OCTOBER 20, 2020 – ABB DATA CENTER EXPERT DAY

By the Numbers

T-Mobile Drives Data Center Density with Direct Distribution Power

In cooperation with

Speakers

Don Doyle

Critical Facilities Member of Technical Staff

T-Mobile

Paul Smith

Senior Applications Engineer

ABB

Agenda

Your Questions, Answered

01. What is Direct Distribution Power?

02. When and where does it make sense?

03. How is the new data center power architecture achieved?

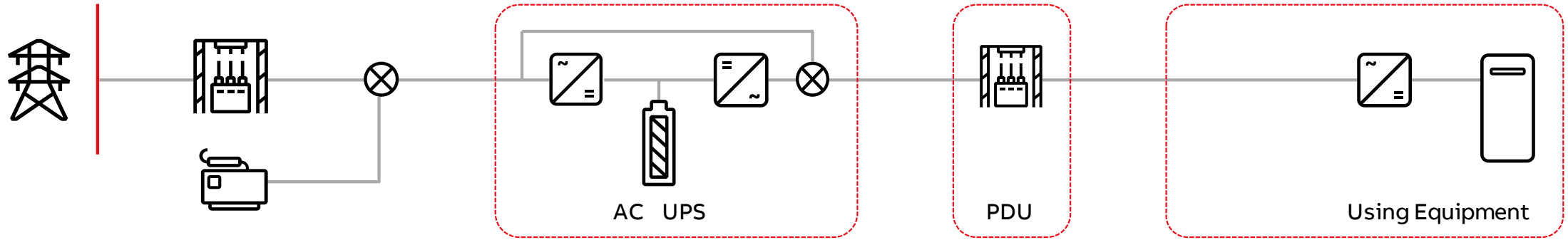
04. What ROI can be achieved with Direct DC Power Distribution in the Data Center?

1

What is
Direct Distribution Power?

Data Center Power

AC UPS

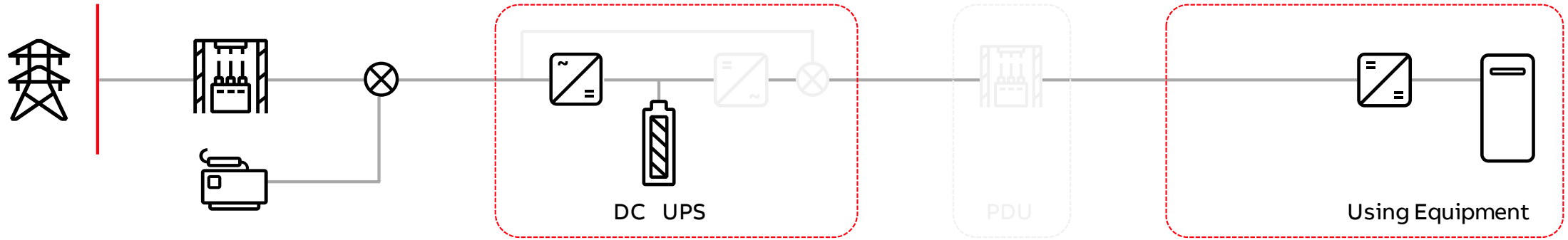


AC1 → **AC2** → **DC1** → **AC3** → **AC4** → **DC2**

480V **540V** **480V** **208V** **12V**

Data Center Power

DC UPS – Telecom Standard



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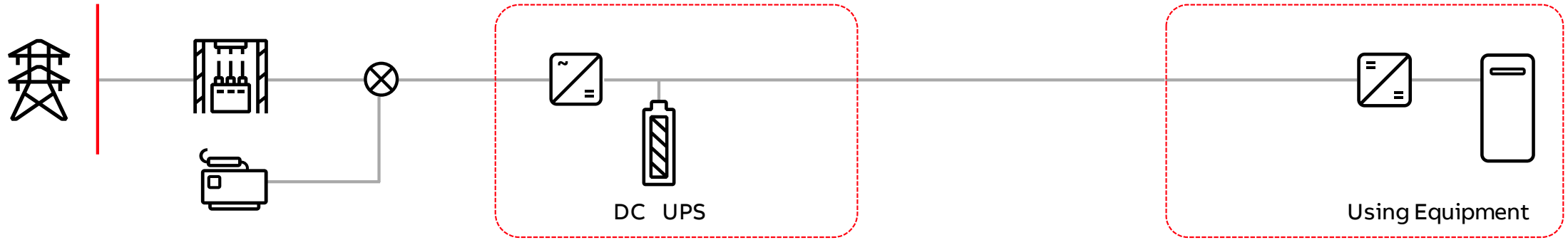
Data Center Power

DC UPS – Telecom Standard

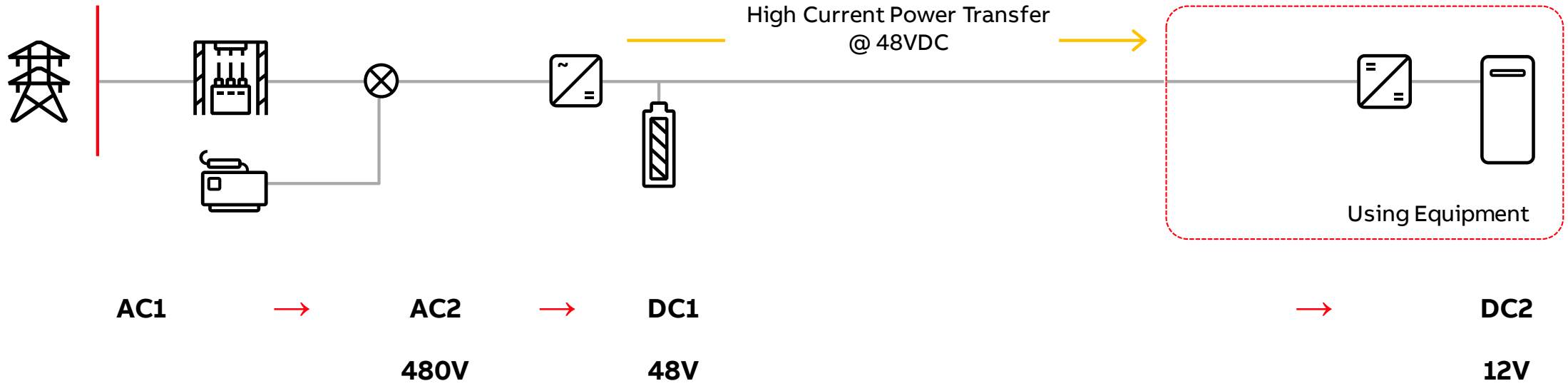


AC1 → **AC2** → **DC1** → **DC2**

480V **48V** **12V**

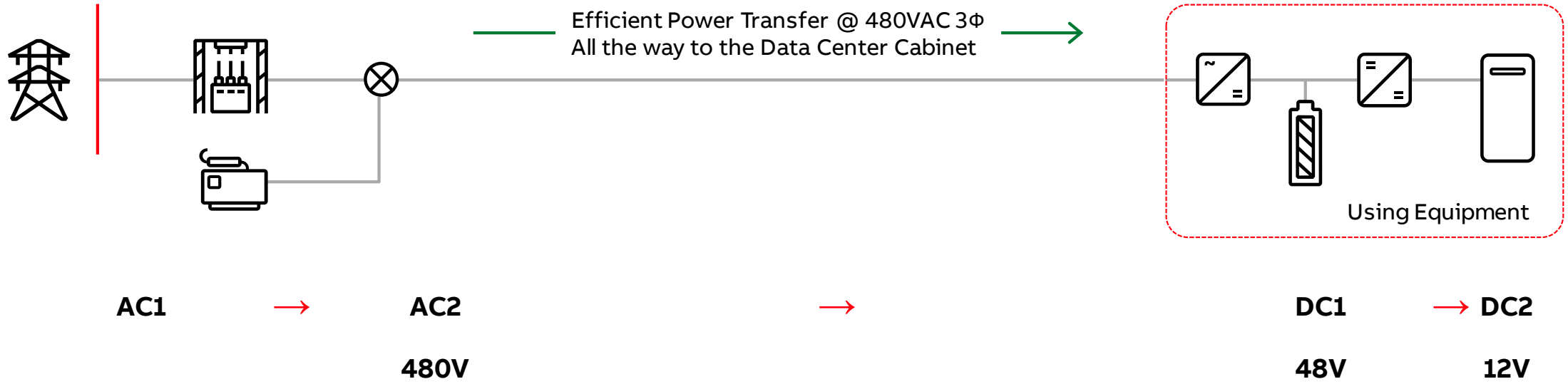
Data Center Power

Integrated DC UPS



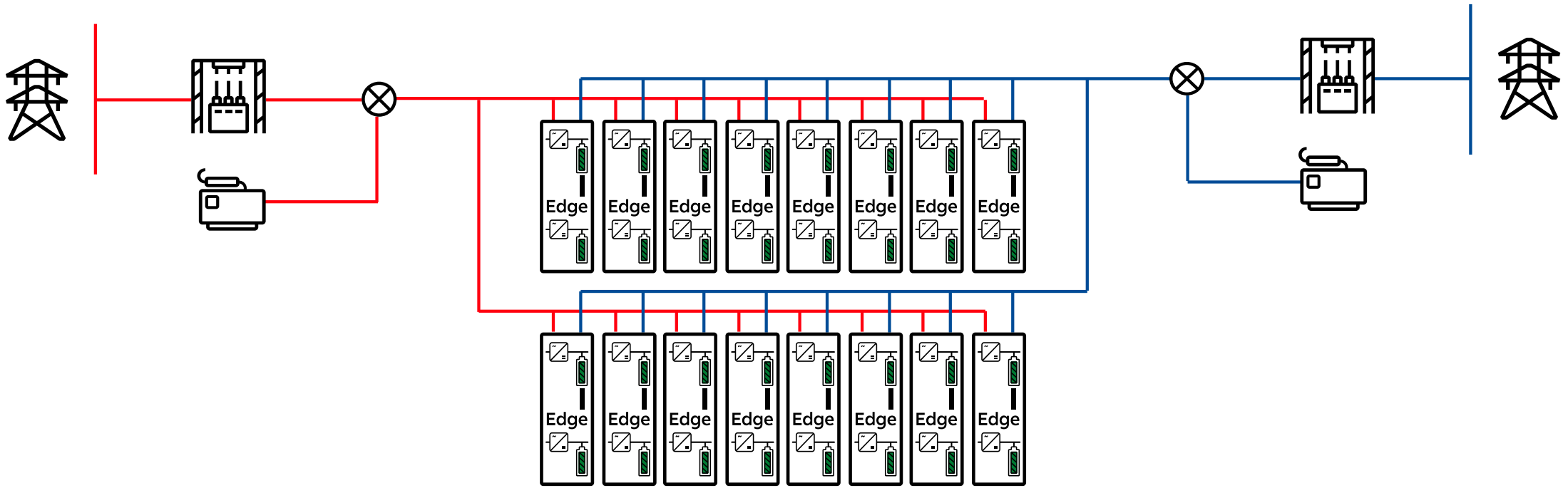
Data Center Power

Direct Distribution - DC UPS



Direct-AC-to-Rack Power Architecture

Dual AC Power Feed



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Why
Direct Distribution Power?

Why Direct Distribution Power?

… The Tech and Market Drivers

1

Exponential growth of data and digital content

- High-density computing … in smaller and smaller footprint
- Demands higher power density
- 24-36-month server refresh
- AC UPS or DC Power Plant can't keep up with relentless upgrade
- 2X computational increase … with only 1.3X power
- Higher power density by bypassing / limiting # of power conversion steps

2

Capital Cost Comparison

- Costs -- $8M batteries vs. $2M generator
- Power room real estate and construction costs
- Secondary switchgear distribution eliminated

3

The Path to
Direct Distribution Power

Path to Direct Distribution Power

Centralized DC Plant
One Large Plant

- Dedicated room
- Massive distribution
- 5 nines + battery
- Work all circuits LIVE
- Specialized maintenance
- Blast Area = Whole Office

- Power room eliminated
- ($1M) distribution cable cost
- 8 nines + battery
- Energy/Human isolation
- Specialized maintenance
- Blast Area = 1 Row

Cabinet Distribution
A/B Plant per Cabinet

Direct Distribution
A/B Plant per Row

- Power system area eliminated
- +30% more cabinets
- 8 nines A cab & 8 nines B
- Concurrently Maintainable
- Plug-n-Play maintenance, replace module in alarm
- Electrical install simplified
- Blast Area = 1 cabinet

4

Getting Power to the Rack

A New Power Architecture

Edge Distributed Data Center Power Architecture

Power to the Rack

- Direct A&B AC feed to cabinet
- Conversion, battery backup, power distribution … all located in the side and back of cabinet
- Direct-to-rack = reduces power conversion steps and boosts power density
  - 480 Vac 3Φ 3W to 48Vdc
- Plug-in rectifiers, batteries, distribution and controls … frees up rack for increase servers and load capacity

Edge Distributed Data Center Power Architecture

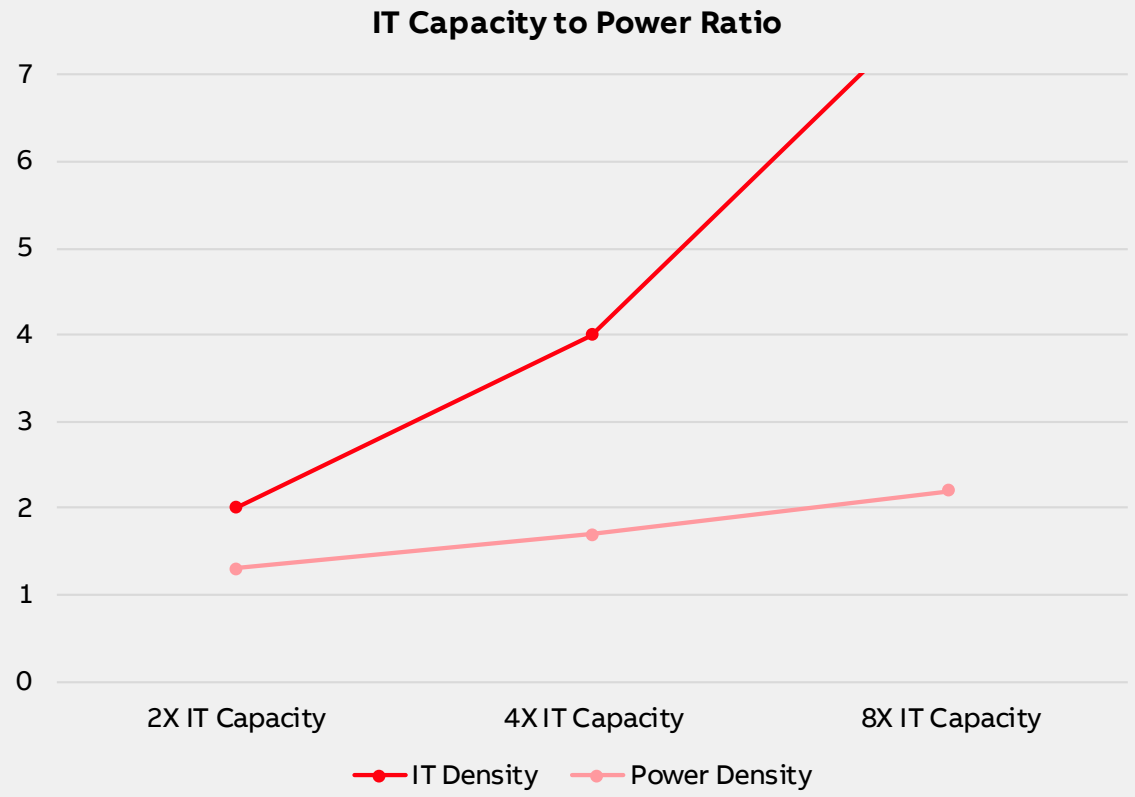
Power Density to Meet Computational Capacity

Expansion of smaller but high-density data center computing capacity …

plus 24-36-month server refresh …

can't be served by traditional power centralized power architectures

- Both cost and space
- Need for better IT-Capacity-to-Power-Density ratio
- Direct power distribution
- Only 1.3X power to meet 2X computing increase
- Virtualization = 40% lower compute costs



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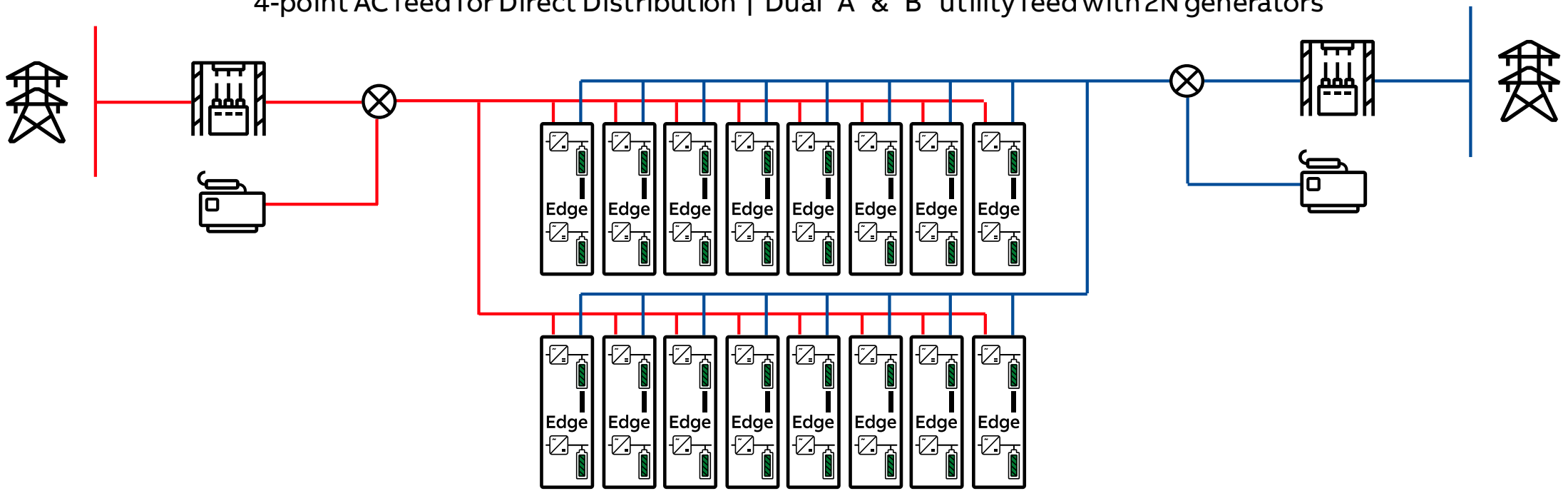
Battery Backup at the Rack

Centralized vs Direct Power

Battery Backup

Why only 2 minutes of battery?

4-point AC feed for Direct Distribution | Dual “A” & “B” utility feed with 2N generators



“When was the last time your data center needed to run on battery backup?”

Battery Backup

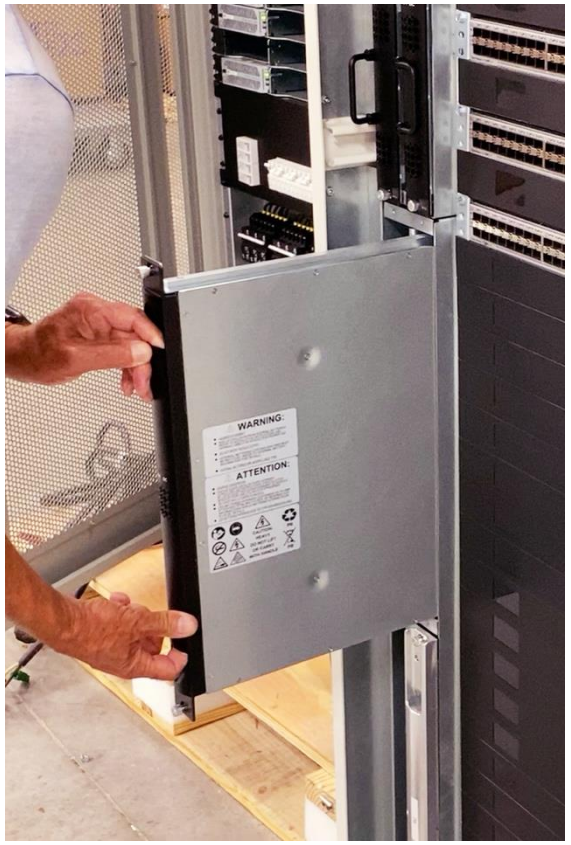
Battery Chemistries

- VRLA battery chemistry – record of safe, stable operation in data center applications
- With short back-up time – only minimum amount of stored charge required

Battery Backup

Managing Multiple Battery Banks vs. Hundreds of Battery Modules?

- Rack-deployed battery modules employ microprocessor to automatically, and remotely, monitor
- Eliminates manual monitoring and reporting



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Calculating ROI

New Models for ROI

Calculating ROI

1 CapEx

Reducing or eliminating battery plant or AC UPS

- 20-30% reduction in CapEx for centralized backup system
- 20-30% reduction in CapEx for battery plant

2 Installation

Traditional "12-box" installation

- 10 separate contractors – one week

New direct distribution cabinets

- ¼ man-day per cabinet

Enabling Architecture

- 480V AC utility infrastructure
- Roll-in cabinets – retractable wheels
- Modular plug & play components
- Twist-lock connections

3 Maintenance and Safety

- Modular, plug & play components
- Safe and easy access
- Regular maintenance / operations teams
- Batteries modules "cold" until installation

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The Case for
A Direct Distribution Power Architecture

Making the Case

The Imperative for Direct Distribution Power Architecture

1

Exponential computing density …

with optimum computing-to-power ratio

2

Scalable power …

for 24-36 month “server refresh”
without central power constraint

3

4-way AC utility and power generation …

for less cost, redundancy and reliability

4

New models for ROI …

CapEx, rapid deployment,
maintenance and safety

Q&A


ABB

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Addendum

Edge Distributed Data Center Power Architecture

Computational Capacity … Stranded White Space and Density

Direct distribution replaces the space and infrastructure of central power systems – either AC UPS or DC Battery Plant.

– **Centralized Power**

- 101 feet = 111 cabinets = 58 sq. ft. /cabinet

– **Direct Distribution Power**

- 85 feet = 132 cabinets = 41 sq. ft. / Cabinet
- 30% reduction in total space
- 41% increase in revenue generation per sq. ft.
- Up to 50% CapEx Saving Over AC UPS
- Up to 20-30% CapEx Saving Over DC Power Plant

58 sq. ft. cabinet

41 sq. ft. cabinet

Battery Backup

Why 2 minutes?

- 4-point AC feed for Direct Distribution …
  - Dual “A” & “B” utility feed with dual “A” & “B” generators
- New Power Back-up Equation …
  - 10-second transfer speed between one of four AC feeds = two minutes of battery time

- 97% reduction of battery storage – space and cost
- $8 million battery plant versus $2 million generator

			Reliability							Power at 1-minute Discharge	
480V3P			0.999996			.999975				3800	
			Rect Qty			Batt Qty				W	
Rectifier Rated Capacity	Load kW peak type	Redundancy	Rect A	Rect B	Nines	Batt A	Batt B	Nines	Redundancy	1 Minute Discharge Power -1 module	
6.0	3.8	2n	1	1	10	1	1	9	n+1	3.8	kW
6.0	5.4	2n	1	1	10	2	1	8	n+1	7.6	kW
12.0	10.8	2n	2	2	10	2	2	8	n+1	11.4	kW
18.0	16.2	2n	3	3	9	3	3	8	n+1	19.0	kW
24.0	21.6	2n	4	4	9	4	4	8	n+1	26.6	kW
30.0	27.0	2n	5	5	9	5	5	8	n+1	34.2	kW
36.0	32.4	2n	6	6	9	6	6	8	n+1	41.8	kW