industry standard servers

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technical white paper

hp ProLiant DL320 generation 2 server high-density deployment

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abstract

This white paper is intended for use as a planning guide to expedite the concentrated deployment of several HP ProLiant DL320 Generation 2 servers. Use this white paper in conjunction with other documents for the ProLiant DL320 Generation 2 server and Compaq branded rack deployment products. This paper is intended for Field Systems Engineers (FSEs) and customers (IT managers, system managers, account managers, and installers).

executive summary

Many business enterprises and service providers use network infrastructure and web applications that work best on dedicated servers. This creates the need to fit a large number of smaller servers into existing server rooms and data centers. HP meets this need with the density-optimized line of ProLiant servers, such as the ProLiant DL320 Generation 2 server. At a height of 1U each, up to 42 servers can fit in a single Compaq branded 42U rack. While this server has clear space saving benefits, its compressed size presents new challenges for rapid server deployment, as well as cable management and environmental considerations.

HP engineers have developed innovations in rapid high-volume deployment and improved cable management for large installations of ProLiant DL320 Generation 2 servers. This white paper introduces planning, power and thermal considerations, server and rack requirements, and installation configurations. It also outlines the products associated with high-volume deployment in Compaq branded rack configurations, such as keyboard, video, and mouse infrastructure.

IMPORTANT: This document principally discusses the ProLiant DL320 Generation 2 server, the Compaq branded 7000-, 9000-, and 10000-series racks and related Compaq branded rack options. This document does not discuss other servers, products, or racks not manufactured by HP.

general guidelines

Power, thermal, and weight are the most important considerations for optimizing a hardware installation in high-volume server environments.

HP designed the dense ProLiant DL320 Generation 2 server to meet the challenges associated with deploying a high concentration of servers in a single rack. HP suggests that customers evaluate their environments, power distribution, console, cable, and thermal management choices well in advance to ensure efficient deployments.

All discussions of power requirements for this server are based on the input power of the server. This document uses the maximum rated power supply input of 180 W for calculation purposes. However, derating the input power might be effective to help:

- Minimize the number of PDUs required for each rack.
- Match the rack current requirements with the existing circuit breaker capacity.
- Match the rack cooling requirements with the existing facility cooling capability.

IMPORTANT: In this document, derating the input power budget means using less than the maximum rated input power values for the power supply. **HP strongly recommends using the installation planner to ensure that the derated power budget will satisfy all the installation requirements, including future upgrade plans.**

Refer to the *HP ProLiant DL320 Generation 2 Server QuickSpecs* for detailed specifications and options for this server.

power and thermal budgeting

accounting for server input power

Note: In this document, derating the input power budget means not using the maximum rated input power values for the power supply. **HP strongly recommends using the installation planner to ensure that the derated power budget will satisfy all the installation requirements, including future upgrade plans.**

All power requirement discussions in this document are based on the input power of the server, since this number has direct impact in planning for the PDU selection and the facility power source. One of the following methods can be used to account for input power in the facility power distribution planning:

- Use the maximum rated input power of 277 W.
- Use the derated input power, which can be calculated by subtracting the power budgets of uninstalled optional components from the rated input power.
- Use the allocated input power, which can be calculated by dividing the maximum power of a PDU by the number of servers. This calculated power should be at least 250 W to support all the optional components initially released with the server.

The power budgets of optional components, referred to in the following sections, were derived from the system input power of a set of selectively measured server configurations. These configurations measured range from a basic low-end configuration to a fully populated high-end configuration. Since the input power values used in an installation might vary depending on the software applications, the information provided in this section should be used as a guideline only.

The server power supply is designed to support future upgrades of processors, DIMMs, and hard drives. As such, the power supply **output power** is rated at 180 W. Assuming the power supply efficiency of 65 percent (including the Power Factor Correction), the power supply **input power** is rated at 277 W. This input power value may be used in planning for the power source implementation and facility cooling requirements. In some cases the input power requirement for each server might be desired to be lower than 277 W.

The input power requirement might be lowered in the following instances:

- To minimize the number of PDUs, that is, the number of facility power feed lines, required for each rack.
- To match the rack current requirements with the existing facility branch circuit breakers.
- To match the rack cooling requirements with the existing facility environment.

Table 1 demonstrates how significant reduction in input current and thermal dissipation can be realized, if a deployment plan can limit each server configuration over the useful lifetime of a rack configuration.

Table 1. Derated Current and Thermal Dissipation for Reduced Input Power Assumptions

Input Power	Derated		Fully Rated
	120 W	250 W	277 W
Input Current at 110 VAC	1.09 A	2.27 A	2.52 A
Input Current at 208 VAC	0.57 A	1.20 A	1.33A
Thermal Dissipation	409 BTUs/hour	852 BTUs/hour	944 BTUs/hour

The derated input power values of 120 W and 250 W can be correlated with the measured input power values for the minimum and maximum configurations of the server. However, the derated input power value must be high enough to account for any future upgrades for a deployment plan.

As stated earlier, the power supply is designed to support future processor and hard drive upgrades. When installing 42 servers, the number of PDUs to be installed will depend on the support for the input current requirement. Carefully derating the input power may very well satisfy deployment needs and also reduce the number of PDUs per rack. Reducing the number of PDUs has a direct impact on the deployment time and maintenance of an installation.

DL320 generation 2 server power, thermal, and weight parameters

Table 2 provides server parameters necessary to calculate the power, thermal, and weight requirements for any number of servers.

Table 2. ProLiant DL320 Generation 2 Server Parameters

Item @	Specification
Dimensions HxWxD	
4.24x48.3x55.6 cm (1.67x19.0x21.9 in) – including bezel	
Server Weights	
Minimum Configuration: 1x processor, 1x128-MB DIMM, 1x CD/Diskette Blank, 0x HDD	19.8 lb (8.98 kg)
Standard Configuration: 1x processor, 1x128-MB DIMM, 1x HDD, 1x CD/Diskette Assembly	22.1 lb 10.02 kg)
Maximum Configuration: 1x processor, 4x DIMMs, 2x HDDs, 1x SA431, 1x CD/Diskette Assembly	24.6 lb 11.16 kg)
Component Weights	
CD/Diskette Drive Assembly	1.4 lb (0.63 kg)
DIMM	0.1 lb (0.05 kg)
HDD	1.3 lb (0.59 kg)
Remote Insight Lights-Out Edition	0.5 lb (0.23 kg)
SA5302	1.0 lb (0.45 kg)
Power Ratings	
Maximum Power Supply Rated Input AC Power	
240 V	277 W
Maximum System Measured Input AC Power	
110 V	231 W

Item	@	Specification
Maximum Power Supply Rated Input Current		
	100 VAC	2.77A
	200 VAC	1.38A
Maximum System Measured Input Current		
Maximum System Thermal Dissipation (per hour)		
		944BTUs
Relative Humidity (noncondensing)		
	Operating	10 to 90%
	Nonoperating	10 to 95%

Note: The SA5302 option is a PCI card available from HP. Any third-party PCI cards used in the server must comply with the industry-standard PCI specifications for dimension, weight, power, and thermal requirements.

input current and thermal dissipation calculations

Input power is the key in deriving input current and thermal dissipation. For a given input power, the input current will vary depending on the input voltage level.

The relationship among the current, the voltage, and the power for the power supply input is as follows:

Input Current = Input Power/Input Voltage

For example,

Input Current = 100 W/110 V = 0.91 A
Input Current = 100 W/208 V = 0.48 A

The input power of a server depends on the operational state of the system. For example, during the initial power up, a server consumes more power due to the hard drives' spin-ups. It should be noted that in the ProLiant DL320 Generation 2 server, the two hard drives spin-up one after the other. Therefore, the peak input power requirement changes significantly when the first drive is added, but not as much when the second drive is added. After the initial power up, the input power varies depending on the operating system and the application software running on the server. During standby, only the auxiliary portion of the power supply is consuming power to support operations of a very limited part of the system, for example, the Remote Insight Lights-Out Edition (RILOE) option, NICs, and so on.

Thermal dissipation can be calculated from the input power as follows:

Thermal Dissipation = Input Power * 3.41

For example,

*Thermal Dissipation = 100 W * 3.41 = 341 BTUs/hour*
*Thermal Dissipation = 292 W * 3.41 = 996 BTUs/hour*

The easiest way to calculate the thermal dissipation for the entire rack is to add the input power requirements for all the servers and other units populated in a rack, and then multiply the total input power by 3.41.

The "measured input power" section explains more on how adding or removing of an optional subsystem component affects the input power and thermal calculations.

measured input power

Table 3 lists the measured input power of the server with varying subsystem components, to illustrate the effects of adding or removing optional components.

Table 3. Measured Input Power for Selected Server Configurations

Configuration Number	ProLiant DL320 Generation 2 Server Configuration	Power Input Typical/Peak
1	1x2.26 GHz, 1x128 MB, 1xATA (base-line)	143 W/158 W
2	1x2.26 GHz, 1x128 MB, + 2x18.2 GB SCSI	148 W/168 W
3	1x2.26 GHz, 1x128 MB, 4 GB + 2xATA	165 W/191 W
4	1x2.26 GHz, 1x128 MB, 4 GB + 2x36 GB SCSI	188 W/212 W
5	1x2.26 GHz, 1x128 MB, 4 GB + 2x36 GB SCSI + 5304	209 W/231 W

Note: The peak power listed in Table 3 is of a fully configured ProLiant DL320 Generation 2 server (Configuration 4 was measured to be only about 83 percent of its rated peak input power).

Note: DIMM and HDD input power can vary depending on the component and drive manufacturer.

input power budget derating

If a deployment plan limits the future expansion beyond certain configuration options, which may be added in the future, then adjustments can be made to the expected input current and thermal requirements of the servers.

To derate the input power, start with the minimum configuration 1 from Table 2. Add the typical power of the components included in the desired system configuration to calculate the derated power budget. Typical input powers for various components are listed in Table 3.

Example

Assuming the desired server configuration is as follows; use to calculate the derated power budget using the typical power from Table 3.

Processor: 2.26 GHz

Memory: 4x128 MB

Storage: 2x18.2 GB

Smart Array Controller 5304: 1x SA5304

Table 4. Example Derating Worksheet

	Maximum Rated Input Power for the Base Configuration	Typical Power 143 W
1.	Add the typical power for the additional memory.	2 W per DIMM
2.	Add the typical power for the second HDD.	5 W
3.	Add the typical power for the PCI card	15W
	Typical power for the desired configuration	169 W
4.	Calculate the thermal dissipation.	×3.41
	Thermal dissipation for the desired configuration (in BTUs)	576 BTUs/hour

Therefore, the new power budget for this configuration is **169 W** (compared to the rated 277 W), and the thermal dissipation is approximately **576 BTUs/hour** (compared to the rated 945 BTUs/hour).

The rated input power for the server power supply is 277 W. Therefore, the power budget for a maximum configuration is **231 W**, and the thermal dissipation will be approximately 231 * 3.41 = **788 BTUs/hour**.

This derated input power budget significantly reduces the power and thermal requirements for highly populated racks, which reduces the number of PDUs for certain configurations. Fewer PDUs decreases deployment time and lowers costs. Costs for the facility electrical plumbing, data center floor ventilation, and facility air conditioning installation can also be reduced.

IMPORTANT: HP strongly recommends verifying that the derated power budget satisfies all the installation requirements, including future upgrade plans.

input power budget allocation

This section explains how to allocate the input power budget for each server. This method can be used when a PDU supports a known number of servers. It is important to verify that the calculated power budget allocation will be sufficient to support the worst-case server configurations that are to be deployed.

The allocated input power for each server is calculated by multiplying the allocated input current for each server by the line voltage.

Allocated Input Power = Allocated Input Current * Input Line Voltage

Example

Assume a high-voltage PDU rated at 24 A is to support 21 servers. Each server can be allocated 1.143 A. If the line voltage is assumed to be at 208 V, then the allocated input power budget for each server will be (1.143*208) = 238 W.

Since the input power budget of 238 W satisfies the fully configured system measured input power of 185 W (as shown in Table 3), 21 servers may be supported by a 24 A high-voltage PDU. That means only two of these PDUs are needed to support 42 servers in a 42U rack.

power distribution units

HP offers a wide range of 1U/0U PDUs, supporting both low voltage and high voltage applications. Designed especially for high volume rack deployments, HP PDUs help with cable management and power distribution within the rack. These PDUs are equipped with circuit breakers to provide short circuit and over current protection.

The Modular PDUs (mPDUs), range from 16 A to 40 A, and provide up to 32 outlets*, easy accessibility, and improved cable management. These mPDUs have a unique modular architecture that allows increased flexibility and customization. And all mounting hardware, including both the 0U and 1U mounting brackets are included in the Modular PDU kit (no additional mounting brackets need to be purchased).

In addition, HP also offers the Dual Input PDU, a fault-tolerant solution that automatically switches over to a secondary input source when the first source fails. Equipped with two input ends and a built-in AC transfer switch, this device is designed for mission critical environments where customers depend on the reliability of redundant power systems housed in their facility. The Dual Input PDUs ship with both 0U and 1U mounting brackets (no additional mounting brackets need to be purchased).

*The number of outlets vary by model, please refer to the Table 5 for more specific information. Additional information is also available at www.hp.com/products/ups

Table 5. HP PDUs

Part Number	Availability	Input Voltage	Current Rating	Maximum Servers per PDU	Input Connectors and Cord	Output Connectors	Output Breakers	Dimensions	Weight
Modular PDUs (Up to 32 outlets, 0U/1U mounting)									
252663-B24[3]	Worldwide	High	16A	10	Detachable input cord; IEC 320 C-20	16 X IEC320-C13	2 X 10 A	17.5 x 1.62 x 5.6 in (444.5 x 41.2 x 142.2mm)	18 lb (8.16 kg)
252663-D71[3]	North America, Japan	Low	24 A	8	NEMA L5-30P 12-ft cord	32 × NEMA 5-15R	4 × 15 A	17.5 x 1.62 x 5.6 in (444.5 x 41.2 x 142.2mm)	18 lb (8.16 kg)
252663-D72[3]	North America, Japan	High	24 A	16	NEMA L6-30P 12-ft cord	32 × IEC 320-C13	4 × 15 A	17.5 x 1.62 x 5.6 in (444.5 x 41.2 x 142.2mm)	18 lb (8.16 kg)
252663-B31[3]	International	High	32 A	21	NEMA L6-30P 12-ft cord	32 × IEC 320-C13	4 × 15 A	17.5 x 1.62 x 5.6 in (444.5 x 41.2 x 142.2mm)	18 lb (8.16 kg)
252663-B21[2,3]	Worldwide	High	40 A	27	Hardwired	24 × IEC 320-C13 4 × IEC 320-C19	4 × 15 A	17.5 x 1.62 x 5.6 in (444.5 x 41.2 x 142.2mm)	18 lb (8.16 kg)
Single Input PDUs (Up to 12 outlets, 0U/1U mounting)									
207590-B21[4]	Worldwide	High	16A	10	Detachable input cord; IEC 320 C-20	12 X IEC320-C13	2 X 10 A	17.0 x 1.65 x 8.0 in (431.8 x 41.9 x 203.2mm)	7 lbs (3.2 kgs)

continued

Table 5. HP PDUs *(continued)*

Part Number	Availability	Input Voltage	Current Rating	Maximum Servers per PDU	Input Connectors and Cord	Output Connectors	Output Breakers	Dimensions	Weight
Dual Input PDU (12 Outlets, built-In Transfer switch, 0U/1U mounting)									
191186-001[1]	North America	High	24 A	16	x2 NEMA L6-30P 12-ft cord	12 × IEC 320-C13	4 × 10 A	1.72 x 17 x 15.25 in (4.37 x 43.18 x 38.74cm)	20 lb (9.1 kg)
191186-B31[1]	International	High	30 A	20	x2 IEC 309-32A 12-ft cord	12 × IEC 320-C13	4 × 10 A	1.72 x 17 x 15.25 in (4.37 x 43.18 x 38.74cm)	20 lb (9.1 kg)
Note 1: This PDU supports power from two different sources. If one power source fails, the PDU uses the alternate source.									
Note 2: This PDU must be hardwired to the power source by a certified electrician.									
Note 3: This PDU is using the maximum rated power supply input and not the derated values.									
Note 3: This PDU to discontinue 1H2003.									

Figuring Type and Number of PDUs

Comment – make sure all examples use the new Modular PDUs, **252663-xxx**

The type and number of PDUs required to power a full rack of servers depends on each server's power requirement, the number of servers deployed in the rack, and the available power for the servers.

HP PDUs support both high-voltage and low-voltage applications. The input current rating for a ProLiant DL320 Generation 2 server is either 1.38 A at 200 to 240 V or 2.77 A at 100 to 120 V. To determine the number of servers supported by a PDU, divide the PDU's current rating by the server's total input current rating.

IMPORTANT: The examples shown in the following sections use the maximum rating of the power supply. They are for reference only.

Example

PDU number 295363-003 is a high-voltage PDU with a current rating of 24 A. The server has a total input current rating of 1.38 A at 200 V.

24 A (PDU current rating)/1.38 A (server total input current rating) = 17.4

PDU number 295363-003 can support a maximum of 17 servers at full server input current ratings.

For more information, refer to the "Power Distribution Unit High Voltage Models for North America and International Use, (NA CPQ # 295363-002; INT'L CPQ # 295363-B31)" website:

www.hp.com/servers/proliant/manage

Example

PDU number 295363-001/291 is a low-voltage PDU with a current rating of 24 A. The server has a total input current rating of 2.77A at 100 V.

24 A (PDU current rating)/2.77 A (server total input current rating) = 8.7

PDU number 295363-001/291 can support a maximum of 8 servers at full server input current ratings.

For more information on high-voltage PDUs, refer to the "Power Distribution Unit High-Voltage Models for North America and International Use, (NA CPQ # 295363-002; INT'L CPQ # 295363-B31)" website:

www.hp.com/servers/proliant/manage

For more information on low-voltage PDUs, refer to the "Power Distribution Unit Low-Voltage Models for North America and International Use" website:

www.hp.com/servers/proliant/manage

The HP ProLiant DL320 Generation 2 server does not support either a DC input power supply or a redundant power supply. However, the power supply for this server automatically senses input voltage level.

selecting server power cords

The appropriate server power cord to use depends on the cable management system installed in the rack. Generally, the sliding rail cable management system requires a power cord that is 1.83 m (6 ft) in length. This length provides enough slack for the power cord to route through the cable management solution.

high-voltage Y-cables

The Vertical-Mount PDU Bracket with High-Voltage Cables kit includes 11 Y-cables, each of which is 3.0 m (10 ft) long. The single-cord PDU section is 1.8 m (6 ft) long, and the dual-cord server section is 1.3 m (4 ft) long. Refer to Table 6 for part numbers.

Y-cables have a single-cord section with an IEC connector that connects to the PDU, a dividing joint in the center, and a dual-cord section with IEC connectors that connect to the servers. One Y-cable supplies power from the PDU to two servers in the standard configuration.

CAUTION: When installing server power cords into the PDUs, ensure that the load is balanced among the output circuit breakers. Do not exceed the ratings of the circuit breakers.

Table 6. HP High-Voltage Power Cables

Description	HP Part #	Description
10A IEC-to-IEC Cables Kit	142257-001 (6 ft) 142257-002 (8 ft) 142257-003 (10 ft)	The IEC-to-IEC cables can be used either as individual power cords for the server or to extend the length of the high-voltage Y-cables. The cables are available in six-, eight-, and ten-foot lengths. The ProLiant DL320 Generation 2 Server ships with one 10-ft IEC to IEC cable, part number 142257-003.

power cords

The server ships with an IEC-IEC power cord (PN 142257-002) used for rack mounting with high-voltage Power Distribution Units (PDUs). For low-voltage, stand-alone deployments or installation without a rack, country-specific power cord options are available.

U.S. and Japanese models ship with two power cords - IEC-IEC and a country-specific cord:

- Power cord, US, IEC320-C13 to IEC320-C14, 10 A 250 V, Straight (10 ft/2.5 m) (PN 142257-002)
- Power cord, US, IEC320-C13 to NEMA 5–15P, 15 A 125 V, Straight (10 ft/3 m) (PN 103541-001)

Console Management Systems

A KVM (keyboard, video, and mouse) console management Table 7 system enables a single keyboard and video console to control multiple servers. An in-rack console management system may be used to manage a single rack of servers or groups of racks. The HP IP console switch products have 16 ports that can access up to 128 servers. The HP IP Consoling Solution combines analog and digital technology to provide flexible, centralized KVM control of data center servers. This solution provides enterprise customers with a significant reduction in cable volume, secure remote access, and high-performance server KVM access. Using the IP console viewer, users can access local KVM functions from any Windows or Linux workstation by means of a 10/100 network connection. Alternatively, an off-rack console management system may also be used in the local vicinity of the servers it manages.

Table 7. Local/IP Console Management Options

Product Name	HP Part No.	Description
1x1x16 IP Console Switch	262585-B21	16-port Keyboard Video Mouse switch - provides access for 2 simultaneous user sessions (1 network session and 1 local session at a rackmounted console)
3x1x16 IP Console Switch	262586-B21	16-port Keyboard Video Mouse switch - provides access for up to 4 simultaneous user sessions (3 network sessions and 1 local session at a rackmounted console)
Interface Adapters (8 per Pack)	262587-B21	Transitions traditional keyboard/video/mouse cabling to CAT5 - one needed for each server (convenient 8-pack)
Interface Adapters (Single Pack)	262588-B21	Transitions traditional keyboard/video/mouse cabling to CAT5 - one for each server
Expansion Module	262589-B21	Enables tiering of up to 8 servers per port on the IP console switch
CAT5 Cables 3FT (4 per Pack)	263474-B21	4-pack of 3ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 6FT (8 per Pack)	263474-B22	8-pack of 6ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 12FT (8 per Pack)	263474-B23	8-pack of 12ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 20FT (4 per Pack)	263474-B24	4-pack of 20ft UTP CAT5 cables with RJ-45 connectors
CAT5 Cables 40FT (1 per Pack)	263474-B25	Single 40ft UTP CAT5 cable with RJ-45 connectors
TFT5600 Rack-Mount Keyboard and Monitor	221546-001	1U integrated keyboard and monitor.
TFT5110R Flat Panel Monitor	281683-B21	1U rack-optimized monitor (keyboard not included).
1U Integrated Keyboard with Hot Keys	257054-001	1U Form Factor

In-Rack Local IP Consoles

With an in-rack local console, all equipment, servers, switchboxes, keyboards, keyboard drawers, and video displays are installed together in the same rack. The HP switchboxes mount behind the keyboard drawer and do not consume extra U-space in the rack. Using the TFT5600RKM and an

IP console switch will consume a total of 1U to accommodate up to 128 servers. One console switchbox can support up to 16 directly attached servers with no user blocking. Up to eight servers may be tiered or cascaded on each switch port using either a legacy Compaq KVM switch or an Expansion Module; however, only one user can access tiered switches or servers connected by Expansion Modules at any one time. Critical devices requiring frequent access should be attached directly to a switch port. Server accessibility should be assessed by the IT manager prior to deployment to determine the appropriate server density per console switch.

Table 8 outlines the number of devices that fully populate a 47U, 42U or 36U rack with an in-rack local console (Figure 1).

Table 8. Device Configuration for an In-Rack Local IP Console

Device or Cable	47U Rack	42U Rack	36U Rack
ProLiant DL360/320 Generation 3 Servers	46	41	35
KVM IP Console Switches	1	1	1
Interface adapters	46	41	35
UTP CAT5 cables for KVM access	46	41	35
Expansion modules	4-16	3-16	3-16
TFT5600 RKM (integrated monitor/keyboard)	1	1	1

Each server deployed in a fully populated rack with an in-rack IP console management system requires the following accessories for successful deployment and operation:

- Interface adapter
- UTP CAT5 cable [1.8 m (6-ft) cables for sliding rail solutions].
- Universal Rack Rail (the quick deploy rail kit that ships standard with the server and comes with a cable management solution), or the option Sliding Rail Kit (with cable management solution), or optional telco rack solution, or third party rail kit.

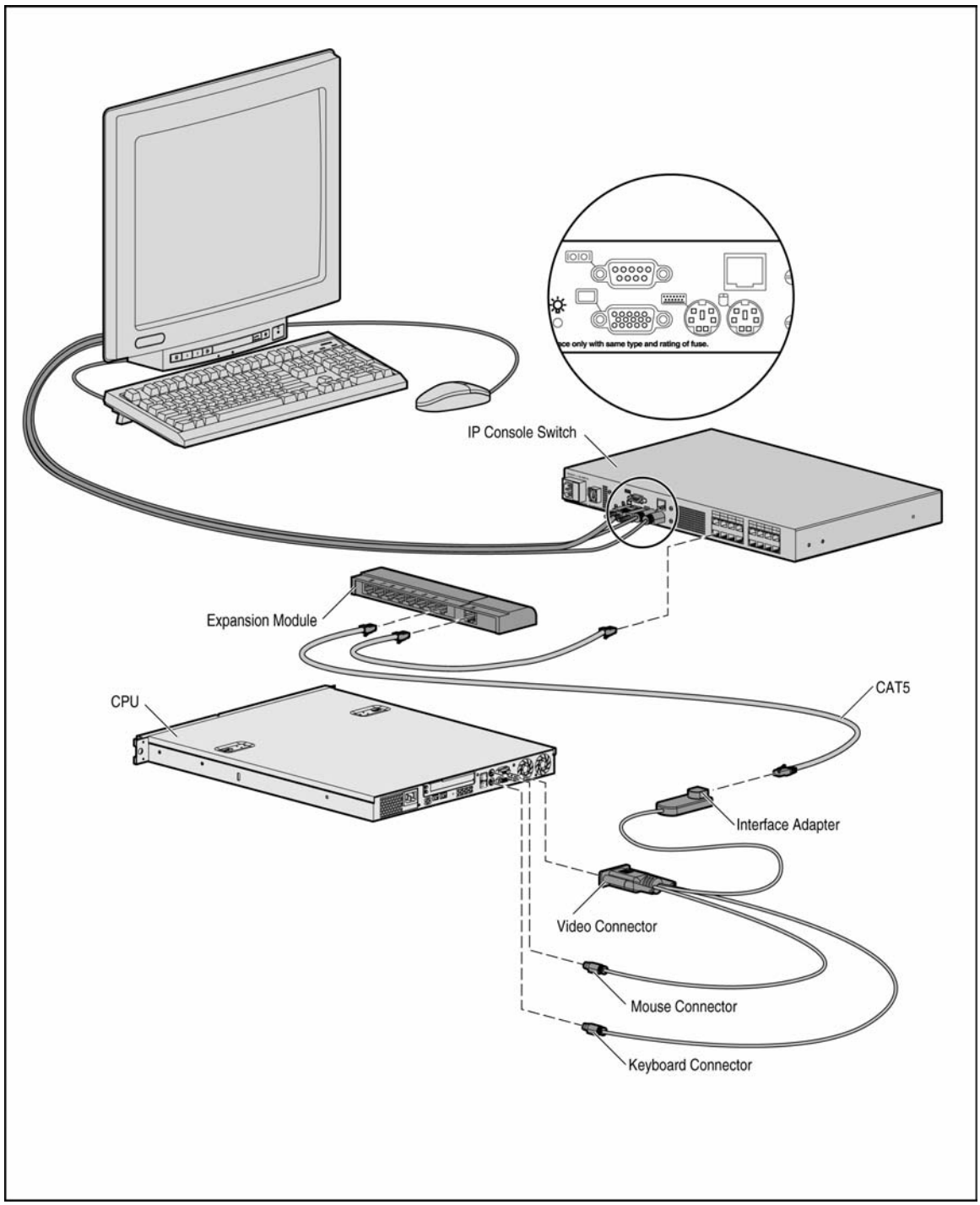

Figure 1: Console Management System

planning rack configurations

Consider several important factors when planning a rack configuration:

- The number of servers deployed in the rack

- The number of other devices such as keyboards, keyboard drawers, video displays, and console switchboxes that support the servers
- The number of PDUs and their orientation
- The type of rack
- The rack management system
- The console management system
- The remote management system
- The network interface scheme

All of these factors influence floor support requirements, future service and upgrade requirements, and installation requirements.

IMPORTANT: HP recommends populating a rack with servers and other rack option products only after the rack is in or very near its final position. HP does not recommend transporting a fully populated rack.

weight considerations

Table 9 lists the weight and power specifications for Compaq branded racks and rack option products. To calculate floor support requirements for a particular rack configuration, add the weight measurements to calculate the total weight of a rack fully populated with servers. See the following example:

1 ×	10642 rack	114 kg (253 lb)
36 ×	ProLiant DL320 Generation 2 server with hard disk drives (16 kg/37 lb each)	604 kg (1,332 lb)
36 ×	Cable management system	76 kg (168 lb)
2 ×	High-voltage PDUs with brackets	17 kg (38 lb)
18 ×	High-voltage Y-cables	9 kg (21 lb)
36 ×	Keyboard/Video/Mouse cables	27 kg (59 lb)
	Total configured rack weight	848 kg (1,871 lb)

IMPORTANT: Populate a rack with ProLiant DL320 Generation 2 servers and other rack option products only after the rack is in or very near its final position. Do not transport a fully populated rack.

Table 9. Compaq Branded Rack and Related Options Weight (and power if applicable)

Option	Note	Weight	Power
Compaq Branded Rack 10642 (42U)	Without the side panels	114.84 kg (253 lb)	
Compaq Branded Rack 9142 (42U)	Without the side panels	114.76 k (/253 lb)	
Compaq Branded Rack 9136 (36U)	Without the side panels	74.84 kg (165 lb)	
Compaq Branded Rack 7142 (42U)	Without the side panels	114.76 kg (253 lb)	
High-voltage Power Y-cable	10 ft	0.45 kg (1 lb)	
Keyboard/Video/Mouse molded cable	6 ft	0.64 kg (1.42 lb)	
High-voltage 16 A PDU		4.99 kg (11 lb)	
High-voltage 24 A PDU		4.99 kg (11 lb)	
Low-voltage 24 A PDU		4.99 kg (11 lb)	
Keyboard/trackball	With sliding tray	7.26 kg (16 lb)	
TFT5010R Flat Panel Monitor	With sliding tray	22.00 kg (48.5 lb)	45 W
TFT5600 Rack-mount keyboard and monitor	With sliding tray	6.24 kg (13.75)lb	50 W
Server Console Switch	1 x 8 port (100-230 V AC)	2.38 kg (5.25 lb)	100 W

rack builder online

HP Rack Builder Online is a tool that assists in planning and configuring new racks. It provides users with a powerful web-based tool for configuring one or many racks with HP components. Using either a simple guided interface or a “build it yourself” mode for advanced users, rack configurations are created using a complete and current database that includes all HP rack-mountable products. To access HP Rack Builder Online, see

www.compaq.com/rackbuilder

special considerations for Compaq branded racks

WARNING: Follow these guidelines to reduce the risk of personal injury or damage to the equipment:

- Do not install a server into a rack until the rack has been placed in its final location.
- Pre-install slide rails, PDUs, power cords, and cables into the rack in a build room or other location before moving the rack to its final location.
- Extend the leveling jacks to the floor and rest the full weight of the rack on the jacks before installing any servers. The casters are not designed to support the full weight of a populated rack.
- Do not attempt to move a rack populated with servers. A fully populated rack can weigh up to 848 kg (1,871 lb) pounds. Moving a populated rack can cause the rack to become unstable, resulting in serious personal injury or equipment damage.

To effectively cool the servers in a Compaq branded 7000-series rack, replace the front door of the rack with the High Air Flow Rack door. Insert before deploying the servers in the rack.

HP strongly recommends using the HP Rack Extension kit (P/N 154392-B21) to alleviate any space problems for cable bundles at the rear of a Compaq branded 7000-series racks.

rack management systems

HP recommends using the standard rack rails and cable management solution. The rack management solution installed in the rack determines the position of the PDUs installed in the rack side panels. To determine the best rack management solution, consider the service and upgrade demands of the servers deployed in the rack.

IMPORTANT: Read the *HP Ultra-Dense Server Deployment in Third-party Cabinet Racks* or the *HP Ultra-Dense Server Deployment in telco Racks* before deploying ProLiant DL320 Generation 2 servers in a third-party rack or telco rack.

optional sliding rack rails

The optional sliding rack rails and cable management solution work best with a rack of servers that are frequently serviced or upgraded. With this solution, a server can be powered down and serviced without disconnecting the server cables or removing the server from the rack.

The optional sliding rack rails and cable management solution are designed for 29-in deep, square-hole racks. The sliding rack rails compress and snap securely in place in the rack without screws or nuts.

The cable management solution attaches directly onto the rear of the server and the rear of the rack. It secures and routes the cables along the rear of the rack. This not only prevents the cables from sagging and tangling, but it also enables proper air ventilation through the rack while enabling the servers to be fully extended without disconnecting any of the server cables.

The standard rack rails and cable management solution are conducive to in-rack servicing and provide convenient access to the server cables and connectors. Refer to the *HP ProLiant DL320 Generation 2 Setup and Installation Guide* for complete installation instructions.

third-party rack cabinet solution for non-Compaq branded racks

Because not all customers use Compaq branded racks, the server design supports deployment in third-party rack cabinets. HP offers a Third-Party Rack Cabinet kit to use in installing ProLiant DL320 Generation 2 servers in third-party racks. This kit includes variable length rack rails that are compatible with a variety of third-party racks. The Third-Party Rack Cabinet kit can be installed in racks that are 610 mm (21 in) to 740 mm (29.13 in) deep.

IMPORTANT: Always install the HP Third-Party Rack Cabinet kit when deploying a ProLiant DL320 Generation 2 server in a third-party rack. The kit supports the same cable management solution that the standard fixed rack rail solution uses.

telco rack solution

Many data centers use telco racks. The server design supports deployment in telco racks. HP offers a telco rack kit for installing ProLiant DL320 Generation 2 servers in telco racks. This kit includes rack rails and screws that are compatible with a variety of telco racks. The telco rack kit includes replacement server rails designed to fit on the server. Before deploying servers into a telco rack, remove the standard server rails and replace them with the telco server rails included in the telco rack kit.

suggested rack configurations

Listed in Table 10 is a Quick Reference table with suggested rack configurations for deploying the ProLiant DL320 Generation 2 servers. Examples of these configurations are given in the "Configuration A", "Configuration B", and "Configuration C" sections of this paper.

Table 10. Suggested Rack Configurations Quick Reference

Configuration	A	B	C
Priority	**Maximum Performance Density**	**Maximum Flexibility**	**Traditionalist**
Rack Size	42U	42U	42U
Server Count	42	35	28
Power Source	High Voltage	Low Voltage	Low Voltage
Rack Level Power (derated)	9996W	8750W	7000W
PDU	2x40 Amp Modular PDU	2x40 Amp Dual Input PDU	4x24 Amp Dual Input PDU
KVM	No Local KVM Console	52x8 Port KVM Switch	
IP Connections	6x16 Port Switch (0+16) for Data	2x24 Port Switch (0+16) for Data	

configuration A: maximum performance density (42 derated servers, 24 A high voltage)

This configuration shows a "best practice" for a 42U rack with 42 servers in a high-voltage facility where a deployment plan can accommodate the derating of each server. The "power and thermal budgeting" section of this paper explains power budgeting methods and measured power for different base-line configurations and subsystem components. The following calculation verifies supporting 42 servers with 24 A high-voltage PDUs:

Since there are 2 PDUs to support 42 servers, each PDU needs to support 21 servers. A 24 A high-voltage PDU supporting 21 servers can allocate each server with a maximum current of 24/21 = 1.143 A at 208 V. Therefore, the allocated maximum input power for each server will be:

1.143 A * 208 V = 238 W

The maximum thermal dissipation per server will be:

238 W * 3.41 = 812 BTUs/hour

For 42 servers, the total thermal dissipation will be 812*42 = 34,104 BTUs/hour.

In the "power and thermal budgeting" section, a fully configured system was measured to consume lower than 250 W (Table 3, server configuration 4). If each derated server configuration input power is lower than 238 W, then 42 servers can be supported with this configuration summary.

Table 11. Configuration A Summary

Configuration A Summary		
Rack Contents		
Units		
42 Servers with all fixed or all sliding rails with cable trays		
2 High Voltage 24 A PDUs vertically mounted in the side panel compartments		
Internal Cables		
22 Y-Power cords going to 2 PDUs in the side panels		
Cables External to Rack		
42 Management network cables from the optional RILOE RJ-45 connectors to external switches		
42 Data network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server		
2 Input power cords from the rack to external power outlets		
Site Utility Requirements (worst-case)		
Power: 2 Dedicated 200 V-240 V 30 A branch circuits.		
Thermal: Up to 34,100 BTUs/hour [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]		
Weight: Up to 1,665 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]		
Configuration A Parts List	**Qty.**	**Notes**
ProLiant DL320 Generation 2 Sliding Rail Option Kit, P/N 233274-B21	42	Optional for in-rack servicing
High Voltage 24 A PDU Option, P/N 207590-D72	2	N.A.
Vertical-Mount PDU Bracket Kit with High Voltage Cables, P/N 191265-B21	2	Contains 4 PDU brackets and 11 Y-power cords

The optional HP Remote Insight Lights-Out Edition II is recommended for all console management, local and remote, for this configuration. The network cables originating from each server connect to network switches outside this rack enclosure. This configuration still accommodates a "walk-up" local console, whereby a person can walk up to the rear of the rack and plug in a set of KVM cables to any server rear panel in the rack.

Note: This list does not include the rack, the servers and the network cables. At this time, only one model of the high current (24 A) high-voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed.

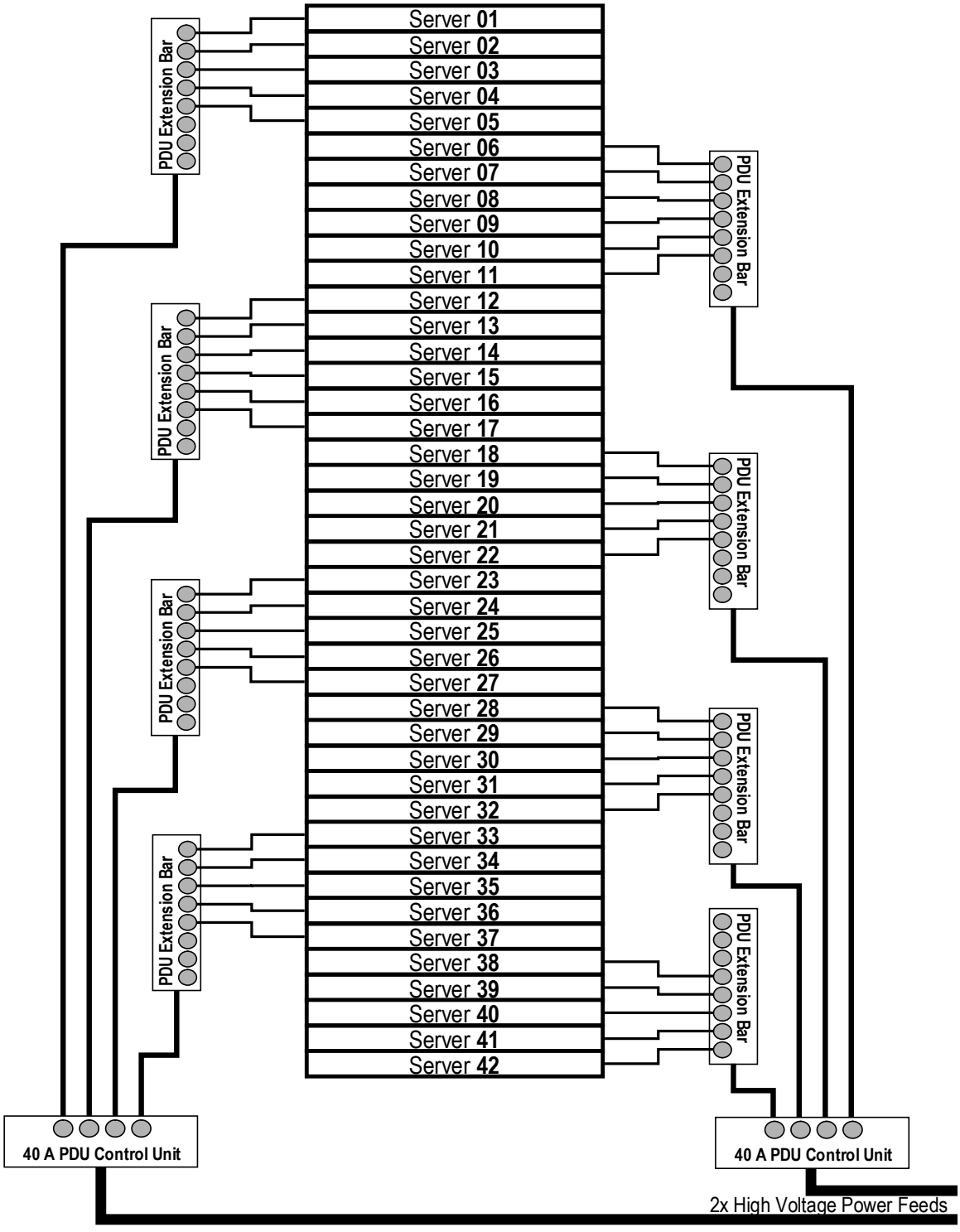

Figure 2. Configuration A (Maximum Performance Density) Power Diagram

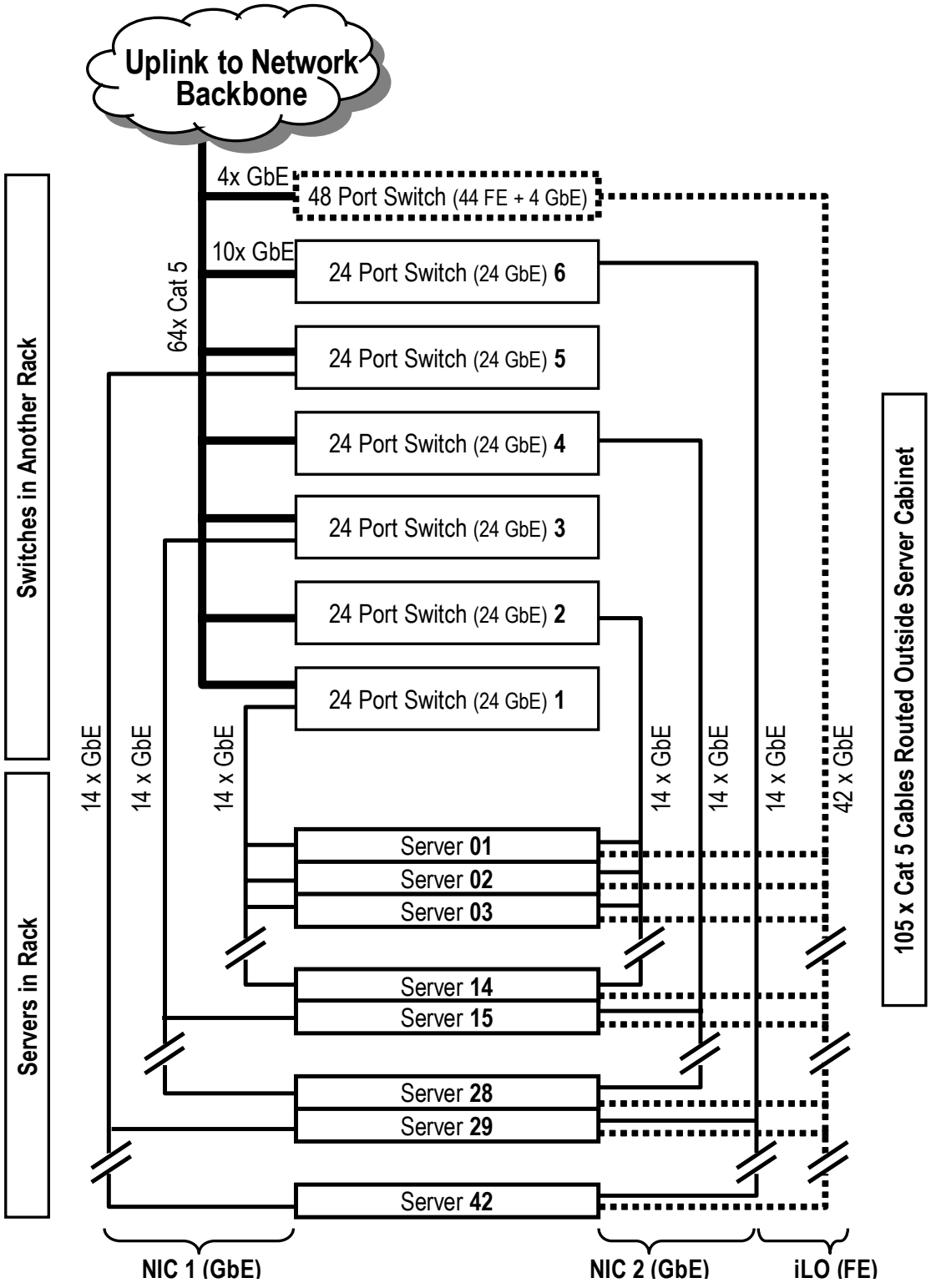

Figure 3. Configuration A (Maximum Performance Density) Ethernet Cable Diagram

Note: There are no KVM Switches used in Configuration A. The Integrated Lights-Out Advanced Pack handles all of the local consoles. See Figure 2 for the Ethernet Cable Diagram.

configuration B: maximum flexibility (35 derated servers, low voltage)

The following calculation verifies supporting 35 servers (derated power budget) with 24 A high-voltage PDUs:

Since there are 4 PDUs supporting 35 servers, each PDU will need to support up to 9 servers. A 24 A low-voltage PDU supporting 9 servers can allocate each server with maximum current of 24/9 = 2.67 A. Assuming 110 V, the allocated maximum input power for each server will be:

2.67 A * 110 V = 293.7 W

The maximum thermal dissipation per server will be:

293.7 W * 3.41 = 1002 BTUs/hour

For 42 servers, the total thermal dissipation will be 1002*35= 35,070 BTUs/hour.

In the "power and thermal budgeting" section, a fully configured system was measured to consume lower than 250 W (Table 3, server configuration 4). Since the derated server configuration input power is lower than 293 W, then 35 servers can be supported with this configuration summary.

Table 12. Configuration B Summary

Configuration B Summary		
Rack Contents		
Units		
35 Servers with all fixed or all sliding rails with cable trays		
4 low voltage 24 A PDUs vertically mounted in the side panel compartments		
Internal Cables		
42 Power cords going to 4 PDUs in the side panels [These cables are supplied with the servers.]		
Cables External to Rack		
42 Management network cables from the optional RILOE RJ-45 connector to external switches		
42 Data network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server		
4 Input power cords from the rack to external power outlets		
Site Utility Requirements (worst-case)		
Power: 4 Dedicated 100 V-120 V 30 A branch circuits.		
Thermal: Up to 35,070 BTUs/hour [This number is a worst-case. The actual BTUs/hour will depend on the operating system/application software running and the server hardware configurations.]		
Weight: Up to 1,690 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]		
Configuration B Parts List	**Qty.**	**Notes**
ProLiant DL320 Generation 2 Sliding Rail Option Kit, P/N 233274-B21	36	Optional for in-rack servicing
Low Voltage 24 A PDU Option, P/N 207590-D71	4	N.A.
Vertical-Mount PDU Bracket Kit, P/N 191265-B21	1	Contains 8 PDU brackets

Note: This list does not include the rack, the servers and the network cables. At this time, only one model of the high current (24 A) High Voltage PDU is available. This configuration can be used in regions where NEMA electrical standards are followed.

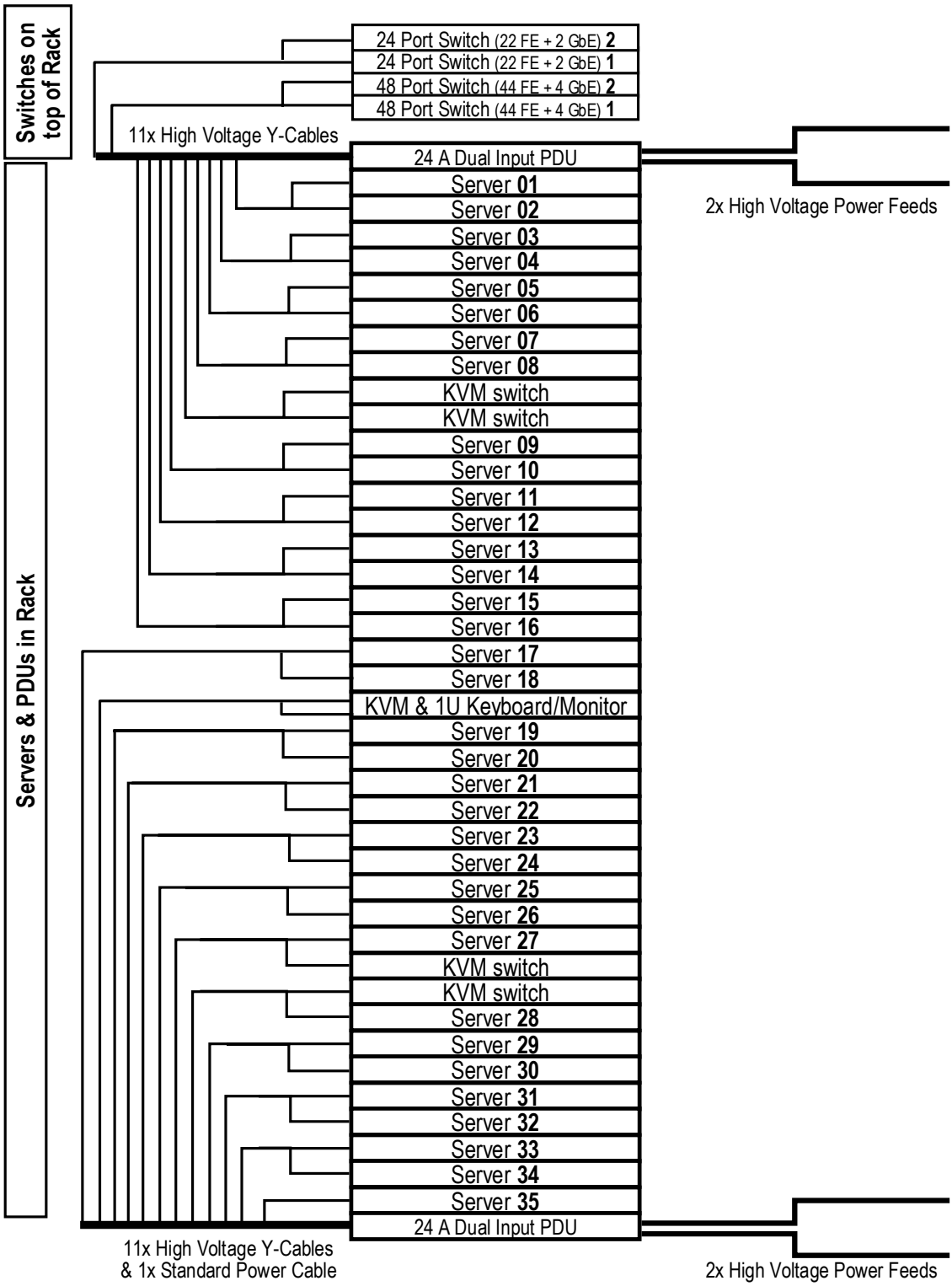

Figure 4. Configuration B (Maximum Flexibility) Power Diagram

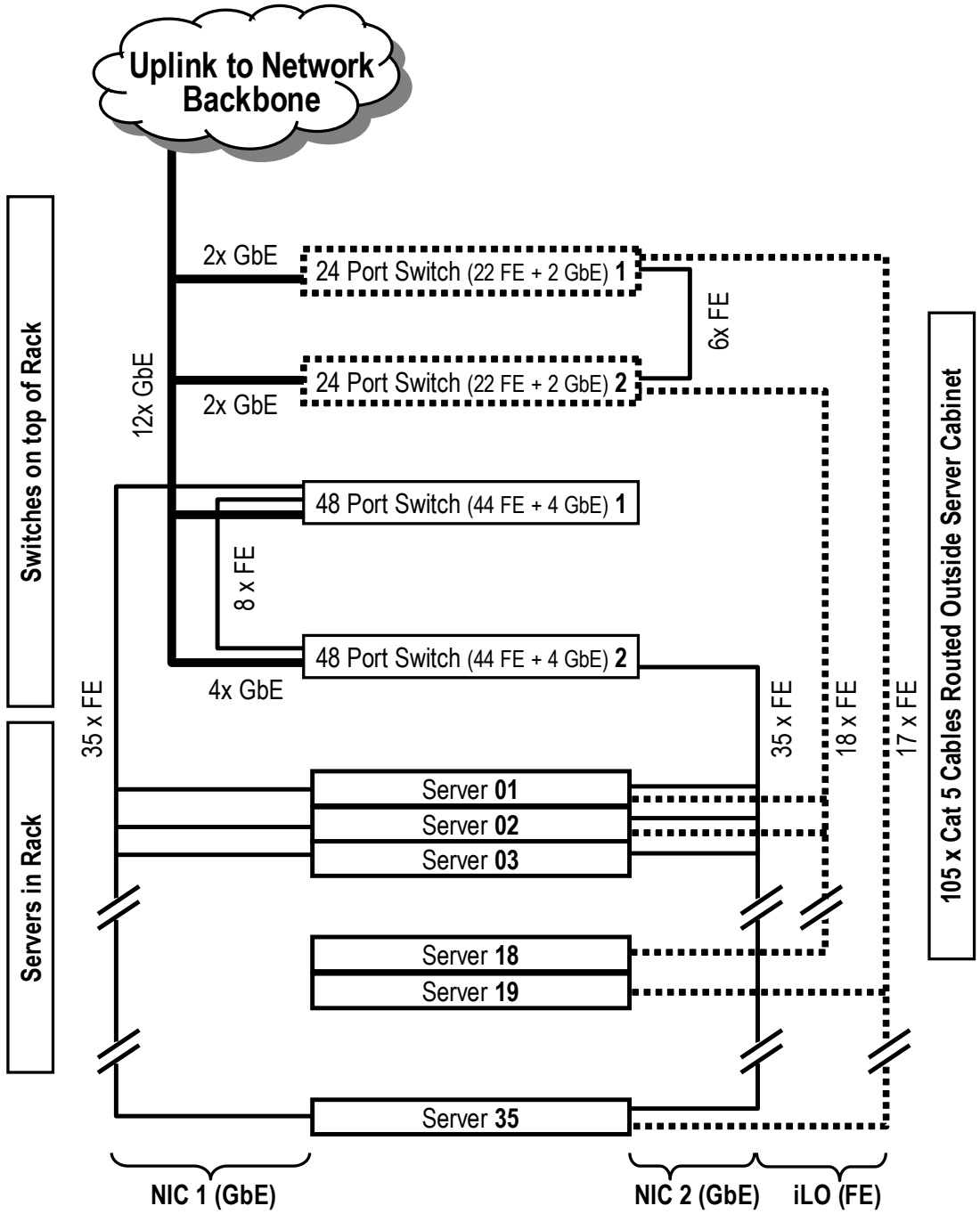

Figure 5. Configuration B (Maximum Flexibility) Ethernet Cable Diagram

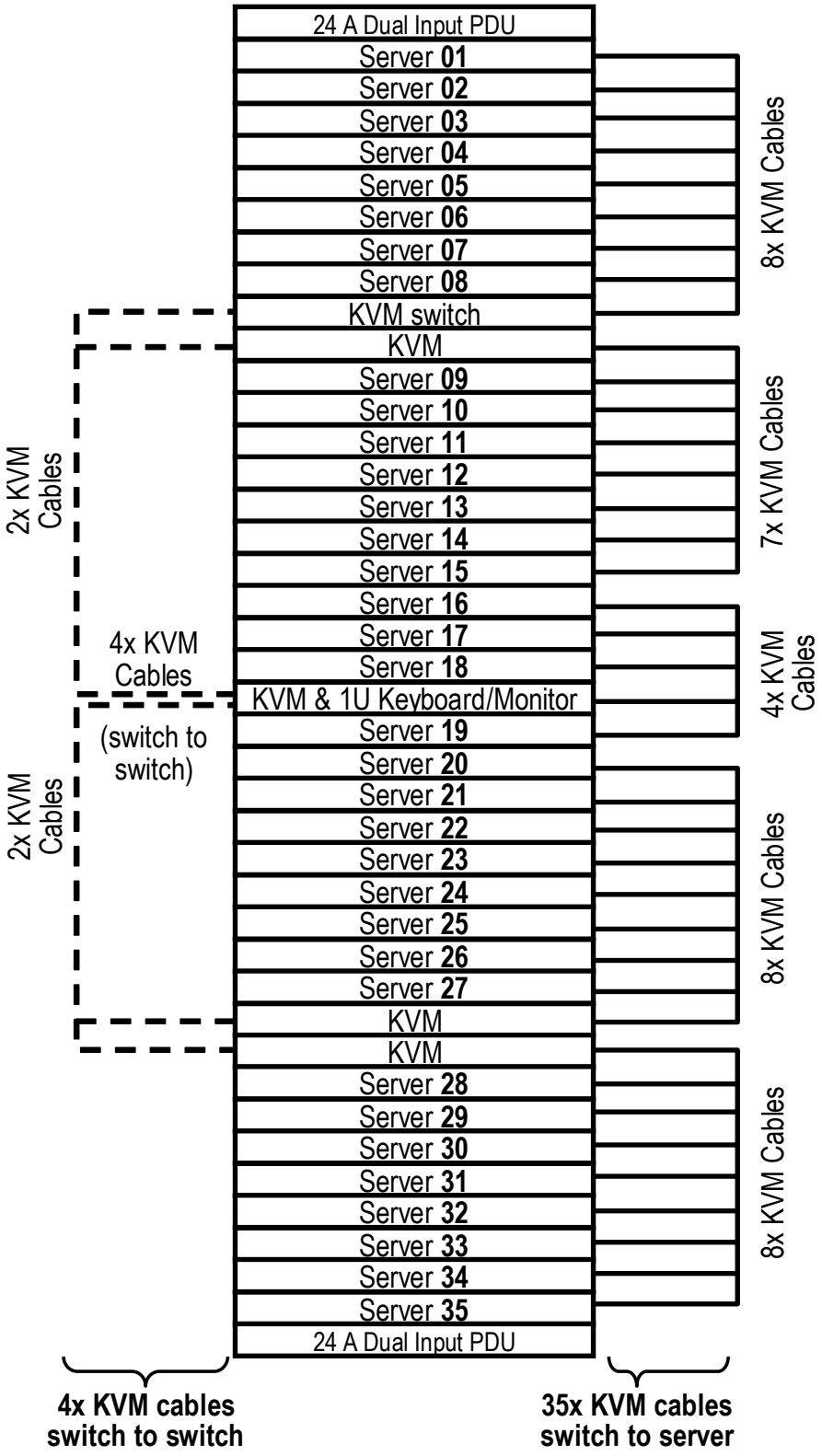

Figure 6. Configuration B (Maximum Flexibility) KVM Diagram

configuration C: traditionalist (28 servers, 24 A low voltage)

The following calculation verifies supporting 28 servers (derated power budget) with 24 A low-voltage PDUs:

Since there are 4 PDUs supporting 28 servers, each PDU will need to support up to 7 servers. A 24 A low-voltage PDU supporting 7 servers can allocate each server with maximum current of 24/7 = 3.43 A. Assuming 110 V, the allocated maximum input power for each server will be:

3.43 A * 110 V = 377 W

The maximum thermal dissipation per server will be:

377 W * 3.41 = 1285 BTUs/hour

For 28 servers, the total thermal dissipation will be 1285*28 = 35,995 BTUs/hour.

In the "power and thermal budgeting" section, a fully configured system was measured to consume lower than 250 W (Table 3, server configuration 4). Since the derated server configuration input power is lower than 241 W, then 28 servers can be supported via this configuration summary.

Table 13. Configuration C Summary

Configuration C Summary		
Rack Contents		
Units		
28 Servers with all fixed or all sliding rails with cable trays		
4 Low-voltage 24 A PDUs vertically mounted in the side panel compartments		
Internal Cables		
28 Power cords going to 4 PDUs in the side panels [These cables are supplied with the servers.]		
Cables External to Rack		
28 Management network cables from the optional Remote Insight Lights-Out Edition's RJ-45 connector to external switches		
28 Data network cables from on-board RJ-45 to external switches, assuming use of only one LAN connection per server		
4 Input power cords from the rack to external power outlets		
Site Utility Requirements (worst-case)		
Power: 4 Dedicated 100 V-120 V 30 A branch circuits.		
Thermal: Up to 35,995 BTUs/hour [This number is a worst-case. The actual BTUs/hour will depend on the OS/application software running and the server hardware configurations.]		
Weight: Up to 1,690 lb (with sliding-rails) [The network cables are not accounted for since most implementations route the network cables to the ceiling-hung cable rails outside of the rack.]		
Configuration-B Parts List	**Qty.**	**Notes**
ProLiant DL320 Generation 2 Sliding Rail Option Kit, P/N 233274-B21	36	Optional for in-rack servicing
Low-voltage 24 A PDU Option, P/N 207590-D71	4	N.A. (See Note A.)
Vertical-Mount PDU Bracket Kit, P/N 191265-B21	1	Contains 8 PDU brackets

Note: This list does not include the rack, the servers, and the network cables.
(A) Low-voltage PDUs are available only in North America and Japan.

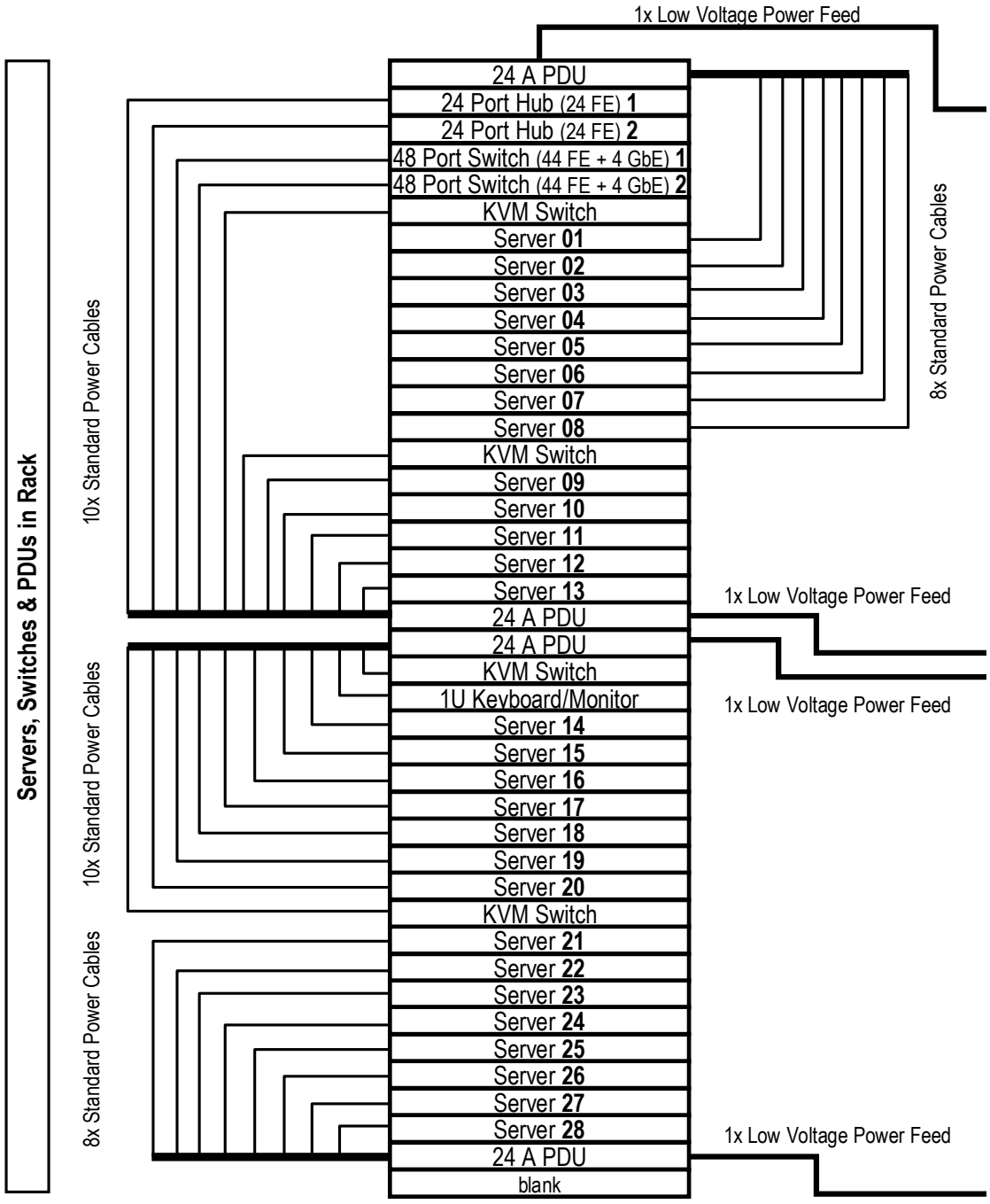

Figure 7. Configuration C (Traditionalist) Power Diagram

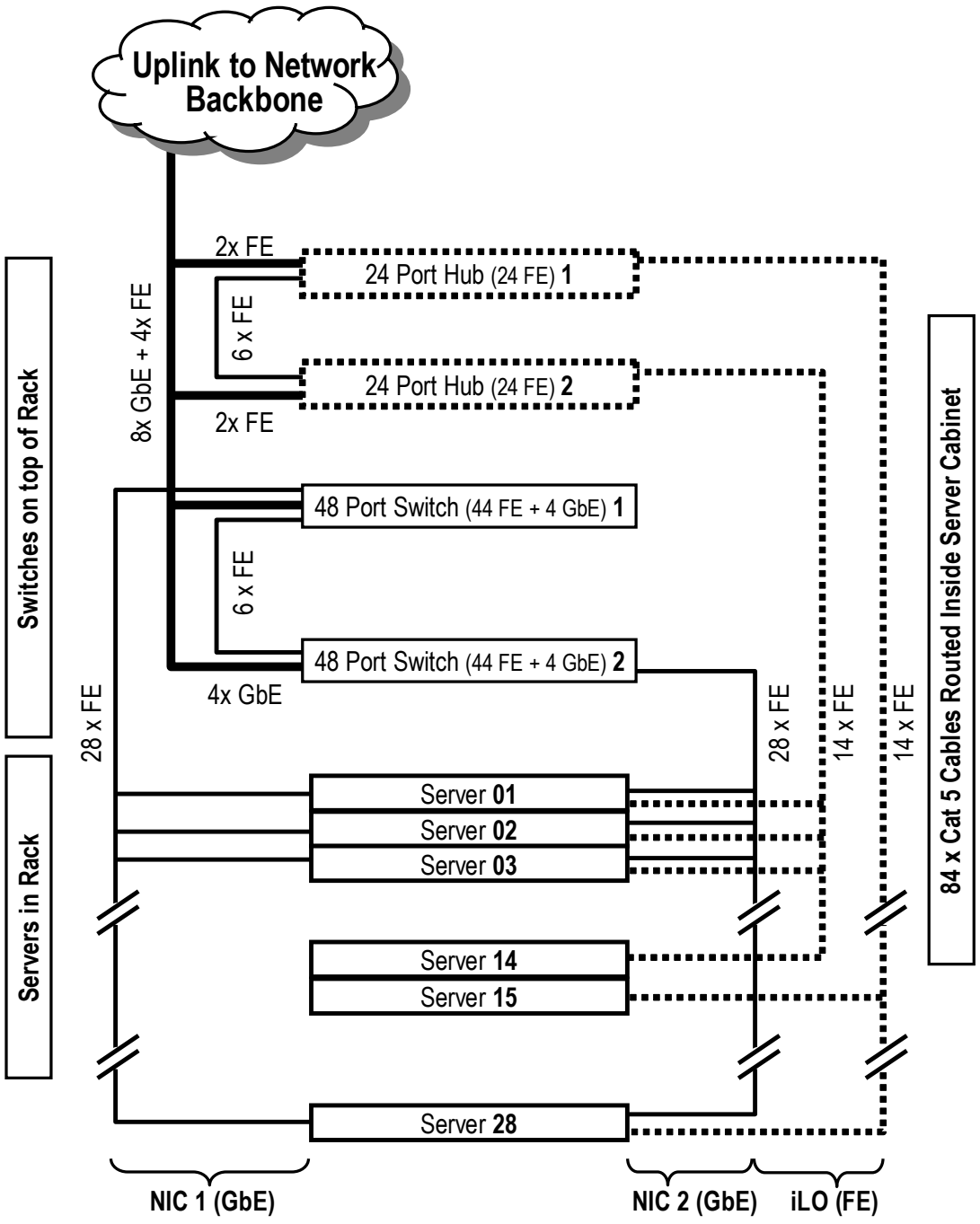

Figure 8. Configuration C (Traditionalist) Ethernet Cable Diagram

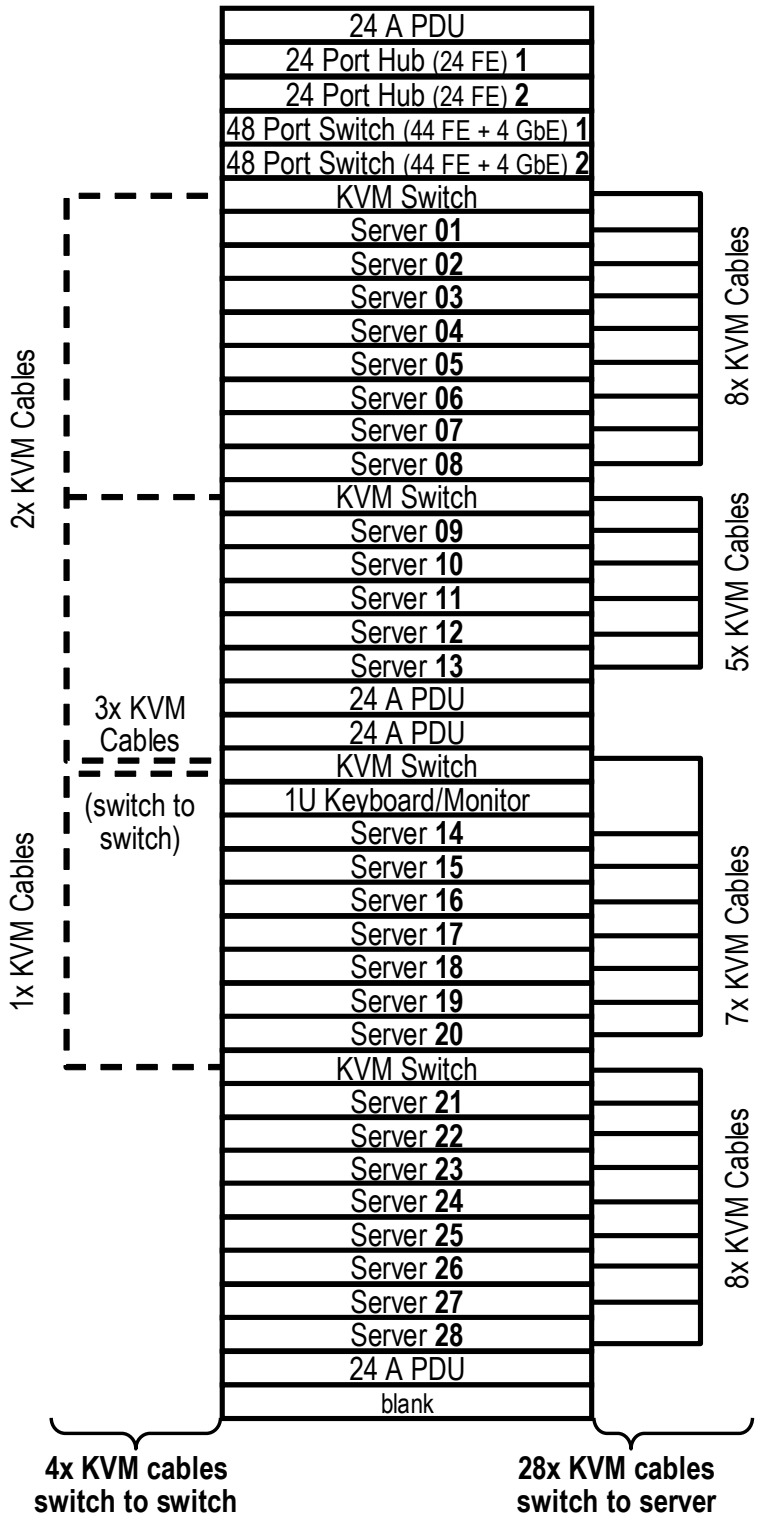

Figure 9. Configuration C (Traditionalist) KVM Diagram

installation procedures

symbols on equipment, server warnings, and rack warnings

symbols on equipment

The following symbols are located on equipment in areas where hazardous conditions might exist.

	This symbol in conjunction with any of the following symbols indicates the presence of a potential hazard. The potential for injury exists if warnings are not observed. Consult the documentation included with the server for specific details.
	This symbol indicates the presence of hazardous energy circuits or electrical shock hazards. Refer all service to qualified personnel. **WARNING:** To reduce the risk of injury from electrical shock hazards, do not open this enclosure. Refer all maintenance, upgrades, and service to qualified personnel.
	This symbol indicates the presence of electrical shock hazards. The area contains no user or field serviceable parts. Do not open for any reason. **WARNING:** To reduce the risk of injury from electrical shock hazards, do not open this enclosure.
	This symbol on a RJ-45 receptacle indicates a Network Interface Connection. **WARNING:** To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.
	This symbol indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists. **WARNING:** To reduce the risk of injury from a hot component, allow the surface to cool before touching.

server warnings

Adhere to the following guidelines when servicing or installing a ProLiant DL320 Generation 2 server:

WARNING: To reduce the risk of electrical shock or damage to the equipment:

- Unplug the power cord from the system.
- Do not disable the power cord grounding plug. The grounding plug is an important safety feature.
- Plug the power cord into a grounded (earthed) electrical outlet that is easily accessible at all times.

CAUTION: To properly ventilate the system, provide at least 7.6 cm (3 inches) of clearance at the front and back of the computer.

CAUTION: The system is designed to be electrically grounded. To ensure proper operation, plug the AC power cord only into a properly grounded (earthed) AC outlet.

rack warnings

Adhere to the following guidelines when installing a ProLiant DL360 Generation 3 server into a rack:

WARNING: To reduce the risk of personal injury or damage to the equipment:

- Do not attempt to move or relocate an equipment rack populated with servers. A fully populated rack can weigh as much as 848 kg (1,871 lb). The rack might become unstable and cause serious personal injury or equipment damage.
- Before installing the servers, extend the leveling jacks to the floor and rest the full weight of the rack on the leveling jacks. Either install the stabilizer kit or couple multiple racks together for stability.
- Always load the heaviest item first and load the rack from the bottom to the top. Loading in this manner makes the rack "bottom-heavy" and helps prevent the rack from becoming unstable.
- Extend only one ProLiant DL320 Generation 2 server at a time. A rack might become unstable if more than one server is fully extended for any reason.

CAUTION: Do not overload the AC supply branch circuit that provides power to the rack.

NOTE: Take necessary precautions for all procedures.

This section describes the preparation and brief installation procedures that are common to various configurations described in the "suggested rack configurations" section.

1. Observe symbols on equipment and server and rack warnings
2. Server Preparation
3. Rack Preparation
4. Installing PDUs
5. Installing the Rack Rails
6. Installing a Server in a Rack
7. Connecting Cables
8. Completing the Installation

HP recommends that customers execute these steps in order, especially when multiple racks are connected together or when a rack is populated in a separate room and relocated to its final position. However, Step 2 can be done any time before Step 5.

server preparation

This section briefly describes the server preparation. Refer to the *HP ProLiant DL320 Generation 2 Setup and Installation Guide* and accompanying documentation for details.

The server comes with standard a fast deployment fixed rack rail kit designed for 29-in deep square-hole racks, like the Compaq branded racks. If the application does not require in-rack servicing, then the factory-equipped fixed-rails may be used for installation.

The sliding rails and cable management solution option allows the server to be extended fully from the rack, and temporarily locked in place for servicing, without removing the cables from the server. It also provides better access to the rear cabling connections. The rails are designed for 29-in deep square-hole racks, like the Compaq branded racks. If customers choose to use the sliding rail and cable management solution option, then replace the factory-mounted fixed server rails with the optional sliding server rails on the server. Then install the optional cable tray to the rear of the server chassis per the instructions that come with the option.

Prior to installing the server in a rack, install all the necessary optional components inside the server, such as the RILOE, and additional DIMMs.

rack preparation

Most of the discussions in this section will focus around Compaq branded 36, 42, and 47U racks. The rack selection criteria and recommendations are beyond the scope of this document. A bustle or an extension kit may be required if the installation will end up with several cables for all the servers, for example, KVM cables. For complete details on rack installation, refer to the set up and install guides for the respective rack models.

installing PDUs

PDU installation varies depending on the rack configuration, the number of servers deployed in the rack, the selected type of PDU, as well as the voltage and current rating for each PDU. Refer to the "power distribution units" section for information about the Vertical-Mount PDU Bracket kits available from HP. The installation card in the Vertical-Mount PDU Bracket kit contains detailed instructions for installing the Vertical-Mount PDU Brackets on a PDU and in a rack.

positioning PDUs in 36U, 42U, and 47U racks

The position of the PDUs in the rack side panels varies depending on the rack size, the number of servers deployed in the rack, and the cable management solution. As a rule, install PDUs from the bottom to the top on the same side of the rack as the cable management solution (viewing the rack from the front).

installing PDUs in a 36U, 42U, and 47U rack

Before installing PDUs in a 36, 42 or 47U rack, you might need to remove the center support bracket and center it between the PDUs. Install the PDUs on the same side of the rack as the cable management solution (viewing the rack from the front).

routing power cords

Use the following general procedures to route server power cords in 36, 42 or 47U racks.

IMPORTANT: When installing server power cords into the PDUs, ensure that the load is balanced among the output circuit breakers.

high-voltage power cords

To route and connect high-voltage power cords:

IMPORTANT: Route and connect the high-voltage power cord to the PDU after the server is installed.

1. Connect the power cord to the server and route it through the cable management system with the other server cables.
2. Route the power cord inside the rear rack support to the PDU.

high-voltage Y-cables

To route high-voltage Y-cables:

1. Connect the single-cord section of the Y-cable to the PDU installed on the same side as the cable management tray.
2. Align the Y-joint with the rear rack support and center it between the rack rails of the two servers that the Y-cable supports.
3. Use two plastic tie wraps to secure the Y-joint to the rack support.
4. After installing the servers, connect the cables to the servers and route them through the cable management system with the other server cables.

low-voltage power cords

To route and connect low-voltage power cords:

IMPORTANT: Route and connect the low-voltage power cord to the PDU after the server is installed.

1. Connect the power cord to the server first and route it through the cable management system with the other server cables.
2. Route the power cord inside the rear rack support to the PDU.

IMPORTANT: In Compaq branded 7000-series racks, route the power cables from the servers to the PDUs through the gap in the rear of the rack rail.

installing the rack rails

The following procedure describes how to install the standard rack rails onto the rack. The rails are designed to snap in place without screws or nuts.

1. Insert the rails into the rack holes.
2. Insert the server into the rack.
3. Install the cable management solution.
4. Cable and power up the server.

Repeat the procedure for any subsequent rack rails. For detailed instructions on installing standard rack rails, refer to the *HP ProLiant DL320 Generation 2 Server Setup and Installation Guide* and to the *HP ProLiant DL320 Generation 2 Hardware Configuration and Installation Poster*.

installing the server in a rack

CAUTION: Always install servers from the bottom of the rack to the top. Installing servers in this manner provides more stability for the rack and reduces the risk of the rack tipping over.

To properly install servers:

1. Install servers in the rack from the bottom to the top for maximum density.
2. Tighten the thumbscrews on the front of each server to secure the server to the rack.
3. Attach the cable management solution to the rear of the server and to the rear of the rack.

WARNING: To reduce the risk of serious personal injury, fire, or damage to the equipment:

- Extend the leveling jacks to the floor and rest the full weight of the rack on the leveling jacks.
- Install either the stabilizer kit or couple multiple racks together for stability.
- Load the heaviest item first and load the rack from the bottom to the top. Loading the rack in this manner makes the rack "bottom-heavy" and helps prevent the rack from becoming unstable.
- Do not overload the AC supply branch circuit that provides power to the rack.
- Extend only one server at a time. A rack might become unstable if more than one server is fully extended for any reason.

connecting cables

This section discusses connecting and routing cables with different cable management solutions and different console management solutions.

in-rack local console

To install cables with in-rack local consoles:

1. Connect the cables to each device installed in the rack, working from the bottom to the top.
2. Connect the cables to the bottom piece of equipment.
3. Bundle the cables and route them through the cable management solution.
4. Connect the cables to the console switchbox.
5. Connect the power cord to the PDU. Do not connect the PDU to any power source until all equipment is fully deployed in the rack.

Refer to *HP ProLiant DL320 Generation 2 Server Setup and Installation Guide* for the recommended order for connecting cables.

When the cables are properly connected and routed through the cable management solution, the rear door of the rack closes easily over the cables. If the rear door does not close easily, additional space might be required. Install the rack extension or the bustle kit to provide more space for the cables at the rear of the rack.

WARNING: To reduce the risk of electrical shock or damage to the equipment:

- Unplug the power cord from the system.
- Do not disable the power cord grounding plug. The grounding plug is an important safety feature.
- Plug the power cord into a grounded (earthed) electrical outlet that is easily accessible at all times.
- Do not route the power cord where it can be walked on or pinched by items placed against it. Pay particular attention to the plug, electrical outlet, and the point where the cord extends from the server.

IMPORTANT: In Compaq branded 7000-series racks, route the power cables from the servers to the PDUs through the gap in the rear of the rack rail.

remote console management

The remote console management system uses a CAT5 cable connected to the RJ-45 connector in the Remote Insight Lights-Out PCI board and the power cord. Route these cables through the cable management system according to the instructions either in the *HP ProLiant DL320 Generation 2 Server Setup and Installation Guide* or the *HP Sliding Rails and Cable Management Guide for the ProLiant DL320 Generation 2 Server*. Connect the power cord to the PDU and the CAT5 cable to the network data line outlet.

completing the installation

To complete the installation:

1. Install side panels on the outsides of the end racks.
2. Install the front and rear doors.
3. Connect the PDUs to the power source.
4. Power up the servers.

reference information and glossary

references

Sources referenced in this paper are listed in Table 14.

Table 14. Sources of Information

Topic	Where to Find
Information focal point for the HP ProLiant DL320 Generation 2 server	www.hp.com/servers/proliant/manage
Specifications, options, and a list of other HP products and options compatible with the ProLiant DL320 Generation 2 server	*HP ProLiant DL320 Generation 2 QuickSpecs*
Installation and service guidelines for the ProLiant DL320 Generation 2 server	www.hp.com/servers/proliant/manage *HP ProLiant DL320 Generation 2 Setup and Installation Guide*, P/N 293166-001 *HP ProLiant DL320 Generation 2 Maintenance and Service Guide*, P/N 293164-001

Table 15. Notations for Optional Components

Notation	Description
1x, 2x, 4x	Number of components, for example, 1x128 MB means one 128-MB DIMM
2.26 GHz	Intel Pentium IV 2.26-GHz processor speed
128 MB	128-MB DIMM
256 MB	256-MB DIMM
1 GB	1-GB DIMM
HDD	Hard drive
	36-GB HDD SCSI 80 GB ATA
SA5300	Smart Array 5300 Controller option (64-bit PCI card)
RILOE	RILOE option (32-bit PCI card)
FE	Fast Ethernet or 10/100 Mbs
GbE	Gigabit Ethernet or 10/100/1000 Mbs

glossary

1U – A rack unit (1U) is 4.45 cm or 1.75 in in vertical dimension. The height of a device (also known as form factor) can be expressed in rack units (U). The ProLiant DL320 Generation 2 server is a 1U server.

1U Integrated Keyboard/Mouse/TFT – The TFT5600 RKM (rack-mount keyboard and monitor) is a 1U integrated keyboard and monitor. Its full 15-inch TFT active matrix display provides flicker-free, quality display at viewing angles up to 120 degrees horizontally and 105 degrees vertically.

Flat Panel Display (FPD) – A HP TFT5010R (15-inch) flat panel monitor provides a large image size and exceptional screen performance in a space-saving 2U size that enables the monitor to be neatly tucked away when not in use.

High Voltage – AC line voltage of 200 V to 240 V. With higher voltage levels, a server can use a lower current and still meet its power requirements. HP recommends using a high-voltage source to support high-volume deployments of ProLiant DL320 Generation 2 servers in a rack.

In-Rack Keyboard – The 1U rack keyboard drawer and the internal keyboard with trackball are designed to work together to save room in space-constrained, rack-mount environments. The 1U keyboard drawer requires only half the Compaq branded rack depth and provides enough space behind it to mount a HP Server Console switch.

Keyboard/Video/Mouse (KVM) – KVM refers to a keyboard cable, a video cable, a mouse cable, or a switch. Some HP parts lists might refer to KVM switches as Server Console Switches.

Local Console –A local console system interacts with a server using a set of KVM devices and can be in-rack or off-rack. In this paper, **in-rack** local console refers to a flat panel display and a keyboard/trackball in the same rack as the servers. **Off-rack** local console refers to any combination of a display, a keyboard, and a pointing device located outside of the rack. A local console system does not use a network connection to interact with the server.

Low Voltage – AC line voltage of 100 V to 120 V.

N.A. – North America, including U.S., Canada, and Mexico.

Network Interface Controllers (NICs) – Controllers that are embedded on the system board of the ProLiant DL320 Generation 2 server.

Power Distribution Unit (PDU) – A PDU is a high-voltage or low-voltage device that is equipped with circuit breakers that help prevent electrical surges and external equipment malfunction by providing over current and surge protection for connected devices. See the "power distribution units" section of this paper.

Remote Console – A remote console is a server console system that uses a network connection to interact with the server. This system enables any computer with appropriate software and network access to control a server from anywhere across the globe. HP recommends using the remote-console system for managing a large number of servers because it eliminates the congestion of KVM cabling.

Remote Insight Lights-Out Edition (RILOE) – The HP Remote Insight Lights-Out Edition is designed to provide remote access and control of ProLiant server products from anywhere on the network with a standard web browser. Consequently, customers can deploy a ProLiant DL320 Generation 2 server in a true "headless" fashion with a minimum of only three cables per server: one power cord for the server, one network cable for the LAN connection, and one network cable for the Remote Insight Lights-Out Edition management LAN connection. Using the Remote Insight Lights-Out Edition, customers can deploy 42 ProLiant DL320 Generation 2 servers in a 42U Compaq branded rack with significantly fewer cables than in a local console.

Server Console Switch – A device that enables multiple servers in a rack to be accessed and managed by a single keyboard, mouse, and monitor. These switches are also known as KVM switches.

Sliding Rail – A tool-free rack management system designed for Compaq branded and third-party racks that support in-rack serviceability for ProLiant DL320 Generation 2 servers.

UID LED and Switch – The blue Unit Identification (UID) LED identifies that the ProLiant DL320 Generation 2 server requires service. A UID switch toggles both the front and rear UID LEDs simultaneously.

Wake on LAN (WOL) – An option that enables a remote restart of the server.

For detailed information about the products in this glossary, refer to:

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