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Prepared by:  
Storage Products Group  
Compaq Computer Corporation

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# Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks

*Abstract:* The Compaq ProLiant DL360 server was developed with high volume deployments 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 telecommunications (telco) racks. This document describes deployments involving the Compaq ProLiant DL360 server and the Compaq Telco Rack Option Kit.

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

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## 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 1U server deployment, including:

- Mounting option kits for varying rack environments
- Weight and center-of-gravity considerations
- 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 a telco rack environment using the Compaq Telco Rack Option Kit (P/N: 174576-B21), and provides information on Compaq rack products and related options. For information regarding third-party racks, see the white paper, “Compaq Ultra-Dense Server Deployment in Third-party Racks,” Compaq Document Number 12CU-0400A-WWEN available at

[ftp://ftp.compaq.com/pub/products/servers/CUDS\\_Other\\_Rack.pdf](ftp://ftp.compaq.com/pub/products/servers/CUDS_Other_Rack.pdf)



**Figure 1: Deployment of ultra-dense 1U ProLiant DL360 servers in a telco 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 Telco Rack Option Kit installation guide (poster included with each kit).
- “Compaq Ultra-Dense Server Deployment Solutions Overview,” Compaq Document Number 1237-0300A-WWEN, 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.

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**WARNING:** Ensure proper floor support. Ultra-dense Compaq ProLiant DL360 server deployments, related equipment and cables may exceed 1,800 pounds.

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**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.

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

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**CAUTION:** Thermal dissipation requirements of an ultra-dense Compaq ProLiant DL360 server deployment mandate 3 inch minimum unrestricted airspace to the front and the rear of each server.

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## Telco Rack Option Kit for Compaq ProLiant DL360 Server Installation

The Compaq Telco Rack Option Kit for Compaq ProLiant DL360 servers provides a complete mounting solution that adapts to a variety of telco racks. The telco rack rails adjust to accommodate telco rack frame thickness from 2 inches to 5.375 inches.

### Kit Contents

The installation kit includes a set of adjustable rack rails that attach to telco racks using fasteners included in the kit. The rack rails mate to optional server rails that replace the standard rails pre-installed on the Compaq ProLiant DL360 server.

The Compaq Telco Rack Option Kit comes with a detailed installation guide. Consult the Installation Guide for details on adapting the option kit to your telco rack.

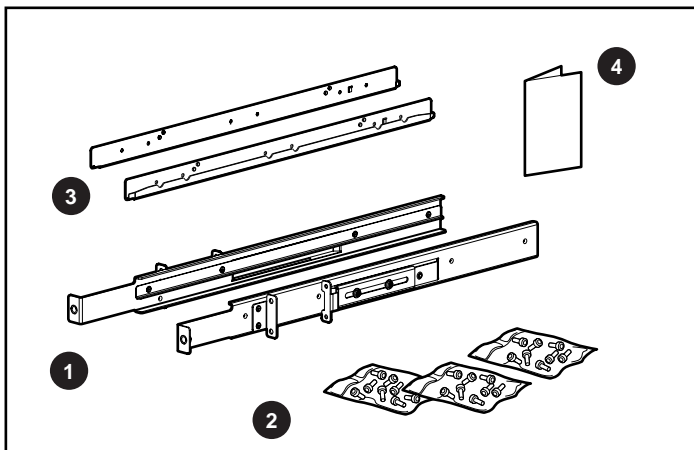


Figure 2: The ProLiant DL360 server Telco Rack Option Kit

- |   |                       |   |                    |
|---|-----------------------|---|--------------------|
| ① | Rack Rails            | ② | Fasteners          |
| ③ | Optional Server Rails | ④ | Installation Guide |

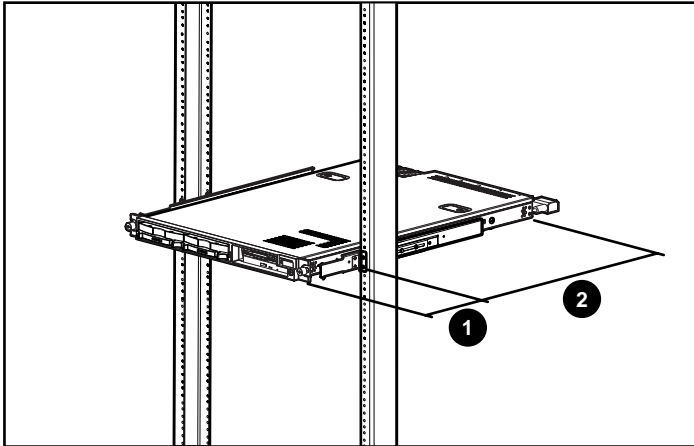
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**Note:** The Compaq Telco Rack Option Kit is for fixed rail installation. Although the Compaq ProLiant DL360 server slides in for installation, remove the server from the rack for service.

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## Cantilever Design

The Compaq ProLiant DL360 server is 25 inches in depth. When properly installed using the Compaq Telco Rack Option Kit, the Compaq ProLiant DL360 server extends 5.625 inches in front **1**, and 19.375 inches to the rear **2** of the front telco rack attachment point.



**Figure 3: Cantilever specifications for the Compaq ProLiant DL360 server Telco Rack Option Kit**

The Compaq Telco Rack Option Kit rack rails support the server, distributing the load. This cantilever design balances the installation much better than a full cantilever design. The balanced cantilever installation is robust, without blocking access to other front panel mount equipment in the rack.

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**WARNING:** The center of gravity of a fully configured Compaq ProLiant DL360 server installed using the Compaq Telco Rack Option Kit is slightly behind the telco rails. The telco rack must be fully secured to adequate support structures for deployments of ultra-dense 1U Compaq ProLiant DL360 Servers.

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# Compaq ProLiant DL360 Server Specifications for Deployment

Compaq ProLiant DL360 server specifications for telco racks include:

- Weight
- Dimensions
- Power consumption
- Thermal dissipation

## Weight

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

- Two Wide Ultra2 hard disk drives
- A Remote Insight Lights-Out Edition
- Factory installed server rails

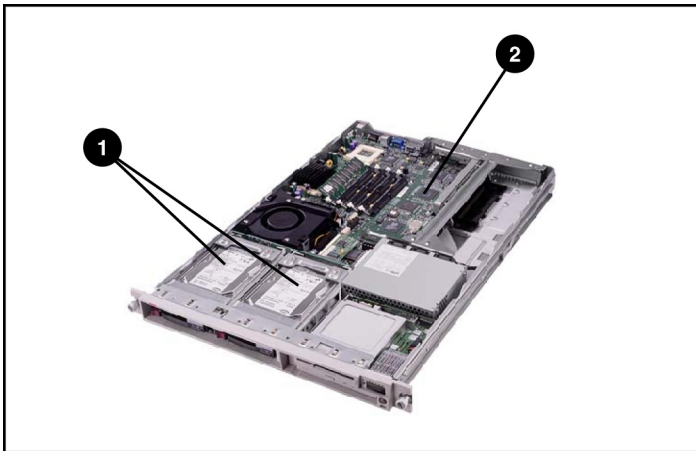


Figure 4: Fully configured ProLiant DL360 server

- ❶ Wide Ultra2 hard disk drives
- ❷ Remote Insight Lights-Out Edition

Table 1 lists the weights of components used in deployments of ultra-dense Compaq ProLiant DL360 servers in telco racks.

**Table 1. Deployment Component Weights for Calculation**

Item	Weight (lb)
Wide Ultra2 hard disk drive	1.9
Remote Insight Lights-Out Edition	0.5
Telco Rack Option Kit rack rails (set)	1.7
KVM Cable Bundle	1.42
High Voltage Y Power Cable	1
Server Console Switch	5.25

Do not exceed the specified weight limit for the telco rack. When creating deployments of ultra-dense Compaq ProLiant DL360 servers in a telco rack, include the weight of the rack rails and cables whose load bears on the rack.

If the Compaq ProLiant DL360 servers do not include hard disk drives or Remote Insight Lights-Out Edition boards, subtract those components from the weight totals.

### **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 and cables.

Each installed Compaq Telco Rack Option Kit bracket set weighs 1.7 pounds. Forty-two mounting rack rail sets will add at least 70 pounds.

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**WARNING:** External cable weight contributes to the overall weight of the rack installation and can greatly affect center of gravity in telco rack installations. Because cable installation and load-bearing design varies greatly, carefully consider cable weight in all designs.

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### **Floor**

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



## Dimensions

Compaq designed the Compaq Telco 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 Telco Rack Option Kit. When designing deployments of ultra-dense servers in telco racks, include the minimum airspace requirements for the server.

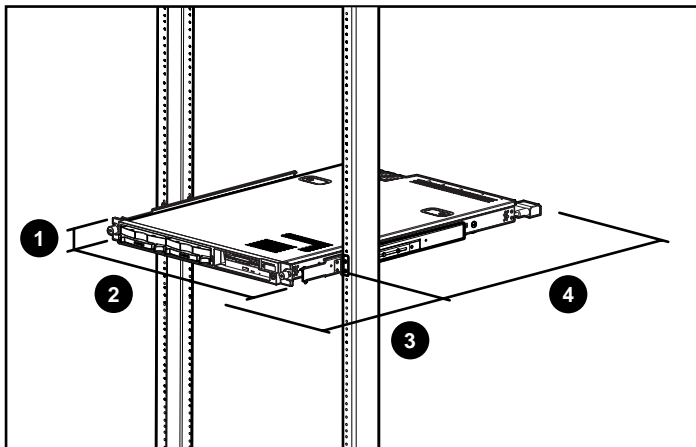
**IMPORTANT:** Any installation of Compaq ProLiant DL360 servers will require 3 inches airspace front and back.

**Table 2. Minimum space requirements for each ProLiant DL360 server installed using Compaq Telco Rack Option Kit**

Dimension	Measurement
① Height	1.75 inches (1U)
② Width	17.72 inches
③ Unrestricted airspace measured forward from front of telco rack <sup>1</sup>	8.65 inches (5.65 inches cantilever space, plus 3 inches of airspace for thermal dissipation)
④ Unrestricted airspace measured rearward from front of telco rack <sup>2</sup>	22 inches (19 inches cantilever space, plus 3 inches of airspace for thermal dissipation)

**Note 1:** The minimum space requirements above do not include the spatial requirements for sliding the ProLiant DL360 server onto the rack rails. This installation procedure requires at least 27 inches, measured forward from the front of the telco rack.

**Note 2:** The minimum space requirements above do not include the recommended spatial requirements for cable installation and service procedures. Compaq recommends at least 8 inches for cable attachment and service procedures, measured from the back of the installed server.



**Figure 5: ProLiant DL360 server minimum space requirements**

## Power Consumption

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

- Using 110V AC power, a fully loaded system can draw up to 2.66A.
- Using 208V AC power, a fully loaded system can draw up to 1.41A.

Deployments of ultra-dense servers represent a significant power requirement. A simple formula to calculate Compaq ProLiant DL360 server power requirements for your installation is:

$$(\text{number of ProLiant DL360 servers}) * (292\text{W}) = \text{maximum power requirements for servers}$$

Plan the installation to provide for adequate power distribution and backup. In high voltage installations, Compaq also offers a Y-shaped power cable to simplify power distribution wiring by powering two servers from each outlet.

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**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's wiring and installation requirements.

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

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## 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 can 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; 42 Compaq ProLiant DL360 servers under maximum workload can generate as much as 42,000 BTU/hr.

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

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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 6) to allow for proper ventilation, but additional environmental measures may be required for your installation.

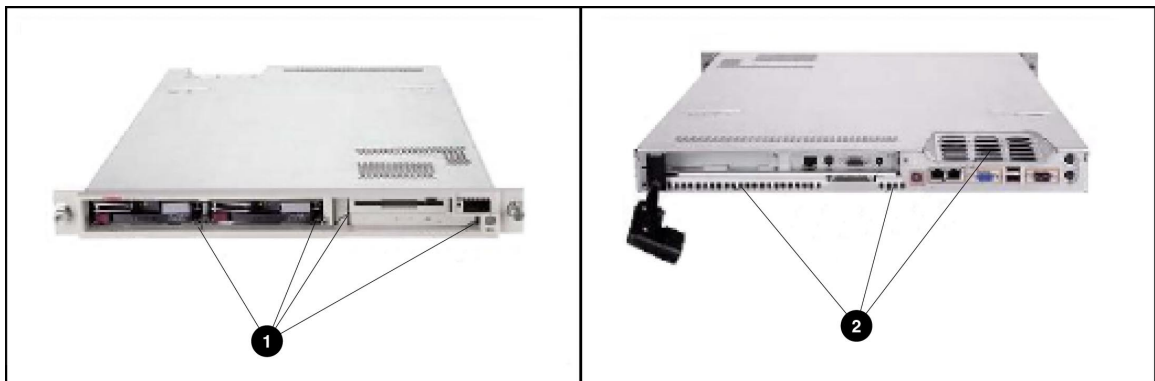
Even when installed in an ultra-dense 1U server deployment, air flow is sufficient to cool the Compaq ProLiant DL360 server if the following criteria are met:

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.

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**Note:** Cabling must not restrict airflow. Ensure airflow exiting the server's exhaust vents is unrestricted (see Figure 6).

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**Figure 6: Intake and Exhaust vents for the Compaq ProLiant DL360 server**

❶ Intake vents

❷ Exhaust vents

## Installation Procedures for Telco Racks

Adapt the following procedures to create deployments of ultra-dense Compaq ProLiant DL360 servers in a telco rack.

### Installing the Compaq Telco Rack Option Kit Rack Rails

Install all rack rails to the telco frame before installing any servers. The rack rail mounting brackets adjust from 3 inches to 5 inches to accommodate varying telco frame thickness. The adjustment screws require a #15 Torx driver or sloithead screwdriver.



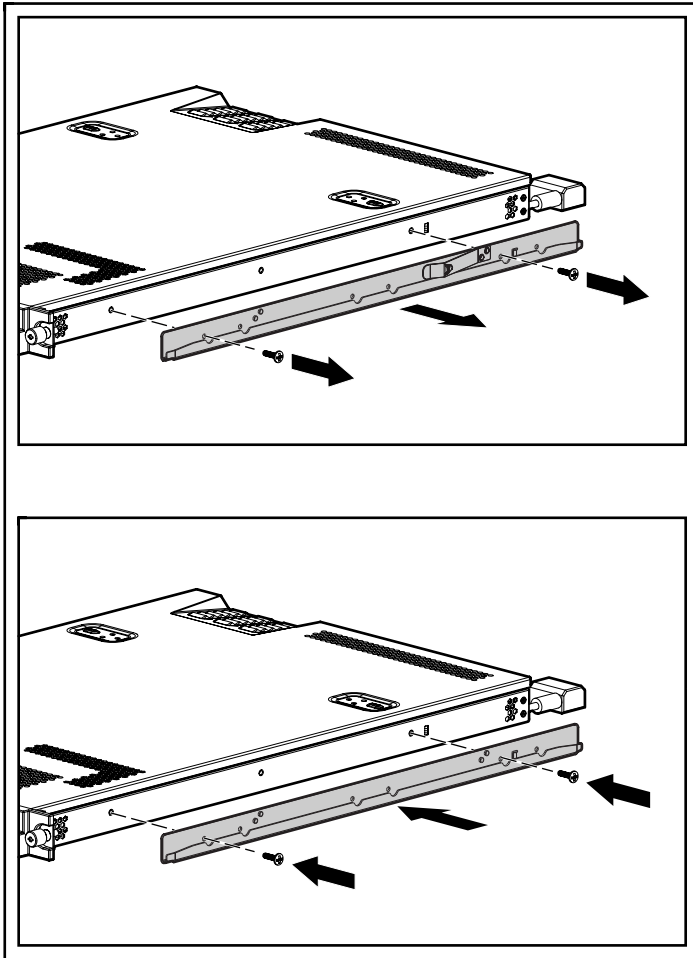
**Figure 7: Bracket mount adjustment screws on the Compaq Telco Rack Option Kit rack rails**

Refer to the *Compaq Telco Rack Option Kit installation guide* for complete instructions.

## 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.

Compaq ProLiant DL360 servers ship with standard server rails attached. These rails must be removed and replaced with the optional server rails included in the Telco Rack Option Kit.



**Figure 8: Removing the standard server rails on the Compaq ProLiant DL360 server and installing the server rails from the Telco Rack Option Kit**

## Installing Compaq ProLiant DL360 servers in the Rack

After installing all the rack rails, start installing servers at the bottom of the rack and work upward. Slide the first server into the bottom set of rack rails. Secure the server to the rack rail nut using the thumbscrews attached to the server faceplate.

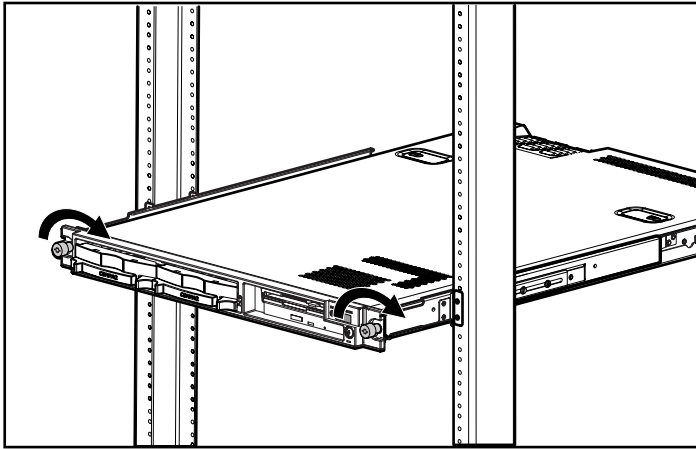


Figure 9: Using the thumbscrews to secure the Compaq ProLiant DL360 server to the telco rack rail

## Console Management Choices and Cabling for Ultra-Dense Server Deployment

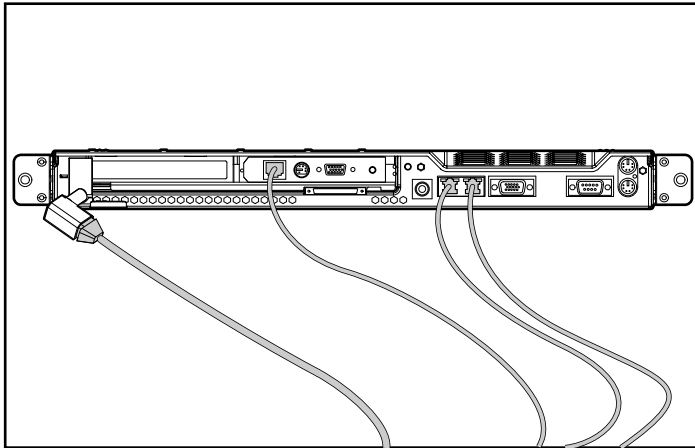
The console management scheme determines cabling design and management.

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

- Use of remote management option boards, such as the Remote Insight Lights-Out Edition, in each server.
- Use of rack space to house 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 to eliminate loop-back cabling for the keyboard, mouse, and video.



**Figure 10: Typical wiring using the Remote Insight Lights-Out Edition board**

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.

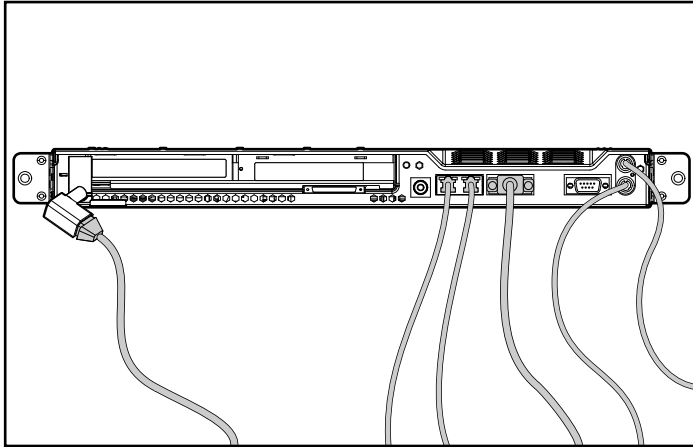
For additional information on remote management options, consult the Compaq website:

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

## Local Console

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.

Typical wiring for a Compaq ProLiant DL360 server includes the server power cord, the two CAT5 cables to the redundant server NICs, the video cable, the keyboard cable, and the mouse cable.



**Figure 11: Typical wiring for a local console**



## Cabling

Cabling will vary based on your I/O options. The Compaq ProLiant DL360 server ships with a 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 at

[www.compaq.com/proliant/ultrathin](http://www.compaq.com/proliant/ultrathin)

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

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

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Figure 12 shows a typical local console rack configuration for a 42U rack. A single K1U 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.

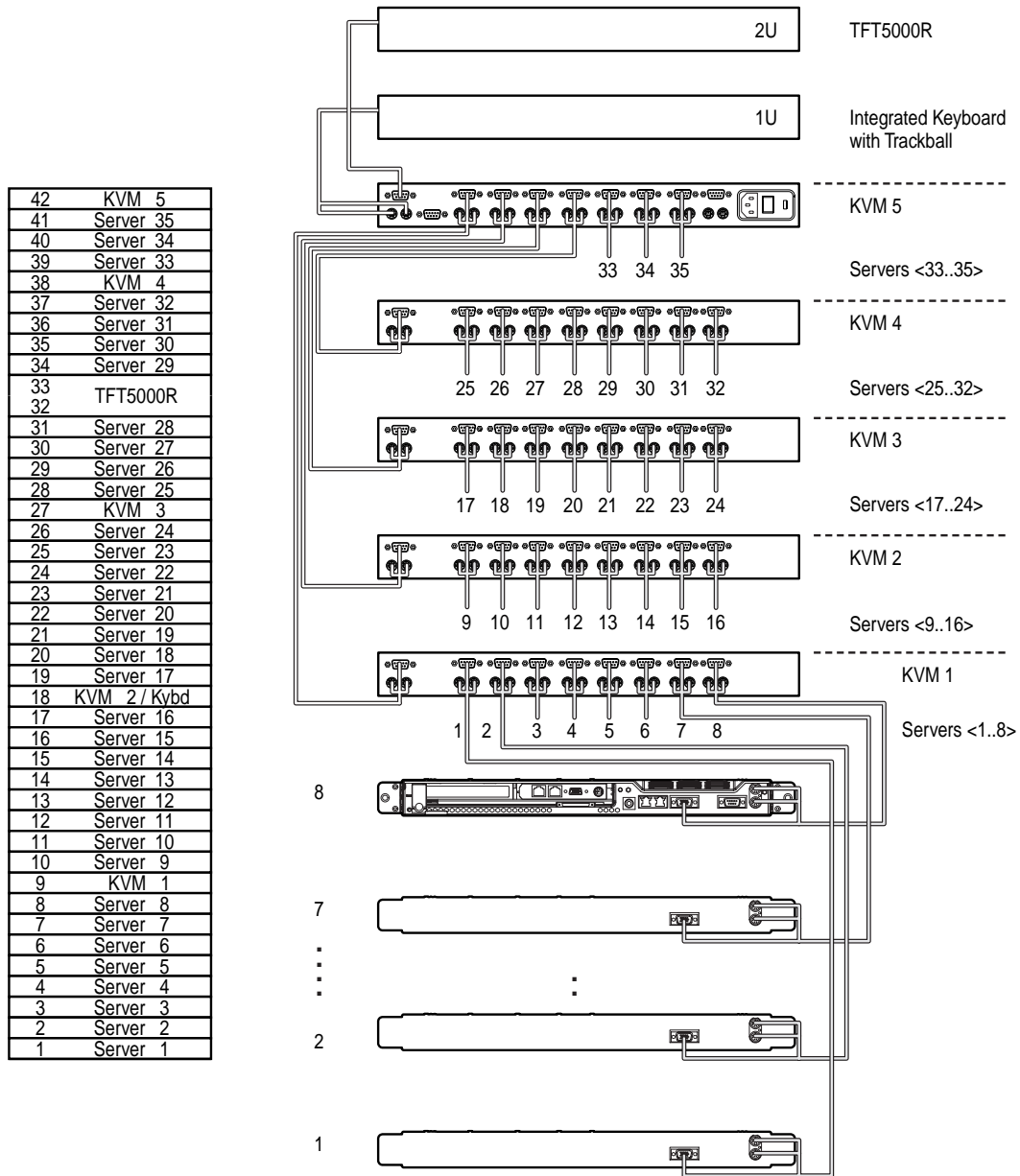


Figure 12: Typical KVM and cascading console switch solution for 35 Compaq ProLiant DL360 Servers

## 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 13: Unit Identification (UID) LEDs and switches on the Compaq ProLiant DL360 server

- ① Faceplate LED
- ② Faceplate UID Switch
- ③ 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. The utility can be downloaded from the Compaq website:

[www.compaq.com/support/files/server/softpaqs/Rompaq/RackBuilpro.html](http://www.compaq.com/support/files/server/softpaqs/Rompaq/RackBuilpro.html)

Compaq Rack Builder Pro is intelligent Windows-based software that allows quick prototyping of a rack configuration. Compaq Rack Builder Pro 2.5 or later assists with safety issues, such as component placement, power requirements, and cooling.

Although the program is designed to build Compaq rack solutions, the program can be adapted 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 14: 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 at

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

### 15-inch Flat Panel Monitor (TFT5000R)



Figure 15: 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) designed to effectively use available rack space.

### K1U Drawer and Internal Keyboard with Trackball



Figure 16: 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 17: Server Console Switch**

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 3 lists the part numbers for local console components.

**Table 3. 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