Data Center Infrastructure

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Overview

I. Data Center 101
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III. Cooling Systems
IV. Computer Room Designs
V. Hot/Cold Air Solutions
VI. Energy Consumption
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Data Center 101

- Simplest explanation: Facility that houses digital infrastructure
  - or furthermore any physical facility an org. uses to store / access data and critical apps
  - This a spectrum.

- All share one major role in business: Secure and provide a location for an org. to access data

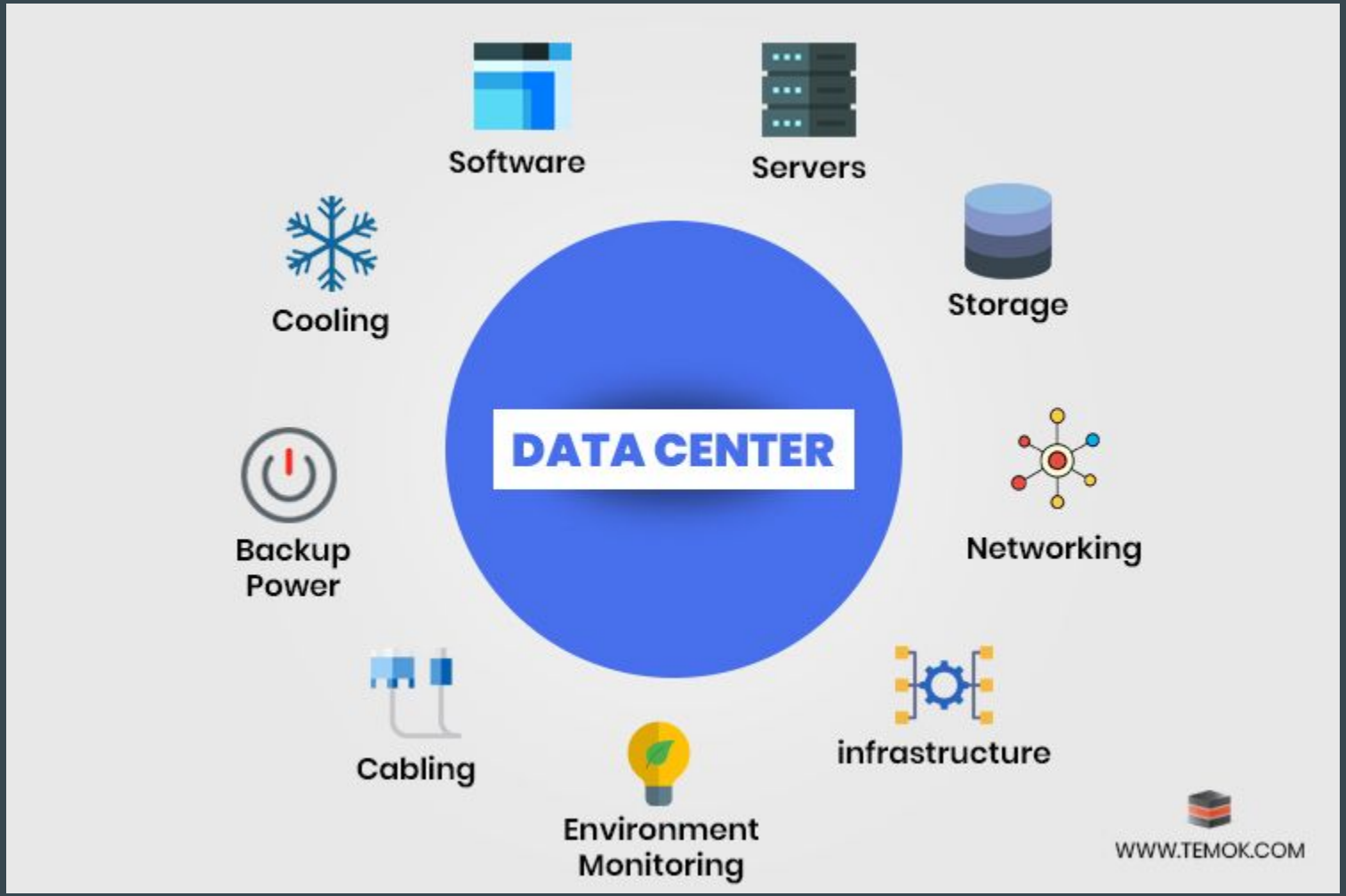
- Qualities that best align with Data Centers:
  - Optimal Security
  - LOCATION
  - Network Infrastructure

Data Center 101

Infrastructure details 4 core components:

- Servers
  - Backbone of Data Center
- Network Infrastructure
  - Communication
- Storage Infrastructure
  - Devices, hard drives, solid state drives etc
- Power and Cooling Systems
  - This cost $$$$

- Among these data centers need to make sure they solutions to network and security issues.
  - VPN
  - Firewalls
  - Intrusion detection and prevention


Software
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Cooling
Storage
DATA CENTER
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Data Center 101

Types Of Data Centers:

- Enterprise Data Center
- Colocation Data Center
- Hyperscale Data Center
- Modular Data Center (new stuff)
- Carrier Hotels

Data Center Tiers:

- Tier I
- Tier II
- Tier III
- Tier IIII

Server Infrastructure within Data Centers

Servers defined:

- Supercomputers, providing processing power to spin up applications and access data.
  - engine of data centers.
- Memory can be virtualized, physical or distributed.
- Importance!
- Servers are built to share resources

Types of Server Infrastructure:

- Centralized Organization
- Decentralized Organization

Server Infrastructure within Data Centers

Types of Servers:

- File servers
- DNS servers
- Web servers
- Application servers
- Database servers
- Print servers
- Virtual servers

Commonly seen form of Server in DCs:

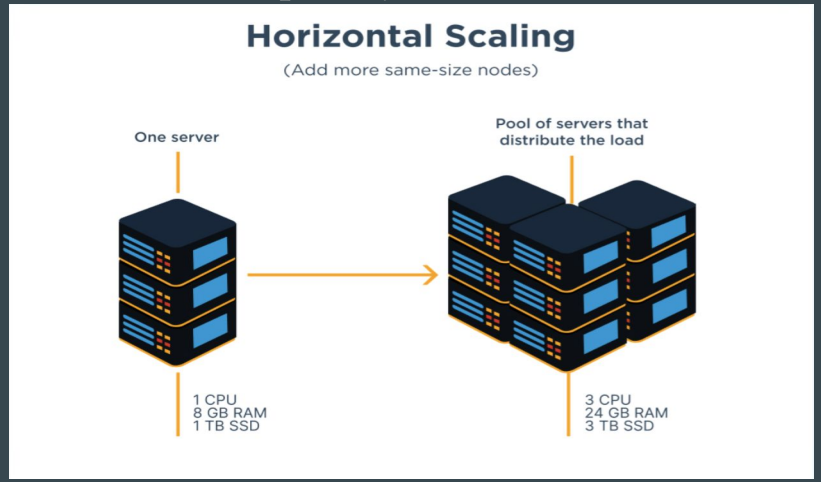
- Rack-mount servers
- Blade servers
- Mainframes

How do these work together?

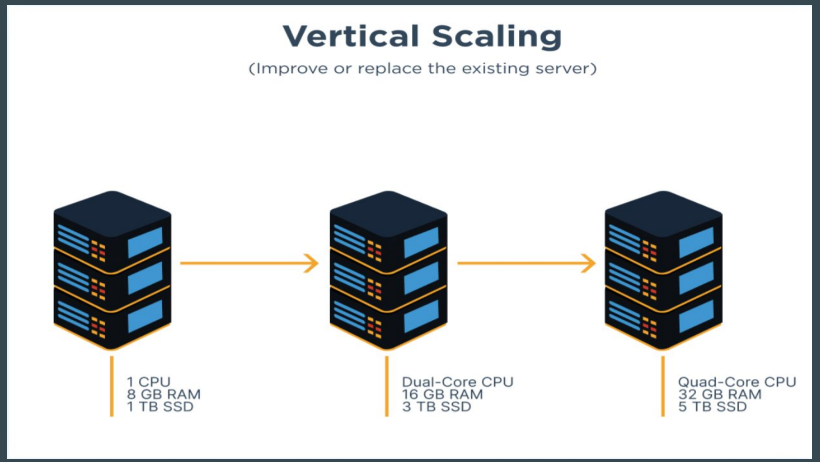
Server Infrastructure within Data Centers

Horizontal Stacked Servers vs Vertically Stacked Server

- Scaling out
- adding additional resources to infrastructure to handle workload.
- Add complexity



- Scaling up
- adding additional resources to meet demand.
- No complexity added

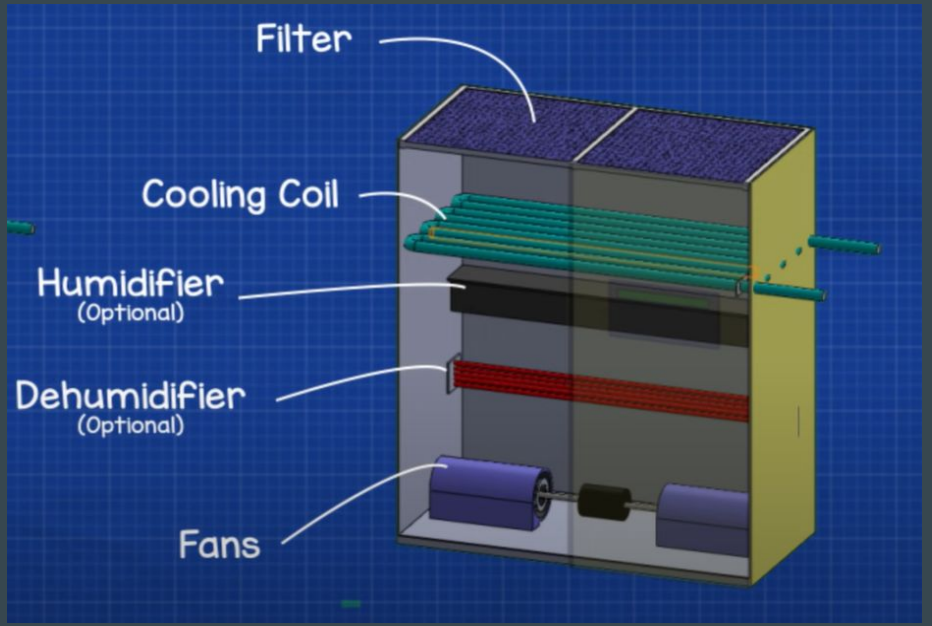


Cooling Systems

- CRAC Units
- Server Room Design
- Hot/Cold Aisles
- CFD Simulations

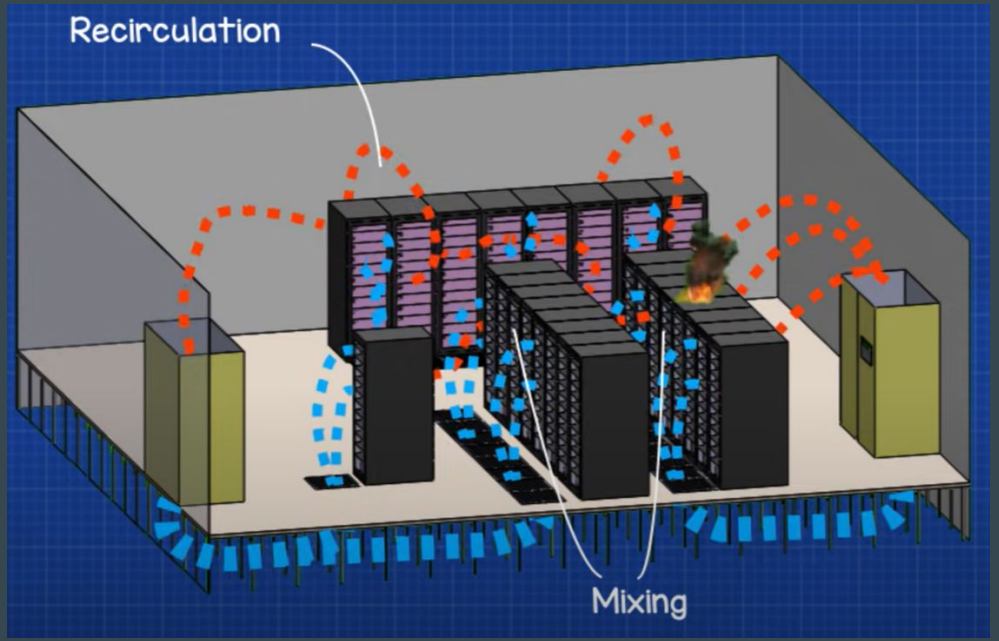
CRAC Unit Design

- Filters remove dust from the hot air.
- Humidifier/Dehumidifier controls the static electricity in the air.
- Cooling coils cool the air and the electronically controlled fans push the air out from the bottom.



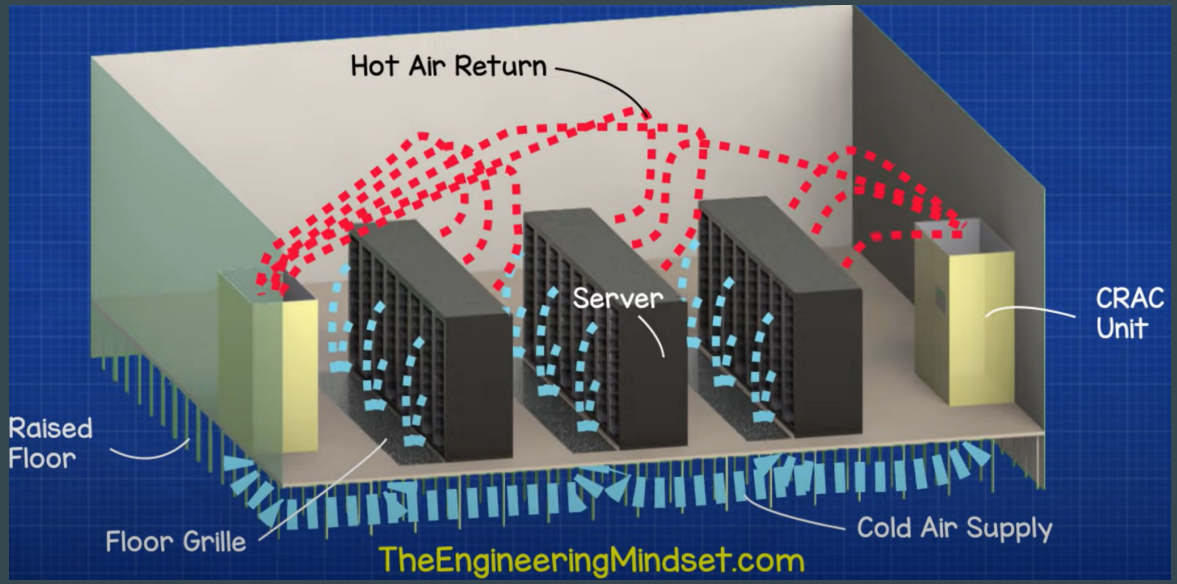
Basic Computer Room Design

- Server racks positioned different ways.
- Cold air gets mixed with the discharge air.
- This creates inefficiency and unpredictable temperature levels.



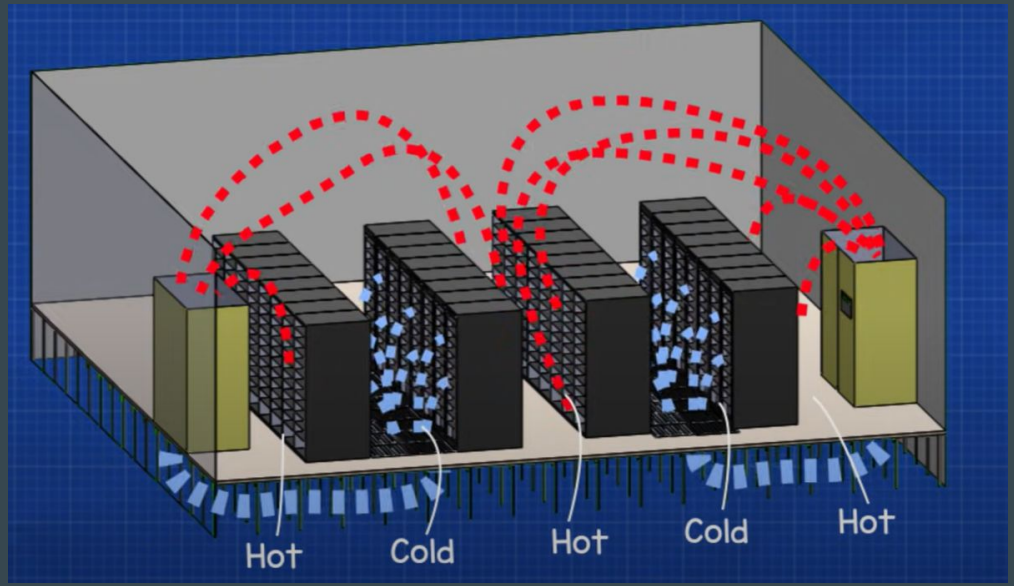
Improved design

- Server Racks on top of a raised floor.
- CRAC (Computer Room Air Conditioners) distribute the cold air.
- Hot air gets sucked back into the CRAC units.
- What is the main concern when designing a cooling system?



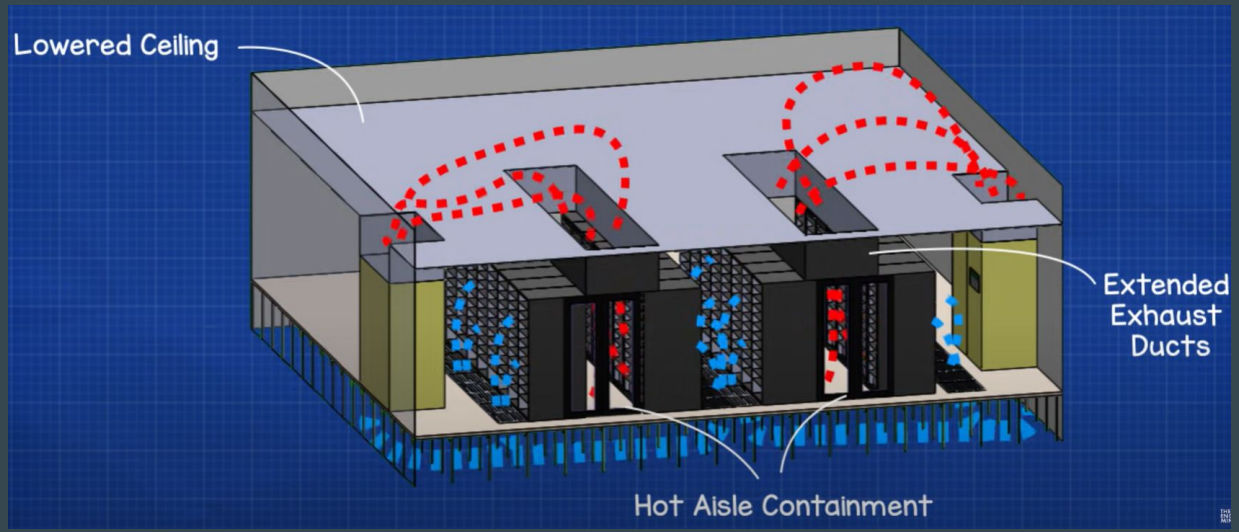
Further Improved Design

- Dedicated Hot/Cold Aisles, so that the air doesn't mix.
- The temperature differential in the CRAC Unit = Efficiency
- Not a perfect design, air can still leak from aisle to another.
- Too much cold air, it leaks over the server rack.
- Too little cold air, hot air recirculates back into the wrong aisle.

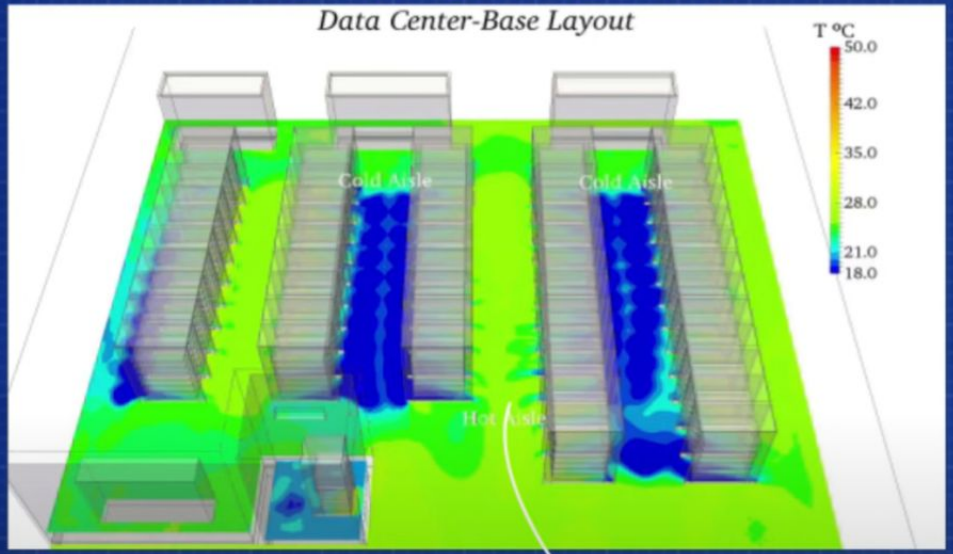


Final Improvement

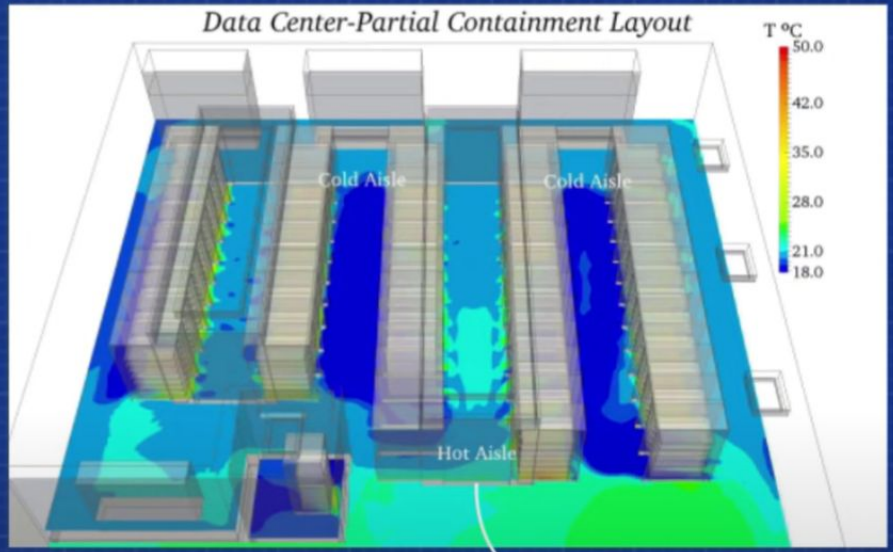
- Hot/Cold Aisles completely isolated.
- The room stays cool, while the hot air is trapped in specific aisles from where it travels above the false ceiling.
- The aisles can be reversed, which is the cheaper solution.



Standard Hot/Cold Asile



Partial Hot Aisle Containment

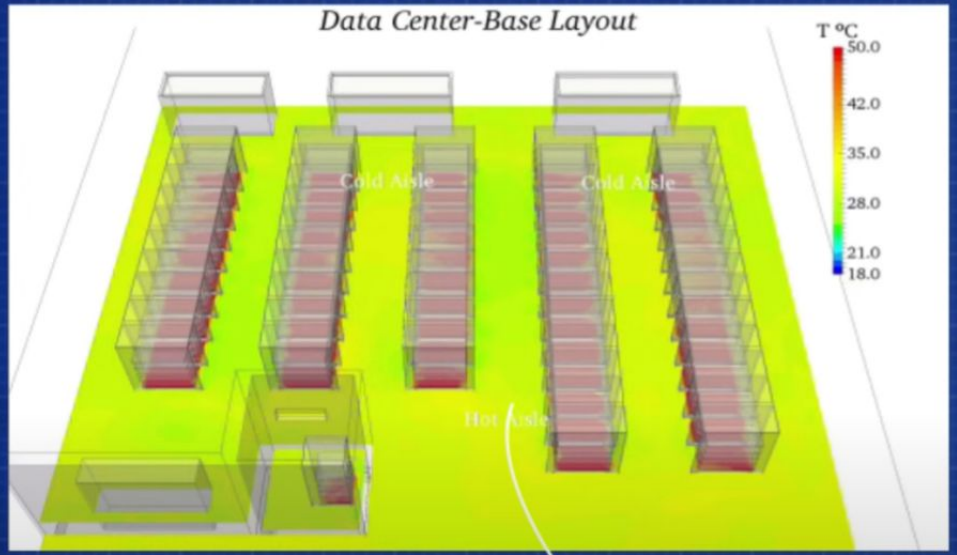


Lower Levels:

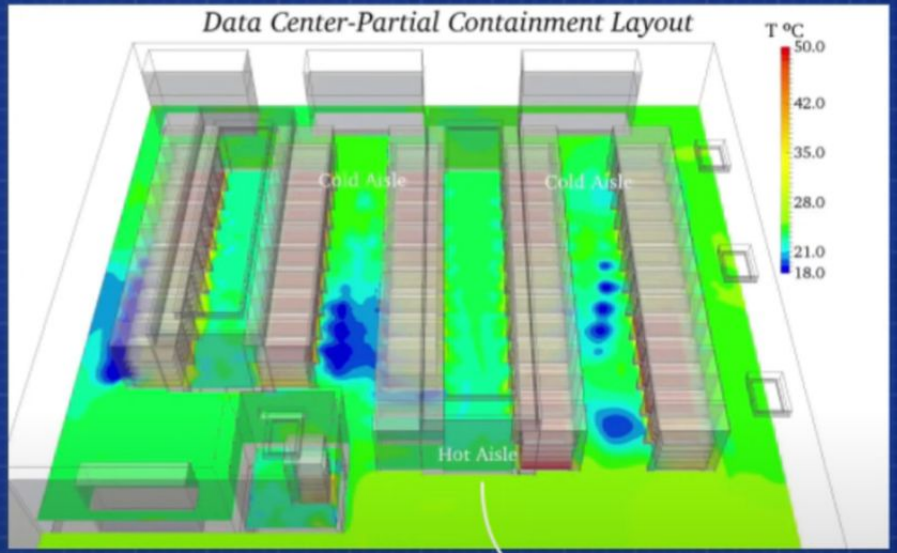
~25°C (~77°F)

~21°C (~70°F)

Standard Hot/Cold Asile



Partial Hot Aisle Containment

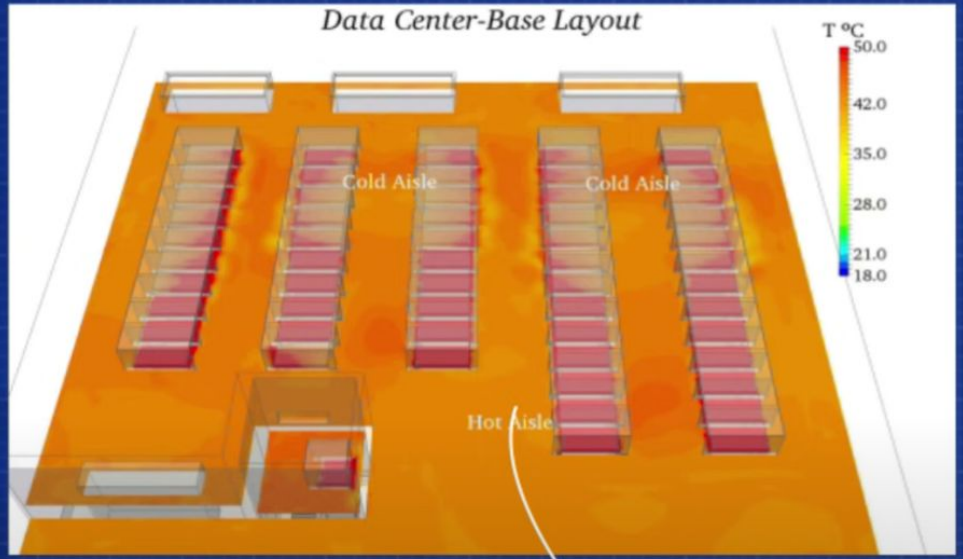


Middle Levels:

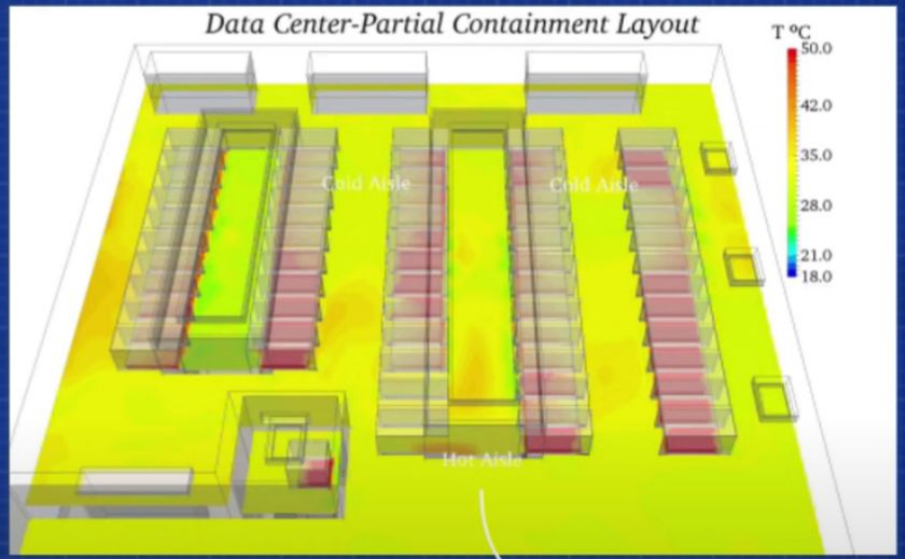
~29°C (~84°F)

<28°C (<82°F)

Standard Hot/Cold Asile



Partial Hot Aisle Containment



Top Levels:

+40°C (+104°F)

~30°C (~86°F)

Hot/Cold Air Containment in Conclusion

- Air Mixing leads to uneven cooling, which increase failure rate and energy consumption.
- The more precisely you can direct the cooling, the less energy you need.

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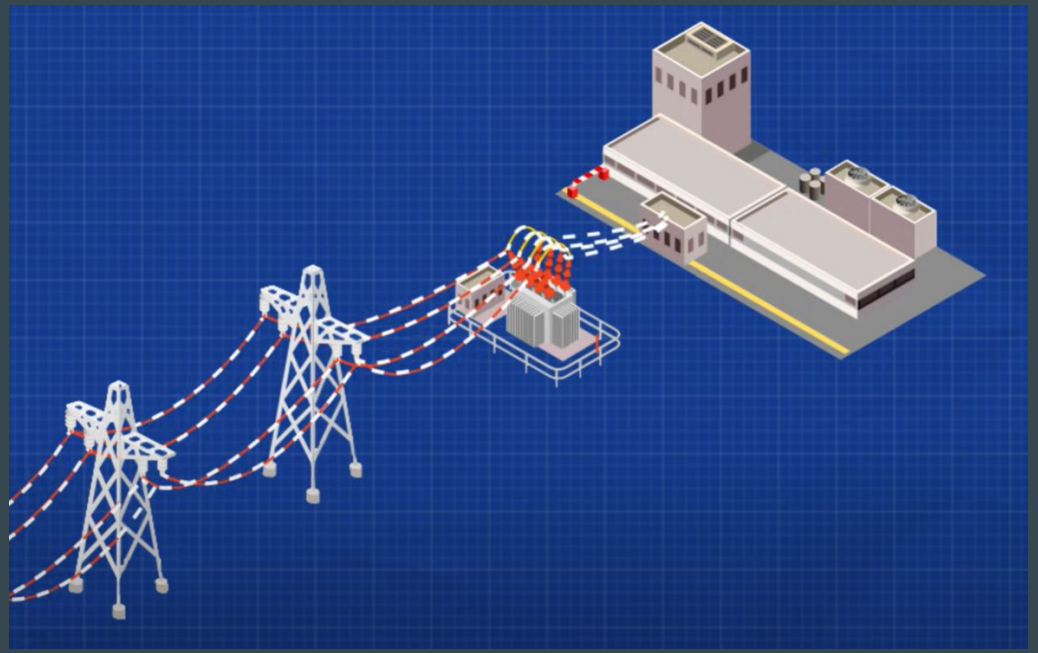
- The CRAC Unit will work more efficiently the more discrepancy there is between the cold and hot air streams.

Energy Consumption

- Energy requirements
- UPS
- Tolerance for downtime
- Device redundancy



Uninterrupted Power Supply

- Device (UPS) that provides near instantaneous backup power when the main supply stops.
- A redundant backup generator “fleet” will turn on in a matter of seconds after a power outage.

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- For large facilities each generator will provide up to 3 MW of power.
- Multiple starter engines, multiple fuel filtration systems, multiple tanks of on sight diesel stored...

Basic Redundancy Math

- N = Amount of capacity required at Full load. (No redundancy)
- N + 1 = One piece of backup (UPS device, Generator etc.) for the whole operation. (Minimal Redundancy)

●●●

- 2N = The whole set of devices is mirrored. Everything can fail at once without harming regular operations.
- 2N + 1 = Most comprehensive approach for facilities that can withstand very little downtime

Conclusion

- Data centers industry as a whole is going to continue to grow.
- These facilities aren't going anywhere.
- Efficient cooling cuts down costs and improves reliability.
- Power supply must be constant, large centers require redundancy in everything.

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