DataON™

2-Node Intel® Select Solution
For Microsoft Azure Stack HCI v2
Deployment Guide

November 2019

intel® select solution

Contents

Microsoft Azure Stack HCI

Microsoft Azure Stack HCI is an evolution of data center computing that blends Windows Server technologies with new Azure management service integration. It helps customers with large and complex IT estates and varying needs, helping them solve IT problems while being able to grow and evolve as business and IT needs change.

- **Replace aging server and storage infrastructure**, consolidate virtualized workloads, and gain cloud efficiencies on-premises with hyper-converged solutions that bring together software-defined compute, storage, and networking on industry-standard x86 servers and components, similar to technologies that Microsoft uses to run its Azure data centers.
- **Extend to Azure** quickly and easily with simplified access to cloud management and security services, including offsite backup, site recovery, and cloud-based monitoring.

Azure Stack HCI gets you get up and running quickly and reliably. It features the same Hyper-V based software-defined compute, storage, and networking as Azure Stack and shares similar testing and validation criteria. It follows engineering best practices to get customers up and running without lengthy design and build times.

Built-in integration to Azure makes it easy for IT staff to start using Azure for infrastructure management services and start building cloud skills. With the Azure management services in Windows Admin Center and DataON MUST, customers can easily integrate on-premises workloads with services such as Azure Site Recovery, Azure Backup, Cloud Witness, and Azure Monitor.

Storage Spaces Direct is the software-defined storage component of a Microsoft-based hyper-converged infrastructure and is included in the Windows Server Datacenter edition.

Storage Spaces Direct

Overview

Storage Spaces Direct uses industry-standard servers with locally attached drives to create highly available, highly scalable software-defined storage at a fraction of the cost of traditional SAN or NAS arrays. Its converged or hyper-converged architecture radically simplifies procurement and deployment, while features like caching, storage tiers, and erasure coding, together with the latest hardware innovation like RDMA networking and NVMe drives, deliver unrivaled efficiency and performance.

Storage Spaces Direct is included in Windows Server 2016/2019 Datacenter Edition using Full Desktop Experience (GUI) or Core.

- **High performance** – Utilizes all-flash NVMe SSDs to achieve over 2M IOPS in 2-node cluster

- **Switch-less** – Reduce cost by directly attaching 2 nodes for cluster and storage traffic

- **Supports more VMs** - Supports 40+ Hyper-V VM's per nodes, with up to 16 nodes per cluster

- **Highly scalable** – Delivers computer, networking and storage resources with near-linear scalability

- **Easy to deploy** – Simple out-of-the-box deployment and easy installation

- **Easy to manage** – Exclusive DataON MUST extension for Windows Admin Center provides infrastructure visibility and management for Storage Spaces Direct

How Storage Spaces Direct Works

Storage Spaces Direct is the evolution of Storage Spaces, first introduced in Windows Server 2012. It leverages many of the features you know today in Windows Server, such as Failover Clustering, the Cluster Shared Volume (CSV) file system, Server Message Block (SMB) 3.0, and of course Storage Spaces. It also introduces new technology, most notably the Software Storage Bus.

Here's an overview of the Storage Spaces Direct stack:
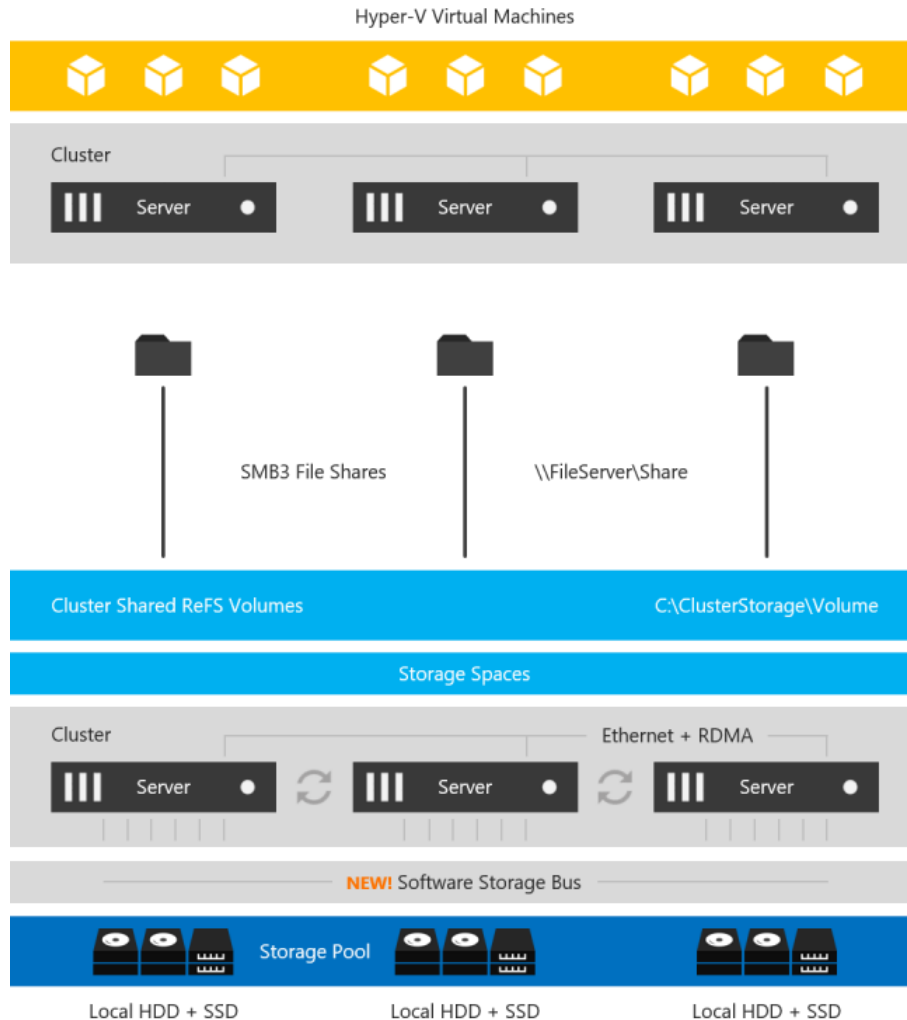
Networking hardware – Storage Spaces Direct uses SMB 3.0, including SMB Direct and SMB Multichannel, over Ethernet to communicate between servers. Microsoft strongly recommends 10GbE+ with remote-direct memory access (RDMA), either iWARP or RoCE.

Storage hardware – From 2 to 16 servers with local attached SATA, SAS, or NVMe drives. Each server must have at least 2 solid state drives, and at least 4 additional drives. The SATA and SAS devices should be behind a host bus adapter (HBA) and SAS expander. DataON platforms are fully certified for Microsoft Windows Server 2016/2019.

Failover clustering – The built-in clustering feature of Windows Server is used to connect the servers.

Software storage bus – Software storage bus is new in Storage Spaces Direct. It spans the cluster and establishes a software-defined storage fabric whereby all the servers can see all of

each other's local drives. You can think of it as replacing costly and restrictive Fibre Channel or Shared SAS cabling.

Storage Bus Layer Cache – The Software Storage Bus dynamically binds the fastest drives present (e.g. SSD) to slower drives (e.g. HDDs) to provide server-side read/write caching that accelerates I/O and boosts throughput.

Storage Pool – The collection of drives that form the basis of Storage Spaces is called the storage pool. It is automatically created, and all eligible drives are automatically discovered and added to it. We strongly recommend you use one pool per cluster, with the default settings.

Storage Spaces – Storage Spaces provides fault tolerance to virtual "disks" using mirroring, erasure coding, or both. You can think of it as distributed, software-defined RAID using the drives in the pool. In Storage Spaces Direct, these virtual disks typically have resiliency to two simultaneous drive or server failures (e.g. 3-way mirroring, with each data copy in a different server) though chassis and rack fault tolerance is also available.

Resilient File System (ReFS) – ReFS is the premier filesystem purpose-built for virtualization. It includes dramatic accelerations for .vhdx file operations such as creation, expansion, and checkpoint merging, and built-in checksums to detect and correct bit errors. It also introduces real-time tiers that rotate data between so-called "hot" and "cold" storage tiers in real-time based on usage.

Cluster Shared Volumes – The CSV file system unifies all the ReFS volumes into a single namespace accessible through any server, so that to each server, every volume looks and acts like it's mounted locally.

Scale-Out File Server (SoFS) – This final layer is necessary in converged deployments only. It provides remote file access using the SMB3 access protocol to clients, such as another cluster running Hyper-V, over the network, effectively turning Storage Spaces Direct into network-attached storage (NAS).

Deployment Options
Storage Spaces Direct was designed for two distinct deployment options:

Converged

Storage and compute in separate clusters. The converged deployment option, also known as 'disaggregated', layers a Scale-out File Server (SoFS) atop Storage Spaces Direct to provide network-attached storage over SMB 3.0 file shares. This allows for

scaling compute/workload independently from the storage cluster, essential for larger-scale deployments such as Hyper-V IaaS (Infrastructure as a Service) for service providers and enterprises.
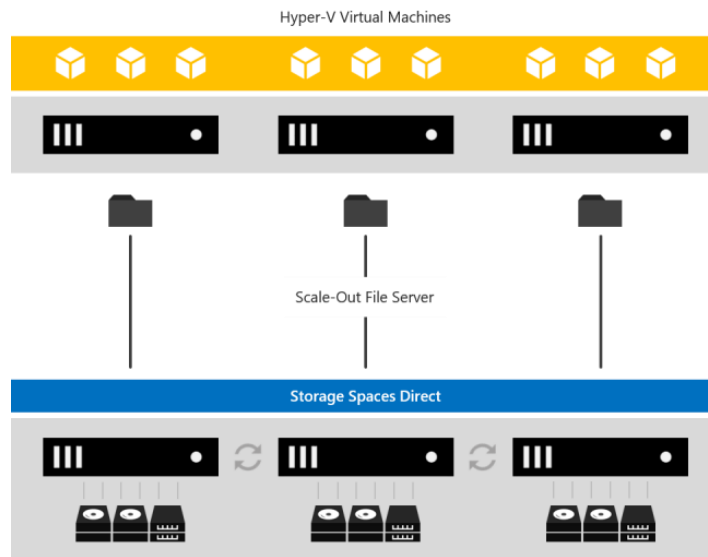
Hyper-Converged

One cluster for compute and storage. The hyper-converged deployment option runs Hyper-V virtual machines or SQL Server databases directly on the servers providing the storage, storing their files on the local volumes. This eliminates the need to configure file server access and permissions and reduces hardware costs for small-to-medium business or remote office/branch office deployments.
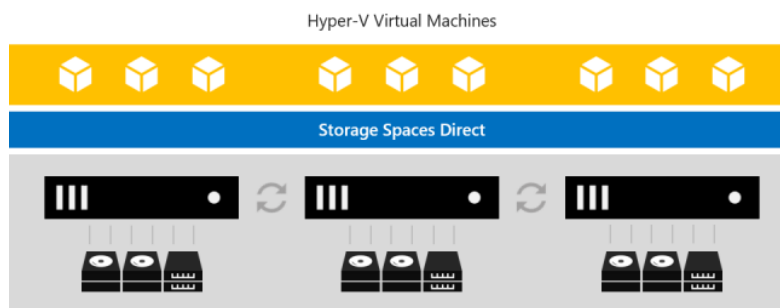
Deploying Storage Spaces Direct

Configuration Checklist

Use the checklist below to ensure your Storage Spaces Direct configuration is ready for production. This will make sure you meet all prerequisites before proceeding, including cabling, and switch and network configuration.

During your configuration, use the built-in validation tests to confirm your RDMA connections and validate the cluster. Once configuration is complete, test the solution for resiliency and performance using DataON's MUST application.

DataON's Deployment Package

Your DataON & Storage Spaces Direct solution includes a customized deployment package provided to you by the technician who built and tested your cluster. This package will include:

- **Storage Spaces Direct deployment PowerShell script** – To be opened and run in PowerShell ISE to build your cluster
- **DataON scripts folder** – Supplemental scripts to rename NICs, clean drives and check volume information
- **MUST folder** – Link to download Windows Admin Center
- **Rail kit installation guide** – Steps on how to install the rail kit and rack the servers
- **Firmware and drivers spreadsheet** – List of components and the driver version installed for you cluster. Please check with us if you have a business or technical requirement to update any of these in case there are known issues with the updated version.
- **VM Fleet benchmark report** – Synthetic tests performed on your cluster prior to shipment to ensure Storage Spaces Direct is performing properly. If desired, we can make the testing tools available to perform your own testing.
- **Troubleshooting Storage Spaces Direct guide from Windows Docs** – Microsoft's guide on various Storage Spaces Direct states and status
- **A deployment document** which contains:
    - Hardware configuration
    - Server front & rear view
    - Network connections diagram
    - Firmware and drivers installed
    - Storage Spaces Direct stack
    - Example on how to run the deployment script
    - VM Fleet performance benchmarks

- o DataON MUST for Windows Admin Center
- o Storage Spaces Direct troubleshooting guide
- o Resources for DataON servers (documents, tools, BIOS/drivers and O/S RAID information)
- o Intel BMC KVM information

The information provided in this document will be based on our deployment package. Some items may not be specific for your deployment.

Physical Setup

After receiving the server hardware, follow the rack installation guide to properly rack the servers into the cabinet.

Hardware View

Below are front and rear views of 1U and 2U server nodes used in S2D cluster and its associated network ports.

K2N-108 Front and Rear View – Consists of two DataON S2D-5108i 1U servers each with eight bays for NVMe drives. Connectivity between the two nodes will be two 25GbE connections.

DataON K2N-108
K2N-108 consists of (2) S2D-5108i server nodes direct-attached

S2D-5108i Front View

S2D-5108i Rear View
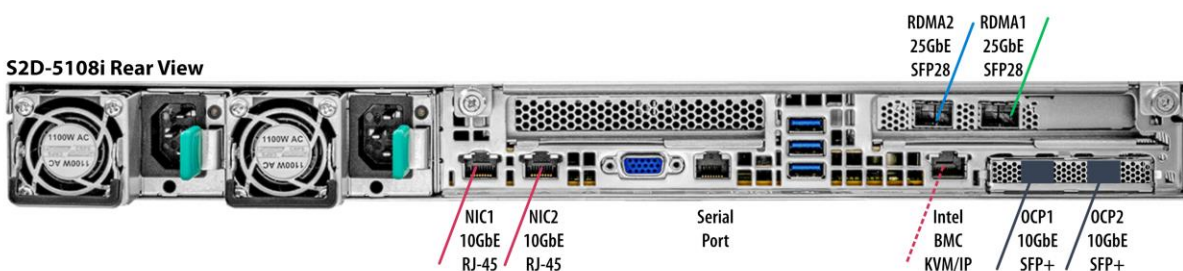
RDMA2 RDMA1
25GbE 25GbE
SFP28 SFP28

NIC1 NIC2   Serial   Intel   OCP1 OCP2
10GbE 10GbE   Port   BMC   10GbE 10GbE
RJ-45 RJ-45   KVM/IP   SFP+ SFP+

10GbE - RJ-45	On-board NIC 1 & 2 - North-South Client/Management Traffic (option 1)
10GbE - SFP+	OCP 1 & 2 - North-South Client/Management Traffic (option 2)
25GbE - SFP28	RDMA 1 - East-West Cluster and Storage Traffic
25GbE - SFP28	RDMA 2 - East-West Cluster and Storage Traffic
RJ-45	Intel BMC/IPMI RJ-45 for KVM/IP

Note on SFP+ and SFP28

Our dual-port 25GbE RDMA adapters have ports in the form factor of SFP+. To achieve the following speeds, please select the appropriate cables:

- For 25Gb/s, select SFP28 cables
- For 10Gb/s, select SFP+ cables

K2N-212 Front and Rear View – Consists of two DataON S2D-5212i 2U servers with two bays for NVMe and 10 bays for SATA/SAS drives. Connectivity between the two nodes will be two 25GbE connections.

DataON K2N-212
K2N-212 consists of (2) S2D-5212i server nodes direct-attached

S2D-5212i Front View

RDMA2 25GbE SFP28 (client/mgmt)
RDMA1 25GbE SFP28
RDMA4 25GbE SFP28 (client/mgmt)
RDMA3 25GbE SFP28

S2D-5212i Rear View

NIC1 10GbE RJ-45
NIC2 10GbE RJ-45
Serial Port
Intel BMC KVM/IP

10GbE - RJ-45	On-board NIC 1 & 2 - North-South Client/Management Traffic (option 1)
25GbE - SFP28	RDMA 2 & 4 - North-South Client/Management Traffic (option 2)
25GbE - SFP28	RDMA 1 - East-West Cluster and Storage Traffic
25GbE - SFP28	RDMA 3 - East-West Cluster and Storage Traffic
RJ-45	Intel BMC/IPMI RJ-45 for KVM/IP

Note on SFP+ and SFP28

Our dual-port 25GbE RDMA adapters have ports in the form factor of SFP+. To achieve the following speeds, please select the appropriate cables:

- For 25Gb/s, select SFP28 cables
- For 10Gb/s, select SFP+ cables

Cabling Diagram and Cluster Witness

Proper connectivity for the cluster-to-cluster traffic is essential for the storage and cluster traffic to function properly. In additional, a 2-node cluster requires a quorum witness to prevent a split-brain scenario.

DataON K2N-108
K2N-108 consists of (2) S2D-5108i server nodes direct-attached

Cluster Quorum
2-node clusters require a witness to prevent split-brain scenarios. See **Understanding Cluster and Pool Quorum** at https://docs.microsoft.com/en-us/windows-server/storage/storage-spaces/understand-quorum

Customer Switch 1

Customer Switch 2

Witness

S2D-5108i Node 1

S2D-5108i Node 2

10GbE - RJ-45	On-board NIC 1 & 2 - North-South Client/Management Traffic (option 1)
10GbE - SFP+	OCP 1 & 2 - North-South Client/Management Traffic (option 2)
25GbE - SFP28	RDMA 1 - East-West Cluster and Storage Traffic
25GbE - SFP28	RDMA 2 - East-West Cluster and Storage Traffic
RJ-45	Intel BMC/IPMI RJ-45 for KVM/IP

Note on SFP+ and SFP28

Our dual-port 25GbE RDMA adapters have ports in the form factor of SFP+. To achieve the following speeds, please select the appropriate cables:

- For 25Gb/s, select SFP28 cables
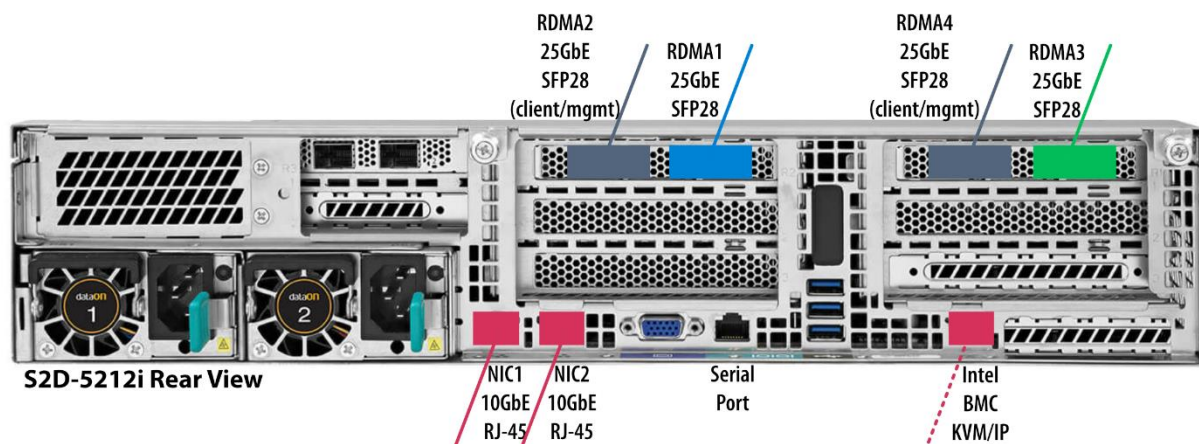- For 10Gb/s, select SFP+ cables

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DataON K2N-212

K2N-212 consists of (2) S2D-5212i server nodes direct-attached

Customer Switch 1   Customer Switch 2

Witness

Cluster Quorum
2-node clusters require a witness to prevent split-brain scenarios.
See **Understanding Cluster and Pool Quorum** at https://docs.microsoft.com/en-us/windows-server/storage/storage-spaces/understand-quorum

S2D-5212i Node 1

S2D-5212i Node 2

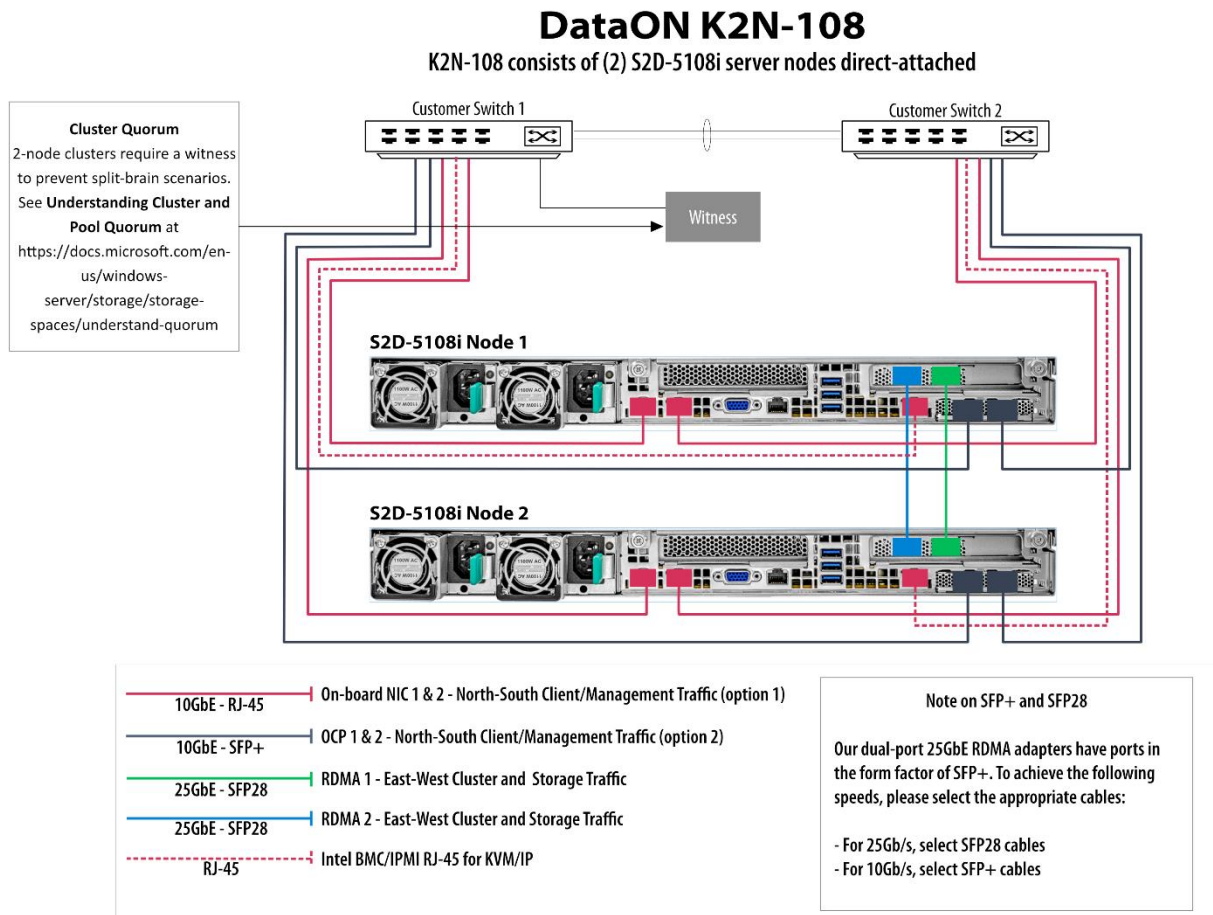| Legend	
10GbE - RJ-45	On-board NIC 1 & 2 - North-South Client/Management Traffic (option 1)
25GbE - SFP28	RDMA 2 & 4 - North-South Client/Management Traffic (option 2)
25GbE - SFP28	RDMA 1 - East-West Cluster and Storage Traffic
25GbE - SFP28	RDMA 3 - East-West Cluster and Storage Traffic
RJ-45	Intel BMC/IPMI RJ-45 for KVM/IP

Note on SFP+ and SFP28

Our dual-port 25GbE RDMA adapters have ports in the form factor of SFP+. To achieve the following speeds, please select the appropriate cables:

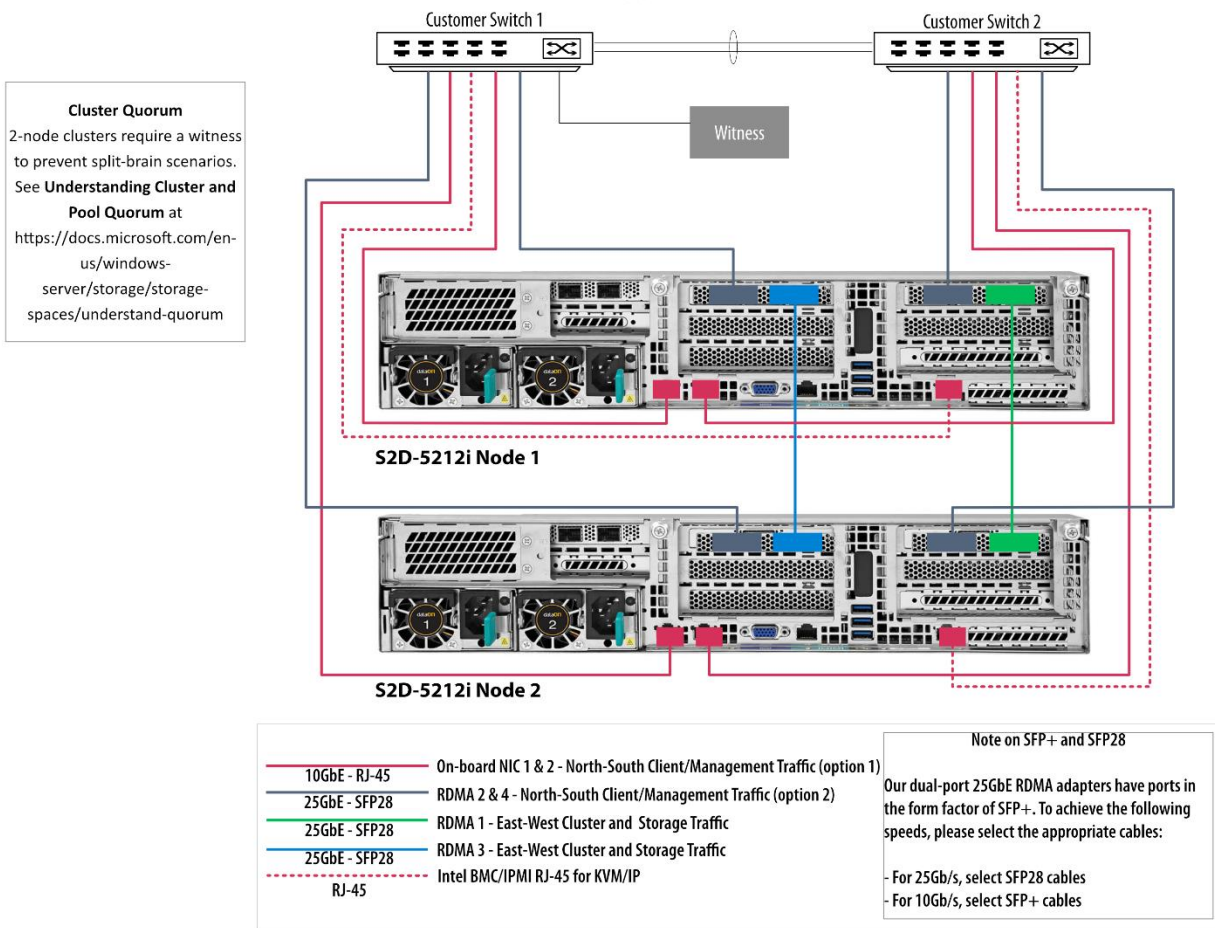- For 25Gb/s, select SFP28 cables
- For 10Gb/s, select SFP+ cables

Note: For brevity, only the S2D-5212i is shown above as a representative of the 2U 2-node cluster. Other 2U 2-node S2D models are available from DataON and will have the similar network connections.

Logical Configuration

BMC

Your DataON servers will either have a static BMC IP address you provided to us during the testing phase or a dynamic address using DHCP. With BMC access, you can remote console into the system using KVM/IP.

Note: Your browser will indicate there is a lack of a SSL certificate for this https connection. This is normal. Click **Advanced.**
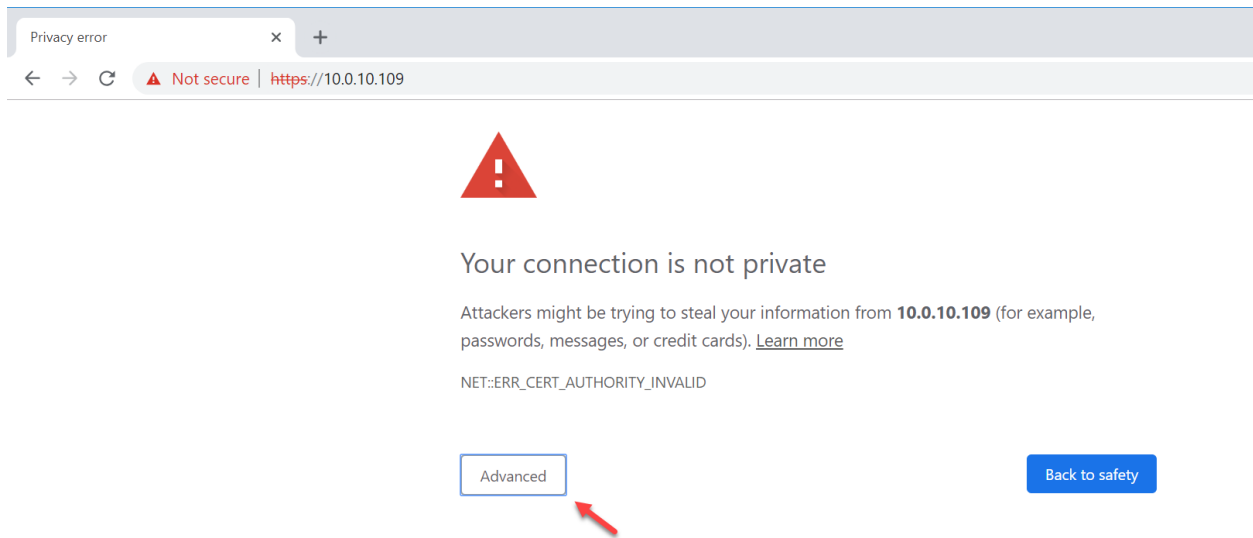
After clicking advanced, click on **Proceed** to <your IP address>.

You will be presented with the login screen for BMC. Enter the credentials provided by DataON.

Select the **Remote Control** tab then **iKVM over HTML5** (other option is KVM/Console Redirection using Java) then click on **Launch iKVM over HTML5**. You will then have remote console access to the system.
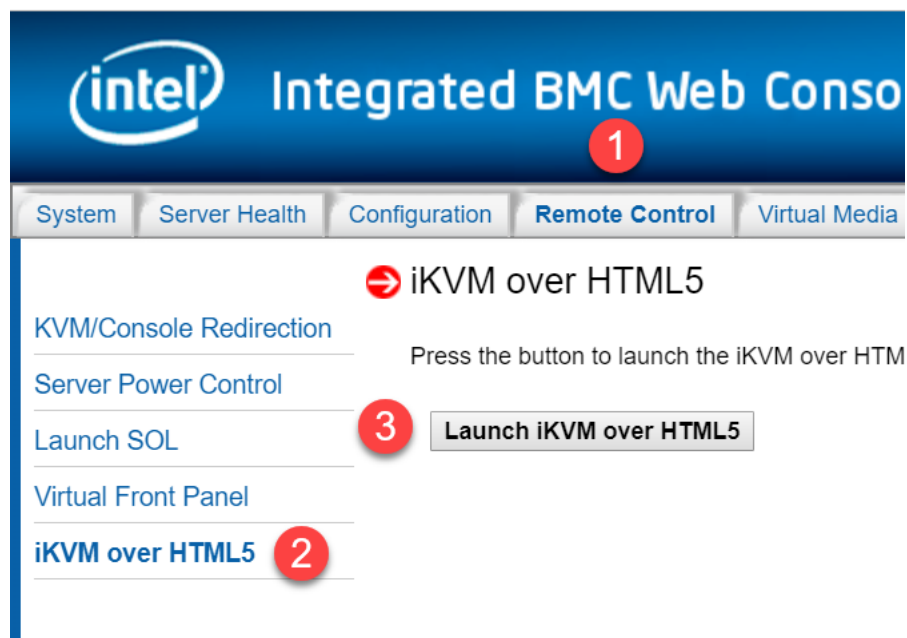
Note: iKVM over HTML5 is available starting with Intel BIOS v15. Prior to this version, the only option is Java-based KVM/IP option.

Initial Windows Configuration

1. Our standard deployment uses an out-of-box experience so that our users can set the basic Windows Server configuration.
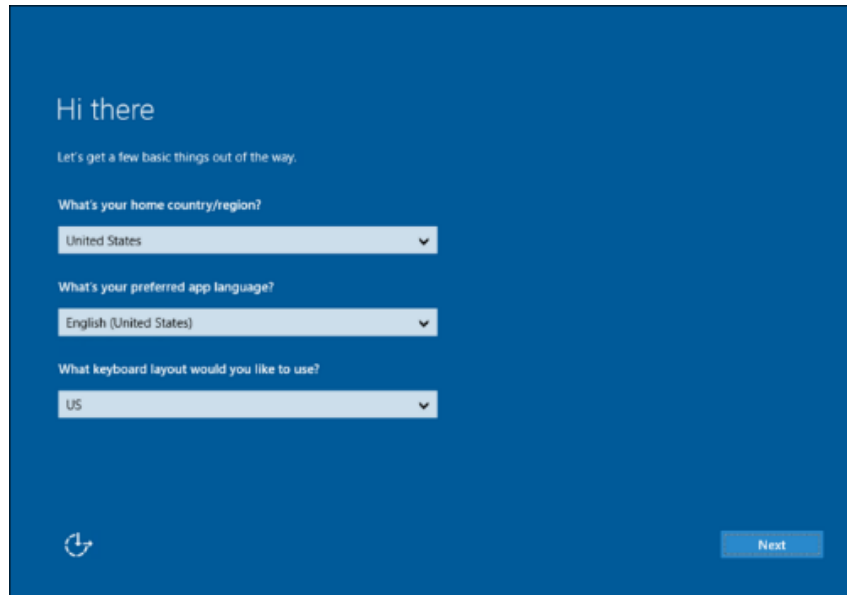
2. After clicking '**Next**', enter your own password for the built-in Administrator account. Then log into the Administrator account to proceed.

Windows Server 2016/2019 License Key

Every DataON S2D server node has Windows Server 2016/2019 Datacenter Evaluation version pre-installed for your convenience. This version is provided for proof-of-concept only. Please apply your own license before official deployment using the command lines below to apply the license.

Note: The eval license is good for approximately 180 days from the day DataON installed the OS. After 180 days, the server will automatically reboot on an hourly basis.

Open PowerShell window as Administrator

```
# To view the current edition installed
dism /online /get-currentedition

# To view the possible target editions available
dism /online /get-targeteditions

# To input the retail or KMS Windows License Key
dism /online /set-edition:ServerDatacenter /AcceptEula /ProductKey:<input your product key
or KMS key>
```

Update Windows Server with the latest patches

Prior to shipment, DataON makes every effort to load the latest Windows Server cumulative patch available. However, there will be cases where you will need to run Windows updates again to ensure your OS is up-to-date prior to building the cluster.

DataON S2D Server Node Configuration

Your Windows Server 2016/19 OS image has the drivers pre-installed with the DataON S2D server node. After entering the license information, you will need to rename the servers and join it to your domain. Once complete, you're ready to build the DataON S2D cluster.

With the exception of Step 1 (rename server), the boxes below are the PowerShell commands to run on **One** of the hosts. Open a PowerShell ISE window as Administration to execute the commands.

System Pre-Setup

Step 1: Rename the Server

(Optional) Rename the server using the convention of "[Node 1 name]-N1". For example, if we have two DataON S2D-5108's, so we could rename the server name to S2D-2108-N1 and N2 and join it to your own domain.

```
Rename-Computer <Host Name>
Add-Computer -DomainName <Domain Name>
Restart-Computer
```

Step 2: Assign hostnames to $nodes

Once all the nodes boot up, run the command below with your hostnames. The $nodes variable will be used in subsequent commands.

```
$S1 = "<host name 1>"
$S2 = "<host name 2>"

$nodes = ($S1, $S2)
```

Step 3: Enable the Remote Desktop Connection

(Optional) Enable the remote desktop connection.

Note: make sure the entire block of commands starting from Invoke-Command to the "}" at the bottom.

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Set-ItemProperty -Path 'HKLM:\System\CurrentControlSet\Control\Terminal Server'-Name
"fDenyTSConnections" -Value 0
    Set-ItemProperty -Path 'HKLM:\System\CurrentControlSet\Control\Terminal
Server\WinStations\RDP-Tcp' -Name "UserAuthentication" -Value 0
    Enable-NetFirewallRule -DisplayGroup "Remote Desktop"
    Get-NetFirewallRule -DisplayGroup "Remote Desktop" | ft Name,Enabled,Profile
}
```

Step 4: Enable Ping for Every Node

Allow the firewall to receive pings.

Note: make sure the entire block of commands starting from Invoke-Command to the "}" at the bottom.

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Enable-NetFirewallRule -Name 'FPS-ICMP4-ERQ-In'
}
```

Step 5: Disable the Firewall

(optional) Disable the firewall.

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Set-NetFirewallProfile -Profile Domain,Private,Public -Enabled False
}
```

Step 6: Clear All the Disks

Clear all the disks in the current configuration before setting up the DataON S2D server node.

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Set-ExecutionPolicy Unrestricted
    cd C:\DataON\script
    .\Clear-SdsConfig.ps1
}
```

Step 7: Display the Number of Clean Disks

Display the number of clean disks that are available to be in the DataON S2D storage pool for the entire cluster.

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Get-PhysicalDisk -CanPool $true
} | measure
```

In this example, we have four disks on each node that are available: Intel® P3700 800GB NVMe SSDs and eight Intel® P3520 2TB NVMe SSDs per server. With four DataON S2D servers, we should see 40 clean disks during setup.

```
PS C:\VMfleet\control> Invoke-Command –ComputerName (get-clusternode) -ScriptBlock {
    Get-PhysicalDisk -CanPool $true
} | measure


Count     : 8
Average   :
Sum       :
Maximum   :
Minimum   :
Property  :
```

Networking Setup

Step 1: Rename the NICs across all nodes

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Set-ExecutionPolicy Unrestricted
    C:\DataON\script\NicConfig.ps1 C:\DataON\script\nic.config Rename
}
```

Step 2: Check the Network Status

Check the status of the network (NIC).

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Get-NetAdapter | where Status -Like Up | ft ifAlias, Status,LinkSpeed
}
```

Step 3: Get the Disconnected NIC

Get the disconnected / disabled NIC.

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    Get-NetAdapter | where Status -Like "Disconnected" | ft Name, Status
    Get-NetAdapter | where Status -Like "Disabled" | ft Name, Status
}
```

Step 4: Disable the disconnected NIC

Disable the disconnected NIC.

```
Invoke-Command -ComputerName $nodes -ScriptBlock {
    $nics = Get-NetAdapter | Where-Object Status -NE "Up"| Select-Object -ExpandProperty Name
    foreach( $nic in $nics) {
        Write-Verbose 'Disable $nic'
        Disable-NetAdapter $nic -Confirm:$false
    }
}
```

Step 5: Configure static IPs on NIC 1

This assumes you haven't already configured the IPs on NIC 1 (which is defined in Step 1). Ignore if this was completed manually.

You can set the **IP address, prefix length, default gateway and server address** for node 1.

```
Invoke-Command -ComputerName $S1 -ScriptBlock {
    Set-NetIPInterface -InterfaceAlias "NIC1" -DHCP Disabled
    Remove-NetIPAddress -InterfaceAlias "NIC1" -Confirm:$false
    New-NetIPAddress -InterfaceAlias "NIC1" -IPAddress <IP Address> -PrefixLength <subnet
prefix> -DefaultGateway <gateway IP>
    Set-DnsClientServerAddress -InterfaceAlias "NIC1" -ServerAddresses <DNS IP separated by
comma for multiple IPs>
}
```

Set Node 2 - NIC 1 as static IP.

You can set the **IP address, prefix length, default gateway and server address** for node 2.

```
Invoke-Command -ComputerName $S2 -ScriptBlock {
    Set-NetIPInterface -InterfaceAlias "NIC1" -DHCP Disabled
    Remove-NetIPAddress -InterfaceAlias "NIC1" -Confirm:$false
    New-NetIPAddress -InterfaceAlias "NIC1" -IPAddress <IP Address> -PrefixLength <subnet
prefix> -DefaultGateway <gateway IP>
    Set-DnsClientServerAddress -InterfaceAlias "NIC1" -ServerAddresses <DNS IP separated by
comma for multiple IPs>
}
```

Step 6: Confirm NIC 1 on the servers can ping.

```
ipconfig.exe /flushdns
ping $S1
ping $S2
```

Step 7: Configure RDMA 1 and 2.

These will be the ports for server-to-server cluster, storage and live migration communication. You will use the same steps as above but for InterfaceAlias RDMA 1 and 2.

You can set the **IP address, prefix length and server address** for node 1. These connections will not have a DNS nor gateway as they're direct connections. RDMA 1 and 2 will be on separate subnets.

Node 1

```
Invoke-Command -ComputerName $S1 -ScriptBlock {
    Set-NetIPInterface -InterfaceAlias "RDMA1" -DHCP Disabled
    Remove-NetIPAddress -InterfaceAlias "RDMA1" -Confirm:$false
    New-NetIPAddress -InterfaceAlias "RDMA1" -IPAddress 192.168.101.11 -PrefixLength 24
}

Invoke-Command -ComputerName $S1 -ScriptBlock {
    Set-NetIPInterface -InterfaceAlias "RDMA2" -DHCP Disabled
    Remove-NetIPAddress -InterfaceAlias "RDMA2" -Confirm:$false
    New-NetIPAddress -InterfaceAlias "RDMA2" -IPAddress 192.168.102.11 -PrefixLength 24
}
```

Node 2

```
Invoke-Command -ComputerName $S2 -ScriptBlock {
    Set-NetIPInterface -InterfaceAlias "RDMA1" -DHCP Disabled
    Remove-NetIPAddress -InterfaceAlias "RDMA1" -Confirm:$false
    New-NetIPAddress -InterfaceAlias "RDMA1" -IPAddress 192.168.101.12 -PrefixLength 24
}

Invoke-Command -ComputerName $S2 -ScriptBlock {
    Set-NetIPInterface -InterfaceAlias "RDMA2" -DHCP Disabled
    Remove-NetIPAddress -InterfaceAlias "RDMA2" -Confirm:$false
    New-NetIPAddress -InterfaceAlias "RDMA2" -IPAddress 192.168.102.12 -PrefixLength 24
}
```

Configuring Intel® Optane™ DC Persistent Memory

For Edge Plus and Data Center Plus configurations

Persistent memory BIOS configuration for memory mode:

1. Advanced > PCI Configuration > UEFI optionROM control > Intel® Optane™ DC Persistent Memory Configuration > Regions > Create goal config

2. Change the Memory % from [0] to [100]

3. Select Create goal config

4. Save change and reboot

```
                        PCI Configuration


    Add-in Video Adapter        <Disabled>
    Onboard Video               <Enabled>
    Fast Video                  <Enabled>
    Legacy VGA Socket           <CPU Socket 1>
    ARI Support                 <Enabled>
    SR-IOV Support              <Enabled>

  ▶ PCIe Slot Bifurcation Setting
  ▶ PCIe Error Maintain
  ▶ NIC Configuration
  ▶ UEFI Network Stack
  ▶ UEFI Option ROM Control
  ▶ PCIe Port Oprom Control
  ▶ Processor PCIe Link Speed
```

```
                     UEFI Option ROM Control


        IPv4 Network Configuration
    Intel(R) Ethernet Connection X722 for 10GbE SFP+ -
    A4:BF:01:2F:D4:EB
        IPv6 Network Configuration
        VLAN Configuration
        IPv4 Network Configuration
    Memory Controller
    Intel(R) Optane(TM) DC Persistent Memory
    Configuration
    Storage Controller
    MSCC HBA 1100-16i Slot:0x0312
```

```
        Intel(R) Optane(TM) DC Persistent Memory Configuration


    Version: 1.0.0.3286                    View and configure
    Select an action below.                installed DCPMMs.


    Detected DIMMs:           [8]
    All DIMMs are healthy.

  ▶ DIMMs
  ▶ Regions
  ▶ Namespaces
  ▶ Total capacity
  ▶ Diagnostics
  ▶ Preferences
```
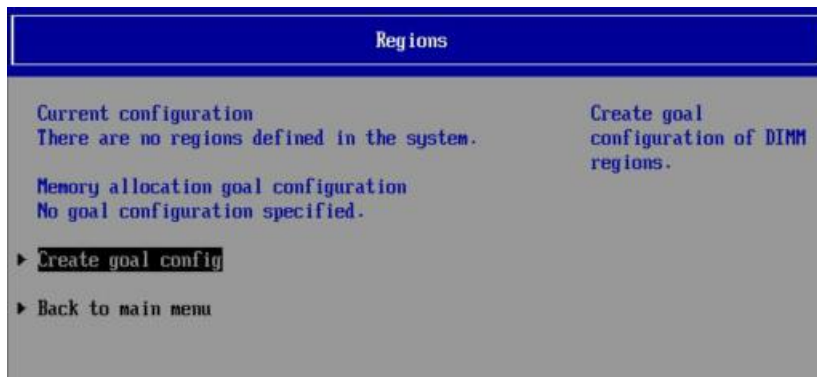
```
┌────────────────────────────────────────────────────────────┐
│                          Regions                            │
├────────────────────────────────────────────────────────────┤
│  Current configuration              Create goal             │
│  There are no regions defined in the system.   configuration of DIMM │
│                                     regions.                │
│  Memory allocation goal configuration                       │
│  No goal configuration specified.                           │
│                                                             │
│  ▶ Create goal config                                       │
│                                                             │
│  ▶ Back to main menu                                        │
│                                                             │
└────────────────────────────────────────────────────────────┘
```

```
┌────────────────────────────────────────────────────────────┐
│                      Create Goal Config                     │
├────────────────────────────────────────────────────────────┤
│  Select the scope of the new region then set the    Select target to │
│  desired sizes.                                      create goal config. │
│                                                             │
│  Create goal config for:    <Platform>                      │
│                                                             │
│  Reserved [%]:              [0]                             │
│  Memory Mode [%]:           [0]                             │
│                                                             │
│  Persistent memory type:    <App Direct>                    │
│                                                             │
│  Namespace Label version:   <1.2>                           │
│                                                             │
│  ▶ Create goal config                                       │
│  ▶ Back to Regions menu                                     │
│  ▶ Back to main menu                                        │
└────────────────────────────────────────────────────────────┘
```
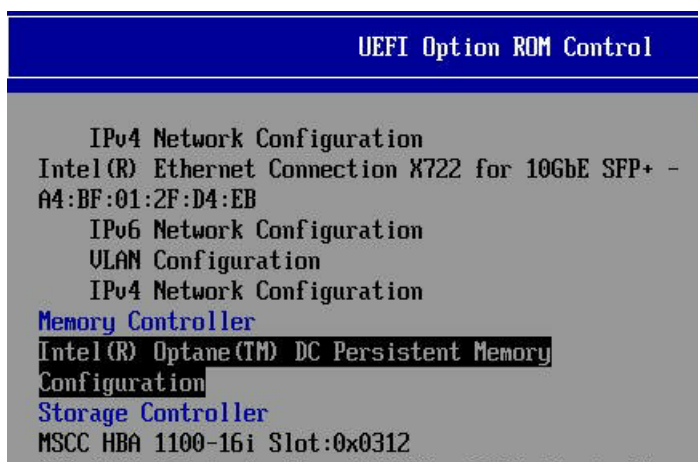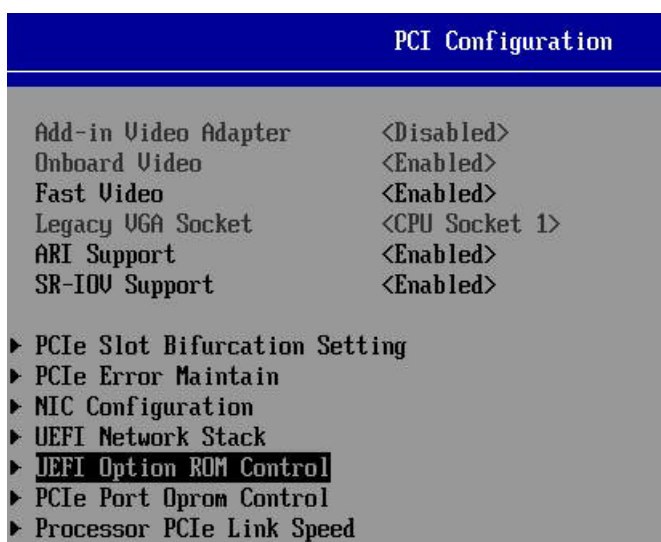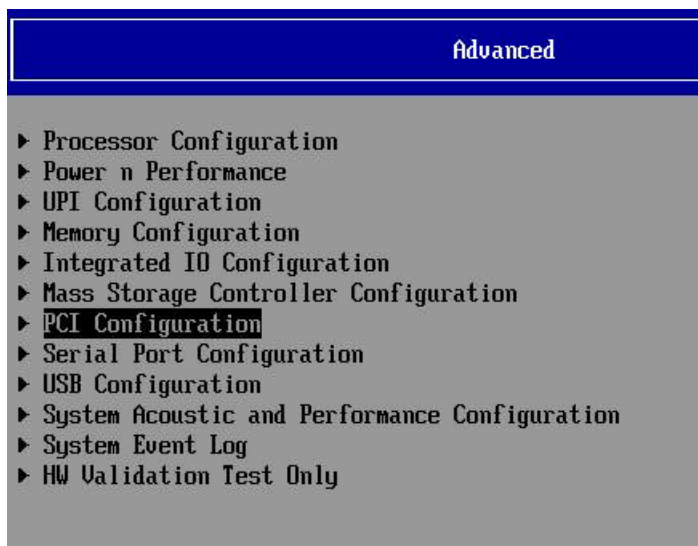
For Data Center Plus configurations

Step1:

Persistent Memory BIOS Configuration for Memory mode and Storage over App Direct Mode:

1. Advanced > PCI Configuration > UEFI optionROM control > Intel® Optane™ DC Persistent Memory Configuration > Regions > Create goal config

2. Change the Memory % from [0] to [34]

3. Change the Persistent memory type to App Direct

4. Select Create goal config

5. Save change and reboot

Advanced

▸ Processor Configuration
▸ Power n Performance
▸ UPI Configuration
▸ Memory Configuration
▸ Integrated IO Configuration
▸ Mass Storage Controller Configuration
▸ PCI Configuration
▸ Serial Port Configuration
▸ USB Configuration
▸ System Acoustic and Performance Configuration
▸ System Event Log
▸ HW Validation Test Only

PCI Configuration

Add-in Video Adapter	<Disabled>
Onboard Video	<Enabled>
Fast Video	<Enabled>
Legacy VGA Socket	<CPU Socket 1>
ARI Support	<Enabled>
SR-IOV Support	<Enabled>

▸ PCIe Slot Bifurcation Setting
▸ PCIe Error Maintain
▸ NIC Configuration
▸ UEFI Network Stack
▸ UEFI Option ROM Control
▸ PCIe Port Oprom Control
▸ Processor PCIe Link Speed

UEFI Option ROM Control

    IPv4 Network Configuration
Intel(R) Ethernet Connection X722 for 10GbE SFP+ -
A4:BF:01:2F:D4:EB
    IPv6 Network Configuration
    VLAN Configuration
    IPv4 Network Configuration
Memory Controller
Intel(R) Optane(TM) DC Persistent Memory
Configuration
Storage Controller
MSCC HBA 1100-16i Slot:0x0312

Intel(R) Optane(TM) DC Persistent Memory Configuration

Version: 1.0.0.3286   View and configure
Select an action below.   installed DCPMMs.

Detected DIMMs: [8]
All DIMMs are healthy.

▶ DIMMs
▶ Regions
▶ Namespaces
▶ Total capacity
▶ Diagnostics
▶ Preferences

Regions

Current configuration   Create goal
There are no regions defined in the system.   configuration of DIMM
                                        regions.

Memory allocation goal configuration
No goal configuration specified.

▶ Create goal config

▶ Back to main menu

Create Goal Config

Select the scope of the new region then set the   Select target to
desired sizes.   create goal config.

Create goal config for: <Platform>

Reserved [%]:   [0]
Memory Mode [%]:   [0]

Persistent memory type: <App Direct>

Namespace Label version: <1.2>

▶ Create goal config
▶ Back to Regions menu
▶ Back to main menu

Step 2:

Boot in Windows and configure DCPMM to cache:

1. Get the region ID of the DCPMM [command: Get-PmemUnusedRegion]

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

PS C:\Users\Administrator> Get-PmemUnusedRegion

RegionId TotalSizeInBytes DeviceId
-------- ---------------- --------
       1     541165879296 {1, 11, 101, 111}
       3     541165879296 {1001, 1011, 1101, 1111}


PS C:\Users\Administrator>
```

2. Create DCPMM disk in Windows   [command: New-PmemDisk -RegionId <1or3> - AtomicityType BlockTranslationTable]

```
PS C:\bin> New-PmemDisk -RegionId 1 -AtomicityType BlockTranslationTable
Creating new persistent memory disk. This may take a few moments.
```

Step 3:

Configure Persistent Disk to cache in windows

1. Get all physical disk [command: Get-PhysicalDisk]

```
PS C:\Users\administrator.FAST> Get-PhysicalDisk

DeviceId FriendlyName          SerialNumber                                   MediaType CanPool OperationalStatus HealthStat
                                                                                                                  us
-------- ------------          ------------                                   --------- ------- ----------------- ----------
14       NVMe INTEL SSDPE2KE01  0100_0000_0100_0000_5CD2_E4EE_E582_5051.       SSD       False   OK                Healthy
12       Intel Raid 1 Volume    OS                                            SSD       False   OK                Healthy
13       NVMe INTEL SSDPE2KE01  0100_0000_0100_0000_5CD2_E4D3_CC82_5051.       SSD       False   OK                Healthy
1005     HGST HUH721212AL4200   8DGLVNTC                                      HDD       False   OK                Healthy
1008     HGST HUH721212AL4200   8DJ7M7AC                                      HDD       False   OK                Healthy
2011     HGST HUH721212AL4200   8DJ6A0HC                                      HDD       False   OK                Healthy
2008     HGST HUH721212AL4200   8DJNEGLC                                      HDD       False   OK                Healthy
1000     HGST HUH721212AL4200   8DJ6A0LC                                      HDD       False   OK                Healthy
1010     HGST HUH721212AL4200   8DJ6D46C                                      HDD       False   OK                Healthy
2005     HGST HUH721212AL4200   8DJ6A9VC                                      HDD       False   OK                Healthy
2000     HGST HUH721212AL4200   8DKNEH5H                                      HDD       False   OK                Healthy
1001     HGST HUH721212AL4200   8DJ7LXKC                                      HDD       False   OK                Healthy
2003     HGST HUH721212AL4200   8DKN4YDH                                      HDD       False   OK                Healthy
1004     HGST HUH721212AL4200   8DJ69P0C                                      HDD       False   OK                Healthy
2001     HGST HUH721212AL4200   8DK38ZVH                                      HDD       False   OK                Healthy
2015     Persistent memory disk 0301808949e7a36cd8d70c4b8c4b5d46b742982a      SCM       False   OK                Healthy
1015     Persistent memory disk 03018089edc41e6d0861054b81fc04d8337640c6      SCM       False   OK                Healthy
1007     HGST HUH721212AL4200   8DJNDHYC                                      HDD       False   OK                Healthy
1002     HGST HUH721212AL4200   8DJ6D0WC                                      HDD       False   OK                Healthy
1009     HGST HUH721212AL4200   8DJ6A65C                                      HDD       False   OK                Healthy
2016     Persistent memory disk 03018089f0e3468b66d53e4f8ad8d66e80deabe2      SCM       False   OK                Healthy
1011     HGST HUH721212AL4200   8DJ6BPXC                                      HDD       False   OK                Healthy
2004     HGST HUH721212AL4200   8DJ69ALC                                      HDD       False   OK                Healthy
1003     HGST HUH721212AL4200   8DJ69UYC                                      HDD       False   OK                Healthy
1016     Persistent memory disk 0301808970c4a9aebeae3f43b035614d2ada2e09      SCM       False   OK                Healthy
2006     HGST HUH721212AL4200   8DJ7M3JC                                      HDD       False   OK                Healthy
2010     HGST HUH721212AL4200   8DJNE00C                                      HDD       False   OK                Healthy
1006     HGST HUH721212AL4200   8DJ7LS8C                                      HDD       False   OK                Healthy
2002     HGST HUH721212AL4200   8DJ69SEC                                      HDD       False   OK                Healthy
2007     HGST HUH721212AL4200   8DJ6ASGC                                      HDD       False   OK                Healthy
2009     HGST HUH721212AL4200   8DJ6A6NC                                      HDD       False   OK                Healthy
```

2. To enable the S2D cluster set the cache device to 'Persistent memory disk'

   [command: Enable-ClusterS2D -CacheDeviceModel 'Persistent memory disk'

Install Windows Server Features

Install Hyper-V, Failover Clustering and File Services. You will need to reboot afterwards.

```
icm $nodes {Install-WindowsFeature Failover-Clustering -IncludeAllSubFeature -
IncludeManagementTools}
icm $nodes {Install-WindowsFeature -Name Hyper-V, File-Services -IncludeManagementTools}
icm $nodes {Restart-Computer -Force}
```

Cluster Validation and Creation

Step 1: Validate that nodes are ready for cluster creation

Run the following command to test $S1 and $S2 are ready to be a cluster. A report will be generated. Open the report using Internet Explorer to address any issues.

```
Test-Cluster -node $nodes -Include "Storage Spaces Direct",Inventory,Network, "System
Configuration" -ReportName C:\Windows\cluster\Reports\report
```

Step 2: Check the cluster report.

```
& 'C:\Program Files (x86)\Internet Explorer\iexplore.exe'
C:\Windows\cluster\Reports\report.htm
```

Step 3: Create a failover cluster with a name and a static IP

```
New-Cluster -Name <cluster name> -Node $nodes -NoStorage -StaticAddress <IP Address>
```

Step 4: Review the cluster creation log to ensure there are no errors

```
Invoke-Item C:\Windows\cluster\Reports\
```

Storage Spaces Direct Creation

Enable and Configure Storage Spaces Direct with disk volumes

Step 1: Enable Storage Spaces Direct – This will depend on whether you have cache drives or not.

Step 1a. Storage Spaces Direct with cache drives
If you have cache drives, use the following example

Configure Storage Spaces Direct's cache tier with performance devices, such as NVMe SSDs. Use this command to identify the friend name of the highest performance device.

As administrator, run:

```
Get-PhysicalDisk
```


Change the **CacheDeviceModel** and enable it as journal cache.

```
Enable-ClusterS2D -CacheDeviceModel 'INTEL SSDPE2MD80'
```

Continue to Step 2.

Step 1b. Storage Spaces Direct without Cache Drives

For clusters with all SSDs as capacity (with no cache drives), run:

```
Enable-ClusterS2D -CacheState Disabled
```

Step 2: Check the enable cache report

```
Invoke-Item C:\Windows\cluster\Reports\
```

Step 3: Check the storage pool size in TB or GB (single pool)

```
Get-StoragePool S2* | ft FriendlyName, @{n='Size in TB';e={$_.Size / 1TB}}
Get-StoragePool S2* | ft FriendlyName, @{n='Size in GB';e={$_.Size / 1GB}}
```

Step 4: Create 2-way mirror volume, one volume per node

```
Get-ClusterNode |% { New-Volume -StoragePoolFriendlyName S2D* -FriendlyName $_ -FileSystem
CSVFS_ReFS -Size <size>TB -ResiliencySettingName "Mirror" -PhysicalDiskRedundancy 1 }
```

DataON MUST for Windows Admin Center

DataON MUST™ (Management Utility Software Tool) provides a high level of infrastructure visibility, monitoring, and management for Windows Server-based hyper-converged systems, networking and storage. Built to support Microsoft's suite of software-defined storage technologies, including Storage Spaces Direct, Storage Replica and Storage Quality-of-Service (QoS), MUST simplifies data center management and helps enterprise customers transition from traditional SANs to a Windows Server-based hyper-converged infrastructure.

MUST can be used through its standalone console or can be used within Windows Admin Center, allowing customers to use both Windows Admin Center and MUST through a single pane of glass.

Window Admin Center is an evolution of Windows Server management tools that complements but does not replace, System Center and Operations Management Suite. It gives you full control over all aspects of your server infrastructure from a locally deployed, browser-based management experience. MUST enhance the Windows Admin Center experience with expanded functionality:

- **Historic Data Reporting** – Provides real-time and monthly dashboards of your system performance data including IOPS, latency, throughput on your cluster, storage pool, volume, and nodes.

- **Enhanced Disk Mapping** – MUST displays the device types and components in each of the nodes, providing a clear disk map of your entire node. It shows the number of disks, disk type, location and slot of each drive, and disk health status. MUST supports over 20 configurations for disk mapping.

- **System Alerts** – Leverages Windows Health Service faults to identify hardware failures, configuration issues, and resource saturation. It also provides a multi-level assessment of specific locations, fault descriptions, and recovery actions. You can also leverage third-party SNMP monitoring traps to alert you when you need disk or hardware replacements.

- **Alert Services** – Provides real-time e-mail alerts to systems administrators based on Microsoft Health Service faults. E-mail alerts can be setup based on multiple levels, such as critical, warning, and information

- **Call Home Service** – Integrates alert services with Azure Analytics to provide real-time monitoring of DataON solutions for Azure Stack HCI for disk failures or predicted disk failures. MUST can notify system administrators and start the process to send a replacement disk.

- **Diagnostic Deployment Tool** – Simply click a button to generate a report of your environment, pull your configuration and disk mapping from Azure Cloud, and complete your installation.

Installing the DataON MUST extension

To utilize DataON's MUST extension, you will first need to [download and install Windows Admin Center](#).

Step 1: Download Windows Admin Center

Look for the **Get it Here** link at the top. Windows Admin Center can be installed on Windows 10 or Windows Server 2016/2019.

Step 2: Add cluster to Windows Admin Center

After installing Windows Admin Center, add the HCI cluster using the following steps:

Click the **+ Add** to add your cluster. Select **Hyper-converged Cluster Connection**

Input the cluster name or the hostname of one of the server cluster nodes (Windows Admin Center will find the rest).

Select the cluster by the cluster name that you've just added. In the type column, it should be listed as a **Hyper-Converged Cluster**. Select that link to see the default HCI dashboard components in Windows Admin Center.

Step 3: Install DataON's MUST extension for Windows Admin Center:

Click on the upper right gear icon.

Select **Extensions** on the left side bar

Select **DataON MUST** from the list then click **Install**. Windows Admin Center will ask for a confirmation to continue.

Click on **Windows Admin Center** on the upper left corner to return to the Windows Admin Center's homepage

Return to the HCI cluster you previously added. You should now see **DataON MUST** near the bottom on the left side under **Extensions**.

MUST will automatically detect the DataON server model then collect the disk information. It will then display the disk mapping. This may take a few minutes.

After the mapping completes, you can visit the **Alerts** tab to request for a code from DataON to setup alerts for HCI events.

Once you receive the code from DataON, you can input it into the extension to setup your SMTP server information and individual users who will receive alerts generated by Windows Server's Health Service.

Intel® Select Solutions for Microsoft Azure Stack HCI

Intel® Select Solutions are designed to reduce the time required to evaluate, select, and purchase hardware for today's workloads and applications. They are vigorously benchmark-tested with today's high-priority workloads, helping businesses realize smooth deployments and optimal performance. By eliminating guesswork and ensuring predictability with pre-defined configurations, businesses can take advantage of new technologies faster.

Intel Select Solutions are powered by 2nd generation Intel® Xeon® Scalable processors. They represent a new class of Intel® Xeon® processors designed for demanding high-performance computing (HPC) and infrastructure-as-a-service (IaaS) workloads. In addition, they support Intel's breakthrough Intel® Optane™ DC persistent memory, delivering greater than 3TB per socket. These solutions also support Intel® Optane™ Solid State Drives (SSDs) which can accelerate applications, reduce transactions costs for latency-sensitive workloads, and improve overall data center TCO.

Intel® Select Solutions for Microsoft Azure Stack HCI are performance-optimized specifically for hyper-converged compute and storage. This solution improves performance by utilizing Intel Optane DC Persistent Memory as cache storage for Storage Spaces Direct to accelerate the cache tier for storage at DDR4 speeds versus PCIe/SATA speeds.

DataON offers four validated configurations for Intel Select Solutions for Microsoft Azure Stack HCI:

> **Data center model, base configuration** – For enterprise environments, supports primary workloads in a hybrid storage design.

> **Data center model, plus configuration** – For enterprise environments, supports the most demanding critical production workloads. Ideal for healthcare environments where electronic healthcare (EHR) database software require fast responses.

> **Edge model, base configuration** – For small-to-medium sized businesses (SMB), remote office/branch office (ROBO), and edge environments

> **Edge model, plus configuration** – For SMB, ROBO, and edge environments. Leverages leveraging Intel® Optane™ technology to support more demanding workloads such as Microsoft SQL Server.

Intel Select Solutions for Microsoft Azure Stack HCI are performance-optimized specifically for hyper-converged compute and storage. This solution improves performance by utilizing Intel

Optane DC Persistent Memory as cache storage for Storage Spaces Direct to accelerate the cache tier for storage at DDR4 speeds versus PCIe/SATA speeds.

With the Plus configuration, businesses can add four times greater memory capacity per cluster and five times greater raw storage capacity per cluster over the Base configuration[1]. With the Plus configuration of Intel Select Solutions for Microsoft Azure Stack HCI, businesses can achieve 20 percent more cores for computation and 90 percent higher throughput in IOPS over the Base configuration[2].

These solutions add to DataON's first generation of Intel® Select Solutions for Windows Server Software-Defined Storage, and second-generation Intel® Select Solutions for Azure Stack HCI and Microsoft SQL Server.

1. Intel internal testing as of February 15, 2019. Intel® Select Solutions for Microsoft Azure Stack* HCI Edge model Base configuration: 2x Intel® Xeon® Gold 5218 processor, Intel® Server Board S2600WFT, 256GB total memory (8 x 32 GB, 2,666 mega transfers per second [MT/s]), Intel® Hyper-Threading Technology (Intel® HT Technology) enabled, Intel® Turbo Boost Technology enabled, storage (boot): 1x 480 GB Intel® SSD DC 3520 U.2 SATA, storage tier: 4x 1.6 TB Intel® SSD DC P4610 PCIe* NVM Express* (NVMe*), 1x 25 gigabits per second (Gbps) Chelsio* network adapter, 10 GbE, Windows Server 2019 Datacenter edition* build 17763. Plus configuration: 2x Intel® Xeon™ Gold 6230 processor, Intel® Server Board S2600WFT, 512 GB Intel® Optane™ DC persistent memory (4 x 128 GB, 2,666 MT/s), 192 GB DRAM (12 x 16 GB, 2,666 MT/s), Intel® HT Technology enabled, Intel® Turbo Boost Technology enabled, storage (boot): 1x 480 GB Intel® SSD DC 3520 M.2 SATA, storage (cache): 2x 375 GB Intel® Optane™ SSD DC P4800X, storage (capacity): 4x 4 TB Intel® SSD DC P4510 PCIe NVMe, 1x 25 gigabits per second (Gbps) Chelsio network adapter, 25 GbE, Windows Server 2019 Datacenter edition build 17763.

2. Intel internal testing as of February 15, 2019. Intel® Select Solutions for Microsoft Azure Stack* HCI Data Center model Base configuration: 2x Intel® Xeon® Gold 6230 processor, Intel® Server Board S2600WFT, 512 GB Intel® Optane™ DC persistent memory (4x 128 GB, 2,666 mega transfers per second [MT/s]), 192 GB DRAM (12x 16 GB, 2,666 MT/s), Intel® Hyper-Threading Technology (Intel® HT Technology) enabled, Intel® Turbo Boost Technology enabled, storage (boot): 1x 480 GB Intel® SSD DC 3520 M.2 SATA, storage (cache): 2x 375 GB Intel® Optane™ SSD DC P4800X, storage (capacity): 4x 4 TB Intel® SSD DC P4510 PCIe* NVM Express* (NVMe*), 1x 25 gigabits per second (Gbps) Chelsio* network adapter, 25 GbE, Windows Server 2019 Datacenter edition* build 17763. Plus configuration: 2x Intel® Xeon® Gold 6252 processor, Intel® Server Board S2600WFT, 1,584 GB Intel® Optane™ DC persistent memory (12x 128 GB, 2,666 MT/s), 192 GB DRAM (12x 16 GB, 2,666 MT/s), Intel® HT Technology enabled, Intel® Turbo Boost Technology enabled, storage (boot): 1x 480 GB Intel® SSD DC 3520 M.2 SATA, storage (cache): 2x 500 GB Intel® Optane™ SSD DC persistent memory, storage (capacity): 4x 4 TB Intel® SSD DC P4510 PCIe NVMe, 1x 25 gigabits per second (Gbps) Chelsio network adapter, 25 GbE, Windows Server 2019 Datacenter edition build 17763.

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Appendix

Collateral

[Intel Select Solutions for Azure Stack HCI](#)

[Microsoft Windows – Compare Features in Windows Server versions](#)

[Azure and Azure Stack HCI](#)

[DataON MUST datasheet](#)

Videos

[Azure Stack HCI demo](#)

[Build your hybrid cloud strategy with Azure, Azure Stack, and Azure Stack HCI](#)

[DataON helps customers craft a next gen data center with Intel Select Solutions](#)

[Azure Stack HCI, Intel Select Solutions, and Upgrading and Migrating to Windows Server 2019](#)

[Windows 2019 Deep Dive](#)

[Windows Admin Center](#)

[HCI Management with Windows Admin Center](#)

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