

# Cable management for rack-mounted systems

technology brief, 2<sup>nd</sup> edition



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## Abstract

High-density server installations involve an increasing amount of power and data cables within each rack. Mismanagement of cable assemblies can lead to poor system performance, difficult maintenance, unnecessary downtime, and even safety hazards. This paper describes proper methods and recommended techniques and products for safe and effective cable management.

## Introduction

The trend in high performance computing (HPC) data centers is to implement high-density systems that make the most of available facility space. Of high importance with HPC systems are reliability and availability—issues that are addressed with the use of redundant components and cabling. These strategies result in highly populated equipment racks with an abundance of power and data cables.

As the component density of a rack increases, so does the need to manage associated cables effectively. Mismanaged or unmanaged cables (Figure 1) can result in several types of issues:

- Reduced performance due to signal crosstalk and interference across adjacent cables
- Difficult maintenance because components are blocked by cables
- Hazardous situations of damaged cables due to unchecked or unprotected movement
- Thermal (cooling) issues due to poor or restricted airflow around active components

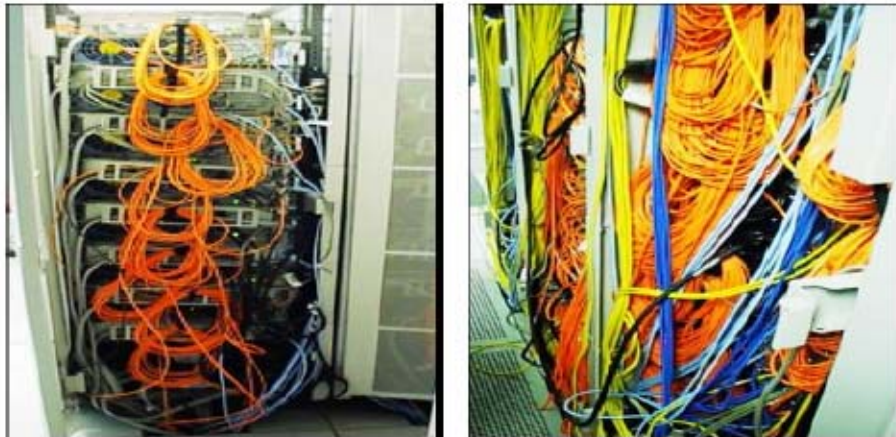
Any of the above situations can require unscheduled downtime to correct, and for enterprise HPC systems that is very costly and unacceptable. Effective management of power and data cabling of a rack can help achieve important overall goals of the IT infrastructure:

- Stable, reliable performance through reduced or eliminated crosstalk and interference
- Ease of serviceability and maintenance through better and safer access to individual components
- Thermal efficiency through maximum air flow for cost-efficient equipment cooling

The following sections describe cabling management guidelines that can help achieve the goals of system design. HP solutions that address the cabling issues are also described.

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**Figure 1.** Examples of poor cable management in racks



# Cable routing guidelines

To minimize maintenance, safety, and performance issues, routing of power and data cables should be in accordance with the following guidelines.

## Separation of power and data cables

Cables in close proximity to each other, especially those oriented in parallel or in loops, can create electromagnetic interference (EMI) through induction. EMI can result in erratic or error-prone data transfers. To minimize the effects of EMI, power cables should be segregated from data cables as much as possible:

- Dress all signal cables on the left side of the rack and all power cables on the right side of the rack.
- Arrange and secure excess power and data cabling separately.
- Use HP cable management kits described later in this paper to facilitate the segregation.

## Retention of excess cable

Installing a number of components in a rack typically results in the use of some cables that are longer than necessary. This is especially true when similar or redundant components with the same cable types are installed at various levels in a rack. The excess cable lengths are often hurriedly bundled and tied, resulting in problems associated with EMI or in damaged cables.

Here are some preferred methods of handling excess cables:

- Run and attach excess cables for easy, safe maintenance activities and proper operations.
- Ensure that secured cables are not pinched, damaged, or kinked (refer to the "[Cable bend radius restrictions](#)" section of this paper).
- When possible, use all cable management arms included in component kits.
- Use HP cable management kits described later in this paper for maintaining and managing cables.

## Protection of cables

Cables must be protected at points where they might rub or come in contact with sharp edges or heated areas. Extra care must be used with power cables because damaged conductors could cause downtime and because exposed conductors are a safety hazard.

To protect cables, HP recommends the following practices:

- Avoid dressing cables tightly over sharp edges of railing or panels.
- Avoid pinching of cables between components or mounting/sliding rails.
- Protect the cables if they may be pinched or damaged.

## Securing cables and connectors

Cables and connectors should be secured to prevent excessive movement and to provide strain relief at critical points.

### Securing data cables

For securing data cables, HP recommends the following practices:

- Ensure that cable connections are not stressed from any cable or chassis movement.
- Dress cables on management arms securely enough to prevent interference with movement or pinched cables, yet not so tight as to cause binding to the arm.

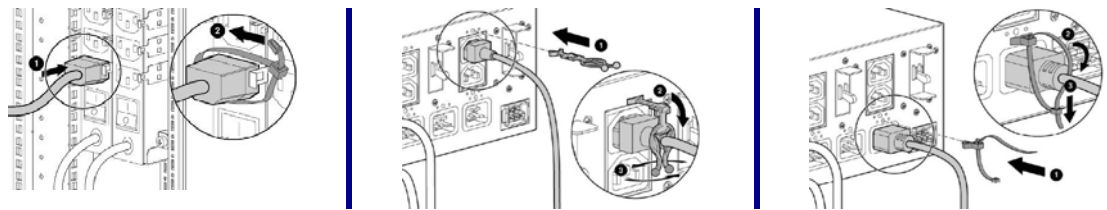
## Securing power cables and connectors

Power cables and connectors should receive extra care during installation, since loose cables or connectors can result in loss of power and unscheduled downtime. A loose power connector can create high contact resistance that can result in arcing and a fire hazard. HP power distribution products are often supplied with cable retaining clips or clamps (Figure 2), and HP strongly advises using these accessories when they are provided.

For securing power cables and connectors, HP recommends the following:

- Always use any provided hardware (such as retaining clips or tie strips) to secure power connectors and cords to the product chassis.
- When possible, secure PDU power cables with removable ties to prevent accidental removal of the cords from the system.

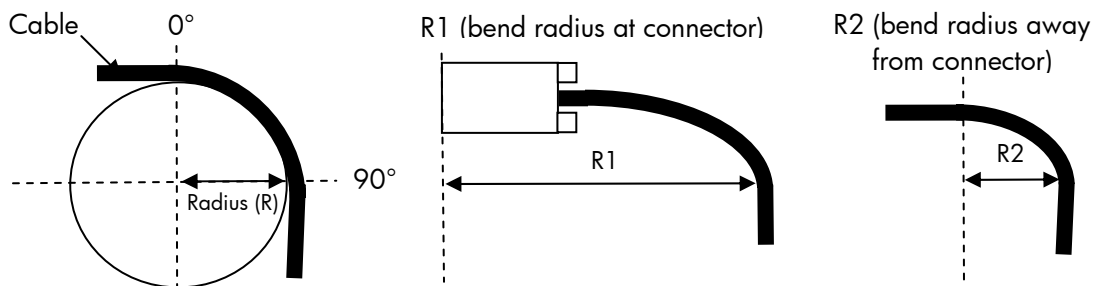
**Figure 2.** Example of retaining, clamp system securing power cords on HP products



## Cable bend-radius restrictions

Routing cables typically requires looping excess cable or bending cable around chassis components. The bend radius is defined as the minimum radius (Figure 3) to which a cable may safely be bent without damaging the cable or affecting its performance.

**Figure 3.** Cable bend radius



To avoid the consequences of a too short or too tight bend radius, HP recommends the following practices:

- Avoid tight bend radii. Never bend cables tight enough to cause a crease in the sheathing.
- With no exceptions, fiber cables must not violate their minimum bend radius.
- Avoid excessive bends in cable, and run as large a bend as space allows.

- Use cable routing accessories designed to maintain and secure cable.
- Leave enough slack in cables for operation of articulated arms and rail slides.

Since actual conductor size and type vary among types of cables, the bend radius rule can differ among cable types. For example, Table 1 lists the minimum bend radius for HP fiber optic cables and HP InfiniBand cables.

**Table 1.** Bend radius for HP cables

Cable type	Minimum bend radius (R, R1, or R2)
HP LC-Type fiber optic	R = 0.8in (~2cm)
HP SC-Type fiber optic	R = 1in (~3cm)
HP InfiniBand 4xcable	R1 = 4.6in (12cm) R2 = 2.3in (6cm)

**Note**

The bend radius restrictions on some cable types, such as InfiniBand cable, vary depending upon connector proximity. For other cables, HP recommends that users refer to cable specifications or contact the cable supplier for more information.

Excessive bending of cables can create one or more of the following problems:

- For power cables, stressed insulators or arcing across conductors
- For copper data cables, stressed terminators, stress on center conductors, or disturbed twists on conductors that increase sensitivity to noise
- For fiber optic cables, micro-bending of fibers that results in degradation of light transmission or breaking of fibers, which results in loss of signal

## Thermal issues with cable routing

HP rack-mountable products that use forced-air cooling typically draw cool air through the front of the chassis and push warm air out the back. If this air flow is restricted in any way, component temperatures can rise, resulting in unscheduled system downtime due to thermal shutdown or damage. For safe and reliable operation, ventilation slots and blowers at the rear of products must not be obstructed by any components, including cables. Therefore, for proper cooling of rack-mounted components, ensure that cabling does not impede the airflow to or from the rack-mountable servers.

## Routing fiber optic cable

Fiber optic cable is lighter than copper cable; but it is relatively delicate, must be handled carefully during installation, and may require extra protection. Damaged fiber optic cable poses no safety hazards but can result in degraded or interrupted performance. HP recommends the following guidelines for installing fiber optic cable:

- Use only Velcro ties to reduce the chance of damaging cable from over-cinching or accidental cutting.

- Do not allow other cables or components to exert tension on fiber optic cables, which can be easily crushed or damaged.
- Avoid routing fiber optic cable around chassis and cabinet corners. If this is unavoidable, protect the cable.

## Routing network cable

Network interconnects can involve a large amount of cabling due to the component/data path redundancy required to meet high availability goals. Network devices also require high serviceability, so cabling must be arranged to allow easy access to individual circuits.






HP recommends the following guidelines for routing data cables:

- For components that must be movable while powered on, ensure that a full range of motion is possible without cable interference or disconnection.
- When securing cables inside the rack, dress the bundle in a way that avoids interference with installed components, rack side panels, or rails.
- Do not block access to field-replaceable components.

## HP Cable Management Kit

HP offers a complete line of products that provide reliable, serviceable, and safe cabling options for assembling rack installations. Routing, securing, and protection solutions available from HP are listed in Table 2 and can be found at the main rack options product page at [www.hp.com/products/rackoptions](http://www.hp.com/products/rackoptions).

**Table 2.** HP cabling solutions

Product	HP part number	Description
<p>Cable Management D-ring Kit</p> 	168233-B21	This kit contains 10 D-rings that mount in the back rails of the rack and allow for cables to be routed and organized within the rack.
<p>Network Cable Management Kit</p> 	AF099A	This kit provides an easy way to organize and route cables within HP racks. Cable clips, cable rings, and 1U and 2U access panels are included.
<p>Hook and Loop Strips</p> 	379820-B21	Adjustable, reusable strap with metal clip that can attach to rack perforations or other clips.
<p>Rack-Top Cable Tray</p> 	383982-B21 (600mmWide)  383983-B21 (800mm wide)	Designed to mount on top of the HP Rack 10000 Series for orderly and efficient cable routing. The three levels within the trays allow for routing power, data, and fibre channel cables separately.
<p>Rack-to-Rack Adjustable Cable Tray, Aisle Transfer Bridge</p> 	383984-B21	Adjustable cable bridge used to transfer cables from the back of a rack, across the datacenter hot aisle, to the back of another rack. Comes in a single size.

## HP Factory Express services

HP provides system integration services through HP Factory Express,<sup>1</sup> an extensive portfolio of more than 50 services. Through Factory Express, HP offers routing and cabling management service in accordance with the best cabling practices.

<sup>1</sup> HP Factory Express is a robust portfolio of flexible, pre-priced, configured, customized, and integrated factory solutions and deployment services. Through Factory Express, HP racks can be customized, configured, and integrated into ready-to-deploy solutions to save customers time, money, and resources.

## For more information

For additional information about racks, rack options, and accessories, refer to the HP Infrastructure Products page at <http://h18004.www1.hp.com/products/servers/platforms/rackandpower.html>.

To learn more about HP Factory Express, contact your HP sales representative or visit our website at [www.hp.com/go/factory-express](http://www.hp.com/go/factory-express).

## Call to action

Send comments about this paper to [TechCom@HP.com](mailto:TechCom@HP.com).