# Reference Architecture: Inverse Virtualization with TidalScale on Lenovo ThinkSystem Servers

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**See how Inverse Virtualization scales many servers into one software-defined sever**

**Discover how Lenovo two-socket servers and TruScale fix both scale and cost issues**

**Reduce Oracle core-based license costs and improve business performance**

**Remove infrastructure over-sizing and shorten procurement cycles**

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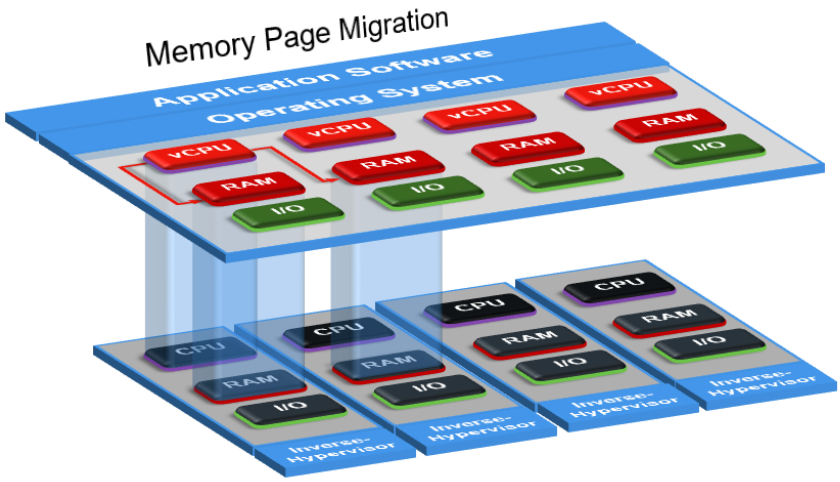
# 1 Introduction

This document describes the reference architecture for Inverse Virtualization with Lenovo ThinkSystem using TidalScale. TidalScale technical labs use Lenovo hardware to test their software daily and to provide customers with proof of concepts when needed. This paper in intended to provide the planning, design considerations, and best practices for implementing TidalScale on Lenovo ThinkSystem servers and storage.

The intended audience of this document is IT professionals, technical architects, sales engineers, and consultants to assist in planning, designing, and implementing TidalScale on Lenovo. Use cases include - but are not limited to - x86 migrations from IBM Power or Mainframe, Oracle Exadata, and Superdome where expensive hardware can be replaced with low-cost scalable compute in a 1U form with the Lenovo ThinkSystem SR630 V2 server.

Databases can be easily relocated via a backup and restore process from any existing Unix, Linux, or Exadata-based system to a scalable TidalScale software-defined server. The TidalScale hypervisor running directly on the bare metal server uses artificial intelligence and simple Intel machine instructions to make the system perform uniformly to deliver optimized memory and compute capacity.

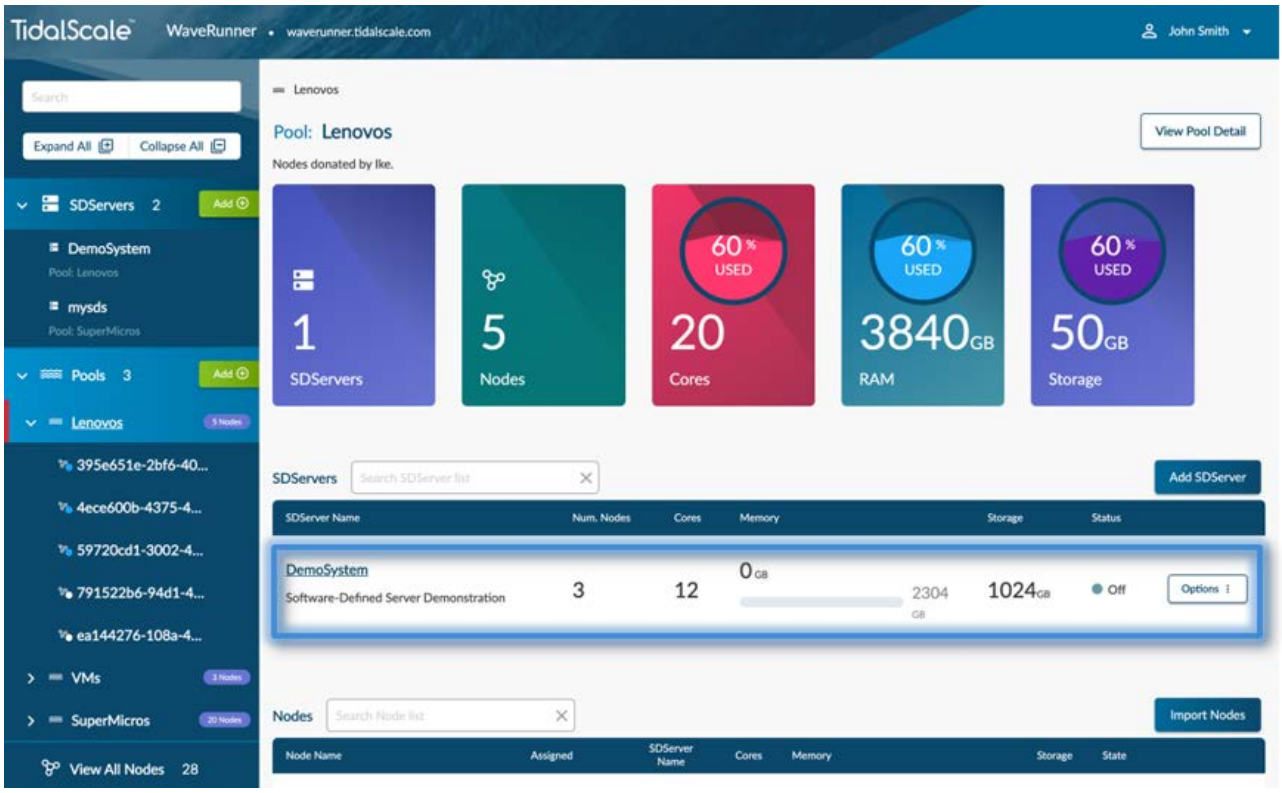



- Patented technology
- Transparently migrates vCPUs and memory
- Dynamically load balances
- Self-optimizing

For core-based software licensing, you can now minimize core license fees and provide as much memory as required with Lenovo's high frequency configuration with a low core count. Reducing license costs alone can often bring a very high Return on Investment (ROI). For other needs where core count is not as important of a concern, our balanced configuration provides dense compute and memory using the lowest cost systems – all in a small 1U format.

## 1.1 Inverse Virtualization with TidalScale

Composable server infrastructure is made possible through the creation of software-defined servers through TidalScale's inverse-hypervisor technology. Multiple physical servers are presented as a single, large Linux-based server to the application. For this reference architecture, Lenovo is combining our 1U 2-socket ThinkSystem SR630 V2 server with the latest in TidalScale software to enable easy scaling of memory and compute for Linux-based applications and databases.




## 1.2 Lenovo TruScale for OpEx Financing and Managed Services

Lenovo TruScale is an optional feature that allows for fixed-cost billing along with Lenovo provided managed infrastructure services. Now your CFO and CTO can both meet their desired objectives through infrastructure that is deployed in an OpEx model and managed in a similar manner to public cloud providers. Additionally, Lenovo partners with hosted providers to also provide an off-premises, hosted cloud model as well, should that be an attractive option. There are minimal deal sizes that are required to use the TruScale feature so check with your Lenovo partner, or sales representative to ensure needs are consolidated to meet the minimum.

# 2 Business problem and business value

Data center transformation requires flexibility and agility. Infrastructure and the configurations and their management must be more flexible to business needs. The ability to deploy cloud-like features on-premises along with scalable hardware solves many business issues. Lenovo TidalScale for ThinkSystem combines compact but powerful Lenovo ThinkSystem Servers and the TidalScale WaveRunner software, including TidalScale's Inverse-Hypervisor, to deliver that transformation. Optional Lenovo TruScale and Lenovo Storage options fill in the blanks to deliver the full range of needs and transformation.

## 2.1 Business Problem

Business Infrastructure must support application needs for compute and memory that are not always well defined or fixed. Choosing the wrong infrastructure can cause business bottlenecks when too small, or huge costs when too large. This provides several challenges that can greatly impact the total cost of ownership (TCO) including;

- sizing the infrastructure for a new application that has to run for years requiring at best educated guesses on what the maximum business need will be at in 3, 5, or 10-year lifetime of the hardware
- large swings in the compute and memory needs based on cyclic business processes like end-o-month or end-of-year financial closes or volatile market changes
- long hardware procurement cycles required to get large systems to meet the future unknown business needs
- wasted software license costs for oversized cores vs business impact if too little hardware is obtained
- no capital funding available for these large expensive systems
- the business is too complex or regulated to move to the cloud

## 2.2 Business Value

Supplying business applications with the correct infrastructure capacity requires flexible smart configurations that can grow and shrink with your business needs. With TidalScale, you grow your business easily in small chucks of memory and compute. You can;

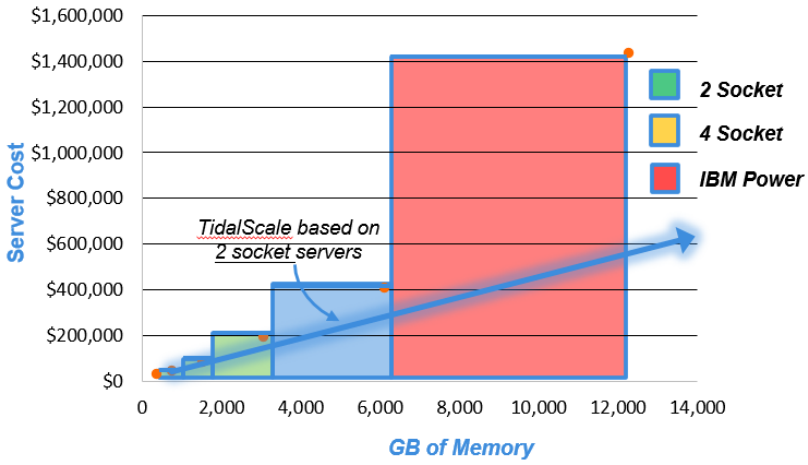
- size for your minimum need and grow 2x, 3x, 4x, or more without ever entering the data center
- add and subtract compute and memory as your business fluctuates demand
- procure low cost ThinkSystem SR630 V2 servers with little to no risk of exceeding needs
- with the SR630 V2 server with the High Frequency configuration, keep your database memory footprint but reduce cores as well as the resulting database license fees
- use Lenovo TruScale option to provide cloud like OpEx fixed cost monthly billing and Lenovo managed services to keep the system sized and performing to your business needs just like in the cloud

TidalScale systems are built on compact 1U 2 socket servers

Cost is linear not exponential

Deploy or Re-Deploy cost-efficient capacity as business needs change

Memory size bounded only by what Linux supports, not physical hardware limitations



# 3 Components

The required and optional components for this reference architecture are desribed below. Be sure that all required components are addressed by either Lenovo, the customer, or the systems integrator.

## 3.1 Required Components

For the solution to work you must have:

1) One or more 1U compact SR630 V2 servers, or Lenovo approved alternative, with the recommended CPUs, memory, Ethernet adaptor, and, if needed, host bus adaptor
2) A TidalScale management software subscription (WaveRunner) in each data center to add servers to pools and clusters
3) A TidalScale Subscription for each server by memory size (2 or 4TB) for 1, 3, or 5-year periods for Oracle or Non-Oracle use cases
4) A Linux OS to run on each software defined server (SDS)
5) An initial sizing for the SDS cluster (memory and cores) and the expected peak memory

## 3.2 Optional Components

In addition to the above, there are optional add-ons that can be offered directly or via partners including:

1. Professional Services to migrate applications and databases from their source hardware to x86-based Lenovo ThinkSystem servers running Linux on top of TidalScale.
2. A Proof of Concept using a TidalScale Lab or Lenovo Try & Buy or Rental hardware with trial TidalScale software.
3. Lenovo TruScale to provide managed services and an Op/Ex model to provide cloud benefits on-premise.
4. Storage as needed for a migration target

# 4 Architectural overview

The TidalScale solution running on Lenovo ThinkSystem servers uses a building-block approach. Each server in a single Software-Defined Server (SDS) must have the same total memory. The standard configuration combines the server, the TidalScale Software including software support, and a standard mission critical Lenovo 4-hr hardware support.

Options include upgrading or downgrading hardware support, choosing between TidalScale Oracle software and hardware or TidalScale non-Oracle software and hardware. The TidalScale software is subscription based for 1, 3, or 5 years. Renewals can match the same terms. Lenovo storage is optional as well.

**Note**: The minimum number of nodes for TidalScale is one. This is a viable configuration if there are plans to eventually grow/expand to two or more nodes. Additionally, TidalScale supports both Lenovo and non-Lenovo storage. The benefit of adopting Lenovo storage is there will be a single vendor for service and support of both the servers and storage.

## 4.1 Balanced Configuration

The SR630 V2 Balanced Configuration is designed with a high core-count as well as a high memory capacity. This configuration is targeted for non-Oracle databases and any application needing to scale compute and memory. In summary, the configuration is as follows:

| | |
|---|---|
| 2x Intel Xeon Gold 6348 Processor | 56 cores |
| 32x 64GB or 128GB TruDDR4 3200 MHz 3DS RDIMM | 2 or 4TB RAM |
| 2x M.2 480GB M.2 SATA SSD | |
| 1x Intel I350 1GbE 4-Port OCP Ethernet Adapter | |
| 1x Mellanox ConnectX-4 10/25GbE 2-Port PCIe Ethernet Adapter | |
| 1x Emulex 16Gb Gen6 FC Dual-port HBA | |
| TidalScale for Non-Oracle 1/3/5 year subscription | 2 or 4TB |

## 4.2 High Frequency Configuration

The SR630 V2 High Frequency configuration is designed with a low core-count but with a 3.6GHz base frequency and a high memory to core ratio. This configuration is targeted toward traditional Oracle workloads with core based licenses.

TidalScale Oracle customers have saved ten’s of millions in license costs and improved performance by reducing production application’s core counts and still scaling memory up to what the business needs. The result is better performance at huge license cost reductions. This configuration is intended to provide that lower core count while still allowing the memory to grow.

In summary, the configuration is as follows:

| | |
|---|---|
| 2x Intel Xeon Gold 6334 Processor | 16 cores |
| 32x 64GB or 128TB TruDDR4 3200 MHz 3DS RDIMM | 2 or 4TB RAM |
| 2x M.2 480GB M.2 SATA SSD | |
| 1x Intel I350 1GbE 4-Port OCP Ethernet Adapter | |
| 1x Mellanox ConnectX-4 10/25GbE 2-Port PCIe Ethernet Adapter | |
| 1x Emulex 16Gb Gen6 FC Dual-port HBA | |
| TidalScale for Non-Oracle 1/3/5 year subscription | 2 or 4TB |

## 4.3 Additional Configuration Information

Every server in a TidalScale SDS must have the same total memory. A SR630 V2 with the Balanced Configuration will support a 2 or 4TB depending on the memory DIMM size. For peak needs of up to 8TB (4x2TB) use the smaller 2TB server configurations. If scale up to 16TB (4x4TB) is needed use the 4TB server configurations.

Use the Oracle TidalScale software with the high frequency configs for Oracle and low core count needs. Use the Non-Oracle TidalScale software with the balanced configuration for all other needs.

## 4.4 Storage

The ThinkSystem DE4000F Storage Array is an optional component if additional storage is required.

The DE4000F is configured using a RAID 6 array plus a hot-spare for the optimal resiliency. In summary, the configuration is as follows:

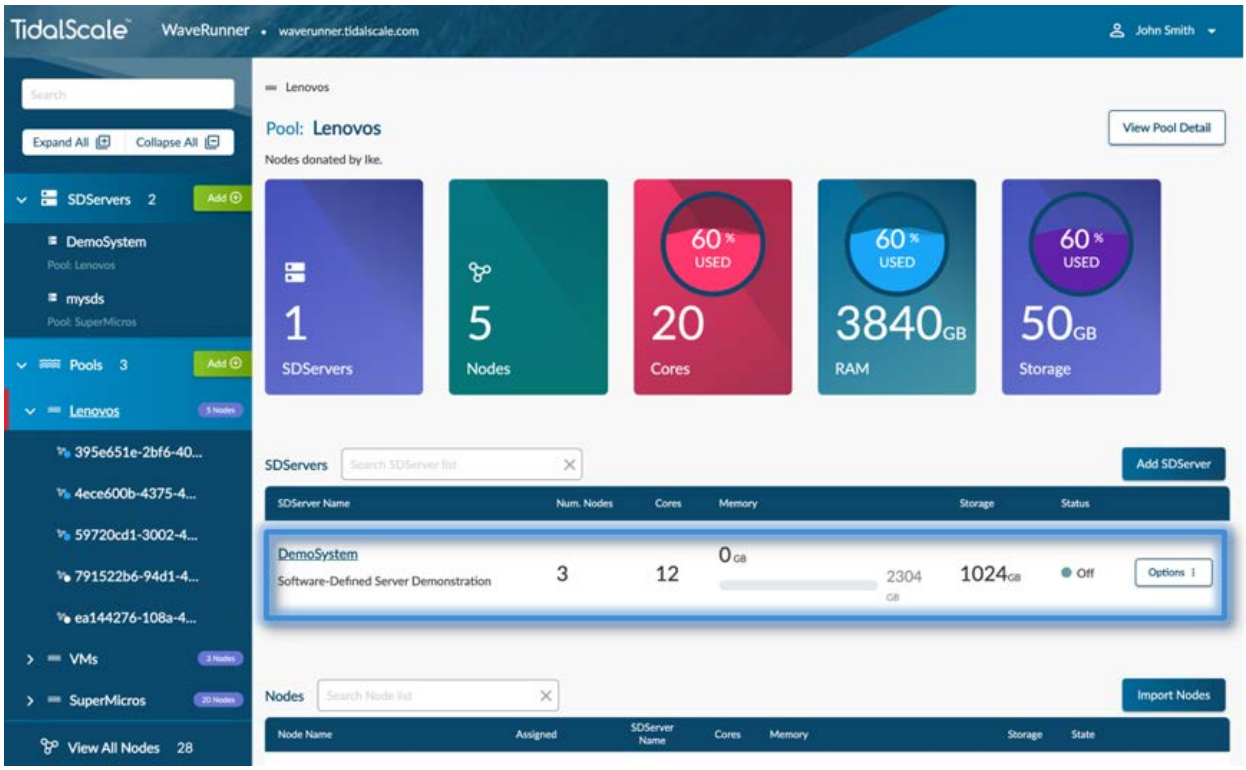
| | |
|---|---|
| 2x DE4000 Controller 32GB | |
| 2x 16Gb FC, 4 Ports | |
| 12x 800GB 3DWD 2.5" SSD | ~ 7TB Usable |

The DE4000F supports up to 300,000 random read IOPS (4 KB blocks), up to 9.2 GBps sequential read throughput (64 KB blocks). As configured, the DE4000F will easily support a SQL database with a 100MB core table, 1,000MB events and task table, and a 2,000MB statistics table, or a 4TB in-memory database. Additional information regarding the DE4000F can be found in the appendix.

# 5 Deployment considerations

## 5.1 Systems Management TidalScale

TidalScale's management software, WaverRunner™, provides a simple, graphical user interface which allows for the easy addition or subtraction of server capacity to the environment to meet changing business needs.




For hardware management, Lenovo XClarity is used as Lenovo's hardware manager.

All other management software that can run on the selected Linux OS is available as well. Testing is advised to validate your selected custom add-ons to the solution.

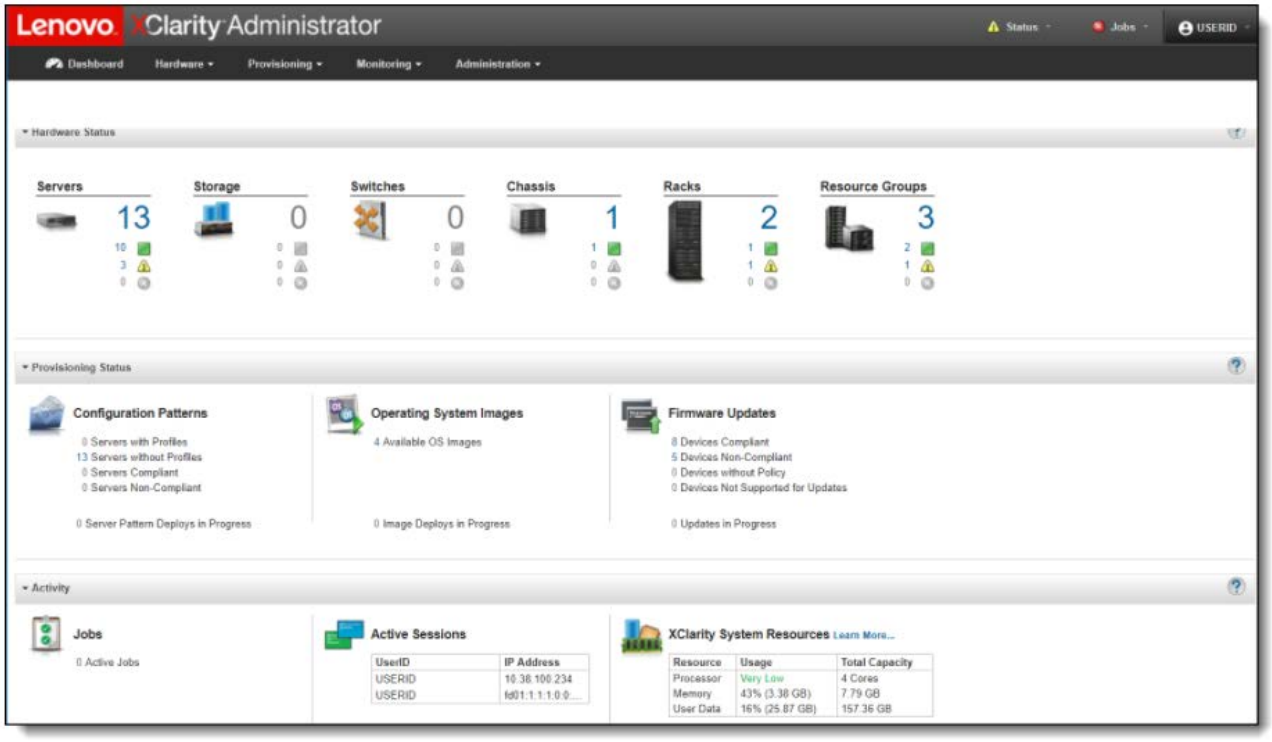
## 5.2 Systems Management XClarity Administrator

**Introduction**

Lenovo XClarity™ Administrator is a centralized resource management solution that is aimed at reducing complexity, speeding response, and enhancing the availability of Lenovo® server systems and solutions.

Lenovo XClarity Administrator runs as a virtual appliance and provides agent-free hardware management that automates discovery, inventory, tracking, updates, monitoring, and provisioning for Lenovo® server systems, storage, network switches, hyperconverged and ThinkAgile solutions. A single XClarity Administrator instance supports managing a maximum of 1,000 devices.

Additionally, Lenovo XClarity offers a mobile app for Android and iOS devices. The app enables you to securely monitor physical systems, get real-time status alerts and notifications, and take action on common system level tasks. The app can also connect directly via an enabled USB port to a ThinkSystem server and provide virtual LCD capability.




**Features**

The XClarity Administrator dashboard is an HTML 5-based web interface that allows fast location of resources so tasks can be run quickly. Because Lenovo XClarity Administrator does not include any agent software that is 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 delivers Lenovo resources faster. With a simplified administration dashboard, the following functions can be easily achieved:

- Discovery
- Inventory
- Monitoring
- Firmware management
- Firmware updates
- Windows device driver updates
- Configuration management and compliance
- Deployment of operating systems and hypervisors to bare metal servers

Fast time to value is realized through automatic discovery of existing or new Lenovo rack servers and Flex System infrastructure. Inventory of the discovered endpoints is gathered, so the managed hardware inventory and its status can be viewed-at-a-glance.

A centralized view of events and alerts that are generated from managed endpoints is available. When an issue is detected by a managed endpoint, an event is passed to Lenovo XClarity Administrator. Alerts and events are visible via the XClarity Administrator Dashboard, the Status bar, and the Alerts and Events detail for the specific system.

**Security**

Lenovo XClarity Administrator includes several features that can help you secure your environment. These include:

- When you manage Lenovo chassis and servers in XClarity Administrator, you can configure XClarity Administrator to change the firewall rules for the devices so that incoming requests are accepted only from XClarity Administrator. This is referred to as encapsulation.
- If you must be compliant with NIST SP 800-131A or FIPS 140-2, XClarity Administrator can help you meet that compliance. XClarity Administrator supports self-signed SSL certificates (issued by an internal certificate authority) or external SSL certificates (private or commercial CA).
- When changing cryptographic settings within XClarity Administrator you can choose to apply the settings to the management server only, to the managed devices only, or both.
- XClarity Administrator includes an audit log that provides a historical record of user actions, such as logging on, creating users, or changing user passwords.

**Integration**

XClarity Administrator can be integrated into external, higher level management, automation, and orchestration platforms using the XClarity Integrators, through SNMP and through open REST application programming interfaces (APIs). This means Lenovo XClarity can easily integrate with your existing management infrastructure.

## 5.3 Security

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 SR630 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.

## 5.4 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 feature code BB0P in the DCSC configurator, under the Security tab.

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.

# 6 Appendix: Lenovo Bill of materials

This appendix contains the bill of materials (BOMs) for different configurations of hardware for Lenovo TidalScale on ThinkSystem deployments. There are sections for user servers, management servers, storage, and networking.

## 6.1 Lenovo ThinkSystem SR630 V2 Server – Balanced Configuration

Additional servers can be added as needed, up to a maximum of four total.

| Lenovo | Data Center Solution Configurator<br>Bill of Materials | |
|---|---|---|
| | Your final configuration may contain hardware, software, and services; therefore, accounting implications need to be taken into consideration. A bottom-line price for the package/bundle should only be presented with accounting approval. | |
| **Part number** | **Product Description** | **Qty** |
| **7Z71CTO1WW** | TidalScale Balanced Configuration 2TB Node: ThinkSystem SR630 V2-3yr Warranty | 1 |
| **BH9Q** | ThinkSystem 1U 2.5" Chassis with 8 or 10 Bays | 1 |
| **BFYB** | Operating mode selection for: "Maximum Performance Mode" | 1 |
| **BB2L** | Intel Xeon Gold 6348 28C 235W 2.6GHz Processor | 2 |
| **B966** | ThinkSystem 64GB TruDDR4 3200 MHz (2Rx4 1.2V) RDIMM | 32 |
| **5977** | Select Storage devices - no configured RAID required | 1 |
| **B5XH** | ThinkSystem M.2 SATA 2-Bay RAID Enablement Kit | 1 |
| **B919** | ThinkSystem M.2 5300 480GB SATA 6Gbps Non-Hot Swap SSD | 2 |
| **B8N2** | ThinkSystem 1U PCIe Gen4 x16/x16 Riser 1 | 1 |
| **B8NC** | ThinkSystem 1U LP+LP BF Riser Cage Riser 1 | 1 |
| **B8MV** | ThinkSystem 1U PCIe Gen4 x16 Riser 2 | 1 |
| **B93E** | ThinkSystem Intel I350 1GbE RJ45 4-port OCP Ethernet Adapter | 1 |
| **ATZV** | Emulex 16Gb Gen6 FC Dual-port HBA | 1 |
| **B653** | ThinkSystem Mellanox ConnectX-4 Lx 10/25GbE SFP28 2-port PCIe Ethernet Adapter | 1 |
| **AV1B** | Lenovo 25GBase-SR SFP28 Transceiver | 2 |

| | | |
|---|---|---|
| **B8QB** | ThinkSystem V2 1800W (230V) Platinum Hot-Swap Power Supply | 2 |
| **6400** | 2.8m, 13A/100-250V, C13 to C14 Jumper Cord | 2 |
| **AUPW** | ThinkSystem XClarity Controller Standard to Enterprise Upgrade | 1 |
| **BH9M** | ThinkSystem 1U Performance Fan Option Kit | 8 |
| **B8LA** | ThinkSystem Toolless Slide Rail Kit v2 with 1U CMA | 1 |
| **B0MK** | Enable TPM 2.0 | 1 |
| **B7XZ** | Disable IPMI-over-LAN | 1 |
| **B97M** | ThinkSystem SR630 V2 MB | 1 |
| **B0ML** | Feature Enable TPM on MB | 1 |
| **BHS7** | UEFI Operating Modes Support | 1 |
| **BK15** | High voltage (200V+) | 1 |
| **B8KY** | ThinkSystem WW Lenovo LPK | 1 |
| **AWF9** | ThinkSystem Response time Service Label LI | 1 |
| **B97B** | XCC Label | 1 |
| **B97G** | SR630 V2 Service Label for LI | 1 |
| **B97K** | ThinkSystem SR630 V2 Model Number Label | 1 |
| **AUTQ** | ThinkSystem small Lenovo Label for 24x2.5"/12x3.5"/10x2.5" | 1 |
| **B8KG** | ThinkSystem 1800W RDN PSU Caution Label | 1 |
| **B7KM** | ThinkSystem OCP NIC Label 1-4 | 1 |
| **BCYL** | SR630 V2 Lenovo Agy LBL No CCC | 1 |
| **B8GY** | M.2 Module Cable | 1 |
| **BE0E** | N+N Redundancy With Over-Subscription | 1 |
| **AUAK** | 2U Bracket for Mellanox ConnectX-4 Lx 2x25GbE SFP28 Adapter | 1 |
| **AUWG** | Lenovo ThinkSystem 1U VGA Filler | 1 |
| **B8NK** | ThinkSystem 1U Super Cap Holder Dummy | 1 |
| **AVKJ** | ThinkSystem 2x2 Quad Bay Gen4 2.5" HDD Filler | 2 |
| **AVEN** | ThinkSystem 1x1 2.5" HDD Filler | 2 |
| **B955** | ThinkSystem 4R ICX CPU HS Clip | 2 |
| **B8N7** | ThinkSystem 1U MS LP Riser Cage Riser1&2 | 1 |
| **AVWK** | ThinkSystem EIA Plate with Lenovo Logo | 1 |
| **B173** | Companion Part for XClarity Controller Standard to Enterprise Upgrade | 1 |

| | | |
|---|---|---|
| | in Factory | |
| **B989** | ThinkSystem V2 1U Package | 1 |
| **B984** | ThinkSystem 1U PLV Top Cover Sponge | 1 |
| **BH9R** | 10x2.5" Media Bay w/ Cable | 1 |
| **BHJS** | 1U MB PSU Airduct for CPU>125W | 1 |
| **B975** | ThinkSystem V2 Performance Heatsink | 2 |
| **5PS7A67541** | Premier Essential - 3Yr 24x7 4Hr Resp + YDYD SR630 V2 | 1 |
| **5AS7A83088** | Hardware Installation (Business Hours) for SR630 | 1 |
| **5641PX3** | XClarity Pro, Per Endpoint w/3 Yr SW S&S | 1 |
| **1340** | Lenovo XClarity Pro, Per Managed Endpoint w/3 Yr SW S&S | 1 |
| **3444** | Registration only | 1 |
| **7S17CTO1WW** | TidalScale SW | 1 |
| **S6PW** | TidalScale non-Oracle 3 Yr 2TB | 1 |

## 6.2 Lenovo ThinkSystem SR630 V2 Server – High Frequency

Additional servers can be added as needed, up to a maximum of four total.

| Lenovo | Data Center Solution Configurator<br>Bill of Materials | |
|---|---|---|
| | Your final configuration may contain hardware, software, and services; therefore, accounting implications need to be taken into consideration. A bottom-line price for the package/bundle should only be presented with accounting approval. | |
| **Part number** | **Product Description** | **Qty** |
| **7Z71CTO1WW** | TidalScale High Frequency 2TB Node: ThinkSystem SR630 V2-3yr Warranty | 1 |
| **BH9Q** | ThinkSystem 1U 2.5" Chassis with 8 or 10 Bays | 1 |
| **BFYB** | Operating mode selection for: "Maximum Performance Mode" | 1 |
| **BB3D** | Intel Xeon Gold 6334 8C 165W 3.6GHz Processor | 2 |
| **B966** | ThinkSystem 64GB TruDDR4 3200 MHz (2Rx4 1.2V) RDIMM | 32 |
| **5977** | Select Storage devices - no configured RAID required | 1 |
| **B5XH** | ThinkSystem M.2 SATA 2-Bay RAID Enablement Kit | 1 |
| **B919** | ThinkSystem M.2 5300 480GB SATA 6Gbps Non-Hot Swap SSD | 2 |

| | | |
|---|---|---|
| **B8N2** | ThinkSystem 1U PCIe Gen4 x16/x16 Riser 1 | 1 |
| **B8NC** | ThinkSystem 1U LP+LP BF Riser Cage Riser 1 | 1 |
| **B8MV** | ThinkSystem 1U PCIe Gen4 x16 Riser 2 | 1 |
| **B93E** | ThinkSystem Intel I350 1GbE RJ45 4-port OCP Ethernet Adapter | 1 |
| **ATZV** | Emulex 16Gb Gen6 FC Dual-port HBA | 1 |
| **B653** | ThinkSystem Mellanox ConnectX-4 Lx 10/25GbE SFP28 2-port PCIe Ethernet Adapter | 1 |
| **AV1B** | Lenovo 25GBase-SR SFP28 Transceiver | 2 |
| **B8QB** | ThinkSystem V2 1800W (230V) Platinum Hot-Swap Power Supply | 2 |
| **6400** | 2.8m, 13A/100-250V, C13 to C14 Jumper Cord | 2 |
| **AUPW** | ThinkSystem XClarity Controller Standard to Enterprise Upgrade | 1 |
| **BH9M** | ThinkSystem 1U Performance Fan Option Kit | 8 |
| **B8LA** | ThinkSystem Toolless Slide Rail Kit v2 | 1 |
| **B0MK** | Enable TPM 2.0 | 1 |
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| **B8KG** | ThinkSystem 1800W RDN PSU Caution Label | 1 |
| **B7KM** | ThinkSystem OCP NIC Label 1-4 | 1 |
| **BCYL** | SR630 V2 Lenovo Agy LBL No CCC | 1 |
| **B8GY** | M.2 Module Cable | 1 |
| **BE0E** | N+N Redundancy With Over-Subscription | 1 |
| **AUAK** | 2U Bracket for Mellanox ConnectX-4 Lx 2x25GbE SFP28 Adapter | 1 |

| | | |
|---|---|---|
| **AUWG** | Lenovo ThinkSystem 1U VGA Filler | 1 |
| **B8NK** | ThinkSystem 1U Super Cap Holder Dummy | 1 |
| **AVKJ** | ThinkSystem 2x2 Quad Bay Gen4 2.5" HDD Filler | 2 |
| **AVEN** | ThinkSystem 1x1 2.5" HDD Filler | 2 |
| **B955** | ThinkSystem 4R ICX CPU HS Clip | 2 |
| **B8N7** | ThinkSystem 1U MS LP Riser Cage Riser1&2 | 1 |
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| **B173** | Companion Part for XClarity Controller Standard to Enterprise Upgrade in Factory | 1 |
| **B989** | ThinkSystem V2 1U Package | 1 |
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| **3444** | Registration only | 1 |
| **7S17CTO1WW** | TidalScale SW | 1 |
| **S6Q2** | TidalScale for Oracle 3 Yr 2TB | 1 |

## 6.3 Lenovo ThinkSystem DE4000F All Flash Storage Array

**Note**: The DE4000F is an optional component if additional storage is required.

Lenovo ThinkSystem DE4000F is a scalable, all flash storage system that is designed to provide performance, simplicity, capacity, security, and high availability. It delivers enterprise-class storage management capabilities with a wide choice of host connectivity options, flexible drive configurations, and enhanced data management features. The ThinkSystem DE4000F is a perfect fit for a wide range of enterprise workloads, including big data and analytics, video surveillance, technical computing, and other storage I/O-intensive applications.

ThinkSystem DE4000F models are available in a 2U rack form-factor with 24 small form-factor (2.5-inch SFF) drives (2U24 SFF) and include two controllers, each with 32 GB cache for a system total of 64 GB. Universal 1/10 Gb iSCSI or 4/8/16 Gb Fibre Channel (FC) ports provide base host connectivity, and the host interface

cards provide additional 1/10 Gb iSCSI or 4/8/16 Gb FC, 12 Gb SAS, 10/25 Gb iSCSI, or 8/16/32 Gb FC connections.

The ThinkSystem DE4000F Storage Array scales up to 120 dual-port and hot-swappable SSDs (up to 1.84 PB of raw storage capacity) with the attachment of ThinkSystem DE240S 2U24 SFF Expansion Enclosures.

The following functions are included with every ThinkSystem DE4000F:

- **RAID levels 0, 1, 3, 5, 6, and 10**: Provide the flexibility to choose the level of performance and data protection required.
- **Dynamic Disk Pools (DDP) technology**: Helps improve performance and availability with significantly faster rebuild time and reduced exposure to multiple drive failures by allowing data and built-in spare capacity to be distributed across all physical drives in the storage pool.
- **All Flash Array (AFA) capability**: Meets the demand for higher speed storage and provide higher IOPS and bandwidth with lower power usage and total cost of ownership than hybrid or HDD-based solutions.
- **Thin provisioning**: Optimizes efficiency of Dynamic Disk Pools by allocating storage space based on the minimum space required by each application at any given time, so that applications consume only the space they are actually using, not the total space that has been allocated to them, which allows customers to purchase storage they need today and add more as application requirements grow.
- **Snapshots**: Enables creation of copies of data for backup, parallel processing, testing, and development, and have the copies available almost immediately (up to 512 snapshot targets per system).
- **Encryption**: Provides encryption for data at rest for enhanced data security with the optional FIPS 140-2 Level 2 drives and embedded key management (AES-256) or an external key management server.
- **Automatic load balancing**: Provides automated I/O workload balancing of I/O traffic from the hosts across both controllers.
- **Data assurance**: Ensures industry-standard T10-PI end-to-end data integrity in the storage system (from the host ports to the drives).
- **Dynamic volume and capacity expansion**: Allows the capacity of a volume to be expanded by adding new physical drives or making use of unused space on existing drives.
- **Asynchronous mirroring**: Provides storage system-based data replication between the storage systems containing primary (local) and secondary (remote) volumes by using asynchronous data transfers over iSCSI or Fibre Channel communication links at set intervals (both storage systems must have licenses for asynchronous mirroring).

The ThinkSystem DE4000F capabilities can be expanded with the optional **synchronous mirroring** licensed function. Synchronous mirroring provides storage system-based online, real-time data replication between the storage systems containing primary (local) and secondary (remote) volumes by using synchronous data transfers over Fibre Channel communication links (both storage systems must have licenses for synchronous mirroring).

| Lenovo | Data Center Solution Configurator<br>Bill of Materials | |
|---|---|---|
| | Your final configuration may contain hardware, software, and services; therefore, accounting implications need to be taken into consideration. A bottom-line price for the package/bundle should only be presented with accounting approval. | |
| **Part number** | **Product Description** | **Qty** |
| **7Y76CTO1WW** | TidalScale DE4000F: Lenovo ThinkSystem DE4000F All Flash Array SFF | 1 |
| **B38L** | Lenovo ThinkSystem Storage 2U24 Chassis | 1 |
| **B4DA** | Fiber Channel | 1 |
| **B4B7** | Lenovo ThinkSystem DE4000 HIC, 16Gb FC/10GbE,4-ports | 2 |
| **B88D** | Lenovo ThinkSystem DE4000 Controller 32GB | 2 |
| **B4B2** | Lenovo 10Gb iSCSI/16Gb FC Universal SFP+ Module | 4 |
| **B4BT** | Lenovo ThinkSystem DE Series 800GB 3DWD 2.5" SSD 2U24 | 12 |
| **B4BP** | Lenovo ThinkSystem Storage USB Cable, Micro-USB | 1 |
| **6201** | 1.5m, 10A/100-250V, C13 to IEC 320-C14 Rack Power Cable | 2 |
| **B4DY** | Lenovo ThinkSystem DE4000F Premium Bundle | 1 |
| **A1NN** | High Performance Analytics Appliance | 1 |
| **B4AR** | Lenovo ThinkSystem DE Series Ship Kit (RoW), 2U | 1 |
| **B38Y** | Lenovo ThinkSystem Storage Rack Mount Kit 2U24/4U60 | 1 |
| **B4MD** | Lenovo ThinkSystem DE4000H SMID Controller Base Setting | 1 |
| **B38Z** | Lenovo ThinkSystem Storage SFF Drive Filler | 12 |
| **B4AY** | Lenovo ThinkSystem DE Series 2U24 End Cap Kit (Pair) | 1 |
| **B4AW** | Lenovo ThinkSystem Storage Packaging 2U | 1 |
| **B4BG** | Lenovo ThinkSystem Storage 2U24 System Label | 1 |
| **B4EY** | Lenovo ThinkSystem DE Series DE4000F Product Label | 1 |
| **B4DZ** | Lenovo ThinkSystem DE4000H Snapshot Upgrade 512 | 1 |
| **B4E0** | Lenovo ThinkSystem DE4000H Asynchronous Mirroring | 1 |
| **B4G6** | Lenovo ThinkSystem DE4000H Controller Upgrade Key FC to DE4000F | 1 |
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|---|---|---|
| **5PS7A22386** | Premier Essential - 3Yr 24x7 4Hr Resp + YDYD DE4000F 2U24 | 1 |
| | | |
| **5MS7A24104** | ThinkSystem DE Onsite Deployment | 1 |
| | | |
| **5AS7A83022** | Hardware Installation (Business Hours) for DE4000F 2U24 | 1 |
| | | |
| **5641PX3** | XClarity Pro, Per Endpoint w/3 Yr SW S&S | 1 |
| **1340** | Lenovo XClarity Pro, Per Managed Endpoint w/3 Yr SW S&S | 1 |
| **3444** | Registration only | 1 |
| | | |

# Resources

- TidalScale Web Site
- Lenovo TruScale
- Product Guide Lenovo ThinkSystem SR630 V2 Server
- Product Guide Lenovo ThinkSystem DE4000F All Flash Storage Array
- Product Guide Lenovo XClarity Administrator
- Intel Transparent Supply Chain on ThinkSystem Servers

# Document history

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|---|---|---|
| Version 1.0 | September 2021 | First version with SR630 V2 Balanced and High Frequency Configs |

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