Microsoft

Azure Networking Overview

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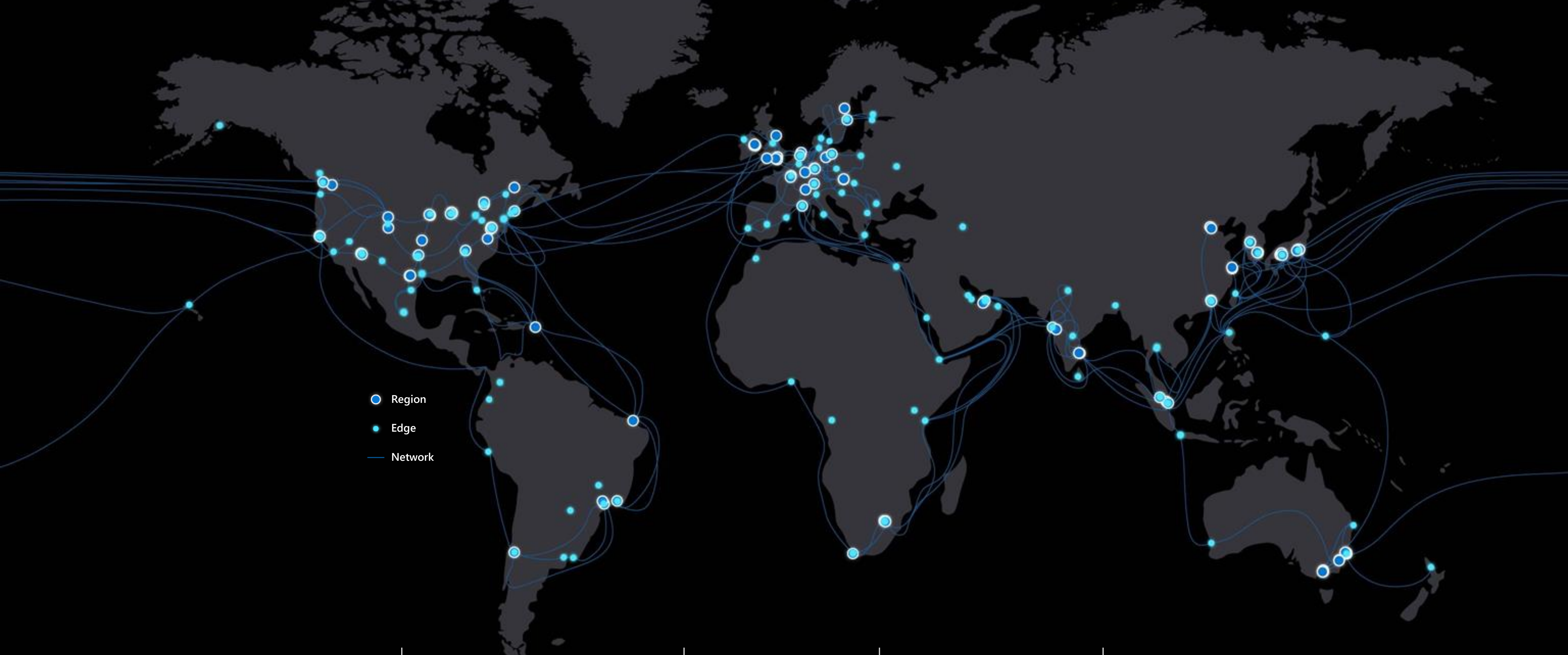
Microsoft global network



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

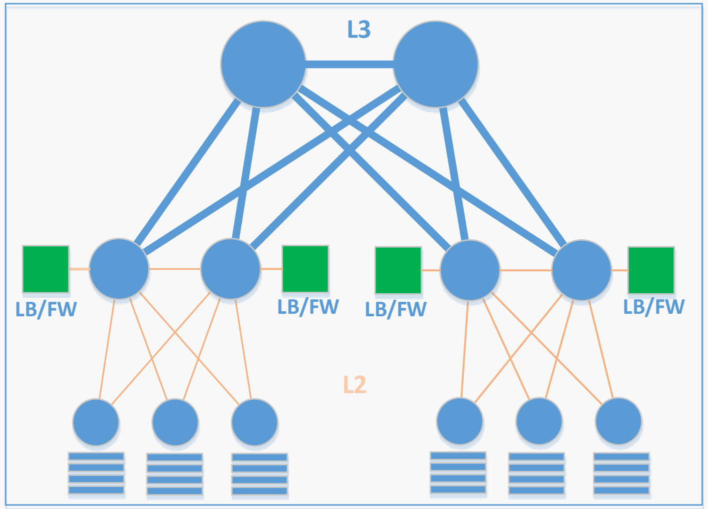
"IP traffic stays entirely within our global network and never enters the public Internet"

Classic network vs. Hyper-scale network architecture

Large L2 Domains

HW-based service modules

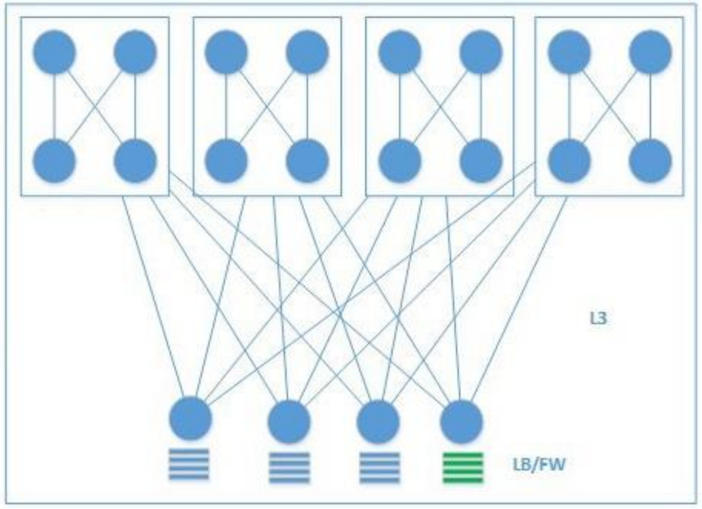
Simple Tree Design



L3 at all layers

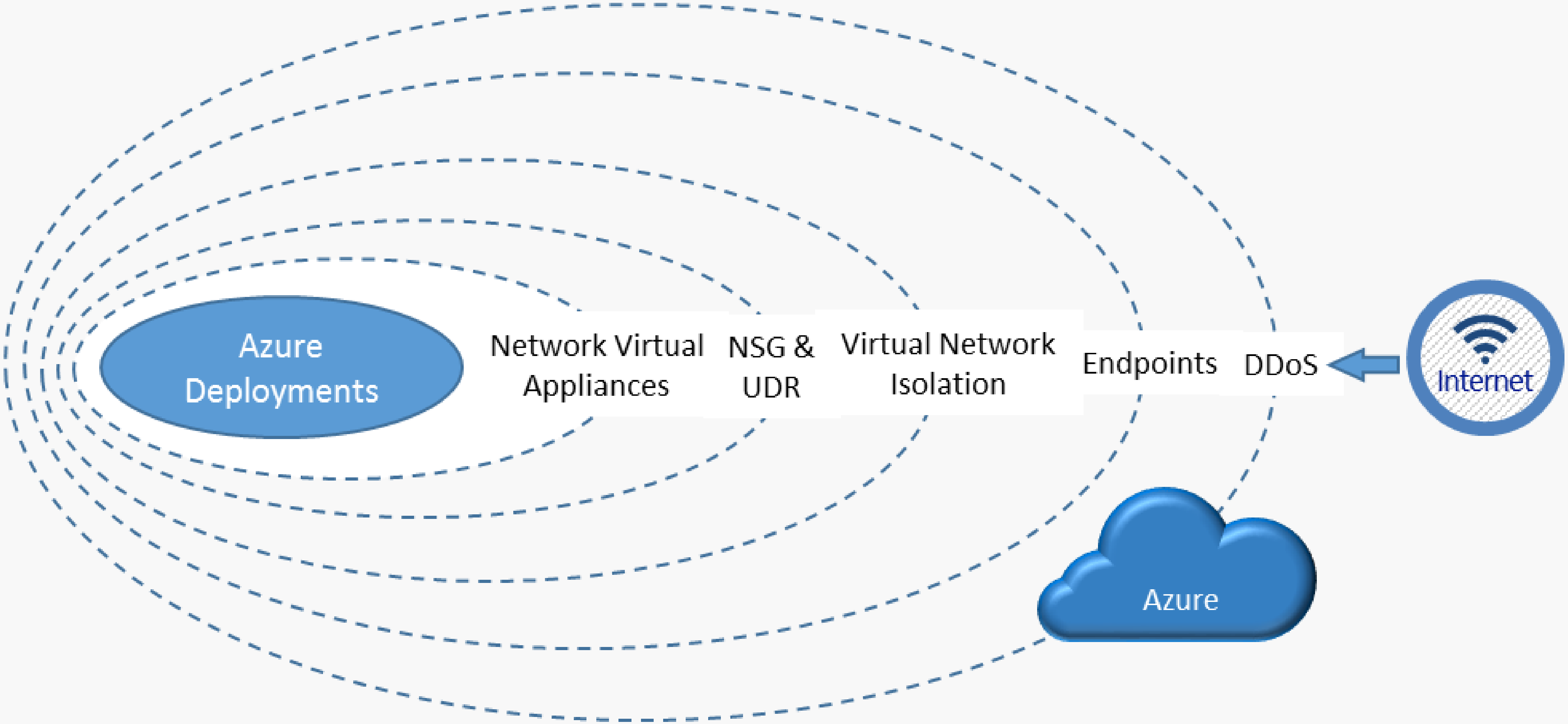
Services in software

Clos-based design



Low due to diversity and manual provisioning process	**Agility**	↑	Automated network provisioning, integrated process
Low due to complex hardware and lack of automated operations	**Efficiency**	↑	Simplify requirements, optimize design, and unify infrastructure
Low due to high complexity and human error	**Availability**	↑	Resilient design, automated monitoring and remediation, minimum human involvement

Security layers

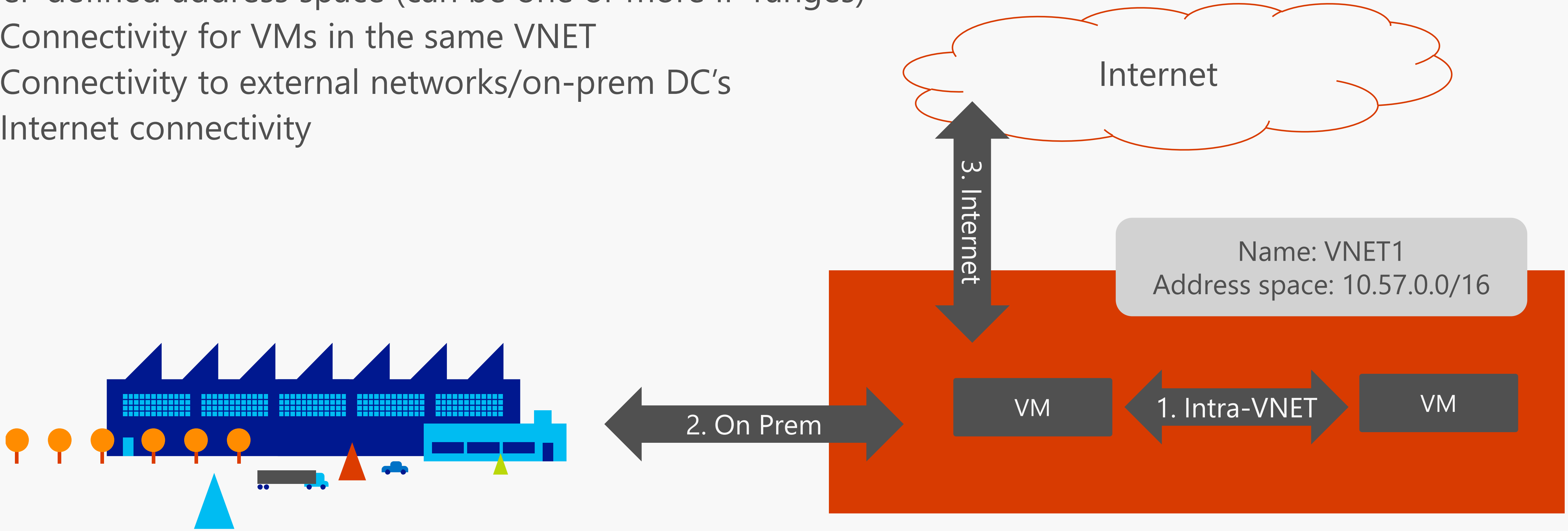


Virtual Network

Isolated, logical network that provides connectivity for Azure Virtual Machines

User-defined address space (can be one or more IP ranges)

1. Connectivity for VMs in the same VNET
2. Connectivity to external networks/on-prem DC's
3. Internet connectivity



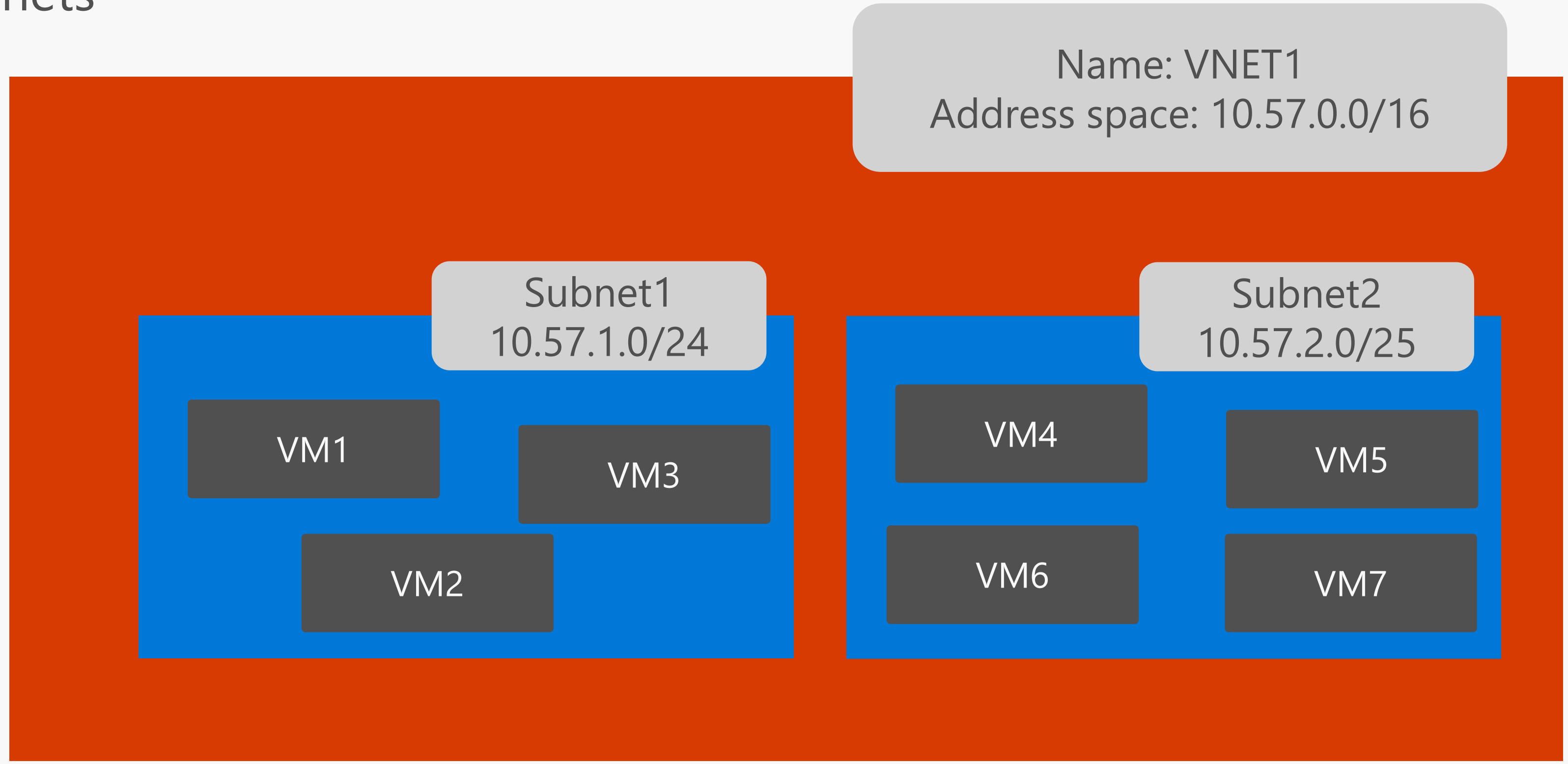
Subnet

IP subnet

Provides full layer-3 semantics and partial layer-2 semantics (DHCP, ARP, no broadcast/multicast)

Subnets can span only one range of contigous IP addresses

VMs can be deployed only to subnets



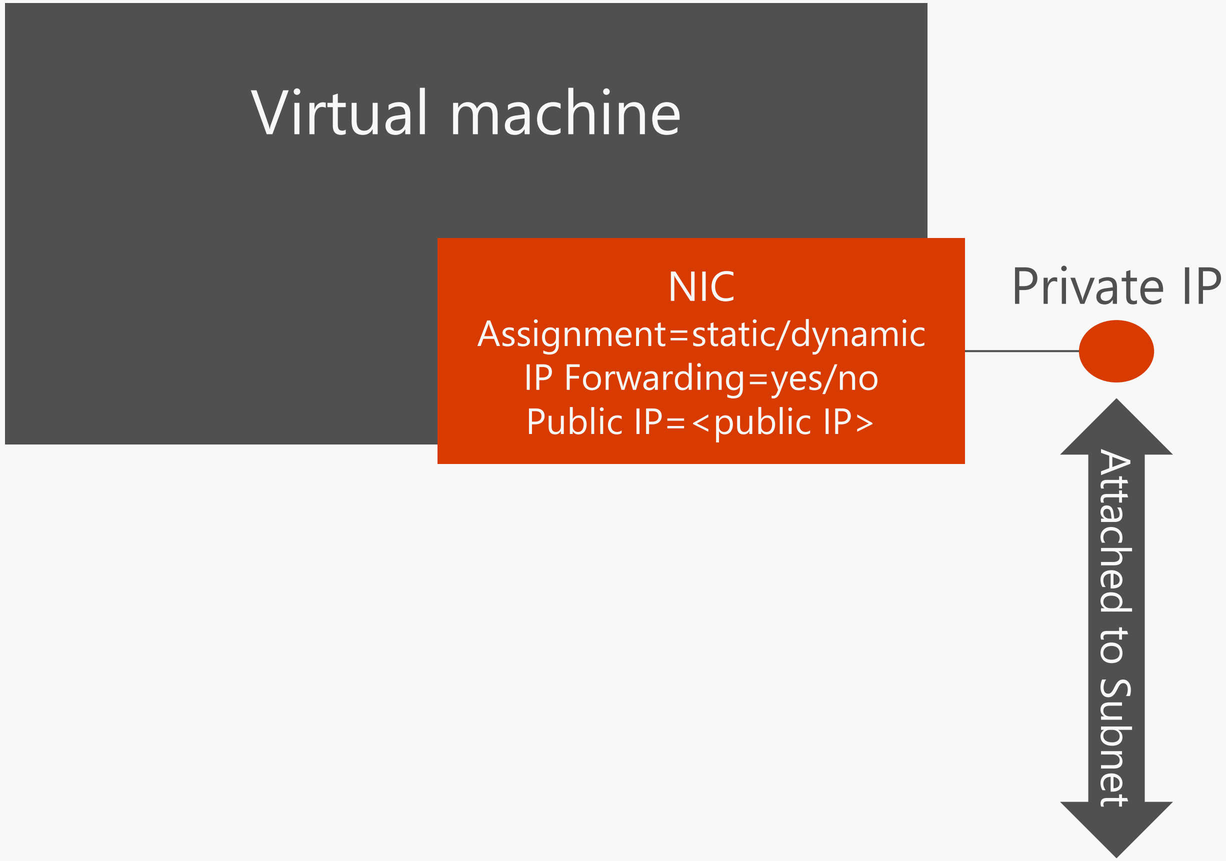
Network Interface

Virtual NIC that connects a VM to a Subnet

One private IP address (private == included in the subnet's IP range)

Private IP address always assigned via Azure DHCP

- Dynamic assignment = DHCP assigns new IP when VM is restarted
- Static assignment =DHCP assigns always the same IP
- IP forwarding = NIC can receive packets with dest IP address different from its private IP
- Multiple NICs
- Multiple IP addr per NIC


Virtual machine

NIC
Assignment=static/dynamic
IP Forwarding=yes/no
Public IP=<public IP>

IP addresses come in two types in Azure

Public vs. Private

Public IP Addresses allow Azure resources to communicate with Internet and other Azure public-facing services

- Virtual machines (VM)
- Internet-facing (public) load balancers
- VPN gateways
- Application gateways

Private IP Addresses allows communication between resources in a virtual network, along with those connected through a VPN, without using an Internet-routable IP addresses.

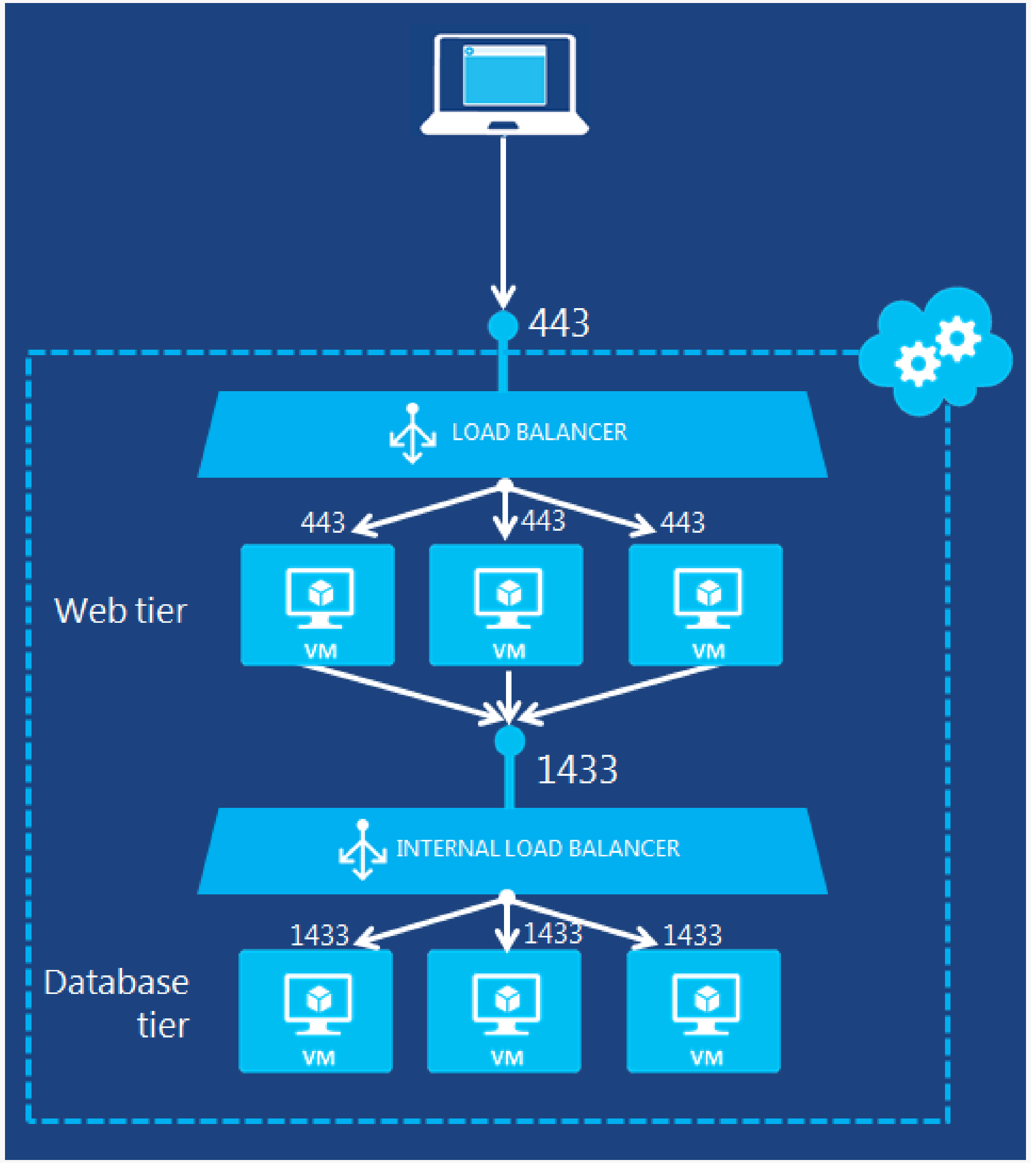
- VMs
- Internal load balancers (ILBs)
- Application gateways

Load Balancers

External vs. Internal

- **External load balancer.** You can use an external load balancer to provide high availability for IaaS VMs and PaaS role instances accessed from the public Internet.

- **Internal load balancer.** You can use an internal load balancer to provide high availability for IaaS VMs and PaaS role instances accessed from other services in your VNet.



NSG key facts

5-tuple ACL’s

Source IP, Destination IP, Source Port, Destination Port, Protocol (TCP, UDP, any)

Actions: allow or deny

Directions: inbound, outbound

Priority: 100-4096 (lower value = higher priority)

Stateful

No need to define rules for «return traffic»

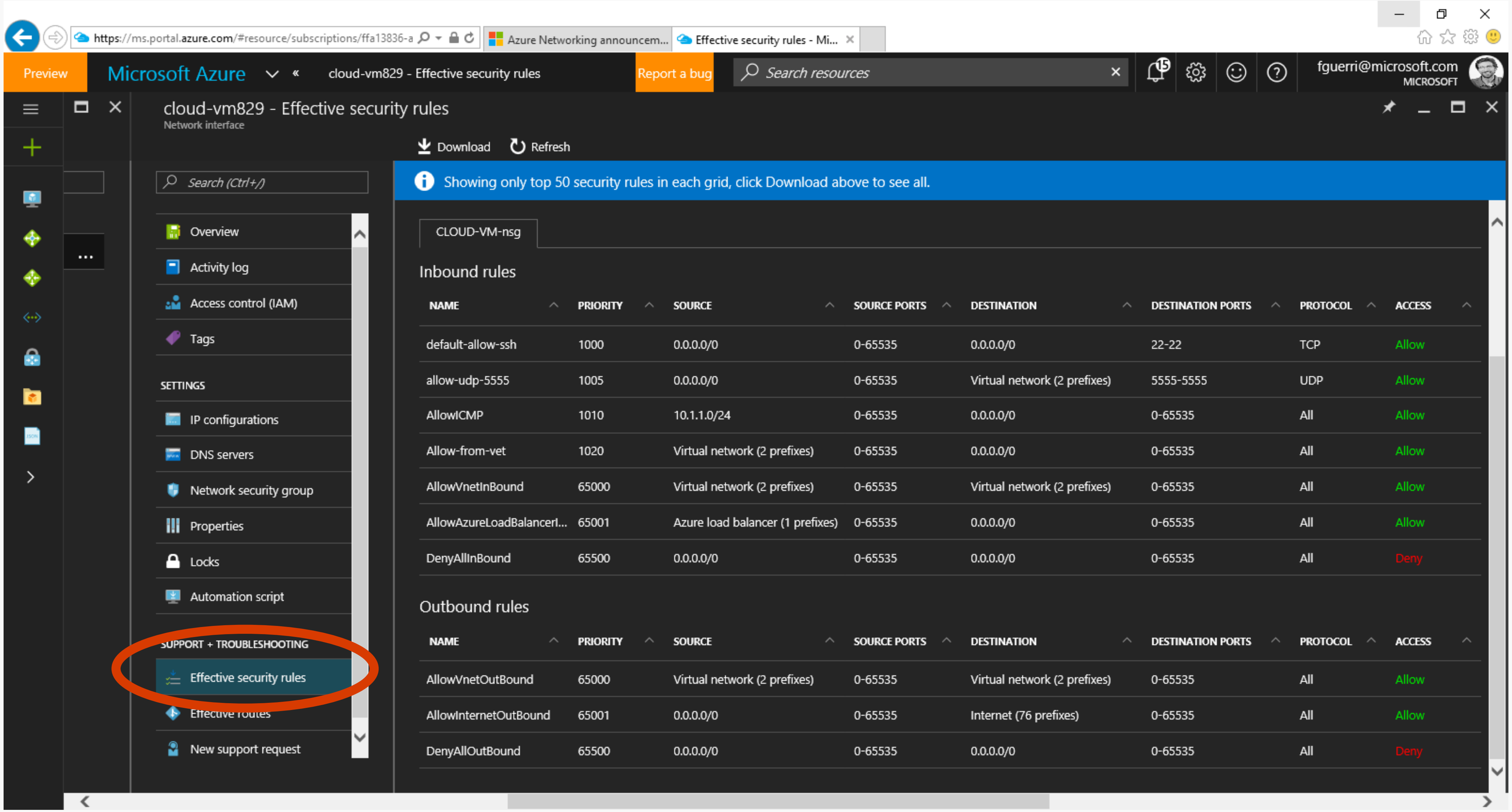
Can be applied to NICs and Subnets (ARM)

Inbound connections: subnet-level NSG evaluated first, NIC-level NSG evaluated next

Outbound connections: NIC-level NSG evaluated first, subnet-level NSG evaluated next

Deny wins

Troubleshooting NSGs



cloud-vm829 - Effective security rules

Showing only top 50 security rules in each grid, click Download above to see all.

Inbound rules

NAME	PRIORITY	SOURCE	SOURCE PORTS	DESTINATION	DESTINATION PORTS	PROTOCOL	ACCESS
default-allow-ssh	1000	0.0.0.0/0	0-65535	0.0.0.0/0	22-22	TCP	Allow
allow-udp-5555	1005	0.0.0.0/0	0-65535	Virtual network (2 prefixes)	5555-5555	UDP	Allow
AllowICMP	1010	10.1.1.0/24	0-65535	0.0.0.0/0	0-65535	All	Allow
Allow-from-vet	1020	Virtual network (2 prefixes)	0-65535	0.0.0.0/0	0-65535	All	Allow
AllowVnetInBound	65000	Virtual network (2 prefixes)	0-65535	Virtual network (2 prefixes)	0-65535	All	Allow
AllowAzureLoadBalancerI...	65001	Azure load balancer (1 prefixes)	0-65535	0.0.0.0/0	0-65535	All	Allow
DenyAllInBound	65500	0.0.0.0/0	0-65535	0.0.0.0/0	0-65535	All	Deny

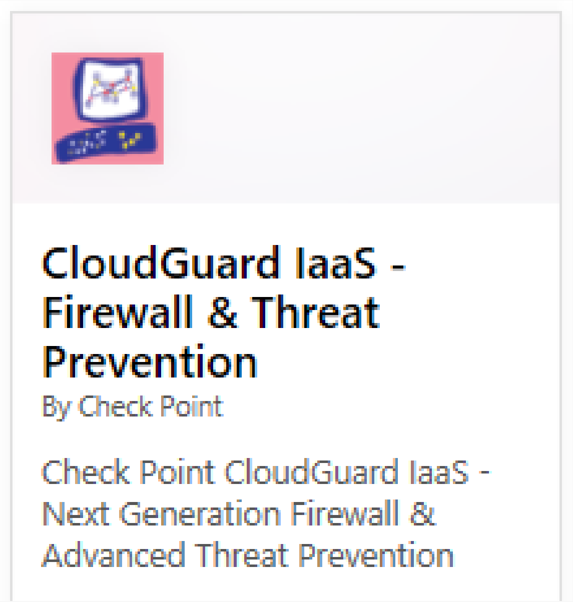
Outbound rules

NAME	PRIORITY	SOURCE	SOURCE PORTS	DESTINATION	DESTINATION PORTS	PROTOCOL	ACCESS
AllowVnetOutBound	65000	Virtual network (2 prefixes)	0-65535	Virtual network (2 prefixes)	0-65535	All	Allow
AllowInternetOutBound	65001	0.0.0.0/0	0-65535	Internet (76 prefixes)	0-65535	All	Allow
DenyAllOutBound	65500	0.0.0.0/0	0-65535	0.0.0.0/0	0-65535	All	Deny

Network Virtual Appliance

A VM in your VNet that runs software

- Example: firewall, WAN optimization..etc
- You can create a route in Azure to route your VNet traffic through a virtual appliance to use its capabilities.
- NSGs provide security on your Vnet (layer 4 ACL on incoming/outgoing packets). NVA will offer a layer 7 security model.



CloudGuard IaaS - Firewall & Threat Prevention

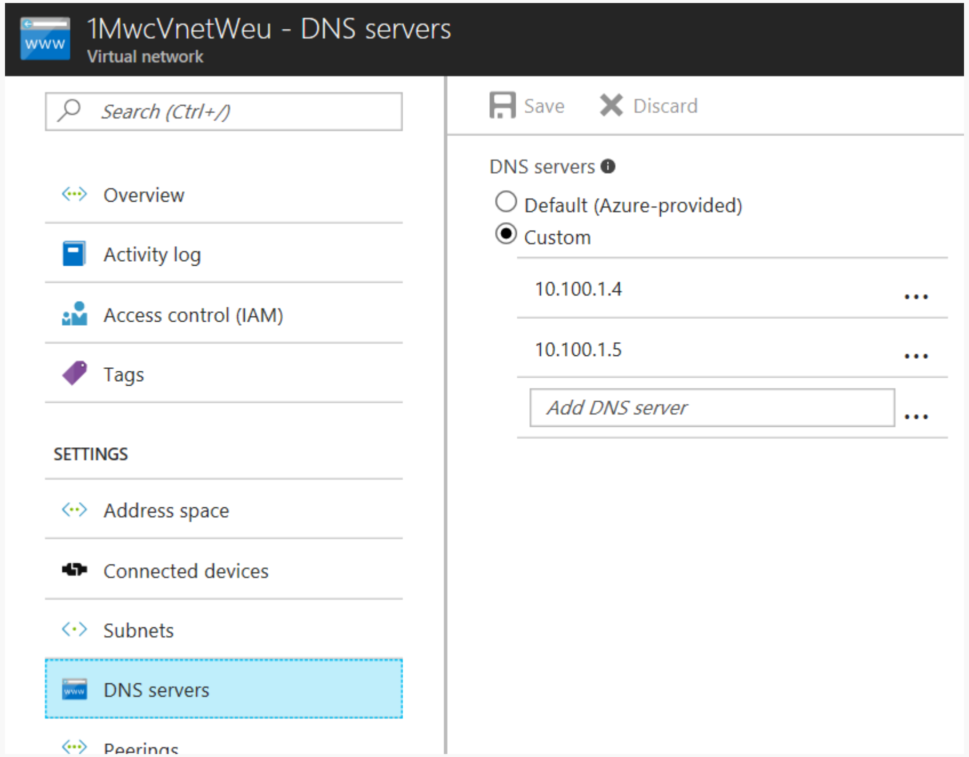
By Check Point

Check Point CloudGuard IaaS - Next Generation Firewall & Advanced Threat Prevention

Name Resolution

By default, your VNet uses Azure-provided name resolution to resolve names inside the VNet, and on the public Internet.

If you connect your VNets to your on-premises data centers, you need to provide your own DNS server to resolve names between your networks.



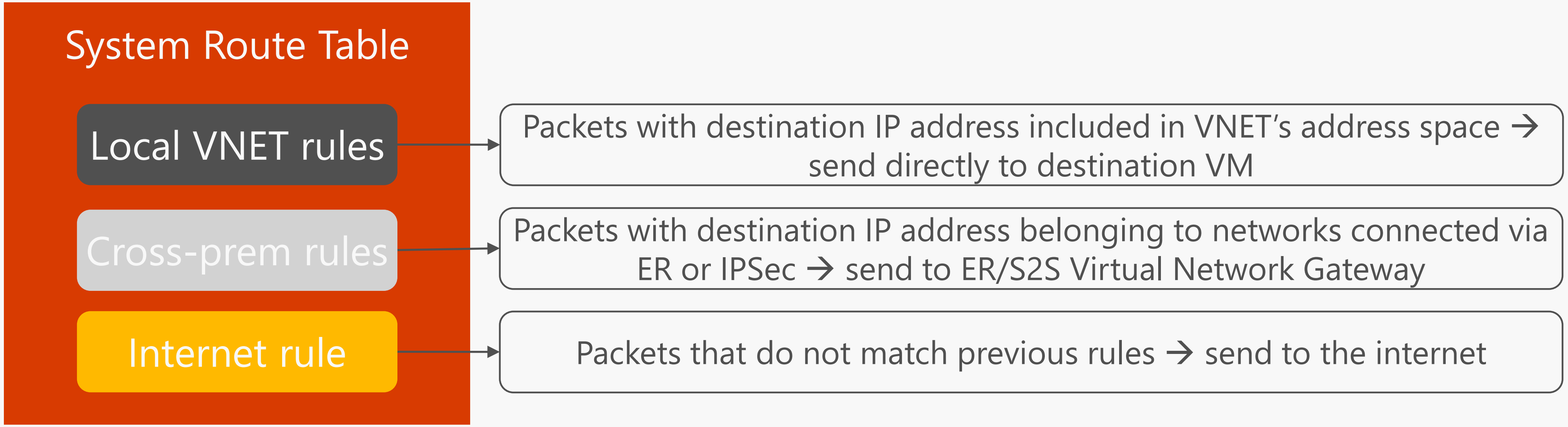
1MwcVnetWeu - DNS servers
Virtual network

DNS servers
○ Default (Azure-provided)
● Custom
10.100.1.4
10.100.1.5
Add DNS server

System Route Table

Default rules for routing/switching traffic in Azure VNETs

- Route table: set of rules that define where IP packets must be sent based on their destination IP address
- The default routing behavior for an Azure VNET is defined by the «System Route Table»



System Route Table

Local VNET rules → Packets with destination IP address included in VNET's address space → send directly to destination VM

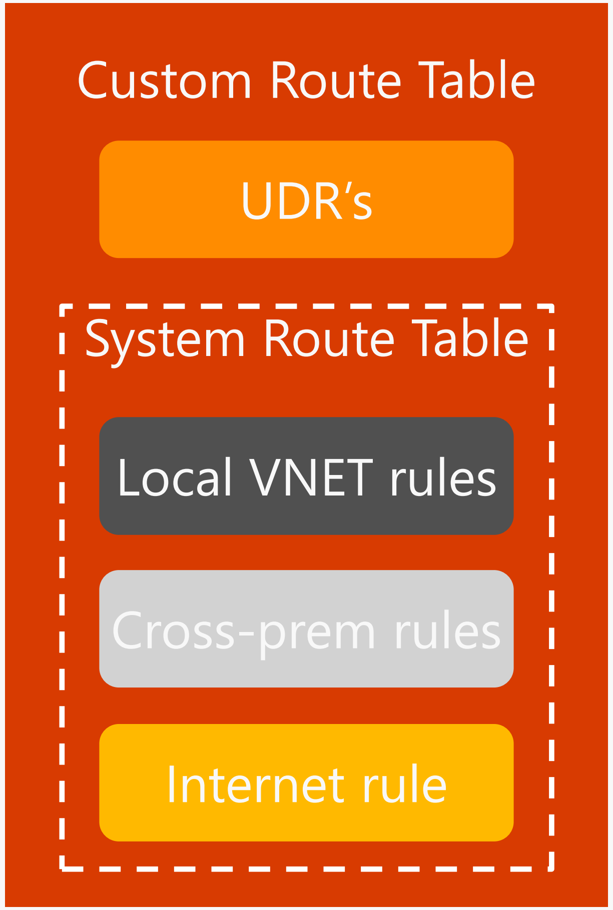
Cross-prem rules → Packets with destination IP address belonging to networks connected via ER or IPSec → send to ER/S2S Virtual Network Gateway

Internet rule → Packets that do not match previous rules → send to the internet

User Defined Routes (UDR's)

Additional routes that modify a VNET's default routing policy

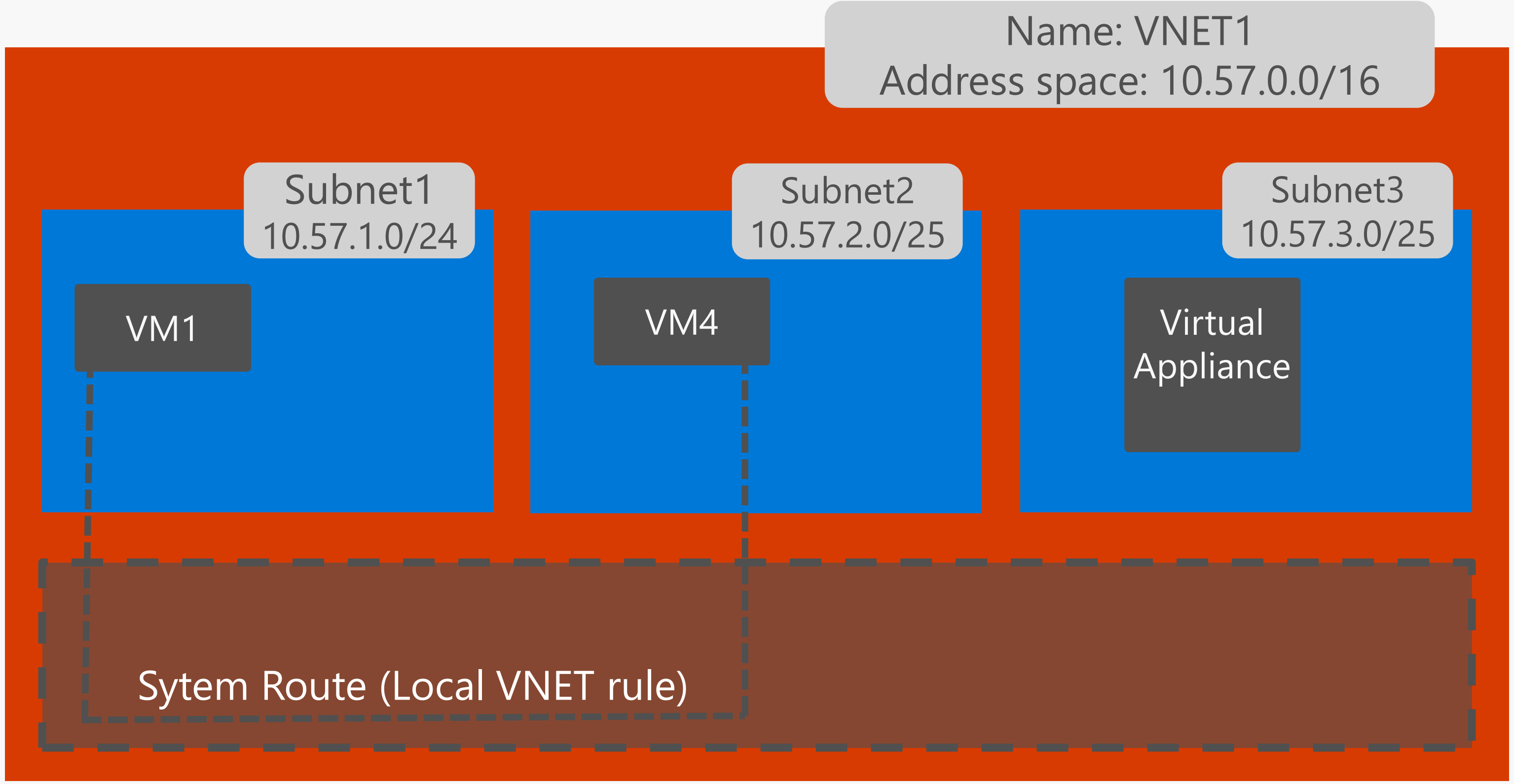
- A custom route table contains one or more UDR's AND the system routes
- UDR's are preferred over system routes with the same prefix length
- Each subnet in a VNET can be assigned a different custom route table
- A custom route table can be assigned to the Gateway Subnet



User Defined Routes (UDR's)

Use case 1: Virtual appliances

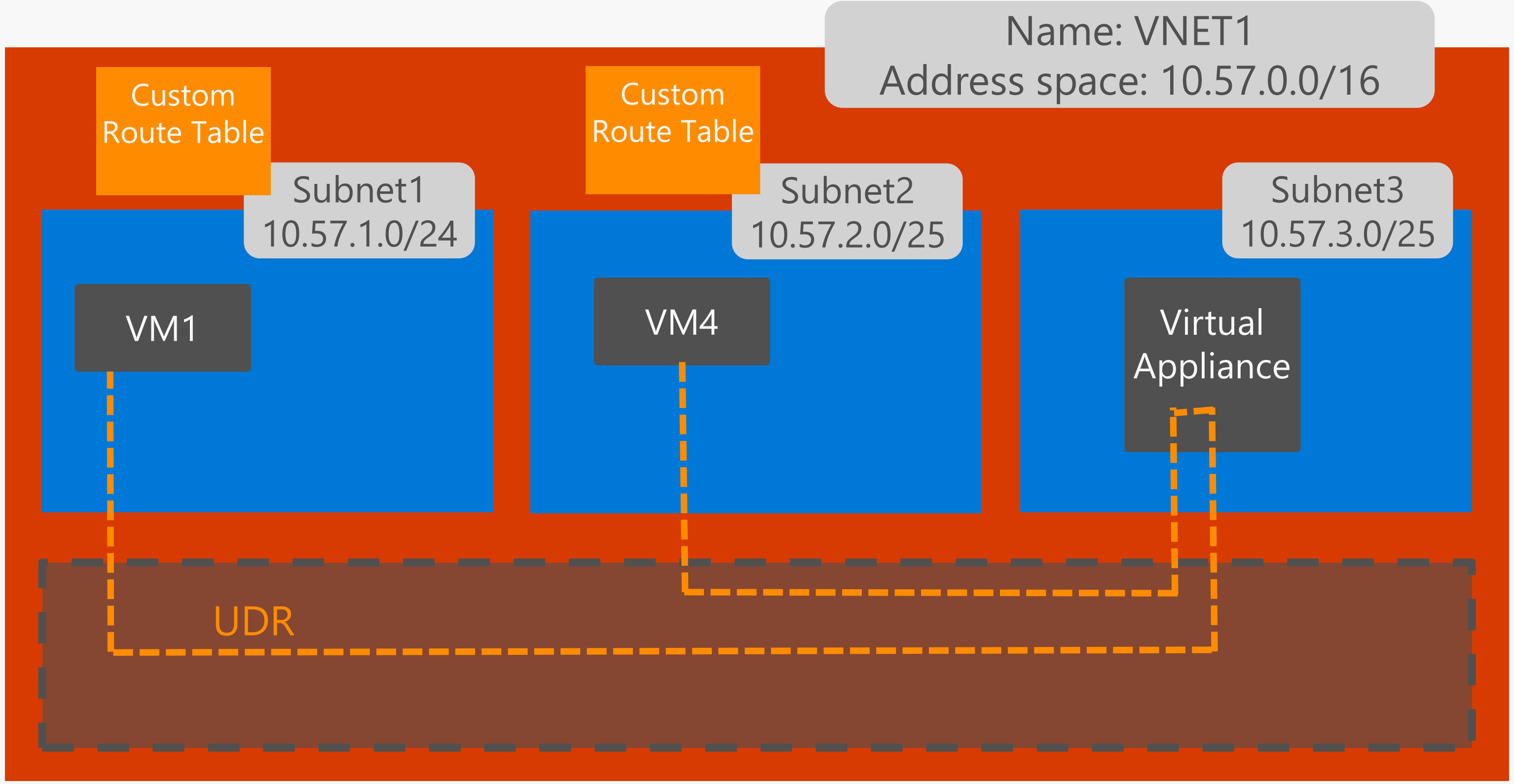
- According to the system route table, traffic will flow directly from VM1 to VM4



User Defined Routes (UDR's)

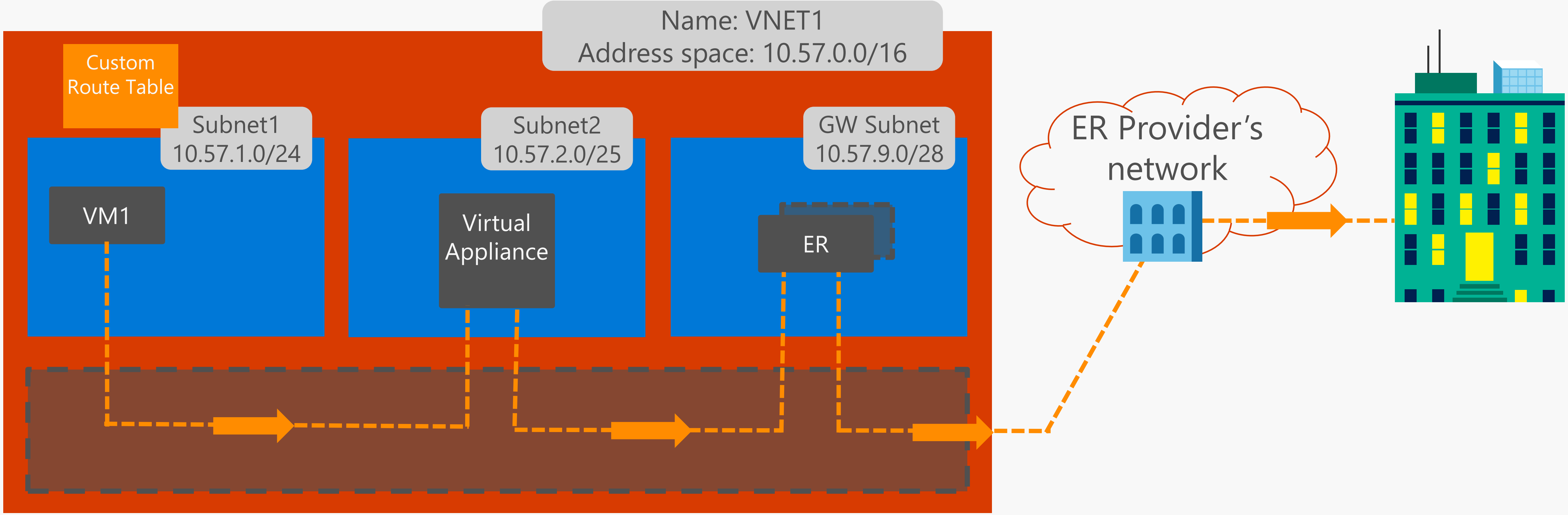
Use case 1: Virtual appliances

- According to the system route table, traffic will flow directly from VM1 to VM4
- A UDR can be used to override this behavior and send the traffic through an intermediate hop (e.g. a firewalling VA)
- UDR cannot be overridden by VM local route table



User Defined Routes (UDR's)

Use case 2: Inbound ER or S2S traffic



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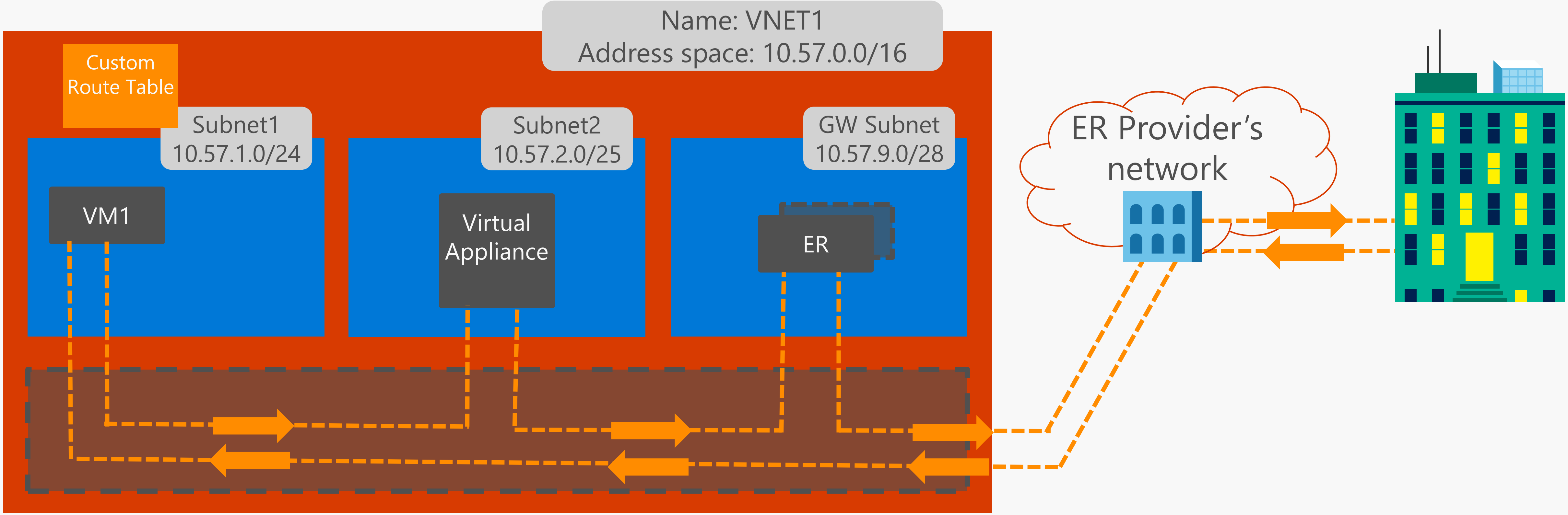
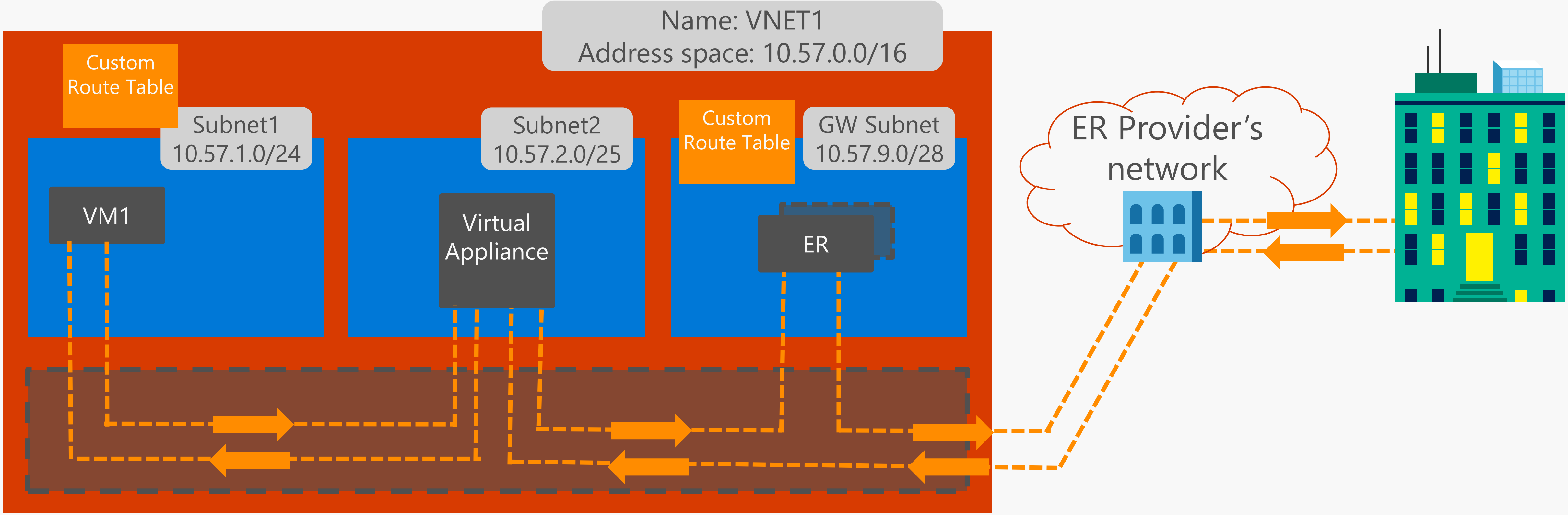


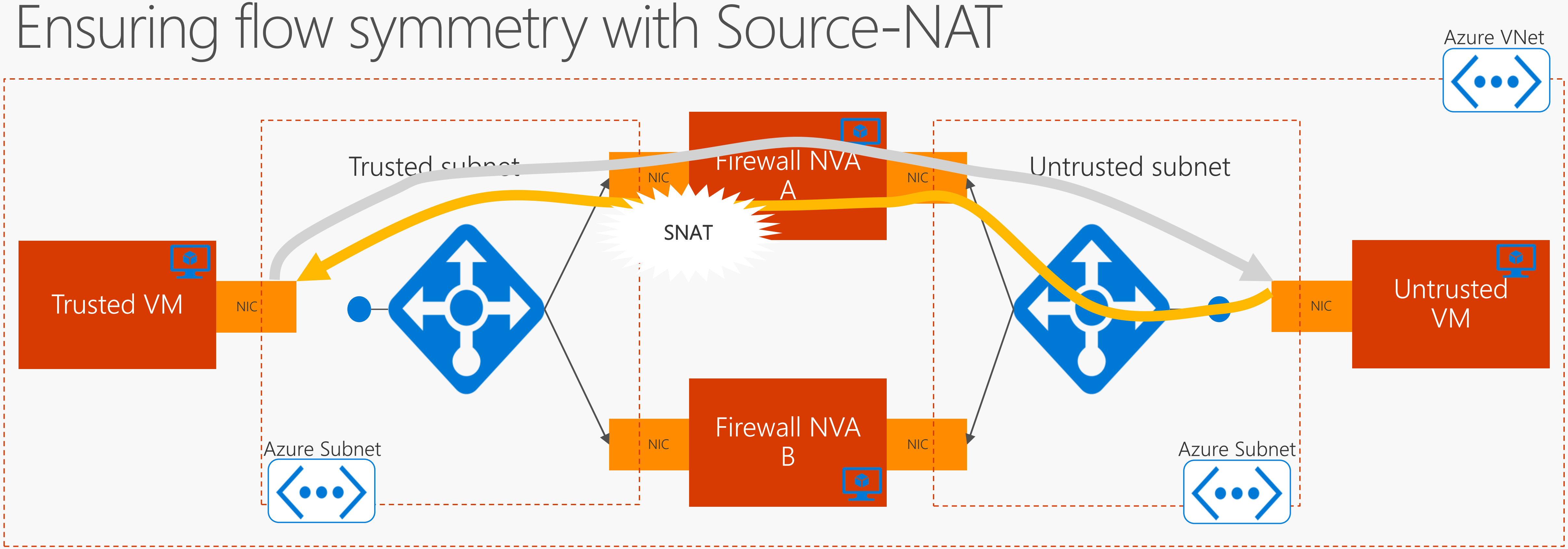
User Defined Routes (UDR's)

Use case 2: Inbound ER or S2S traffic



HA NVAs

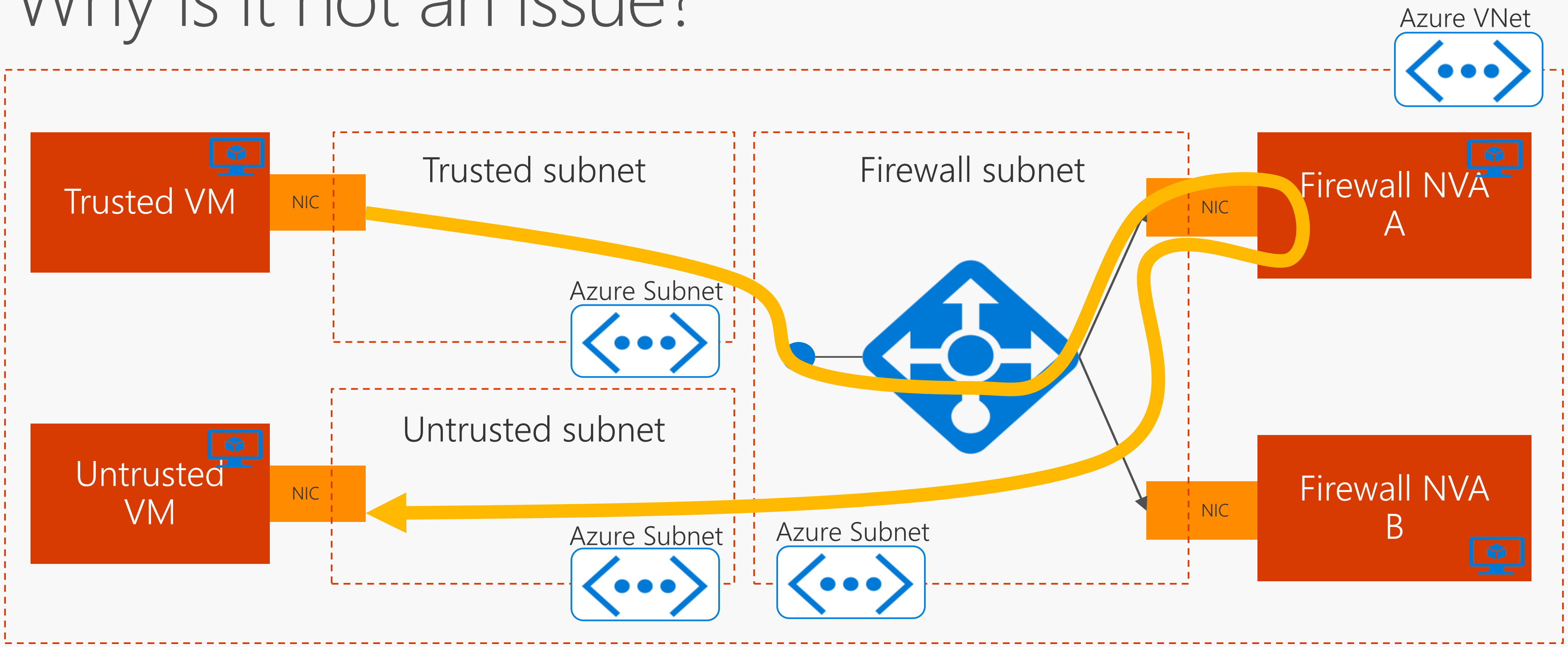
Ensuring flow symmetry with Source-NAT



- Load balancer in “Untrusted” subnet assigns outbound flow to NVA “A”
- NVA “A” source-NATs traffic behind its “Trusted” subnet interface’s IP
- Return flow goes to NVA “A” without hitting the load balancer

Flow symmetry with single NIC configuration

Why is it not an issue?



Outbound packet	Src IP Addr Trusted VM IP	Dest IP Addr: Untrusted VM IP	Src Port: 65000	Dest Port: 80	Payload
Return packet	Src IP Addr Untrusted VM IP	Dest IP Addr: Trusted VM IP	Src Port: 80	Dest Port: 65000	Payload

- Both packets have the same src/dest IP addresses and ports, in reverse order
- The load balancer's hashing algorithm assigns both packets to the same backend instance

VNet Peering

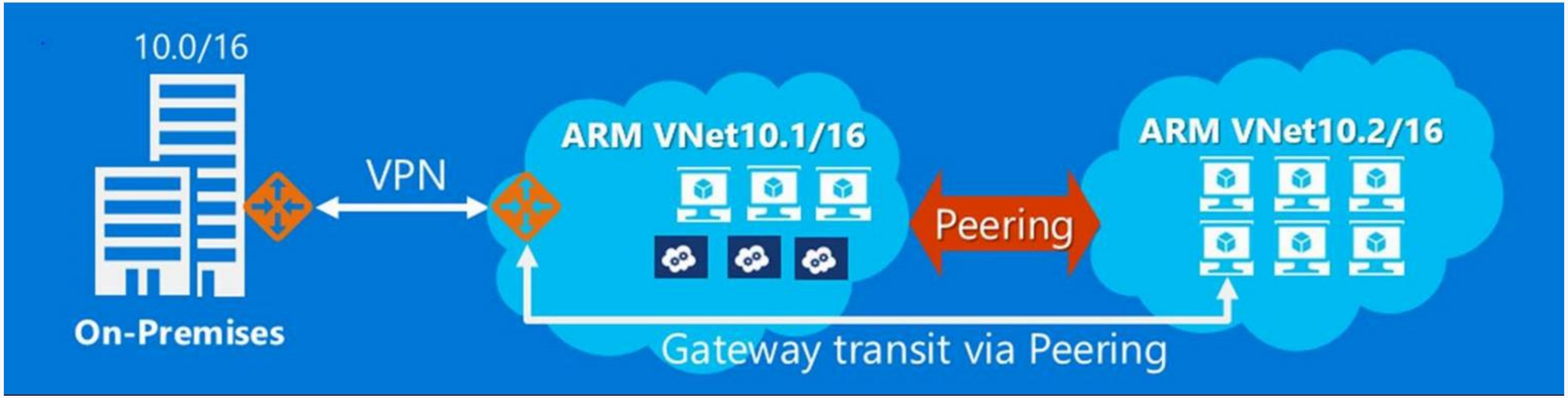
Peering connects 2 VNets together seamlessly

Works globally (across regions)!

No additional hop

Non-transitive (except gateway)

Can only ever have a single Gateway in a VNet (local or remote)



Important Addresses

KMS

kms.core.windows.net

https://docs.microsoft.com/en-us/azure/virtual-machines/windows/troubleshoot-activation-problems

DNS & monitoring

Including Load Balancer probes

168.63.129.16/32

https://blogs.msdn.microsoft.com/mast/2015/05/18/what-is-the-ip-address-168-63-129-16/

Q&A