Network Design and Switch Configuration for Vertiv™ PowerIT Upgradeable rPDU

A Vertiv Application Brief

Vertiv™ PowerIT Upgradeable rPDU Networks

Vertiv™ PowerIT Upgradeable rPDUs include two network ports which allow them to be networked in the following ways:

rPDU-to-switch direct connections, utilizing only one network port per rPDU.

Open-ended daisy chain connections, reducing cabling and switch port count.

Fault-tolerant daisy chain connections, utilizing Rapid Spanning Tree Protocol (RSTP) to reduce cabling and switch port count while providing fault tolerance.
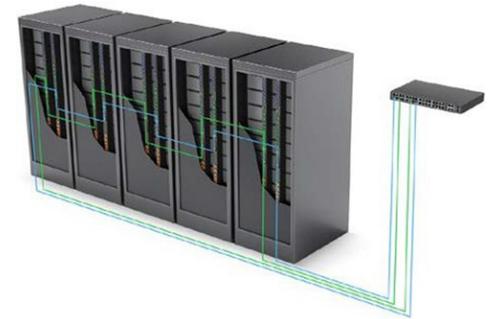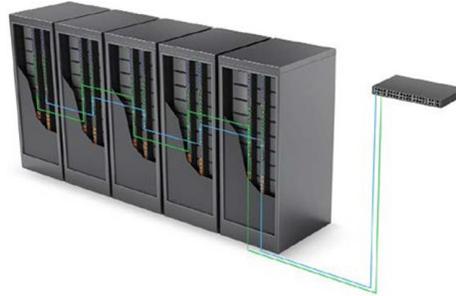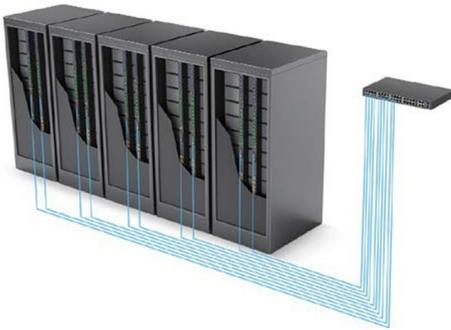
Overview

- This application note provides advice about Vertiv™ PowerIT Upgradeable rPDU network design, network switch selection and managed network switch configuration.

- For best performance, it is strongly recommended to update all Vertiv™ PowerIT Upgradeable rPDUs to the latest firmware available from Vertiv.com.

Terminology:

- Root Switch: The root switch is the switch with the lowest bridge priority. If multiple switches have equal bridge priority, the root switch would have the lowest MAC address.

Vertiv™ PowerIT Upgradeable rPDU Networks Utilizing Unmanaged Switches

Unmanaged network switches allow Ethernet devices to communicate with one another and are typically used in smaller networks. They have limited functionality and do not have the ability to be configured.

When connecting Vertiv™ PowerIT Upgradeable rPDUs in daisy chains, it is recommended that only small networks are implemented using unmanaged network switches and that the following installation guidelines are followed:

Unmanaged Switch Network Recommendations

rPDU-to-switch direct connections:	Open-ended daisy chaining:	Fault-tolerant daisy chaining:
1 rPDU per port, no maximum rPDU number	Up to 5 daisy chains of up to 20 rPDUs each (total 100 rPDUs)	Up to 2 RSTP loops of up to 20 rPDUs each (total 40 rPDUs)

For daisy chained connections, greater numbers of daisy chains or loops may work; however, due to differences in installation environments, it is recommended to adhere to the above installation sizes when using unmanaged network switches.

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Vertiv™ PowerIT Upgradeable rPDU Networks Utilizing Unmanaged Switches

In addition to providing all the features of an unmanaged switch, managed switches offer advanced features which can be configured to control and monitor network traffic. Managed switches should be used to implement all but the smallest Vertiv™ PowerIT Upgradeable rPDU networks.

When selecting a managed switch for deployment in a Vertiv™ PowerIT Upgradeable daisy chained rPDU network ensure the switch supports the ability to manage Rapid Spanning Tree (RSTP or 802.1w).

When using managed network switches with the Vertiv™ PowerIT Upgradeable rPDU, it is recommended to follow these installation guidelines:

Managed Switch Network Recommendations

rPDU-to-switch direct connections:	Open-ended daisy chaining:	Fault-tolerant daisy chaining:
1 rPDU per port, no maximum rPDU number	Any number of daisy chains of up to 40[1] rPDUs each	Any number of loops of up to 40[1] rPDUs each

Vertiv™ PowerIT Upgradeable rPDU Network Managed Switch Configuration

Managed switches should be configured with the following spanning tree parameters when deployed with Vertiv™ PowerIT Upgradeable rPDUs (refer to the switch manufacturer's documentation for details regarding how to configure your switch).

In some instances, different settings may also work with Vertiv™ PowerIT Upgradeable rPDUs, please consult with your network administrator if you are unsure.

Managed Switch Configuration

Spanning tree protocol (STP) global configuration:	Spanning tree protocol (STP) port configuration:
• Spanning Tree = Enabled • Mode = RSTP • Bridge Priority = 16384 • Hello Time = 2 • Max Age = 40 • Forward Delay = 21 • TxHoldCount = 5 • Max Hops = 40	• Spanning Tree = Enabled

Configure each managed network switch with a unique IP address so the switches can be remotely accessed once deployed. Once switch configuration is complete, ensure the configuration is saved so it is not lost in the event of the switch being power cycled.

If your network is already running spanning tree, consult your network administrator before proceeding with the configuration.

[1] The maximum number of rPDUs in any open ended or fault tolerant daisy chain can be less than 40 when deployed in a network with multiple managed switches.
See Vertiv™ PowerIT Upgradeable rPDU Networks Utilizing Multiple Managed Switches later in this document.

Items to Note:

- Bridge Priority is sometimes known as CIST Priority or, simply, Priority.

- TxHoldCount and Max Hops settings are not always available.

- Spanning Tree Port Status should be set enabled for every switch port which is connected to a Upgradeable rPDU.

- Spanning Tree Port Configuration is automatic with some managed switches and cannot be manually configured. Refer to the switch manufacturer's documentation for details.

- If deploying a network with multiple managed switches, the switch designated as the root switch should have a lower Bridge Priority, for example 8192. Vertiv™ PowerIT Upgradeable rPDUs have a Spanning Tree Bridge Priority of 24576.

- Spanning Tree configuration is not required for non- daisy chained Vertiv™ PowerIT Upgradeable rPDU networks.

Vertiv™ PowerIT Upgradeable RPDU Network Utilizing Multiple Managed Switches

When deploying multiple managed switches, the maximum number of rPDUs in any open ended or fault tolerant daisy chain must be decreased from 40 by the number of network hops between the switch connected to the rPDU daisy chain or loop and the root switch. The root switch is the switch with the lowest bridge priority. Or if multiple switches have equal bridge priority, the switch with the lowest MAC address.

The following example shows a network of three managed switches connected to three rPDU daisy chains. Managed switch 3 has been configured with the lowest bridge priority and is, therefore, the root switch in this network.
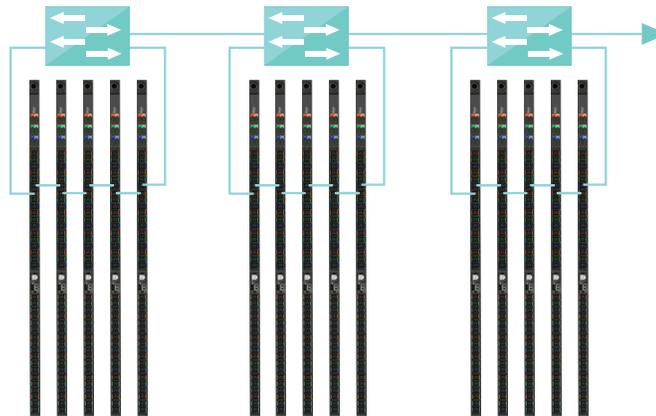
The maximum number of Vertiv™ PowerIT Upgradeable rPDUs in Daisy Chain 1, and any other daisy chains connected to switch 1, is 38 because the maximum 40 is reduced by the two network hops between switch 1 (where the rPDUs are connected) and switch 3 (the root switch).

Similarly, the maximum number of Vertiv™ PowerIT Upgradeable rPDUs in Daisy Chain 2 is 39 because the maximum 40 is reduced by one due to the single network hop between switch 2 (where the rPDUs are connected) and switch 3 (the root switch).

The maximum number of Vertiv™ PowerIT Upgradeable rPDUs in Daisy Chain 3 is 40 as the rPDUs are connected directly to the root switch and no additional network hops are required to reach it.

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