

## ThinkSystem SD650 Direct Water Cooled Server Product Guide

The ThinkSystem SD650 direct water cooled server is an open, flexible, and simple data center solution for users of technical computing, grid deployments, analytics workloads, and large-scale cloud and virtualization infrastructures. The direct water cooled solution is designed to operate by using warm water, up to 45°C (113°F). Chillers are not needed for most customers, meaning even greater savings and a lower total cost of ownership.

The ThinkSystem SD650 server and the n1200 DWC enclosure are designed to optimize density and performance within typical data center infrastructure limits. The n1200 DWC enclosure is a 6U rack mount unit that fits in a standard 19-inch rack and houses up to 12 water-cooled servers in 6 trays.

The two ThinkSystem SD650 servers are shown installed in a tray in the following figure.

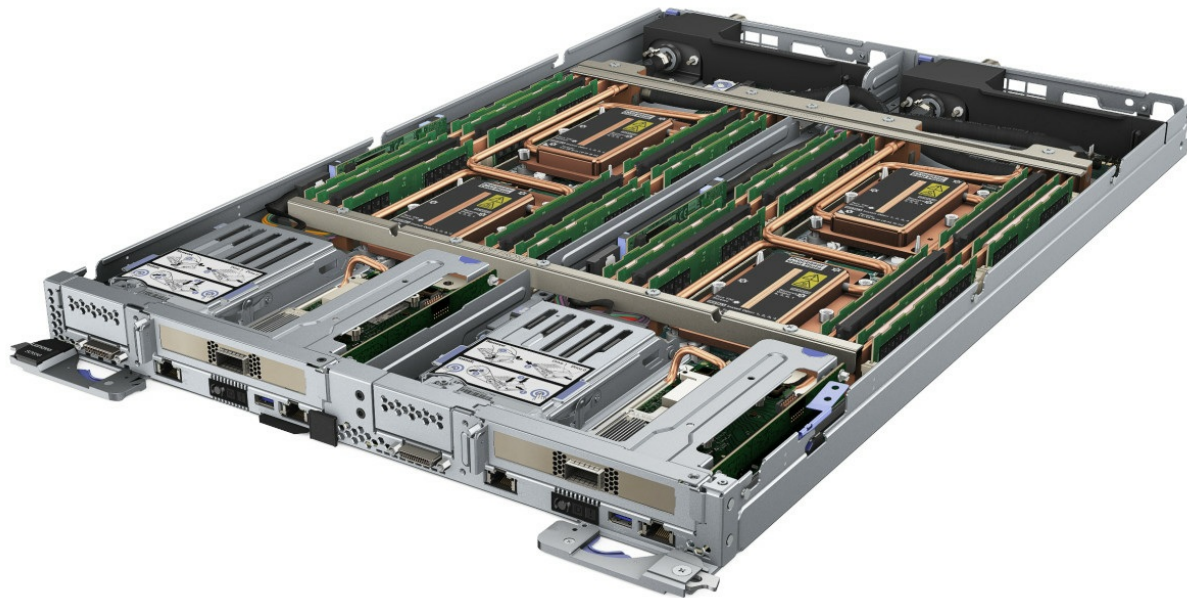


Figure 1. Two Lenovo ThinkSystem SD650 servers on the Compute Tray that provides water cooling

### Did you know?

The ThinkSystem SD650 server and n1200 DWC enclosure with direct water cooling provide the ultimate in data center cooling efficiencies and performance. You can obtain upwards of 40% energy savings in data center expenses with the reduced need for air conditioning and air chillers. Direct water cooling means that the processors installed in the servers can enable the Intel Turbo Boost performance feature more often to further increase processor performance.

## Key features

The ThinkSystem SD650 direct water cooled offering is a dense platform from Lenovo that achieves maximum performance with innovative warm-water cooling functionality. The DWC offering includes a dense chassis and two half-wide compute nodes on a compute tray, all fitting in a standard rack.

With direct water cooling, Lenovo drives increased compute density, performance, and cooling efficiency for High Performance Computing and other workloads that require dense compute performance, such as Cloud, Grid, and Analytics. Direct water cooling is achieved by circulating the cooling water directly through cold plates that contact the CPU thermal case, DIMMs, and other high-heat-producing components in the server.

One of the main advantages of direct water cooling is the water can be relatively warm and still be very effective, as water conducts heat much more effectively than air. Depending on the server configuration, 85 - 90% of the heat is removed by water cooling; the rest can easily be managed by a standard computer room air conditioner. With allowable inlet temperatures for the water being as high as 45°C (113°F), in many cases the water can be cooled by using ambient air and chilled water and a heat exchanger is not required.

The rear view of the two ThinkSystem SD650 servers in the water-cooled tray is shown in the following figure.

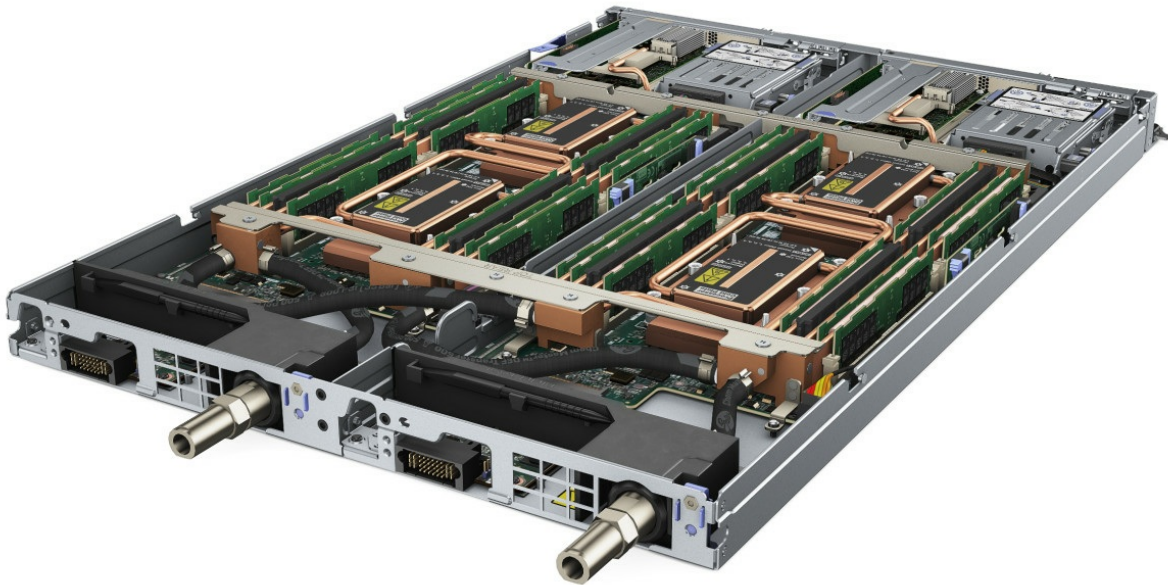


Figure 2. Rear view of two SD650 servers showing the water inlet and outlet

Designed to industry-standards, the SD650 is a general-purpose platform that is designed to give customers a flexible IT infrastructure. Customized solutions can be configured to provide an application-appropriate platform with a choice of servers, networking switches, adapters, and racks.

ThinkSystem SD650 servers provide a dense, flexible solution with a low TCO. The half-wide, dual-socket server is designed for data centers that require high performance but are constrained by floor space. By taking up less physical space in the data center, the SD650 enhances density and supports the Intel Xeon Scalable Family of processors up to 28 cores and 205 W TDP. The SD650 is designed to support future processors of up to 245 W, thus providing for even more performance per server. The SD650 contains only essential components in the base architecture to provide a cost-optimized platform.

The NeXtScale n1200 DWC Enclosure is an efficient, 6U, 12-node chassis with no built-in networking or switching capabilities; therefore, it requires no chassis-level management. Sensibly designed to provide shared, high-efficiency power and cooling for housed servers, the n1200 DWC enclosure is designed to scale with your business needs.

### **Scalability and performance**

The ThinkSystem SD650 server NeXtScale n1200 DWC chassis offer the following features to boost performance, improve scalability, and reduce costs:

- Up to 12 compute nodes, each with two of the latest Intel Xeon Scalable Family processors, 12 TruDDR4 DIMMs, and one PCIe slot, up to two drive bays, in 6U of rack space. It is a highly dense, scalable, and price-optimized offering.
- The Intel Xeon Scalable Family processors improves productivity by offering superior system performance. Supported processors have up to 28 cores, core speeds of up to 3.9 GHz, L3 cache sizes of up to 38.5 MB, DDR4 memory operating at 2666 MHz, and UPI interconnect links running at 10.4 GTps.
- Two processors, up to 56 cores, and up to 112 threads maximize the concurrent execution of multi-threaded applications.
- Intelligent and adaptive system performance with Intel Turbo Boost Technology 2.0 allows CPU cores to run at maximum speeds during peak workloads by temporarily going beyond processor TDP.
- By providing better cooling than possible with air cooling, direct water cooled servers optimize Turbo Boost 2.0 enablement. With water cooling, it may be possible to operate the processors in continuous Turbo mode.
- Intel Hyper-Threading Technology boosts performance for multithreaded applications by enabling simultaneous multithreading within each processor core, up to two threads per core.
- Intel Virtualization Technology integrates hardware-level virtualization hooks that allow operating system vendors to better use the hardware for virtualization workloads.
- Intel Advanced Vector Extensions 512 (AVX-512) enable acceleration of enterprise-class workloads, including databases, and enterprise resource planning.
- Supports "F"-suffix processors with embedded PCIe x16 Omni Path fabric for high-performance networking with a lower-cost OPA implementation.
- Each processor has six memory channels with memory speeds of up to 2666 MHz to maximize system performance.
- A total of 12 DIMMs of registered 2666 MHz TruDDR4 ECC memory provide speed, high availability, and a memory capacity of up to 1.5 TB.
- One full-height half-length PCIe 3.0 x16 slot. Supports an Intel Omni-Path Architecture (OPA) adapter or Mellanox ConnectX-5 VPI adapter delivering ultra-high performance connectivity.
- Planned support for an additional mezzanine LOM Generation 2 (ML2) slot, which is also x16 PCIe Gen 3. The ML2 slots supports NC-SI for out-of-band systems management.
- Supports SATA or NVMe SSDs drives to maximize I/O performance in terms of throughput, bandwidth, and latency.
- Supports a new Lenovo patented-design M.2 adapter for convenient operating system boot functions. Available M.2 adapters support either one M.2 drive or two M.2 drives in a RAID 1 configuration for boot drive performance and reliability.
- The use of solid-state drives (SSDs) instead of, or along with, traditional hard disk drives (HDDs) can improve I/O performance. An SSD can support up to 100 times more I/O read operations per second (IOPS) than a typical HDD.
- PCI Express 3.0 I/O expansion capabilities improve the theoretical maximum bandwidth by 60% compared with the previous generation of PCI Express 2.0.

## Energy efficiency

The direct water cooled solution offers the following energy efficiency features to save energy, reduce operational costs, increase energy availability, and contribute to a green environment:

- Water cooling eliminates power that is drawn by cooling fans in the chassis and dramatically reduces the required air movement in the server room, which also saves power. Savings as much as 40% are possible in the data center due to the reduced need for air conditioning.
- Water chillers may not be required with a direct water cooled solution. Chillers are a major expense for most geographies and can be reduced or even eliminated because the water temperature can now be 45°C instead of 18°C in an air-cooled environment. For special bid situations, the solution can operate with inlet water temperatures of up to 50°C.
- 85-90% heat recovery is possible with the DWC design. Heat energy absorbed may be reused for heating buildings in the winter for further operating expense savings.
- The processors and other microelectronics are run at lower temperatures because they are water cooled, which uses less power.
- 80 Plus Platinum and Titanium power supplies ensure energy efficiency.
- Intel Intelligent Power Capability can power on and off individual processor elements as needed to reduce power draw.
- Low-voltage 1.2 V DDR4 memory DIMMs use up to 20% less energy than 1.35 V DDR3 DIMMs.
- There are power monitoring and power capping capabilities through the FPC in the chassis
- Optional Lenovo XClarity Energy Manager provide advanced data center power notification, analysis, and policy-based management to help achieve lower heat output and reduced cooling needs.

## Manageability and security

The following powerful systems management features simplify local and remote management of the SD650 server:

- The server includes an XClarity Controller (XCC) to monitor server availability. Optional upgrade to XCC Advanced to provide remote control (keyboard video mouse) functions. Optional upgrade to XCC Enterprise enables the additional support for the mounting of remote media files (ISO and IMG image files), boot capture, and power capping.
- Lenovo XClarity Administrator offers comprehensive hardware management tools that help to increase uptime, reduce costs and improve productivity through advanced server management capabilities.
- New UEFI-based Lenovo XClarity Provisioning Manager, accessible from F1 during boot, provides system inventory information, graphical UEFI Setup, platform update function, RAID Setup wizard, operating system installation function, and diagnostic functions.
- Support for Lenovo XClarity Energy Manager which captures real-time power and temperature data from the server and provides automated controls to lower energy costs.
- Integrated Trusted Platform Module (TPM) 2.0 support enables advanced cryptographic functionality, such as digital signatures and remote attestation.
- Supports Secure Boot to ensure only a digitally signed operating system can be used. Supported on standard drives as well as M.2 drives in the M.2 Adapter.
- Industry-standard Advanced Encryption Standard (AES) NI support for faster, stronger encryption.
- Intel Execute Disable Bit functionality can prevent certain classes of malicious buffer overflow attacks when combined with a supported operating system.
- Intel Trusted Execution Technology provides enhanced security through hardware-based resistance to malicious software attacks, allowing an application to run in its own isolated space, protected from all other software running on a system.

- The n1200 DWC chassis includes drip sensors that monitor the inlet and outlet manifold quick connect couplers; leaks are reported via the Fan and Power Controller (FPC).

### **Availability and serviceability**

The SD650 server and NeXtScale n1200 DWC chassis provide the following features to simplify serviceability and increase system uptime:

- The NeXtScale n1200 DWC chassis supports N+N and N+1 power policies for its six power supplies, which means greater system uptime.
- The power supplies are hot-swappable.
- Toolless cover removal provides easy access to upgrades and serviceable parts, such as adapters and memory.
- The server offers Single Device Data Correction (SDDC, also known as Chipkill), Adaptive Double-Device Data Correction (ADDDC, also known as Redundant Bit Steering or RBS), memory mirroring, and memory rank sparing for redundancy in the event of a non-correctable memory failure.
- The Dual M.2 Boot Adapter supports RAID-1 which enables two installed M.2 drives to be configured as a redundant pair.
- Proactive Platform Alerts (including PFA and SMART alerts): Processors, voltage regulators, memory, internal storage (HDDs and SSDs, NVMe SSDs, M.2 storage), fans, power supplies, and server ambient and subcomponent temperatures. Alerts can be surfaced through the XClarity Controller to managers such as Lenovo XClarity Administrator and other standards-based management applications. These proactive alerts let you take appropriate actions in advance of possible failure, thereby increasing server uptime and application availability.
- The XCC offers optional remote management capability and can enable remote keyboard, video, and mouse (KVM) control and remote media for the server.
- The power source-independent light path diagnostics functionality provides individual light path LEDs that lead the technician to failed (or failing) components, which simplifies servicing, speeds up problem resolution, and helps increase system availability.
- Built-in diagnostics in UEFI, using Lenovo XClarity Provisioning Manager, speed up troubleshooting tasks to reduce service time.
- Lenovo XClarity Provisioning Manager supports diagnostics and can save service data to a USB key drive or remote CIFS share folder for troubleshooting and reduce service time.
- Auto restart in the event of a momentary loss of AC power (based on power policy setting in the XClarity Controller service processor)
- There is a three-year customer replaceable unit and onsite limited warranty, with next business day 9x5 coverage. Optional warranty upgrades and extensions are available.
- With water cooling, system fans are not required; only small power supply fans operate. This results in significantly reduced noise levels on the data center floor, a significant benefit to personnel having to work on site.



## Components and connectors

The front of the SD650 tray (two servers) is shown in the following figure.

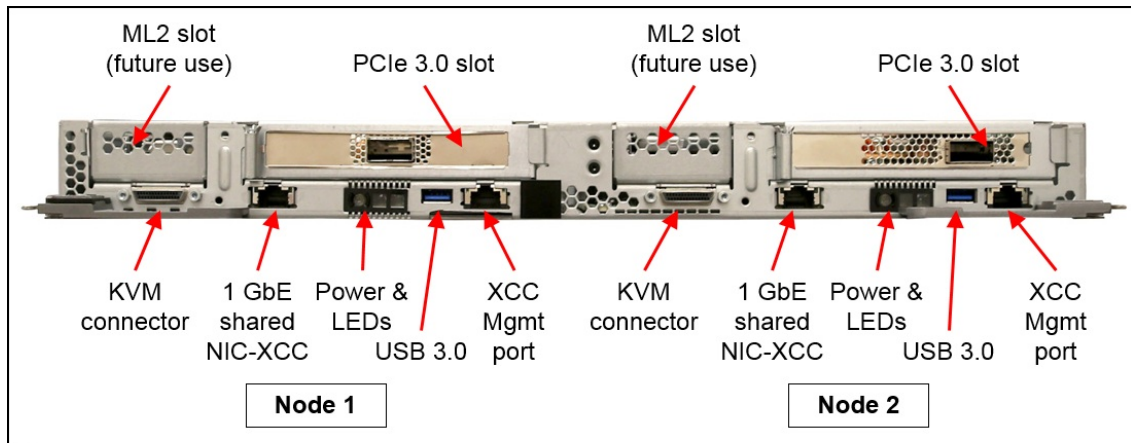


Figure 3. Front view of ThinkSystem SD650 tray (two independent servers)

The following figure shows the locations of key components inside the server.

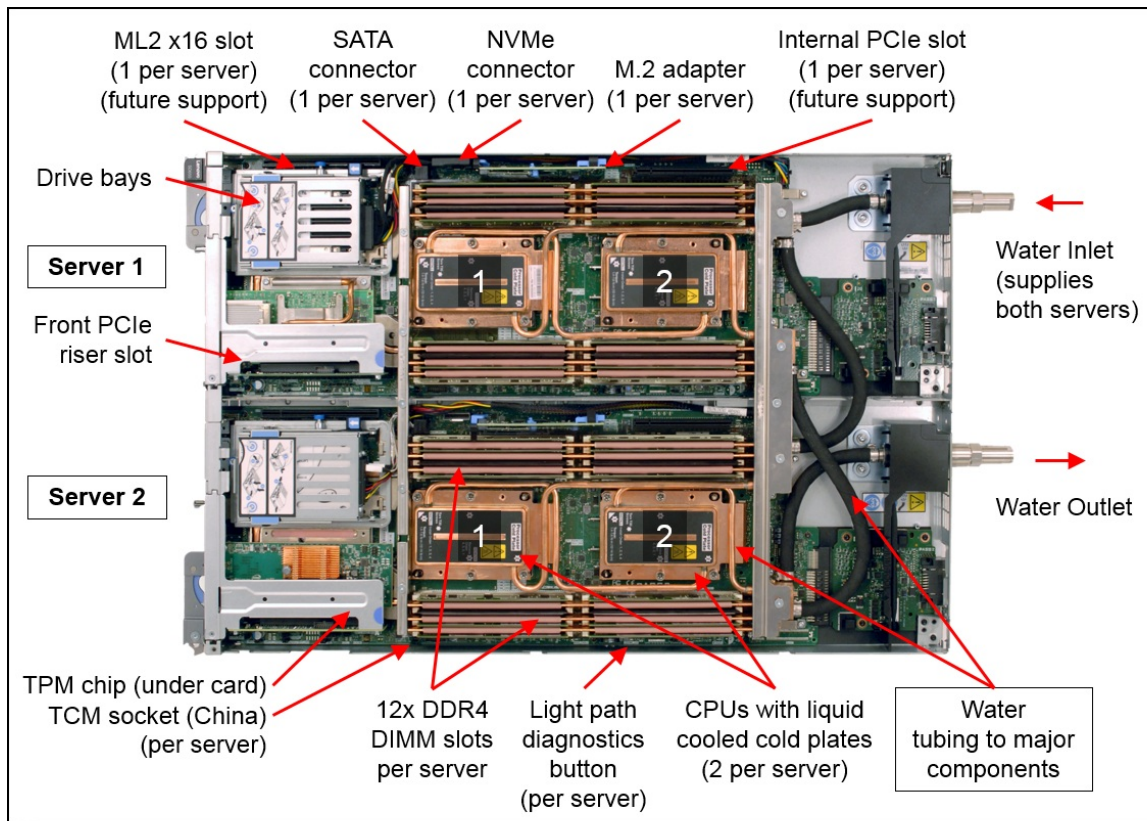


Figure 4. Inside view of two SD650 servers in the water cooled tray

The compute nodes are installed in the NeXtScale n1200 DWC enclosure, as shown in the following figure.



Figure 5. Front view of the n1200 DWC enclosure

The rear of the enclosure contains the power supplies, cooling water manifolds, and the Fan and Power Controller, as shown in the following figure.

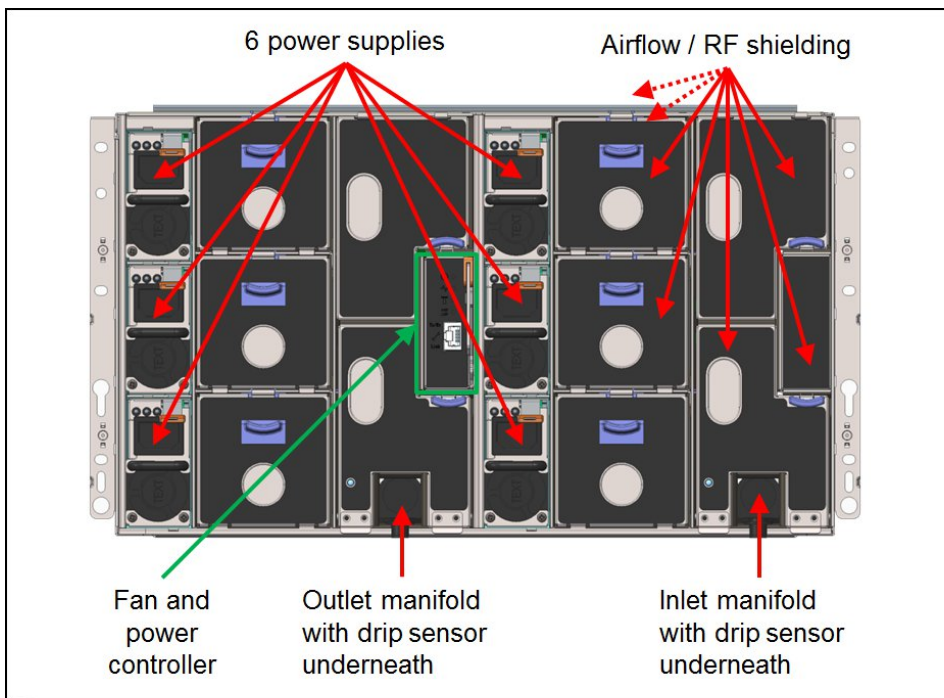


Figure 6. Rear view of the n1200 DWC enclosure

## System architecture

The following figure shows the architectural block diagram of the SD650, showing the major components and their connections.

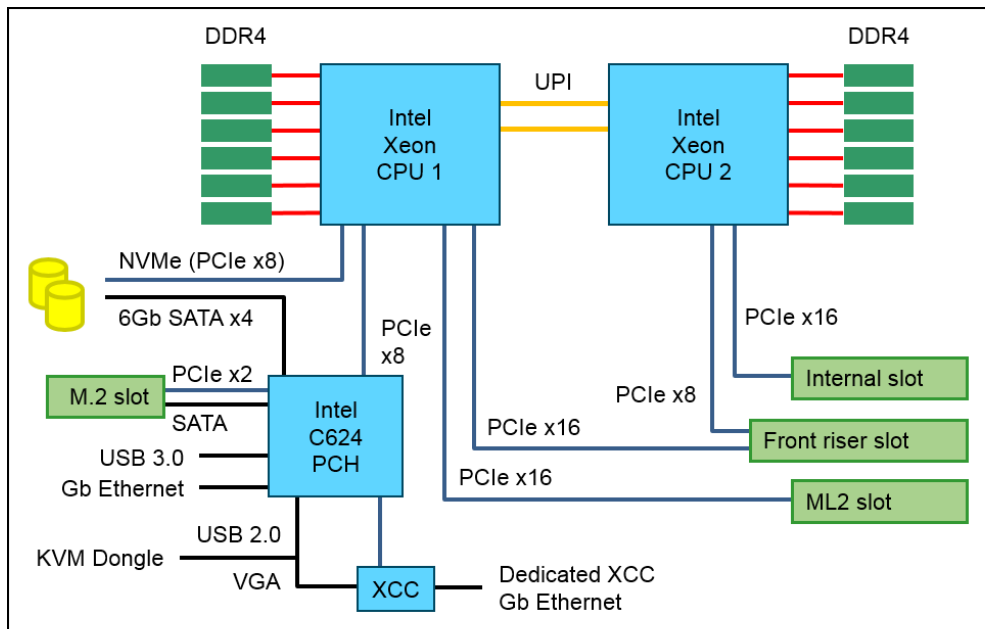


Figure 7. SD650 system architectural block diagram

## Standard specifications - SD650

The following table lists the standard specifications of the SD650 server.

Table 1. Standard specifications - SD650

Components	Specification
Machine type	7X58 for the compute tray, comprised of two independent servers
Form factor	Half-wide, 1U server. 2 server per full wide 1U compute tray.
Processor	Each server: Two Intel Xeon Processor Scalable Family of processors, either Gold or Platinum level processors (formerly codename "Skylake"). Supports processors with up to 28 cores, core speeds up to 3.9 GHz, and TDP ratings up to 205W. Supports "F"-suffix processors with embedded Omni Path fabric.
Chipset	Intel C624 chipset (formerly codename "Lewisburg")
Memory	Each server: 12 DIMM sockets (6 DIMMs per processor). Lenovo TruDDR4 RDIMMs, LRDIMMs and 3DS RDIMMs are supported. Each processor has 6 memory channels, with 1 DIMM per channel.
Memory maximum	Up to 1.5 TB memory with 12x 128 GB 3DS RDIMMs
Memory protection	ECC, SDDC (for x4-based memory DIMMs), ADDDC (for x4-based memory DIMMs), memory mirroring, and memory sparing.



<b>Components</b>	<b>Specification</b>
Disk drive bays	<p>Each server supports either of:</p> <ul style="list-style-type: none"> <li>• Two 7mm SATA SSDs</li> <li>• One 15mm SATA SSD or NVMe SSD (SATA HDD supported via Special Bid)</li> </ul> <p>In addition, the server supports M.2 drives with the addition of an M.2 adapter.</p> <p>Note: Drive bays are mutually exclusive with the use of the ML2 slot.</p>
Maximum internal storage	Each server: 3.84 TB using two 1.92 GB Enterprise Mainstream SATA 2.5" SSDs.
Storage controllers	<p>6 Gbps SATA:</p> <ul style="list-style-type: none"> <li>• Onboard SATA AHCI (non-RAID).</li> <li>• RAID 0 and 1 with the onboard SATA RAID (Intel RSTe)</li> </ul> <p>PCIe x4 NVMe:</p> <ul style="list-style-type: none"> <li>• Onboard NVMe</li> <li>• No RAID support</li> </ul> <p>Optional M.2 adapter:</p> <ul style="list-style-type: none"> <li>• Single M.2 Adapter: 1x M.2 drive, no RAID</li> <li>• Dual M.2 Adapter: 1 or 2x M.2 drives, RAID 0 or 1 with two drives</li> </ul>
Optical drive bays	None. Support for an external USB DVD RW Optical Disk Drive (See <a href="#">Optical drives</a> ).
Network interfaces	<p>Each server:</p> <ul style="list-style-type: none"> <li>• One Gigabit Ethernet port with an RJ45 connector, based on the Intel Ethernet Connection X722, shared between the operating system and the XClarity Controller (XCC) management processor.</li> <li>• One Gigabit Ethernet port dedicated for use with the XCC management processor.</li> <li>• Optional network adapters for high-speed InfiniBand or Omni Path Architecture (OPA) communications</li> </ul> <p>Enclosure:</p> <ul style="list-style-type: none"> <li>• 10/100 Mb Ethernet port dedicated for use with the Fan and Power Controller (FPC) for systems management</li> </ul>
PCI Expansion slots	<p>Each server:</p> <ul style="list-style-type: none"> <li>• One PCIe 3.0 x24 front-accessible FHHL slot with riser card</li> </ul> <p>Planned support:</p> <ul style="list-style-type: none"> <li>• One ML2 x16 front-accessible slot with riser card. Supports NC-SI.</li> <li>• One internal PCIe x16 slot</li> </ul>
Ports	Front of the server: KVM connector; with the addition of a console breakout cable (1 cable standard with the chassis) supplies one RS232 serial port, one VGA port, and two USB 1.1 ports for local console connectivity. Two 1 Gbps Ethernet ports with RJ45 connectors (one dedicated to the XCC management processor). 10/100 Mb Ethernet port for use with the Fan and Power Controller at the rear of the chassis.

Components	Specification
Video	Matrox G200 with 16 MB memory integrated into the XClarity Controller. Maximum resolution is 1920x1200 at 60 Hz with 16 bits per pixel.
Security features	Power-on password, administrator's password, Trusted Platform Module (TPM), supporting TPM 1.2 or TPM 2.0. In China only, optional Trusted Cryptographic Module (TCM).
Systems management	Operator panel with status LEDs. Light path diagnostics for local failure detection and reporting. XClarity Controller embedded management, XClarity Administrator centralized infrastructure delivery, XClarity Integrator plugins, and XClarity Energy Manager centralized server power management. Optional XClarity Controller Advanced to enable remote control functions.
Operating systems supported	Red Hat Enterprise Linux and SUSE Linux Enterprise Server. See the <a href="#">Operating system support</a> section for specific versions.
Limited warranty	Three-year customer-replaceable unit and onsite limited warranty.
Service and support	Optional service upgrades are available through Lenovo Services: 4-hour or 2-hour response time, 6-hour fix time, 1-year or 2-year warranty extension, software support for Lenovo hardware and some third-party applications.
Dimensions	Compute tray width:432 mm (17 in.), height: 41.0 mm (1.6 in.), depth: 658.8 mm (25.9 in.).
Weight	Compute tray (2 servers): 17.2 kg (38 lb)

The SD650 tray is shipped with the following items:

- Documentation flyer

## Standard specifications - Enclosure

The NeXtScale n1200 DWC enclosure provides shared high-efficiency power supplies. The SD650 trays connect to the midplane of the n1200 enclosure. This midplane connection is for power and control only; the midplane does not provide any I/O connectivity.

The following table lists the standard specifications of the enclosure.

Table 2. Standard specifications:NeXtScale n1200 DWC enclosure

Components	Specification
Machine type	5468
Form factor	6U rack-mounted chassis.
Maximum number of servers supported	Up to 12 compute nodes (2 compute nodes on 1 compute tray) per chassis.
Server support	Supports both ThinkSystem SD650 servers and NeXtScale nx360 M5 WCT servers (can coexist in the same enclosure)
Servers per 42U rack	Up to 72 servers in six 6U chassis (36U total, leaving space for top-of-rack switches, UPS units, and so on)
Midplane	Passive midplane provides connections to the 12 servers in the front to the power supplies and fans at the rear. Provides signals to control fan speed, power consumption, and node throttling as needed.

Components	Specification
Fan and Power Controller	The FPC module is the management device for the chassis. Provides integrated systems management functions and controls the power and cooling features of the enclosure. Hot-swappable. Browser and CLI-based user interfaces for remote access via the dedicated 10/100 Mbps Ethernet port. Internal USB memory key for logging and configuration data.
Ports	RJ45 port on the rear of the chassis for 10/100 Ethernet connectivity to the FPC for power and cooling management. Each server has RJ45 Ethernet connectors as well as a KVM connector for USB, video and serial connections.
I/O architecture	None integrated. Use top-of-rack networking and storage switches.
Power supplies	Up to six hot-swap power supplies either 1300 W, 1500 W, or 2000 W. Power supplies installed at the rear of the chassis. Single power domain supplies power to all servers. Optional redundancy (N+1 or N+N) and oversubscription. Integrated 2500 RPM fan. 80 PLUS Platinum certified (1300 W power supply also available as Titanium certified). Built-in overload and surge protection.
Cooling	Direct water cooling supplied by water manifolds connected from the rear of the chassis. Lower-power internal components cooled by power supply fans.
System LEDs	FPC LEDs: Power, Activity, Locator, System error log, Ethernet port LEDs. Power supply LEDs: AC power, DC power, Fault LEDs. Servers have more LEDs.
Security features	Login password for remote connection. Secure Sockets Layer (SSL) security for remote management access. Supports LDAP for authorization. Trusted and signed firmware.
Systems management	Browser-based chassis management through an Ethernet port on the FPC at the rear of the enclosure. Servers provide more management features.
Temperature	<p>Operating water temperature:</p> <ul style="list-style-type: none"> <li>ASHRAE class W4: 2°C - 45°C (35.6°F - 113°F)</li> </ul> <p>Note: The minimum inlet water temperature is data center dependent, that is, the dew point at which condensation occurs. A minimum of 2°C is supported provided ambient air conditions are not such that condensation will occur. A minimum of 18°C is recommended.</p> <p>Operating air temperature:</p> <ul style="list-style-type: none"> <li>ASHRAE class A2 environment: 10°C - 35°C (50°F - 95°F)</li> <li>Derate maximum allowable temperature 1°C/175 m above 950 m</li> </ul> <p>See <a href="#">Operating Environment</a> for more information.</p>
Electrical power	200 V - 240 V ac input (nominal), 50 or 60 Hz
Power consumption	Maximum rated power consumption 9000 W per chassis (using 2000W power supplies)
Power cords	One AC power cord for each power supply, 1.5 m 10 A, IEC320 C14 to C13
Limited warranty	Three-year customer-replaceable unit and onsite limited warranty with 9x5/NBD.
Dimensions	Height: 263.3 mm (10.4 in.) Depth: 914.5 mm (36 in.) Width: 447 mm (17.6 in.)
Weight	Fully configured (stand-alone): approximately 135.5 kg (298 lbs) Empty enclosure (with midplane, FPC, and cables): approximately 25 kg (55 lbs)

The chassis ships with the following items:

- Rail kit
- Four detachable chassis lift handles
- One Console breakout cable (also known as a KVM Dongle)
- Documentation flyer

## Standard models

There are no standard SD650 models; all servers must be configured by using the configure-to-order (CTO) process. The ThinkSystem SD650 machine type is 7X58.

## Enclosure models

There are no standard models of the water-cooled chassis; all NeXtScale n1200 DWC chassis must be configured by using the CTO process. The machine type is 5468.

The water manifold a separate machine type 5469.

## Processor options

The SD650 supports the processors that are listed in the following table. Two processors must be selected - the server is not supported with only one processor installed.

All supported processors have the following features:

- Two AVX-512 units
- UPI links operating at 10.4 GT/s
- Support for Hyper-Threading, Turbo Boost, and Virtualization Technology VT-x and VT-d

Certain processors (those with an "F" suffix) have an embedded Omni Path Architecture (OPA) fabric in the processor. To make use of this embedded fabric, an Intel Omni Path Internal Faceplate Transition (IFT) Interposer Card must be installed and connected to the processor. The IFT adapter is described in the [Network adapters](#) section.

Table 3. Processor support

Feature code	Description*	Memory speed	Supports >768 GB per CPU	Embedded Omni Path	L3 cache
B1D8	Intel Xeon Gold 6126 12C 125W 2.6GHz	2666 MHz	No	No	19.25 MB**
B1CE	Intel Xeon Gold 6126F 12C 135W 2.6GHz	2666 MHz	No	Yes	19.25 MB**
B1DC	Intel Xeon Gold 6126T 12C125W 2.6GHz	2666 MHz	No	No	19.25 MB**
B1D7	Intel Xeon Gold 6130 16C 125W 2.1GHz	2666 MHz	No	No	19.25 MB**
B1CD	Intel Xeon Gold 6130F 16C 135W 2.1GHz	2666 MHz	No	Yes	19.25 MB**
B1DB	Intel Xeon Gold 6130T 16C 125W 2.1GHz	2666 MHz	No	No	22 MB
B1D6	Intel Xeon Gold 6132 14C 140W 2.6GHz	2666 MHz	No	No	19.25 MB
B1D5	Intel Xeon Gold 6134 8C 130W 3.2GHz	2666 MHz	No	No	24.75 MB**
B1D4	Intel Xeon Gold 6136 12C 150W 3.0GHz	2666 MHz	No	No	24.75 MB**
B32F	Intel Xeon Gold 6137 8C 205W 3.9GHz	2666 MHz	No	No	24.75 MB**
B1D3	Intel Xeon Gold 6138 20C 125W 2.0GHz	2666 MHz	No	No	27.5 MB
B1CB	Intel Xeon Gold 6138F 20C 135W 2.0GHz	2666 MHz	No	Yes	27.5 MB
B1DA	Intel Xeon Gold 6138T 20C 125W 2.0GHz	2666 MHz	No	No	27.5 MB

Feature code	Description*	Memory speed	Supports >768 GB per CPU	Embedded Omni Path	L3 cache
B1D2	Intel Xeon Gold 6140 18C 140W 2.3GHz	2666 MHz	No	No	24.75 MB
B1D1	Intel Xeon Gold 6142 16C 150W 2.6GHz	2666 MHz	No	No	22 MB
B1CA	Intel Xeon Gold 6142F 16C 160W 2.6GHz	2666 MHz	No	Yes	22 MB
B1CY	Intel Xeon Gold 6148 20C 150W 2.4GHz	2666 MHz	No	No	27.5 MB
B1C9	Intel Xeon Gold 6148F 20C 160W 2.4GHz	2666 MHz	No	Yes	27.5 MB
B1CX	Intel Xeon Gold 6150 18C 165W 2.7GHz	2666 MHz	No	No	24.75 MB
B1CW	Intel Xeon Gold 6152 22C 140W 2.1GHz	2666 MHz	No	No	30.25 MB
B1CV	Intel Xeon Gold 6154 18C 200W 3.0GHz	2666 MHz	No	No	24.75 MB
B1CU	Intel Xeon Platinum 8153 16C 125W 2.0GHz	2666 MHz	No	No	22 MB
B20P	Intel Xeon Platinum 8158 12C 150W 3.0GHz	2666 MHz	No	No	24.75 MB**
B1CT	Intel Xeon Platinum 8160 24C 150W 2.1GHz	2666 MHz	No	No	33 MB
B1C8	Intel Xeon Platinum 8160F 24C 160W 2.1GHz	2666 MHz	No	Yes	33 MB
B1D9	Intel Xeon Platinum 8160T 24C 150W 2.1GHz	2666 MHz	No	No	33 MB
B1CS	Intel Xeon Platinum 8164 26C 150W 2.0GHz	2666 MHz	No	No	35.75 MB
B1CR	Intel Xeon Platinum 8168 24C 205W 2.7GHz	2666 MHz	No	No	33 MB
B1CQ	Intel Xeon Platinum 8170 26C 165W 2.1GHz	2666 MHz	No	No	35.75 MB
B1CP	Intel Xeon Platinum 8176 28C 165W 2.1GHz	2666 MHz	No	No	38.5 MB
B1C7	Intel Xeon Platinum 8176F 28C 165W 2.1GHz	2666 MHz	No	Yes	38.5 MB
B1CN	Intel Xeon Platinum 8180 28C 205W 2.5GHz	2666 MHz	No	No	38.5 MB

\* Processor detail: Model, core count, TDP power and core speed

\*\* L3 cache is 1.375 MB per core except with the processors indicated with \*\*

## Memory options

Each SD650 server has 12x TruDDR4 DIMM slots, as shown in the following figure.

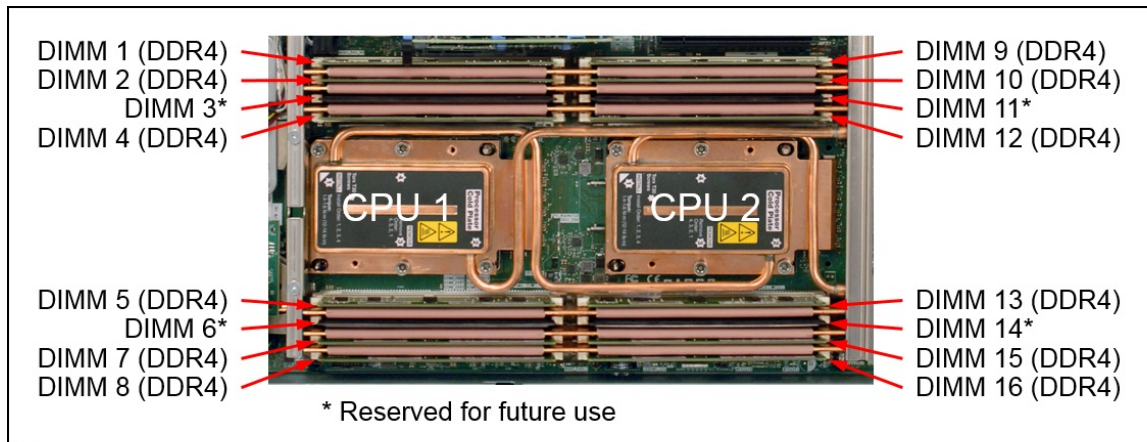


Figure 8. Location of DIMMs in each server (two servers per tray)

The SD650 uses Lenovo TruDDR4 memory operating at 2666 MHz. The server supports 12 DIMMs with two processors installed, 6 DIMMs per processor. Each processor has six memory channels with 1 DIMM per channel. With 12x 64 GB LRDIMMs, each server supports up to 768 GB of memory. In addition to the 12 TruDDR4 DIMM slots, the server has 4 additional DIMM slots reserved for future use.



The DIMMs supported with the SD650 server are listed in the following table.

Table 4. Memory support

Feature code	Description	Maximum supported
<b>RDIMMs</b>		
AUU1	ThinkSystem 8GB TruDDR4 2666 MHz (1Rx8 1.2V) RDIMM	12
B21T	ThinkSystem 8GB TruDDR4 2666MHz (2Rx8 1.2V) RDIMM	12
AUNC	ThinkSystem 16GB TruDDR4 2666 MHz (2Rx8 1.2V) RDIMM	12
AUND	ThinkSystem 32GB TruDDR4 2666 MHz (2Rx4 1.2V) RDIMM	12
<b>LRDIMMs</b>		
AUNE	ThinkSystem 64GB TruDDR4 2666 MHz (4Rx4 1.2V) LRDIMM	12
<b>3DS RDIMMs</b>		
AUNF	ThinkSystem 128GB TruDDR4 2666 MHz (8Rx4 1.2V) 3DS RDIMM	12

Lenovo TruDDR4 memory uses the highest quality components that are sourced from Tier 1 DRAM suppliers and only memory that meets the strict requirements of Lenovo is selected. It is compatibility tested and tuned to maximize performance and reliability. From a service and support standpoint, Lenovo TruDDR4 memory automatically assumes the system warranty, and Lenovo provides service and support worldwide.

The following rules apply when selecting the memory configuration:

- The server supports RDIMMs, LRDIMMs and 3DS RDIMMs. UDIMMs are not supported.
- Mixing RDIMMs and LRDIMMs is not supported.
- Mixing 3DS RDIMMs with either RDIMMs or LRDIMMs is not supported.
- Mixing x4 and x8 DIMMs is supported.

The following memory protection technologies are supported:

- ECC
- SDDC (also known as Chipkill, for x4-based memory DIMMs; look for "x4" in the DIMM description)
- ADDDC (also known as Redundant Bit Steering or RBS, for x4-based memory DIMMs)
- Memory mirroring
- Memory rank sparing

If memory channel mirroring is used, then DIMMs must be installed in pairs or sets of three (minimum of one pair or set of three per processor), and all DIMMs in the pair or set of three must be identical in type and size. 50% of the installed capacity is available to the operating system.

If memory rank sparing is used, then a minimum of two single-rank or dual-rank DIMMs must be installed per populated channel (the DIMMs do not need to be identical). In rank sparing mode, one rank of a DIMM in each populated channel is reserved as spare memory. The largest rank in the channel will be automatically selected as the spare rank. The amount of memory available to the operating system depends on the number, capacity and rank counts of the DIMMs installed.

## Internal storage

The SD650 server supports one or two 2.5-inch drives internally in each server. These are Simple-Swap drives that are not front accessible so will require both servers in the tray to be powered off and the tray removed from the chassis before replacing the drives.

Each server supports two 7mm high drives or one 15mm drive:

- Two 7mm SATA SSDs
- One 15mm SATA SSD and NVMe SSD

The following figure shows two 7mm drives installed in a drive cage. See the [Components and connectors](#) section for the location of the drive bays.

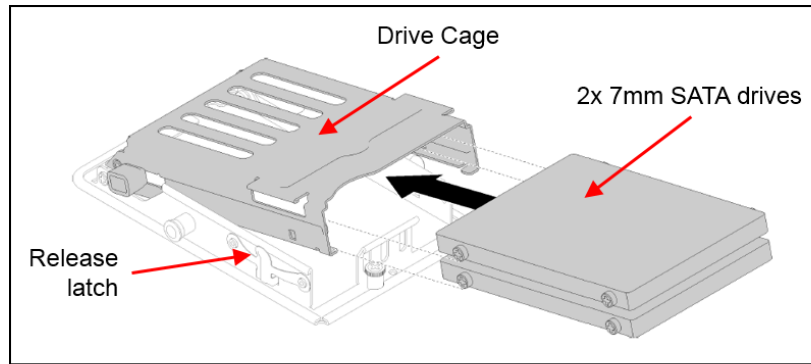


Figure 9. Two 7mm SATA SSDs installed in a drive cage

Supported drives are listed in the following table. The table also lists the drive cage that is required to mount the drive in the server.

**Tip:** Additional drives are planned to be supported or can be included in a Special Bid configuration.

Table 5. Supported internal drives and drive cages

Feature code	Description	Maximum supported
<b>Drive cages</b>		
B1BU	ThinkSystem SD650 DWC Storage Cage (SATA) (for 7mm drives)	1 per server
B1BV	ThinkSystem SD650 DWC Storage Cage (NVMe/SATA) (for 15mm drives)	1 per server
<b>7mm SATA SSDs</b>		
B0ZJ	Intel S4500 240GB Enterprise Entry SATA 2.5" SSD for NeXtScale	2 per server
B0ZK	Intel S4500 480GB Enterprise Entry SATA 2.5" SSD for NeXtScale	2 per server
B10M	Intel S4600 1.92TB Enterprise Mainstream SATA 2.5" SSD for NeXtScale	2 per server
B10J	Intel S4600 240GB Enterprise Mainstream SATA 2.5" SSD for NeXtScale	2 per server
B10K	Intel S4600 480GB Enterprise Mainstream SATA 2.5" SSD for NeXtScale	2 per server
B10L	Intel S4600 960GB Enterprise Mainstream SATA 2.5" SSD for NeXtScale	2 per server
AVHV	PM863a 240GB Enterprise Entry SATA 2.5" SSD for NeXtScale	2 per server
AVHW	PM863a 480GB Enterprise Entry SATA 2.5" SSD for NeXtScale	2 per server
<b>15mm NVMe SSDs</b>		
B315	ThinkSystem SD650 U.2 Intel P4600 1.6TB Mainstream NVMe PCIe3.0 x4 Hot Swap SSD	1 per server

In addition, the SD650 supports M.2 adapters and drives, similar to other servers in the ThinkSystem portfolio. The M.2 adapter is installed in a dedicated slot on the system board. The M.2 drives attach to the adapter: the single M.2 adapter supports 1 drive and the dual M.2 adapter supports two drives and supports RAID-0, RAID-1, or JBOD.

**Note:** When the dual M.2 adapter is selected, only 32GB M.2 drives can be used. The 128GB M.2 drives are not supported with the dual M.2 adapter when installed in the SD650.

The following table lists the supported M.2 adapters and drives.

Table 6. M.2 adapters and drives

Feature code	Description	Maximum supported
<b>M.2 adapters</b>		
AUMU	ThinkSystem M.2 Enablement Kit (Single M.2 Adapter)	1 per server
AUMV	ThinkSystem M.2 with Mirroring Enablement Kit (Dual M.2 Adapter)	1 per server
<b>M.2 drives</b>		
AUUV	ThinkSystem M.2 CV3 128GB SATA 6Gbps Non-Hot Swap SSD	1 per server*
AUUL	ThinkSystem M.2 CV1 32GB SATA 6Gbps Non-Hot Swap SSD	2 per server**

\* The SD650 only supports one 128 GB M.2 drive; only supported in the Single M.2 Adapter. See the environmental requirements in the [Operating environment](#) section

\*\* The use of 2 requires the Dual M.2 Adapter

For more information about the M.2 adapters and M.2 drives, see the M.2 product guide: <https://lenovopress.com/lp0769-thinksystem-m2-drives-adapters>

## Internal tape drives

The SD650 does not support internal tape drives.

## Optical drives

The SD650 server supports the external USB optical drive option listed in the following table.

Table 7. Optical drive

Part number	Feature code	Description	Maximum supported
7XA7A05926	AVV8	ThinkSystem External USB DVD RW Optical Disk Drive	1

The External USB DVD RW Optical Disk Drive supports the following types of media: CD-ROM, CD-R, CD-RW, DVD-R, DVD+R, DVD-ROM, DVD-RW, and DVD+RW.

## I/O expansion options

The SD650 has the following I/O expansion options:

- One PCIe 3.0 x24 front-accessible FHHL slot with riser card

The server also has the following slots ready for future support of adapters:

- One ML2 x16 front-accessible slot with riser card
- One internal PCIe x16 slot

The front accessible slots are shown in the following figure.

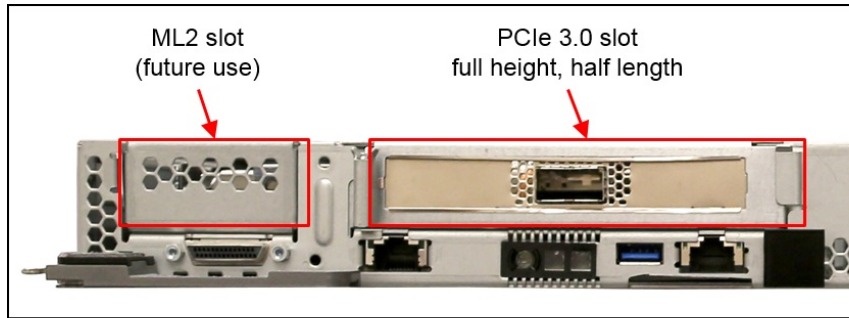


Figure 10. Front accessible PCIe slots

To use the front-accessible FHHL slot, the riser cards listed in the following table is required.

Table 8. Riser card options

Feature code	Description	Maximum supported
B1BX	ThinkSystem SD650 DWC PCI-E Riser	1

## Network adapters

The server offers one Gigabit Ethernet port with an RJ45 connector, based on the Intel Ethernet Connection X722, shared between the operating system and the XClarity Controller (XCC) management processor. The second standard Gigabit Ethernet port is reserved for systems management.

The server supports high-speed network adapters in the front-accessible full-height half-length PCIe slot. Supported adapters are listed in the following table. The use of an adapter in this slot also requires the installation of the PCIe riser card.

Table 9. Network adapters

Feature code	Description	Maximum supported
Riser card		
B1BX	ThinkSystem SD650 DWC PCI-E Riser	1
Adapter cards		
B1C2	ThinkSystem SD650 DWC Mellanox ConnectX-5 EDR 1-port Adapter	1
AU0B	Intel OPA 100 Series Single-port PCIe 3.0 x16 HFA	1
B21S	ThinkSystem SD650 DWC Intel OPA 100 Series Single-port PCIe 3.0 x16 HFA	1
B1C3	ThinkSystem SD650 DWC IFT Interposer Card (routes OPA signals from an F-suffix processor)	1

The SD650 server offers three Omni Path Architecture solutions. Feature AU0B is a standard PCIe x16 OPA adapter with an air-cooled headsink, whereas feature B21S is the same adapter but with a cold plate and copper tubing that connects to the water infrastructure of the server. Select feature B21S in your configuration when you want to maximize heat recovery through water cooling, rather than relying on room airconditioning.

A third OPA offering is the IFT Interposer Card (feature B1C3), an Intel Omni Path Internal Faceplate Transition (IFT) Carrier Card which provides the mechanism to route the OPA fabric that is embedded in Intel Xeon Processors with an F suffix. The Interposer Card is installed in the front-accessible PCIe slot. The use of the IFT Carrier Card is an overall lower cost solution for implementing Omni Path Architecture compared to one of the traditional OPA adapters, however under some conditions, there may be a performance impact on the processor.

Feature B1C3 includes three cables: Two cables are routed to the Interposer Card from each processor - the cables are connected directly into the processors. An additional third sideband cable attaches to the Interposer Card from the system board.

**Note:** The use of the IFT Interposer Card requires F-suffix processors (embedded fabric) be installed. See the table of supported processors in the [Processor options](#) section.

The following figure shows the IFT Interposer Card connected to each of the two F-suffix processors (the sideband cable is not shown).

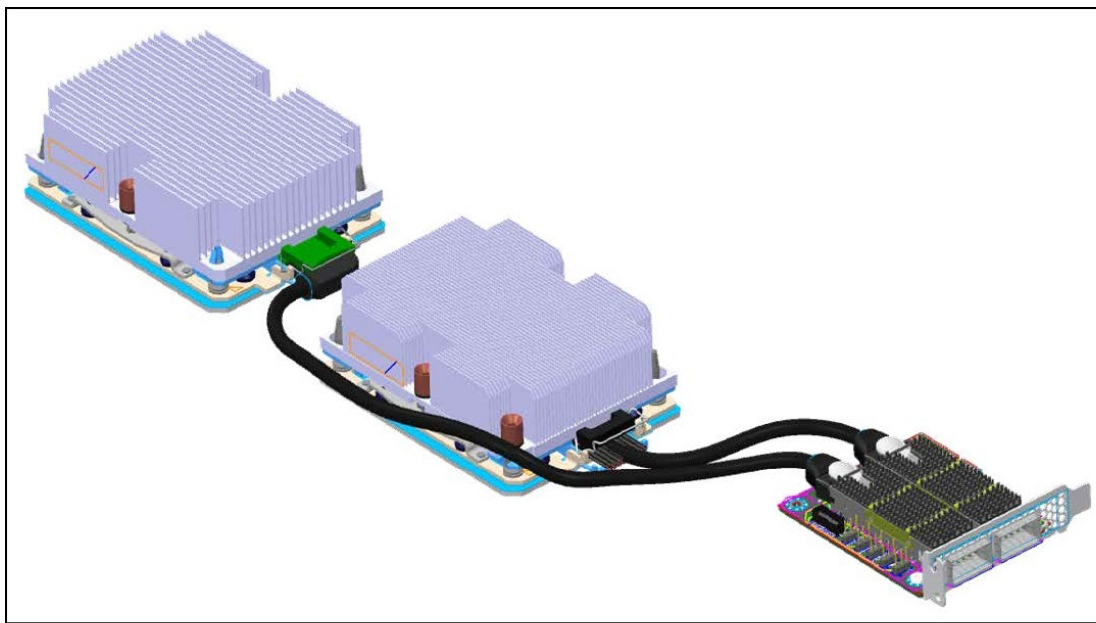


Figure 11. IFT Interposer Card and cables

### **Storage host bus adapters**

The SD650 server currently does not support storage host bus adapters.

### **Flash storage adapters**

The SD650 server currently does not support Flash storage adapters.

### **GPU adapters**

The SD650 server currently does not support GPUs.



## Cooling

One of the most notable features of the ThinkSystem SD650 offering is direct water cooling. Direct water cooling (DWC) is achieved by circulating the cooling water directly through cold plates that contact the CPU thermal case, DIMMs, and other high-heat-producing components in the server.

One of the main advantages of direct water cooling is the water can be relatively warm and still be effective because water conducts heat much more effectively than air. Depending on the server configuration, 85-90% of the heat is removed by water cooling; the rest can be easily managed by a standard computer room air conditioner.

Allowable inlet temperatures for the water can be as high as 45°C (113°F). In most climates, water-side economizers can supply water at temperatures below 45°C for most of the year. This ability allows the data center chilled water system to be bypassed thus saving energy because the chiller is the most significant energy consumer in the data center. Typical economizer systems, such as dry-coolers, use only a fraction of the energy that is required by chillers, which produce 6-10 °C (43-50 °F) water. The facility energy savings are the largest component of the total energy savings that are realized when the SD650 is deployed.

The advantages of the use of water cooling over air cooling result from water's higher specific heat capacity, density, and thermal conductivity. These features allow water to transmit heat over greater distances with much less volumetric flow and reduced temperature difference as compared to air.

For cooling IT equipment, this heat transfer capability is its primary advantage. Water has a tremendously increased ability to transport heat away from its source to a secondary cooling surface, which allows for large, more optimally designed radiators or heat exchangers rather than small, inefficient fins that are mounted on or near a heat source, such as a CPU.

The ThinkSystem SD650 offering uses the benefits of water by distributing it directly to the highest heat generating server subsystem components. By doing so, the offering realizes 7% - 10% direct energy savings when compared to an air-cooled equivalent. That energy savings results from the removal of the system fans and the lower operating temp of the direct water-cooled system components.

The direct energy savings at the chassis level, combined with the potential for significant facility energy savings, makes the SD650 an excellent choice for customers that are burdened by high energy costs or with a Green mandate.

Water is delivered to each of the nodes from a chiller distribution unit (CDU) via the water manifold. As shown in the following figure, each manifold section attaches to a chassis and connects directly to the water inlet and outlet connectors for each compute node to safely and reliably deliver water to and from each Compute Tray.

The DWC Manifold is modular and is available in multiple configurations that are based on the number of chassis drops that are required in a rack. The Manifold scales to support up to six Enclosures in a single rack, as shown in the following figure.

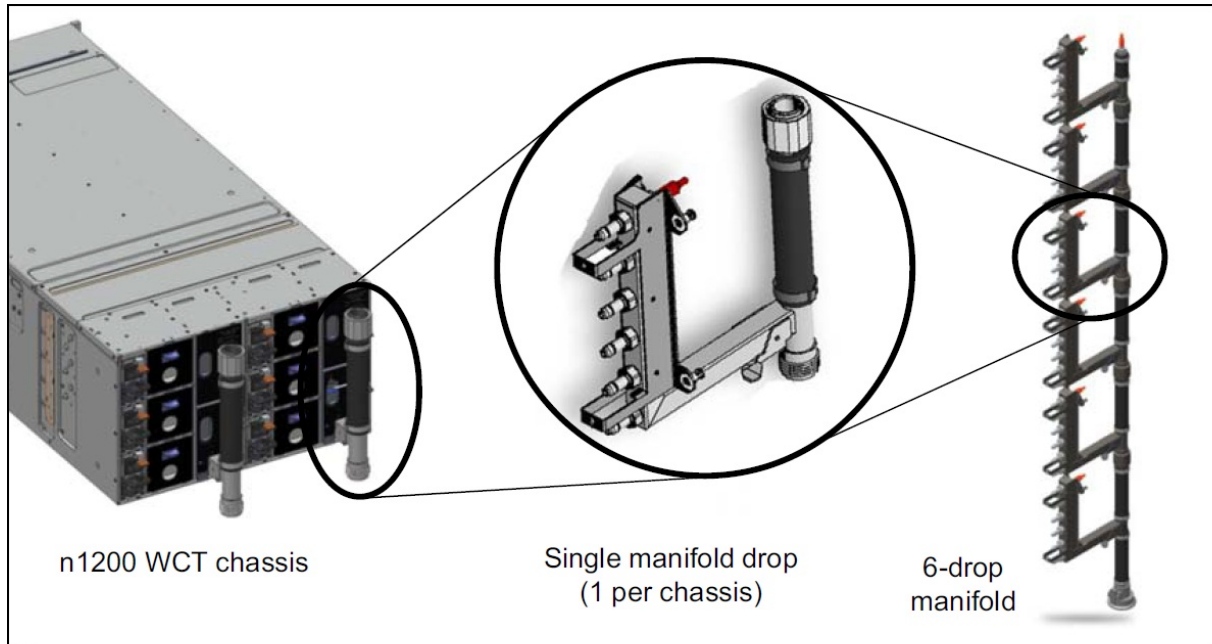


Figure 12. n1200 DWC Enclosure and Manifold assembly showing scaled up Water Manifold

The water flows through the SD650 as shown in the following animation. The inlet water is split into two parallel paths, one for each server in the tray. Each path is then split further, one for the processors and one for the memory, drives and PCIe adapter.

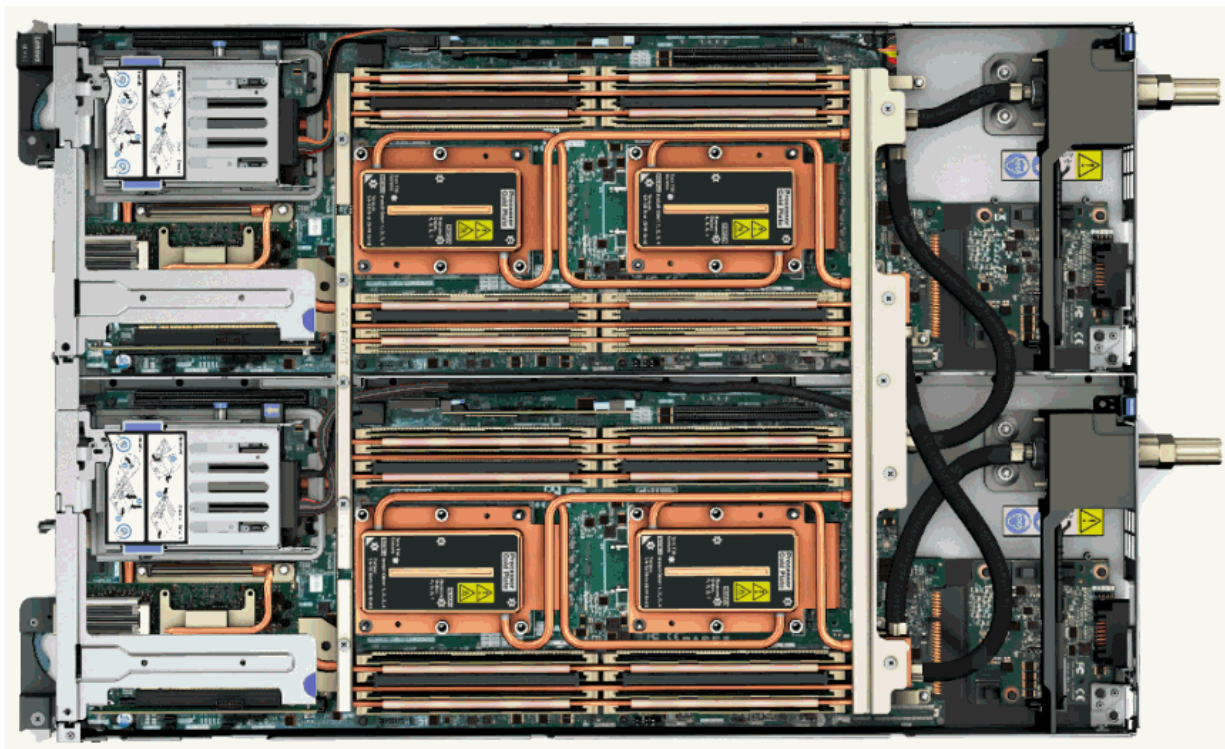


Figure 13. Animation showing water flow through the SD650 tray  
 (for PDF users, see the animation at <https://lenovopress.com/LP0636#animation>)

## Power supplies

The NeXtScale n1200 DWC enclosure supports up to six redundant hot-plug power supplies, which provides N+N or N+1 redundancy. Power policies with no redundancy also are supported. These power supplies are either 80 PLUS Platinum or Titanium certified to allow for the best efficiency values of your data center. The following table lists the supported power supplies.

Table 10. Power supplies

Feature code	Description	Maximum supported
ASYJ	NeXtScale n1200 1500W Platinum Power Supply	6
A4MM	NeXtScale n1200 1300W Platinum Power Supply	6
ASYH	NeXtScale n1200 1300W Titanium Power Supply	6
B22A	NeXtScale n1200 2000W Platinum Power Supply	6

The power supply options have the following features:

- Supports N+N or N+1 Power Redundancy, or Non-redundant power configurations to support higher density
- Power management controller and configured through the Fan and Power Controller
- Integrated 2500 RPM fan
- 80 PLUS Platinum or Titanium certified
- Built-in overload and surge protection
- Supports high-range voltage only: 200 - 240 V
- 200 - 240 (nominal) V AC; 50 or 60 Hz; 6.9 A (maximum)

## Integrated virtualization

The server supports booting from an operating system or hypervisor installed on an M.2 solid-state drive. See the [Internal storage](#) for details and the list of available options.

You can download supported VMware vSphere hypervisor images from the following web page and load it on the M.2 drive using the instructions provided:  
[https://vmware.lenovo.com/content/custom\\_iso/](https://vmware.lenovo.com/content/custom_iso/)

## Local server management

The SD650 provides local console access through the KVM connector at the front of the server. A console breakout cable is used with this connector, which provides a VGA port, two USB ports, and a DB9 serial port. The cable is shown in the following figure.



Figure 14. Console breakout cable

One console breakout cable is shipped with the NeXtScale n1200 DWC enclosure. Additional cables can be ordered per the following table.

Table 11. Console breakout cable

Feature code	Description	Maximum supported
A4AK	Console breakout cable (KVM Dongle cable)	1

To aid with problem determination, the server includes light path diagnostics, which is a set of LEDs on the front of the server and inside the server that show you which component is failing. The LEDs are shown in the following figure.

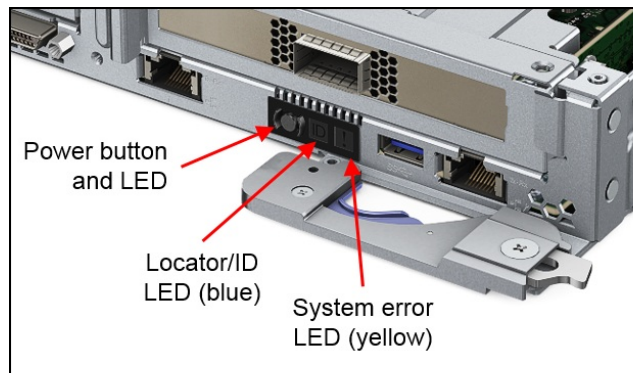


Figure 15. Power button and system LEDs

When an error occurs, the system error LED lights up. Review the logs through the web interface of the XClarity Controller (see the [Remote server management](#) section). If needed, power off the server and remove it from the enclosure. Then, press and hold the light path diagnostics button to activate the system board LEDs (see [Figure 4](#) for the location of the button). The LED next to the failed component then lights up.

**Note:** The server does not support local management using XClarity Mobile running on a tethered smartphone or table.

## Remote server management

The SD650 contains an integrated service processor, XClarity Controller (XCC), which provides advanced

service-processor control, monitoring, and alerting functions. The XCC is based on the Pilot4 XE401 baseboard management controller (BMC) using a dual-core ARM Cortex A9 service processor.

The server offers two Ethernet ports that can be use for remote management:

- An Ethernet port that is dedicated for remote management, connected directly the XCC.
- An Ethernet port that is shared between the operating system and remote management. The shared-NIC functionality can be enabled or disabled in the server's UEFI panels.

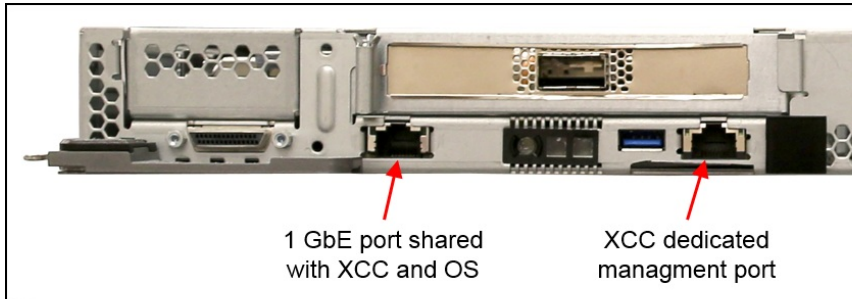


Figure 16. Ethernet ports on each SD650 server

Remote server management is provided through industry-standard interfaces:

- Intelligent Platform Management Interface (IPMI) Version 2.0
- Simple Network Management Protocol (SNMP) Version 3 (no SET commands; no SNMP v1)
- Common Information Model (CIM-XML)
- Representational State Transfer (REST) support
- Redfish support (DMTF compliant)
- Web browser - HTML 5-based browser interface (Java and ActiveX not required) using a responsive design (content optimized for device being used - laptop, tablet, phone) with NLS support

There are two XClarity Controller upgrades available for the server, Advanced and Enterprise.

Lenovo XClarity Controller Advanced adds the following remote control functions:

- Remotely viewing video with graphics resolutions up to 1600x1200 at 75 Hz with up to 23 bits per pixel, regardless of the system state
- Remotely accessing the server using the keyboard and mouse from a remote client
- Capturing blue-screen errors
- International keyboard mapping support
- LDAP-based authentication

Lenovo XClarity Controller Enterprise enables the following additional features:

- Boot Capture
- Remote mounting of CD-ROM (ISO) and diskette (IMG) files as virtual drives
- Virtual console collaboration - Ability for up to 6 remote users to be log into the remote session simultaneously
- Power capping
- License for XClarity Energy Manager

When configuring the server for ordering via configure-to-order (CTO), you can elect to have XCC Advanced or XCC Enterprise by selecting the appropriate feature codes as listed in the following table:



- XCC Standard - select neither feature listed in the table
- XCC Advanced - select feature AVUT
- XCC Enterprise - select feature AUPW

Table 12. XClarity Controller Upgrades for configure-to-order

Feature code	Description
AVUT	ThinkSystem XClarity Controller Standard to Advanced Upgrade
AUPW	ThinkSystem XClarity Controller Standard to Enterprise Upgrade

## Remote enclosure management

The NeXtScale n1200 DWC Enclosure offers a remote management capability through the Fan and Power Controller (FPC), which is at the back of the enclosure, as shown in the following figure.



Figure 17. Fan and Power Controller

The Fan and Power Controller has one external RJ45 port, which provides a 10/100 Mbps Ethernet connection for browser-based remote control.

The port provides the following interfaces:

- An HTTP (web browser) interface for remote management
- An IPMI interface to the IMM in each server
- An IPMI interface to higher managers, such as xCAT

The module provides the following functions:

- Power supply redundancy and over-subscription configuration
- Power capping/saving configuration
- Power restore policy
- Acoustic mode setting
- Configuration/log export to USB (a USB port is provided inside the module)
- IMM remote reset or Server remote reset (AC cycle)
- Status monitor: Power consumption, node status, power supply status, and fan status
- Network configuration

The FPC also includes a USB key that is housed inside the unit. The USB key stores the event log for the FPC plus power, cooling, and network configuration data.

## Security

The server offers the following security features:

- Administrator and power-on password
- Trusted Platform Module (TPM) supporting both TPM 1.2 and TPM 2.0
- Optional Trusted Cryptographic Module (TCM), available only in China

The TCM module, available only for China customers, is installed in a dedicated socket on the system board, as shown in [Figure 4](#). Ordering information is shown in the following table.

Table 13. Security options

Feature code	Description
AVKE	ThinkSystem Trusted Cryptographic Module (China customers only)

## Operating system support

The server supports the following operating systems:

- Red Hat Enterprise Linux 7.3\*
- Red Hat Enterprise Linux 7.4\*
- SUSE Linux Enterprise Server 12 SP2\*
- SUSE Linux Enterprise Server 12 SP3\*

\* Support is only when the server is ordered via [Lenovo Scalable Infrastructure \(LeSI\)](#).

For the latest information about the specific versions and service levels that are supported, and any other prerequisites, see the Operating System Interoperability Guide:  
<https://lenovopress.com/osig#servers=sd650-7x58>

The server has also been tested with the following operating systems:

- CentOS 7.3
- CentOS 7.4

## Physical and electrical specifications

The compute tray with two SD650 servers has the following dimensions:

- Width: 432 mm (17.0 in.)
- Height: 41.0 mm (1.6 in.)
- Depth: 659 mm (25.9 in.)
- Weight (two servers on each compute tray): 17.2 kg (38 lb)

The NeXtScale n1200 DWC enclosure features the following dimensions:

- Width: 447 mm (17.6 in.)
- Height: 262.2 mm (10.3 in.)
- Depth : 915 mm (36.0 in.)
- Weight:
  - Fully configured (stand-alone): approximately 135.5 kg (298 lbs)
  - Empty enclosure (with midplane, FPC, and cables): approximately 25 kg (55 lbs)

The system operates at the following electrical specification:

- 200 - 240 (nominal) V AC, 50 Hz or 60 Hz
- Maximum input current:
  - 1300W power supply: 6.9A
  - 1500W power supply: 8.2A
  - 2000W power supply: 10A

## Operating environment

The SD650 tray and n1200 DWC enclosure are supported in the following environment:

### Water requirements:

- Water temperature: ASHRAE class W4: 2°C - 45°C (35.6°F - 113°F)  
Note: The minimum inlet water temperature is data center dependent, that is, the dew point at which condensation occurs. A minimum of 2°C is supported provided ambient air conditions are not such that condensation will occur. A minimum of 18°C is recommended.
- Maximum pressure: 4.4 bars
- Minimum water flow rate: 6.0 liters per minute per enclosure, assuming 1.0 lpm per compute tray with 6 trays per enclosure (1 tray consists of 2 compute nodes)
  - For processors below 205 W: 6.0 liters per minute per enclosure, assuming 1.0 lpm per compute tray with 6 trays per enclosure
  - For 205 W processors: 7.5 liters per minute per enclosure, assuming 1.25 lpm per compute tray with 6 trays per enclosure

Note: The water required to initially fill the system side cooling loop must be reasonably clean, bacteria-free water (<100 CFU/ml) such as de-mineralized water, reverse osmosis water, de-ionized water, or distilled water. The water must be filtered with an in-line 50 micron filter (approximately 288 mesh). The water must be treated with anti-biological and anti-corrosion measures.

### Air temperature requirements:

- Operating: ASHRAE class A2: 10°C - 35°C (50°F - 95°F); when the altitude exceeds 900 m (2953 ft), the maximum ambient temperature value decreases by 1°C (1.8°F) with every 300 m (984 ft) of altitude increase.
- Powered off: 5°C - 45°C (41°F - 113°F)
- Shipping/storage: -40°C - 60°C (-40°F - 140°F)
- Maximum altitude: 3048 m (10 000 ft)

To use the 128 GB M.2 drive, the following conditions must be met:

- If inlet water temperature is 45°C, then the ambient air temperature cannot exceed 27°C.
- If inlet water temperature is 30°C, then the ambient air temperature cannot exceed 35°C.

### Relative humidity (non-condensing):

- Operating: ASHRAE Class A2: 8% - 80%, maximum dew point : 21°C (70°F)
- Shipment/storage: 8% - 90%

### Heat output:

- Minimum configuration (with one minimal configuration tray): 433 BTU per hour (127 watts)
- Maximum configuration (with six maximal configuration trays): 40946 BTU per hour (12000 watts)

## Regulatory compliance

The server conforms to the following international standards:

- FCC - Verified to comply with Part 15 of the FCC Rules, Class A
- Canada ICES-003, issue 5, Class A
- UL/IEC 60950-1
- CSA C22.2 No. 60950-1
- Japan VCCI, Class A
- IEC 60950-1 (CB Certificate and CB Test Report)
- China CCC GB4943.1, GB9254, Class A, and GB17625.1
- Russia EAC/GOST ME01, IEC-60950-1, GOST R 51318.22, and GOST R 51318.24, GOST R 51317.3.2, GOST R 51317.3.3
- CE Mark (EN55032 Class A, EN60950-1, EN55024, and EN61000-3-2, EN61000-3-3)
- CISPR 22, Class A

## Warranty options

The warranty terms are as follows:

- ThinkSystem SD650: Three years
- NeXtScale n1200 DWC Enclosure: Three years

The standard warranty terms are customer-replaceable unit (CRU) and onsite (for field-replaceable units, FRUs, only) with standard call center support during normal business hours and 9x5 Next Business Day Parts Delivered.

Also available are Lenovo Services warranty maintenance upgrades and post-warranty maintenance agreements, with a predefined scope of services, including service hours, response time, term of service, and service agreement terms and conditions.

Lenovo warranty service upgrade offerings are country-specific. Not all warranty service upgrades are available in every country. For more information about Lenovo warranty service upgrade offerings that are available in your country, go to the Data Center Advisor and Configurator (formerly known as LESC) website <http://lesc.lenovo.com>, then do the following:

1. In the Customize a Model box in the middle of the page, select the **Services** option in the Customization Option dropdown menu
2. Enter the machine type & model of the system
3. From the search results, you can click either **Deployment Services** or **Support Services** to view the offerings



The following table explains warranty service definitions in more detail.

Table 14. Warranty service definitions

Term	Description
Onsite Service	If a problem with your product cannot be resolved via telephone, a Service Technician will be dispatched to arrive at your location.
Parts Delivered	If a problem with your product cannot be resolved via telephone and a CRU part is required, Lenovo will send a replacement CRU to arrive at your location. If a problem with your product cannot be resolved via telephone and a FRU part is required, a Service Technician will be dispatched to arrive at your location.
Technician Installed Parts	If a problem with your product cannot be resolved via telephone, a Service Technician will be dispatched to arrive at your location.
Hours of coverage	<ul style="list-style-type: none"> <li>• 9x5: 9 hours/day, 5 days/week, during normal business hours, excluding local public &amp; national holidays</li> <li>• 24x7: 24 hours per day, 7 days per week, 365 days per year.</li> </ul>
Response time target	2 hours, 4 hours, or Next Business Day: The time period from when the telephone based troubleshooting is completed and logged, to the delivery of the CRU or arrival of a Service Technician and part at the Customer's location for repair.
Committed Repair	6 hours: The time period between the service request registration in Lenovo's call management system and the restoration of the product to conformance with its specification by a Service Technician.

The following Lenovo warranty service upgrades are available:

- Warranty and maintenance service upgrades:
  - Three, four, or five years of 9x5 or 24x7 service coverage
  - Parts delivered or technician installed parts from next business day to 4 or 2 hours
  - Committed repair service
  - Warranty extension of up to 5 years
  - Post warranty extensions
- Committed Repair Service
 

Committed Repair Services enhances the level of Warranty Service Upgrade or Post Warranty/Maintenance Service offering associated with the selected systems. Offerings vary and are available in select countries.

  - Priority handling to meet defined time frames to restore the failing machine to good working condition
  - 24x7x6 committed repair: Service performed 24 hours per day, 7 days per week, within 6 hours
- YourDrive YourData
 

Lenovo's YourDrive YourData service is a multi-drive retention offering that ensures your data is always under your control, regardless of the number of drives that are installed in your Lenovo server. In the unlikely event of a drive failure, you retain possession of your drive while Lenovo replaces the failed drive part. Your data stays safely on your premises, in your hands. The YourDrive YourData service can be purchased in convenient bundles with Lenovo warranty upgrades and extensions.

- **Microcode Support**

Keeping microcode current helps prevent hardware failures and security exposure. There are two levels of service: analysis of the installed base and analysis and update where required. Offerings vary by country and can be bundled with other warranty upgrades and extensions.

- **Enterprise Software Support**

Lenovo Enterprise Server Software Support can help you troubleshoot your entire server software stack. Choose support for server operating systems from Microsoft, Red Hat, SUSE, and VMware; Microsoft server applications; or both operating systems and applications. Support staff can help answer troubleshooting and diagnostic questions, address product compatibility and interoperability issues, isolate causes of problems, report defects to software vendors, and more.

In addition, you can access hardware “how to” support for ThinkSystem servers. Staff can help resolve hardware problems not covered under warranty, refer you to the right documentation and publications, provide corrective service information for known defects, and transfer you to a hardware support call center if needed.

- **Hardware Installation Services**

Lenovo experts can seamlessly manage the physical installation of your server, storage, or networking hardware. Working at a time convenient for you (business hours or off shift), the technician will unpack and inspect the systems on your site, install options, mount in a rack cabinet, connect to power and network, check and update firmware to the latest levels, verify operation, and dispose of the packaging, allowing your team to focus on other priorities. Your new systems will be configured and ready for your software installation.

## **Rack cabinets**

The NeXtScale n1200 DWC enclosure is supported in the following racks:

- 42U 1100mm Enterprise V2 Dynamic Rack and Rack Expansion, type 9363
- 42U 1100mm Deep Primary Rack and Expansion Rack, type 1410

For more information, see the list of Lenovo Press Product Guides in the Rack cabinets and options category:

<http://lenovopress.com/systemx/rack>

## Top-of-rack Ethernet switches

The server supports the top-of-rack Ethernet switches that are listed in the following table.

Table 15. Top-of-rack switches

Part number	Description
1 Gb top-of-rack switches	
715952F	Lenovo RackSwitch G8052 (Front to Rear)
10 Gb top-of-rack switches	
7159A2X	Lenovo ThinkSystem NE1032 RackSwitch (Front to Rear)
7159B2X	Lenovo ThinkSystem NE1032T RackSwitch (Front to Rear)
7159C2X	Lenovo ThinkSystem NE1072T RackSwitch (Front to Rear)
7159BF7	Lenovo RackSwitch G8124E (Front to Rear)
715964F	Lenovo RackSwitch G8264 (Front to Rear)
7159DFX	Lenovo RackSwitch G8264CS (Front to Rear)
7159CFV	Lenovo RackSwitch G8272 (Front to Rear)
7159GR5	Lenovo RackSwitch G8296 (Front to Rear)
40 Gb top-of-rack switches	
7159BFX	Lenovo RackSwitch G8332 (Front to Rear)
100 Gb top-of-rack switches	
7159D2X	Lenovo ThinkSystem NE10032 RackSwitch (Front to Rear)

For more information, see the list of Product Guides in the Top-of-rack switches categories:

- 1 Gb Ethernet switches: <http://lenovopress.com/networking/tor/1gb?rt=product-guide>
- 10 Gb Ethernet switches: <http://lenovopress.com/networking/tor/10gb?rt=product-guide>
- 40 Gb Ethernet switches: <http://lenovopress.com/networking/tor/40gb?rt=product-guide>
- 100 Gb Ethernet switches: <https://lenovopress.com/networking/tor/100Gb?rt=product-guide>

Additional edge switches are offered as part of the Intelligent Cluster™ program, as listed in the following table.

Table 16. Switches in the Intelligent Cluster program

Feature code	Description
1 Gb top-of-rack switches	
2733	Cisco 2960G-48TC-L (48 port, Layer 2)
Not available	Juniper EX4200 (48 port, Layer 2/3)
6941	SMC 8126L2 (26 port, Layer 2)
6673	SMC 8150L2 (50 port, Layer 2)
10 Gb top-of-rack switches	
A1M6	Cisco 3750X-48T-L (48 port, Layer 2/3)

## Uninterruptible power supply units

The following table lists the uninterruptible power supply (UPS) units that are offered by Lenovo.

Table 17. Uninterruptible power supply units

Part number	Description
55941AX	RT1.5kVA 2U Rack or Tower UPS (100-125VAC)
55941KX	RT1.5kVA 2U Rack or Tower UPS (200-240VAC)
55942AX	RT2.2kVA 2U Rack or Tower UPS (100-125VAC)
55942KX	RT2.2kVA 2U Rack or Tower UPS (200-240VAC)
55943AX	RT3kVA 2U Rack or Tower UPS (100-125VAC)
55943KX	RT3kVA 2U Rack or Tower UPS (200-240VAC)
55945KX	RT5kVA 3U Rack or Tower UPS (200-240VAC)
55946KX	RT6kVA 3U Rack or Tower UPS (200-240VAC)
55948KX	RT8kVA 6U Rack or Tower UPS (200-240VAC)
55949KX	RT11kVA 6U Rack or Tower UPS (200-240VAC)
55948PX	RT8kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
55949PX	RT11kVA 6U 3:1 Phase Rack or Tower UPS (380-415VAC)
55943KT†	ThinkSystem RT3kVA 2U Standard UPS (200-230VAC) (2x C13 10A, 2x GB 10A, 1x C19 16A outlets)
55943LT†	ThinkSystem RT3kVA 2U Long Backup UPS (200-230VAC) (2x C13 10A, 2x GB 10A, 1x C19 16A outlets)
55946KT†	ThinkSystem RT6kVA 5U UPS (200-230VAC) (2x C13 10A outlets, 1x Terminal Block output)
5594XKT†	ThinkSystem RT10kVA 5U UPS (200-230VAC) (2x C13 10A outlets, 1x Terminal Block output)

† Only available in China and countries in the Asia Pacific region.

For more information, see the list of Product Guides in the UPS category:

<https://lenovopress.com/servers/options/ups>

## Power distribution units

The following table lists the power distribution units (PDUs) that are offered by Lenovo.

Table 18. Power distribution units

Part number	Description
0U Basic PDUs	
00YJ776	0U 36 C13/6 C19 24A/200-240V 1 Phase PDU with NEMA L6-30P line cord
00YJ777	0U 36 C13/6 C19 32A/200-240V 1 Phase PDU with IEC60309 332P6 line cord
00YJ778	0U 21 C13/12 C19 32A/200-240V/346-415V 3 Phase PDU with IEC60309 532P6 line cord
00YJ779	0U 21 C13/12 C19 48A/200-240V 3 Phase PDU with IEC60309 460P9 line cord
Switched and Monitored PDUs	
00YJ780	0U 20 C13/4 C19 Switched and Monitored 32A/200-240V/1Ph PDU w/ IEC60309 332P6 line cord
00YJ781	0U 20 C13/4 C19 Switched and Monitored 24A/200-240V/1Ph PDU w/ NEMA L6-30P line cord
00YJ782	0U 18 C13/6 C19 Switched / Monitored 32A/200-240V/346-415V/3Ph PDU w/ IEC60309 532P6 cord

Part number	Description
00YJ783	0U 12 C13/12 C19 Switched and Monitored 48A/200-240V/3Ph PDU w/ IEC60309 460P9 line cord
46M4002	1U 9 C19/3 C13 Switched and Monitored DPI PDU (without line cord)
46M4003	1U 9 C19/3 C13 Switched and Monitored 60A 3 Phase PDU with IEC 309 3P+Gnd line cord
46M4004	1U 12 C13 Switched and Monitored DPI PDU (without line cord)
46M4005	1U 12 C13 Switched and Monitored 60A 3 Phase PDU with IEC 309 3P+Gnd line cord
Ultra Density Enterprise PDUs (9x IEC 320 C13 + 3x IEC 320 C19 outlets)	
71762NX	Ultra Density Enterprise C19/C13 PDU Module (without line cord)
71763NU	Ultra Density Enterprise C19/C13 PDU 60A/208V/3ph with IEC 309 3P+Gnd line cord
C13 Enterprise PDUs (12x IEC 320 C13 outlets)	
39M2816	DPI C13 Enterprise PDU+ (without line cord)
39Y8941	DPI Single Phase C13 Enterprise PDU (without line cord)
C19 Enterprise PDUs (6x IEC 320 C19 outlets)	
39Y8948	DPI Single Phase C19 Enterprise PDU (without line cord)
39Y8923	DPI 60A 3 Phase C19 Enterprise PDU with IEC 309 3P+G (208 V) fixed line cord
Front-end PDUs (3x IEC 320 C19 outlets)	
39Y8938	DPI 30amp/125V Front-end PDU with NEMA L5-30P line cord
39Y8939	DPI 30amp/250V Front-end PDU with NEMA L6-30P line cord
39Y8934	DPI 32amp/250V Front-end PDU with IEC 309 2P+Gnd line cord
39Y8940	DPI 60amp/250V Front-end PDU with IEC 309 2P+Gnd line cord
39Y8935	DPI 63amp/250V Front-end PDU with IEC 309 2P+Gnd line cord
NEMA PDUs (6x NEMA 5-15R outlets)	
39Y8905	DPI 100-127V PDU with Fixed NEMA L5-15P line cord
Line cords for PDUs that ship without a line cord	
40K9611	DPI 32a Line Cord (IEC 309 3P+N+G)
40K9612	DPI 32a Line Cord (IEC 309 P+N+G)
40K9613	DPI 63a Cord (IEC 309 P+N+G)
40K9614	DPI 30a Line Cord (NEMA L6-30P)
40K9615	DPI 60a Cord (IEC 309 2P+G)
40K9617	DPI Australian/NZ 3112 Line Cord
40K9618	DPI Korean 8305 Line Cord

For more information, see the Lenovo Press documents in the PDU category:  
<https://lenovopress.com/servers/options/pdu>

## Lenovo Financial Services

Lenovo Financial Services reinforces Lenovo's commitment to deliver pioneering products and services that are recognized for their quality, excellence, and trustworthiness. Lenovo Financial Services offers financing solutions and services that complement your technology solution anywhere in the world.

We are dedicated to delivering a positive finance experience for customers like you who want to maximize your purchase power by obtaining the technology you need today, protect against technology obsolescence, and preserve your capital for other uses.

We work with businesses, non-profit organizations, governments and educational institutions to finance their entire technology solution. We focus on making it easy to do business with us. Our highly experienced team of finance professionals operates in a work culture that emphasizes the importance of providing outstanding customer service. Our systems, processes and flexible policies support our goal of providing customers with a positive experience.

We finance your entire solution. Unlike others, we allow you to bundle everything you need from hardware and software to service contracts, installation costs, training fees, and sales tax. If you decide weeks or months later to add to your solution, we can consolidate everything into a single invoice.

Our Premier Client services provide large accounts with special handling services to ensure these complex transactions are serviced properly. As a premier client, you have a dedicated finance specialist who manages your account through its life, from first invoice through asset return or purchase. This specialist develops an in-depth understanding of your invoice and payment requirements. For you, this dedication provides a high-quality, easy, and positive financing experience.

For your region specific offers please ask your Lenovo sales representative or your technology provider about the use of Lenovo Financial Services. For more information, see the following Lenovo website:

<http://www.lenovofs.com>



## Related publications and links

For more information, see these resources:

- ThinkSystem SD650 home page  
<http://www3.lenovo.com/us/en/p/77XX7DSSD65>
- ThinkSystem SD650 datasheet  
<http://lenovopress.com/DS0024>
- Interactive 3D tour of the SD650  
<http://lenovopress.com/LP0840>
- ThinkSystem SD650 drivers and support  
<http://datacentersupport.lenovo.com/products/servers/thinksystem/sd650-dwc-dual-node-tray/7x58/downloads>
- Blog post: *Lenovo's Customer-Driven Cooling Innovations Push New Performance and Energy Efficiency Limits In High Performance Computing*, by Vinod Kamath, Lenovo Thermal Architect  
<https://lenovoxperience.com/shareContent?newsId=283yi044hzgcdv7snkrmmx9ovczuovmrbj7g8uxrx4d1j94v>
- ThinkSystem SD650 and NeXtScale n1200 DWC enclosure product publications:  
<http://thinksystem.lenovofiles.com/help/topic/SD650/introduction.html>
  - Quick Start
  - Setup Guide
  - Maintenance Manual
  - Messages and Codes Reference
  - Fan and Power Control User's Guide
- Lenovo Scalable Infrastructure home page:  
<https://www3.lenovo.com/us/en/data-center/servers/high-density/Lenovo-Scalable-Infrastructure/p/WMD00000276>
- Lenovo Capacity Planner  
<https://datacentersupport.lenovo.com/us/en/products/solutions-and-software/software/lenovo-capacity-planner/solutions/ht504651>
- Power planning documents  
<https://support.lenovo.com/documents/LNVO-POWINF>

## Related product families

Product families related to this document are the following:

- [High Density Servers](#)
- [ThinkSystem SD650 Server](#)

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