# Revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Document revision</th>
<th>Description of changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2018</td>
<td>1.8</td>
<td>Added support for VMware DVS Switch and VxBlock Central.</td>
</tr>
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<td>Updated Cisco UCS Servers for Cisco UCS GPUs.</td>
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<td>Added support for AMP-3S.</td>
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</tr>
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</tr>
<tr>
<td></td>
<td></td>
<td>• Updated Compute components.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Updated Cisco UCS Servers.</td>
</tr>
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</tr>
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<td>Added support for XtremIO X2.</td>
</tr>
<tr>
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<td>1.2</td>
<td>Added support for Cisco UCS C-Series M5 servers.</td>
</tr>
<tr>
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<td>1.1</td>
<td>Updated graphics in the compute section and the sample elevations.</td>
</tr>
<tr>
<td>February 2018</td>
<td>1.0</td>
<td>Initial version</td>
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This document describes the high-level design of the VxBlock System 1000 and the hardware and software components.

The VxBlock 1000 offers the latest storage arrays, compute, and networking equipment from Cisco Systems and AMP management infrastructure. VxBlock 1000 provides the following benefits:

- **Customization:** The VxBlock 1000 enables a choice of multiple storage arrays, compute servers, and network stacks. The compute layer includes both Cisco UCS B-Series and C-Series Servers. The storage layer includes multiarray support from VMAX All-Flash, Dell EMC Unity, PowerMax, XtremIO, and Isilon storage to fulfill both block and file storage needs. Networking options for VxBlock 1000 with Cisco UCS Gen 3 include:
  - LAN networking supports 10 Gb/s, 40 Gb/s, and 100-Gb/s uplinks to the network. LAN networking supports 10 Gb/s or 40-Gb/s access for attached devices, depending on the configuration.
  - SAN networking supports 16-Gb/s FC access from both the compute and storage arrays.

- **Expansion:** The VxBlock 1000 can be expanded by adding compute, network, and storage resources. After the initial deployment, you can add more disks for increased capacity and servers for increased performance.

- **Management:** VxBlock Central user interface is provided in multiple options to manage VxBlock Systems.
  
  AMP-VX is scalable and deployed inside the VxBlock System 1000. AMP-VX can manage multiple system platforms in a single data center.

  AMP-3S is a single system management infrastructure platform to manage a single platform in a data center.
The VxBlock System 1000 allows a choice of multiple storage arrays, compute servers, and network stacks.

The following table provides key hardware and software components for management, virtualization, compute, network and storage for VxBlock 1000:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Components</th>
</tr>
</thead>
</table>
| Management | Vision Intelligent Operations or VxBlock Central  
  The following options are available for VxBlock Central:  
  • The Base option provides the VxBlock Central user interface.  
  • The Advanced option adds VxBlock Central Orchestration, which provides:  
  — VxBlock Central Orchestration Services  
  — VxBlock Central Orchestration Workflows  
  • The Advanced Plus option adds VxBlock Central Operations and VxBlock Central Orchestration. |
| Virtualization |  
  • VMware vSphere Server Enterprise Plus  
  • VMware vSphere ESXi  
  • VMware vCenter Server  
  • VMware vSphere Web Client  
  • VMware Platform Services Controller (PSC)  
  • PowerPath/VE  
  • License Manager for PowerPath/VE  
  • PowerPath Management Appliance  
  • Cisco UCS Manager  
  • Cisco UCS CIMC  
  • Unisphere for Dell EMC Unity  
  • Unisphere for VMAX  
  • Isilon OneFS  
  • XtremIO XMS  
  • Secure Remote Services (ESRS)  
  • Cisco Data Center Network Manager (DCNM) for SAN  
  • Cisco DCNM for LAN |
| Compute | Cisco UCS Gen 3 components:  
  • Cisco UCS 5108 Blade Server Chassis  
  • Cisco UCS B-Series M4 and M5 Servers  
  • Cisco UCS C-Series M4 and M5 Servers  
  • Cisco UCS 2304 Fabric Extenders  
  • Cisco Nexus 2348UPQ Fabric Extenders  
  • Cisco UCS 6332-16UP Fabric Interconnects |
### Resource Components

#### Network
- Cisco UCS Gen 3 components:
  - Cisco Nexus 9336C-FX2, Cisco Nexus 93180YC-FX, Cisco Nexus 93180LC-EX Data Plane Switches
  - Cisco MDS 9148S Multilayer Fabric Switch, Cisco MDS 9396S 16G Multilayer Fabric Switch, Cisco MDS 9710 Multilayer Director, or Cisco MDS 9706 Multilayer Director
  - Cisco Nexus 31108TC-V Switches
  - Optional Cisco Nexus 3232C or Cisco Nexus 9336C-FX2 Management Aggregation Switches
  - VMware vSphere Distributed Switch (VDS)

#### Storage
- VMAX All-Flash 950F and 950FX
- VMAX All Flash 250F and 250FX
- Dell EMC Unity 350F, 450F, 550F and 650F
- Isilon F800, H600, H500, H400, A200, and A2000
- PowerMax 2000
- PowerMax 8000
- XtremIO X2-R and X2-S

### Minimum and maximum configurations

VxBlock System 1000 compute, network, and storage components scale with blade and rack mount servers, bandwidth and connectivity options, and storage capacity and performance.

The following table provides minimum and maximum requirements for the VxBlock 1000:

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute</td>
<td>1 Cisco UCS domain</td>
<td>Cisco UCS Gen 3:</td>
</tr>
<tr>
<td></td>
<td>2 Cisco UCS 5108 Blade Server Chassis (unless using a Cisco UCS C-Series server configuration)</td>
<td>7 Cisco UCS domains with Cisco Nexus 9336-FX2 Switch</td>
</tr>
<tr>
<td></td>
<td>3 Cisco UCS B-Series or C-Series servers</td>
<td>10 Cisco UCS 5108 Blade Server Chassis per domain (total of 50)</td>
</tr>
<tr>
<td></td>
<td>1 Cisco UCS C-Series server for bare metal deployments</td>
<td>8 Cisco UCS B-Series servers (half-width) per chassis (total of 400)</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS B-Series blade type including all supported M4 and M5 blade configurations</td>
<td>20 40 GbE Cisco UCS C-Series Rack Mount servers per domain (total of 140)</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS C-Series servers including all supported M4 and M5 configurations</td>
<td>160 FEX-connected 10 GbE Cisco UCS C-Series Rack Mount servers per domain (total of 1120)</td>
</tr>
<tr>
<td>Network</td>
<td>1 pair of Cisco Nexus 31108TC-V Switches (96 management ports)</td>
<td>2 pairs of Cisco Nexus 31108TC-V Switches (192 management ports)</td>
</tr>
<tr>
<td></td>
<td>1 pair of Cisco Nexus 9336C-FX Switches</td>
<td>1 pair of Cisco Nexus 3232C or Cisco Nexus 9336C-FX Management Aggregation Switches</td>
</tr>
<tr>
<td></td>
<td>1 pair of Cisco MDS 9148S Multilayer Fabric Switches</td>
<td>6 pairs of Cisco Nexus 9336C-FX data plane switches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 pair of Cisco MDS 9710 Multilayer Directors with 348 16 Gb FC ports each</td>
</tr>
<tr>
<td>Hardware</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| **Storage VMAX All-Flash** | • VMAX All-Flash 950F and 950FX  
  — 1 engine  
  — 16 front-end ports  
  — Supports 17 drives  
  • VMAX All-Flash 250F and 250FX  
  — 1 engine  
  — 16 front-end ports  
  — Supports 9 drives | • VMAX All-Flash 950F and 950FX  
  — 8 engines  
  — 192 front-end ports  
  — Supports 1920 drives  
  • VMAX All-Flash 250F and 250FX  
  — 2 engines  
  — 64 front-end ports  
  — Supports 100 drives |
| **Storage PowerMax** | • PowerMax 8000  
  — 1 engine  
  — 16 front-end ports  
  — Supports 8 drives  
  • PowerMax 2000  
  — 1 engine  
  — 16 front-end ports  
  — Supports 5 drives | • PowerMax 8000  
  — 8 engines  
  — 256 front-end ports  
  — Supports 288 drives  
  • PowerMax 2000  
  — 2 engines  
  — 64 front-end ports  
  — Supports 96 drives |
| **Storage Dell EMC Unity** | • Dell EMC Unity All-Flash arrays  
  — 350F models: 10 drives  
  — 450F models: 10 drives  
  — 550F models: 10 drives  
  — 650F models: 10 drives  
  All Dell EMC Unity arrays support 4–20 16G FC ports or 0–16 10 GbE ports. | • Dell EMC Unity All-Flash arrays  
  — 350F models: 150 drives  
  — 450F models: 250 drives  
  — 550F models: 500 drives  
  — 650F models: 1000 drives  
  All Dell EMC Unity arrays support 4–20 16G FC ports or 0–16 10 GbE ports. The storage array count depends on the number of 16 Gb/s FC ports available in a single Cisco MDS director per SAN fabric. |
| **Storage Isilon** | • 4 nodes with 10 Gb/s front end connectivity  
  • 4 nodes with 40 Gb/s front end connectivity  
  • 2.5-inch drives (F800 and H600 models only)  
  • 3.5-inch drives (H500, H400, A200, and A2000 models only) | • 144 nodes with 10 Gb/s front end connectivity  
  • 144 nodes with 40 Gb/s front end connectivity  
  • 2.5-inch drives (F800 and H600 models only)  
  • 3.5-inch drives (H500, H400, A200, and A2000 models only)  
  The maximum 10 Gb Isilon configuration requires 4 pairs of Cisco Nexus 9336C-FX ToR switches. The maximum 40 Gb Isilon configuration requires 6 Cisco Nexus 9336C-FX ToR switch pairs. |

**NOTE:** A single-cabinet configuration of the VMAX All-Flash 250F and 250FX is available with a single engine.
AMP-VX or AMP-3S is available in configurations that use their own resources to run workloads without consuming resources on the VxBlock 1000.

AMP-3S can be configured with two to six servers. Use a minimum of three servers to build a viable AMP-3S VMware vSphere HA and DRS cluster, based on the core and optional workloads. Some management applications require memory or CPU reservations, which adversely affect the AMP-3S VMware vSphere HA cluster memory and CPU slot size. Memory and CPU reservations impact available slots on a VMware vSphere ESXi host and limit the number of VMs supported on each host.

If AMP-3S is built with two servers, the vArchitect must determine if the proposed configuration can support VMware vSphere HA and DRS. Depending on the workload, VMware vSphere HA admission control may disallow VM migration due to a lack of available slots on a VMware vSphere ESXi host.

Together, the components offer balanced CPU, I/O bandwidth, and storage capacity relative to the compute and storage arrays in the VxBlock 1000. All components have N+N or N+1 redundancy.

Depending upon the configuration, the following maximums apply:

<table>
<thead>
<tr>
<th>Component</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco UCS 6332-16UP Fabric Interconnects</td>
<td>The maximum number of Cisco UCS Servers with connected Cisco Nexus ToR switches and seven Cisco UCS domains are:</td>
</tr>
<tr>
<td></td>
<td>• 400 Cisco UCS B-Series half-width servers</td>
</tr>
<tr>
<td></td>
<td>• 140 Cisco UCS C-Series direct-connected servers</td>
</tr>
<tr>
<td></td>
<td>• 1120 Cisco UCS C-Series FEX-connected servers</td>
</tr>
</tbody>
</table>

### Scaling up compute resources

To scale up compute resources, add servers and chassis when the VxBlock System 1000 is built or after it is deployed.
Servers

Cisco UCS servers are sold individually. Each server type must have a minimum of three servers as a base and can increase in single server increments thereafter. Each server is added with license packs for the following software:

- Cisco UCS Manager
- VMware vSphere ESXi
- PowerPath/VE

The base configuration of a VxBlock System 1000 includes a minimum of three servers. The maximum number of servers depends on the selected scale point.

License packs for VMware vSphere ESXi and PowerPath/VE are not available for bare metal blades.

Chassis

The power supplies and FEX for all chassis are prepopulated and cabled, and all required Twinax cables and transceivers are populated. However, in the base configuration, there is a minimum of two Cisco UCS 5108 Blade Server Chassis. There is no unpopulated server chassis unless they are ordered that way. This limited licensing reduces the entry cost for the VxBlock System 1000.

As more blades are added and more chassis are required, more chassis are added automatically to an order. The kit contains software licenses to enable extra FI ports.

Only enough port licenses for the minimum number of chassis to contain the blades are ordered. More chassis can be added upfront to enable flexibility in the field or to initially spread the blades across a larger number of chassis.

Cisco Nexus 2300 Fabric Extenders (Cisco UCS Gen 3 configurations)

For Cisco Nexus FEX-connected C-Series Servers, the first pair of FEXs can support up to 48 servers. Each additional pair of FEXs can support another 48 servers until the fourth pair of FEXs has been added. The fourth pair, FEX 7, and FEX 8, can support only 16 FEX-connected Cisco UCS C-Series servers. With eight FEXs connected, the Cisco UCS domain can support the Cisco UCS Manager maximum of 160 servers.

Each individual FEX requires two uplinks to the FI for every 16 connected servers. Four uplinks per FEX are required to support 17–32 servers, and six uplinks are required to support 33–48 Cisco UCS C-Series Servers.

Populate each pair of Cisco Nexus FEXs with 48 connected servers before adding a new pair to the domain.

Network topology

LAN and SAN connectivity is segregated into separate Cisco switches.

Cisco UCS Gen 3 LAN switching uses the following switches:

- Cisco Nexus 93180YC-FX Switch
- Cisco Nexus 93180LC-EX Switch
• Cisco Nexus 9336C-FX2 Switch

SAN switching uses the following Cisco MDS switches:

• Cisco MDS 9148S 16 Gb Multilayer Fabric Switch
• Cisco MDS 9396S 16 Gb Multilayer Fabric Switch
• Cisco MDS 9706 Multilayer Director
• Cisco MDS 9710 Multilayer Director

The compute layer connects to both the Ethernet and FC components of the network layer. Cisco UCS FIs connect to the Cisco Nexus switches in the Ethernet network through 40 GbE or 10 GbE port channels. Cisco UCS FIs connect to the Cisco MDS switches through port channels made up of multiple 16 Gb links.

Front-end IO modules in the storage array connect to the Cisco MDS switches in the network layer over 16 Gb FC links.
The following illustration shows a network block storage configuration for the VxBlock System 1000:

**Host boot configuration**

By default, VMware vSphere ESXi boots from SD cards.

VMware vSphere ESXi hosts can optionally boot over the FC SAN.
Compute layer

VxBlock System 1000 includes Cisco UCS 6332-16UP Fabric Interconnects with four or six 40 Gb links connected to a pair of 40 Gb capable Cisco Nexus 9336C-FX2 or 93180LC-EX Switches. Alternatively, the FIs can connect to a pair of 10 Gb capable Cisco Nexus 93180YC-FX Switches using 4 x 10 Gbps break-out cables.

Cisco UCS Servers provide computing power within the VxBlock System 1000.

Each FI also has multiple ports reserved for FC ports. These ports connect to Cisco SAN switches and carry FC traffic between the compute layer and the storage layer. SAN port channels carrying FC traffic are configured between the FIs and upstream Cisco MDS switches. The Cisco UCS 6332-16UP Fabric Interconnects can be configured with 8, 12, or 16 FC connections per FI.

FEX within the Cisco UCS 5108 Blade Server Chassis connect to FIs over converged networking.

In a Cisco UCS Gen 3 environment, two or four 40 GbE connections on each FEX connect northbound to the FIs, regardless of the number of blades in the chassis. Cisco UCS C-Series Servers can connect directly to ports on FIs. Optionally, a pair of Cisco Nexus 2348UPQ FEXs can be used for increased Cisco UCS C-Series server scalability. These connections carry IP and FC traffic.

By default, servers in the VxBlock System 1000 boot VMware vSphere ESXi from local mirrored SD cards. Booting from SAN is optional.

The following table lists the compute hardware components that can be included in the VxBlock System 1000:

<table>
<thead>
<tr>
<th>Component</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco UCS Gen 3 FIs</td>
<td>Cisco UCS 6332-16UP (required)</td>
</tr>
<tr>
<td>Cisco UCS Gen 3 FEX</td>
<td>Cisco UCS 2304, Cisco Nexus 2348UPQ</td>
</tr>
<tr>
<td>Chassis</td>
<td>Cisco UCS 5108</td>
</tr>
<tr>
<td>B-Series Servers</td>
<td>Cisco B200 M4, B260 M4, B420 M4, B460 M4, B200 M5, B480 M5</td>
</tr>
<tr>
<td>C-Series Servers</td>
<td>Cisco C220 M4, C240 M4, C220 M5, C240 M5,</td>
</tr>
</tbody>
</table>

Cisco UCS Fabric Interconnects

The default Cisco UCS 6332-16UP Fabric Interconnects are 40 port, 16-Gb FC, and 40-Gb Ethernet capable switches. The Cisco UCS FIs run the Cisco UCS Manager application and database. Each VxBlock System 1000 contains at least two FIs that form a high availability cluster.

Cisco UCS 6332-16UP Fabric Interconnects provide network connectivity and management capability to the Cisco UCS blades and chassis. Each pair of Cisco UCS 6332-16UP Fabric Interconnects form a Cisco UCS compute domain.

The following table shows how many Cisco UCS compute domains the Cisco Nexus ToR switches can support:

<table>
<thead>
<tr>
<th>Component</th>
<th>Maximum Cisco UCS compute domains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco Nexus 93180YC-FX</td>
<td>2</td>
</tr>
<tr>
<td>Cisco Nexus 93180LC-EX</td>
<td>5</td>
</tr>
</tbody>
</table>
### Cisco UCS Servers

The Cisco UCS data center platform unites compute, network, and storage access.

Optimized for virtualization, the Cisco UCS Gen 3 environment integrates a low-latency, lossless 40 Gb or 10 Gb Ethernet on Cisco UCS 6332-16UP.

The VxBlock System 1000, powered by Cisco UCS, offers the following features:

- Built-in redundancy for high availability
- Hot-swappable components for serviceability, upgrade, or expansion
- Fewer physical components than in a comparable system built piece by piece
- Reduced cabling
- Improved energy efficiency over traditional blade server chassis

For VMware deployments, the VxBlock System 1000 can scale from a minimum of three Cisco UCS B-Series blade servers or three Cisco UCS C-Series Servers, to hundreds of Cisco UCS B-Series/C-Series Servers. The maximum number of servers that can be installed depends on the number of Cisco UCS domains in the system and the underlying storage array configuration.

The maximums assume that server models are consistent within the domain/system and that the configured host count is supported by the connected storage array(s). Mixing server models in a domain or system is supported but reduces the maximum quantity listed. Cisco UCS B-series blade servers require 10 Cisco UCS chassis per domain with the two-link connection option to achieve the maximum listed. The maximum quantity supported per system value can only be achieved with five Cisco UCS domains.

The following table lists the maximum supported Cisco UCS servers in a Cisco UCS Gen 3 environment:

<table>
<thead>
<tr>
<th>Server model and type</th>
<th>Maximum servers per Cisco UCS domain</th>
<th>Maximum servers per system with Cisco Nexus 93180 Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco UCS B200 M4, B200 M5 (half-width)</td>
<td>80</td>
<td>400</td>
</tr>
<tr>
<td>Cisco UCS B420 M4, B260 M4, B480 M5 (full-width)</td>
<td>40</td>
<td>200</td>
</tr>
<tr>
<td>Cisco UCS B460 M4 (double-height)</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Cisco UCS C220 M4, C240 M4 , C220 M5, C240 M5 (Direct connect - 40 Gbps)</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Cisco UCS C220 M4, C240 M4 , C220 M5, C240 M5 (FEX connect - 10 Gbps)</td>
<td>160</td>
<td>800</td>
</tr>
</tbody>
</table>

See to the *Cisco UCS 6300 Series Fabric Interconnect Specification Sheet* for additional information regarding Cisco UCS 6332-16UP Fabric Interconnects.
The following table shows the maximum Cisco UCS B-Series blade quantities in relation to deploying Cisco UCS C-Series direct-connect servers within the same Cisco UCS Gen 3 domain:

<table>
<thead>
<tr>
<th>Cisco UCS Chassis count</th>
<th>Maximum Cisco UCS B-Series servers</th>
<th>Maximum Cisco UCS C-Series direct-connect servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>12</td>
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<td>40</td>
<td>10</td>
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<td>6</td>
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<td>8</td>
<td>64</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>72</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>0</td>
</tr>
</tbody>
</table>

The following table shows the maximum Cisco UCS B-Series blade quantities in relation to deploying Cisco UCS C-Series FEX-connect servers within the same Cisco UCS Gen 3 domain:

<table>
<thead>
<tr>
<th>Cisco UCS Chassis count</th>
<th>Maximum Cisco UCS B-Series servers</th>
<th>Maximum Cisco UCS C-Series FEX-connect servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>160</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>144</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>128</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>112</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>96</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>48</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>56</td>
<td>48</td>
</tr>
<tr>
<td>8</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>9</td>
<td>72</td>
<td>16</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>0</td>
</tr>
</tbody>
</table>

The following table shows the CPUs and memory each Cisco UCS server can support:

<table>
<thead>
<tr>
<th>Cisco UCS server</th>
<th>Maximum supported CPUs and memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco UCS B200 M5, C220 M5, and C240 M5 servers</td>
<td>Two Intel Xeon scalable CPUs and 3 TB of memory</td>
</tr>
<tr>
<td>Cisco UCS B200 M4, B420 M4, C220 M4, and C240 M4 servers</td>
<td>Two Intel Xeon v4 CPUs and 1.5 TB of memory.</td>
</tr>
</tbody>
</table>
Cisco UCS server | Maximum supported CPUs and memory
---|---
Cisco UCS B260 M4 server | Two Intel Xeon v4 CPUs and 3 TB of memory
Cisco UCS B460 M4, B480 M5 servers | Four Intel Xeon v4 CPUs and 6 TB of memory

**NOTE:** GPUs are available to order in all supported Cisco UCS B- and C-Series M4 and M5 servers, either from the factory or by ordering an additional server through the expansion services for Converged Systems.

**NOTE:** Dell EMC contacts Cisco support for issues and concerns with GPUs ordered as part of a Converged System.

By default, all Cisco UCS B-Series and C-Series servers are configured with local SD cards for OS boot.

### Compute server connectivity

Each Cisco UCS B-Series Blade Server contains at least one physical VIC that passes converged FC and IP network traffic through the chassis mid-plane to the FEXs.

Cisco UCS C-Series rack mount servers contain at least one physical VIC as well. The Cisco UCS C-Series rack mount servers can connect directly to each FI or to a pair of Cisco Nexus FEXs which are connected to the FIs.

### Cisco UCS B-Series server connectivity

Half-width M4 blade servers can be configured to contain a VIC 1340.

Optionally, a VIC 1380 on M4 servers can be installed in the PCIe mezzanine slot next to a VIC 1340 to separate non-management network traffic to a separate physical adapter. In a Cisco UCS B200 Series Server, both the VIC 1340 and 1380 can connect at 20 Gbps to each fabric. Also, the VIC 1340 can be installed with a port expander card to achieve native 40 Gbps connectivity to each fabric.

Full-width M4 blade servers can be configured to contain a VIC 1340. Optionally, a full-width blade M4 server can be configured with a VIC 1340 and 1380. The VIC 1340 can connect at 20 Gbps while the VIC 1380 can communicate at a maximum bandwidth of 40 Gbps to each fabric. Another option is to configure the full-width blade server to contain a VIC 1340, a port expander card, and a VIC 1380 card. With this configuration, the server’s network interfaces each communicate at a maximum bandwidth of 40 Gbps per fabric.

Each Cisco UCS B-Series Servers connects to the a Cisco UCS 2304 Fabric Extender I/O Module (IOM), through the Cisco UCS 5108 Blade Server Chassis midplane. Each IOM carries converged network traffic through two or four 40 Gb links to the fabric interconnect.

The following table shows the network connectivity, based on server type and VIC combination:

<table>
<thead>
<tr>
<th>Server type</th>
<th>VIC combination</th>
<th>Bandwidth to each FEX</th>
<th>Total bandwidth available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half-width blade</td>
<td>1340 only</td>
<td>20 Gbps</td>
<td>40 Gbps</td>
</tr>
<tr>
<td></td>
<td>1340 + Port Expander</td>
<td>40 Gbps</td>
<td>80 Gbps</td>
</tr>
<tr>
<td></td>
<td>1340 + 1380</td>
<td>20 Gbps (1340), 40 Gbps (1380)</td>
<td>80 Gbps</td>
</tr>
<tr>
<td>Server type</td>
<td>VIC combination</td>
<td>Bandwidth to each FEX</td>
<td>Total bandwidth available</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------</td>
<td>----------------------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Full-width blade</td>
<td>1340 only</td>
<td>20 Gbps</td>
<td>40 Gbps</td>
</tr>
<tr>
<td></td>
<td>1340 + Port Expander</td>
<td>40 Gbps</td>
<td>80 Gbps</td>
</tr>
<tr>
<td></td>
<td>1340 + 1380</td>
<td>20 Gbps (1340), 40 Gbps (1380)</td>
<td>120 Gbps</td>
</tr>
<tr>
<td></td>
<td>1340 + Port Expander + 1380</td>
<td>40 Gbps (1340), 40 Gbps (1380)</td>
<td>160 Gbps</td>
</tr>
</tbody>
</table>

The following illustration shows the IO module to Gen 3 FI connections on a chassis:

**Cisco UCS C-Series Server direct connect**

Cisco UCS Manager supports an option to connect the Cisco UCS C-Series Rack Mount Server directly to the FIs.

In a Cisco UCS Gen 3 configuration, you do not need the Cisco Nexus 2300 (Gen 3) Fabric Extenders. This option enables Cisco UCS Manager to manage the Cisco UCS C-Series Rack Mount Servers using a single cable for both management and data traffic. The Cisco UCS VIC connects to the FI of the system. This connection uses a single connection from each VIC to each FI. This method is used for configurations that require a few servers.
A Cisco UCS Gen 3 C-Series directly connected configuration provides the following features:

- Cisco UCS C-Series Servers
- 40 Gbps per fabric from the Cisco UCS VIC 1385 or 1387 on M4 or M5 servers
- Cisco UCS C-Series Server direct connect license

The following illustration shows a direct connection between the Cisco UCS C-Series Server and the Cisco UCS 6332-16UP Fabric Interconnects:

---

**Cisco UCS C-Series Gen 3 Fabric Extender connection**

The Cisco Nexus 2348UPQ Fabric Extender allows for a greater number of 10 GbE rack mount servers.

The server connects to the FEX instead of connecting directly into the FI of the system. This method allows for 48 host-capable connections per FEX and six uplink ports.

A Cisco UCS FEX-connected server configuration has the following features:

- Cisco UCS C-Series Servers
- Cisco Nexus 2348UPQ 10 GE FEX
- Two, four or six 40-Gbps uplinks to the Cisco FI
- Cisco UCS port licensing
Mixed Cisco UCS B-Series and C-Series servers

Cisco UCS has a unique architecture that integrates compute, data network access, and storage network access into a common set of components under a single-pane-of-glass management interface.

Cisco UCS fuses access layer networking and servers. The hardware and software components support the Cisco unified fabric, which runs multiple types of data center traffic over a single converged network adapter. By eliminating switching inside a chassis, network access-layer fragmentation is significantly reduced. This simplification reduces the number of switches, cables, adapters, and management points by up to two thirds. All devices in a Cisco UCS domain remain under a single management domain, which remains highly available through the use of redundant components.
The following illustration shows a configuration with a FEX connection:
The following illustration shows a configuration with a direct connection:

**Cisco Trusted Platform Module**

The Cisco Trusted Platform Module (TPM) is a computer chip that securely stores artifacts such as measurements, passwords, certificates, or encryption keys that are used to authenticate the Converged System. The Cisco TPM provides authentication and attestation services that enable safer computing in all environments.

Dell EMC supports Cisco TPM hardware but does not support the Cisco TPM functionality. Using Cisco TPM features involves using a software stack from a vendor with significant domain experience in trusted computing. Consult your software stack vendor for configuration and operational considerations relating to the Cisco TPMs.

**Disjoint Layer 2 configuration**

Traffic is split between two or more different networks at the FI in a Disjoint Layer 2 configuration to support two or more discrete Ethernet clouds.

Cisco UCS servers connect to two different clouds. Upstream Disjoint Layer 2 networks allow two or more Ethernet clouds that never connect to be accessed by servers or VMs located in the same Cisco UCS domain.
The following illustration provides an example of Disjoint Layer 2 networking into a Cisco UCS domain:

vPCs 101 and 102 are production uplinks that connect to the network layer of the Converged System. vPCs 105 and 106 are external uplinks that connect to other switches.

Disjoint Layer 2 network connectivity can also be configured with an individual uplink on each FI.

**Bare metal support policy**

Since many applications cannot be virtualized due to technical and commercial reasons, Converged Systems support bare metal deployments, such as non-virtualized operating systems and applications.
While it is possible for Converged Systems to support these workloads (with the following caveats), due to the nature of bare metal deployments, Dell EMC can only provide reasonable effort support for systems that comply with the following requirements:

- Converged Systems contain only Dell EMC published, tested, and validated hardware and software components. The Release Certification Matrix provides a list of the certified versions of components for Converged Systems.

- The operating systems used on bare metal deployments for compute components must comply with the published hardware and software compatibility guides from Cisco and Dell EMC.

- For bare metal configurations that include other hypervisor technologies (Hyper-V, KVM, etc.) those hypervisor technologies are not supported by Dell EMC. Dell EMC support is provided only on VMware Hypervisors.

Dell EMC reasonable effort support includes Dell EMC acceptance of customer calls, a determination of whether a Converged System is operating correctly, and assistance in problem resolution to the extent possible.

Dell EMC is unable to reproduce problems or provide support on the operating systems and applications installed on bare metal deployments. In addition, Dell EMC does not provide updates to or test those operating systems or applications. The OEM support vendor should be contacted directly for issues and patches related to those operating systems and applications.
Network layer

The VxBlock System 1000 network layer consists of switches responsible for management, routing, and storage communication.

Data network routing topology

VxBlock System 1000 supports two routing topology configurations, depending on where Layer 3 traffic is routed. One configuration uses Layer 3 routing protocols and the other uses Layer 2 links. The two configurations are explained in the following list:

- The VxBlock 1000 implements the OSPF, EIGRP, or static routing protocol to provide Layer 3 routing services for east-west traffic within the Cisco Nexus 9300 series ToR switches and north-south flows for traffic leaving the VxBlock 1000.

- The VxBlock 1000 is uplinked to the customer network with Layer 2 links. In this case, routing for all VxBlock System and external VLANs occurs at the customer network. This scenario applies if you need Layer 2 adjacency between endpoints both inside and outside of the VxBlock System. This allows for workload mobility without requiring a network overlay, such as VXLAN, since a subnet can be consumed both inside and outside of the VxBlock System.

This reduces the amount of traffic traversing the uplinks to the external network for VxBlock 1000 inter-VLAN communications and improves overall performance.

Both routing topologies are supported on the management plane as well as the data plane.

The VxBlock System 1000 system is configured with a pair of Cisco Nexus 9300 Series TOR switches. If additional connectivity is required, you can add more Cisco Nexus 9300 Series switch pairs.

Management network layer

The management network layer of the VxBlock System 1000 includes at least one pair of Cisco Nexus 31108TC-V management switches.

If more than one pair of Cisco Nexus 31108TV-C switches is required, a pair of Cisco Nexus 3232C Cisco Nexus or 9336C-FX2 switches is introduced to aggregate management traffic.

The Cisco Nexus management switches provide 1/10 Gb connectivity to the management interfaces of the system's components and the AMP-VX or AMP-3S.

The following table shows management network layer components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco Nexus 31108TC-V Switch</td>
<td>• 1 RU appliance</td>
</tr>
<tr>
<td></td>
<td>• Supports 48 fixed, 100 Mbps/1000 Mbps/10 Gbps twisted pair connectivity ports and 6 fixed, 40/100 Gbps QSFP uplink ports for the management layer</td>
</tr>
<tr>
<td>Component</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cisco Nexus 3232C Switch</td>
<td>• 1 RU appliance</td>
</tr>
<tr>
<td></td>
<td>• Supports 32 fixed, 100 Gbps QSFP28 connectivity ports for aggregating Cisco Nexus 31108TC-V switches</td>
</tr>
<tr>
<td></td>
<td>• Supports 10/25/40/100 Gbps SFP+/QSFP28 connections for external uplinks</td>
</tr>
<tr>
<td>Cisco Nexus 9336C-FX2 Switch</td>
<td>• 1 RU appliance</td>
</tr>
<tr>
<td></td>
<td>• Supports 36 fixed, 100 Gbps QSFP28 connectivity ports for aggregating Cisco Nexus 31108TC-V switches</td>
</tr>
<tr>
<td></td>
<td>• Supports 10/40/100 Gbps SFP+/QSFP28 connections for external uplinks</td>
</tr>
</tbody>
</table>

**Cisco Nexus 31108TC-V Switch**

The base Cisco Nexus 31108TC-V Switches are deployed in pairs. Each switch provides 48 100 Mbps/1 GbE/10 GbE Base-T fixed ports and six QSFP28 ports to provide 40/100 GbE connections.

The following components connect to the Cisco Nexus 31108TC-V switches using Cat6 connections at 1/10 Gb:

- Cisco UCS FI management
- Cisco Nexus 9000 Series ToR switch management
- Cisco MDS SAN switch management
- Storage array management
- IPI Appliance management
- AMP-VX iDRAC
- AMP-VX workload
- AMP-VX VMware vSAN
- AMP-VX Data Protection appliance connections
- AMP-3S CIMC
- AMP-3S OOB management.iSCSI
- AMP-3S Dell EMC Unity 300 management
- AMP-3S Dell EMC Unity 300 iSCSI
- Data Protection appliance connections

The Cisco Nexus 31108TC-V Switches uplink to the external network using one of the following:

- Cat6 at 1/10 Gb
- Multi-mode fibre at 10/40/100 Gb
- Active optical cable (AOC) direct-attach at 100 Gb

At least two uplinks per management switch are required.

**Cisco Nexus 3232C Switch**

The Cisco Nexus 3232C Switch is a management aggregation switch used in the management plane to aggregate pairs of Cisco Nexus 31108TC-V Switches. These switches are required only if the solution requires more than 96 management ports.

The Cisco Nexus 3232C Switch provides:

- 100 Gb QSFP ports to aggregate traffic between multiple pairs of Cisco Nexus 31108TC-V Switches
- 100 Gb QSFP ports for vPC peer link
- 10/40/100 Gb uplinks to the external network using QSFP or QSA adapter

Each Cisco Nexus 31108TC-V Switch has one or two uplinks to each Cisco Nexus 3232C Switch.

**Cisco Nexus 9336C-FX2 Switch**

The Cisco Nexus 9336C-FX2 Switch is a management aggregation switch used in the management plane to aggregate pairs of Cisco Nexus 31108TC-V Switches. These switches are required only if the solution requires more than 96 management ports.

The Cisco Nexus 9336C-FX2 Switch provides:

- 100 Gb QSFP ports for aggregating traffic between multiple pairs of Cisco Nexus 31108TC-V management switches
- 100 Gb QSFP ports for vPC peer link
- 10/40/100 Gb uplinks to the external network using QSFP/MPO hydra

Each Cisco Nexus 31108TC-V Switch has one or two uplinks to each Cisco Nexus 9336C-FX2 Switch.

**VxBlock System 1000 with no management aggregation layer**

The most simple management network deployment for the VxBlock System 1000 consists of a pair of Cisco Nexus 31108TC-V Switches connected directly to the external network.
For a single VxBlock System 1000 with no management aggregation layer, the following illustration shows the base management network topology:

In this scenario, management network SVIs and HSRP addresses can reside on the VxBlock System 1000 management switches (Layer 3) or on the external network (Layer 2).

### Single VxBlock System 1000 with a management aggregation layer

This option for a single VxBlock System 1000 introduces the management network to enable a much larger scale for the management network.
The following illustration shows the management network topology for a single VxBlock System 1000 with the management aggregation layer:

In this scenario, management network Layer 3 SVIs and HSRP addresses can reside on the VxBlock System 1000 management aggregation switches or on the external network. There is one uplink from each Cisco Nexus 31108TC-V Switch to each Cisco Nexus management aggregation switch at 100 Gb.

### Multiple VxBlock Systems 1000 with a management aggregation layer

This option for multiple VxBlock Systems 1000 puts the management network on the management aggregation switches.
The following illustration depicts the management network topology for a multiple VxBlock Systems 1000 with the optional management aggregation layer. This topology has the following configuration:

- All management network Layer 3 SVIs and HSRP addresses reside on the VxBlock System 1000 management aggregation switches.
- Each connected VxBlock System 1000 has a unique VLAN ID and subnet for out-of-band management

When adding a second VxBlock System 1000 to an existing AMP-VX deployment, you may choose to add two Cisco Nexus 9336C-FX2 or Cisco Nexus 3232C management aggregation switches to the second VxBlock System 1000. At the time of deployment, move all existing SVIs and uplinks for VxBlock
System 1000 1 management switches to the Cisco Nexus 9336C-FX2 or Cisco Nexus Cisco Nexus 3232C switch pair.

Software licensing

For deployments where the Cisco Nexus 31108TC-V Switches are the only management switches in the solution, if you choose the Layer 3 uplink configuration, you must purchase a LAN Enterprise Services license to enable the Layer 3 protocols.

If you choose the Layer 2 uplink model, you do not need to purchase a LAN Enterprise Service license.
All Cisco Nexus 31108TC-V Switches must include a Cisco DCNM LAN license.

For solutions including a management aggregation switch pair, refer to the Software Licensing in the Cisco Nexus 9336C-FX2 data plane switch.

**Cisco Nexus 93180YC-FX Switch**

The Cisco Nexus 93180YC-FX Switch is a data plane that provides 48 10/25 Gb/s SFP+/SFP28 ports and six 40/100 Gb/s QSFP/QSFP28 uplink ports.

The Cisco Nexus 93180YC-FX switch is for solutions that include:

- Up to two Cisco UCS domains with standard uplink bandwidth requirements (160 Gb/s per fabric).
- No Isilon nodes requiring 40 Gb/s connectivity.
- No requirement for 40 Gb/s uplinks from the Cisco UCS FIs to the ToR switch.

**Cisco UCS uplinks**

Uplinks from the Cisco UCS 6332-16UP Fabric Interconnects to the Cisco 93180YC-FX Switch use Cisco QSFP to 4x10 Gb/s SFP+ Active Optical breakout cables. Each pair of Cisco UCS FIs consumes 16 SFP + ports on each Cisco Nexus 93180YC-FX Switch.

**Storage array Network-Attached Storage connections**

Connectivity from the Network-Attached Storage (NAS) ports on a VxBlock System 1000 storage array to the Cisco Nexus 93180YC-FX Switch is made through a standard 10 Gb/s optical SFP. NAS devices are cross-connected to both switches.

**AMP-VX connections**

One connection from each AMP-VX node is made to each Cisco Nexus 93180YC-FX Switch with Cisco 10 Gb/s direct-attach cables or 10 Gb/s optics. These connections are used for data-plane traffic, such as connections to the VMware vSphere ESXi Management network from workloads residing on the AMP-VX.

**AMP-3S connections**

One connection from each AMP-3S server is made to each Cisco Nexus 93180YC-FX Switch with Cisco 10 Gb/s direct-attach cables or 10 Gb/s optics. These connections are used for data-plane traffic, such as connections to the VMware vSphere ESXi Management network from workloads residing on the AMP-3S.

**vPC peer link**

Two 100 Gb/s ports are used to form the vPC peer-link between the Cisco Nexus 93180YC-FX Switches.
Customer uplinks

The following table shows the supported connections to the external network:

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Transceiver</th>
<th>Media</th>
<th>Min uplinks per switch pair</th>
<th>Max uplinks per switch pair</th>
<th>Max distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Gb/s</td>
<td>QSFP-100G-SR4-S</td>
<td>OM4 MPO MMF</td>
<td>4</td>
<td>8</td>
<td>100 M</td>
</tr>
<tr>
<td>100 Gb/s</td>
<td>QSFP-100G-AOC</td>
<td>Direct-attach Active Optical</td>
<td>4</td>
<td>8</td>
<td>30 M</td>
</tr>
<tr>
<td>40 Gb/s</td>
<td>QSFP-40G-SRBD</td>
<td>MMF</td>
<td>4</td>
<td>8</td>
<td>100 M for OM3, 150 M for OM4</td>
</tr>
<tr>
<td>40 Gb/s</td>
<td>QSFP-H40G-AOC</td>
<td>Direct-attach Active Optical</td>
<td>4</td>
<td>8</td>
<td>30 M</td>
</tr>
<tr>
<td>10 Gb/s</td>
<td>QSFP-40G-SR4</td>
<td>MPO MMF terminated with LC</td>
<td>16</td>
<td>32</td>
<td>100 M for OM3, 150 M for OM4</td>
</tr>
</tbody>
</table>

Integrated Data Protection connections

Most Dell EMC Integrated Data Protection solutions include a pair of dedicated Cisco Nexus 93180YC-FX Switches, which are linked to the Cisco Nexus 93180YC-FX Switches using 10 Gb/s SFP+ optical connections.

For small deployments, direct connectivity from the Integrated Data Protection components to the switches is made with standard 10 Gb/s optical SFP+ based connections to the Cisco Nexus 93180YC-FX Switch. In-band management connections from the Integrated Data Protection components use 1 Gb/s GLC-T SFP+ to Cat6 connections. In deployments with multiple Cisco Nexus 9300 Series Switch pairs, the Integrated Data Protection components can be connected to any Cisco Nexus 9300 Series Switch pair.

Isilon connections

For small Isilon deployments, the ToR Cisco Nexus 93180YC-FX Switches can be used to connect Isilon nodes at 10 Gb/s using SFP-10G-SR transceivers. Isilon deployments that include 40 Gb/s Isilon nodes require Cisco Nexus 93180LC-EX Switches. For large Isilon deployments, additional Cisco Nexus 9300 Series Switch pairs can be added to provide adequate ports. These additional switch pairs are trunked at Layer 2 to the ToR network switches.

Cisco Nexus 93180LC-EX Switch

The Cisco Nexus 93180LC-EX Switch is a data plane switch that provides 24 40 Gbps QSFP ports and six 40/100 Gbps QSFP/QSFP28 uplink ports.

This switch can be used for the ToR network and for additional switch pairs to support Isilon connectivity.

The Cisco Nexus 93180LC-EX Switch is for solutions that include:

- Up to five Cisco UCS domains with standard uplink bandwidth requirements (160 Gb per fabric)
• Isilon nodes requiring 40 Gb connectivity

• Requirements for 40 Gb uplinks from the Cisco UCS FIs to the ToR switch

Odd numbered ports 1, 3, 5, through 23 can be configured as 4x10 Gbps breakouts to facilitate 10 Gbps connections to SFP+ based devices. When one of these ports is configured as a breakout, the even-numbered port below it is disabled. Ports 25 and 27 are dedicated as 100 Gbps vPC peer links, and ports 26 and 28 are disabled. Uplink ports 29 through 32 can be configured as 40 Gbps, 100 Gbps, or 4x10 Gbps breakouts to facilitate connections to external networks.

**Cisco UCS uplinks**

Uplinks from the Cisco UCS 6332-16UP Fabric Interconnects to the Cisco Nexus 93180YC-FX Switch use Cisco 40 Gbps QSFP Active Optical cables for the first two Cisco UCS domains, and QSFP optical BiDi transceivers for Cisco UCS domains three through five. Each pair of Cisco UCS FIs consumes four QSFP ports on each Cisco Nexus 93180LC-EX Switch for a standard uplink topology or six QSFP ports on each Cisco Nexus 93180LC-EX Switch for enhanced bandwidth uplink topology.

**Storage array NAS connections**

A Cisco QSFP-40G-SR4 transceiver provides connectivity from the 10 Gb NAS ports on a VxBlock System 1000 storage array to the Cisco Nexus 93180LC-EX Switch.

A combination of MPO-to-LC hydra cables, MPO trunks, and MPO-to-LC cassettes are used to provide fiber connectivity to the endpoint.

The NAS device is populated with 10 Gb optical SFP+ modules. A direct-attach QSFP cable provided with the node connects to a 40 Gb Isilon node. NAS devices are cross-connected to both switches.

**AMP-VX/AMP-3S connections**

One connection from each AMP node is made to each ToR Cisco Nexus 93180LC-EX Switch using Cisco QSFP-40G-SR4 transceiver.

A combination of MPO-to-LC hydra cables, MPO trunks, and MPO-to-LC cassettes are used to provide fiber connectivity to the endpoint.

This provides four 10 Gb LC fiber connections from each QSFP module. These connections are used for data-plane traffic, such as connections to the VMware vSphere ESXi Management network from workloads residing on the AMP.

**vPC peer link**

Two 100 Gb copper direct-attach connections form the vPC peer link between the Cisco Nexus 93180LC-EX Switches.
External uplinks

The following connections to the external network are supported:

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Transceiver</th>
<th>Media</th>
<th>Min uplinks per switch pair</th>
<th>Max uplinks per switch pair</th>
<th>Max distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Gb</td>
<td>QSFP-100G-SR4-S</td>
<td>OM4 MPO MMF</td>
<td>4</td>
<td>8</td>
<td>100 M</td>
</tr>
<tr>
<td>100 Gb</td>
<td>QSFP-40/100G-SRBD</td>
<td>LMMF</td>
<td>4</td>
<td>8</td>
<td>100 M</td>
</tr>
<tr>
<td>40 Gb</td>
<td>QSFP-40G-SR4</td>
<td>MMF</td>
<td>4</td>
<td>8</td>
<td>100 M for OM3, 150 M for OM4</td>
</tr>
<tr>
<td>40 Gb</td>
<td>QSFP-40G-SR4</td>
<td>MPO MMF</td>
<td>4</td>
<td>8</td>
<td>100 M</td>
</tr>
<tr>
<td>10 Gb</td>
<td>QSFP-40G-SR4</td>
<td>MPO MMF terminated with LC</td>
<td>4 QSFP</td>
<td>8 QSFP</td>
<td>100 M for OM3, 150 M for OM4</td>
</tr>
</tbody>
</table>

Integrated Data Protection connections

Most Dell EMC Integrated Data Protection solutions include a pair of dedicated Cisco Nexus 93180YC-EX Switches, which are uplinked to the Cisco Nexus 93180LC-EX Switches using 40 Gb QSFP direct-attach cables.

For small deployments, direct connectivity from the data protection components to the switches is made with Cisco QSFP-40G-SR4 transceiver using the same connection method as the NAS connections. This provides four 10 Gb LC fiber connections from each QSFP module. In-band management connections from the Integrated Data Protection components use 1 Gb GLC-T SFP+ to Cat6 connections.

Isilon connections

For small Isilon deployments, the ToR Cisco Nexus 93180LC-EX Switches can connect Isilon nodes at 40 Gb using the QSFP-40G-SR4 transceiver and MPO cabling, or at 10 Gb using the connection method described for NAS connections. Larger Isilon deployments require additional Cisco Nexus 93180LC-EX Switch pairs.

Cisco Nexus 9336C-FX2 Data Plane Switch (Gen 3)

The Cisco Nexus 9336C-FX2 Switch provides 36 40/100-Gbps QSFP28 ports and can be used for the ToR network and for more switch pairs to support Isilon connectivity.

Cisco UCS uplinks

Uplinks from the Cisco UCS 6332-16UP Fabric Interconnects to the Cisco Nexus 9336C-FX2 Switch use Cisco 40-Gbps QSFP Active Optical cables for the first two UCS domains, and QSFP optical BiDi transceivers for Cisco UCS domains three through seven. Each pair of Cisco UCS FIs consumes four QSFP ports on each Cisco Nexus 9336C-FX2 Switch for a standard uplink topology or six QSFP ports on each Cisco Nexus 9336C-FX2 Switch for enhanced bandwidth uplink topology.
**Storage array NAS connections**

A Cisco QSFP-40G-SR4 transceiver provides connectivity from the 10-Gb NAS ports on a VxBlock System 1000 storage array to the Cisco Nexus 9336C-FX2 Switch.

A combination of MPO-to-LC hydra cables, MPO trunks, and MPO-to-LC cassettes are used to provide fiber connectivity to the endpoint.

The NAS device is populated with 10-Gb optical SFP+ modules. A direct-attach QSFP cable provided with the node connects to a 40-Gb Isilon node. NAS devices are cross-connected to both switches.

**AMP-VX connections**

One connection from each AMP-VX node is made to each ToR Cisco Nexus 9336C-FX2 Switch using Cisco QSFP-40G-SR4 transceiver.

A combination of MPO-to-LC hydra cables, MPO trunks, and MPO-to-LC cassettes are used to provide fiber connectivity to the endpoint.

This provides four 10-Gb LC fiber connections from each QSFP module. These connections are used for data plane traffic, such as connections to the VMware vSphere ESXi Management network from workloads residing on the AMP-VX.

**AMP-3S connections**

One connection from each AMP-3S node is made to each ToR Cisco Nexus 9336C-FX2 Switch using Cisco QSFP-40G-SR4 transceiver. A combination of MPO-to-LC hydra cables, MPO trunks, and MPO-to-LC cassettes are used to provide fiber connectivity to the endpoint. This provides four 10-Gb LC fiber connections from each QSFP module. These connections are used for data plane traffic and in-band management for AMP-3S and VxBlock 1000, such as connections to the VMware vSphere ESXi Management network from workloads residing on AMP-3S.

**vPC peer-link**

Two 100-Gb copper direct-attach connections form the vPC peer link between the Cisco Nexus 93180LC-EX Switches.

**External uplinks**

The following connections to the external network are supported:

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Transceiver</th>
<th>Media</th>
<th>Min uplinks per switch pair</th>
<th>Max uplinks per switch pair</th>
<th>Max distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Gb</td>
<td>QSFP-100G-SR4-S</td>
<td>OM4 MPO MMF</td>
<td>4</td>
<td>16</td>
<td>100 M</td>
</tr>
<tr>
<td>100 Gb</td>
<td>QSFP-400/100G-SRBD</td>
<td>LMMF</td>
<td>4</td>
<td>16</td>
<td>100 M</td>
</tr>
<tr>
<td>40 Gb</td>
<td>QSFP-40G-SRBD</td>
<td>MMF</td>
<td>4</td>
<td>16</td>
<td>100 M for OM3, 150 M for OM4</td>
</tr>
<tr>
<td>40 Gb</td>
<td>QSFP-40G-SR4</td>
<td>MPO MMF</td>
<td>4</td>
<td>16</td>
<td>100 M</td>
</tr>
</tbody>
</table>
### Integrated Data Protection connections

Most Integrated Data Protection solutions include a pair of dedicated Cisco Nexus 93180YC-EX Switches that are uplinked to the Cisco Nexus 9336C-FX2 Switches using 40-Gb QSFP direct-attach cables.

For small deployments, direct connectivity from the Integrated Data Protection components to the switches is made with Cisco QSFP-40G-SR4 transceiver using the same connection method as the NAS connections. This provides four 10-Gb LC fiber connections from each QSFP module. In-band management connections from the Integrated Data Protection components use 1-Gb GLC-T SFP+ to Cat6 connections.

### Isilon connections

For small Isilon deployments, the ToR Cisco Nexus 9336C-FX2 Switches can connect Isilon nodes at 40 Gb using the QSFP-40G-SR4 transceiver and MPO cabling, or at 10 Gb using the connection method described for NAS connections. Larger Isilon deployments require more Cisco Nexus 9336C-FX2 Switch pairs.

### Software licensing

The Cisco Nexus 9336C-FX2 switch introduces a new tiered licensing model. If you choose the Layer 3 uplink model for the VxBlock 1000, you must purchase a license bundle that includes these services for the ToR switch pair. The license packages offered with the VxBlock 1000 are NX-OS Essentials and NX-OS Advanced. Both of these license packages include all L3 protocols, and Cisco DCNM LAN, used by the VxBlock 1000.

If you choose the Layer 2 uplink model, you do not need to purchase a license bundle, but you must purchase a Cisco DCNM LAN license for each switch in the solution.

Subordinate switches connected to the ToR Cisco Nexus 9336C-FX2 switch pair do not require a tiered license package, but do require a Cisco DCNM LAN license.

### Cisco Data Center Network Manager

Cisco Data Center Network Manager (DCNM) provides a central point of management for Cisco Nexus 9000 Series and Cisco MDS 9000 Series Switches used in the VxBlock System 1000.

Cisco DCNM is deployed as a virtual appliance onto AMP-VX or AMP-3S. A single Cisco DCNM instance manages all connected VxBlock 1000.

Cisco DCNM is divided into two sections:

- **LAN** for managing Cisco Nexus 9000 Series Switches. This is a mandatory component.
- **SAN** for managing Cisco MDS Switches. This is also a mandatory component; however, the Cisco DCNM license for the Cisco MDS Switches is optional.
Cisco DCNM provides a graphical user interface for viewing and managing switches, as well as a RESTful API to enable automation.

**Vscale Architecture and ACI readiness**

The VxBlock System 1000 is designed with Dell EMC Vscale Architecture and Cisco ACI compatibility in mind.

Each Cisco Nexus 9300 series ToR switch included in a VxBlock 1000 is Vscale Architecture and ACI compatible. Spine-and-leaf data centers can repurpose the existing VxBlock 1000 data network uplinks for spine-to-leaf connectivity with minimal recabling or reconfiguration.

The Dell EMC Vscale Architecture Overview contains additional information.

**VMware NSX factory integration**

VMware NSX is an option for VxBlock System 1000.

VMware NSX provides a VXLAN network overlay and allows you to implement the full range of SDN features provided by the VMware NSX solution.

**Storage network layer**

Two Cisco MDS switches/directors make up two separate fabrics to provide 16 Gb of FC connectivity between the compute and storage layer.

The Cisco MDS model selection depends on the total number of SAN ports required to support the compute and storage components.

Connections from the storage components are over 16 Gb connections. The number of storage connections varies depending on the storage platform and size.

Connections from the Cisco UCS FIs provide a FC port channel of eight 16 Gb connections (128 Gb bandwidth per fabric), 12 connections (192 Gb), or 16 connections (256 Gb).

**NOTE:** The Cisco MDS 9148S Multilayer Fabric Switch supports eight connections from the Cisco UCS domain and up to two domains.

The Cisco MDS switches provide:

- FC connectivity between compute and storage layer components
- Connectivity for backup and business continuity requirements (if configured)

**NOTE:** Inter-Switch Links (ISLs) to the external SAN or between switches are not permitted.
The following table shows SAN network layer components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
</table>
| Cisco MDS 9148S Multilayer Fabric | • 1 RU appliance.  
• Provides 24 to 48 line-rate ports for non-blocking 16 Gbps throughput.  
• 12 ports per switch are included in the base license.  
• One Ports On Demand (POD) license per switch for 12 additional ports is required.  
• Additional POD licenses can be added to increase the licensed port count to 36 or 48 per switch.                                                                                                                                                                      |
| Fabric Switch                     |                                                                                                                                                                                                                                                                                                                                                          |
| Cisco MDS 9396S Multilayer Fabric | • 2 RU appliance.  
• Provides 48 to 96 line-rate ports for non-blocking 16 Gbps throughput.  
• 48 ports per switch are included in the base license.  
• Additional ports can be licensed in increments of 12 ports.                                                                                                                                                                                                                      |
| Fabric Switch                     |                                                                                                                                                                                                                                                                                                                                                          |
| Cisco MDS 9706 Multilayer Director| • 9 RU appliance.  
• Provides up to 12 Tbps front panel FC line rate non-blocking, system level switching.  
• Dell EMC leverages the advanced 48 port line cards at line rate of 16 Gbps for all ports.  
• Consists of two 48 port line cards per director. Two additional 48 port line cards can be added.  
• Dell EMC requires that four fabric modules are included with all Cisco MDS 9706 Multilayer Directors for an N+1 configuration.  
• Also includes four PDUs and two supervisors.                                                                                                                                                                                                                               |
| Director                          |                                                                                                                                                                                                                                                                                                                                                          |
| Cisco MDS 9710 Multilayer Director| • 14 RU appliance.  
• Provides up to 24 Tbps front panel FC line rate non-blocking, system level switching.  
• Dell EMC leverages the advanced 48 port line cards at line rate of 16 Gbps for all ports.  
• Consists of two 48 port line cards per director. Additional 48 port line cards can be added in pairs (up to 6).  
• Dell EMC requires that four fabric modules are included with all Cisco MDS 9710 Multilayer Directors for an N+1 configuration.  
• Dell EMC requires that two additional power supplies are included with all Cisco MDS 9710 Multilayer Directors for a total of eight.                                                                                                                                 |

**Cisco MDS 9148S Multilayer Fabric Switch**

The Cisco MDS 9148S Multilayer Fabric Switch provides 12 to 48 line-rate ports for non-blocking, 16 Gbps throughput.

In the base configuration, 24 ports are licensed (with one POD per switch). Additional ports can be licensed as needed in 12-port increments.
The following table provides core connectivity for the Cisco MDS 9148S Multilayer Fabric Switch per fabric:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Used ports</th>
<th>Port speeds</th>
<th>Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI uplinks</td>
<td>8 per domain</td>
<td>16 Gbps</td>
<td>SFP+ and optical cable</td>
</tr>
<tr>
<td>Storage arrays</td>
<td>2 to 40</td>
<td>16 Gbps</td>
<td>SFP+ and optical cable</td>
</tr>
</tbody>
</table>

**Note:** Due to TCAM limitations, the Cisco MDS 9148S Switch supports up to 192 servers.

### Cisco MDS 9396S 16G Multilayer Fabric Switch

The Cisco MDS 9396S 16G Multilayer Fabric Switches provide 48 to 96 line-rate ports for non-blocking, 16 Gb/s throughput.

The base license includes 48 ports. Additional ports can be licensed in 12-port increments. The Cisco MDS 9396S 16 Gbps Multilayer Fabric Switch is a 96-port fixed switch with no IOM expansion slots.

The following table provides core connectivity for the Cisco MDS 9396S 16 Gbps Multilayer Fabric Switch per fabric:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Used ports</th>
<th>Port speeds</th>
<th>Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI uplinks</td>
<td>8, 12, or 16 per domain</td>
<td>16 Gbps</td>
<td>SFP+ and optical cable</td>
</tr>
<tr>
<td>Storage arrays</td>
<td>2 to 88</td>
<td>16 Gbps</td>
<td>SFP+ and optical cable</td>
</tr>
</tbody>
</table>

### Cisco MDS 9706 and 9710 Multilayer Directors

Cisco MDS 9706 and 9710 Multilayer Directors are modular directors that provide greater scalability than the fixed SAN switches.

Both models deploy two supervisor modules for redundancy and three fabric modules for intra-director communication. The VxBlock System 1000 requires one additional fabric module for each Cisco MDS 9706 and 9710 Multilayer Director for N+1 redundancy while providing full line rate support for all 16 Gb FC ports in the directors.

The Cisco MDS 9706 and 9710 Multilayer Directors are director-class SAN switches with IOM expansion slots for 48-port 16 Gb FC line cards. The 9706 has four slots available for line cards and the 9710 has eight. Line cards are added to each director in pairs.

Port licenses are not required for the Cisco MDS 9706 and 9710 Multilayer Directors.
The following table provides core connectivity for the Cisco MDS 9706 and 9710 Multilayer Directors per fabric:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Used ports</th>
<th>Port speeds</th>
<th>Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI uplinks</td>
<td>8, 12, or 16 per domain</td>
<td>16 Gbps</td>
<td>SFP+ and optical cable</td>
</tr>
<tr>
<td>Storage arrays</td>
<td>Cisco MDS 9706: 2 to 184</td>
<td>16 Gbps</td>
<td>SFP+ and optical cable</td>
</tr>
<tr>
<td></td>
<td>Cisco MDS 9710: 2 to 376</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Storage layer

The VxBlock System 1000 offers several storage arrays, which are detailed in this section.

VMAX All-Flash storage overview

VMAX All-Flash arrays deliver the highest possible flash density by supporting the highest capacity flash drives.

The VMAX All-Flash arrays are flexible to expand performance and capacity to address real-world workloads. With a base capacity of 13 TBu (usable) capacity the VMAX All-Flash array can provide up to 4.42 PBe (effective) through inline compression. The VMAX All-Flash array can provide up to 6.7 million IOPS of performance.

Array components and specifications

The base component of VMAX All-Flash array is the V-Brick.

VMAX All-Flash components

The V-Brick is comprised of the following components:

- Director: Each V-Brick has two redundant directors for storage processing. Each director contains Broadwell-based CPUs, DDR4 memory, and 6 Gb or 12 Gb SAS back-end connectivity to the SSD drives. There are four slots on each director that are dedicated to front-end connectivity. Those slots can contain FC or Ethernet IO modules. The VMAX 950F and 950FX models have a compression IO module located in one of those four slots. Dell EMC requires two 16 Gb FC IO modules for each director. Remaining slots can be used for additional functionality, such as eNAS, SRDF, or ProtectPoint.

- DAE: The VMAX 950F/FX DAES are 6 Gb SAS and can contain 120 2.5 inch SSD drives. The VMAX 250F/FX DAES are 12 Gb SAS and can contain 25 2.5 inch SSD drives. Both DAE models support two independent IO channels with automatic failover and fault isolation. There are two DAEs per V-Brick.

Models

The following table shows capacity and performance of the VMAX All-Flash models:

<table>
<thead>
<tr>
<th>Capacity/performance</th>
<th>VMAX 250F/FX</th>
<th>VMAX 950F/FX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum IOPS</td>
<td>1 million</td>
<td>6.7 million</td>
</tr>
<tr>
<td>Initial capacity</td>
<td>11.3 TBU</td>
<td>56.6 TBU</td>
</tr>
<tr>
<td>Incremental capacity</td>
<td>11.3 TBU</td>
<td>13.2 TBU</td>
</tr>
<tr>
<td>Maximum capacity per array</td>
<td>1.16 PBe</td>
<td>4.42 PBe</td>
</tr>
</tbody>
</table>

The following table shows a component comparison of the VMAX All-Flash models:

<table>
<thead>
<tr>
<th>Component</th>
<th>VMAX 250F/FX</th>
<th>VMAX 950F/FX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of V-Bricks</td>
<td>1 to 2</td>
<td>1 to 8</td>
</tr>
</tbody>
</table>
### VMAX All-Flash Storage

**CPU**
- **VMAX 250F/FX:** Intel Xeon E5-2650-v4 2.2 GHz 12 core
- **VMAX 950F/FX:** Intel Xeon E5-2697-v4 2.3 GHz 18 core

**Number of cores per CPU/Engine/System**
- **VMAX 250F/FX:** 12 / 48 / 96
- **VMAX 950F/FX:** 18 / 72 / 576

**Cache: Per engine options**
- **VMAX 250F/FX:** 512 Gb /1024 Gb/2048 Gb
- **VMAX 950F/FX:** 1024 Gb/2048 Gb

**Cache: System minimum**
- **VMAX 250F/FX:** 512 Gb
- **VMAX 950F/FX:** 1024 Gb

**Cache: System maximum**
- **VMAX 250F/FX:** 4 TB (with 2048 Gb per engine)
- **VMAX 950F/FX:** 16 TB (with 2048 Gb per engine)

**Maximum front-end I/O modules per engine**
- **VMAX 250F/FX:** 8
- **VMAX 950F/FX:** 6

**DAE**
- **VMAX 250F/FX:** 12 Gb SAS, 25 drives
- **VMAX 950F/FX:** 6 Gb SAS, 120 drives

**Maximum drives per V-Brick**
- **VMAX 250F/FX:** 50
- **VMAX 950F/FX:** 240

**Maximum drives per array**
- **VMAX 250F/FX:** 100
- **VMAX 950F/FX:** 1920

**Maximum software data movers**
- **VMAX 250F/FX:** 4 (3 active plus 1 standby)
- **VMAX 950F/FX:** 8 (7 active plus 1 standby)

**Maximum number eNAS I/O modules per software data mover**
- **VMAX 250F/FX:** 2
- **VMAX 950F/FX:** 1 (Dell EMC limitation due to slot count)

### Storage features

VMAX All-Flash storage offers a number of features, including Integrated Data Protection, encryption, file storage, and replication.

### General features

VMAX All-Flash storage arrays have the following features in common:

- Two 16 Gb multimode (MM), FC, four-port IO modules per director (four per engine). The VMAX All-Flash 250F and 250FX have two additional slots per director for front-end connectivity. The VMAX All-Flash 950F and 950FX arrays have one additional slot for front-end connectivity.

- Only 2.5 inch SSD drives are supported for VMAX All-Flash models.

- The number of supported Cisco UCS domains and servers depends on the number of array engines.

- All V-Bricks must contain identical cache types. This standard provides consistent performance throughout the array.

- A single cabinet configuration is available for both models of VMAX All-Flash arrays.

- VMAX All-Flash 950F and 950FX arrays support system bay dispersion of up to 25 meters between system bay 1 and any other system bay.

### Integrated Data Protection

The following Integrated Data Protection features are supported for VMAX All-Flash arrays:

- VPLEX
• RecoverPoint and RecoverPoint for VM
• Avamar, Data Domain, ProtectPoint

Encryption

Data At Rest Encryption (D@RE) provides hardware-based, on-array, back-end encryption for VMAX All-Flash arrays by using SAS IO modules that incorporate AES-XTS inline data encryption. These modules encrypt and decrypt data as it is being written to or read from disk. D@RE supports either an internal embedded key manager or an external, enterprise-grade key manager accessible through Key Management Interoperability Protocol (KMIP). The following external key managers are supported:

• SafeNet KeySecure by Gemalto
• IBM Security Key Lifecycle Manager

File storage

Embedded Network Attached Storage (eNAS) is fully integrated into the VMAX All-Flash array. eNAS provides flexible and secure multi-protocol file sharing (NFS 2.0, 3.0, 4.0/4.1), CIFS/SMB 3.0), and multiple file server identities (CIFS and NFS servers). eNAS uses the Hypermax OS hypervisor to create virtual instances of NAS data movers and control stations on VMAX All-Flash controllers. Control stations and data movers are distributed within the VMAX All-Flash array based on the number of engines and their associated mirrored pair.

By default, VMAX All-Flash arrays are configured with:

• Two control station VMs
• Data mover VMs. The number of data movers varies by array size:
  – The VMAX 250F array can have two (default) or four (maximum configuration that requires two V-Bricks)
  – VMAX 950F array can have two (default), four, six, or eight
• All configurations include one standby data mover.

By default, a single two-port, 10 GbE optical IO module is configured per data mover. A second IO module can be configured for the VMAX All-Flash 250F array. All eNAS IO modules must reside in the same slot on each director on which a data mover resides.

Replication

Native local replication on the VMAX All-Flash array is provided by TimeFinder. This software delivers point-in-time copies of volumes that can be used for backup, decision support, data warehouse refreshes, or any other process that requires parallel access to production data. TimeFinder SnapVX provides snapshot and clone technologies. The following features are available with TimeFinder SnapVX:

• Targetless snapshots – snapshot an entire Storage Group with one command
• Secure snaps – prevents the intentional or unintentional deletion of snapshots
• Cascading snapshots – provides flexibility to present multiple versions of a snapshot
Native remote replication on the VMAX All-Flash array is provided by Symmetrix Remote Data Facility (SRDF). This family of products offers a range of array based disaster recovery, parallel processing, and data migration solutions for VMAX All-Flash arrays. SRDF replicates data between two to four arrays located in the same room, on the same campus, or thousands of kilometers apart. SRDF can utilize Ethernet or FC connections for replication.

SRDF operates in the following modes:

- **Synchronous mode (SRDF/S)** maintains a real-time copy at arrays located within 200 kilometers. Writes from the production host are acknowledged from the local array when they are written to cache at the remote array.

- **Asynchronous mode (SRDF/A)** maintains a dependent-write consistent copy at arrays located at unlimited distances. Writes from the production host are acknowledged immediately by the local array, thus replication has no impact on host performance. Data at the remote array is typically only seconds behind the primary site.

- **SRDF/Metro** makes target devices Read/Write accessible to a host (or multiple hosts in clusters). Hosts write to both the R1 and R2 sides of SRDF device pairs, and SRDF/Metro ensures that each copy remains current and consistent.

- **Adaptive copy mode (SRDF/DM)** moves large amounts of data quickly with minimal host impact.

SRDF can be tightly integrated with TimeFinder to provide robust solutions to a variety of data replication and disaster recovery needs.

SRDF can be paired with VMware Site Recovery Manager to provide automated storage-based disaster restart operation for VMware environments.

### Software licensing

Each VMAX All-Flash model can be purchased with two primary software packages (F and FX). Each package includes software licenses to meet the variety of customer needs. Extra software licenses can be purchased separately.

The following table identifies licenses that are included in each software package:

<table>
<thead>
<tr>
<th>Software/feature</th>
<th>F-suite</th>
<th>FX-suite</th>
</tr>
</thead>
<tbody>
<tr>
<td>AppSync Starter Pack</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Compression</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CloudArray Enabler</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>D@RE</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Embedded Management</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>eNAS</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-Disruptive Migration</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PowerPath</td>
<td>No</td>
<td>75 Licenses</td>
</tr>
<tr>
<td>ProtectPoint</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>RecoverPoint</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>SnapVX</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Software/feature

<table>
<thead>
<tr>
<th></th>
<th>F-suite</th>
<th>FX-suite</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRDF</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>SRDF/Metro</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Storage Analytics</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Unisphere 360</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>ViPR Suite</td>
<td>Optional</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### VMAX storage scale

The number of VxBlock System 1000 hosts supported by the VMAX AF array depends on the number of V-Bricks in the array and the number of 16 Gb FC ports available in each. All host IO ports (16 Gb FC) are placed in port groups of four ports. Ports are spread across directors, SAN fabrics, and IO modules for redundancy. Each port group can support a maximum of 64 hosts per Dell EMC standard.

The following table indicates the number of hosts supported by a VMAX AF array:

<table>
<thead>
<tr>
<th>Array model</th>
<th>V-Bricks</th>
<th>Minimum port groups</th>
<th>Hosts supported</th>
<th>Maximum port groups</th>
<th>Hosts supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>250F/FX</td>
<td>1</td>
<td>4</td>
<td>256</td>
<td>8</td>
<td>512</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>512</td>
<td>16</td>
<td>1024</td>
</tr>
<tr>
<td>950F/FX</td>
<td>1</td>
<td>4</td>
<td>256</td>
<td>6</td>
<td>384</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>512</td>
<td>12</td>
<td>768</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>12</td>
<td>768</td>
<td>18</td>
<td>*1152</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>16</td>
<td>*1024</td>
<td>24</td>
<td>*1536</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>20</td>
<td>*1280</td>
<td>30</td>
<td>*1920</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>24</td>
<td>*1536</td>
<td>36</td>
<td>*2304</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>28</td>
<td>*1792</td>
<td>42</td>
<td>*2688</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>32</td>
<td>*2048</td>
<td>48</td>
<td>*3072</td>
</tr>
</tbody>
</table>

*Maximum number of hosts supported in a VxBlock 1000 is 800.

**NOTE:** A system with the maximum port group count sacrifices functionality of optional features, such as eNAS, SRDF, and ProtectPoint. A four (or more) V-Brick VMAX 950F or 950FX supports the maximum number of VxBlock 1000 hosts and still provides optional features.
PowerMax storage overview

PowerMax storage arrays introduce a new family of Dell EMC Non-Volatile Memory Express (NVMe) storage. This new family of storage advances the leadership of Dell EMC All-Flash arrays. PowerMax storage arrays deliver:

- The next generation of low latency measured in microseconds, not milliseconds
- Unparalleled performance and scalability with mission-critical multi-controller storage arrays

With a base capacity of 13 TBu (usable), the PowerMax array can provide up to 4.42 PBe (effective) through inline compression and deduplication. The PowerMax array can provide up to 6.7 million IOPS of performance.

Array components and specifications

The base component of PowerMax array is the PowerMax brick.

Components

The base PowerMax brick is comprised of the following components:

- **Director**
  
  Each PowerMax brick has two redundant directors for storage processing. Each director contains Broadwell-based CPUs, DDR4 memory, and Gen3 PCIe backend connectivity to the NVMe SSD (dual port) drives.
  
  - Four slots on each director are dedicated to front-end connectivity. Those slots can contain FC or Ethernet IO Modules. One compression/dedupe I/O module is in slot 7.
  
  - Two NVMe flash SLICs exist on slots 0 and 6 in PowerMax 2000 models.
  
  - Four NVMe flash SLICs exist on slots 0, 1, 6, and 7 in single-engine PowerMax 8000 models. A compression and dedupe IO module is located in slot 9, leaving you with three slots for front-end connectivity for the life of the array, including any PowerMax bricks added to the array.
  
  - Three NVMe flash SLICs exist on slots 0, 1, and 6 in multiple-engine PowerMax 8000 models. Dell EMC requires two 16 Gb FC IO modules for each director. Remaining slots may be used for additional functionality, such as eNAS, SRDF, or ProtectPoint.

- **DAE**

  The DAEs can contain 24 2.5-inch PCIe NVMe connected SSD drives. 16 x 4-lane min-SAS HD PCIe connectors are on each DAE. There are two DAEs per PowerMax brick. PowerMax 8000 models share a second DAE (three DAEs for two PowerMax bricks).

Models

The following tables show capacity and performance of the PowerMax models:

<table>
<thead>
<tr>
<th>Capacity/Performance</th>
<th>2000</th>
<th>8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum IOPS</td>
<td>1 million</td>
<td>6.7 million</td>
</tr>
</tbody>
</table>
### Capacity/Performance

<table>
<thead>
<tr>
<th>Component</th>
<th>2000</th>
<th>8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial capacity</td>
<td>13.2 Tbu*</td>
<td>54 TBu</td>
</tr>
<tr>
<td>Incremental capacity</td>
<td>13.2 Tbu*</td>
<td>13.2 Tbu</td>
</tr>
<tr>
<td>Maximum capacity per array</td>
<td>1 PBe</td>
<td>4 PBe</td>
</tr>
</tbody>
</table>

* 13.2Tbu base capacity and flash capacity increments are possible with RAID5(3+1) on PowerMax 2000.

The following table compares components of the PowerMax models:

<table>
<thead>
<tr>
<th>Component</th>
<th>PowerMax 2000</th>
<th>PowerMax 8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of PowerMax bricks</td>
<td>1 to 2</td>
<td>1 to 8</td>
</tr>
<tr>
<td>CPU</td>
<td>Intel Xeon E5-2650-v4 2.5 GHz 12 core</td>
<td>Intel Xeon E5-2697-v4 2.8 GHz 18 core</td>
</tr>
<tr>
<td>Number of cores per CPU/engine/system</td>
<td>12 / 48 / 96</td>
<td>18 / 72 / 576</td>
</tr>
<tr>
<td>Cache: per engine options</td>
<td>512 Gb / 1024 Gb / 2048 Gb</td>
<td>1024 Gb / 2048 Gb</td>
</tr>
<tr>
<td>Cache: system minimum</td>
<td>512 Gb</td>
<td>1024 Gb</td>
</tr>
<tr>
<td>Cache: system maximum</td>
<td>4 TB (with 2048 Gb per engine)</td>
<td>16 TB (with 2048 Gb per engine)</td>
</tr>
<tr>
<td>Maximum front-end I/O modules per engine</td>
<td>8</td>
<td>8*</td>
</tr>
<tr>
<td>Disk Array Enclosure</td>
<td>Gen 3 PCIe, NVMe SSD 24 drives</td>
<td>Gen 3 PCIe, NVMe SSD 24 drives</td>
</tr>
<tr>
<td>NVMe Drives Supported (2.5”)</td>
<td>1.92 TB, 3.84 TB, 7.68 TB</td>
<td>1.92 TB, 3.84 TB, 7.68 TB</td>
</tr>
<tr>
<td>Maximum drives per PowerMax brick</td>
<td>48**</td>
<td>36**</td>
</tr>
<tr>
<td>Maximum drives per array</td>
<td>96</td>
<td>288</td>
</tr>
<tr>
<td>Maximum software data movers</td>
<td>4 (3 active +plus 1 standby)***</td>
<td>4 (3 active plus 1 standby)****</td>
</tr>
<tr>
<td>Maximum number eNAS I/O Modules per software Data Mover</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*A single-engine PowerMax 8000 has six I/O modules for the life of the array. Slot 9 is not used.

**On PowerMax 8000:

- Each PowerMax brick starts with two 24 slot 2.5 inch DAEs.
- Each additional even-numbered PowerMax brick adds a third DAE.
- The middle DAE is shared between PowerMax brick pairs.

(The first PowerMax brick has 38 drives including spares, and the second has 34 drives.)

PowerMax 8000 has 32 usable drives with RAID 5 (7+1) (Default) or RAID 6 (6+2) plus spares.

PowerMax 2000 has 40 usable drives with RAID 5 (7+1) (Default) or RAID 6 (6+2) plus spares (2 DAES), 44 usable drives with RAID 5 (3+1) plus spares (2 DAES).

***Four data movers require minimum 2 PowerMax bricks.
Four data movers require a minimum of 2 PowerMax bricks. Six or eight data movers are available by RPQ.

**Storage features**

PowerMax storage offers a number of features, including Integrated Data Protection, encryption, file storage, and replication.

**General features**

PowerMax storage arrays have the following general features in common:

- Four 16 Gb multimode (MM), FC, four-port IO modules per director (four per engine). The PowerMax 8000 has one less slot per director for front-end connectivity in single-engine configurations.
- Only 2.5-inch NVMe SSD drives are supported for PowerMax models.
- The number of supported Cisco UCS domains and servers depends on the number of array PowerMax bricks.
- Intelligent inline compression/deduplication is available.
- A single cabinet configuration is available for both models of PowerMax. For PowerMax 8000, up to four PowerMax bricks are supported in a single cabinet.

**Data Protection**

The following Integrated Data Protection features are supported for PowerMax:

- VPLEX
- RecoverPoint and RecoverPoint for VM
- Avamar / Data Domain / ProtectPoint

**Encryption**

Data At Rest Encryption (D@RE) provides hardware-based, on-array, back-end encryption for PowerMax arrays by using SAS IO modules that incorporate AES-XTS inline data encryption. These modules encrypt and decrypt data as it is being written to or read from disk. D@RE supports either an internal embedded key manager, or an external, enterprise-grade key manager accessible through Key Management Interoperability Protocol (KMIP). The following external key managers are supported:

- SafeNet KeySecure by Gemalto
- IBM Security Key Lifecycle Manager

**File storage**

Embedded Network Attached Storage (eNAS) is fully integrated into the PowerMax array. eNAS provides flexible and secure multi-protocol file sharing (NFS 2.0, 3.0, 4.0/4.1), CIFS/SMB 3.0), and multiple file server identities (CIFS and NFS servers). eNAS uses the PowerMax OS hypervisor to create virtual instances of NAS Data Movers and Control Stations on PowerMax controllers. Control Stations and Data
Movers are distributed within the PowerMax based upon the number of engines and their associated mirrored pair.

By default, PowerMax arrays are configured with:

- Two Control Station virtual machines
- Data Mover virtual machines. The number of Data Movers varies by array size:
  - PowerMAX 2000 can have two (default) or four (maximum configuration that requires two PowerMax bricks)
  - PowerMAX 8000 can have two (default) or four (six or eight are available by RPQ.)
- All configurations include one standby data mover

By default, a single two-port, 10 GbE optical IO module is configured per data mover. A second IO module can be configured for the PowerMax array. All eNAS IO modules must reside in the same slot on each director on which a data mover resides.

**Replication**

Native local replication on PowerMax is provided by TimeFinder. This software delivers point-in-time copies of volumes that can be used for backup, decision support, data warehouse refreshes, or any other process that requires parallel access to production data. TimeFinder SnapVX provides snapshot and clone technologies. Following are some of the features available with TimeFinder SnapVX:

- Targetless snapshots – snapshot an entire Storage Group with one command
- Secure snaps – prevents the intentional or unintentional deletion of snapshots
- Cascading snapshots – provides flexibility to present multiple versions of a snapshot

Native remote replication on PowerMax is provided by Symmetrix Remote Data Facility (SRDF). This family of products offers a range of array based disaster recovery, parallel processing and data migration solutions for PowerMax. SRDF replicates data between 2, 3, or 4 arrays located in the same room, on the same campus, or thousands of kilometers apart. SRDF can utilize Ethernet or Fibre Channel connections for replication.

SRDF operates in the following modes:

- Synchronous mode (SRDF/S)
  
  This mode maintains a real-time copy at arrays located within 200 kilometers. Writes from the production host are acknowledged from the local array when they are written to cache at the remote array.

- Asynchronous mode (SRDF/A)
  
  This mode maintains a dependent-write consistent copy at arrays located at unlimited distances. Writes from the production host are acknowledged immediately by the local array, thus replication has no impact on host performance. Data at the remote array is typically only seconds behind the primary site.
• SRDF/Metro

This mode makes target devices Read/Write accessible to a host (or multiple hosts in clusters). Hosts write to both the R1 and R2 sides of SRDF device pairs, and SRDF/Metro ensures that each copy remains current and consistent.

• Adaptive copy mode (SRDF/DM)

The mode moves large amounts of data quickly with minimal host impact.

SRDF can be tightly integrated with TimeFinder to provide robust solutions to a variety of data replication and disaster recovery needs.

SRDF can be paired with VMware Site Recovery Manager to provide automated storage-based disaster restart operation for VMware environments.

Software licensing

Each PowerMax model can be purchased with two primary software packages (Essentials and Pro). Each package includes software licenses to meet the variety of customer needs. Additional software licenses can be purchased separately.

The following table identifies licenses included in each software package:

<table>
<thead>
<tr>
<th>Software/Feature</th>
<th>Essentials software package</th>
<th>Pro software package</th>
</tr>
</thead>
<tbody>
<tr>
<td>AppSync Starter Pack</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Compression/deduplication</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Data At Rest Encryption</td>
<td>Optional</td>
<td>Yes (not required)</td>
</tr>
<tr>
<td>Embedded Management</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Embedded NAS</td>
<td>Optional</td>
<td>Yes (not required)</td>
</tr>
<tr>
<td>PowerPath</td>
<td>No</td>
<td>75 Licenses</td>
</tr>
<tr>
<td>ProtectPoint</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>RecoverPoint</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>SnapVX</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SRDF</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>SRDF/Metro</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Storage Analytics</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Unisphere 360</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>ViPR Suite</td>
<td>Optional</td>
<td>Yes</td>
</tr>
</tbody>
</table>

PowerMax storage scale

The number of VxBlock System 1000 hosts supported by the PowerMax array depends on the number of PowerMax bricks in the array and the number of 16 Gb FC ports available in each. All host IO ports (16 Gb FC) are placed in port groups of four ports. Ports are spread across directors, SAN fabrics, and IO modules for redundancy. Each port group can support a maximum of 64 hosts.
The following table indicates the number of hosts support by a PowerMax array:

<table>
<thead>
<tr>
<th>Array model</th>
<th>PowerMax bricks</th>
<th>Minimum port groups</th>
<th>Hosts supported</th>
<th>Maximum port groups</th>
<th>Hosts supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1</td>
<td>4</td>
<td>256</td>
<td>8</td>
<td>512</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>512</td>
<td>16</td>
<td>1024</td>
</tr>
<tr>
<td>8000</td>
<td>1</td>
<td>4</td>
<td>256</td>
<td>6</td>
<td>384</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>512</td>
<td>16</td>
<td>1024</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>12</td>
<td>768</td>
<td>24</td>
<td>*1536</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>16</td>
<td>*1024</td>
<td>32</td>
<td>*2048</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>20</td>
<td>*1280</td>
<td>40</td>
<td>*2560</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>24</td>
<td>*1536</td>
<td>48</td>
<td>*3072</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>28</td>
<td>*1792</td>
<td>56</td>
<td>*3584</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>32</td>
<td>*2048</td>
<td>64</td>
<td>*4096</td>
</tr>
</tbody>
</table>

*Maximum number of hosts supported in a VxBlock 1000 is 800.

**NOTE:** To reach the maximum port group count, additional functionality, such as eNAS, SRDF, and ProtectPoint is inhibited. Four (or more) PowerMax bricks with PowerMax 8000 support the maximum number of VxBlock 1000 hosts and still provide optional features.

## Dell EMC Unity storage overview

Dell EMC Unity storage arrays are midrange storage solutions that include transactional workloads, such as databases, virtualized servers, and multiple workload consolidations. Dell EMC Unity is a unified solution that supports block and file environments with the flexibility to configure a system, capacity points, and Integrated Data Protection options. Dell EMC Unity storage arrays support integrated block and file storage and are optimized for VMware virtualized applications.

Regardless of the storage protocol implemented, VxBlock Systems 1000 can include cabinet space, cabling, and power to support the hardware. Dell EMC Unity storage includes controllers that eliminate the need for separate hardware for file sharing. The controllers also facilitate moving from block storage to unified storage, avoiding hardware changes.

Dell EMC Unity All-Flash storage arrays provide a scalable hardware design and advanced software capabilities using spinning and flash drives. Dell EMC Unity All-Flash arrays support high-density solid-state disks (SSDs) including 3D NAND triple level cell (TLC) drives.

The following Dell EMC Unity All-Flash storage array models are available:

- 350F
- 450F
- 550F
- 650F
The Dell EMC Unity All-Flash 350F to 650F storage arrays have the latest system hardware and contain only flash drives. The following table lists the processors and memory per storage processor:

<table>
<thead>
<tr>
<th>Storage array</th>
<th>Processor (per SP)</th>
<th>Memory (per SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>350F</td>
<td>Intel E5-2603v4 6-core, 1.7 GHz</td>
<td>48 Gb (3 x 16 Gb) @ 1866 MHz</td>
</tr>
<tr>
<td>450F</td>
<td>Intel E5-2630v4 10-core, 2.2 GHz</td>
<td>64 Gb (4 x 16 Gb) @ 2133 MHz</td>
</tr>
<tr>
<td>550F</td>
<td>Intel E5-2660v4 14-core, 2.0 GHz</td>
<td>128 Gb (4 x 32 Gb) @ 2400 MHz</td>
</tr>
<tr>
<td>650F</td>
<td>Intel E5-2680v4 14-core, 2.4 GHz</td>
<td>256 Gb (4 x 64 Gb) @ 2400 MHz</td>
</tr>
</tbody>
</table>

Array components and specifications

Dell EMC Unity storage arrays contain the disk processor enclosure (DPE) that house the redundant storage processors (SPs).

The DPE provides slots for two SPs and integrated drive slots for 25 2.5-inch drives or 12 3.5-inch drives.

Dell EMC Unity All-Flash models support only the drive carrier in the DPE with 25 Slots for 2.5-inch drives.

Each SP contains the following components:

- Single socket CPU
- Three to four DDR5 DIMM slots, depending on the model
- Internal battery backup unit (BBU)
- Two integrated 10 GbE BaseT ports (RJ45)
- Two integrated converged network adapter (CNA) ports (SFP+ or Twinax)
  - 10 GbE optical
  - 16 Gb FC
- Two integrated 12 Gb SAS ports for DAE connections
- Two slots for additional I/O modules (SLICs)
  - Four-port 12 Gb SAS (bus expansion)
  - Four-port 16 Gb FC
  - Four-port Ethernet 10 GbE optical

The integrated Ethernet ports and the Ethernet I/O modules supply Network Attached Storage (NAS) to associated hosts for file system access. The SPs run virtual NAS servers for file sharing.

| NOTE: VxBlock System 1000 uses the 10 GbE optical option for NAS usage.

DAEs contain individual disk drives and are available in the following configurations:

- Two-RU model that can house 25 2.5-inch disks
• Three-RU model that can house 80 2.5-inch disks

## Models

The following tables show capacity and performance of the Dell EMC Unity All-Flash storage arrays:

<table>
<thead>
<tr>
<th>Component</th>
<th>350F</th>
<th>450F</th>
<th>550F</th>
<th>650F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor per SP</td>
<td>6 core, 1.7 GHz</td>
<td>10 core, 2.2 GHz</td>
<td>14 core, 2.0 GHz</td>
<td>14 core, 2.4 GHz</td>
</tr>
<tr>
<td>Memory (Gb per storage array)</td>
<td>48</td>
<td>64</td>
<td>128</td>
<td>256</td>
</tr>
<tr>
<td>Maximum drive count</td>
<td>150</td>
<td>250</td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td>Bus expansion (x4 lane configuration)</td>
<td>NA</td>
<td>NA</td>
<td>4 port, 12 Gb/s SAS</td>
<td>4 port, 12 Gb/s SAS</td>
</tr>
<tr>
<td>Bus expansion (x8 lane configuration)</td>
<td>NA</td>
<td>NA</td>
<td>4 port, 12 Gb/s SAS</td>
<td>4 port, 12 Gb/s SAS</td>
</tr>
<tr>
<td>LUNs</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td>6000</td>
</tr>
<tr>
<td>Pool LUN size (TB)</td>
<td>256</td>
<td>256</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>File systems</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td>4000</td>
</tr>
<tr>
<td>File system size (TB)</td>
<td>256</td>
<td>256</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>Pools</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>NAS servers</td>
<td>90</td>
<td>128</td>
<td>128</td>
<td>256</td>
</tr>
</tbody>
</table>

## Storage features

Dell EMC Unity offers several features, including Integrated Data Protection, encryption, file storage, and replication.

### Integrated Data Protection

The following Integrated Data Protection features are supported:

- VPLEX
- RecoverPoint and RecoverPoint for VM
- Avamar/Data Domain

### Encryption

Dell EMC Unity Data at Rest Encryption (D@RE) prevents unauthorized access to lost, stolen, or failed drives by encrypting all sensitive user data. D@RE uses hardware-based encryption modules in the SAS controllers and 12 Gb/s SAS IO modules. The modules encrypt data written to the drives and decrypt data retrieved from the drives. Because of the controller-based approach, D@RE supports all Dell EMC Unity drive types.
The D@RE feature offers external key management as a security option. If an entire Dell EMC Unity system, including drives, is lost or stolen, external key management prevents unauthorized access.

During system initialization, the D@RE feature is enabled when the license file is installed. Installing the license on the storage array activates D@RE. If the license file includes D@RE, D@RE is permanently enabled on the system and cannot be disabled. Similarly, if the license file does not include D@RE, D@RE is permanently disabled on the system and cannot be enabled. D@RE is enabled or disabled only during initial installation. D@RE does not support enabling encryption on non-D@RE enabled systems.

### File storage

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal shares/exports</td>
<td>Data from resources inside the VxBlock System 1000. Either VMware vSphere ESXi datastores or file system mounts for guest operating systems</td>
</tr>
<tr>
<td>External shares/exports</td>
<td>Data from resources outside of the VxBlock 1000.</td>
</tr>
</tbody>
</table>

If sufficient Ethernet ports can provide separate LACP connections, the same array can provide internal and external file systems.

- Each LACP pair needs a connection to each LAN switch in the VxBlock 1000.
- Both SPs must have the same LACP configurations. For example, if the integrated CNA ports are configured for 10 GbE, Ethernet port 4 connects to LAN switch A and port 5 connects to LAN switch B.
- Both SPs should be cabled the same. The two ports (Ethernet ports 4 and 5) should be an LACP pair. An internal or external NAS server can use the LACP pair. You create an extra LACP pair to allow both internal and external NAS Servers.

Internal and external shares are created with two different NAS servers:

- SP-A hosts one share.
- SP-B hosts one share.

Each server hosts different file systems. The file systems are balanced across the NAS servers. More NAS servers can be created for different VLANs, but always in pairs for balance across the SPs.

### Replication

Dell EMC Unity storage arrays provide native support for both synchronous and asynchronous remote replication and support for RecoverPoint to provide remote replication.

For block storage configurations, the VxBlock System 1000 can include RecoverPoint, which provides continuous data protection and remote replication for on-demand protection and recovery. RecoverPoint capabilities include:

- Policy-based management
- Application integration
- Bandwidth reduction

The Dell EMC Unity All-Flash All-Inclusive Base Software package includes RecoverPoint.
To implement RecoverPoint, add two or more RecoverPoint Appliances (RPAs) in a cluster to the VxBlock System 1000. This cluster can accommodate approximately 80 MBps sustained throughput through each RPA.

To ensure proper sizing and performance of an RPA solution, Dell EMC Technical Consultants collect the following information:

- The type of data to be replicated
- Data change rates
- Data growth rates
- Network speeds

**Software licensing**

Dell EMC Unity licenses include base and optional software.

All-inclusive base software includes the following:

**Management software**

- Unisphere: Element Manager
- Unisphere Central: Consolidated dashboard and alerting
- CloudIQ: Cloud-based storage analytics
- Thin provisioning
- Dynamic pools (Available only with All-Flash arrays)
- Traditional pools (Available only with All-Flash arrays through the CLI)
- Data reduction (Block and File)
- Proactive assist: Configure remote support, online chat, open a service request, and so on
- Quality of Service
- Dell EMC Storage Analytics Adapter for VMware vRealize
- File and Block tiering/archiving to public/private cloud (Cloud Tiering Appliance)

**Unified protocols**

- File
- Block

**Local protection**

- Controller-Based Encryption (optional), with internal or external key management
- Local point-in-time copies (Snapshots and thin clones)
• AppSync Basic
• Common Event Enabler; Antivirus Agent, Event Publishing Agent

Remote protection
• Native Asynchronous Block and File Replication
• Native Synchronous Block Replication
• Snapshot Shipping
• RecoverPoint Basic
• RecoverPoint for VMs

Optional software
• AppSync Advanced
• Integrated Data Protection Suite: Backup, archive, and collaboration software
• RecoverPoint Advanced
• PowerPath Migration Enabler
• PowerPath Multipathing
• VPLEX

**NOTE:** For more details on software licensing, contact your sales representative.

Storage scale
The number of VxBlock System 1000 hosts that the Dell EMC Unity arrays support depends on the number of 16 Gb FC ports available on each SP.

All host IO ports (16 Gb FC) are placed in port groups of four ports. Ports are spread across SPs, SAN fabrics, and IO modules for redundancy. Each port group supports a maximum of 64 hosts.

The following table indicates the number of hosts that each Dell EMC Unity array supports:

<table>
<thead>
<tr>
<th>Array model</th>
<th>FC ports</th>
<th>Port groups</th>
<th>Supported hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td>350F - 650F</td>
<td>4</td>
<td>1</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>2</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>3</td>
<td>192</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>4</td>
<td>256</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>5</td>
<td>320</td>
</tr>
</tbody>
</table>
**Isilon storage overview**

Isilon storage is a scale-out NAS storage solution that delivers increased performance for file-based data applications and workflows from a single file-system architecture.

Isilon storage provides scale-out capacity for use as NFS and SMB CIFS shares within the VMware vSphere VMs.

Depending on the specific configuration, Isilon storage may contain the following key hardware components:

<table>
<thead>
<tr>
<th>Node type</th>
<th>Processor (per node)</th>
<th>Memory (per node)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F800</td>
<td>Intel E5-2697Av4 16-core, 2.6 GHz</td>
<td>256 Gb</td>
</tr>
<tr>
<td>H600</td>
<td>Intel E5-2680v4 14-core, 2.2 GHz</td>
<td>256 Gb</td>
</tr>
<tr>
<td>H500</td>
<td>Intel E5-2630v4 10-core, 2.2 GHz</td>
<td>128 Gb</td>
</tr>
<tr>
<td>H400</td>
<td>Intel D-1527 4-core, 2.2 GHz</td>
<td>64 Gb</td>
</tr>
<tr>
<td>A200</td>
<td>Intel D-1508 2-core, 2.2 GHz</td>
<td>16 Gb</td>
</tr>
<tr>
<td>A2000</td>
<td>Intel D-1508 2-core, 2.2 GHz</td>
<td>16 Gb</td>
</tr>
</tbody>
</table>

The following Cisco Nexus switches provide front-end connectivity:

- Cisco Nexus 93180YC-FX
- Cisco Nexus 93180LC-EX
- Cisco Nexus 9336C-FX2

The Isilon back-end Ethernet switches have the following features:

- 10 GbE 24 port
- 10 GbE 48 port
- 10 GbE 96 port (2 x 48 port leaf modules)
- 10 GbE 46 port leaf module
- 40 GbE 32 port
- 40 GbE 64 port (2 x 32 port leaf modules)

⚠️ **NOTE:** Leaf modules are only applicable in 10 GbE over 48 nodes and 40 GbE over 32 nodes.

**Array components and specifications**

Isilon All-Flash, hybrid, and archive nodes are contained within a chassis that holds four nodes.
Each chassis contains the following components:

- Four compute slots per chassis
  - Compute suitcase
    - Single-socket CPU
    - Four DDR4 DIMM slots
    - Front-end 10 GbE or 40 GbE optical (depending on node type)
    - Back-end 10 GbE or 40 GbE optical (depending on node type)
    - Single on-board 1 GbE Ethernet
    - DB-9 serial connection
  - Up to 2 x 2.5-inch SSD for Cache
  - Up to 2 x M.2 vault disks
  - Dual 1100 W or 1450 W PSUs
- Drive sleds of 20 drives each
  - 2.5-inch drives
    - F800
    - H600
  - 3.5-inch drives
    - H500
    - H400
    - A200
    - A2000

**NOTE:** VxBlock System 1000 does not use 1 GbE connections in each compute suitcase.

The following models are supported:

<table>
<thead>
<tr>
<th>Component</th>
<th>F800</th>
<th>H600</th>
<th>H500</th>
<th>H400</th>
<th>A200</th>
<th>A2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor per node</td>
<td>16 core, 2.6 GHz</td>
<td>14 core, 2.4 GHz</td>
<td>10 core, 2.2 GHz</td>
<td>4 core, 2.2 GHz</td>
<td>2 core, 2.2 GHz</td>
<td>2 core, 2.2 GHz</td>
</tr>
<tr>
<td>Memory per node (Gb)</td>
<td>256</td>
<td>256</td>
<td>128</td>
<td>64</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>
### Storage features

Isilon supports encryption, file storage, and replication features.

#### Encryption

The OneFS system is available as a cluster that is composed of Isilon OneFS nodes that contain only self-encrypting drives (SEDs). The system requirements and management of data at rest on self-encrypting nodes are identical to that of nodes that do not contain self-encrypting drives. Clusters of mixed node types are not supported.

Self-encrypting drives store data on an Isilon cluster that is specially designed for data-at-rest encryption.

D@re on self-encrypted drives occurs when data that is stored on a device is encrypted to prevent unauthorized data access. All data written to the storage device is encrypted when it is stored, and all data read from the storage device is decrypted when it is read. The stored data is encrypted with a 256-bit data AES encryption key and decrypted in the same manner. OneFS controls data access by combining the drive authentication key with on-disk data-encryption keys.

The VxBlock System 1000 initial release does not include SED options.

#### File storage

Isilon OneFS combines the three layers of traditional storage architectures (file system, volume manager, and data protection) into one unified software layer, creating a single intelligent distributed file system that runs on an Isilon storage cluster.

VxBlock System 1000 configures the two front-end interfaces of each node in an LACP port channel. The front-end interfaces are then used via SmartConnect to load balance share traffic across the nodes in the cluster depending on the configuration.

#### Replication

Isilon OneFS leverages the SyncIQ licensed feature for replication. SyncIQ is an application that enables you to flexibly manage and automate data replication between two Isilon clusters. SyncIQ delivers unique, highly parallel replication performance that scales with the dataset to provide a solid foundation for disaster recovery. SyncIQ can send and receive data on every node in the Isilon cluster so replication performance is increased as your data grows.
Software licensing

Isilon OneFS comes with a variety of different licensable features that expand the functionality of the Isilon cluster.

The following table lists the Isilon features:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>CloudPools</td>
<td>Cloud tiering</td>
</tr>
<tr>
<td>Security hardening</td>
<td>Cluster security (STIG, etc)</td>
</tr>
<tr>
<td>HDFS</td>
<td>Hadoop file system protocol</td>
</tr>
<tr>
<td>Isilon Swift</td>
<td>OneFS Swift object API</td>
</tr>
<tr>
<td>SmartConnect</td>
<td>Cluster connection load balancing</td>
</tr>
<tr>
<td>SmartDedupe</td>
<td>Data deduplication</td>
</tr>
<tr>
<td>SmartLock</td>
<td>WORM data immutability</td>
</tr>
<tr>
<td>SmartPools</td>
<td>Data tiering</td>
</tr>
<tr>
<td>SmartQuotas</td>
<td>Quota management</td>
</tr>
<tr>
<td>SnapshotIQ</td>
<td>File system snapshots</td>
</tr>
<tr>
<td>SyncIQ</td>
<td>Cluster asynchronous replication</td>
</tr>
<tr>
<td>Isilon Gen 6 Nodes</td>
<td>Current generation of Isilon cluster hardware</td>
</tr>
</tbody>
</table>

Perpetual and subscription models

The following licensing models are available:

<table>
<thead>
<tr>
<th>Subscription model</th>
<th>Type</th>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perpetual</td>
<td>Basic bundle</td>
<td>SmartConnect, SnapshotIQ</td>
</tr>
<tr>
<td></td>
<td>Enterprise Bundle</td>
<td>SmartConnect, SnapshotIQ, SmartQuotas</td>
</tr>
<tr>
<td></td>
<td>Enterprise Advanced Bundle</td>
<td>SmartConnect, SnapshotIQ, SmartQuotas, SyncIQ, SmartPools</td>
</tr>
<tr>
<td>Subscription</td>
<td>OneFS Essentials Subscription</td>
<td>SmartConnect, SnapshotIQ, SmartQuotas</td>
</tr>
<tr>
<td></td>
<td>OneFS Advanced Subscription</td>
<td>All software except CloudPools</td>
</tr>
<tr>
<td></td>
<td>OneFS CloudPools 3rd Party Subscription</td>
<td>CloudPools for third party</td>
</tr>
</tbody>
</table>

Isilon storage scale

The number of Isilon nodes supported depends on the number of 10 GbE or 40 GbE ports available in the system.
All node front-end ports (10 GbE or 40 GbE) are placed in LACP port channels. Each node’s front-end ports are connected to a pair of redundant network switches.

**NOTE:** The maximum Isilon configuration requires two pairs of ToR switches.

The following table indicates the number of nodes supported:

<table>
<thead>
<tr>
<th>Model</th>
<th>Node scalability</th>
<th>Capacity scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>F800</td>
<td>4 – 96 @ 10 GbE</td>
<td>96 TB per chassis</td>
</tr>
<tr>
<td></td>
<td>4 – 48 @ 40 GbE</td>
<td></td>
</tr>
<tr>
<td>H600</td>
<td>4 – 96 @ 10 GbE</td>
<td>72 TB per chassis</td>
</tr>
<tr>
<td></td>
<td>4 – 48 @ 40 GbE</td>
<td></td>
</tr>
<tr>
<td>H500</td>
<td>4 – 96 @ 10 GbE</td>
<td>120 TB per chassis</td>
</tr>
<tr>
<td></td>
<td>4 – 48 @ 40 GbE</td>
<td></td>
</tr>
<tr>
<td>H400</td>
<td>4 – 96 @ 10 GbE</td>
<td>120 TB per chassis</td>
</tr>
<tr>
<td>A200</td>
<td>4 – 96 @ 10 GbE</td>
<td>120 TB per chassis</td>
</tr>
<tr>
<td>A2000</td>
<td>4 – 96 @ 10 GbE</td>
<td>800 TB per chassis</td>
</tr>
</tbody>
</table>

**XtremIO storage overview**

The XtremIO Storage Array is an all-flash system based on a scale-out architecture. The system uses building blocks called X-Bricks which are clustered together using an InfiniBand backbone Remote Direct Memory Access (RDMA) network. The system operation is managed using a stand-alone dedicated Linux-based server, called the XtremIO Management Server (XMS).

The XtremIO array architecture is specifically designed to deliver the full performance potential of flash, while linearly scaling all resources such as CPU, RAM, SSDs and host ports.

Due to its content-aware storage architecture, XtremIO provides:

- Even distribution of data blocks, leading to maximum performance and minimal flash wear
- Even distribution of metadata
- No data or metadata hotspots
- Easy setup and no tuning
- Advanced storage functionality, including inline data deduplication and compression, thin provisioning, advanced data protection (XDP), snapshots, and more

**Array components and specifications**

The base component of the XtremIO storage array is the X-Brick. Each X-Brick consists of two redundant active-active storage controllers. The new multidimensional scalability of X2 enables you to scale up by adding as few as six SSDs at a time to a single X-Brick. You can also scale out with more X-Brick building blocks in any odd or even increments.
The management platform used to manage the XtremIO clusters is the XtremIO Management Server (XMS). The XMS is a VM deployed on the AMP-VX or AMP-3S. It is not in the data path. An XMS can manage up to 8 XtremIO X2 clusters. X1 clusters can be managed from the XMS provided it is running version 6.0.1-30 or later.

The XMS controls and manages the system, including:

- Monitoring system health and events
- Monitoring system performance
- Maintaining a performance statistics history database
- Providing webUI and CLI services to clients
- Providing RESTful API interfaces

**Models**

X2 is enhanced with newer Intel CPUs and expanded memory to optimize performance and enable consistent sub-millisecond latency. XtremIO X2 X-Brick building blocks are available in two types:

- **X2-S-** is available for use cases such as virtual desktops which have lower capacity requirements and benefit highly from compression and deduplication.
- **X2-R-** is available for workloads that do not benefit as much from compression and deduplication. These applications require higher physical capacity such as databases.

<table>
<thead>
<tr>
<th>Component</th>
<th>X2-S</th>
<th>X2-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of X-Brick building blocks</td>
<td>1–4</td>
<td>1–4</td>
</tr>
<tr>
<td>CPU</td>
<td>Intel® Xeon® processors 2 x 12 core 2.5 GHz Haswell 24 cores per controller (48 per X-Brick)</td>
<td>Intel® Xeon® processors 2 x 12 core 2.5 GHz Haswell 24 cores per controller (48 per X-Brick)</td>
</tr>
<tr>
<td>Number of cores per controller/X-Brick/cluster</td>
<td>24 / 48 / 192</td>
<td>24 / 48 / 192</td>
</tr>
<tr>
<td>Minimum number of storage controllers</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Maximum number of storage controllers</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Memory: per X-Brick options</td>
<td>384 GB</td>
<td>1024 GB</td>
</tr>
<tr>
<td>Minimum FC ports (16 Gb/s) per X-Brick</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Maximum 16-Gbps FCs per cluster</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>DAE quantity and speed</td>
<td>four 12-Gb/s SAS, 72 drives</td>
<td>four 12-Gb/s SAS, 72 drives</td>
</tr>
<tr>
<td>DAE SSD sizes</td>
<td>400 GB</td>
<td>1920 GB</td>
</tr>
<tr>
<td>Maximum SSD drives per X-Brick</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>Minimum SSD enclosures</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
### Storage features

Describes the features of XtremIO X2 storage.

XtremIO X2 includes:

- Top load 72-drive DAE for higher density
- Scale-Up and Scale-Out architecture
- HTML GUI
- Inline deduplication and compression
- XtremIO Integrated Copy Data Management for snapshots
- Thin Provisioning
- D@RE

Each X-Brick is composed of:

- One 2 U Disk Array Enclosure (DAE) containing:
  - Up to 72 SSDs
  - Two redundant power supply units
  - Two redundant SAS interconnect models
  - 12 Gbps SAS Connectivity
- Two 1 U Storage Controllers
  
  Each Controller includes:
  - Two redundant power supply units (PSUs)
  - Two 16 Gbps FC ports
  - Two 56 Gbps InfiniBand HCA
  - One 10 Gbps management port
  - NVRAM for power loss protection

<table>
<thead>
<tr>
<th>Component</th>
<th>X2-S</th>
<th>X2-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum SSD enclosures</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Maximum Ethernet port for management</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>management (10 Gb/s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Infiniband switches</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Infiniband switches</td>
<td>12 ports (56 Gb/s)</td>
<td>36 ports (56 Gb/s)</td>
</tr>
</tbody>
</table>
XtremIO X2 storage scale

Describes the relationship between hosts, FC ports, and X-Bricks.

The number of VxBlock System 1000 hosts supported by the XtremIO X2 arrays depends on the number of X-Bricks in the cluster.

Each X-Brick contains four 16 Gb/s ports and each host should connect to at least four ports in the cluster.

The host ports are spread between storage controllers, X-Bricks, and SAN fabrics for redundancy.

Each group of four ports can support a maximum of 64 hosts in line with Dell EMC standards.

The following table indicates the number of hosts supported by X2 arrays:

<table>
<thead>
<tr>
<th>X-Brick count</th>
<th>FC ports</th>
<th>Supported hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>64</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>128</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>192</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>256</td>
</tr>
</tbody>
</table>

Scale-out architecture

An XtremIO storage system can include a single X-Brick or multiple X-Bricks. Currently both the X2-R and X2-S support up to four X-Bricks.

With clusters of two more X-Bricks, XtremIO utilizes two redundant 56 Gb/s InfiniBand HCA ports for an ultra-low latency back-end connectivity between storage controllers. The X2-S includes a 12 port InfiniBand switch while the X2-R includes a 36 port InfiniBand switch for future expansion.

Scale-up architecture

More capacity can be added to an existing configuration without adding compute resources. The minimum number of drives in a DAE is 18. Afterwards disks can be added in packs of 6 until a total of 36 are reached. After 36 have been added, the next disk addition must include 18 additional disks for a total of 54. Afterwards, disks may again be added in packs of six until the DAE is full at 72 disks.

Supported Integrated Data Protection options

XtremIO Virtual Copies (XVC) are created at a particular point in time, allowing users to access the data when needed, even when the source volume has been changed.

VPLEX VS2 and VS6 are supported.

RecoverPoint Gen6 is supported.

Multiple storage array overview

The VxBlock System 1000 offers multiple storage arrays natively without the addition of a Converged Technology Extension.
You can add as many storage arrays or platforms as the connectivity model allows.

**Block storage**

You can combine multiple storage arrays for block-level storage.

The following best practices are implemented when combining multiple storage arrays and storage array platforms for block level storage:

- Each port group per array is spread across the SAN fabric.
- Hosts do not share array workloads when performance is required.
- VMware vSphere ESXi advanced settings are configured.
- When mixing storage array platforms, common settings are used.
- Host level and/or array level maximum boundaries are maintained per array.

**NOTE:** Mixing storage array platforms may affect performance.

**File storage**

You can combine multiple storage arrays for file-level storage.

The following best practices are implemented when combining multiple storage arrays and storage array platforms for file-level storage:

- Storage array Ethernet ports are spread across the LAN switches.
- Each pair of ports is configured in an LACP port channel.
- Only VMAX and Dell EMC Unity provide access to VMware vSphere ESXi datastore.
- Guest access to file shares is supported by VMAX, Dell EMC Unity, and Isilon.
- Host-level and/or array-level maximum boundaries are maintained per array.

**Management and monitoring options for multiple storage arrays**

Multiple storage arrays have management and monitoring features.

**Unisphere for multiple VMAX arrays**

Unisphere 360 enables you to access the data center from any device, including tablets and mobile devices. Unisphere 360 consolidates and simplifies management for VMAX storage arrays. Managing a data center with multiple storage systems can be a large-scale project on its own. Although Unisphere for VMAX allows multiple arrays to be managed from the same instance, the maximum number of devices and arrays are limited. Unisphere 360 supports up to 200 systems covering VMAX All-Flash, VMAX3 and VMAX. A single window view with access to all VMAX storage arrays allows you to manage, monitor, and plan at the array level or for the entire data center.
Unisphere and CloudIQ for multiple Dell EMC Unity arrays

Unisphere Central obtains aggregated status, alerts, host details, performance and capacity metrics, and storage usage information from the systems. Unisphere Central allows administrators to take a quick look at their entire storage environment and rapidly access storage systems that are in need of attention or maintenance.

CloudIQ is a no cost software-as-a-service (SaaS) cloud-based storage analytics application. CloudIQ uses near real-time intelligence, proactive monitoring, and predictive analytics to deliver comprehensive health scores for Dell EMC Unity storage systems from the cloud.
Management

Use VxBlock Central to manage and monitor VxBlock Systems in a data center.

VxBlock Central provides the ability to:

- View the health and RCM compliance of multiple VxBlock Systems.
- View charts of key performance indicators (KPI) for one or more components or elements.
- Download software and firmware components to maintain compliance with the current RCM.
- Track real-time information regarding critical faults, errors, and issues affecting VxBlock Systems.
- Configure multisystem Active Directory (AD) integration and map AD Groups to VxBlock Central roles.
- Set up compute, storage, networks, and PXE services, manage credentials, and upload ISO images for server installation.
- Monitor VxBlock System analytics and manage capacity through integration with VMware vRealize Operations (vROps).

VxBlock Central options

VxBlock Central is available in Base, Advanced, and Advanced Plus options to manage your VxBlock System.

Base option

The Base option enables you to monitor the health and compliance of VxBlock Systems through a central dashboard.

VxBlock System health is a bottom-up calculation that monitors health or operational status of the following:

- The VxBlock System as a whole system.
- The physical components such as a chassis, disk array enclosure, fan, storage processor, or X-Blade.
- The compute, network, storage, and management components that logically group the physical components.

The landing page of VxBlock Central provides a view of the health and compliance of multiple VxBlock Systems. You can run a compliance scan on one or more VxBlock Systems. You can view key performance indicators (KPI) for one or more components.

VxBlock Central contains dashboards that allow you to:

- View all components for selected VxBlock Systems, including detailed information such as serial numbers, IP address, firmware version, and location.
- View compliance scores and security and technical scan risks.
• View and compare RCMs on different systems.

• View real-time alerts for your system including severity, time, the system where the alert occurred, the ID, message, and status.

• Configure roles with AD integration.

The following table describes each dashboard:

<table>
<thead>
<tr>
<th>Dashboard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory</td>
<td>Provides high-level details of the components that are configured in a single view. It provides the name, IP address, type, and element manager, RCM scan results, and alert count for components. An inventory item can be selected to suppress alerts and enable alerts. When alerts are suppressed for a specific component, real-time alert notifications are suspended. You can search VxBlock Systems for specific components or subcomponents and export a spreadsheet of your search.</td>
</tr>
<tr>
<td>RCM</td>
<td>Provides the compliance score, security, and technical risks associated with each VxBlock System. From the dashboard, you can: • View noncompliant components, security, and technical risks associated for components. • Download software and firmware for your VxBlock System components to upgrade to a new RCM or remediate drift from your current RCM. • Run compliance scans and download and assess the results. • Check the base profile to determine whether components have the correct firmware versions. • Upload and install the latest compliance content. • Customize the compliance profile.</td>
</tr>
<tr>
<td>Alerts</td>
<td>Provides real-time alerting to monitor and receive alerts for critical failures on compute, storage, and network components. Administrators and Dell EMC Support can respond faster to incidents to minimize any impact of failures. Using the predefined alert notification templates to create alert notification profiles, you can specify how you want to be notified for a critical alert.</td>
</tr>
<tr>
<td>Roles</td>
<td>When VxBlock Central is integrated with Active Directory (AD), VxBlock Central authenticates AD users and supports mapping between AD groups and roles. Role mappings control the actions that a user is authorized to perform. By mapping an AD group to a role, you can control user permissions. When an AD user logs in to VxBlock Central, role mappings are checked for AD groups to which the user is assigned. The set of available permissions depends on the roles mapped to the groups in which the user is a member.</td>
</tr>
<tr>
<td>Advanced Management</td>
<td>Provides access to Advanced and Advanced Plus.</td>
</tr>
</tbody>
</table>

**Advanced**

The Advanced option provides automation and orchestration for daily provisioning tasks through the following features:

• VxBlock Central Orchestration Services

• VxBlock Central Orchestration Workflows

VxBlock Central Orchestration provides automation and orchestration for daily provisioning tasks through integration with VMware vRealize Orchestrator (vRO).
VxBlock Central Orchestration Services

VxBlock Central Orchestration Services sets up compute, storage, network, and PXE services. VxBlock Central Orchestration Services manages credentials and uploads ISO images for server installation.

The VxBlock Central Orchestration vRO Adapter provides supported workflows for VxBlock System compute expansion.

VxBlock Central Orchestration Workflows

VxBlock Central Orchestration Workflows simplify complex compute, storage, and network provisioning tasks using automated workflows for VMware vRO.

Automated VxBlock Central Orchestration Workflows enable you to concurrently provision multiple VMware vSphere ESXi hosts and add these hosts to the VMware vCenter cluster. The workflows implement Dell EMC best practices for VxBlock Systems and provide the validation and resilience that is required for enterprise-grade operations. Once hosts are provisioned, workflows trigger an RCM compliance scan to ensure compliance with RCM standards. The VMware vRO workflows also support bare-metal server provisioning.

The following table provides an overview of available workflows and their tasks:

<table>
<thead>
<tr>
<th>Workflow</th>
<th>Description</th>
<th>Available workflow tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Establishes the connection between VMware vRO with automation workflows and VxBlock Central Orchestration Services to run workflow automation.</td>
<td>Add VxBlock Central Orchestration Services API gateway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Update VxBlock Central Orchestration Services API gateway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add a vCenter Server instance</td>
</tr>
<tr>
<td>Service</td>
<td>Provides a presentation layer for user input and data validation. Service workflows create multiple instances of fulfillment workflows to run concurrently.</td>
<td>Provision a host (bare metal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provision a host (bare metal) - VMAX3/PowerMax boot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provision a host (ESXi) and add to a cluster - VMAX3/PowerMax boot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add a host to a cluster</td>
</tr>
<tr>
<td>Fulfillment</td>
<td>Performs overall orchestration of resources and runs automation tasks. You can run multiple fulfillment workflows concurrently based on user input.</td>
<td>Provision a bare metal server (UCS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provision bare metal servers (optional - with VMAX boot LUN)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provision an ESXi host using VMAX boot LUN</td>
</tr>
</tbody>
</table>

Advanced Plus

The Advanced Plus option contains VxBlock Central Orchestration, and VxBlock Central Operations. VxBlock Central Operations provides features that simplify operations you must perform for Vblock Systems through advanced monitoring, system analytics, and simplified capacity management.

VMware vRealize Operations (vROps) Manager integration with VxBlock Central presents the topology and relationship of VxBlock Systems with compute, storage, network, virtualization, and management components. VxBlock Central Operations provides advanced monitoring, system analytics, and simplified capacity management through integration with VMware vROps Manager.
VxBlock Central Operations allows you to:

- Monitor health, performance, and capacity through predicative analytics.
- Troubleshoot and optimize your environment though alerts and recommended actions.
- Manage inventory and create reports.
- Define custom alerts for performance and capacity metrics in the following actions:
  - Collect data from VxBlock Systems every 15 minutes by default.
  - Collect real-time alerts from VxBlock Systems every three minutes, by default.
  - View VxBlock Central VM relationships to physical infrastructure. Core VM, MSM VM, and MSP VM resource monitoring enables you to identify and monitor a collection of resources associated with a VM.

The following illustration provides an overview of how VxBlock Central uses VMware vRealize:
VxBlock Central architecture

VxBlock Central uses VMs to provide services.

The following table provides an overview of VxBlock Central VMs:

<table>
<thead>
<tr>
<th>VM</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Discovers and gathers information about the inventory, location, and health of the VxBlock System.</td>
</tr>
<tr>
<td>MSM</td>
<td>Provides functions to manage multiple VxBlock Systems. In a data center environment, one MSM VM can be associated with up to 8 Core VMs.</td>
</tr>
<tr>
<td>MSP (optional)</td>
<td>Provides functions for RCM content prepositioning.</td>
</tr>
<tr>
<td>VMware vRO</td>
<td>Provides workflow engine and workflow designer capabilities.</td>
</tr>
<tr>
<td>VxBlock Central Orchestration Services</td>
<td>Provides firmware repository management, credentials management, log management, PXE management VxBlock System workflows require.</td>
</tr>
</tbody>
</table>

VxBlock Central includes the Core VM and the multisystem management (MSM) VM as a minimum configuration. The multisystem prepositioning (MSP) VM deployment is optional for prepositioning.

Discovery

The discovery model resides within a database and is exposed through REST and SNMP interfaces. Initial discovery is performed during manufacturing of the VxBlock System and relies on an .XML file that contains build and configuration information. Core VM uses the .XML file to populate basic information about the VxBlock System and establish communication with components.

After initial discovery, Core VM uses the following methods to discover the VxBlock System, including physical components and logical entities:

- XML API
- SNMP
- SMI-S
- Vendor CLIs, such as Unisphere CLI
- Platform Management Interface

Core VM performs discovery every 15 minutes, by default. This setting can be changed as desired.
The following illustration is a high-level overview of integration between Core VM and various products and protocols:

**Data collection**

VxBlock Central uses data collectors to unzip required data from various web services.
The following table describes the data collectors:

<table>
<thead>
<tr>
<th>Data collector</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VxBlock Central collector</td>
<td>Uses the VxBlock Central REST API to collect the VxBlock System configuration data and key performance indicators (KPI) already discovered in Core VM. The configuration is stored with KPI data from Core VM into the Cassandra and Elasticsearch databases.</td>
</tr>
<tr>
<td>SMI-S collector</td>
<td>Works with the CIM Object Manager (ECOM) service that runs on SMI components to discover metrics for VMAX:</td>
</tr>
<tr>
<td></td>
<td>• Storage array</td>
</tr>
<tr>
<td></td>
<td>• Storage processor</td>
</tr>
<tr>
<td></td>
<td>• Storage volume</td>
</tr>
<tr>
<td></td>
<td>• Storage pool</td>
</tr>
<tr>
<td></td>
<td>• Storage tier</td>
</tr>
<tr>
<td></td>
<td>• Disk</td>
</tr>
<tr>
<td>SNMP collector</td>
<td>Collects information from SNMP enabled devices such as Cisco Nexus and MDS switches to discover metrics. Information can be collected from the following network components:</td>
</tr>
<tr>
<td></td>
<td>• Switches</td>
</tr>
<tr>
<td></td>
<td>• Network chassis</td>
</tr>
<tr>
<td></td>
<td>• Container</td>
</tr>
<tr>
<td></td>
<td>• Fan</td>
</tr>
<tr>
<td></td>
<td>• Expansion module</td>
</tr>
<tr>
<td></td>
<td>• Power supply bay</td>
</tr>
<tr>
<td></td>
<td>• PSU</td>
</tr>
<tr>
<td></td>
<td>• Network temperature sensor</td>
</tr>
<tr>
<td></td>
<td>• SFP</td>
</tr>
<tr>
<td></td>
<td>• IPI appliance</td>
</tr>
<tr>
<td>vSphere API collector</td>
<td>Works with VMware vCenter Server using the VMware vSphere API to discover metrics, for datastores, disk partitions, and clusters.</td>
</tr>
<tr>
<td>Dell EMC Unity REST collector</td>
<td>Collects configuration data from a Dell EMC Unity storage array and its components.</td>
</tr>
<tr>
<td>XIO REST collector</td>
<td>Collects metrics for storage array, storage volume, disk, and port. VxBlock Central collects all other configuration information with the collector.</td>
</tr>
<tr>
<td>XML API collector</td>
<td>Collects information from the Cisco UCS using the XML API to discover metrics.</td>
</tr>
<tr>
<td>VMware NSX collector</td>
<td>Collects information about VMware NSX components, such as Virtual Appliance Management and the NSX controllers. The NSX collector interfaces with the NSX Manager APIs.</td>
</tr>
</tbody>
</table>

**VxBlock Central Shell**

The VxBlock Central Shell removes the complexity of working with individual component interfaces and provides a plug-in structure that can be extended to include more functionality. VxBlock Central Shell creates an abstraction layer that removes the burden of having to use different login credentials, IP addresses, and syntax to make configuration changes across multiple components. VxBlock Central Shell can help manage multiple VxBlock Systems.
For example, to update the NTP server IP addresses for all switches on a VxBlock System, you can issue a single command without having to log on to each component.

```
> ntp switch set ['10.1.139.235', '10.1.219.13']
[Switch 'N5B' at 10.1.139.23:, result: ['10.1.139.235', '10.1.219.13'],
 Switch 'N5A' at 10.1.139.22:, result: ['10.1.139.235', '10.1.219.13'],
 Switch 'MGMT-N3B' at 10.1.139.2:, result: ['10.1.139.235', '10.1.219.13'],
 Switch 'MGMT-N3A' at 10.1.139.1:, result: ['10.1.139.235', '10.1.219.13'],
 Switch 'N1A' at 10.1.140.235:, result: ['10.1.139.235', '10.1.219.13'],
 Switch 'M9A' at 10.1.139.20:, result: ['10.1.139.235', '10.1.219.13'],
 Switch 'M9B' at 10.1.139.21:, result: ['10.1.139.235', '10.1.219.13']]```

The shell is a framework layer built on top of Python and VxBlock CentralAPI bindings. In addition to the commands provided, any valid Python command can be run in the shell.

Developers writing extensions for the VxBlock Central Shell can provide a single interface for all components and enable users to:

- Perform operations on each VxBlock System as a single logical entity rather than a collection of components.
- Configure and manage settings at the individual VxBlock System component level.

**Secure Remote Services**

VxBlock Central can connect to Secure Remote Services to automatically send system inventory, real-time alerts, and RCM fitness information through the Secure Remote Services connection to collect and analyze data.

Use the VxBlock Central Shell Secure Remote Services Extension Pack to perform the following functions:

- Configure VxBlock Central to use Secure Remote Services
- Deregister VxBlock Central with Secure Remote Services
- Update a Secure Remote Services gateway configuration or VxBlock Central ID (SWID)
- Upload information to Secure Remote Services about your VxBlock System:
  - Release Certification Matrix (RCM) compliance scan results (ZIP file containing CSV, XLS, PDF, and XML files) (if you have installed RCM content and selected a default profile)
  - VxBlock System inventory files (JSON)
  - VxBlock System real-time alerts are automatically sent to SRS if SRS notification is configured.
- Modify the schedule VxBlock Central uses to regularly send RCM and inventory information to Secure Remote Services

**Key performance indicators**

Access key performance indicator (KPI) information using VxBlock Central or MSM VM. VxBlock Central displays charts and graphs of KPI information for the selected element type.
The following table provides examples of KPI information:

<table>
<thead>
<tr>
<th>Element type</th>
<th>Examples of KPI information</th>
</tr>
</thead>
<tbody>
<tr>
<td>storagearray</td>
<td>Remaining raw capacity</td>
</tr>
<tr>
<td></td>
<td>Total space available for user data</td>
</tr>
<tr>
<td></td>
<td>Remaining managed space</td>
</tr>
<tr>
<td></td>
<td>Total IO per second</td>
</tr>
<tr>
<td>storagepool</td>
<td>User capacity</td>
</tr>
<tr>
<td>disk</td>
<td>Disk raw capacity</td>
</tr>
<tr>
<td></td>
<td>Bandwidth</td>
</tr>
<tr>
<td>switch</td>
<td>Current bandwidth</td>
</tr>
<tr>
<td></td>
<td>Number of error inbound packets</td>
</tr>
<tr>
<td>rack</td>
<td>Monitor total energy</td>
</tr>
<tr>
<td></td>
<td>Monitor average power consumption</td>
</tr>
<tr>
<td>computeserver</td>
<td>Total memory</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
</tr>
</tbody>
</table>

The MSM VM API for multisystem services retrieves the following KPI data:

- All existing KPI definitions in the VxBlock System.
- Existing KPI definitions for a particular element type and/or component category.
- Time series KPI data:
  - A particular time resolution.
  - A start time for time series queries.
  - An end time for time series queries.
The following illustration shows VxBlock Central Orchestration with VMware vRealize Orchestrator (vRO):
Data center architecture

VxBlock Central supports a clustered environment that includes multiple MSM VMs configured to run in a single physical data center or in multiple, geographically separate physical data centers.
In a data center environment, one MSM VM can be associated with up to eight Core VMs:
The following illustration shows a single-site environment consisting of three MSM VMs, each associated with a single Core VM:

MSM VMs are configured to form a cluster. Capabilities and functionality are exposed after deployment and configuration.

In a single-site configuration with one datacenter, VxBlock Central supports up to three MSM VMs running within the data center. Up to eight Core VMs are supported.

VxBlock Central supports a multisite clustering configuration that includes a maximum of three data centers. Up to two MSM VMs are supported.

**AMP overview**

AMP-VX and AMP-3S manage local and production workloads.

AMP-3S is available with VxBlock Central Base, Advanced, and Advanced Plus options.

AMP-VX is available with VxBlock Central Base option only.

**AMP hardware components**

AMP systems support management software that help install and operate components within VxBlock Systems 1000.
The following table provides an overview of the AMP hardware components:

<table>
<thead>
<tr>
<th>AMP</th>
<th>Physical server</th>
<th>Storage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMP-3S</td>
<td>2-6 Cisco UCS C220 servers (3 recommended for HA)</td>
<td>FlexFlash SD for VMware vSphere ESXi boot</td>
<td>Provides limited scalability configuration using Cisco UCS C220 servers and additional storage expansion capacity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dell EMC Unity with FAST Cache and FAST VP</td>
<td></td>
</tr>
<tr>
<td>AMP-VX</td>
<td>4-8 PowerEdge R640 servers</td>
<td>SD card for VMware vSphere ESXi boot</td>
<td>The base AMP-VX configuration of 4 servers supports the core management workload for the AMP-VX and one VxBlock System. Servers can be added as required, to manage multiple VxBlock Systems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VMware vSAN all-flash shared storage</td>
<td></td>
</tr>
</tbody>
</table>

**AMP software components (VMware vSphere 6.5)**

AMPs are delivered with specific installed software components dependent on the selected Release Certification Matrix (RCM).

The following software components are installed dependent on the selected Dell EMC RCM:

- Microsoft Windows Server 2012 R2 Standard x64
- VMware vSphere Enterprise Plus
- VMware vSphere Hypervisor ESXi
- VMware Single Sign-On (SSO) Service
- VMware vSphere Platform Services Controller (PSC)
- VMware vSphere Web Client Service
- VMware vSphere Inventory Service
- VMware vCenter Server Appliance (vCSA)

**NOTE:** For VMware vSphere 6.5, only the VMware vCSA deployment model is offered.

- VMware vCenter Update Manager (VUM – Integrated with VMware vCenter Server Appliance)
- VMware vSphere client
- VMware vSphere Web Client (Flash/Flex client)
- VMware vSphere Syslog Service (optional)
- VMware vSphere Core Dump Service (optional)
- VMware vSphere Distributed Switch (VDS)
• PowerPath/VE Management Appliance (PPMA)
• Secure Remote Services (ESRS)
• Array management modules, including but not limited to:
  — Unisphere Client
  — Unisphere Service Manager
  — VNX Initialization Utility
  — VNX Startup Tool
  — SMI-S Provider
• Cisco Prime Data Center Network Manager (DCNM) and Device Manager
• (Optional) RecoverPoint management software that includes the management application and deployment manager

**AMP-3S management network connectivity**

Network connectivity and server assignment illustrations on Cisco UCS C220 M4 servers are provided for VxBlock Systems.
AMP-3S uses VMware virtual distributed switches with network input output configuration (NIOC) in place of VMware standard switches.
The following illustration shows VM placement with two AMP-3S servers:

![Diagram](image1)

The following illustration shows VM placement with three AMP-3S servers:

![Diagram](image2)
Virtualization layer

VMware vSphere is the virtualization platform that provides the foundation for the private cloud.

Virtualization components

The core VMware vSphere components are the VMware vSphere ESXi and VMware vCenter Server for management.

VMware vSphere 6.5 includes a pair of VMware Platform Service Controller (PSC) Linux appliances to provide VMware Single Sign-on (SSO) service. With VMware vSphere 6.5, VMware vCenter Server Appliance (vCSA) is the default deployment model for VMware vCenter Server.

The hypervisors are deployed in a cluster configuration. The cluster allows dynamic allocation of resources, such as CPU, memory, and storage. The cluster also provides workload mobility and flexibility with the use of VMware vMotion and Storage vMotion technology.

VMware vSphere Hypervisor ESXi

The VMware vSphere Hypervisor ESXi runs on the Management Appliance and Converged Systemss servers using VMware vSphere Enterprise Plus.

The lightweight hypervisor requires little space to run (less than 6 Gb of storage required to install) with minimal management overhead.

By default, the hypervisor is installed on a 64 Gb Cisco FlexFlash SD Card (mirrored HV partition). All Cisco FlexFlash (boot) capable hosts are configured with a minimum of two 64 Gb SD cards.

The compute hypervisor supports 4–6 10 GbE physical NICs (pNICS) on the VxBlock System 1000 VICs.

VMware vSphere ESXi does not contain a console operating system. The VMware vSphere Hypervisor ESXi boots from Cisco FlexFlash SD cards. The stateless hypervisor (PXE boot into memory) is not supported.

Cluster configurations

VMware vSphere ESXi hosts and their resources are pooled together into clusters.

These clusters contain the CPU, memory, network, and storage resources available for allocation to VMs. Clusters can scale up to a maximum of 64 hosts, enabling the support for thousands of VMs.

The clusters can also support various Cisco UCS blades running inside the same cluster. Some advanced CPU functionality might be unavailable if more than one blade model is running in a given cluster.

Datastores

The VxBlock System 1000 supports a mixture of datastore types: block level storage using VMFS or file level storage using NFS.
The maximum size per VMFS5/VMFS6 volume is 64 Tb (50 Tb VMFS3 @ 1 Mb), with a maximum VMDK file size of 62 Tb. Each host can support a maximum of 512 VMFS volumes and/or a maximum of 256 NFS datastores.

Dell EMC optimizes advanced settings for VMware vSphere ESXi hosts deployed in the VxBlock 1000 to maximize the throughput and scalability of VMFS and NFS datastores.

**Virtual networks**

VMware Virtual Distributed Switch (VDS) provides virtual networking and uses a minimum of four uplinks presented to the hypervisor.

vNICs are equally distributed across all available physical adapter ports to ensure redundancy and maximum bandwidth where appropriate. This distribution provides general consistency and balance across all Cisco UCS B-series and C-series models, regardless of the Cisco UCS Virtual Interface Card (VIC) hardware.

VMware vSphere ESXi has a predictable uplink interface count. All applicable VLANs, native VLANs, MTU settings, and QoS policies are assigned to the vNIC to ensure consistency if uplinks require migration to VMware VDS after manufacturing.

**VMware vCenter Server**

VMware vCenter Server is a central management point for the hypervisors and VMs. VMware vCenter Server 6.5 resides on the VMware vCenter Server Appliance (vCSA).

By default, VMware vCenter Server is deployed using the VMware vCSA. VMware vCenter Update Manager is fully integrated with the VMware vCSA and runs as a service to assist with host patch management.

AMP-VX and the VxBlock System 1000 each have a VMware vCSA instance with a pair of VMware Platform Service Controllers (PSCs). Both the AMP-VX and the VxBlock 1000 VMware vCenter instances are hosted by the AMP-VX management appliance. VMware vCenter Server provides the following functionality:

- Clone VMs
- Create templates
- VMware vSphere vMotion and VMware Storage vMotion
- Initially configure VMware Distributed Resource Scheduler (DRS) and VMware vSphere high-availability clusters

The AMP-3S and the VxBlock 1000 share a VMware vCSA instance with a pair of VMware PSCs. AMP-3S and VMware vCenter Server is hosted by the AMP-3S management appliance using a Dell EMC Unity 300 array for iSCSI storage.

VMware vCenter Server provides the following functionality:

- Cloning of VMs
- Creating templates
- VMware vSphere vMotion and VMware Storage vMotion
• Initial configuration of VMware DRS and VMware vSphere high availability clusters

VMware vCenter Server provides monitoring and alerting capabilities for hosts and VMs. Converged System administrators can create and apply the following alarms to all managed objects in VMware vCenter Server:

• Data center, cluster, and host health, inventory, and performance
• Datastore health and capacity
• VM usage, performance, and health
• Virtual network usage and health

**Databases**

The VMware vCSA uses the embedded PostgreSQL database. The VMware vCenter Update Manager and the VMware vCSA share the same PostgreSQL database server, but use separate PostgreSQL database instances.

**Authentication**

VxBlock 1000 supports the VMware Single Sign-On (SSO) Service capable of integrating multiple identity sources including AD, Open LDAP, and authenticating local accounts. VMware vSphere 6.5 includes a pair of VMware PSC Linux appliances to provide the VMware SSO service. VMware vCenter Server, Inventory, Web Client, VMware SSO, Core Dump Collector, and Update Manager run as separate services. Each service can be configured to use a dedicated service account depending on the security and directory services requirements.

**Supported VMware vCenter Server features**

Dell EMC supports the following VMware vCenter Server features:

• VMware SSO
• VMware PSC
• VMware vSphere Web Client (used with VxBlock Central)
• VMware vSphere Distributed Switch (VDS)
• VMware vSphere HA
• VMware DRS
• VMware Fault Tolerance
• VMware vSphere vMotion
• VMware Storage vMotion
• VMware Storage vMotion (Layer 3 capability available for compute resources)
• Raw Device Mappings
• Resource Pools
• Storage DRS (capacity only)
• Storage driven profiles (user-defined only)
• Distributed power management (up to 50 percent of VMware vSphere ESXi hosts/blades)
• VMware Syslog Service
• VMware Core Dump Collector
• VMware vCenter Web Client
VxBlock System 1000 sample configurations

Cabinet elevations vary based on the specific configuration requirements.

VxBlock System 1000 with AMP-3S

Elevations are provided for sample purposes only. For specifications for a specific design, consult your vArchitect.

Cabinet 1
Cabinet 3

RU 42  Patch Panel C
RU 41  Reserved for system expansion
RU 40  VMAX SPS 1-1_3
RU 39  VMAX InfiniBand Switch 1B
RU 38  VMAX InfiniBand Switch 1A
RU 37  Reserved for system expansion
RU 36  VMAX All Flash Engine 1-1
RU 35  Reserved for system expansion
RU 34  VMAX All Flash Engine 1-2
RU 33  VMAX KVM 1
RU 32  VMAX Ethernet Switch 1
RU 31  Reserved for system expansion
RU 30  VMAX SPS 1-1_2
RU 29  VMAX All Flash DAE 1-1_4
RU 28  VMAX All Flash DAE 1-1_3
RU 27  VMAX All Flash DAE 1-1_2
RU 26  VMAX All Flash DAE 1-1_1
RU 25  VMAX All Flash DAE 1-1_1
RU 24  VMAX All Flash DAE 1-1_1
VxBlock System 1000 with Dell EMC Unity 350F storage

Elevations are provided for sample purposes only. For specifications for a specific design, consult your vArchitect.

VxBlock System 1000 with Dell EMC Unity and Isilon Gen 6 storage

Elevations are provided for sample purposes only. For specifications for a specific design, consult your vArchitect.
Cabinet 1

RU 42: Patch Panel A
RU 41: Duct
RU 40: Cisco Nexus 31108TC-V Switch 1A
RU 39: Cable Management
RU 38: PowerEdge R640 Controller 1B
RU 37: PowerEdge R640 Controller 1A
RU 36: Data Domain Controller 1
RU 34: Disk Array Enclosure 1-1_3
RU 33: Disk Array Enclosure 1-0_3
RU 32: Disk Array Enclosure 1-1_2
RU 31: Disk Array Enclosure 1-0_2
RU 29: Disk Array Enclosure 1-1_1
RU 28: Disk Array Enclosure 1-0_1
RU 27: Disk Array Enclosure 1-1_0
RU 26: Disk Array Enclosure 1-1_0
RU 25: Dell EMC Unity All Flash DPE 1
RU 24: Duct
RU 17: Cisco MDS 9306S Multilayer Fabric Switch 1A
RU 16: Duct
RU 15: Cisco Nexus 9336C-FX2 Switch 1A
RU 14: Duct
RU 12: Cisco UCS 6332-16UP Fabric Interconnect 1A
RU 11: Cisco Nexus 2348UPQ Switch 1A
RU 10: Cable Management
RU 9: Cisco UCS C220 Server M4 1H
RU 8: Cisco UCS C220 Server M4 1G
RU 7: Cisco UCS C220 Server M4 1F
RU 6: Cisco UCS C220 Server M4 1E
RU 5: Reserved for system expansion
RU 4: Cisco UCS C220 Server M4 1D
RU 3: Cisco UCS C220 Server M4 1C
RU 2: Cisco UCS C220 Server M4 1B
RU 1: Cisco UCS C220 Server M4 1A
Cabinet 2

RU 42  Patch Panel B
RU 41  Duct
RU 40  Cisco Nexus 31108TC-V Switch 1B
RU 39  Cable Management
RU 38  PowerEdge R640 Controller 1D
RU 37  PowerEdge R640 Controller 1C
RU 36  Support Shelf
RU 35
RU 34
RU 33
RU 32
RU 31
RU 30
RU 29  Reserved for system expansion
RU 28
RU 27
RU 26
RU 25
RU 24
RU 23
RU 22  Disk Array Enclosure 1-1_4
RU 21
RU 20  Disk Array Enclosure 1-0_4
RU 19
RU 18  Duct
RU 17  Cisco MDS 9395S Multilayer Fabric Switch 1B
RU 16
RU 15  Duct
RU 14  Cisco Nexus 9336C-FX2 Switch 1B
RU 13  Duct
RU 12  Cisco UCS 6332-16UP Fabric Interconnect 1B
RU 11  Cisco Nexus 2348UPQ Switch 1B
RU 10  Cable Management
RU 9  Cisco UCS C220 Server M4 1P
RU 8  Cisco UCS C220 Server M4 1O
RU 7  Cisco UCS C220 Server M4 1N
RU 6  Cisco UCS C220 Server M4 1M
RU 5  Reserved for system expansion
RU 4  Cisco UCS C220 Server M4 1L
RU 3  Cisco UCS C220 Server M4 1K
RU 2  Cisco UCS C220 Server M4 1J
RU 1  Cisco UCS C220 Server M4 1I
Cabinet 3

VxBlock System 1000 with PowerMax 2000 storage

Elevations are provided for sample purposes only. For specifications for a specific design, consult your vArchitect.
Cabinet 1

RU 42  Patch Panel A
RU 41  Duct
RU 40  Cisco Nexus 31108TC-V Switch 1A
RU 39  Cable Management
RU 38  PowerEdge R640 Controller 1B
RU 37  PowerEdge R640 Controller 1A
RU 36  Data Domain Controller 0
RU 35  Reserved for system expansion
RU 34
RU 33
RU 32
RU 31
RU 30
RU 29
RU 28  PowerMax Drive Array Enclosure 1-2
RU 27
RU 26  PowerMax Drive Array Enclosure 1-1
RU 25
RU 24
RU 23
RU 22  PowerMax Engine 1-1
RU 21
RU 20
RU 19  PowerMax SFS 1-3
RU 18  Duct
RU 17  Cisco MDS 9396S Multilayer Fabric Switch 1A
RU 16
RU 15  Duct
RU 14  Cisco Nexus 9336C-FX2 Switch 1A
RU 13  Cisco UCS 6332-16UP Fabric Interconnect 1A
RU 12  Cable Management
RU 11  Cisco UCS C220 Server M5 1C
RU 10  Cable Management
RU 9
RU 8  Cisco UCS C240 Server M5 1A
RU 7  Cable Management
RU 6
RU 5
RU 4  Cisco UCS 5108 Blade Server Chassis 1A
RU 3
RU 2
RU 1
VxBlock System 1000 with PowerMax 8000 storage

Elevations are provided for sample purposes only. For specifications for a specific design, consult your vArchitect.
Cabinet 2

RU 42  Patch Panel B
RU 41  Duct
RU 40  Cisco Nexus 31108TC-V Switch 1B
RU 39  Cable Management
RU 38  PowerEdge R640 Controller 1D
RU 37  PowerEdge R640 Controller 1C
RU 36  Support Shelf
RU 35
RU 34
RU 33
RU 32
RU 31
RU 30
RU 29
RU 28  Reserved for system expansion
RU 27
RU 26
RU 25
RU 24
RU 23
RU 22
RU 21
RU 20  Duct
RU 19
RU 18
RU 17  Duct
RU 16  Cisco Nexus 9336-C-FX2 Switch 1B
RU 15  Cisco UCS 6332-16UP Fabric Interconnect 1B
RU 14  Cable Management
RU 13  Cisco UCS C220 Server M5 1P
RU 12  Cisco UCS C220 Server M5 1O
RU 11  Cisco UCS C220 Server M5 1N
RU 10  Cisco UCS C220 Server M5 1M
RU 9   Cable Management
RU 8   Cisco UCS C240 Server M5 1H
RU 7   Cisco UCS C240 Server M5 1G
RU 6   Cisco UCS C240 Server M5 1F
RU 5   Cisco UCS C240 Server M5 1E
RU 4   Cisco UCS C240 Server M5 1D
RU 3   Cisco UCS C240 Server M5 1C
RU 2   Cisco UCS C240 Server M5 1B
RU 1   Cisco UCS C240 Server M5 1A
VxBlock System 1000 with VMAX 950F storage

Elevations are provided for sample purposes only. For specifications for a specific design, consult your vArchitect.
Cabinet 2

RU 42  Patch Panel B
RU 41  Duct
RU 40  Cisco Nexus 31108TC-V Switch 1B
RU 39  Cable Management
RU 38  PowerEdge R640 Controller 1D
RU 37  PowerEdge R640 Controller 1C
RU 36  Support Shelf
RU 35
RU 34
RU 33
RU 32
RU 31
RU 30
RU 29
RU 28
RU 27
RU 26
RU 25
RU 24
RU 23
RU 22
 Reserved for system expansion
RU 21  Duct
RU 20  Cisco MDS 9395S Multilayer Fabric Switch 1B
RU 19
RU 18  Duct
RU 17  Cisco Nexus 9336C-FX2 Switch 1B
RU 16  Cisco UCS 6332-16UP Fabric Interconnect 1B
RU 15  Cable Management
RU 14  Cisco UCS C220 Server M4 1L
RU 13  Cisco UCS C220 Server M4 1K
RU 12  Reserved for system expansion
RU 11  Cisco UCS C220 Server M4 1J
RU 10  Cisco UCS C220 Server M4 1L
RU  9  Cisco UCS C220 Server M4 1H
RU  8  Cisco UCS C220 Server M4 1G
RU  7  Cable Management
RU  6
RU  5
RU  4  Cisco UCS 5108 Blade Server Chassis 1B
RU  3
RU  2
RU  1
**VxBlock System 1000 with XtremIO X2 storage**

Elevations are provided for sample purposes only. For specifications for a specific design, consult your vArchitect.
Cabinet 1

RU 42 | Patch Panel A
RU 41 | Duct
RU 40 | Cisco Nexus 31108TC-V Switch 1A
RU 39 | Cable Management
RU 38 | PowerEdge R640 Controller 1B
RU 37 | PowerEdge R640 Controller 1A
RU 36 | Data Domain Controller 0
RU 34
RU 33
RU 32
RU 31
RU 30
RU 29
RU 28
RU 27
RU 26
RU 24 | Duct
RU 23 | Cisco MDS 9148S Multilayer Fabric Switch 1A
RU 22 | Duct
RU 21 | Cisco Nexus 9336C-FX2 Switch 1A
RU 20 | Cisco UCS 6332-16UP Fabric Interconnect 1A
RU 19 | Cable Management
RU 18 | Cisco UCS C220 Server M5 1J
RU 17 | Cisco UCS C220 Server M5 1I
RU 16 | Cable Management
RU 15 | Cisco UCS C240 Server M5 1D
RU 14 | Cisco UCS C240 Server M5 1C
RU 13
RU 12
RU 11
RU 10 | Cisco UCS C240 Server M5 1B
RU 09
RU 08 | Cisco UCS C240 Server M5 1A
RU 07 | Cable Management
RU 06
RU 05
RU 04 | Cisco UCS 5108 Blade Server Chassis 1A
RU 03
RU 02
RU 01

Reserved for system expansion
Cabinet 2

RU 42  Patch Panel B
RU 41  Duct
RU 40  Cisco Nexus 31108TC-V Switch 1B
RU 39  Cable Management
RU 38  PowerEdge R640 Controller 1D
RU 37  PowerEdge R640 Controller 1C
RU 36  Support Shelf
RU 35
RU 34
RU 33
RU 32
RU 31
RU 30
RU 29
RU 28
RU 27  Reserved for system expansion
RU 26
RU 25
RU 24
RU 23
RU 22
RU 21
RU 20
RU 19
RU 18
RU 17  Duct
RU 16  Cisco MDS 9143S Multilayer Fabric Switch 1B
RU 15  Duct
RU 14  Cisco Nexus 9336C-FX2 Switch 1B
RU 13  Cisco UCS 6332-16UP Fabric Interconnect 1B
RU 12  Cable Management
RU 11  Cisco UCS C220 Server M5 1L
RU 10  Cisco UCS C220 Server M5 1K
RU  9  Cable Management
RU  8  Cisco UCS C240 Server M5 1H
RU  7  Cisco UCS C240 Server M5 1G
RU  6  Cisco UCS C240 Server M5 1F
RU  5  Cisco UCS C240 Server M5 1E
RU  4
RU  3
RU  2
RU  1  Cisco UCS C240 Server M5 1E
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