Server Power Management with Lenovo ThinkServer Energy Manager

For Lenovo Next-Generation ThinkServer Systems

Lenovo Enterprise Product Group

Version 1.0

September 2014

©2014 Lenovo. All rights reserved.
LENOVO PROVIDES THIS PUBLICATION “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This information could include technical inaccuracies or typographical errors. Changes may be made to the information herein; these changes will be incorporated in new editions of the publication. Lenovo may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

The following terms are trademarks of Lenovo in the United States, other countries, or both: Lenovo, and ThinkServer.

Microsoft and the Windows Logo are trademarks of Microsoft Corporation in the United States and/or other countries.
List of Figures

Figure 1 - Overview of Energy Manager Architecture .......................................................... 8
Figure 2: Customizable TEM Dashboard ............................................................................. 9
Figure 3: Datacenter Management Hierarchy ...................................................................... 10
Figure 4: TEM Energy Optimization screen ....................................................................... 11
Figure 5: TEM Cooling Analysis .......................................................................................... 12
Figure 6: Identifying poorly utilized servers ....................................................................... 12
Figure 7: Workload Placement Analysis reports on server utilization ................................. 13
Figure 8: Devices and Racks database tab .......................................................................... 14
Figure 9: TEM licensing screen .......................................................................................... 17
Introduction

The drive to increase data center efficiencies is a key focus for many organizations. IT must keep pace with the exploding demand for computing, storage and networking resources while reducing costs and managing data center growth.

This increased demand for IT resources is challenging data center power and cooling capacity and the associated cost has captured the attention of CIOs.

As a result, many IT managers are being pressured to find creative ways to manage power consumption and cooling costs while maintaining or improving the quality of IT service delivery. The implementation of private clouds, virtualization and server consolidation can greatly reduce power costs, but there is additional opportunity to increase your energy efficiency and reduce total cost of ownership (TCO).

The Lenovo® ThinkServer® Energy Manager (TEM) utility enables you to analyze, optimize and automate server power consumption through a single management console. Obtaining data from server resident Intel® Node Manager, TEM provides real time server power and thermal data as well as the ability to monitor and manage server power at all tiers, from the data center to rack or individual server level.

The capacity to examine and control dynamic server performance enables you to avoid over- and under-provisioning of compute power and related cooling systems. Accurate energy and cooling data and closed loop management may enable IT and facilities to selectively raise the data center thermostat. Next-generation Lenovo ThinkServer systems are able to run at 45°C continuously, without time restrictions – an industry first. By enabling servers to run at higher temperatures, innovative cooling strategies such as fresh-air and chiller-less technologies can be employed in the data center.

The powerful combination of Lenovo TEM and intrinsically energy efficient Lenovo next-generation servers based on Intel® Xeon® E5-2600 v3 processors creates the potential for large savings in facilities data center costs and can dramatically increase your return-on-investment (ROI). Intel estimates that such visibility into data center energy and power capping policies can result in reduction of data center peak power usage by 16-18%1.

TEM is supported on all ThinkServer systems based on Intel Xeon E5-2600 v2 (rack servers) and E5-2600 v3 processors (rack and tower servers) and other supported servers2.

---

1 For further information, refer to the Intel document: Dynamically Controlling Server Power Consumption and Reducing Data Center Peak Usage by 16 to 18 Percent.
2 For supported non-Lenovo servers, visit the Intel website.
Solution Overview

Lenovo TEM is software designed to provide data center energy management. TEM provides a stand-alone, web-based, agent-less power management console that provides real time data and enables you to observe, plan and manage server power and cooling.

Using built-in intelligence, TEM identifies server power consumption trends, ideal power settings and cooling analysis so that you can define and optimize power-saving policies. When a user-defined threshold is reached, an alert can be generated to inform you of the event. You can even monitor a server’s inlet temperature to locate hot spots, reducing the risk of data or device damage.

With the ability to monitor, analyze and control the power and cooling of Lenovo and non-Lenovo servers, TEM enables you to take control of power management and reduce costs:

- Manage rack CAPEX – by using real time and historical power consumption data, you can optimize the number of servers in a supported rack; potentially reducing the number of racks supported.
- Decommission servers – save power costs by decommissioning and consolidating underutilized and ‘ghost’ servers.
- Reduce OPEX cooling costs by raising data center temperatures while continuously monitoring devices for temperature issues.

ThinkServer Energy Manager Architecture

Leveraging Intel® Node Manager, TEM takes advantage of Intel Xeon processor micro-architecture. Intel Node Manager, a server firmware feature, provides key functionality:

- Reports vital server information, such as power, temperature and resource utilization.
- Provides finely-grained controls to limit platform power in compliance with IT policy.

TEM communicates with the new Intel Node Manager firmware on the Intel C610 chipsets in next-generation Lenovo ThinkServer system to enable secure, precise, out-of-band readings on system power consumption, thermal telemetry and compute utilization per second (CUPS) metrics. TEM utilizes the data provided by Node Manager and in turn, provides intelligent analysis to IT and enforces the power-capping policies set by the administrator.

TSM

The ThinkServer System Manager (TSM) is a specialized microcontroller embedded on all next generation ThinkServers. The TSM provides the intelligence behind intelligent platform
management; that is, the autonomous monitoring and recovery features implemented directly in platform management hardware and firmware.

As shown in Figure 1, different types of sensors built into the server report to the TSM on parameters such as temperature, cooling fan speeds, power mode, operating system, etc. The TSM provides monitoring and control of the server sensors. These sensors include soft sensors that are used for reporting system state and events, and hardware sensors that monitor voltage, temperature, system fans and power supplies.

**Intel Node Manager**

The TSM interfaces with Intel Node Manager, which resides within the firmware of every next-generation Lenovo ThinkServer system. Node Manager enables setting platform power to a targeted power budget while maintaining maximum performance for the given power level. Node Manager receives power policy from TEM through Intelligent Platform Management Interface (IPMI) and maintains power at the targeted level.

TEM utilizes the capability of Node Manager to monitor and manage servers via the TSM.

**TEM Server**

A TEM server hosts the software and data store used to monitor and control the managed servers. TEM enables you to model your data center, building a physical hierarchy view and customized logical view.

Once installed, TEM can be accessed via any web browser.
ThinkServer Energy Manager Features and Functionality

This section describes TEM features and functionality.

Energy Manager Dashboard
The customizable TEM dashboard (as shown in Figure 2) provides an overview of the overall health status of data center power and cooling. Content at-a-glance is customizable by selecting Gadget checkboxes. Available content includes:

- Current power and cooling status – provides overview at a glance.
- Historical power and temperature trend – customizable by day, week or month.
- Hot rooms and hot spots – indication of problem areas before device damage occurs.
- Power and capacity information – measures actual utilization against capacity.
- Critical events – indicates breached thresholds.
- Emergency power reduction – throttle device power to prolong service time in an emergency event.
Data Center Management

Data Center Management enables you to build a hierarchy to display and control all of the entities managed by TEM. This hierarchical view provides a logical view of the data center, enabling you to group your data center devices and easily apply management policies. As shown in Figure 3, you can customize the hierarchical view according to your environment.
Groups

Functionality of the Groups tab enables you to manage and sort devices into a custom group for easy manageability. You can manage, monitor and configure the devices into groups in the same manner as in the hierarchy. Only devices added to the hierarchy can be added to groups.

Energy Optimization

The Energy Optimization tab provides data analysis, enabling you to optimize the energy efficiency of your data center.
Shown in Figure 4 above, the Energy Optimization tab includes the following features:

**Cooling Analysis**

*Cooling Analysis* provides real-time monitoring of server inlet temperatures. As shown in Figure 5, this analysis provides data to assist you in defining data center hotspots and ensuring cooling optimization.
Low-Utilization Servers

As shown in Figure 6, TEM can identify poorly utilized servers as potential targets for consolidation to optimize energy efficiency.
The Daily Utilization Pattern shows the result of analyzing server utilization patterns based on historical monitoring data. This type of analysis can help you to identify potential server consolidation targets. For example, if one server is busy at night and idle during the day while another server is idle at night, but busy during the day, you may consider consolidating the workloads on a single server and decommissioning the other one.

**Server Power Characteristics**

This analysis provides feedback on all servers within a certain model. For example, each server model will be displayed along with the power range of all servers measured within that model.

**Workload Placement**

*Workload Placement* analysis displays server workload and evaluates whether the server can accommodate additional resource demands. Shown in Figure 7, this analysis is based on CPU, memory and disk utilization.

*NOTE:* This analysis is provided via Intel Node Manager. TEM communicates with Intel Node Manager to provide out-of-band readings on compute utilization per second (CUPS) and other metrics.

![Figure 7: Workload Placement Analysis reports on server utilization](image)
Discovery and Import
The *Discovery and Import* tab enables you to discover and import devices into TEM. Devices are discovered automatically via IP range or input manually. You can also import devices from a spreadsheet with pre-populated hierarchical data.

Devices and Racks
The *Devices and Racks* section contains all of the devices discovered, imported and manually added. Shown in Figure 8, this section provides you with a searchable database for all devices. Basic search options include IP address and device name (resolved by reverse DNS). Advanced search options are also available.

![Figure 8: Devices and Racks database tab](image)

Policies
The *Policies* section enables you to set policies to limit the power that a device consumes. Each policy applies to either a device or group. ThinkServer Energy Manager provides several policy types:
• **Custom Power Limit** – limits the total power consumption of the group or device. When the policy applies to a group, Energy Manager monitors server power consumption, estimates server power demand and reallocates the power to the individual servers in the group during each monitoring cycle.

• **Minimum Power** – throttles power consumption; this policy is used to prolong business continuity in the event of an emergency.

There are four priority levels for servers in the group: Critical/High/Medium/Low. The **High** setting will take precedence to get maximum power budget; the **Critical** setting will allocate as much from the power budget as the administrator has set. If no priority has been set or if all of the servers are set to the same priority, power budget will be divided intelligently by TEM.

Three policy schedules are available within the TEM console:

• Permanent – once enabled, it is constantly applied until it is manually disabled.

• Specific time – only works at a specified time period. For example, if you know that there is a power limitation during certain times, you can set the power capping at that time to cap the power in the event that actual power exceeds the limitation.

• Recurrent – more complex than **Specific Time**; useful for scenarios where server power trends the same every day.

**Events and Thresholds**

The **Thresholds** tab manages event threshold configurations. Device power and temperature are compared to the threshold and an **Event** is triggered when the defined condition is met. TEM supports event triggers from managed devices and from TEM itself. Users can also define custom events.

**Settings**

The **Settings** section provides tabs for configuring User Management, SNMP traps and predefined events:

• **User Management** – Manage user roles, such as Administrator or Guest.

• **SNMP Trap** – Ease of management capability for 3\(^{rd}\) party management tools, such as assigning a recipient to for triggered events.

• **Predefined Events** – Lists event types and severity level.

**Emergency Power Reduction**

The **Emergency Power Reduction** (EPR) tab enables you to throttle device power to prolong service time of a device in the event of an emergency. All of the devices with EPR capability are throttled according to the customizable settings configured by IT.
Initiation of the EPR is a manual process available only to designated Administrators. Once an administrator initiates the EPR process, device power is throttled according to your pre-set policies.

The EPR process primarily affects the CPU and memory sub-systems, which are dropped to their lowest operating levels in order to remain functional while still accommodating the drop in power.

**Hardware and Software Support**

This section describes ThinkServer Energy Manager supported network protocols as well as hardware and software requirements.

**Software**

OS and browsers listed in this section are supported by Energy Manager.

**Supported OS**

- Microsoft Windows Server 2008
- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2012
- Microsoft Windows 2012 R2
- Red Hat Enterprise Linux 6 (EL6) Server
- SUSE Linux Enterprise Server 11 (SLES 11)

**Supported Browsers**

- Mozilla Firefox 25
- Google Chrome 31
- Microsoft Internet Explorer 9 (and above)

**Hardware Requirements**

Energy Manager requires the following hardware to support the TEM installation:

- Dual-core processor (2.6GHz or higher)
- 8GB RAM
- 80GB hard drive space

**Communication Protocols**

The following communication protocols are supported:

---

3 Refer to the TEM User Guide for OS that support in-band monitoring
4 TEM supports physical and virtual machines
Configuring and Using ThinkServer System Manager

- IPMI - Temperature and power monitoring
- SSH – Linux OS support (port setting adjustable)
- SNMP – 3rd party device monitoring
- WSMAN – Blade servers (port setting adjustable)
- HTTPS – Secure browser support
- WMI/DCOM – Windows server performance

**Licensing**

This section describes the process for downloading and licensing TEM.

TEM licensing can be purchased in two ways:

- Purchase of ThinkServer System Manager Premium (single server license)
- Purchase of Node Bundle (1/5/50 node increments)\(^5\)

- Retrieve the TEM key from the About section in the TEM console, as shown in Figure 9
- Email the token, key and customer information to the ThinkServer License Activation Center (TSEML@lenovo.com) to obtain TEM license.
- The Activation Center will generate licenses and email the licenses to you

![Figure 9: TEM licensing screen](image)

**NOTE:** TEM can support 5,000 physical nodes in a data center.

**Supported ThinkServer platforms**

Lenovo TEM is supported on the following ThinkServer systems\(^6\):

- TD340

\(^5\) Node bundle supports non-Lenovo servers: TEM tokens sent via postal mail for node bundle options

\(^6\) For supported non-Lenovo devices, visit the [Intel website](http://intel.com).
Conclusions

Providing a convenient web console, TEM software provides real-time power and cooling telemetry information directly from the server sensors. TEM provides out-of-band, secure communication, enabling you to collect utilization information outside of the operating system (to avoid slowing down workload) and provides critical events and alerting.

Utilizing the improved capabilities of server sensors on next-generation Lenovo ThinkServer systems and Intel Node Manager, you now have the ability to deploy workloads on the appropriate servers with confidence, knowing that the target server has the ability to support the desired application.

Lenovo TEM enables you to plan and manage data center power and cooling based upon real power and thermal data. Ultimately, TEM provides the visibility you need to make better business decisions regarding available data center power, space and temperature.

For further information, contact your Lenovo sales representative or channel partner.

References

The following are links to other documentation that provides additional insight into Lenovo’s next generation ThinkServer, and systems management with ThinkServer System Manager.

TEM User Guide

TEM Quick Start Guide

Overview of Intel Node Manager