

# Deploy Complex Workloads with Azure Agility

## From Zero to SDN in 45 minutes



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<https://aka.ms/larryexchange>

# Motivation

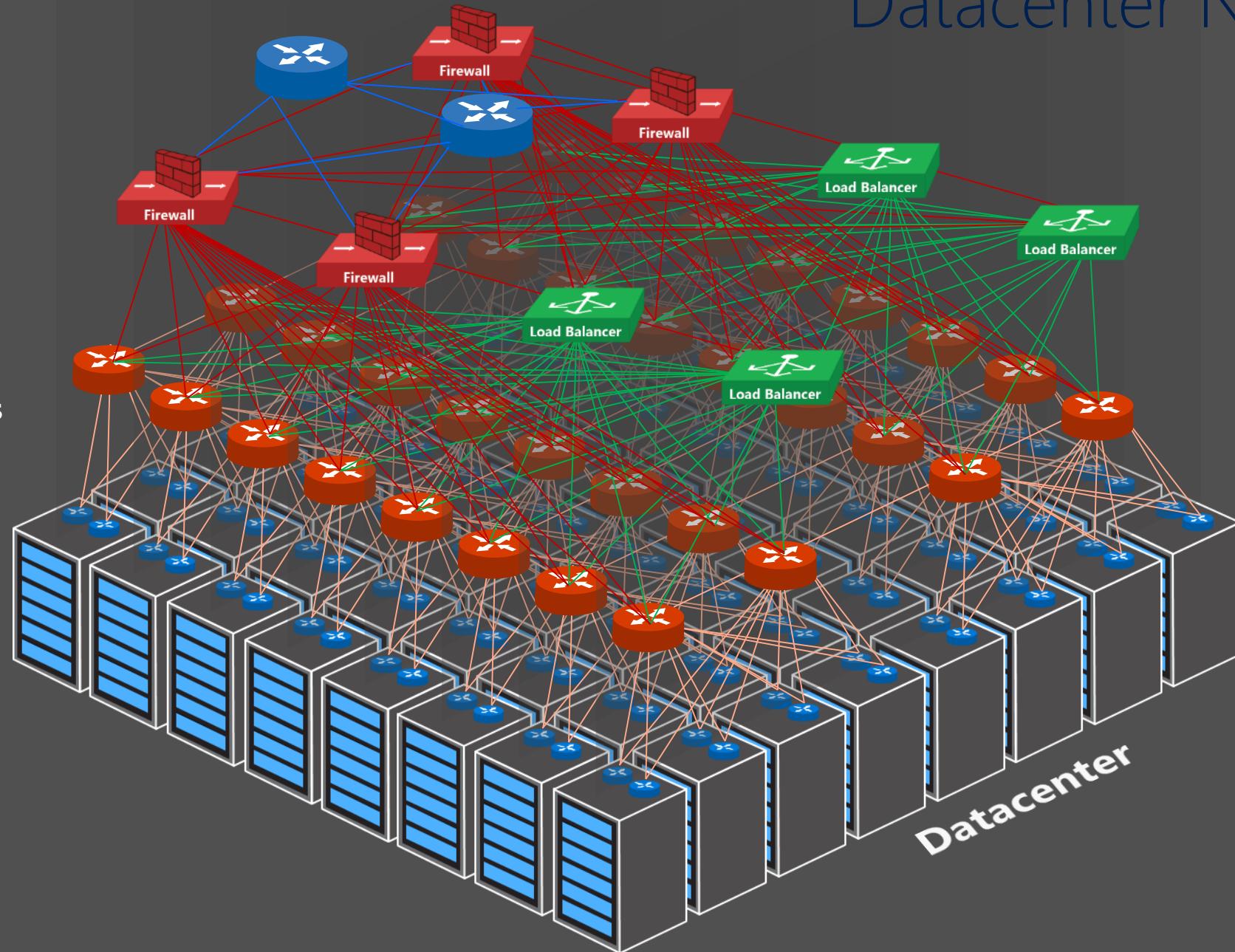
# Datacenter Network

Edge Routers

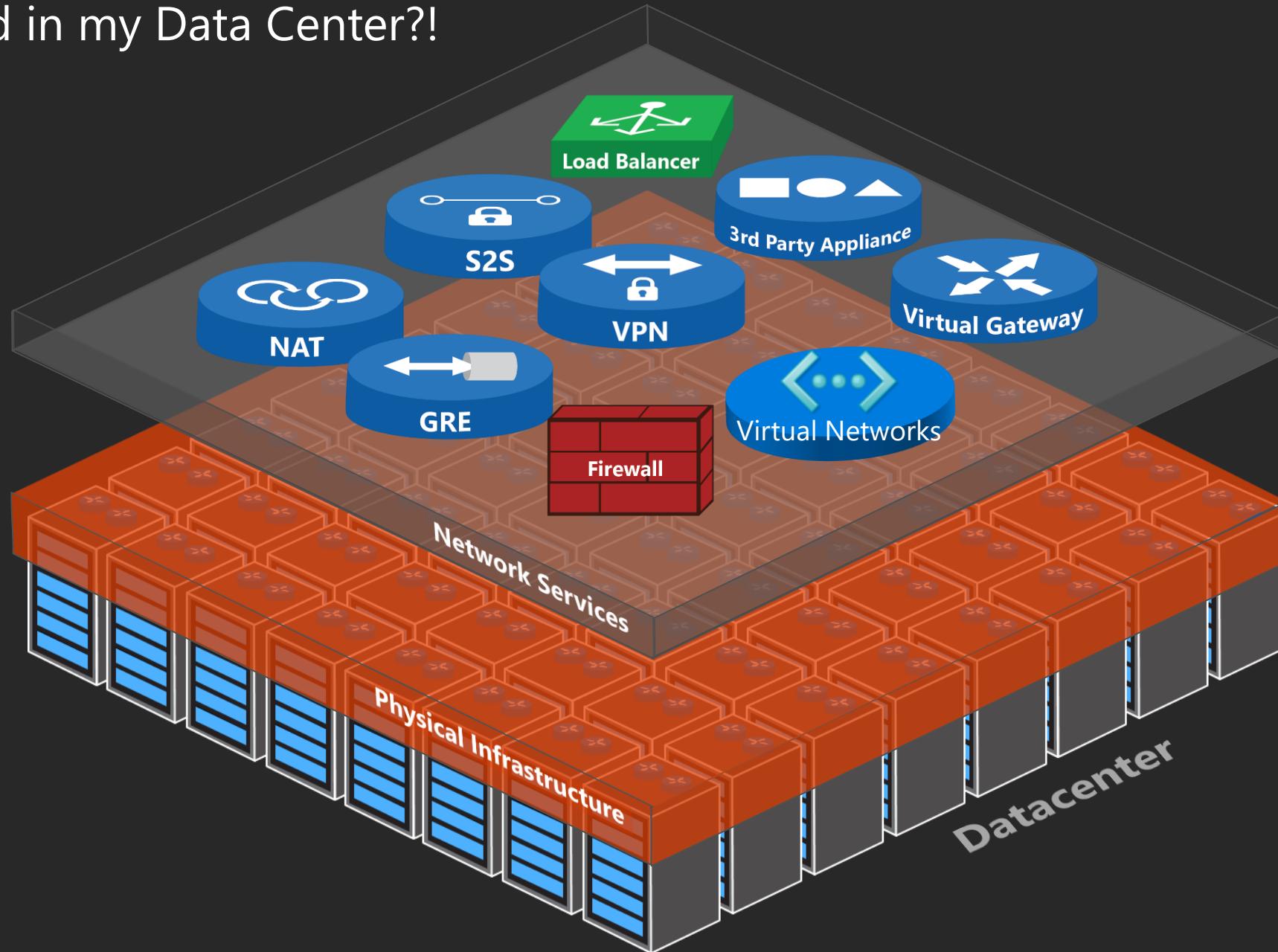
Fixed-Function  
Physical Appliances

Spine Switches/Routers

Compute/Storage  
& TOR Switches



How can I manage all of the network services found in my Data Center?!



# Challenges customers face



## Increase agility

"I need to onboard workloads with complex policies across my own datacenter and/or other clouds in days – not weeks – to remain competitive."



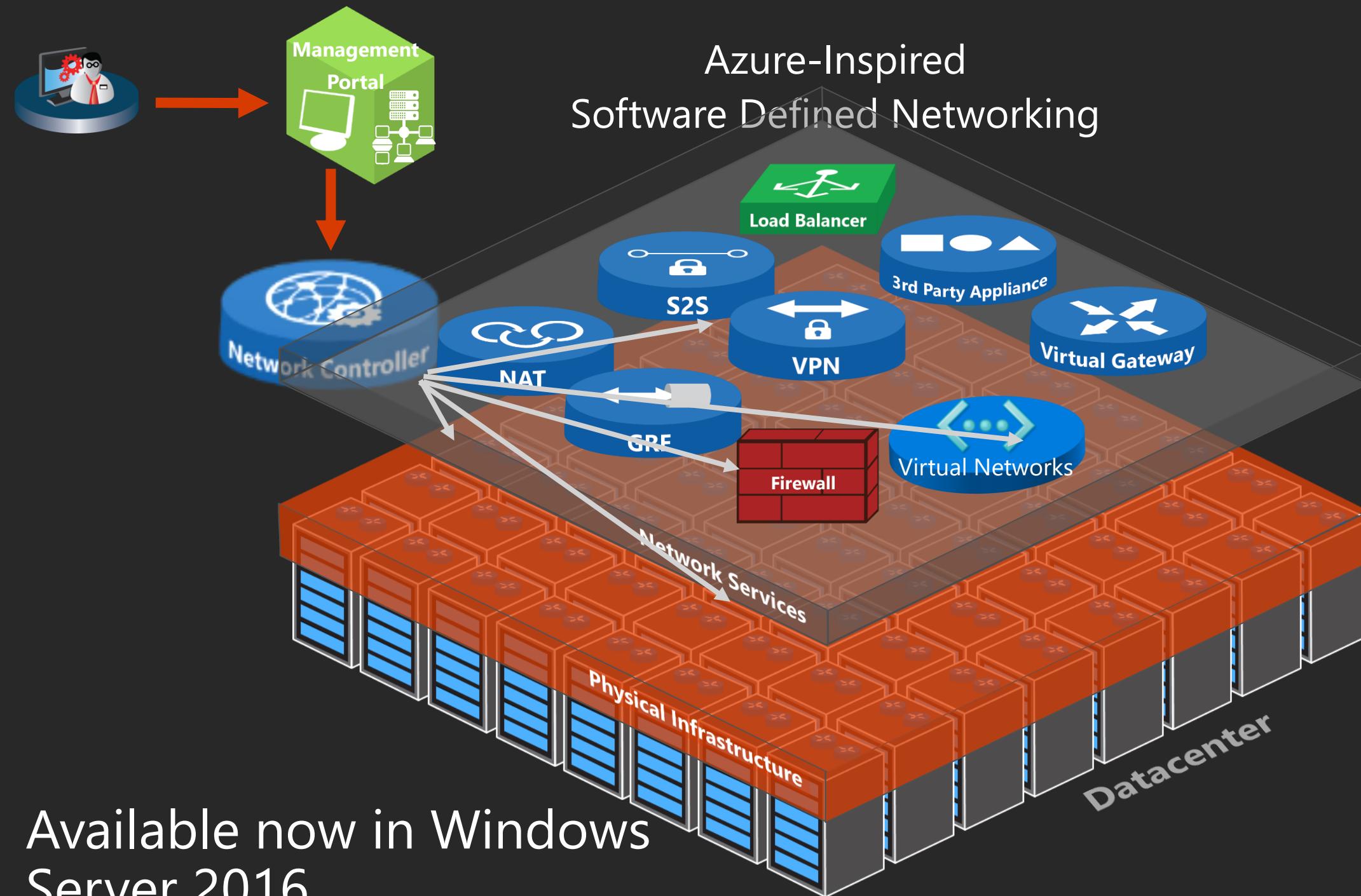
## Enhance security

"I must be able to instantaneously react to evolving threats and stop an attack from spreading."



## Reduce costs

"I need to reduce the number of operator interventions and efficiently meet network growth demands. Current practices just won't scale."



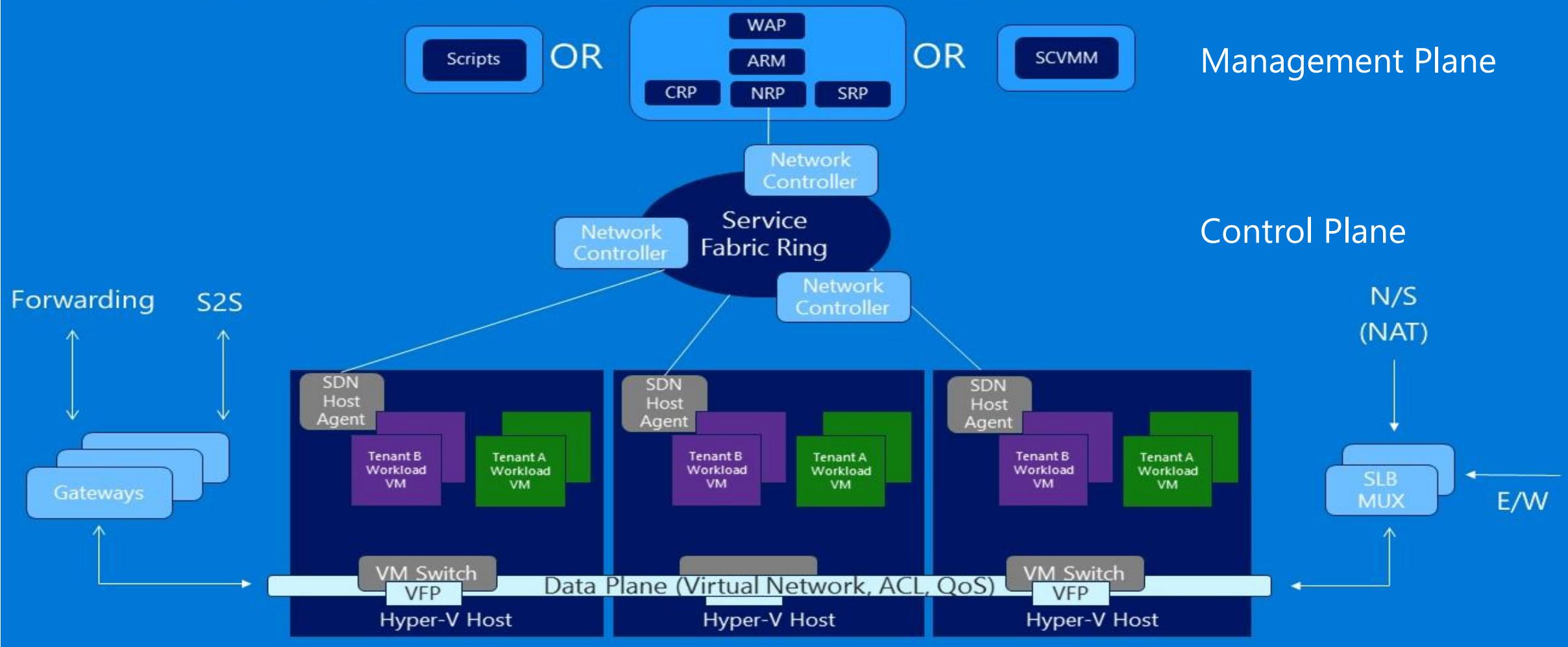
Ready... Set... Go!

# DEMO: Deploy Microsoft Network Controller

SDN Fabric Deployment

# Core SDN Terms and Concepts

# Windows Server 2016 SDN Stack



**GOAL:** Scale-out via Host-based Networking by separating Control-plane decisions from Data-plane traffic flow

# Step 0. Deploy Fabric Infrastructure

# Review the Physical Network Plan

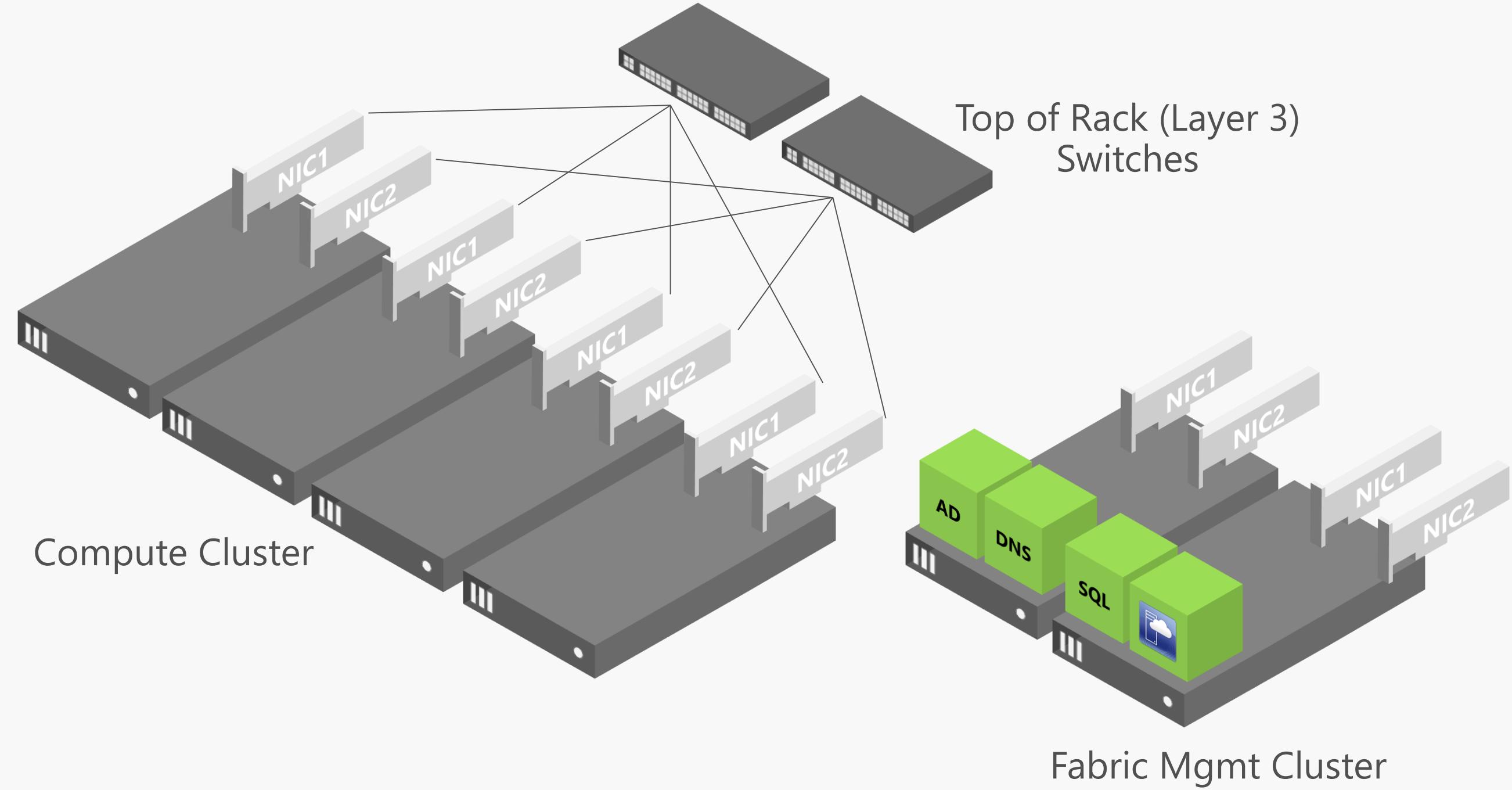
## Top of Rack (ToR) Switch

Network	IP Prefix	VLAN	Default Gateway	IP Pool
Management	192.168.20.0/24	200	192.168.20.1	*.51 – *.100
HNV Provider				
Transit				
Public VIP				
Private VIP				

- One Management IP Address per Hyper-V Host (Static or DHCP)

## Physical Network Adapters

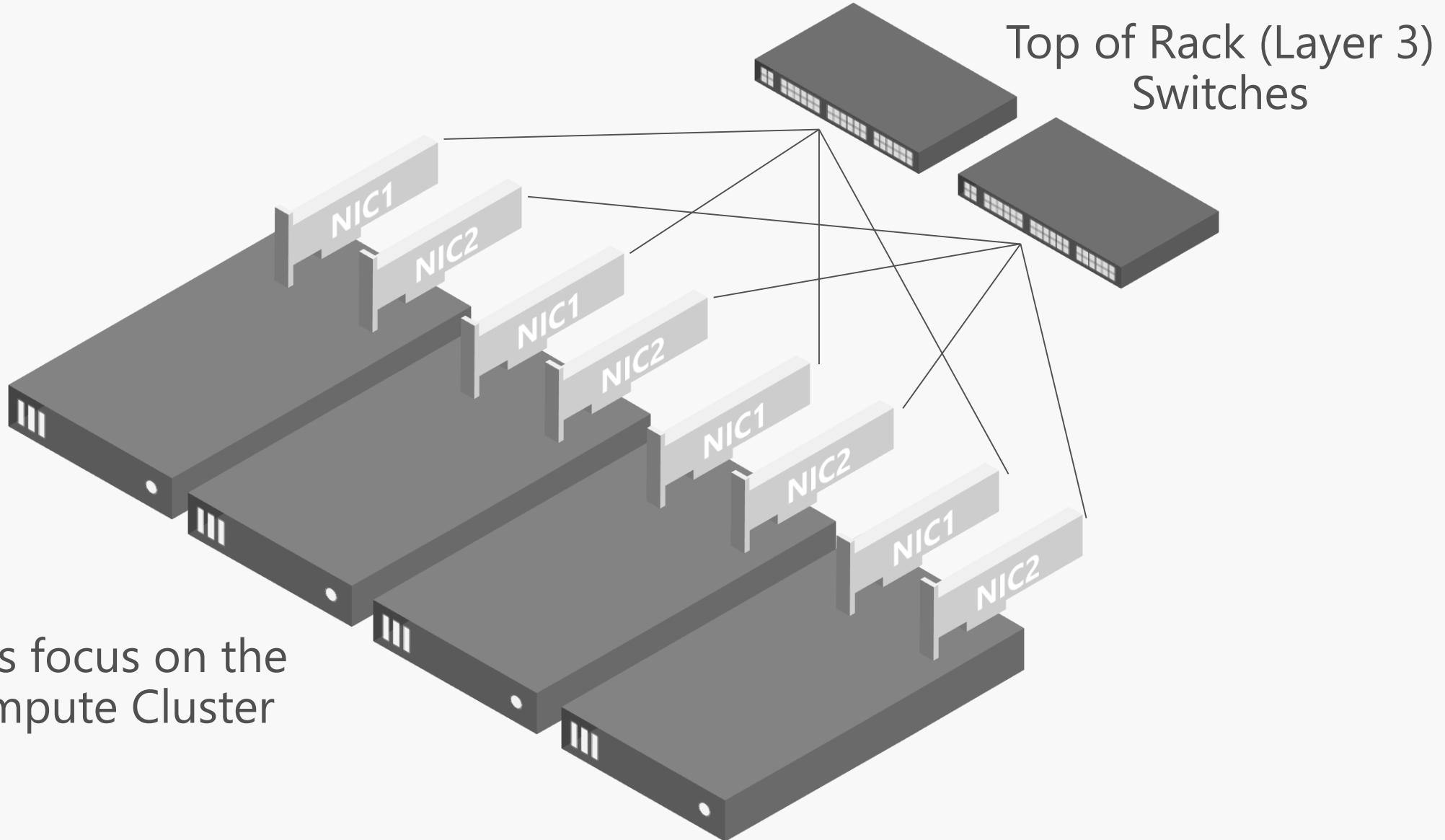
(Optional Two) NIC(s) teamed into Hyper-V Virtual Switch using Switch Embedded Teaming (SET)  
Assign IP addresses and set VLAN isolation (on management vNICs)





System Center Virtual  
Machine Manager  
(SCVMM)

Let's focus on the  
Compute Cluster

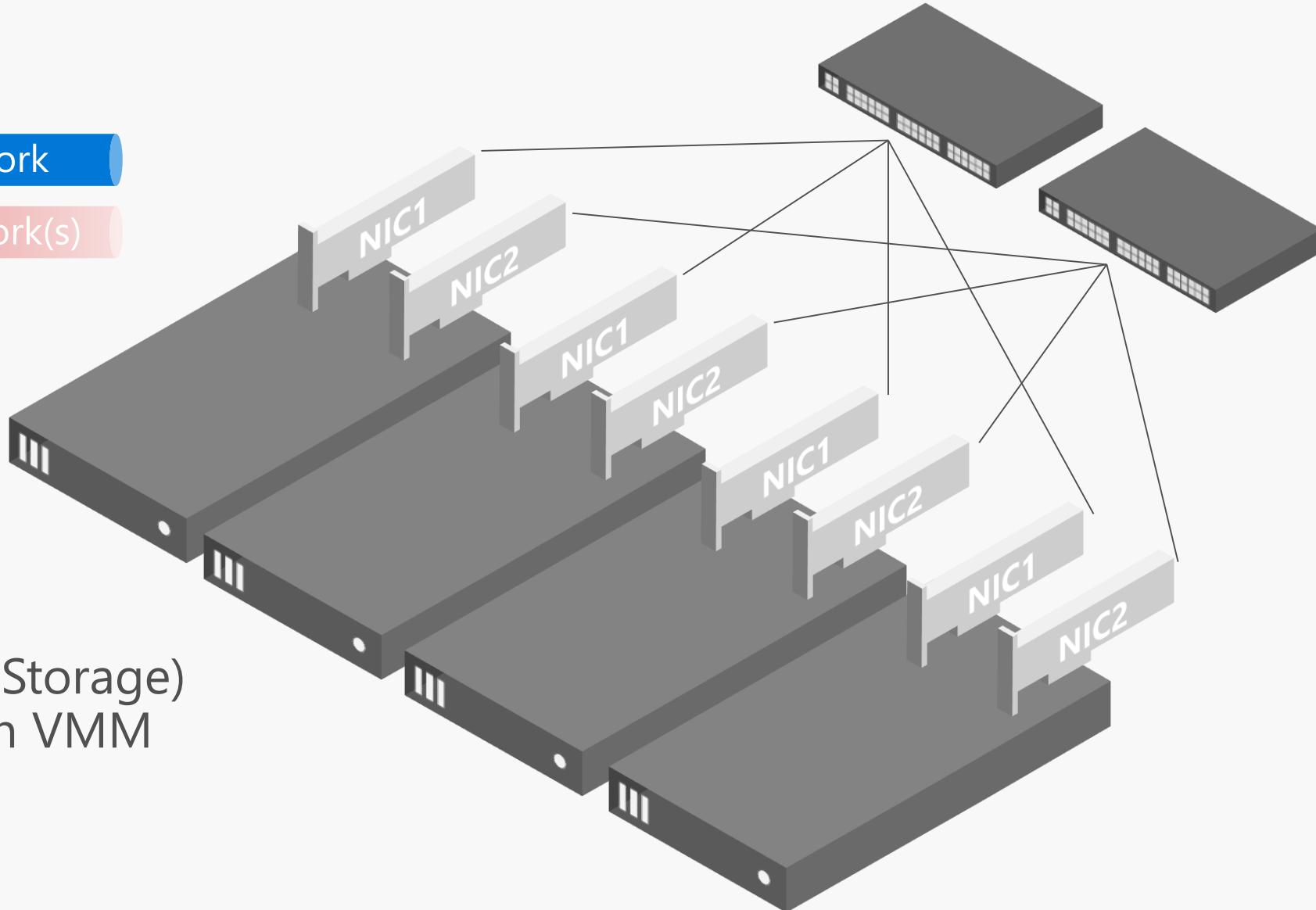


Mgmt Logical Network

Storage Logical Network(s)

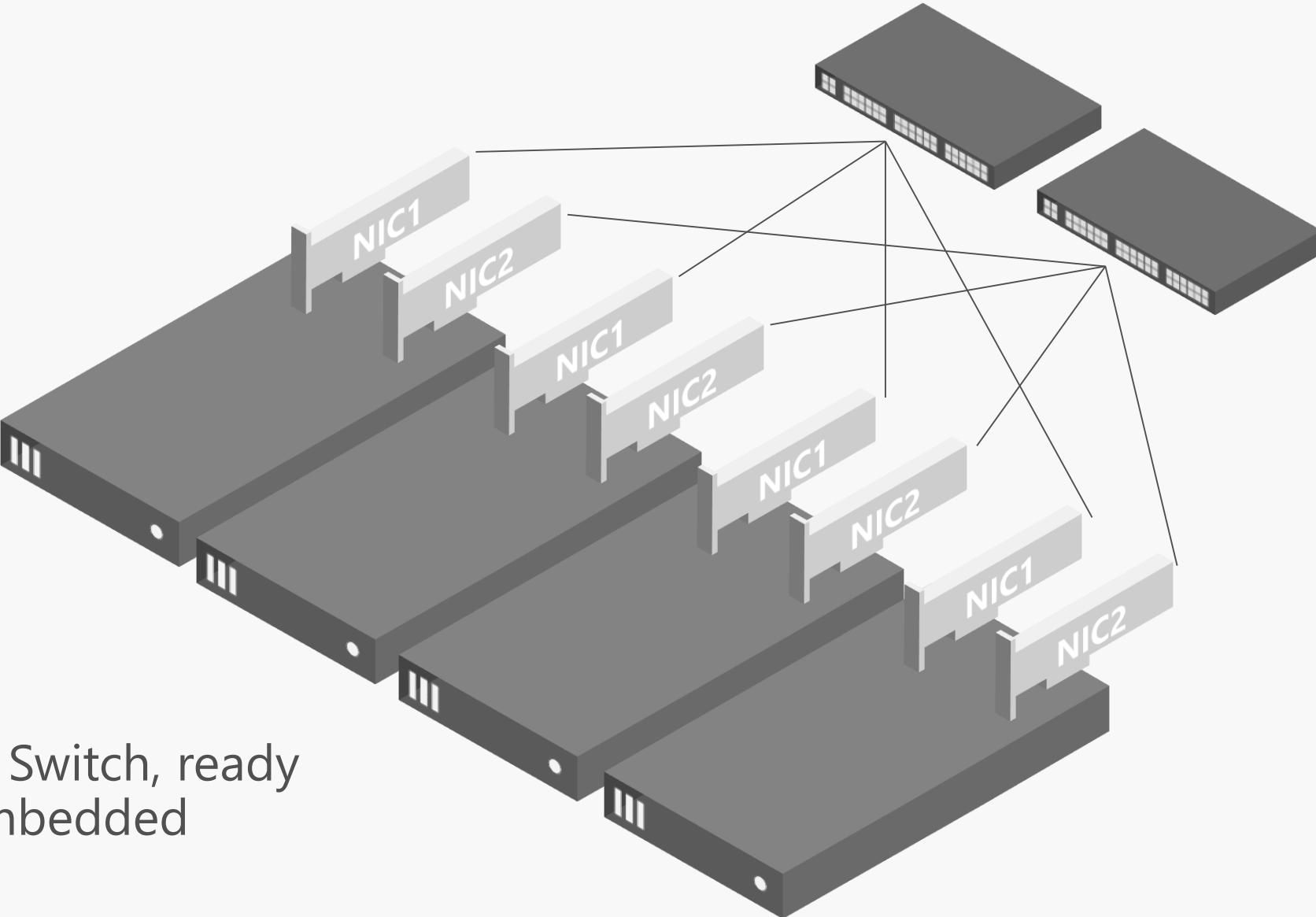


Create Mgmt (and Storage)  
Logical Networks in VMM



Mgmt

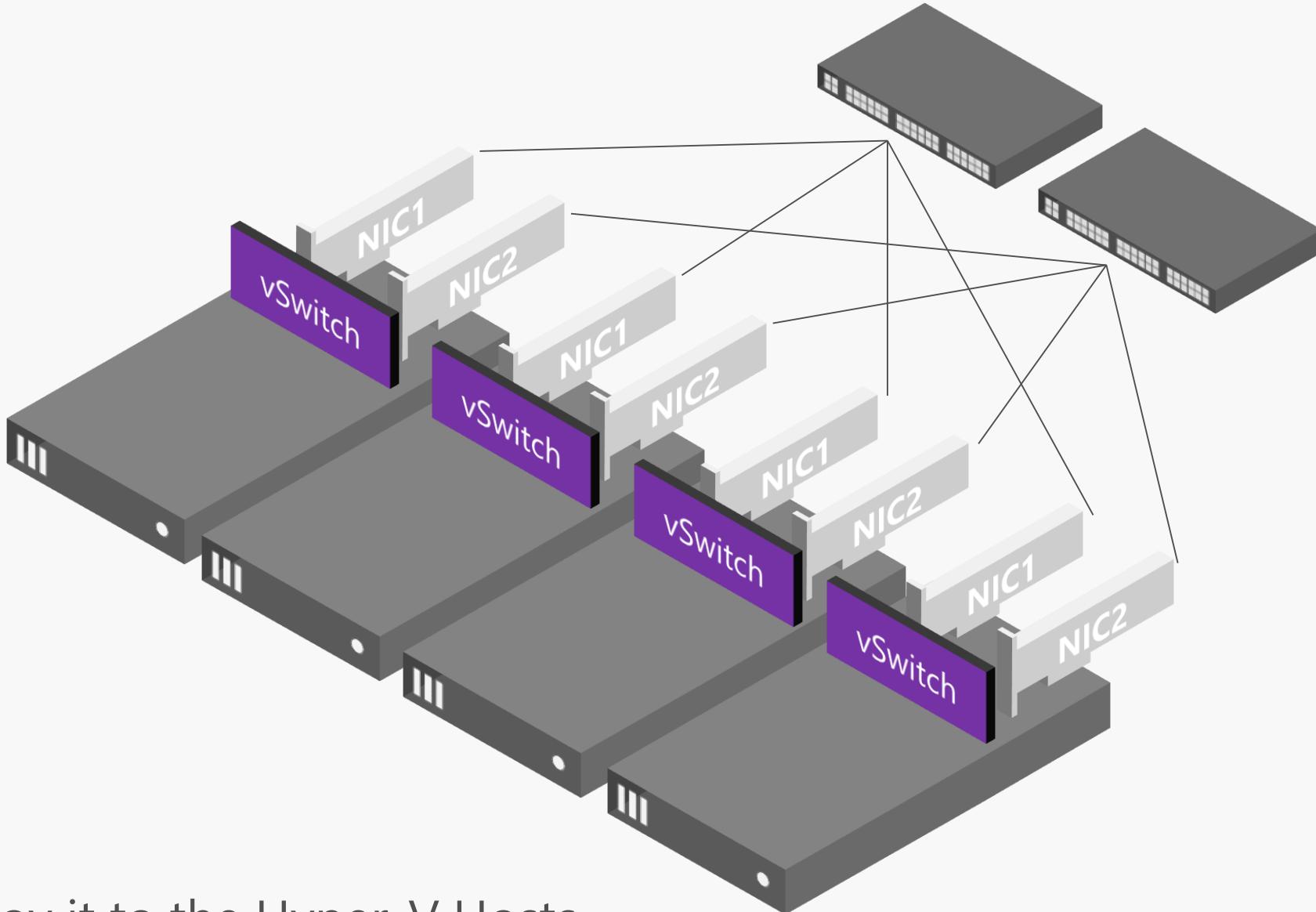
VMM  
Logical  
Networks



Create a Logical Switch, ready  
to use Switch Embedded  
Teaming (SET)

Mgmt

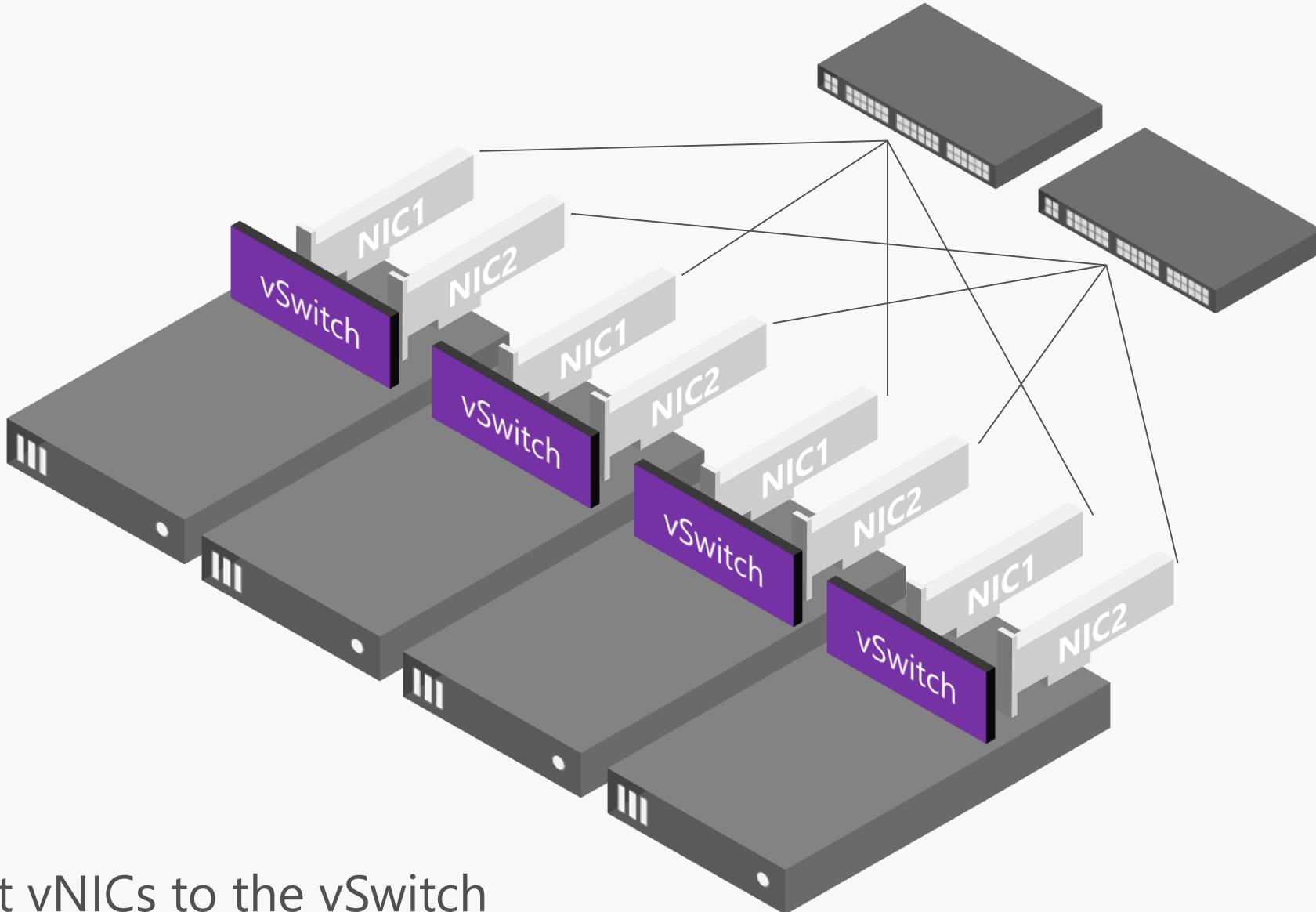
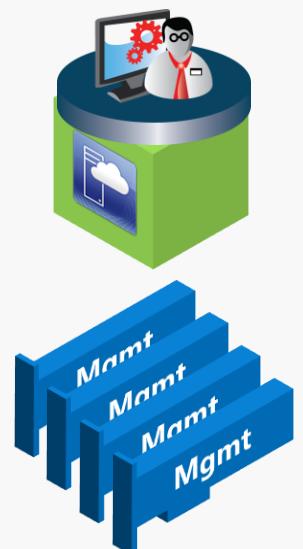
VMM  
Logical  
Networks



And deploy it to the Hyper-V Hosts

Mgmt

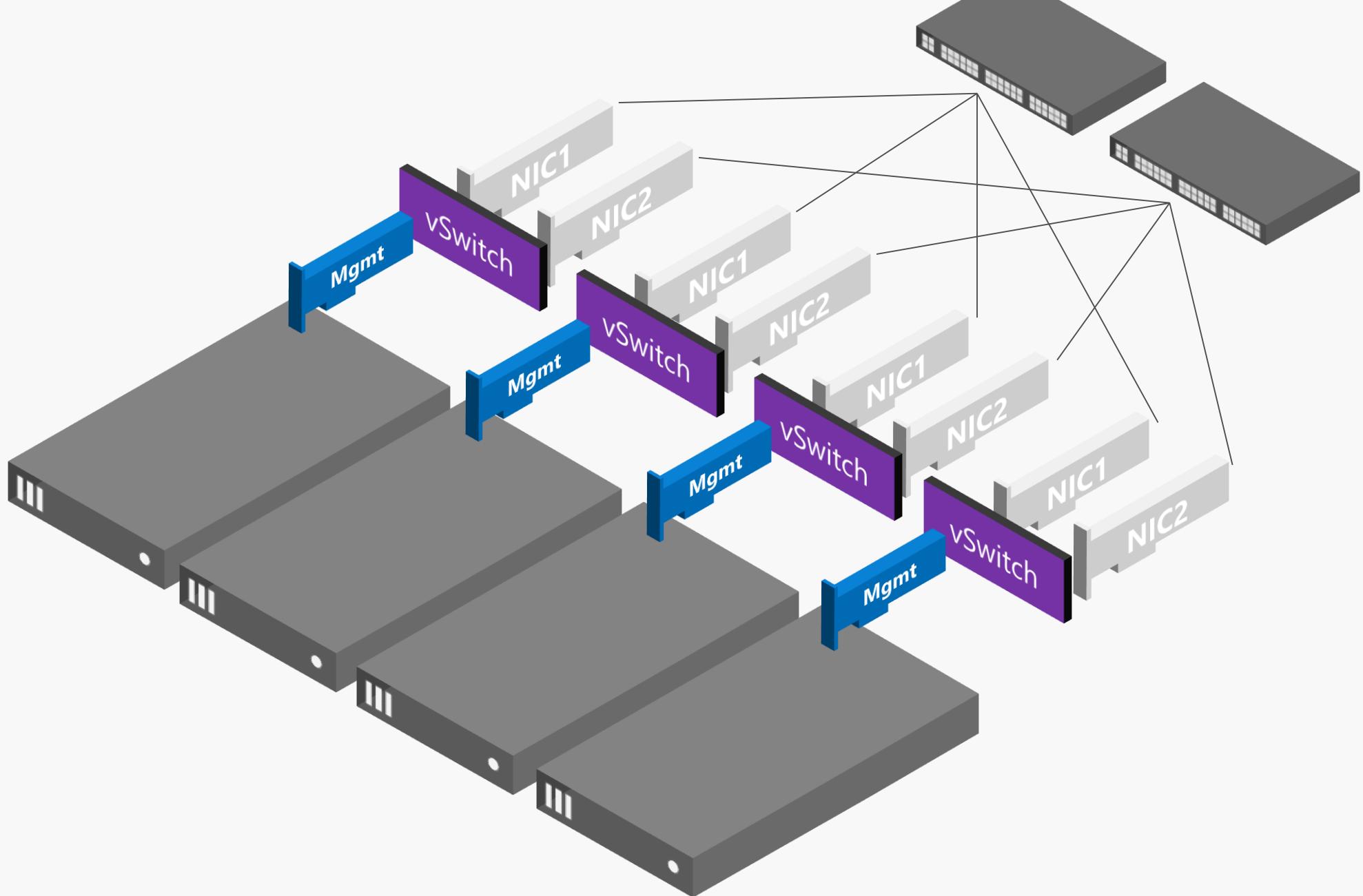
VMM  
Logical  
Networks



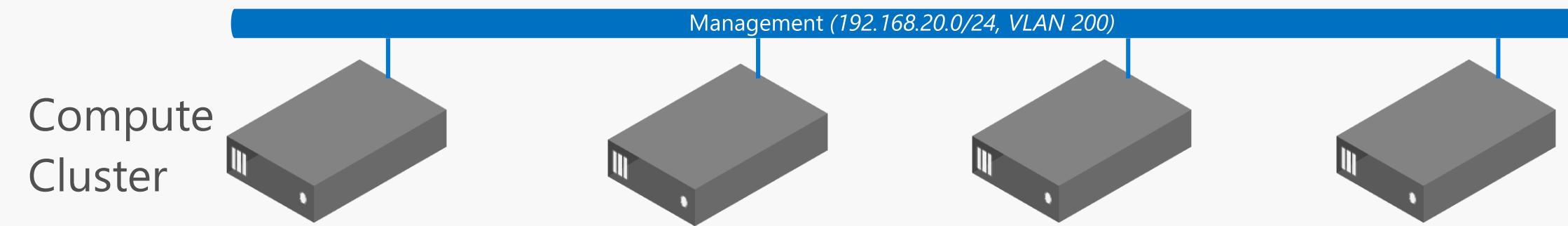
Attach Mgmt Host vNICs to the vSwitch

Mgmt

VMM  
Logical  
Networks



# Logical Network Diagram



# Step 1. Deploy Network Controller

# Review the Physical Network Plan

## Top of Rack (ToR) Switch

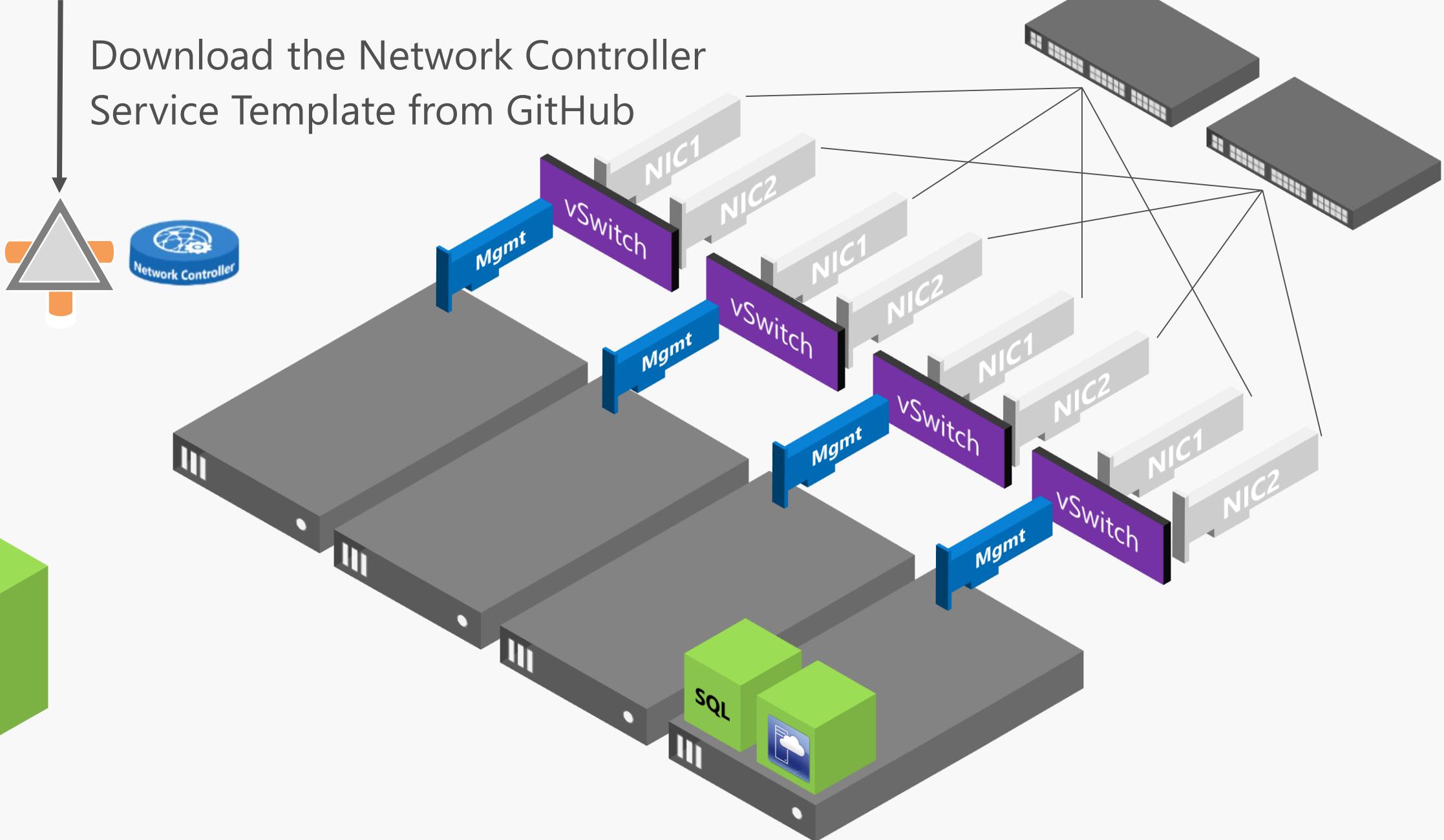
Network	IP Prefix	VLAN	Default Gateway	IP Pool
Management	192.168.20.0/24	200	192.168.20.1	*.51 – *.100
HNV Provider				
Transit				
Public VIP				
Private VIP				

- One Management IP Address per Network Controller Node VM
- (Optional) One Management IP Address for Network Controller REST Endpoint

Mgmt

VMM  
Logical  
Networks

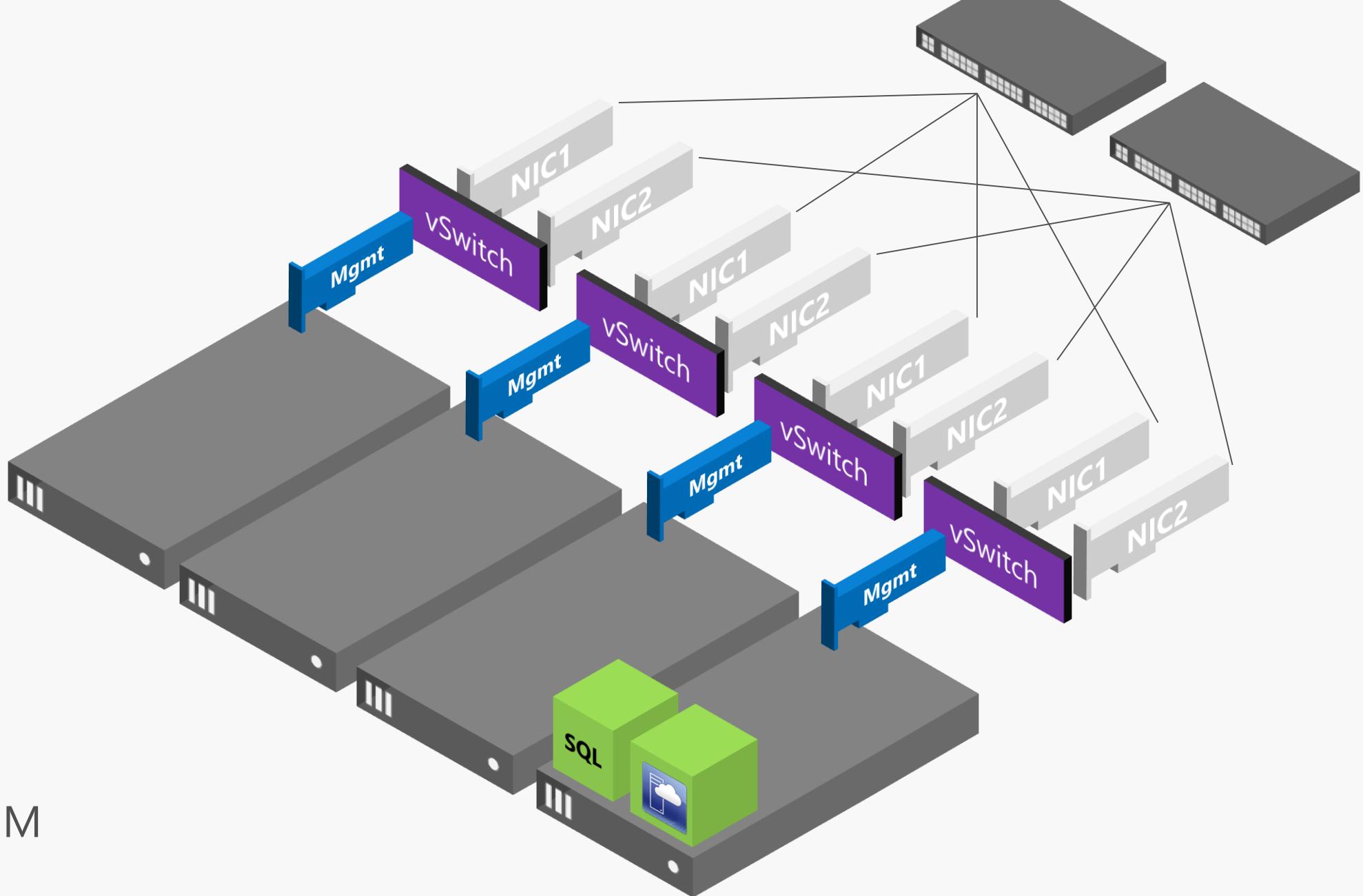
Download the Network Controller Service Template from GitHub



<https://github.com/microsoft/SDN/VMM/Templates>

Mgmt

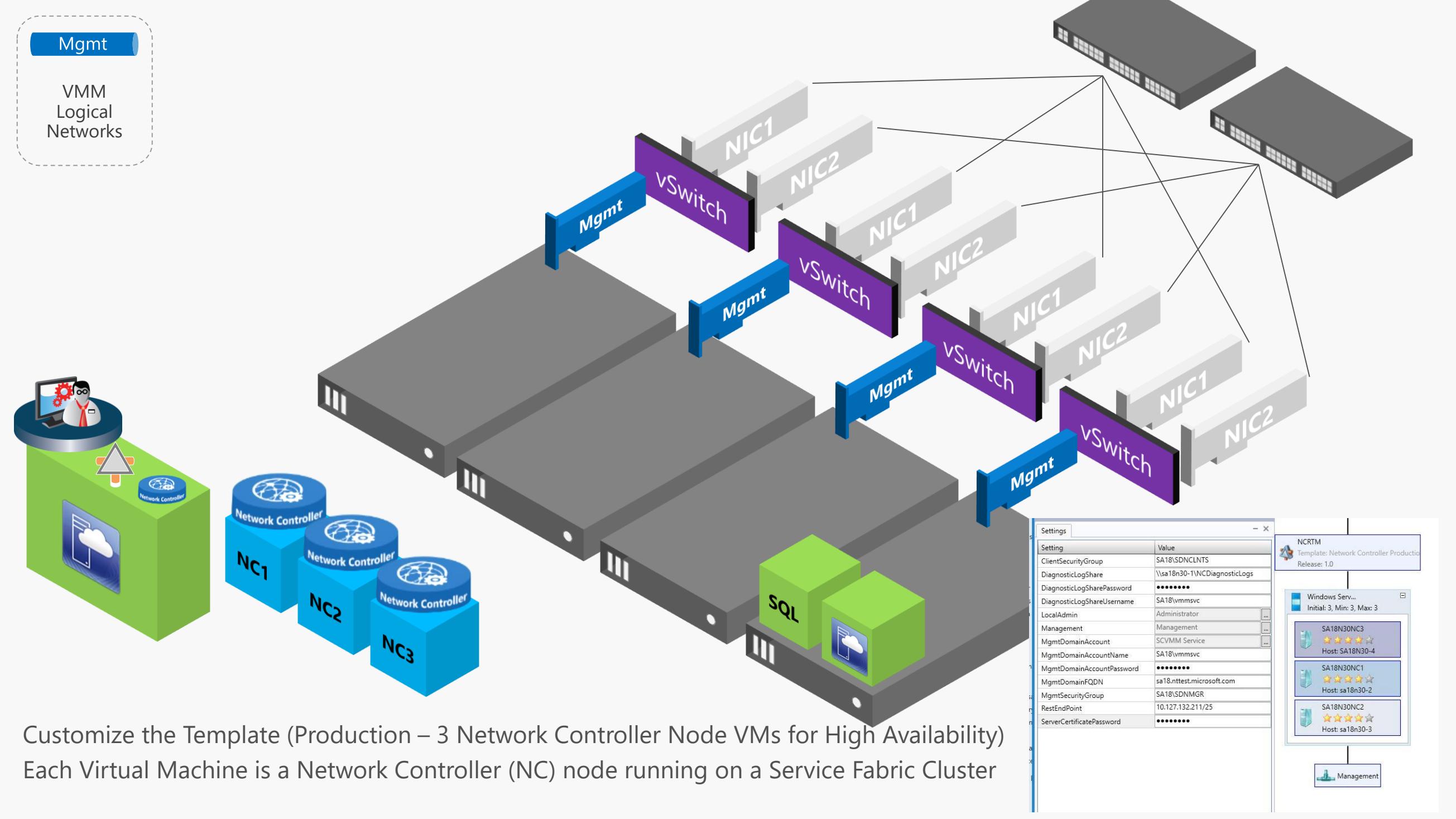
VMM  
Logical  
Networks



Import it into VMM

Mgmt

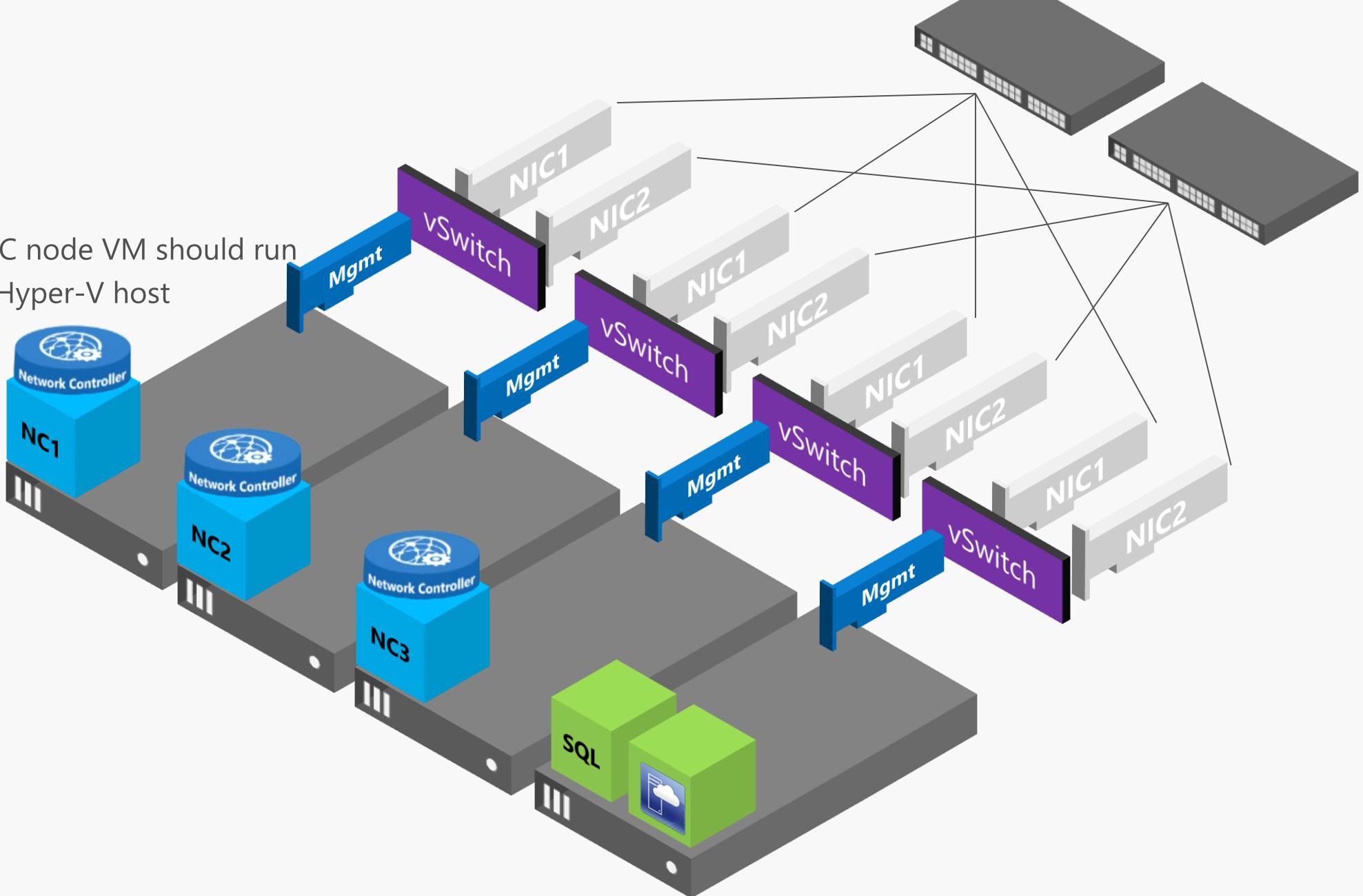
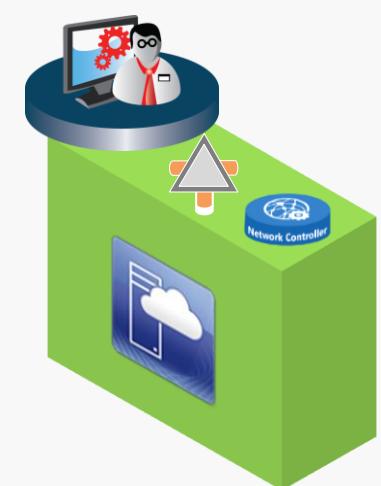
VMM  
Logical  
Networks



Mgmt

VMM  
Logical  
Networks

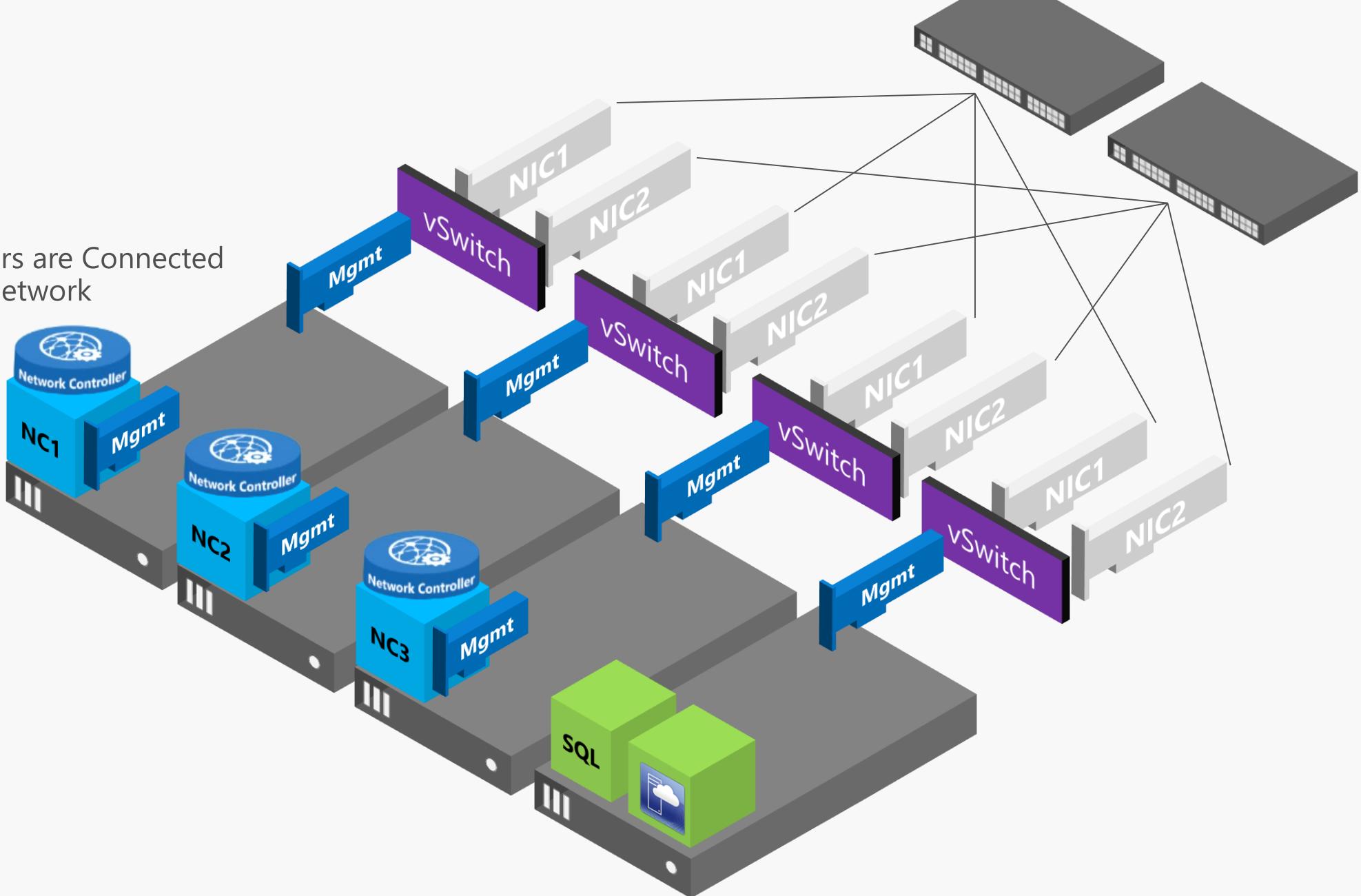
Ideally, each NC node VM should run  
on a different Hyper-V host

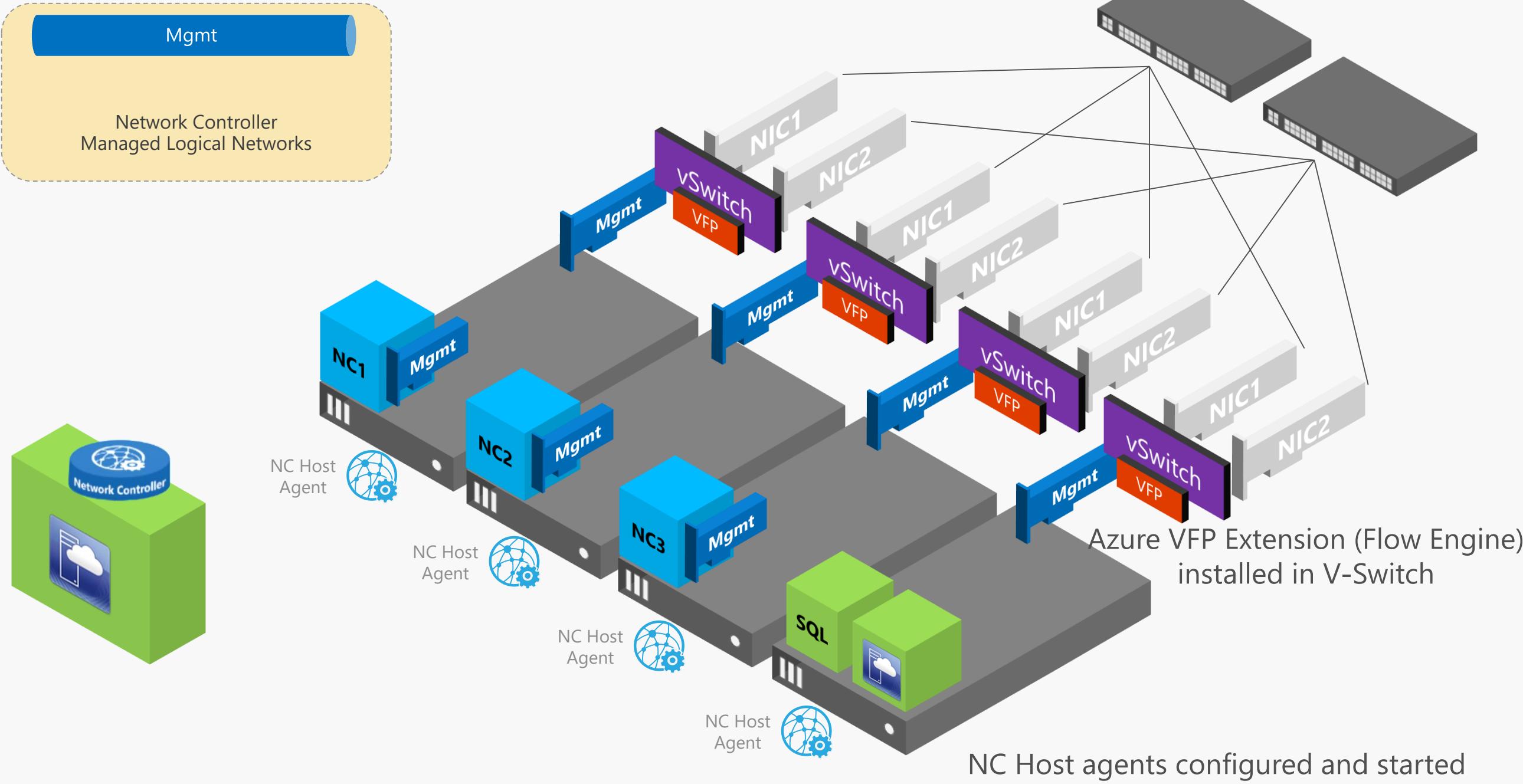


Mgmt

VMM  
Logical  
Networks

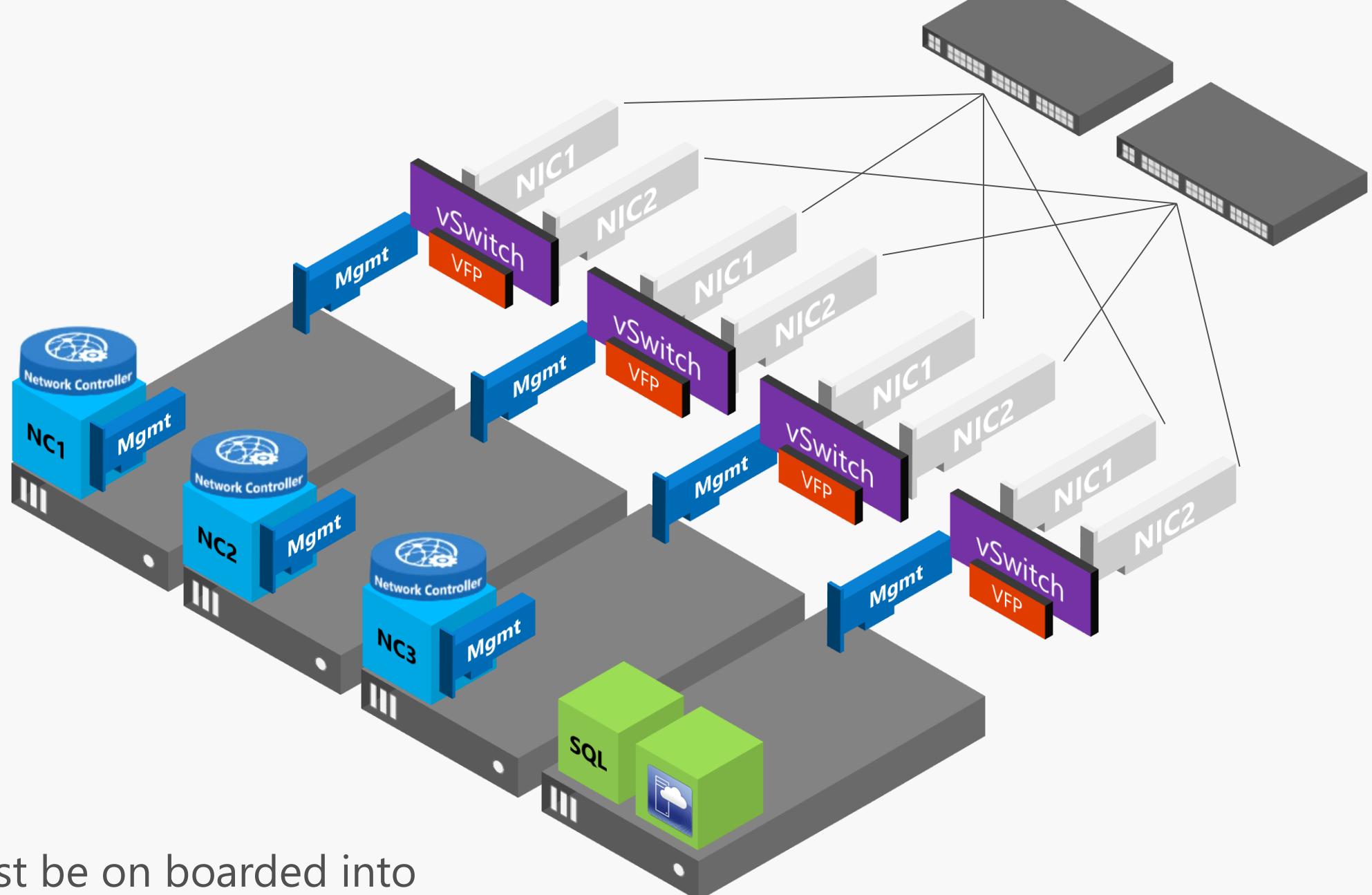
Network Controllers are Connected  
to Management Network





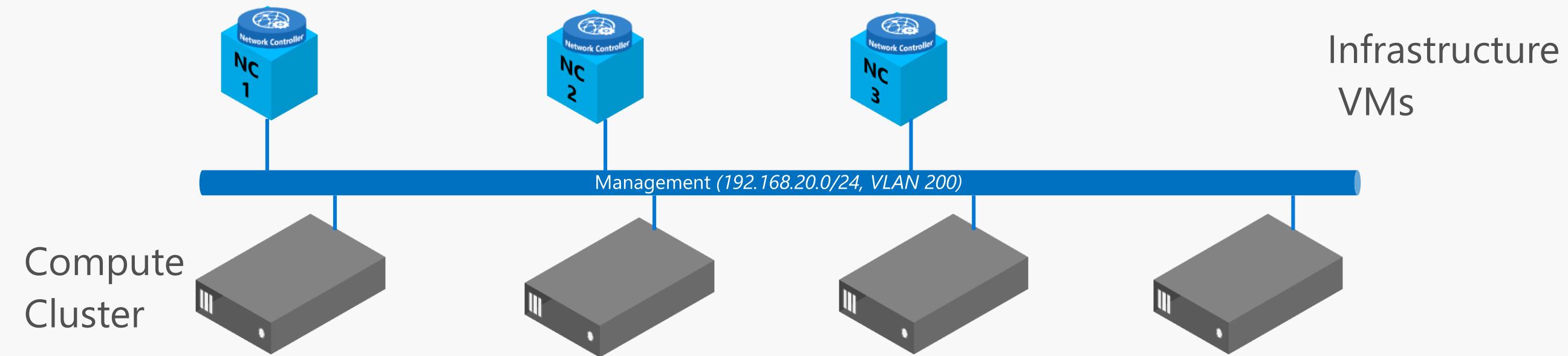
Mgmt

VMM  
Logical  
Networks



NC must be on boarded into  
VMM as a Network Service

# Logical Network Diagram



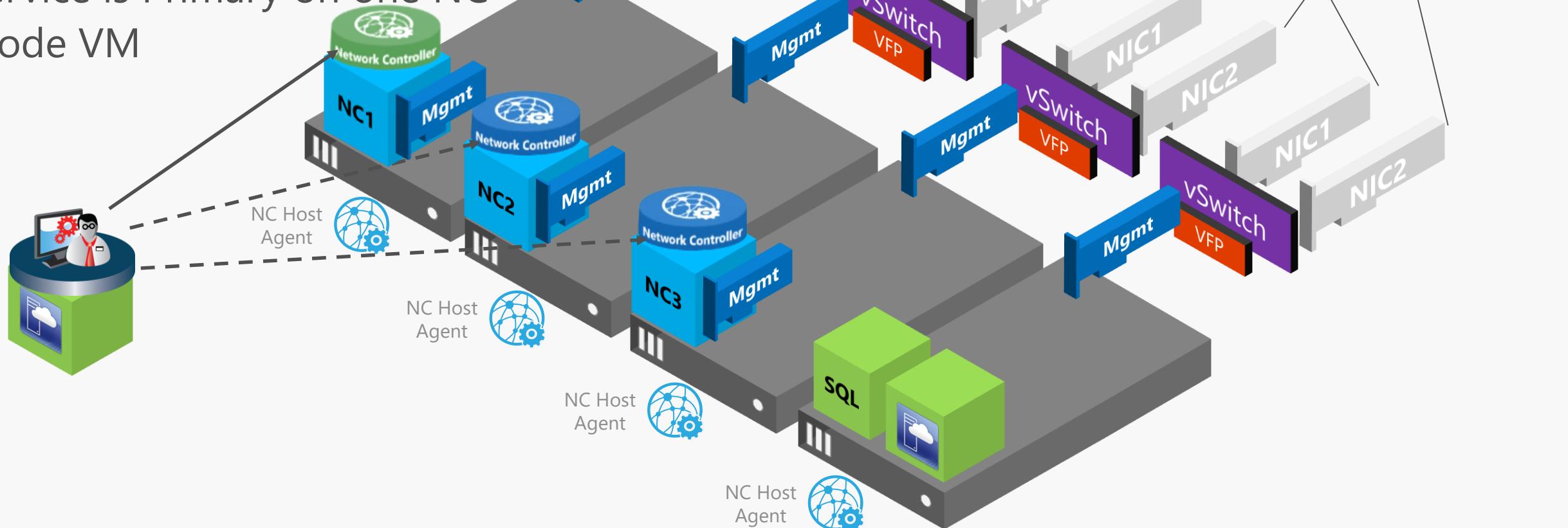
# DEMO: Onboard Microsoft Network Controller in SCVMM

SDN Fabric Deployment

Mgmt

Network Controller  
Managed Logical Networks

Network Controller REST API  
service is Primary on one NC  
Node VM



Through VMM communicating with the NC service we can now Create, Manage and Delete policy and resources such Logical Networks, Virtual Networks, Access Control Lists, Load Balancers...

## Step 2. Create Tenant VM Networks and Deploy VMs

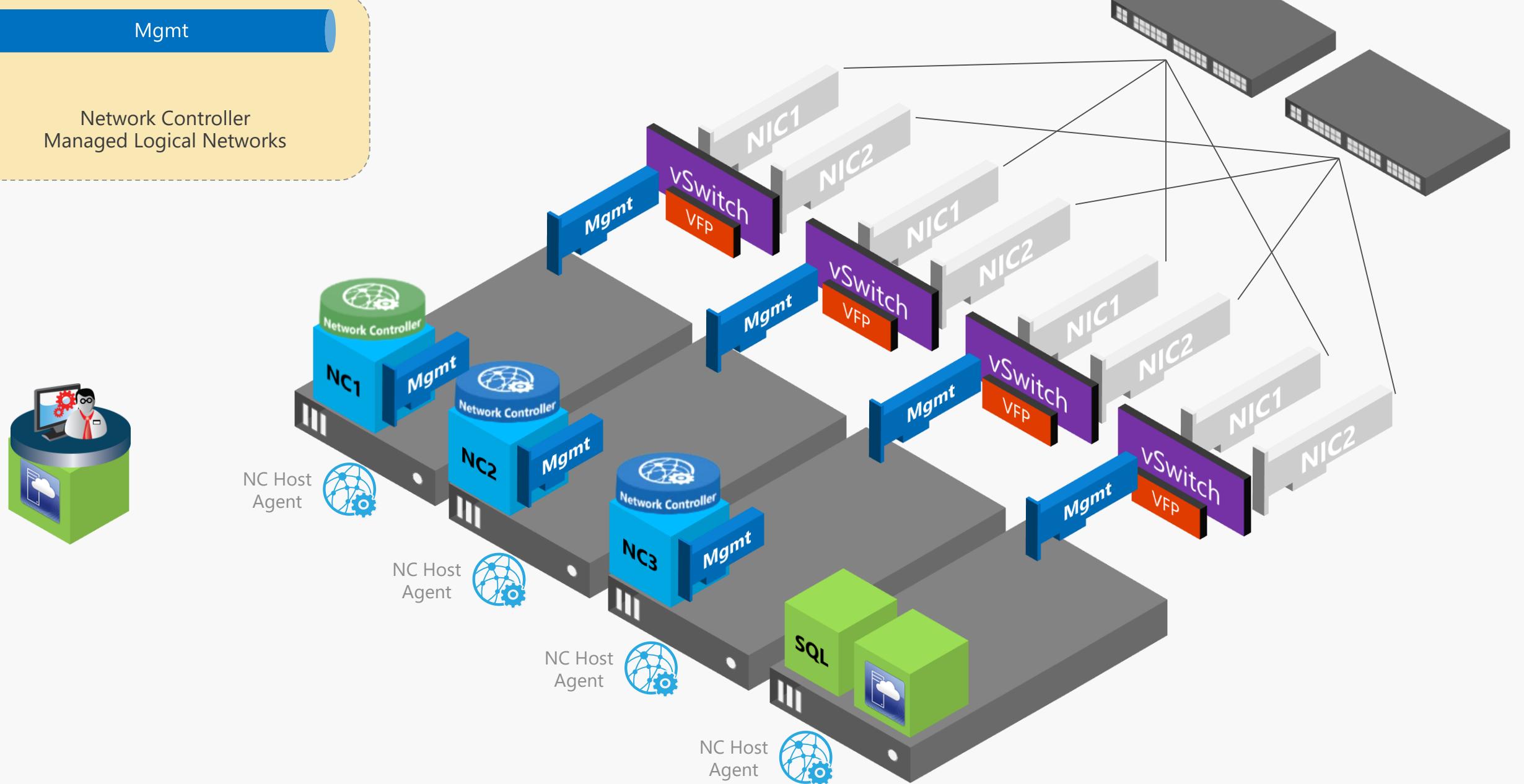
# Review the Physical Network Plan

Create the HNV Provider Logical Network

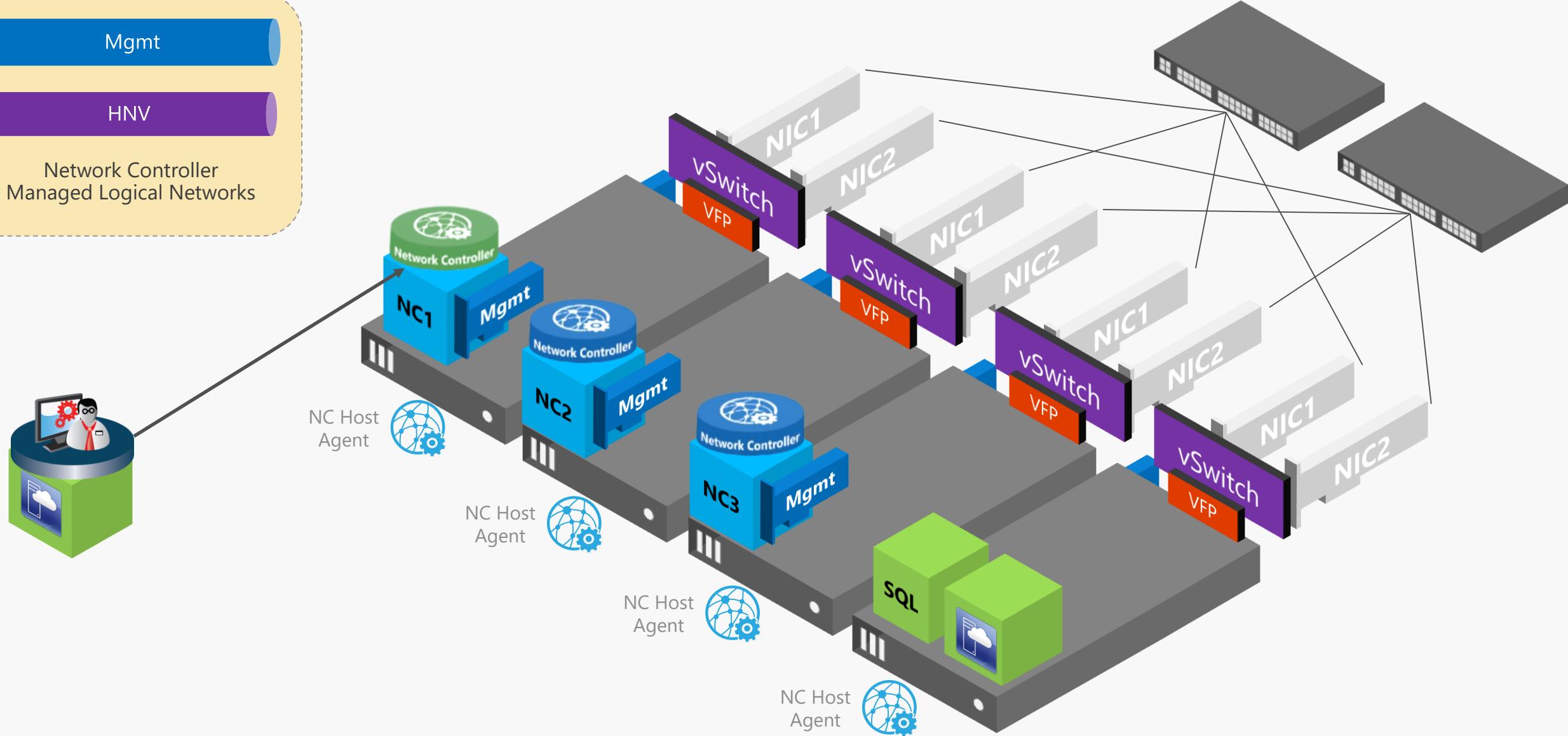
## Top of Rack (ToR) Switch

Network	IP Prefix	VLAN	Default Gateway	IP Pool
Management	192.168.20.0/24	200	192.168.20.1	*.51 – *.100
HNV Provider	192.168.21.0/24	201	192.168.21.1	*.51 - *.100
Transit				
Public VIP				
Private VIP				

- One Management IP Address per Network Controller Node VM
- (Optional) One Management IP Address for Network Controller REST Endpoint
- Two HNV Provider IP Addresses per Hyper-V Host

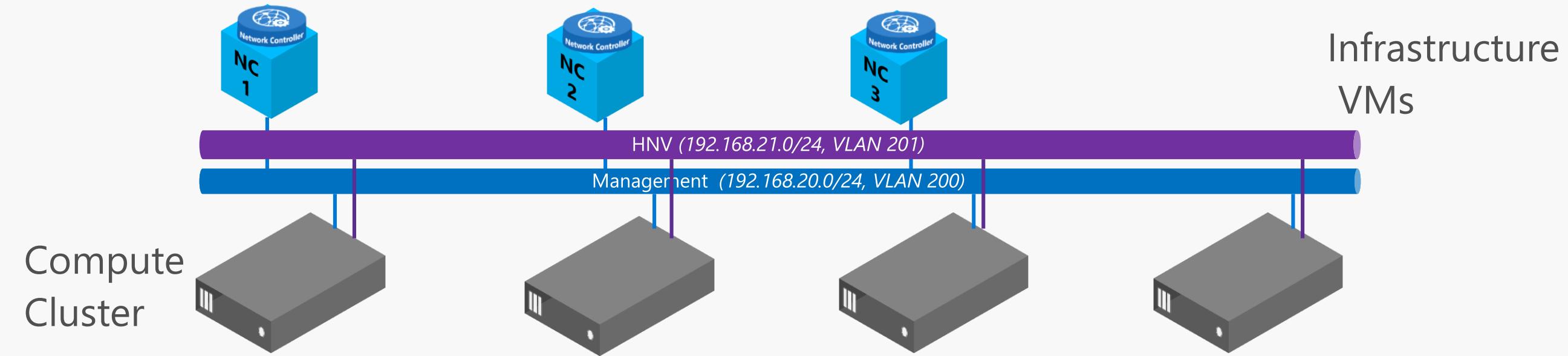


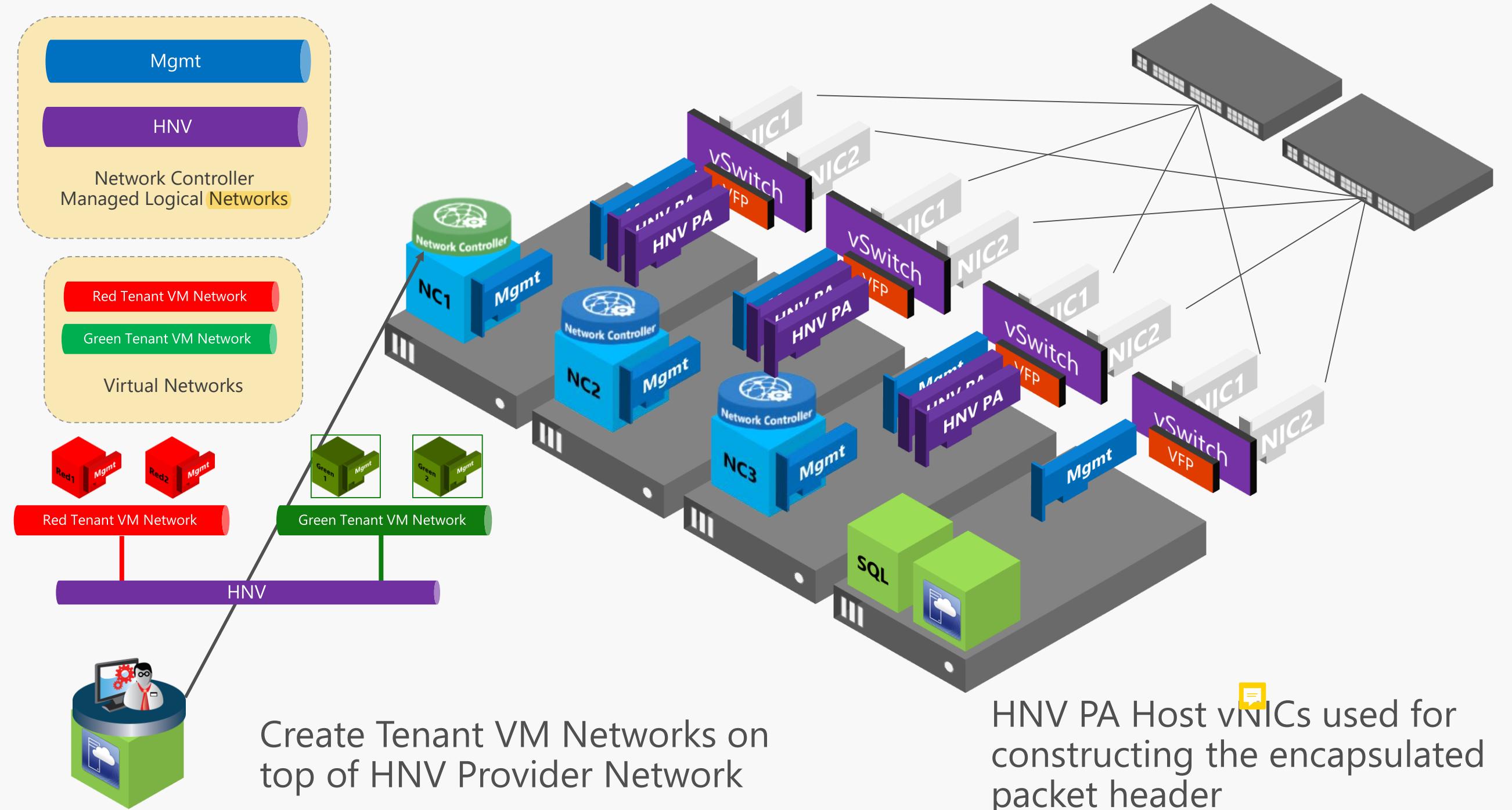
Let's use the Microsoft Network Controller to create some Tenant Virtual Networks!!

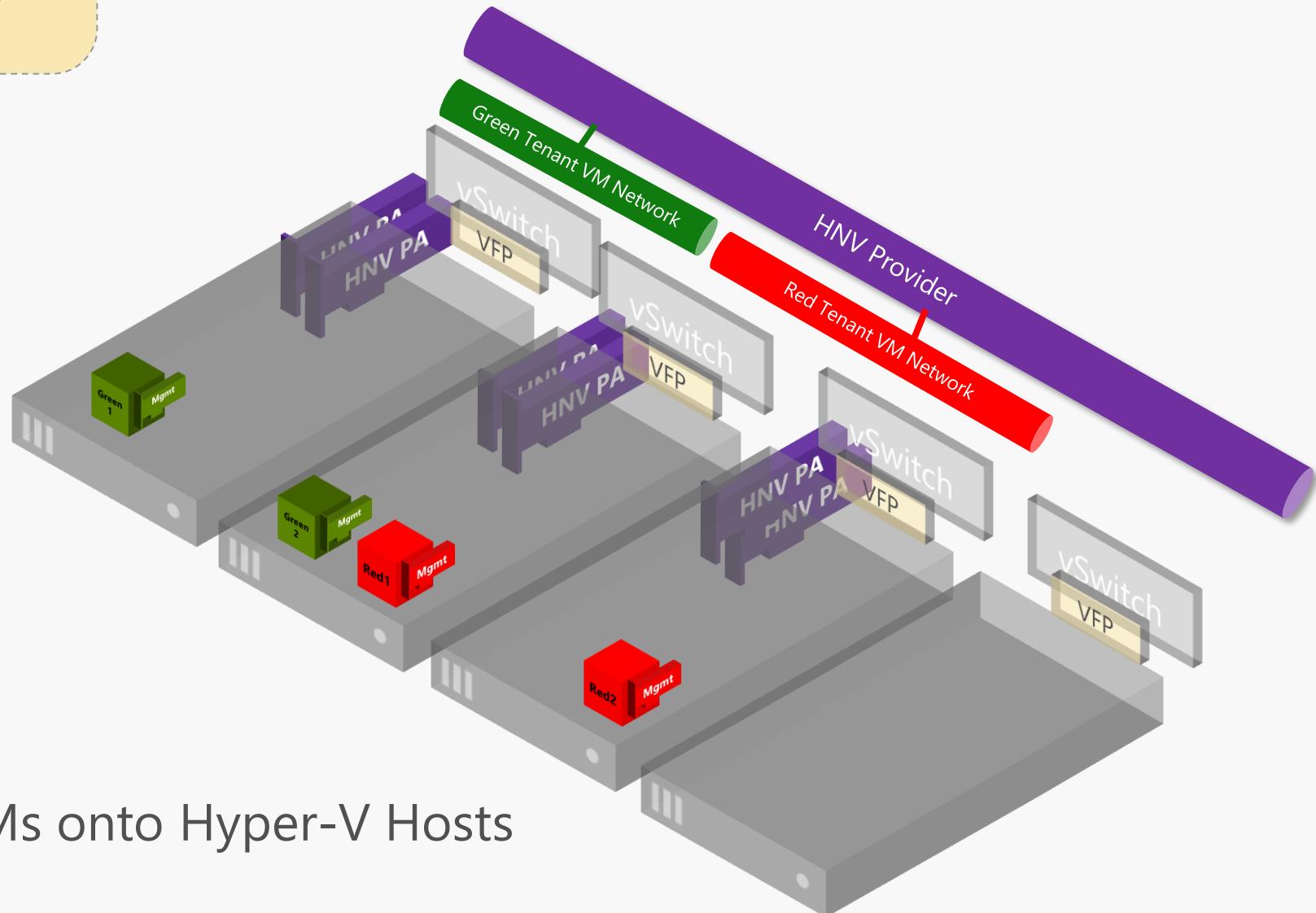
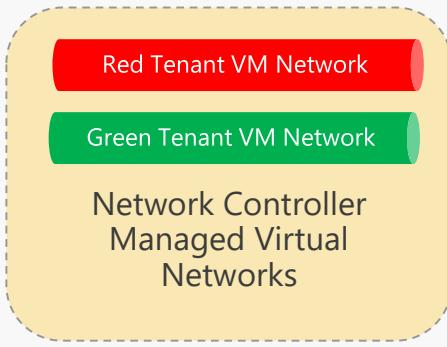
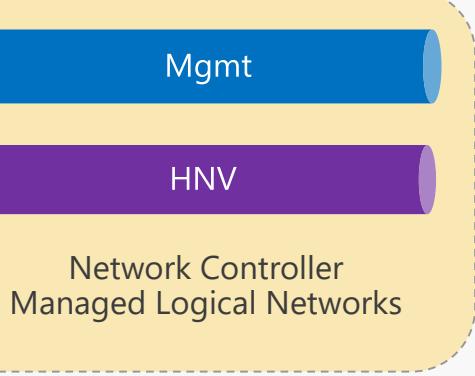


Start by creating an HNV Provider Logical Network and IP Pool for carrying encapsulated tenant traffic

# Logical Network Diagram

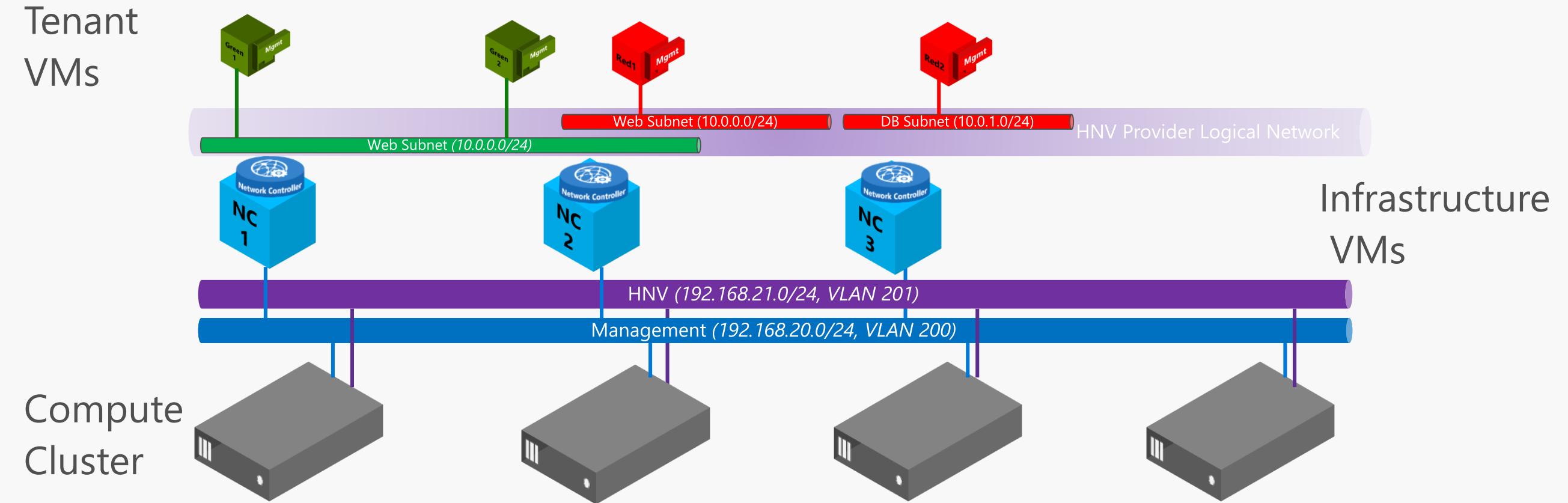






## Deploy VMs onto Hyper-V Hosts

# Logical Network Diagram



# DEMO: Deploy Virtual Networks and VMs

SDN Tenant Deployment

## Step 3. Deploy Software Load Balancer

# Review the Physical Network Plan

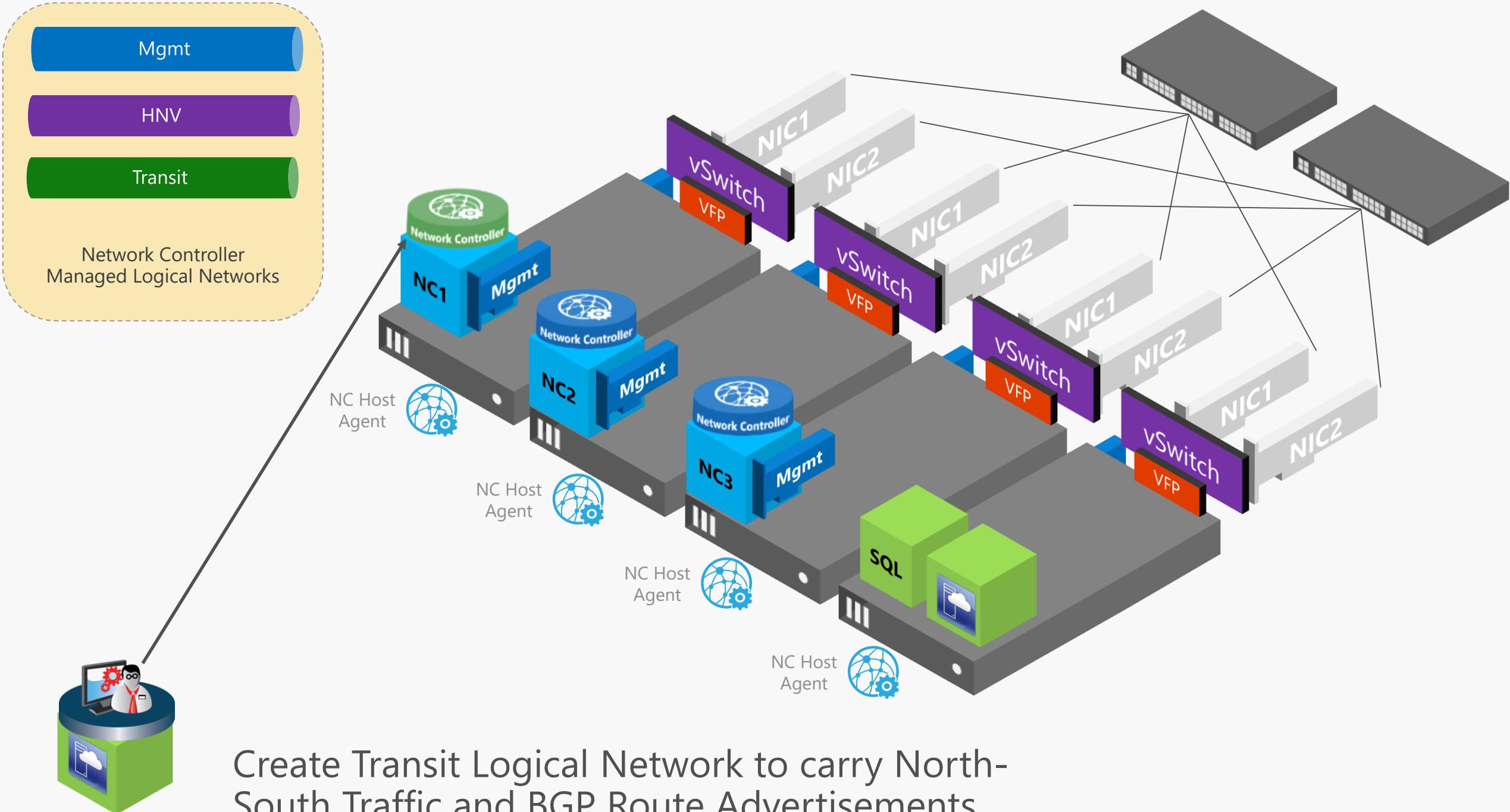
Create the Transit Logical Network

## Top of Rack (ToR) Switch

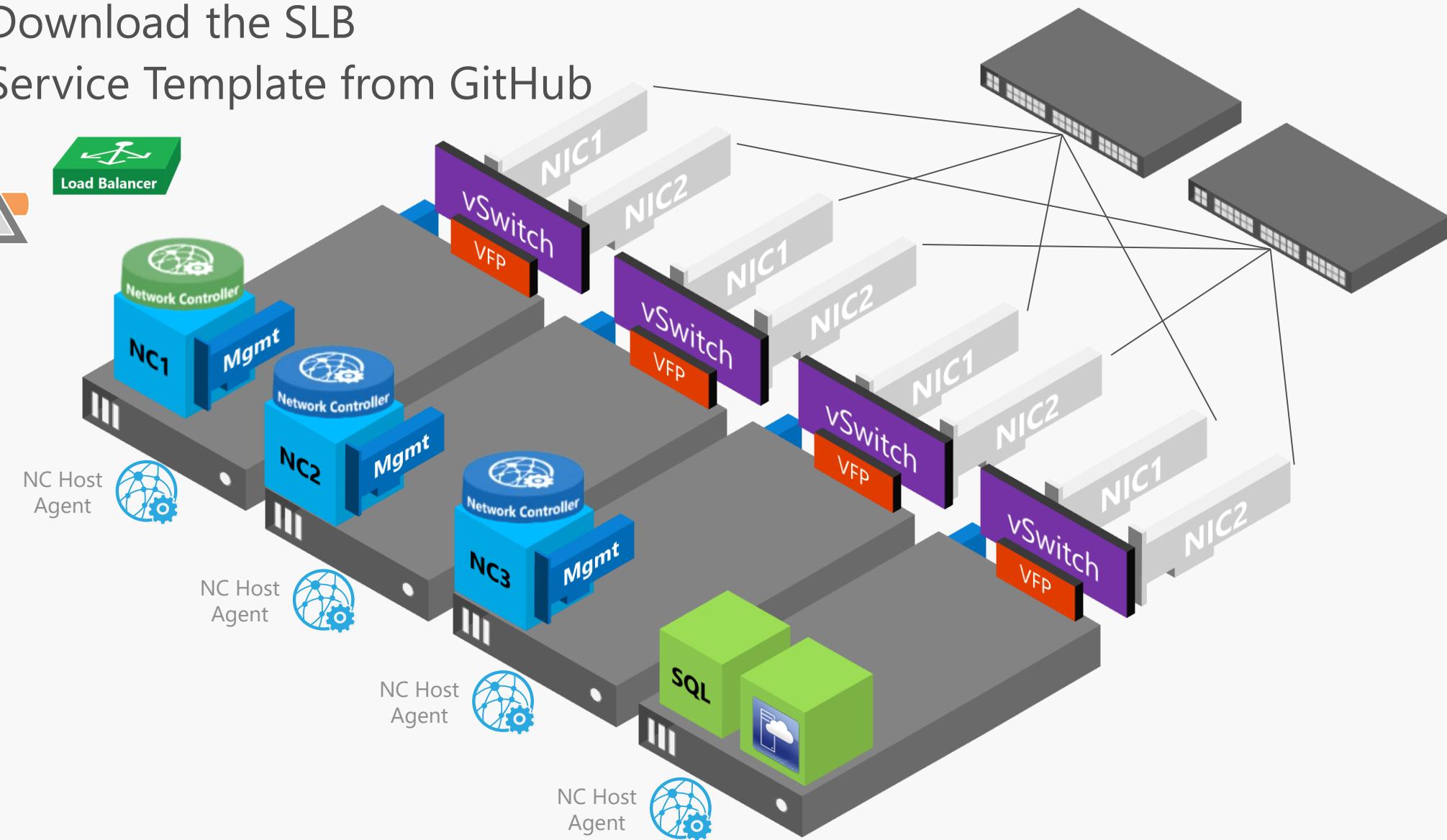
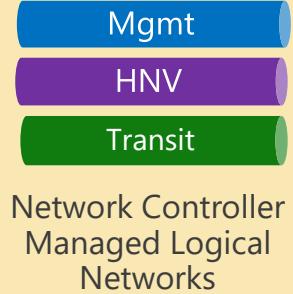
Network	IP Prefix	VLAN	Default Gateway	IP Pool
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HNV Provider	192.168.21.0/24	201	192.168.21.1	*.51 – *.100
Transit	192.168.30.0/24	300	192.168.30.1	*.51 – *.100
Public VIP				
Private VIP				

- One Management IP Address per Software Load Balancer Mux VM
- One HNV Provider IP Address per Software Load Balancer Mux VM
- One Transit IP Address per Software Load Balancer Mux VM

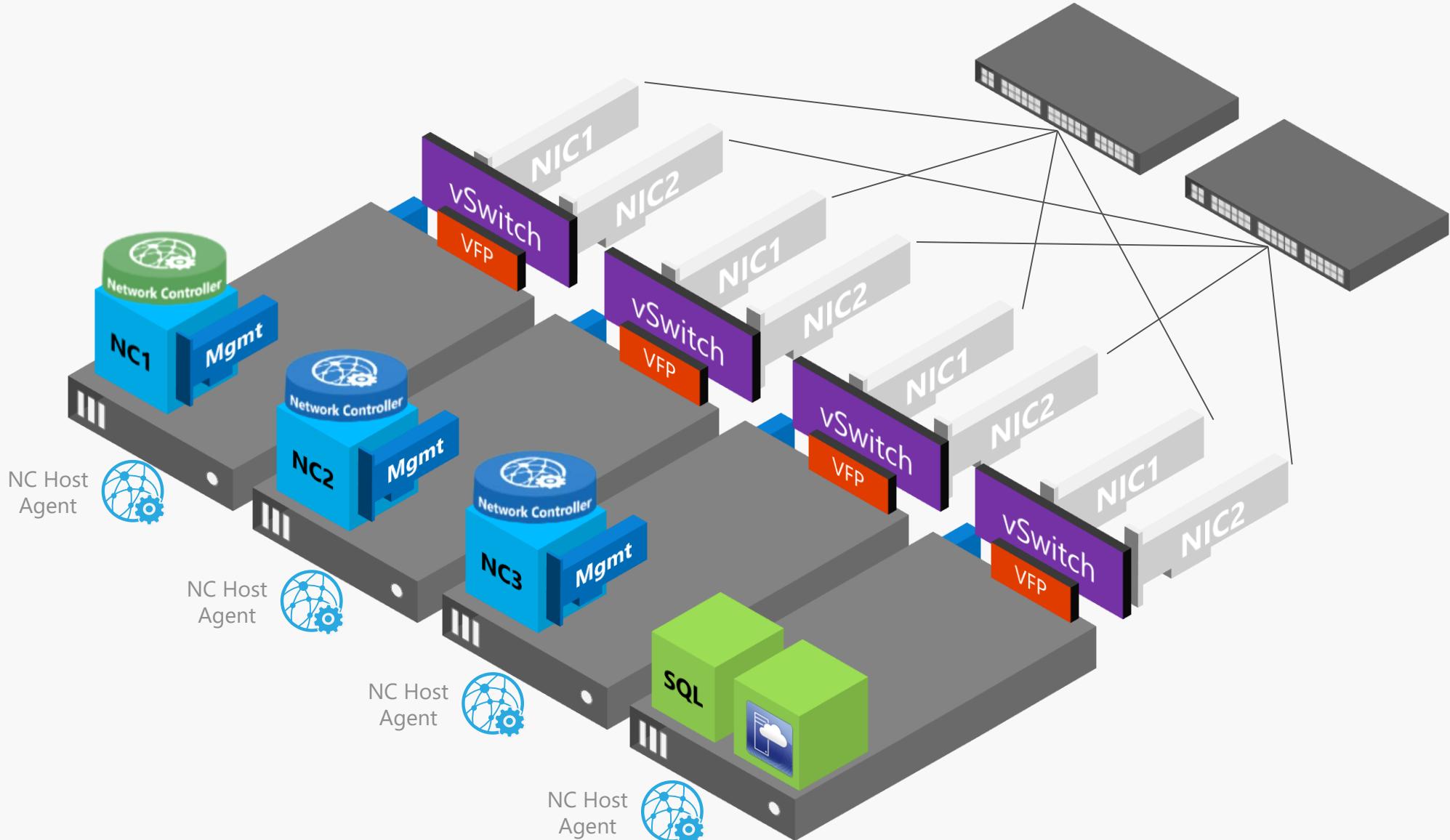
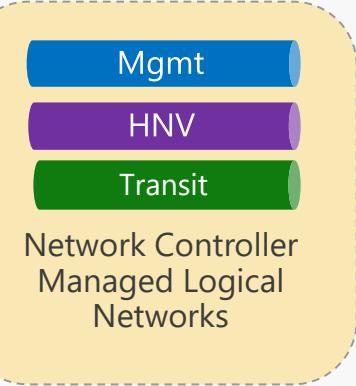




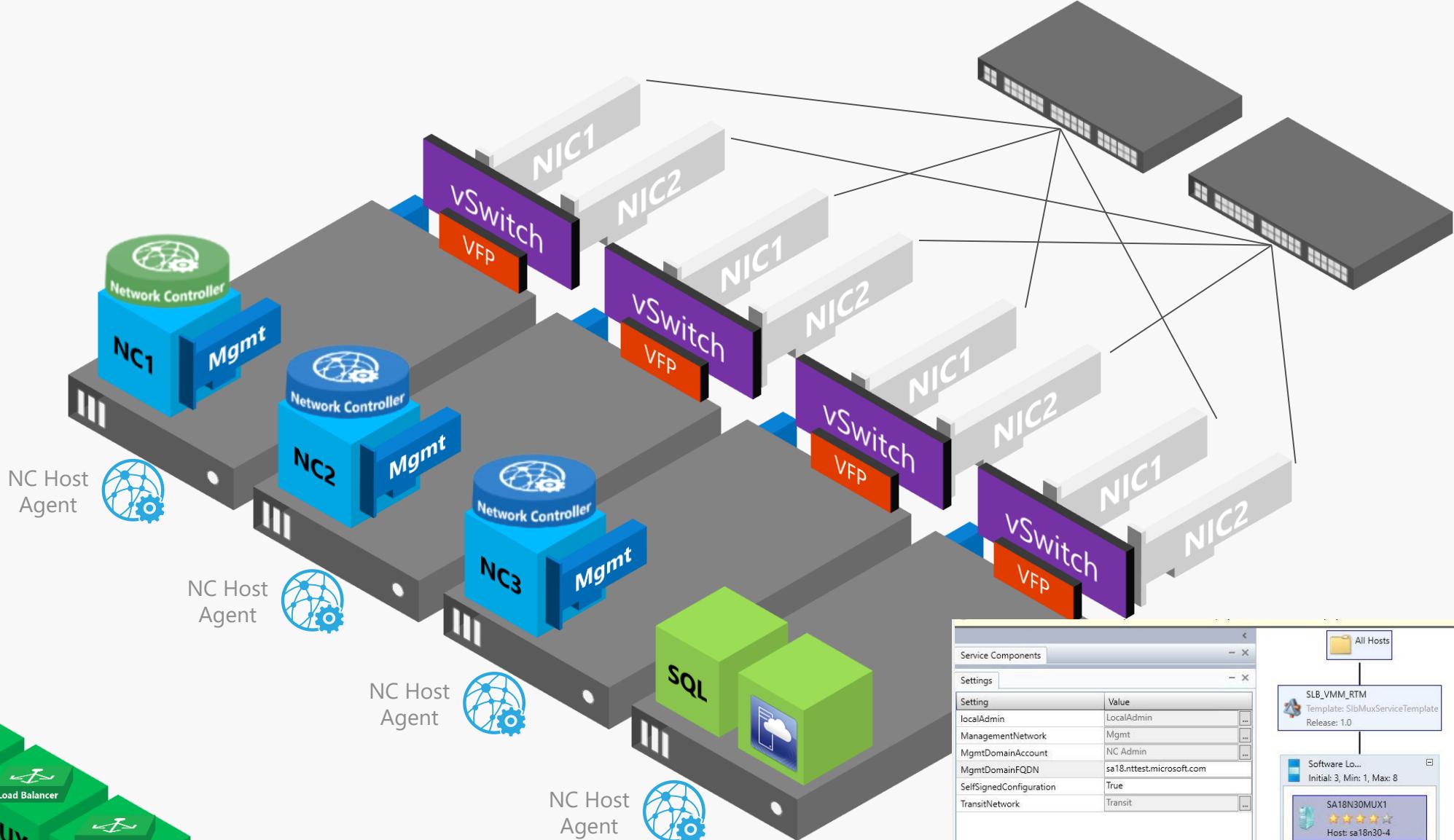
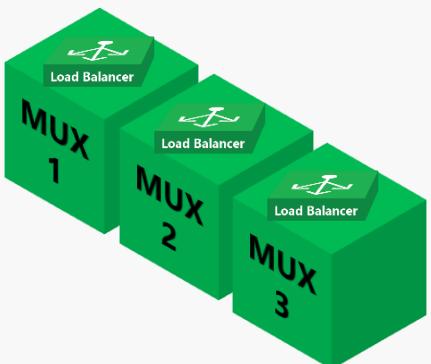
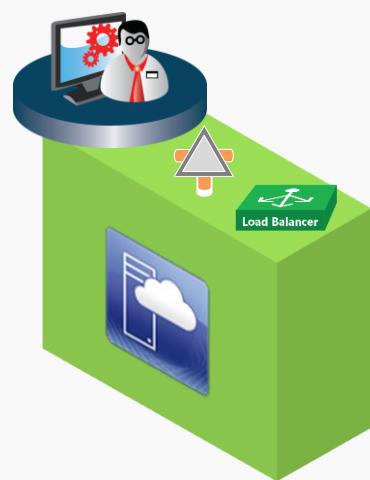
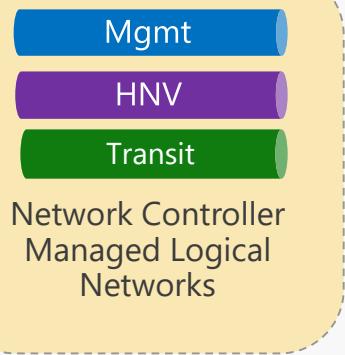
# Download the SLB Service Template from GitHub



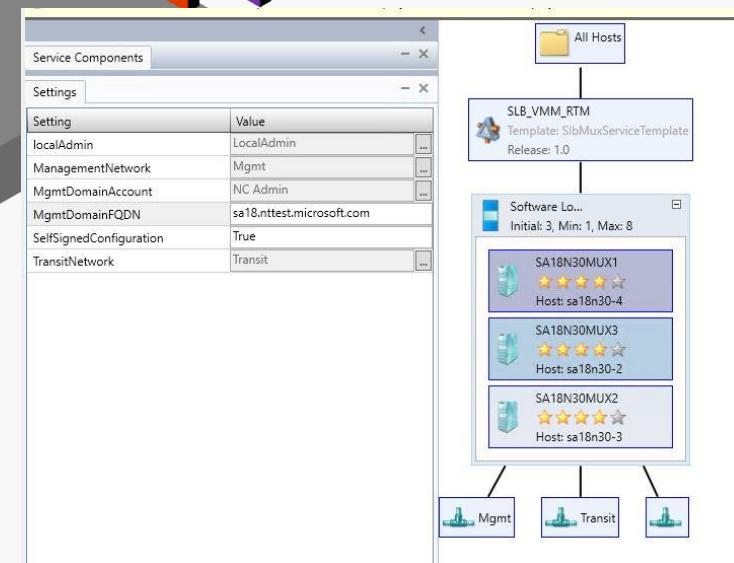
<https://github.com/microsoft/SDN/VMM/Templates>

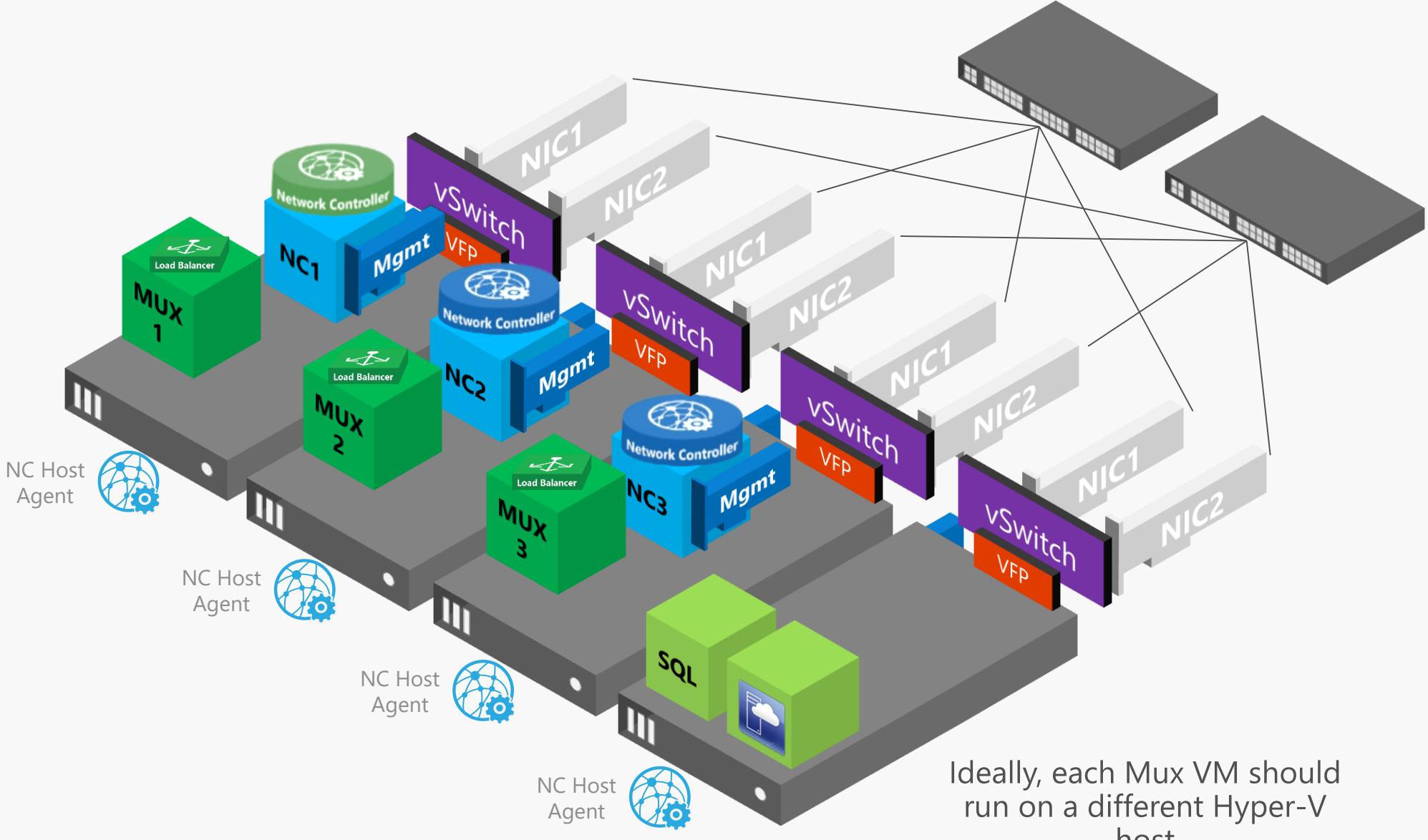
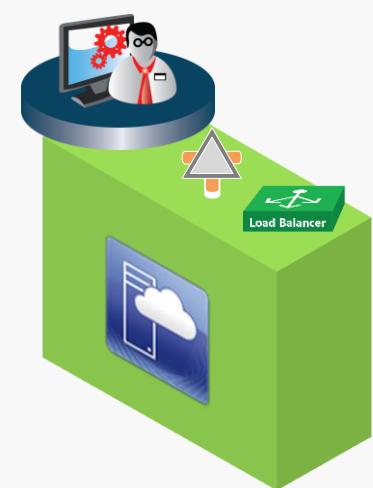
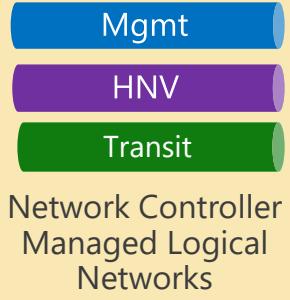


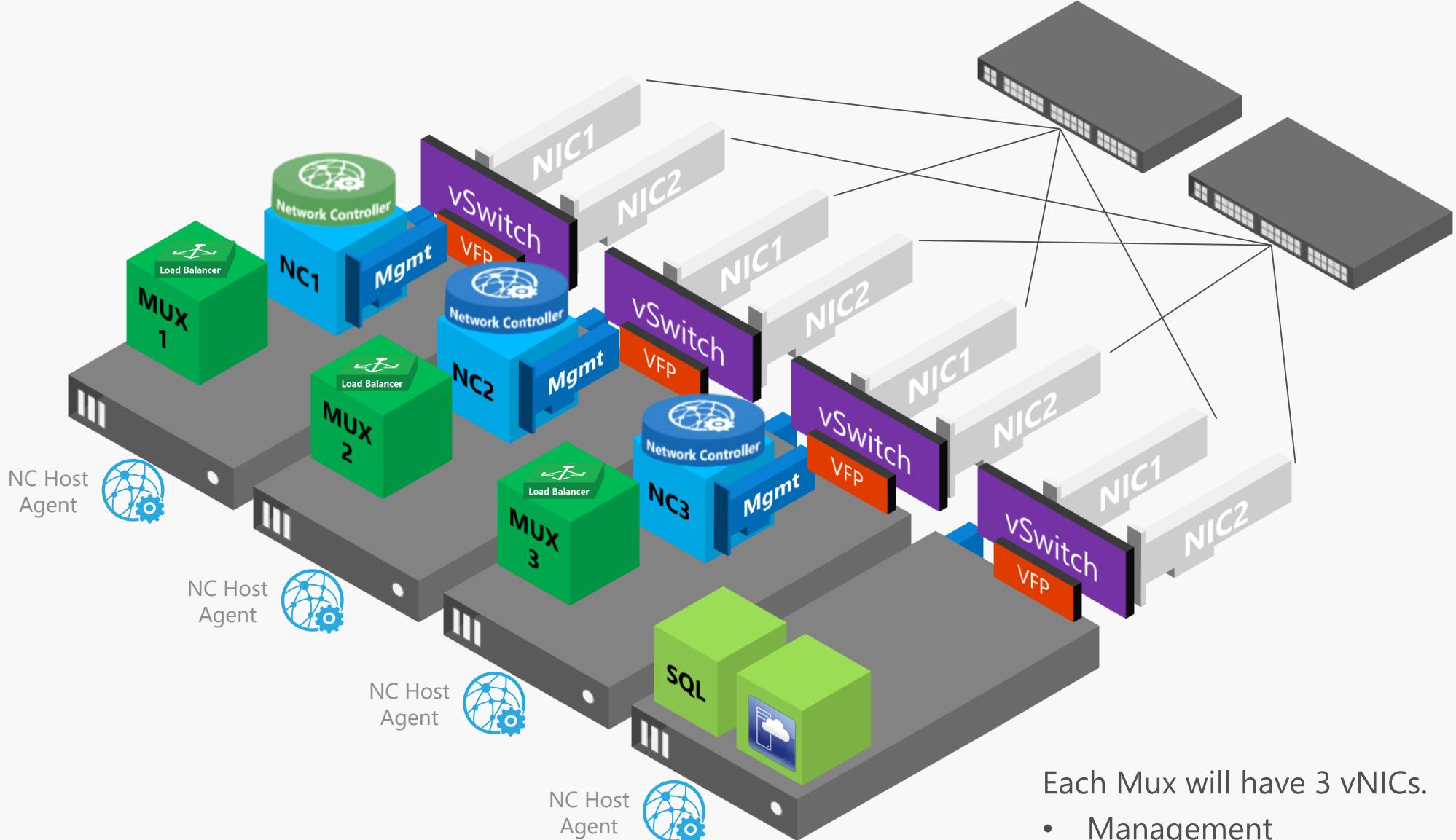
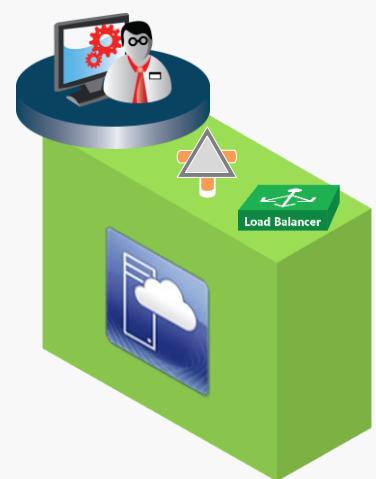
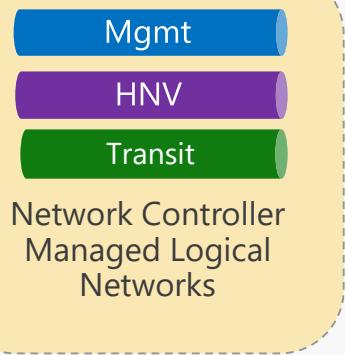
Import the SLB Service  
Template to VMM



SLB (Production) Service Template  
 creates 3 SLB Mux VMs

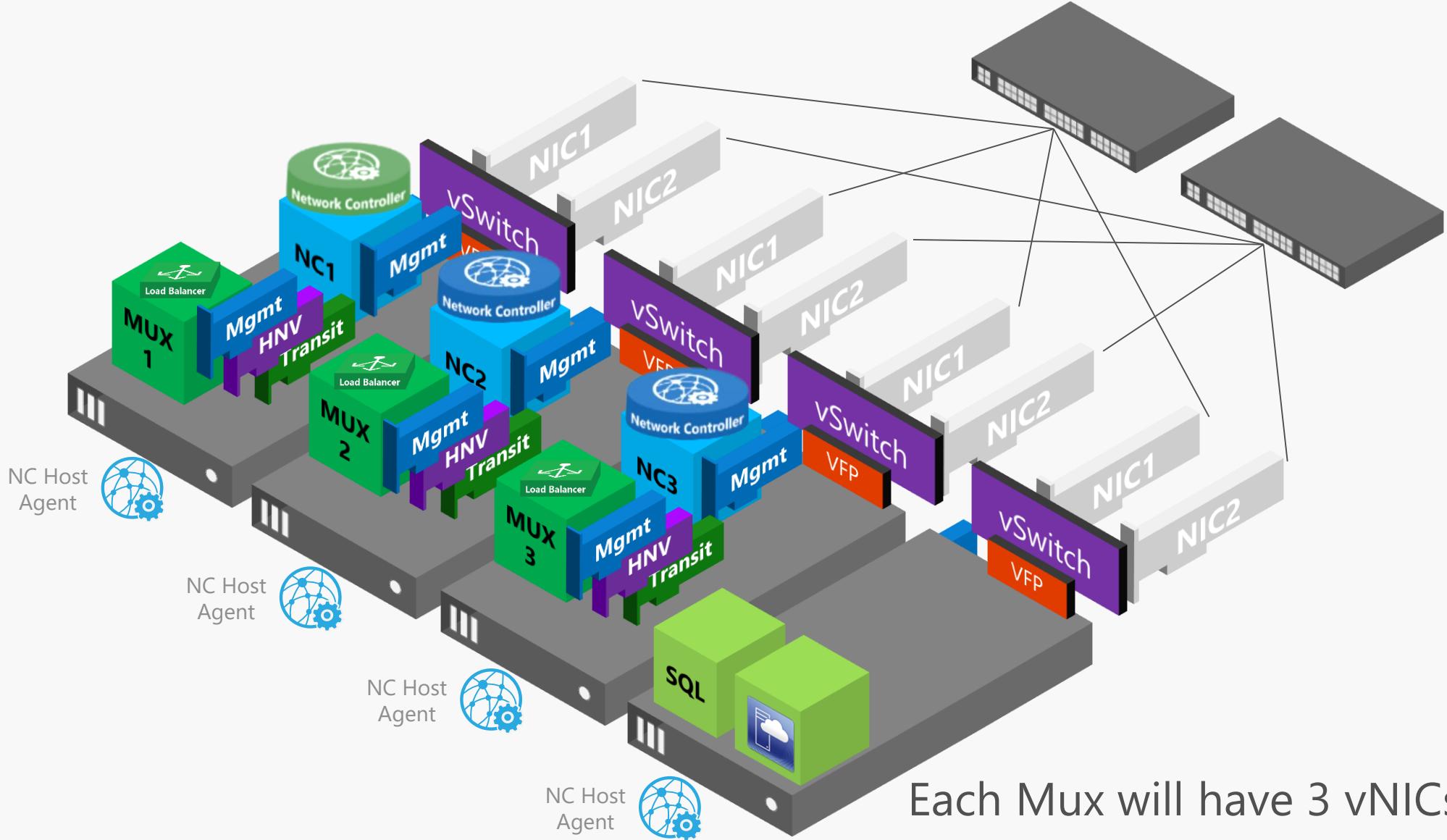
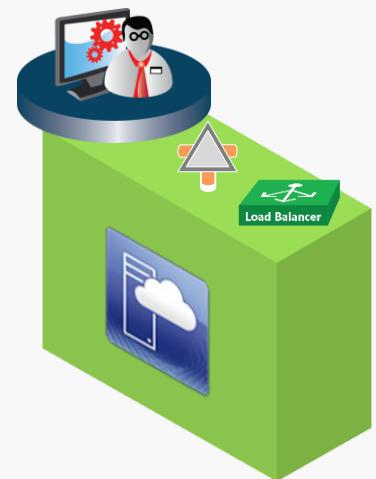
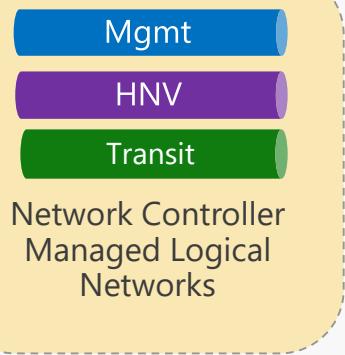






Each Mux will have 3 vNICs.

- Management
- HNV
- Transit



NC Host Agent

NC Host Agent

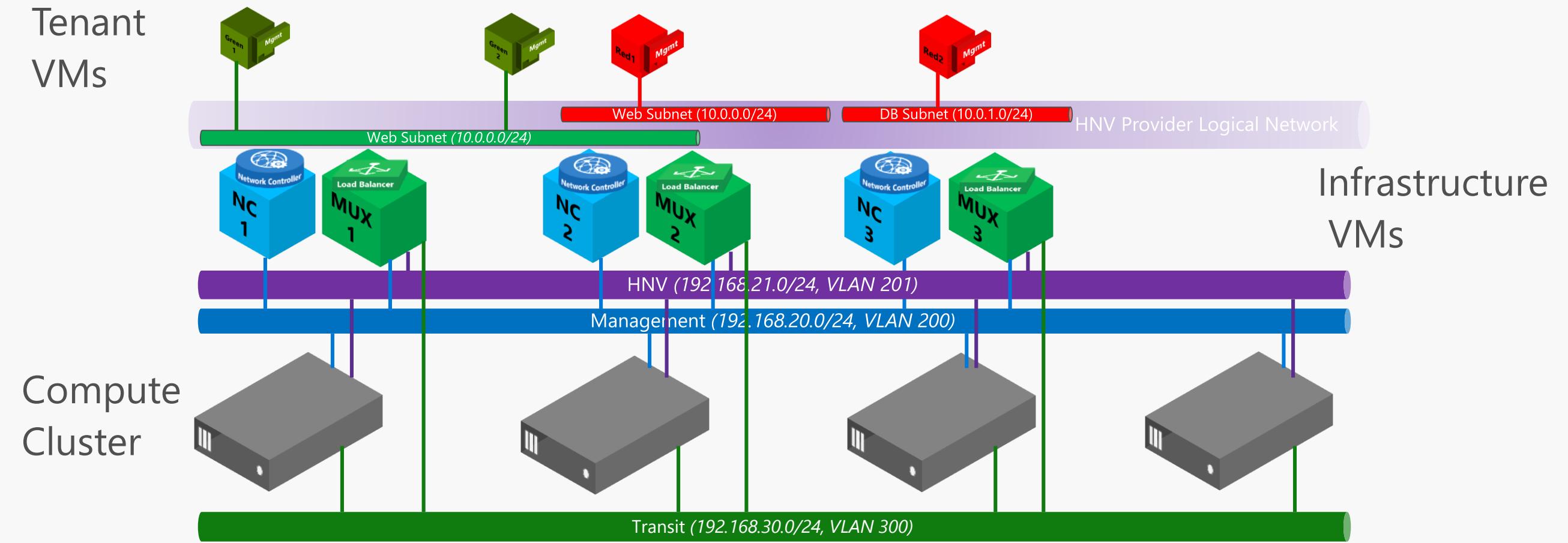
NC Host Agent

NC Host Agent

Each Mux will have 3 vNICs

- Management
- HNV
- Transit

# Logical Network Diagram



# Review the Physical Network Plan

Create the Private and Public Virtual IP (VIP) Logical Networks

## Top of Rack (ToR) Switch

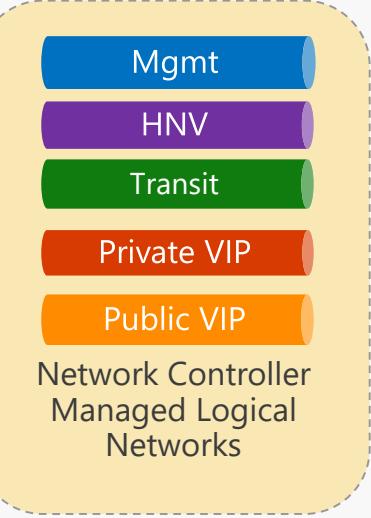
Network	IP Prefix	VLAN	Default Gateway	IP Pool
Management	192.168.20.0/24	200	192.168.20.1	*.51 – *.100
HNV Provider	192.168.21.0/24	201	192.168.21.1	*.51 – *.100
Transit	192.168.30.0/24	300	192.168.30.1	*.51 – *.100
Public VIP	10.10.10.0/24	NA	10.10.10.1*	*.51 – *.100
Private VIP	20.20.20.0/24	NA	20.20.20.1*	*.51 – *.100

**Public VIPs** should be routable outside the datacenter

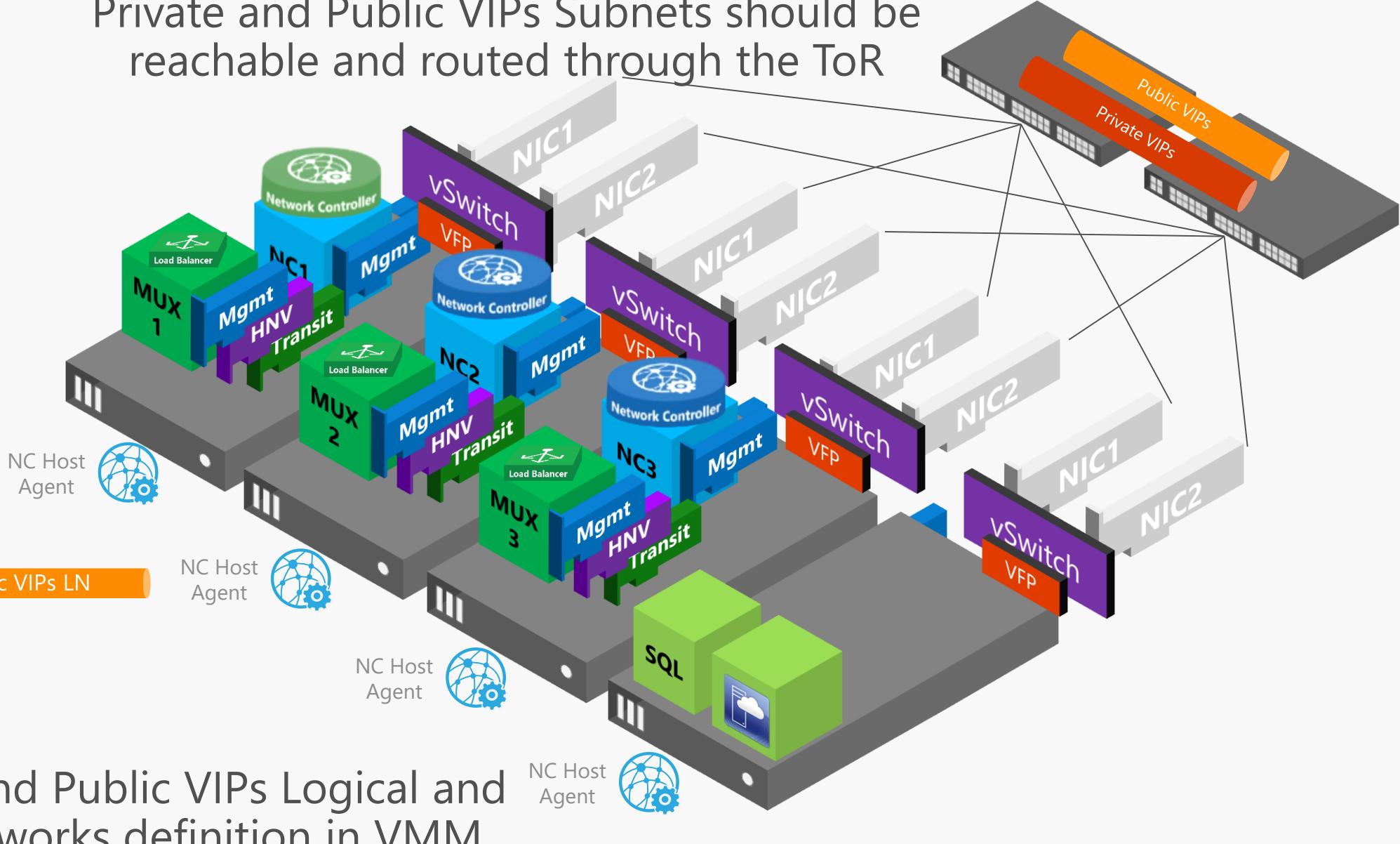
**Private VIPs** only need to be routable inside the datacenter

- Public and Private VIPs will be provided for external connectivity
- One Private VIP IP Address will be used by the SLB Manager for communication with Hyper-V Hosts

\*SCVMM currently requires that the first IP in any IP Pool be reserved for a gateway (even though no gateway is used by VIPs)

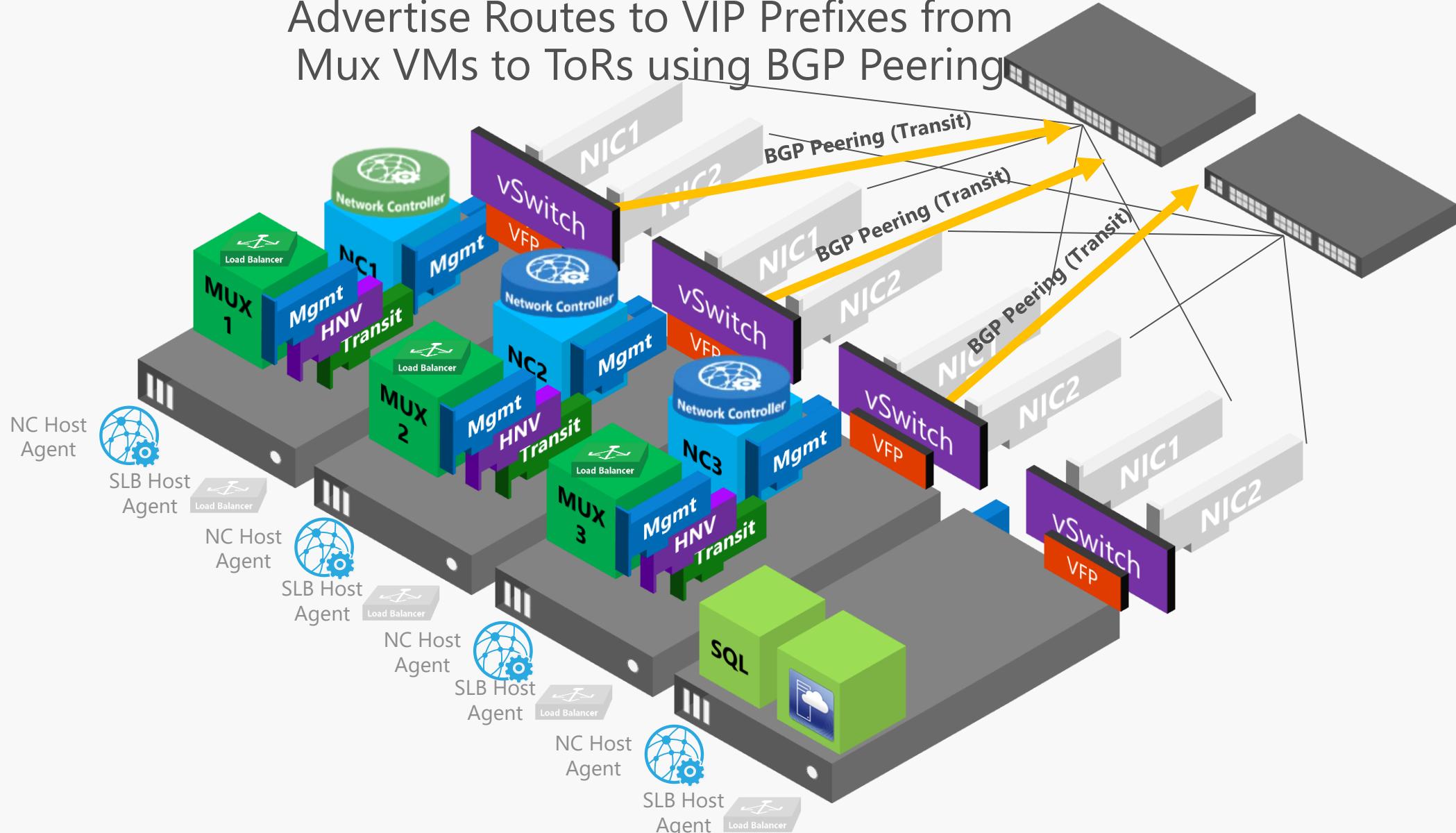


Private and Public VIPs Subnets should be reachable and routed through the ToR





# Advertise Routes to VIP Prefixes from Mux VMs to ToRs using BGP Peering



SLB Host Agents get configured and started on each NC managed host

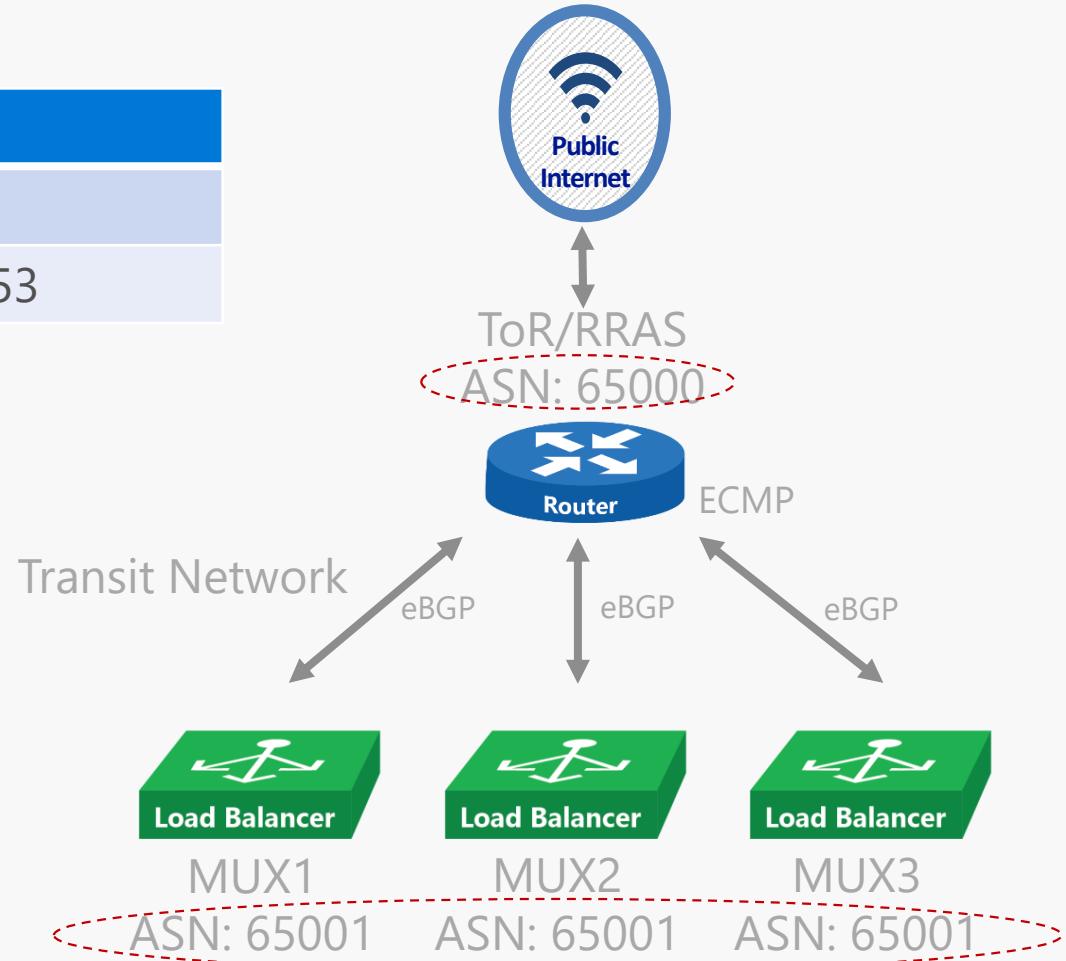
# A note about BGP Peering

Autonomous System Numbers (ASN)

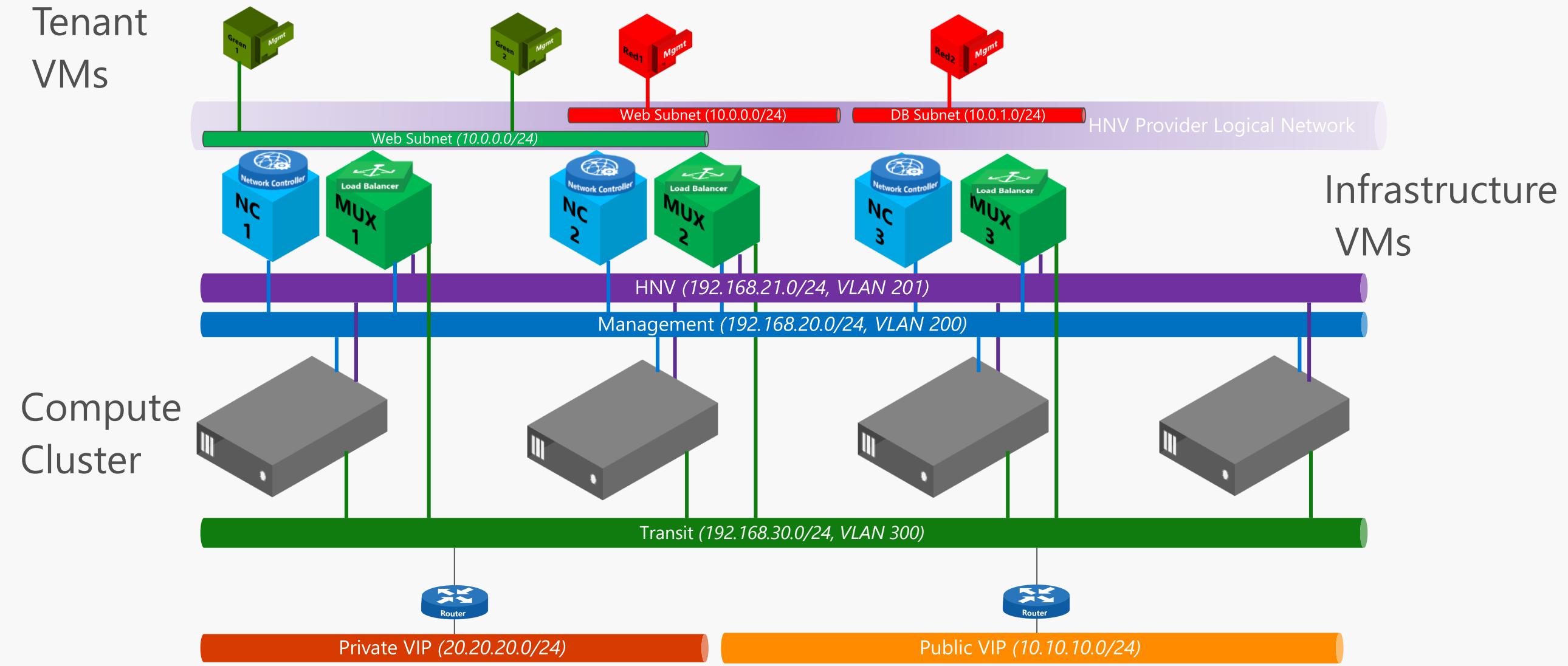
Device	ASN	Transit IP Addresses
Layer-3 ToR Switch/RRAS	65000	192.168.30.1
SLB Mux	65001	192.168.30.51, *.52, *.53

Routes Advertised by SLB Mux

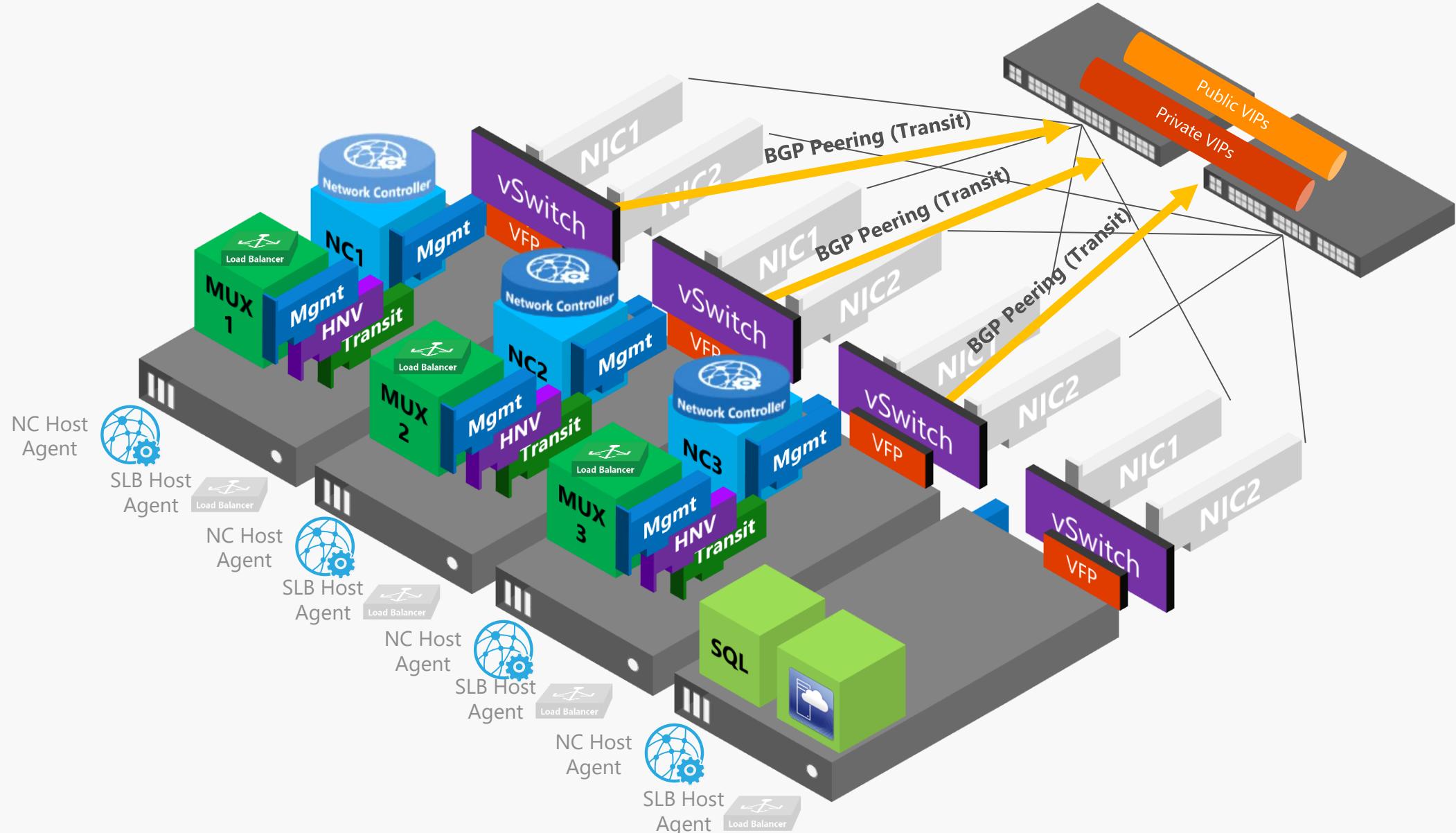
Route	IP Prefix	Next-Hop
SLBM VIP	20.20.20.100/32	192.168.30.51
		192.168.30.52
		192.168.30.53
Tenant VIP	10.10.10.X	192.168.30.51
		192.168.30.52
		192.168.30.53

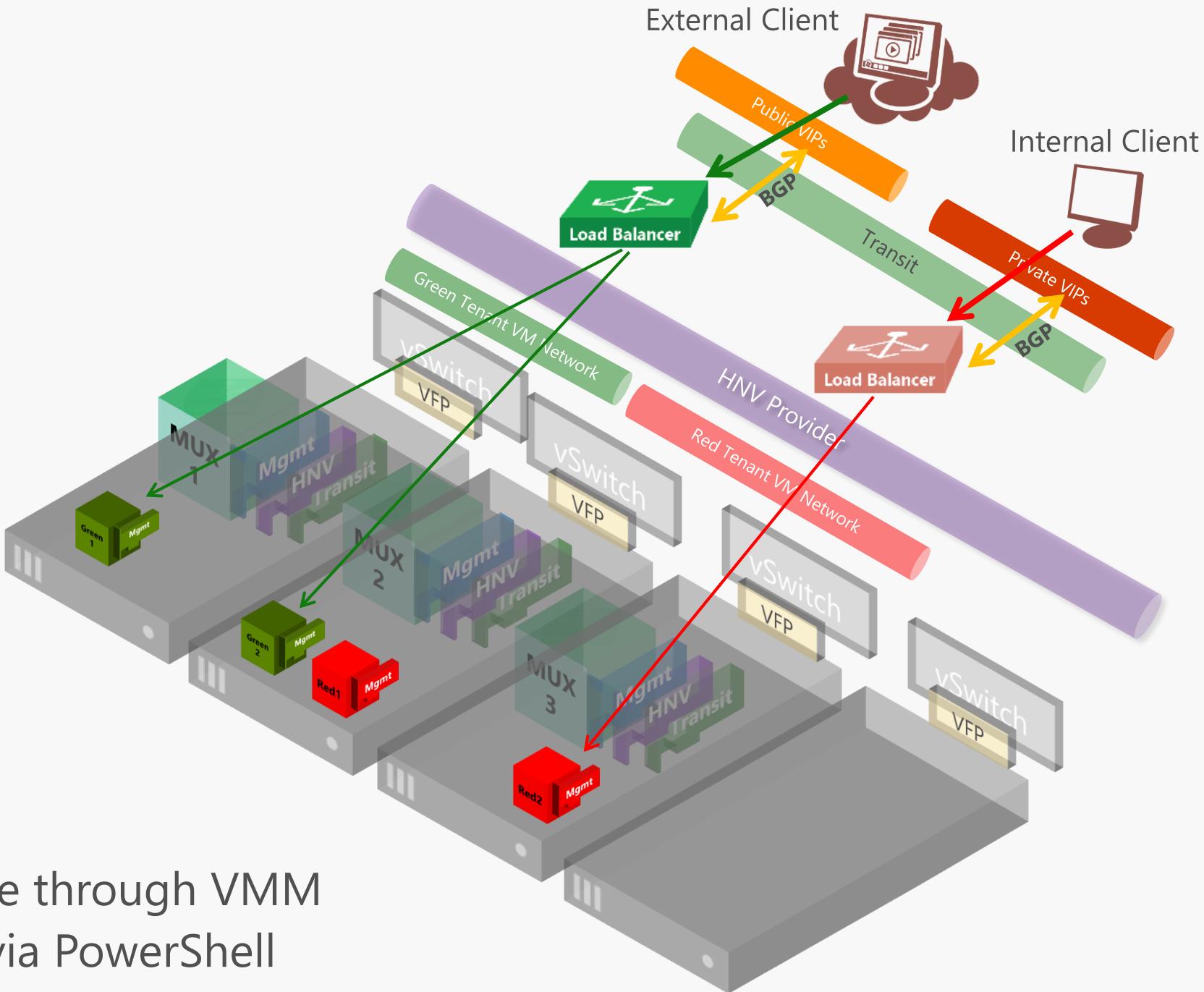
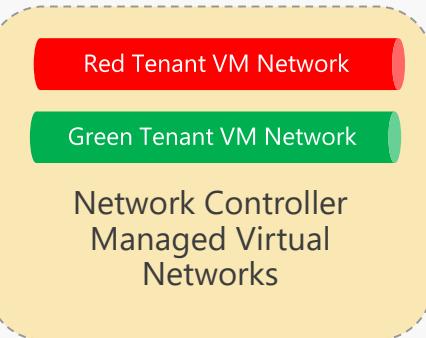


# Logical Network Diagram



## Step 4. Create Load-Balanced Tenant VIPs



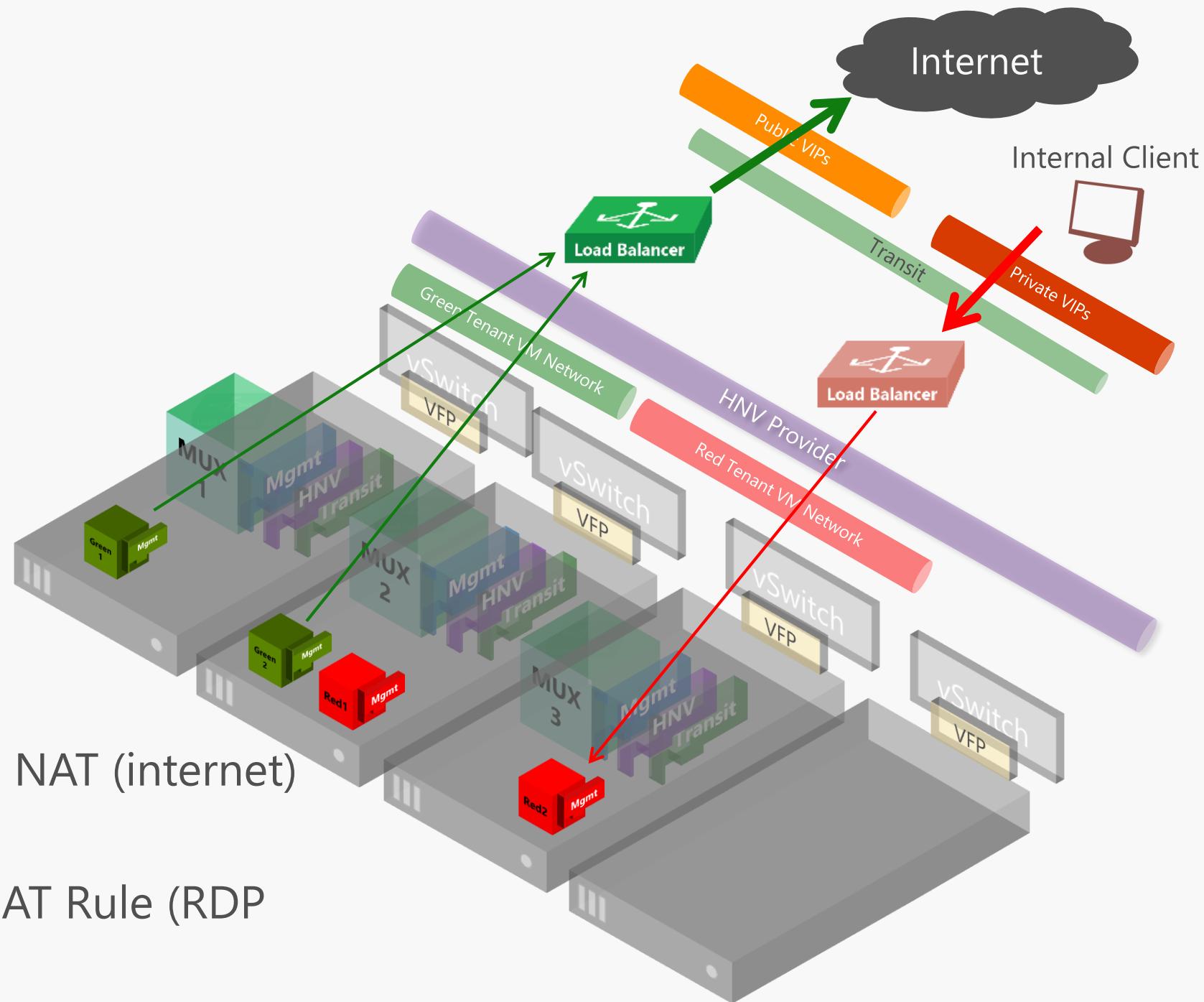
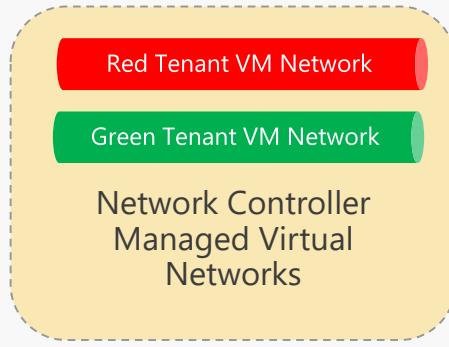


1. Create VIP Template through VMM
2. Create Tenant VIP via PowerShell

# DEMO: Deploy Software Load Balancer

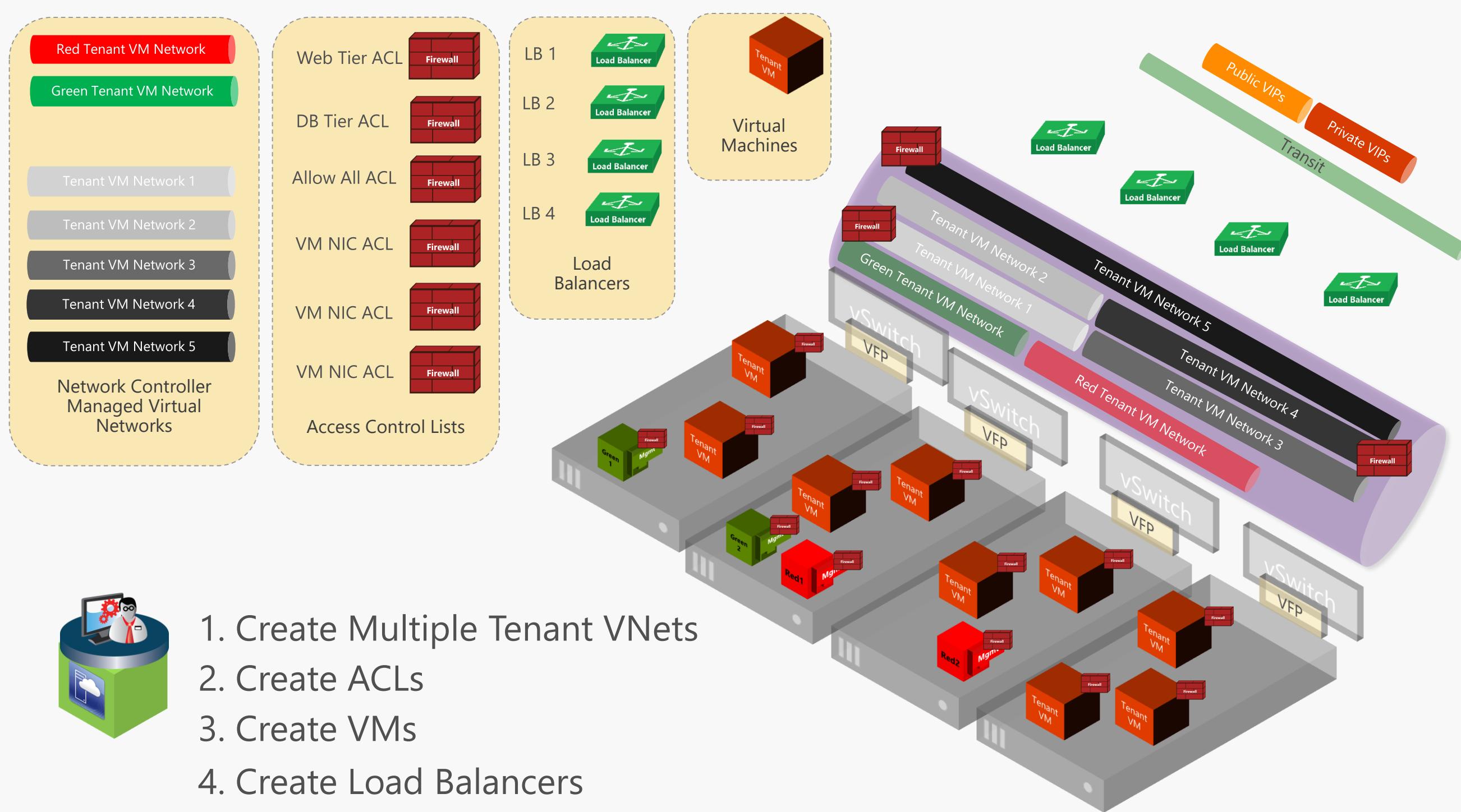
SDN Fabric Deployment

## Step 5. Configure Inbound and Outbound NAT



1. Create Outbound NAT (internet) for Green Tenant
2. Create Inbound NAT Rule (RDP In) for Red Tenant

Massive Policy  
Deployment!!!!



## Step 6. Deploy Gateways

# Review the Physical Network Plan

Create the GRE Virtual IP (VIP) Logical Network

## Top of Rack (ToR) Switch

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HNV Provider	192.168.21.0/24	201	192.168.21.1	*.51 – *.100
Transit	192.168.30.0/24	300	192.168.30.1	*.51 – *.100
Public VIP	10.10.10.0/24	NA	10.10.10.1	*.51 - *.100
Private VIP	20.20.20.0/24	NA	20.20.20.1	*.51 - *.100
GRE VIP	30.30.30.0/24	NA	30.30.30.1	*.51 - *.100

*Site-to-Site (S2S)  
Tunnel Endpoint  
accessible through  
SLB Mux*

- One GRE VIP IP Address will be used by the Gateway Nodes for Site-to-Site GRE Tunnels
- One Public VIP Address will be used as the Endpoint to Site-to-Site IPSec Tunnels

Mgmt

HNV

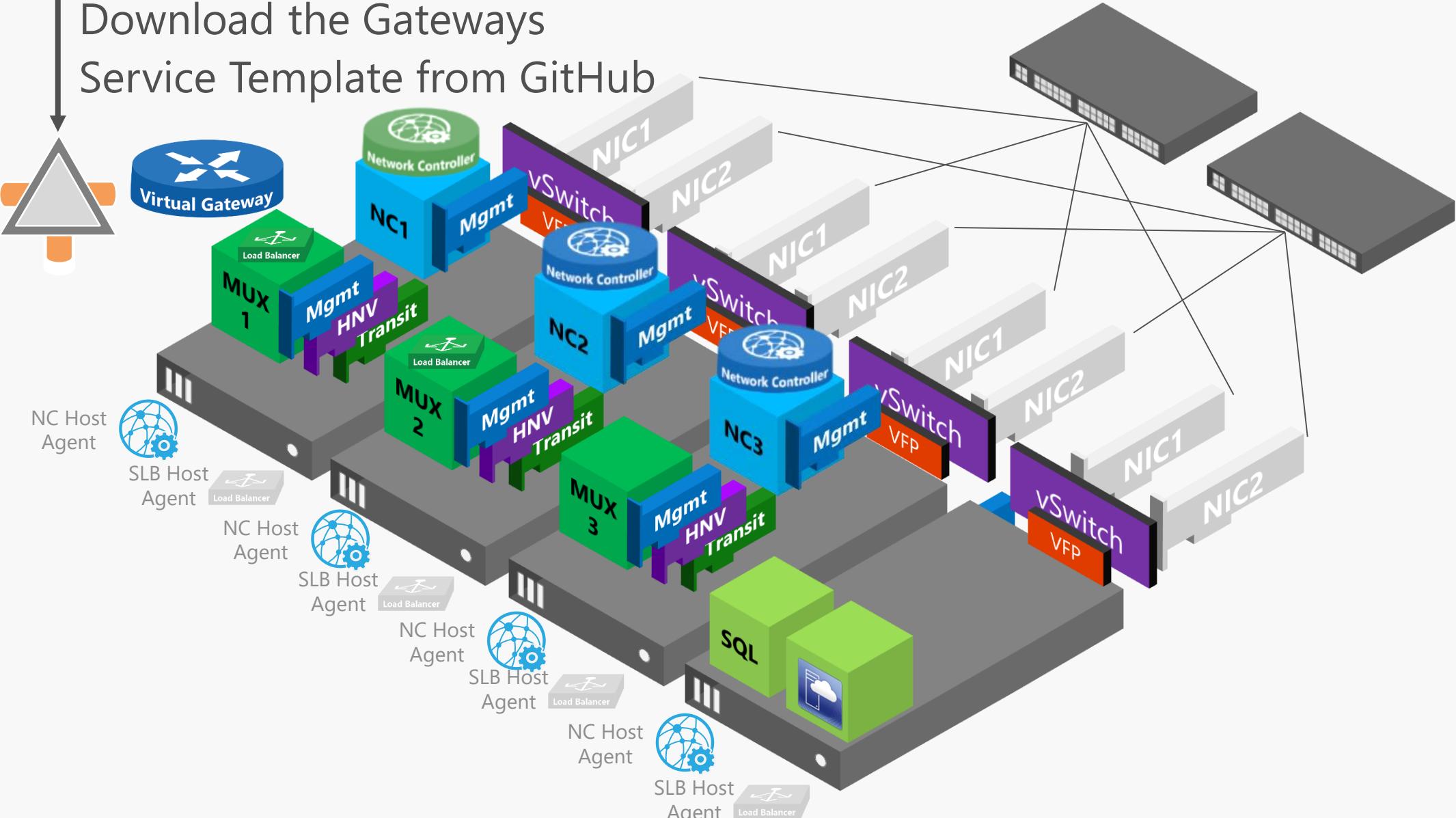
Transit

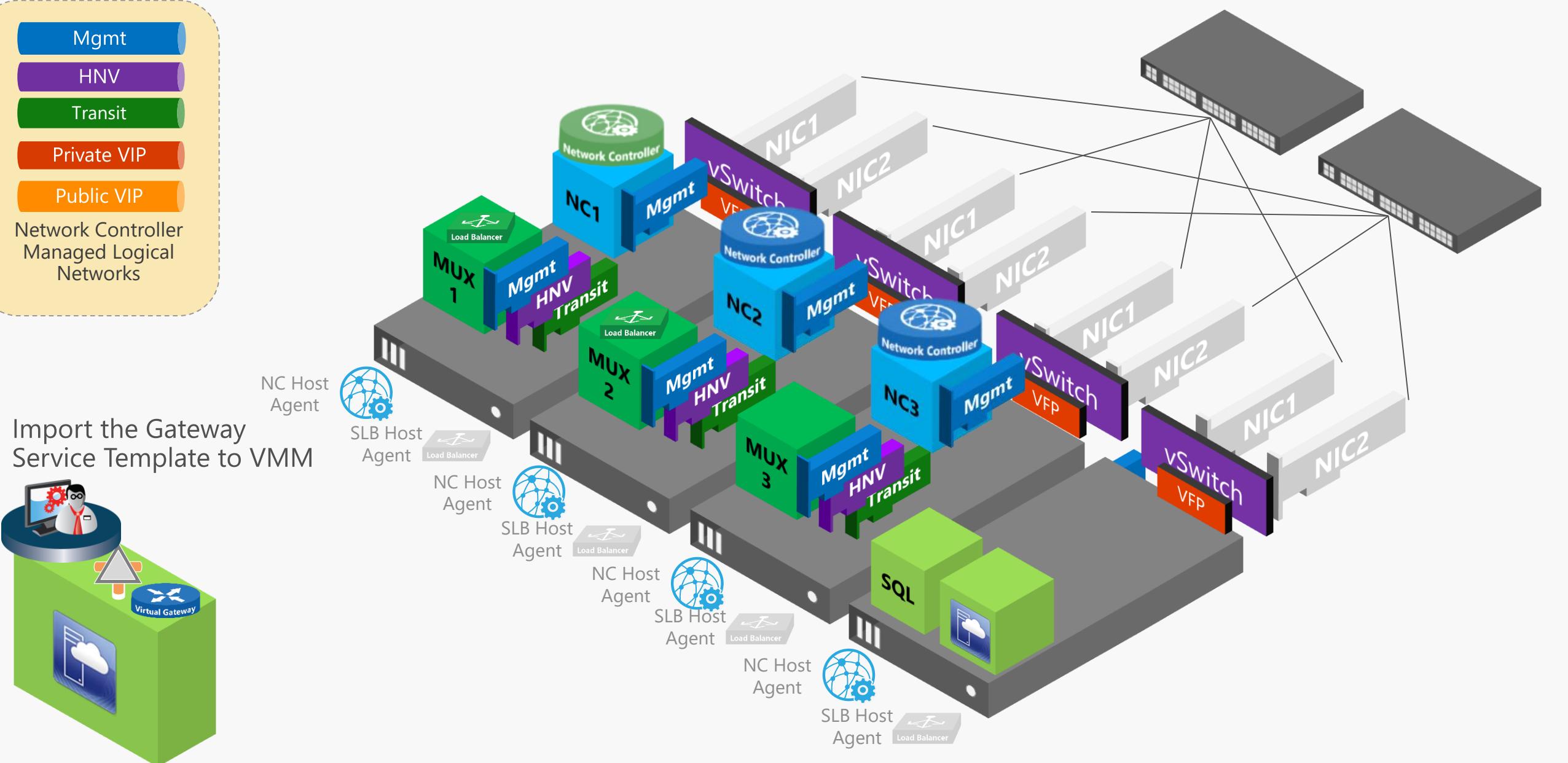
Private VIP

Public VIP

Network Controller  
Managed Logical Networks

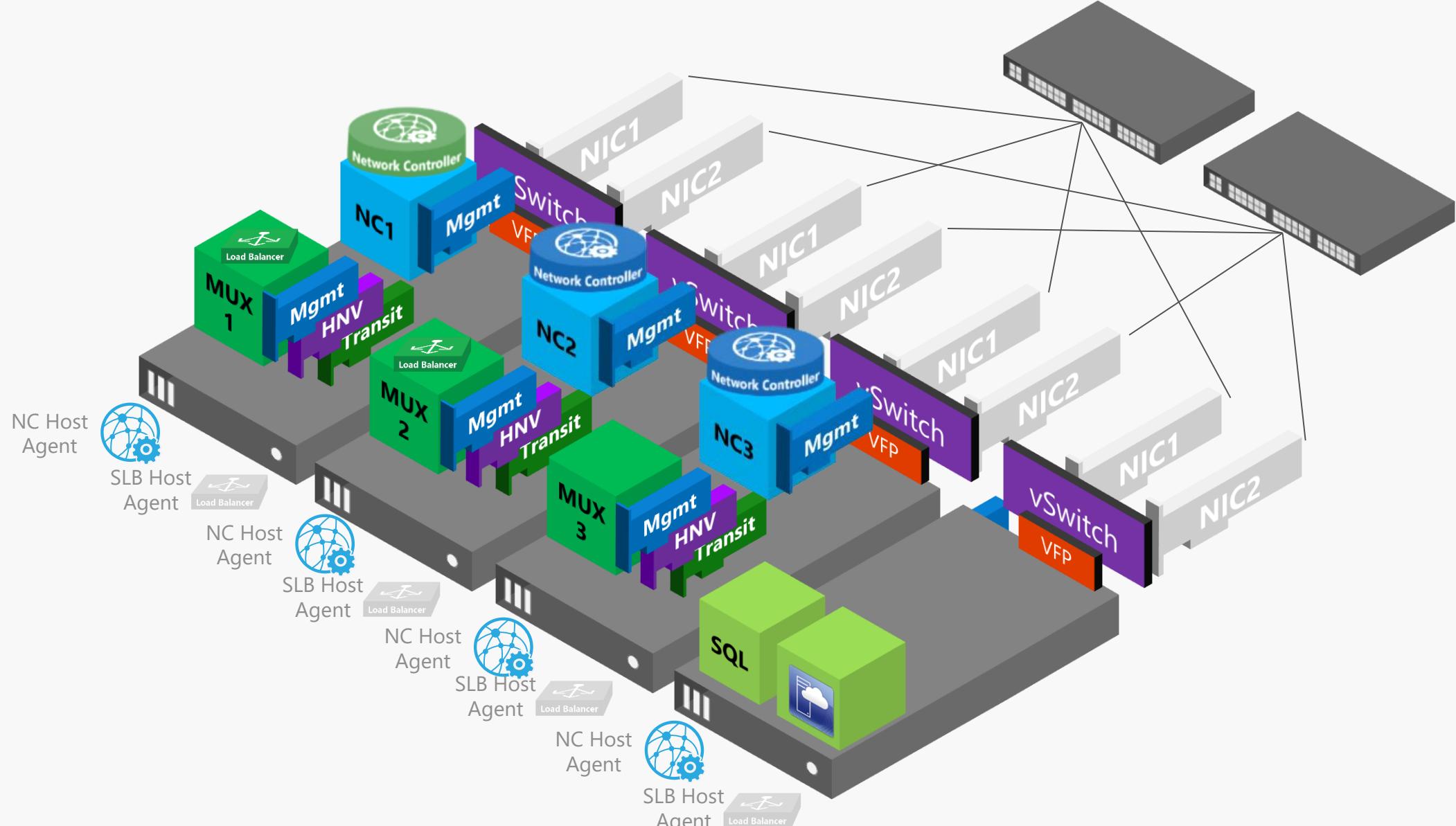
# Download the Gateways Service Template from GitHub



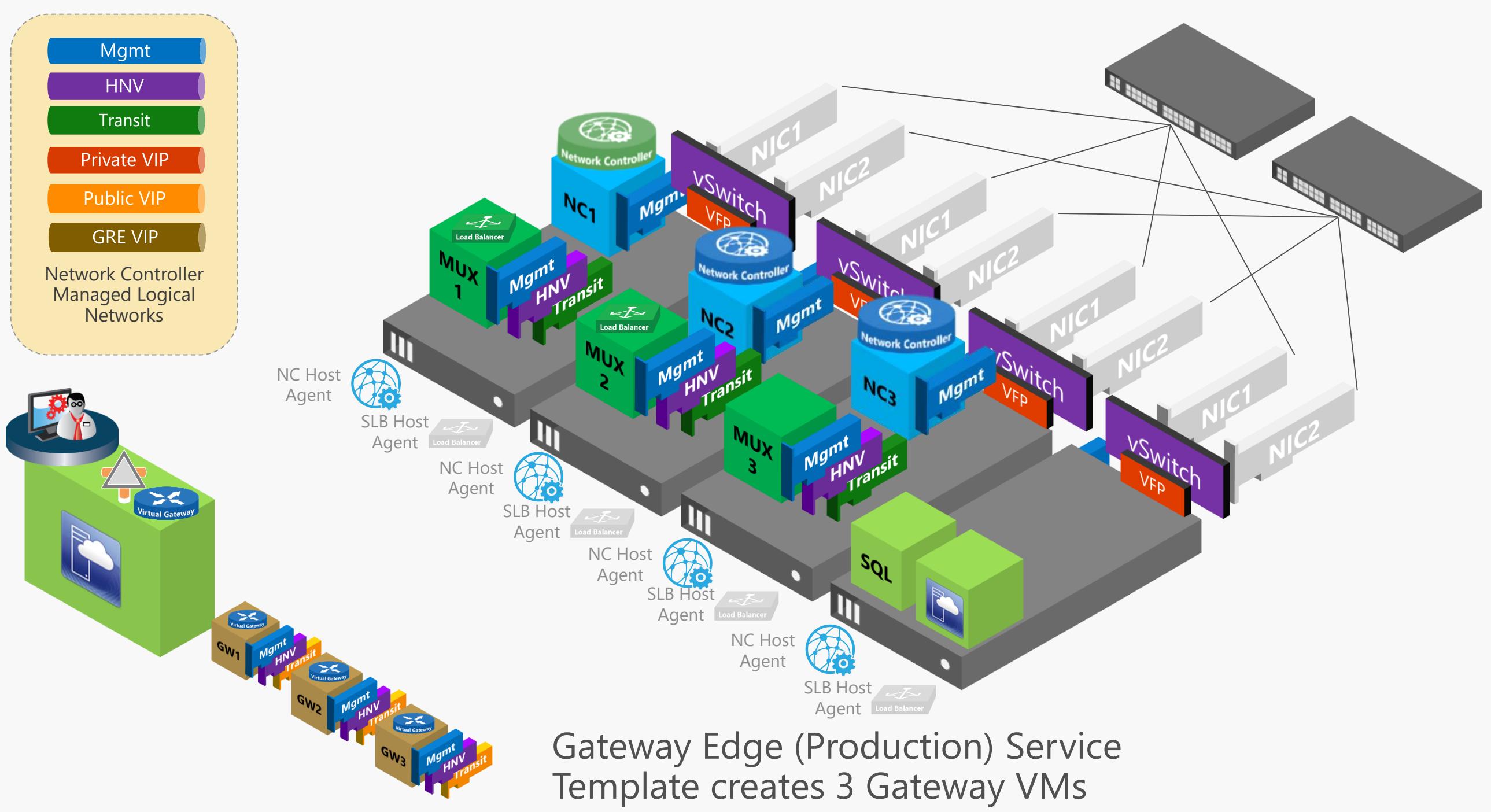


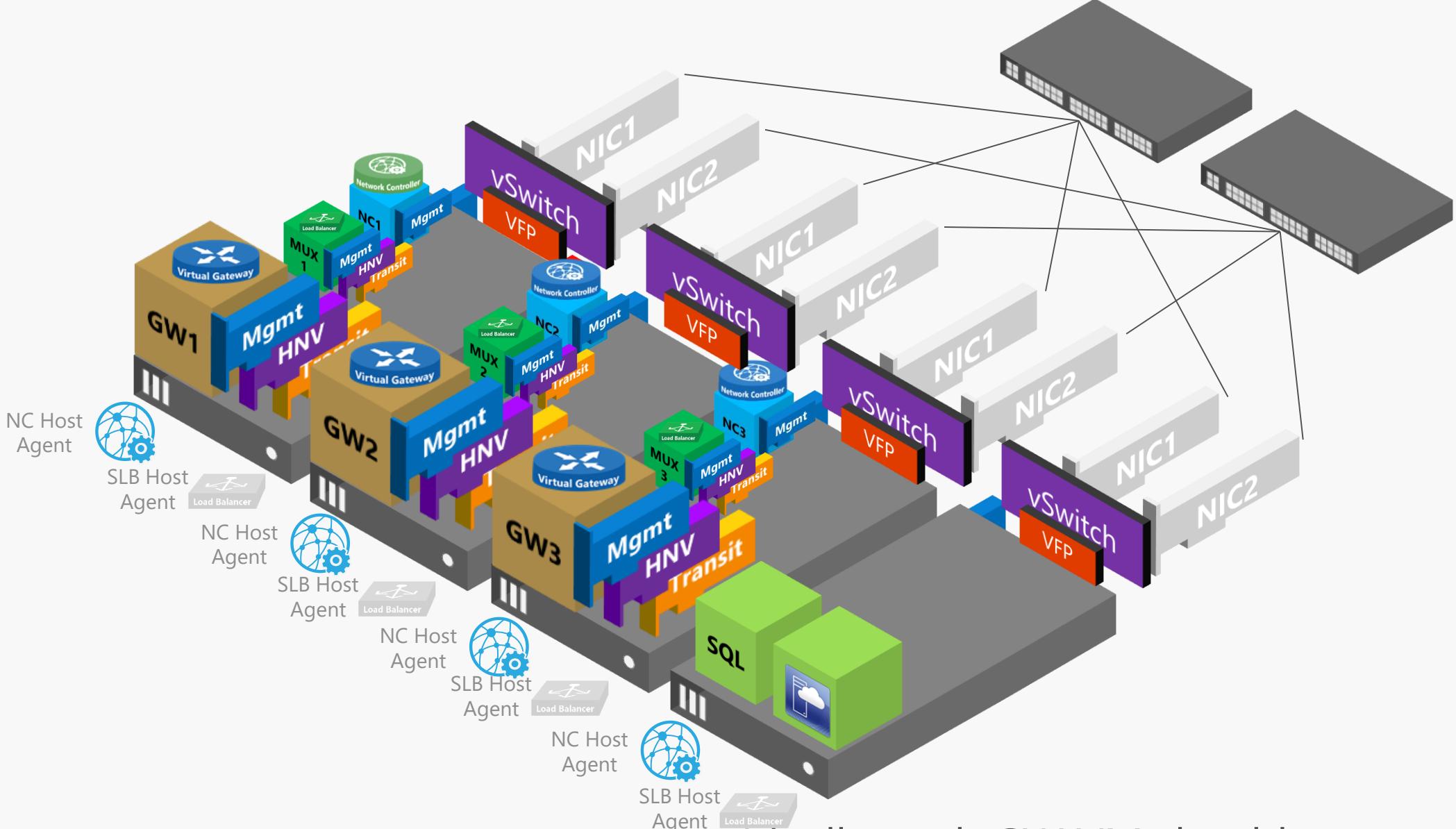


Network Controller  
Managed Logical  
Networks



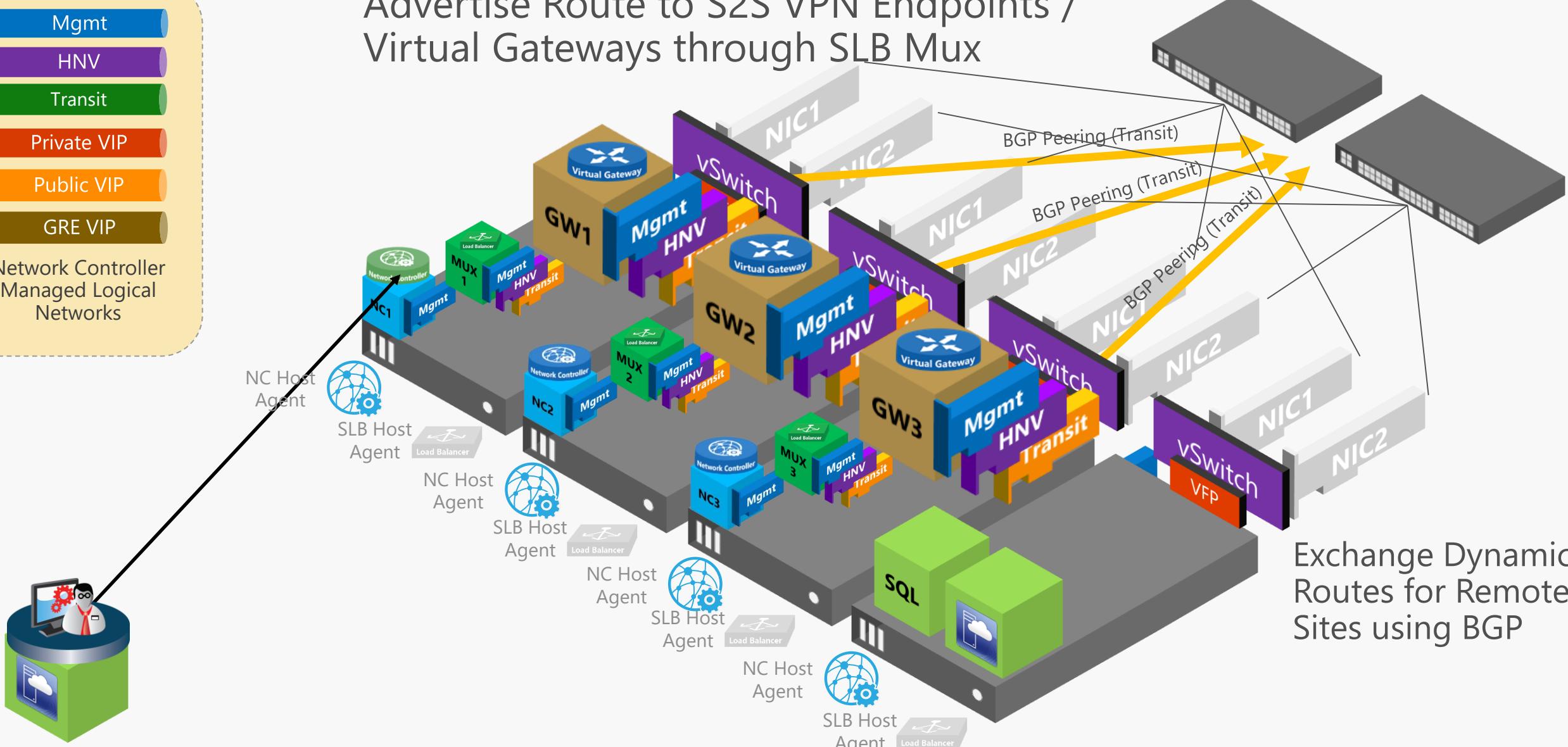
Create GRE VIP Logical Network for S2S GRE  
Tunnel Endpoints





Ideally, each GW VM should run on separate Hyper-V Hosts

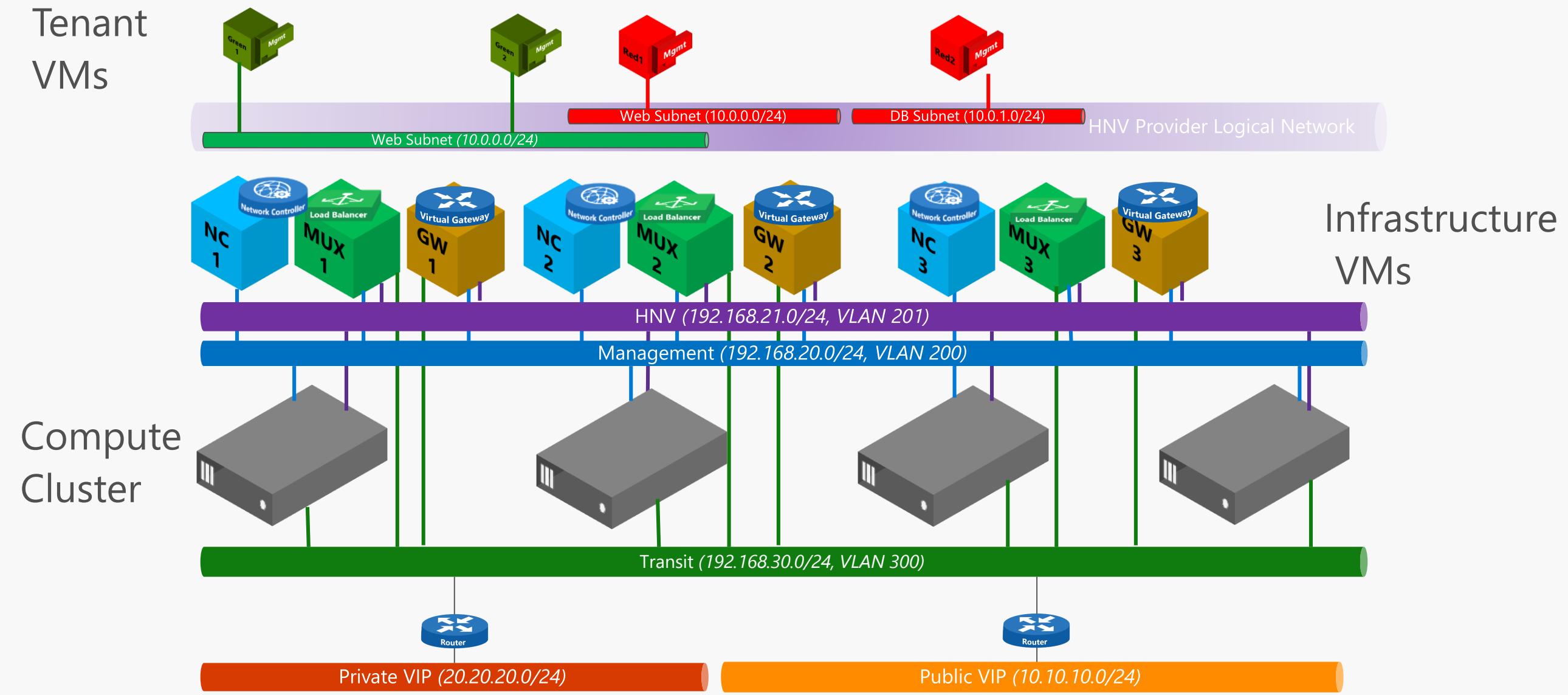
# Advertise Route to S2S VPN Endpoints / Virtual Gateways through SLB Mux



During the GWs onboarding to NC we will need to specify:

1. ASN Number for ToR and GWs
2. ToR IP Address on the Transit Subnet for BGP Peering

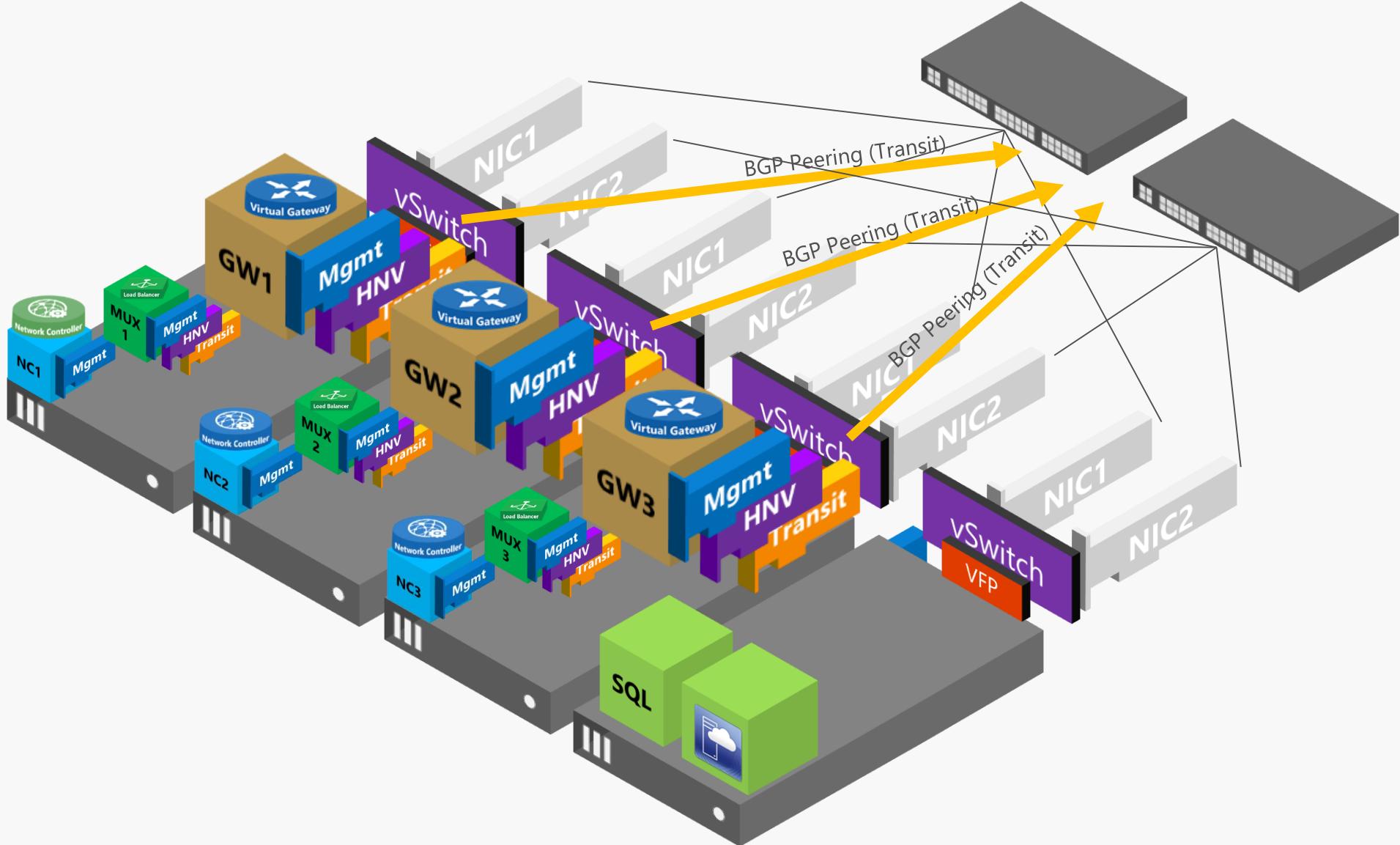
# Logical Network Diagram

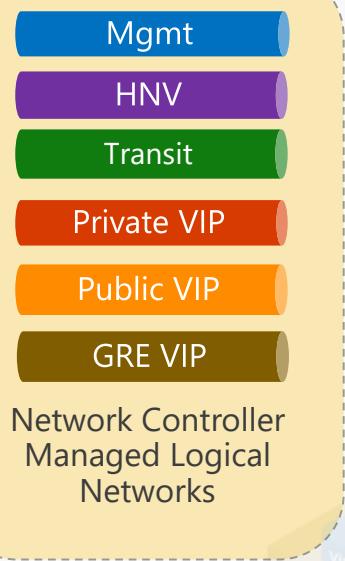


# DEMO: Deploy Gateway

SDN Fabric Deployment

## Step 7. Create S2S VPN Tunnel

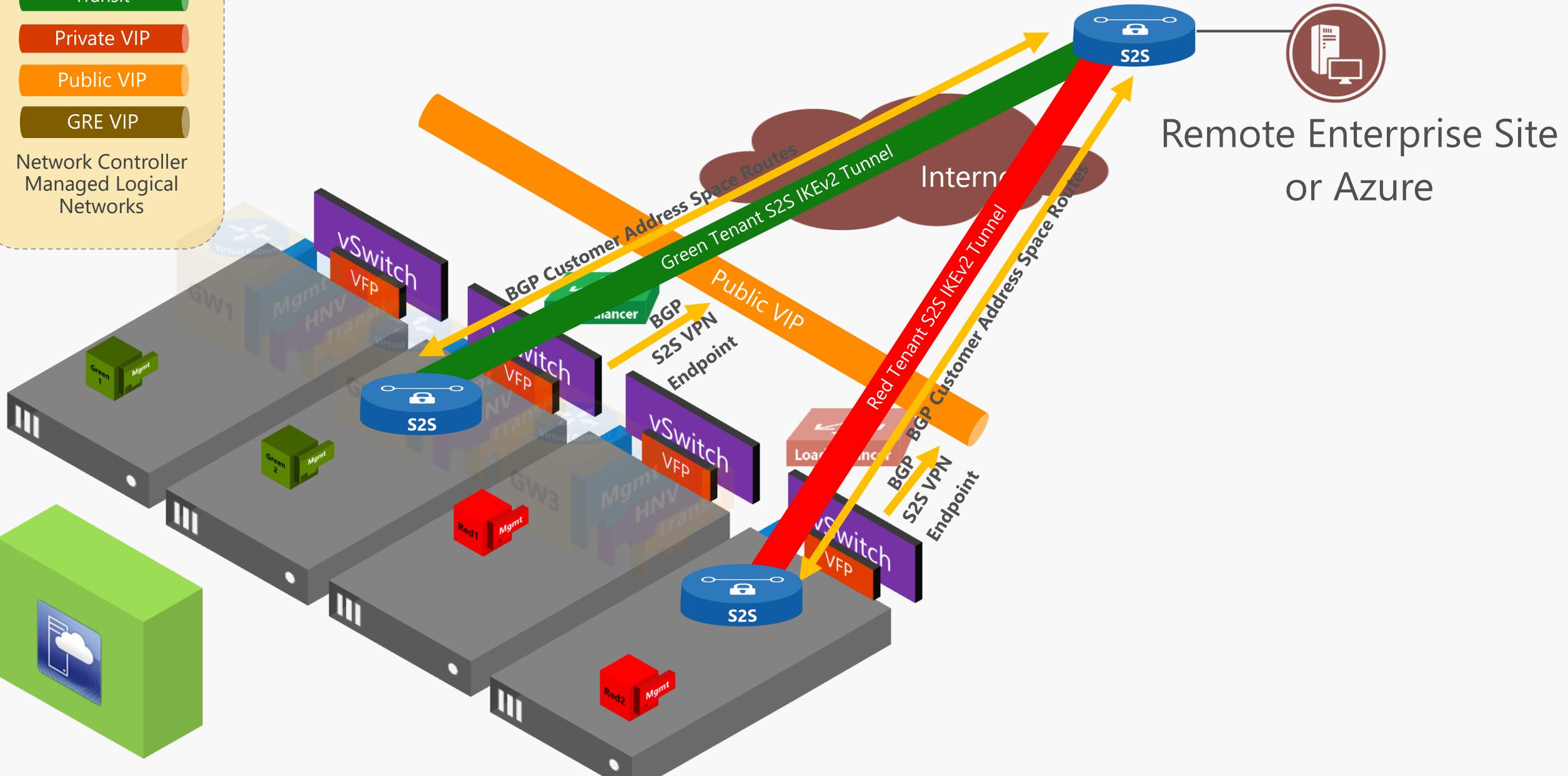




Remote Enterprise Site  
or Azure



Network Controller  
Managed Logical  
Networks



# What Just Happened?!

We Deployed the SDN Fabric using SCVMM 2016

- Network Controller
- Software Load Balancer
- *Hybrid SDN Gateway (Began Deployment)*

We Created Tenant Virtual Networks with

- ACLs
- Load Balancers
- S2S VPN Tunnels

*All in under 45 minutes! Hopefully... ☺*

# Cloud inspired networking for your datacenter

Deploy faster

Enhance network  
security

Reduce costs and  
increase perf

# SDN Capabilities in WS 2016

- Network controller
  - Central control plane
  - Fault tolerant
- Virtual Networking
  - BYO address space
  - Distributed routing
  - VXLAN and NVGRE
- Network Security
  - Distributed Firewall
  - Network Security Groups
  - BYO Virtual Appliances
- Robust Gateways
  - M:N availability model
  - Multi-tenancy for all modes of operation
  - BGP Transit Routing
- Software Load Balancing
  - L4 load balancing (N-S and E-W) with DSR
  - NAT
  - For tenants and cloud based infrastructure
- Data Plane Advancements
  - Performance: 10G, 40G and **beyond!**
  - RDMA over Virtual Switch

Consistency with Azure in UI, API and Services

# Resources

## Documentation

<https://technet.microsoft.com/windows-server-docs/networking/sdn/plan/plan-a-software-defined-network-infrastructure>

<https://technet.microsoft.com/system-center-docs/vmm/Manage/Deploy-a-Network-Controller-using-VMM>

<https://technet.microsoft.com/system-center-docs/vmm/Manage/deploy-a-software-load-balancer-using-vmm>

<https://technet.microsoft.com/en-us/system-center-docs/vmm/manage/deploy-a-ras-gateway-using-vmm>

## Blogs

<https://blogs.technet.microsoft.com/windowsserver/2015/11/04/4-datacenter-challenges-and-how-windows-server-2016-software-defined-networking-can-help/>

<https://blogs.technet.microsoft.com/windowsserver/2016/02/04/zero-to-sdn-in-under-five-minutes/>

<https://blogs.technet.microsoft.com/larryexchange/2016/05/30/step-by-step-for-deploying-a-sdnv2-using-vmm-part-1/>

## GitHub

<https://github.com/Microsoft/sdn>

# Free IT Pro resources

## To advance your career in cloud technology

Plan your  
career path

Microsoft IT Pro Career Center  
[www.microsoft.com/itprocareercenter](http://www.microsoft.com/itprocareercenter)

Get started  
with Azure

Microsoft IT Pro Cloud Essentials  
[www.microsoft.com/itprocloudessentials](http://www.microsoft.com/itprocloudessentials)

Demos and  
how-to videos

Microsoft Mechanics  
[www.microsoft.com/mechanics](http://www.microsoft.com/mechanics)

Connect with peers  
and experts

Microsoft Tech Community  
<https://techcommunity.microsoft.com>