DELL Technologies

PANDUIT®

Hyperconverged Reference Architecture

Dell Technologies with Panduit

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Introduction

Physical infrastructure solutions from Panduit enable a complete solution when paired with active electronics from Dell Technologies. Given the relative cost of these physical network components, they are commonly left to the end of a network design or overlooked altogether. Yet physical infrastructure is critical to optimal performance, reliability, and manageability in IT solutions.

At Panduit, we understand that physical infrastructure is not the highest priority for a system architect or IT professional. These are not the most costly or visible elements of a network design, but they are foundational. We have taken the time to think about these often-overlooked network elements, so you do not have to!

In the follow-on documentation, we have put forward a reference architecture utilizing a Dell Technologies configuration and validated Panduit physical infrastructure components. This reference architecture is built with Panduit and Dell Technologies solution architect inputs and is intended to ease the design and implementation process of Dell Technologies systems for integrators, consultants, installers, and contractors.

With this proposed reference architecture, Data Center managers should expect:

- Proven Technology – CI and HCI integration
- Validated Design – Built with Dell Technologies and Panduit engineering
- Panduit physical infrastructure compliments Dell Technologies solution
- Long term reliability enabled by Panduit physical infrastructure
- High Availability - 2nd Day HC & HCI Program for racks, PDUs, and accessories
- Ease of migration to higher power and speed technology
- Optimized in-cabinet deployments for Dell Technologies in the data center

Hyperconverged Systems

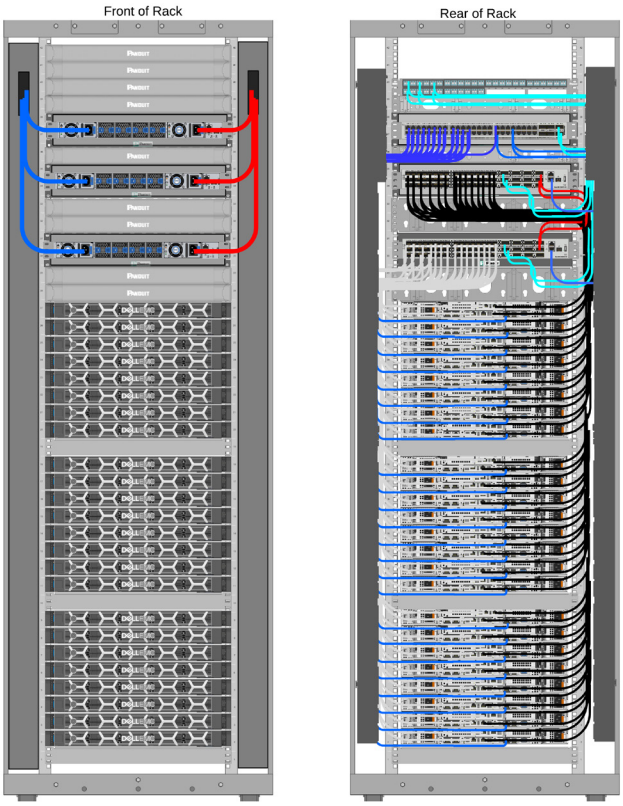
In today's ever-changing data center world, hyperconverged systems have become more and more prevalent as workloads and data storage needs adapt and scale. Hyperconverged rack-scale engineered systems with integrated networking enable an organization to deliver a predictable performance that is scalable to meet the modern business environment. In a modern one-layer hyperconverged (HCI) deployment, the ScaleIO Data Client (SDC) and ScaleIO Data Server (SDS) run on the same set of nodes. This deployment maximizes hardware utilization and reduces infrastructure requirements. In HCI deployments with storage servers and clients running on the same physical nodes, the resource utilization efficiency of the overall stack (storage, CPU, and memory) is extremely high. A hyperconverged system built on software-centric architecture to deliver tightly integrated software-defined compute, storage, network, and system management resources delivers scalability, performance, flexibility, ease of management, and fast time to market.

Businesses today are faced with the daunting task of building a completely customized solution, integrating storage, networking, compute, data protection, monitoring, and reporting. Figuring out how to get all the hardware and software components to work together, while still leaving flexibility and scalability available, can be a time-consuming endeavor. Planning, designing, and building a custom solution is a complex project that often takes months or years to come to fruition. Often times this timeline does not align with a solution to address immediate business demands. This development can also be costly to maintain or upgrade over the long term. The purpose of this design guide is to remove the complexity of this process and reduce the time to deploy.

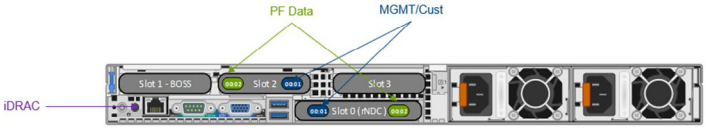
PowerFlex Design

This PowerFlex design utilizes a set of Top of Rack (ToR) switches for 25 GbE connections to each node. A set of aggregation switches provide 10/40 or 100 GbE IP Uplink connectivity to the external network for superior performance. Each Rack appliance (Node) contains 4*25 GB connections for data traffic and 1*1 Gb/s Management connection. Fault tolerance is achieved via dedicated data path switches with redundant switch paths that enable maximum system bandwidth. The ToR appliance approach of this document is “bring your own” networking appliance. It is only required for the network switch to meet the bandwidth and management capabilities of the desired performance. The Cisco NEXUS 93240YC-FX2 is used in images and power calculations within this document.

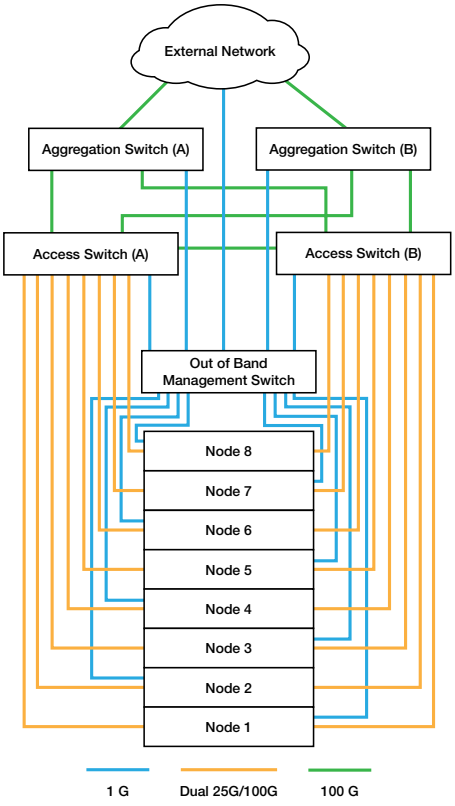
The PowerFlex Appliance has dual network connectivity. Each slot is connected to each of the ToR switches with 25 GB Direct Attach Twinax Cables (DAC). This design allows for full redundancy with fault tolerance.



PowerFlex rack : Example Node Configuration



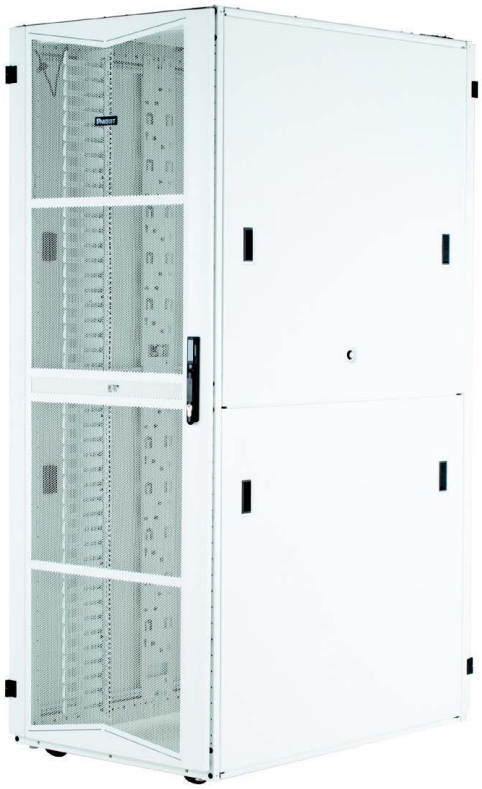
A PowerFlex R640 Appliance is used as a basis of design in this infrastructure. Deployment in a rack should be grouped with no more than 8 continuous rack units without a thermal break. The Cisco 93240YC-FX2 can support a total of 24 Nodes utilizing the configuration shown. Out of Band services will be handled with the Nexus 92348GC-X platform. Nodes will be deployed in a bottom-up fashion as the stack grows.



Thermal Management

Cabinets

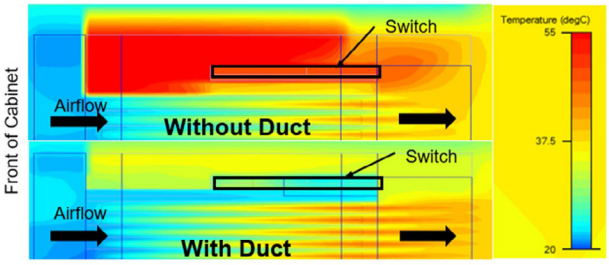
Panduit FlexFusion™ Cabinets offer a unique universal platform for all types of data centers and application needs including Hyperscale, Edge, and Multi-Tenant Data Center. Built with a best-in-class weight load of 3,500 lbs. and doors with a maximum airflow of 80%, the cabinet design can tackle your most challenging cabinet deployments. Designed for applications that require maximum thermal management capability and the capacity to manage high cable densities, the FlexFusion™ Cabinets incorporate integral thermal sealing and cable management options that provide cost-effective solutions to meet the diverse application needs of today's data centers. Available in 42, 45, 48, and 51 RU heights based on the needs of the application. The height ranges allow customers to match Brownfield requirements. This paper recommends at least 700mm in width and 1200mm in depth to allow for proper PDU placement and cable routing. A 42 RU 700mm wide, 1200mm depth cabinet is utilized as the basis of design.



Part Number	Description
XG74222BS00D2	Cabinet with intelligent handle
XG74222BS001V	Cabinet with keyed doors

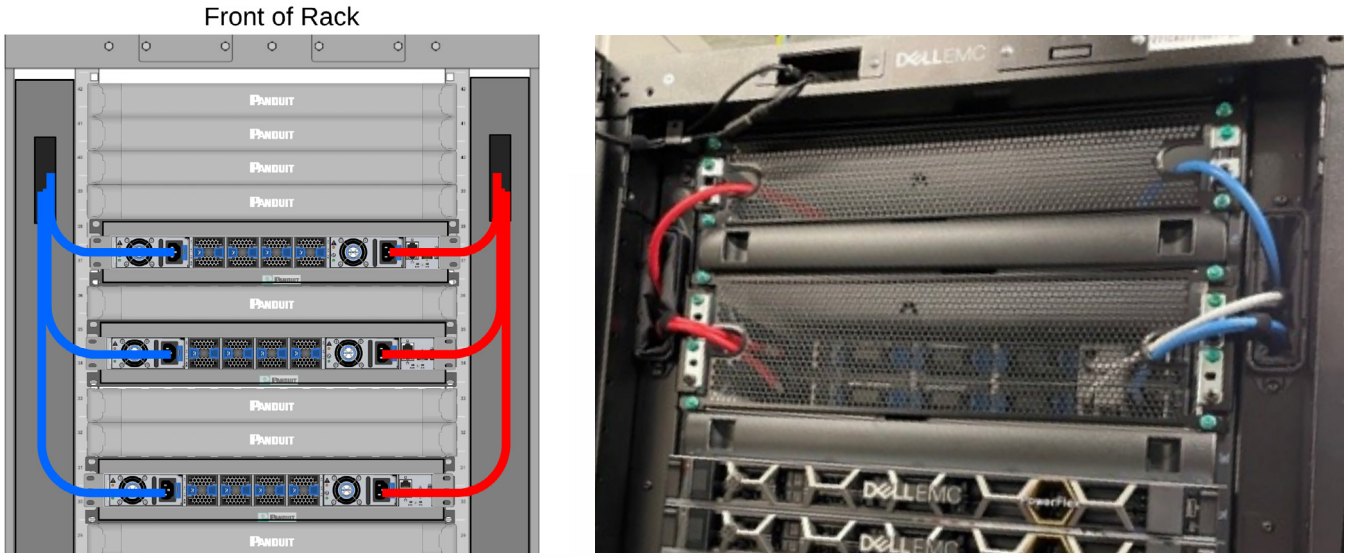
Switch Ducts

Top of Rack (TOR) Inlet Ducts effectively manages airflow when used to extend the inlet duct to receive incoming cold air. These ducts channel cold air directly into the switch intake and create a front-to-back airflow pattern. Inlet ducting prevents hot air recirculation within the cabinet and enables reduced inlet temperature for improved performance and cooling efficiency. They also enable reduced energy consumption by lowering the fan speeds on the switch, allowing higher data center supply air temperatures and higher chilled water temperatures. The CID2RU-UNI/N Universal Duct proposed within this design fits a wide range of switches.



General Thermal Best Practices

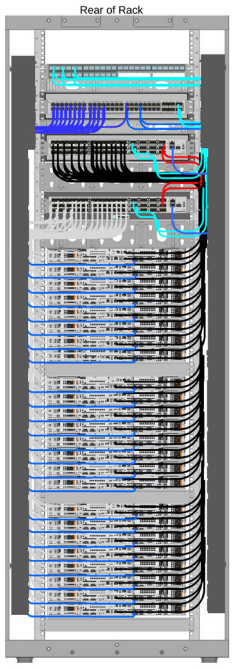
Maintaining a “Best Practices” front-to-back airflow pattern requires that all empty spaces be filled with air dams or blanking panels. Typical Node deployment patterns and designs make the use of 8 RU sections logical (eight R640s or four R740s). Between sections, it is advisable to place a minimum of a 1 RU break to reduce heat buildup. The selection of a 700mm or wider cabinet allows cable placement to be outside the 19 inch rack space and reduces the likelihood that cable placement will obstruct airflow.



2 or 3 RU Ducts allow for switch cold air to be routed to the inlet of the switch.
Power cables are routed thru the front to the cabinet to the back along with the vertical pass-throughs.

Cable Management

Copper Direct Attached Cables (DAC) are recommended for use within an individual cabinet to reduce cost and complexity. Each HBA Card within the server appliance connects to each ToR Switch to allow complete redundancy. ToR Connectivity to a Node should be color-coded to allow quick identification of redundant circuits. Slack should also be managed in the vertical space outside the equipment rail area, and care should be taken to reduce the amount of slack with the proper cable length selection.



In this diagram, the Appliance Nodes are deployed from the bottom up and the switches are populated from left to right. White and black cables demonstrate the routing of SFP28 25 Gb/s Direct Attach Cable Assemblies. Aqua color cables represent the pathways of OM4 fiber uplinks. Inner switch connectivity is shown in red, while RJ45 out of band management cables are depicted in blue. Appliance connectivity shown on the left is listed below.

SFP28 25 Gb/s Direct Attach Passive Cable Assembly Lengths

Part Number	Description	Nodes
PSF2PZA1MBL	SFP28 25 Gb/s Direct Attach Passive Cable Assembly Black	20-24
PSF2PZA1.5MBL	SFP28 25 Gb/s Direct Attach Passive Cable Assembly Black	17-19
PSF2PZA2MBL	SFP28 25 Gb/s Direct Attach Passive Cable Assembly Black	5-16
PSF2PZA2.5MBL	SFP28 25 Gb/s Direct Attach Passive Cable Assembly Black	1-4
PSF2PZA1.5MWH	SFP28 25 Gb/s Direct Attach Passive Cable Assembly White	13-24
PSF2PZA2MWH	SFP28 25 Gb/s Direct Attach Passive Cable Assembly White	1-12

Category 6 Small Diameter Out of Band Cable Lengths

Part Number	Description	Nodes
UTP28SP4BU	TX6-28™ Cat 6 UTP Patch Cord	21-24
UTP28SP5BU	TX6-28™ Cat 6 UTP Patch Cord	17-20
UTP28SP6BU	TX6 28™ Cat 6 UTP Patch Cord	11-16
UTP28SP7BU	TX6- 28™ Cat 6 UTP Patch Cord	7-10
UTP28SP8BU	TX6- 28™ Cat 6 UTP Patch Cord	1-6

- Switch interconnectivity is accomplished with dual QSFP28 40/100 Gb/s Direct Attach Passive Cable Assemblies: PQSF2PXA1MBL
- Fiber uplinks utilize OM4 Fiber Jumpers: FZ2ERLNLNSNM002
- OBM patch cord part numbers: UTP28SP3BU
- PDU management ports utilize UTP28SP6BU

Power Management

Power is critical to the reliability and availability of IT services. Data Center managers need to continuously monitor their infrastructure to plan for future capacity requirements and ensure system health to mitigate downtime. The majority of downtime accrued by clients within production-grade, commercial retail multi-tenant data center facilities is due to an improper understanding and implementation of the power management at the hardware receptacle level.

If a single server has both of its power cords plugged into live power outlets, the load will be shared across both power plugs equally. Should either of the two circuits fail and stop delivering power, the other will automatically start the total load required from the server. Assuming of course, that the total load consumed by the servers attached to both power circuits does not exceed the load of any one circuit.

Calculation of power requirements can be very time-consuming and ultimately relies on a good understanding of true power requirements. The use of nameplate power numbers can result in oversizing of circuits and stranded power capacity for the data center user. In order to avoid this, it is important to utilize online configuration tools provided by the equipment manufacturers to determine a typical power utilization and a maximum power draw. Dell Technologies Enterprise configuration tool (https://dell-ui-eipt.azurewebsites.net/#/) was utilized to compute the following power numbers for the R640 servers utilized in this reference design. Typical and maximum power numbers for the Cisco devices were determined from the respective switch specification sheets.

PowerFlex R640 Power Consumption

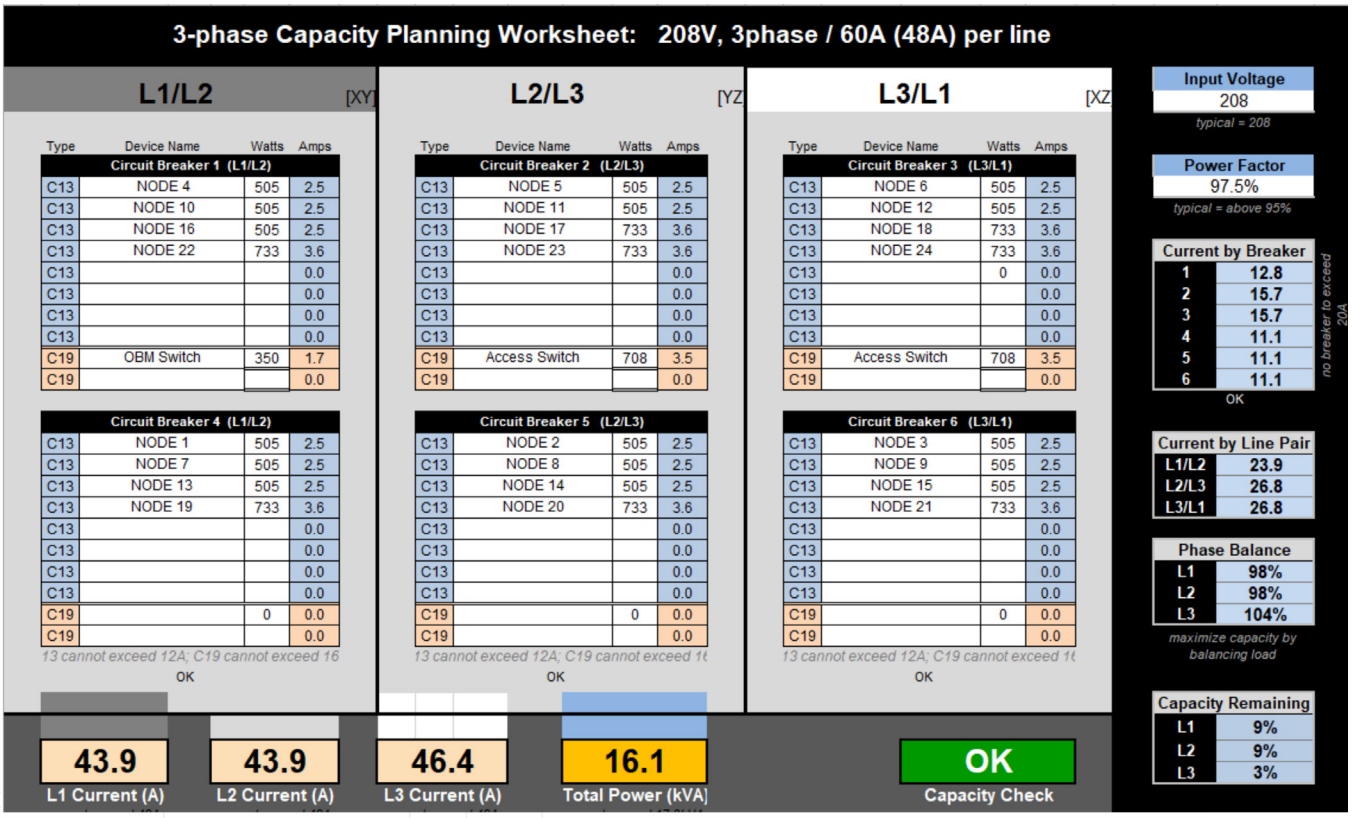
IDLE	**Transactional** 60% CPU Loading 100% Loading	**Maximum Power Potential** Fans at Full Speed
168 W	371 W 505 W	733 W

Switch Power Consumption

Switch Model Number	**Typical Power**	**Maximum Power Consumption**
Nexus 92348GC-X	135 W	350 W
Nexus 93240YC-FX2	298 W	708 W

Total capacity for rack-mounted Power Distribution Units must be calculated at the individual circuit level not just the aggregate circuit level. Circuit redundancy is rendered null/void when the aggregate load across dual circuits exceeds what an individual breaker can support during a failure of either the primary or redundant delivered load. Below are Load Balancing Charts for Panduit P36D31M PDUs. During normal deployment where an organization grows from 8 to 16 and up to 24 Nodes in a cabinet, a single 3-phase 60 Amps 208 V circuit can support the proposed deployment.

A user may choose to utilize 4 - 50 Amps input circuits to allow for future configurations that may have additional power requirements (Utilize Panduit - P36DJ1M).



3-phase Capacity Planning Worksheet: 208V, 3phase / 60A (48A) per line

L1/L2 [XY]

Type	Device Name	Watts	Amps
Circuit Breaker 1 (L1/L2)			
C13	NODE 4	505	2.5
C13	NODE 10	505	2.5
C13	NODE 16	505	2.5
C13	NODE 22	733	3.6
C13			0.0
C13			0.0
C13			0.0
C13			0.0
C19	OBM Switch	350	1.7
C19			0.0
Circuit Breaker 4 (L1/L2)			
C13	NODE 1	505	2.5
C13	NODE 7	505	2.5
C13	NODE 13	505	2.5
C13	NODE 19	733	3.6
C13			0.0
C13			0.0
C13			0.0
C13			0.0
C19		0	0.0
C19			0.0

13 cannot exceed 12A; C19 cannot exceed 16

OK

L2/L3 [YZ]

Type	Device Name	Watts	Amps
Circuit Breaker 2 (L2/L3)			
C13	NODE 5	505	2.5
C13	NODE 11	505	2.5
C13	NODE 17	733	3.6
C13	NODE 23	733	3.6
C13			0.0
C13			0.0
C13			0.0
C13			0.0
C19	Access Switch	708	3.5
C19			0.0
Circuit Breaker 5 (L2/L3)			
C13	NODE 2	505	2.5
C13	NODE 8	505	2.5
C13	NODE 14	505	2.5
C13	NODE 20	733	3.6
C13			0.0
C13			0.0
C13			0.0
C13			0.0
C19		0	0.0
C19			0.0

13 cannot exceed 12A; C19 cannot exceed 1t

OK

L3/L1 [XZ]

Type	Device Name	Watts	Amps
Circuit Breaker 3 (L3/L1)			
C13	NODE 6	505	2.5
C13	NODE 12	505	2.5
C13	NODE 18	733	3.6
C13	NODE 24	733	3.6
C13		0	0.0
C13			0.0
C13			0.0
C13			0.0
C19	Access Switch	708	3.5
C19			0.0
Circuit Breaker 6 (L3/L1)			
C13	NODE 3	505	2.5
C13	NODE 9	505	2.5
C13	NODE 15	505	2.5
C13	NODE 21	733	3.6
C13			0.0
C13			0.0
C13			0.0
C13			0.0
C19		0	0.0
C19			0.0

13 cannot exceed 12A; C19 cannot exceed 1t

OK

Input Voltage	
208	
typical = 208	
Power Factor	
97.5%	
typical = above 95%	

Current by Breaker	
1	12.8
2	15.7
3	15.7
4	11.1
5	11.1
6	11.1

no breaker to exceed 20A

OK

Current by Line Pair	
L1/L2	23.9
L2/L3	26.8
L3/L1	26.8

Phase Balance	
L1	98%
L2	98%
L3	104%

maximize capacity by balancing load

Capacity Remaining	
L1	9%
L2	9%
L3	3%

43.9	43.9	46.4	16.1	OK
L1 Current (A)	L2 Current (A)	L3 Current (A)	Total Power (kVA)	Capacity Check

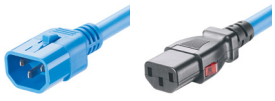
Utilized a downloadable free planning tool available from multiple sources.

The 3-phase Capacity Planning Worksheet above shows 16 Nodes deployed and the startup amperage of 8 additional units added at the same time. It is important to note that this is sufficient during normal operation for the model configuration used in this design. During the startup of all 24 Nodes in the event of catastrophic failure, individual breaker amperage can be as high as 18 Amps which is still below the 20 Amps breaker rating.

The recommended power cords should be mechanically connected at the point of entry to the rack or piece of ITE. This may be accomplished via the ITE manufacturer's cable tie-downs, hook-and-eye straps, cable ties, or similar attachments that allow for the secure attachment of the power cable to the enclosure that would prevent the accidental disconnection or damage of the cable. Provide slack loop, as appropriate, in the tie-down to allow for some cable movement. Locking receptacles should be used for connecting the server and switch input cords of the rack-mounted PDU. It is best practice to color code the different input circuits to ease in additions and circuit mapping. Lengths of cords will vary based on overhead or underfloor distribution systems.

For a full listing of available lengths and colors please check out the SmartZone™ G5 PDU Guide.

Dual Locking Power Cords

Color	Description	Ratings	Gauge/Cross Section	Length (feet)	Length (meters)	Part Number (10 pk)	
Red	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	2	0.6	LPCA01-X	 IEC320 C14 IEC320 C13
Red	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	4	1.2	LPCA02-X	
Red	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	6	1.8	LPCA03-X	
Red	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	8	2.4	LPCA04-X	
Blue	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	2	0.6	LPCA06-X	 IEC320 C14 IEC320 C13
Blue	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	4	1.2	LPCA07-X	
Blue	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	6	1.8	LPCA08-X	
Blue	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	8	2.4	LPCA09-X	
Black	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	2	0.6	LPCA11-X	 IEC320 C14 IEC320 C13
Black	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	4	1.2	LPCA12-X	
Black	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	6	1.8	LPCA13-X	
Black	Locking Power Cord, IEC C14 to IEC C13	10A/250 V	17 AWG/1.0mm²	8	2.4	LPCA14-X	

Dual Locking Power Cords — continued

Color	Description	Ratings	Gauge/Cross Section	Length (feet)	Length (meters)	Part Number (10 pk)	
Red	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	2	0.6	LPCB01-X	 IEC320 C20  IEC320 C19
Red	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	4	1.2	LPCB02-X	
Red	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	6	1.8	LPCB03-X	
Red	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	8	2.4	LPCB04-X	
Blue	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	2	0.6	LPCB06-X	 IEC320 C20  IEC320 C19
Blue	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	4	1.2	LPCB07-X	
Blue	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	6	1.8	LPCB08-X	
Blue	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	8	2.4	LPCB09-X	
Black	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	2	0.6	LPCB11-X	 IEC320 C20  IEC320 C19
Black	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	4	1.2	LPCB12-X	
Black	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	6	1.8	LPCB13-X	
Black	Locking Power Cord, IEC C20 to IEC C19	16A/250 V	15 AWG/1.5mm²	8	2.4	LPCB14-X	

Conclusion

This reference design outlines an optimized hyperconverged equipment cabinet within a data center that uses Dell Technologies software-defined network architecture based on industry standards and best practices. It also provides an informative guideline for engineers looking to accelerate the deployment and integration of components from Dell Technologies and Panduit.

Planning, designing, and building a custom solution is a complex project that often takes months or years to come to fruition. All aspects of the physical infrastructure have been thoroughly reviewed and mapped to the corresponding logical architecture. The design allows a data center architect to deploy an architecture that results in a reliable, scalable, high-performing, and secure implementations. The purpose of this design guide is to remove the complexity of this process and reduce the time to deploy.

- Additional information on Dell Technologies products and services can be found on Dell Technologies website
- Additional information on Panduit products and services can be found on Panduit's website.
- For more information on Panduit System Integrator Tools, please visit here.

Authors

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A former Naval Flight Officer who graduated from Vanderbilt University with a Civil Engineering degree. Credentialed as Registered Communications Distribution Designer for over 20 years and Data Center Design Consultant with Building Industry Consulting Service International. As a Technical Sales Engineer with Panduit, he has been assisting customers in understanding their needs and maximizing their the physical Infrastructures usefulness and life for the last 26 years.

Alva B. Eaton
Dell Technologies
Chief Architect, Principle Engineer

Alva B. Eaton is a Chief Architect, and Principal Engineer with Dell Technologies focusing on CI (Converged Infrastructure), HCI (Hyperconverged Infrastructure), and Data Center physical infrastructure. He has over 25 years of experience in IT across multiple disciplines. Along his journey, Alva has held roles including Data Center SME in the CTO Office at Panduit, Sr. Manager Engineering CI at VCE, and Director of Engineering HCI at Dell Technologies.

A straight talker who can accurately and quickly decipher complex requirements, Alva's ability to identify core issues, and craft and work with engineering to implement elegant solutions sets him above his industry peers. Alva is a sociable and approachable individual who enjoys meeting new people from all walks of life and all facets of business. He strives to be the leader and teacher of CI and HCI products to the Pre-Sales Community at Dell Technologies, driving innovation between sales and engineering.

Required Equipment for Deployment

Cabinets and Ducts (Choose 1 Cabinet Type)

Part Number	Description	Qty.	Units
XG74222BS0001	FlexFusion™ Cabinet, 700mm x 42 RU x 1200mm, Black, Hardware Mount Rail, Top Cap with Brush Seal, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, Left PDU Bracket, Casters	1	pc
*Use of Electronic handle requires an intelligent Panduit G5 PDU			
XG74222BS001V	FlexFusion™ Cabinet, 700mm x 42 RU x 1200mm, Black, Hardware Mount Rail, Top Cap with Brush Seal, Single Hinge Perforated Front Door, Split Perforated Rear Door, Standard Locks, Left and Right Side Panels, One Set Short Cable Mgmt. Fingers, Left and Right PDU Brackets, Left and Right Vert Cable Management Panels, Casters	1	pc
TLBP1R-V	1 RU tool-less blanking panel, with a round hole 19" (483mm) width for tapped rails	3	pkg
CMPH1	The Open-Access™ Horizontal D-Ring Cable Manager provides open and efficient access to power, coaxial, and communications cables. Made of a steel frame with modular plastic snap-in D-rings, the cable manager is lightweight and durable, but flexible enough to endure seamless moves, adds, and changes. It is compatible with any standard EIA 19" (483mm) rack or cabinet. The manager is 1 RU and comes with 3" deep D-rings on the front and 5" deep D-rings on the rear. The manager is black.	2	pkg
CMPH2	The Open-Access™ Horizontal D-Ring Cable Manager provides open and efficient access to power, coaxial, and communications cables. Made of a steel frame with modular plastic snap-in D-rings, the cable manager is lightweight and durable, but flexible enough to endure seamless moves, adds, and changes. It is compatible with any standard EIA 19" (483mm) rack or cabinet. The manager is 2 RU and comes with 3" deep D-rings on the front and 5" deep D-rings on the rear. The manager is black.	2	pkg

Vertically Mounted Power Distribution Strip

Part Number	Description	Qty.	Units
P48D35M	The SmartZone™ G5 Monitored Input PDU features (36) C13 and (12) C19 outlets. It is 60 Amps, 208 V, three-phase PDU with an IEC 60309 3P+E 9h 60 Amps (IP44) input plug and a 10' (3m) power cord. The PDU is black.	2	pc
P36D08M	The SmartZone™ G5 Monitored Input PDU features (30) C13 and (6) C19 outlets. It is 30 Amps, 208 V, three-phase PDU with a NEMA L15-30P input plug and a 10' (3m) power cord. The PDU is black.	2, 4 or 6	pc

Direct Attach and OBM Cable Packages

Servers 1-8

Part Number	Description	Qty.	Units
PSF2PZA2MBL	The high-speed twinaxial cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. It is black and 2m in length.	8	pc
PSF2PZA2.5MBL	Direct-attach passive copper cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. The high-speed assembly has a twinaxial cable, is black, and is 2.5m in length.	8	pc
PSF2PZA2MWH	Direct-attach passive copper cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. The high-speed assembly has a twinaxial cable, is white, and is 2m in length.	16	pc
UTP28SP8BU	The TX6-28™ Cat 6 UTP Patch Cord is constructed of 28 AWG, unshielded, twisted pair, stranded, CM/LSZH cable with enhanced performance modular plugs. The use of 28 AWG cable ensures that this patch cord has a small diameter, making it easy to install and work with. The patented tangle-free latch prevents snags and provides easy release saving time on frequent moves, adds, and changes. The patch cord is 8' in length, 0.150" (3.8mm) nominal in diameter, and blue.	6	pc
UTP28SP7BU	The TX6-28™ Cat 6 UTP Patch Cord is constructed of 28 AWG, unshielded, twisted pair, stranded, CM/LSZH cable with enhanced performance modular plugs. The use of 28 AWG cable ensures that this patch cord has a small diameter, making it easy to install and work with. The patented tangle-free latch prevents snags and provides easy release saving time on frequent moves, adds, and changes. The patch cord is 7' in length, 0.150" (3.8mm) nominal in diameter, and blue.	2	pc

Direct Attach and OBM Cable Packages

Servers 9-16			
PSF2PZA2MBL	The high-speed twinaxial cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. It is black and 2m in length.	16	pc
PSF2PZA1.5MWH	Direct-attach passive copper cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. The high-speed assembly has a twinaxial cable, is white, and is 1.5m in length.	8	pc
PSF2PZA2MWH	Direct-attach passive copper cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. The high-speed assembly has a twinaxial cable, is white, and is 2m in length.	8	pc
UTP28SP6BU	The TX6-28™ Cat 6 UTP Patch Cord is constructed of 28 AWG, unshielded, twisted pair, stranded, CM/LSZH cable with enhanced performance modular plugs. The use of 28 AWG cable ensures that this patch cord has a small diameter, making it easy to install and work with. The patented tangle-free latch prevents snags and provides easy release saving time on frequent moves, adds, and changes. The patch cord is 6' in length, 0.150" (3.8mm) nominal in diameter, and blue.	6	pc
UTP28SP7BU	The TX6-28™ Cat 6 UTP Patch Cord is constructed of 28 AWG, unshielded, twisted pair, stranded, CM/LSZH cable with enhanced performance modular plugs. The use of 28 AWG cable ensures that this patch cord has a small diameter, making it easy to install and work with. The patented tangle-free latch prevents snags and provides easy release saving time on frequent moves, adds, and changes. The patch cord is 7' in length, 0.150" (3.8mm) nominal in diameter, and blue.	2	pc
Servers 17-24			
PSF2PZA1MBL	The high-speed twinaxial cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. It is black and 1m in length.	10	pc
PSF2PZA1.5MBL	Direct-attach passive copper cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. The high-speed assembly has twinaxial cable, is black, and is 1.5m in length.	6	ft
PSF2PZA1.5MWH	Direct-attach passive copper cable assembly features 25 Gb/s SFP28 hot pluggable modular connectors on each end. The high-speed assembly has twinaxial cable, is white, and is 1.5m in length.	16	pc
UTP28SP5BU	The TX6-28™ Cat 6 UTP Patch Cord is constructed of 28 AWG, unshielded, twisted pair, stranded, CM/LSZH cable with enhanced performance modular plugs. The use of 28 AWG cable ensures that this patch cord has a small diameter, making it easy to install and work with. The patented tangle-free latch prevents snags and provides easy release saving time on frequent moves, adds, and changes. The patch cord is 5' in length, 0.150" (3.8mm) nominal in diameter, and blue.	4	pc
UTP28SP4BU	The TX6-28™ Cat 6 UTP Patch Cord is constructed of 28 AWG, unshielded, twisted pair, stranded, CM/LSZH cable with enhanced performance modular plugs. The use of 28 AWG cable ensures that this patch cord has a small diameter, making it easy to install and work with. The patented tangle-free latch prevents snags and provides easy release saving time on frequent moves, adds, and changes. The patch cord is 4' in length, 0.150" (3.8mm) nominal in diameter, and blue.	4	pc
Switch to Switch Connectivity			
PQSF2PXA1MBL	High-speed twinaxial cable assembly with QSFP28 100 Gb/s hot pluggable modular connectors on each end, is black, and 1m in length.	2	pc
UTP28SP3BU	The TX6-28™ Cat 6 UTP Patch Cord is constructed of 28 AWG, unshielded, twisted pair, stranded, CM/LSZH cable with enhanced performance modular plugs. The use of 28 AWG cable ensures that this patch cord has a small diameter, making it easy to install and work with. The patented tangle-free latch prevents snags and provides easy release saving time on frequent moves, adds, and changes. The patch cord is 3' in length, 0.150" (3.8mm) nominal in diameter, and blue.	2	pc

Fiber Patch Cables

Part Number	Description	Qty.	Units
FZ2ERLNLNSNM002	The duplex fiber patch cord is OM4 with 1.6mm jacketed cable. It is Riser (OFNR) rated, features LC Duplex connectors, has standard insertion loss, and is 2m long.	6	pc

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