Azure ExpressRoute: Connect to Microsoft Cloud using Global Reach | Microsoft Docs]

Improve data path performance between networks with ExpressRoute FastPath

Learning Objectives - ExpressRoute FastPath

- ExpressRoute FastPath
- Configure ExpressRoute FastPath
- Learning Recap

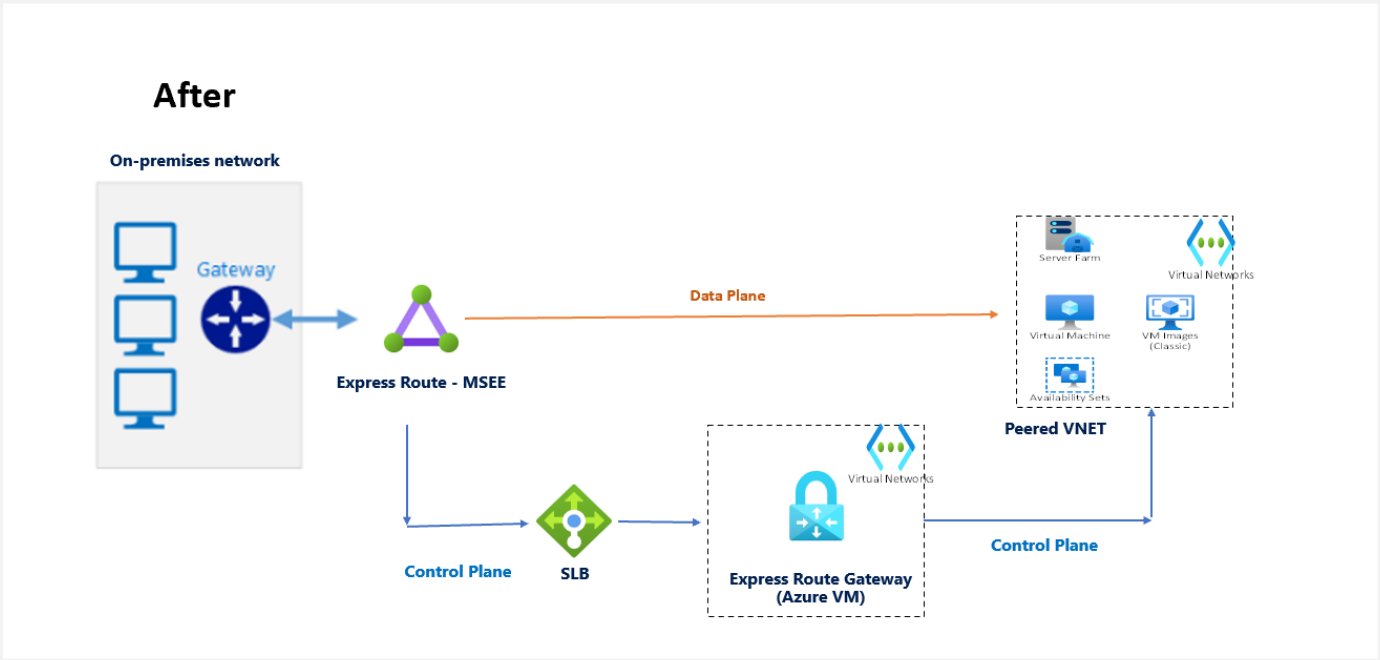
ExpressRoute FastPath

FastPath is designed to improve the data path performance between your on-premises network and your virtual network

When enabled, FastPath sends network traffic directly to virtual machines in the virtual network, bypassing the gateway.

FastPath improves data path performance such as packets per second and connections per second between your on-premises network and your virtual network.

You can enable ExpressRoute FastPath if your virtual network gateway is Ultra Performance or ErGw3AZ



Configure ExpressRoute FastPath

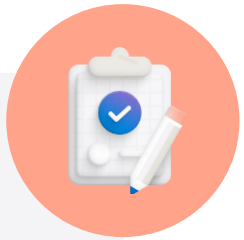
Updating an existing connection to enable FastPath

Azure PowerShell

Copy Open Cloudshell

```
$connection = Get-AzVirtualNetworkGatewayConnection -Name "MyConnection" -ResourceGroupName "MyRG"
$connection.ExpressRouteGatewayBypass = $True
Set-AzVirtualNetworkGatewayConnection -VirtualNetworkGatewayConnection $connection
```

Learning Recap – ExpressRoute FastPath



Check your knowledge questions and additional study

[About Azure ExpressRoute FastPath | Microsoft Docs]

Troubleshoot ExpressRoute connection issues

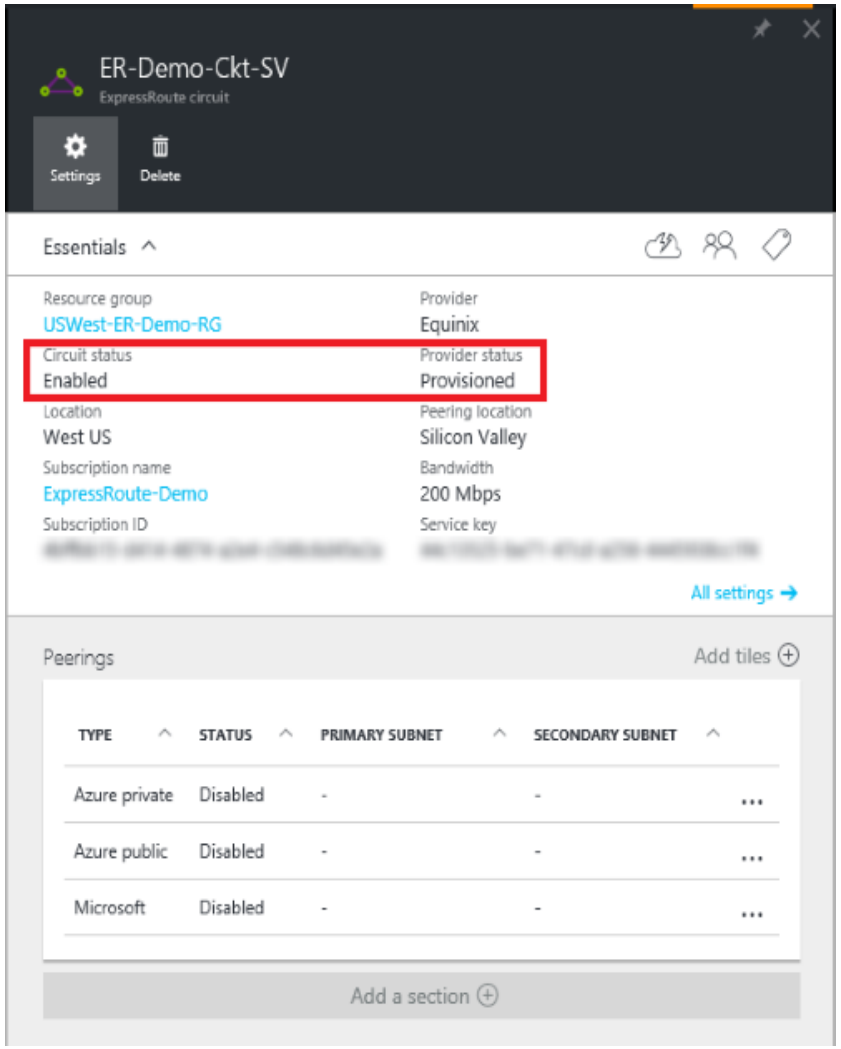
Learning Objectives - Troubleshoot ExpressRoute Connection

- Verify circuit provisioning and state through the Azure portal
- Validate Peering Configuration
- Validate Address Resolution Protocol (ARP)
- Troubleshooting network performance
- Learning Recap

Verify circuit provisioning and state

Get-AzExpressRouteCircuit -ResourceGroupName “USWest-ER-Demo-RG” –Name “ER-Demo-Ckt-SV”

```
Name                          : ER-Demo-Ckt-SV
ResourceGroupName             : USWest-ER-Demo-RG
Location                      : westus
Id                            : /subscriptions/**************************/resourceGroups/
USWest-ER-Demo-RG /providers/**********/expressRouteCircuits/ ER-Demo-Ckt-SV
Etag                          : W/"################################"
ProvisioningState             : Succeeded
Sku                           : {
                                "Name": "Standard_UnlimitedData",
                                "Tier": "Standard",
                                "Family": "UnlimitedData"
                                }
CircuitProvisioningState      : Enabled
ServiceProviderProvisioningState : Provisioned
ServiceProviderNotes          :
ServiceProviderProperties     : {
                                "ServiceProviderName": "****",
                                "PeeringLocation": "******",
                                "BandwidthInMbps": 200
                                }
ServiceKey                    : ************************************
Peerings                      : []
Authorizations                : []
```



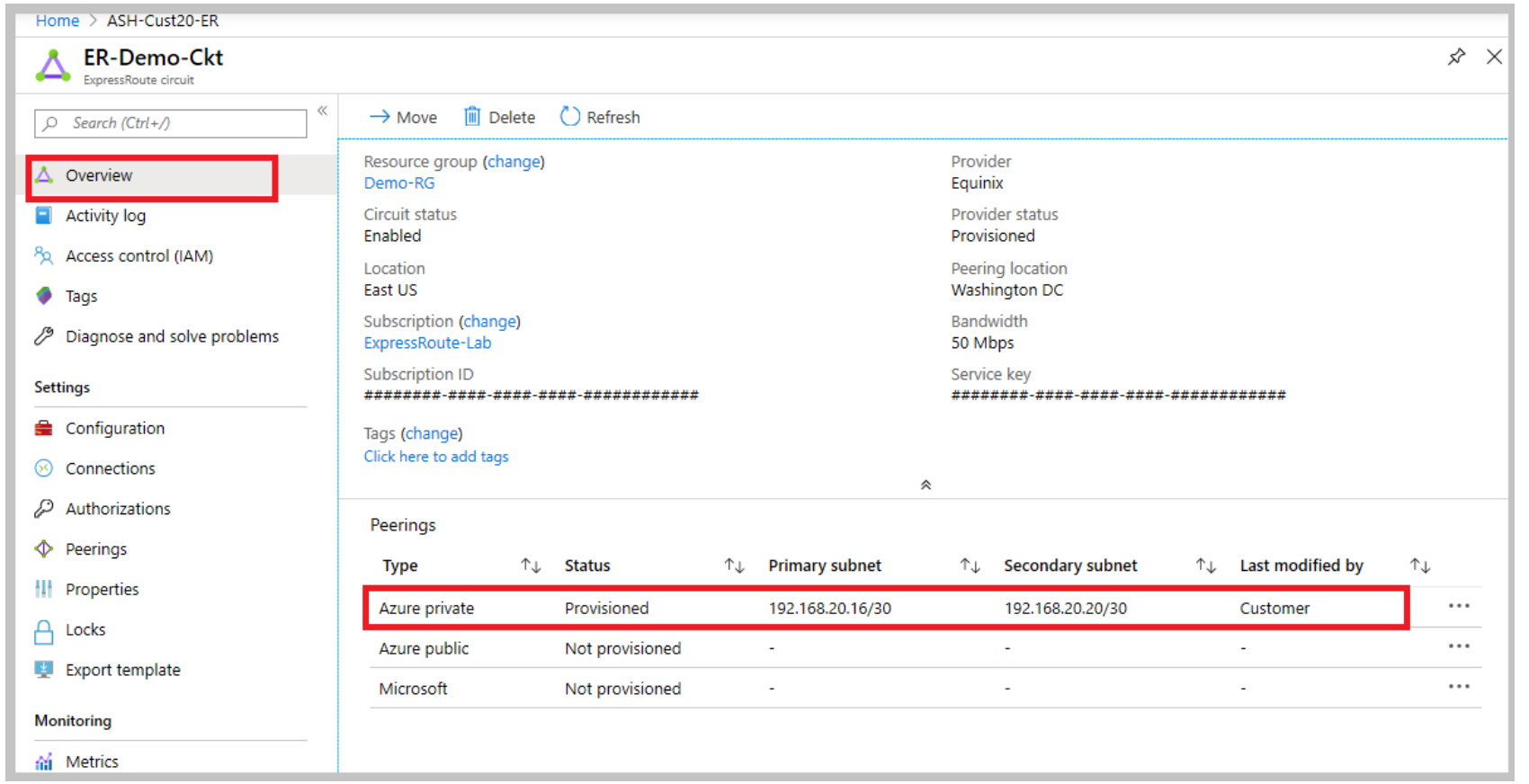
Reset a failed circuit

```
Connect-AzAccount
Get-AzSubscription
Select-AzSubscription -SubscriptionName "Replace_with_your_subscription_name“
$ckt = Get-AzExpressRouteCircuit -Name "ExpressRouteARMCircuit" -ResourceGroupName
"ExpressRouteResourceGroup"

Set-AzExpressRouteCircuit -ExpressRouteCircuit $ckt
```

The circuit should now be healthy. Open a support ticket with Microsoft support if the circuit is still in a failed state.

Validate Peering Configuration



Validate ARP

Address Resolution Protocol (ARP):

- layer 2 protocol defined in RFC 826.
- Used to map the Ethernet address (MAC address) with an ip address.

Title of ARP table error messages:

- On-premises MAC address show incomplete
- Microsoft entry in the ARP table

The ARP table provides a mapping of the IP address and MAC address for a particular peering. The ARP table for an ExpressRoute circuit peering provides the following information for each interface (primary and secondary):

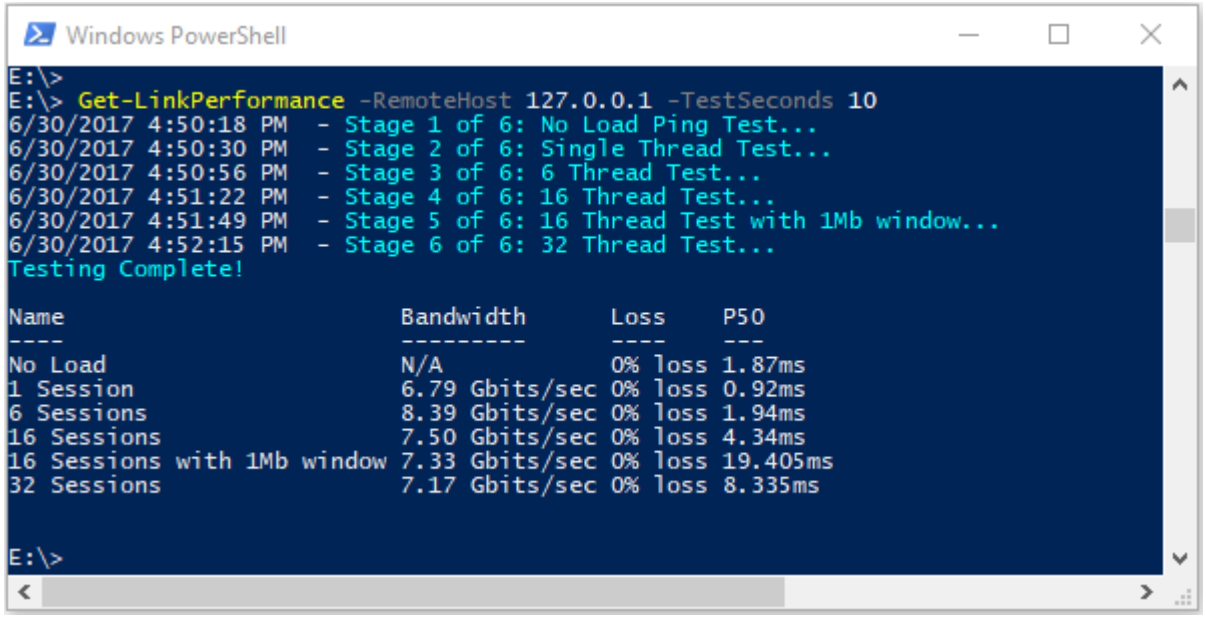
- Mapping of on-premises router interface ip address to the MAC address
- Mapping of ExpressRoute router interface ip address to the MAC address
- Age of the mapping ARP tables can help validate layer 2 configuration and troubleshooting basic layer 2 connectivity issues.

Troubleshooting network performance

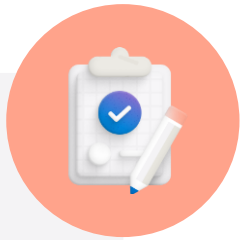
Most network issues can be analyzed and isolated with Azure Network Watcher or PowerShell and CLI

To help with troubleshooting, the Azure Connectivity Toolkit (AzureCT) was developed to put some of these tools in an easy package.

These tools and methods are wrapped into a PowerShell module (AzureCT) that you can install and use



Learning Recap – Troubleshoot ExpressRoute Connection Issues



Check your knowledge questions and additional study

[Azure ExpressRoute: Verify Connectivity – Troubleshooting Guide | Microsoft Docs]

[Troubleshoot network link performance: Azure | Microsoft Docs]

[Reset a failed circuit – ExpressRoute: PowerShell: Azure | Microsoft Docs]

End of presentation