COMPAQ
Guidelines

Contents

Compaq Ultra-Dense Server Deployment in Third-Party Racks

Abstract: The Compaq ProLiant DL360 server was developed with high volume deployment in mind. As a result, Compaq addresses environmental, thermal, mechanical, power, installation and service considerations for the server and rack specific options.

While Compaq 9000 and 7000 series racks are ideal for this ultra-dense server, Compaq recognizes that customers may want to plan and implement deployments using third-party racks. This document describes deployments involving the Compaq ProLiant DL360 server and Compaq Third-Party Rack Option Kit.

Compaq provides hardware, specifications, and guidelines for deployment schemes using third-party racks as a service to its customers.

Notice

Introduction

Compaq designed the ProLiant™ DL360 ultra-dense server with maximally configured deployments in mind. The Compaq ProLiant DL360 server requires only 1U (1.75 inches) of rack height.

From its inception, Compaq engineers anticipated issues that customers face when installing and servicing an ultra-dense server deployment, including:

- Mounting options for varying rack environments

- Weight

- Power distribution

- Thermal and environmental considerations

- Console management choices

- Cable management

- Unit identification

This paper provides guidelines for deploying multiple Compaq ProLiant DL360 servers in third-party racks using the Compaq Third-Party Rack Option Kit (P/N: 174574-B21), and provides information on Compaq rack products and related options. For information regarding Compaq deployment of ultra-dense servers in third-party telecommunications (telco) racks, consult the white paper, "Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks," Compaq Document Number 12CZ-0400A-WWEN, available on the Compaq website at:

ftp://ftp.compaq.com/pub/products/servers/CUDS_Telco_Rack.pdf

Figure 1: Deployment of 1U ProLiant DL360 ultra-dense servers in a cabinet rack

Following the guidelines in this document will minimize planning and installation time; however, do not use this document as your sole source of information for the rack installation. Other rack installation references include:

- Compaq Third-Party Rack Option Kit installation guide (poster included with each kit).
- "Compaq Ultra-Dense Server Deployment Solutions Overview," white paper available at
  http://www.compaq.com/support/techpubs/whitepapers/index.html
- Compaq Rack Builder Pro 2.5 or later, design and planning software utility, available for download from the Compaq website at
- http://www.compaq.com

Detailed information specific to a product described in this document can be found in the corresponding product manuals.

Rack Warnings

This document should be used only as an information source for planning your deployment. Avoid personal injury and equipment damage by following accepted safety practices.

WARNING: Ensure proper floor support. Deployments of Compaq ProLiant DL360 ultra-dense servers, related equipment, and cables exceed 1,800 pounds for a single 42U rack.

WARNING: Be aware of the center of gravity and tip hazard. Compaq recommends that the footings extend 10 inches from the front and back of any Compaq rack 22U or higher. Adequate stabilization measures are required. Ensure that the entire rack assembly is properly secured and that all personnel are trained in proper maintenance and operation procedures. Tip hazards include personal injury and death.

WARNING: Ensure your installation has adequate power supply and branch circuit protection.

WARNING: Thermal dissipation requirements of an ultra-dense server deployment mandate minimum unrestricted airspace of 3 inches in both the front and the rear of each Compaq ProLiant DL360 server.

Compaq Third-Party Rack Option Kit

The Compaq Third-Party Rack Option Kit for ProLiant DL360 servers provides a complete mounting solution that adapts to a variety of third-party racks.

The Compaq Third-Party Rack Option Kit includes a set of adjustable rack rails that attach to third-party rack posts using customer-supplied fasteners appropriate for the rack. Compaq supplies adapter washers for M5 and 10-32 thread mounting screws.

The depth-adjustable rack rails mate to the rails pre-installed on the Compaq ProLiant DL360 server for slide-in installation.

The Compaq Third-Party Rack Option Kit includes a cable management tray option. A minimum rack depth of 28 inches is required to use the cable management tray.

The Compaq Third-Party Rack Option Kit comes with a detailed installation guide. Consult the installation guide for details on adapting to your particular third-party rack.

Figure 2: The ProLiant DL360 server third-party rack option kit

❶	Rack Rails	❷	Adapter Washers
❸	Cable Management Tray	❹	Installation Guide

Note: The Compaq Third-Party Rack Option Kit is for fixed rail installation. Although the Compaq ProLiant DL360 server slides in for installation, remove the server from the rack for service.

Compaq ProLiant DL360 Server Specifications for Deployment

For third-party rack design, Compaq ProLiant DL360 server specifications include:

- Weight

- Minimum and maximum dimensions for kit installation

- Power consumption

- Thermal dissipation

Weight

A fully configured Compaq ProLiant DL360 server weighs 29 pounds. The ProLiant DL360 Server includes:

- Two Wide Ultra2 hard disk drives.

- A Remote Insight Lights-Out Edition option.

- Standard server rails attached to the server chassis.

Table 1 lists the weights of individual components used in deployments of Compaq ProLiant DL360 servers in third-party racks.

Table 1. Component Weights for Calculation

Item	Weight (lb)
Wide Ultra2 hard disk drive	1.9
Remote Insight Lights-Out Edition option	0.5
Third-Party Rack Option Kit rack rails (set)	2.5
Third-Party Rack Option Kit cable management tray	1
KVM cable bundle	1.42
High voltage Y power cable	1
Server console switch	5.25

WARNING: Do not exceed the specified weight limit for the third-party rack or the floor. When creating deployments of Compaq ProLiant DL360 ultra-dense servers in a third-party rack, include in the weight calculations the weight of the rack rails, cable management trays and cables whose load is bearing on the rack.

If the Compaq ProLiant DL360 servers do not include Wide Ultra2 hard disk drives ❶, or a Remote Insight Lights-Out Edition option ❷, subtract those component weights from the weight totals.

Figure 3: Fully configured ProLiant DL360 server

❶ **Wide Ultra2 hard disk drives**

❷ **Remote Insight Lights-Out Edition remote management board**

Calculations

When fully configured, each Compaq ProLiant DL360 server weighs 29 pounds. Forty-two servers will weigh more than 1,200 pounds, not including the rack rails, cable management trays, and cabling.

Each installed Compaq Third-Party Rack Option Kit rack rails set weighs 2.5 pounds. Forty-two mounting rack rail sets will add at least 105 pounds.

WARNING: External cable weight contributes to the overall weight of the rack installation. Because cable installation and load-bearing designs vary greatly, carefully consider cable weight in all designs.

CAUTION: The cable management tray design reduces cable congestion and relieves strain on connectors. Ensure that the cabling design provides both adequate airspace for thermal dissipation and strain relief for the cable connections on the Compaq ProLiant DL360 server if the cable management tray is not used.

Floor

The floor area must be designed to provide proper support for a fully populated rack.

Dimensions

Compaq designed the Compaq Third-Party Rack Option Kit to comply with EIA 310-D specifications for rack width.

Table 2 lists the minimum dimensions for installing Compaq ProLiant DL360 servers using the Compaq Third-Party Rack Option Kit.

Table 2. Minimum space requirements for each ProLiant DL360 server installed using Compaq Third-Party Rack Option Kit

Dimension	Measurement
Height	1.75 inches (1U)
Width	17.72 inches
Depth (minimum)	22 inches (28 inches with cable management tray)

Note: When creating deployments of ultra-dense servers in third-party racks, include the minimum clearances for installation of the server, rack rails and cables.

IMPORTANT: Any installation of Compaq components will require a free-flow front door (solid material doors cannot be used), and 3 inches airspace front and back.

Height

Each Compaq ProLiant DL360 server installed using a Compaq Third-Party Rack Option Kit requires a minimum rack height of 1.75 inches (1U).

Width

In accordance with the EIA 310-D specification, each installed ProLiant DL360 server requires a minimum internal install width (distance between the vertical rails) of 17.72 inches.

Depth

The EIA 310-D specification does not specify how deep a rack can or should be. The ProLiant DL360 server measures 25 inches front-to-back. The rack rails in the Compaq Third-Party Rack Option Kit are depth-adjustable from 22 inches to 33 inches.

The appropriate depth for a rack that will house Compaq rack-mountable components is determined by:

- Depth of the components and associated unrestricted airspace for cooling

- Space required for cable management

- Minimum and maximum depth adjustment for rack rails

Table 3 lists the minimum and maximum depth adjustments for the Compaq Third-Party Option Kit rack rails (see Figure 4).

Table 3. Minimum and Maximum Depth Adjustments for Compaq Third-Party Rack Option Kit Rack Rails

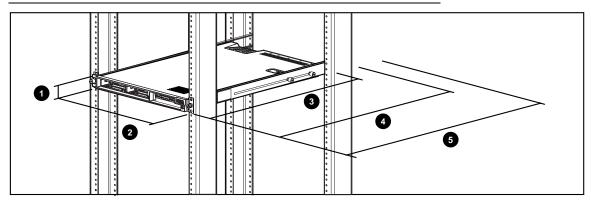| Compaq ProLiant DL360 server Installation Configuration	Minimum Depth	Maximum Depth
Without cable management tray	22 inches	33 inches
With cable management tray	28 inches	33 inches

Figure 4: Height, width, and depth requirements for Compaq ProLiant DL360 server installation using the Compaq Third-Party Rack Option Kit

❶ **Height**   ❷ **Width**

❸ **Minimum depth**   ❹ **Minimum depth with cable management tray**

❺ **Maximum depth adjustment**

Power Consumption

The Compaq ProLiant DL360 server power supply is rated for a maximum 190W DC output. Maximum input AC power consumption is approximately 292W.

- Using 110V AC power, a fully loaded system can consume up to 2.66A.

- Using 208V AC power, a fully loaded system can consume up to 1.41A.

Deployment of ultra-dense 1U servers represent a significant power requirement. A simple formula to calculate ProLiant DL360 server power requirements for an installation is:

(Number of ProLiant DL360 servers) * (292W) = maximum power requirements for servers

Compaq uninterruptible power supplies and Compaq power distribution units are used in Compaq solutions. Plan the installation to provide for adequate power distribution and backup. For high voltage installations, Compaq also offers a Y-shape power cable to simplify power distribution wiring by powering two servers from each outlet.

WARNING: To reduce the risk of personal injury, fire, or damage to the equipment, do not overload the AC supply branch circuit that provides power to the rack. Consult the electrical authority having jurisdiction over the facility wiring and installation requirements.

CAUTION: If the rack is equipped with an integrated power distribution scheme, make sure that the power distribution circuits are not overloaded.

Thermal Dissipation

The Compaq ProLiant DL360 server internal design achieves efficient cooling through unrestricted airflow. A large cooling fan and three smaller power supply fans move cool air from the front of the unit, over the heated components, and out the chassis through large, specially angled air vents at the rear of the unit.

A fully configured Compaq ProLiant DL360 server under maximum workload can produce approximately 1,000 BTU/hr. Air temperature measurements around the server may vary as much as 25°C (45°F) from front to back. Deployment of multiple ultra-dense servers will produce a significant amount of heat. For example, 42 Compaq ProLiant DL360 servers under maximum workload can generate as much as 42,000 BTU/hr.

IMPORTANT: Forty-two Compaq ProLiant DL360 servers can produce up to 42,000 BTU/hr. Ensure the environmental infrastructure is designed to respond to the thermal burden of the installation.

Managing thermal dissipation requires appropriate clearance and environmental design. Compaq specifies minimum adequate unrestricted airspace for the intake vents at the front and exhaust vents at the back of the server (see Figure 5) to allow for proper ventilation, but additional environmental measures may be required for the installation.

Figure 5: Intake and Exhaust vents for the Compaq ProLiant DL360 server

❶   **Intake vents**   ❷   **Exhaust vents**

Even when installed in a 1U ultra-dense server deployment, air flow is sufficient to cool the Compaq ProLiant DL360 server if the following criteria are met:

1. Ambient air temperature at the front of the unit does not exceed 35°C (95°F).

2. Relative humidity does not exceed 90 percent while operating.

3. Unrestricted airspace of at least 3 inches in front of the server.

4. Unrestricted airspace of at least 3 inches at the rear of the server.

Note: Cabling must not restrict airflow. The Compaq Third-Party Rack Option Kit includes a cable management tray to provide appropriate clearance for airflow. Ensure airflow exiting the server's exhaust vents is unrestricted if not using the cable management tray. (See Figure 5).

Third-Party Rack Doors and Panels

All Compaq rack-mountable components draw in cool, ambient air through the front of the rack and exhaust hot air through the rear of the rack. However, the vast majority of third-party rack enclosures are designed to be used only in raised floor computer rooms, with cool air being forced in from the bottom of the rack and exhausted through the roof. Therefore, the front and rear doors of most third-party racks are solid and permit no airflow. Installation of a Compaq component in a third-party rack with solid doors may lead to overheating and consequent failure of those components.

Installation Procedures for Third-Party Racks

Adapt the following procedures to create deployments of Compaq ProLiant DL360 ultra-dense servers in third-party racks.

Installing the Compaq Third-Party Rack Option Kit Rack Rails

Compaq ProLiant DL360 servers ship with standard rails attached. These rails will mate to the rack rails found in the Compaq Third-Party Rack Option Kit.

Install all rack rails to the third-party rack before installing any servers. Compaq provides adapter washers for M5 and 10-32 thread mounting screws. Refer to the Compaq Third-Party Rack Option Kit installation guide for rack rail installation instructions.

Adjusting Depth

The rack rails allow for depth adjustment from 22 to 33 inches. The adjustment is a tool-free design, using thumbscrews. Turn the thumbscrews counterclockwise to adjust the depth, then turn the thumbscrews clockwise to secure the rack rail adjustment.
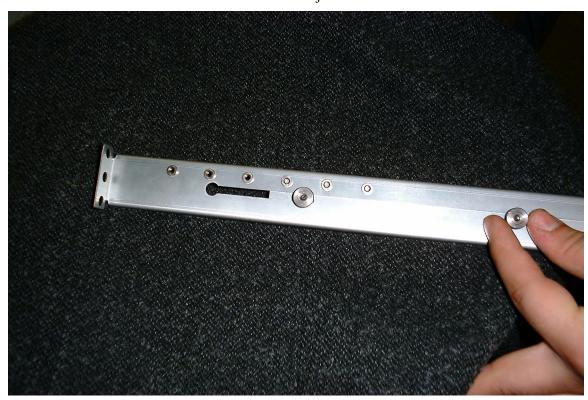

Figure 6: Compaq Third-Party Rack Option Kit rack rail depth adjustment

Preparing the Server

Install all internal options such as PCI boards, memory or processors before mounting the server into the rack. Refer to the *Compaq ProLiant DL360 Server Operation and Reference Guide* for information on installing options.

Installing Compaq ProLiant DL360 servers in the Rack

Start installing servers at the bottom of the rack and work upward. Slide the server ❶ into the rack rails. Attach the server to the rack rails using the thumbscrews ❷ on the server faceplate.
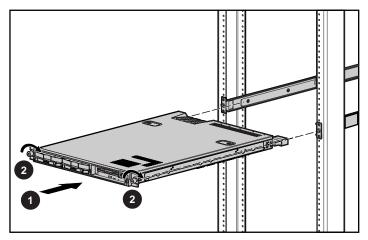

Figure 7: Compaq ProLiant DL360 server third-party rack installation

Console Management Choices and Cabling for Deployment of Ultra-Dense 1U Servers

The console management scheme determines cabling design and management.

Two ways to design a full rack deployment of ultra-dense 1U Compaq ProLiant DL360 servers include:

- Use of remote management option boards, such as the Remote Insight Lights-Out Edition board, in each server.

- Use of adjacent rack space to house remote console switches, monitors, and keyboards.

Remote Insight Lights-Out Edition

Remote management boards simplify server monitoring, control and wiring. Typical wiring for a Compaq ProLiant DL360 Server with a Remote Insight Lights-Out Edition installed is reduced to the server power cord, the Remote Insight Lights-Out Edition CAT5 network connection, and the two CAT5 cables to the redundant server NICs. The Compaq ProLiant DL360 server uses an internal cable to supply power to the Remote Insight Lights-Out Edition and eliminate loop-back cabling for the keyboard, mouse, and video.
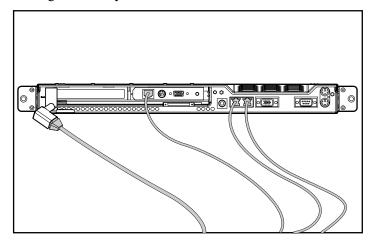

Figure 8: Typical cabling using the Remote Insight Lights-Out Edition

The Remote Insight Lights-Out Edition allows full graphical control of the server, even when the server operating system is down or the server is powered off. The Remote Insight Lights-Out Edition can cycle the power on the server, and allow a reboot from a "virtual floppy" imaged anywhere on the network. The Remote Insight Lights-Out Edition is accessed through a Web browser, and no additional software is required on the server or the system providing access.

For additional information on remote management options, consult the Compaq website at

http://www.compaq.com/manage/

Console switches, monitors and keyboards

The Compaq ProLiant DL360 server can be cabled to a Compaq 1U console switch. Each of these low profile console switches provides connectivity for up to 8 servers. The console switches can be cascaded one level to provide connectivity for up to 64 servers. Using a 2U Compaq TFT display and Compaq keyboard options, customers can deploy Compaq ProLiant DL360 ultra-dense servers in minimal rack space configurations.
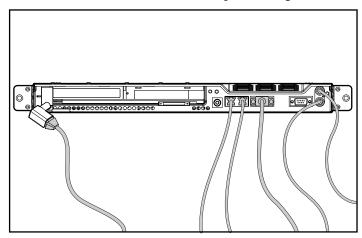

Figure 9: Typical cabling using server console switches

Cabling

Cabling will vary based on the I/O options. The Compaq ProLiant DL360 server ships with a standard 12 foot power cable. For specific cabling solutions developed by Compaq, refer to the white paper, "Compaq Ultra-Dense Server Deployment in Compaq Racks," available on the Compaq website:

www.compaq.com/proliant/ultrathin

CAUTION: Any cabling solution must ensure sufficient airspace for thermal dissipation, and provide strain relief for cable connectors.

Note: For high-voltage installations, Compaq offers a High Volume Deployment Option Kit containing 11 Y-shaped high voltage power cables for powering two servers with one wire. This design provides clean power cable management.

Figure 10 shows a typical in-rack local-console rack configuration for a 42U rack. A single 1U Internal Keyboard with Trackball and one 2U TFT5000R 15-inch Flat Panel Monitor support 35 ProLiant DL360 servers through five cascaded Server Console (KVM) switches.
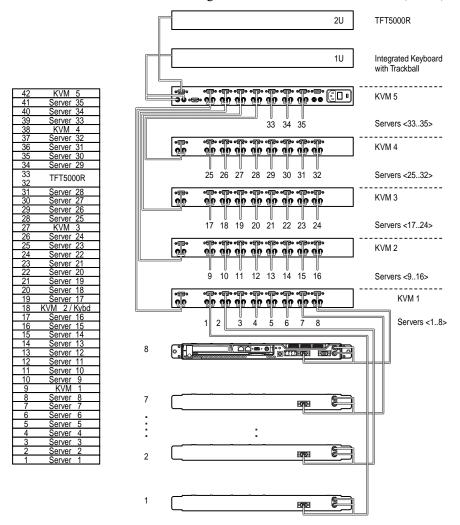

Figure 10: Typical KVM and cascading console switch solution for 35 Compaq ProLiant DL360 Servers

Cable Management Tray

The cable management tray provides:

- Strain relief for cables and connectors
- Space for airflow required for cooling

The cable management tray can be mounted after the servers are installed in the rack. The tray features tool-free thumbscrews ❶ for quick installation. Any installation that does not use the tray must include proper measures to relieve strain on connectors and provide the appropriate amount of unrestricted airspace required by the Compaq ProLiant DL360 server for thermal dissipation.
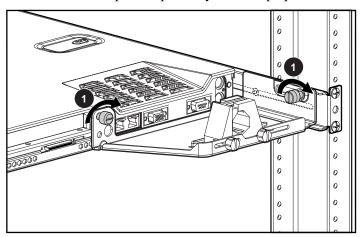

Figure 11: Compaq Third-Party Rack Option Kit Cable Management Tray

Appendix A: Unit Identification

In an ultra-dense server deployment, properly identifying a server requiring service can be difficult. The Compaq ProLiant DL360 server includes special LEDs that identify servers requiring service.

Compaq ProLiant DL360 server Unit Identification (UID) features on both the front and rear of the server simplify server identification in deployments of ultra-dense servers. The faceplate LED and switch are easy to locate. The rear UID is an integrated LED and switch.

Figure 12: Unit Identification (UID) LEDs and switches on the Compaq ProLiant DL360 server

❶ **Faceplate LED** ❷ **Faceplate UID Switch**

❸ **Integrated Rear LED and Switch**

When the UID switch is on, the blue LEDs illuminate on the front and back of the server, marking it as targeted for service. This front-and-rear feature reduces the risk of disconnecting cables from the wrong server. Front and rear NIC link and NIC activity LEDs also help to identify servers requiring service.

Appendix B: Compaq Rack Builder Pro

The Compaq Rack Builder Pro 2.5 or later is a rack configuration tool for planning the overall installation. Compaq Rack Builder Pro 2.5 or later can be adapted for use in planning installations that do not use Compaq Racks.

Compaq Rack Builder Pro is intelligent Windows-based software that allows quick prototyping of a rack configuration. Compaq Rack Builder Pro also assists with safety issues, such as component placement, power requirements, and cooling.

Compaq Rack Builder Pro 2.5 or later can be downloaded from the Compaq website at

www.compaq.com/support/files/server/softpaqs/Rompaq/RackBuilpro.html

Although the program is designed to build Compaq rack solutions, you can adapt the program for third-party equipment. For rack heights other than 42U, calculate the difference in height between the rack and 42U, and create a dummy component to fill that extra space. (Leave the component weight at zero, the default, so that the dummy component fills extra space at the top of the rack.)

Add the projected components to the virtual racks. Compaq Rack Builder Pro will automatically provide suggested placement based on predefined placement rules. The program will also generate a report that provides all of the pertinent planning data, such as power requirements and heat dissipation.

Figure 13: Screen captures from Compaq Rack Builder Pro 2.5

Appendix C: Monitors, Keyboards, and Console Switches

Additional information about Compaq Storage Division products is available on the Compaq website:

http://www.compaq.com/storage/index.html

15-inch Flat Panel Monitor (TFT5000R)

Figure 14: 15-inch Flat Panel Monitor (TFT5000R)

The Compaq TFT5000R (15 inch) Flat Panel Monitor can be neatly tucked away in the rack when not in use. With its large viewable image size and exceptional screen performance, the new Flat Panel Monitor epitomizes a trend in rack-mounted products (servers, storage, UPS, and other options) that are designed to effectively use available rack space.

K1U Drawer and Internal Keyboard with Trackball

Figure 15: K1U drawer and internal keyboard with trackball

Designed to work together to save room in space-constrained rack-mount environments, the Compaq 1U Keyboard Drawer and Internal Keyboard with Trackball give corporate IT managers extraordinary convenience, reliable performance, and improved manageability.

The 1U Keyboard Drawer requires half the depth of other keyboard drawers and provides mounting options for Compaq server console switches. The Compaq Internal Keyboard and Trackball is designed to fit neatly inside the keyboard drawer and provides hardware support for the Euro currency symbol used in European Community (EC) markets.

Console Switches

Figure 16: Server console switches (KVM)

Compaq server console switches allow multiple servers in a rack to be accessed and managed by one keyboard, mouse, and monitor. Five models are available, including a 2-port, a 4-port, and three 8-port switches. Two 8-port switches provide dual user functionality, for system control by more than one user. The console switches can be cascaded to allow up to 64 servers to share one console.

Local Console Component Part Numbers

Table 4 lists the part numbers for local console components.

Table 4. Local Console Components

Description	P/N	Notes
Server Console Switch 1x8-port (1000-230VAC)	400337-B21	
	400337-291	Japan
	400337-B31	International
TFT5000R Flat Panel Monitor	120207-001	
	120207-291	Japan
	120207-B31	International
Rack Internal Trackball Keyboard - Opal	185152-186	
	185152-406	
Keyboard Tray	338-056-B21	
CPU-to-Switchbox Cable	110936-B24	3' cables
	110936-B25	6' cables