MC2MC

Azure Virtual WAN for everyone

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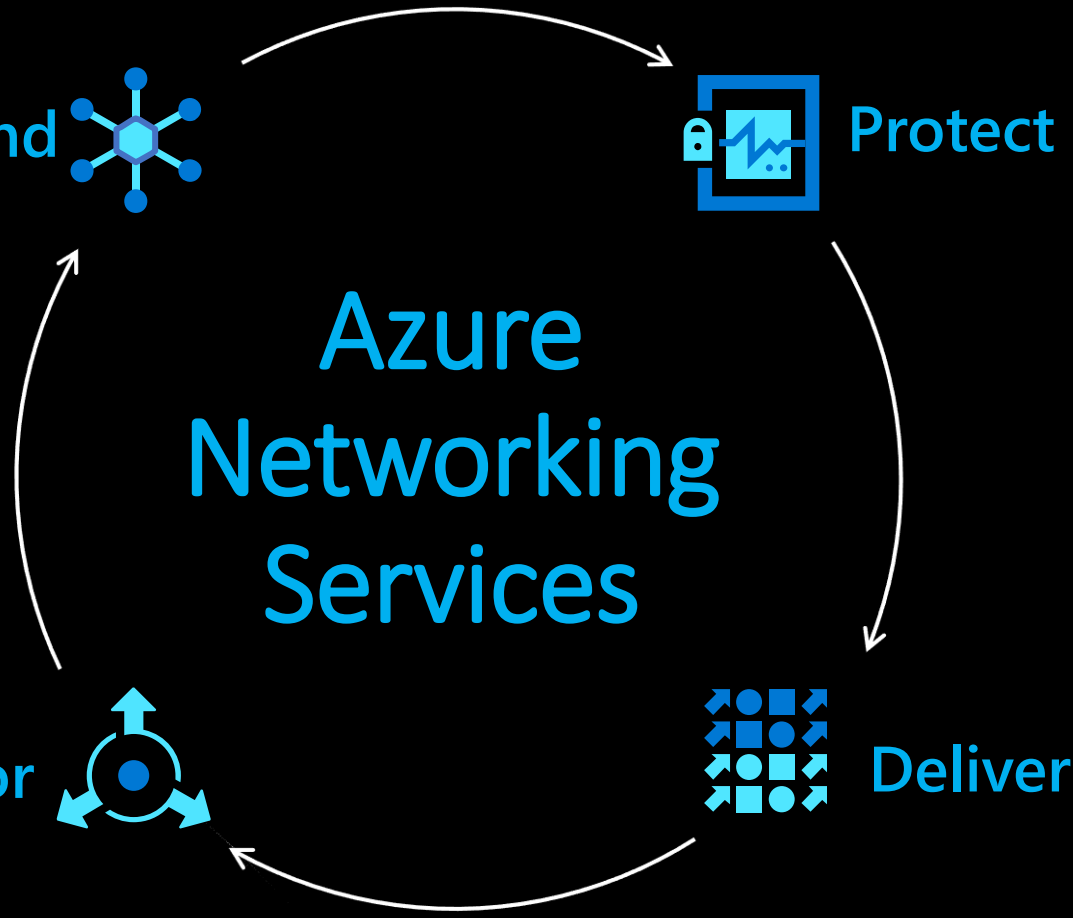
Azure Networking Services



- Azure Peering Services
- Virtual WAN
- ExpressRoute
- VPN Gateway
- S2S VPN
- P2S VPN
- MEC

- Azure Firewall
- Firewall Manager
- Service endpoints/Private Link
- WAF
- Bastion
- DDOS

- IPv4/v6 in Azure VNETs
- Virtual Network
- Virtual Subnet
- DNS
- CDN
- NAT Gateway
- Load Balancer
- Trafic Manager
- Application Gateway
- Front Door

- Internet Analyzer
- Network Watcher Traffic Analytics
- Azure Monitor Insights for Virtual WAN
- Log & Metrics

Dive Into Azure Virtual WAN

- What is it?
- Why use it?
- HUBs/Routing/ Connections/Gateways
- Secured Virtual Hubs
- Azure Monitoring

What is Azure Virtual WAN?

- A global networking service (GA November 2019) that allows us to **easily** leverage the Azure network backbone to build private, high-speed, global transit network architectures.
- Use the Azure global network backbone to connect customer locations to Microsoft Azure & each other.

1. What is so special about the Azure Global Backbone?
2. Wait a minute! We can already do that can we not?

Microsoft global network

Region
Edge
Network

60+ Azure regions | **130k+** miles of fiber + subsea cables | **160+** edge sites | **500+** network partners | **20k+** peering connections

1.6 Pbps of aggregate inter-datacenter bandwidth within a region

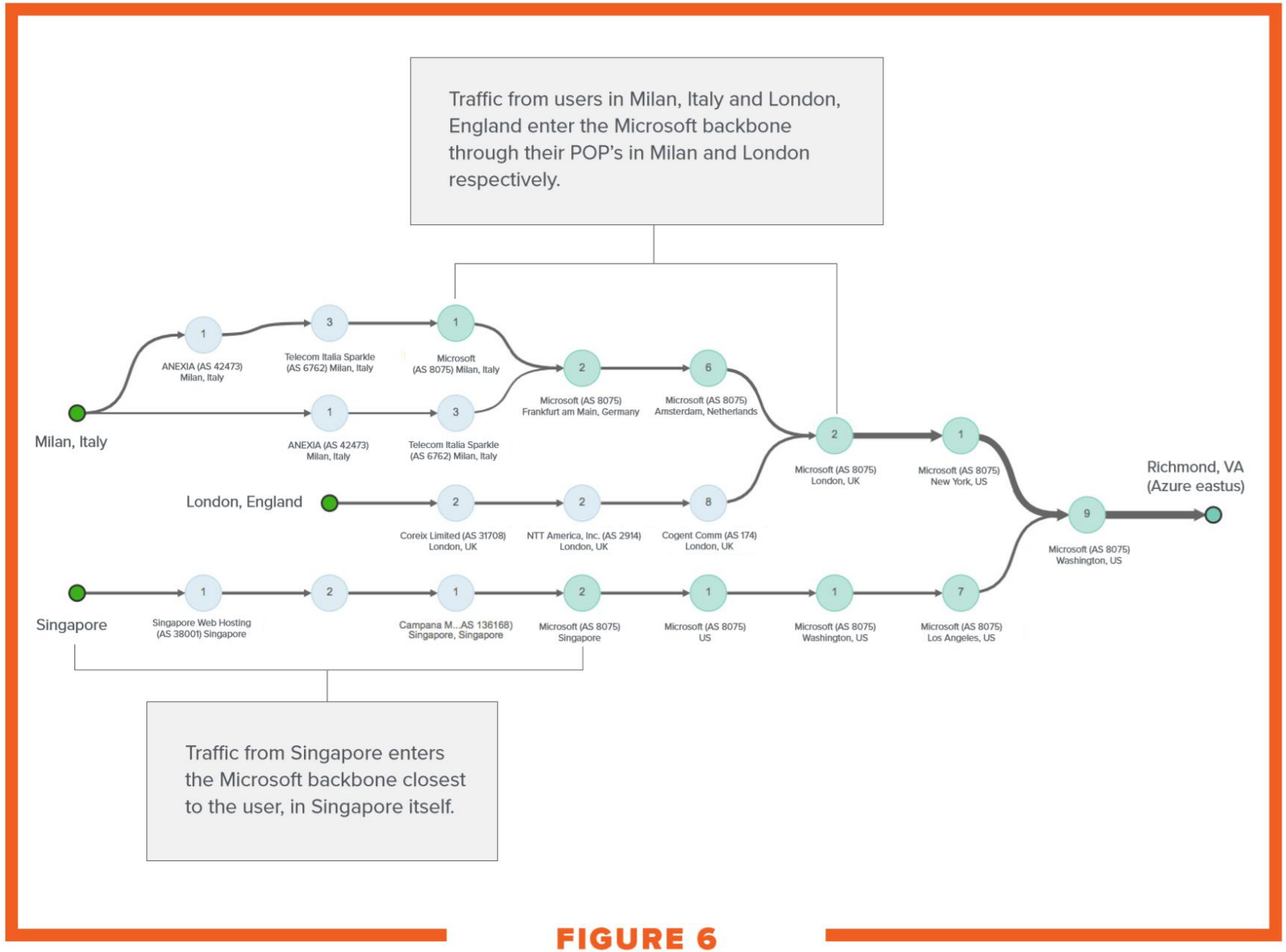
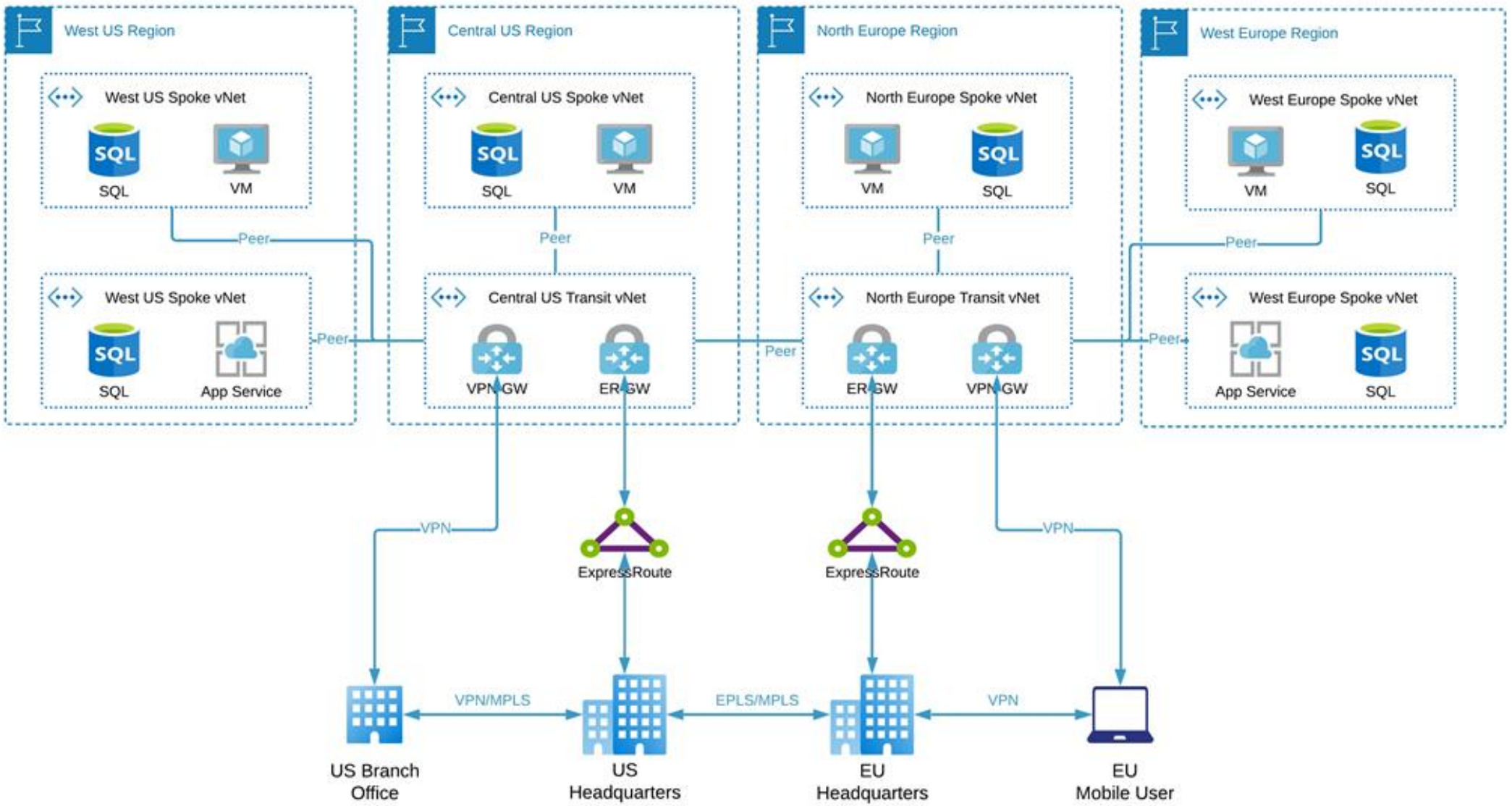


FIGURE 6

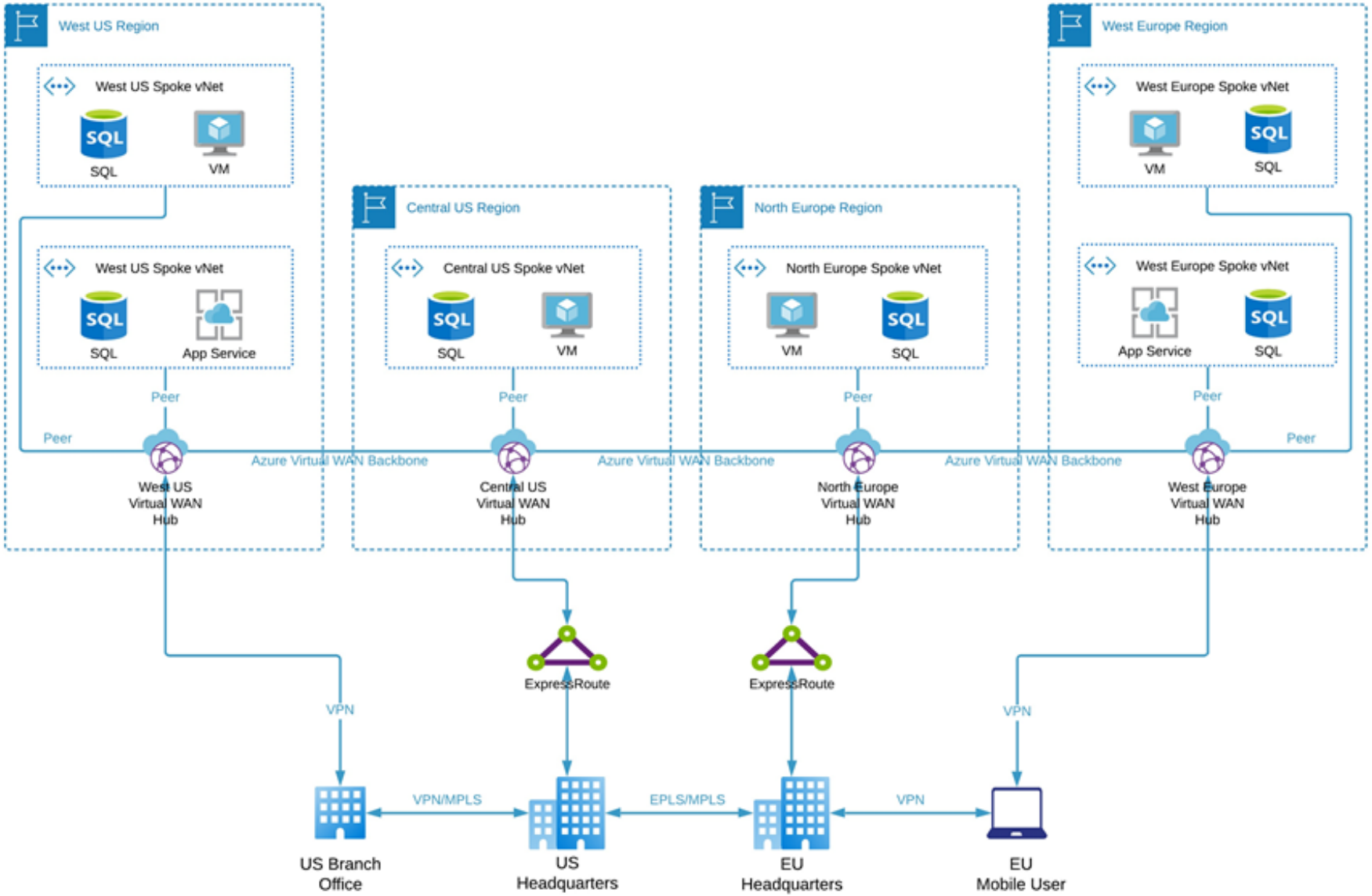
Azure connectivity architecture

https://www.thousandeyes.com/resources/cloud-performance-benchmark-report-november-2019

Traditional approach

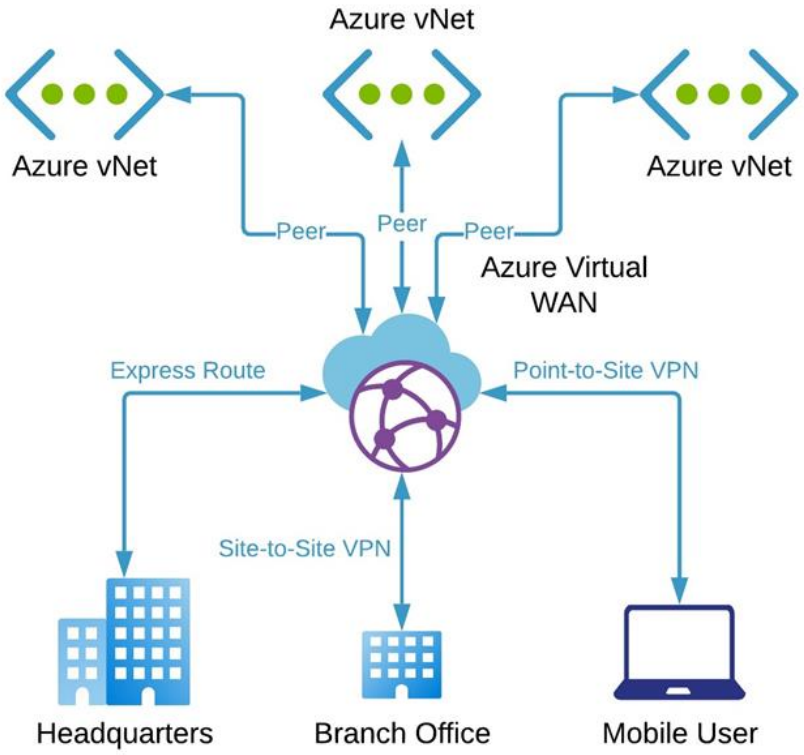


Azure Virtual WAN approach

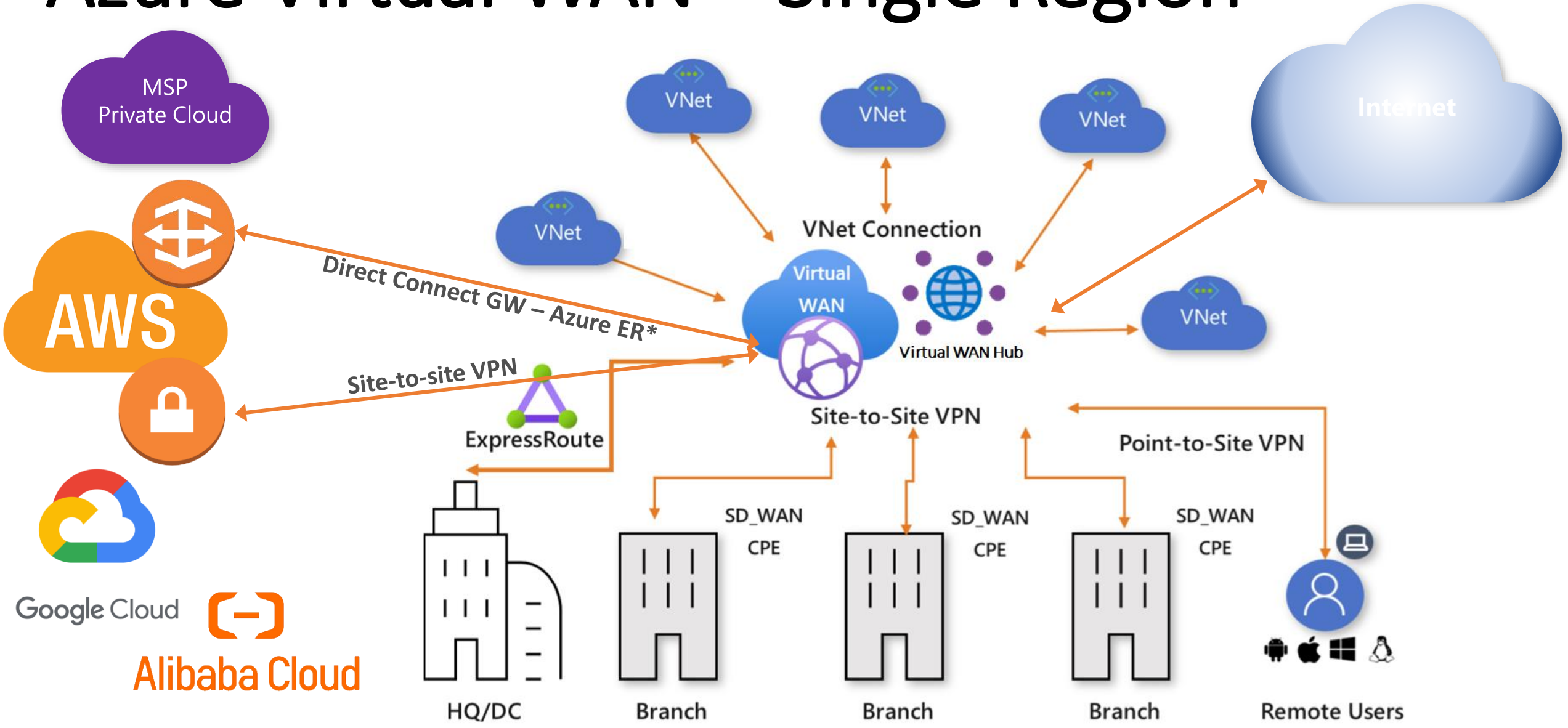


Azure Virtual WAN offers more

- Global Transit: centralized, easier, **transitive** vNET-to-vNET, branch-to-vNet and branch-to-branch connectivity
- Connectivity options: Use Site-to-Site VPN, Point-to-Site VPN and Express Route to link sites to Virtual WAN Hubs.
- Routing: Default, None, Custom
- Integrates with Azure Firewall via Firewall Manager
- Partners => integrated solutions provide automated branch connectivity, NVA's and services
- Monitoring in Azure



Azure Virtual WAN – Single Region



Azure Virtual WAN Components (1/4)

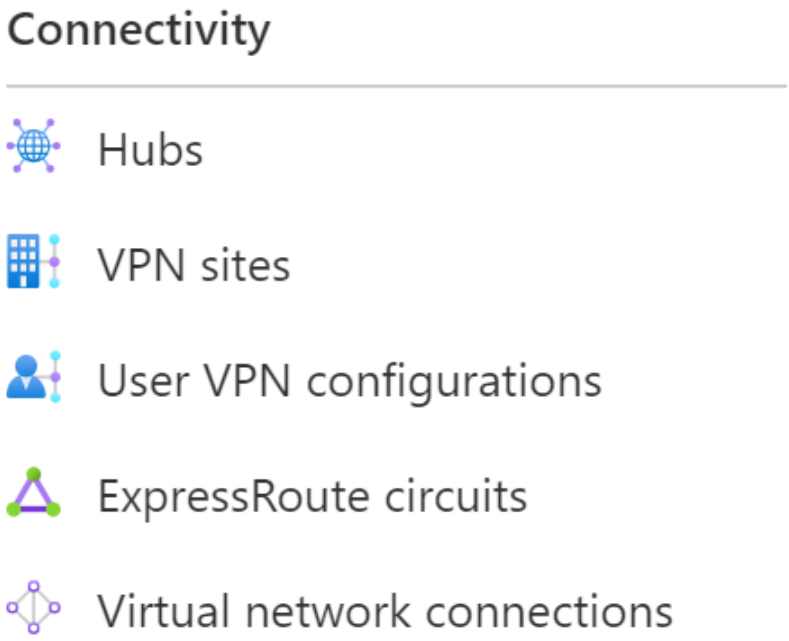
- **Virtual WAN**

  - The control plane of your private, globally distributed network which contains multiple resources that comprise the Azure Virtual WAN.
- **Virtual WAN Hub**: the regional core of a virtual WAN
  - Contains a hub gateway that serves as a connection point for branches, users and virtual networks.

  - You can deploy only 1 hub/region based on proximity to datacenters, branch offices and end users.
  - Replaces DIY Transit vNET hub construct with its VNG, virtual networks, firewall, route tables) along with manual peering and full mesh peering required. All traffic flows through the Virtual WAN Hub.
  - They are assigned an address space upon creation

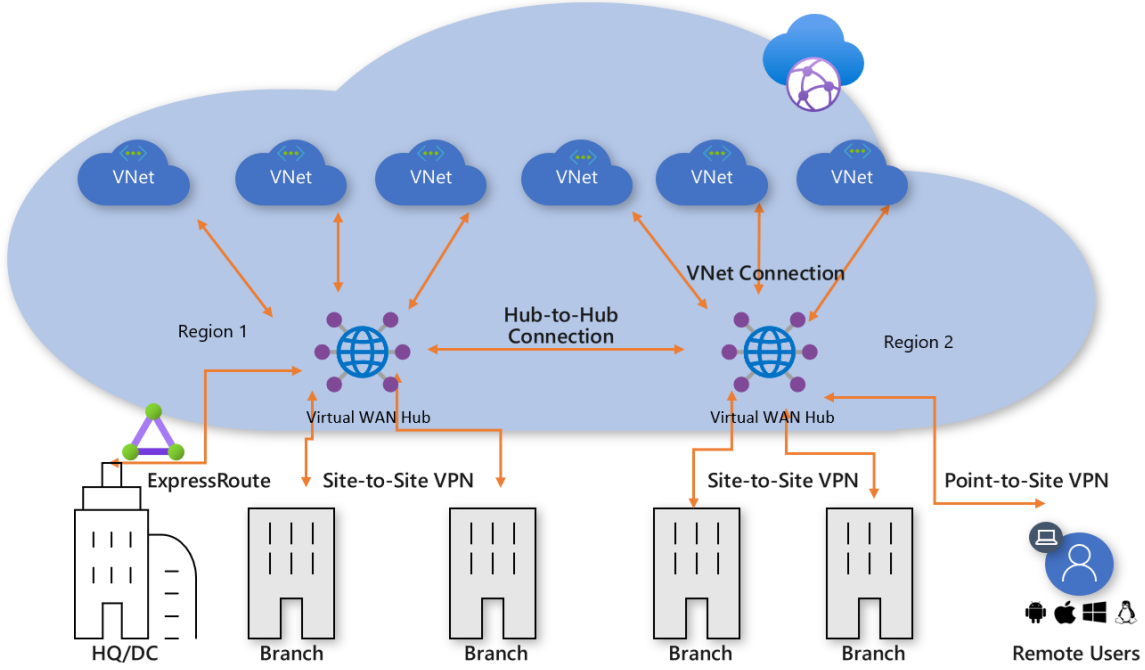
Azure Virtual WAN Components (2/4)

- **Hub Connectivity**
  - Site-to-site VPN, point-to-site VPN and Express Route (Branch Connections).
  - Virtual Network Connection: virtual networks (spokes) to the Virtual WAN Hub
  - Max 500 spokes (peering limitation)

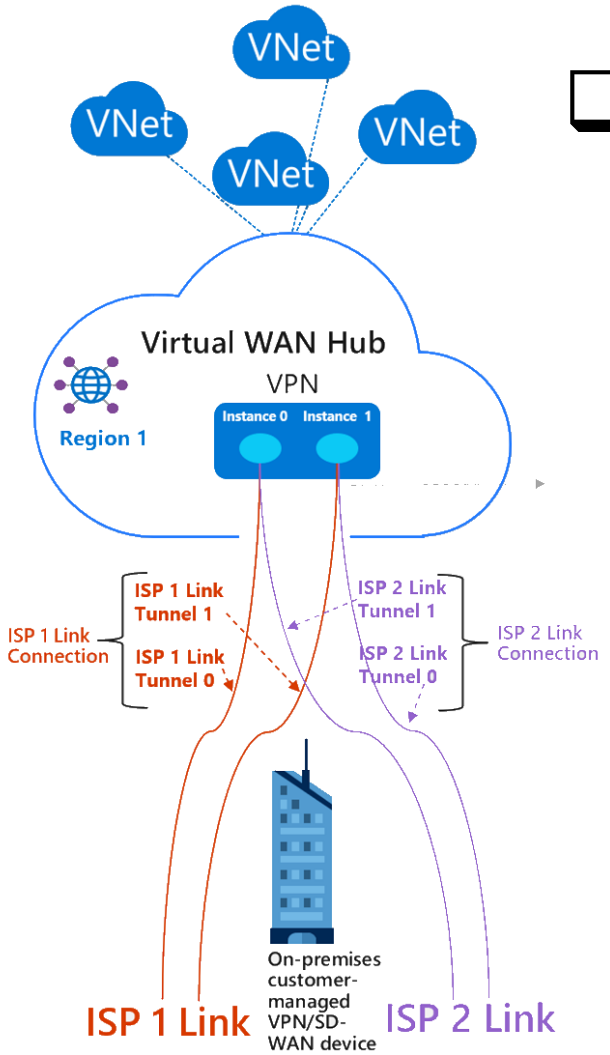


Azure Virtual WAN Components (3/4)

- **Hub-to-Hub Connectivity**
  - Provides global interconnection of hubs deployed in various regions under a common Virtual WAN Service
- **Hub Route Tables**
  - The regional routing construct
  - Populated manually or dynamically using BGP
- **None Route tables**
- **Custom Route Tables for vNETs**



Azure Virtual WAN Components (4/4)

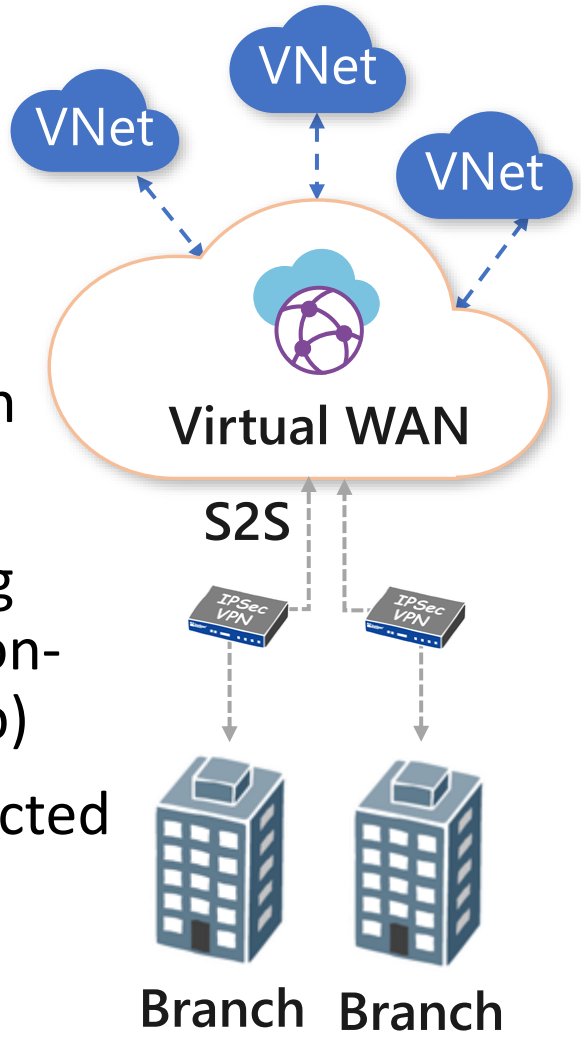


- **VPN Site:** customer end branch location for site-to-site VPN connections into Virtual WAN Hubs.
  - **Links**: Represents the actual connectivity between the site & the remote site.
    - A site link has an active-active tunnel construct for failover.
    - A site can have multiple links (max 4) for bandwidth aggregation & redundancy (failover, auto path selection)

Azure Virtual WAN Types

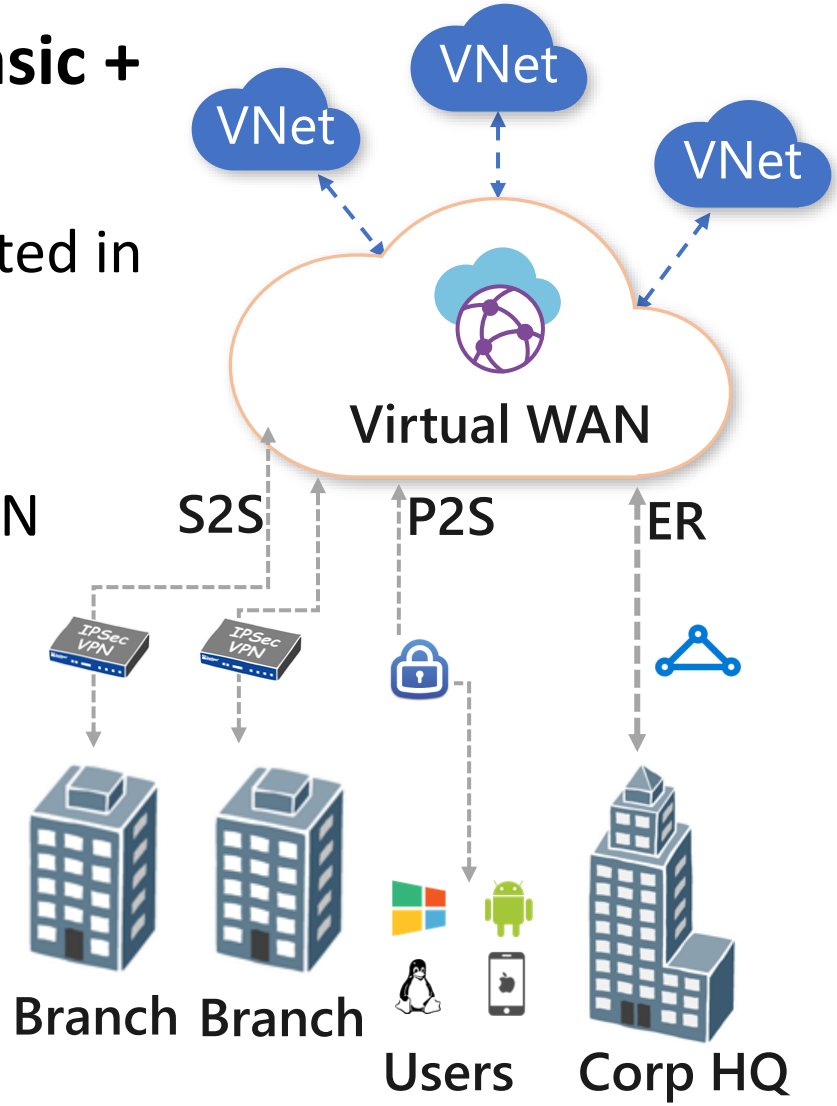
Basic

- ❑ S2S VPN only
  - ❑ Branch to Azure
  - ❑ Azure to Branch
  - ❑ Branch to Branch
- ❑ Connect VNET
  - ❑ DIY VNet Peering (VNet to VNet non-transitive via hub)
- ❑ Hubs are not connected
- ❑ Scale!



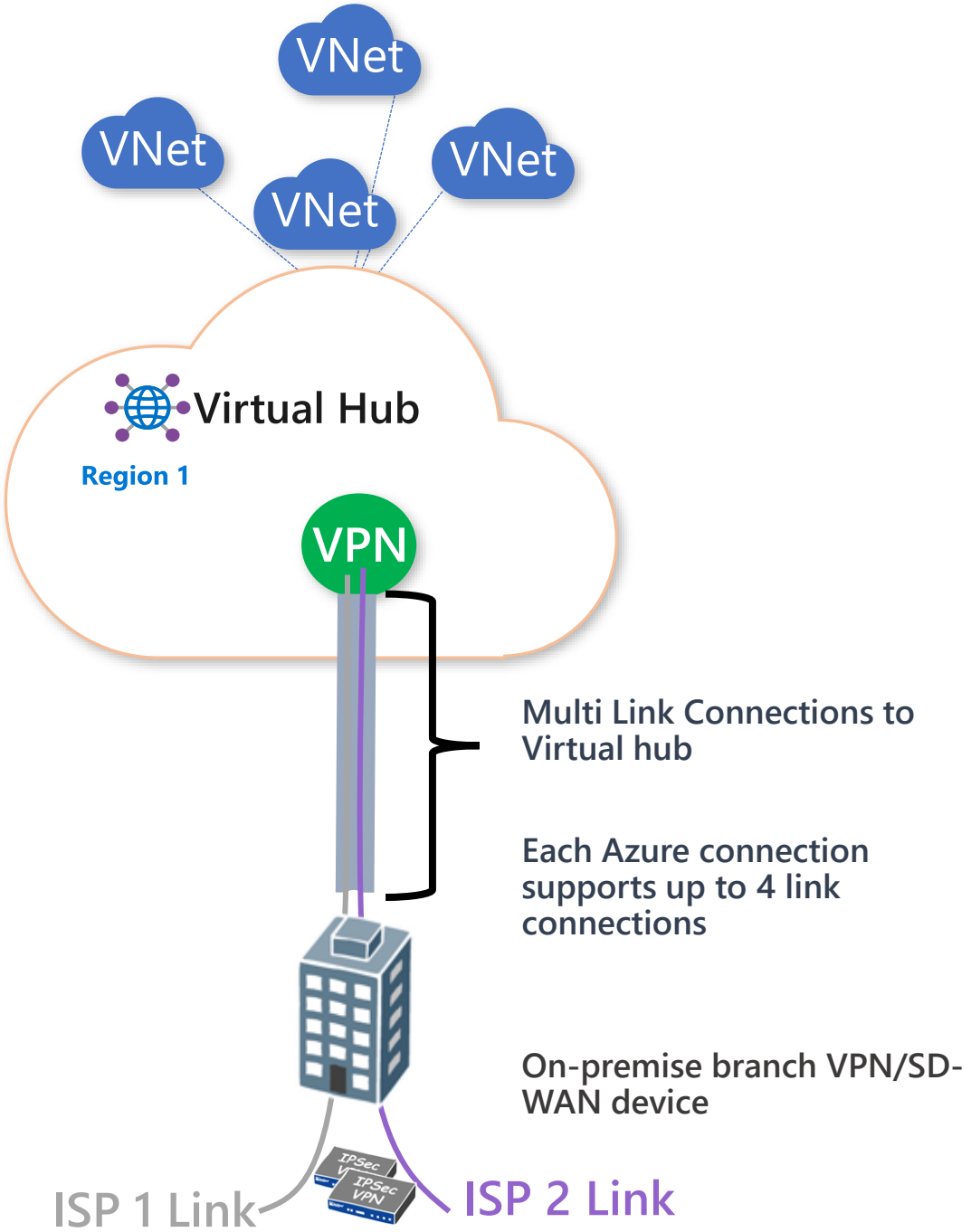
Standard = Basic + following

- ❑ Hubs connected in full mesh
- ❑ ExpressRoute
- ❑ User (P2S) VPN
- ❑ Any-to-any transitive connectivity
- ❑ Scale!



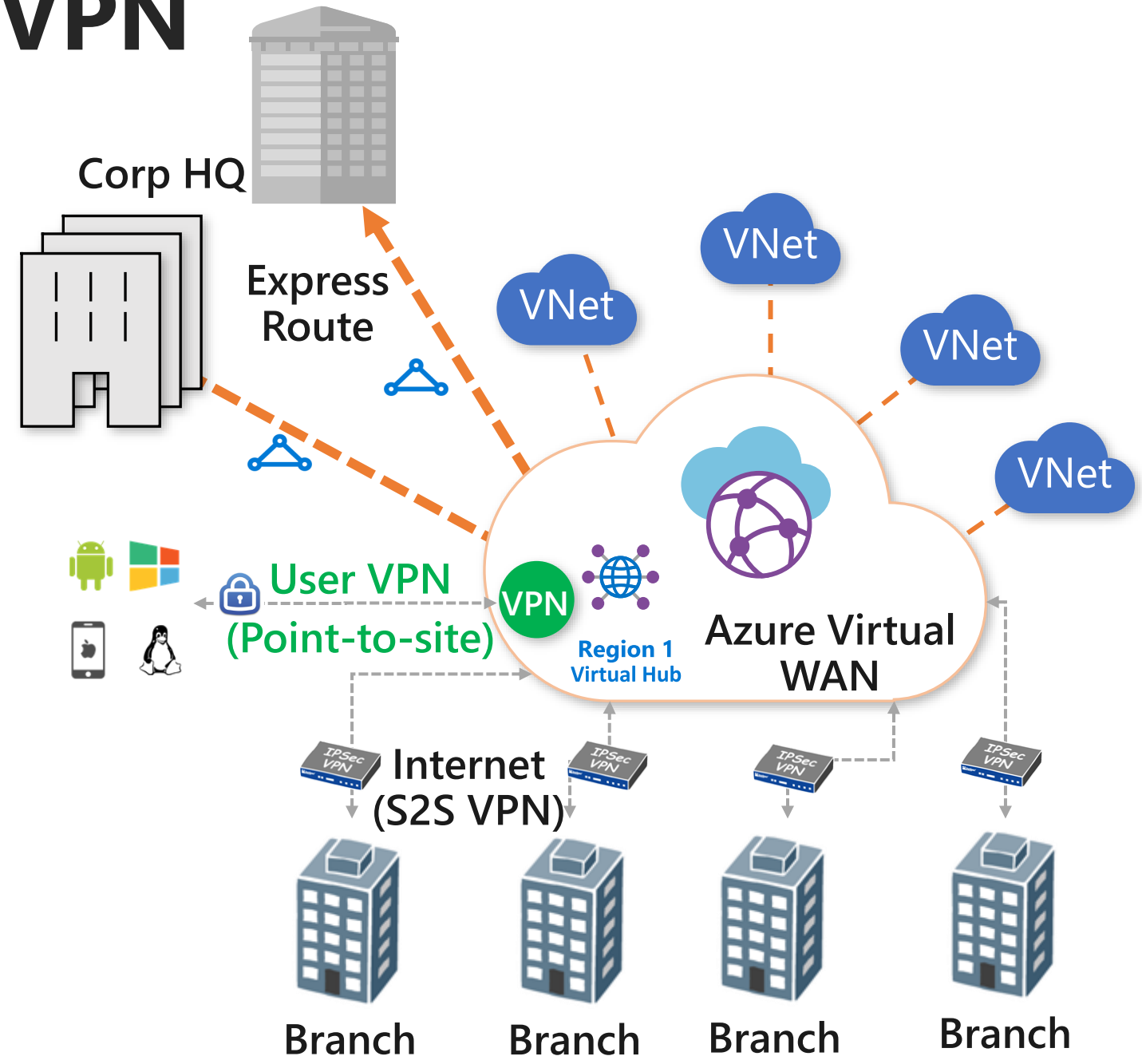
Site-to-Site (S2S) VPN

- **Multi Link support**
  - **Dynamic traffic distribution across ISP at the branch site**
    - 1 connection with path selection across multiple links (≠ ISP's) to Azure
    - Lots of hardware & Virtual appliance partners
  - **Always-on redundant access to cloud-based resources**
    - Automatic path failover in case of ISP failure
    - Improved reliability
    - Possible TCO reduction
- **Scale**
  - Up to 20 Gbps aggregate throughput (1 scale unit = 500 Mbps)
  - 1000 S2S connections per hub
- **IKEv1** & **IKEv2**
- **FQDN based IPsec, Dynamic DNS** support in Azure**, CustomBGP/APIPA** (AWS)



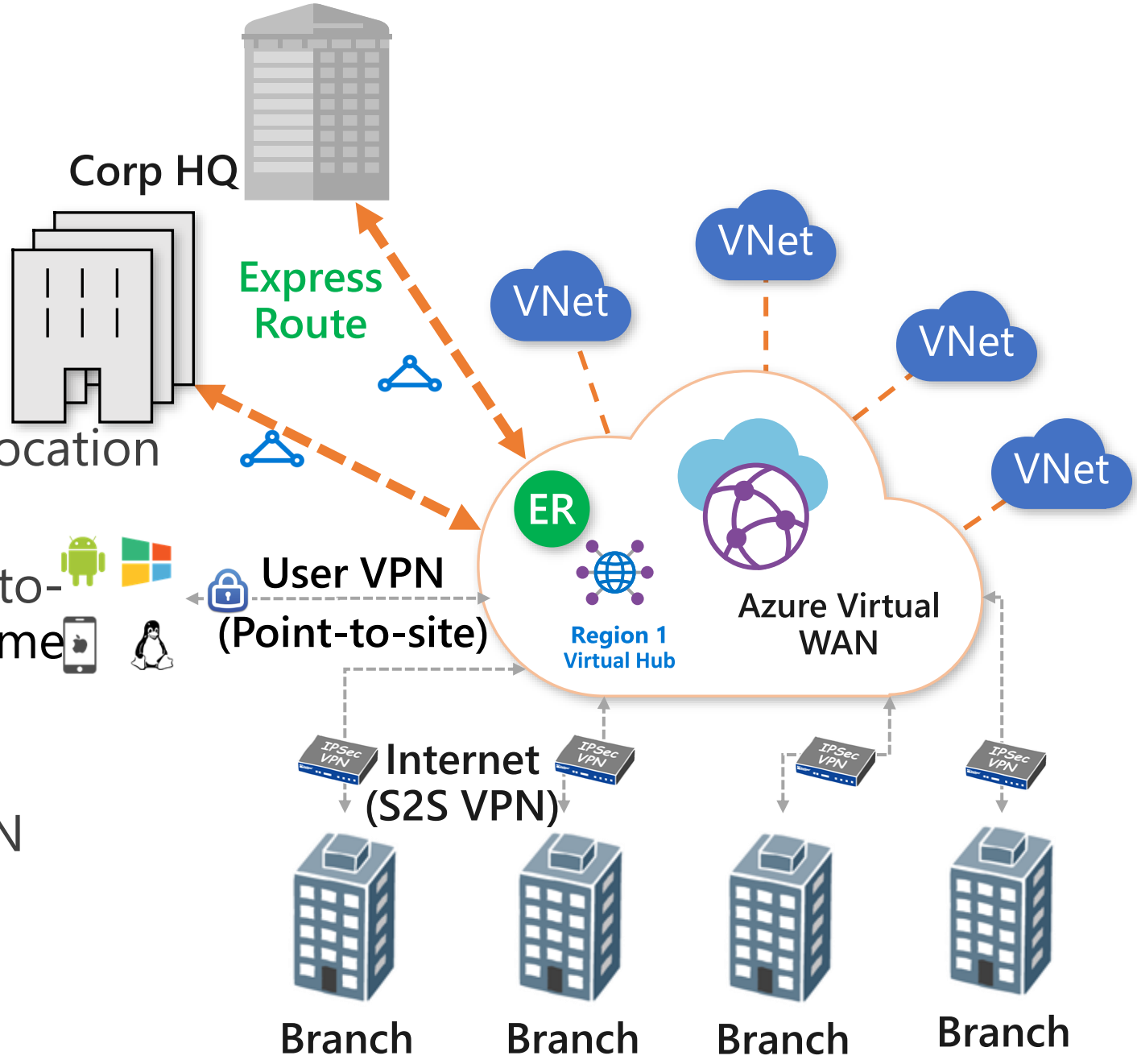
Point-to-Site (P2S)VPN

- Only in **Standard Virtual WAN**
- **Scale**:
  - Up to 20 Gbps aggregate throughput & 10K users per hub
- **Cloud based secure remote access**
  - Works with OpenVPN (Azure VPN client) and IKEv2 client
  - Cert based & RADIUS authentication or Azure AD
  - IP or **FQDN** Based & **Custom DNS**
- **Any-to-any**
  - User to Branch , User to Azure VNET
- **Integrated with Azure Monitor**
  - Metrics

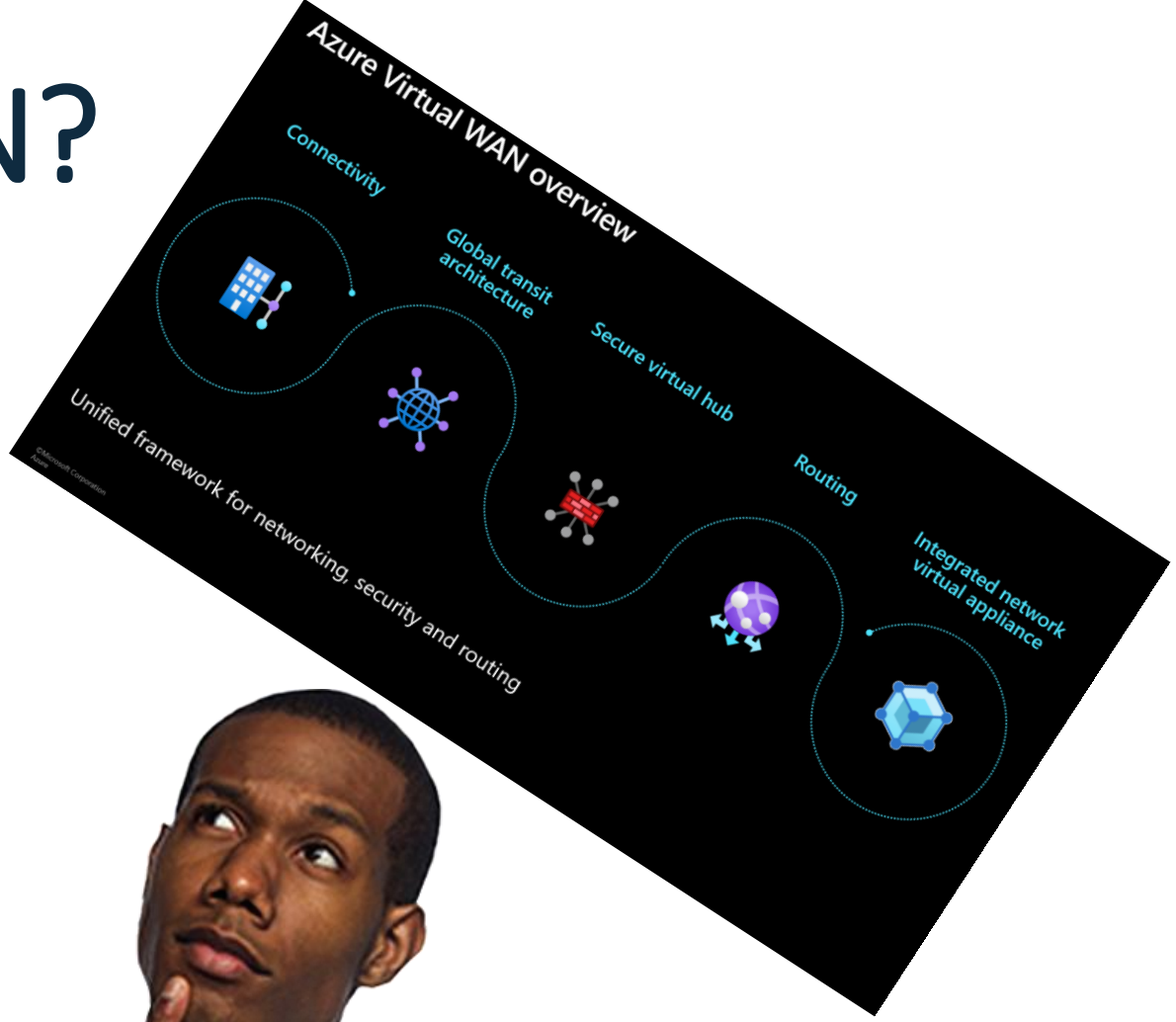


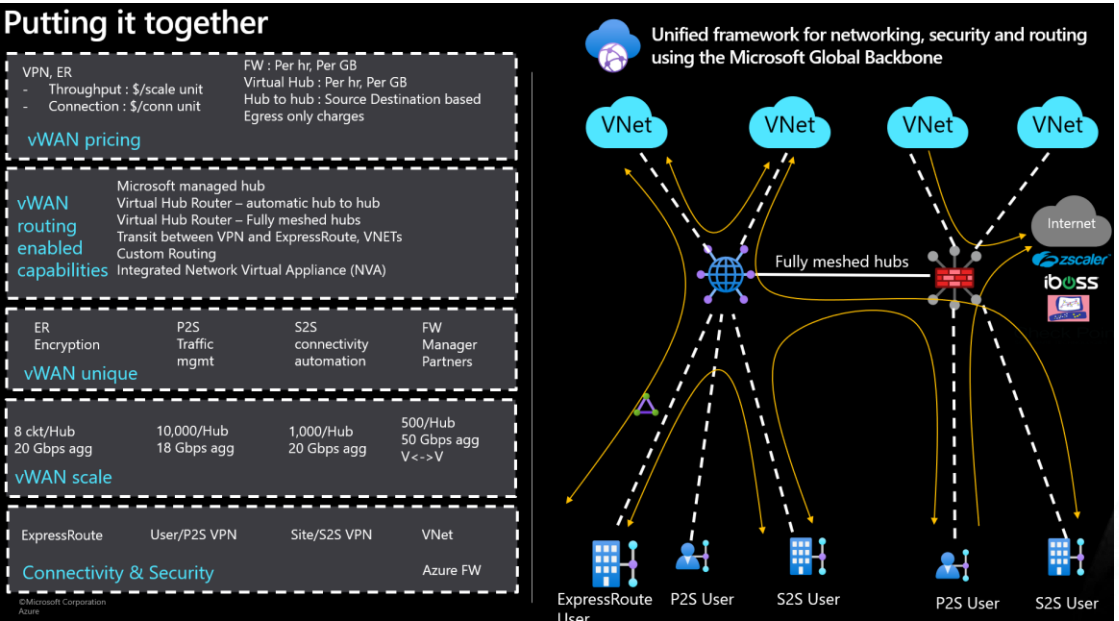
ExpressRoute

- Only in **Standard Virtual WAN**
- **Scale**: Up to 20 Gbps aggregate throughput (1 scale unit = 2 Gbps)
  Up to **8** circuits/region (up from 4)
- **Private Connectivity**
  - Premium Circuit in Global Reach Location
  - **Standard** Circuit within geopolitical region (disables branch-to-branch) or **Local** circuit (spokes in same region)
- **ExpressRoute VPN Interconnect**
  - ExpressRoute & S2S/ P2S User VPN
- **Encrypt your traffic over ER**
- **ER to ER via Global Reach**
- **Integrates with Azure Monitor**



Why Azure Virtual WAN?





Azure Virtual WAN Benefits (1/2)

- Operational efficiencies & scalability
  - Simplified architecture by replacing transit vNets with the Virtual WAN Hubs.
  - Simpler in network design and routing architecture.
  - Reduce operational cost ➔ ease of use & automation (3rd party appliances, MSPs,…)
  - Increased scale for S2S and P2S VPN tunnels
    - 10Gbps ➔ 20Gbps: doubles overall aggregate VPN throughput (20Gbps S2S + 20Gbps P2S)
    - 10K Users per hub
    - 1000 S2S connections per hub
  - Higher overall throughput (20Gbps S2S + 20Gbps P2S) + 20Gbps ExpressRoute
- Redundancy & high availability
  - Virtual WAN Hubs are zone redundant by default.
  - No worries about selecting zone redundant SKUs for VPN & Express Route Network Gateways.

Azure Virtual WAN Benefits (2/2)

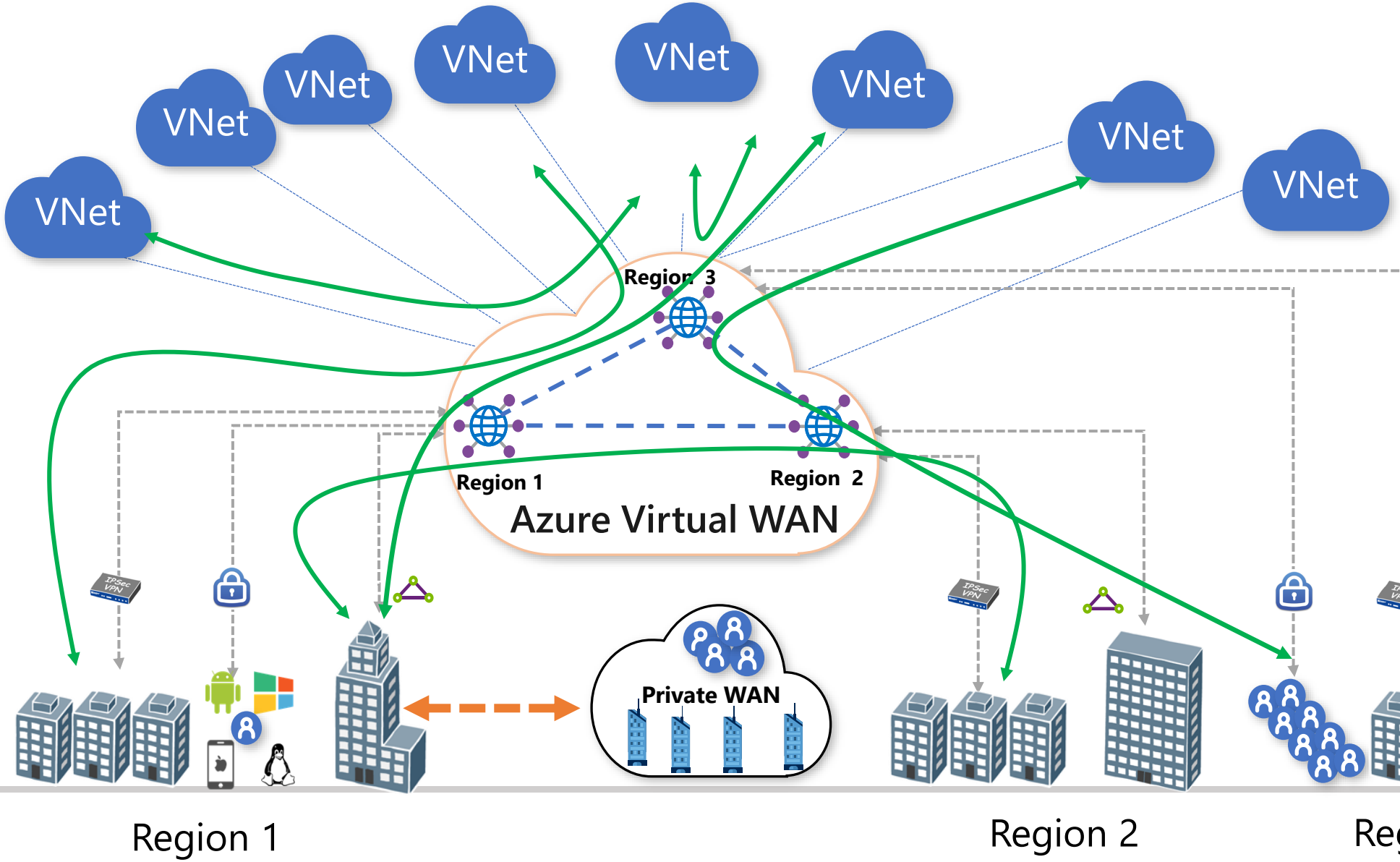
- Any-to-Any networking
  - All routing* is performed within the Virtual WAN Hub. Any vNet that is peered to the Virtual WAN Hub will automatically trigger an update to the global routing table
  - This eliminates the need to configure routing within the spoke vNet itself and/or establishing peering relationships between spoke vNets that need to communicate with each other.
  - Hub-to-Hub means this is a global construct!

*Exception: Express Route Premium + Global Reach bypass Virtual Hubs

Global Transit Architecture

Any-to-any connectivity

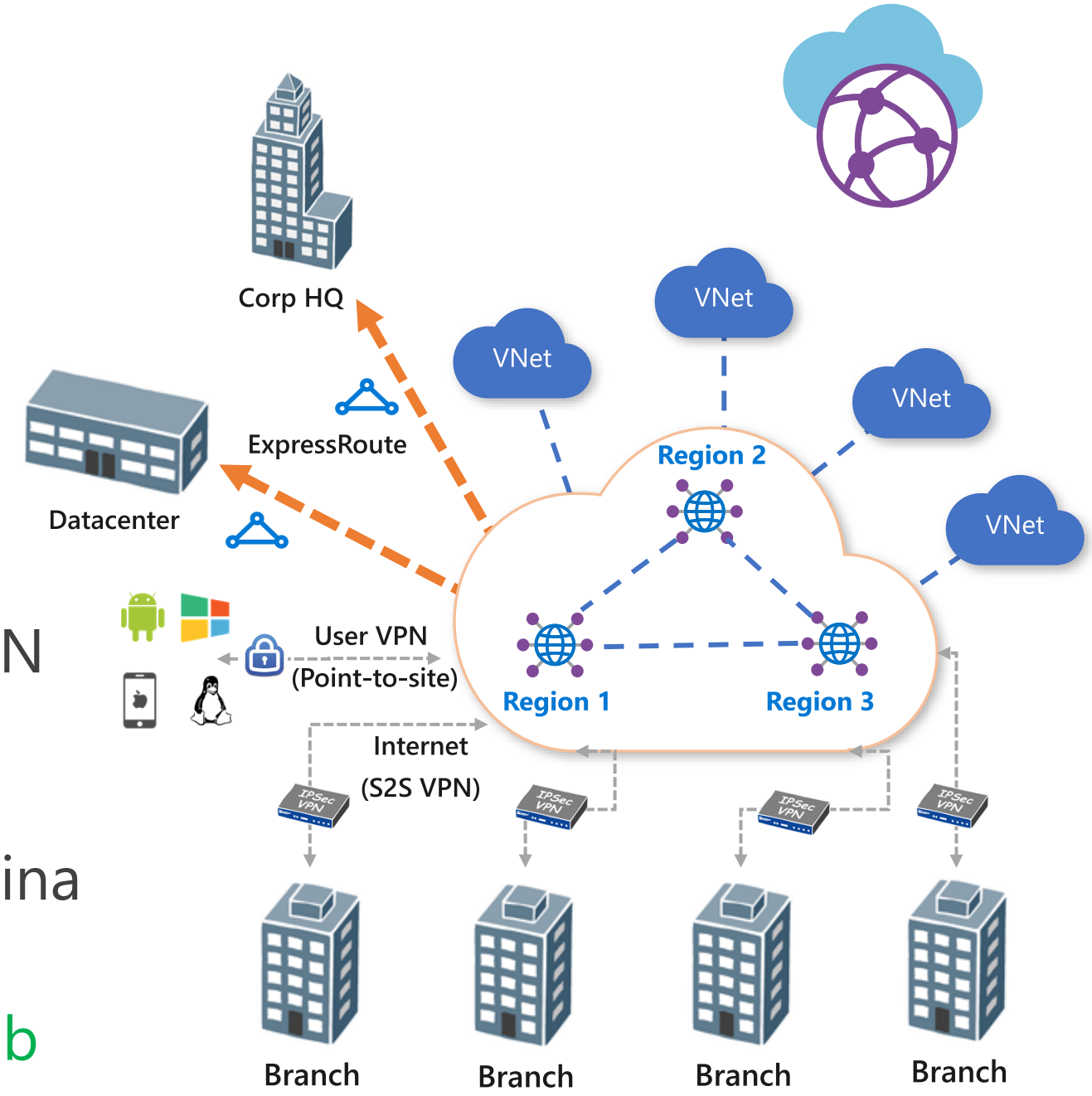
- ✓ Full mesh hubs
- ✓ Branch to Azure
  - ✓ S2S to VNet
  - ✓ P2S to VNet
  - ✓ ER to VNet
- ✓ Branch to Branch
  - ✓ VPN<->ER
  - ✓ P2S<->S2S
- ✓ VNet to VNet



- ❑ Simplified network
- ❑ Ease of use
- ❑ operational savings

State of the union

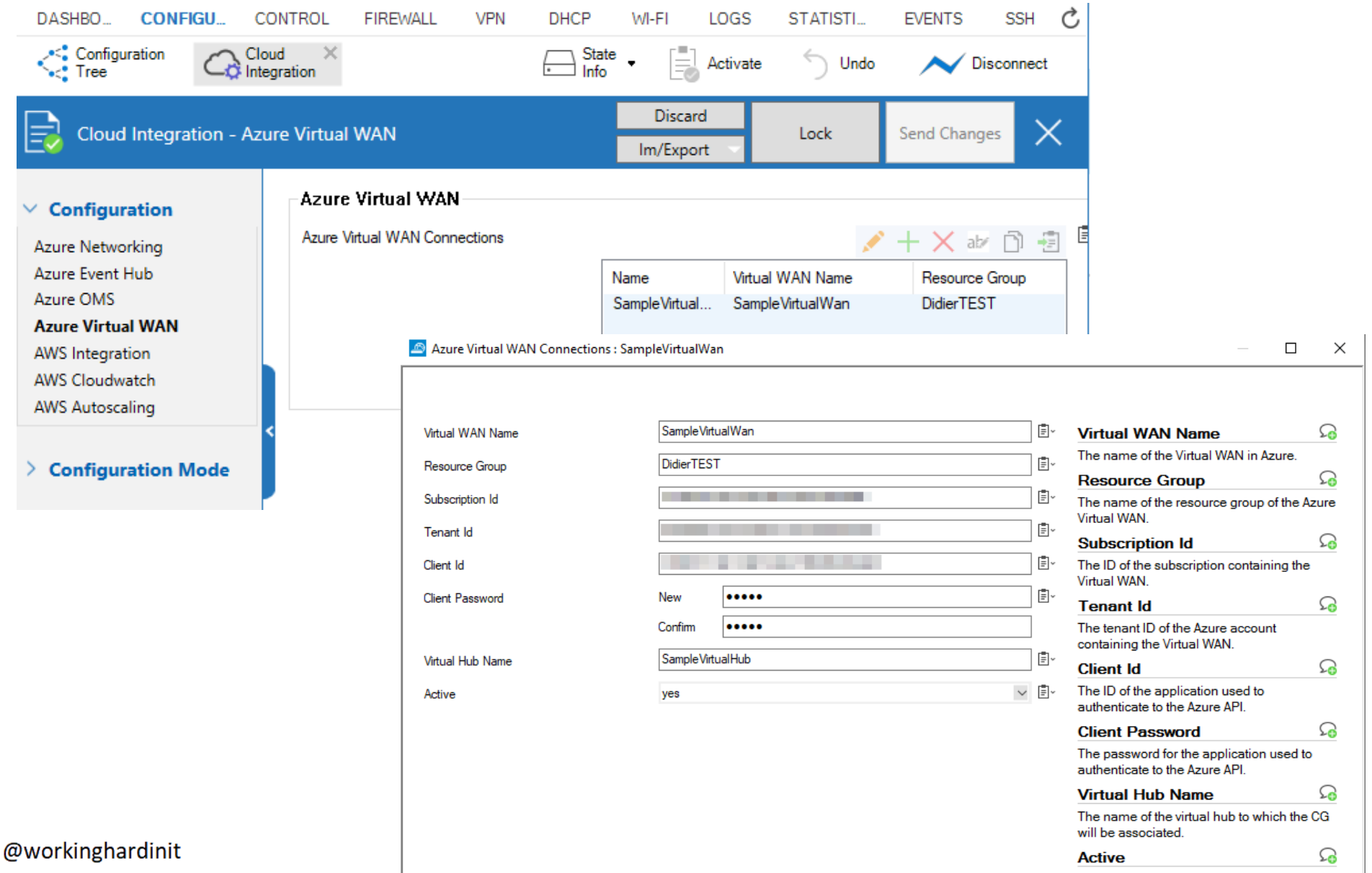
- ❑ Any-to-Any connectivity
- ❑ ExpressRoute, P2S, S2S
- ❑ ExpressRoute Encryption
- ❑ Hub-2-Hub
- ❑ Multi Link Azure Path Selection
- ❑ Custom IPsec
- ❑ Connect VNG VPN to Azure vWAN
- ❑ Azure Firewall (Manager) integration
- ❑ Also available in Gov Cloud & China
- ❑ Custom Route Tables
- ❑ Partners, NVA in Azure vWAN Hub



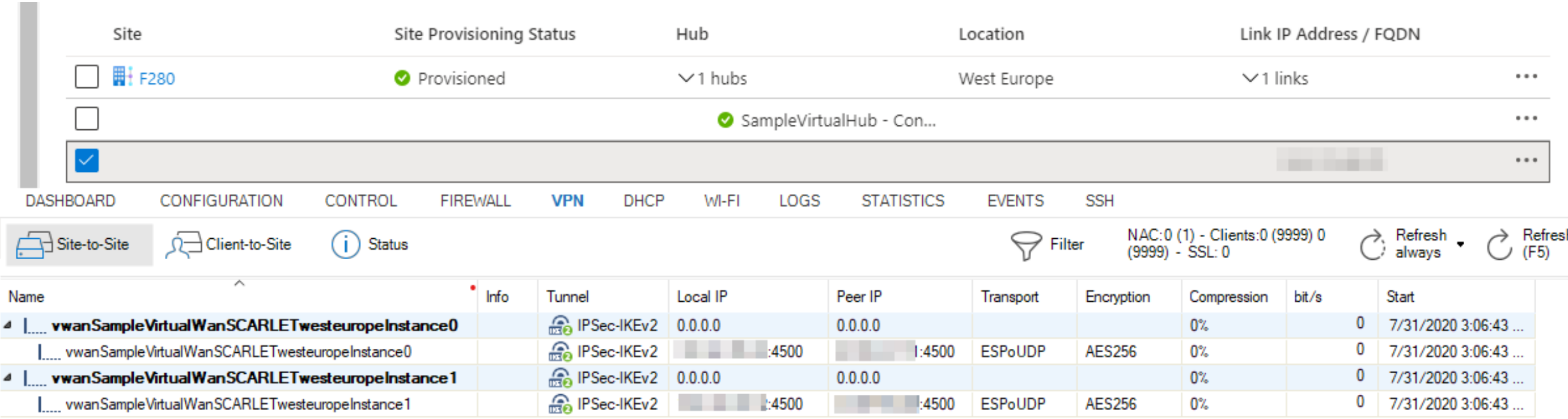
3rd Party Network Virtual & Physical Appliances

Connectivity Automation Example

Partner Example – Barracuda CGFW (1/2)



Partner Example – Barracuda CGFW (2/2)



Site	Site Provisioning Status	Hub	Location	Link IP Address / FQDN
F280	Provisioned	1 hubs	West Europe	1 links
		SampleVirtualHub - Con...		

DASHBOARD CONFIGURATION CONTROL FIREWALL VPN DHCP WI-FI LOGS STATISTICS EVENTS SSH

Site-to-Site Client-to-Site Status Filter NAC:0 (1) - Clients:0 (9999) 0 (9999) - SSL: 0 Refresh always Refresh (F5)

Name	Info	Tunnel	Local IP	Peer IP	Transport	Encryption	Compression	bit/s	Start
vwanSampleVirtualWanSCARLETwesteuropeInstance0		IPSec-IKEv2	0.0.0.0	0.0.0.0			0%	0	7/31/2020 3:06:43 ...
vwanSampleVirtualWanSCARLETwesteuropeInstance0		IPSec-IKEv2	[redacted]:4500	[redacted]:4500	ESPoUDP	AES256	0%	0	7/31/2020 3:06:43 ...
vwanSampleVirtualWanSCARLETwesteuropeInstance1		IPSec-IKEv2	0.0.0.0	0.0.0.0			0%	0	7/31/2020 3:06:43 ...
vwanSampleVirtualWanSCARLETwesteuropeInstance1		IPSec-IKEv2	[redacted]:4500	[redacted]:4500	ESPoUDP	AES256	0%	0	7/31/2020 3:06:43 ...

Barracuda

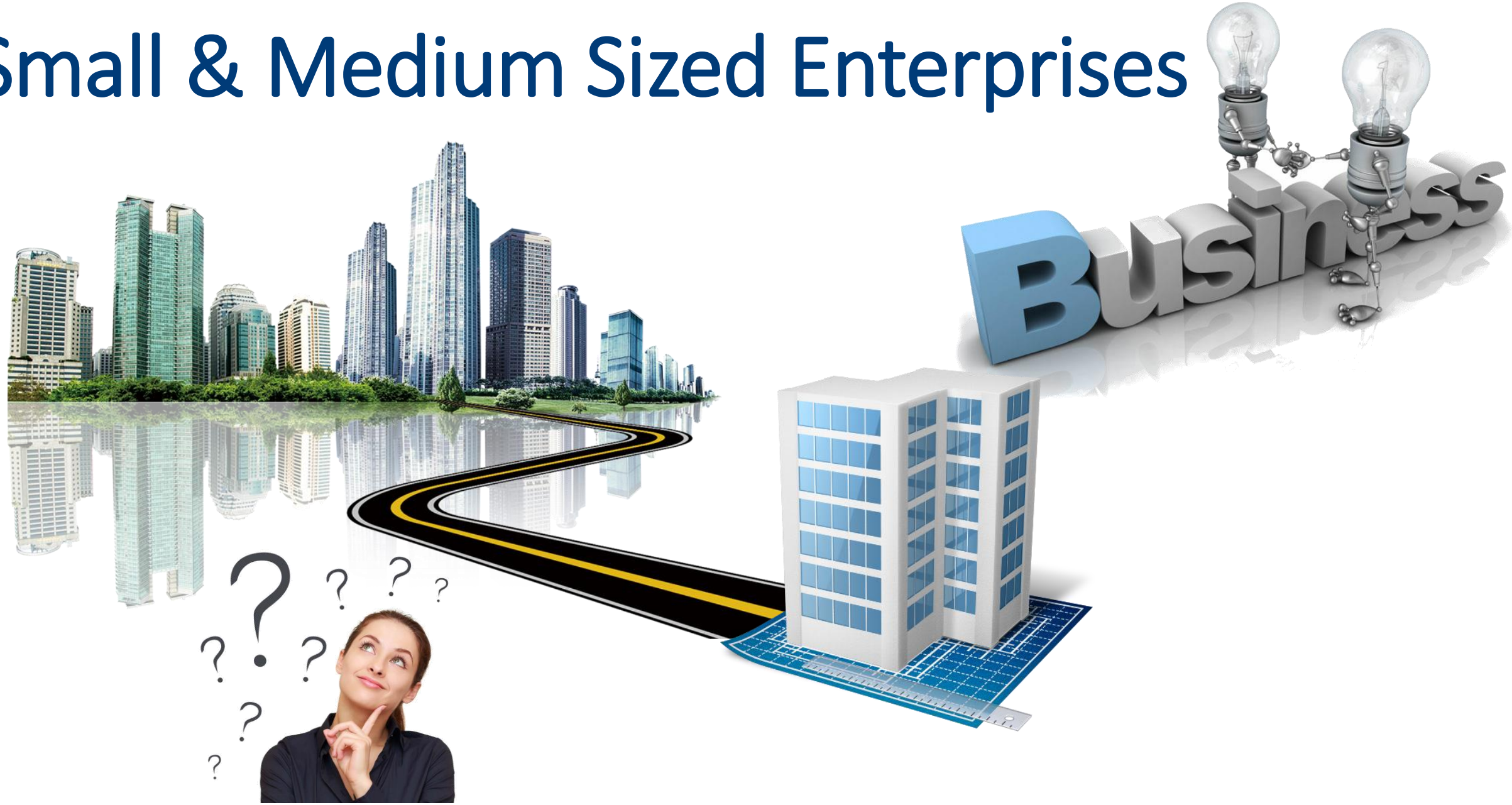
Connectivity Automation

Coming Soon

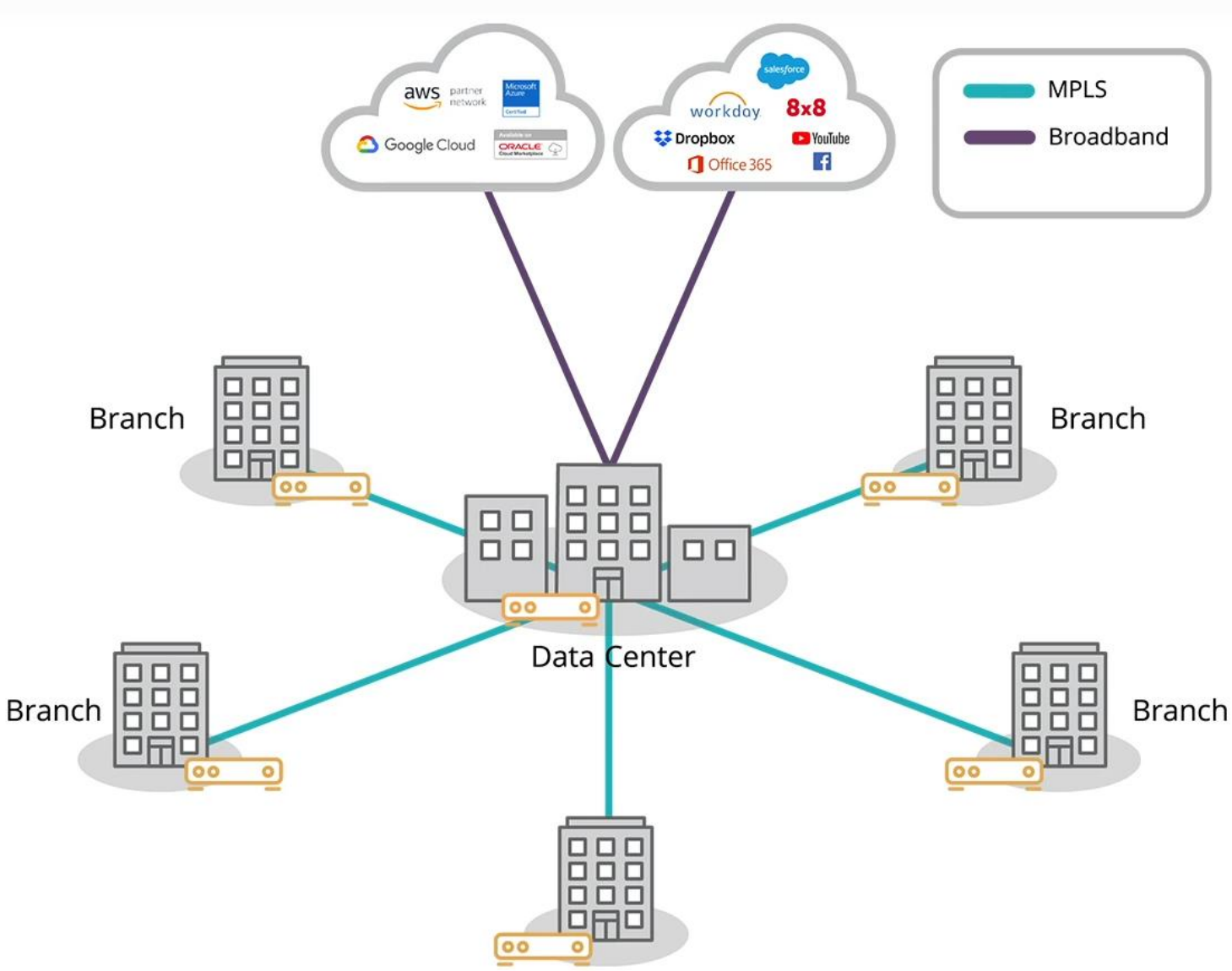
MSP Partners providing Azure Virtual WAN Services

Create a NVA in an Azure Virtual WAN hub (Preview): https://docs.microsoft.com/en-us/azure/virtual-wan/about-nva-hub

Small & Medium Sized Enterprises

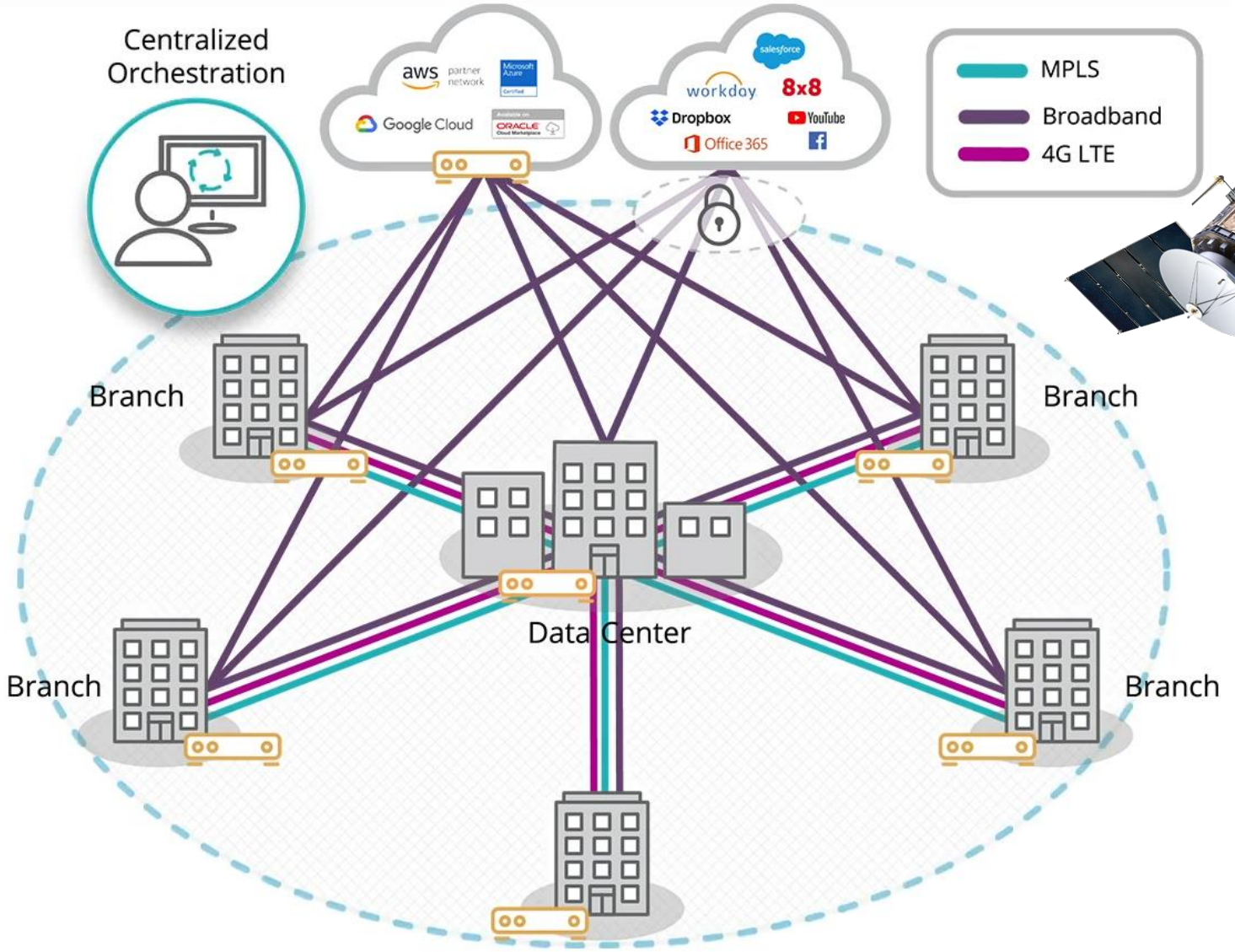


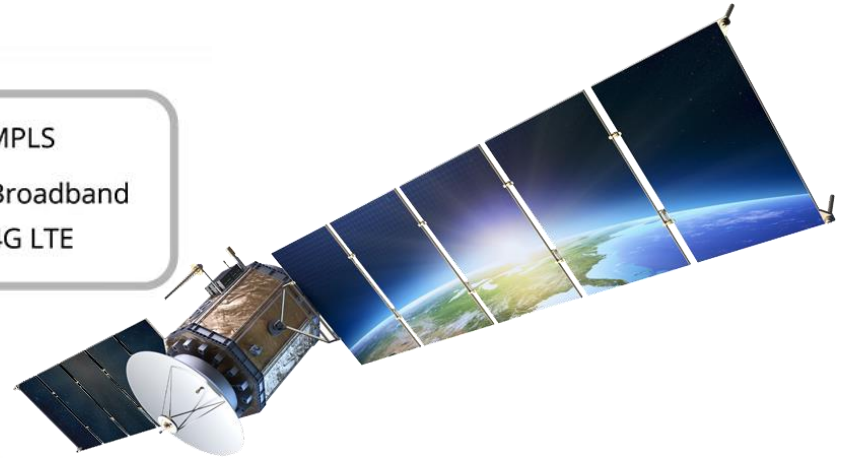
MPLS



https://www.silver-peak.com/sd-wan/sd-wan-explained

MPLS



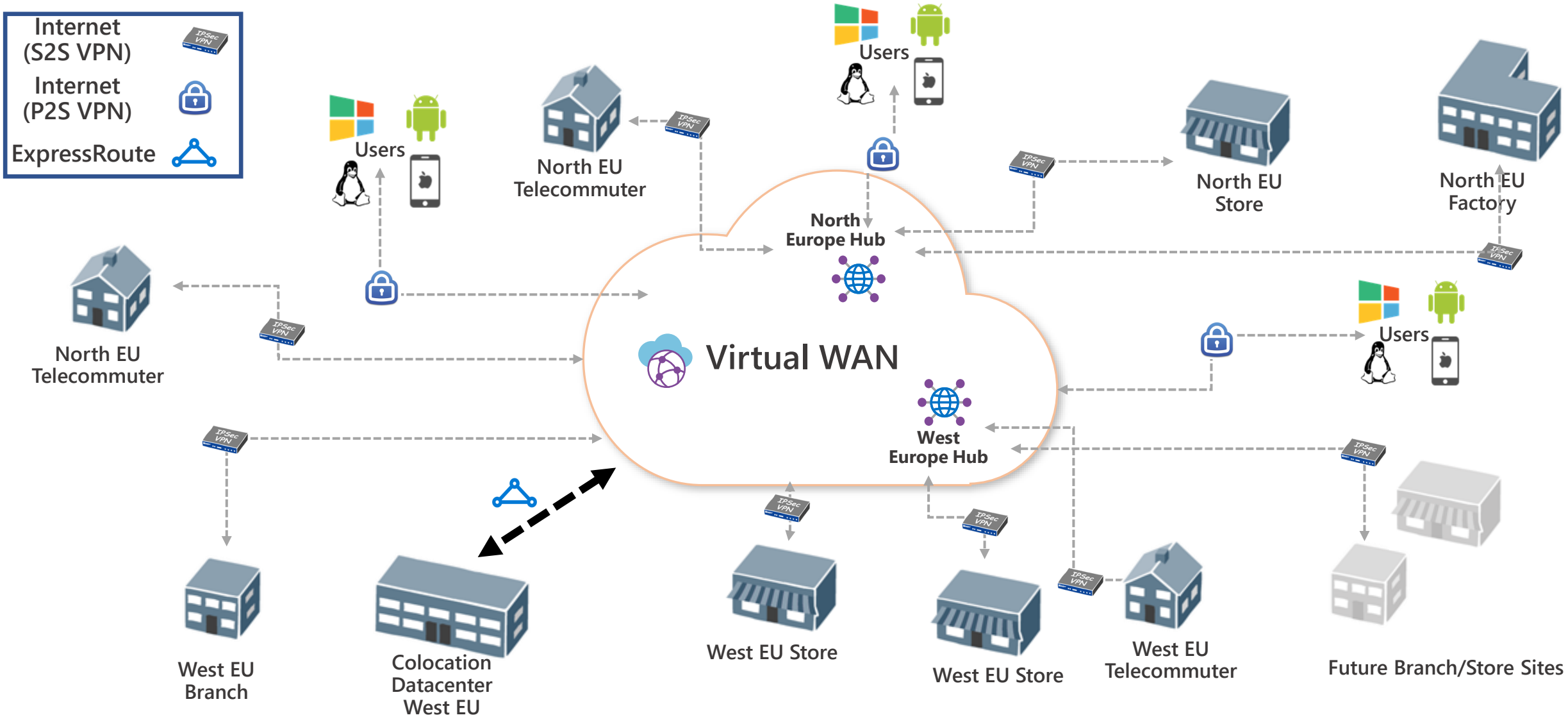


https://www.silver-peak.com/sd-wan/sd-wan-explained

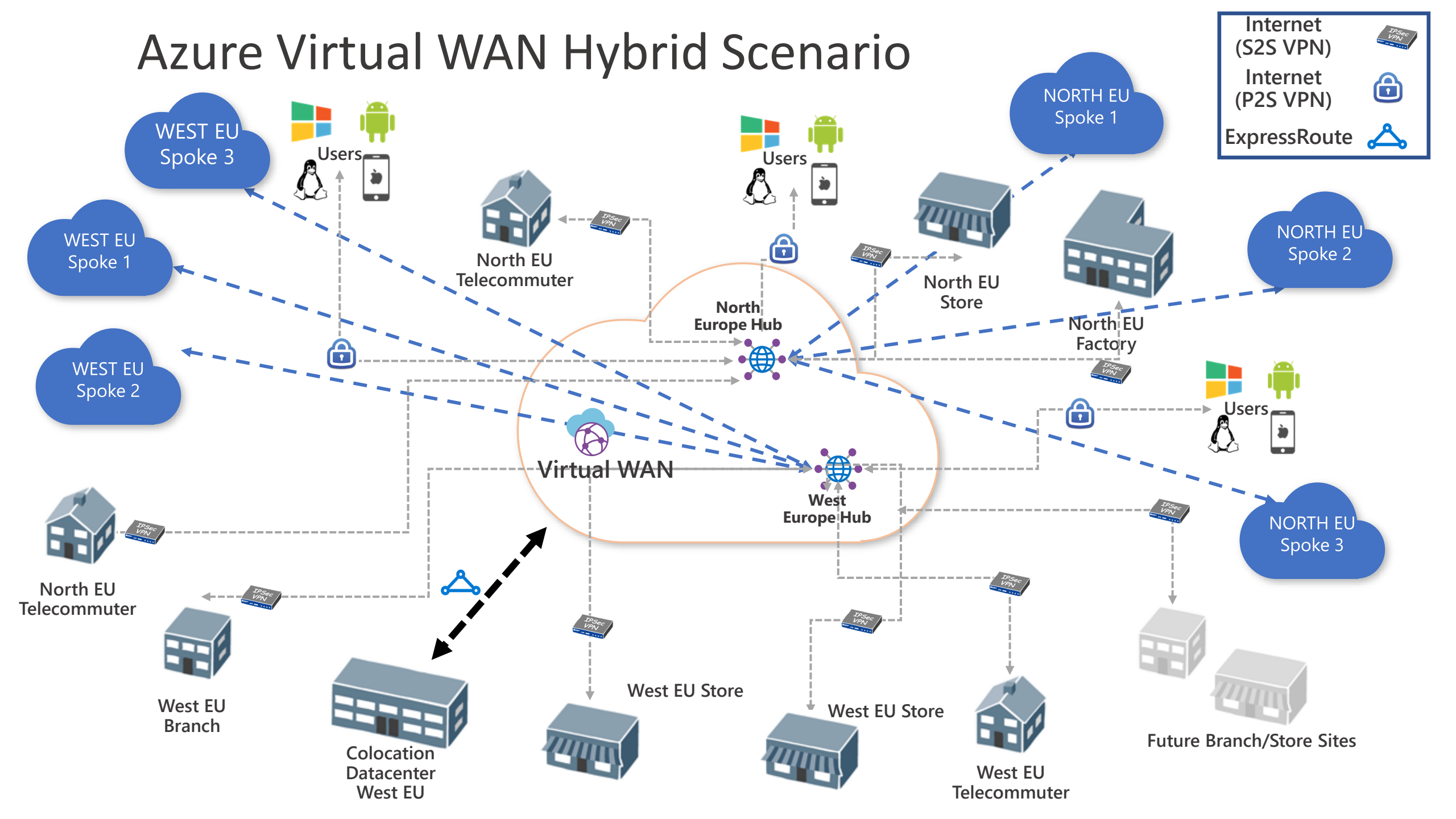
Benefits for SME

- Same as for multinationals …
- … with the exception of scale
- Definitely the way to go and future proof designs
- SME also require 2 regions to design for failure

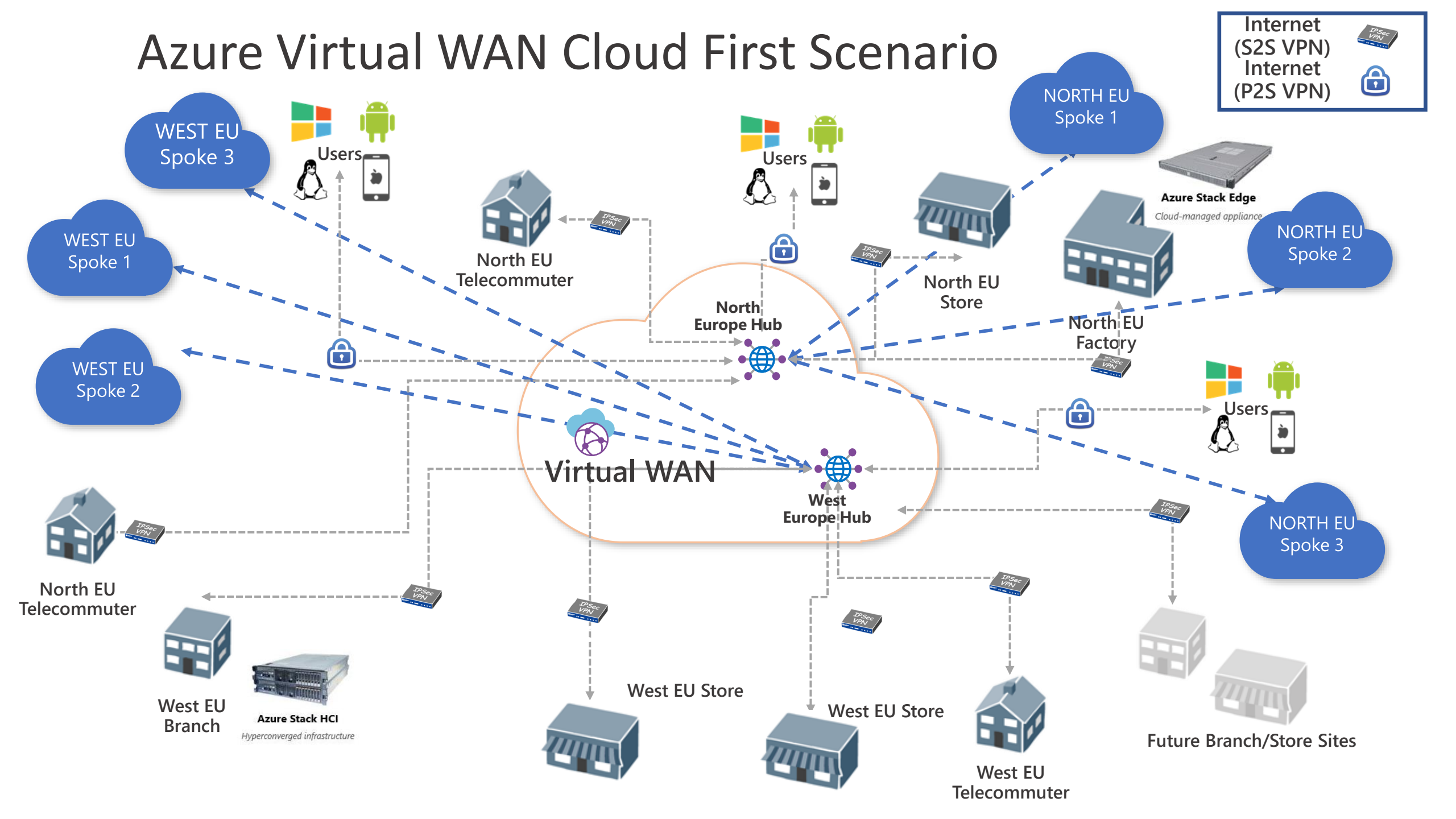
Azure Virtual WAN only used as SD-WAN carrier



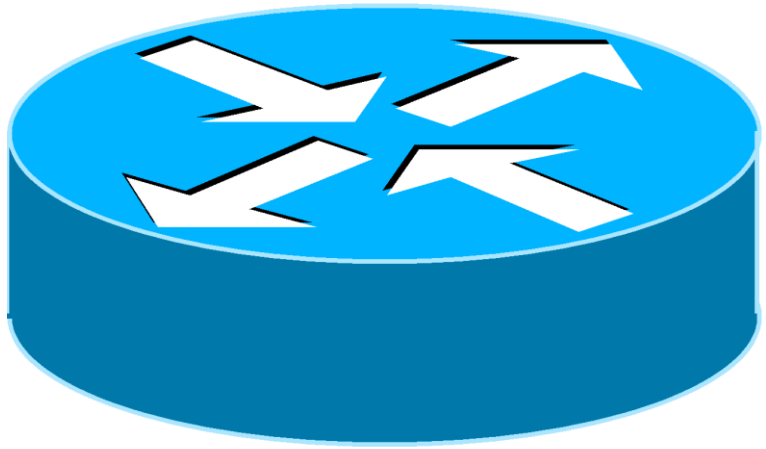
Azure Virtual WAN Hybrid Scenario



Azure Virtual WAN Cloud First Scenario

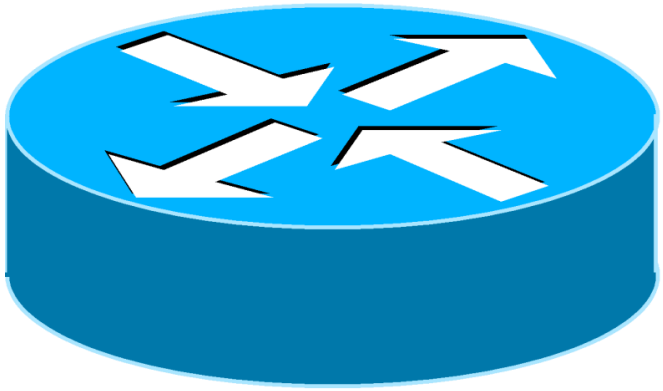


Azure Virtual WAN - Routing



- Every virtual hub has a router (hidden)
- A virtual HUB router has a capacity of 50Gbps
- It controls the connectivity between all gateways:
  - S-2-S
  - P-2-S
  - ExpressRoute
- Delivers VNet transitive peering (hub-spoke)
- Three types route table exist:
  - Default Route Table
  - None Route Table
  - Custom route Table(s) - Optional

Azure Virtual WAN - Custom Routing



Create Route Table

Basics Labels Associations Propagations

Labels Name

TEST

Review + create | Previous | Next : Associations >

Create Route Table

Current settings (Routing Configuration) of branches

Associated to: defaultRouteTable

Propagating to: defaultRouteTable

Virtual Networks

Associating a Virtual network connection to a route table allows the traffic to be sent from the Virtual network connection to the selected route table. A connection can only be associated to one route table

Choose virtual network(s): TEST-VNET-02

Current settings (Routing Configuration) of Virtual Network Connections

Name	Associated to	Propagating to
itopstest-virtualwanhub-vnet	defaultRouteTable	defaultRouteTable
TEST-VNET-02	defaultRouteTable	defaultRouteTable

Review + create | Previous | Next : Propagations >

Create Route Table

Basics Labels Associations Propagations

Creating propagation will allow routes to be propagated from a connection to the selected route table. A connection can be propagated to multiple route table.

Branches (Site VPN/ExpressRoute/User VPN)

All VPN sites, ExpressRoute circuits and User VPN connections on each hub propagate to same Route Tables

Propagate routes from connections to this route table? Yes No

Propagate routes from all branch connections to these labels across virtual WAN: default

Current settings (Routing Configuration) of branches

Associated to: defaultRouteTable

Create | Previous | Next

Custom Routing

- Virtual WAN received routing enhancements
  - Ability to set up **custom route tables for** VNETs
  - Optimize virtual network routing via route **association** & **propagation**
  - Logically group route tables with **labels**
  - Helps achieve numerous network routing scenarios (isolation, access to shared services, virtual network appliances)

https://docs.microsoft.com/en-us/azure/virtual-wan/about-virtual-hub-routing

Edit VNet Connection

Some of the functionality may not be accessible as it is currently being rolled out and expected to complete in the week of Aug 3rd.

Propagate Default Route ⓘ Enable **Disable**

Routing configuration

Select Route Tables for this connection

Associate Route Table

Propagate to Route Tables

0 selected

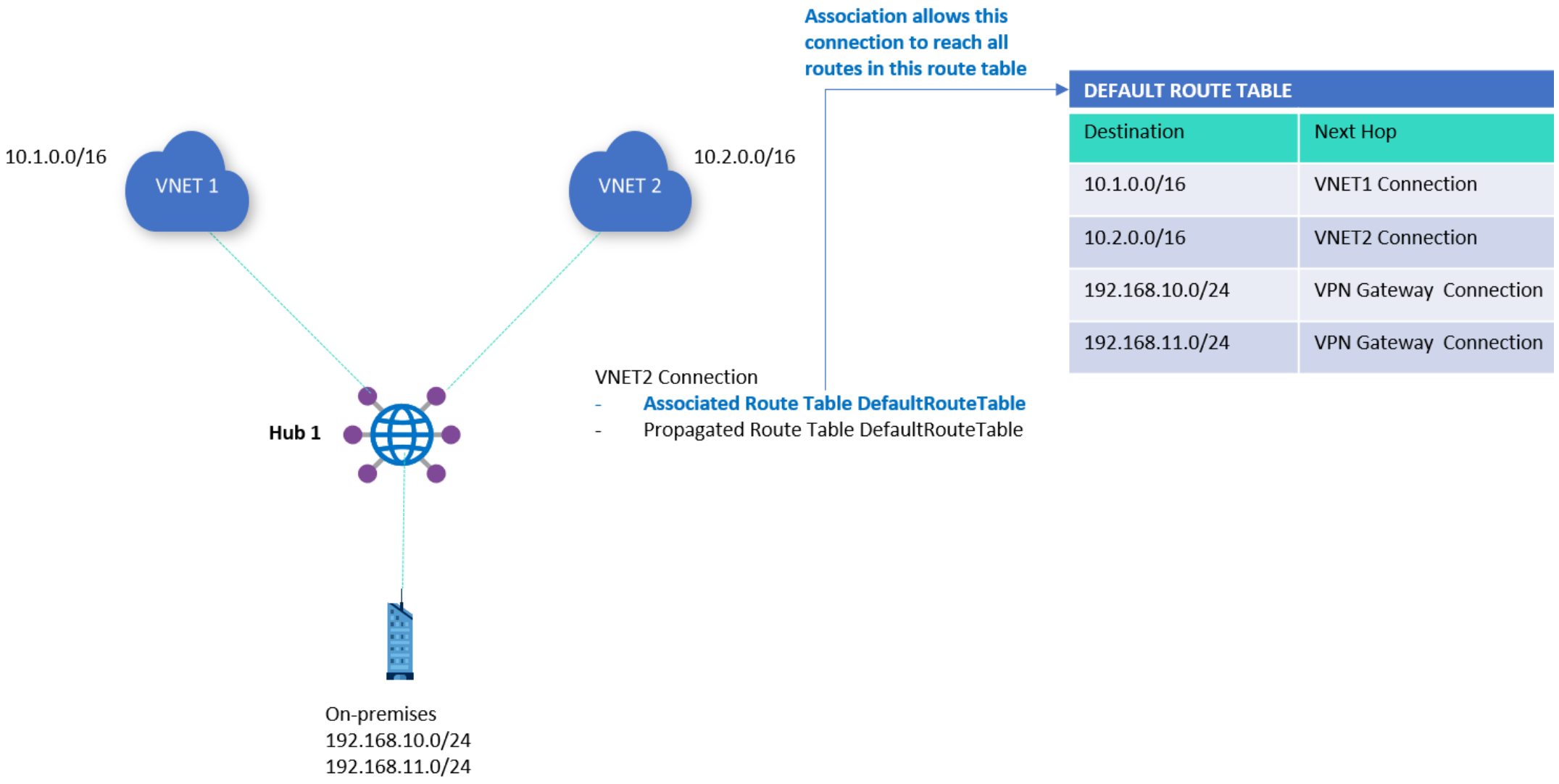
Propagate to labels ⓘ

0 selected

Static routes ⓘ

Route name	Destination prefix	Next hop

Association

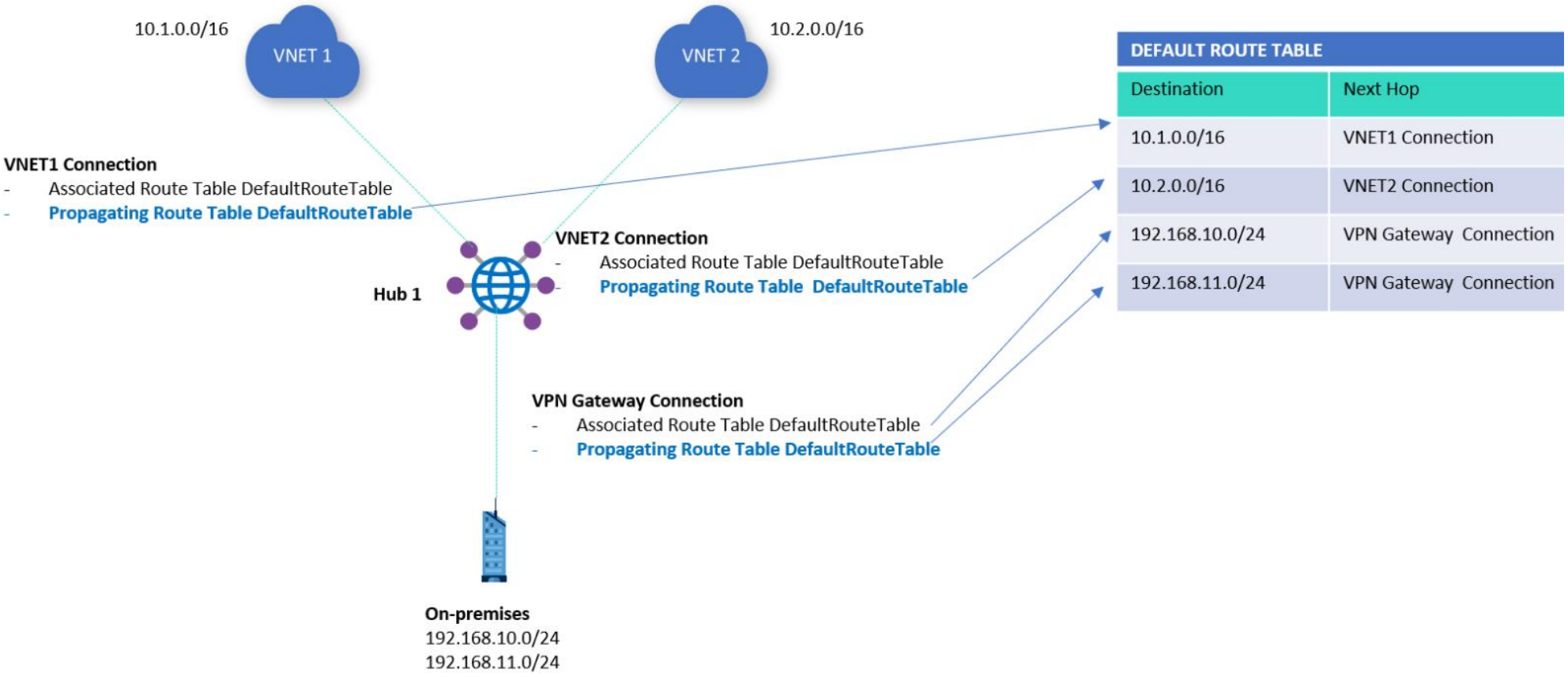


DEFAULT ROUTE TABLE	
Destination	Next Hop
10.1.0.0/16	VNET1 Connection
10.2.0.0/16	VNET2 Connection
192.168.10.0/24	VPN Gateway Connection
192.168.11.0/24	VPN Gateway Connection

Association

- Each connection is associated to one route table.
- The association allows the connection to reach all the routes in the route table (destination/next hop).
- Multiple connections can be associated to the same route table.
- All S2S and P2S VPNs as well as ExpressRoute connections are associated to the same (default) route table.
- By default, all connections are associated to a **default route table** in a virtual hub.
- Each virtual hub has its own default route table, to which you can add a static route(s). Static routes take precedence over dynamically learned routes for the same prefixes.

Propagation



DEFAULT ROUTE TABLE	
Destination	Next Hop
10.1.0.0/16	VNET1 Connection
10.2.0.0/16	VNET2 Connection
192.168.10.0/24	VPN Gateway Connection
192.168.11.0/24	VPN Gateway Connection

Propagation

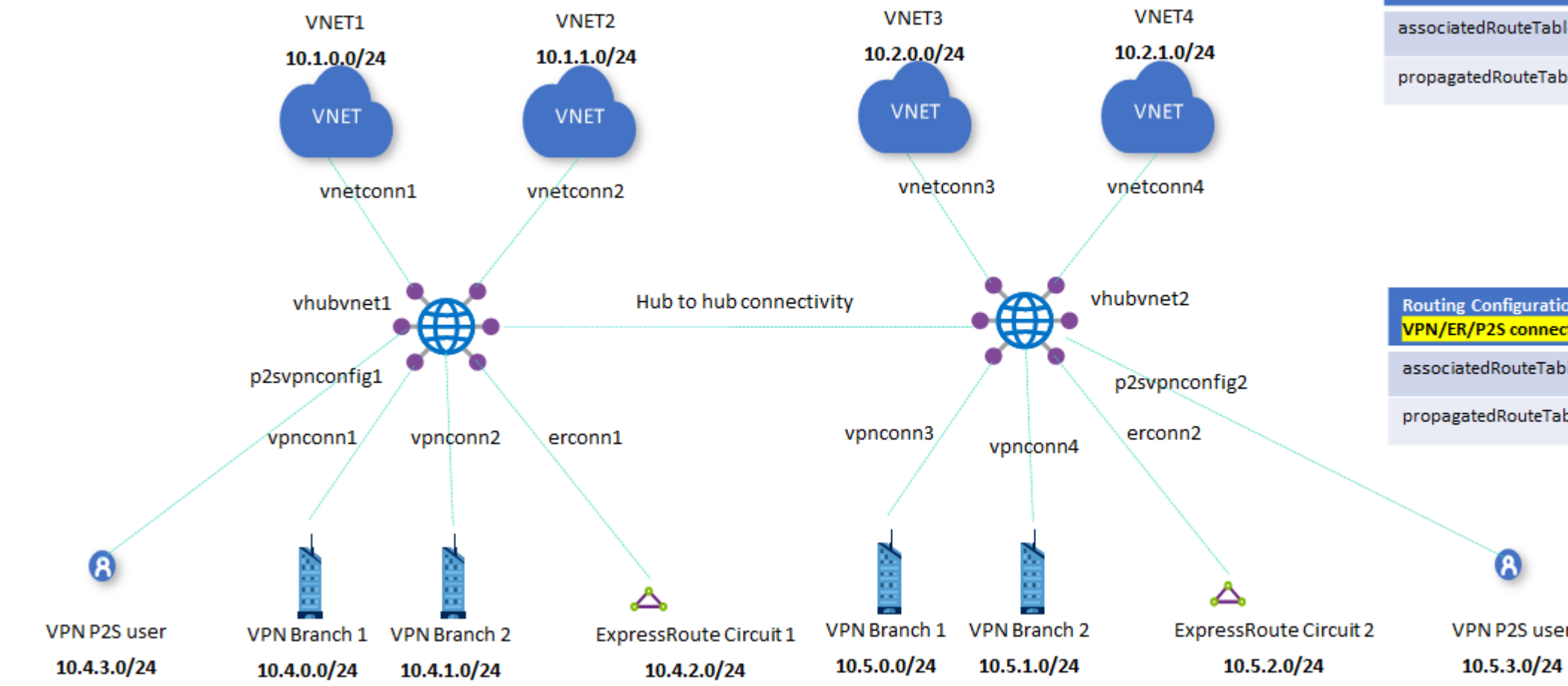
- Connections dynamically propagate routes to a route table.
- Routes can be propagated to one or multiple route tables.
- A **None route table** is also available for each virtual hub. Propagating to the None route table implies that no routes are required to be propagated from the connection.
- S2S and P2S VPNs as well as ExpressRoute connections propagate routes to the same set of route tables. This happens via the “Default” label, which means the Default Route Table in every Virtual WAN HUB.

LABELS

- Labels are a logical grouping of route tables
- Helps propagate routes from connections to multiple route tables.
  - The Default Route Table has a built in label called 'Default' . When users propagate connection routes to 'Default' label, it automatically applies to all the Default Route Tables across every hub in the Virtual WAN.
- Define your own labels

Custom Routes – Example 1

- Any-2-Any
- This is the default situation



Routing Configuration of VNET connections	
associatedRouteTable	default
propagatedRouteTable	default

Routing Configuration of VPN/ER/P2S connections	
associatedRouteTable	default
propagatedRouteTable	default

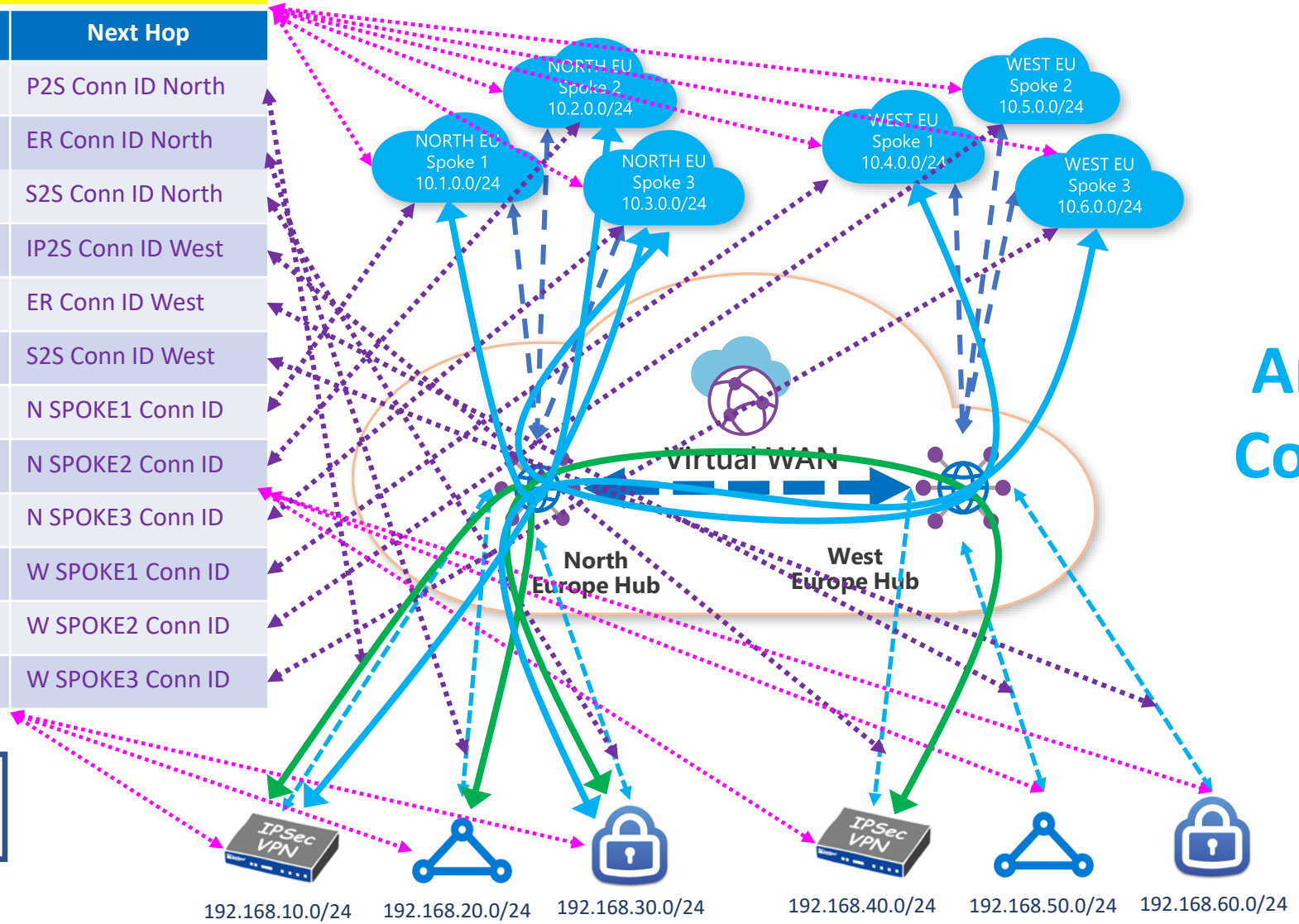
Walk Trough Exercise:

Branches ⟷ Branches
Branches ⟷ VNET
VNET ⟷ VNET

Internet (S2S VPN)
Internet (P2S VPN)
ExpressRoute

Default Route Table

Route	Next Hop
192.168.10.0/24	P2S Conn ID North
192.168.20.0/24	ER Conn ID North
192.168.30.0/24	S2S Conn ID North
192.168.40.0/24	IP2S Conn ID West
192.168.50.0/24	ER Conn ID West
192.168.60.0/24	S2S Conn ID West
10.1.0.0/24	N SPOKE1 Conn ID
10.2.0.0/24	N SPOKE2 Conn ID
10.3.0.0/24	N SPOKE3 Conn ID
10.4.0.0/24	W SPOKE1 Conn ID
10.5.0.0/24	W SPOKE2 Conn ID
10.6.0.0/24	W SPOKE3 Conn ID



Association
Propagation

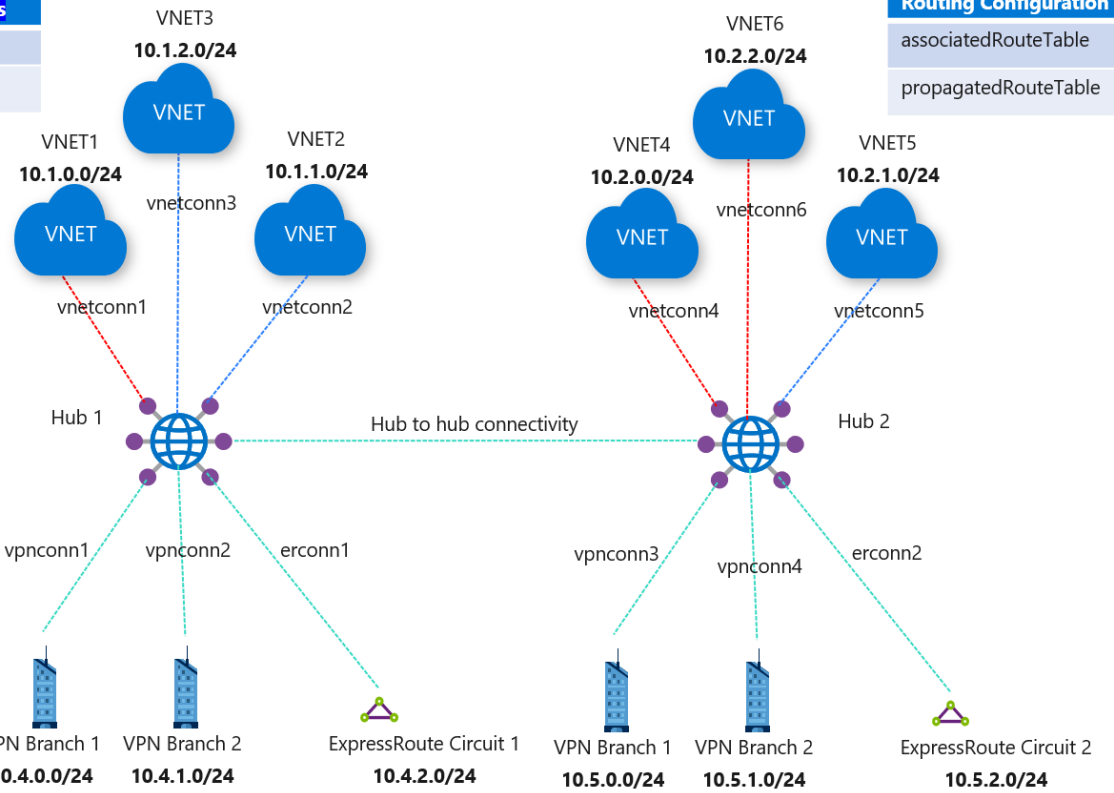
Any-to-Any Connectivity

Custom Routes – Example 3

- **Isolate Red VNETs from Blue VNETs but let red reach red & blue reach blue**
- **Allow all VNETs and Branches to reach each other**

Routing Configuration of BLUE VNET connections	
associatedRouteTable	RT_BLUE
propagatedRouteTable	default, RT_BLUE

Routing Configuration of RED VNET connections	
associatedRouteTable	RT_RED
propagatedRouteTable	default, RT_RED



Routing Configuration of VPN/ER/P2S connections	
associatedRouteTable	Default
propagatedRouteTable	Default, RT_BLUE, RT_RED

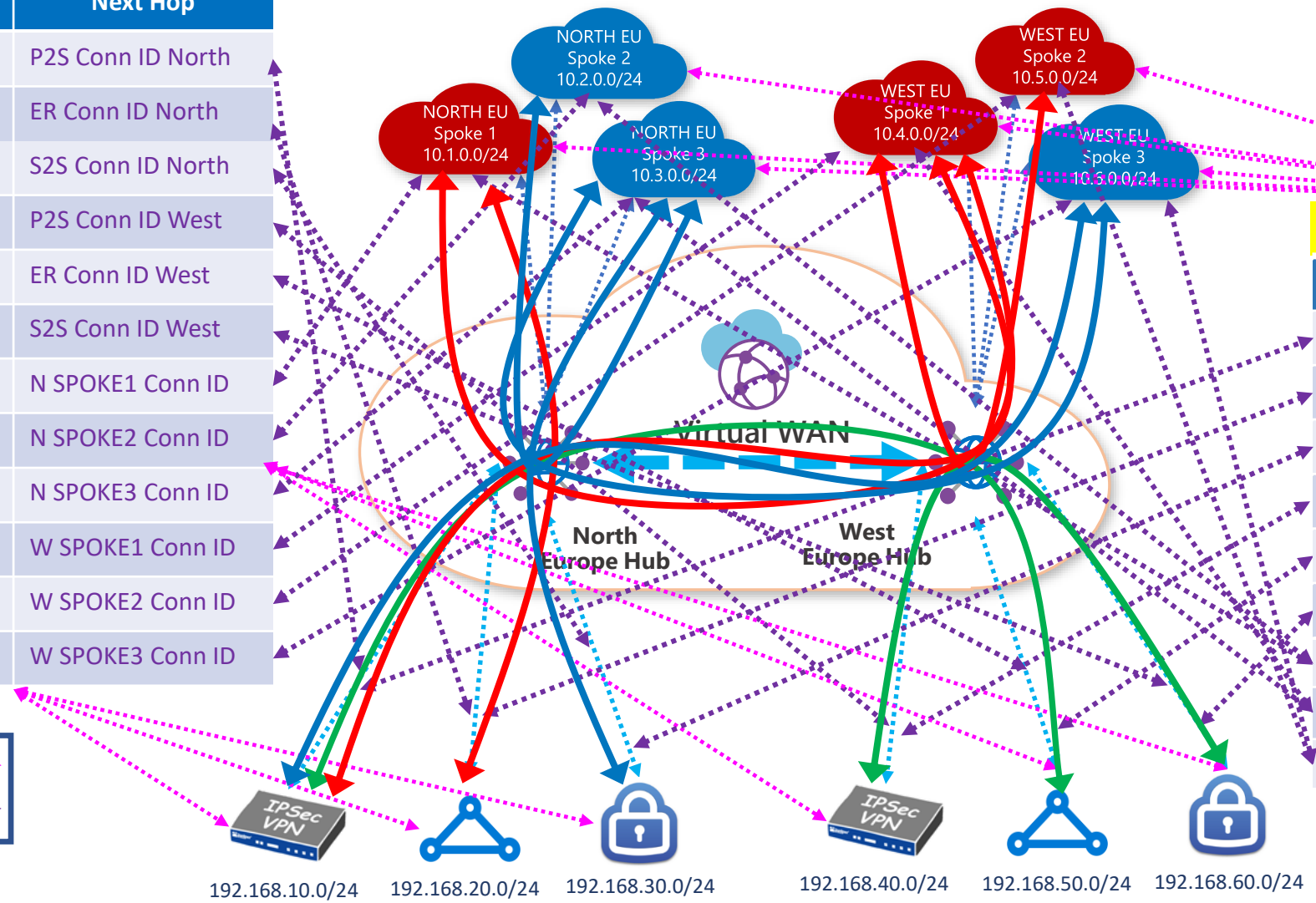
Walk Trough Exercise:

Branches ⟷ Branches
Branches ⟷ VNET
Red VNET ⟷ Red VNET
Blue VNET ⟷ Blue VNET

Internet (S2S VPN)
Internet (P2S VPN)
ExpressRoute

Default Route Table

Route	Next Hop
192.168.10.0/24	P2S Conn ID North
192.168.20.0/24	ER Conn ID North
192.168.30.0/24	S2S Conn ID North
192.168.40.0/24	P2S Conn ID West
192.168.50.0/24	ER Conn ID West
192.168.60.0/24	S2S Conn ID West
10.1.0.0/24	N SPOKE1 Conn ID
10.2.0.0/24	N SPOKE2 Conn ID
10.3.0.0/24	N SPOKE3 Conn ID
10.4.0.0/24	W SPOKE1 Conn ID
10.5.0.0/24	W SPOKE2 Conn ID
10.6.0.0/24	W SPOKE3 Conn ID



Custom BLUE_RT_VNET

Route	Next Hop
192.168.10.0/24	P2S Conn ID North
192.168.20.0/24	ER Conn ID North
192.168.30.0/24	S2S Conn ID North
192.168.40.0/24	S2S Conn ID West
192.168.50.0/24	ER Conn ID West
192.168.60.0/24	P2S Conn ID WEST
10.2.0.0/24	N SPOKE2 Conn ID
10.3.0.0/24	N SPOKE3 Conn ID
10.6.0.0/24	W SPOKE3 Conn ID

Association ⟷
Propagation ⟷

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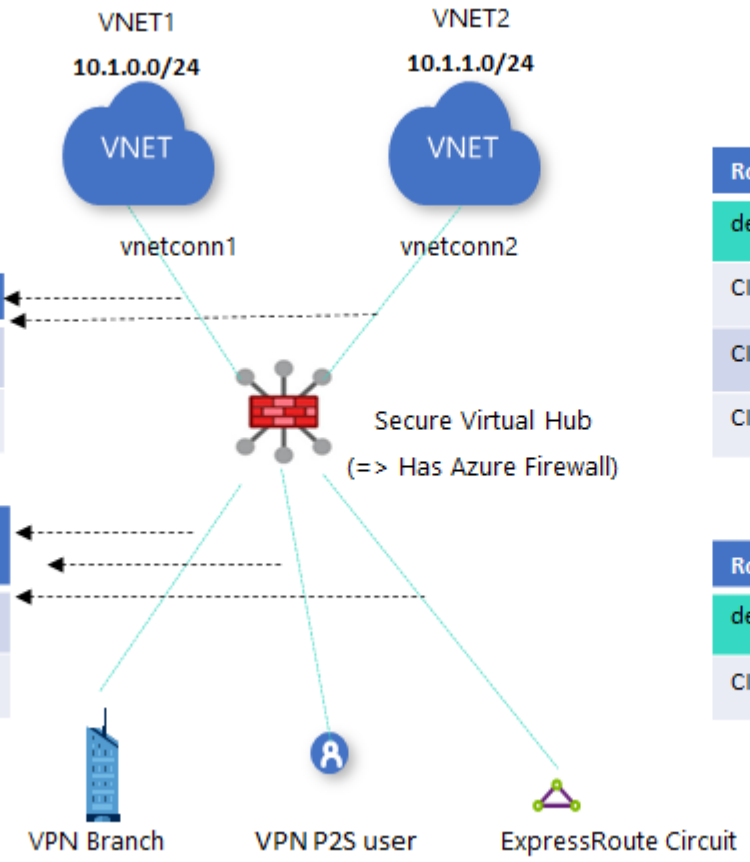
Azure Firewall & Custom Routes

- **VNET-2-VNET Direct / Branch-2-Branch Direct**
- **VNET-2-Branch/Internet via Azure Firewall**



Routing Configuration of VNET connections	
associatedRouteTable	RT_VNET
propagatedRouteTable	RT_VNET

Routing Configuration of VPN/ER/P2S connections	
associatedRouteTable	default
propagatedRouteTable	default

Route Table RT_VNET

destType	destination	nextHop
CIDR	10.1.0.0/24	vnetconn1 resourceid
CIDR	10.1.1.0/24	vnetconn2 resourceid
CIDR	0.0.0.0/0	AZFW resourceid

Propagated routes from VNET connections being more specific for VNETs activates V2V bypassing AZFW

Static route added activates V2I, V2B via AZFW

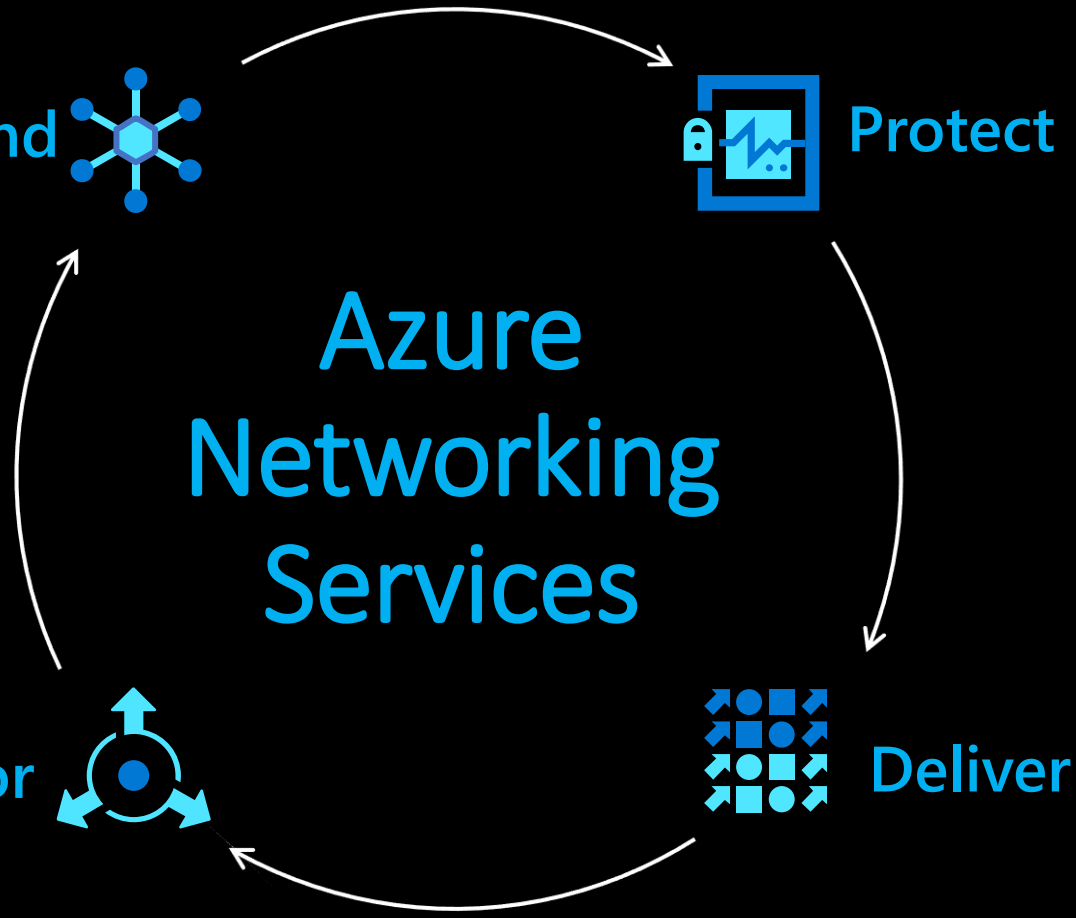
Route Table Default Route Table

destType	destination	nextHop
CIDR	10.1.0.0/16	AZFW resourceid

Static route with aggregated routes for VNETS activates B2V via AZFW

Secure Virtual Hub

Azure Networking Services



- Azure Peering Services
- Virtual WAN
- ExpressRoute
- VPN Gateway
- S2S VPN
- P2S VPN
- MEC

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- Network Watcher Traffic Analytics
- Azure Monitor Insights for Virtual WAN
- Azure Virtual WAN Log & Metrics

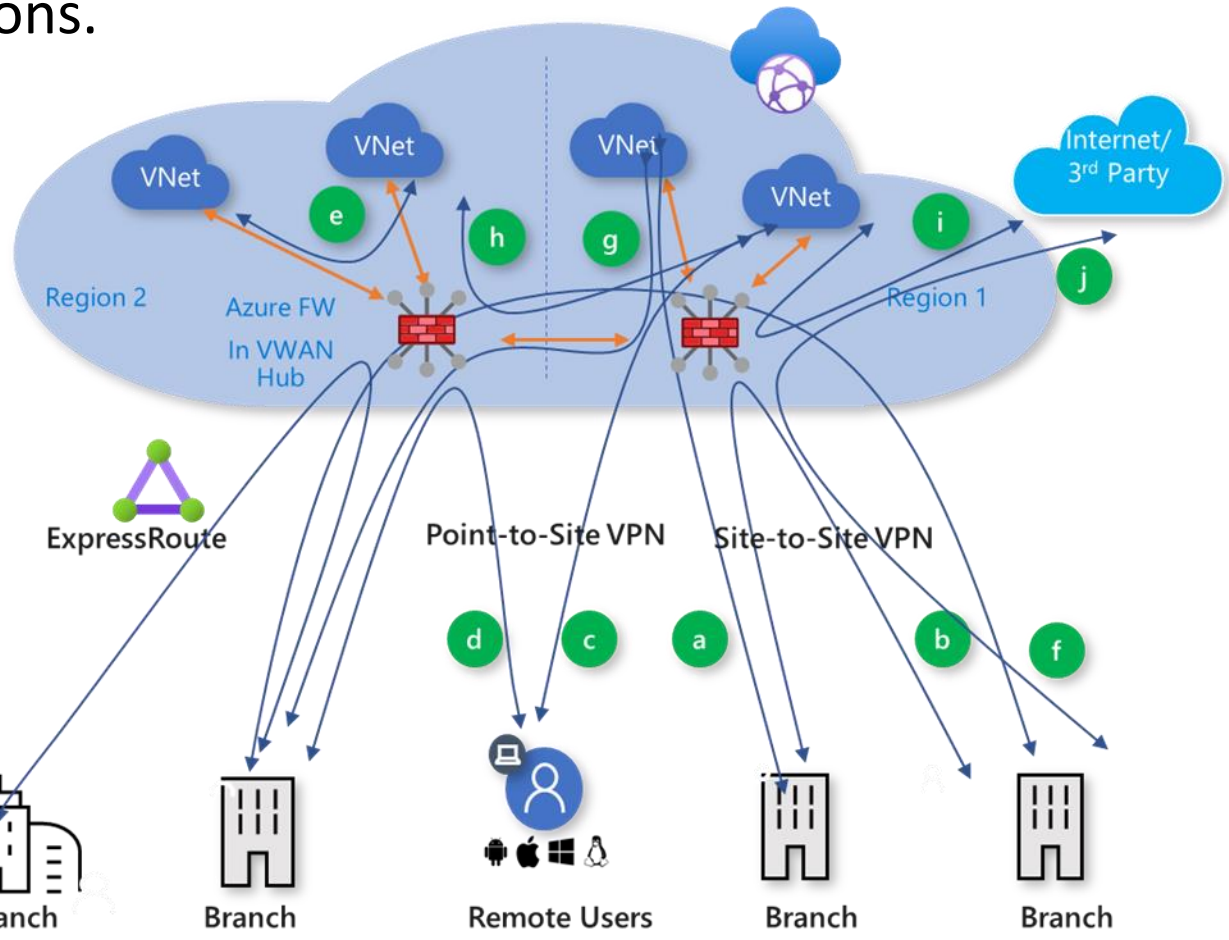
Any-to-Any … meet the CISO!

- A transitive global Azure virtual WAN leads to security concerns
- You have a firewall at the branch offices, data centers, 3rd party clouds and even at the clients with P2S connections
- You might want (need) a firewall and manage routing at the Azure Virtual WAN Hub

Azure Firewall Manager

Central Azure Firewall deployment, configuration & management

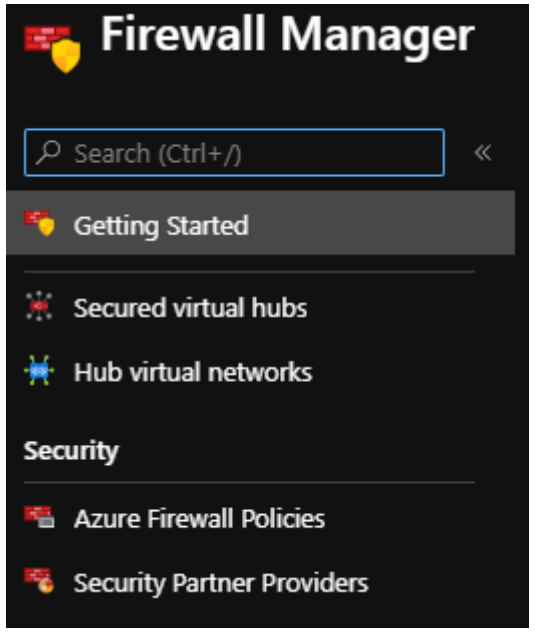
- You can centrally deploy and configure multiple Azure Firewall instances that span different Azure regions and subscriptions.
- Policy driven

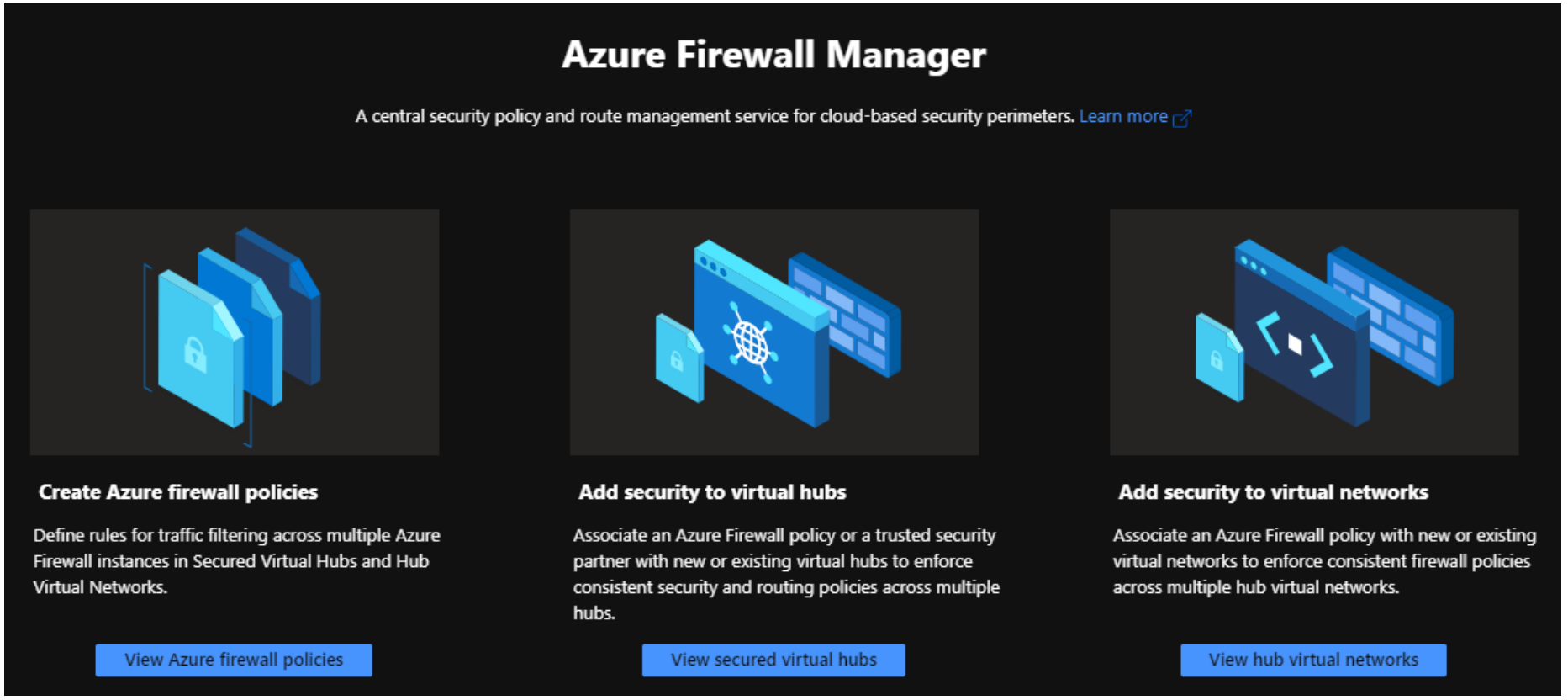


What is a Secured Virtual Hub?

- A virtual hub is a Microsoft-managed virtual network that enables connectivity from other resources. When a virtual hub is created from a Virtual WAN in the Azure portal, a virtual hub VNet and gateways (optional) are created as its components.
- An Azure Virtual Hub becomes a *secured virtual hub* when security and routing policies are associated with it via an Azure Virtual Firewall Manager
- Use secured virtual hubs to easily create hub-and-spoke and transitive architectures **with native security services** for traffic governance and protection.

Azure Firewall Manager

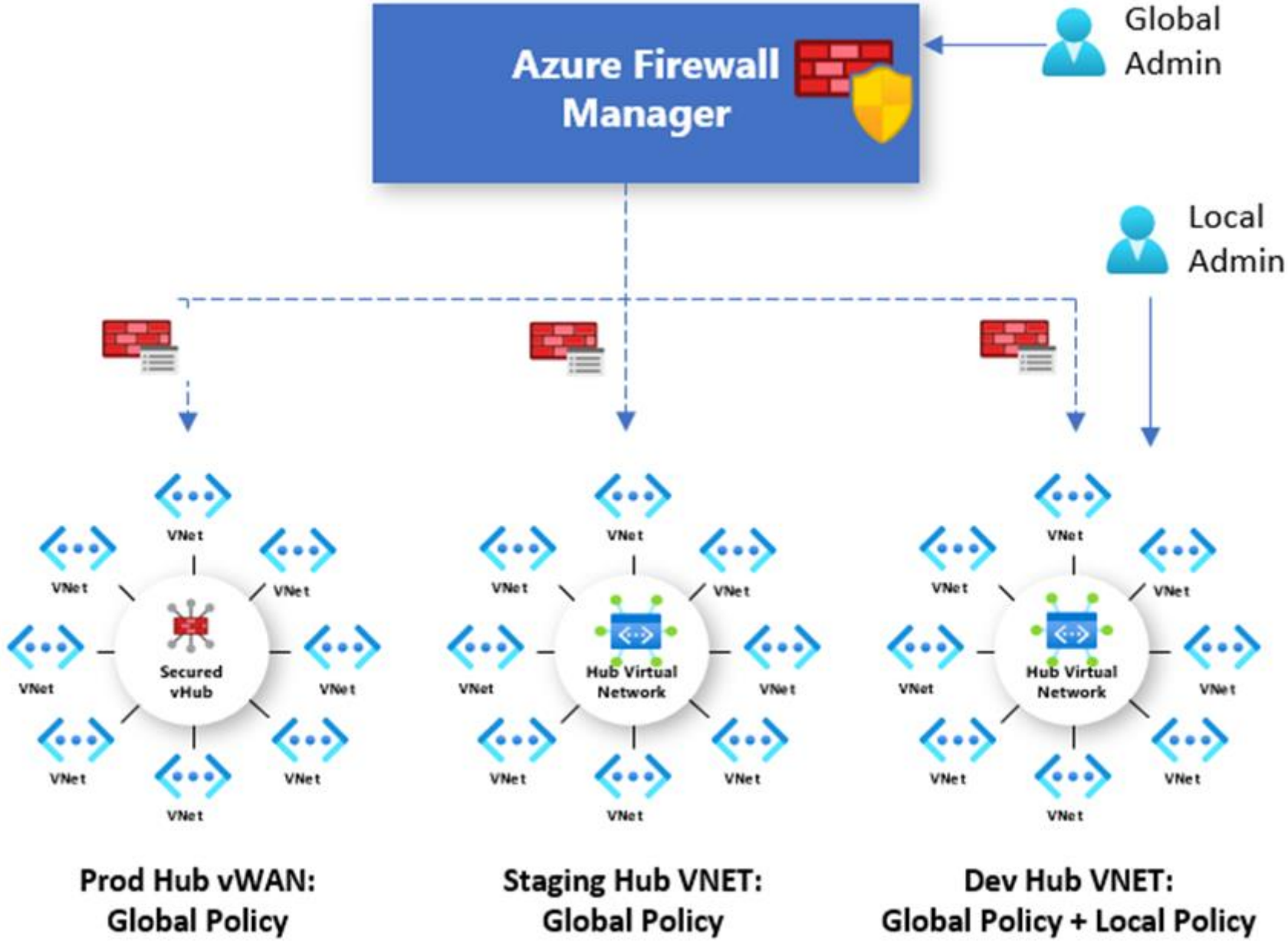




Options for using a Secured Virtual Hub

- **As a managed central VNet with no on-prem connectivity**
- Replaces the central VNet previously required for an Azure Firewall deployment.
- Provides automated routing, without configuring your own UDRs (user defined routes) to route traffic through your firewall.

- **As part of a full Virtual WAN architecture**
- This provides secured, optimized, and automated branch connectivity to and through Azure.
- You can choose the services used protect and govern your network traffic, including Azure Firewall and other third-party security as a service (SECaaS) providers.


Azure Firewall Manager
Global Admin
Local Admin
VNet
Secured vHub
Hub Virtual Network
Hub Virtual Network
Prod Hub vWAN: Global Policy
Staging Hub VNET: Global Policy
Dev Hub VNET: Global Policy + Local Policy

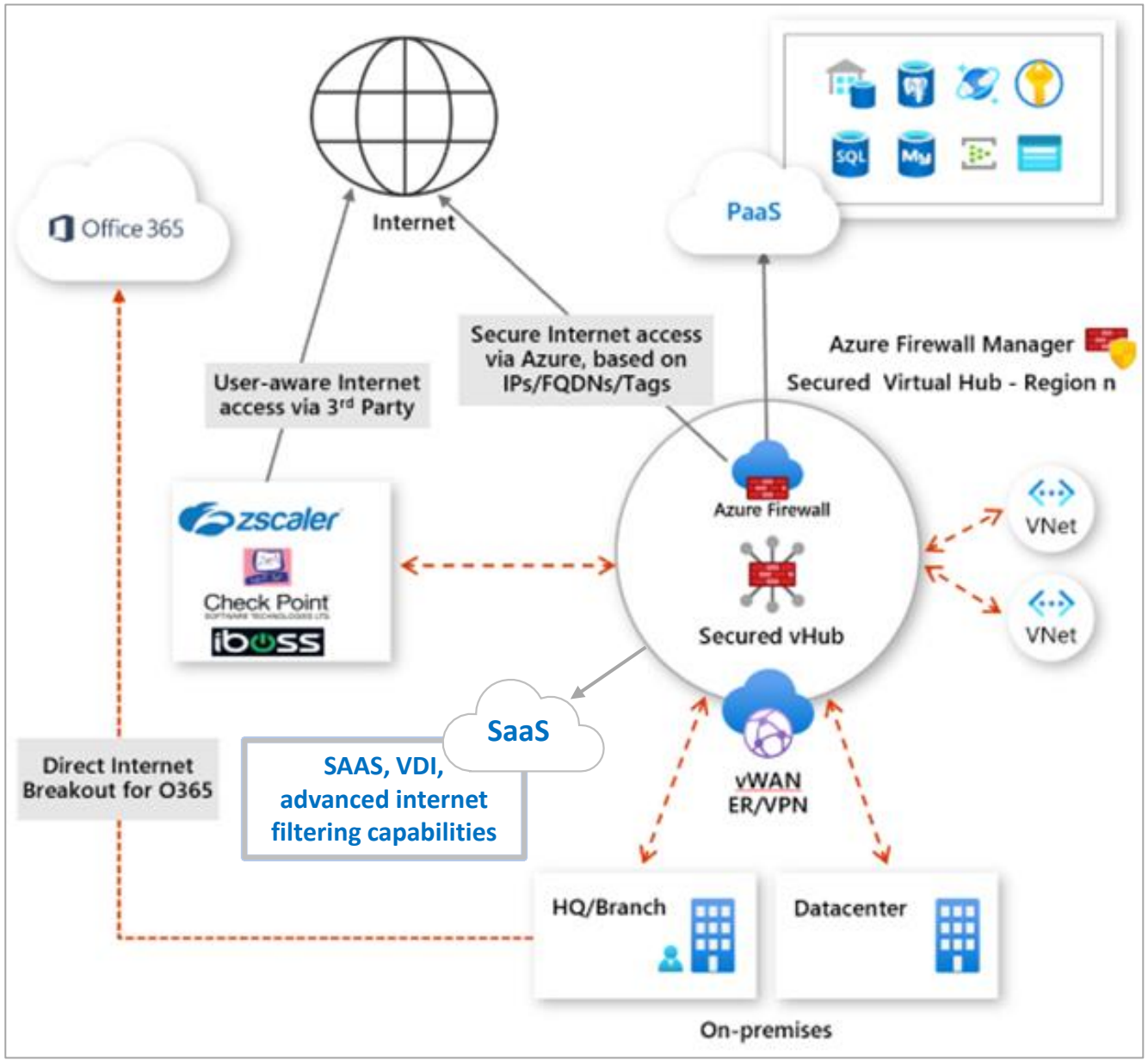
Azure Hierarchical Firewall Policies

- Policies are hierarchical (global and local)
  - You can use Azure Firewall Manager to centrally manage Azure Firewall policies across multiple secured virtual hubs and hub virtual networks.
  - Your central IT teams can author global firewall policies to enforce organization wide firewall policy across teams.
  - Locally authored firewall policies allow a DevOps self-service model for better agility.

Azure Firewall Policy Hierarchies

- **Creating new policies**
  - A policy is created from scratch or inherited from existing policies
  - With inheritance, any changes to the parent policy are automatically applied down to associated firewall child policies.
  - A policy can also be imported from an existing Azure Firewall (*NAT inheritance)

Secured Virtual Hub Internet traffic filtering



Integrate with 3rd party SECaaS

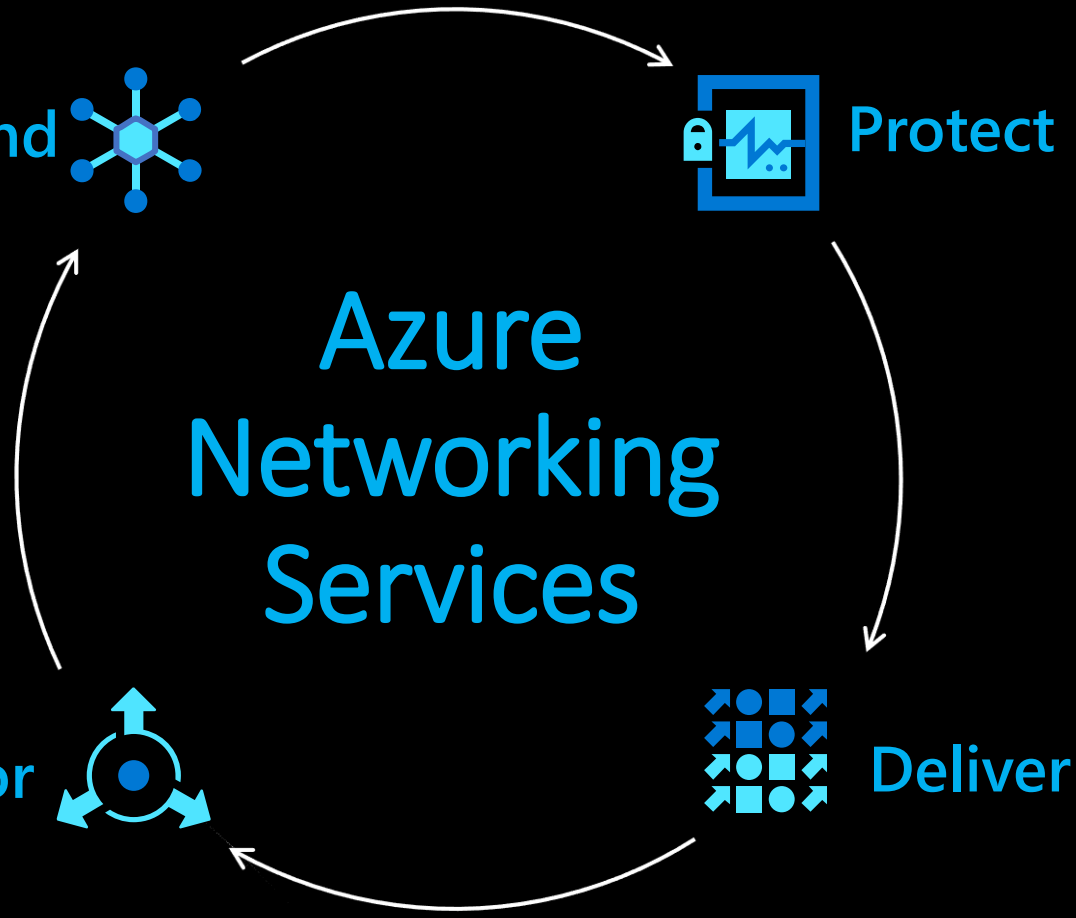
- Integrate 3rd party security-as-a-service (SECaaS) providers to deliver additional network protection for VNet and branch Internet connections.
- Only available for secured virtual hubs!

Examples:

- VNet to Internet (V2I) traffic filtering
  - Filter outbound virtual network traffic with your preferred third-party security provider.
  - Leverage advanced user-aware Internet protection for your cloud workloads running on Azure.
- Branch to Internet (B2I) traffic filtering
  - Leverage your Azure connectivity and global distribution to easily add third-party filtering for branch to Internet scenarios.

Azure Virtual WAN Monitoring

Azure Networking Services



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- P2S VPN
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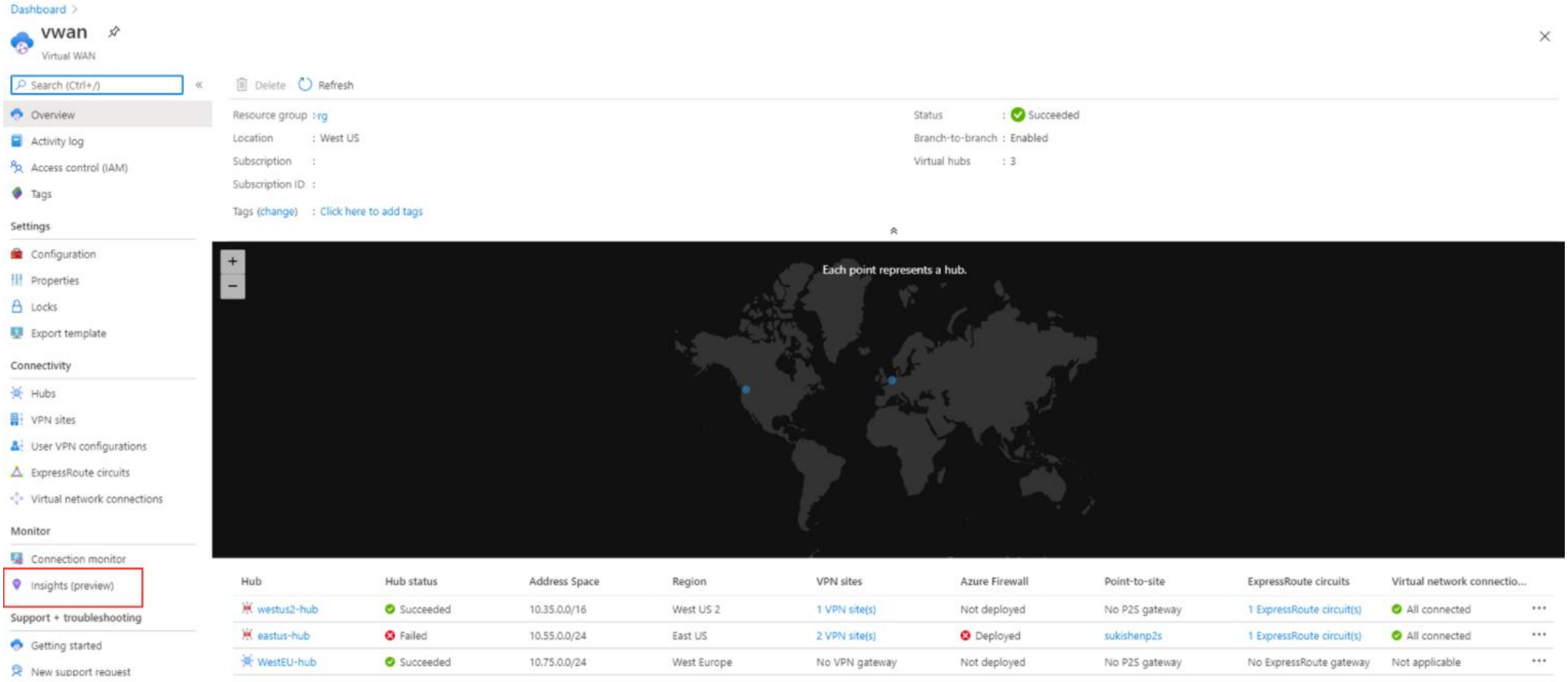
Monitor – Insights (preview)



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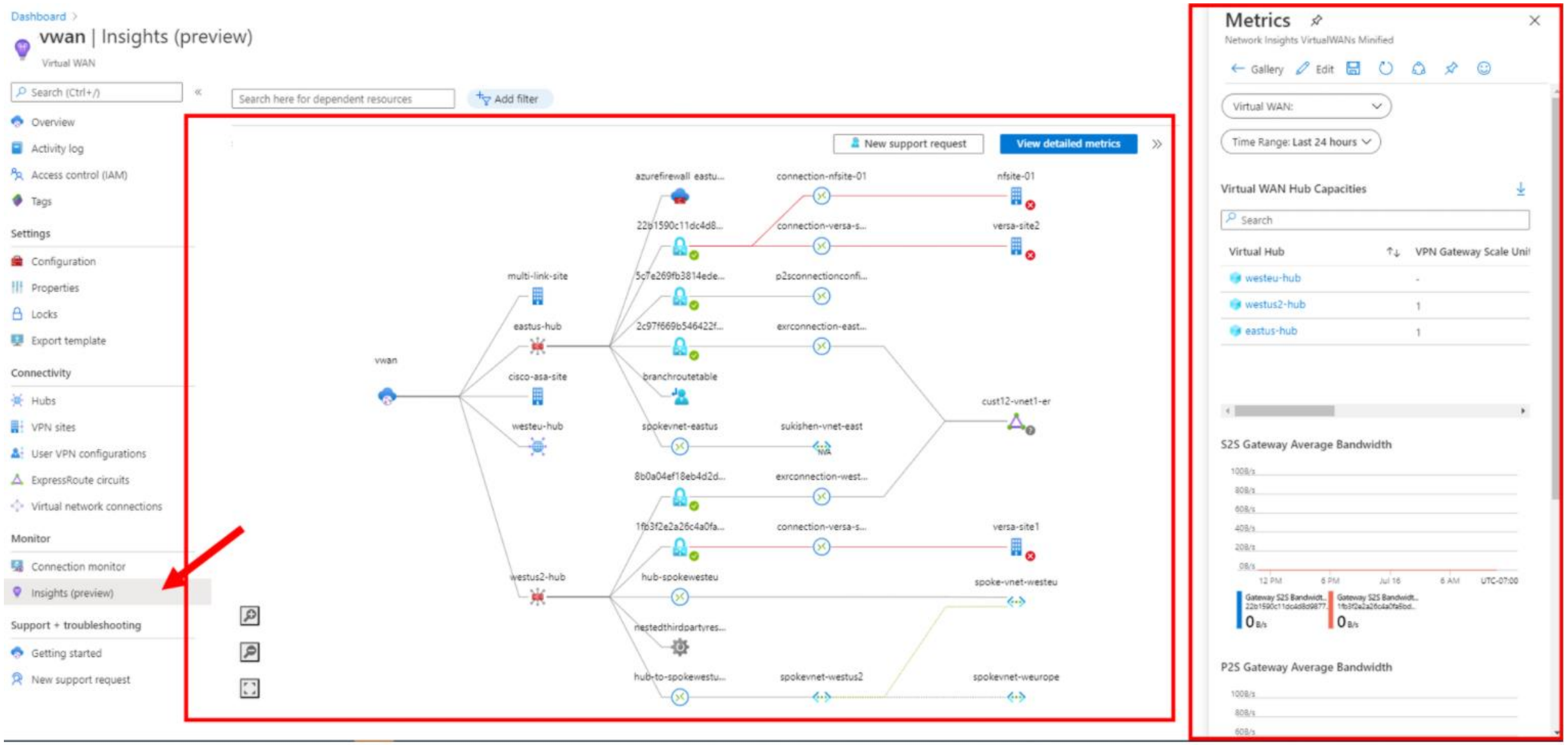
Monitor – Insights (preview)



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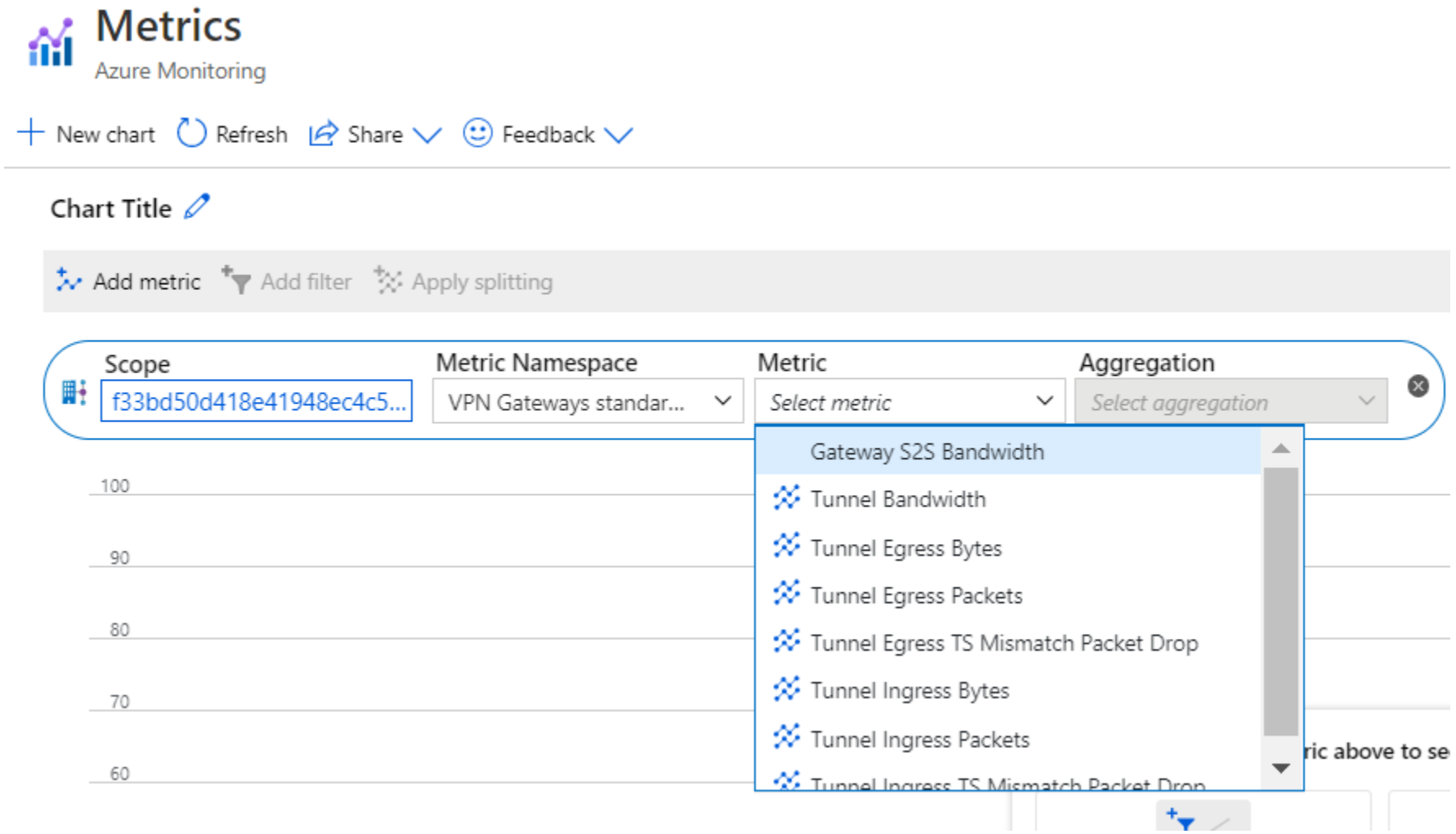
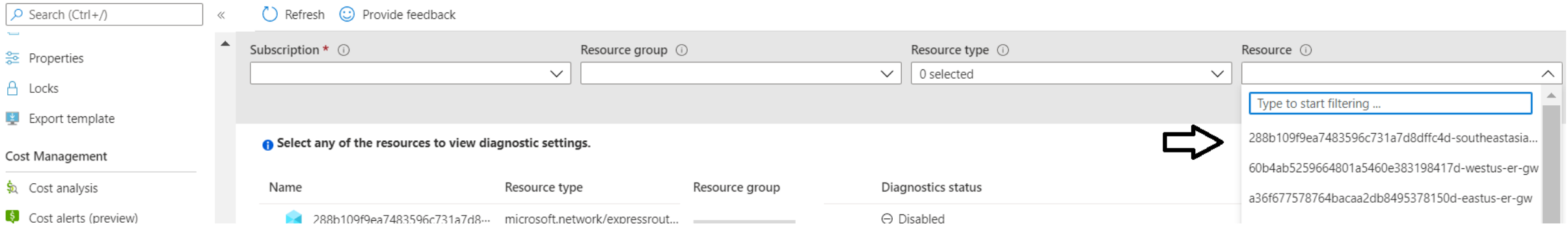
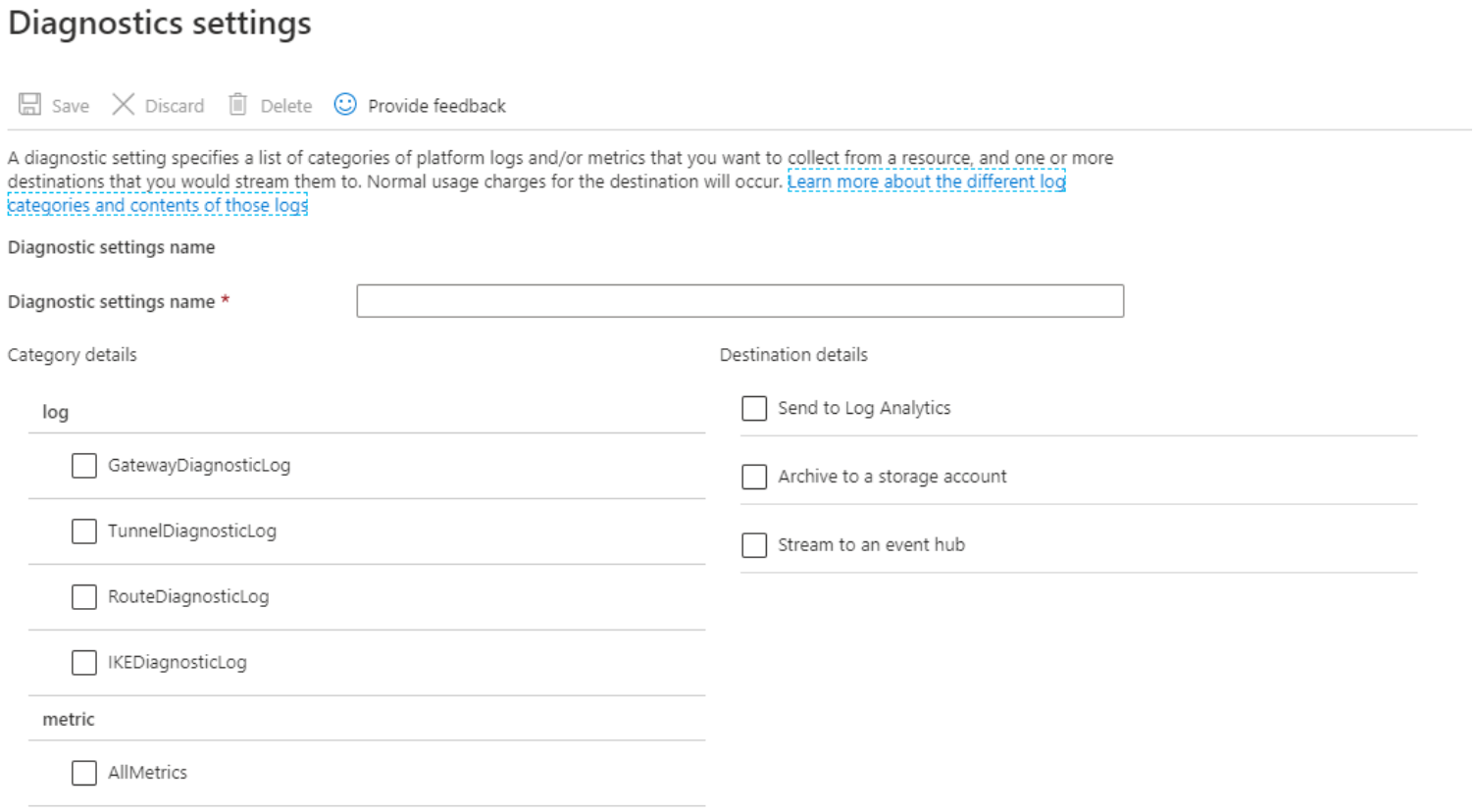
Metrics

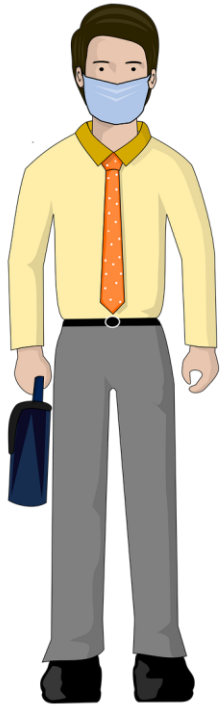

Metrics
Azure Monitoring
New chart
Refresh
Share
Feedback
Chart Title
Add metric
Add filter
Apply splitting
Scope
f33bd50d418e41948ec4c5...
Metric Namespace
VPN Gateways standar...
Metric
Select metric
Aggregation
Select aggregation
Gateway S2S Bandwidth
Tunnel Bandwidth
Tunnel Egress Bytes
Tunnel Egress Packets
Tunnel Egress TS Mismatch Packet Drop
Tunnel Ingress Bytes
Tunnel Ingress Packets
100
90
80
70
60

Diagnostic logs



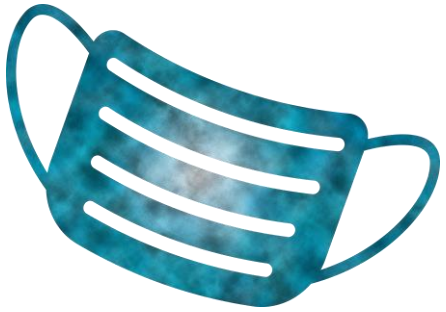


Thank you for attending



Work from home!

Stay safe!



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MC2MC

Azure Virtual WAN for everyone

Didier Van Hoye - @WorkingHardInIT

Technical Architect & Technology Strategist

Microsoft MVP Most Valuable Professional

VEEAM VANGUARD

Dell TechCenter ROCKSTAR

meet Microsoft Extended Experts Team

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