Lenovo ThinkSystem SD650 V2 Server
Product Guide

The ThinkSystem SD650 V2 server is the next-generation high-performance server based on Lenovo's fourth generation Lenovo Neptune™ direct water cooling platform.

With two third-generation Intel Xeon Scalable processors, the ThinkSystem SD650 V2 server combines the latest Intel processors and Lenovo's market-leading water cooling solution, which results in extreme performance in an extreme dense packaging, supporting your application from Exascale to Everyscale™.

The direct water cooled solution is designed to operate by using warm water, up to 50°C (113°F). Chillers are not needed for most customers, meaning even greater savings and a lower total cost of ownership. The servers are housed in the ThinkSystem DW612 enclosure, a 6U rack mount unit that fits in a standard 19-inch rack.

Two ThinkSystem SD650 V2 servers, mounted on a shared 1U tray with a water loop covering all major heat sources, is shown in the following figure.
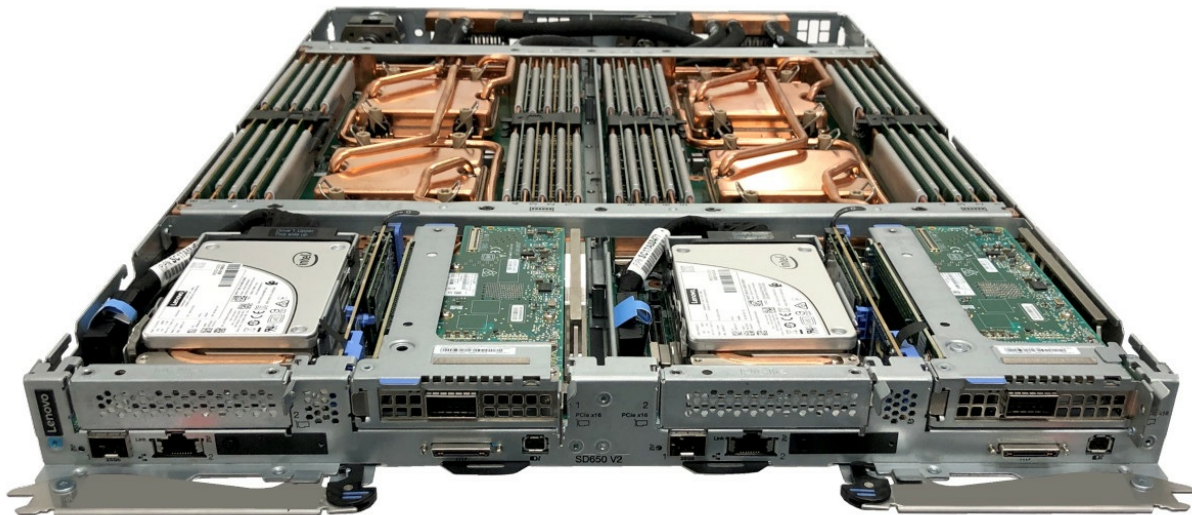

Figure 1. The Lenovo ThinkSystem SD650 V2 server tray with two distinct two-socket servers

Did you know?

The ThinkSystem SD650 V2 server and DW612 enclosure with direct water cooling provide the ultimate in data center cooling efficiencies and performance. The new water loop design is bifurcating to balance and parallelize the cooling across all major heat sources in both servers. This ensures temperature uniformity to avoid thermal jitter as you would observe in serial loops. Combined with the low pressure-drop design, you can use higher water temperatures on the highest performing chips while benefiting from saving energy and cost associated to cold water chillers.

Key features

Lenovo ThinkSystem SD650 V2 is based on our fourth generation Lenovo Neptune direct water cooling (DWC) platform leveraging two 3rd Gen Intel Xeon Scalable processors with NVIDIA HDR InfiniBand networking. The ability to use water as the cooling method results in extreme performance in dense packaging.

Direct water cooling is part of Lenovo's Neptune family of liquid cooling technologies which drive both greater energy efficiency and higher performance. Lenovo Neptune's approach uses liquid cooling to dissipate heat from systems with high thermal output, which, combined with Energy Aware Runtime environments, enables data centers to run up to 40% more efficiently while maintaining uncompromised performance and preserving a dense data center footprint.

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 50°C (122°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 ThinkSystem SD650 V2 server in the water-cooled tray is shown in the following figure.
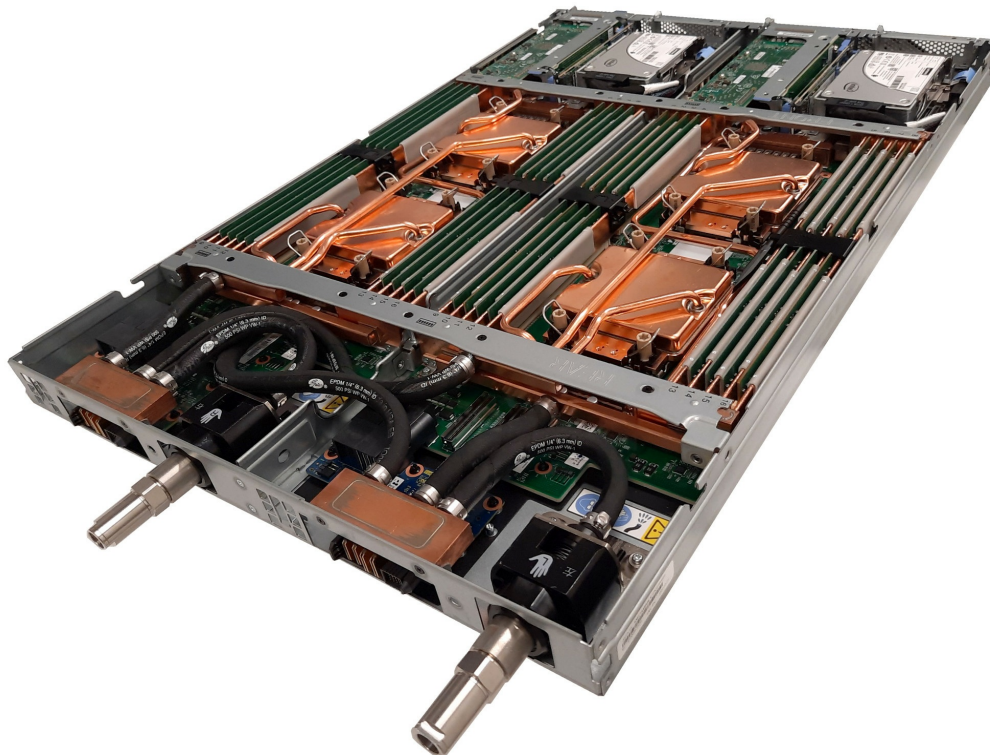

Figure 2. Rear view of SD650 V2 server tray, showing the water inlet and outlet

The SD650 V2 is designed to provide highest CPU performance density adhering to industry-standards like the 19-inch rack footprint or standard 42U rack heights at 2 meters. To truly support every scale, it is available starting at a single tray within a single Enclosure in the rack to thousands of clustered nodes in hundreds of racks in the datacenter.

ThinkSystem SD650 V2 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 V2 enhances density and supports the Intel Xeon Scalable Family of processors, including the Q-suffix processor that require water cooling.

The ThinkSystem DW612 Enclosure is an efficient, 6U rack mount enclosure with no built-in networking or switching capabilities; therefore, it requires no enclosure-level management. Sensibly designed to provide shared, high-efficiency power and cooling for housed servers, the DW612 enclosure is designed to scale with your business needs. The DW612 supports both the GPU-rich SD650-N V2 and twin-tray SD650 V2 servers.

Lenovo's direct water-cooled solutions are factory-integrated and are re-tested at the rack-level to ensure that a rack can be directly deployed at the customer site. This careful and consistent quality testing has been developed as a result of over a decade of experience designing and deploying DWC solutions to the very highest standards.

Scalability and performance

The ThinkSystem SD650 V2 server and DW612 enclosure offer the following features to boost performance, improve scalability, and reduce costs:

- Each SD650 V2 server supports two third-generation Intel Xeon Scalable Family processors, 16 TruDDR4 DIMMs, up to two PCIe slots for high-speed I/O, and up to two drive bays, in a half-wide 1U form factor.
- Up to 12 SD650 V2 servers are installed in the DW612 enclosure, occupying only 6U of rack space. It is a highly dense, scalable, and price-optimized offering.
- Supports two third-generation Intel Xeon Processor Scalable processors
    - Up to 40 cores and 80 threads
    - Core speeds of up to 3.6 GHz
    - TDP ratings of up to 270W
- Support for up to 16 TruDDR4 memory DIMMs operating at up to 3200 MHz means you have the fastest available memory subsystem.
- Each processor supports 8 DIMMS, each with its own memory channel.
- Using 128GB RDIMMs, the server supports up to 2TB of system memory
- Supports combinations of PCIe 4.0 x16 slots and SSDs, as follows:
    - One PCIe 4.0 x16 slot and two 7mm SSDs
    - One PCIe 4.0 x16 slot and one 15mm SSD
    - Two PCIe 4.0 x16 slots without SSDs (M.2 still supported)
- Drives can be either SATA or high-performance NVMe drives, to maximize I/O performance in terms of throughput, bandwidth, and latency.
- Supports two M.2 drives installed in an adapter for convenient operating system boot functions.
- The server includes onboard Gigabit and 25 Gb Ethernet ports for cost effective networking. High speed networking can be added through the included PCIe slots.
- The server offers PCI Express 4.0 I/O expansion capabilities that doubles the theoretical maximum bandwidth of PCIe 3.0 (16GT/s in each direction for PCIe 4.0, compared to 8 GT/s with PCIe 3.0). A PCIe 4.0 x16 slot provides 64 GB/s bandwidth, enough to support a 200GbE network connection.

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 enclosure and dramatically reduces the required air movement in the server room, which also saves power. In combination with an Energy Aware Runtime environment, 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 50°C instead of 18°C in an air-cooled environment.

- 85-90% heat recovery is possible with the direct water cooled design, depending on water temperature chosen. Heat energy absorbed may be reused for heating buildings in the winter, or generating cold through Adsorption Chillers, for further operating expense savings.

- The processors and other microelectronics are run at lower temperatures because they are water cooled, which uses less power, and allows for higher performance through Turbo Mode.

- The processors and accelerators are run at uniform temperatures because they are cooled in parallel loops, which avoid thermal jitter and provides higher and more reliable performance at same power.

- 80 Plus Platinum power supplies ensure energy efficiency.

- Intel Intelligent Power Capability can power on and off individual processor elements as needed to reduce power draw.

- There are power monitoring and power capping capabilities through the System Management Module in the DW612 enclosure.

- Lenovo power/energy meter based on TI INA226 measures DC power both for the CPU as well as the GPU board at higher than 97% accuracy and 100 Hz sampling frequency to the XCC and can be leveraged both in-band and out-of-band using IPMI raw commands.

- 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.

- Optional Energy Aware Runtime provides sophisticated power monitoring and energy optimization on a job-level during the application runtime without impacting performance negatively.

Manageability and security

The following powerful systems management features simplify local and remote management of the SD650 V2 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.

- Lenovo XClarity Provisioning Manager, based in UEFI and 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.

- Support for industry standard management protocols, IPMI 2.0, SNMP 3.0, Redfish REST API, serial console via IPMI

- Supports Lenovo Intelligent Computing Orchestration (LiCO), a powerful platform that manages cluster resources for HPC and AI applications. LiCO supports multiple AI frameworks, including TensorFlow, Caffe, Neon, and MXNet, allowing you to leverage a single cluster for diverse workload requirements.

- 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.

- 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.
- With the System Management Module (SMM) installed in the enclosure, only one Ethernet connection is needed to provide remote systems management functions for all SD650 V2 servers and the enclosure.
- The SMM management module has two Ethernet ports which allows a single Ethernet connection to be daisy chained across 6 enclosures and 72 servers, thereby significantly reducing the number of Ethernet switch ports needed to manage an entire rack of SD650 V2 servers and enclosures.
- The DW612 enclosure includes drip sensors that monitor the inlet and outlet manifold quick connect couplers; leaks are reported via the SMM.

Availability and serviceability

The SD650 V2 server and DW612 enclosure provide the following features to simplify serviceability and increase system uptime:

- Depending on the configuration and node population, the DW612 enclosure supports N+N and N+1 power policies for its power supplies, which means greater system uptime.
- The power supplies are hot-swappable.
- Toolless cover removal on the trays 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) and memory mirroring for redundancy in the event of a non-correctable memory failure.
- The M.2 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.
- 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 tray with two distinct SD650 V2 servers is shown in the following figure.
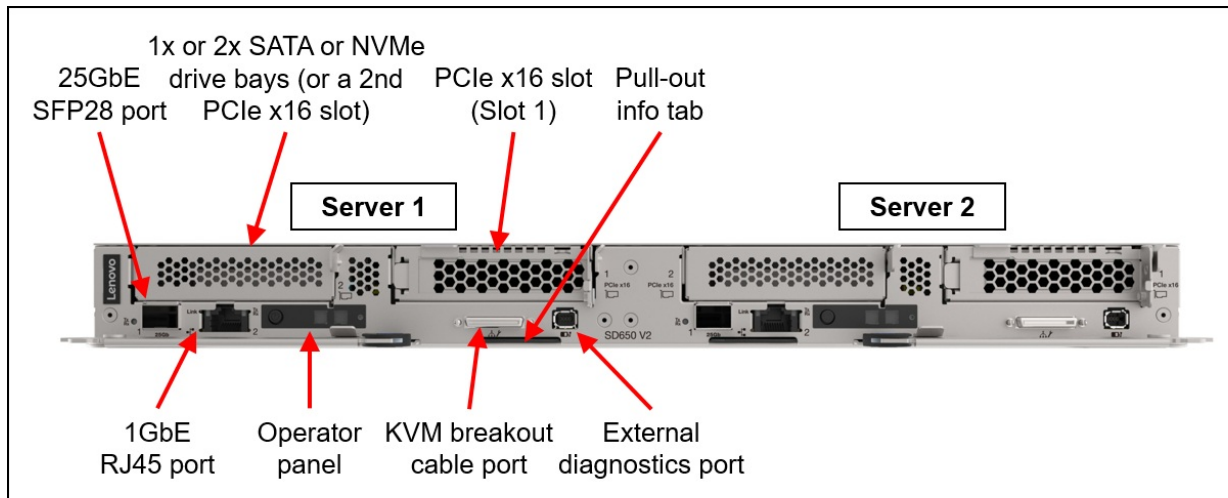

Figure 3. Front view of the tray with two ThinkSystem SD650 V2 servers

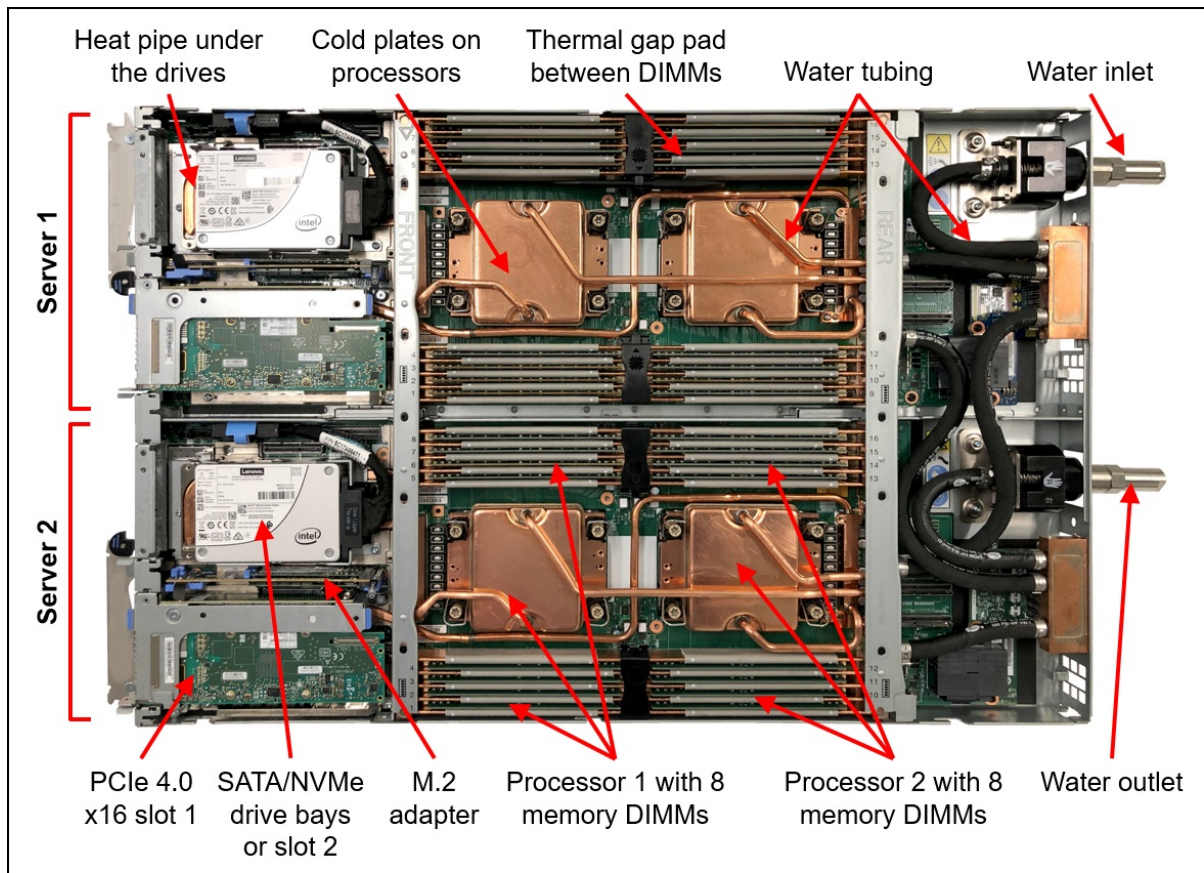The following figure shows key components internal to the server tray.

Figure 4. Inside view of the two SD650 V2 servers in the water cooled tray

The compute nodes are installed in the ThinkSystem DW612 enclosure, as shown in the following figure.

12 two-socket servers in a
6U enclosure

Figure 5. Front view of the DW612 enclosure

The rear of the enclosure contains the power supplies, cooling water manifolds, and the System Management Module, as shown in the following figure.

6x power
supplies total

Water outlet
from enclosure

System
Management
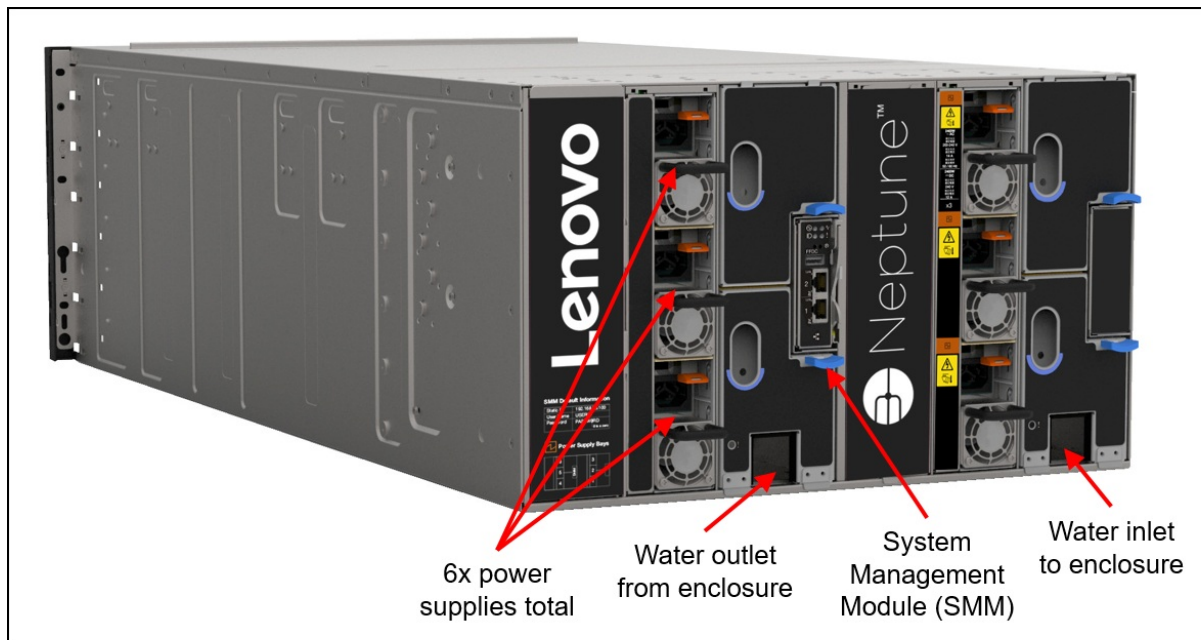Module (SMM)

Water inlet
to enclosure

Figure 6. Rear view of the DW612 enclosure

System architecture

The following figure shows the architectural block diagram of the SD650 V2 with one PCIe slot and support for up to two drives.
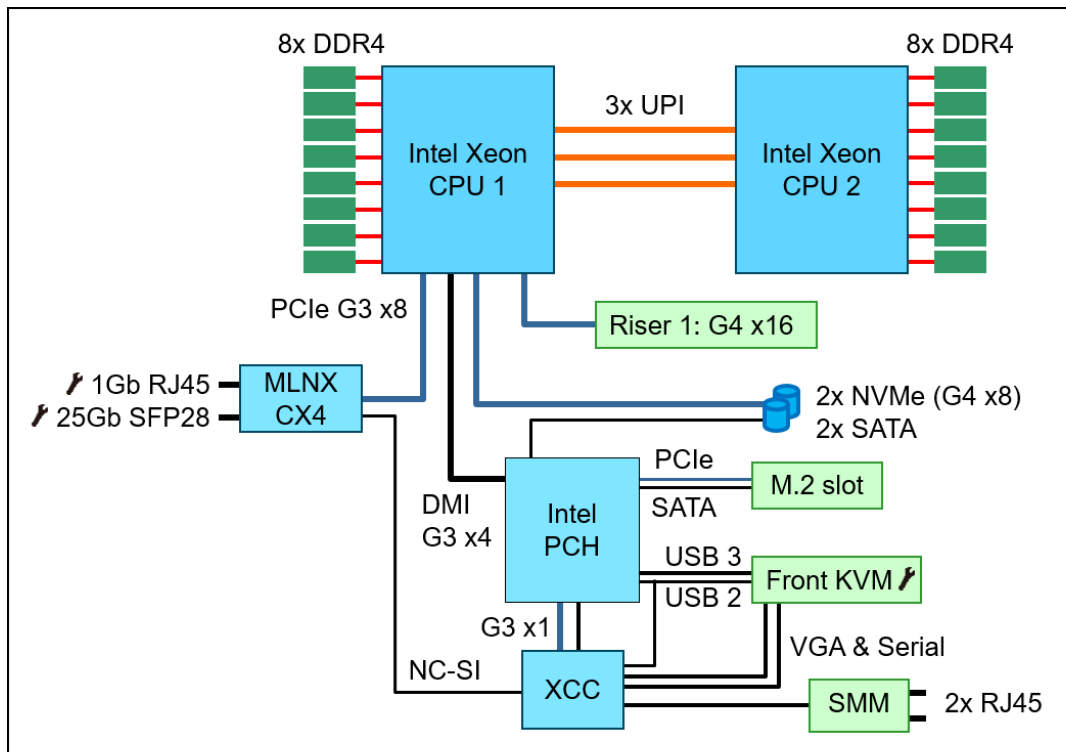

Figure 7. SD650 V2 system architectural block diagram - 1 PCIe slot

The following figure shows the architectural block diagram of the SD650 V2 with two PCIe slot.
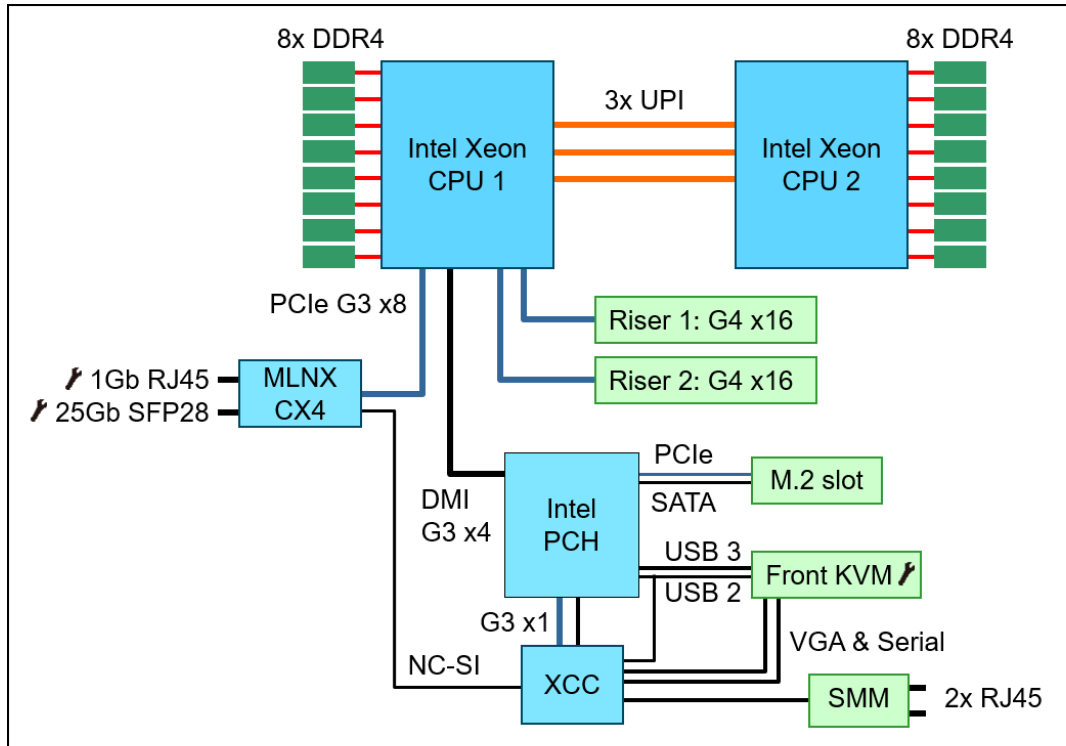
Figure 8. SD650 V2 system architectural block diagram - 2 PCIe slots

Standard specifications - SD650 V2

The following table lists the standard specifications of the SD650 V2 server.

Table 1. Standard specifications - SD650 V2

Components	Specification
Machine type	7D1M - 3 year warranty
Form factor	Two independent 2-socket servers mounted on a 1U water-cooled tray
Processor	Two third-generation Intel Xeon Scalable processor (formerly codenamed "Ice Lake"). Supports processors up to 40 cores, core speeds of up to 3.6 GHz, and TDP ratings of up to 270W. Includes support for the 8368Q liquid-cooled processor.
Chipset	Intel C621A "Lewisburg" chipset, part of the platform codenamed "Whitley"
Memory	16 DIMM slots with two processors (8 DIMM slots per processor). Each processor has 8 memory channels, with 1 DIMM per channel (DPC). Lenovo TruDDR4 RDIMMs are supported. DIMMs operate at up to 3200 MHz.
Persistent memory	Not supported
Memory maximum	Up to 2TB by using 16x 128GB 3DS RDIMMs
Memory protection	ECC, SDDC (for x4-based memory DIMMs), ADDDC (for x4-based memory DIMMs), memory mirroring.

Components	Specification
Disk drive bays	The server supports one of the following: • 2x 7mm 2.5-inch drive bays supporting SATA or NVMe drives (configurations with 1x PCIe slot) • 1x 15mm 2.5-inch drive bay supporting an NVMe drive (configurations with 1x PCIe slot) Support for up to two M.2 SSDs on an M.2 adapter. **Note**: Configurations with 2x PCIe slots only support M.2 drives.

Maximum internal storage	• 7mm drives
	   ○ 960GB using 2x 480GB 7mm SATA SSDs
	   ○ 15.36TB using 2x 7.68TB 7mm NVMe SSDs
	• 15mm drives
	   ○ 3.84TB using 1x 3.84TB 15mm NVMe SSD

Storage controllers	• 2x Onboard SATA ports (Intel VROC SATA RAID, formerly known as Intel RSTe RAID) • 2x Onboard NVMe ports (includes Intel VROC NVMe RAID for Intel SSDs; optional license for non-Intel SSDs)
Optical drive bays	No internal bays; use an external USB drive.
Network interfaces	Onboard 1 Gb Ethernet RJ45 and 25 Gb Ethernet SFP28 connectors, based on Mellanox ConnectX-4 controller. One of these ports can optionally be shared with the XClarity Controller (XCC) management processor for Wake-on-LAN and NC-SI support.
PCIe slots	1x or 2x PCIe 4.0 x16 slot with low profile form factor.
GPUs	No support.
Ports	External diagnostics port, console connector (for a breakout cable that provides one VGA port, one USB 3.1 port and one DB9 serial port for local connectivity). Additional ports provided by the enclosure as described in the Enclosure specifications section.
Video	Matrox G200 graphics with 16 MB memory with 2D hardware accelerator, integrated into the XClarity Controller. Maximum resolution is 1920x1200 32bpp at 60Hz.
Security features	Power-on password, administrator's password, Trusted Platform Module (TPM), supporting TPM 2.0. In China only, optional Nationz TPM 2.0.
Systems management	Operator panel with status LEDs. Optional External Diagnostics Handset with LCD display. XClarity Controller (XCC) embedded management, XClarity Administrator centralized infrastructure delivery, XClarity Integrator plugins, and XClarity Energy Manager centralized server power management. Optional XClarity Controller Advanced and Enterprise to enable remote control functions. Lenovo power/energy meter based on TI INA226 for 100Hz power measurements with >97% accuracy. System Management Module (SMM2) in the DW612 enclosure provides additional systems management functions.
Operating systems supported	Red Hat Enterprise Linux and SUSE Linux Enterprise Server. See the Operating system support section for specific versions.
Limited warranty	Three-year customer-replaceable unit and onsite limited warranty with 9x5 next business day (NBD).
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	Width: 438 mm (17.2 inches), height: 41 mm (1.6 inches), depth 692 mm (27.2 inches)

Components	Specification
Weight	20.7 kg (45.6 lb)

Standard specifications - DW612 enclosure

The ThinkSystem DW612 enclosure provides shared high-efficiency power supplies. The SD650 V2 servers connect to the midplane of the DW612 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: ThinkSystem DW612 enclosure

Components	Specification
Machine type	7D1L - 3 year warranty
Form factor	6U rack-mounted enclosure.
Maximum number of servers supported	Up to 12 SD650 V2 servers per enclosure in 6 trays (2 server per tray). The DW612 supports both SD650-N V2 trays and SD650 V2 trays (can coexist in the same enclosure).
Enclosures per rack	Up to six DW612 enclosures per 42U rack and up to seven DW612 enclosures per 48U rack.
Midplane	Passive midplane provides connections to the 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.
System Management Module (SMM)	The hot-swappable System Management Module (SMM2) is the management device for the enclosure. Provides integrated systems management functions and controls the power and cooling features of the enclosure. Provides remote browser and CLI-based user interfaces for remote access via the dedicated Gigabit Ethernet port. Remote access is to both the management functions of the enclosure as well as the XClarity Controller (XCC) in each server. The SMM has two Ethernet ports which enables a single incoming Ethernet connection to be daisy chained across 6 enclosures and 72 servers, thereby significantly reducing the number of Ethernet switch ports needed to manage an entire rack of SD650 V2 servers and enclosures.
Ports	Two RJ45 port on the rear of the enclosure for 10/100/1000 Ethernet connectivity to the SMM for power and cooling management.
I/O architecture	None integrated. Use top-of-rack networking and storage switches.
Power supplies	Six hot-swap power supplies, either 1800W or 2400W. Power supplies installed at the rear of the enclosure. Single power domain supplies power to all servers. Optional redundancy (N+1 or N+N) and oversubscription, depending on configuration and node population. Each power supply has an integrated fan. 80 PLUS Platinum certified. Built-in overload and surge protection.
Cooling	Direct water cooling supplied by water manifolds connected from the rear of the enclosure. Lower-power internal components cooled by power supply fans.
System LEDs	SMM has four LEDs: system error, identification, status, and system power. Each power supply has AC, DC and error LEDs. Servers have more LEDs.
Systems management	Browser-based enclosure management through an Ethernet port on the SMM at the rear of the enclosure. Integrated Ethernet switch provides direct access to the XClarity Controller (XCC) embedded management of the installed servers. Servers provide more management features.

Components	Specification

Temperature	• Operating water temperature:
	    ○ 2°C to 50°C (35.6°F to 122°F) (ASHRAE W4 compliant)
	
	• Operating air temperature:
	    ○ 10°C - 35°C (50°F - 95°F) (ASHRAE A2 compliant)
	
	See Operating Environment for more information.

Electrical power	200 V - 240 V ac input (nominal), 50 or 60 Hz
Power cords	One AC power cord for each power supply, C13 or C19 depending on the power supplies selected
Limited warranty	Three-year customer-replaceable unit and onsite limited warranty with 9x5/NBD.
Dimensions	Width: 447 mm (17.6 in.), height: 264 mm (10.4 in.), depth: 931 mm (36.6 in.). See Physical and electrical specifications for details.
Weight	Empty enclosure (with midplane and cables): 23.6 kg (52 lbs) Fully configured enclosure with six SD650 V2 server trays: 156.5 kg (345 lbs)

Models

There are no standard SD650 V2 models; all servers must be configured by using the configure-to-order (CTO) process with the Lenovo Data Center Solution Configurator (DCSC) or the Lenovo Cluster Solutions configurator (x-config). The ThinkSystem SD650 V2 machine type is 7D1M.

The following table lists the base CTO model.

Table 3. Base CTO model

Machine Type/Model	Description
7D1MCTO1WW	ThinkSystem SD650 V2 Neptune DWC Tray (3-Year Warranty)

The following table lists the base feature code for CTO configurations.

Table 4. Base feature code for CTO models

Feature code	Description
B94Y	ThinkSystem SD650 V2 Dual Node Tray Base

Enclosure models

There are no standard models of the DW612 enclosure. All enclosures must be configured by using the CTO process. The machine type is 7D1L.

The following table lists the base CTO model.

Table 5. Base CTO model

Machine Type/Model	Description
7D1LCTO1WW	ThinkSystem DW612 Neptune DWC Enclosure (3-Year Warranty)

The following table lists the base feature code for CTO configurations.

Table 6. Base feature code for CTO models

Feature code	Description
B950	ThinkSystem DW612 Enclosure Base

Manifold assembly

There are no standard models of the DWC full assembly. All models must be configured by using the CTO process. The machine type is 5469.

The following table lists the base CTO model.

Table 7. Base CTO model

Machine Type/Model	Description
5469HC1	Lenovo Neptune DWC Node Manifold

The following table lists the base feature code for CTO configurations. Select the correct feature code based on the number of enclosures installed in the rack and how long the hose should be at the base of the manifold, 1.3 meters or 2.3 meters.

Table 8. Base feature code for CTO models

Feature code	Description
1.3 meter extension	
A5MN	Neptune DWC Manifold Assembly for 1 Enclosure w/ 1.3m hose
A5N7	Neptune DWC Manifold Assembly for 2 Enclosures w/ 1.3m hose
A5N8	Neptune DWC Manifold Assembly for 3 Enclosures w/ 1.3m hose
A5N9	Neptune DWC Manifold Assembly for 4 Enclosures w/ 1.3m hose
A5MM	Neptune DWC Manifold Assembly for 5 Enclosures w/ 1.3m hose
A5ML	Neptune DWC Manifold Assembly for 6 Enclosures w/ 1.3m hose
A5MK	Neptune DWC Manifold Assembly for 7 Enclosures w/ 1.3m hose
2.3 meter extension	
BEZX	Neptune DWC Manifold Assembly for 5 Enclosures w/ 2.3m hose
BEZW	Neptune DWC Manifold Assembly for 6 Enclosures w/ 2.3m hose
BJAK	Neptune DWC Manifold Assembly for 7 Enclosures w/ 2.3m hose

Processors

The SD650 V2 supports processors in the third-generation Intel Xeon Scalable Processor family. The server supports two processors. A configuration of a single processor is not supported.

Topics in this section:

- Processor options
- Processor features

Processor options

The table below lists the processors that are supported.

Some processors include a suffix letter in the processor model number:

- M: Media Processing optimized
- N: NFV optimized
- P: High frequency-optimized for IaaS virtualization customers
- Q: Optimized for liquid cooling
- S: Large (512GB) SGX Enclave size
- T: High Tcase
- U: Single socket
- V: High density/low power-optimized for SaaS virtualization customers
- Y: Speed Select

Memory tiers: All processors support up to 6TB of memory. There are no L or M suffix processors.

Tip: In the SD650 V2, two processors are installed in the factory so there are no part numbers for field upgrades.

Table 9. Processor options

Feature code	Description	Quantity required
BB35	Intel Xeon Gold 5318Y 24C 165W 2.1GHz Processor	2

Feature code	Description	Quantity required
BB2R	Intel Xeon Gold 5320 26C 185W 2.2GHz Processor	2
BB4E	Intel Xeon Gold 6326 16C 185W 2.9GHz Processor	2
BB3H	Intel Xeon Gold 6330 28C 205W 2.0GHz Processor	2
BB3D	Intel Xeon Gold 6334 8C 165W 3.6GHz Processor	2
BB3S	Intel Xeon Gold 6336Y 24C 185W 2.4GHz Processor	2
BB3P	Intel Xeon Gold 6338 32C 205W 2.0GHz Processor	2
BB3B	Intel Xeon Gold 6342 24C 230W 2.8GHz Processor	2
BB2W	Intel Xeon Gold 6346 16C 205W 3.1GHz Processor	2
BB2L	Intel Xeon Gold 6348 28C 235W 2.6GHz Processor	2
BB2U	Intel Xeon Gold 6354 18C 205W 3.0GHz Processor	2
BKDB	Intel Xeon Platinum 8352M 32C 185W 2.3GHz Processor	2
BB2V	Intel Xeon Platinum 8352Y 32C 205W 2.2GHz Processor	2
BB3R	Intel Xeon Platinum 8358 32C 250W 2.6GHz Processor	2
BB3A	Intel Xeon Platinum 8358P 32C 240W 2.6GHz Processor	2
BB2P	Intel Xeon Platinum 8360Y 36C 250W 2.4GHz Processor	2
BKDC	Intel Xeon Platinum 8362 32C 265W 2.8GHz Processor	2
BB37	Intel Xeon Platinum 8368 38C 270W 2.4GHz Processor	2
BB2T	Intel Xeon Platinum 8368Q 38C 270W 2.6GHz Processor	2
BB3G	Intel Xeon Platinum 8380 40C 270W 2.3GHz Processor	2

Processor features

Supported processors have the following features:

- Third-generation Intel Xeon Scalable processors (formerly codenamed "Ice Lake")
- 10 nm process technology
- 8x DDR4 memory channels
- 64x PCIe 4.0 I/O lanes available for PCIe and NVMe devices
- 1.25 MB L2 cache per core
- 1.5 MB or more L3 cache per core
- Intel Deep Learning Boost, which provides built-in Artificial Intelligence (AI) acceleration with the Vector Neural Network Instruction set (VNNI). DL Boost and VNNI are designed to deliver significant, more efficient Deep Learning (Inference) acceleration for high-performance AI workloads.
- Intel Hyper-Threading Technology, which boosts performance for multithreaded applications by enabling simultaneous multithreading within each processor core, up to two threads per core.
- Intel Turbo Boost Technology 2.0, which allows processor cores to run at maximum speeds during peak workloads by temporarily going beyond processor TDP.
- Intel Virtualization Technology (includes VT-x and VT-d), which integrates hardware-level virtualization hooks that allow operating system vendors to better use the hardware for virtualization workloads.
- Intel Speed Select Technology, supported on some processor models, enables increased core Turbo Boost frequency on specific individual cores to maximize application performance.
- Intel Advanced Vector Extensions 512 (AVX-512), to enable acceleration of enterprise-class workloads, including databases and enterprise resource planning (ERP).
- Up to two Intel AVX-512 Fused-Multiply Add (FMA) units
- Intel SGX (Software Guard Extensions) and Intel TME (Total Memory Encryption) security features
- Two or three Intel Ultra Path Interconnect (UPI) links at up to 11.2 GT/s, to maximize inter-processor communication

The following table compares the features of the supported third-generation Intel Xeon processors.

Abbreviations used in the table:

- TB: Turbo Boost 2.0
- UPI: Ultra Path Interconnect
- TDP: Thermal Design Power
- SGX: Software Guard Extensions
- PMem: Persistent Memory support

Table 10. Processor features

CPU model	Cores/ threads	Core speed (Base / TB max)	L3 cache*	Max memory speed	UPI links & speed	TDP	SGX Enclave Size
5318Y	24 / 48	2.1 GHz / 3.4 GHz	36 MB	2933 MHz	3 / 11.2 GT/s	165W	64 GB
5320	26 / 52	2.2 GHz / 3.4 GHz	39 MB	2933 MHz	3 / 11.2 GT/s	185W	64 GB
6326	16 / 32	2.9 GHz / 3.5 GHz	24 MB	3200 MHz	3 / 11.2 GT/s	185W	64 GB
6330	28 / 56	2.0 GHz / 3.1 GHz	42 MB	2933 MHz	3 / 11.2 GT/s	205W	64 GB
6334	8 / 16	3.6 GHz / 3.7 GHz	18 MB*	3200 MHz	3 / 11.2 GT/s	165W	64 GB
6336Y	24 / 48	2.4 GHz / 3.6 GHz	36 MB	3200 MHz	3 / 11.2 GT/s	185W	64 GB
6338	32 / 64	2.0 GHz / 3.2 GHz	48 MB	3200 MHz	3 / 11.2 GT/s	205W	64 GB

CPU model	Cores/ threads	Core speed (Base / TB max)	L3 cache*	Max memory speed	UPI links & speed	TDP	SGX Enclave Size
6342	24 / 48	2.8 GHz / 3.5 GHz	36 MB	3200 MHz	3 / 11.2 GT/s	230W	64 GB
6346	16 / 32	3.1 GHz / 3.6 GHz	36 MB*	3200 MHz	3 / 11.2 GT/s	205W	64 GB
6348	28 / 56	2.6 GHz / 3.5 GHz	42 MB	3200 MHz	3 / 11.2 GT/s	235W	64 GB
6354	18 / 36	3.0 GHz / 3.6 GHz	39 MB*	3200 MHz	3 / 11.2 GT/s	205W	64 GB
8352M	32 / 64	2.3 GHz / 3.5 GHz	48 MB	3200 MHz	3 / 11.2 GT/s	185W	64 GB
8352Y	32 / 64	2.2 GHz / 3.4 GHz	48 MB	3200 MHz	3 / 11.2 GT/s	205W	64 GB
8358	32 / 64	2.6 GHz / 3.4 GHz	48 MB	3200 MHz	3 / 11.2 GT/s	250W	64 GB
8358P	32 / 64	2.6 GHz / 3.4 GHz	48 MB	3200 MHz	3 / 11.2 GT/s	240W	8 GB
8360Y	36 / 72	2.4 GHz / 3.5 GHz	54 MB	3200 MHz	3 / 11.2 GT/s	250W	64 GB
8362	32 / 64	2.8 GHz / 3.6 GHz	48 MB	3200 MHz	3 / 11.2 GT/s	265W	64 GB
8368	38 / 76	2.4 GHz / 3.4 GHz	57 MB	3200 MHz	3 / 11.2 GT/s	270W	512 GB
8368Q	38 / 76	2.6 GHz / 3.7 GHz	57 MB	3200 MHz	3 / 11.2 GT/s	270W	512 GB
8380	40 / 80	2.3 GHz / 3.4 GHz	60 MB	3200 MHz	3 / 11.2 GT/s	270W	512 GB

* L3 cache is 1.5 MB per core or larger. Processors with a larger L3 cache per core are marked with an *

Memory

The SD650 V2 uses Lenovo TruDDR4 memory and supports 16 DIMMs with both processors installed. Each processor has eight memory channels with one DIMM per channel. With 128 GB RDIMMs installed, the SD650 V2 supports a total of 2 TB of system memory.

Memory operates at up to 3200 MHz , depending on the memory DIMMs and processor model selected. If the processor selected has a lower memory bus speed, then all DIMMs will operate at that lower speed.

The following table lists the memory options that are available for the server.

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.

Table 11. Memory options

Part number	Feature code	Description	Maximum supported
RDIMMs			
4X77A08632	B963	ThinkSystem 16GB TruDDR4 3200MHz (2Rx8 1.2V) RDIMM	16 (8 per processor)
4X77A08633	B964	ThinkSystem 32GB TruDDR4 3200MHz (2Rx4 1.2V) RDIMM	16 (8 per processor)
4X77A08635	B966	ThinkSystem 64GB TruDDR4 3200MHz (2Rx4 1.2V) RDIMM	16 (8 per processor)
3DS RDIMMs			
4X77A08636	BA62	ThinkSystem 128GB TruDDR4 3200 MHz (2S2Rx4 1.2V) 3DS RDIMM	16 (8 per processor)

The following rules apply when selecting the memory configuration:

- In the SD650 V2, each processor must have 8 DIMMs installed. Other quantities per processor are not supported.
- The server supports RDIMMs and 3DS RDIMMs; UDIMMs and LRDIMMs are not supported
- Mixing RDIMMs and 3DS RDIMMs is not supported
- Mixing DIMM capacities is not supported

The following memory protection technologies are supported:

- ECC
- SDDC (for x4-based memory DIMMs; look for "x4" in the DIMM description)
- ADDDC (for x4-based memory DIMMs)
- Memory mirroring

Note: Memory sparing is not supported

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. Memory rank sparing is not supported.

GPU accelerators

GPUs are not supported in the SD650 V2.

For NVIDIA A100 GPU support in a water-cooled solution, consider the ThinkSystem SD650-N V2 server. For details, see the SD650-N V2 product guide, https://lenovopress.com/LP1396.

Internal storage

The SD650 V2 server supports one or two SSDs drives internally in the server. These are internal drives that are not front accessible. See the Components and connectors section for the location of the drives.

- With one PCIe slot, the drives are mounted in the second slot area in front of the processors. One of the following drive configurations is supported:
    - 2x 2.5-inch 7mm NVMe drives (feature B95S)
    - 2x 2.5-inch 7mm SATA drives (feature B95T)
    - 1x 2.5-inch 15mm drive, either NVMe or SATA (feature B95U)
- With two PCIe slots, 2.5-inch drives are not supported, however M.2 drives are still supported.

The relevant feature codes are listed in the following table:

Table 12. Drive cages

Feature code	Description
B95S	ThinkSystem SD650/650-N V2 2x2.5" 7mm NVMe Storage Cage
B95T	ThinkSystem SD650/650-N V2 2x2.5" 7mm SATA Storage Cage
B95U	ThinkSystem SD650/650-N V2 1x2.5" SATA/NVMe Storage Cage

When two 7mm drives are installed, a RAID-1 array can be formed using Intel VROC SATA RAID (RSTe) or Intel VROC NVMe RAID, as described in the next section.

Intel VROC onboard SATA and NVMe RAID

Intel VROC (Virtual RAID on CPU) is a feature of the Intel processor that enables RAID support. There are two separate functions of VROC:

- Intel VROC SATA RAID, formerly known as Intel RSTe
- Intel VROC NVMe RAID

VROC SATA RAID (RSTe) is available and supported with all SATA drives , both SATA SSDs and SATA HDDs. It offers a 6 Gb/s connection to each drive and on the SD650 V2 implements RAID 0 and 1.

VROC NVMe RAID offers RAID support for any NVMe drives directly connected to the ports on the server's system board. On the SD650 V2, it implements RAID 0 and 1.

> **Performance tip**: For best performance with VROC NVMe RAID, the drives in an array should all be connected to the same processor. Spanning processors is possible however performance will be unpredictable and should be evaluated based on your workload.

By default, VROC NVMe RAID support is limited to use with only Intel-branded NVMe drives (feature B9X7). If you wish to enable RAID support for non-Intel NVMe SSDs, select the VROC Premium license using the ordering information in the following table. VROC Premium is fulfilled as a Feature on Demand (FoD) license and is activated via the XCC management processor user interface.

Table 13. VROC upgrade

Part number	Feature code	Description
4L47A39164	B96G	Intel VROC (VMD NVMe RAID) Premium

VROC Premium is only needed for non-Intel NVMe drives in a RAID configuration. You do not need the VROC Premium license upgrade under any of the following conditions:

- If you have SATA drives connected to the onboard SATA ports, you do not need VROC Premium
- If you have Intel NVMe drives connected to the onboard NVMe ports, you do not need VROC Premium
- If you have non-Intel NVMe drives connected to the onboard NVMe ports, but you don't want RAID support, you do not need VROC Premium

Virtualization support: Virtualization support for Intel VROC is as follows:

- **VROC SATA RAID (RSTe)** : VROC SATA RAID is not supported by virtualization hypervisors such as ESXi, KVM, Xen, and Hyper-V. Virtualization is only supported on the onboard SATA ports in AHCI (non-RAID) mode.
- **VROC (VMD) NVMe RAID** : VROC (VMD) NVMe RAID is supported by ESXi, KVM, Xen, and Hyper-V. ESXi support is limited to RAID 1 only; other RAID levels are not supported. Windows and Linux OSes support VROC RAID NVMe, both for host boot functions and for guest OS function, and RAID-0, 1, 5, and 10 are supported.

M.2 drives

The SD650 V2 supports one or two M.2 form-factor SATA drives for use as an operating system boot solution. The M.2 drives install into an M.2 adapter which in turn is installed in a dedicated slot on the system board. See the internal view of the server in the Components and connectors section for the location of the M.2 slot.

The ordering information of the M.2 adapter is listed in the following table. Supported drives are listed in the Internal drive options section.

Table 14. M.2 adapter

Part number	Feature code	Description	Maximum supported
4Y37A09740	B967	ThinkSystem M.2 2-Bay Enablement Kit for Dense Systems	1

Note: In the SD650 V2, the M.2 adapter only supports SATA drives. NVMe M.2 drives are not supported

The M.2 adapter, when used in the SD650 V2, has the following features:

- Supports one or two SATA M.2 drives
- Supports 42mm, 60mm, 80mm and 110mm drive form factors (2242, 2260, 2280 and 22110)
- 6Gbps SATA interface to the drives
- Uses the onboard SATA controller of the server
- JBOD native support; no built-in RAID support (RAID can be enabled via Intel VROC)
- Supports monitoring and reporting of events and temperature through I2C
- Firmware update via Lenovo firmware update tools

Controllers for internal storage

The drives of the SD650 V2 are connected to controller on the system board:

- Onboard SATA ports with software RAID support (Intel VROC SATA RAID, formerly known as Intel RSTe)
- Onboard NVMe ports with software RAID support (Intel VROC NVMe RAID)

The following table lists the adapters used for the internal storage of the server.

Table 15. Internal Storage adapter support

Part number	Feature code	Description
Onboard SATA - Intel VROC SATA RAID (Intel RSTe)		
None	AVV0	On Board SATA Software RAID Mode
Onboard NVMe - Intel VROC NVMe RAID		
4L47A39164	B96G	Intel VROC (VMD NVMe RAID) Premium (license upgrade - to enable RAID support for non-Intel NVMe SSDs)

The onboard SATA controller has the following features:

- Controller integrated into the Intel PCH
- 6 Gbps SATA host interface
- Supports RAID-0, and RAID-1 with two drives (Intel VROC SATA RAID, previously known as RSTe)
- Supports JBOD

The onboard NVMe support has the following features:

- Controller integrated into the Intel processor
- Each drive has PCIe 4.0 x4 host interface
- Supports JBOD - Intel and non-Intel NVMe SSDs - no license required
- Supports RAID-0 and RAID-1 (Intel VROC NVMe RAID) - Intel NVMe SSDs only

Internal drive options

The following tables list the drive options for internal storage of the server.

Trayless drives:

- 7mm 2.5-inch trayless 6 Gb SATA SSDs
- 7mm 2.5-inch trayless PCIe 3.0 NVMe SSDs
- 15mm 2.5-inch trayless PCIe 4.0 NVMe SSDs

M.2 drives:

- M.2 SATA drives

M.2 drive support: The use of M.2 drives requires an additional adapter as described in the M.2 drives subsection.

Table 16. 7mm 2.5-inch trayless 6 Gb SATA SSDs

Part number	Feature	Description	Maximum supported
7mm 2.5-inch trayless SSDs - 6 Gb SATA - Mixed Use/Mainstream (3-5 DWPD)			
4XB7A77061	BKSY	ThinkSystem 2.5" 7mm S4620 960GB Mixed Use SATA 6Gb Trayless SSD	2
4XB7A77062	BKSZ	ThinkSystem 2.5" 7mm S4620 1.92TB Mixed Use SATA 6Gb Trayless SSD	2
4XB7A78629	BM1F	ThinkSystem 2.5" 7mm S4620 3.84TB Mixed Use SATA 6Gb Trayless SSD	2
4XB7A13670	B49W	ThinkSystem SD650 2.5" S4610 240GB Mixed Use SATA 6Gb HS SSD	2
4XB7A13933	B49X	ThinkSystem SD650 2.5" S4610 480GB Mixed Use SATA 6Gb HS SSD	2
4XB7A17186	B95H	ThinkSystem 5300 2.5" 7mm 240GB Mainstream SATA 6Gb Trayless SSD	2
4XB7A17187	B95J	ThinkSystem 5300 2.5" 7mm 480GB Mainstream SATA 6Gb Trayless SSD	2
4XB7A17188	BNHY	ThinkSystem 2.5" 7mm 5300 960GB Mainstream SATA 6Gb Trayless SSD	2
7mm 2.5-inch trayless SSDs - 6 Gb SATA - Read Intensive/Entry (<3 DWPD)			
4XB7A77056	BKST	ThinkSystem Intel S4520 2.5" 7mm 240GB Entry SATA 6Gb Non-Hot Swap SSD Trayless	2
4XB7A77057	BKSU	ThinkSystem Intel S4520 2.5" 7mm 480GB Entry SATA 6Gb Non-Hot Swap SSD Trayless	2
4XB7A77058	BKSV	ThinkSystem 2.5" 7mm S4520 960GB Read Intensive SATA 6Gb Trayless SSD	2
4XB7A77059	BKSW	ThinkSystem 2.5" 7mm S4520 1.92TB Read Intensive SATA 6Gb Trayless SSD	2
4XB7A78627	BM1D	ThinkSystem 2.5" 7mm S4520 3.84TB Read Intensive SATA 6Gb Trayless SSD	2
4XB7A78628	BM1E	ThinkSystem 2.5" 7mm S4520 7.68TB Read Intensive SATA 6Gb Trayless SSD	2
4XB7A13666	B49J	ThinkSystem SD650 2.5" S4510 240GB Read Intensive SATA 6Gb HS SSD	2
4XB7A13667	B49K	ThinkSystem SD650 2.5" S4510 480GB Read Intensive SATA 6Gb HS SSD	2
4XB7A17182	BA46	ThinkSystem 5300 2.5" 7mm 240GB Entry SATA 6Gb Trayless SSD	2
4XB7A17183	BA47	ThinkSystem 5300 2.5" 7mm 480GB Entry SATA 6Gb Trayless SSD	2
4XB7A17184	BNHX	ThinkSystem 2.5" 7mm 5300 960GB Entry SATA 6Gb Trayless SSD	2

Table 17. 7mm 2.5-inch trayless PCIe 3.0 NVMe SSDs

Part number	Feature	Description	Maximum supported
7mm 2.5-inch SSDs - U.2 PCIe 3.0 NVMe - Read Intensive/Entry (<3 DWPD)			
4XB7A38170	B95G	ThinkSystem PM983 2.5" 7mm 960GB Read Intensive Entry NVMe PCIe 3.0 x4 Trayless SSD	2
4XB7A76731	BJLU	ThinkSystem PM983 2.5" 7mm 1.92TB Read Intensive Entry NVMe PCIe 3.0 x4 Trayless SSD	2
4XB7A76732	BJLV	ThinkSystem PM983 2.5" 7mm 3.84TB Read Intensive Entry NVMe PCIe 3.0 x4 Trayless SSD	2
4XB7A76733	BJLW	ThinkSystem PM983 2.5" 7mm 7.68TB Read Intensive Entry NVMe PCIe 3.0 x4 Trayless SSD	2

Table 18. 15mm 2.5-inch trayless PCIe 4.0 NVMe SSDs

Part number	Feature	Description	Maximum supported
15mm 2.5-inch SSDs - U.2 PCIe 4.0 NVMe - Mixed Use/Mainstream (3-5 DWPD)			
4XB7A71356	BFPN	ThinkSystem 2.5" 15mm U.2 P5600 1.6TB Mixed Use NVMe PCIe 4.0 x4 Trayless SSD	1
4XB7A71357	BFPP	ThinkSystem 2.5" 15mm U.2 P5600 3.2TB Mixed Use NVMe PCIe 4.0 x4 Trayless SSD	1
15mm 2.5-inch SSDs - U.3 PCIe 4.0 NVMe - Mixed Use/Mainstream (3-5 DWPD)			
4XB7A63069	BCNB	ThinkSystem Kioxia CM6-V 2.5" 15mm 1.6TB Mainstream NVMe PCIe 4.0 x4 Trayless SSD	1
4XB7A63070	BCN9	ThinkSystem Kioxia CM6-V 2.5" 15mm 3.2TB Mainstream NVMe PCIe 4.0 x4 Trayless SSD	1
15mm 2.5-inch SSDs - U.2 PCIe 4.0 NVMe - Read Intensive/Entry (<3 DWPD)			
4XB7A71355	BFPM	ThinkSystem 2.5" 15mm U.2 P5500 1.92TB Read Intensive NVMe PCIe 4.0 x4 Trayless SSD	1
4XB7A71358	BFPQ	ThinkSystem 2.5" 15mm U.2 P5500 3.84TB Read Intensive NVMe PCIe 4.0 x4 Trayless SSD	1

Table 19. M.2 SATA drives

Part number	Feature	Description	Maximum supported
M.2 SSDs - 6 Gb SATA - Read Intensive/Entry (<3 DWPD)			
4XB7A17071	B8HS	ThinkSystem M.2 5300 240GB SATA 6Gbps Non-Hot Swap SSD	2

Optical drives

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

Table 20. External optical drive

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

The drive is based on the Lenovo Slim DVD Burner DB65 drive and supports the following formats: DVD-RAM, DVD-RW, DVD+RW, DVD+R, DVD-R, DVD-ROM, DVD-R DL, CD-RW, CD-R, CD-ROM.

I/O expansion options

The SD650 V2 supports 1x or 2x slots depending on the configuration:

- 1x PCIe 4.0 x16 slot with support for 2x 7mm or 1x 15mm 2.5-inch drive
- 2x PCIe 4.0 x16 slots without 2.5-inch drive support

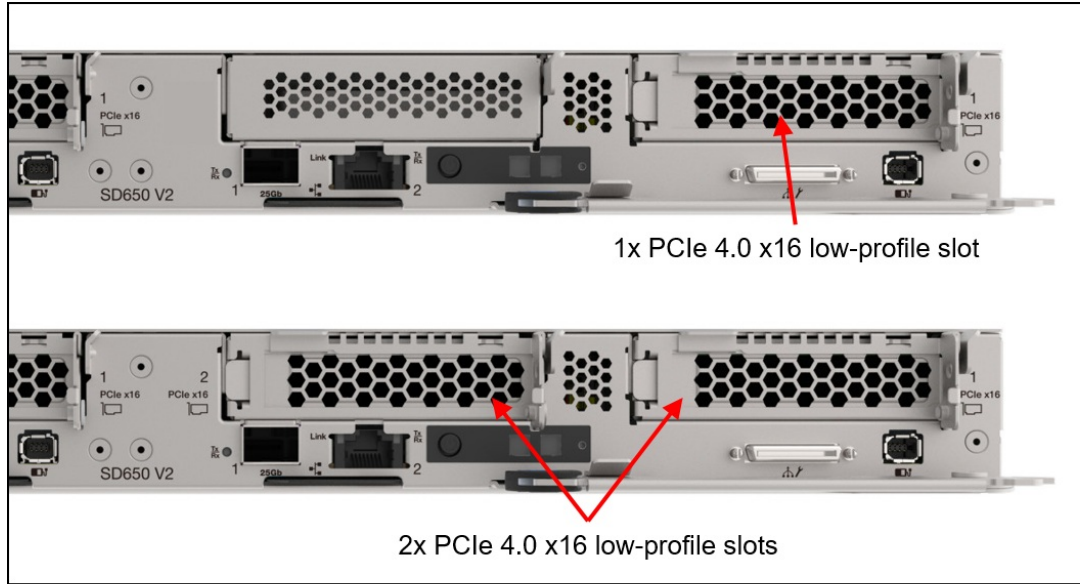The location of the slows is shown in the following figure.

Figure 9. SD650 V2 slot choices

Slots are implemented using a 1-slot riser. Ordering information is in the following table.

Table 21. Riser ordering information

Part number	Feature code	Description	Maximum supported
Riser for slot 1 and slot 2			
4M17A11751	B95W	ThinkSystem 1U PCIe Riser for Dense Systems	2

Network adapters

The SD650 V2 has two dedicated network ports connected to an onboard Mellanox ConnectX-4 Lx controller.

- 25GbE port, implemented with an SFP28 cage for optical or copper connections
- 1GbE port, implemented with an RJ45 port for copper cabling

Locations of these ports is shown in the Components and connectors section. Either onboard port supports NC-SI for remote management. For factory orders, to specify which ports should have NC-SI enabled, use the feature codes listed in the Remote Management section. If neither is chosen, both ports will have NC-SI disabled.

For the specifications of the controller, see the Mellanox ConnectX-4 product guide:
https://lenovopress.com/lp0098-mellanox-connectx-4

The following table lists the transceivers that are supported in the 25GbE port.

Table 22. Transceivers supported in the 25GbE port

Part number	Feature code	Description
10Gb transceivers		
46C3447	5053	SFP+ SR Transceiver
25Gb transceivers		
7G17A03537	AV1B	Lenovo 25GBase-SR SFP28 Transceiver

The following table lists the fiber optic cables and Active Optical Cables that are supported in the 25GbE port.

Table 23. Optical cables

Part number	Feature code	Description
LC-LC OM3 Fiber Optic Cables (these cables require a 10 GbE SFP+ SR or 25 GbE SFP28 SR transceiver)		
00MN499	ASR5	Lenovo 0.5m LC-LC OM3 MMF Cable
00MN502	ASR6	Lenovo 1m LC-LC OM3 MMF Cable
00MN505	ASR7	Lenovo 3m LC-LC OM3 MMF Cable
00MN508	ASR8	Lenovo 5m LC-LC OM3 MMF Cable
00MN511	ASR9	Lenovo 10m LC-LC OM3 MMF Cable
00MN514	ASRA	Lenovo 15m LC-LC OM3 MMF Cable
00MN517	ASRB	Lenovo 25m LC-LC OM3 MMF Cable
00MN520	ASRC	Lenovo 30m LC-LC OM3 MMF Cable
MTP-4xLC OM3 MMF Breakout Cables (these cables require a transceiver)		
00FM412	A5UA	Lenovo 1m MPO-4xLC OM3 MMF Breakout Cable
00FM413	A5UB	Lenovo 3m MPO-4xLC OM3 MMF Breakout Cable
00FM414	A5UC	Lenovo 5m MPO-4xLC OM3 MMF Breakout Cable
SFP+ 10Gb Active Optical Cables		
00YL634	ATYX	Lenovo 1M SFP+ to SFP+ Active Optical Cable
00YL637	ATYY	Lenovo 3M SFP+ to SFP+ Active Optical Cable
00YL640	ATYZ	Lenovo 5M SFP+ to SFP+ Active Optical Cable
00YL643	ATZ0	Lenovo 7M SFP+ to SFP+ Active Optical Cable
00YL646	ATZ1	Lenovo 15M SFP+ to SFP+ Active Optical Cable
00YL649	ATZ2	Lenovo 20M SFP+ to SFP+ Active Optical Cable
SFP28 25Gb Active Optical Cables		
7Z57A03541	AV1F	Lenovo 3m 25G SFP28 Active Optical Cable
7Z57A03542	AV1G	Lenovo 5m 25G SFP28 Active Optical Cable
7Z57A03543	AV1H	Lenovo 10m 25G SFP28 Active Optical Cable
7Z57A03544	AV1J	Lenovo 15m 25G SFP28 Active Optical Cable
7Z57A03545	AV1K	Lenovo 20m 25G SFP28 Active Optical Cable
QSFP28 100Gb Breakout Active Optical Cables		
7Z57A03551	AV1R	Lenovo 3m 100G to 4x25G Breakout Active Optical Cable
7Z57A03552	AV1S	Lenovo 5m 100G to 4x25G Breakout Active Optical Cable
7Z57A03553	AV1T	Lenovo 10m 100G to 4x25G Breakout Active Optical Cable

Part number	Feature code	Description
7Z57A03554	AV1U	Lenovo 15m 100G to 4x25G Breakout Active Optical Cable
7Z57A03555	AV1V	Lenovo 20m 100G to 4x25G Breakout Active Optical Cable
OM4 LC to LC Cables (these cables require a transceiver)		
4Z57A10845	B2P9	Lenovo 0.5m LC-LC OM4 MMF Cable
4Z57A10846	B2PA	Lenovo 1m LC-LC OM4 MMF Cable
4Z57A10847	B2PB	Lenovo 3m LC-LC OM4 MMF Cable
4Z57A10848	B2PC	Lenovo 5m LC-LC OM4 MMF Cable
4Z57A10849	B2PD	Lenovo 10m LC-LC OM4 MMF Cable
4Z57A10850	B2PE	Lenovo 15m LC-LC OM4 MMF Cable
4Z57A10851	B2PF	Lenovo 25m LC-LC OM4 MMF Cable
4Z57A10852	B2PG	Lenovo 30m LC-LC OM4 MMF Cable

The following table lists the direct-attach copper (DAC) cables that are supported in the 25GbE port.

Table 24. Copper cables

Part number	Feature code	Description
SFP+ 10Gb Passive DAC Cables		
00D6288	A3RG	0.5m Passive DAC SFP+ Cable
90Y9427	A1PH	1m Passive DAC SFP+ Cable
00AY764	A51N	1.5m Passive DAC SFP+ Cable
00AY765	A51P	2m Passive DAC SFP+ Cable
90Y9430	A1PJ	3m Passive DAC SFP+ Cable
90Y9433	A1PK	5m Passive DAC SFP+ Cable
00D6151	A3RH	7m Passive DAC SFP+ Cable
SFP28 25Gb Passive DAC Cables		
7Z57A03557	AV1W	Lenovo 1m Passive 25G SFP28 DAC Cable
7Z57A03558	AV1X	Lenovo 3m Passive 25G SFP28 DAC Cable
7Z57A03559	AV1Y	Lenovo 5m Passive 25G SFP28 DAC Cable
QSFP28 100G-to-4x25G Breakout Cables		
7Z57A03564	AV22	Lenovo 1m 100G QSFP28 to 4x25G SFP28 Breakout DAC Cable
7Z57A03565	AV23	Lenovo 3m 100G QSFP28 to 4x25G SFP28 Breakout DAC Cable
7Z57A03566	AV24	Lenovo 5m 100G QSFP28 to 4x25G SFP28 Breakout DAC Cable

Network adapters

The server also supports a network adapter installed in the PCIe slot. The following table lists the supported adapters.

Table 25. PCIe network adapters

Feature code	Description	Maximum supported
Network adapters in each server		
AU0B	Intel OPA 100 Series Single-port PCIe 3.0 x16 HFA	1
B952	ThinkSystem Mellanox ConnectX-6 HDR/200GbE QSFP56 1-Port PCIe 4 VPI Adapter DWC	2
Shared I/O between servers		
B951	ThinkSystem Mellanox ConnectX-6 HDR/200GbE QSFP56 1-Port PCIe 4 VPI Adapter (SharedIO) DWC	1 in Server 2
B4RB	ThinkSystem Mellanox HDR/200GbE 2x PCIe Aux Kit	1 in Server 1

The SD650 V2 supports a feature called Shared I/O (SharedIO), also known as Mellanox Multi-Host technology, where a single HDR/200GbE connection is shared between the two servers in a tray. With Shared I/O, the Mellanox ConnectX-6 HDR/200GbE adapter (feature B951) is installed in one server in a tray and an auxiliary adapter (feature B4RB) is installed in the adjacent server in the same tray. A cable connects the two adapters together. The result is that the two servers share the network connection of the HDR adapter with significant savings both in the cost of the adapters but also the cost of switch ports.

For more information, including the transceivers and cables that each adapter supports, see the list of Lenovo Press Product Guides in the Networking adapters category:
https://lenovopress.com/servers/options/ethernet

Storage host bus adapters

The SD650 V2 server does not support storage host bus adapters.

Flash storage adapters

The SD650 V2 server does not support Flash storage adapters.

Cooling

One of the most notable features of the ThinkSystem SD650 V2 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 50°C (122°F) with the SD650 V2. In most climates, water-side economizers can supply water at temperatures below 50°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 V2 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 V2 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 enclosure level, combined with the potential for significant facility energy savings, makes the SD650 V2 an excellent choice for customers that are burdened by high energy costs or with a sustainability 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 an enclosure and connects directly to the water inlet and outlet connectors for each compute node to deliver water safely and reliably to and from each server tray.

The DWC Manifold is modular and is available in multiple configurations that are based on the number of enclosure 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.
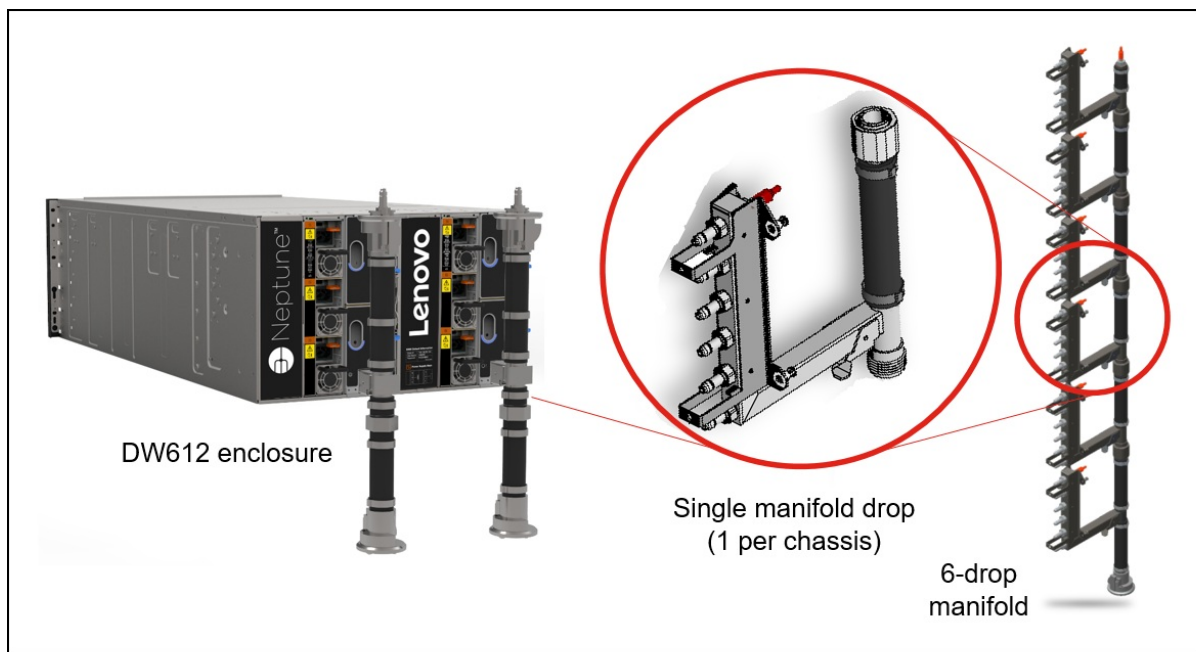

Figure 10. DW612 enclosure and manifold assembly

The water flows through the SD650 V2 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.

During the manufacturing and test cycle, Lenovo's water-cooled nodes are pressure tested with Helium according to ASTM E499 / E499M – 11 (Standard Practice for Leaks Using the Mass Spectrometer Leak Detector in the Detector Probe Mode) and later again with Nitrogen to detect micro-leaks which may be undetectable by pressure testing with water and/or a water/glycol mixture as Helium and Nitrogen have smaller molecule sizes.

This approach also allows Lenovo to ship the systems pressurized without needing to send hazardous antifreeze-components to our customers.

Onsite the materials used within the waterloop from the CDU to the nodes should be limited to Copper alloys with brazed joints, Stainless steels with TIG and MIG welded joints and EPDM rubber. In some instances, PVC might be an acceptable choice within the facility.

The water the system is filled with must be reasonably clean, bacteria-free water (< 100 CFU/ml) such as de-mineralized water, reverse osmosis water, de-ionized water, or distilled water. It must be filtered with in-line 50 micron filter. Biocide and Corrosion inhibitors ensure a clean operation without microbiological growth or corrosion.

Lenovo Data Center Power and Cooling Services can support you in the design, implementation and maintenance of the facility water-cooling infrastructure.

Power supplies

The DW612 enclosure currently supports up to six redundant hot-plug power supplies, with a design that supports up to nine power supplies. The power supplies provide N+N or N+1 redundancy, depending on population and configuration of the node trays. Power policies with no redundancy also are supported.

Power supplies are implemented in the DW612 enclosure in vertical cages, with up to three power supplies in each cage, as shown in the following figure.
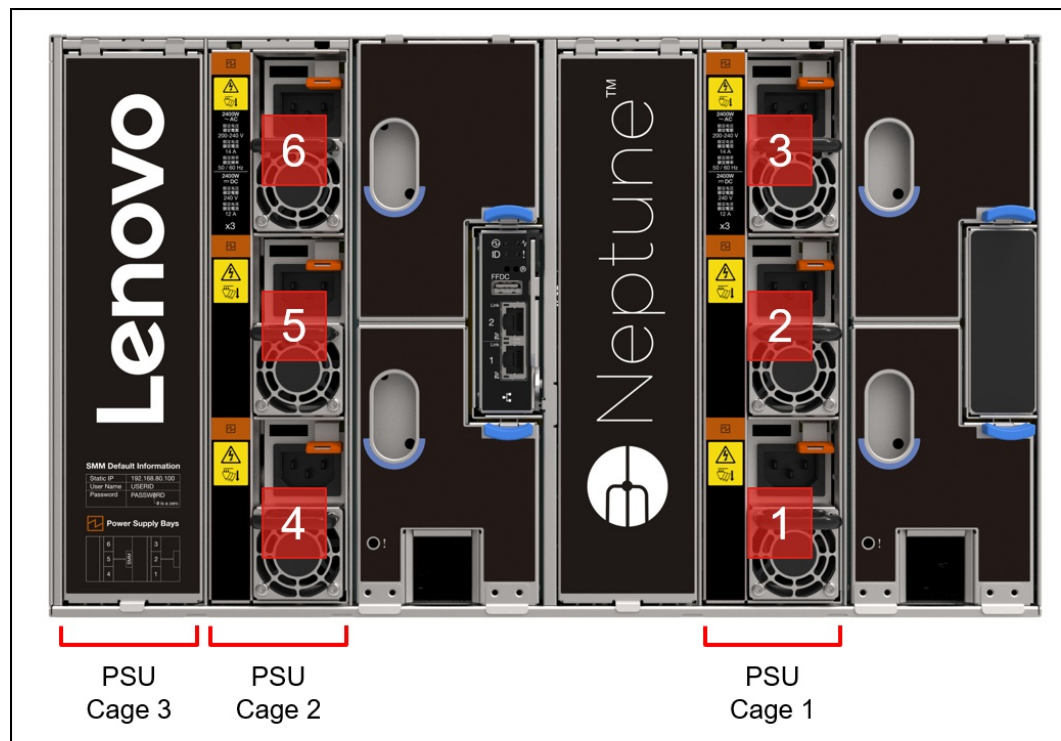

Figure 11. Power supplies and cages in the DW612 enclosure (shown with 6 power supplies)

For configurations with six power supplies, you can specify whether you want 3 power supplies in each of 2 cages, or you can specify if you want 2 power supplies installed in each of 3 cages. The latter means that you can later upgrade the enclosure to a total of 9 power supplies by adding one more power supply to each cage.

The following table lists the supported power supply configurations.

Table 26. Power supply cage configuration choices

Feature code	Description
BF7J	ThinkSystem DW612 2 PSU Cage with 6 PSU Configuration
BF7K	ThinkSystem DW612 3 PSU Cage with 6 PSU Configuration
BF7L	ThinkSystem DW612 3 PSU Cage with 9 PSU Configuration

The following table lists the supported power supplies for use in the DW612 enclosure with SD650 V2 servers installed.

Six power supplies are the minimum required. Only the 2400W power supply can be also supported in a quantity of nine. Other quantities are not supported. Nine power supplies are only needed if you are configuring the enclosure to support a mix of SD650 V2 servers and SD650-N V2 servers with 500W GPUs. Mixing of power supply capacities (different part number) is not supported.

Table 27. Power supply options

Part number	Feature	Description	Connector	Quantity supported	110V AC	220V AC	240V DC China only
4P57A26294	B8QB	ThinkSystem V2 1800W (230V) Platinum Hot-Swap Power Supply	C13	6	No	Yes	Yes
4P57A69999	BF7M	ThinkSystem DW612 2400W (230V) Platinum Hot-Swap Power Supply	C19	6 or 9*	No	Yes	Yes

* The DW612 enclosure supports up to 9 power supplies, however the when fully populated with SD650 V2 trays, only 6 power supplies are needed.

The power supply units have the following features:

- 80 PLUS Platinum certified
- Supports N+N or N+1 Power Redundancy, or Non-redundant power configurations
- Power management configured through the SMM
- Integrated 2500 RPM fan
- 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)

The 1800W power supplies in the DW612 enclosure have C13 connectors and support the following rack power cables.

Table 28. C13 rack power cables

Part number	Feature code	Description
00Y3043	A4VP	1.0m, 10A/100-250V, C13 to IEC 320-C14 Rack Power Cable
39Y7937	6201	1.5m, 10A/100-250V, C13 to IEC 320-C14 Rack Power Cable
4L67A08365	B0N4	2.0m, 10A/100-250V, C13 to IEC 320-C14 Rack Power Cable
4L67A08366	6311	2.8m, 10A/100-250V, C13 to IEC 320-C14 Rack Power Cable
39Y7932	6263	4.3m, 10A/100-250V, C13 to IEC 320-C14 Rack Power Cable

The 2400W power supplies in the DW612 enclosure have C19 connectors and support the following rack power cables.

Table 29. C19 rack power cables

Part number	Feature code	Description
CTO only	B4L0	1.0m, 16A/100-250V, C19 to IEC 320-C20 Rack Power Cable
CTO only	B4L1	1.5m, 16A/100-250V, C19 to IEC 320-C20 Rack Power Cable
CTO only	B4L2	2.0m, 16A/100-250V, C19 to IEC 320-C20 Rack Power Cable
39Y7916	6252	2.5m, 16A/100-250V, C19 to IEC 320-C20 Rack Power Cable
CTO only	B4L3	4.3m, 16A/100-250V, C19 to IEC 320-C20 Rack Power Cable

System Management

The server 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.

Topics in this section

- Local console
- External Diagnostics Handset
- System status with XClarity Mobile
- Remote management
- Remote management using the SMM
- Lenovo XClarity Provisioning Manager
- Lenovo XClarity Essentials
- Lenovo XClarity Administrator
- Lenovo XClarity Energy Manager
- Lenovo Capacity Planner

Local console

The SD650 V2 server supports a local console with the use of a console breakout cable. The cable connects to the port on the front of the server as shown in the following figure.
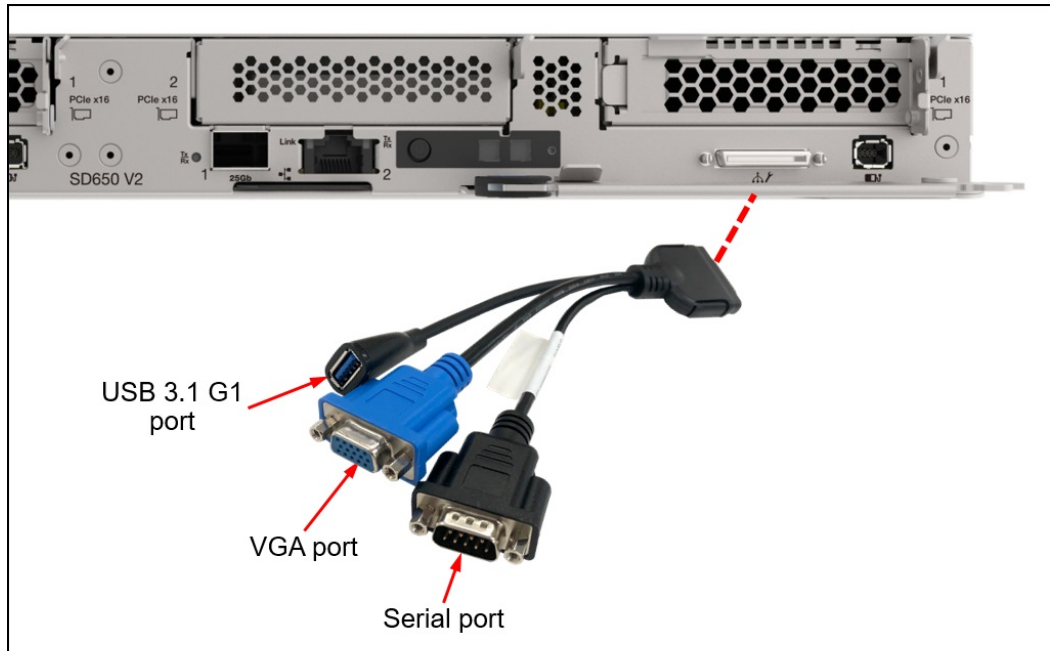
Figure 12. Console breakout cable

The cable has the following connectors:

- VGA port
- Serial port
- USB 3.1 Gen 1 (5 Gb/s) port

As well as local console functions, the USB port on the breakout cable also supports the use of the XClarity Mobile app as described in the next section.

Ordering information for the cable is listed in the following table.

Table 30. Console breakout cable ordering information

Part number	Feature code	Description
4X97A83213	7D1L BMJB	ThinkSystem USB 3.0 Console Breakout Cable for Dense Systems v2
4X97A12612	7D1L B953	ThinkSystem USB 3.0 Console Breakout Cable for Dense Systems

External Diagnostics Handset

The SD650 V2 has a port to connect an External Diagnostics Handset as shown in the following figure.

The External Diagnostics Handset allows quick access to system status, firmware, network, and health information. The LCD display on the panel and the function buttons give you access to the following information:

- Active alerts
- Status Dashboard
- System VPD: machine type & mode, serial number, UUID string
- System firmware levels: UEFI and XCC firmware
- XCC network information: hostname, MAC address, IP address, DNS addresses
- Environmental data: Ambient temperature, CPU temperature, AC input voltage, estimated power consumption
- Active XCC sessions
- System reset action

The handset has a magnet on the back of it to allow you to easily mount it on a convenient place on any rack cabinet.
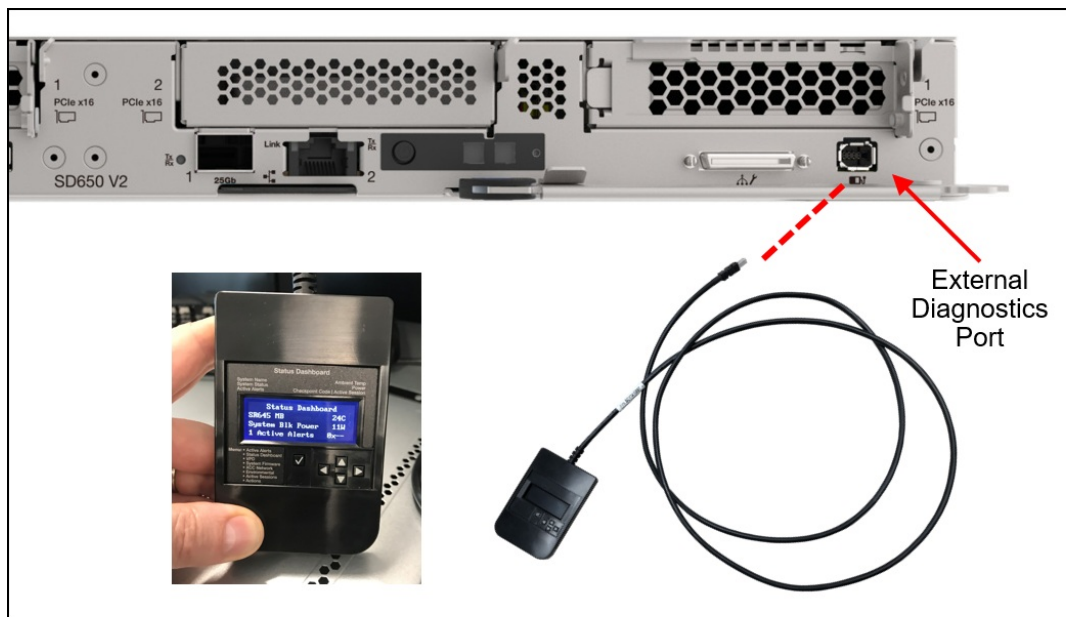

Figure 13. SD650 V2 External Diagnostics Handset

Ordering information for the External Diagnostics Handset with is listed in the following table.

Table 31. External Diagnostics Handset ordering information

Part number	Feature code	Description
4TA7A64874	7D1L BEUX	External Diagnostics Handset

System status with XClarity Mobile

The XClarity Mobile app includes a tethering function where you can connect your Android or iOS device to the server via USB to see the status of the server.

The steps to connect the mobile device are as follows:

1. Enable USB Management on the server, by holding down the ID button for 3 seconds (or pressing the dedicated USB management button if one is present)
2. Connect the mobile device via a USB cable to the server's USB port with the management symbol

3. In iOS or Android settings, enable Personal Hotspot or USB Tethering
4. Launch the Lenovo XClarity Mobile app

Once connected you can see the following information:

- Server status including error logs (read only, no login required)
- Server management functions (XClarity login credentials required)

Remote management

Both the 1Gb and 25Gb embedded ports on the front of the SD650 V2 offer a connection to the XCC for remote management. This shared-NIC functionality allows the ports to be used both for operating system networking and for remote management.

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

The 1Gb and 25Gb embedded ports support NC-SI. You can enable NC-SI in the factory using the feature codes listed in the following table. If neither feature code is selected, both ports will have NC-SI disabled.

Table 32. Enabling NC-SI on the embedded network ports

Feature code	Description
BEXY	ThinkSystem NC-SI enabled on SFP28 Port
BEXZ	ThinkSystem NC-SI enabled on RJ45 Port

IPMI via the Ethernet port (IPMI over LAN) is supported and is enabled by default in the SD650 V2. For CTO orders you can specify whether you want to the feature enabled or disabled in the factory, using the feature codes listed in the following table.

Table 33. IPMI-over-LAN settings

Feature code	Description
B7XZ	Disable IPMI-over-LAN
B7Y0	Enable IPMI-over-LAN (default)

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

XCC Advanced Upgrade adds the following 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
- International keyboard mapping support
- Syslog alerting
- Redirecting serial console via SSH
- Component replacement log (Maintenance History log)
- Access restriction (IP address blocking)
- Lenovo SED security key management
- Displaying graphics for real-time and historical power usage data and temperature

XCC Enterprise Upgrade enables the following additional features:

- Boot video capture and crash video capture
- Virtual console collaboration - Ability for up to 6 remote users to be log into the remote session simultaneously
- Remote console Java client
- Mapping the ISO and image files located on the local client as virtual drives for use by the server
- Mounting the remote ISO and image files via HTTPS, SFTP, CIFS, and NFS
- Power capping
- System utilization data and graphic view
- Single sign on with Lenovo XClarity Administrator
- Update firmware from a repository
- License for XClarity Energy Manager

For configure-to-order (CTO), you can enable the required XCC functionality by selecting the appropriate XCC feature codes 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 34. 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

For systems with XCC Standard or XCC Advanced installed, field upgrades are available as listed in the following table.

Table 35. XClarity Controller field upgrades

Part number	Description
4L47A09132	ThinkSystem XClarity Controller Standard to Advanced Upgrade (for servers that have XCC Standard)
4L47A09133	ThinkSystem XClarity Controller Advanced to Enterprise Upgrade (for servers that have XCC Advanced)

Remote management using the SMM

The DW612 enclosure includes a System Management Module 2 (SMM), installed in the rear of the enclosure. See Enclosure rear view for the location of the SMM. The SMM provides remote management of both the enclosure and the individual servers installed in the enclosure. The SMM can be accessed through a web browser interface and via Intelligent Platform Management Interface (IPMI) 2.0 commands.

The SMM provides the following functions:

- Remote connectivity to XCC controllers in each node in the enclosure
- Node-level reporting and control (for example, node virtual reseat/reset)
- Enclosure power management
- Enclosure thermal management
- Enclosure inventory

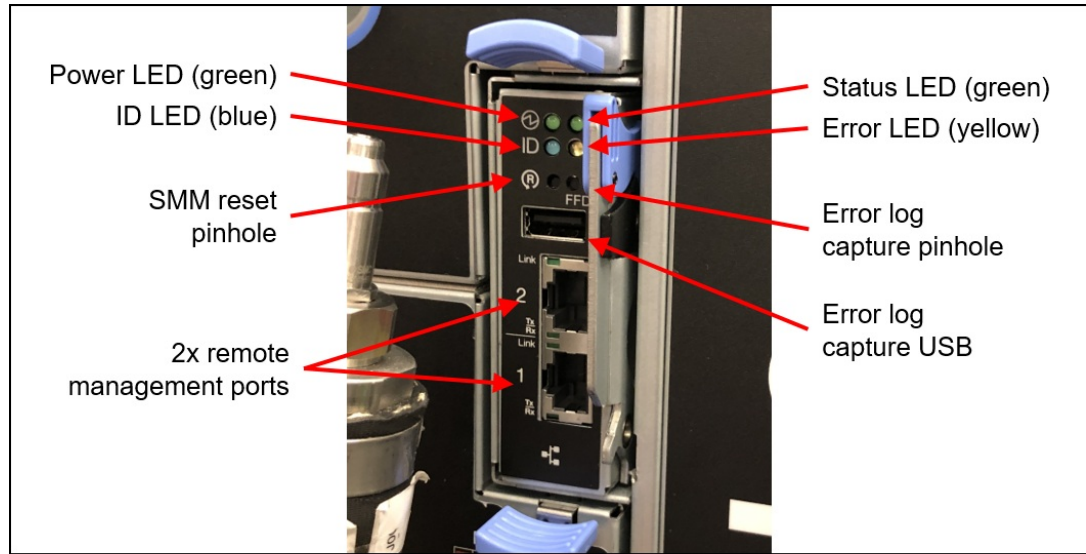The following figure shows the LEDs and connectors of the SMM.

Figure 14. System management module in the DW612 enclosure

The SMM has the following ports and LEDs:

- 2x Gigabit Ethernet RJ45 ports for remote management access
- USB port and activation button for service
- SMM reset button
- System error LED (yellow)
- Identification (ID) LED (blue)
- Status LED (green)
- System power LED (green)

The USB service button and USB service port are used to gather service data in the event of an error. Pressing the service button copies First Failure Data Collection (FFDC) data to a USB key installed in the USB service port. The reset button is used to perform an SMM reset (short press) or to restore the SMM back to factory defaults (press for 4+ seconds).

The use of two RJ45 Ethernet ports enables the ability to daisy-chain the Ethernet management connections thereby reducing the number of ports you need in your management switches and reducing the overall cable density needed for systems management. With this feature you can connect the first SMM to your management network and the SMM in a second enclosure connects to the first SMM. The SMM in the third enclosure can then connect to the SMM in the second enclosure.

Up to 6 enclosures can be connected in a daisy-chain configuration, which means that with 12 servers in each enclosure, a total of 72 servers can be managed remotely via one single Ethernet connection.

Notes:

- If you are using IEEE 802.1D spanning tree protocol (STP) then at most 6 enclosures can be connected together

- Do not form a loop with the network cabling. The dual-port SMM at the end of the chain should not be connected back to the switch that is connected to the top of the SMM chain.

Lenovo XClarity Provisioning Manager

Lenovo XClarity Provisioning Manager (LXPM) is a UEFI-based application embedded in ThinkSystem servers and accessible via the F1 key during system boot.

LXPM provides the following functions:

- Graphical UEFI Setup
- System inventory information and VPD update
- System firmware updates (UEFI and XCC)
- RAID setup wizard
- OS installation wizard (including unattended OS installation)
- Diagnostics functions

Lenovo XClarity Essentials

Lenovo offers the following XClarity Essentials software tools that can help you set up, use, and maintain the server at no additional cost:

- Lenovo Essentials OneCLI

  OneCLI is a collection of server management tools that uses a command line interface program to manage firmware, hardware, and operating systems. It provides functions to collect full system health information (including health status), configure system settings, and update system firmware and drivers.

- Lenovo Essentials UpdateXpress

  The UpdateXpress tool is a standalone GUI application for firmware and device driver updates that enables you to maintain your server firmware and device drivers up-to-date and help you avoid unnecessary server outages. The tool acquires and deploys individual updates and UpdateXpress System Packs (UXSPs) which are integration-tested bundles.

- Lenovo Essentials Bootable Media Creator

  The Bootable Media Creator (BOMC) tool is used to create bootable media for offline firmware update.

For more information and downloads, visit the Lenovo XClarity Essentials web page:
http://support.lenovo.com/us/en/documents/LNVO-center

Lenovo XClarity Administrator

Lenovo XClarity Administrator is a centralized resource management solution designed to reduce complexity, speed response, and enhance the availability of Lenovo systems and solutions.

Lenovo XClarity Administrator provides agent-free hardware management for ThinkSystem servers, in addition to ThinkServer, System x, and Flex System servers. The administration dashboard is based on HTML 5 and allows fast location of resources so tasks can be run quickly.

Because Lenovo XClarity Administrator does not require any agent software to be installed on the managed endpoints, there are no CPU cycles spent on agent execution, and no memory is used, which means that up to 1GB of RAM and 1 - 2% CPU usage is saved, compared to a typical managed system where an agent is required.

Lenovo XClarity Administrator provides full management function to ThinkSystem servers, including the following:

- Discovery
- Inventory
- Monitoring and alerting
- Call home
- Centralized user management
- Cryptography modes, server certificates, and encapsulation
- Configuration patterns
- Operating system deployment
- Firmware updates

For more information about Lenovo XClarity Administrator, including ordering part numbers, see the Lenovo XClarity Administrator Product Guide: https://lenovopress.com/tips1200-lenovo-xclarity-administrator

Lenovo XClarity Integrators

Lenovo also offers software plug-in modules, Lenovo XClarity Integrators, to manage physical infrastructure from leading external virtualization management software tools including those from Microsoft and VMware.

These integrators are offered at no charge, however if software support is required, a Lenovo XClarity Pro software subscription license should be ordered.

Lenovo XClarity Integrators offer the following additional features:

- Ability to discover, manage, and monitor Lenovo server hardware from VMware vCenter or Microsoft System Center

- Deployment of firmware updates and configuration patterns to Lenovo x86 rack servers and Flex System from the virtualization management tool

- Non-disruptive server maintenance in clustered environments that reduces workload downtime by dynamically migrating workloads from affected hosts during rolling server updates or reboots

- Greater service level uptime and assurance in clustered environments during unplanned hardware events by dynamically triggering workload migration from impacted hosts when impending hardware failures are predicted

For more information about all the available Lenovo XClarity Integrators, see the Lenovo XClarity Administrator Product Guide: https://lenovopress.com/tips1200-lenovo-xclarity-administrator

Lenovo XClarity Energy Manager

Lenovo XClarity Energy Manager is a power and temperature management solution for data centers. It is an agent-free, web-based console that enables you to monitor and manage power consumption and temperature in your data center through the management console. It enables server density and data center capacity to be increased through the use of power capping.

Lenovo XClarity Energy Manager is a licensed product. A single-node XClarity Energy Manager license is included with the XClarity Controller Enterprise (XCC Enterprise) upgrade as described in the Remote Management section. If your server does not have the XCC Enterprise upgrade, Energy Manager licenses can be ordered as shown in the following table.

Table 36. Lenovo XClarity Energy Manager

Description	Part number
4L40E51621	Lenovo XClarity Energy Manager Node License (1 license needed per server)

For more information about XClarity Energy Manager, see the following resources:

- Lenovo Support page:
  https://datacentersupport.lenovo.com/us/en/solutions/lnvo-lxem
- Lenovo Information Center:
  https://sysmgt.lenovofiles.com/help/topic/LXEM/lxem_overview.html?cp=4

Lenovo Capacity Planner

Lenovo Capacity Planner is a power consumption evaluation tool that enhances data center planning by enabling IT administrators and pre-sales professionals to understand various power characteristics of racks, servers, and other devices. Capacity Planner can dynamically calculate the power consumption, current, British Thermal Unit (BTU), and volt-ampere (VA) rating at the rack level, improving the planning efficiency for large scale deployments.

For more information, refer to the Capacity Planner web page:
http://datacentersupport.lenovo.com/us/en/solutions/lnvo-lcp

Security

The server offers the following electronic security features:

- Administrator and power-on password
- Trusted Platform Module (TPM) supporting TPM 2.0 (no support for TPM 1.2)
- Optional Nationz TPM 2.0, available only in China (CTO only)

The server is NIST SP 800-147B compliant.

The following table lists the security options for the SD650 V2.

Table 37. Security features

Part number	Feature code	Description
CTO only*	B8LE	ThinkSystem Nationz Trusted Platform Module v2.0 (China customers only)

* Not available as a field upgrade. The component is CTO or on pre-configured models only.

Lenovo ThinkShield - Platform Firmware Resiliency

Lenovo's ThinkShield Security is a transparent and comprehensive approach to security that extends to all dimensions of our data center products: from development, to supply chain, and through the entire product lifecycle.

The ThinkSystem SD650 V2 offers Platform Firmware Resiliency (PFR) hardware Root of Trust (RoT) which is NIST SP800-193 compliant. This offering further enhances key platform subsystem protections against unauthorized firmware updates and corruption, to restore firmware to an integral state, and to closely monitor firmware for possible compromise from cyber attacks.

PFR operates upon the following server components:

- UEFI image – the low level server firmware that connects the operating system to the server hardware
- XCC image – the management "engine" software that controls and reports on the server status separate from the server operating system
- FPGA image – the code that runs the server's lowest level hardware controller on the motherboard

The Lenovo Platform Root of Trust Hardware performs the following three main functions:

- Detection – Measures the firmware and updates for authenticity
- Recovery – Recovers a corrupted image to a known-safe image
- Protection – Monitors the system to ensure the known-good firmware is not maliciously written

These enhanced protection capabilities are implemented using a dedicated, discrete security processor whose implementation has been rigorously validated by leading third-party security firms. Security evaluation results and design details are available for customer review – providing unprecedented transparency and assurance.

Intel Transparent Supply Chain

Add a layer of protection in your data center and have peace of mind that the server hardware you bring into it is safe authentic and with documented, testable, and provable origin.

Lenovo has one of the world's best supply chains, as ranked by Gartner Group, backed by extensive and mature supply chain security programs that exceed industry norms and US Government standards. Now we are the first Tier 1 manufacturer to offer Intel® Transparent Supply Chain in partnership with Intel, offering you an unprecedented degree of supply chain transparency and assurance.

To enable Intel Transparent Supply Chain for the Intel-based servers in your order, add the following feature code in the DCSC configurator, under the Security tab.

Table 38. Intel Transparent Supply Chain ordering information

Feature code	Description
BB0P	Intel Transparent Supply Chain

For more information on this offering, see the paper *Introduction to Intel Transparent Supply Chain on Lenovo ThinkSystem Servers*, available from https://lenovopress.com/lp1434-introduction-to-intel-transparent-supply-chain-on-thinksystem-servers.

Security standards

The SD650 V2 supports the following security standards and capabilities:

- **Industry Standard Security Capabilities**
  - Intel CPU Enablement
    - AES-NI (Advanced Encryption Standard New Instructions)
    - CBnT (Converged Boot Guard and Trusted Execution Technology)
    - CET (Control flow Enforcement Technology)
    - Hardware-based side channel attack resilience enhancements
    - MKTME/TME (Multi-Key Total Memory Encryption)
    - SGX (Software Guard eXtensions)
    - SGX-TEM (Trusted Environment Mode)
    - TDX (Trust Domain Extensions)
    - TXT (Trusted eXecution Technology)
    - VT (Virtualization Technology)
    - XD (eXecute Disable)

- Microsoft Windows Security Enablement
  - Credential Guard
  - Device Guard
  - Host Guardian Service
- TCG (Trusted Computing Group) TPM (Trusted Platform Module) 2.0
- UEFI (Unified Extensible Firmware Interface) Forum Secure Boot

- **Hardware Root of Trust and Security**

  - Independent security subsystem providing platform-wide NIST SP800-193 compliant Platform Firmware Resilience (PFR)

  - Host domain RoT supplemented by AMD Platform Secure Boot (PSB)

  - Management domain RoT supplemented by System x-derived Immutable Boot Block

- **Platform Security**

  - Boot and run-time firmware integrity monitoring with rollback to known-good firmware (e.g., "self-healing")

  - Non-volatile storage bus security monitoring and filtering

  - Resilient firmware implementation, such as to detect and defeat unauthorized flash writes or SMM (System Management Mode) memory incursions

  - Patent-pending IPMI KCS channel privileged access authorization

  - Host and management domain authorization, including integration with CyberArk for enterprise password management

  - KMIP (Key Management Interoperability Protocol) compliant, including support for IBM SKLM and Thales KeySecure

  - Reduced "out of box" attack surface

  - Configurable network services

For more information on platform secuirity, see the paper "How to Harden the Security of your ThinkSystem Server and Management Applications" available from https://lenovopress.com/lp1260-how-to-harden-the-security-of-your-thinksystem-server.

- **Standards Compliance and/or Support**

  - NIST SP800-131A rev 2 "Transitioning the Use of Cryptographic Algorithms and Key Lengths"

  - NIST SP800-147B "BIOS Protection Guidelines for Servers"

  - NIST SP800-193 "Platform Firmware Resiliency Guidelines"

  - ISO/IEC 11889 "Trusted Platform Module Library"

  - Common Criteria TCG Protection Profile for "PC Client Specific TPM 2.0"

  - European Union Commission Regulation 2019/424 ("ErP Lot 9") "Ecodesign Requirements for Servers and Data Storage Products" Secure Data Deletion

  - Optional FIPS 140-2 validated Self-Encrypting Disks (SEDs) with external KMIP-based key management

- **Product and Supply Chain Security**

  - Suppliers validated through Lenovo's Trusted Supplier Program

  - Developed in accordance with Lenovo's Secure Development Lifecycle (LSDL)

  - Continuous firmware security validation through automated testing, including static code analysis, dynamic network and web vulnerability testing, software composition analysis, and subsystem-specific testing, such as UEFI security configuration validation

  - Ongoing security reviews by US-based security experts, with attestation letters available from our third-party security partners

- Digitally signed firmware, stored and built on US-based infrastructure and signed on US-based Hardware Security Modules (HSMs)
- Manufacturing transparency via Intel Transparent Supply Chain (for details, see https://lenovopress.com/lp1434-introduction-to-intel-transparent-supply-chain-on-lenovo-thinksystem-servers)
- TAA (Trade Agreements Act) compliant manufacturing, by default in Mexico for North American markets with additional US and EU manufacturing options
- US 2019 NDAA (National Defense Authorization Act) Section 889 compliant

Operating system support

The server supports the following operating systems:

- Red Hat Enterprise Linux 7.9
- Red Hat Enterprise Linux 8.2
- Red Hat Enterprise Linux 8.3
- Red Hat Enterprise Linux 8.4
- Red Hat Enterprise Linux 8.5
- SUSE Linux Enterprise Server 12 SP5
- SUSE Linux Enterprise Server 12 Xen SP5
- SUSE Linux Enterprise Server 15 SP2
- SUSE Linux Enterprise Server 15 SP3
- SUSE Linux Enterprise Server 15 Xen SP2
- SUSE Linux Enterprise Server 15 Xen SP3

Also review the latest LeSI Best Recipe to see the operating systems that are supported via Lenovo Scalable Infrastructure (LeSI): https://support.lenovo.com/us/en/solutions/HT505184#5

For a complete list of supported, certified and tested operating systems, plus additional details and links to relevant web sites, see the Operating System Interoperability Guide: https://lenovopress.com/osig#servers=sd650-v2-7d1m

Physical and electrical specifications

Six SD650 V2 servers are installed in the DW612 enclosure. Each SD650 V2 server has the following dimensions:

- Width: 438 mm (17.2 inches)
- Height: 41 mm (1.6 inches)
- Depth: 692 mm (27.2 inches) (747 mm, including the water connections at the rear of the server)

The DW612 enclosure has the following overall physical dimensions, excluding components that extend outside the standard enclosure, such as EIA flanges, and power supply handles:

- Width: 447 mm (17.6 inches)
- Height: 264 mm (10.4 inches)
- Depth: 931 mm (36.6 inches)

The following table lists the detailed dimensions. See the figure below for the definition of each dimension.

Table 39. Detailed dimensions

| Dimension	Description
483 mm	X_a = Width, to the outsides of the front EIA flanges
411 mm	X_b = Width, to the rack rail mating surfaces
447 mm	X_c = Width, to the outer most enclosure body feature
264 mm	Y_a = Height, from the bottom of enclosure to the top of the enclosure
915 mm	Z_a = Depth, from the rack flange mating surface to the rearmost I/O port surface
915 mm	Z_b = Depth, from the rack flange mating surface to the rearmost feature of the enclosure body
946 mm (1800W PSU) 972 mm (2400W PSU)	Z_c = Depth, from the rack flange mating surface to the rearmost feature such as power supply handle
17 mm	Z_d = Depth, from the forwardmost feature on front of EIA flange to the rack flange mating surface
17 mm	Z_e = Depth, from the front of security bezel (if applicable) or forwardmost feature to the rack flange mating surface
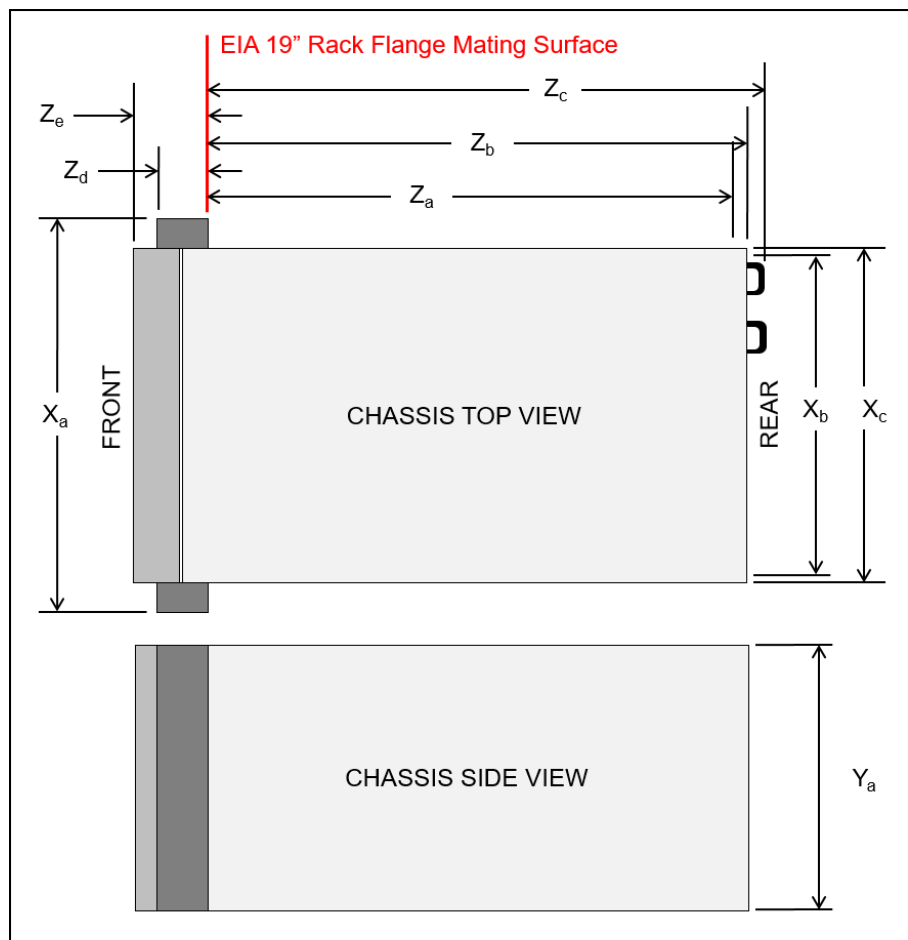
Figure 15. Enclosure dimensions

The SD650 V2 server has the following weight:

- 20.7 kg (45.6 lb)

The DW612 enclosure has the following weight:

- Empty enclosure (with midplane and cables): 23.6 kg (52 lbs)
- Fully configured enclosure with 12x SD650 V2 servers (six trays): 156.5 kg (345 lbs)

The enclosure has the following electrical specifications for AC input power supplies:

- Input voltage:
  - 200 to 240 (nominal) Vac, 50 Hz or 60 Hz
  - 180 to 300 Vdc (China only)
- Inlet current:
  - 1800W power supply: 10 A
  - 2400W power supply: 14 A

Operating environment

The SD650 V2 tray and DW612 enclosure are supported in the following environment:

Water requirements

- Water Temperature: ASHRAE W4: 2°C to 50°C (35.6°F to 122°F), with the following exceptions
    - With processors of 205W or higher: 2°C to 45°C (35.6°F to 113°F)
    - With M.2 drives: 2°C to 45°C (35.6°F to 113°F)
    - With Intel Xeon Platinum 8368Q processor: 2°C to 35°C (35.6°F to 95°F)

- Maximum pressure: 4.4 bars

- Minimum water flow rate: 6.0 liters per minute (lpm) per enclosure, assuming 1.0 lpm per compute tray with 6 trays per enclosure
    - For processors below 205W: 6.0 liters per minute per enclosure, assuming 1.0 lpm per compute tray with 6 trays per enclosure
    - For processors above 205W: 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 A2: 10°C to 35°C (50°F to 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 to 45°C (41°F to 113°F)

- Shipping/storage: -40°C to 60°C (-40°F to 140°F)

To use an 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%

Particulate contamination

Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might damage the system that might cause the system to malfunction or stop working altogether.

The following specifications indicate the limits of particulates that the system can tolerate:

- Reactive gases:
    - The reactivity rate of copper coupons shall be less than 200 Angstroms per month (Å/month)
    - The reactivity rate of silver coupons shall be less than 200 Å/month

- Airborne particulates:
    - The room air should be continuously filtered with MERV 8 filters.
    - Air entering a data center should be filtered with MERV 11 or preferably MERV 13 filters.
    - The deliquescent relative humidity of the particulate contamination should be more than 60% RH
    - Data centers must be free of zinc whiskers

For additional information, see the Specifications section of the Setup Guide for the server, available from the Lenovo ThinkSystem Information Center, https://thinksystem.lenovofiles.com/help/index.jsp

Regulatory compliance

The SD650 V2 conforms to the following standards:

- ANSI/UL 62368-1
- IEC 62368-1 (CB Certificate and CB Test Report)
- FCC - Verified to comply with Part 15 of the FCC Rules, Class A
- Canada ICES-003, issue 7, Class A
- CSA C22.2 No. 62368-1
- CISPR 32, Class A, CISPR 35
- Japan VCCI, Class A
- Taiwan BSMI CNS13438, Class A; Section 5 of CNS15663
- CE, UKCA Mark (EN55032 Class A, EN62368-1, EN55024, EN55035, EN61000-3-2, EN61000-3-3, (EU) 2019/424, and EN50581-1 (RoHS))
- Korea KN32, Class A, KN35
- Russia, Belorussia and Kazakhstan, TP EAC 037/2016 (for RoHS)
- Australia/New Zealand AS/NZS CISPR 32, Class A; AS/NZS 62368.1
- UL Green Guard, UL2819
- Energy Star 3.0
- EPEAT (NSF/ ANSI 426) Bronze
- China CELP certificate, HJ 2507-2011
- Japanese Energy-Saving Act

The DW612 conforms to the following standards:

- ANSI/UL 62368-1
- IEC 62368-1 (CB Certificate and CB Test Report)
- FCC - Verified to comply with Part 15 of the FCC Rules, Class A
- Canada ICES-003, issue 7, Class A
- CSA C22.2 No. 62368-1
- CISPR 32, Class A, CISPR 35
- Japan VCCI, Class A
- CE, UKCA Mark (EN55032 Class A, EN62368-1, EN55024, EN55035, EN61000-3-2, EN61000-3-3, (EU) 2019/424, and EN50581-1 (RoHS))
- Korea KN32, Class A, KN35
- Russia, Belorussia and Kazakhstan, TP EAC 037/2016 (for RoHS)
- Russia, Belorussia and Kazakhstan, EAC: TP TC 004/2011 (for Safety); TP TC 020/2011 (for EMC)
- Australia/New Zealand AS/NZS CISPR 32, Class A; AS/NZS 62368.1
- UL Green Guard, UL2819
- China CELP certificate, HJ 2507-2011
- Mexico NOM-019

Warranty and Support

The server and enclosure have the following warranty:

- ThinkSystem SD650 V2 (7D1M) - 3 year warranty

- ThinkSystem DW612 Enclosure (7D1L) - 3 year warranty

- Neptune DWC Node Manifold (5469) - 3 year warranty

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.

Lenovo's additional support services provide a sophisticated, unified support structure for your data center, with an experience consistently ranked number one in customer satisfaction worldwide. Available offerings include:

- **Premier Support**

  Premier Support provides a Lenovo-owned customer experience and delivers direct access to technicians skilled in hardware, software, and advanced troubleshooting, in addition to the following:

  - Direct technician-to-technician access through a dedicated phone line
  - 24x7x365 remote support
  - Single point of contact service
  - End to end case management
  - Third-party collaborative software support
  - Online case tools and live chat support
  - On-demand remote system analysis

- **Warranty Upgrade (Preconfigured Support)**

  Services are available to meet the on-site response time targets that match the criticality of your systems.

  - 3, 4, or 5 years of service coverage
  - 1-year or 2-year post-warranty extensions
  - **Foundation Service**: 9x5 service coverage with next business day onsite response. YourDrive YourData is an optional extra (see below).
  - **Essential Service:** 24x7 service coverage with 4-hour onsite response or 24-hour committed repair (available only in select markets). Bundled with YourDrive YourData.
  - **Advanced Service:** 24x7 service coverage with 2-hour onsite response or 6-hour committed repair (available only in select markets). Bundled with YourDrive YourData.

- **Managed Services**

  Lenovo Managed Services provides continuous 24x7 remote monitoring (plus 24x7 call center availability) and proactive management of your data center using state-of-the-art tools, systems, and practices by a team of highly skilled and experienced Lenovo services professionals.

  Quarterly reviews check error logs, verify firmware & OS device driver levels, and software as needed. We'll also maintain records of latest patches, critical updates, and firmware levels, to ensure you systems are providing business value through optimized performance.

- **Technical Account Management (TAM)**

  A Lenovo Technical Account Manager helps you optimize the operation of your data center based on a deep understanding of your business. You gain direct access to your Lenovo TAM, who serves as your single point of contact to expedite service requests, provide status updates, and furnish reports to track incidents over time. In addition, your TAM will help proactively make service recommendations and manage your service relationship with Lenovo to make certain your needs are met.

- **Enterprise Server Software Support**

  Enterprise Software Support is an additional support service providing customers with software support on Microsoft, Red Hat, SUSE, and VMware applications and systems. Around the clock availability for critical problems plus unlimited calls and incidents helps customers address challenges fast, without incremental costs. Support staff can answer troubleshooting and diagnostic questions, address product comparability and interoperability issues, isolate causes of problems, report defects to software vendors, and more.

- **YourDrive YourData**

  Lenovo's YourDrive YourData 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 and is optional with Foundation Service. It is bundled with Essential Service and Advanced Service.

- **Health Check**

  Having a trusted partner who can perform regular and detailed health checks is central to maintaining efficiency and ensuring that your systems and business are always running at their best. Health Check supports Lenovo-branded server, storage, and networking devices, as well as select Lenovo-supported products from other vendors that are sold by Lenovo or a Lenovo-Authorized Reseller.

Examples of region-specific warranty terms are second or longer business day parts delivery or parts-only base warranty.

If warranty terms and conditions include onsite labor for repair or replacement of parts, Lenovo will dispatch a service technician to the customer site to perform the replacement. Onsite labor under base warranty is limited to labor for replacement of parts that have been determined to be field-replaceable units (FRUs). Parts that are determined to be customer-replaceable units (CRUs) do not include onsite labor under base warranty.

If warranty terms include parts-only base warranty, Lenovo is responsible for delivering only replacement parts that are under base warranty (including FRUs) that will be sent to a requested location for self-service. Parts-only service does not include a service technician being dispatched onsite. Parts must be changed at customer's own cost and labor and defective parts must be returned following the instructions supplied with the spare parts.

Lenovo Service offerings are region-specific. Not all preconfigured support and upgrade options are available in every region. For information about Lenovo service upgrade offerings that are available in your region, refer to the following resources:

- Service part numbers in Lenovo Data Center Solution Configurator (DCSC):
  http://dcsc.lenovo.com/#/services
- Lenovo Services Availability Locator
  http://lenovolocator.com/

For service definitions, region-specific details, and service limitations, please refer to the following documents:

- Lenovo Statement of Limited Warranty for Infrastructure Solutions Group (ISG) Servers and System Storage
  http://pcsupport.lenovo.com/us/en/solutions/ht503310
- Lenovo Data Center Services Agreement
  http://support.lenovo.com/us/en/solutions/ht116628

Services

Lenovo Services is a dedicated partner to your success. Our goal is to reduce your capital outlays, mitigate your IT risks, and accelerate your time to productivity.

Note: Some service options may not be available in all countries. For more information, go to https://www.lenovo.com/services. For information about Lenovo service upgrade offerings that are available in your region, contact your local Lenovo sales representative or business partner.

Here's a more in-depth look at what we can do for you:

- **Asset Recovery Services**

  Asset Recovery Services (ARS) helps customers recover the maximum value from their end-of-life equipment in a cost-effective and secure way. On top of simplifying the transition from old to new equipment, ARS mitigates environmental and data security risks associated with data center equipment disposal. Lenovo ARS is a cash-back solution for equipment based on its remaining market value, yielding maximum value from aging assets and lowering total cost of ownership for your customers. For more information, see the ARS page, https://lenovopress.com/lp1266-reduce-e-waste-and-grow-your-bottom-line-with-lenovo-ars.

- **Assessment Services**

  An Assessment helps solve your IT challenges through an onsite, multi-day session with a Lenovo technology expert. We perform a tools-based assessment which provides a comprehensive and thorough review of a company's environment and technology systems. In addition to the technology based functional requirements, the consultant also discusses and records the non-functional business requirements, challenges, and constraints. Assessments help organizations like yours, no matter how large or small, get a better return on your IT investment and overcome challenges in the ever-changing technology landscape.

- **Design Services**

  Professional Services consultants perform infrastructure design and implementation planning to support your strategy. The high-level architectures provided by the assessment service are turned into low level designs and wiring diagrams, which are reviewed and approved prior to implementation. The implementation plan will demonstrate an outcome-based proposal to provide business capabilities through infrastructure with a risk-mitigated project plan.

- **Basic Hardware Installation**

  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.

- **Deployment Services**

  When investing in new IT infrastructures, you need to ensure your business will see quick time to value with little to no disruption. Lenovo deployments are designed by development and engineering teams who know our Products & Solutions better than anyone else, and our technicians own the process from delivery to completion. Lenovo will conduct remote preparation and planning, configure & integrate systems, validate systems, verify and update appliance firmware, train on administrative tasks, and provide post-deployment documentation. Customer's IT teams leverage our skills to enable IT staff to transform with higher level roles and tasks.

- **Integration, Migration, and Expansion Services**

  Move existing physical & virtual workloads easily, or determine technical requirements to support increased workloads while maximizing performance. Includes tuning, validation, and documenting ongoing run processes. Leverage migration assessment planning documents to perform necessary migrations.

- **Data Center Power and Cooling Services**

  The Data Center Infrastructure team will provide solution design and implementation services to support the power and cooling needs of the multi-node chassis and multi-rack solutions. This includes designing for various levels of power redundancy and integration into the customer power infrastructure. The Infrastructure team will work with site engineers to design an effective cooling strategy based on facility constraints or customer goals and optimize a cooling solution to ensure high efficiency and availability. The Infrastructure team will provide the detailed solution design and complete integration of the cooling solution into the customer data center. In addition, the Infrastructure team will provide rack and chassis level commissioning and stand-up of the water-cooled solution which includes setting and tuning of the flow rates based on water temperature and heat recovery targets. Lastly, the Infrastructure team will provide cooling solution optimization and performance validation to ensure the highest overall operational efficiency of the solution.

Rack cabinets

The DW612 enclosure is supported in the following racks:

- 42U 1100mm Deep Primary Rack and Expansion Rack, type 1410

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.

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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:

https://www.lenovo.com/us/en/landingpage/lenovo-financial-services/

Related publications and links

For more information, see these resources:

- ThinkSystem SD650 V2 product page
  https://www.lenovo.com/us/en/data-center/servers/high-density/ThinkSystem-SD650-V2/p/77XX7DSD652

- ThinkSystem SD650 V2 datasheet
  https://lenovopress.com/DS0131

- Interactive 3D Tour of the ThinkSystem SD650 V2:
  https://lenovopress.com/LP1427

- ThinkSystem SD650 V2 drivers and support
  http://datacentersupport.lenovo.com/products/servers/thinksystem/sd650v2/7d1m/downloads

- Lenovo ThinkSystem SD650 V2 product publications:
  http://thinksystem.lenovofiles.com/help/index.jsp
    - Quick Start
    - Rack Installation Guide
    - Setup Guide
    - Maintenance Manual
    - Messages and Codes Reference
    - UEFI Manual

- ServerProven hardware compatibility:
  http://www.lenovo.com/us/en/serverproven

- Data Center Solution Configurator (DCSC)
  https://dcsc.lenovo.com

- Lenovo Cluster solutions configurator (x-config)
  https://lesc.lenovo.com/products/hardware/configurator/worldwide/bhui/asit/index.html

Related product families

Product families related to this document are the following:

- Artificial Intelligence
- High Performance Computing
- High Density Servers
- ThinkSystem SD650 V2 server

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