2024

Configure a Replicating Multi-Site Domain using an IPsec VPN Tunnel

DOCUMENTATION

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3/5/24

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

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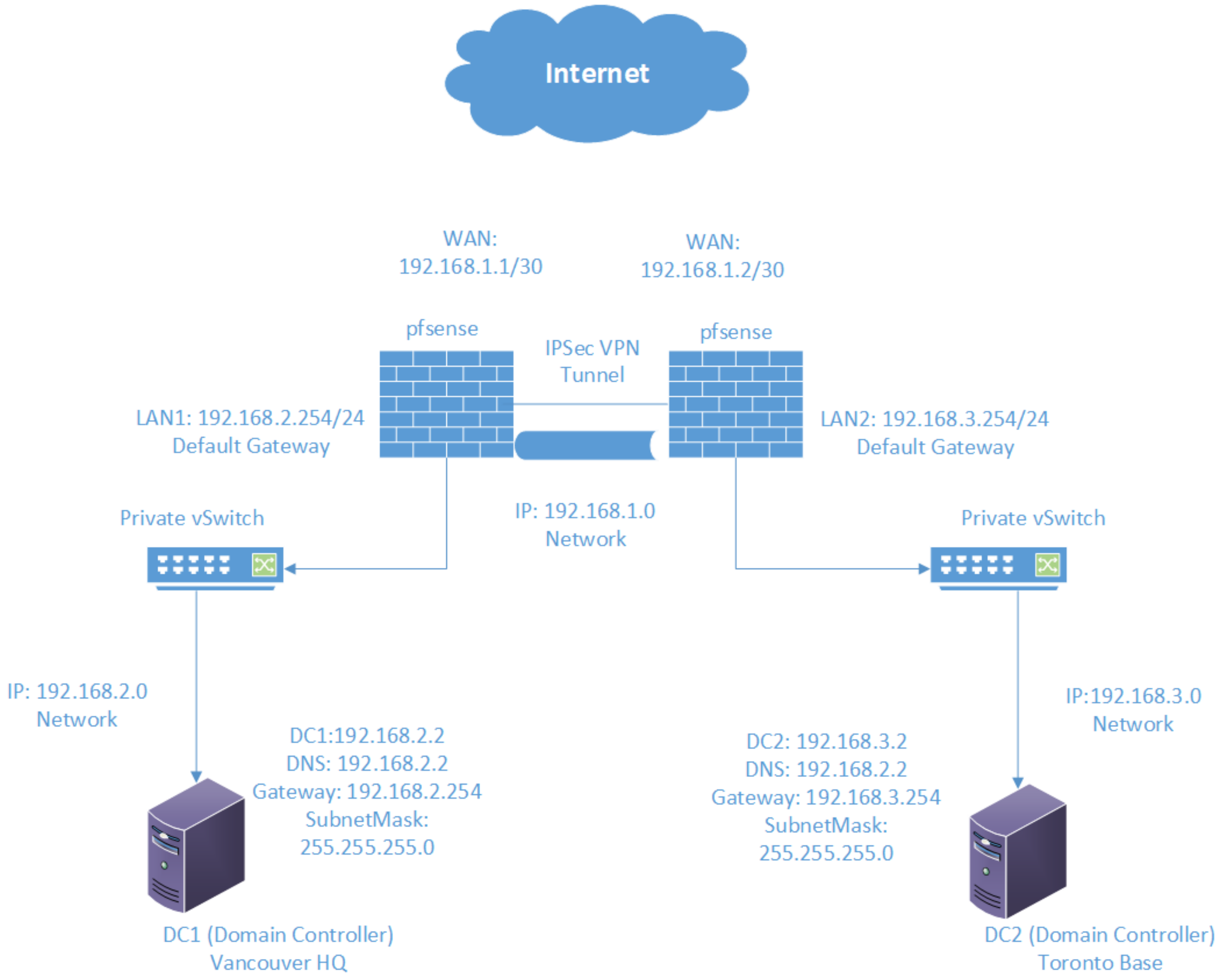
Network Diagram:



What is IPsec?

- What is IPsec and what is the purpose of using it to establish a VPN Tunnel?
  - **IPsec**, which stands for **Internet Protocol Security**, is a suite of protocols designed to ensure the integrity, confidentiality, and authentication of data communications over an Internet Protocol (IP) network
  - The primary purpose of using IPsec to establish a VPN tunnel is to create a secure and encrypted connection over a less secure network, like the internet
- Key Components:
  - Authentication: Data is sent and received by the intended parties and not intercepted by an attacker
    - **Authentication Header (AH)** is one of the protocols used for this purpose
  - Encryption: It encrypts data being transmitted, ensuring data cannot be read by unauthorized entities if intercepted

        - **Encapsulating Security Payload (ESP)** is the protocol used for encrypting data
    - Data Integrity: Ensures data is not altered during transit
        - Both **AH** and **ESP** provide integrity checks
    - Secure Key Exchange: IPsec uses **Internet Key Exchange (IKE)** to safely exchange cryptographic keys between the sender and receiver

Create the Virtual Switches:

- For this lab configuration, we will be utilizing a **Private vSwitch**
    - It allows VMs on a single Hyper-V host to communicate with each other but isolates them from the external network, which can be useful for testing network configurations and firewall rules

- Open Hyper-V Manager on Host Workstation
    - Access **Virtual Switch Manager**
    - Create **3** new *vSwitches*
        - Select "**Private**" > "**Create Virtual Switch**" for all 3

- **WAN vSwitch**: A vSwitch for the 192.168.1.0/30 network to establish a WAN link between both routing devices

- **LAN1 vSwitch**: A vSwitch for the 192.168.2.0/24 network. DC1 and the LAN interface of the first pfSense VM would connect to this vSwitch

- **LAN2 vSwitch**: A vSwitch for the 192.168.3.0/24 network. DC2 and the LAN interface of the second pfSense VM would connect to this vSwitch

WAN IP Configuration Settings:

- WAN facing subnet must only have two usable host IPs
- To create a subnet with only two usable host IPs:
    - We need a subnet that contains exactly four addresses in total, because in every subnet, one address is used for the **network address**, and one is reserved for the **broadcast address**. The remaining two addresses can be used for **hosts**. This configuration requires a **/30 subnet mask (255.255.255.252)**, which divides an IP address space into smaller subnets with four addresses each

- For our lab environment we will utilize the following static IPs for the WAN on both sites:
    - Network Address: 192.168.1.0
    - Usable Host IPs: 192.168.1.1/30 and 192.168.1.2/30
    - Subnet Mask: 255.255.255.252

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

Configure the External Device:

- Install two standalone pfSense Machines in Hyper-V, version 2.7.0
    - **VanRouter**
    - **TorRouter**

VanRouter & TorRouter Configurations:

- Use the pre-configured "**Default Switch**" to allow VM's to share the host's network connection by using NAT (Network Address Translation)
    - This switch can be used to temporarily provide internet access to a VM for updates or package installation before configuring the network according to the static IP setup

Update pfSense:

- 1. *Run option 14 (sshd):*
    - **enable**
- 2. *Run option 8 (shell):*
    - **opens command line interface**
- 3. *Reinstall package database:*
    - **pkg-static bootstrap -f**
        - Ignore mismatch and select Y to continue
- 3. *Update Package Repository Configuration:*
    - **cat /usr/local/etc/pkg/repos/pfSense.conf**
- 4. *Fix Corrupted Package Database:*
    - **pkg-static clean -ay**
    - **pkg-static install -f pkg**
- 5. *Check for Updates:*
    - **pfSense-upgrade**

Remove the Default Switch / Attach the Private vSwitches:

- After completing the updates, shut down both pfSense VMs (**VanRouter**) and (**TorRoute**r)

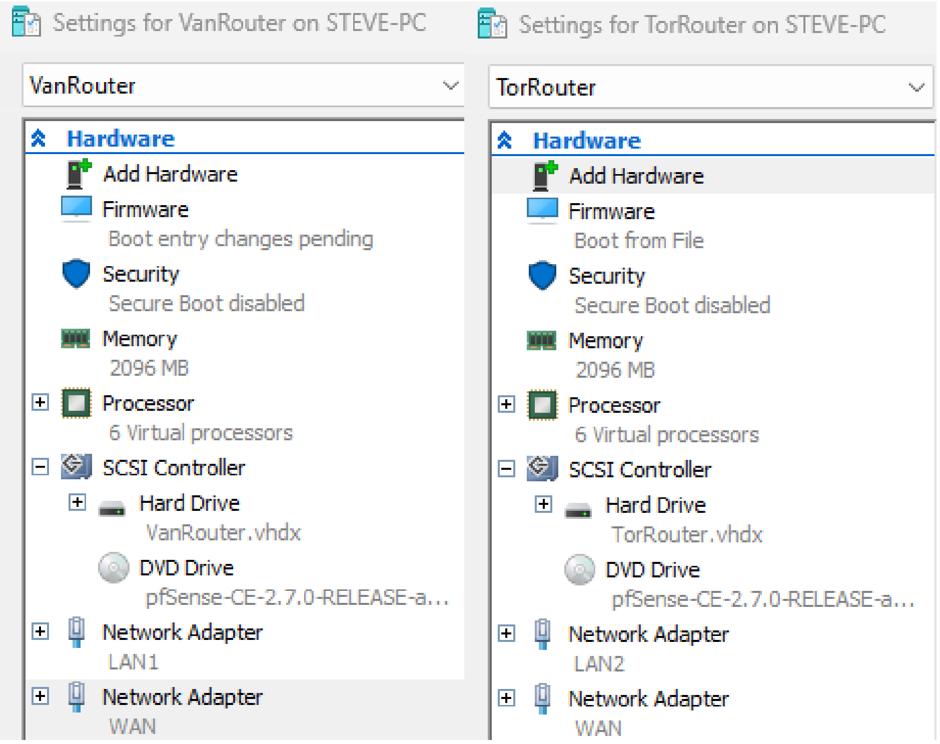
- Go back to Hyper-V Manager and to the **Settings**

- Remove the "**Default Switch**" from the network adapter

- Attach the new private WAN/LAN1 vSwitch to VanRouter

- Attach the new private WAN/LAN2 vSwitch to TorRouter

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL



Settings for VanRouter on STEVE-PC

VanRouter

- Hardware
  - Add Hardware
  - Firmware
    Boot entry changes pending
  - Security
    Secure Boot disabled
  - Memory
    2096 MB
  - Processor
    6 Virtual processors
  - SCSI Controller
    - Hard Drive
      VanRouter.vhdx
    - DVD Drive
      pfSense-CE-2.7.0-RELEASE-a...
  - Network Adapter
    LAN1
  - Network Adapter
    WAN

Settings for TorRouter on STEVE-PC

TorRouter

- Hardware
  - Add Hardware
  - Firmware
    Boot from File
  - Security
    Secure Boot disabled
  - Memory
    2096 MB
  - Processor
    6 Virtual processors
  - SCSI Controller
    - Hard Drive
      TorRouter.vhdx
    - DVD Drive
      pfSense-CE-2.7.0-RELEASE-a...
  - Network Adapter
    LAN2
  - Network Adapter
    WAN

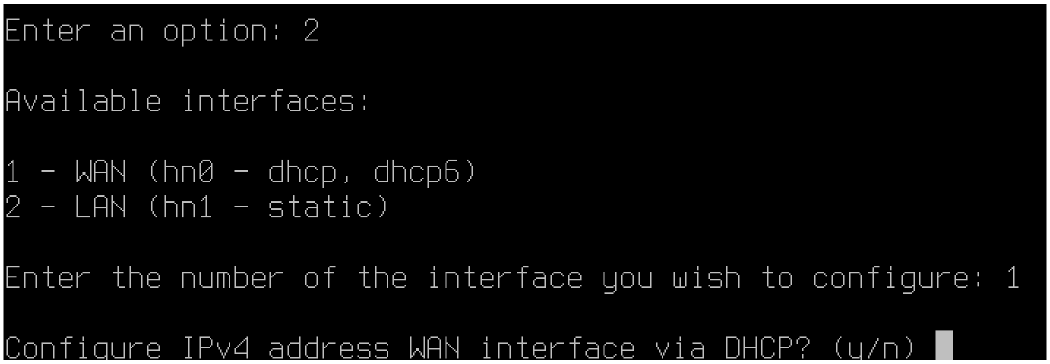
Assign Static IPs:

- Start the pfSense VMs

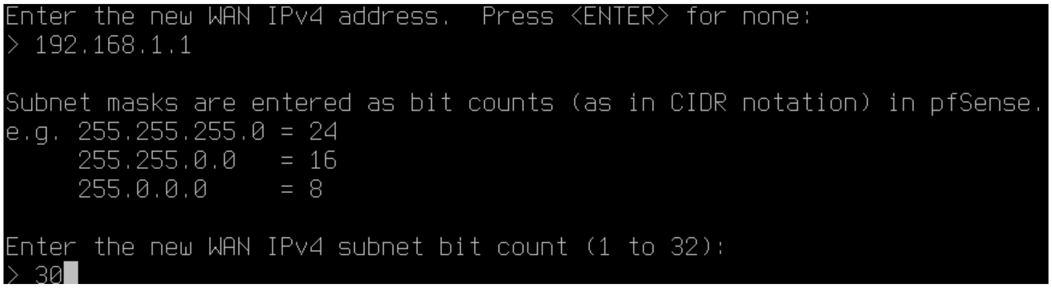
Configure the WAN:

VanRouter:

- Access the pfSense console for **VanRouter** and configure the WAN interface with a static IP address (192.168.1.1/30)
  - Option 2 > 1 for WAN

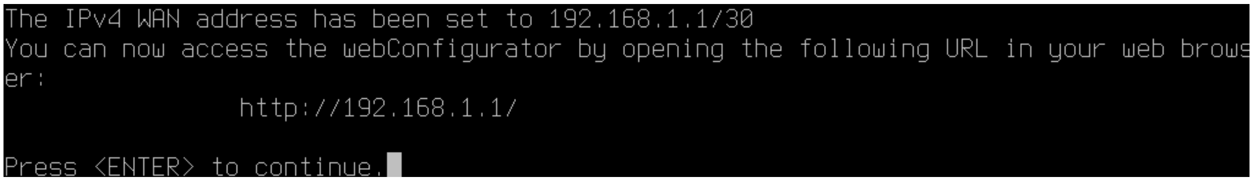


```
Enter an option: 2

Available interfaces:

1 - WAN (hn0 - dhcp, dhcp6)
2 - LAN (hn1 - static)

Enter the number of the interface you wish to configure: 1

Configure IPv4 address WAN interface via DHCP? (y/n)
```



```
Enter the new WAN IPv4 address.  Press <ENTER> for none:
> 192.168.1.1

Subnet masks are entered as bit counts (as in CIDR notation) in pfSense.
e.g. 255.255.255.0 = 24
     255.255.0.0   = 16
     255.0.0.0     = 8

Enter the new WAN IPv4 subnet bit count (1 to 32):
> 30
```

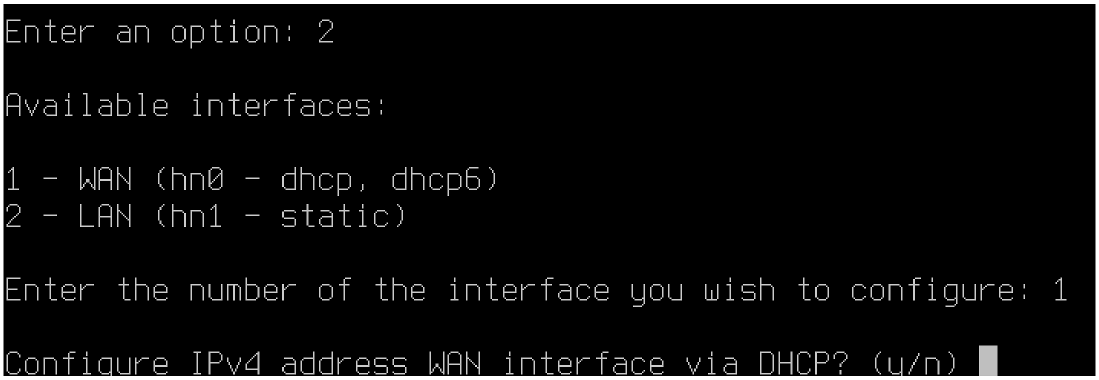
- For a WAN, enter the new WAN IPv4 upstream gateway address. For a LAN, press <ENTER> for none:
    - Press Enter
- Configure IPv6 address WAN interface via DHCP6? (y/n)
    - N
- Enter the new WAN IPv6 address. Press <ENTER> for none:
    - Press Enter
- Do you want to enable the DHCP server on WAN? (y/n)
    - N



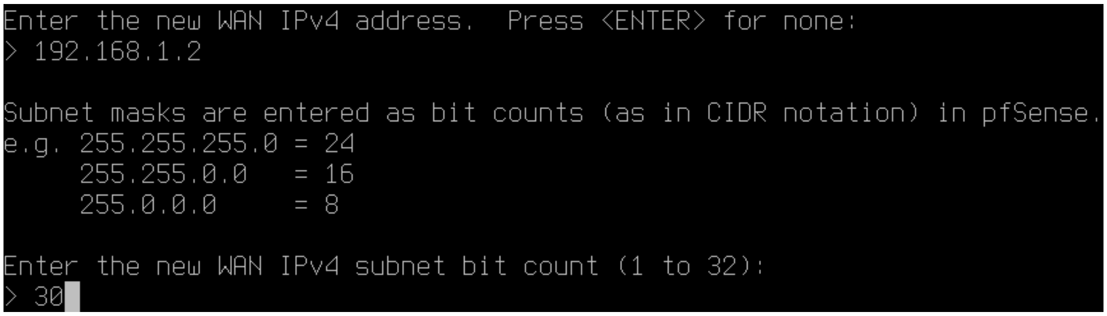
```
The IPv4 WAN address has been set to 192.168.1.1/30
You can now access the webConfigurator by opening the following URL in your web brows
er:
                http://192.168.1.1/

Press <ENTER> to continue.
```

TorRouter:

- Access the pfSense console for **TorRouter** and ensure the WAN interface is also connected to the same "**WAN Private vSwitch**" and configure it with the other static IP (192.168.1.2/30)

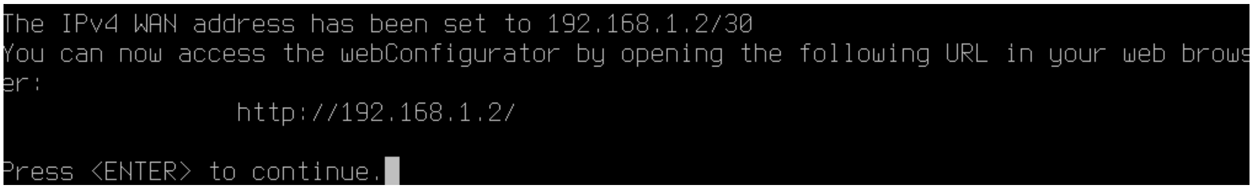


```
Enter an option: 2

Available interfaces:

1 - WAN (hn0 - dhcp, dhcp6)
2 - LAN (hn1 - static)

Enter the number of the interface you wish to configure: 1

Configure IPv4 address WAN interface via DHCP? (y/n)
```



```
Enter the new WAN IPv4 address.  Press <ENTER> for none:
> 192.168.1.2

Subnet masks are entered as bit counts (as in CIDR notation) in pfSense.
e.g. 255.255.255.0 = 24
     255.255.0.0   = 16
     255.0.0.0     = 8

Enter the new WAN IPv4 subnet bit count (1 to 32):
> 30
```

- For a WAN, enter the new WAN IPv4 upstream gateway address. For a LAN, press <ENTER> for none:
  - Press **Enter**
- Configure IPv6 address WAN interface via DHCP6? (y/n)
  - N
- Enter the new WAN IPv6 address. Press <**ENTER**> for none:
  - Press Enter
- Do you want to enable the DHCP server on WAN? (y/n)
  - N

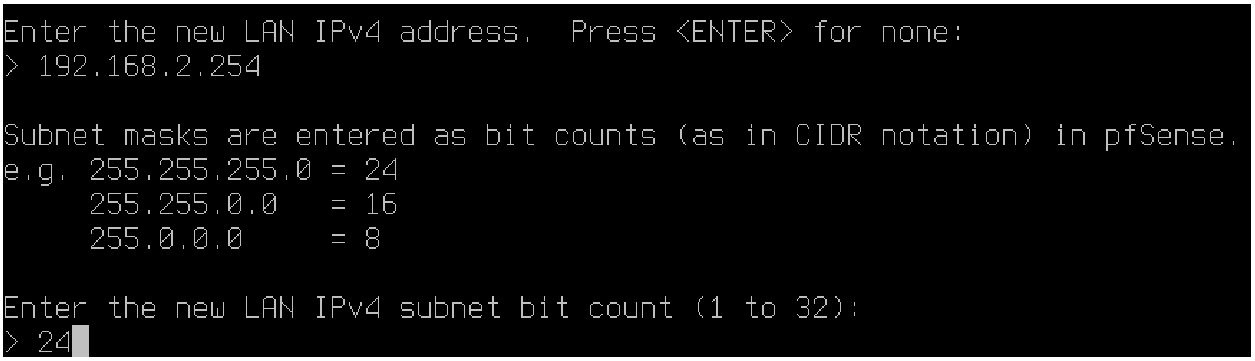


```
The IPv4 WAN address has been set to 192.168.1.2/30
You can now access the webConfigurator by opening the following URL in your web brows
er:
               http://192.168.1.2/

Press <ENTER> to continue.
```

Configure the LAN:

VanRouter:

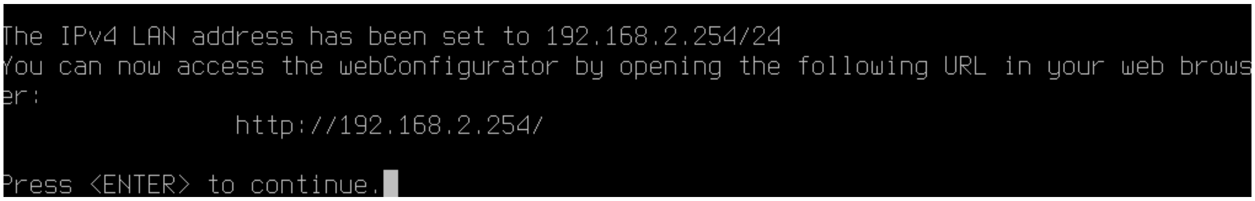
- Access the pfSense console for **VanRouter** and configure the LAN interface with a static IP address (192.168.2.254/24)
  - Option 2 > 2 for LAN



```
Enter the new LAN IPv4 address.  Press <ENTER> for none:
> 192.168.2.254

Subnet masks are entered as bit counts (as in CIDR notation) in pfSense.
e.g. 255.255.255.0 = 24
     255.255.0.0   = 16
     255.0.0.0     = 8

Enter the new LAN IPv4 subnet bit count (1 to 32):
> 24
```

- For a WAN, enter the new WAN IPv4 upstream gateway address. For a LAN, press <ENTER> for none:
  - Press **Enter**

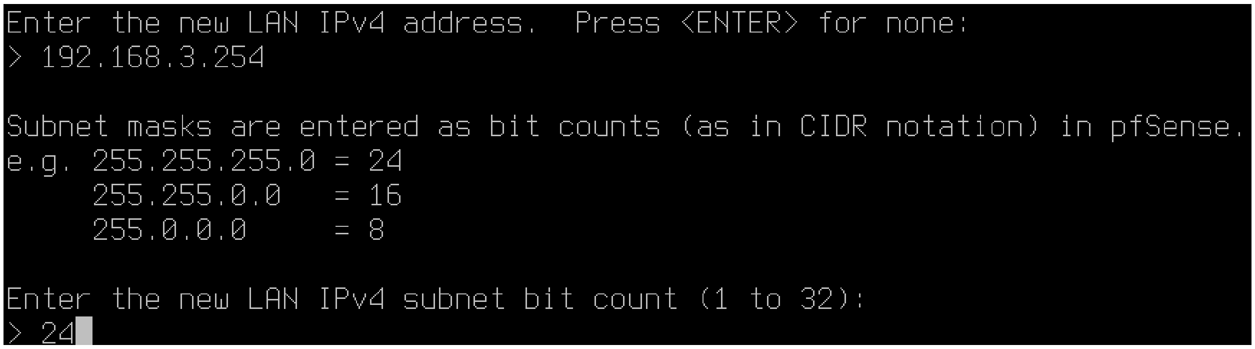
- Configure IPv6 address WAN interface via DHCP6? (y/n)
    - N
- Enter the new WAN IPv6 address. Press <ENTER> for none:
    - Press Enter
- Do you want to enable the DHCP server on WAN? (y/n)
    - N



```
The IPv4 LAN address has been set to 192.168.2.254/24
You can now access the webConfigurator by opening the following URL in your web brows
er:
                http://192.168.2.254/

Press <ENTER> to continue.
```

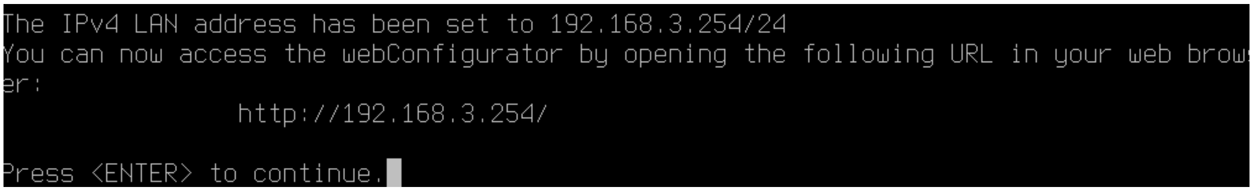
TorRouter:

- Access the pfSense console for **TorRouter** and configure the LAN interface with a static IP address (192.168.3.254/24)
    - Option 2 > 2 for LAN



```
Enter the new LAN IPv4 address.  Press <ENTER> for none:
> 192.168.3.254

Subnet masks are entered as bit counts (as in CIDR notation) in pfSense.
e.g. 255.255.255.0 = 24
     255.255.0.0   = 16
     255.0.0.0     = 8

Enter the new LAN IPv4 subnet bit count (1 to 32):
> 24
```

- For a WAN, enter the new WAN IPv4 upstream gateway address. For a LAN, press <ENTER> for none:
    - Press Enter
- Configure IPv6 address WAN interface via DHCP6? (y/n)
    - N
- Enter the new WAN IPv6 address. Press <ENTER> for none:
    - Press Enter
- Do you want to enable the DHCP server on WAN? (y/n)
    - N



```
The IPv4 LAN address has been set to 192.168.3.254/24
You can now access the webConfigurator by opening the following URL in your web brows
er:
                http://192.168.3.254/

Press <ENTER> to continue.
```

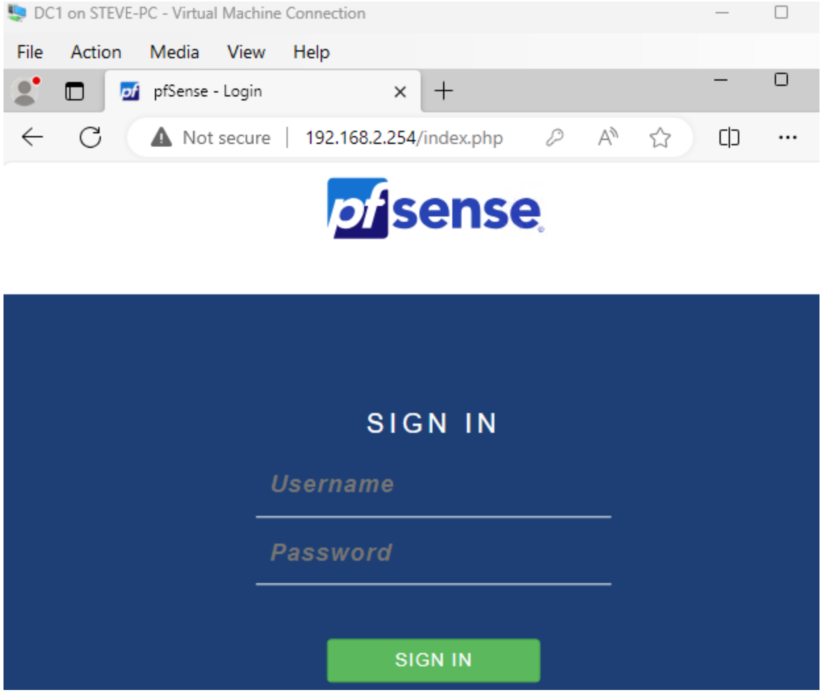
CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

Test Connectivity:

- Verify that the two pfSense VMs can communicate with each other over the WAN interfaces by using the ping command from the pfSense console

- To do this we must allow PING on pfSense WAN via the Firewall rule setting on both Routers

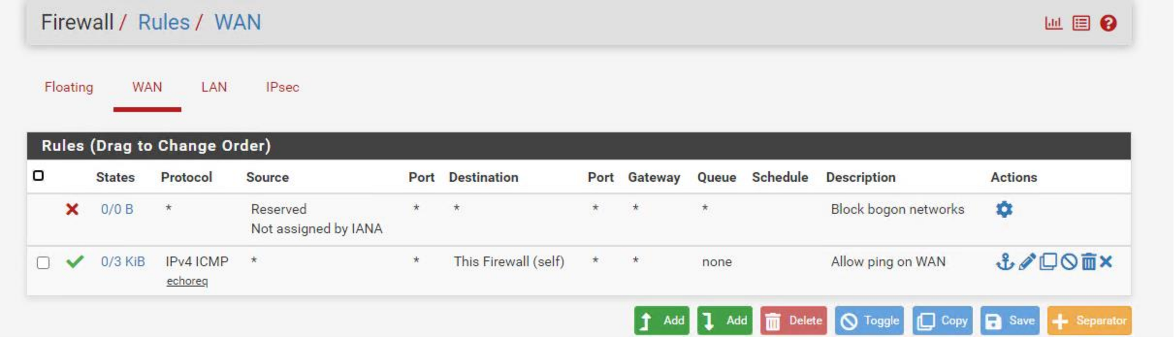
- Navigate to Edge browser on **DC1** > We can access the pfSense Dashboard GUI by entering the Default Gateway on **LAN1** which is 192.168.2.254



- Sign in using the default username and password:
  - **admin/pfsense**

Firewall rules on pfSense for DC1 & DC2:

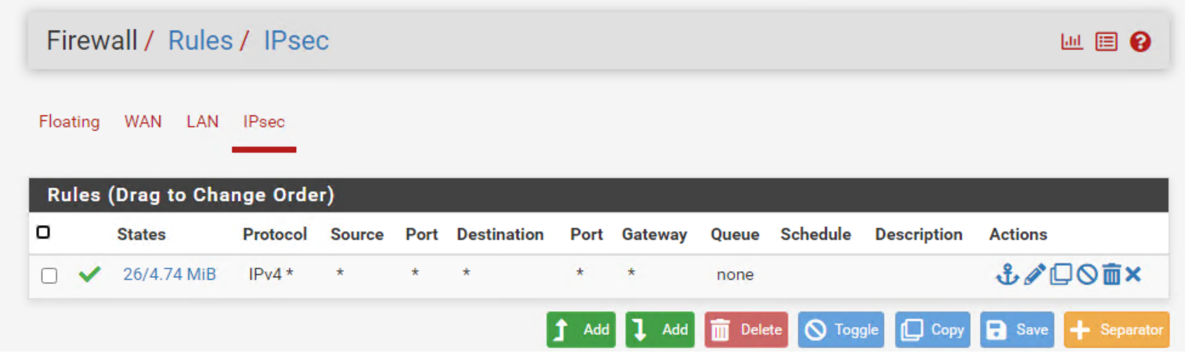
- Go to > **Firewall** > **Rules** > **WAN** (To allow PING from WAN to WAN)
  - Create a new rule by clicking Add
    - Action: **Pass**
    - Protocol: **ICMP**
    - ICMP subtypes: **Echo Request**
    - Source: **any**
    - Destination: **This Firewall**
    - Description: **Allow ping on WAN**
    - Save > **Apply**



Rules (Drag to Change Order)

□		States	Protocol	Source	Port	Destination	Port	Gateway	Queue	Schedule	Description	Actions
	✗	0/0 B	*	Reserved Not assigned by IANA	*	*	*	*	*		Block bogon networks	⚙
□	✓	0/3 KiB	IPv4 ICMP echoreq	*	*	This Firewall (self)	*	*	none		Allow ping on WAN	⚓✎❐⊘🗑✗

- Go to > **Firewall** > **Rules** > **IPsec** (To allow IPv4 traffic to pass from site 1 to site 2)
    - Action: **Pass**
    - Interface: **IPsec**
    - Address Family: **IPv4**
    - Protocol: **Any**
    - Source: **Any**
    - Destination: **Any**



Rules (Drag to Change Order)

□		States	Protocol	Source	Port	Destination	Port	Gateway	Queue	Schedule	Description	Actions
□	✓	26/4.74 MiB	IPv4 *	*	*	*	*	*	none			⚓✎❐⊘🗑✗

- Navigate to Edge browser on **DC2** > We can access the pfSense Dashboard GUI by entering the Default Gateway on **LAN2** which is 192.168.3.254

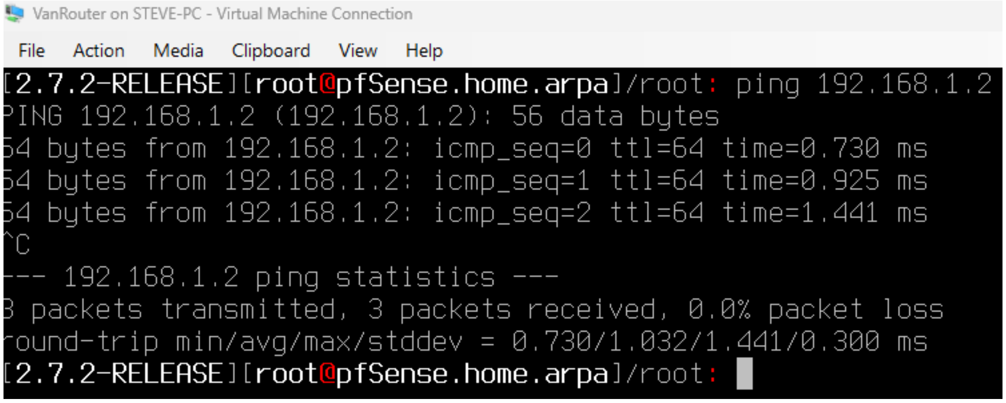
- Go to > Firewall > Rules WAN
    - Create a new rule by clicking **Add**
        - Action: **Pass**
        - Protocol: **ICMP**
        - ICMP subtypes: **Echo Request**
        - Source: **any**
        - Destination: **This Firewall**
        - Description: **Allow ping on WAN**

  - Save > **Apply**

- Go to > **Firewall** > **Rules** > **IPsec** (To allow IPv4 traffic to pass from site 2 to site 1)
  - Action: **Pass**
  - Interface: **IPsec**
  - Address Family: **IPv4**
  - Protocol: **Any**
  - Source: **Any**
  - Destination: **Any**

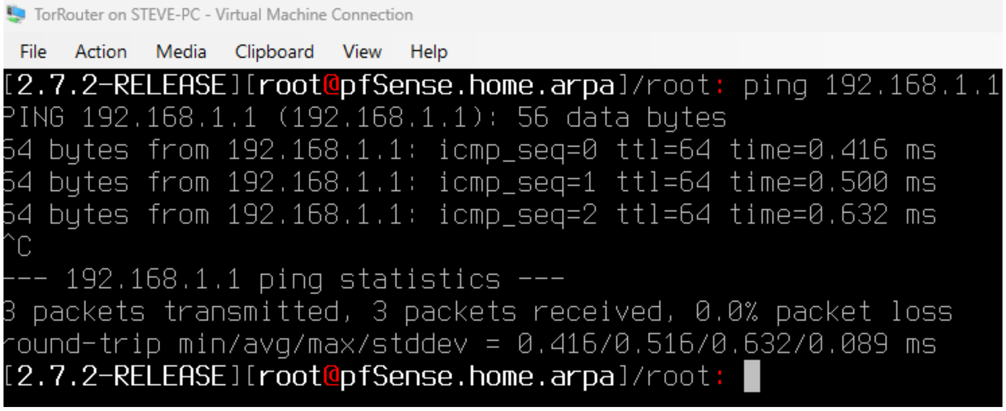
Ping WAN:

1. VanRouter: 192.168.1.1/30
   - PING **WAN** on TorRouter: 192.168.1.2/30



```
[2.7.2-RELEASE][root@pfSense.home.arpa]/root: ping 192.168.1.2
PING 192.168.1.2 (192.168.1.2): 56 data bytes
64 bytes from 192.168.1.2: icmp_seq=0 ttl=64 time=0.730 ms
64 bytes from 192.168.1.2: icmp_seq=1 ttl=64 time=0.925 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=64 time=1.441 ms
^C
--- 192.168.1.2 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.730/1.032/1.441/0.300 ms
[2.7.2-RELEASE][root@pfSense.home.arpa]/root: 
```

2. TorRouter: 192.1681.2/30
   - PING **WAN** on VanRouter: 192.168.1.1/30

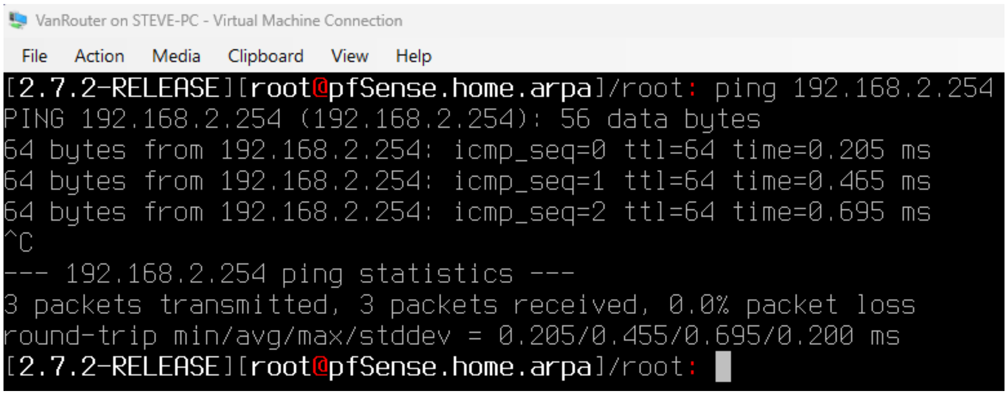


```
[2.7.2-RELEASE][root@pfSense.home.arpa]/root: ping 192.168.1.1
PING 192.168.1.1 (192.168.1.1): 56 data bytes
64 bytes from 192.168.1.1: icmp_seq=0 ttl=64 time=0.416 ms
64 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=0.500 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=0.632 ms
^C
--- 192.168.1.1 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.416/0.516/0.632/0.089 ms
[2.7.2-RELEASE][root@pfSense.home.arpa]/root: 
```

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

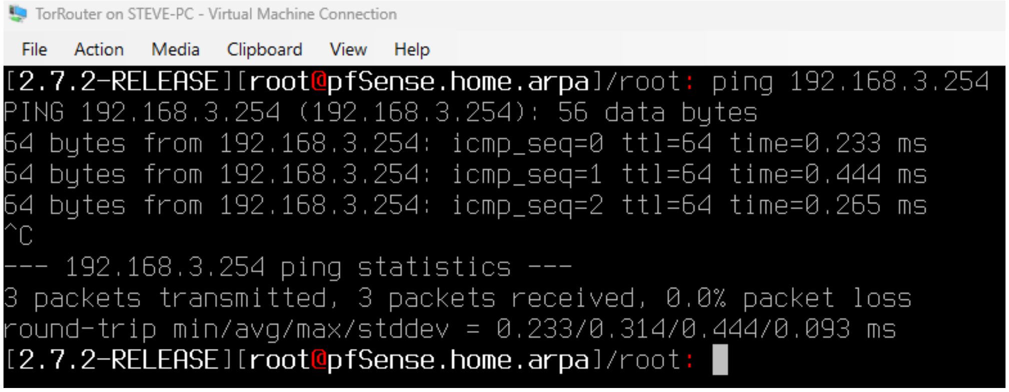
Ping LAN

1. VanRouter: 192.168.1.1/30
   - PING **LAN1** Default Gateway: 192.168.2.254/24


VanRouter on STEVE-PC - Virtual Machine Connection
File Action Media Clipboard View Help

```
[2.7.2-RELEASE][root@pfSense.home.arpa]/root: ping 192.168.2.254
PING 192.168.2.254 (192.168.2.254): 56 data bytes
64 bytes from 192.168.2.254: icmp_seq=0 ttl=64 time=0.205 ms
64 bytes from 192.168.2.254: icmp_seq=1 ttl=64 time=0.465 ms
64 bytes from 192.168.2.254: icmp_seq=2 ttl=64 time=0.695 ms
^C
--- 192.168.2.254 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.205/0.455/0.695/0.200 ms
[2.7.2-RELEASE][root@pfSense.home.arpa]/root:
```

2. TorRouter: 192.168.1.2/30
   - PING **LAN2** Default Gateway: 192.168.3.254/24


TorRouter on STEVE-PC - Virtual Machine Connection
File Action Media Clipboard View Help

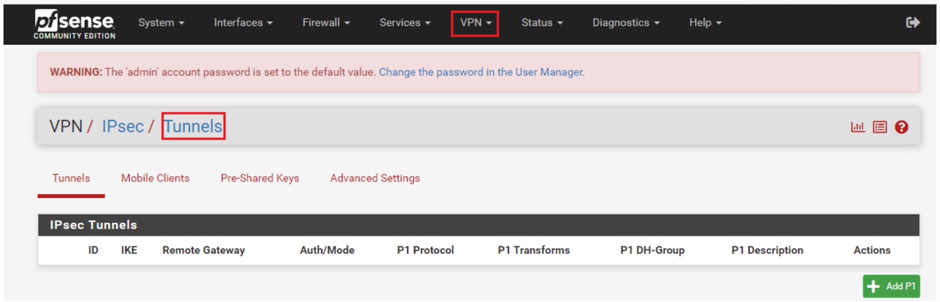
```
[2.7.2-RELEASE][root@pfSense.home.arpa]/root: ping 192.168.3.254
PING 192.168.3.254 (192.168.3.254): 56 data bytes
64 bytes from 192.168.3.254: icmp_seq=0 ttl=64 time=0.233 ms
64 bytes from 192.168.3.254: icmp_seq=1 ttl=64 time=0.444 ms
64 bytes from 192.168.3.254: icmp_seq=2 ttl=64 time=0.265 ms
^C
--- 192.168.3.254 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.233/0.314/0.444/0.093 ms
[2.7.2-RELEASE][root@pfSense.home.arpa]/root:
```

Configure IPsec VPN Tunnel:

Phase 1 on DC1: Set up the VPN Endpoints:

- Login to pfSense Firewall (Site 1):
  - Access the pfSense web interface on the first site (192.168.2.254)
- Navigate to VPN Configuration:
  - Go to **VPN** > **IPSec** and click on the **'Tunnels'** tab

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL



WARNING: The 'admin' account password is set to the default value. Change the password in the User Manager.

VPN / IPsec / Tunnels

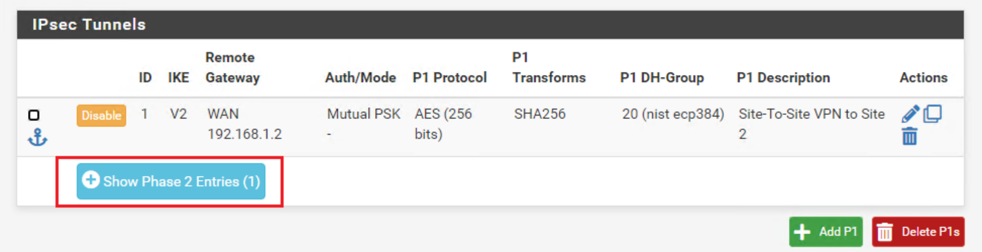
IPsec Tunnels

ID	IKE	Remote Gateway	Auth/Mode	P1 Protocol	P1 Transforms	P1 DH-Group	P1 Description	Actions

- Create Phase 1:
    - General Information
        - Click on '**Add P1**' to create a new **Phase 1** entry
    - IKE Endpoint Configuration
        - Key Exchange version: **IKEv2**
        - Internet Protocol: **IPv4**
        - Interface: **WAN**
        - Remote Gateway: **192.168.1.2** (WAN IP of second pfSense Firewall)
    - Phase 1 Proposal (Authentication)
        - Authentication Method: **Mutual PSK**
        - My identifier: **My IP address**
        - Peer identifier: **Peer IP address**
        - Pre-Shared Key: **a2bb37eeaf2a955e72869a1c4b85bb51f56ba860e204c3e25c8f875e**
    - Phase 1 Proposal (Encryption Algorithm)
        - Encryption Algorithm: **AES** > **256 bits** > **SHA256** > **20 (nist ecp384)**
    - Expiration and Replacement
        - Life Time: **28800**
        - Rekey: **25920**
        - Reauth Time: **0**
        - Rand Time: **2880**
    - Advanced Options
        - Child SA Start Action: **Default**
        - Child SA Close Action: **Restart/Reconnect**
        - NAT Traversal: **Auto**
        - MOBIKE: **Disable**
        -

Phase 2 on DC1: Set up the Tunnel Networks:

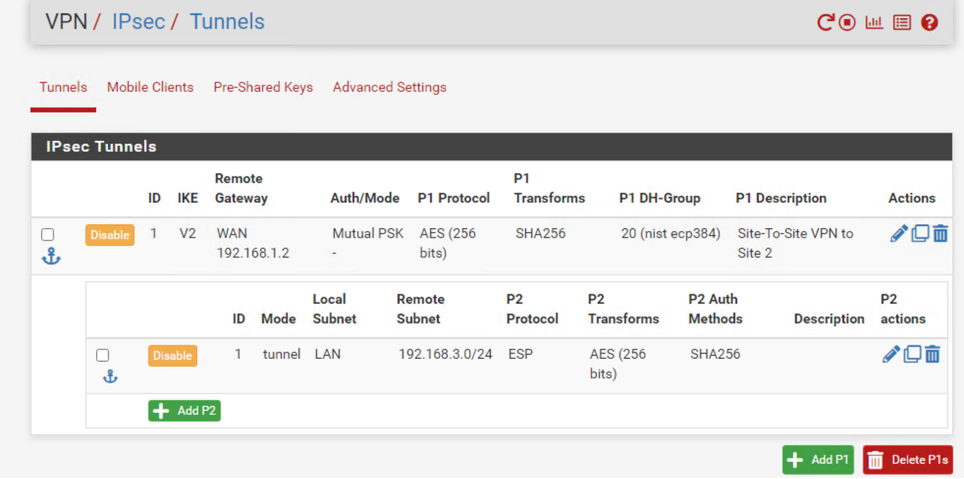
- Create Phase 2:
    - On the same page, click on '**Show Phase 2 Entries'** and add a new Phase 2 entry



IPsec Tunnels

		ID	IKE	Remote Gateway	Auth/Mode	P1 Protocol	P1 Transforms	P1 DH-Group	P1 Description	Actions
□ ⚓	Disable	1	V2	WAN 192.168.1.2	Mutual PSK -	AES (256 bits)	SHA256	20 (nist ecp384)	Site-To-Site VPN to Site 2	

- General Information
  - Mode: **Tunnel IPv4**
- Networks
  - Local Network: **LAN subnet**
  - NAT/BINAT translation: **None**
  - Remote Network: **Network** > **192.168.3.0/24**
- Phase 2 Proposal (SA/Key Exchange)
  - Protocol: **ESP**
  - Encryption Algorithm: **AES** > **256 bits**
  - Hash Algorithm: **SHA256**
  - PFS key group: **20 (nist ecp384)**
- Expiration and Replacement
  - Life Time: **3600**
  - Rekey Time: **3240**
  - Rand Time: **360**
  - Save > **Apply**



IPsec Tunnels

		ID	IKE	Remote Gateway	Auth/Mode	P1 Protocol	P1 Transforms	P1 DH-Group	P1 Description	Actions
□ ⚓	Disable	1	V2	WAN 192.168.1.2	Mutual PSK -	AES (256 bits)	SHA256	20 (nist ecp384)	Site-To-Site VPN to Site 2	

		ID	Mode	Local Subnet	Remote Subnet	P2 Protocol	P2 Transforms	P2 Auth Methods	Description	P2 actions
□ ⚓	Disable	1	tunnel	LAN	192.168.3.0/24	ESP	AES (256 bits)	SHA256		

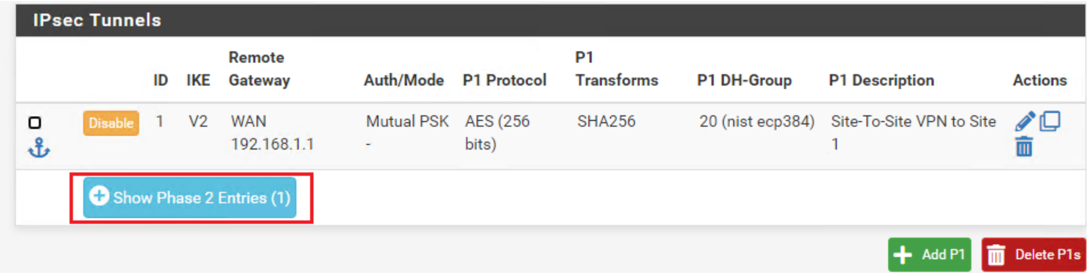
Phase 1 on DC2: Set up the VPN Endpoints:

- Login to pfSense Firewall (Site 2):
  - Access the pfSense web interface on the first site (192.168.3.254)
- Navigate to VPN Configuration:

  - Go to **VPN** > **IPSec** and click on the '**Tunnels'** tab
- Create Phase 1:
  - General Information
    - Click on '**Add P1**' to create a new Phase 1 entry
  - IKE Endpoint Configuration
    - Key Exchange version: **IKEv2**
    - Internet Protocol: **IPv4**
    - Interface: **WAN**
    - Remote Gateway: **192.168.1.1** (WAN IP of first pfSense Firewall)
  - Phase 1 Proposal (Authentication)
    - Authentication Method: **Mutual PSK**
    - My identifier: **My IP address**
    - Peer identifier: **Peer IP address**
    - Pre-Shared Key: **a2bb37eeaf2a955e72869a1c4b85bb51f56ba860e204c3e25c8f875e** (copy the generated shared key from DC1)
  - Phase 1 Proposal (Encryption Algorithm)
    - Encryption Algorithm: **AES** > **256 bits** > **SHA256** > **20 (nist ecp384)**
  - Expiration and Replacement
    - Life Time: **31860**
    - Rekey: **28674**
    - Reauth Time: **0**
    - Rand Time: **3186**
  - Advanced Options
    - Child SA Start Action: **None (Responder Only)**
    - Child SA Close Action: **Close connection and clear SA**
    - NAT Traversal: **Auto**
    - MOBIKE: **Disable**

Phase 2 on DC2: Set up the Tunnel Networks:

- Create Phase 2:
  - On the same page, click on '**Show Phase 2 Entries'** and add a new Phase 2 entry

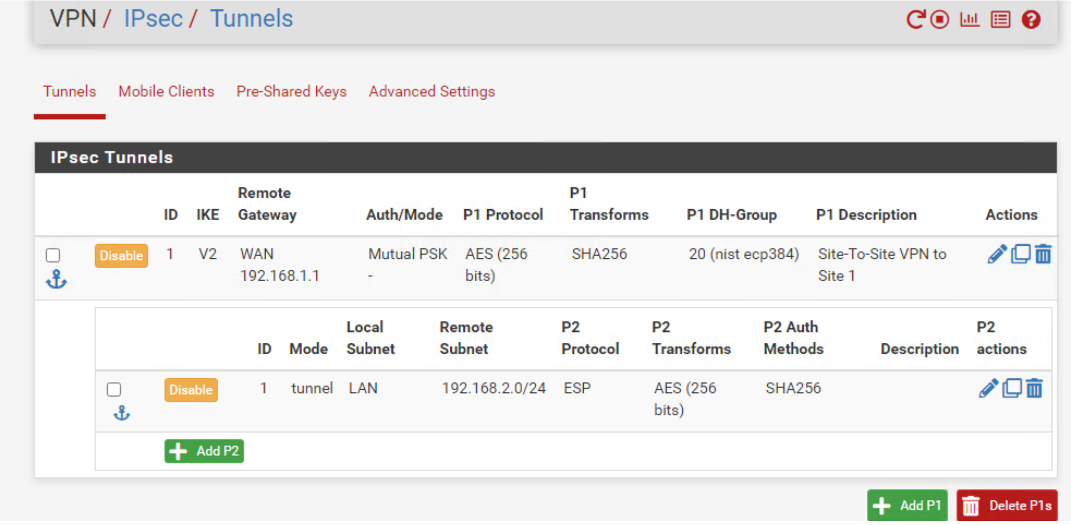


IPsec Tunnels

		ID	IKE	Remote Gateway	Auth/Mode	P1 Protocol	P1 Transforms	P1 DH-Group	P1 Description	Actions
☐ ⚓	Disable	1	V2	WAN 192.168.1.1	Mutual PSK -	AES (256 bits)	SHA256	20 (nist ecp384)	Site-To-Site VPN to Site 1	

- General Information
  - Mode: **Tunnel IPv4**
- Networks
  - Local Network: **LAN subnet**
  - NAT/BINAT translation: **None**
  - Remote Network: **Network** > **192.168.2.0/24**
- Phase 2 Proposal (SA/Key Exchange)
  - Protocol: **ESP**
  - Encryption Algorithm: **AES** > **256 bits**
  - Hash Algorithm: **SHA256**
  - PFS key group: **20 (nist ecp384)**
- Expiration and Replacement
  - Life Time: **5400**
  - Rekey Time: **4860**
  - Rand Time: **540**

- Save > Apply



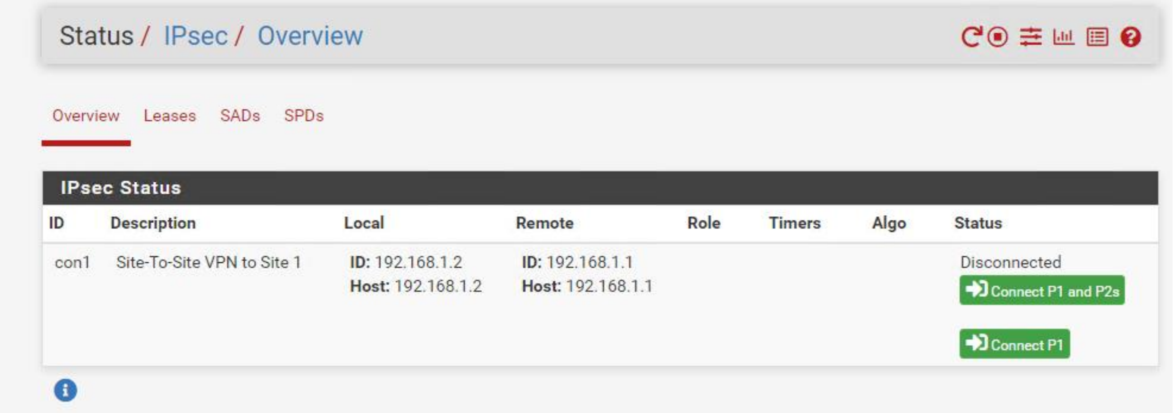
IPsec Tunnels

	ID	IKE	Remote Gateway	Auth/Mode	P1 Protocol	P1 Transforms	P1 DH-Group	P1 Description	Actions
☐ Disable	1	V2	WAN 192.168.1.1	Mutual PSK -	AES (256 bits)	SHA256	20 (nist ecp384)	Site-To-Site VPN to Site 1	

	ID	Mode	Local Subnet	Remote Subnet	P2 Protocol	P2 Transforms	P2 Auth Methods	Description	P2 actions
☐ Disable	1	tunnel	LAN	192.168.2.0/24	ESP	AES (256 bits)	SHA256		

Post-Configuration:

- Start the IPSec Service:
  - On both firewalls, navigate to **Status** > **IPSec**, and click on '**Start Service**' if it's not running
- Establish the Tunnel:
  - Click on '**Connect VPN**' for the newly created IPSec connection



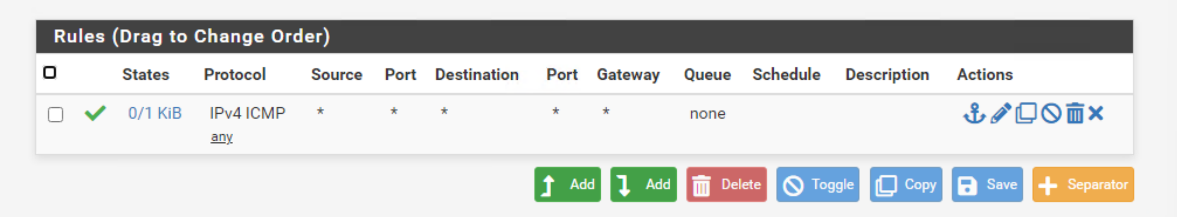
Status / IPsec / Overview

Overview Leases SADs SPDs

IPsec Status

ID	Description	Local	Remote	Role	Timers	Algo	Status
con1	Site-To-Site VPN to Site 1	**ID:** 192.168.1.2 **Host:** 192.168.1.2	**ID:** 192.168.1.1 **Host:** 192.168.1.1				Disconnected Connect P1 and P2s Connect P1

- Firewall Rules:
  - Adjust firewall rules to allow traffic to pass through the tunnel. This is done in the **Firewall** > **Rules** > **IPSec** section



Rules (Drag to Change Order)

□		States	Protocol	Source	Port	Destination	Port	Gateway	Queue	Schedule	Description	Actions
□	✓	0/1 KiB	IPv4 ICMP any	*	*	*	*	*	none			

- Use the **Status** > **IPSec** page to view the status of the IPSec tunnels

Configure the Internal Devices:

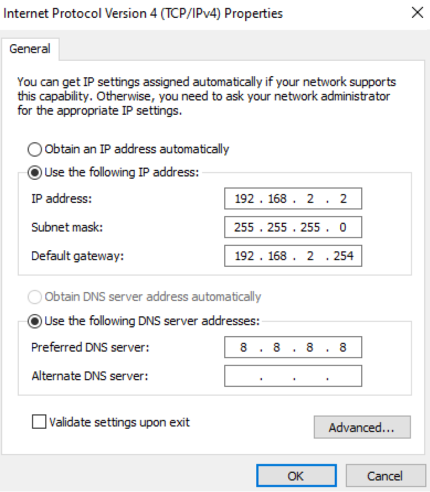
DC1 > Vancouver:

- Configure Networking: **DC1** > **Server Manager** > **Local Server** > **LAN1** > **Properties** > **TCP/IPv4**
  - Set Static IP:
    - IP Address: 192.168.2.2
    - Subnet mask: 255.255.255.0
    - Default Gateway: 192.168.2.254
    - DNS (Before DC Promotion): 8.8.8.8

DC2 > Toronto:

- Configure Networking: **DC2** > **Server Manager** > **Local Server** > **LAN2** > **Properties** > **TCP/IPv4**
  - Set Static IP:
    - IP Address: 192.168.3.2
    - Subnet mask: 255.255.255.0
    - Default Gateway: 192.168.3.254
    - DNS (Before DC Promotion): 8.8.8.8

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

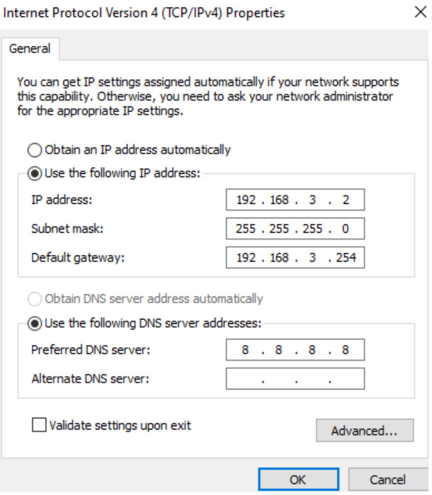
○ Obtain an IP address automatically
● Use the following IP address:

IP address: 192 . 168 . 2 . 2
Subnet mask: 255 . 255 . 255 . 0
Default gateway: 192 . 168 . 2 . 254

○ Obtain DNS server address automatically
● Use the following DNS server addresses:

Preferred DNS server: 8 . 8 . 8 . 8
Alternate DNS server: . . .

□ Validate settings upon exit



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically
● Use the following IP address:

IP address: 192 . 168 . 3 . 2
Subnet mask: 255 . 255 . 255 . 0
Default gateway: 192 . 168 . 3 . 254

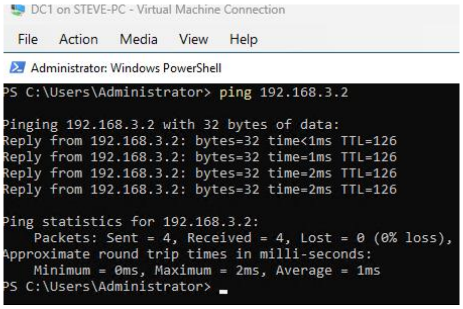
○ Obtain DNS server address automatically
● Use the following DNS server addresses:

Preferred DNS server: 8 . 8 . 8 . 8
Alternate DNS server: . . .

□ Validate settings upon exit

Connect the Vancouver Office to the Toronto Office Through IPsec Tunneling:

- Test Connectivity:
  - Ping 192.168.3.2 **DC2** (Toronto) from DC1 (Vancouver)

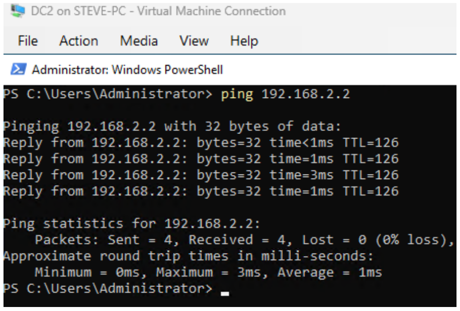


DC1 on STEVE-PC - Virtual Machine Connection

Administrator: Windows PowerShell

```
PS C:\Users\Administrator> ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:
Reply from 192.168.3.2: bytes=32 time<1ms TTL=126
Reply from 192.168.3.2: bytes=32 time=1ms TTL=126
Reply from 192.168.3.2: bytes=32 time=2ms TTL=126
Reply from 192.168.3.2: bytes=32 time=2ms TTL=126

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms
PS C:\Users\Administrator> _
```

  - Ping 192.168.2.2 **DC1** (Vancouver) from DC2 (Toronto)



DC2 on STEVE-PC - Virtual Machine Connection

Administrator: Windows PowerShell

```
PS C:\Users\Administrator> ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time=1ms TTL=126
Reply from 192.168.2.2: bytes=32 time=3ms TTL=126
Reply from 192.168.2.2: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 1ms
PS C:\Users\Administrator> _
```

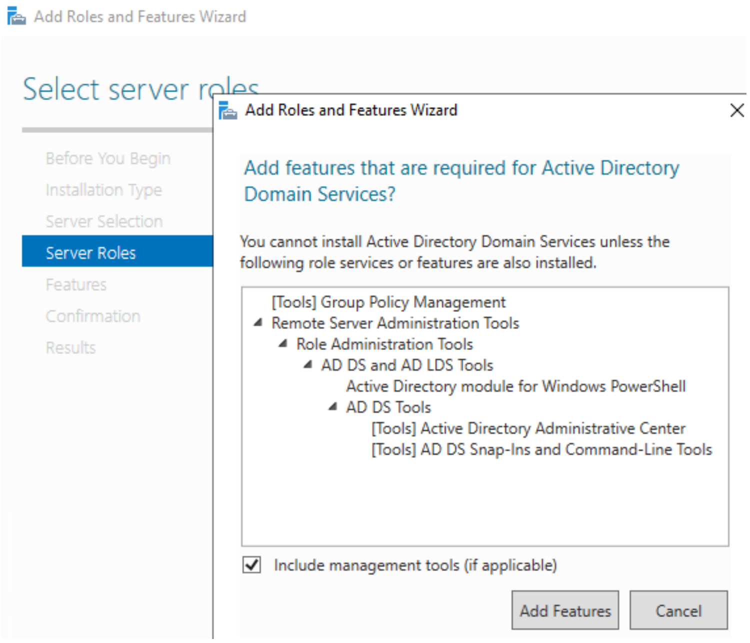
CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

Create the Domain Controllers:

Installation Steps for the First Domain Controller (DC1):

- DC1 Running on Windows Server 2022
- Static IP configuration:
  - IP Address: 192.168.2.2/24
  - Gateway: 192.168.2.254

- Install Active Directory Domain Services (AD DS):
  - Open **Server Manager**
  - Click on **'Add roles and features'**



Add features that are required for Active Directory Domain Services?

You cannot install Active Directory Domain Services unless the following role services or features are also installed.

```
[Tools] Group Policy Management
◢ Remote Server Administration Tools
    ◢ Role Administration Tools
        ◢ AD DS and AD LDS Tools
              Active Directory module for Windows PowerShell
            ◢ AD DS Tools
                  [Tools] Active Directory Administrative Center
                  [Tools] AD DS Snap-Ins and Command-Line Tools
```

☑ Include management tools (if applicable)

- Proceed to the **'Roles'** section and check **'Active Directory Domain Services**'
- Add features that are required for Active Directory Domain Services and click **'Next'**
- Install

Create Secondary Disk for DC1:

- We will create a secondary storage disk to hold all Database files
  - Run script on Host using PowerShell ISE Administrator

- $VHDXname = Read-Host -Prompt 'Input VHDX name'
- $SizeInGB = Read-Host -Prompt 'Input the size in GB. Ex 5, 10'
- $VMName = Read-Host -Prompt 'Input target VM name'
- $VHDPath = "V:\VMs\VHDX\" + $VHDXname + ".vhdx"

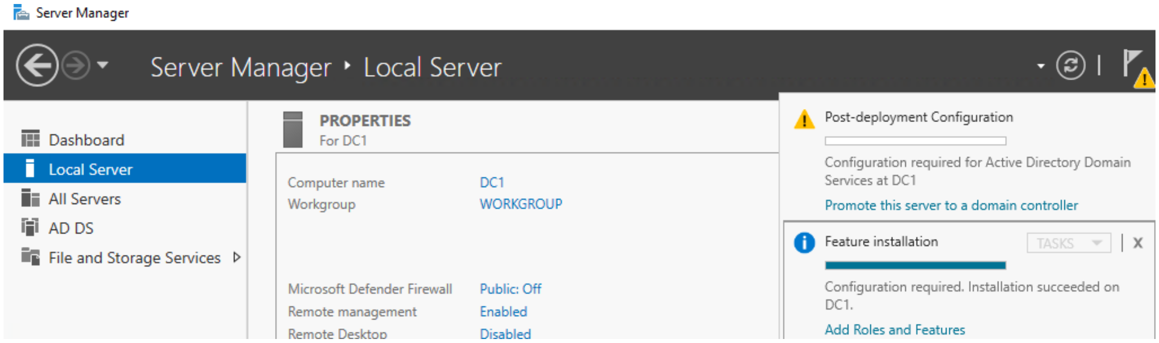
```
$SizeBytes = ($SizeInGB/1 * 1073741824)
$alreadyExists = Test-Path -Path $VHDPath

if ($alreadyExists) {
    Write-Error "Error. The VHDX already exists"
    return
}

New-VHD -Path $VHDPath -Dynamic -SizeBytes $SizeBytes | Mount-VHD -Passthru |Initialize-Disk -Passthru |New-Partition -AssignDriveLetter -UseMaximumSize |Format-Volume -FileSystem NTFS -Confirm:$false -Force
Dismount-VHD -Path $VHDPath
# Optimize-VHD -Path $VHDPath -Mode Full
Add-VMHardDiskDrive -VMName $VMName -Path $VHDPath
```

Bring Disk Online DC1:

- **Server Manager** > **File and Storage Services** > **Volumes** > **Disks** > **Right click** > **Bring Online**
- The Volume is designated as D:\

Promote to Domain Controller:

- After installation, click on the notification flag and select '**Promote this server to a domain controller**'

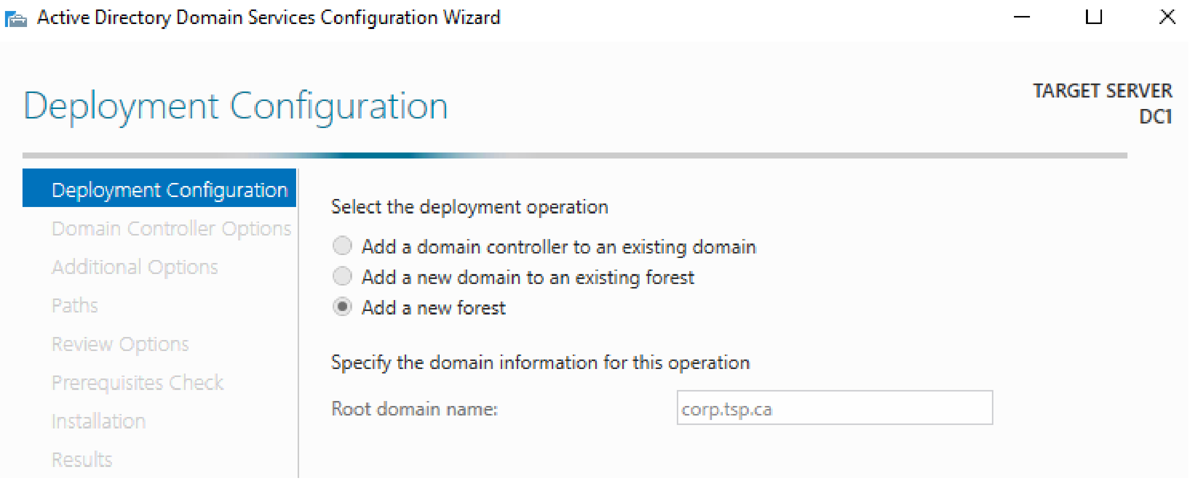


Computer name DC1
Workgroup WORKGROUP
Microsoft Defender Firewall Public: Off
Remote management Enabled
Remote Desktop Disabled

Post-deployment Configuration
Configuration required for Active Directory Domain Services at DC1
Promote this server to a domain controller

Feature installation
Configuration required. Installation succeeded on DC1.
Add Roles and Features

- Choose **'Add a new forest'** and type your Root domain name



Active Directory Domain Services Configuration Wizard

Deployment Configuration

TARGET SERVER
DC1

Select the deployment operation

○ Add a domain controller to an existing domain
○ Add a new domain to an existing forest
● Add a new forest

Specify the domain information for this operation

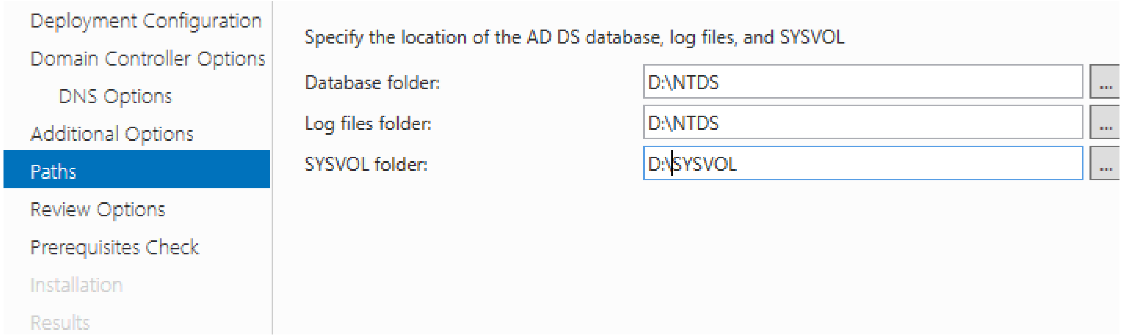
Root domain name: corp.tsp.ca

- **tsp.ca – external domain**
- **corp.tsp.ca – root domain**

- **Set the Directory Services Restore Mode (DSRM)** password
  - **Pa$$w0rd**

- Follow the wizard to configure additional options like **DNS**, and **GC (Global Catalog)**
  - Click the checkbox for **DNS** and **GC**
- Click '**Next**' through the wizard, then click '**Install**'

- **Paths:**

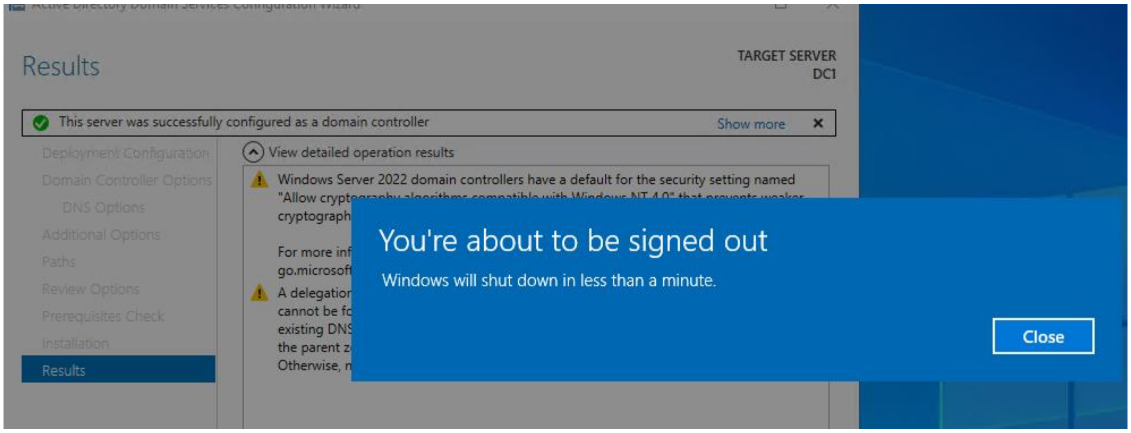


Specify the location of the AD DS database, log files, and SYSVOL

Database folder: D:\NTDS

Log files folder: D:\NTDS

SYSVOL folder: D:\SYSVOL



Results

TARGET SERVER
DC1

This server was successfully configured as a domain controller

Windows Server 2022 domain controllers have a default for the security setting named "Allow crypt… cryptograph…

For more inf… go.microsof…

A delegation… cannot be fo… existing DNS… the parent z… Otherwise, n…

You're about to be signed out

Windows will shut down in less than a minute.

- The server will automatically reboot and become the first Domain Controller

Installation Steps for the First Domain Controller (DC2):

- DC1 Running on Windows Server 2022
- Static IP configuration:
  - IP Address: 192.168.3.2/24
  - Gateway: 192.168.3.254

- Install Active Directory Domain Services (AD DS):
  - Open **Server Manager**
  - Click on **'Add roles and features'**

- Proceed to the **'Roles'** section and check **'Active Directory Domain Services**'
- Add features that are required for Active Directory Domain Services and click **'Next'**
- Install

Create Secondary Disk for DC2:

- We will create a secondary storage disk to hold all Database files
  - Run script on Host using PowerShell ISE Administrator

```
$VHDXname = Read-Host -Prompt 'Input VHDX name'
$SizeInGB = Read-Host -Prompt 'Input the size in GB. Ex 5, 10'
$VMName = Read-Host -Prompt 'Input target VM name'
$VHDPath = "V:\VMs\VHDX\" + $VHDXname + ".vhdx"
$SizeBytes = ($SizeInGB/1 * 1073741824)
$alreadyExists = Test-Path -Path $VHDPath

if ($alreadyExists) {
    Write-Error "Error. The VHDX already exists"
    return
}

New-VHD -Path $VHDPath -Dynamic -SizeBytes $SizeBytes | Mount-VHD -Passthru |Initialize-Disk -Passthru |New-Partition -AssignDriveLetter -UseMaximumSize |Format-Volume -FileSystem NTFS -Confirm:$false -Force
Dismount-VHD -Path $VHDPath
# Optimize-VHD -Path $VHDPath -Mode Full
Add-VMHardDiskDrive -VMName $VMName -Path $VHDPath
```

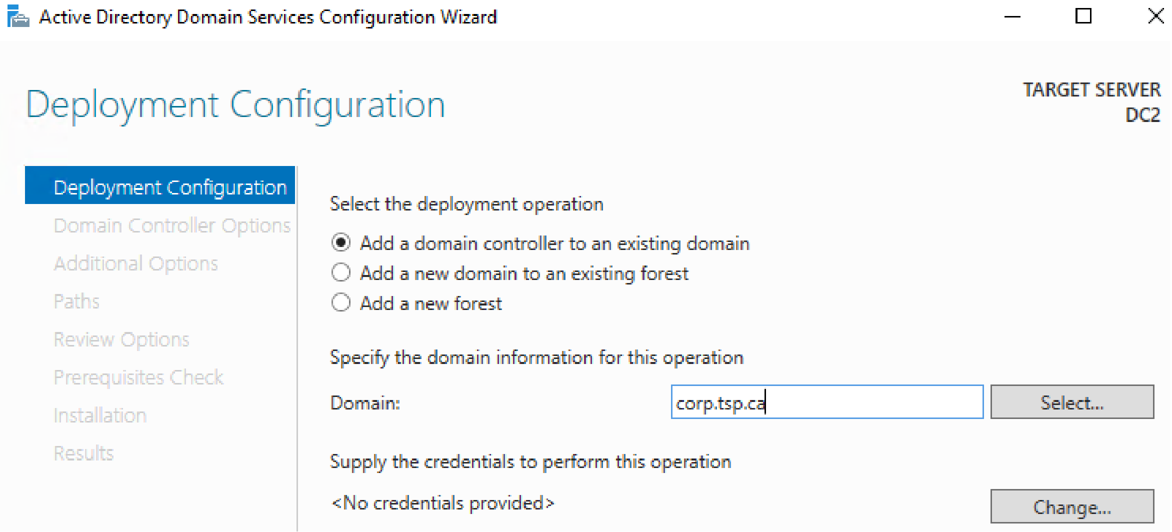
Bring Disk Online DC2:

- **Server Manager** > **File and Storage Services** > **Volumes** > **Disks** > **Right click** > **Bring Online**
- The Volume is designated as D:\

Promote to Domain Controller:

- After installation, click on the notification flag > '**Promote this server to a domain controller**'
- Select "**Add a domain controller to an existing domain**" in the deployment configuration wizard

- In the "**Specify the domain information for this operation**" field type **corp.tsp.ca** which is the **Fully Qualified Domain Name (FQDN)** of the existing domain



Active Directory Domain Services Configuration Wizard

Deployment Configuration

TARGET SERVER
DC2

Select the deployment operation

● Add a domain controller to an existing domain
○ Add a new domain to an existing forest
○ Add a new forest

Specify the domain information for this operation

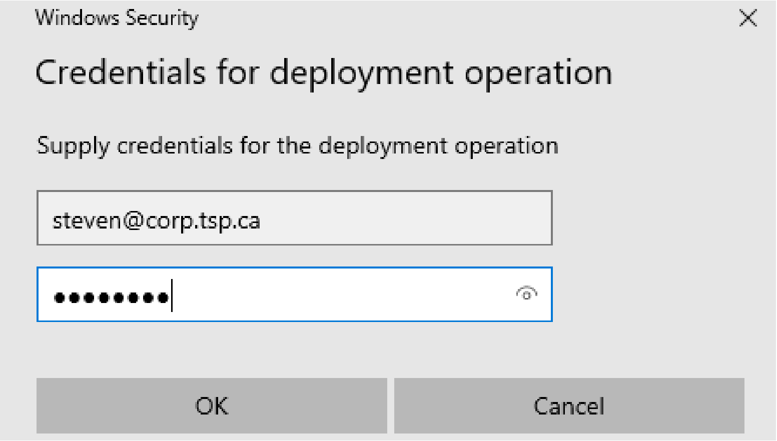
Domain: corp.tsp.ca [Select...]

Supply the credentials to perform this operation

<No credentials provided> [Change...]

- Click "**Select**" to browse for the domain

- You will be prompted to provide credentials
  - Click "**Change**" to enter the *username* and *password* of an account with permissions to add a domain controller to the domain



Windows Security

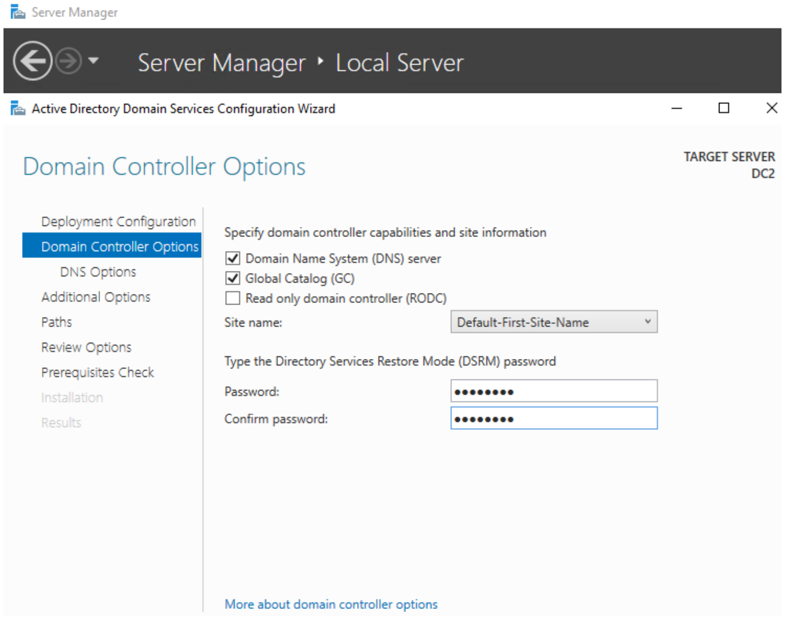
Credentials for deployment operation

Supply credentials for the deployment operation

steven@corp.tsp.ca

•••••••••

- Domain Controller Options:
    - Domain Name System (**DNS**)
    - Global Catalog (**GC**)



Server Manager
Server Manager ‣ Local Server
Active Directory Domain Services Configuration Wizard
Deployment Configuration
Domain Controller Options
DNS Options
Additional Options
Paths
Review Options
Prerequisites Check
Installation
Results
More about domain controller options

Domain Controller Options

TARGET SERVER
DC2

Specify domain controller capabilities and site information

☑ Domain Name System (DNS) server
☑ Global Catalog (GC)
☐ Read only domain controller (RODC)

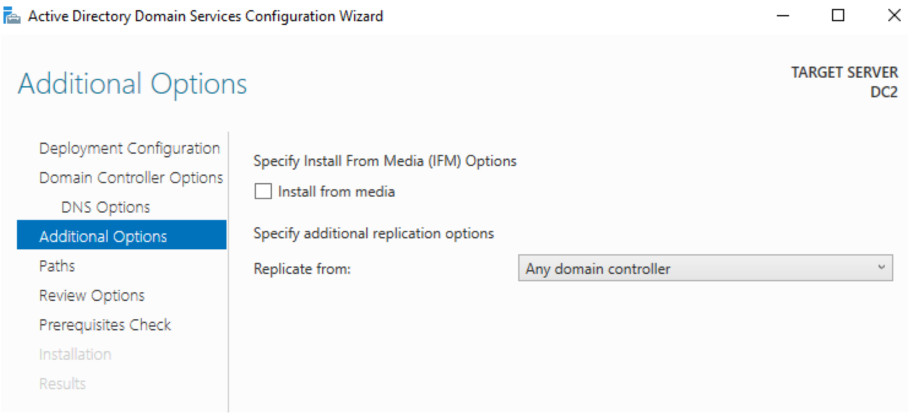
Site name: Default-First-Site-Name

Type the Directory Services Restore Mode (DSRM) password

Password: ••••••••
Confirm password: ••••••••

- DNS Options:
    - Click “**Next**”
- Additional Options:

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL


Active Directory Domain Services Configuration Wizard

Additional Options

TARGET SERVER
DC2

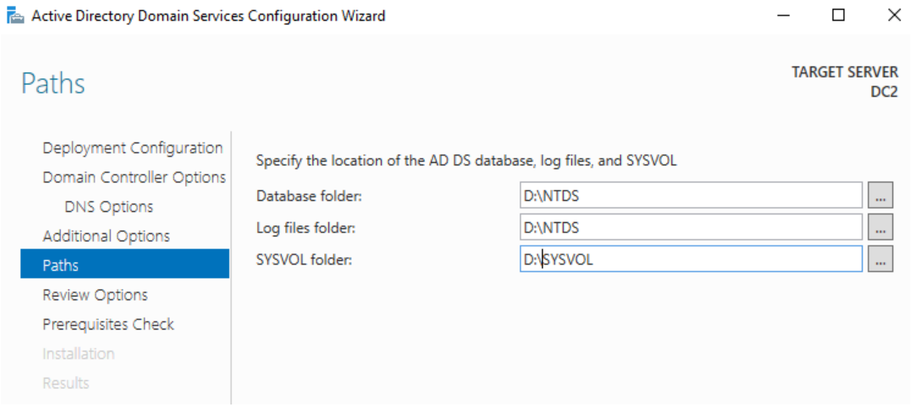
Specify Install From Media (IFM) Options

☐ Install from media

Specify additional replication options

Replicate from: Any domain controller

- Paths:


Active Directory Domain Services Configuration Wizard

Paths

TARGET SERVER
DC2

Specify the location of the AD DS database, log files, and SYSVOL

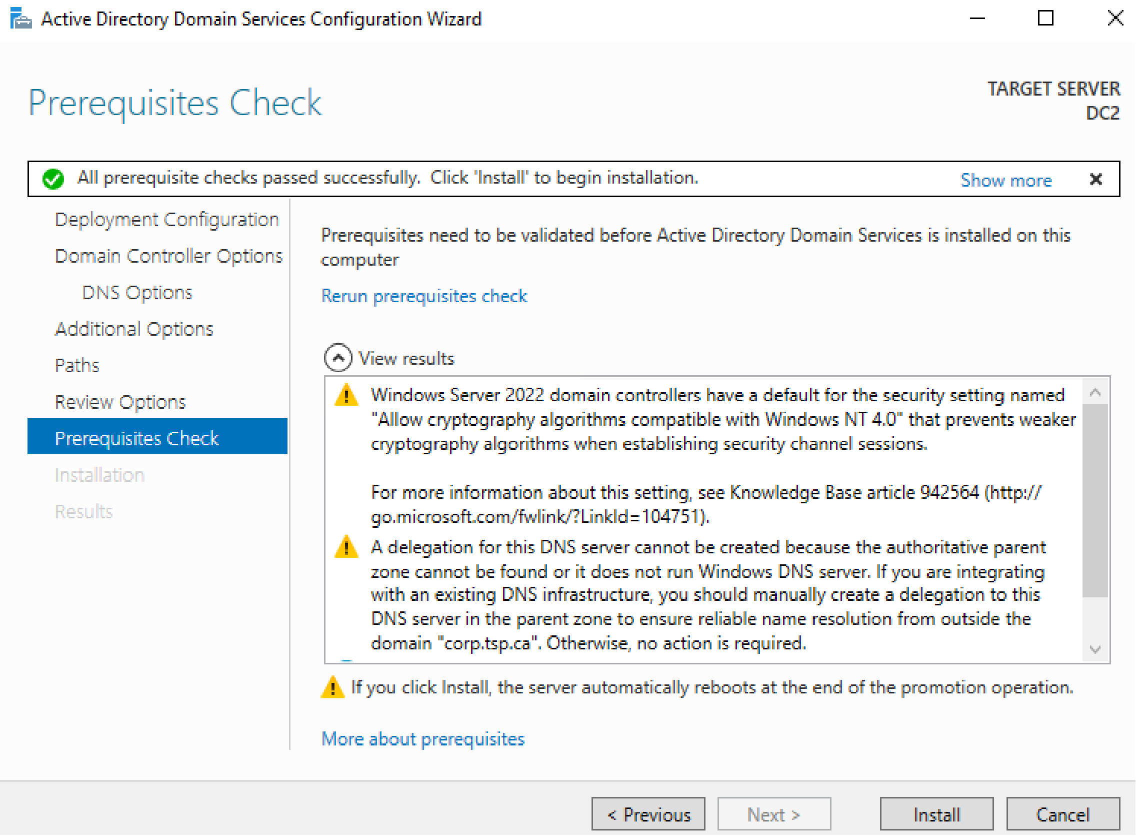
Database folder: D:\NTDS

Log files folder: D:\NTDS

SYSVOL folder: D:\SYSVOL

- After configuring these settings, you will proceed to the prerequisites check

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL



Active Directory Domain Services Configuration Wizard

Prerequisites Check

TARGET SERVER
DC2

All prerequisite checks passed successfully. Click 'Install' to begin installation.

Prerequisites need to be validated before Active Directory Domain Services is installed on this computer

Rerun prerequisites check

View results

Windows Server 2022 domain controllers have a default for the security setting named "Allow cryptography algorithms compatible with Windows NT 4.0" that prevents weaker cryptography algorithms when establishing security channel sessions.

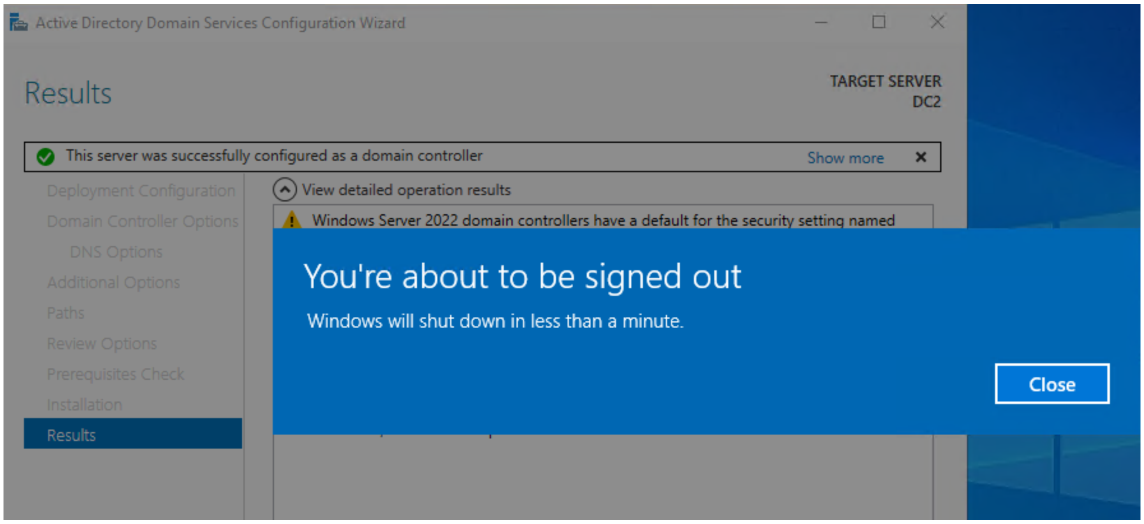
For more information about this setting, see Knowledge Base article 942564 (http://go.microsoft.com/fwlink/?LinkId=104751).

A delegation for this DNS server cannot be created because the authoritative parent zone cannot be found or it does not run Windows DNS server. If you are integrating with an existing DNS infrastructure, you should manually create a delegation to this DNS server in the parent zone to ensure reliable name resolution from outside the domain "corp.tsp.ca". Otherwise, no action is required.

If you click Install, the server automatically reboots at the end of the promotion operation.

More about prerequisites

- The wizard will verify that the server meets all the requirements to become a domain controller
- Once all checks are passed - proceed with the installation
- Computer will restart:



Active Directory Domain Services Configuration Wizard

Results

TARGET SERVER
DC2

This server was successfully configured as a domain controller

View detailed operation results

Windows Server 2022 domain controllers have a default for the security setting named

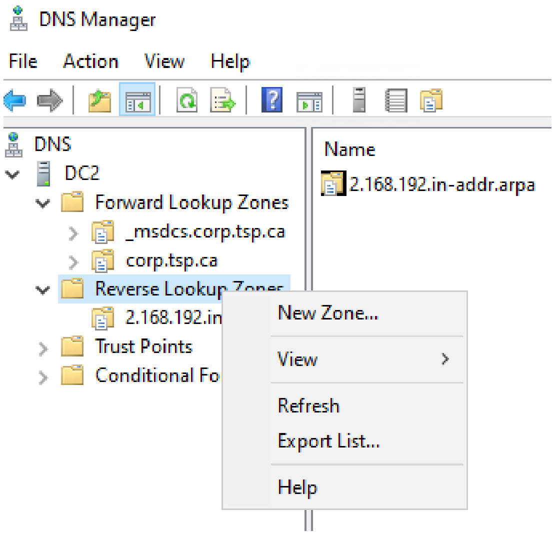
You're about to be signed out

Windows will shut down in less than a minute.

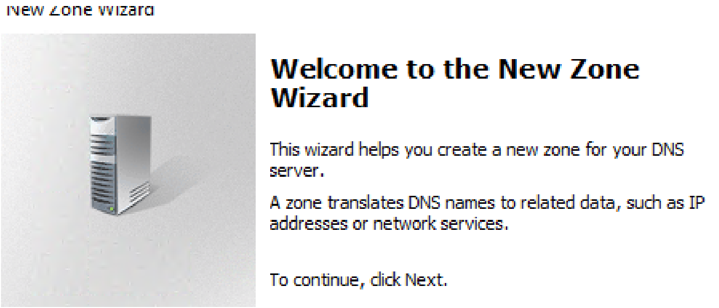
Configure DNS:

Create Reverse Lookup Zone:

DC2 > **Server Manager** > **Tools** > **DNS**



- Click Next


New Zone Wizard

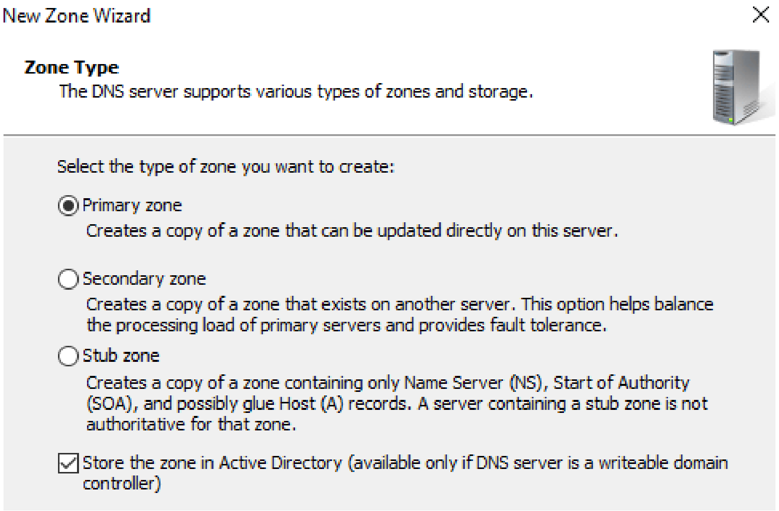
Welcome to the New Zone Wizard

This wizard helps you create a new zone for your DNS server.

A zone translates DNS names to related data, such as IP addresses or network services.

To continue, click Next.

- Click Next


New Zone Wizard

Zone Type
The DNS server supports various types of zones and storage.

Select the type of zone you want to create:

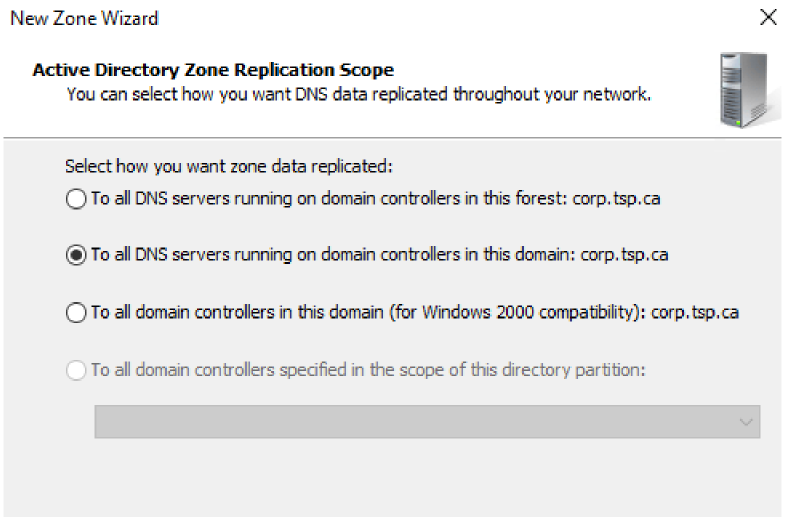
● Primary zone
Creates a copy of a zone that can be updated directly on this server.

○ Secondary zone
Creates a copy of a zone that exists on another server. This option helps balance the processing load of primary servers and provides fault tolerance.

○ Stub zone
Creates a copy of a zone containing only Name Server (NS), Start of Authority (SOA), and possibly glue Host (A) records. A server containing a stub zone is not authoritative for that zone.

☑ Store the zone in Active Directory (available only if DNS server is a writeable domain controller)

- Click Next



New Zone Wizard

Active Directory Zone Replication Scope
You can select how you want DNS data replicated throughout your network.

Select how you want zone data replicated:

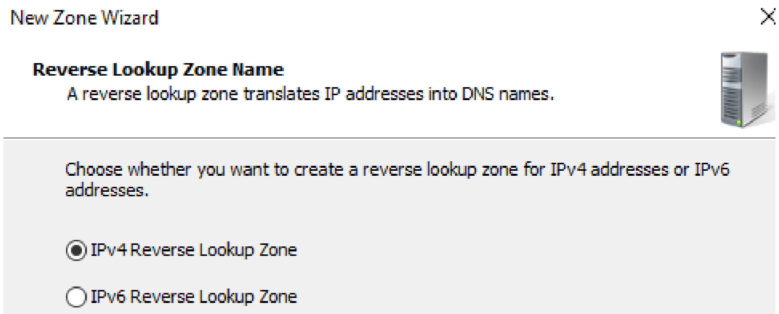
○ To all DNS servers running on domain controllers in this forest: corp.tsp.ca

● To all DNS servers running on domain controllers in this domain: corp.tsp.ca

○ To all domain controllers in this domain (for Windows 2000 compatibility): corp.tsp.ca

○ To all domain controllers specified in the scope of this directory partition:

- Click Next



New Zone Wizard

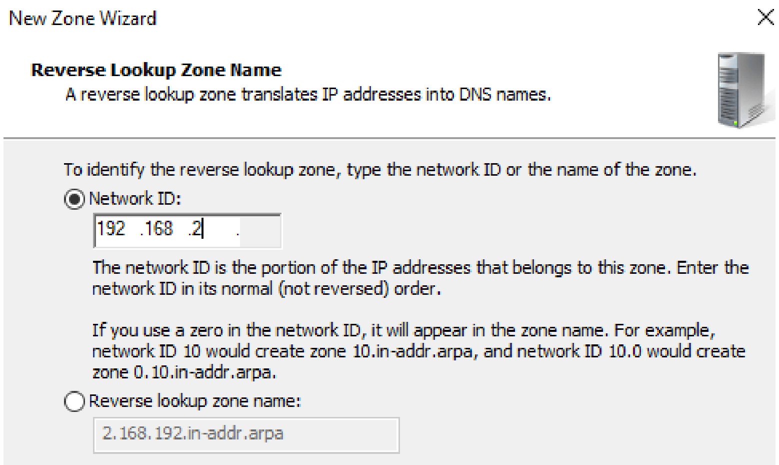
Reverse Lookup Zone Name
A reverse lookup zone translates IP addresses into DNS names.

Choose whether you want to create a reverse lookup zone for IPv4 addresses or IPv6 addresses.

● IPv4 Reverse Lookup Zone

○ IPv6 Reverse Lookup Zone

- Click Next



New Zone Wizard

Reverse Lookup Zone Name
A reverse lookup zone translates IP addresses into DNS names.

To identify the reverse lookup zone, type the network ID or the name of the zone.

● Network ID:

192 .168 .2 .

The network ID is the portion of the IP addresses that belongs to this zone. Enter the network ID in its normal (not reversed) order.

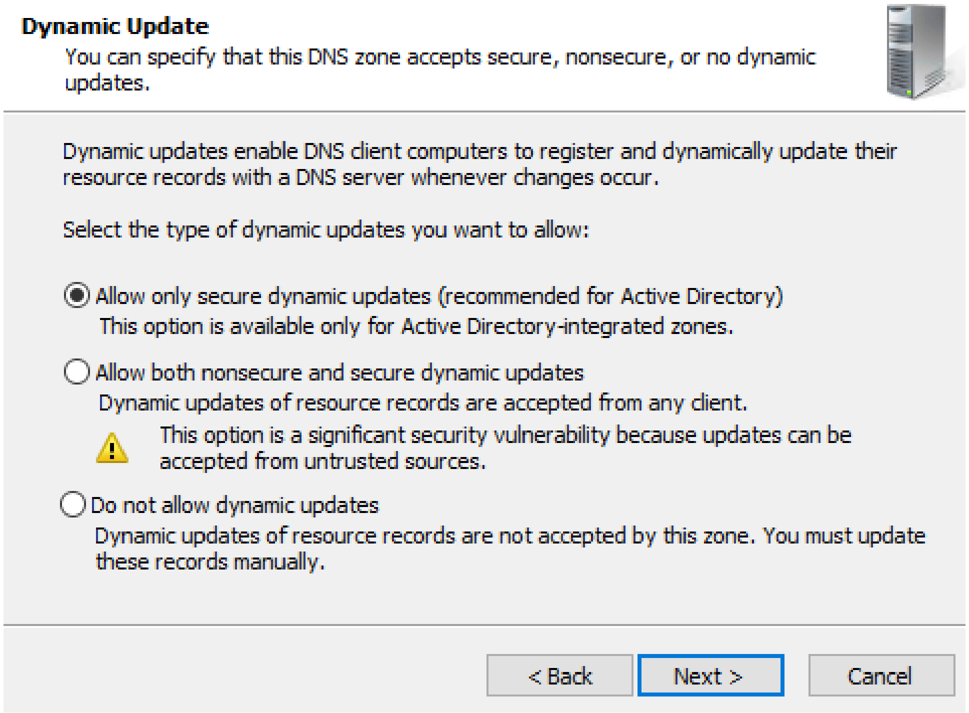
If you use a zero in the network ID, it will appear in the zone name. For example, network ID 10 would create zone 10.in-addr.arpa, and network ID 10.0 would create zone 0.10.in-addr.arpa.

○ Reverse lookup zone name:

2.168.192.in-addr.arpa

- Click Next

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL



Dynamic Update

You can specify that this DNS zone accepts secure, nonsecure, or no dynamic updates.

Dynamic updates enable DNS client computers to register and dynamically update their resource records with a DNS server whenever changes occur.

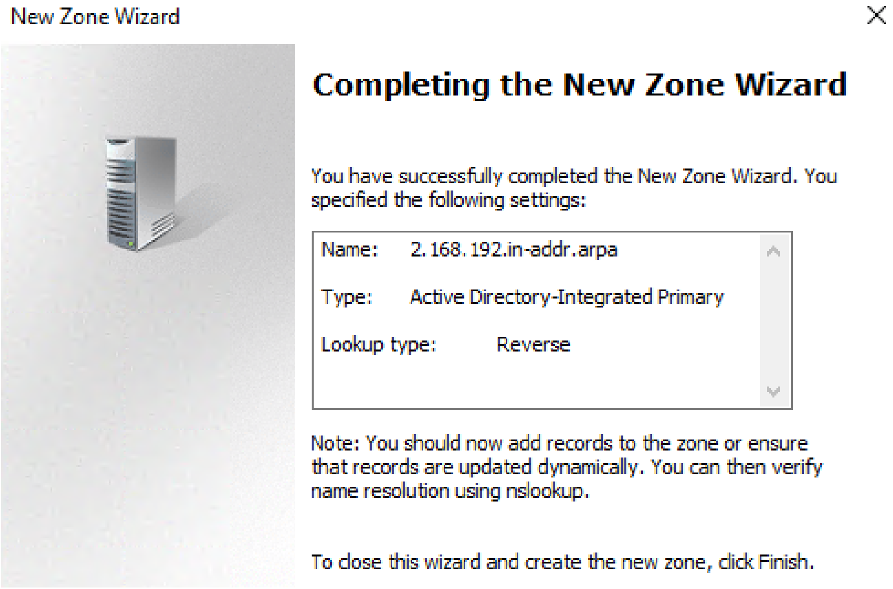
Select the type of dynamic updates you want to allow:

● Allow only secure dynamic updates (recommended for Active Directory)
This option is available only for Active Directory-integrated zones.

○ Allow both nonsecure and secure dynamic updates
Dynamic updates of resource records are accepted from any client.
⚠ This option is a significant security vulnerability because updates can be accepted from untrusted sources.

○ Do not allow dynamic updates
Dynamic updates of resource records are not accepted by this zone. You must update these records manually.

- Click Finish



New Zone Wizard

Completing the New Zone Wizard

You have successfully completed the New Zone Wizard. You specified the following settings:

Name: 2.168.192.in-addr.arpa

Type: Active Directory-Integrated Primary

Lookup type: Reverse

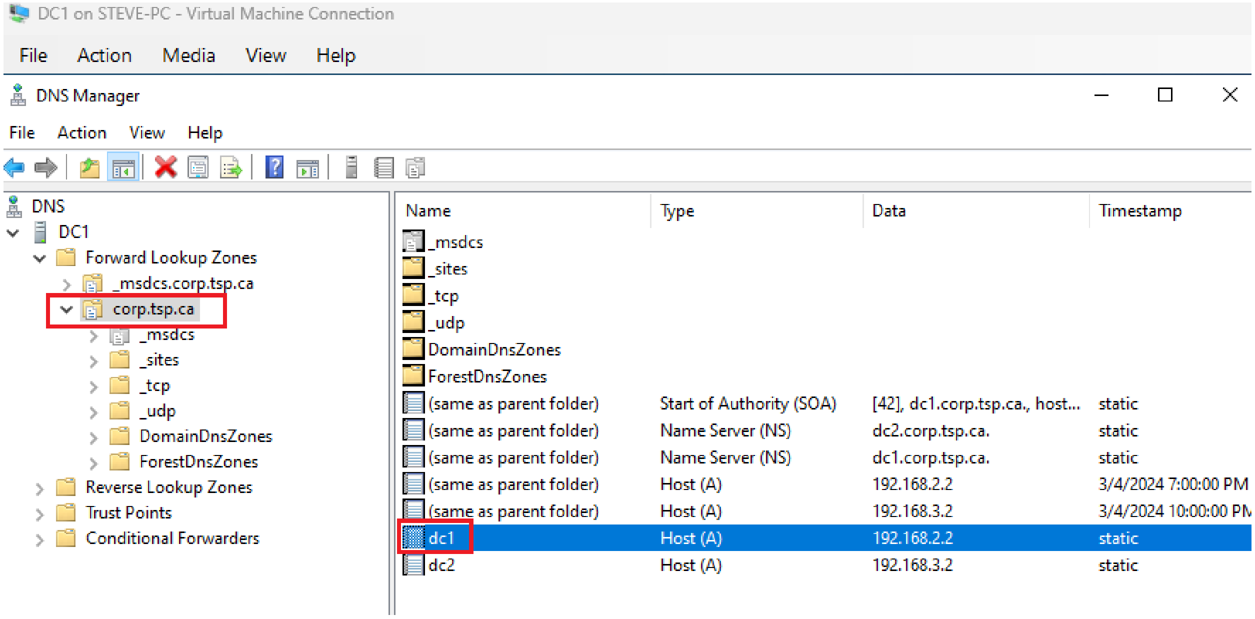
Note: You should now add records to the zone or ensure that records are updated dynamically. You can then verify name resolution using nslookup.

To close this wizard and create the new zone, click Finish.

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

Create PTR Record:

- **DC1**
  - Click **corp.tsp.ca** > **Forward Lookup Zone** > Right click **DC1** and open **Properties**

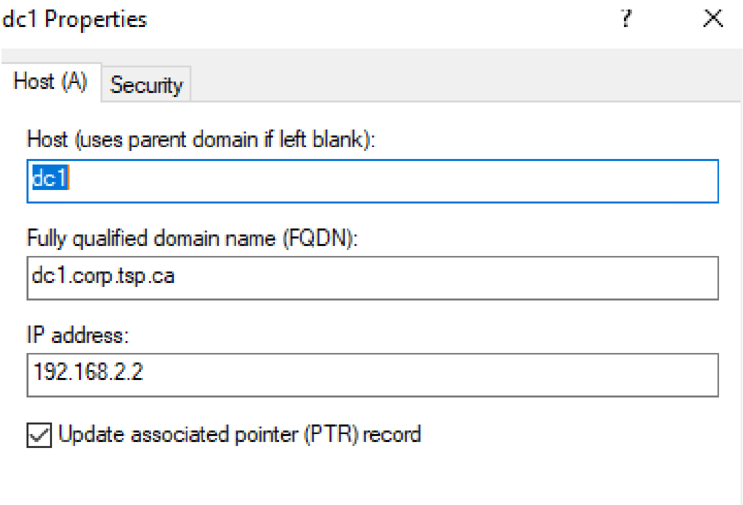


DC1 on STEVE-PC - Virtual Machine Connection

DNS Manager

- DNS
  - DC1
    - Forward Lookup Zones
      - _msdcs.corp.tsp.ca
      - corp.tsp.ca
        - _msdcs
        - _sites
        - _tcp
        - _udp
        - DomainDnsZones
        - ForestDnsZones
    - Reverse Lookup Zones
    - Trust Points
    - Conditional Forwarders

Name	Type	Data	Timestamp
_msdcs			
_sites			
_tcp			
_udp			
DomainDnsZones			
ForestDnsZones			
(same as parent folder)	Start of Authority (SOA)	[42], dc1.corp.tsp.ca., host...	static
(same as parent folder)	Name Server (NS)	dc2.corp.tsp.ca.	static
(same as parent folder)	Name Server (NS)	dc1.corp.tsp.ca.	static
(same as parent folder)	Host (A)	192.168.2.2	3/4/2024 7:00:00 PM
(same as parent folder)	Host (A)	192.168.3.2	3/4/2024 10:00:00 PM
dc1	Host (A)	192.168.2.2	static
dc2	Host (A)	192.168.3.2	static



dc1 Properties

Host (A) | Security

Host (uses parent domain if left blank): dc1

Fully qualified domain name (FQDN): dc1.corp.tsp.ca

IP address: 192.168.2.2

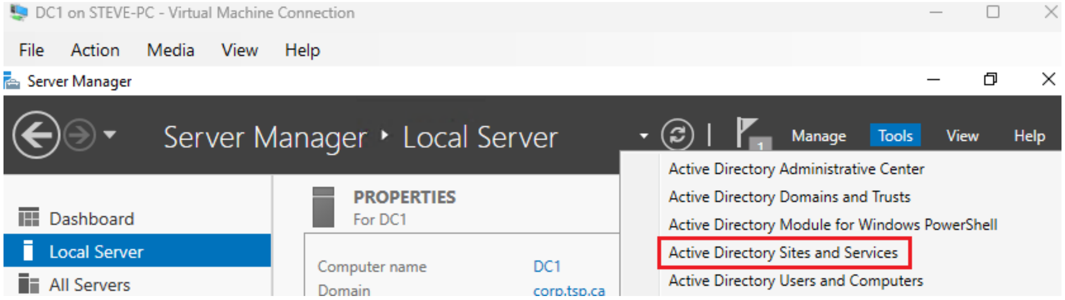
☑ Update associated pointer (PTR) record

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

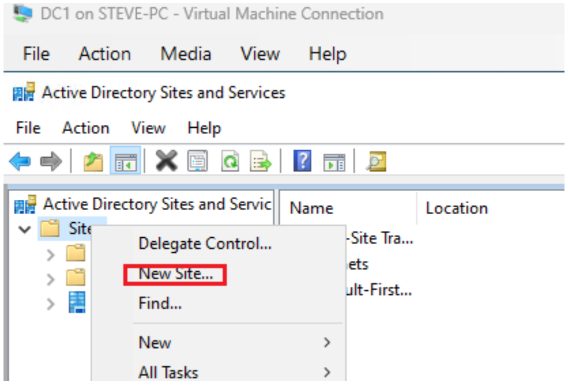
Create/Configure Sites and Services within Active Directory:

Creating a new site through Active Directory Sites and Services:

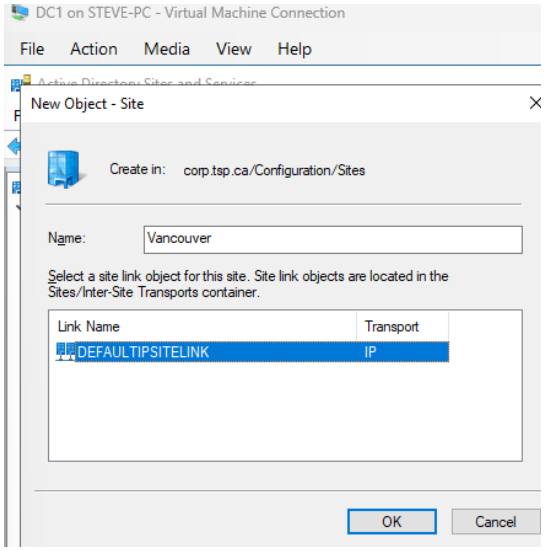
- **DC1** > **Server Manager** > **Tools** > **Active Directory Sites and Services**


DC1 on STEVE-PC - Virtual Machine Connection
File Action Media View Help
Server Manager
Server Manager ‣ Local Server
Manage Tools View Help
Dashboard
Local Server
All Servers
PROPERTIES
For DC1
Computer name DC1
Domain corp.tsp.ca
Active Directory Administrative Center
Active Directory Domains and Trusts
Active Directory Module for Windows PowerShell
Active Directory Sites and Services
Active Directory Users and Computers

- Right click ‘**Sites**’ > ‘**New Site**’


DC1 on STEVE-PC - Virtual Machine Connection
File Action Media View Help
Active Directory Sites and Services
File Action View Help
Active Directory Sites and Servic
Sites
Name
Location
Delegate Control...
New Site...
Find...
New
All Tasks
-Site Tra...
ets
ult-First...

- Enter Site Name:
  - **Vancouver**
- Select the **DEFAULTIPSITELINK** and click OK


DC1 on STEVE-PC - Virtual Machine Connection
File Action Media View Help
Active Directory Sites and Services
New Object - Site

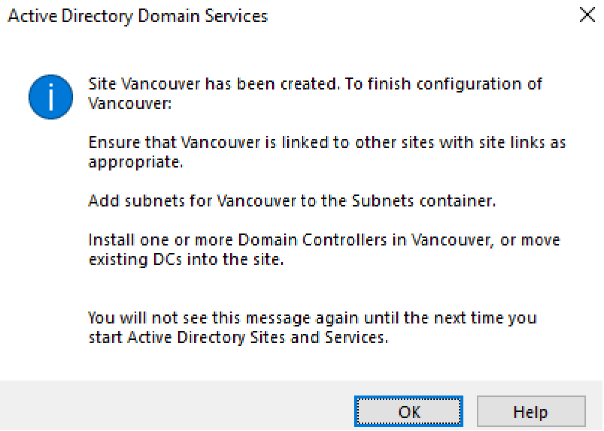
Create in: corp.tsp.ca/Configuration/Sites

Name: Vancouver

Select a site link object for this site. Site link objects are located in the Sites/Inter-Site Transports container.

Link Name	Transport
DEFAULTIPSITELINK	IP

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL



Active Directory Domain Services

Site Vancouver has been created. To finish configuration of Vancouver:

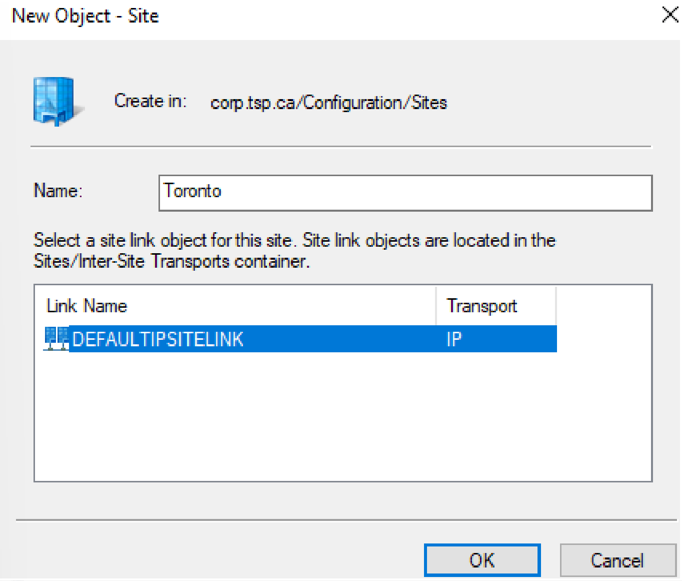
Ensure that Vancouver is linked to other sites with site links as appropriate.

Add subnets for Vancouver to the Subnets container.

Install one or more Domain Controllers in Vancouver, or move existing DCs into the site.

You will not see this message again until the next time you start Active Directory Sites and Services.

- Repeat the steps to create the second site – **Toronto**
- Select the **DEFAULTIPSITELINK** and click **OK**



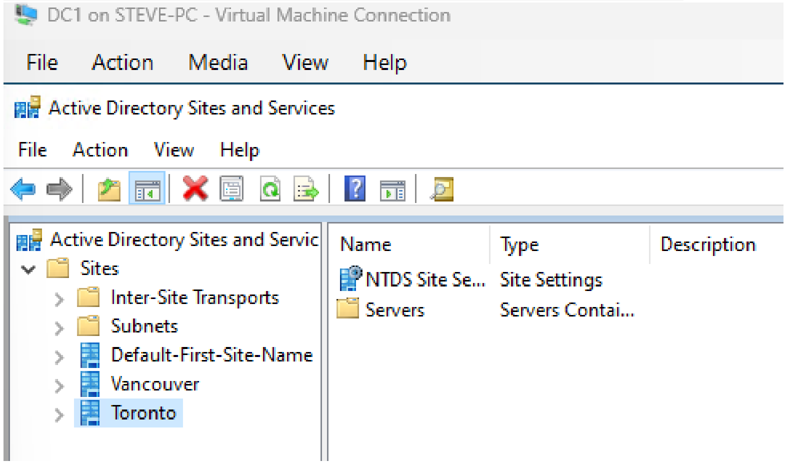
New Object - Site

Create in: corp.tsp.ca/Configuration/Sites

Name: Toronto

Select a site link object for this site. Site link objects are located in the Sites/Inter-Site Transports container.

Link Name	Transport
DEFAULTIPSITELINK	IP

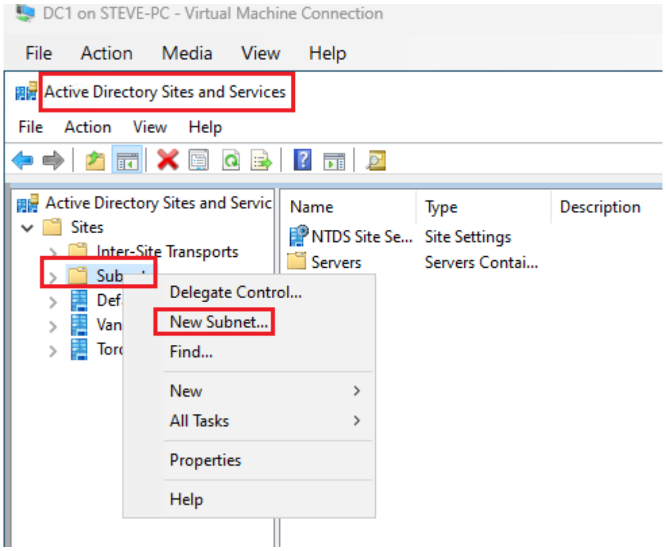


Name	Type	Description
NTDS Site Se...	Site Settings	
Servers	Servers Contai...	

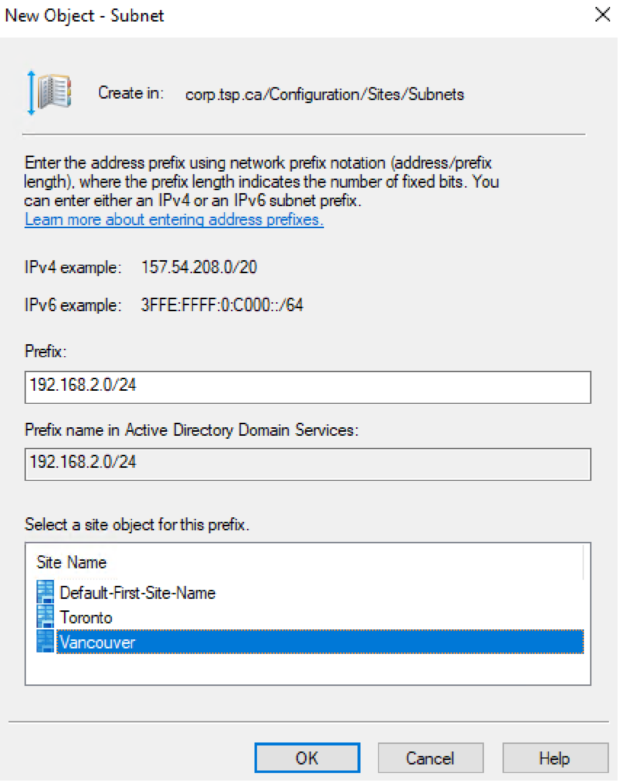
CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

Creating Subnets:

- In the **Active Directory Sites and Services** MMC, Right click '**Subnets'** and select '**New Subnet**'



- Enter the prefix 192.168.2.0/24 as the prefix and select the **Vancouver** site object to associate with this prefix


New Object - Subnet

Create in: corp.tsp.ca/Configuration/Sites/Subnets

Enter the address prefix using network prefix notation (address/prefix length), where the prefix length indicates the number of fixed bits. You can enter either an IPv4 or an IPv6 subnet prefix.
Learn more about entering address prefixes.

IPv4 example: 157.54.208.0/20

IPv6 example: 3FFE:FFFF:0:C000::/64

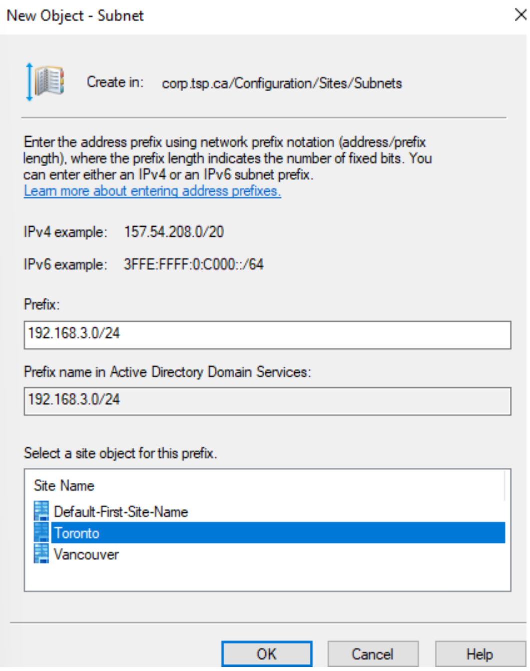
Prefix:
192.168.2.0/24

Prefix name in Active Directory Domain Services:
192.168.2.0/24

Select a site object for this prefix.

Site Name
Default-First-Site-Name
Toronto
Vancouver

- Repeat steps and use the IP assigned to the Toronto subnet
  - 192.168.3.0/24



New Object - Subnet

Create in: corp.tsp.ca/Configuration/Sites/Subnets

Enter the address prefix using network prefix notation (address/prefix length), where the prefix length indicates the number of fixed bits. You can enter either an IPv4 or an IPv6 subnet prefix.
Learn more about entering address prefixes.

IPv4 example: 157.54.208.0/20

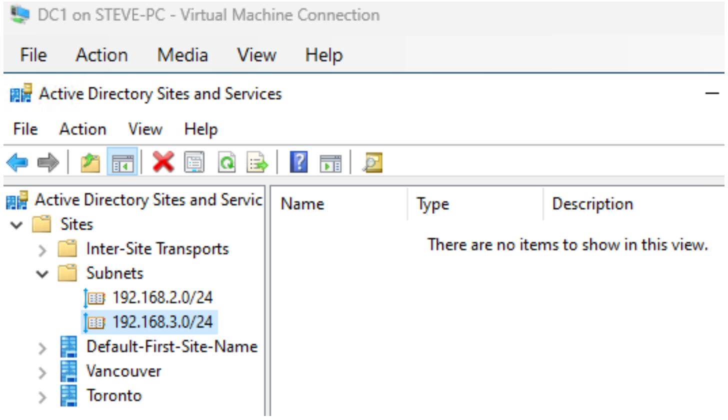
IPv6 example: 3FFE:FFFF:0:C000::/64

Prefix: 192.168.3.0/24

Prefix name in Active Directory Domain Services: 192.168.3.0/24

Select a site object for this prefix.

Site Name
Default-First-Site-Name
Toronto
Vancouver



DC1 on STEVE-PC - Virtual Machine Connection

Active Directory Sites and Services

- Active Directory Sites and Servic
  - Sites
    - Inter-Site Transports
    - Subnets
      - 192.168.2.0/24
      - 192.168.3.0/24
    - Default-First-Site-Name
    - Vancouver
    - Toronto

Name	Type	Description

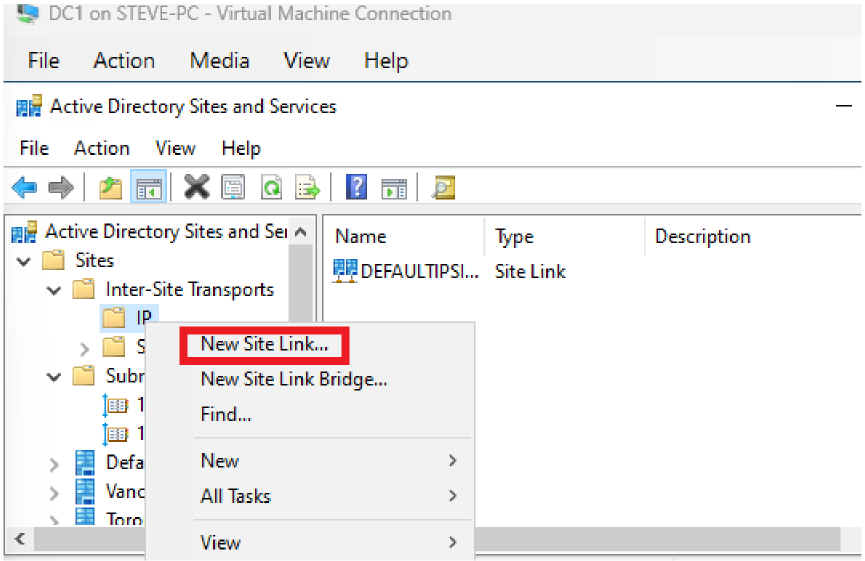
There are no items to show in this view.

- **Why is it important to configure site subnets**?
  - Configuring site subnets in Active Directory is crucial for directing users to the nearest domain controller, ensuring efficient network traffic flow, and minimizing WAN usage. It optimizes replication traffic between domain controllers by aligning it with the actual network topology, reducing overhead on network resources.

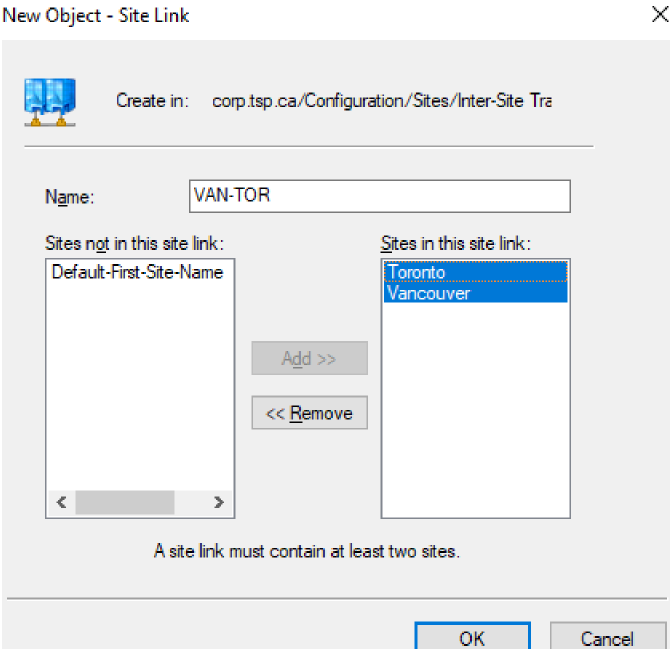
  - Properly assigned subnets also enable the application of site-specific policies and settings, enhancing the overall network performance and user experience. Additionally, they play a key role in disaster recovery by facilitating the redirection of users to alternative sites when necessary.

Creating Site Links:

- **DC1** > **Active Directory Sites and Services** > Expand **Inter-Site Transports** > Right click **IP** > **New Site Link**



- In the '**New Object**' Window – Name the Site Link: **VAN-TOR**
- Select both Sites and click '**Add**'


New Object - Site Link

Create in: corp.tsp.ca/Configuration/Sites/Inter-Site Tra

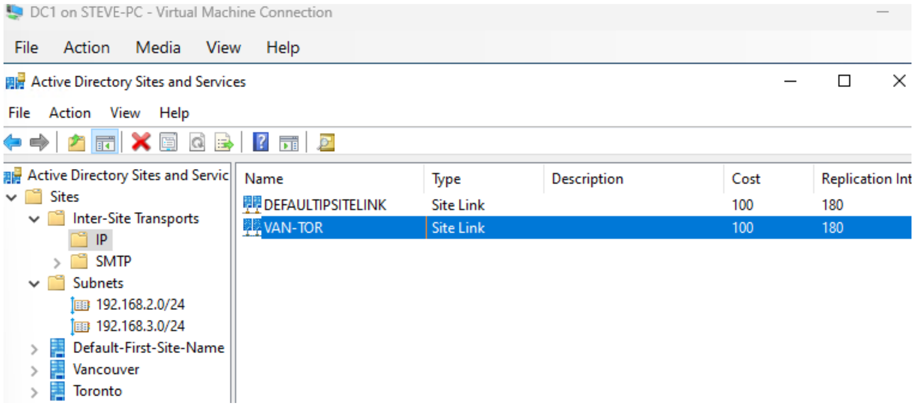
Name: VAN-TOR

Sites not in this site link:
Default-First-Site-Name

Sites in this site link:
Toronto
Vancouver

A site link must contain at least two sites.

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

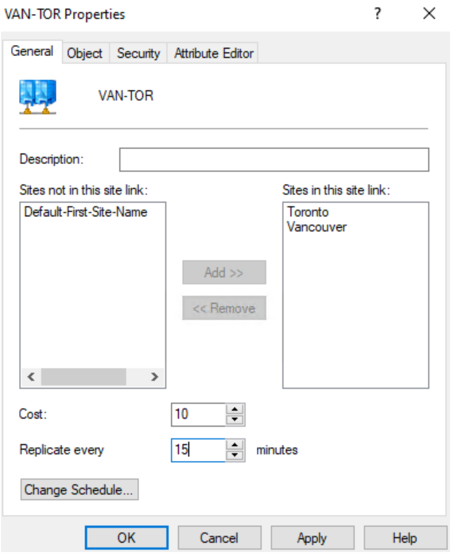

DC1 on STEVE-PC - Virtual Machine Connection
File Action Media View Help
Active Directory Sites and Services
File Action View Help
Active Directory Sites and Servic
Sites
Inter-Site Transports
IP
SMTP
Subnets
192.168.2.0/24
192.168.3.0/24
Default-First-Site-Name
Vancouver
Toronto

Name	Type	Description	Cost	Replication Int
DEFAULTIPSITELINK	Site Link		100	180
VAN-TOR	Site Link		100	180

- Change the replication cost number
  - Right click **VAN-TOR** > **Properties**
  - Change Cost to **10**
  - Set Replicate Every to **15** Minutes

- **Cost**: This is a numerical value that represents the relative cost of replication traffic over this site link. Active Directory uses this cost to determine the most efficient replication route; **lower costs are preferred over higher ones**. If there are multiple possible routes, AD will use the route with the lowest cumulative cost

- **Replicate every**: This value specifies the **frequency with which replication occurs** over this site link. The replication frequency helps balance the need for up-to-date information against the utilization of network resources



VAN-TOR

Description:

Sites not in this site link:
Default-First-Site-Name

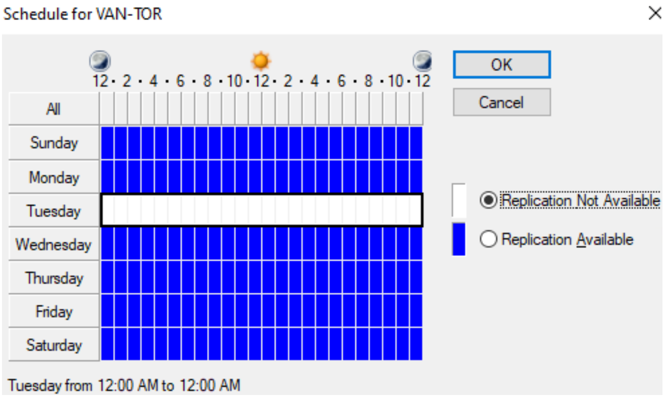
Sites in this site link:
Toronto
Vancouver

Cost: 10

Replicate every 15 minutes

- Click **Change Schedule**

- Set replication schedule
  - In this case, for the entirely of Tuesday, replication will not be available
- Click **OK**



Schedule for VAN-TOR

○ Replication Available
● Replication Not Available

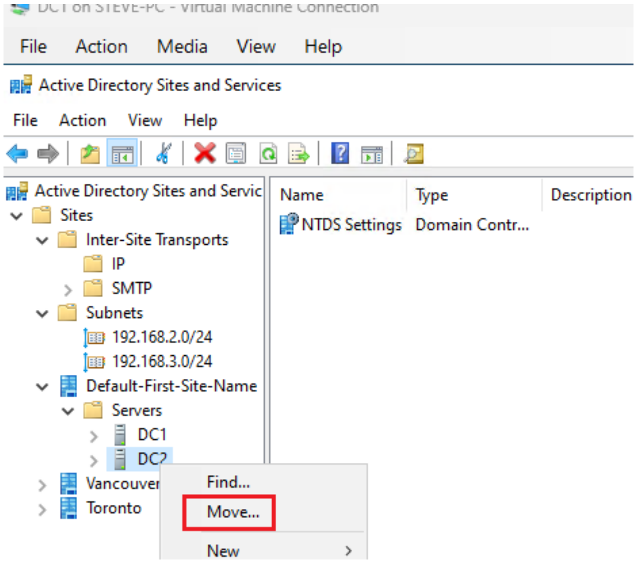
Tuesday from 12:00 AM to 12:00 AM

- Apply > **OK**

- What is the purpose of a site link?
  - A site link in Active Directory defines the replication topology between AD sites by indicating a path through which domain controllers in different sites can replicate data. It allows administrators to control replication traffic by setting a cost, frequency, and available schedule to optimize the use of network resources.

Move the Domain Controllers to their newly created sites:

- **DC1** > **AD Site and Services** > **Default-First-Site-Name** > **Servers**
- Right click on the Domain Controller (**DC2**) required to move and select '**Move**'

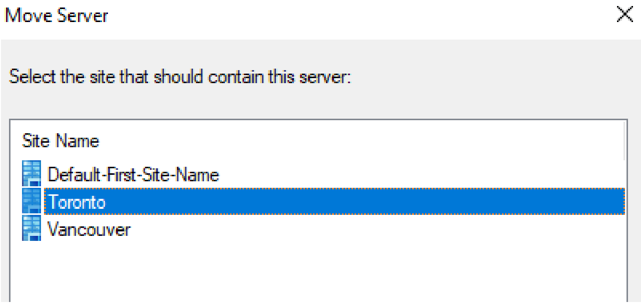


DC1 on STEVE-PC - Virtual Machine Connection

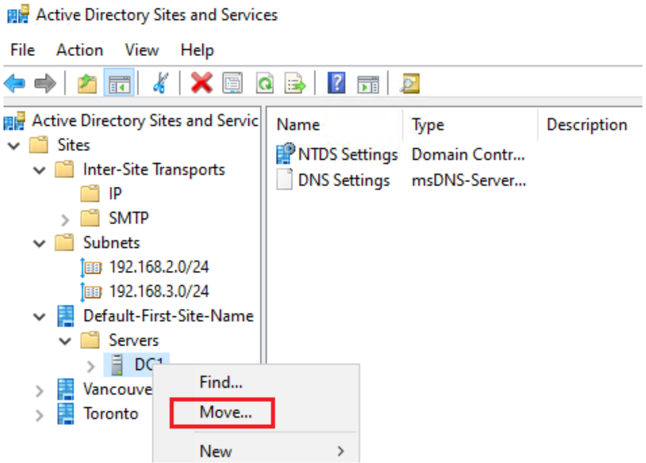
Active Directory Sites and Services

Name	Type	Description
NTDS Settings	Domain Contr...	

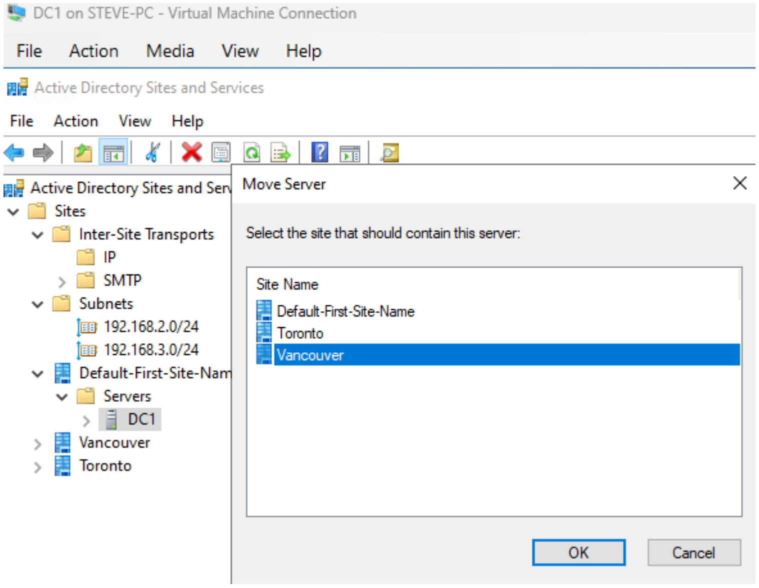
- In the '**Move Server**' Window select Toronto and click OK, as **DC2** is associated to Toronto



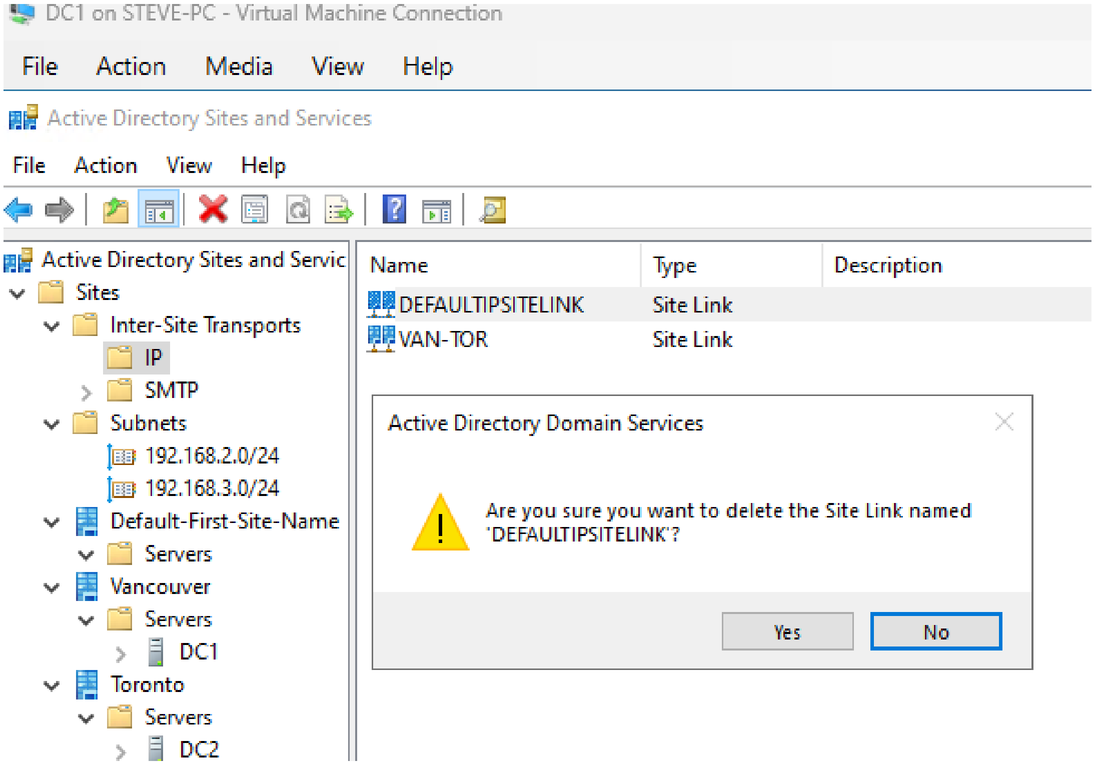
- Right Click **DC1** and click '**Move'**



- Select '**Vancouver'**



- After the DCs are moved there is no need for the DEFAULTIPSITELINK. Delete it
    - **Active Directory Sites and Services** > **Sites** > **Inter-Site Transports** > **IP**


DC1 on STEVE-PC - Virtual Machine Connection
File Action Media View Help
Active Directory Sites and Services
File Action View Help
Active Directory Sites and Servic
Sites
Inter-Site Transports
IP
SMTP
Subnets
192.168.2.0/24
192.168.3.0/24
Default-First-Site-Name
Servers
Vancouver
Servers
DC1
Toronto
Servers
DC2
Active Directory Domain Services
Yes
No

Name	Type	Description
DEFAULTIPSITELINK	Site Link	
VAN-TOR	Site Link	

Are you sure you want to delete the Site Link named 'DEFAULTIPSITELINK'?

Test Replication:

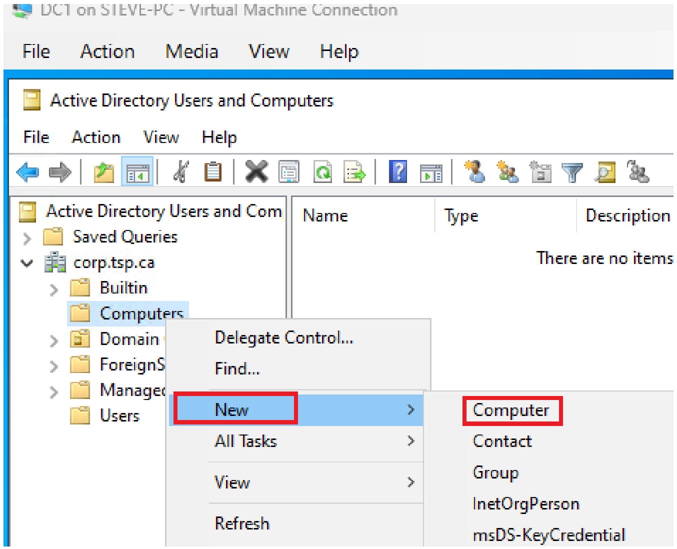
- What are the commands to force replication?
    - To force replication between domain controllers in Active Directory, you can use the following commands:
        - Using repadmin:
        - **repadmin /syncall**: This command synchronizes a specified domain controller with all replication partners

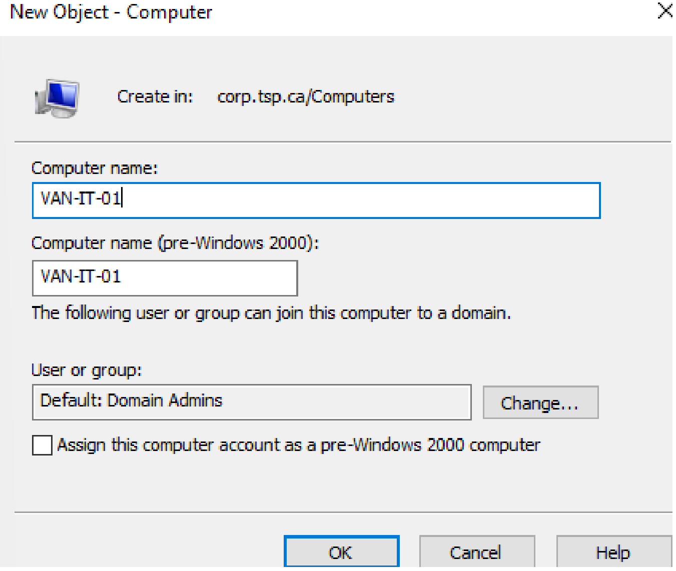
        - **repadmin /syncall /AeP**: This command includes all partitions and attempts to push changes outward from the specified DC.
    - Using PowerShell:
        - **Sync-ADObject**: This cmdlet is used to replicate a single object between any two domain controllers that have partitions in common.

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

Create an Object in the Vancouver DCs ADUC and see if that object is replicated to the Toronto DC:

- **DC1** > **ADUC** > Create a **New Computer** object in the Computers container





Create in: corp.tsp.ca/Computers

Computer name: VAN-IT-01

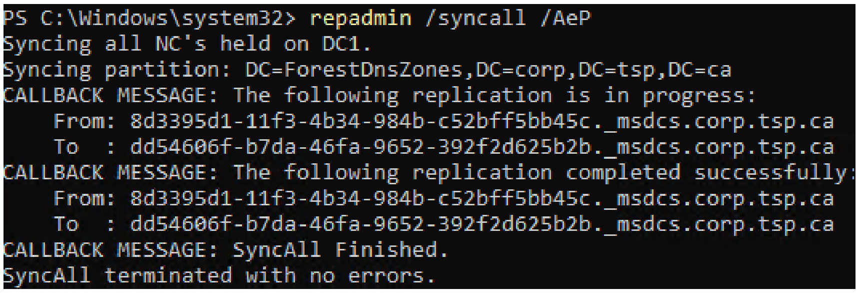
Computer name (pre-Windows 2000): VAN-IT-01

The following user or group can join this computer to a domain.

User or group: Default: Domain Admins

☐ Assign this computer account as a pre-Windows 2000 computer

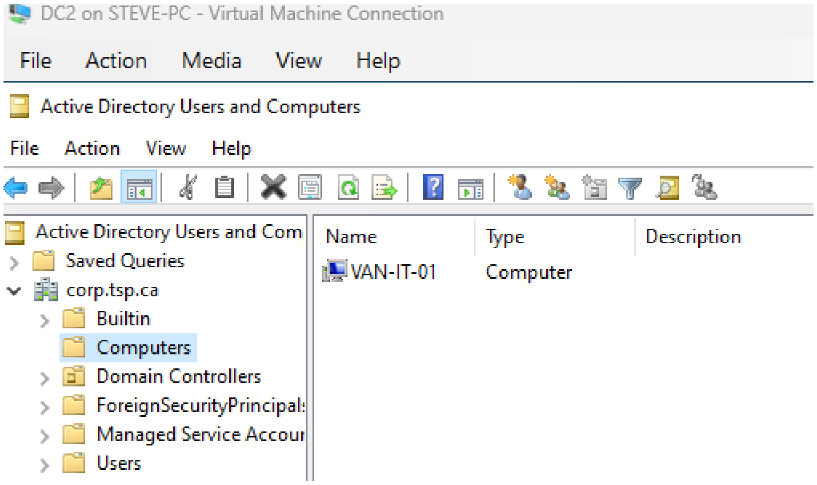
- On DC2, open ADUC to see if VAN-IT-01 appears in the Computers container



```
PS C:\Windows\system32> repadmin /syncall /AeP
Syncing all NC's held on DC1.
Syncing partition: DC=ForestDnsZones,DC=corp,DC=tsp,DC=ca
CALLBACK MESSAGE: The following replication is in progress:
    From: 8d3395d1-11f3-4b34-984b-c52bff5bb45c._msdcs.corp.tsp.ca
    To  : dd54606f-b7da-46fa-9652-392f2d625b2b._msdcs.corp.tsp.ca
CALLBACK MESSAGE: The following replication completed successfully:
    From: 8d3395d1-11f3-4b34-984b-c52bff5bb45c._msdcs.corp.tsp.ca
    To  : dd54606f-b7da-46fa-9652-392f2d625b2b._msdcs.corp.tsp.ca
CALLBACK MESSAGE: SyncAll Finished.
SyncAll terminated with no errors.
```

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

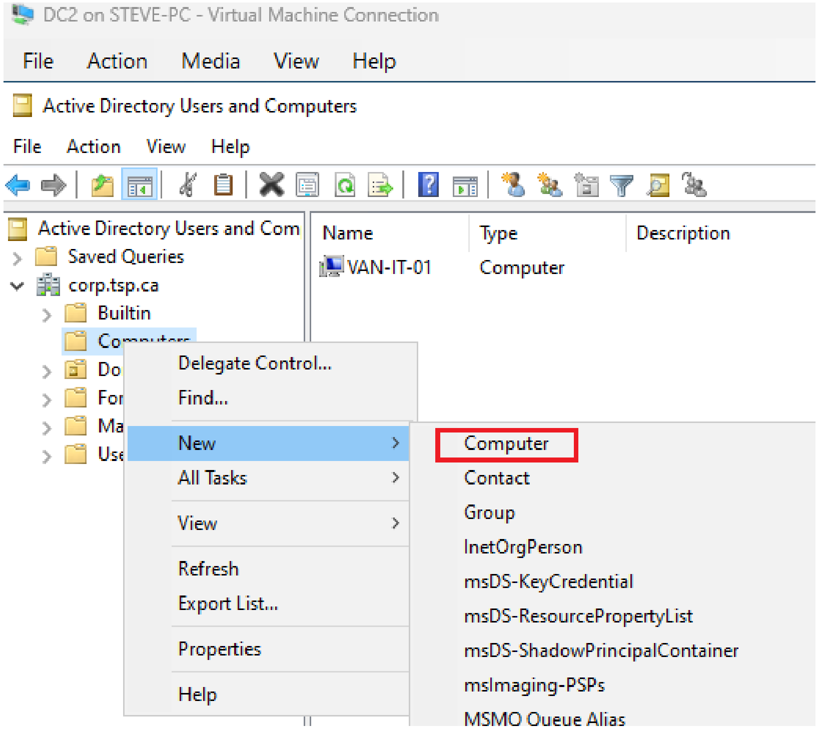
- After forcing replication using the command **repadmin /syncall /AeP** the computer object created on **DC1** (VAN) appears on **DC2** (TOR)


DC2 on STEVE-PC - Virtual Machine Connection
File Action Media View Help
Active Directory Users and Computers
File Action View Help
Active Directory Users and Com
Saved Queries
corp.tsp.ca
Builtin
Computers
Domain Controllers
ForeignSecurityPrincipal:
Managed Service Accour
Users

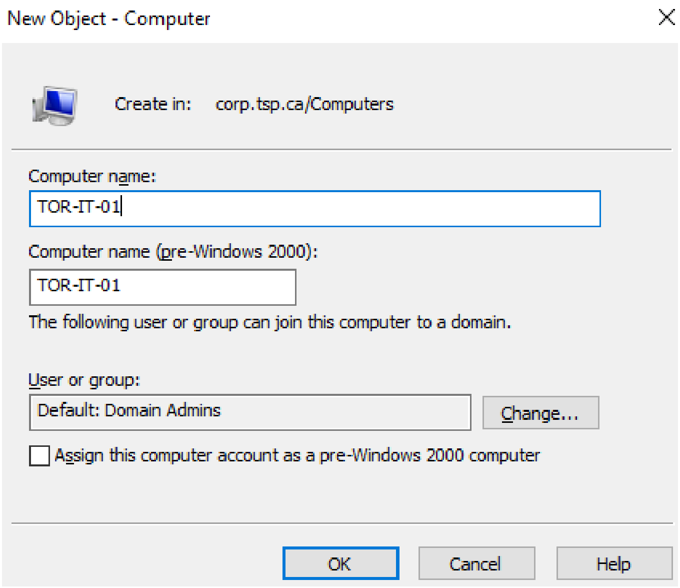
Name	Type	Description
VAN-IT-01	Computer	

Create an object in the Toronto DCs ADUC and see if that object is replicated to the Vancouver DC:

- **DC2** > **ADUC** > Create a **New Computer** object in the Computers container



Name	Type	Description
VAN-IT-01	Computer	



New Object - Computer

Create in: corp.tsp.ca/Computers

Computer name: TOR-IT-01

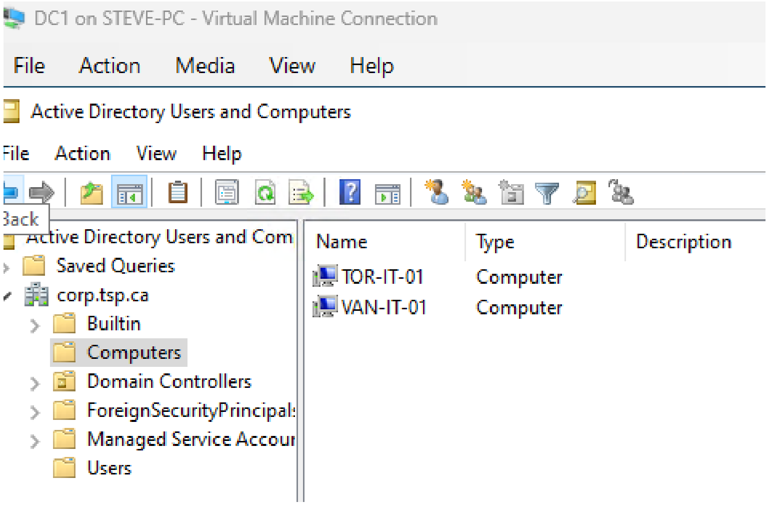
Computer name (pre-Windows 2000): TOR-IT-01

The following user or group can join this computer to a domain.

User or group: Default: Domain Admins

Change...
□ Assign this computer account as a pre-Windows 2000 computer
OK
Cancel
Help

- On DC1, open ADUC to see if TOR-IT-01 appears in the Computers container
- Run **repadmin /syncall /AeP** on **DC2** using PowerShell as Administrator



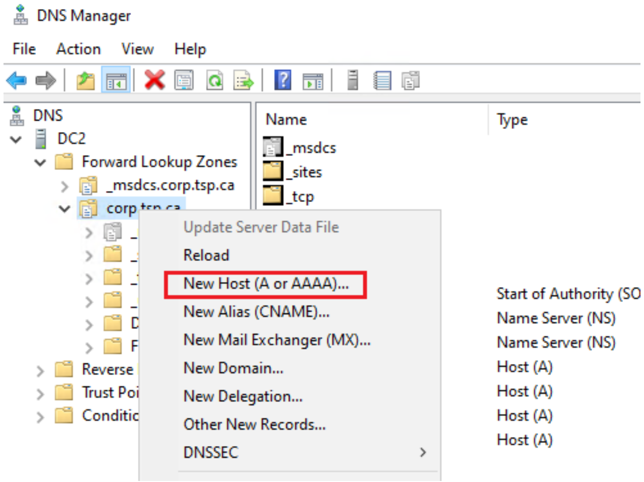
DC1 on STEVE-PC - Virtual Machine Connection

Name	Type	Description
TOR-IT-01	Computer	
VAN-IT-01	Computer	

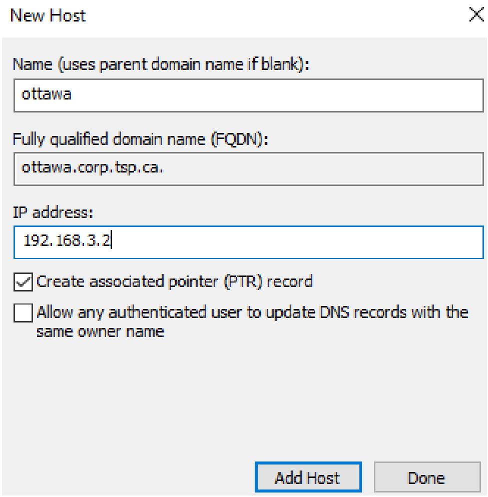
- The computer object created on **DC2** (TOR) appears on **DC1** (VAN)

Create an A record in the Toronto’s DC and see if it replicates to Vancouver’s DC:

- On DC2, open the DNS **Manager**. Create a new **A record** in the corp.tsp.ca forward lookup zone



- Enter ‘**ottawa**’ as the name and 192.168.3.2 as the IP. Click Add Host


New Host

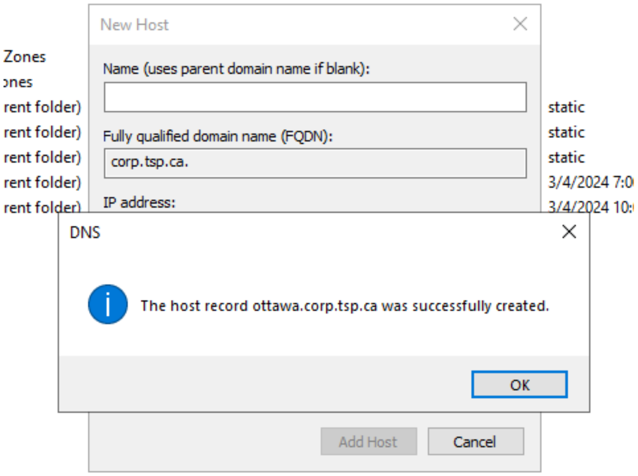
Name (uses parent domain name if blank): ottawa

Fully qualified domain name (FQDN): ottawa.corp.tsp.ca.

IP address: 192.168.3.2

☑ Create associated pointer (PTR) record

☐ Allow any authenticated user to update DNS records with the same owner name


New Host

Name (uses parent domain name if blank):

Fully qualified domain name (FQDN): corp.tsp.ca.

IP address:

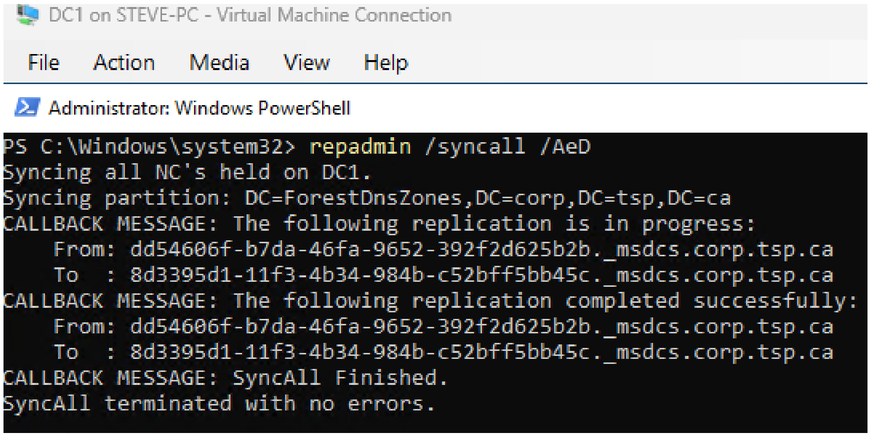
DNS

The host record ottawa.corp.tsp.ca was successfully created.

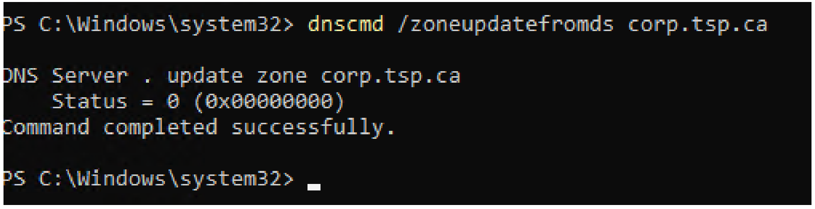
- Note: If the process is refused, restart the DNS Server
  - **DC2** > **Server Manager** > **Tools** > **DNS** > Right click **DC2** > **All Tasks** > **Restart**

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

- On **DC1**, open DNS Manager to verify '**ottawa'** A record entry
- If refreshing doesn't force it appear you can force the entry to arrive by running the command '**repadmin /syncall /AeD'** in PowerShell followed by '**dnscmd /zoneupdatefromds corp.tsp.ca**'

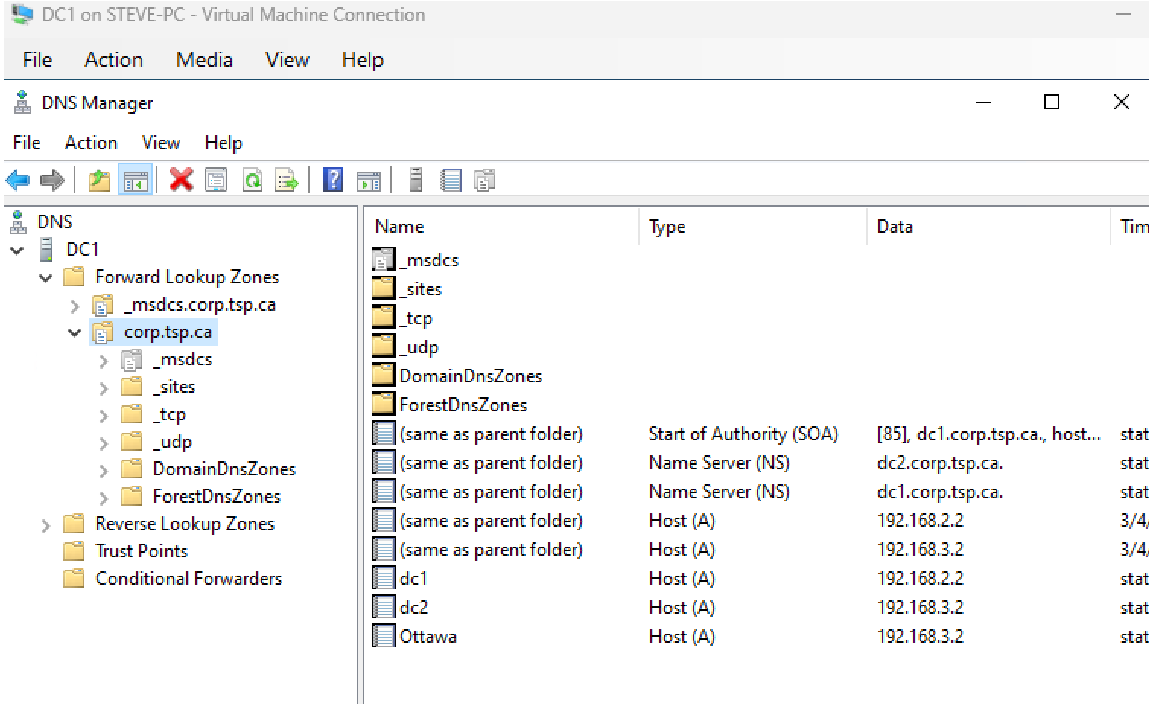

DC1 on STEVE-PC - Virtual Machine Connection
File
Action
Media
View
Help
Administrator: Windows PowerShell

```
PS C:\Windows\system32> repadmin /syncall /AeD
Syncing all NC's held on DC1.
Syncing partition: DC=ForestDnsZones,DC=corp,DC=tsp,DC=ca
CALLBACK MESSAGE: The following replication is in progress:
    From: dd54606f-b7da-46fa-9652-392f2d625b2b._msdcs.corp.tsp.ca
    To  : 8d3395d1-11f3-4b34-984b-c52bff5bb45c._msdcs.corp.tsp.ca
CALLBACK MESSAGE: The following replication completed successfully:
    From: dd54606f-b7da-46fa-9652-392f2d625b2b._msdcs.corp.tsp.ca
    To  : 8d3395d1-11f3-4b34-984b-c52bff5bb45c._msdcs.corp.tsp.ca
CALLBACK MESSAGE: SyncAll Finished.
SyncAll terminated with no errors.
```



```
PS C:\Windows\system32> dnscmd /zoneupdatefromds corp.tsp.ca

DNS Server . update zone corp.tsp.ca
    Status = 0 (0x00000000)
Command completed successfully.

PS C:\Windows\system32> _
```

- Now check:

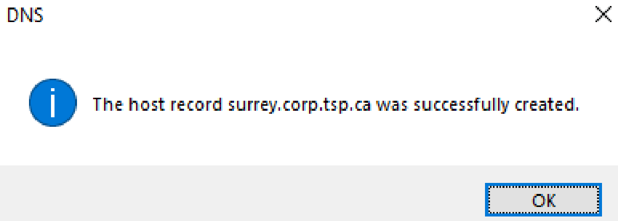


Name	Type	Data	Tim
_msdcs			
_sites			
_tcp			
_udp			
DomainDnsZones			
ForestDnsZones			
(same as parent folder)	Start of Authority (SOA)	[85], dc1.corp.tsp.ca., host...	stat
(same as parent folder)	Name Server (NS)	dc2.corp.tsp.ca.	stat
(same as parent folder)	Name Server (NS)	dc1.corp.tsp.ca.	stat
(same as parent folder)	Host (A)	192.168.2.2	3/4,
(same as parent folder)	Host (A)	192.168.3.2	3/4,
dc1	Host (A)	192.168.2.2	stat
dc2	Host (A)	192.168.3.2	stat
Ottawa	Host (A)	192.168.3.2	stat

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

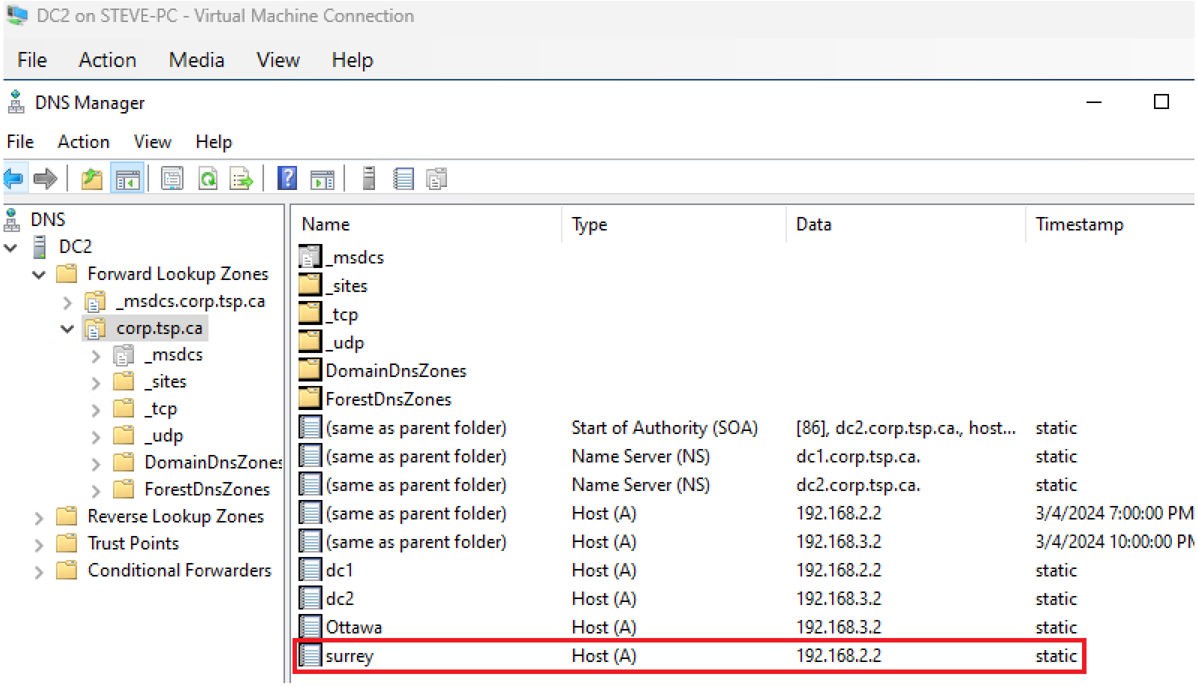
Create an A record in the Vancouver's DC and see if it replicates to Toronto's DC:

- Enter '**surrey**' as the name and 192.168.2.2 as the IP. Click Add Host



The host record surrey.corp.tsp.ca was successfully created.

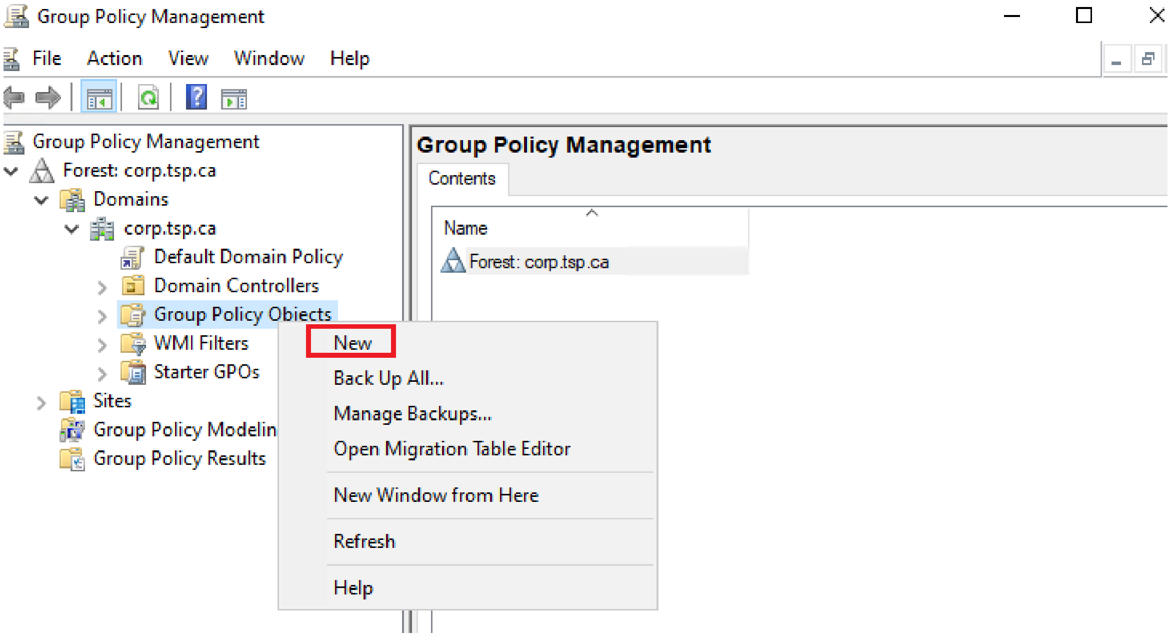
- On **DC2** (Toronto) - force the entry to arrive by running the command '**repadmin /syncall /AeD**' in PowerShell followed by '**dnscmd /zoneupdatefromds corp.tsp.ca**'



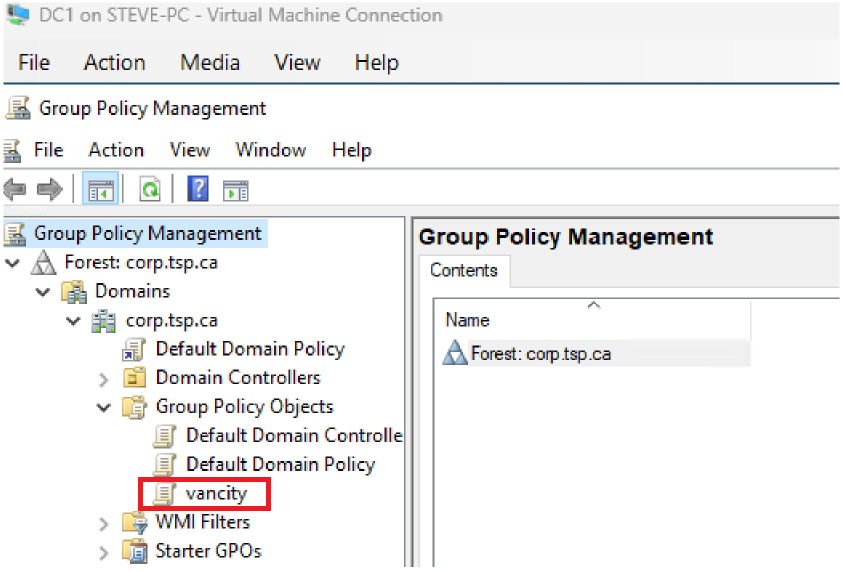
Name	Type	Data	Timestamp
_msdcs			
_sites			
_tcp			
_udp			
DomainDnsZones			
ForestDnsZones			
(same as parent folder)	Start of Authority (SOA)	[86], dc2.corp.tsp.ca., host...	static
(same as parent folder)	Name Server (NS)	dc1.corp.tsp.ca.	static
(same as parent folder)	Name Server (NS)	dc2.corp.tsp.ca.	static
(same as parent folder)	Host (A)	192.168.2.2	3/4/2024 7:00:00 PM
(same as parent folder)	Host (A)	192.168.3.2	3/4/2024 10:00:00 PM
dc1	Host (A)	192.168.2.2	static
dc2	Host (A)	192.168.3.2	static
Ottawa	Host (A)	192.168.3.2	static
surrey	Host (A)	192.168.2.2	static

Create a new group policy (no settings need to be defined) in the Vancouver's DC and see if it replicates to Toronto's DC:

- **DC1** > **Server Manager** > **Tools** > **Group Policy Management**
  - Expand Forest > Domains > corp.tsp.ca > Right click **Group Policy Objects** > **New**

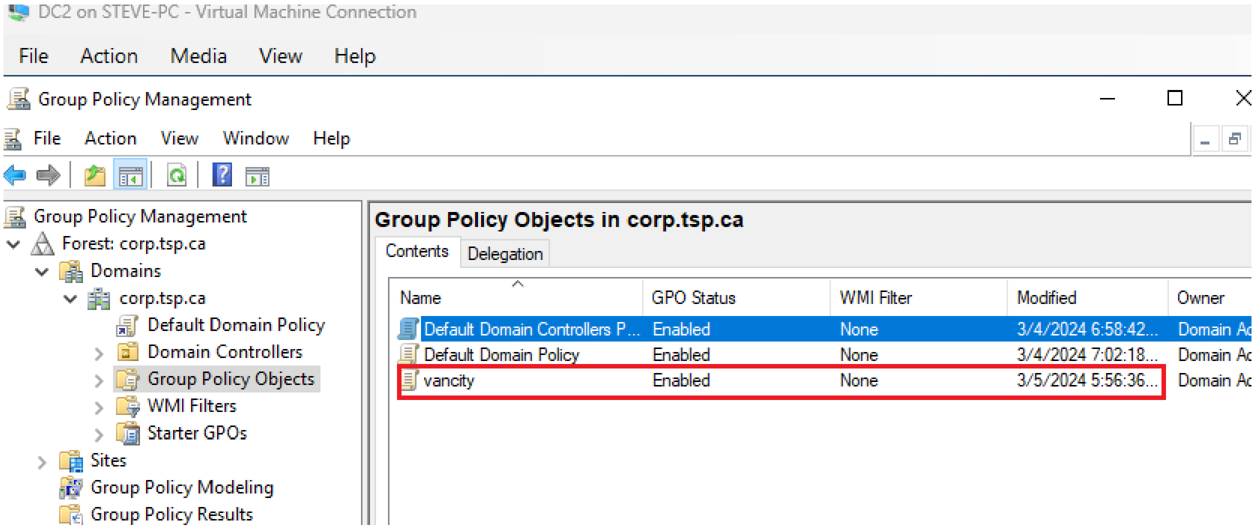


- Name: **‘vancity’**



- Navigate over to **DC2**, open Group Policy Management – Expand Forest > Domains > corp.tsp.ca > click **Group Policy Objects**

CONFIGURE A REPLICATING MULTI-SITE DOMAIN USING AN IPSEC VPN TUNNEL

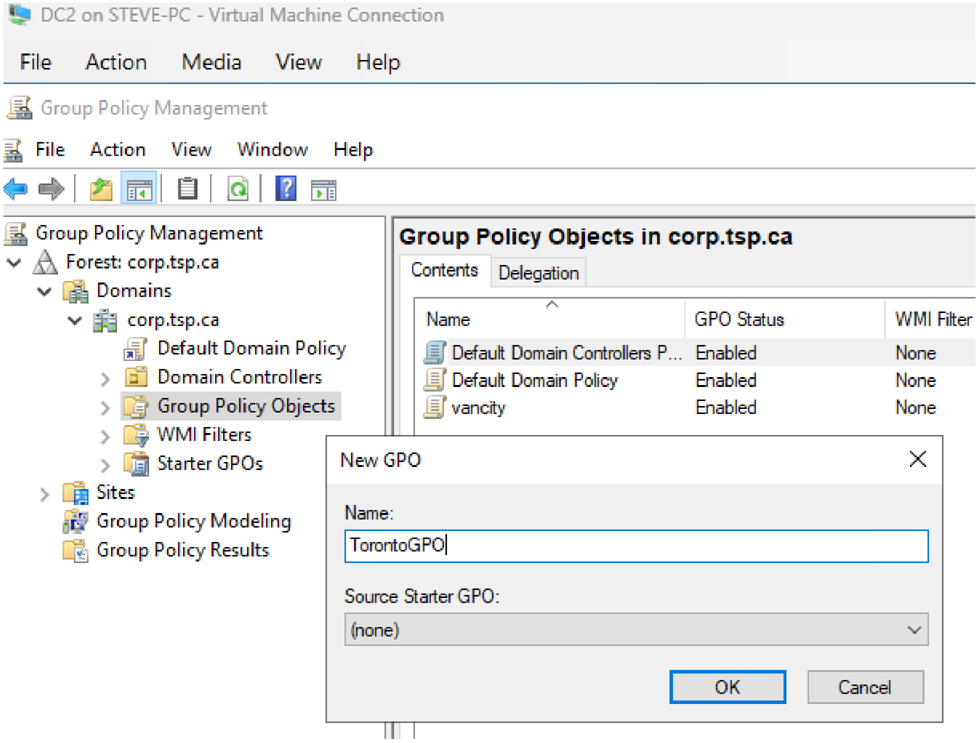


Group Policy Objects in corp.tsp.ca

Name	GPO Status	WMI Filter	Modified	Owner
Default Domain Controllers P...	Enabled	None	3/4/2024 6:58:42...	Domain Ad
Default Domain Policy	Enabled	None	3/4/2024 7:02:18...	Domain Ad
vancity	Enabled	None	3/5/2024 5:56:36...	Domain Ad

Create a new group policy (no settings need to be defined) in the Toronto's DC and see if it replicates to Vancouver's DC:

- On **DC2:**



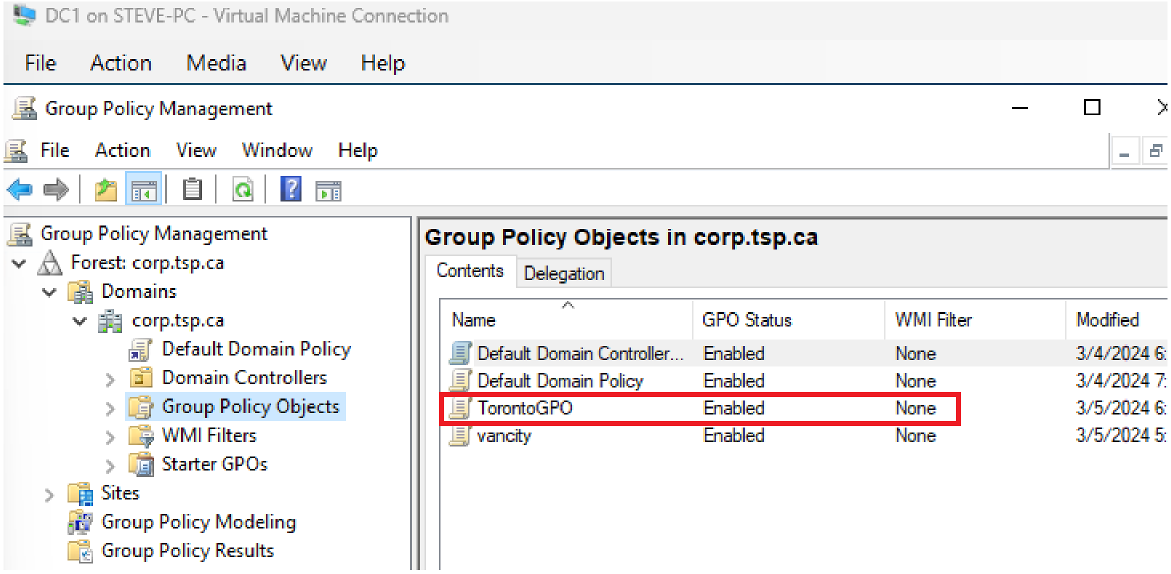
Group Policy Objects in corp.tsp.ca

Name	GPO Status	WMI Filter
Default Domain Controllers P...	Enabled	None
Default Domain Policy	Enabled	None
vancity	Enabled	None

Name: TorontoGPO

Source Starter GPO: (none)

- On **DC1**: Verify Replication:



Group Policy Objects in corp.tsp.ca

Name	GPO Status	WMI Filter	Modified
Default Domain Controller...	Enabled	None	3/4/2024 6:
Default Domain Policy	Enabled	None	3/4/2024 7:
TorontoGPO	Enabled	None	3/5/2024 6:
vancity	Enabled	None	3/5/2024 5:

Troubleshooting:

- I initially configured a rule in pfSense to allow WAN to WAN connectivity. This setup was intended to enable communication between different networks through the VPN IPsec tunnel. However, I observed that only ICMP (Internet Control Message Protocol) traffic was allowed through this rule. ICMP is typically used for network diagnostics purposes, such as ping commands to check the availability of a remote server.

- When I attempted to add a second domain controller (DC2) to an existing domain across the VPN tunnel, the operation was unsuccessful. This failure was attributed to a blockage in the network that specifically affected DNS (Domain Name System) functionality, which is crucial for domain joining and other domain-related communications.

- The root cause of the problem appears to be related to the pfSense configuration that did not adequately allow DNS traffic to pass through the VPN tunnel. DNS uses UDP (User Datagram Protocol) for its queries and responses by default, typically on port 53.

- To resolve the issue, I had to adjust the firewall rules in pfSense to allow UDP traffic to pass through the VPN IPsec tunnel. pfSense > Firewall > Rules.

- Another issue involved a configuration mismatch between pfSense interfaces and Hyper-V virtual switches, where WAN and LAN interfaces were incorrectly assigned. This misalignment resulted in difficulties accessing the pfSense dashboard, typically accessible via the default gateway set on the LAN side of the router. To resolve the problem, the incorrect network adapters in Hyper-V were identified and removed, followed by a reassignment of the virtual switches to the correct pfSense interfaces, ensuring WAN and LAN configurations aligned properly with the intended network design.

References:

- https://www.cloudflare.com/learning/network-layer/what-is-ipsec/#:~:text=IPsec%20tunnel%20mode%20is%20used,addition%20to%20the%20packet%20payload.
- https://www.tp-link.com/ca/support/faq/2136/
- https://docs.netgate.com/pfsense/en/latest/recipes/ipsec-s2s-psk.html
- https://www.provya.com/blog/pfsense-configuring-a-site-to-site-ipsec-vpn/
- https://www.ceos3c.com/pfsense/pfsense-site-to-site-vpn/
- https://geekistheway.com/2020/08/01/how-to-allow-ping-on-pfsense-wan/
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- https://kifarunix.com/setup-ipsec-site-to-site-vpn-tunnel-on-pfsense/?expand_article=1