

Mission Critical Power Quality

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Norman Disney & Young

Quality vs Reliability

*“Power quality problems don’t make headlines the way power reliability problems do
And power quality problems can be more difficult to understand, analyze and solve than reliability problems. But that doesn’t mean power quality should be ignored.”*

(Article: Avoiding Power Quality Headaches in Data Centers By K.L. Godrich November 2004)

- “Traditional” power quality issues
 - Where are they now?
- Developments in power quality management
- Power quality planning & strategies
- Configuration of electrical systems
- Future considerations

The good news.....

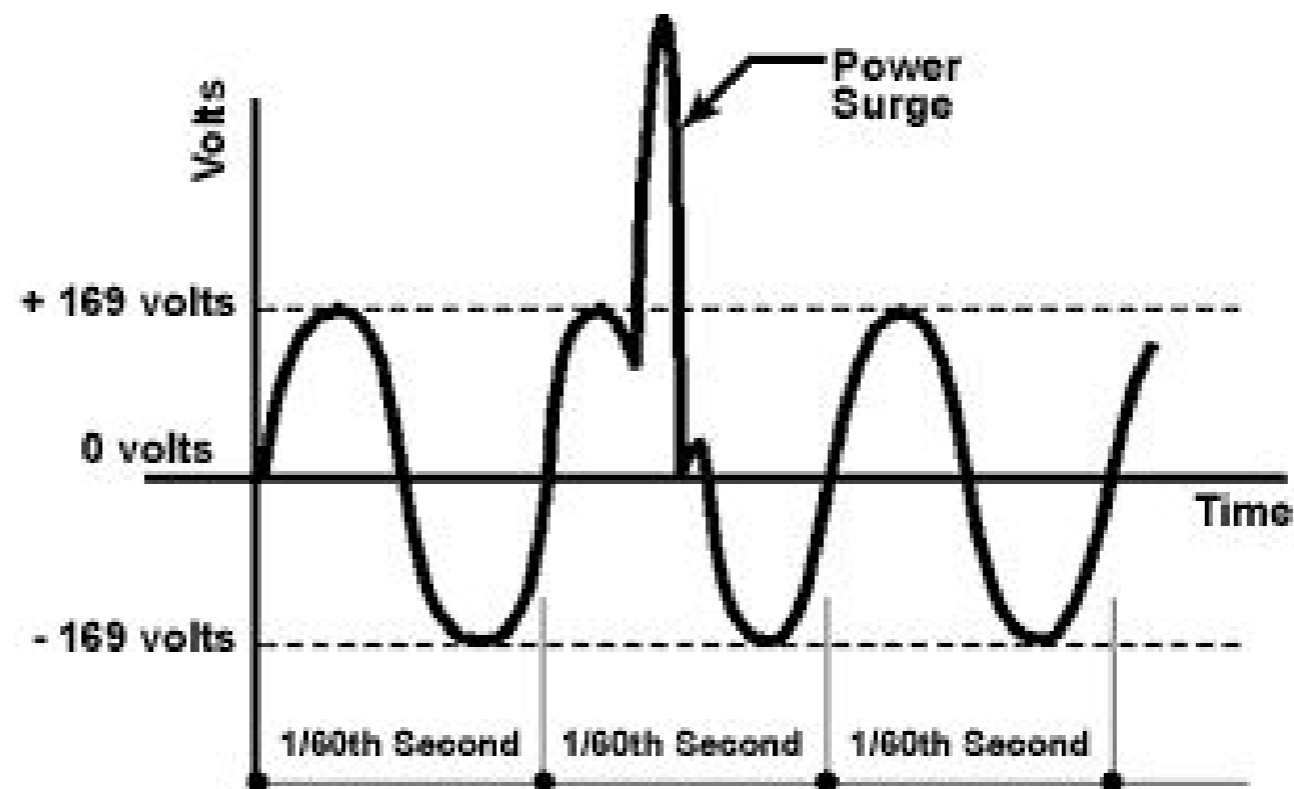


- CBEMA/ ITIC
- IEEE 519
- IEEE 1159
- IEEE 1100
- IEC 61000 series



Big improvements in the past 10 years!!

- How sensitive is equipment to power quality?
- How is Power Quality of equipment improved?



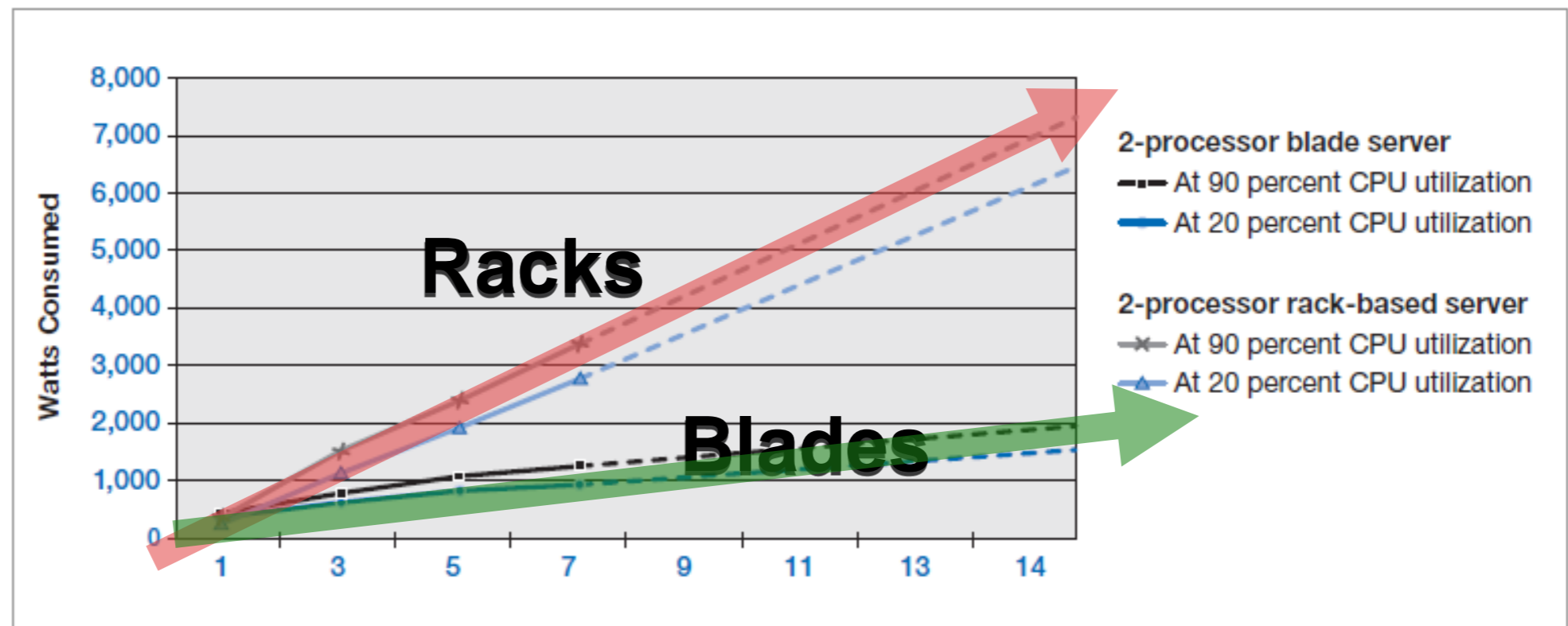
Power Supplies

- Power Supply Unit (PSU's) power quality has improved - a lot! (mainly IEC 61000)
- Better at:
 - Power Factor
 - Harmonics
 - Load matching for efficiency



Racks vs Blades

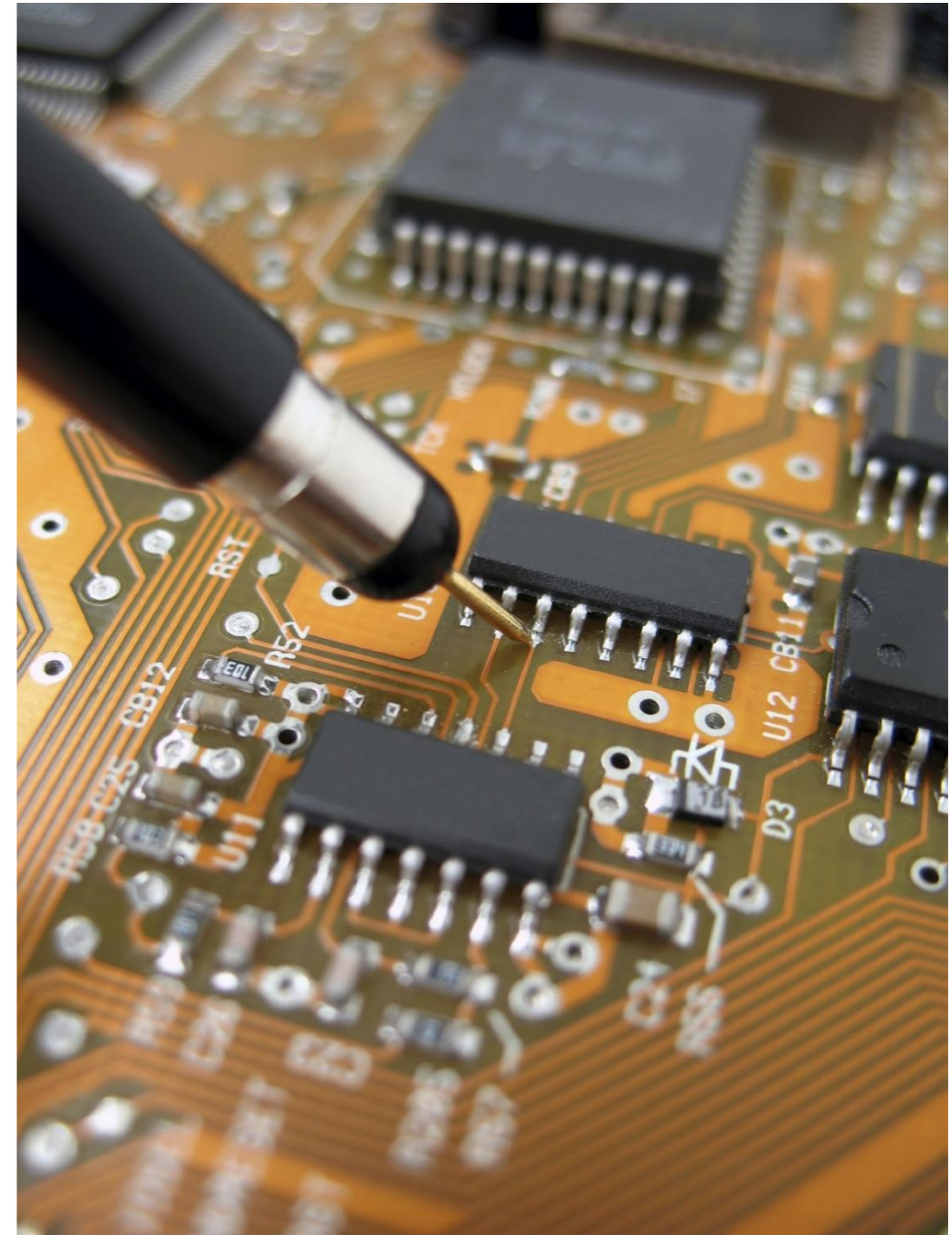
- Improved power utilisation and performance
- Significantly improved power utilization of blade servers compared to rack mounted



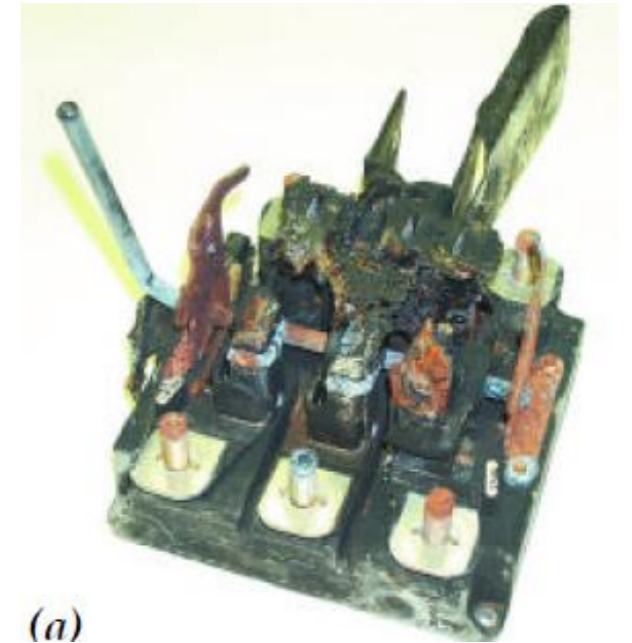
Courtesy: Intel White Paper – Blade Server Benefits

So why are we here now?

Because these guys
still need TLC....

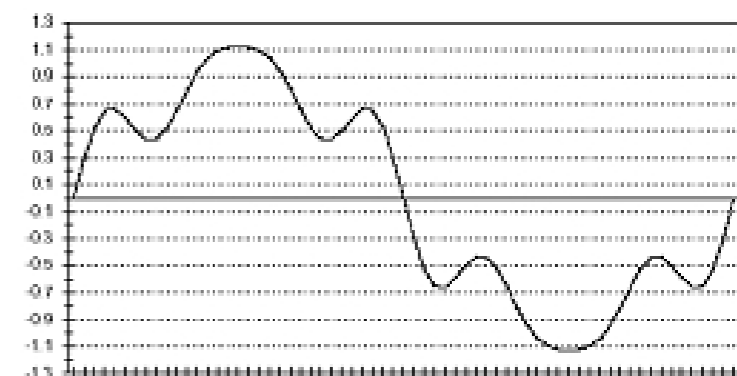


- Surges
- Brown Out/ Black Out
- Sustained Low Voltages
- Power Factor
- Harmonics & Distortion
- Frequency Variations
- Fault Clearance of Equipment
- Earthing



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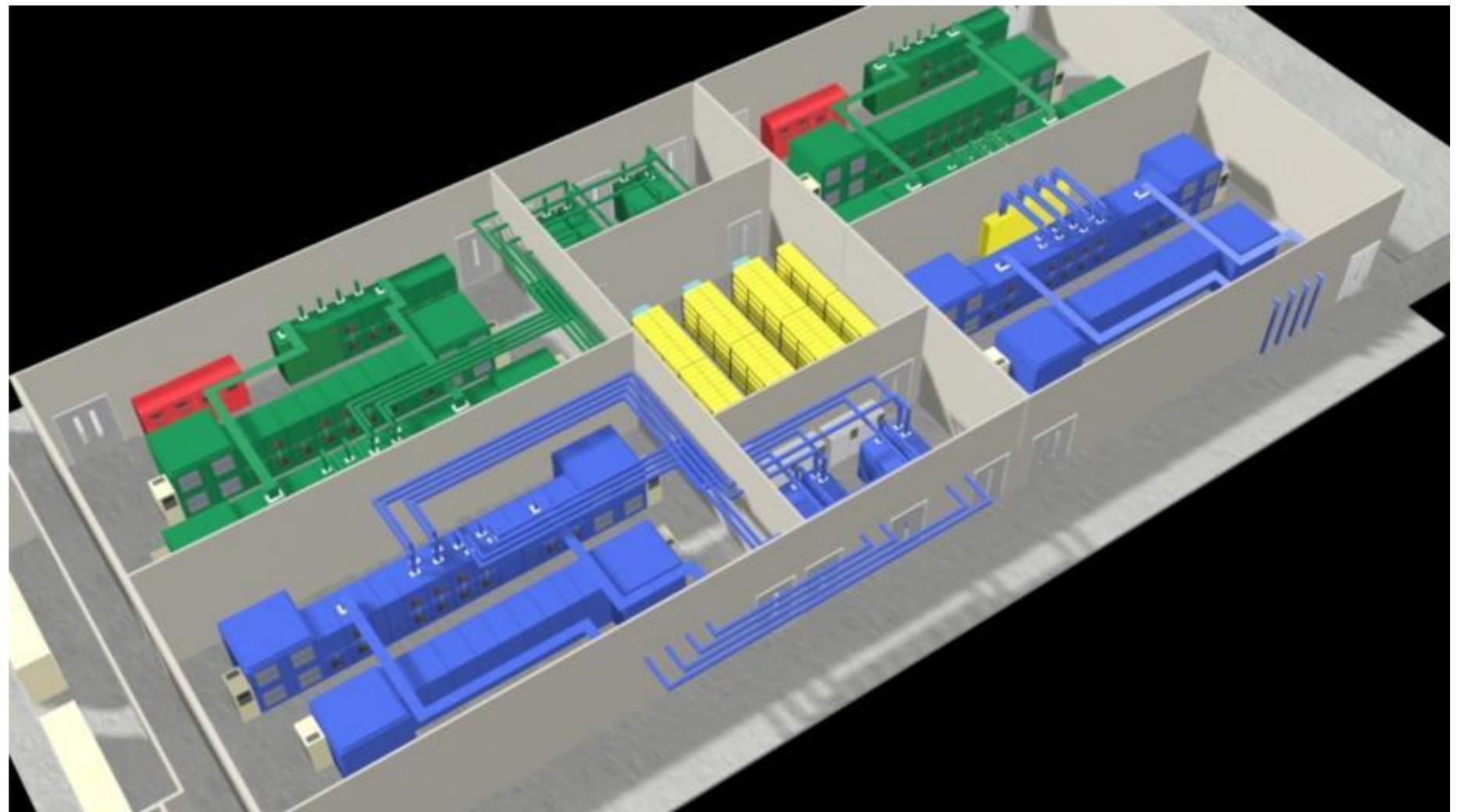
Courtesy: Copper Development Association



- Downtime and interruption
- Data corruption and loss
- Sensitive equipment 'freezes' or 'locks up' requiring restarts
- Damage and destruction of equipment

- Data Centre Power System Considerations
 - Supply configuration (A/B supply, backup power)
 - Power density within the technical space
 - Upgrading capabilities without service interruption
 - Power quality management
 - Cost benefit of fixing power quality
 - Commissioning & Testing

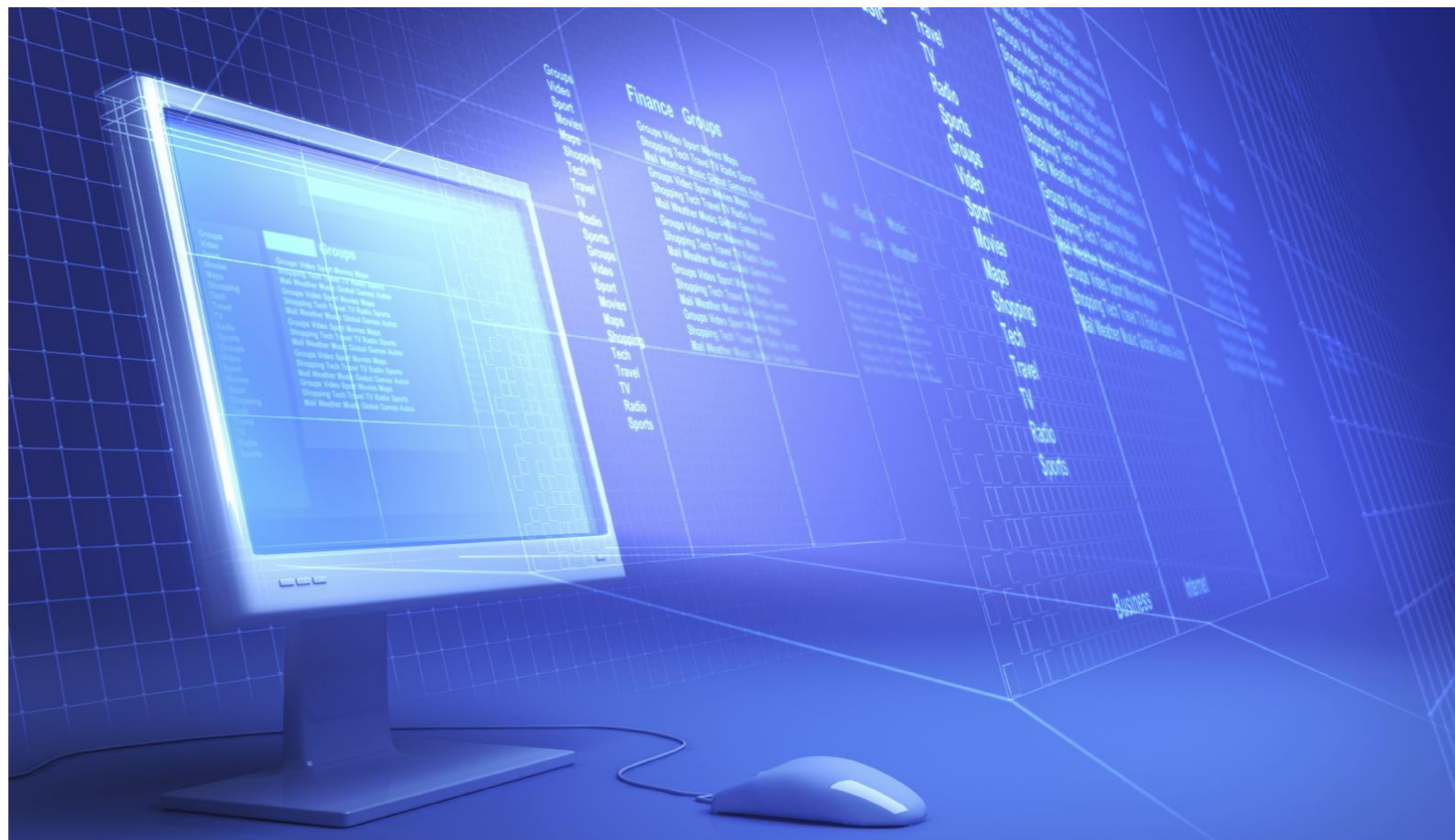
- How is power quality managed?
 - Centralised
 - Distributed



- Solutions:
 - Integrated power quality management
 - Surge Protection
 - Filtering (Active & Passive)
 - Environmental Monitoring

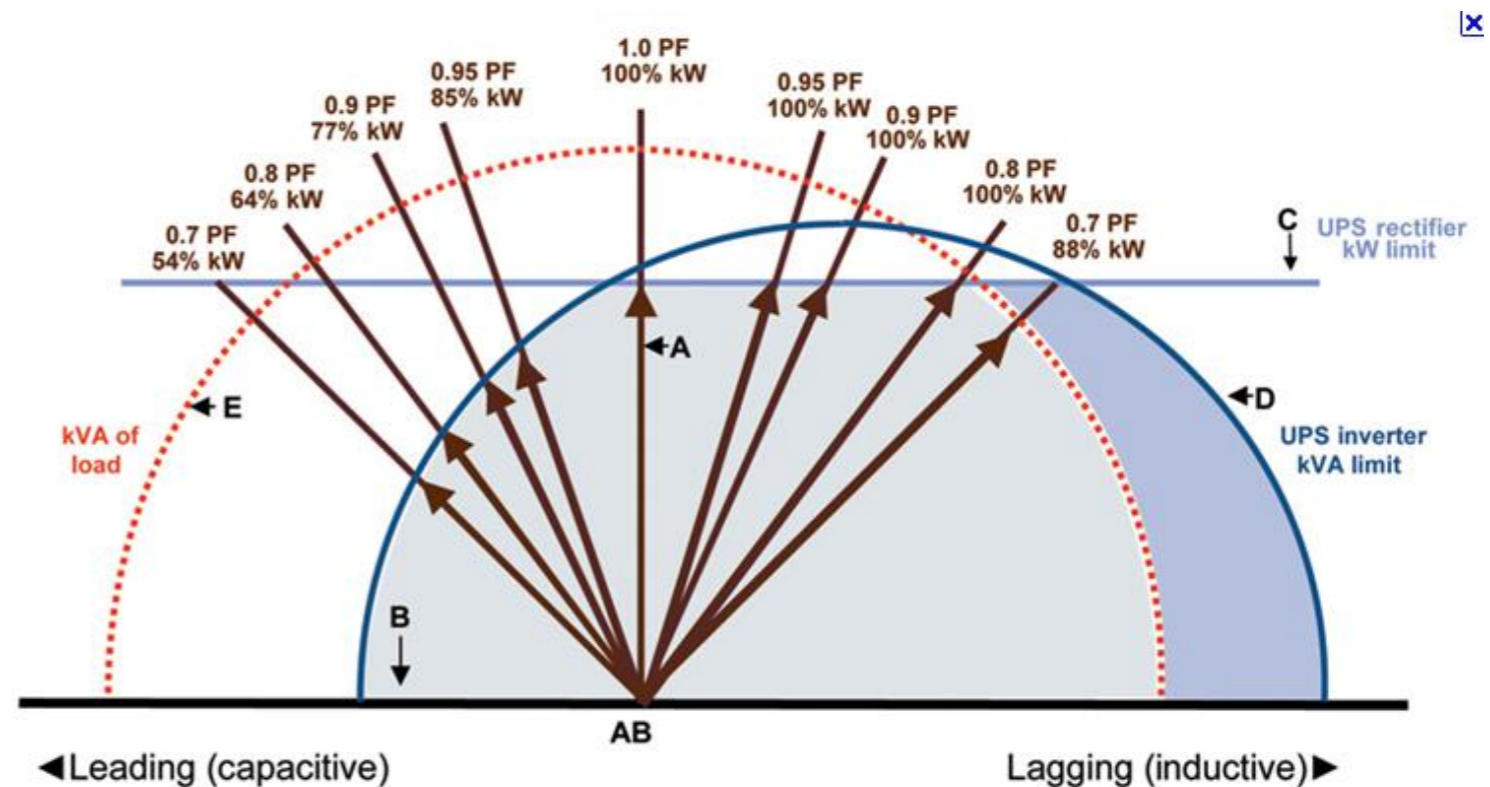


- Understand the loads
- Predictive models
- Cost/benefit of equipment selections



UPS Considerations

- Power factor management
- Fault clearance capabilities
- Testing of UPS/ validation of system capabilities



UPS Considerations

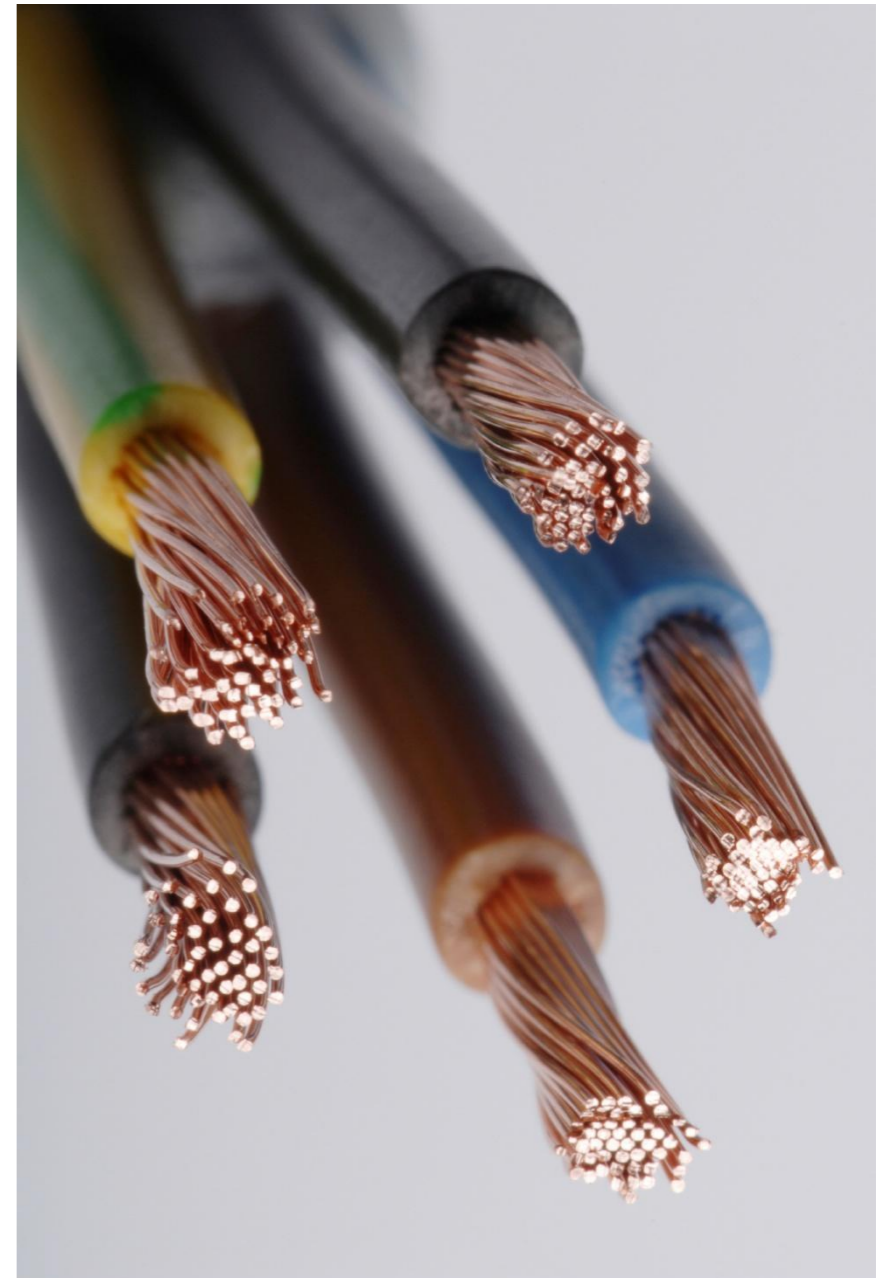
- Off line
- Line Interactive
- On Line

Feature	True Online	Line-Interactive	Standby
Zero Transfer Time	YES	NO	NO
Frequency Regulation	YES	NO	NO
Generates New Sine-wave Continuously	YES	NO	NO
Internal Filtered Dynamic Bypass	YES	NO	NO
Power Factor Correction	YES	NO	NO
Harmonic Distortion Correction	YES	NO	NO
Voltage Regulation	YES	SOME	NO
Eliminates Noise & Transients	YES	SOME	SOME
Power Outage Protection	YES	YES	YES

Courtesy: Liebert Power Quality Consultants

- Some new UPS designs are responding to the Line-Interactive issues

- Break Before Make Switching
 - Earth referencing
 - 3 pole vs 4 pole switching
 - Overlapping neutrals



- Static Switch configuration/settings
 - Tolerances must be set correctly & fully tested
 - Voltage and frequency implications



- Matching equipment to loads
- Impedance matching for paralleling systems
 - Generators
 - UPS



- Integrated System Testing
- Simulating load
- Day 1 vs Ultimate load configuration



- Generator paralleling
 - Multiple set operation, mismatching impedances
- UPS System operation
 - Heavy circulating between parallel UPS units
- Harmonic Assessment
 - Assessment of total site harmonics to assess PQ
- Static Switch Testing
 - Slew rate, transfer times, operating windows

The good news continues....

- Further improvements in equipment power quality
- Less of an issue for UPS backed loads
- Simplified system configuration

....but:

- Still need to plan for power quality

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- Generator paralleling
 - 2 parallel generators working OK, 3rd one ordered and installed to match but didn't – alternator pitch differed due to some issues with as built info, and the result was about 1000 Amps flowing in the neutral of what should have been nearly nothing, circulating between the alternators.

- UPS Installation
 - Heavy circulating HF (3000hz) current between parallel UPS units on the output side , resulting in the failure in UPS Output MSB's ACB CTs.
Power quality problem leads to power loss.
 - Issue was a slight phase difference in the chopping wave between units

- Harmonic Assessment
 - TIA 942 Tier 3 Corporate DC, 2010 build
 - ALL load is UPS backed (Mechanical, IT)
 - Design to IEE 519
 - Modeling done - extensive:
 - Design: 3% THDV at source; 2% at IT load supplies
 - Construction: 2% THDV, 12% THDI (worst case)
 - As Built: So far so good. Waiting on load migration.

References

- <http://www.facilitiesnet.com/datacenters/article/Avoiding-Power-Quality-Headaches-in-Data-Centers--2260>
- http://ecmweb.com/mag/electric_commissioning_mission_critical/
- <http://www.scribd.com/doc/16688803/Power-Quality-Issues-Problems-and-Related-Standards>