Session: R23

IBM

IBM Power and Cooling

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WW Product Marketing- IT Infrastructure

IBM *@*server **xSeries**

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Planning for high density servers

- **What is different?**
  - ✓Ever increasing chip speeds
  - ✓Greater density
  - ✓More PCI slots
  - ✓Larger drives - More drives
  - ✓More memory
- **The results of this...**
  - ✓More power needed to run systems
  - ✓More BTU output from system
  - ✓More cabling and complexity in the rack
- **Things to consider**
  - ✓Racking considerations
  - ✓Power requirements
  - ✓Heat/thermal output
  - ✓Air volume requirements
- **Back up**

Understanding power, power supplies, and power distribution

Overview of power supplies

Our power supplies are rated by the output they can deliver not the input

Example: the 1800W BladeCenter module is able to deliver up to 1800W of DC power
- ✓ A power supply can take in more AC power than it can deliver DC- the difference between the input requirement and the output is commonly called the efficiency rating
- ✓ Server content and server utilization determine the power draw not the size of the supply

AC power wattage is extremely useful

The numbers that we quote are worst case – worst case is constant
- ✓ Typical customer utilization is from 25-75% which reduces power usage greatly
- ✓ If server is not fully optioned up power usage will be less than max
- ✓ We quote worst case because that is not variable

In a redundant solution both power supplies share the load
- ✓ Each power supply delivers half the load if both are powered on and working properly
- ✓ Having supplies share the load leads to longer life, reduced failures
- ✓ One supply can carry the entire power requirement if called on

IBM Server- power guide

System	Power Supply Rating (DC)	Input Power (AC) Max	Input Power (AC) Typical	Line cords	PDU Planning (Amps @220V)	PDU Planning (Amps @110V)	Rack Power Max (W)	Rack Power Typical
x305	220	200	140	1	0.9	1.8	8400	5880
e325	411	587	400	1	2.7	5.3	24654	16800
x335	350	340	245	1	1.5	3.1	14280	10290
x345	514	500	350	1 or 2	2.3	4.5	10500	7350
x235	660	800	560	1 or 2	3.6	7.3	6400	4480
x360	370	740	520	2 or 3	3.4	6.7	10360	7280
x440	950	900	850	2	4.1	8.2	9000	8500
x445	1200	900	850	2	4.1	8.2	9000	8500
x450	1200	900	850	2	4.1	8.2	9000	8500
x365	950	1100	770	1 or 2	5.0	10.0	15400	10780
x255	370	1000	530	2	4.5	9.1	6000	3180
Bladecenter	1800	4000	3400	2 or 4	9.1	N/A	24000	20400

Notes:

Max is based on today's max configuration running at 100% utilization- guide for planning

Typical is based on today's max configuration at average utilization- more realistic however you must really understand what the customer is doing with the server

Amperage guidance- max draw per line cord for planning. Normal operation for dual power is half this load, only failure mode demands this amperage.

CFM - Cubic Feet per minute.

Airflow- low at 22C or less, max at 32C+. Increase linear between the two.

Understanding power terms

- **Wattage- a measurement of real power**
- **Amps-measurement of the rate of current flow**
- **Voltage- definition of the capacity**

- **Formulas:**

Amps = Watts/Voltage

So if server draws 500W how many Amps will it draw at 100V and at 208V?

4.5A at 110V and 2.4A at 208V

What can we derive from AC information

An example with BladeCenter 1800W

90% efficient so 1800/.9 = 2000AC watts

2000W per domain is theoretical max (4000/chassis)

4000W (entire chassis) x 3.41 = 13,640BTU

4000W/.99 = 4040VA

2000/220V = 9.1A

13,640/12000 = 1.13 tons

- **BTU or heat output**
  - BTU is a measurement of heat output from a device
  - AC wattage x 3.41 = BTU (3.41 is a constant)
  - X345 AC draw is 500W max BTU is therefore 1700
- **VA rating**
  - Older way of looking at power usage
  - VA rating x power factor correction = wattage
  - IBM supplies are near unity (98%+)
  - X440 AC draw is 900W so VA rating is around 915 (near unity)
- **Amperage**
  - Measurement of the current flow needed by a power supply
  - AC wattage divided by voltage = amps
  - X335 AC draw is 340W so amperage at 220V is 1.5A
- **Tonnage of AC**
  - Measurement of the AC capacity needed for cooling
  - BTU divided by 12000 = AC tons to cool

Distributed Power Interconnect (DPI) PDUs

New set of high density PDUs
- ✓ Replaced the NetBAY family
- ✓ Easier to install- customer install versus electrician install
- ✓ Easier to scale up
- ✓ Smaller form factor frees up rack space
- ✓ Extremely outlet dense designs
- ✓ Industry leading power density
- ✓ Among the most advanced products available for high density power

More products to come...

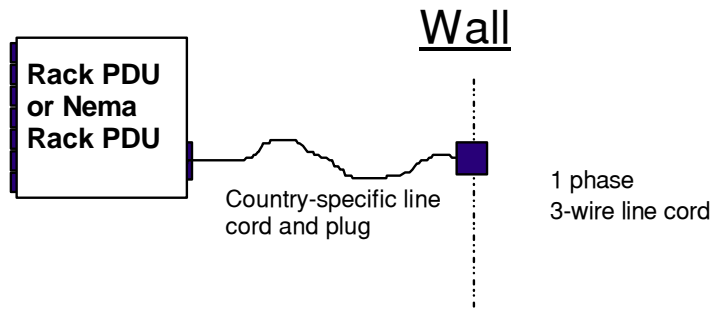**Running new power feeds to a rack means substantial cost**
20amp feed - $450 - $750US
30/32amp feed - $800 - $1200US
60/63amp feed - $1500 - $2000
IBM PDUs can help reduce some of this cost if used properly

The DPI Family of PDUs

DPI Universal Rack PDU

DPI 100-127V Rack PDU

The Rack PDUs can be used on their own

<u>Wall</u>

Rack PDU or Nema Rack PDU

Country-specific line cord and plug

1 phase
3-wire line cord

The Universal Rack PDUs used with the DPI Front-end PDU to consolidate line cords
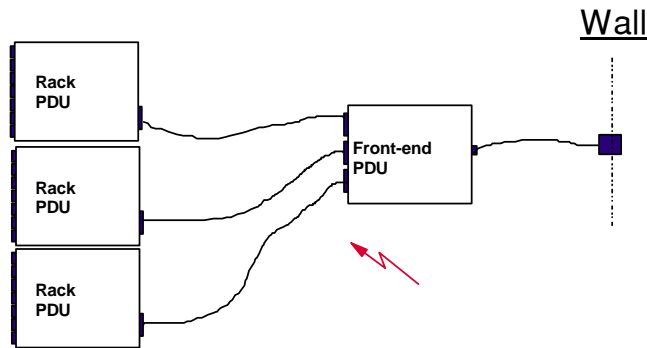
DPI Front-end PDU

<u>Wall</u>

Rack PDU

Rack PDU

Rack PDU

Front-end PDU

Total of 21 outlets- works for Rack PDUs only, Nema is not supported like this.
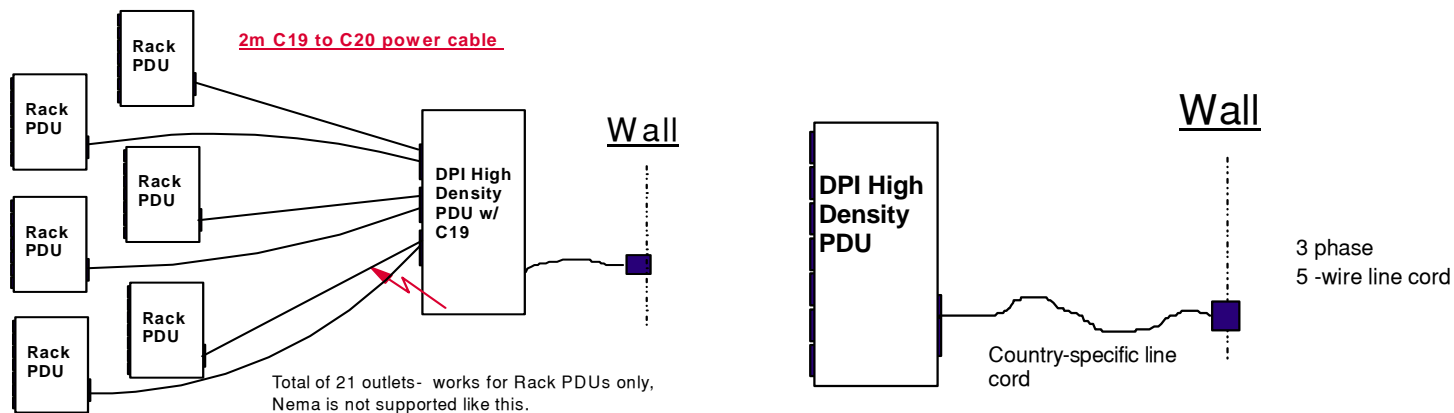
High Density PDUs

New PDUs is a combined Front End/Rack PDU
Improved power support for the high end- x360, x440, x450,
BladeCenter
Complete racks of BladeCenter - only four PDUs, four power feeds
3-phase delivers more power than previously possible
Full rack width
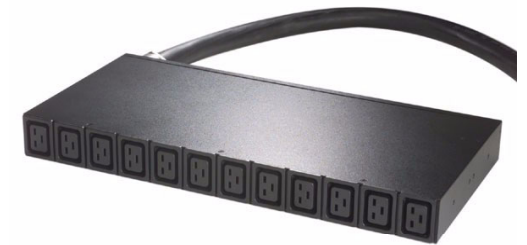
73P5844	DPI 32amp 3-phase High Density C19 PDU with IEC 309 32A 3P+N+Gnd (250V) line cord
73P5847	DPI 60amp 3-phase High Density C19 PDU with IEC 309 60A 3P+Gnd (208V) line cord
73P5856	DPI 63amp 1-phase High Density C19 PDU with Fixed IEC 309 63A 3P+N+Gnd (250V) line cord
73P5855	DPI 60amp 1-phase High Density C19 PDU with IEC 309 60A 2P+Gnd (208V) line cord

Rack PDU

Rack PDU

2m C19 to C20 power cable

Rack PDU

Rack PDU

Rack PDU

DPI High Density PDU w/ C19

Wall

Rack PDU

Total of 21 outlets- works for Rack PDUs only, Nema is not supported like this.

DPI High Density PDU

Wall

3 phase
5 -wire line cord

Country-specific line cord

PDU sizing assistance- fact finding

Items that are needed to pick PDUs
- **Determine what does the customer want in a PDU structure?**
  - ✓The cheapest?
  - ✓Redundancy
  - ✓Lowest number of line cords fed to the rack
- **Need to know the type of power source customer wants to use**
  - ✓Is this World Trade (International) or North American power
  - ✓What is the amperage they are capable of running- 20, 30, or 60
  - ✓Single phase or three phase
- **Number and type of servers and options**
  - ✓Need wattage of supply
  - ✓Number of line cords

We have designed the DPI PDU family to cover a broad range of customer needs
- ✓PDUs work alone or together
- ✓Number of outlets are easily scalable for growth
- ✓PDUs can be mounted in a variety of locations
- ✓DPI PDUs are designed for powering and protecting IBM servers

What type of PDU fits your location?

Simplify the type of PDUs you need to work with

The PDUs designed for the World Trade (International) countries and those designed for North American systems differ greatly.

The rules governing how we use these PDUs also differ greatly.

	North American	World Trade
Countries	North America, Japan, Taiwan, Saudi, Philippines	Rest of the globe
Rack PDUs	20A Rack PDU 32P1736	20A Rack PDU varies by country (32P1736-1749)
	Nema PDU 32P1761	
Front End PDUs	30A Front End PDU for low voltage (100-127V) is 32P1751	32A Front End PDU is 32P1752
	30A Front End PDU for high voltage (200-208V) is 32P1766	63A Front End PDU is 32P1754
	60A Front End PDU (200-208 only) is 32P1767	
High Density PDU	60A Single Phase High Density PDU (200-208V) is 73P5855	63A Single Phase High Density PDU (220-240V) is 73P5856
	60A Three Phase High Density PDU (200-208V) is 73P5847	32A Three Phase High Density PDU (220-240V) is 73P5844

PDU sizing assistance- The basics

Need to know the type(s) of power supply customer has
- ✓ Itemize the type and number of each server in the rack
- ✓ Each server power supplies is unique and draws a specific amount of power
- ✓ Each server power topology is different- some have 1, 2, 3, or 4 supplies and corresponding line cords

Begin adding servers to the Rack PDUs until you reach a limit - either amperage or outlets
- ✓ Rack PDU has a limit of 15amps in total or 10A per outlet
- ✓ Seven C13 outlets
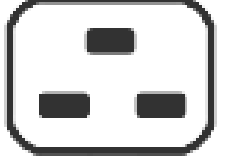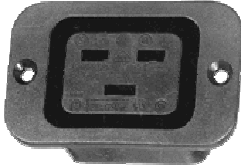
If more than two Rack PDUs and lines are needed look into consolidating with the Front End PDUs
- ✓ Front End PDUs have a limit of either 24, 32, 48 or 63amps depending on type and location installed or 16A per outlet
- ✓ Three C19 outlets

When adding FE PDUs into the topology be careful not to exceed power limits- two maxed out Rack PDUs will fully utilize a FE PDU

The new High Density PDUs are a combined Rack and FE PDU. Amperage limitations depend on type of power input- single phase or three phase

Line cords & connectors

	C13 connector- 10A rated (female) Rack PDU outlet Mating connector to server		
	C14 connector- 10A rated (male) The inlet on most servers & options Rack jumper cords		
	C19 connector- 16A rated (female) FE PDU Outlet FE to Rack PDU cable, BC line cord		
	C20 connector- 16A rated (male) BladeCenter and Rack PDU inlets Part of BladeCenter line cord		

Lower number is female. Power flows from female to male.

PDU connector info

- **The higher power PDUs use industry standard IEC connectors**
- **These connectors are used world wide and are approved for application in the US and CAN**
- **Here is information on the two main connectors used in the high power PDUs**

The 60A 3phase High Density PDU

Receptacle or connector is a type, 3 Phase 60A, 250V,3P4W or 3 Pole and Ground, connected to a 3 Phase 208 Volt, 60 A service.

Link: http://mennekes.com/pdf/ME_460P9W.pdf
PART NO.: ME 460C9W
DESCRIPTION: 60AMP 3 Phase 4W 250VAC Connector
CONSTRUCTION:Watertight IEC IP 67
APPROVALS:
UL Listed Standards 1682
CSA Certification to Spec. C22.2 No.182.1
IEC 309 - 1; IEC309 - 2
IEC COLOR CODE: Blue
GROUND PIN: 9 Hour Position Mates with Male in 3 Hour Position.

Alternately, please check the Hubbell weblink below.

http://www.hubbellcatalog.com/wiring/section-e-datasheet.asp?PN=HBL360R6W&FAM=PS&P=5957,6509,6121,6125

The 60A 1Phase Front End or High Density PDU

Receptacle could be Mennekes type, 1 Phase 60A, 250V,2P3W or 2 Pole and Ground, connected to a 1 Phase 208 Volt, 60 A service.

Link: :http://mennekes.com/pdf/ME_360P6W.pdf
PART NO.: ME 360C6W
DESCRIPTION: 60AMP 1 Phase 3W 250VAC Connector, Watertight IEC IP 67
APPROVALS:
UL Listed Standards 1682; 1686
CSA Certification to Spec. C22.2 No.182.1
IEC 309 - 1; IEC309 - 2
IEC COLOR CODE: Blue
GROUND PIN: 6 Hour Position Mates with Male in 6 Hour Position.

The output at each IEC320--C19 outlet will be 208 Vp-p.

Sizing Up Power

IEC C13
Max rating
10A

IEC C19
Max rating
16A

Server

Rack PDU
30A (24)
or 60A (48)

FE PDU
30A (24)
or 60A (48)

Wall outlet
protected by
breaker of
adequate size

Line cord and
connectors
rated to
needed power
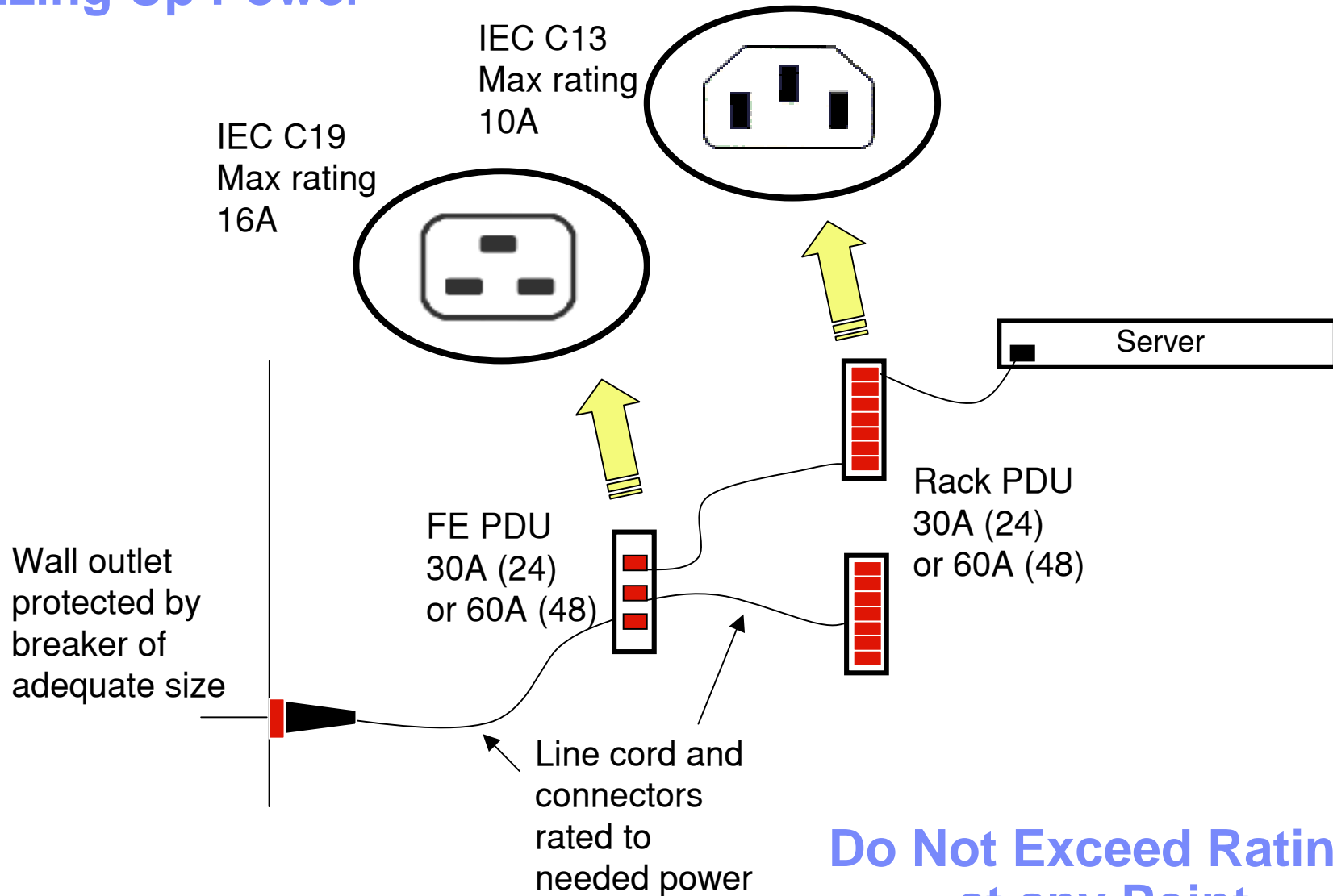
## Do Not Exceed Ratings at any Point

A North Americas Example

Customer wants to install 18 - x345s into a rack and needs power information
✓ This version of the x345 has a 350W supply- so operating at 208V the server will draw a max of 2.25A per supply
✓ X345 has two line cords and two power supplies- 36 line cords total

This means we can add up to 6 servers to each Rack PDU since it has a limit of 15A Since we have more than two Rack PDUs and lines consolidating with the Front End PDUs makes sense if the customer can supply us with a 30A outlet at the rack
✓ Three Racks PDUs each drawing over 13A of power well exceeds the amount of power that a 30A (24A) PDU can deliver so we should move this customer to 60A (48A) PDU.
✓ A quick check 13A times three Rack PDUs is less than the 48A available from the 60A Front End PDU so we are fine.
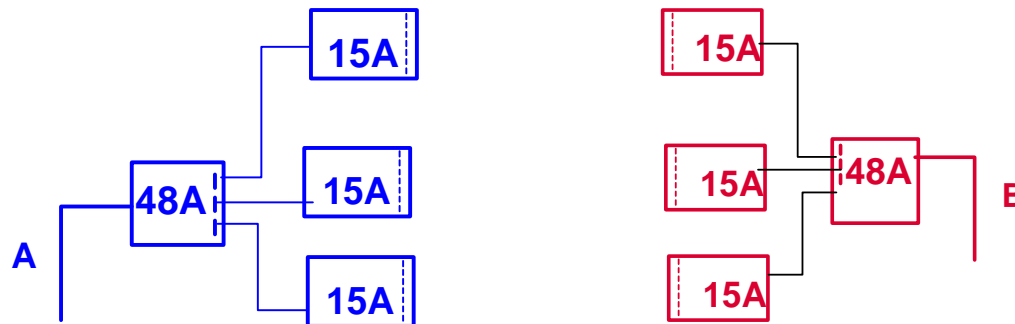
Airflow requirements by server

System	Max system air flow - CFM	Min system air flow - CFM	Rack CFM Max	Rack CFM Min
x 3 0 5	3 5	2 5	1 4 7 0	1 0 5 0
e 3 2 5	4 0	2 5	1 6 8 0	1 0 5 0
x 3 3 5	4 0	2 5	1 6 8 0	1 0 5 0
x 3 4 5	9 8	5 2	2 0 5 8	1 0 9 2
x 2 3 5	9 0	5 0	7 2 0	4 0 0
x 3 6 0	1 1 0	6 0	1 5 4 0	8 4 0
x 4 4 0	1 7 5	1 0 0	1 7 5 0	1 0 0 0
x 4 4 5	1 7 5	1 0 0	1 7 5 0	1 0 0 0
x 4 5 0	1 7 5	1 0 0	1 7 5 0	1 0 0 0
x 3 6 5	3 2 0	7 4	4 4 8 0	1 0 3 6
B l a d e c e n t e r	4 6 5	2 6 5	2 7 9 0	1 5 9 0

Air flow is cumulative- add them all up and you get the rack level data

All IBM servers work in the same manner - as inlet temperatures increase so does air flow (CFM)

- Minimum fan speeds are found at temperatures less than 25C
- Maximum fan speeds are found at and above 32C
- The increase is linear to the temperature increase
- The server MM controls fan speed, responding to inlet temp changes.

How the rack and data center work

Racking considerations

The rack is the basic building block of the data center

Rack needs to be engineered to be part of the thermal solution
- ✓ A poorly designed rack can lead to poor cooling efficiency
- ✓ Shallow racks do not allow room in rear for cable placement
- ✓ Racks with poor airflow will starve servers of needed cooling
- ✓ Need for fans interrupts natural airflow in data center and in rack

IBM racks allow for highly efficient cooling
- ✓ Designed not to allow hot air recirculation within the rack
  - •Side design does not let air from back of rack escape to the front
  - •Rack front to back partition works properly even when in a suite
  - •Top and bottom of rack are set up so that there is not unblock able spaces to let air leak to front
- ✓ Solid top in front of rack
  - •Less chance of hot air re-circulation over top of rack
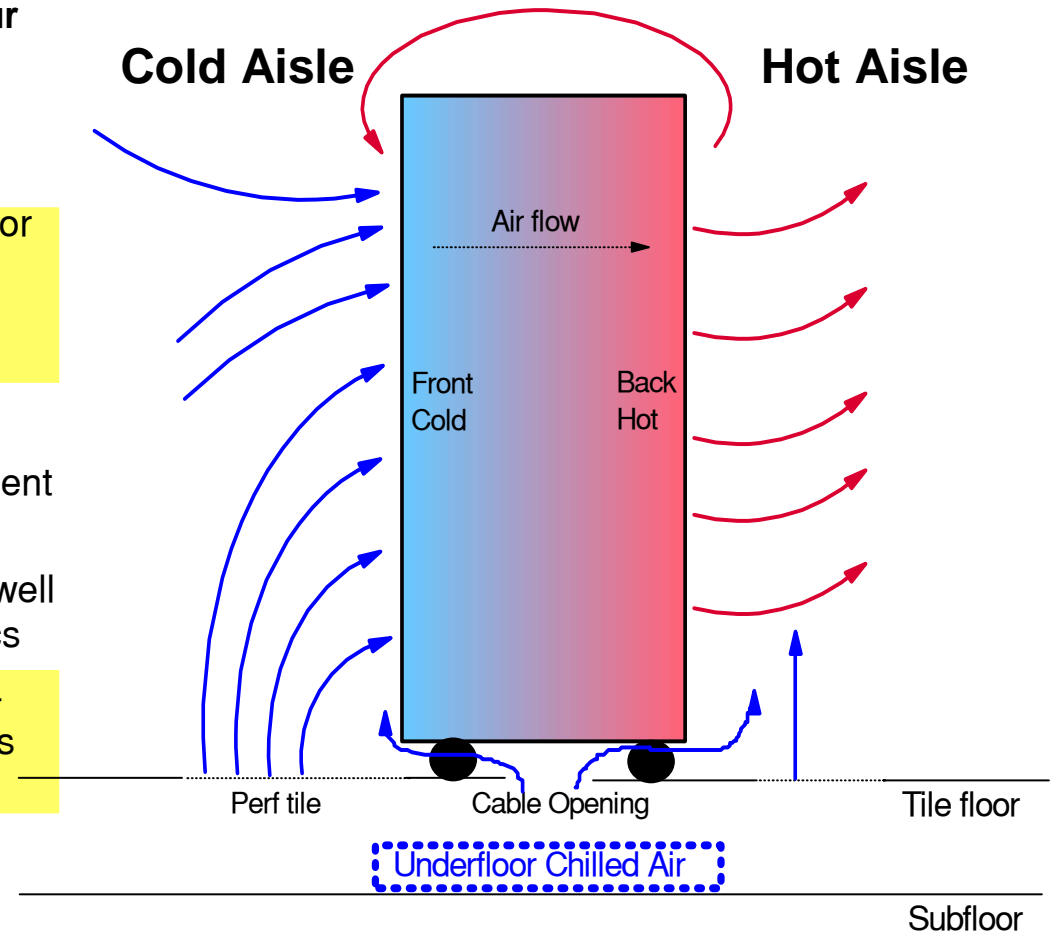 - •Racks with perf top cause more problems that they are worth

note: even a well designed rack that is not set up properly will cause air re-circulation within the rack

How the Rack Works

What are the requirements for cooling our servers?

- ✓ IBM servers are designed to work at temperatures above HP and Dell

- ✓ Inlet air temperatures maintained at or below 35oC temperature for elevation below 3k feet, or 32oC for elevation between 3k and 7k feet

- ✓ Humidity 8-80%

- ✓ Front to back cooling- the most efficient method available

- ✓ Plenty of space in front and rear as well as over head to handle thermal physics

- ✓ Enough CFM (cubic feet per minute- volume) of air to supply the server- this varies by server

Cold Aisle   **Hot Aisle**

Air flow

Front
Cold

Back
Hot

Perf tile   Cable Opening   Tile floor

Underfloor Chilled Air
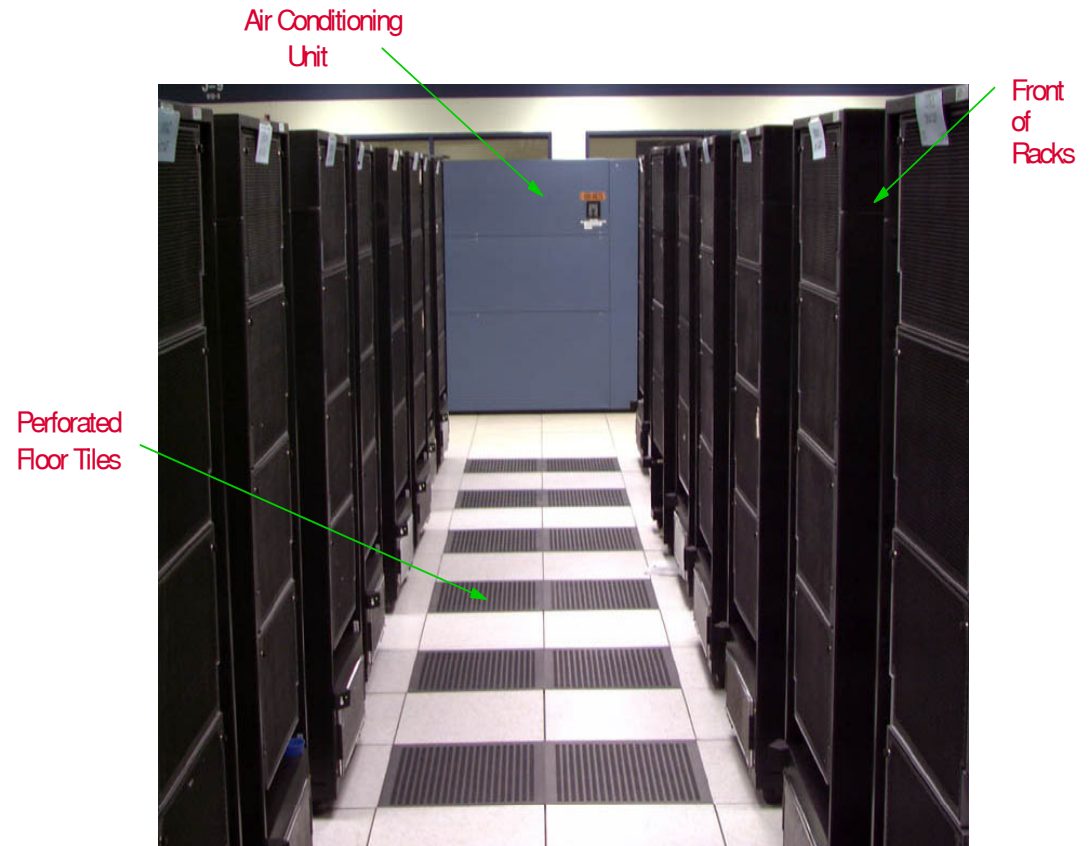
Subfloor

How the data center works

Typical data center

It is a complex environment
- ✓ Items of interest
- ✓ Perforated tiles
- ✓ Raised floor
- ✓ Aisle ways- hot and cold
- ✓ Ceiling height
- ✓ Density in the cabinet
- ✓ Cooling assets
- ✓ Cable opening
- ✓ Types of racks
- ✓ Number of racks
- ✓ KW load of equipment

Air Conditioning Unit

Front of Racks

Perforated Floor Tiles

The data center and how it works

The <u>key</u> requirement maintain rack inlet temperatures within manufacturers specifications

Perforated Floor Tiles (can be 6, 11, 25, 40, 60% open)

Raised Floor

Subfloor
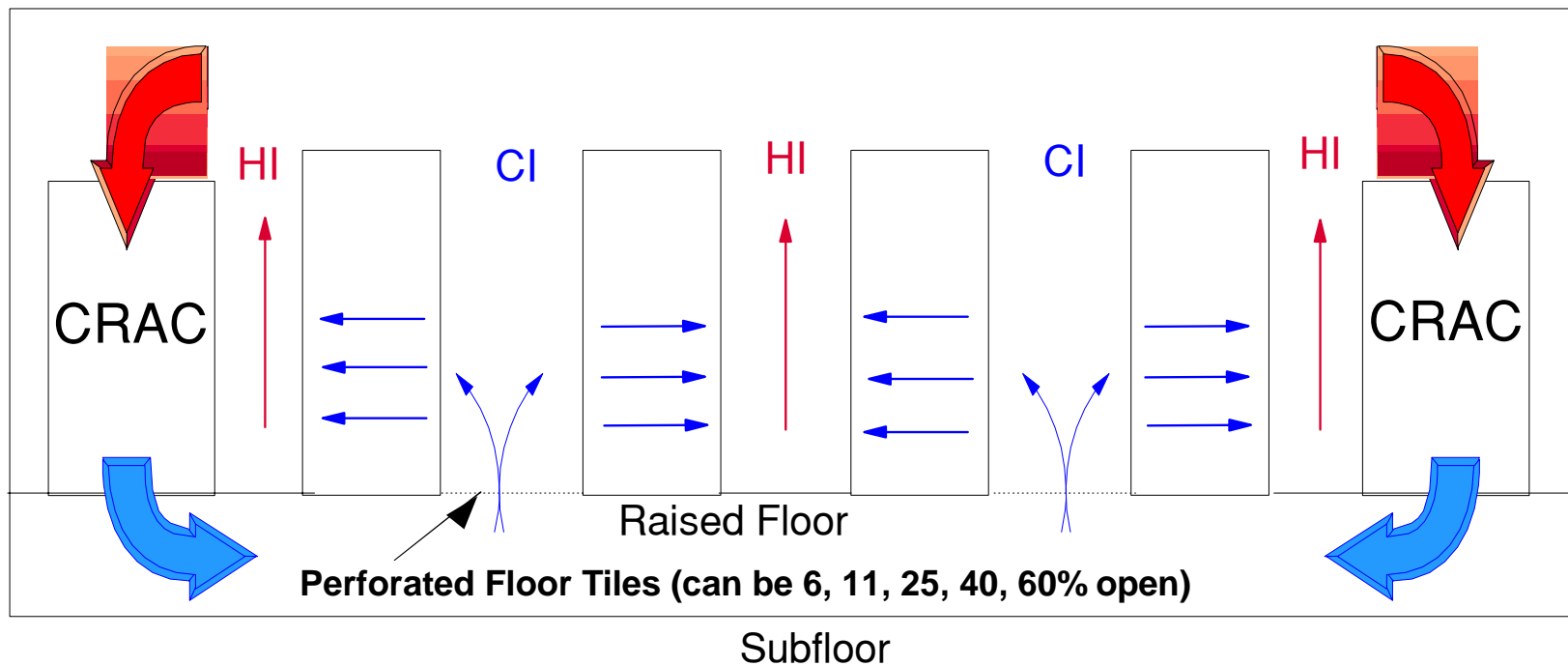
- 2 separate complex thermo-fluid problems- (1) Underfloor air distribution (2) Above floor air/temperature distribution

Examples of different data centers

Raised Floor Supply
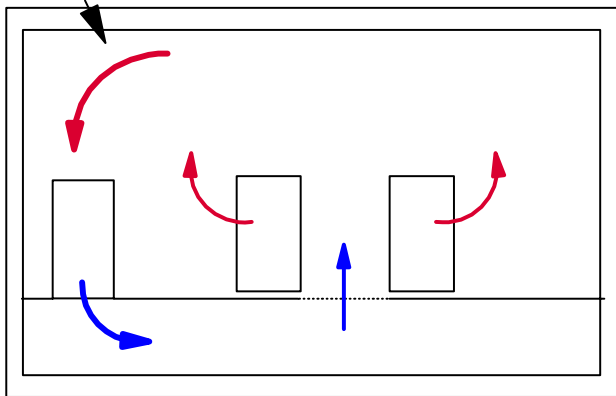
Raised Floor Supply/Ceiling Return

Raised Floor Supply/Ceiling Supply
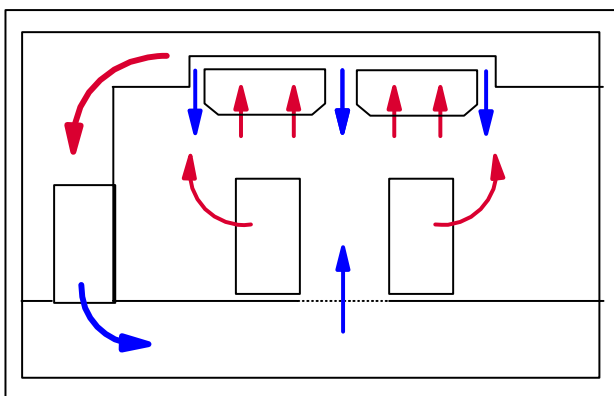
Ceiling Supply
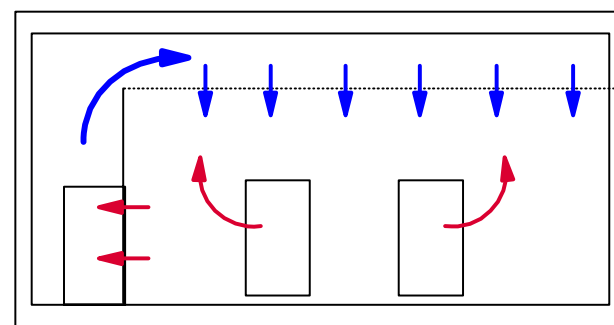
Examples of poor data center design
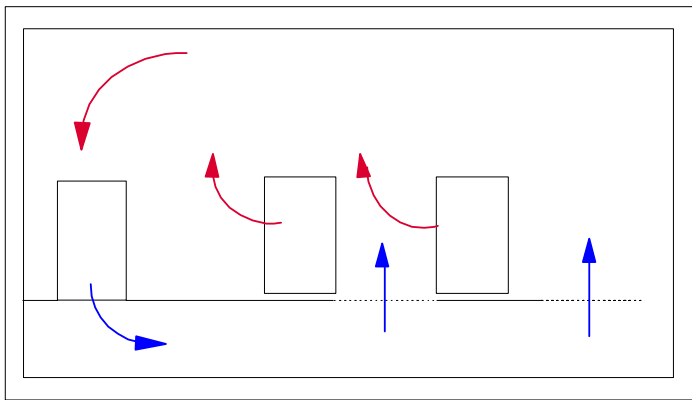
Progressive Oven Design

✓All racks facing the same direction:

✓Hot air from rack 1 is taken in as cooling air through rack 2 and so on.

✓Last rows can get much hotter than first racks
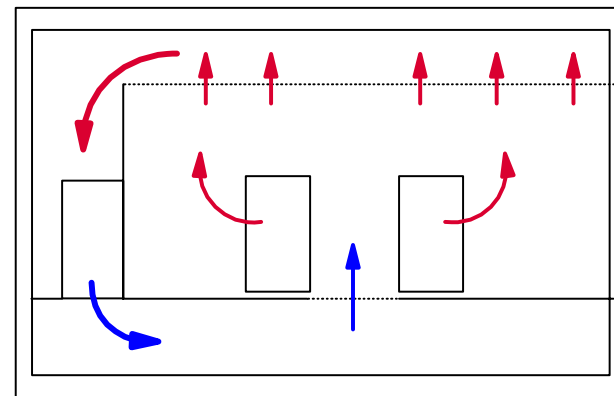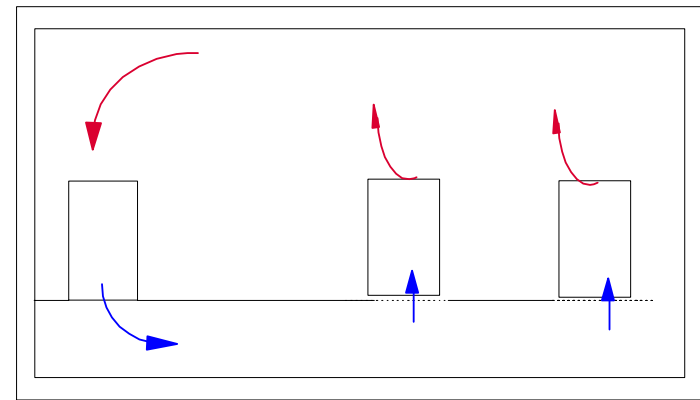

The Seems Like a Good Plan Design

✓Racks with solid doors that feed cool air directly into the rack

✓Low total CFM can cause problems

✓Each rack is a potential failure point

✓Usually depends on fans which fail

✓Depending on ceiling height fans can push air fast enough that it will bounce back down to inlet

There is a lot of information out there to help

Available on ibm.com
- ✓ Decision Makers Guides
- ✓ IBM NetBAY Rack product overview
- ✓ IBM KVM and ACT products
- ✓ IBM UPS Guides- low voltage and high voltage products
- ✓ IBM PDUs options
- ✓ Flat Panel products

Spec sheets
- ✓ IBM Remote Console Manager
- ✓ IBM Local Console Manager
- ✓ IBM UPS3000X family
- ✓ IBM UPD Tower family
- ✓ IBM DP Interconnect PDU- - translated into several languages

(Japanese, Chinese, Korean, French, German, Spanish, Italian)

Internal documents
- ✓ Problem solving guide to ACT - frequently asked question guide version 2.0

BladeCenter Installation and Planning Information

For use with customers

Installing BladeCenter

Rack information

- ✓ 7U high mechanical
- ✓ Chassis mounts on rail kit which fits in a standard 19" rack (conforms to EIA 310D standards)
- ✓ Chassis can be fixed to rack with thumb screws
- ✓ Everything is accessible from front or back of rack
- ✓ BladeCenter chassis is 28" deep
  - •Rear module handles add greater depth (approx 2 inches)
  - •Front handles also add about 2 inches
  - •Acoustic module adds a little more than 7 inches to depth

Weight

- ✓ A fully configured BladeCenter can weigh close to 110kg (240 lbs)
- ✓ Unit contains handles to lift it, best to install chassis then install blades and modules- empty chassis 18.2kg (40 lbs)
- ✓ Full racks of BladeCenters can approach 820kg (1800 lbs)

Power basics

Power basics

BladeCenter is only supported at high line power- 200-240V

Red Power Supplies

- Optional for 86771XX/2XX Chassis
  - ▸ (single p/n, two supplies)
- Operate as Redundant Pair
- Provides redundant power for Blades 7-14
- Load balancing power supplies
- Maximum draw from each supply
  - 1200- 7.5A   1XX
  - 1400- 9.0A   1XX
  - **1800- 12.0A   2XX**

Blue Power Supplies

- Standard in 86771XX/2XX Chassis
- Operate as Redundant Pair
- Provides redundant power for Chassis Modules and Blades 1-6
- Load balancing power supplies
- Maximum draw from each
  - 1200- 7.5A   1XX
  - 1400- 9.0A   1XX
  - **1800- 12.0A   2XX**
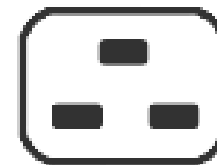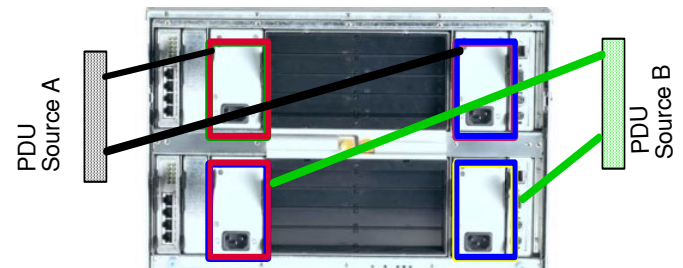

More Power info

- Power cabling for redundancy
- Each feed requires enough power to run entire domain

- Power input connection is a 16A C20 style
- In some installations we exceed the 10A rating of the more common C14 inlet

BladeCenter power supplies

IBM power supplies are rated by the output they can deliver not the input

Example: the 1800W BladeCenter module is able to deliver 1800W of DC power
- ✓ A power supply will take in more AC power than it can deliver DC- the difference between the input requirement and the output is commonly called the efficiency rating
- ✓ The BladeCenter 1800W supply requires about 2100W input
- ✓ The power supplies in our high performance servers are extremely efficient

The numbers that we quote are worst case scenario- they are what the supply could deliver if the server was fully equipped and at full utilization
- ✓ Typical customer utilization is from 25-75%
- ✓ We quote worst case because that is not variable

In a redundant solution both power supplies share the load
- ✓ Each power supply delivers half the load if both are powered on and working properly
- ✓ Having supplies share the load leads to longer life, reduced failures
- ✓ One supply can carry the entire power requirement if called on

What is the real power usage?

- Power usage increases with work load and option content
- Most customers find themselves in the 25-70% utilization range

Power versus utilization
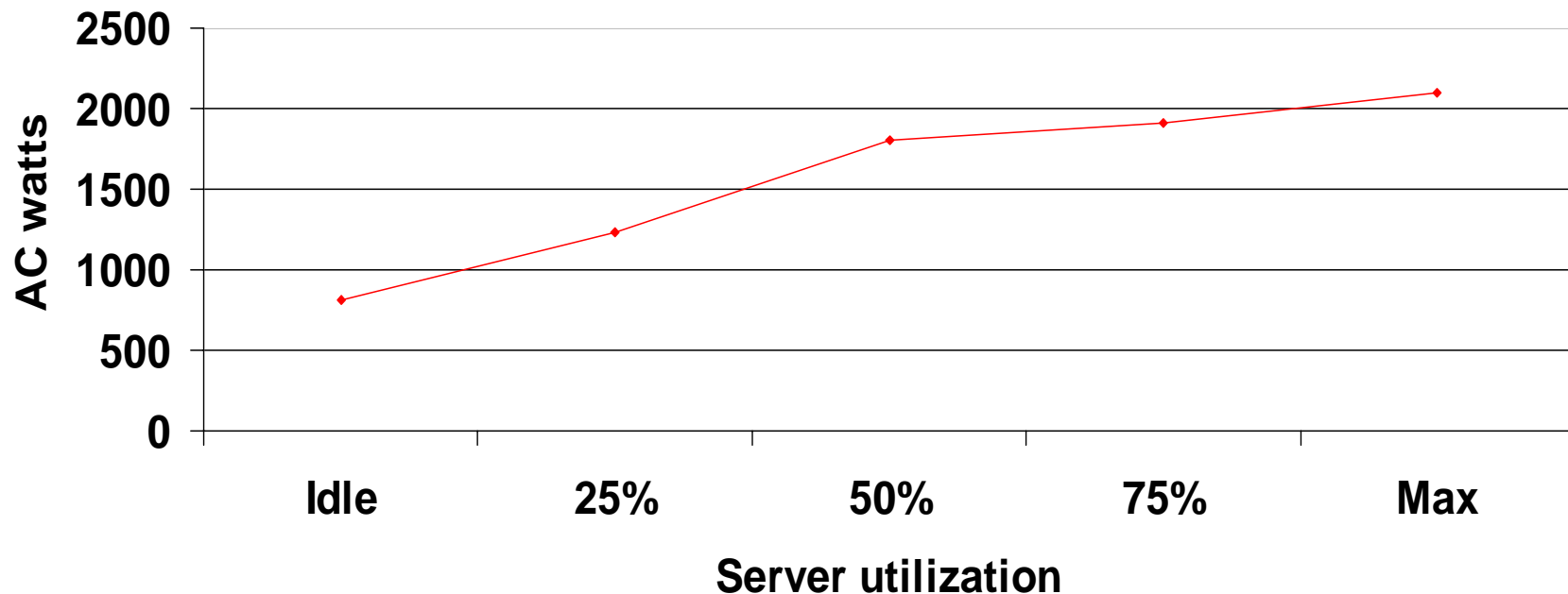
Information measured from domain 2 fully configured: Dual 3.2Mhz, 8GB memory, 2 IDE. Plot points are approximate

Power comparisons

- **X345**

  450W per server

  2 processors

  225W per processor

- **X335**

  350W per server

  2 processors

  175W per processor

- **BladeCenter**

  3600W per chassis

  28 processors

  128W per processor

Power Configurator

Quantity	Description	Idle Power	Max Power	Current
1	**Blade Center**	**1206 W**	**2849 W**	**12.3 A**
	Domain 1	554 W	1311 W	5.7 A
1	IBM BladeCenter Chassis			
	Power Supplies for Blades 1-6: 2x 1200 W & Blades 7-14: 2x 1400 W			
	1 Management Module(s)			
	(1) 4-Port Gigabit Ethernet Switch Module			
6	HS20			
	(2) 2.8 GHz Xeon (533 MHz)			
	(2) 1024 MB Dimm(s)			
	(2) 40 GB 5400-rpm ATA-100 HDD			
	Domain 2	651 W	1538 W	6.7 A
8	HS20			
	(2) 2.8 GHz Xeon (533 MHz)			
	(2) 1024 MB Dimm(s)			
	(2) 40 GB 5400-rpm ATA-100 HDD			

Power consumption

Is BladeCenter a power hog?
- ✓ **The initial perception of blade servers in general was that they were very power intensive. This was primarily due to the rack density possible with these ultra dense offerings**
- ✓ **The truth however is that many blade servers provide a way to add processing power more 'power' efficient than traditional servers and competitive blade offerings.**

What is limiting density in today's data center?
- ✓ **Real estate in the rack**
- ✓ **Power input**
- ✓ **Thermal output**
- ✓ **Airflow requirements**

These limitations in the data center led IBM to rethink how we design servers
- ✓ **More energy efficient power supplies**
- ✓ **A drive to new technologies that can reduce power- new memory technology**
- ✓ **Efficient low power high speed fans**
- ✓ **Finding ways to share components across multiple systems**

The Gartner Report- what does it really mean?

Gartner recently published an Electrical Requirement Study[1] comparing similar dual processor server configurations including IBM BladeCenter, a generic 1U, and HPs BL20p G2. The power savings by using BladeCenter were readily apparent but what does this power savings really mean to the bottom line?

	1U server	HP BL20p G2	IBM BladeCenter
Max configuration/rack	84 Xeon DP 3.2Ghz	96 Xeon DP 3.2Ghz	168 Xeon DP 3.2Ghz
Number of processors	72	72	72
U space required	36	30	21
Power requirement	15,912W	13,891W	**8,872W**
Heat output	54,260 BTU	47,365 BTU	**30,255 BTU**

For customers that adopt BladeCenter the savings will come in three different forms

✓Raw electricity cost savings – less money to your utility company
✓Reduced cooling costs – less cost to run your AC units at max
✓Reduced infrastructure build out costs in the data center – the ability to get more processing power in your current thermal or power envelop

[1]Electrical Requirements for Blade Servers. Written by Jane Wright (G00120690) released April 24, 2004. Available from Gartner Research.
[2]Comparison was done on similar dual 3.2Ghz servers, with 4GB memory, Fibre connectivity, and dual ethernet switching.

The Cost (more accurately the savings) of Ownership

Electricity cost savings – the easiest to see and understand.
- ✓ If we assume an average corporate customer is paying $.05US per kilowatt over an entire day BladeCenter has the capability to save users about $6.00/day over HP and $7.00/day over 1U.
- ✓ *Not sounding like much?* Over a year this could mean savings in this one rack of over $2000.

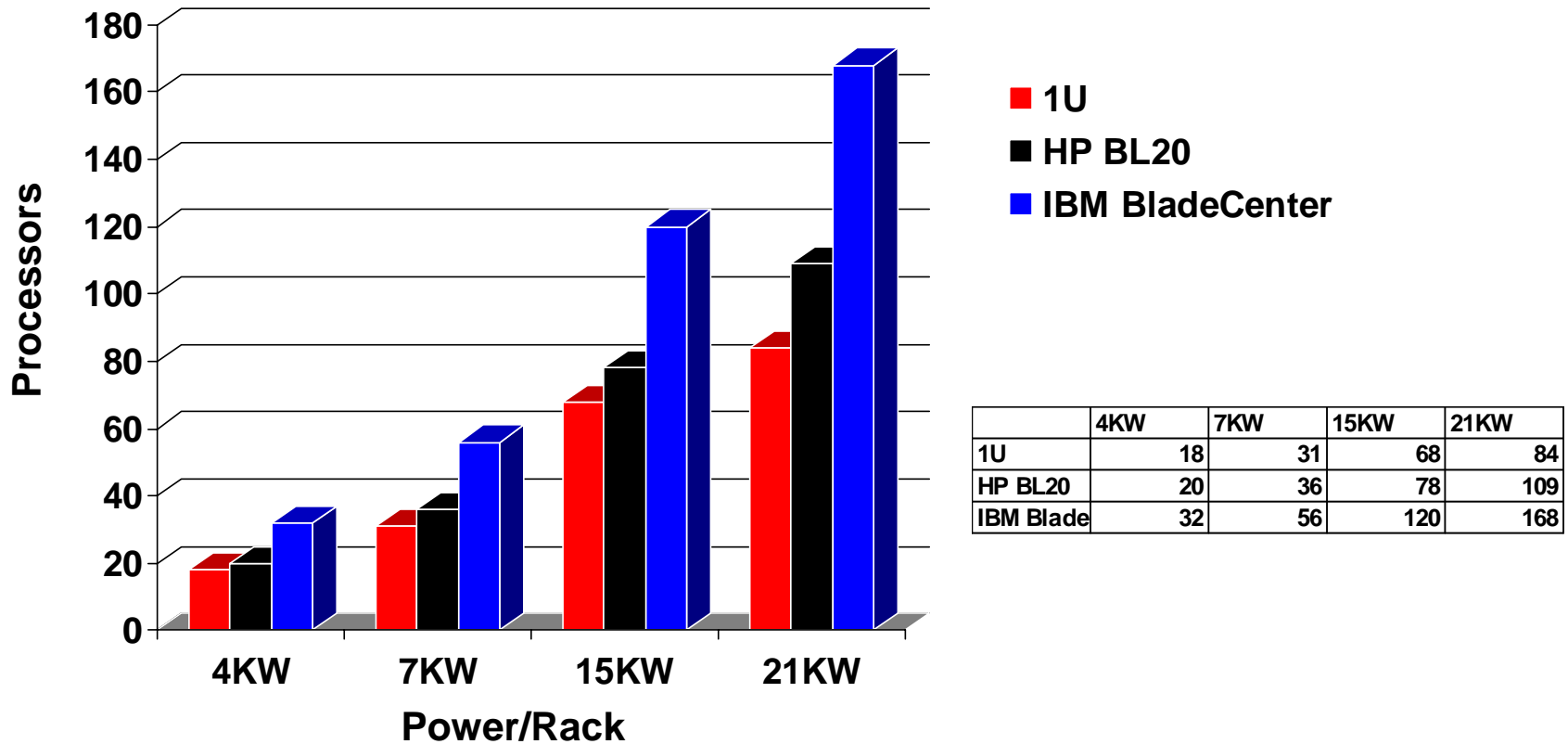**Reduced cooling costs – power not used means heat that is not generated**
- ✓ For every 12,000BTUs produced it requires 1 ton of AC cooling capacity- so in our example BladeCenter saved about 17,000BTU or 1.4 tons of cooling compared to HP and 24,000BTU or 2 tons compared to the 1U
- ✓ This also adds to the electrical saving you may see from not having to run your AC units at max capacity

Reduced infrastructure costs in the data center – if your one of the many customers bumping the ceiling of what your data center can handle from a thermal load this one is big
- ✓ This level of cooling savings spread out over many racks in the data center will not take long to add up to entire HVAC units worth of cooling

[3]Power input costs: Average cost for power varies considerably around the world. In the US the numbers vary from $.02-$.08/KWh for business customers. Conservative average is $.05/KWh.

Fitting the most into the power/thermal envelope

Processors (y-axis): 0, 20, 40, 60, 80, 100, 120, 140, 160, 180
Power/Rack (x-axis): 4KW, 7KW, 15KW, 21KW

Legend:
- 1U
- HP BL20
- IBM BladeCenter

	4KW	7KW	15KW	21KW
1U	18	31	68	84
HP BL20	20	36	78	109
IBM Blade	32	56	120	168

Shared resources and energy efficiency means IBM BladeCenter allows users to pack more processors into a given power/thermal limitation

Air flow requirements

- BladeCenter blowers are completely redundant and hot swappable

  Note: These two blowers take the place of 112 individual fans found in a comparable 14 server 1U installation

- The MM controls blowers, they respond to external temperature changes
- Inlet temperature is critical- temperatures at the back of the rack are less critical

- At 25°C the airflow required by BladeCenter will be 265CFM (cubic feet per minute)
- As temperatures rise to 32°C the fans increase in speed to a maximum of 465CFM. Blowers also go to max in the event of a management module failure
- The increase is linear to the temperature increase
- For a 3 BladeCenter installation under normal data center conditions we need 795CFM of air flow

Airflow comparisons

- **BladeCenter**

  265 CFM per chassis at <25C

  28 processors

  <10 CFM per processor

- **X345**

  52 CFM per server at <25C

  2 processors

  26 CFM per processor

- **X335**

  40 CFM per server at <25C

  2 processors

  20 CFM per processor

Summary

BladeCenter is a very efficient user of power, air, and thermal as compared to alternative products

✓ Compared to the x335, HP, or Dell 1U offerings BladeCenter uses at least 20% less power in normal operation

✓ Compared to HP blades IBM can save more than 20% at like density and utilization

If BladeCenter contains industry standard components how can it run with less power?

✓ Shared Infrastructure

- Common fans

- Common CD and Floppy

- Shared Management and midplane

✓ Energy Efficient power supplies

- 90%+ AC to DC conversion means less AC is lost to heat

Smart server design will reduce power consumption. As long as customers want to deploy the most computing power/watt blades will be a focus

Infrastructure Savings

Per 42 Servers (IDE, dual SAN, dual enet, KVM, redun pwr)	1U Servers	Blades	Reduction / Addition
Rack Space	42U	21U	-50%
Ethernet Cabling	84	6 / 24	-71%
Fibre Channel Cabling	84	12	-86%
KVM Cabling	42	0 / 3	-93%
Systems Mgmt Cabling	42	6	-86%
Power Cords	84	12	-86%
PDU's	8	4	-50%
KVM Switches	6	0 / 1	-83%

Additional Notes: Networking, SAN and KVM Switching takes 10+ Power Cords and 2U to 8U in Rack
Power cord and PDU figures assume equivalent function of redundant power in 1U server

A North Americas Example

Customer wants to install 42 blades (3 BladeCenters) into a rack

✓ BladeCenter has four 1800WDC supplies. Maximum draw from these supplies is 2000W AC.

✓ BladeCenter has four line cords and four power supplies- 12 line cords total

✓ BladeCenter has a 16A rated input

The best choice for larger installations of BladeCenter is the High density PDU. To power three BladeCenters 3 phase power is best.

✓ The Max draw from a BladeCenter power supply is 12A

✓ The 3phase PDU can deliver 28A per phase (derated or 34A not derated).

✓ We can put a pair of power supplies on each phase for a total of 3 BladeCenters.

NOTE:
Input power is derated by 20% for UL safety regulations