*By Tony Harvey,
senior product manager
engineering, Cisco*

*Elizabeth Bagnas,
business value marketing
manager, Eaton*

How to enhance hyperconvergence with infrastructure management

Eaton power management with Cisco HyperFlex Systems reference architecture

Executive summary

Hyperconvergence collapses the physical components of IT with its virtual aspects into a single appliance form factor. Servers, storage and virtualization layers are bundled into one scalable pool of resources and completely integrated for easier, faster and more cost-effective management. With HyperFlex™ Systems, Cisco® went one step further by including integrated network fabric for faster deployment, simpler management and easier scalability. Still, vital to the operation of all hyperconverged solutions is the fundamental reliance on power infrastructure, and to realize the full benefits of hyperconvergence, it is critical to deploy effective monitoring and management of the power infrastructure. This paper demonstrates ways to improve resiliency against power disruptions and make IT resources easier to manage and scale. It offers a technical overview of power considerations for the successful deployment and operation of hyperconverged solutions, specifically Cisco HyperFlex Systems.

Table of contents

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Powering Business Worldwide

Business challenge

Downtime carries an enormous price tag, measured in lost sales and direct costs to remediate problems. But downtime also carries significant indirect costs, such as lost brand reputation, weakened competitive position and lower customer confidence. In the U.S., power interruptions cost the economy $96 billion annually. One retailer incurred a $4.8 million loss in profit and repair due to two power failures.

The cost and effect of power disruptions are even more amplified in virtualized environments. Virtualization means that every server needs more power. A virtualized machine will run at 70% to 80% capacity, whereas a machine that is not virtualized runs at 10% to 15%. This means IT rack enclosures containing these virtualized servers will draw more power, too. Virtualization allows applications to be moved from one server to another at a moment's notice. This instantly shifts the power demands within existing infrastructure and means flexibility assumes a new importance. Not factoring in power as part of virtualized environments in general, and hyperconverged environments in particular, is a big mistake that inevitably creates increased risk.

Risks include:

- **Costs increase** because of overprovisioning of power infrastructure

- **Sub-optimal operating conditions** because of the right amount of power doesn't go to the right place at the right time
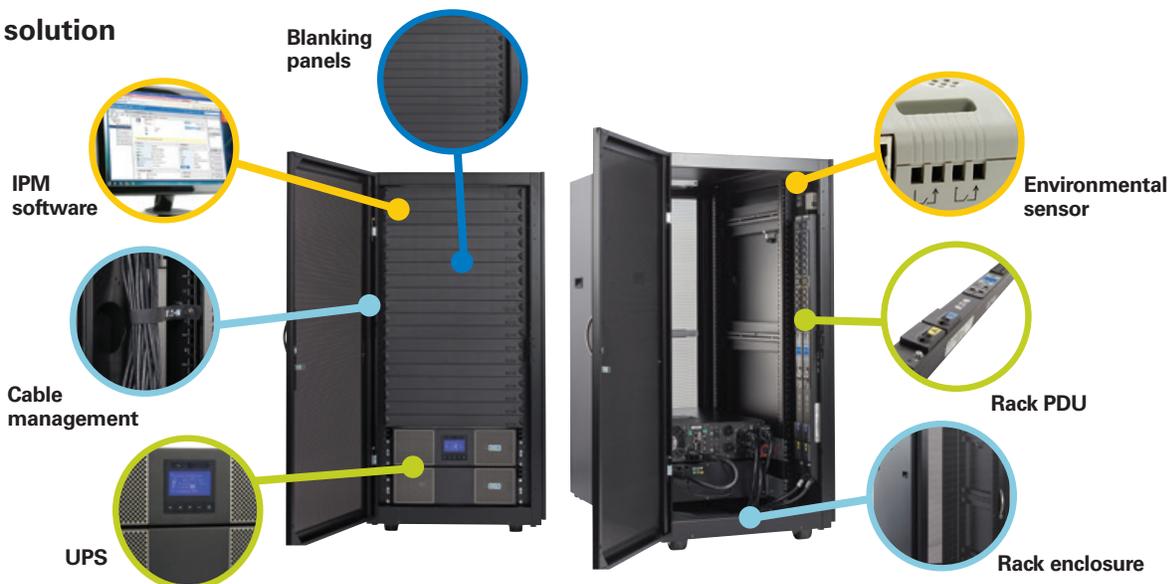
Business solution

Figure 1. Eaton integrated power management solutions maintain uptime and enhance Cisco HyperFlex Systems performance.

HyperFlex Systems are pre-integrated clusters that combine software-defined computing in the form of Cisco Unified Computing System (UCS) servers, software-defined networking with Cisco unified fabric and software-defined storage technology called Cisco HyperFlex HX Data Platform software. Developed through a strategic partnership with Springpath, the Cisco HyperFlex HX Data Platform combines the cluster's solid-state drives and spinning disks into a single distributed, multi-tier, object-based data store. It includes enterprise-class data management features expected from enterprise storage systems to support an entire application lifecycle: for example, snapshots, thin provisioning, and instant and space-efficient cloning. Adding a new HyperFlex System node is simple. The system automatically discovers and configures the new hardware, and adding it to the cluster takes only a few clicks. HyperFlex Systems are managed through vCenter, so administrators who have worked with vSphere have a short learning curve.

Physically, the system is delivered as a cluster of three or more Cisco HyperFlex HX-Series nodes integrated into a single system by two UCS 6200 series fabric interconnects. Each node includes an HX Data Platform controller that communicates over 10 Gb Ethernet to present a single pool of storage that spans the nodes in the cluster. The system is managed as a single entity through a vSphere client plug-in to Cisco UCS management. The controller integrates the data platform software through two preinstalled VMware ESXi vSphere installation bundles.

Eaton provides intelligent, integrated and scalable solutions designed to organize, protect and manage HyperFlex Systems. Eaton's power infrastructure products consist of power protection, power distribution, rack enclosures, cable management and power management software to simplify power management and ensure business continuity.

Eaton integrated power management benefits include:

- **L**ower data center operating cost by doubling runtime with integrated load shedding and power capping capability, avoiding data retrieval costs of $2,450 per hardware device incident through environmental load shedding and reducing generator fuel consumption by ~54% to ride through power outages

- **Simpler power management** through centralized and remote control

- **Simpler operations** with VMware vCenter virtualization integration, eliminating the need to learn yet another management system

- **Easier scaling** when needed

- **Easier configuration** with reference designs and bundle ordering

How to enhance HyperFlex Systems performance with intelligent power management:

Intelligent Power Manager (IPM)

Eaton.com/IntelligentPower

Eaton's IPM software integrates with VMware vCenter, which allows the entire power infrastructure to be viewed and managed over the network, and results in continuous uptime of hosts and virtual machines. It complements many virtualization and cloud management tools by extending their capabilities to include monitoring and management of network-connected power devices, infrastructure-aware workload management, dynamic power capping, and initiation of failover policies.

Dynamic power capping: IPM works with Cisco UCS Manager to enable power capping on demand. The IT manager can set up server power capping to initiate upon specified alarms, such as utility power loss, to reduce the load on the UPS batteries and therefore extend battery runtime.

Load shedding: This IPM feature reduces the workload on the IT devices so power consumption is minimized. Load shedding suspends or shuts down non-critical workloads (applications) and combines the higher critical workloads on fewer servers, then shuts down as many servers as possible. This increases system uptime while extending battery runtime and minimizing generator load.

Initiate VM move or graceful shutdown: IPM can also initiate a move of critical applications to a backup data center based on UPS power alarms from the UPS and PDU (utility power lost) and environmental conditions from the rack sensor (temperature over the limit).

Uninterruptible power supply (UPS)

Eaton.com/9PX

UPS equipment performs three vital functions in hyperconverged infrastructure power protection strategy:

1. Notify the HyperFlex System of utility failures or environmental alarms, causing the IPM software to initiate business continuity measures

2. Provide the emergency power needed to complete virtual machine migrations before gracefully shutting down the system

3. Safeguard the HyperFlex System from potentially hazardous power impurities

ENERGY STAR® qualified 5PX, 9PX and BladeUPS models provide reliable, versatile and efficient backup power. External battery modules extend battery runtime.

Rack PDU

Eaton.com/ePDU

HyperFlex Systems can be ordered with Cisco power distribution unit, model RP208-2P-U-2. Attach Eaton ePDU G3 Metered or Managed models for enhanced monitoring and management capabilities.

Eaton rack power distribution units do more than simply distribute power; they enable the IT manager to:

- Benefit from remotely rebooting connected equipment and turning off unused outlets to prevent unauthorized use

- Measure the most accurate Level 2 power usage effectiveness (PUE) at the outlet level for the most accurate view of power utilization

- View and manage equipment remotely instead of being physically present in the server room or remote location

Eaton Metered and Managed models feature the most accurate view of power usage in its environment, leading to cost-saving opportunities, advanced LCD pixel display, a hot-swap meter, patent-pending IEC grip features and the ability to operate at high 140°F (60°C) temperatures.

Rack enclosures and cable management

Eaton.com/Enclosures

HyperFlex Systems can be installed in the Cisco R4610 rack. If a taller, wider or deeper rack is required, Eaton enclosures come in a variety of sizes that can secure and maintain integrity of hardware equipment while also allowing for scalability and growth. Tool-less blanking panels allow for quick installation and reduce re-circulation of hot exhaust air to the equipment inlet. Cable management maximizes airflow and unit organization resulting in reduced cooling costs.

Environmental monitoring probe

Eaton's environmental monitoring probe delivers up-to-date temperature and humidity readings within the rack enclosure. This sensor helps automate migration of virtual machines to the cloud or backup sites based on temperature, humidity spikes and security alarm notifications.

Use cases

Protecting and managing small, remote data centers

Remote offices, branch offices and satellite offices do not have local IT staff to perform manual operations. These locations also typically do not have UPSs or generators. IPM enables IT managers to remotely monitor, manage and control the power infrastructure on their network, reducing the need for onsite IT personnel. IPM prevents downtime with workload management (load shedding) and power capping, and ensures data integrity with automated failover for business continuity. A dedicated rackmount UPS conditions power to ensure continuous uptime, and during power interruptions, keeps HyperFlex Systems running through battery runtime.

Ensuring uptime and business continuity for data centers

Large data centers that typically use generators benefit from power protection and power management during major disasters like a hurricane or ice storm where power may be out for several days or longer. For example, when Hurricane Sandy hit the northeast U.S. in 2012, data centers ran generators to provide electricity to continue operations. In the meantime, the fuel tanks were draining, causing employees to carry gallons of fuel to generators on building roofs, and IT technicians were determining which applications and virtual machines could be shut down to reduce the generator load. This process was manual. IPM can start the load-shedding process soon after the disaster strikes. It also works with UCS Server Manager for power capping capability to reduce the generator's workload and the corresponding fuel usage.

Implementing disaster recovery

Deploying HyperFlex Systems is one of the easiest and fastest ways to achieve backup and disaster recovery goals. It makes sure the disaster recovery site is protected against power problems and is able to ride through prolonged power outages.

Safeguarding data center scaling

HyperFlex Systems operationalize data center scaling with a modular approach to all-in-one solutions. When the next data center refresh comes due, including power infrastructure and management will optimize uptime.

Best practices for powering hyperconverged solutions

Developing an effective power strategy is achieved by understanding the current rack enclosure environment and workload demands, followed by choosing an optimized rack PDU and then backing up the system with a UPS enabled with virtualized management software. The addition of power management software enables IT managers to monitor HyperFlex System operations to the outlet level, further optimizing operational efficiency.

Populating rack enclosures

Racks enclosures should be populated with the heaviest and most power-dense equipment at the bottom. Place heavy equipment, the UPS and extended battery modules, there to help lower the unit's center of mass and reduce the risk of tipping. Install HyperFlex System nodes above the UPS. Place the fabric interconnect and fabric extenders toward the top of the rack enclosure. Rack enclosure U-space not consumed should be populated with blanking panels for improved airflow.

Managing cables

Proper cable management is critical to reducing airflow blockage. Lack of sufficient airflow may result in increased equipment fan power consumption to compensate for increased airflow impedance. Properly dress the cables with cable rings and Velcro tie-downs to provide the best airflow.
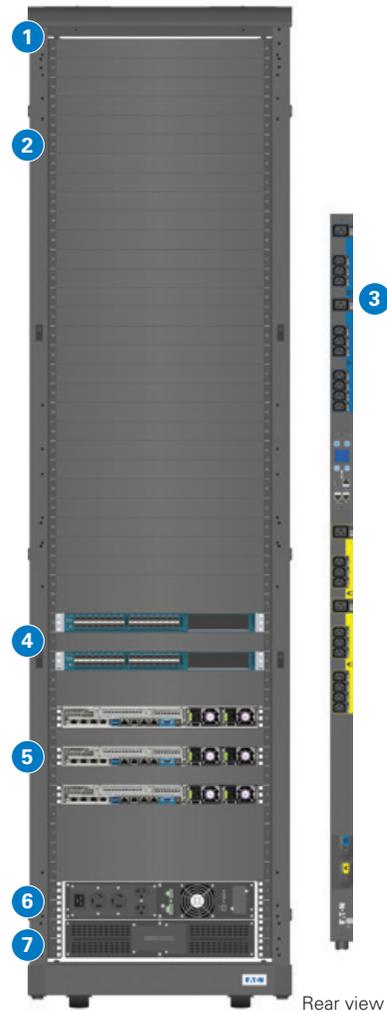
Planning power

Gather basic information about the site where the hyperconverged solution will reside. What voltage is used? Is power available as a single- or three-phase source? What types of power input plugs are used? Answers to these questions will confirm UPS and PDU selection. The Eaton UPS and PDU models listed in the Eaton reference designs match the power requirements of the UCS servers and switches called out in HyperFlex Systems.

HyperFlex Systems and switches have dual power supplies. For a small deployment, connect the nodes and switches to one PDU and then to the UPS for power protection. For larger deployments, use two rack PDUs for redundancy. Plug each rack PDU into a different load segment (group of receptacles that can be independently controlled) of the UPS.

Solution configuration and topology guide

Small footprint using HX220c M4 nodes (3-node minimum)

1. Eaton 42U enclosure
2. Eaton blanking panels
3. Eaton managed ePDU G3
4. Cisco UCS 6248UP 48-port fabric interconnect
5. Cisco HX 220c M4
6. Eaton 9130 rackmount, 2700 Watt, 2U UPS
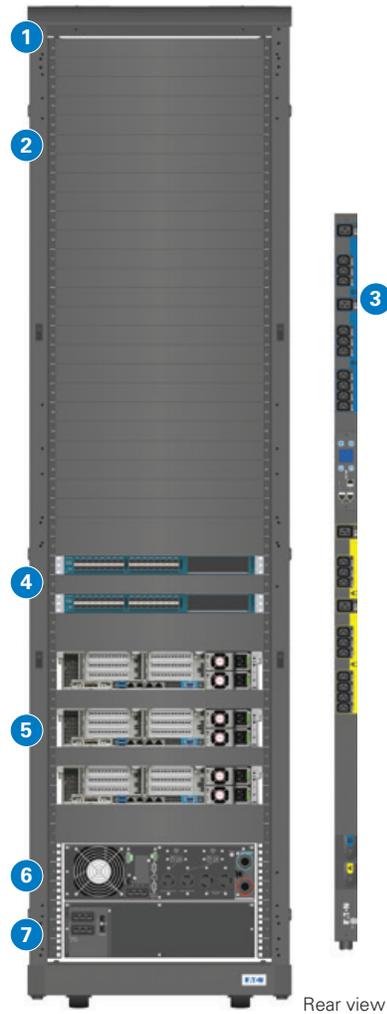7. Eaton external battery module for 9130 UPS, 2U

Rear view

Cisco solutions

Layer	Component	Qty	Power connection	Typical power (watts)	Total typical power (watts
Fabric interconnect	UCS 6248UP	2	(2) C14	380	760
Hyperconverged infrastructure	HX220c M4	3	(2) C14	351	1053
				Total power	**1813**
Software	UCS Manager 2.2 and integrated management controller		Connection to UCS management for automated configuration through a single interface		
Software	HyperFlex DX data platform		1- or 3-year software subscription		
Software	VMware vSphere ESXi 6.0		Preinstalled; ESXi 5.5 supported but not preinstalled		

Eaton solutions

Layer	Component	Qty	Details
Enclosure	ETN-ENC422442SB	1	42U rack, 24 inches wide and 42 inches deep
Cable management	ETN-PBP1U10	4	10-pack 1U blanking panels
Cable management	ETN-STLDRING	2	Cable D-ring kit
Cable management	ETN-CMVBCKL	2	Velcro buckle straps
Power distribution	EMA107-10	1	Managed rack power distribution for outlet-level consumption monitoring, outlet switching and remote site management, 200-240V, L6-30P input plug, (20) C13 and (4) C19 output receptacles
Power protection	PW9130G3000R-XL2U UPS	1	2700W UPS, 208V, L6-20P input plug, (2) 6-20R, (1) L6-20R,and (1) L6-30R receptacles, 2U; provides 6 minutes of battery runtime
Power protection	Network Card-MS	1	Network management card provides real-time monitoring and control across UPSs in the network
Power protection	PW9130N3000R-EBM2U 9PXEBM180RT	1	External battery module, 2U, extends runtime to 25 minutes
Environmental sensor	116750224-001	1	Environmental monitoring probe monitors humidity and temperature
Power management	66926	1	IPM version 1.53 gold license

Capacity-intensive cluster using HX240c M4 nodes (3-node minimum)

1. Eaton 42U enclosure
2. Eaton blanking panels
3. Eaton managed ePDU G3
4. Cisco UCS 6248UP 48-port fabric interconnect
5. Cisco HX 240c M4
6. Eaton 9PX, 4500 Watt, 3U UPS
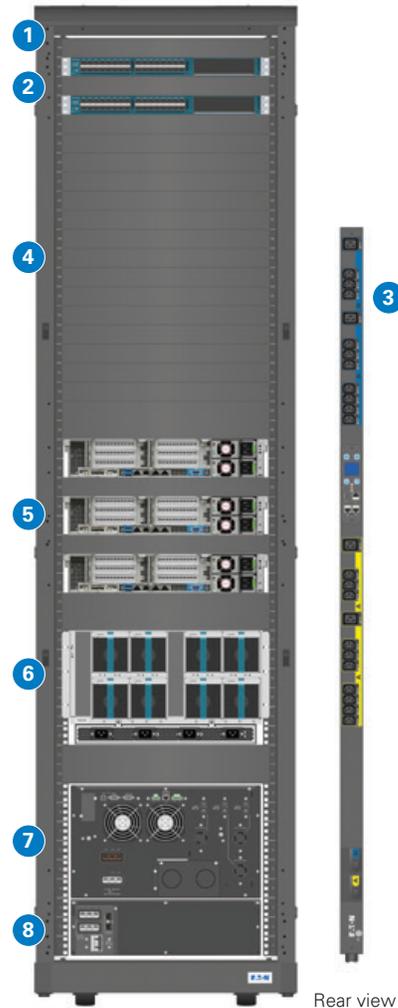7. Eaton external battery module for 9130 UPS, 3U

Rear view

Cisco solutions

Layer	Component	Qty	Power connection	Typical power (watts)	Total typical power (watts
Fabric interconnect	UCS 6248UP	2	(2) C14	380	760
Hyperconverged infrastructure	HX240c M4	3	(2) C14	572	1716
				Total power	**2476**
Software	UCS Manager 2.2 and integrated management controller		Connection to UCS management for automated configuration through a single interface		
Software	HyperFlex DX data platform		1- or 3-year software subscription		
Software	VMware vSphere ESXi 6.0		Preinstalled; ESXi 5.5 supported but not preinstalled		

Eaton solutions

Layer	Component	Qty	Details
Enclosure	ETN-ENC422442SB	1	42U rack, 24 inches wide and 42 inches deep
Cable management	ETN-PBP1U10	4	10-pack 1U blanking panels
Cable management	ETN-STLDRING	2	Cable D-ring kit
Cable management	ETN-CMVBCKL	2	Velcro buckle straps
Power distribution	EMA107-10	1	Managed rack power distribution for outlet-level consumption monitoring, outlet switching and remote site management, 200-240V, L6-30P input plug, (20) C13 and (4) C19 output receptacles
Power protection	9PX5K UPS with Network Management Card	1	4500W UPS, 208V, terminal block with L6-30P input, (2) L6-20R, (2) L6-30R and hardwired terminal block output connections, 3U; includes network management card; provides 10 minutes of battery runtime
Power protection	9PXEBM180RT	1	External battery module, 3U extends runtime to 44 minutes
Environmental sensor	116750224-001	1	Environmental monitoring probe monitors humidity and temperature
Power management	66926	1	IPM version 1.53 gold license

Compute-intensive hybrid cluster using HX240c M4 nodes (3-node minimum)

1. Eaton 42U enclosure
2. Cisco UCS 6248UP 48-port fabric interconnect
3. Eaton managed ePDU G3
4. Eaton blanking panels
5. Cisco HX 240c M4
6. Cisco UCS B200 M4 Blade-Series servers
7. Eaton 9PX, 7200 Watt, 6U UPS
8. Eaton external battery module for 9PX UPS, 3U

Rear view

Cisco solutions

Layer	Component	Qty	Power connection	Typical power (watts)	Total typical power (watts
Fabric interconnect	UCS 6248UP	2	(2) C14	380	760
Hyperconverged infrastructure	HX240c M4	3	(2) C14	572	1716
	UCS5108 blade server chassis	1	(2) C19	2915	2915
	UCS B200 M4 blade servers	2	n/a		
				Total power	5391
Software	UCS Manager 2.2 and integrated management controller		Connection to UCS management for automated configuration through a single interface		
Software	HyperFlex DX data platform		1- or 3-year software subscription		
Software	VMware vSphere ESXi 6.0		Preinstalled		

Eaton solutions

Layer	Component	Qty	Details
Enclosure	ETN-ENC422442SB	1	42U rack, 24 inches wide and 42 inches deep
Cable management	ETN-PBP1U10	3	10-pack 1U blanking panels
Cable management	ETN-STLDRING	2	Cable D-ring kit
Cable management	ETN-CMVBCKL	2	Velcro buckle straps
Power distribution	EMA107-10	2	Managed rack power distribution for outlet-level consumption monitoring, outlet switching and remote site management, 200-240V, L6-30P input plug, (20) C13 and (4) C19 output receptacles
Power protection	9PX8K with Network Management Card	1	7200W UPS, 208V, terminal block with (3) L6-30R and hardwired terminal block output connections; 6U; includes network management card; provides 9 minutes of battery runtime
	9PXEBM240RT	1	External battery module extends runtime to 23 minutes
Environmental sensor	116750224-001	1	Environmental monitoring probe monitors humidity and temperature
Power management	66926	1	IPM version 1.53 gold license

Conclusion

By consolidating the server, storage and hypervisor management layers of traditional IT into one solution, HyperFlex Systems deliver scalability, decreased complexity and increased efficiency —if backed by advanced UPSs, PDUs and integrated power management software. The combination of HyperFlex System with Eaton power management solutions delivers a unique, highly resilient solution that will ensure business continuity.

Eaton and Cisco partnership

As a Preferred Solution Partner, OEM partner and provider of products designated as Cisco Compatible, Eaton offers power management technologies that allow Eaton and Cisco customers to protect their valuable data and equipment from unpredictable power events that can lead to costly business interruption and downtime. Learn more at **Eaton.com/Cisco**.

About Eaton

Eaton's electrical business is a global leader with expertise in power distribution and circuit protection; backup power protection; control and automation; lighting and security; structural solutions and wiring devices; solutions for harsh and hazardous environments; and engineering services. Eaton is positioned through its global solutions to answer today's most critical electrical power management challenges.

Eaton is a power management company with 2015 sales of $20.9 billion. Eaton provides energy-efficient solutions that help customers effectively manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. Eaton has approximately 97,000 employees and sells products to customers in more than 175 countries. For more information, visit **Eaton.com**.

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About the authors

Tony Harvey is a senior product manager at Cisco working on UCS Mini, UCS Chassis Projects, Power, Cooling and Environmental strategies for the Computing Systems Product Group. Tony was responsible for the development of the UCS Mini product for Cisco and is deeply involved in power and cooling solutions for high density blade and rack servers. Tony also works with datacenter vendors and product groups on how to manage increased datacenter density, improve energy efficiency and extend the life of the datacenter infrastructure. Prior to Cisco, Tony spent twenty years in technical support, technical training, product development, and product management roles for technology companies including HP.

Elizabeth Bagnas is a business value marketing manager for Eaton's Distributed Power Quality group, working on promoting and communicating the business benefits of customer-focused, applications-driven power management solutions from Eaton. Before joining Eaton in 2000, she held various roles in business management and inside sales. Elizabeth holds a bachelor's degree in political science from the University of California, San Diego.

For more information, please visit,
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