

Five Power Trends on Their Way to Your Data Center

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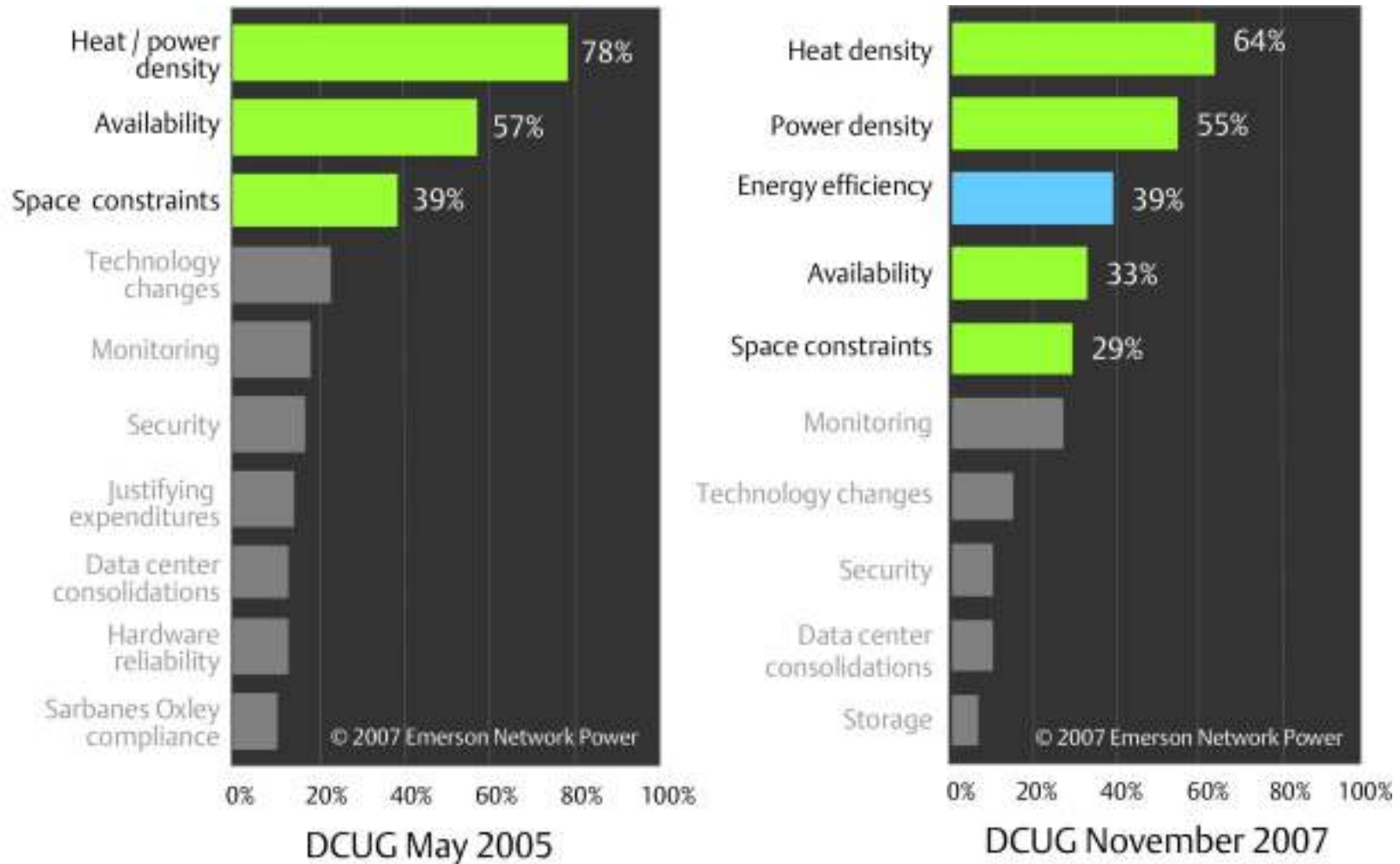
Liebert.



Five Power Trends Heading Your Way

1. Energy Efficiency is gaining importance
2. New ways of Scaling are Emerging
3. Two-Stage Power Distribution
4. Demand for Monitoring and Control is up
5. Alternate High Availability Power Configurations

Energy Efficiency Emerging as a Top Concern of Data Center Managers Along with Power, Cooling & Space Constraints & Availability

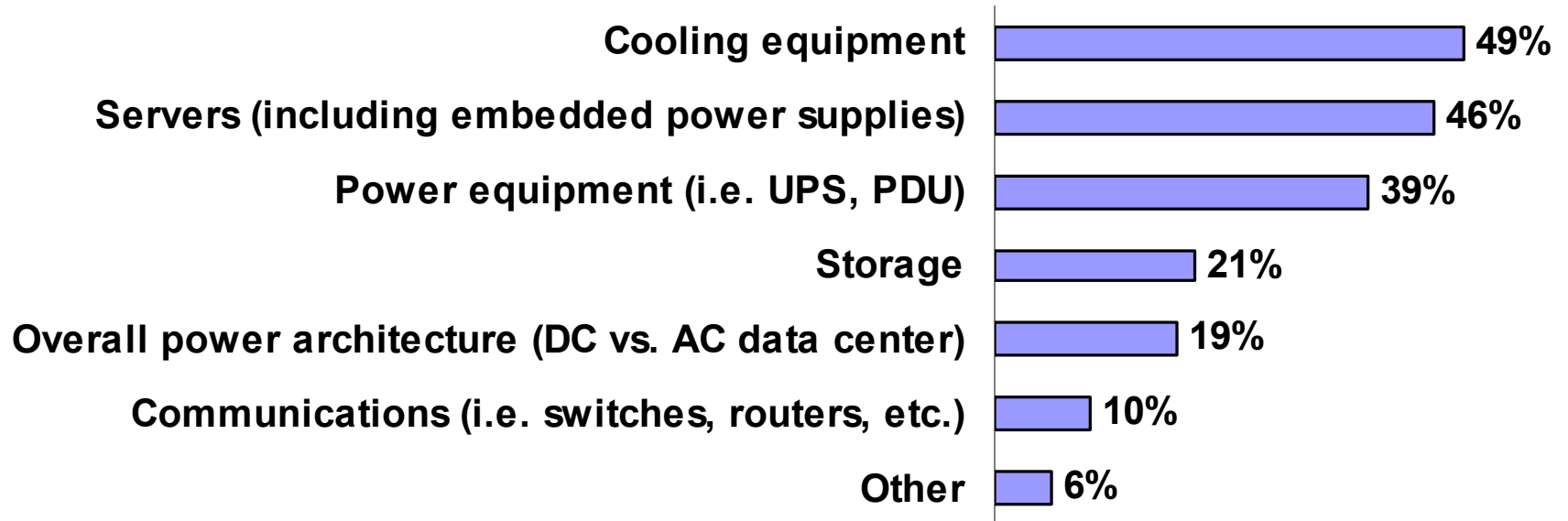


Source: Data Center Users' Group Surveys

Energy Efficiency Is Becoming A Priority

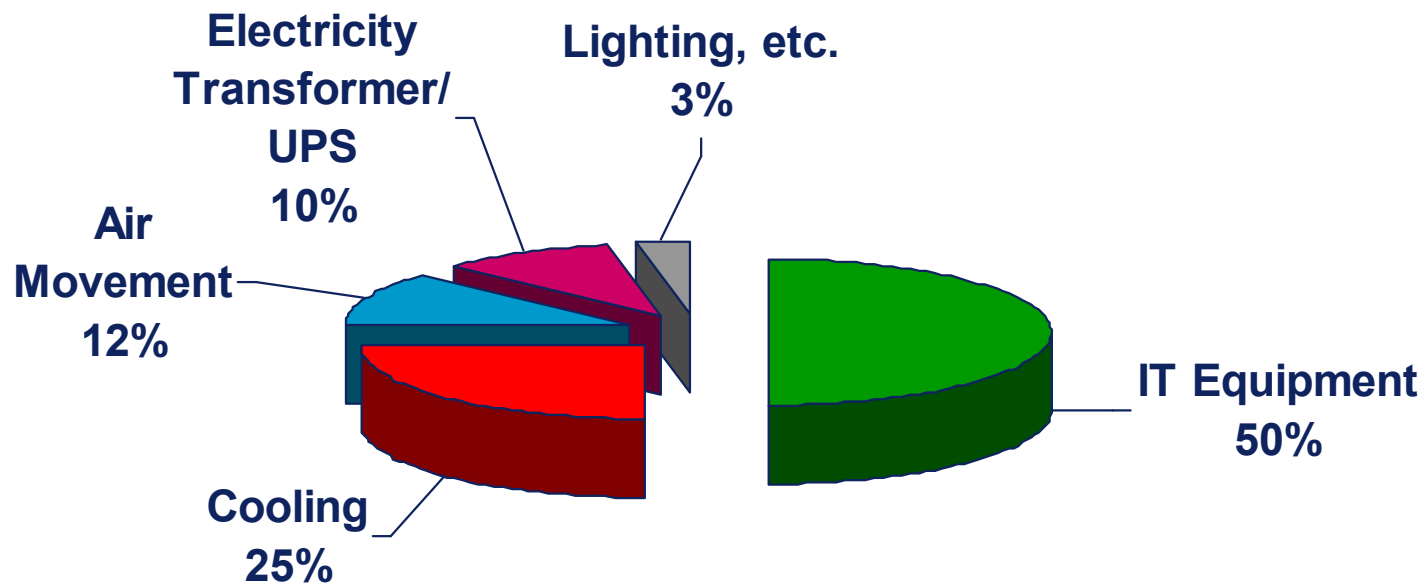
- **42% of survey respondents are currently analyzing their Data Center efficiency**

Respondents perceived the greatest opportunities to be:



Source: DCUG Survey Fall 2007

Data Center Power Draws

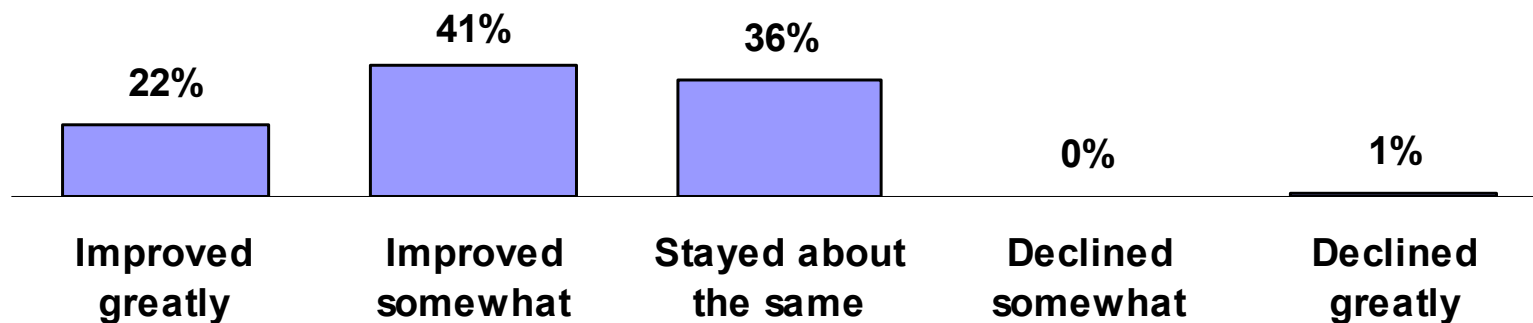


Source: EYP Mission Critical Facilities Inc., New York

Tradeoff Between UPS Efficiency and Availability

Equipment	Efficiency
Double-Conversion UPS	85% - 95%
Line-Interactive UPS	95% - 98%
Off-Line UPS	98% - 99%

Has your data center availability improved or declined over the last 3 years?



Source: DCUG Survey Fall 2006

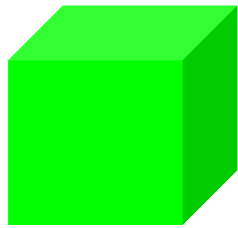
Will You Sacrifice Availability for UPS Efficiency?

Would you be willing to make a sacrifice in the availability / reliability of your data center backup power for an increase in efficiency?

	1	2	3	4	5
	Definitely Not	Unlikely	Possibly	Likely	Definitely
Putting excess UPS capacity modules into stand-by or sleep mode until needed	16%	36%	27%	15%	7%
Using line-interactive UPS instead of a true-online double-conversion UPS	28%	36%	25%	8%	2%
Powering the load through the static bypass switch without power conditioning until the UPS is needed (Off-Line UPS)	35%	36%	23%	3%	3%

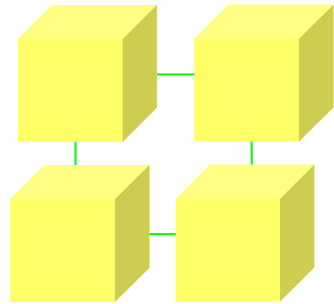
Source: DCUG Survey Fall 2007

2. New Ways of Scaling Are Emerging *UPS Architectures*



Stand Alone

Single unit -
reliable & simple

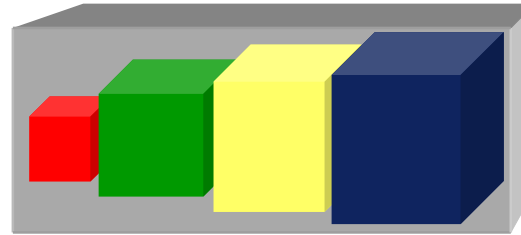


Modular

Standard units with
fixed sizes that work
together

Cost savings by
retaining initial
investment

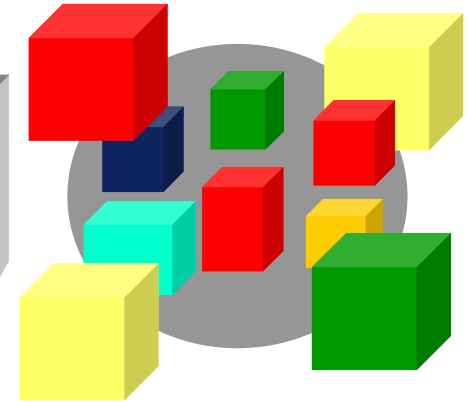
Added redundancy



Scalable

Flexibility with internal
capacity expansion

A unit with single
direction for growth



Adaptive

Flexibility that can deal with
uncertainty (re-configurable)

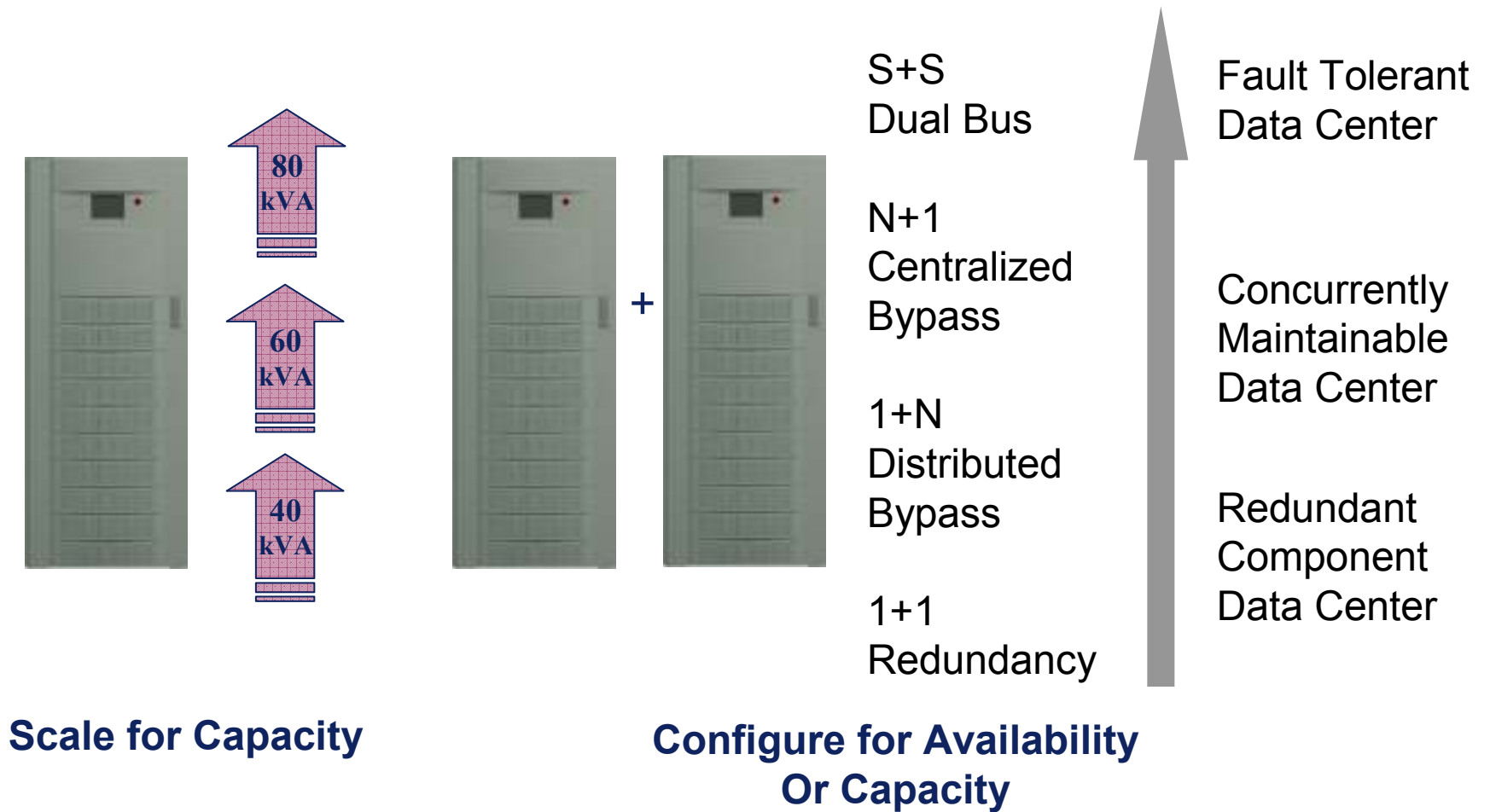
Adapts to changing
requirements in capacity,
density and availability

A platform that works across the
enterprise – small to large scale
– with an optimized building
block approach

Lowest cost method for capital
and operating expenses

Next step beyond modular and scalable...ADAPTIVE!

Adaptive Power: Scale For Capacity, Configure For Availability



Power Scalability Options

Protecting Your Initial Investment

**Upgradeable to
Add capacity to
installed modules**

100%
Initial
Capacity

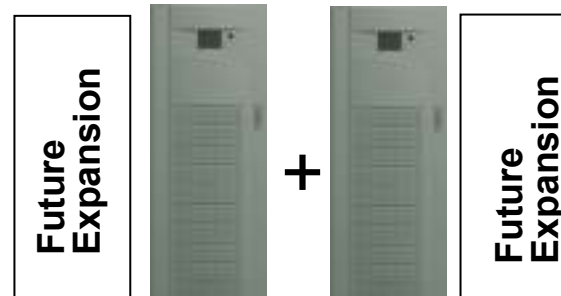


150%
Potential
Capacity

**Add modules for an
N + 1 Configuration**

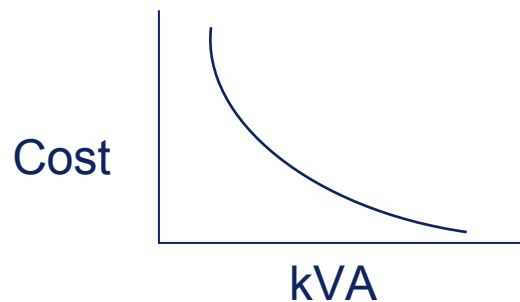


**Add modules for a
S+S Dual Bus
Configuration**

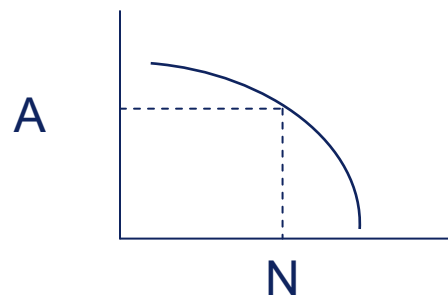


Adaptive Architecture – UPS Module Optimization

- Choose module size relative to desired ultimate capacity
 - Allows for many different growth units
 - If ultimate capacity is 80kVA, don't start with a 10kVA module
- Provides for lowest initial cost and ultimate total cost
 - Larger kVA modules cost less: lower “hardware overhead” cost
- Provides for highest system reliability
 - Fewer modules translates into fewer failures and less service



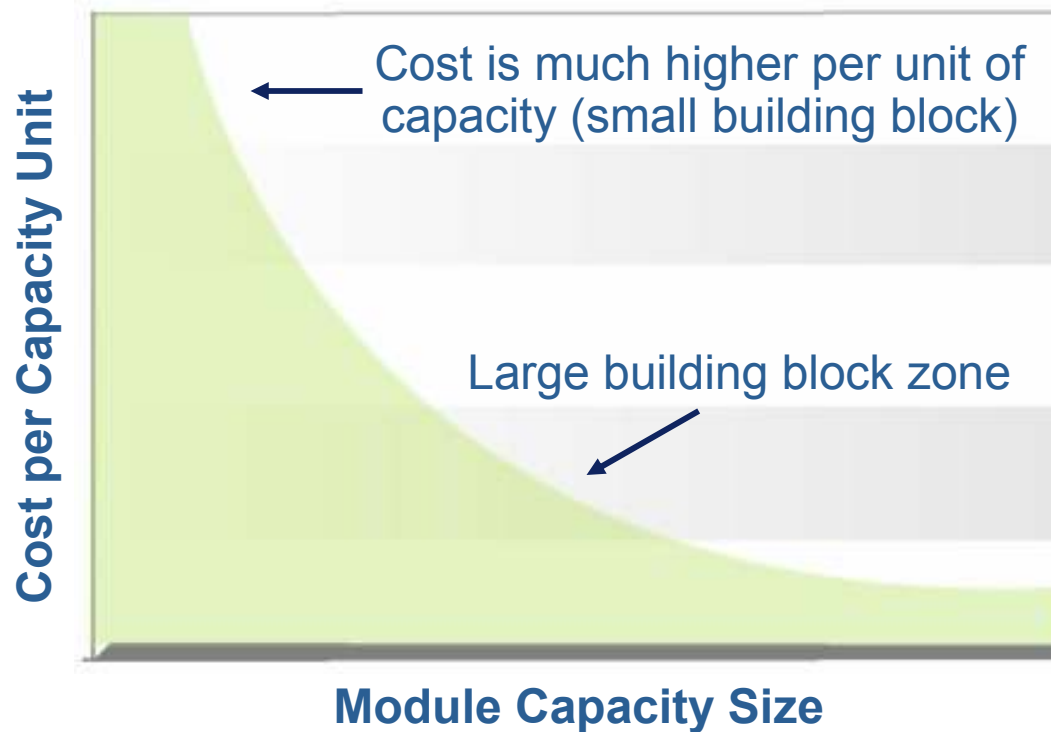
***Economies of scale in
power electronics***



***Parts/module Count
vs. Availability***

Optimized Building Block Approach

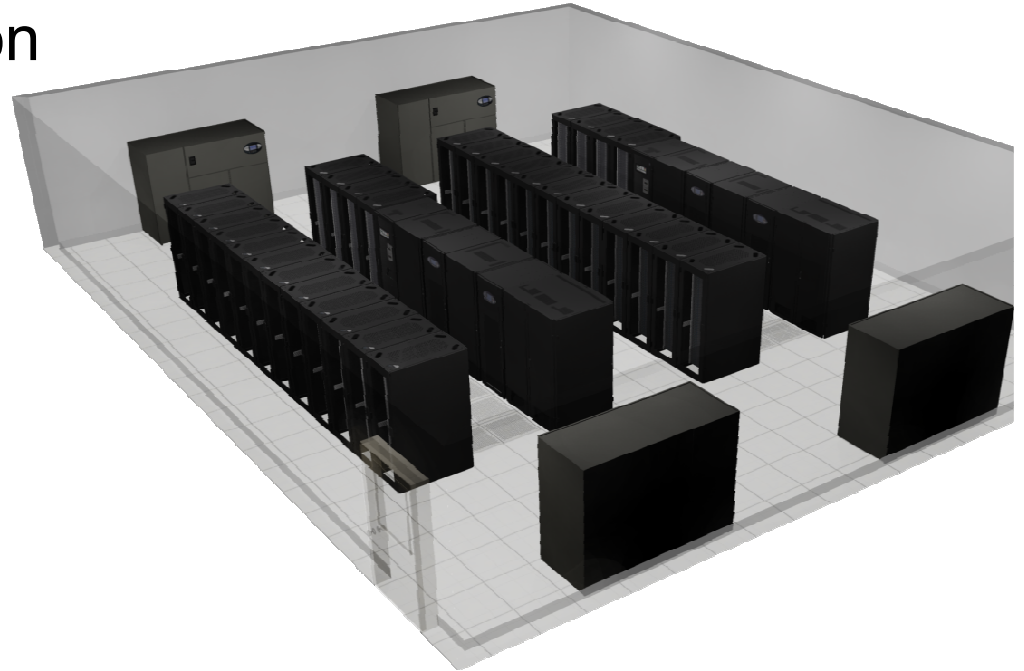
As scale increases, cost per capacity unit decreases (The Economies of Scale)



Create optimized building blocks in standard platforms

3. Two Stage Power Distribution and High Density Power Management

- Optimize space utilization and scale power based on growth
- Facilitate equipment placement to maximize cool air to hot racks
- Facilitate equipment change management



Single Stage Distribution Methods

- **Blocked Air Flow**
- **More Circuits, Bigger Circuits**
- **Longer Cables**
- **More Difficult to Manage Change**



Two-Stage Distribution Adds Pole Capacity and Reduces Under Floor Cabling

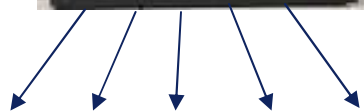
Traditional Single-Stage Distribution



Power Distribution Unit

Voltage Transformation, Monitoring and Branch Circuit Breakers

126 Poles



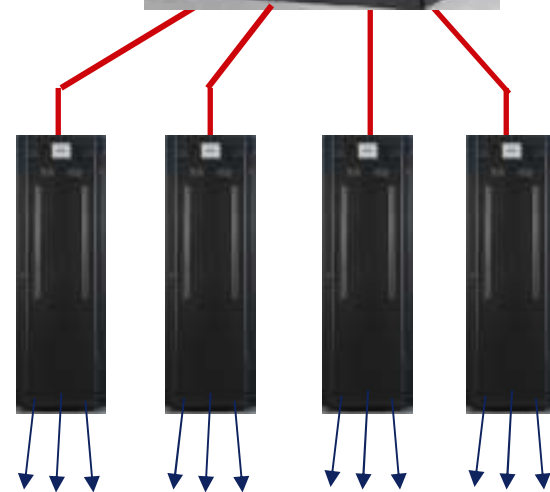
IT Loads

Emerging Two-Stage Distribution



Power Transformation Unit

Voltage Transformation, Monitoring and Subfeed Output Breakers

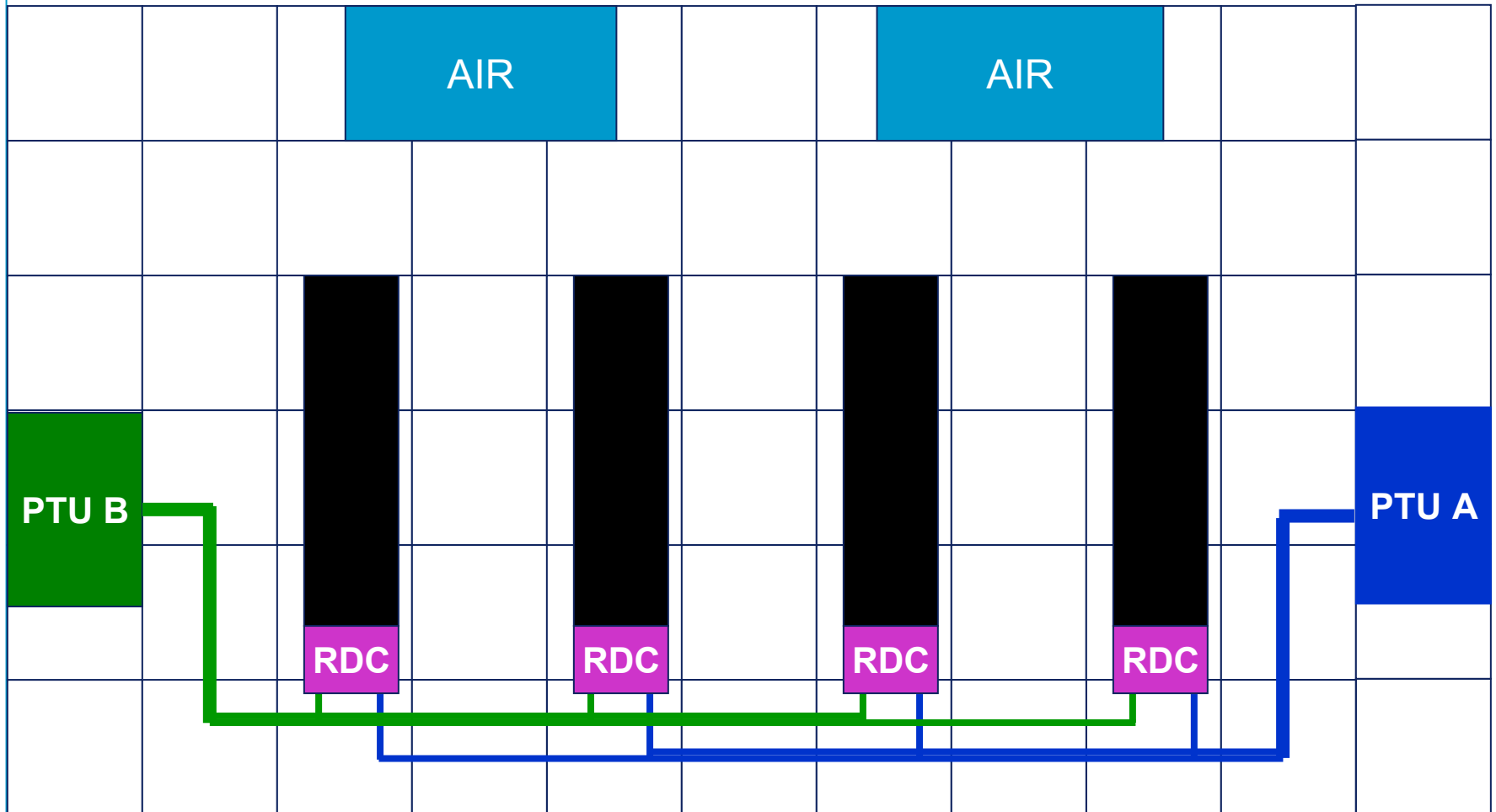


Remote Distribution Cabinets

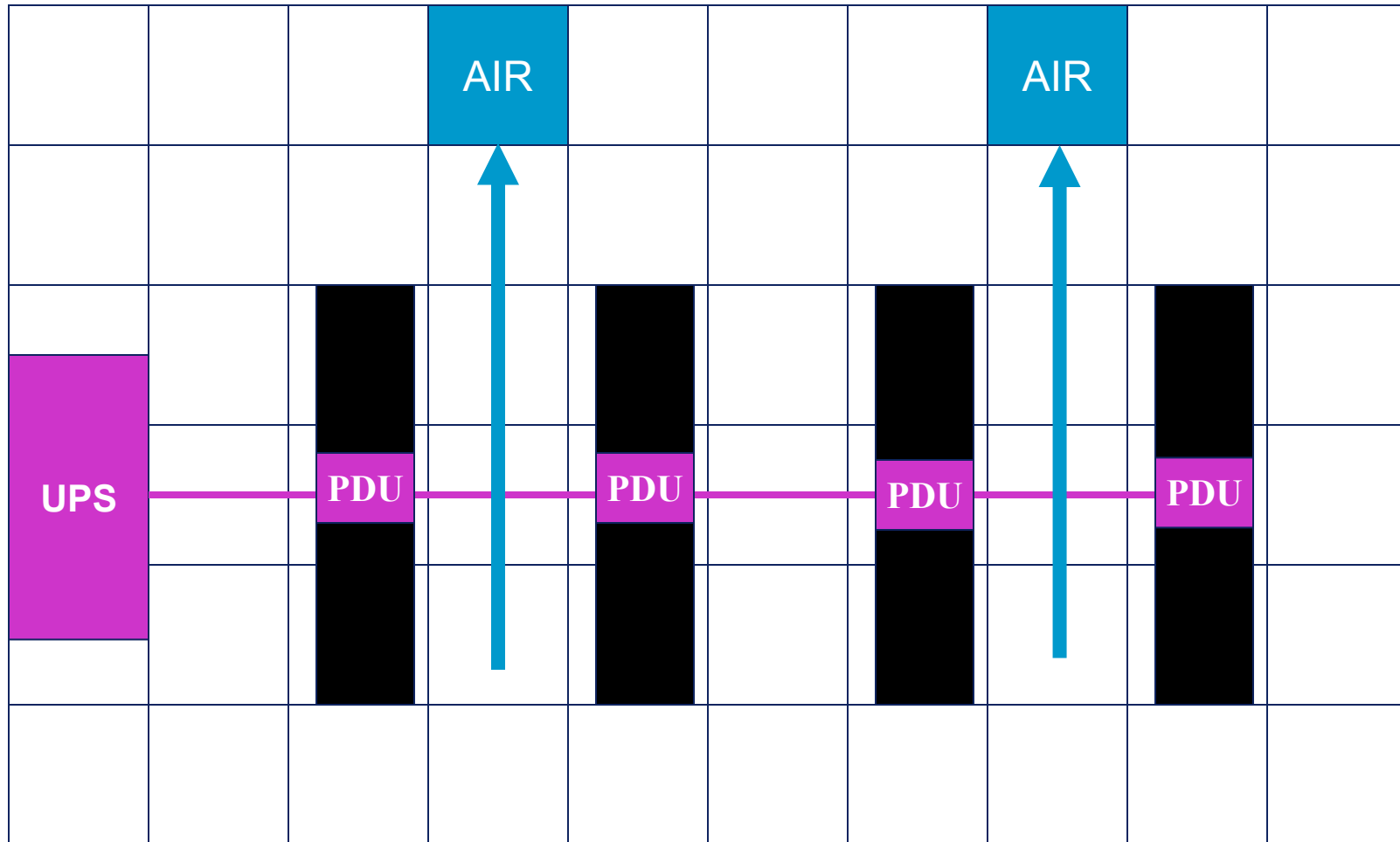
168 Poles Each

IT Loads

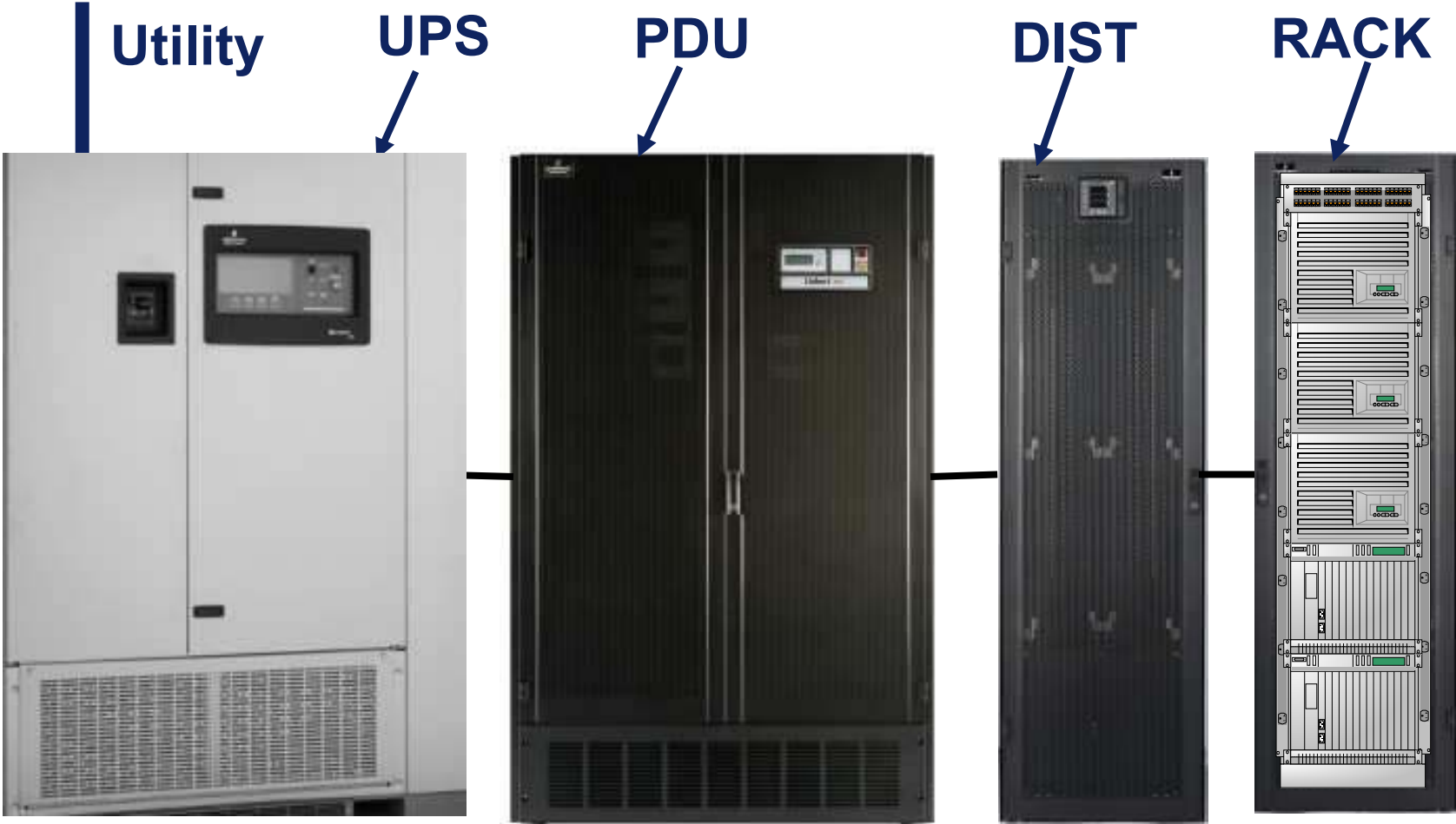
High Density Two-Stage Power Distribution



Middle-Row PDU Rack Distribution



Two-Stage Row Distribution

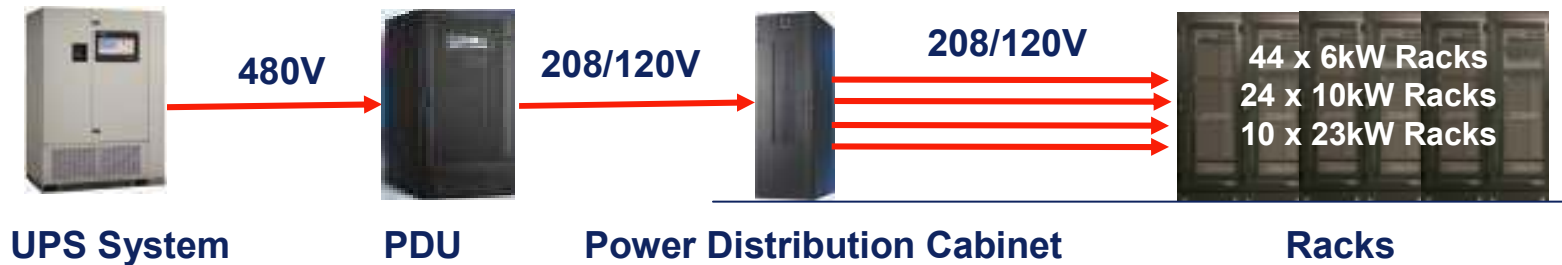


Two Stage Power Distribution Benefits

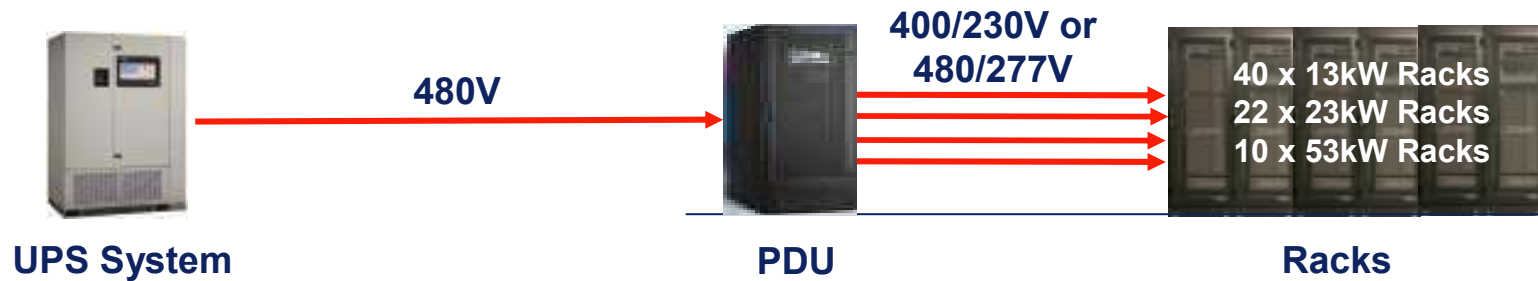
- PDU to Multiple distribution cabinets
 - More distribution per square foot and more breakers per transformer
 - Reduces cross-aisle obstructions
 - Reduces restrictions to cooling air flow
 - Easy to scale with I-Line Distribution
 - Easier to locate, replace, add circuits
 - Shorter circuit lengths
 - More conducive to Dual-Bus distribution

Another Look At High Density Distribution

High density loads – Two-Stage Distribution



Extreme Density Loads – Higher Voltage Distribution



Optimized Racks

Improved Cable Management and Air Flow

- Blanking Panels
- Increased Door Perforations
- Multiple Cable Management Options to fit site needs
- Accessories placed where needed in the frame



4. Demand for Monitoring and Control Is Up

- Top Facility/Network Concerns

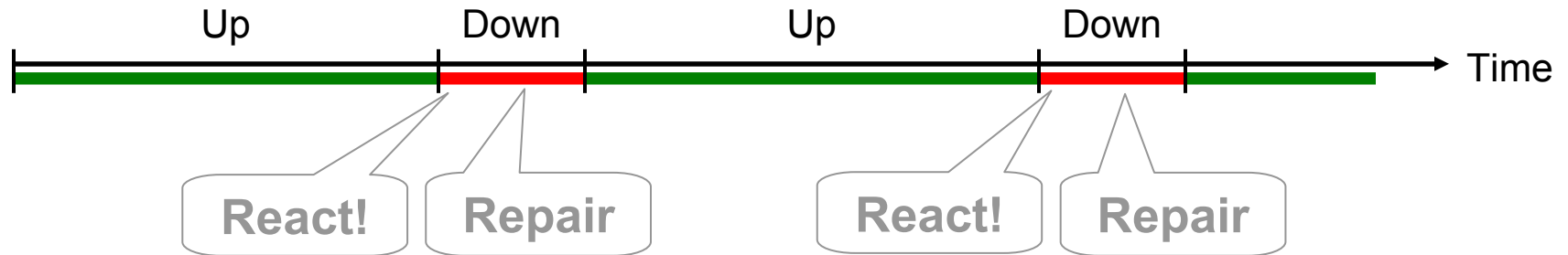
- Heat Density (cooling) 64%
- Power Density 55%
- Energy Efficiency 39%
- Availability (uptime) 33%
- Space Constraints/Growth 29%
- **Monitoring Capabilities** **27%**
- Technology Changes 15%

Gaining in
importance
Up From 18%
Spring 07 DCUG

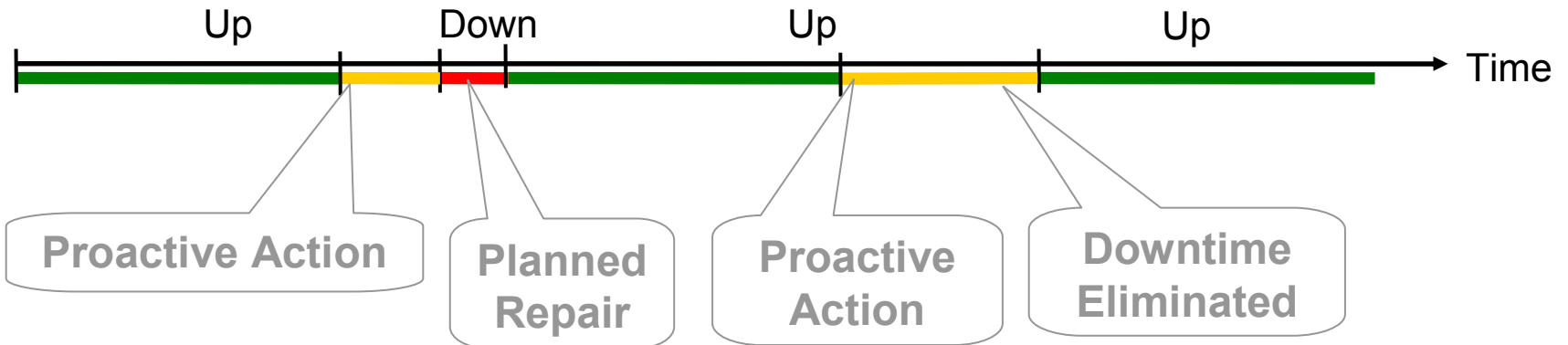
Source: Emerson's Data Center Users' Group (DCUG) Fall 2007 Survey

Proactive Monitoring to Reduce Downtime

Break-Fix, Non-Performance-Based Monitoring



Proactive, Performance-Based Monitoring



New Monitoring Technologies Are Available



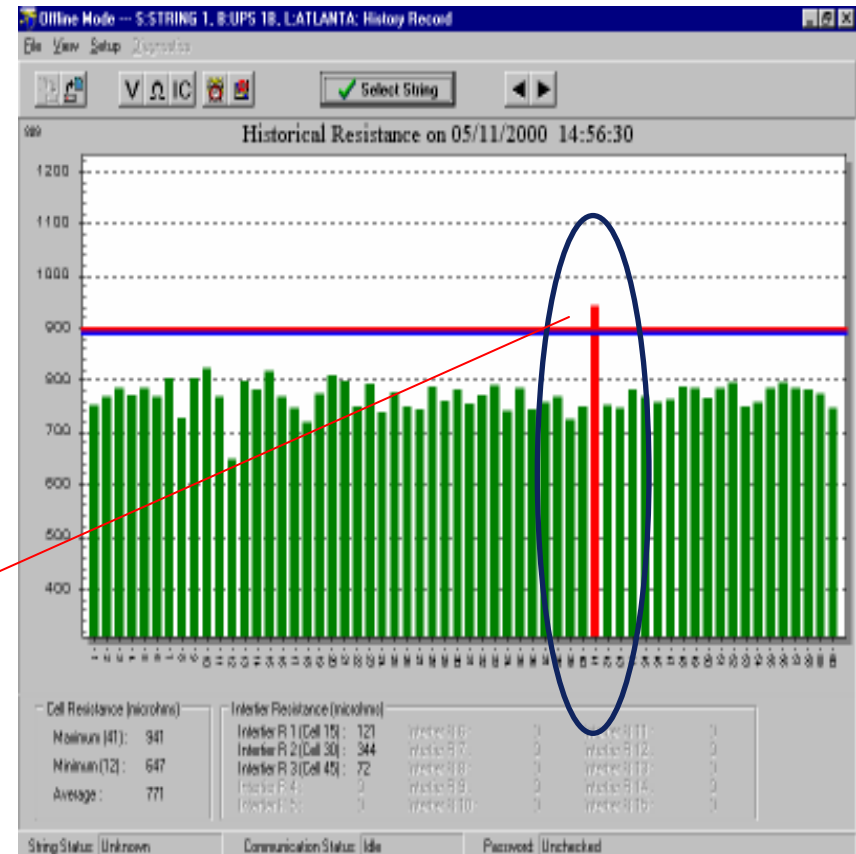
***Smart Power Strips
Monitor In-rack Power and
Environmental Conditions***



***Branch Circuit Monitoring
to monitor each PDU
output circuit***

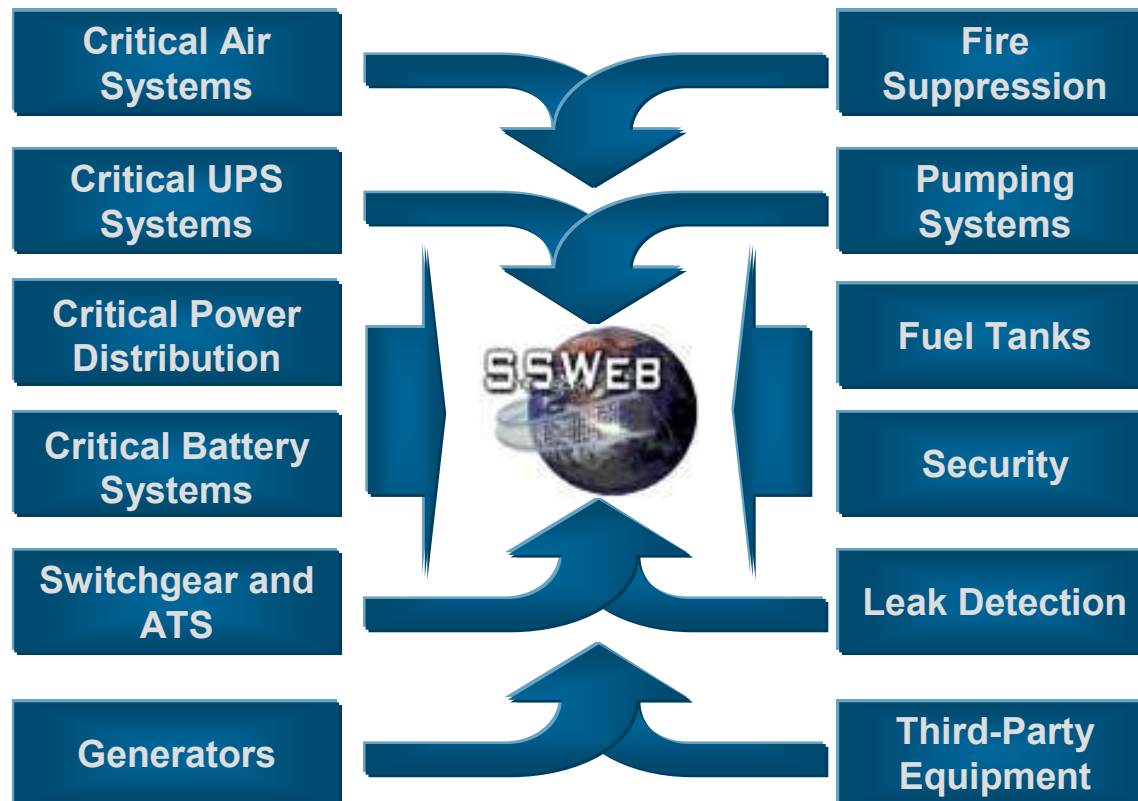
Battery Monitoring Gives You Confidence in Your Battery System

- Problems fixed prior to failure point – locate weak cell among good
- Reduce mean time to repair
- Improve purchasing decisions based on data

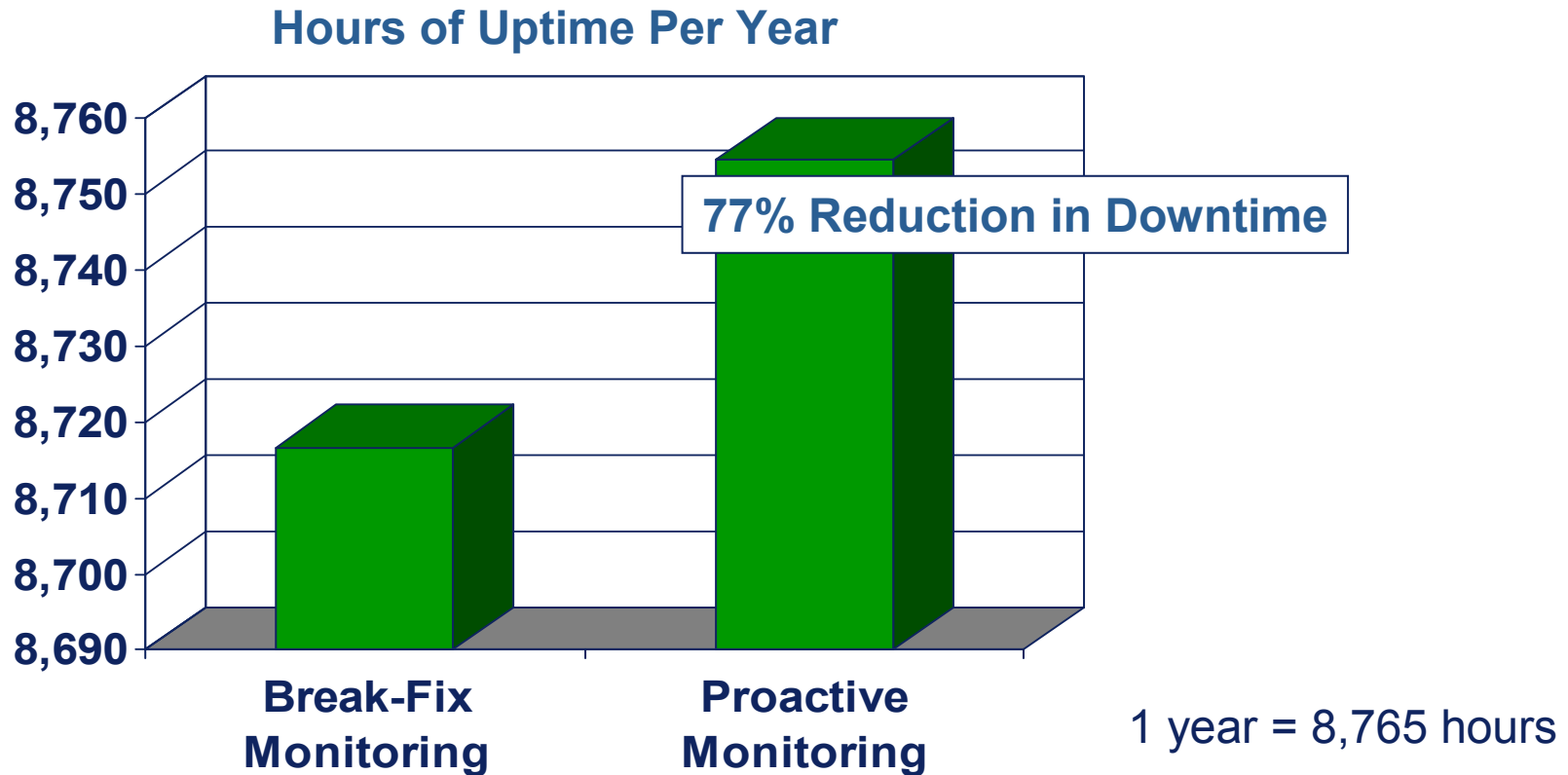


Proactive Alarm Management: Collaborating with Other Systems

Complete Integration of All Critical Facilities Equipment



Proactive Monitoring Increases Availability



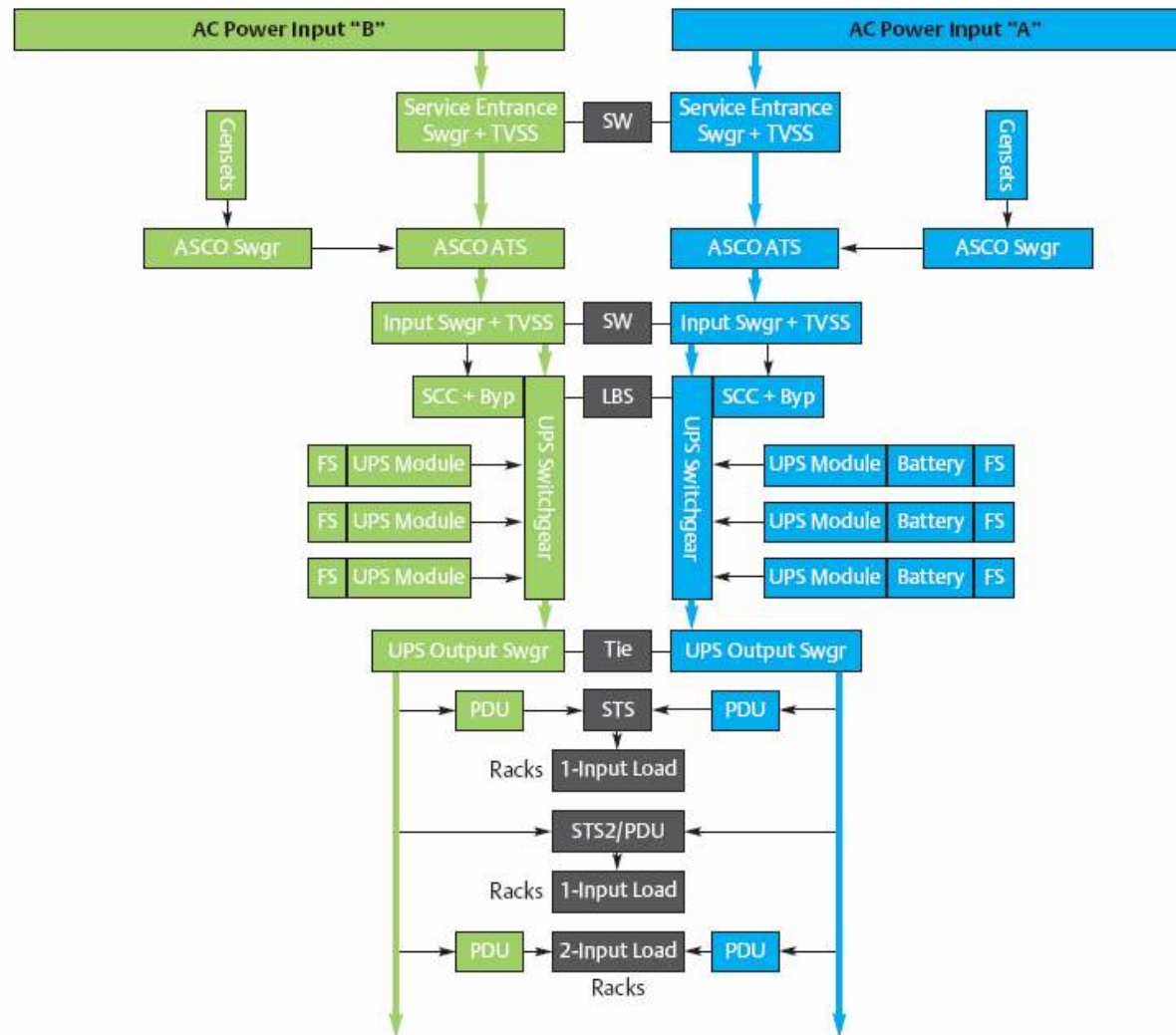
Example is from a Cellular Telephone Company.

The customer invested in very detailed monitoring so that they could:

1. Reduce the number of trips to cell sites by going to the site with the proper equipment and parts
2. Get to the site before the system went down by deploying on warnings and changes

Both were achieved.

5. Alternate High Availability Power Configurations

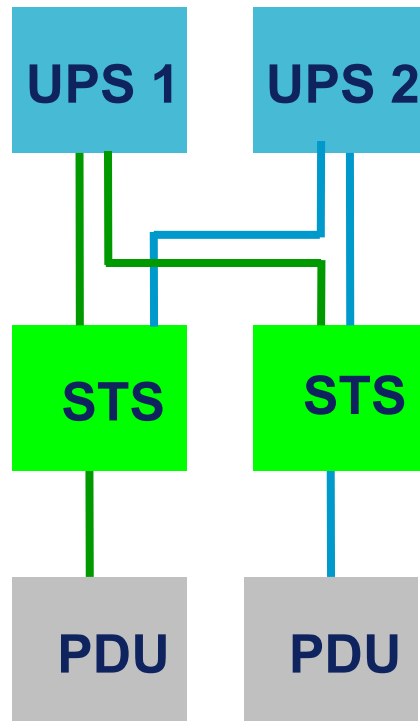


High Availability: Uptime Institute Tier Definitions

Tier Requirement	Tier 1	Tier II	Tier III	Tier IV
Source	System	System	System	System + System
System Component Redundancy	N	N+1	N+1	Minimum of N+1
Distribution Paths	1	1	1 normal and 1 alternate	2 simultaneously active
Compartmentalization	No	No	Yes	Yes
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance (single event)	No	No	No	Yes

- **Tier designations attempt to categorize on how a high availability data centers are designed**

Traditional Dual Bus

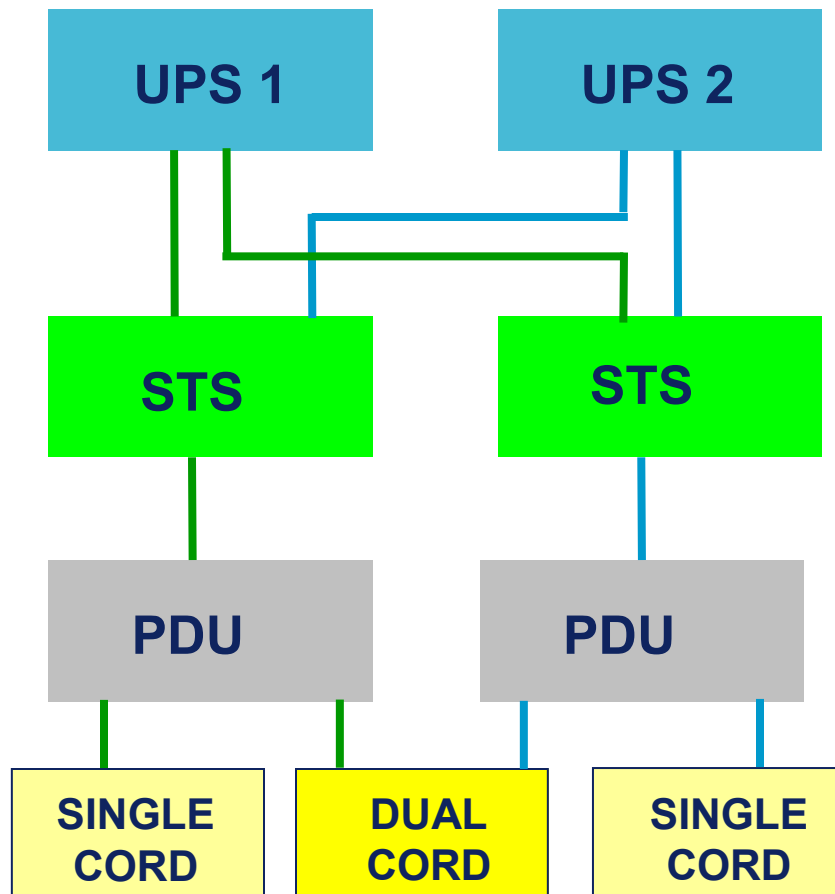


Dual Corded Dual Bus
Maximum Loading N/2

For 2x1000 kVA= 1000 kVA Max Load

- In use for the most highly available sites with predictable demand
- Easy to manage dual cord loads
- Good for traditional transactional services

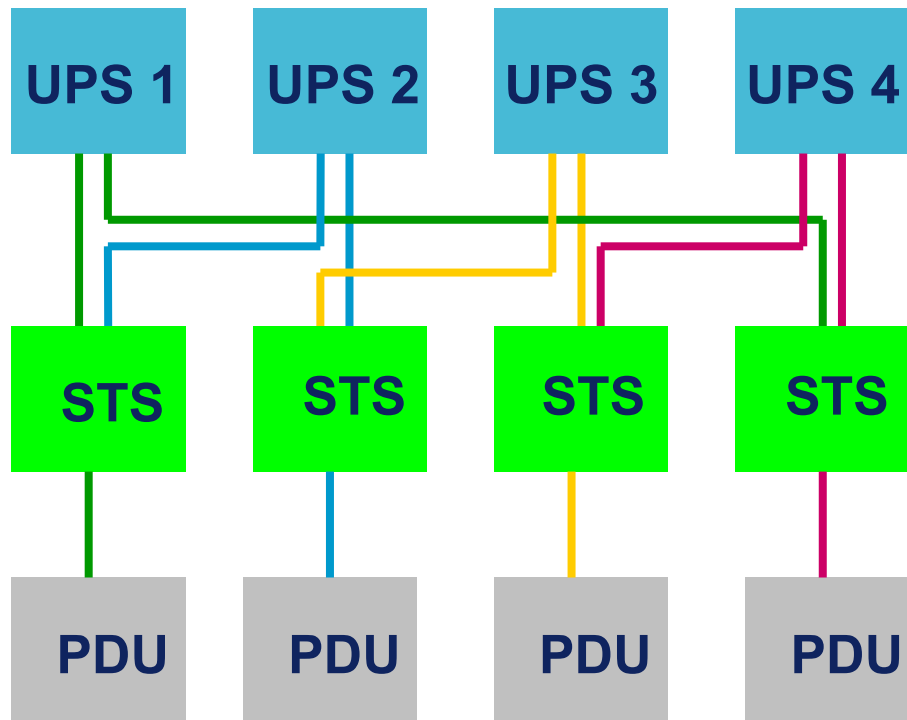
Modular Dual Bus



Modular Dual Bus
Maximum Loading $N/2$

- Simplified Single-Module UPS system configuration
- Expands by adding duplicate dual bus systems
- Useful for managing mixed single and dual corded loads
- Helps expand an existing facility
- Enables concurrent maintenance
- Useful 30 to 1000 KVA

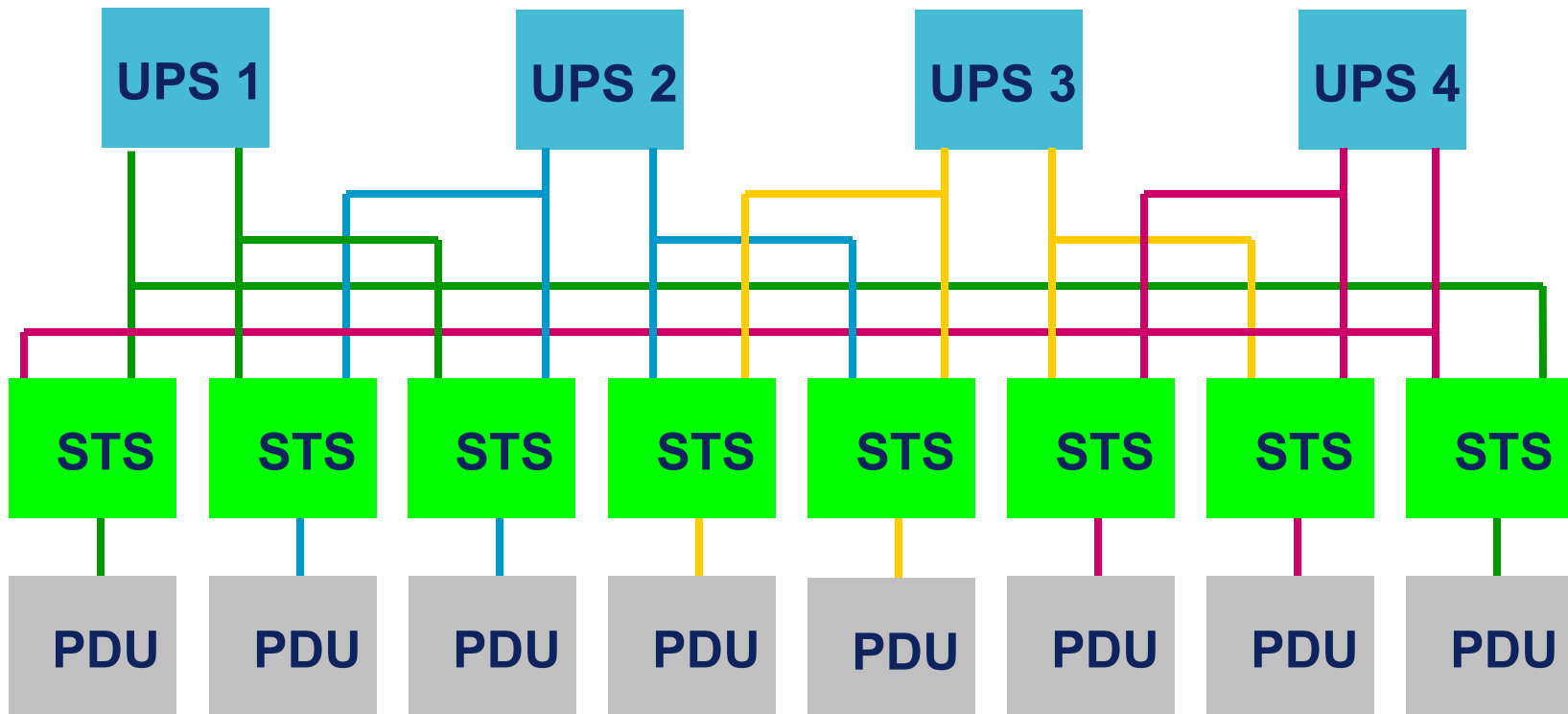
Interleaved Dual Bus



Interleaved Dual Bus
Maximum Loading N/2
For 4x1000 kVA= 2000 kVA Max Load

- Also was known as multi-bus
 - Often used when critical loads can be segmented such that load segments could be shut down without affecting overall operations
- Single module UPSs are common
- Doesn't necessarily need STS
 - Could all be dual-corded loads
- Is a viable alternative to traditional dual bus
 - Maintains all availability advantages
- Manageable approach to dual / multi bus growth
 - Saves on set-up and installation
- Good for traditional financial services

Ring Bus

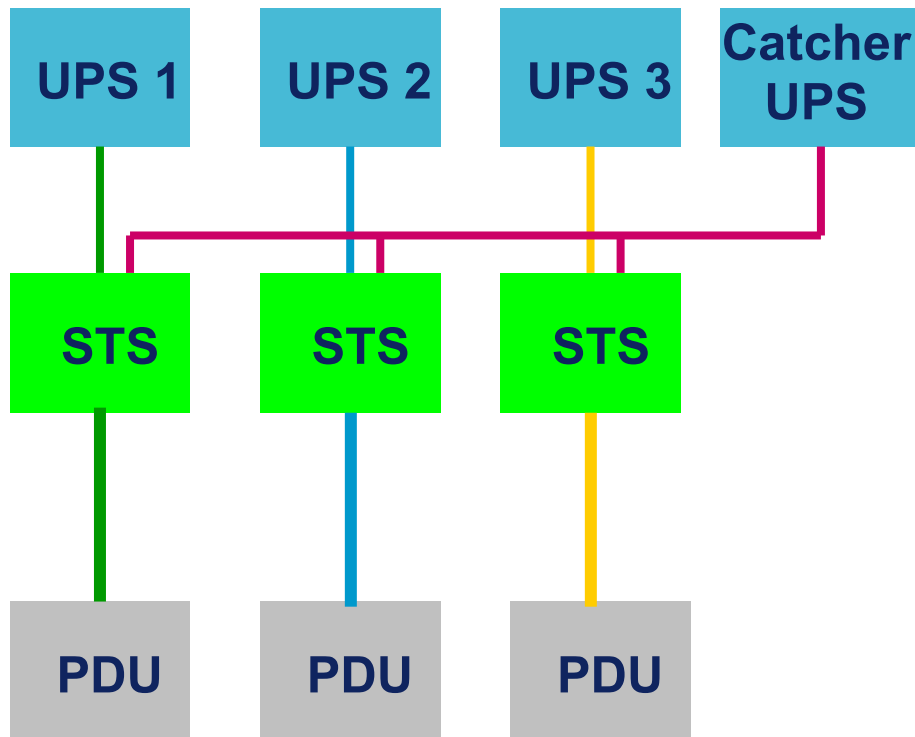


Ring Bus

Requires at least two STS's on the output of each UPS
Each STS would have as its primary the UPS that it is on
One STS would have it's reserve the UPS to the left in the ring
The other STS would have its reserve to the UPS to the right

Maximum Loading $(N-1)/N$
For 4x1000 kVA= 3000 kVA Max Load

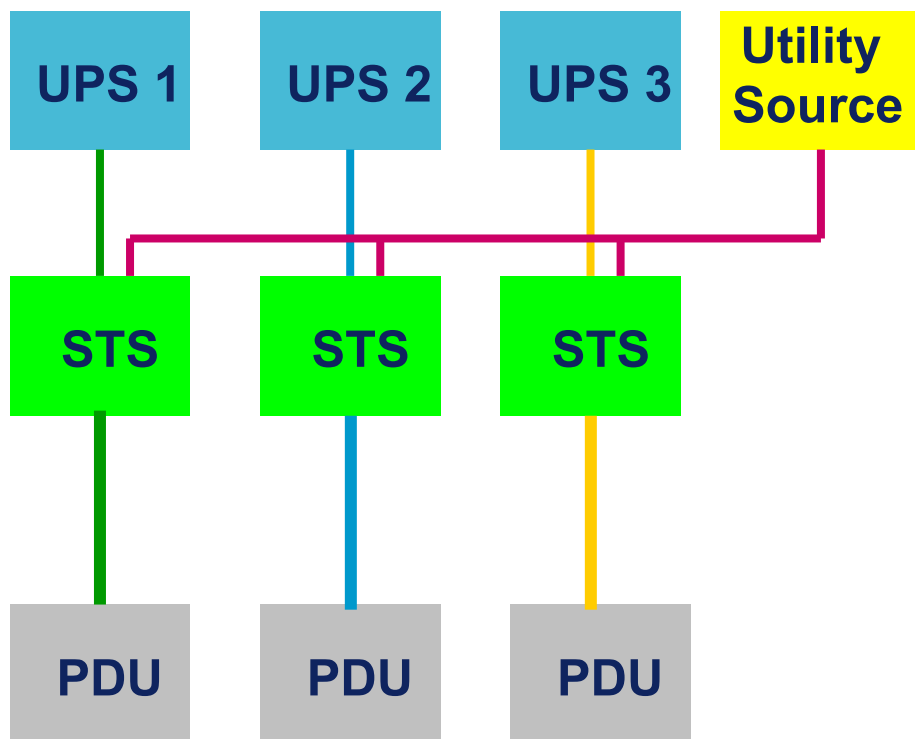
Catcher Dual Bus



Catcher Dual Bus
Maximum Loading $(N-1)/N$
For 4x1000 kVA= 3000 kVA Max Load

- A Variation of “Isolated-Redundant”
- Method to incrementally add dual-bus performance to existing, multiple, single-bus systems
- UPSs can be unequal ratings
- Can segment by availability needs
- Busses must be kept separate

Tier 3 Catcher Dual Bus



- Method to add Tier 3 performance to existing, multiple, single-bus systems
- UPSs can be unequal ratings
- Can segment by availability needs
- **Increases UPS utilization**

Catcher Dual Bus
Maximum Loading N/N

For 3x1000 kVA= 3000 kVA Max Load

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Questions?

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