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Network Power

Energy Optimization Techniques – Data Center Power Chain

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**Are you ready for the future?**

### Data Centre –Power Map

**Data Center Power Draws**

Electricity Transformer and UPS	10%
Cooling	25%
Lighting, etc.	3%
IT Equipment	35-40%

**Sources of Energy Waste**

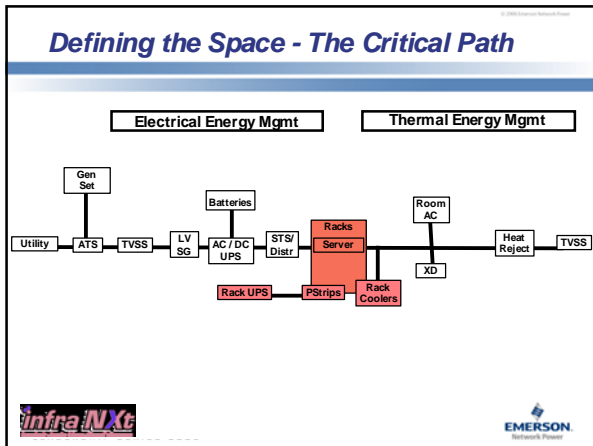
- Lack of humidification control
- Mixing of Hot and Cold air
- Excess fan energy that turns into heat

**Opportunity of Energy Saving in electrical path is lesser as compared to other areas**

**Every WATT saved is WATT produced**

Source: EYP Mission Critical Facilities Inc., New York

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### Data Center Assessment : Power Audit

**Facility Power Audit**

- Determines Health And Integrity Of The Data Center's Power Infrastructure
  - Determine Loading And Capacity Of Electrical Equipment
  - Single Point Of Failure Analysis
  - One-line Drawing Verification
  - Harmonic Snapshot
  - Recommendations To Maximize Availability

**Design**

## Data Center Power Costs

Power required by data center equipment	3 megawatt
Cost of cooling, lighting, power-distribution losses	+ 3 megawatt
<b>Total power requirements</b>	<b>6 megawatt</b>
Cost per kilowatt-hour in USD	\$0.10/KwHr
Annual electricity cost in USD for 24/7 operation	\$5,256,000
Annual savings in USD from a 10% efficiency increase	\$526,000

Source: Computerworld, "Doing the Math," April 3, 2006

Let's look at some ways of saving energy in the data center...

## Power Chain -Evolution

Approaches to consider will be determined by your Business Model ability to balance risk with cost

<b>Infrastructure Strategy Evolution</b> Availability Requirements are Absolute	Balance Cost of Availability with TCO	Focus on SLA over Hardware Availability
<b>Classification: Availability vs. Cost</b> 'Traditional, Proven Methods' • Minimize TCO without sacrificing any availability	'Measured Risk' • Trade calculated availability level for reduced TCO	'Risk-Taker' • Use unproven technologies with little long term reliability data
Motivation Around Cost →		
← Lesson learned to manage availability/risk		

## Anticipate & Adapt To Change

**Flexibility**

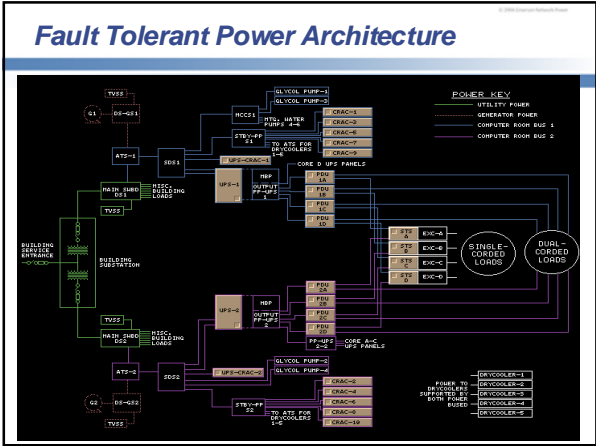
On-site Configurability  
Scalability

**Availability**

System Reliability  
Response Time & MTTR

**Life Cycle Cost**

Copex  
Opex



## Harmonic Control Techniques

**Survive**

- De-rate Up-stream equipments

**Isolate**

- Isolate harmonic from Non harmonic load
- Line Reactors or Isolation transformers

**Divert**

- Use tuned filters

**Cancel**

- Use phase shifting techniques

**Causes**

Non – Linear Load

- SMPS, DC Power Supply
- UPS, Frequency Converter

**Neutralize**

- Active Harmonic Filter

**Active Harmonics solution**

## Active Harmonics Filter

**Features:**

- Modular and easy to extend
- Compensate up to 51st harmonics
- Compensation up to 12 different harmonics simultaneously
- Power Factor Correction & Current Harmonic Reduction
- No problem of overload & Shunt connection, easy for maintenance

**Benefits**

- Saving in Energy Bill
- PF improvement towards unity
- Source gets relieved of excess stress
- DG, breaker sizing and cables gets reduced
- Low heating due to reduced harmonic currents in cables/ distribution systems.

Distorted Input    AF ON    Corrected Input

## Uninterrupted Power Supply

**Customer's Expectations**

- Improved cost of Ownership
- Saving on Energy Bill & Investment Cost
- High Availability, Reliability & Protection
- Scalability, Modularity & Adaptability
- Low MTTR

## Power Systems Require More Than Just a UPS

**Switchgear**

**UPS**

**Batteries**

### Infra Nxt Solution

**High Power Density**

**Up to 96% Efficiency**

**High Availability**

**Improved MTTR & availability**

**0.9 Lead to 0.9 Lag**

**kVA = kW**

**Reduced Footprint**

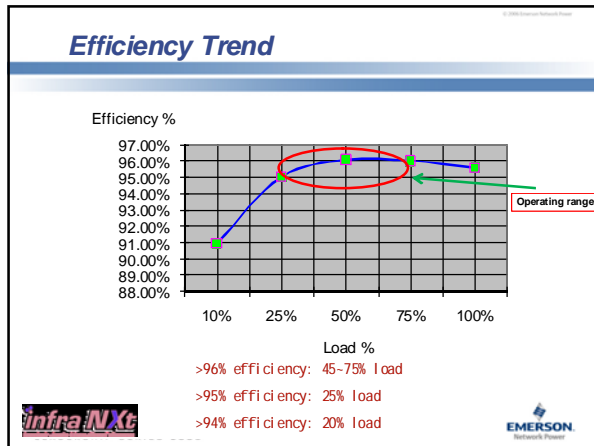
**Xtreme Value**

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### UPS System

- Look for Power, Space & High Efficiency through load range
- Go for UPS with Non-Distorting input Specs >0.95 Input Power Factor & <5% THDi
- Ensure UPS Output is compatible with Unity/Leading Power Factor servers

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### Case Study : UPS Efficiency Savings

**Commercial Tariff : Cost Based on Rs. 7 per kWh**

Rating (kVA)	Traditional UPS (@92%) Energy Charges (in INR) (A)	Liebert Nxt / ITA (@96%) Energy Charges (in INR) (B)	Annual Energy Cost Saving (in INR) (C=A-B)	Annual Air Con. Saving (in INR) (D)	Total Annual Saving (in INR) E=(C+D)	Saving @ 10 Years (in INR)
30	1,999,846	1,516,250	483,596	35,706	519,302	5,193,220
60	3,999,130	3,032,500	967,130	71,413	1,038,543	10,386,440
90	5,998,696	4,548,750	1,449,946	107,120	1,557,066	15,570,660
120	7,998,261	6,065,000	1,933,261	142,826	2,076,087	20,760,870
150	9,997,826	7,581,250	2,416,576	178,533	2,595,109	25,951,090

**Industrial Tariff : Cost Based on Rs. 5 per kWh**

Rating (kVA)	Traditional UPS (@92%) Energy Charges (in INR) (A)	Liebert Nxt / ITA (@96%) Energy Charges (in INR) (B)	Annual Energy Cost Saving (in INR) (C=A-B)	Annual Air Con. Saving (in INR) (D)	Total Annual Saving (in INR) E=(C+D)	Saving @ 10 Years (in INR)
30	1,428,261	1,088,750	339,511	25,906	365,417	3,654,170
60	2,856,522	2,177,500	679,022	51,813	730,835	7,308,350
90	4,284,783	3,266,250	1,018,533	77,719	1,096,252	10,962,520
120	5,713,043	4,355,000	1,358,043	103,626	1,461,669	14,616,690
150	7,141,304	5,443,750	1,697,554	129,533	1,827,087	18,270,870

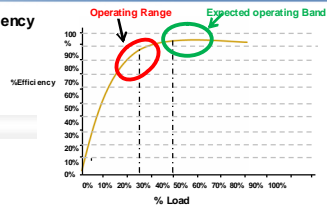
\* The prices assumed are average prices of electricity in India.

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## System Efficiency – Reality Check

### Reasons Attributable for Low Efficiency

- Reality
- Sizing Method of UPS
- Design & Safety Margin
- Capacity Building for redundancy



### Energy Optimizer / Intelligent Paralleling

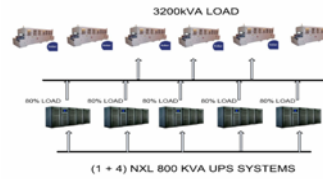
Optimally load each UPS in a multi UPS parallel system, so that each UPS works in its most efficient band of operation

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## Dynamic Capacity Modulation

- Intelligent paralleling
  - In a 1+N system, if the load is much less than the connected modules, one or more module would be idled
  - Improves efficiency without compromising availability
  - Track each module's off-line hours and schedule other modules to be off-line to distribute the operating hours to all modules
    - Just like rotating your tires

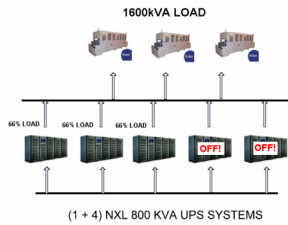


All UPS units running when load is high

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## Dynamic Capacity Modulation



Two (2) UPS units in sleep mode when load is low.

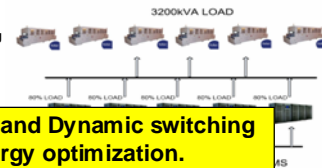
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## Dynamic Capacity Modulation

### Features

- Scheduling on Load Profiling
- Track each module's off-line hours
- Cyclic Operation/Team work



More modules (N) and Dynamic switching achieve better energy optimization.

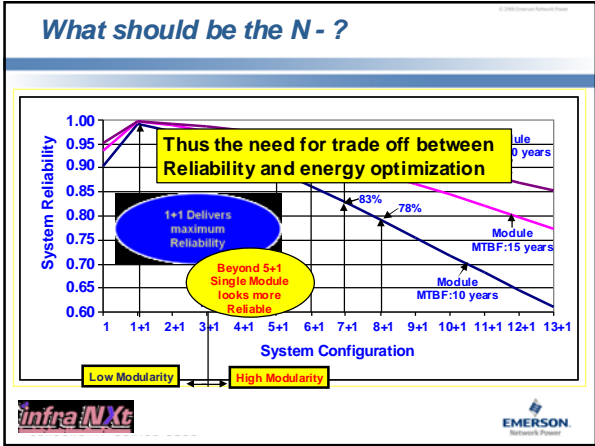
But does anything limit N?

- Data Center
- IT Park / Telecommunication Industry



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### Energy Optimizer – Case Study

#### Load Study with and without Energy Optimizer

Table E- 500 kVA systems

Table E- 500 kVA systems	1	2	3	4	5	6	7	8	9	10	11	12	13
No. of UPS systems	1	2	3	4	5	6	7	8	9	10	11	12	13
Rating of UPS system	500	500	500	500	500	500	500	500	500	500	500	500	500
Redundancy level	1	2	3	4	5	6	7	8	9	10	11	12	13
Design Load	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Before Implementation of Enerwise, all UPS systems were working irrespective of load demand

Load Pattern	Load kW	Load %	Consist. kW	Working Hrs	Hrs	No. of Events	Total Events	Unit rate /hr	Energy Loss kWh
Actual Load Day	1400	70%	21.4	1520*5-10*10hrs	2000	5	267500	6	1669500
Actual Load Night	500	25%	11.5	1520*5-10*14hrs	3000	5	201250	6	1207500
Actual Load Off Days	100	5%	0.5	1520*2-10*24hrs	2736	5	136800	6	732100
									3602500

After Implementation of Enerwise, With redundancy (N+1) maintained

Load Pattern	Load kW	Load %	Consist. kW	Working Hrs	Hrs	No. of Events	Total Events	Unit rate /hr	Energy Loss kWh
Actual Load Day	1400	70%	21.4	1520*5-10*10hrs	2000	5	267500	6	1669500
Actual Load Night	500	42%	13.64	1520*5-10*14hrs	3000	3	136000	6	821000
Actual Load Off Days	100	20%	0.8	1520*2-10*24hrs	2736	2	93600	6	524000
									2740500

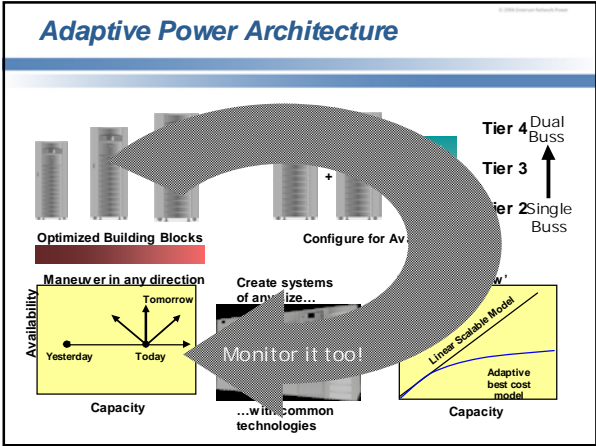
  

After Implementation of Enerwise, Without redundancy

Load Pattern	Load kW	Load %	Consist. kW	Working Hrs	Hrs	No. of Events	Total Events	Unit rate /hr	Energy Loss kWh
Actual Load Day	1400	68%	28.1	1520*5-10*10hrs	2000	4	261000	6	1606000
Actual Load Night	500	63%	19.1	1520*5-10*14hrs	3000	2	133700	6	802000
Actual Load Off Days	100	40%	12.8	1520*2-10*24hrs	2736	1	30500	6	210200
									2618000

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- ### PDU – Power Distribution Unit
- 
- Intelligence built in for,
    - Comprehensive Monitoring & Communication capabilities
    - Branch Monitoring
  - Built in Isolation / K Transformers for,
    - Locally derived "Computer Grade Neutral"
    - Minimized Ground – Neutral Voltages
    - K Rating for enhanced Harmonics handling
  - Significant Savings by,
    - Adoption of 3 Phase 3 Wire Distribution
  - Recommended by IEEE, other agencies
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## Adaptive Architecture



### Modular

Standard units with fixed capacity with internal modularity. A unit with single direction for growth. Added redundancy.

### Scalable

A unit with single direction for growth.

### Adaptive

**Reliability** that can deal with uncertainty from module to system.  
**Flexibility** for changing requirements in capacity, density and availability.  
Lowest **Total Cost** method for capital and operating expenses.

**Beyond Modular, Scalable - Adaptive**



Thank you

