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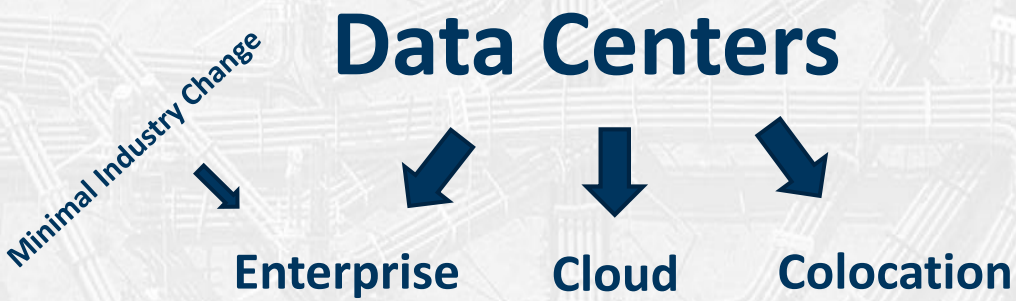
MORRISON HERSHFIELD
MISSION CRITICAL

Data Center Trends:
How the Customer Drives Industry Advances and Design Development

What does the Customer Need?

What does the Customer Need?

It depends on the type of facility…

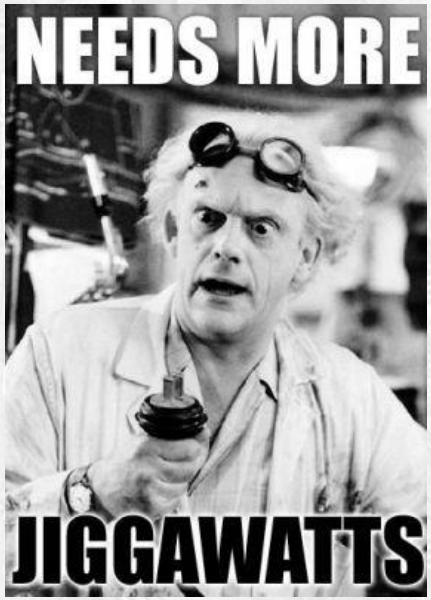


In Colocation and Cloud facilities, increased power density = more revenue.

increased efficiency = less wasted energy.

Bottom Line: Increased Profits!

IT Equipment Trends



IT Equipment Manufacturers recognize this demand for increased power.

- Footprint reduction.
- Decreased Outlet Temperature.
- State-of-the-art Microchip Technology.
- Open compute architecture.

As design engineers, we must support this shift in paradigm…

Both electrically and mechanically!

Electrical Trends

Increased critical power requirements leads to more electrical design options.

- Reliability & Availability.
- Maintainability.
- Modularization & Flexibility.
- Energy Efficiency.
- Infrastructure Utilization.

Electrical Trends

Modularization & Scalability

The desire to scale the facility as the business grows allows the customer to minimized up front costs.

- Initial investment. ⬇
- We as engineers need to allow for this growth potential when considering topology and floor plan layouts.
- Many vendors have added self contained pods to their lines which cater to this need.

Electrical Trends

UPS Manufacturers recognize these customer driven demands and have implemented them into their latest products.

- **Large UPS single module**
- **Distributed paralleling trends**
- **Central Static Switches are unpopular!**
  - Lower TCO.
  - Modularization/Scalability.

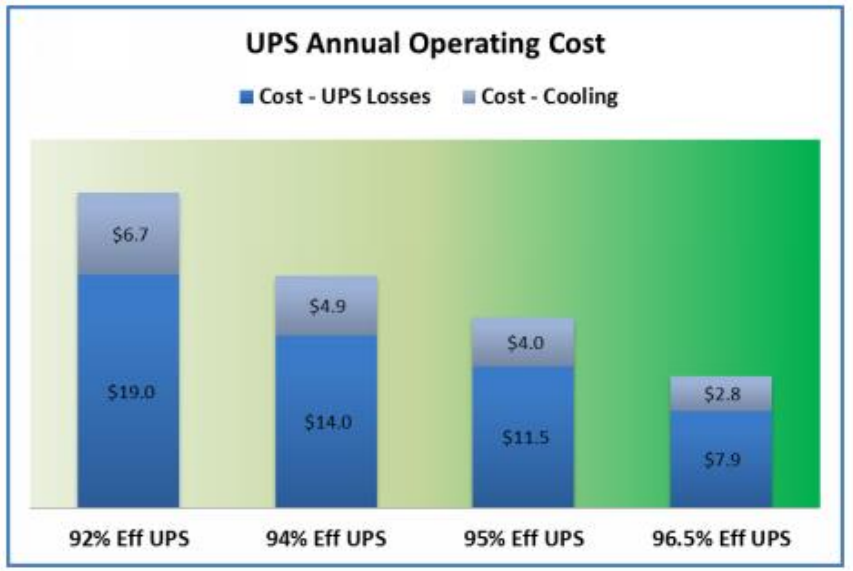
- **Transformer Free Modules trends!**
  - Increased efficiency with mitigated heat loss.
  - Less cooling required!

- **Eco Mode**
  - Running the module on bypass during normal voltage conditions.
  - Increase in efficiency!

Electrical Trends

Efficiency is the key to success… and UPS manufacturers know this!

- Silicon Controlled Rectifiers (SCR) based modules ~80% eff
- Transistors (IGBT) replace SCR ~92% eff
- Transformer Free ~96.5% eff
- Silicon Carbide (SiC) ~98.0% eff
- Eco Mode introduced ~99% eff



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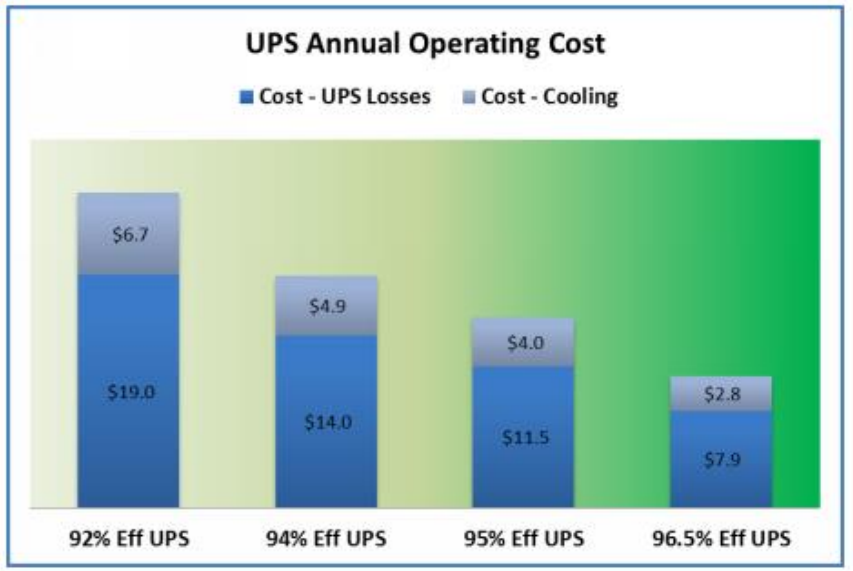


UPS vendors have done their part… *where else can we mitigate loss?*

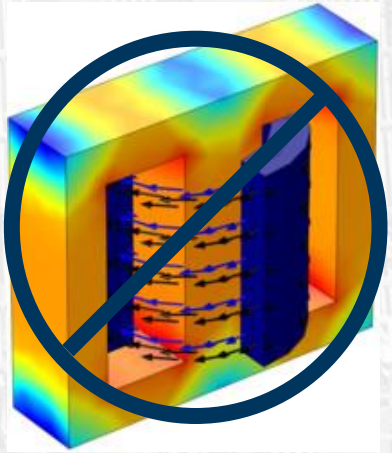
Electrical Trends

Thinking outside the UPS Box

400V Distribution System

Eliminate the need for PDU's and deliver critical power directly from the UPS!

- Still maintain use of standard server equipment.
- Reduces HVAC requirements
- Increases overall electrical efficiency.
- Decreases footprint requirements for infrastructure.
- Reduces maintenance costs.



Electrical Trends

Thinking outside the UPS Box

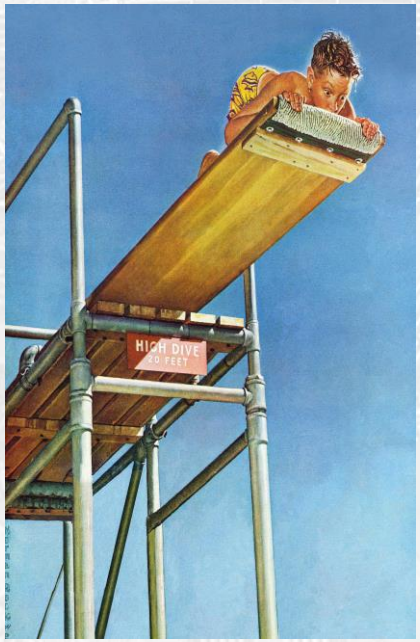
Doesn't the power ultimately get converted into DC at the server level?

DC Distribution System!

- Still maintain use of standard server equipment.
- More efficient than AC.
- Less cable loses over long distances.
- Lower cost.
- No conversion losses.
- Compatible with many alternative energy sources.

Electrical Trends

Unfortunately, many customers are reluctant to try such radical ideas…



…so let's stick with the UPS.

Electrical Trends

Uptime Institute Tier Certifications

	Tier I	Tier II	Tier III	Tier IV
Active capacity components to support the IT load	N	N+1	N+1	N after any failure
Distribution Paths	1	1	1 active 1 alternate	2 simultaneously active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerant	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continues Cooling	No	No	No	Yes

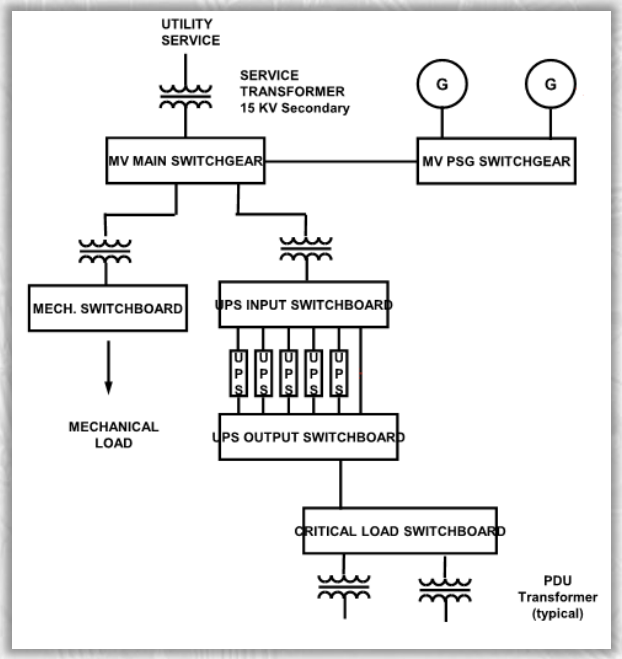
What are the customer's goals?

Electrical Trends

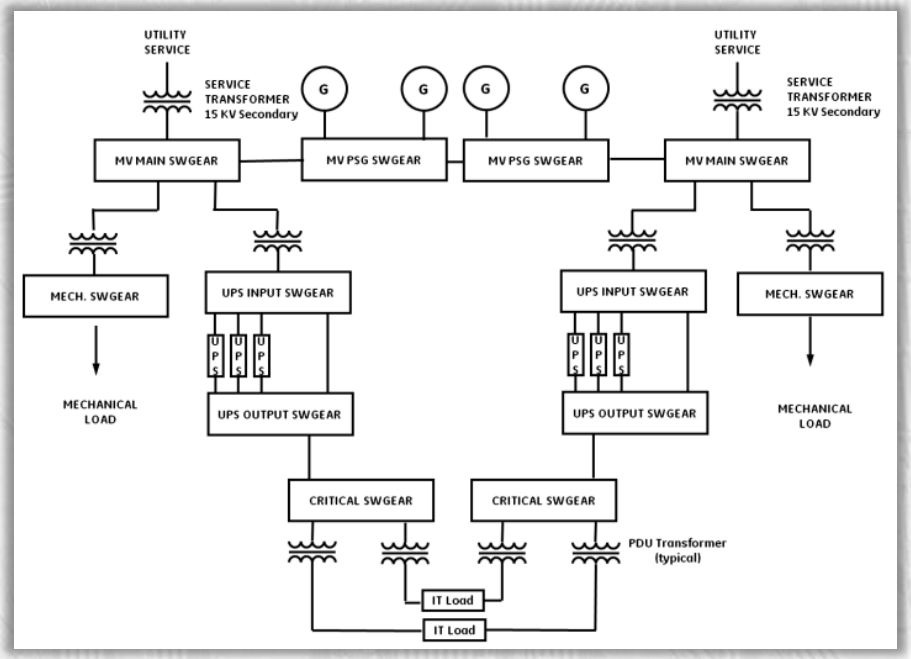
The customer's goals drive Critical Topology

Traditional:

- N
- N+1



- N+N

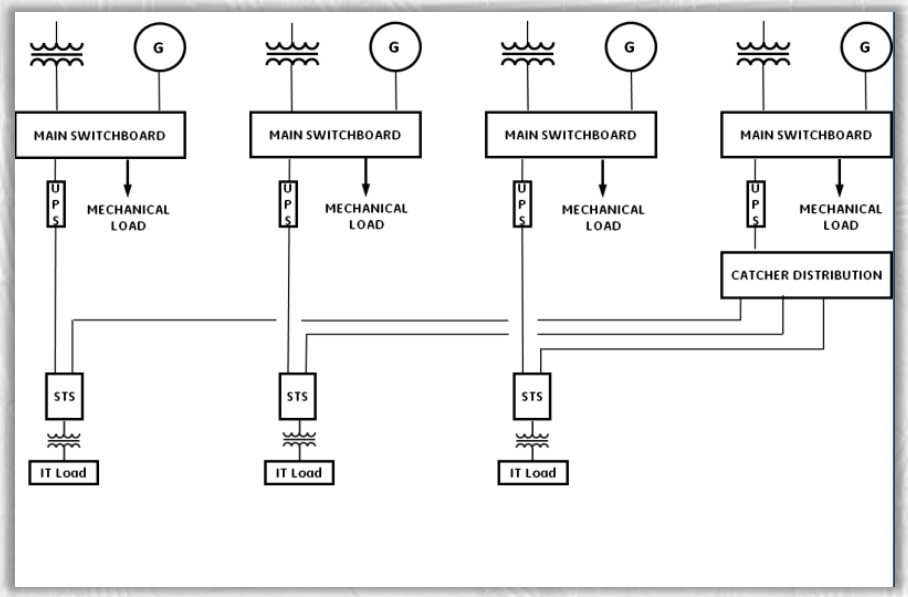


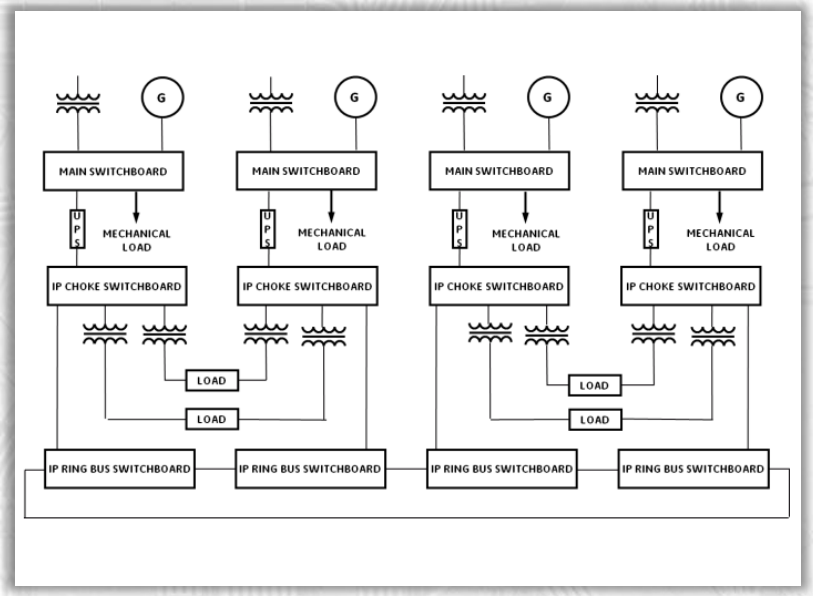
Electrical Trends

The customer's goals drive Critical Topology

Alternatives:

- Catcher Systems
- Isolated Parallel Ring Bus





Higher Utilization of Infrastructure!

Mechanical Trends

Customer trends require a change in the way mechanical design is approached.

What does the customer want?

- High density IT racks require intensive cooling in localized areas.
- Energy efficiency translates more.

Mechanical Trends

What is the mechanical  word?

- Containments.
- Higher Delta T.
- Free cooling.
- Rack level cooling for Very High Density Equipment's.

Mechanical Trends

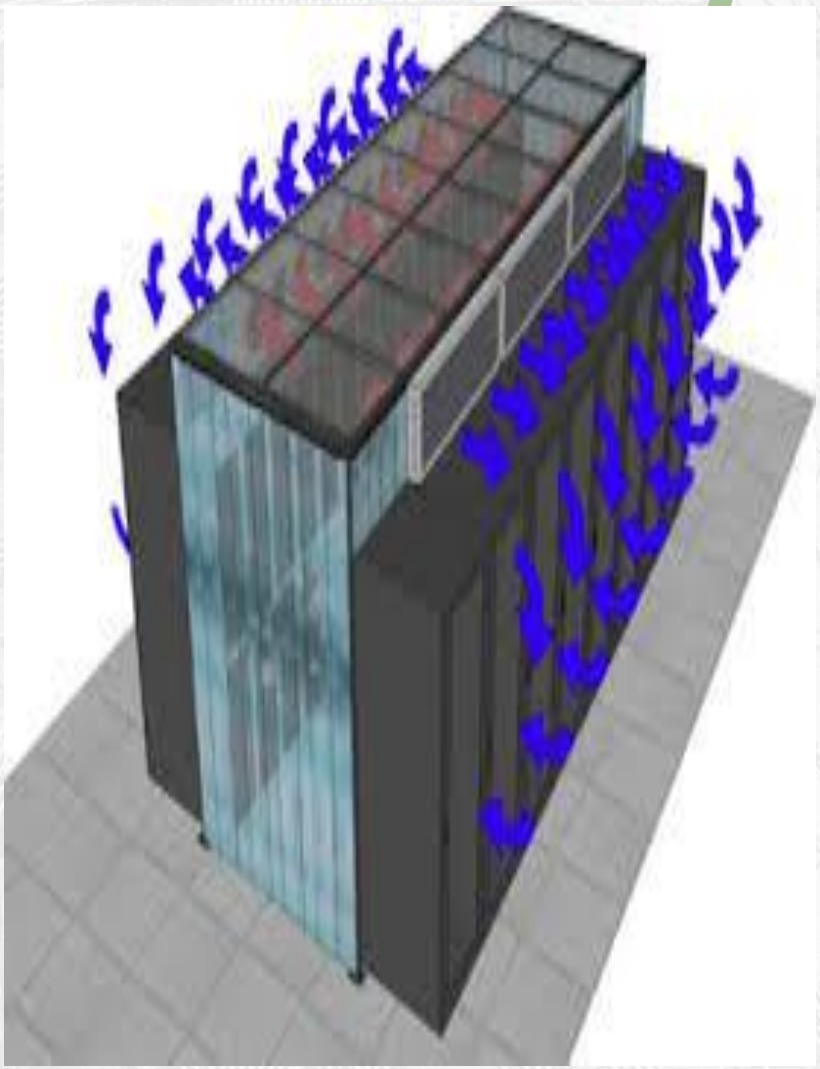
Containments.

Traditional

- Hot Aisle Containments.
- Cold Aisle Containments.

New Trend

- Active Rack Containments.
- Passive Rack Containments.



Mechanical Trends

Active Rack Containments:

- Extreme limiting mixing the hot and cold air
- Fan assist
- Connect directly to return Ceiling plenum
- Up to 20KW/Cabinet

Mechanical Trends

Passive Rack Containments:

- Gravity Chimney
- Connect directly to return Ceiling plenum
- Many manufacturer options

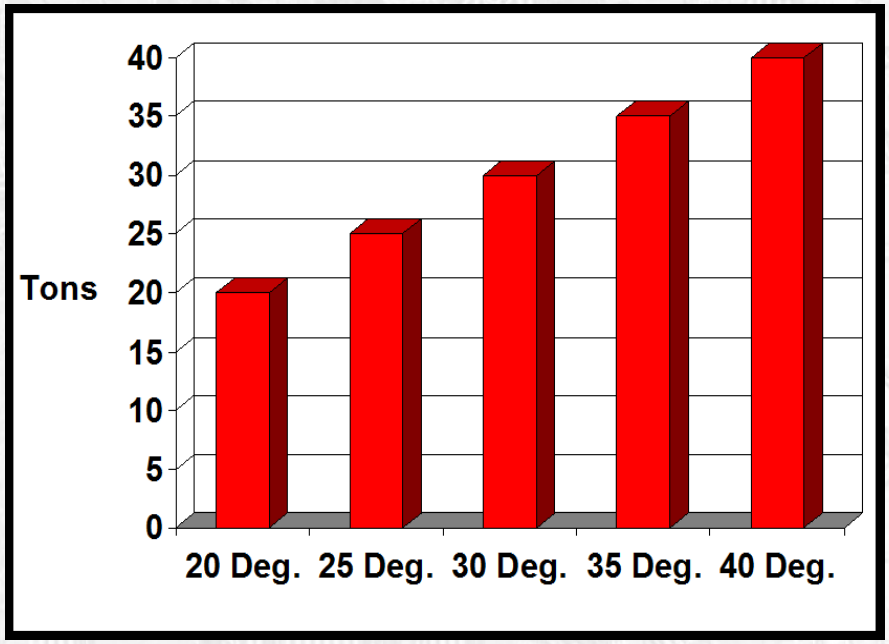
Mechanical Trends

High Delta T:

- Chiller Tons = $\frac{GPM \times \Delta T}{24}$
- CRAH unit calculations Similar

What does this mean?

- Standard 20 tons chilled water unit if the delta T change from 20°F to 35°F will increase capacity 35 tons of cooling.



Mechanical Trends

How does it benefit to the Customer bottom line?

Equipment's and Energy savings:

- Approx. 40% reduction of cooling units.
- 40% reduction in the fan motors and associated fan motor heat.
- 40% Reduction of chilled water pump.
- More efficient chiller operation.
- Less TCO (Total Cost of Ownership).

Mechanical Trends

Thinking outside of mechanical BOX.

What is cheapest cooling out there?

I Got it!!!

Nature

The naturally available air is known as free cooling.

Mechanical Trends

- Packaged Units are on the rise.
- Water reduction techniques are being implemented.

Free Cooling:

There are mainly two types of free cooling

Direct – Outside air ***does*** enter the Data Center

Indirect – Outside air ***does not*** enter the Data Center

New Innovation – Kyoto Wheel

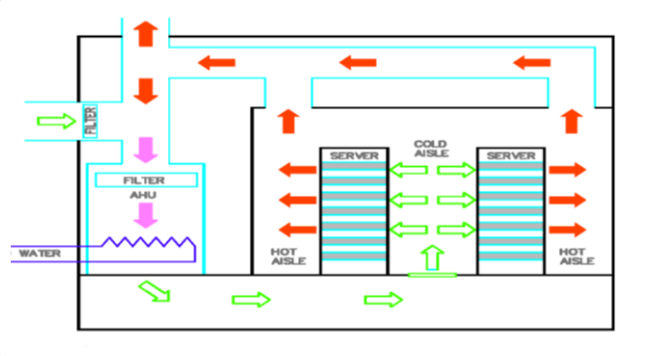
Mechanical Trends

Direct Cooling:

Direct – Outside air ***does*** enter the Data Center

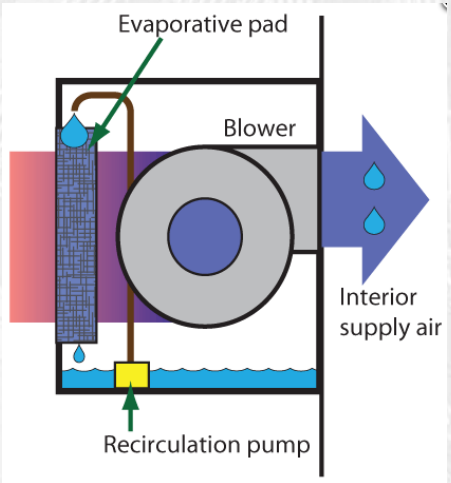
Control moisture as necessary

Direct Air



Outside air **does** enter the data center

Direct Evaporative



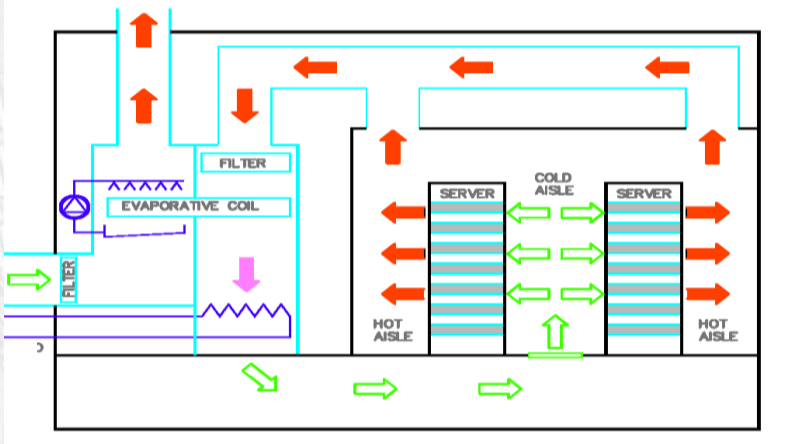
Mechanical Trends

Indirect Cooling:

Indirect – Outside air ***does not*** enter the Data Center

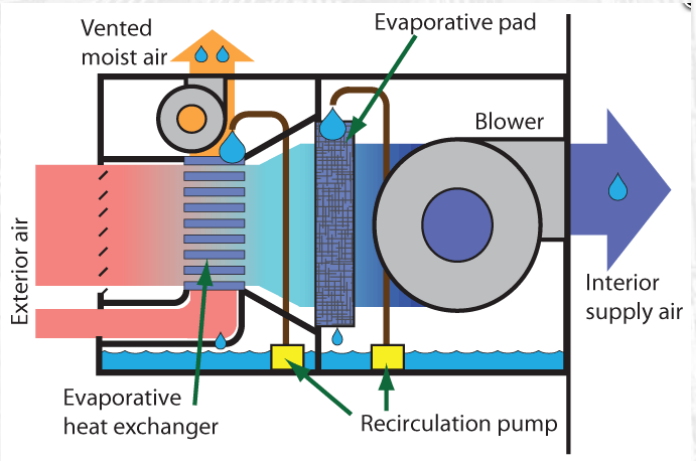
Outside air go through heat exchanger

Indirect Air



Outside air **does** not enter the data center

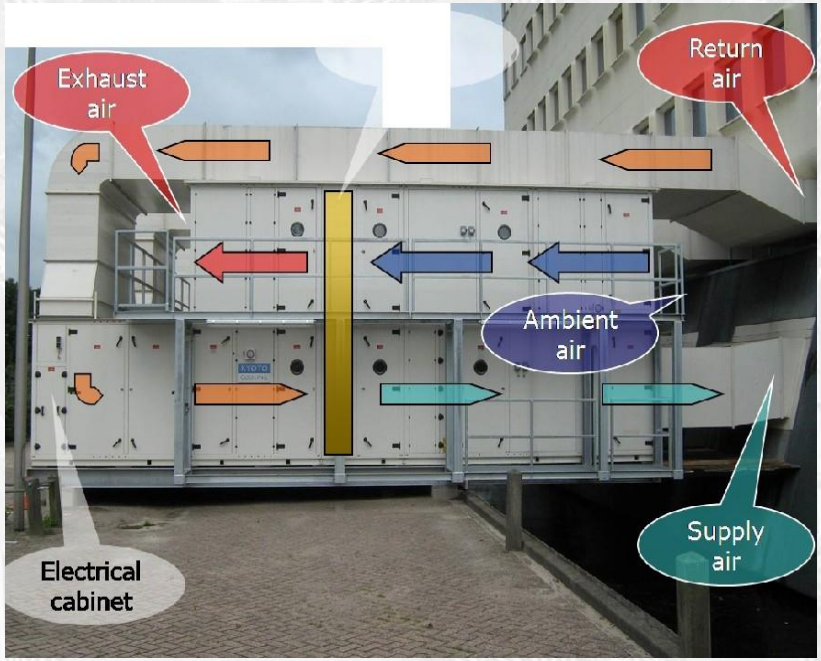
indirect Evaporative



Mechanical Trends

New Innovation-Indirect cooling

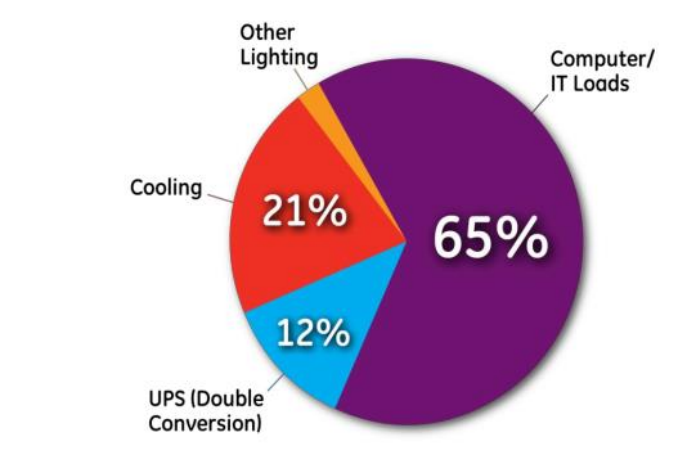
Kyoto Wheel and DX built in for back up



Electro-Mechanical Trends

Power Usage Effectiveness (PUE) – the litmus test between the trades.

How do we calculate PUE?



$$PUE = \frac{\text{Total Facility}}{\text{IT Equipment}}$$

$$= \frac{\text{IT+Cooling+UPS+Other}}{\text{Computer/IT}}$$

$$= \frac{1}{0.65}$$

$$= 1.53$$

Summary

The customer is always right!

High Density PUE Low Footprint	→	More intensive power and cooling requirements.
Uptime Reliability Maintainability	→	Multiple distribution paths. Elimination of single points of failure. Increased redundancy.
Flexibility Growth Potential	→	Modularization. Distribution expansion.
Cost Savings Energy Efficiency Latest Technology	→	Elimination of heat loss. Utilization of infrastructure.

Thank you

Questions??