Datacenters

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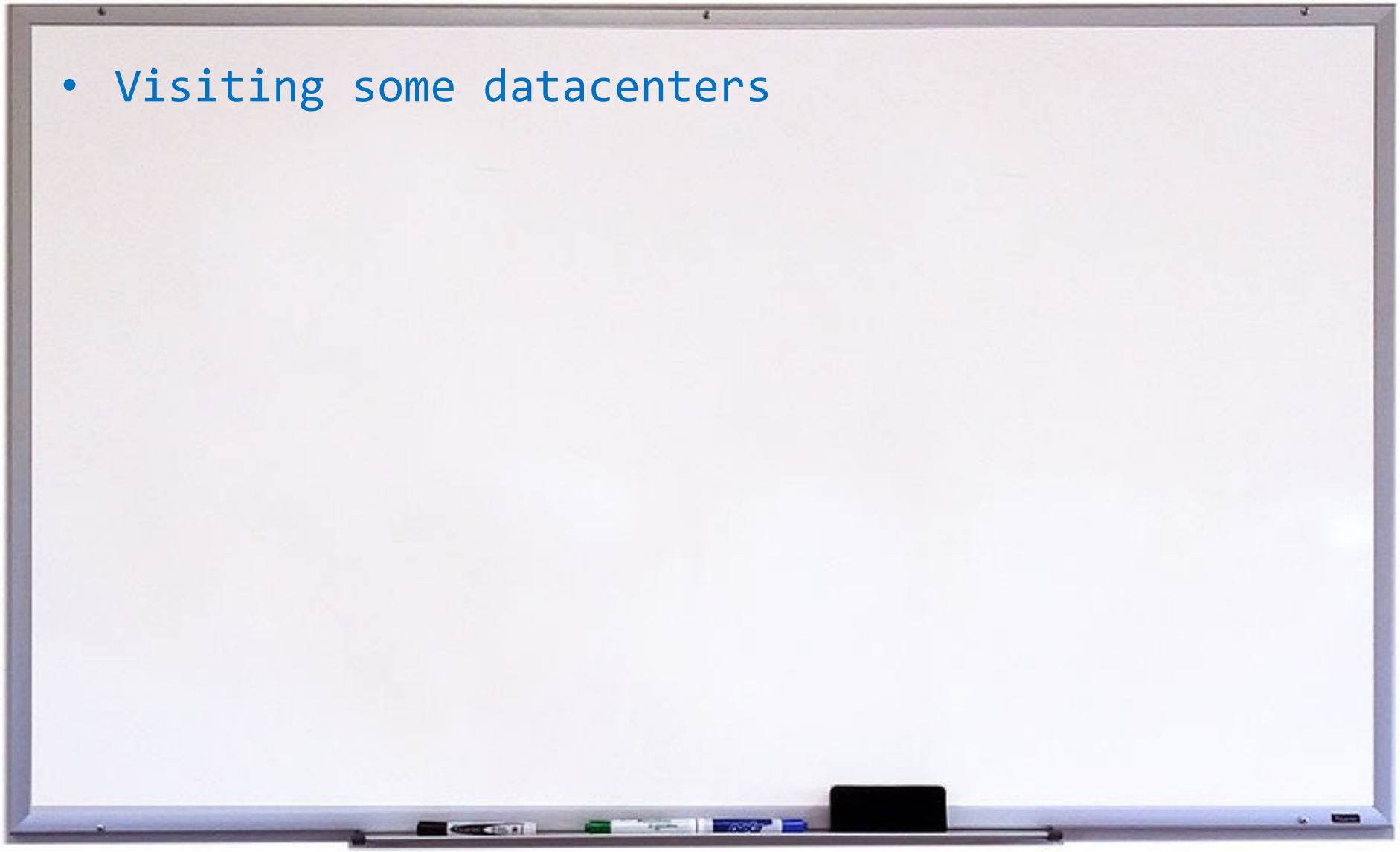
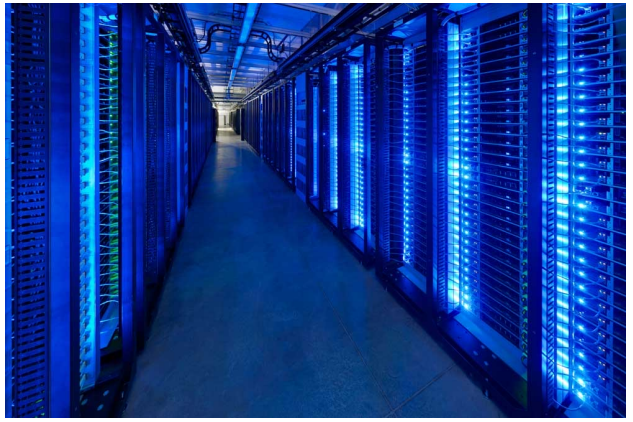

• Visiting some datacenters

Amazon

Google



Facebook

https://www.youtube.com/watch?v=avP5d16wEp0&list=LLe8YQrC8Io0ilj1IsacdJRA

- Employees (24/24)
- Networking room
- Server floor
- Cooling

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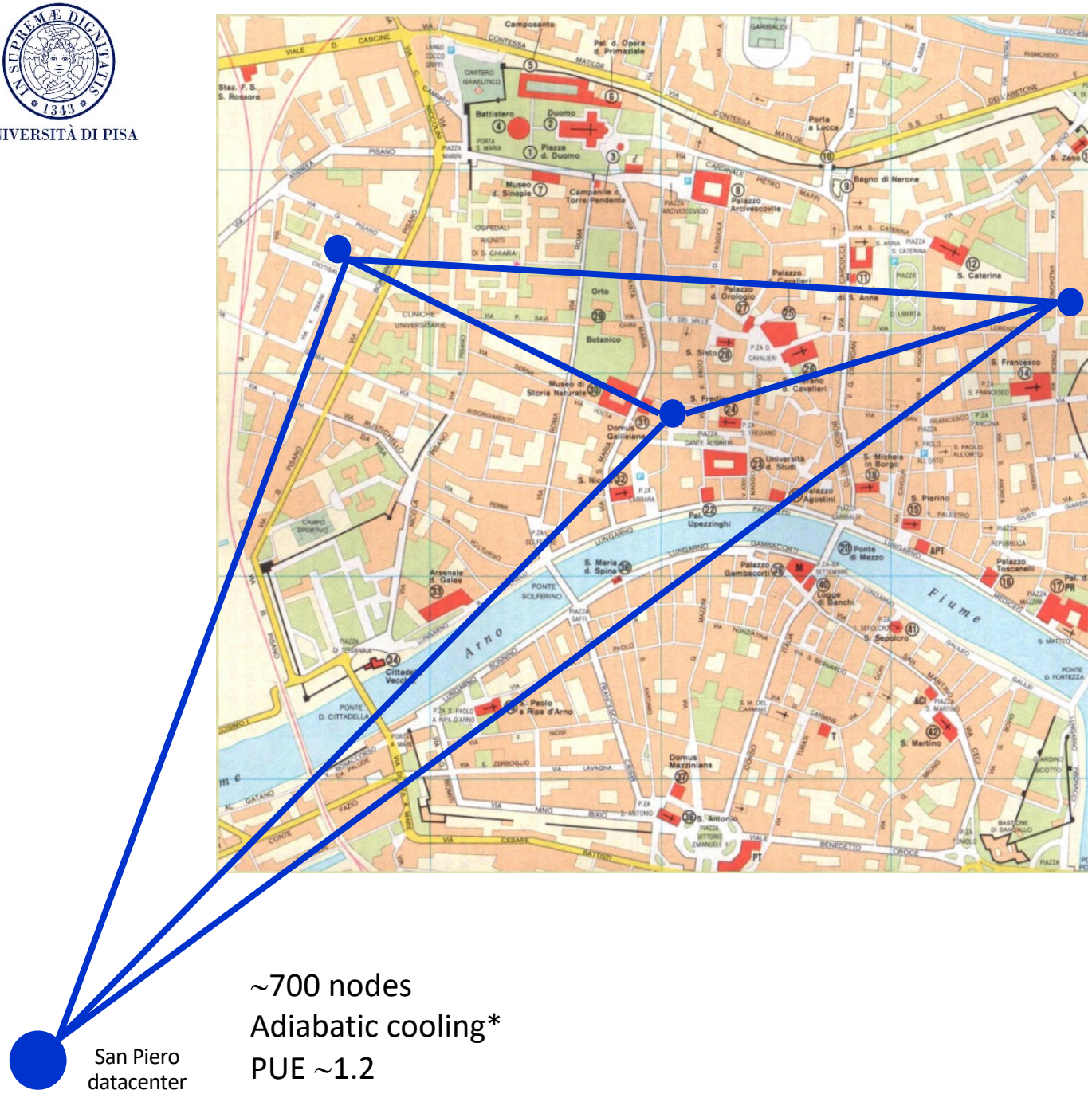
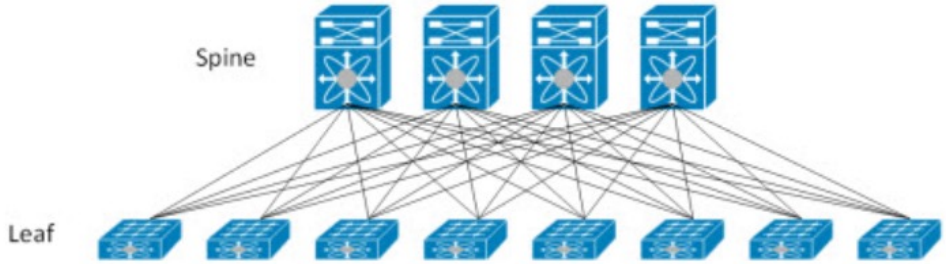


~700 nodes
Adiabatic cooling*
PUE ~1.2
100 Gbit/sec connection with GARR network

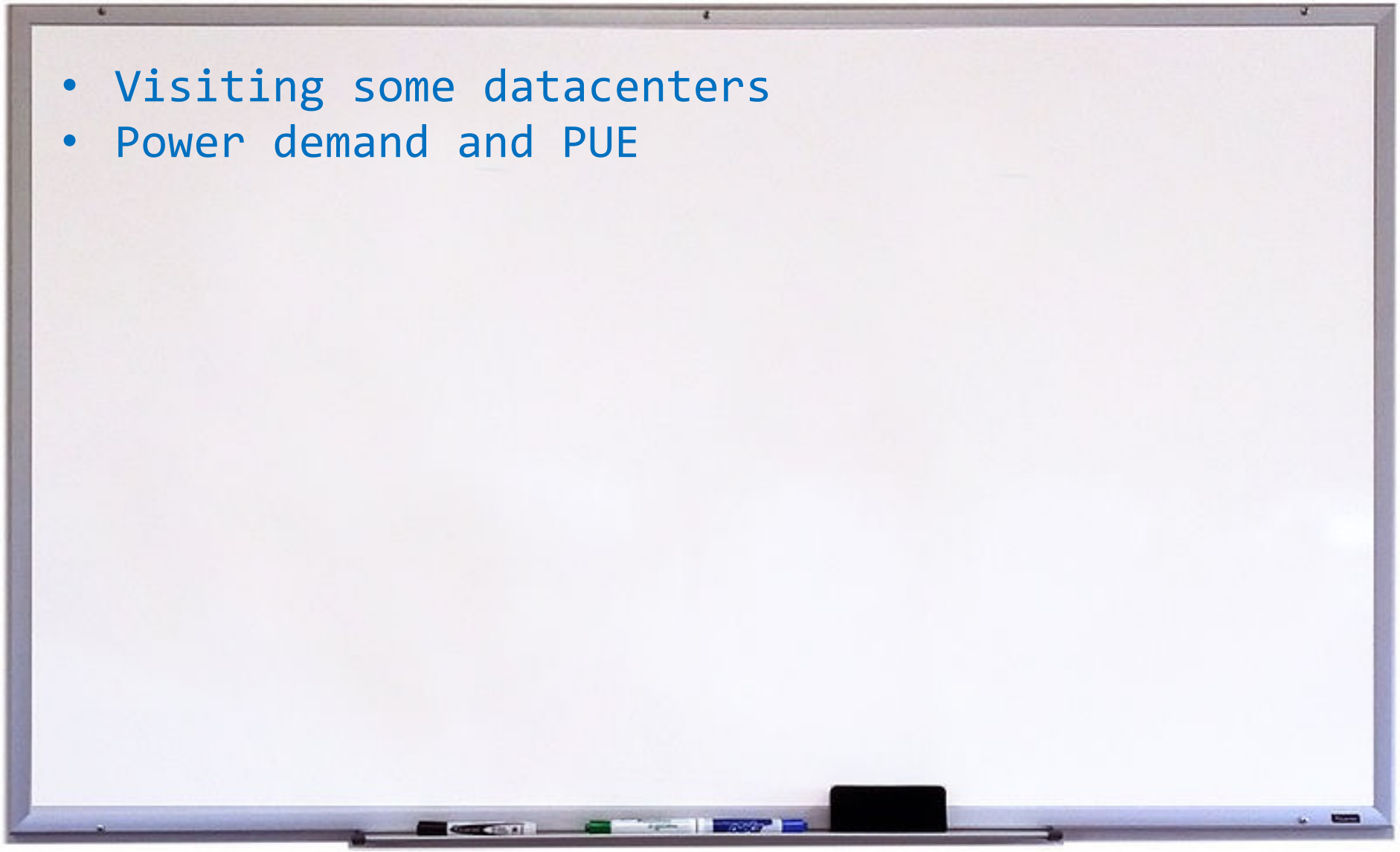
UNIPI network

- 9000+ km of fyber
- 400 Gbit/sec DCI – DataCenter Interconnect
  - no Single Point of Failure
  - redundancy at L3, L2, physical links
- Spine-leaf topology for east–west traffic**



*Uses evaporation of water to pre-cool ambient air during hottest part of day/year

**East–west traffic within datacenter network, north-south traffic with outside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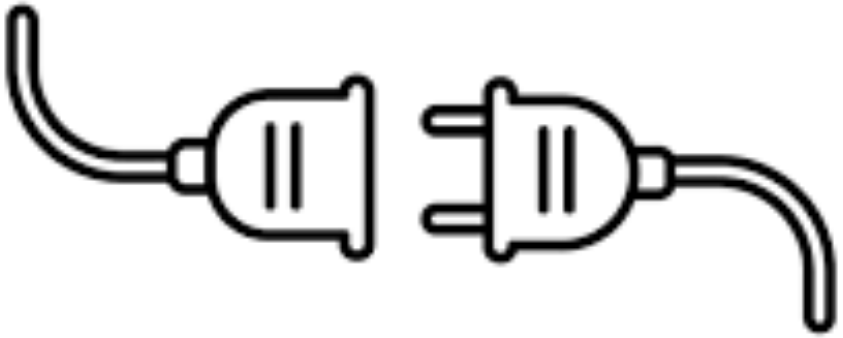
• Power demand and PUE



In 2022 Datacenters globally consumed 460 terawatt-hours (TWh)

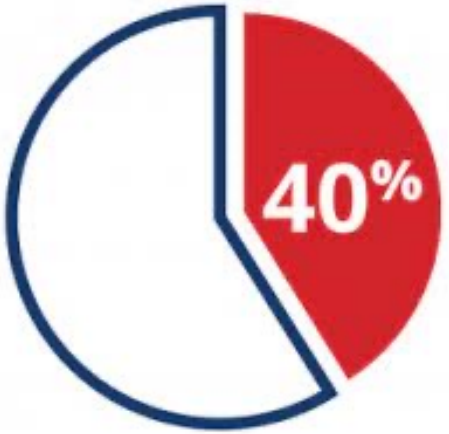
≈ 2% of global electricity demand

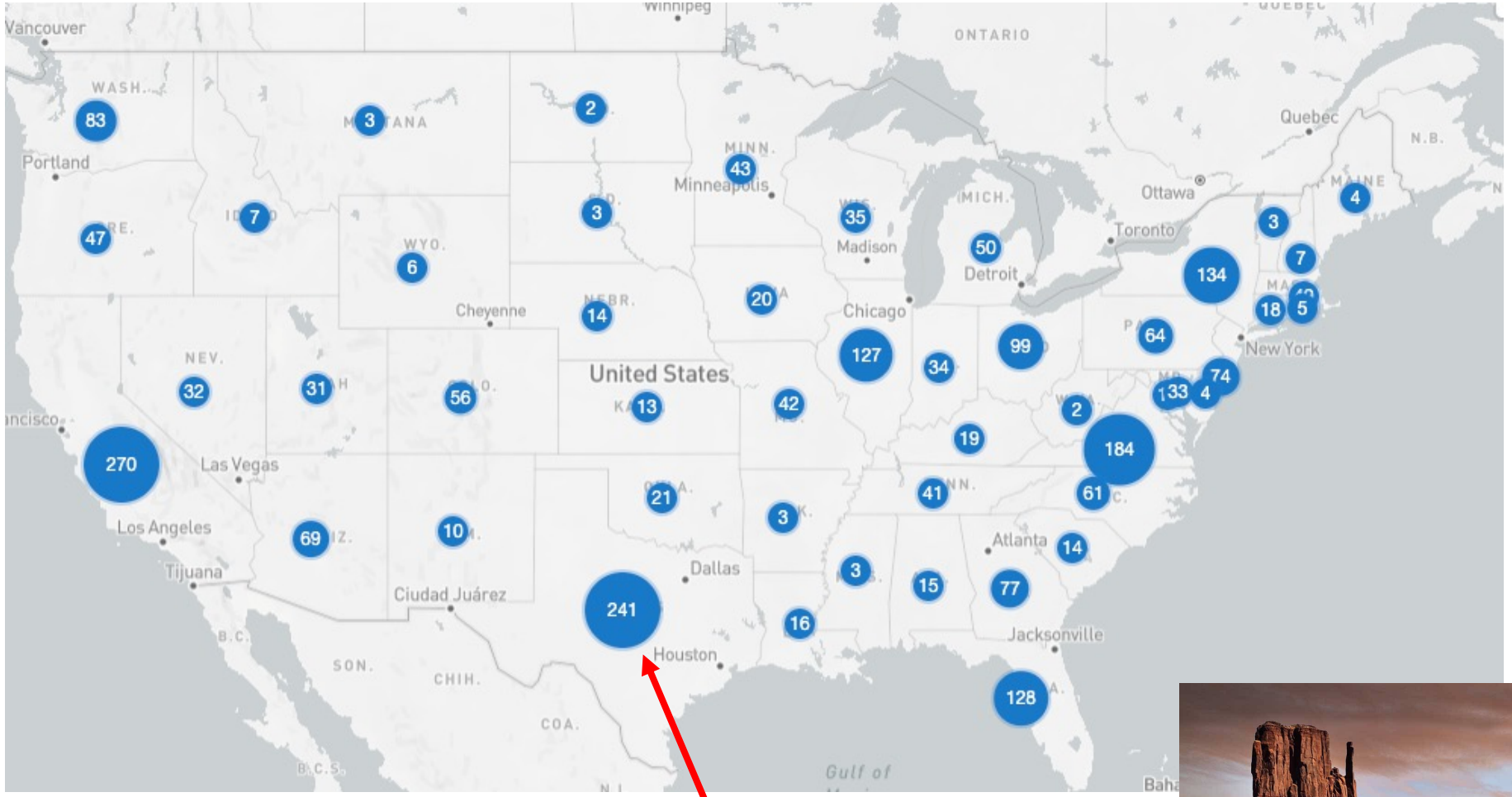
This will probably grow to 1000+ TWh in 2026 (≈ Japan’s electricity consumption)

International Energy Agency. Electricity 2024.

Cooling

~**40%** energy consumption for cooling





Why so many datacenters in Arizona?

https://www.datacentermap.com/usa/

Power Usage Effectiveness

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

$$= \frac{P_{IT} + P_{non-IT}}{P_{IT}}$$

$$= 1 + \frac{P_{non-IT}}{P_{IT}}$$

PUE does NOT measure degree of usage of renewable energy

Power Usage Effectiveness

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

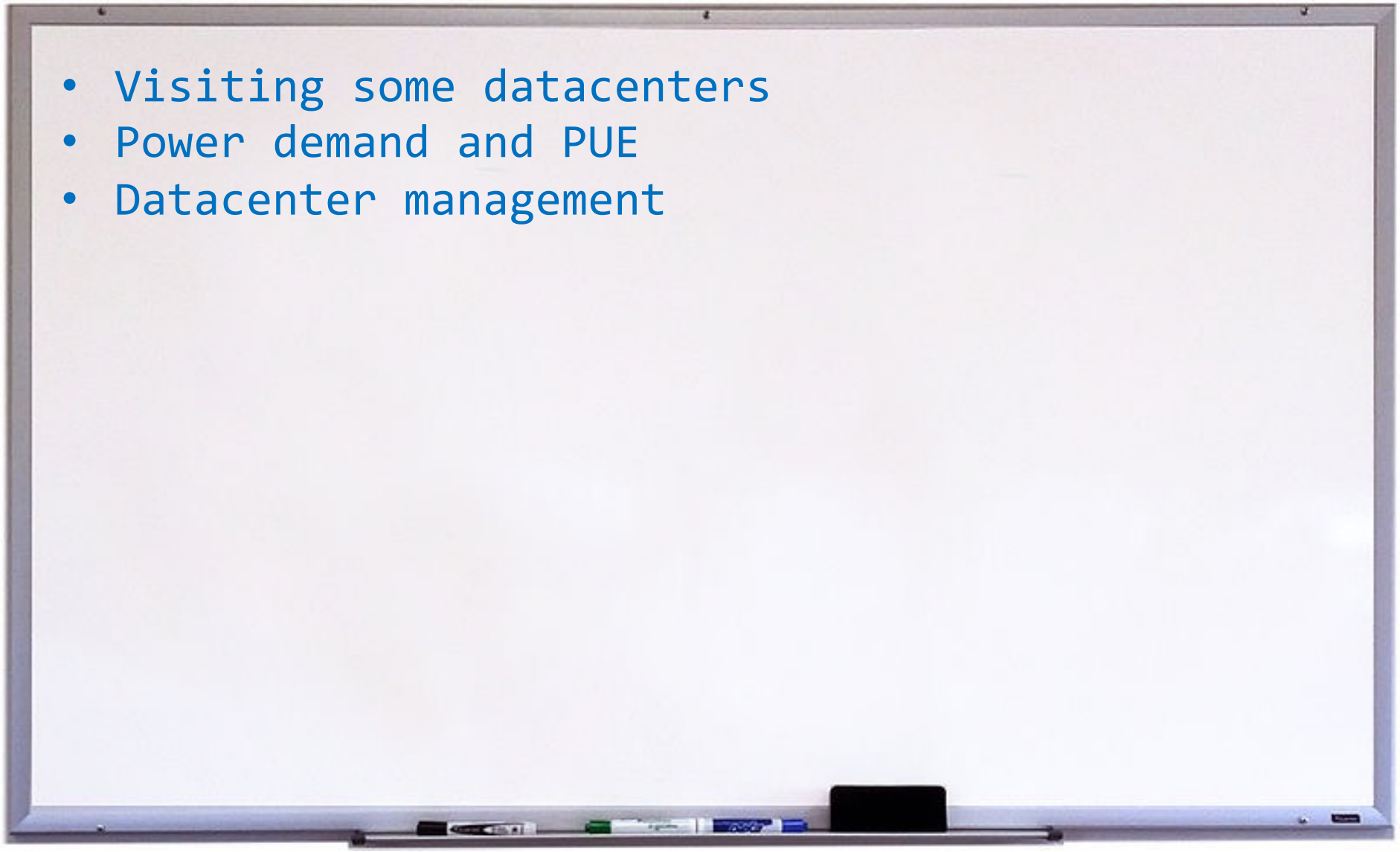
Q - If a datacenter uses 1/3 of the total facility power for the non-IT equipment power, then its PUE is

[ ] 1.5

[ ] 1.3

[ ] 3.0

A: $\frac{X}{\frac{2}{3}X}$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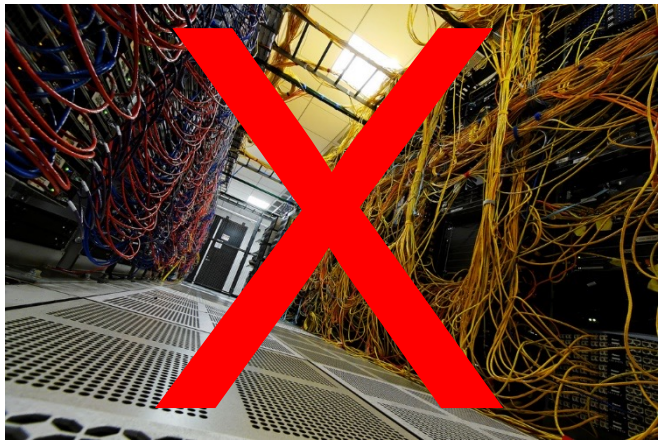
Planning

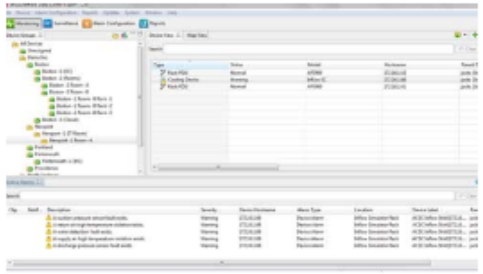
Install and manage racks and connections

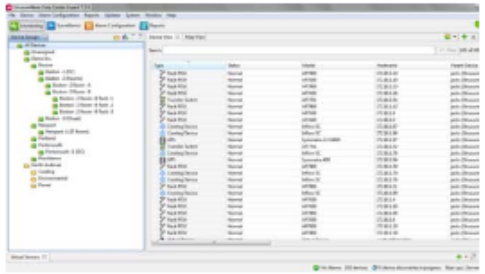


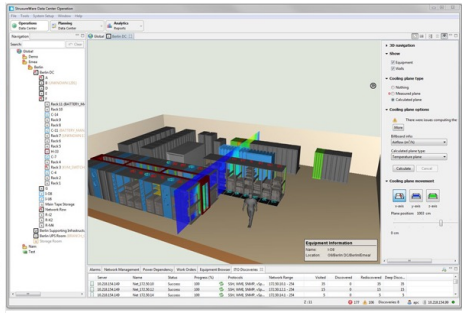
The cable spaghetti nightmare

Cabling!

DCIM – Data Center Infrastructure Management





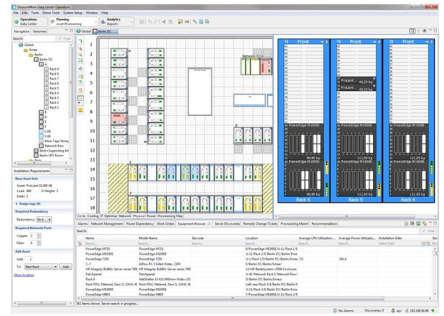


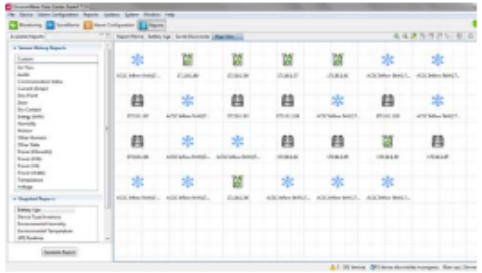
Infrastructure and device monitoring

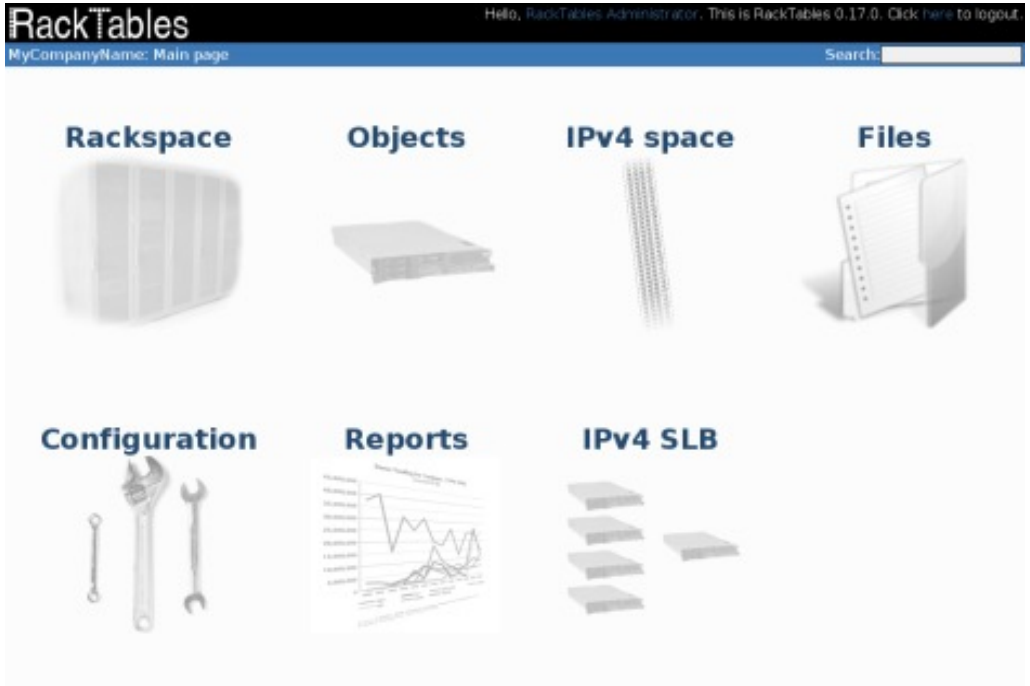
Centralized monitoring of multi-vendor physical infrastructure:

- power,
- cooling,
- security and
- environment.

- Generating user-defined reports and graphs.
- Instant fault notification and escalation enable quick resolution of critical infrastructure events, supporting your data center facility and IT Service Management processes.






RackTables
Hello, RackTables Administrator. This is RackTables 0.17.0. Click here to logout.
MyCompanyName: Main page
Search:
Rackspace
Objects
IPv4 space
Files
Configuration
Reports
IPv4 SLB


Don't Forget
To Document

"Stupid" things NOT to do in your data center

Cable gaffes are a safety hazard

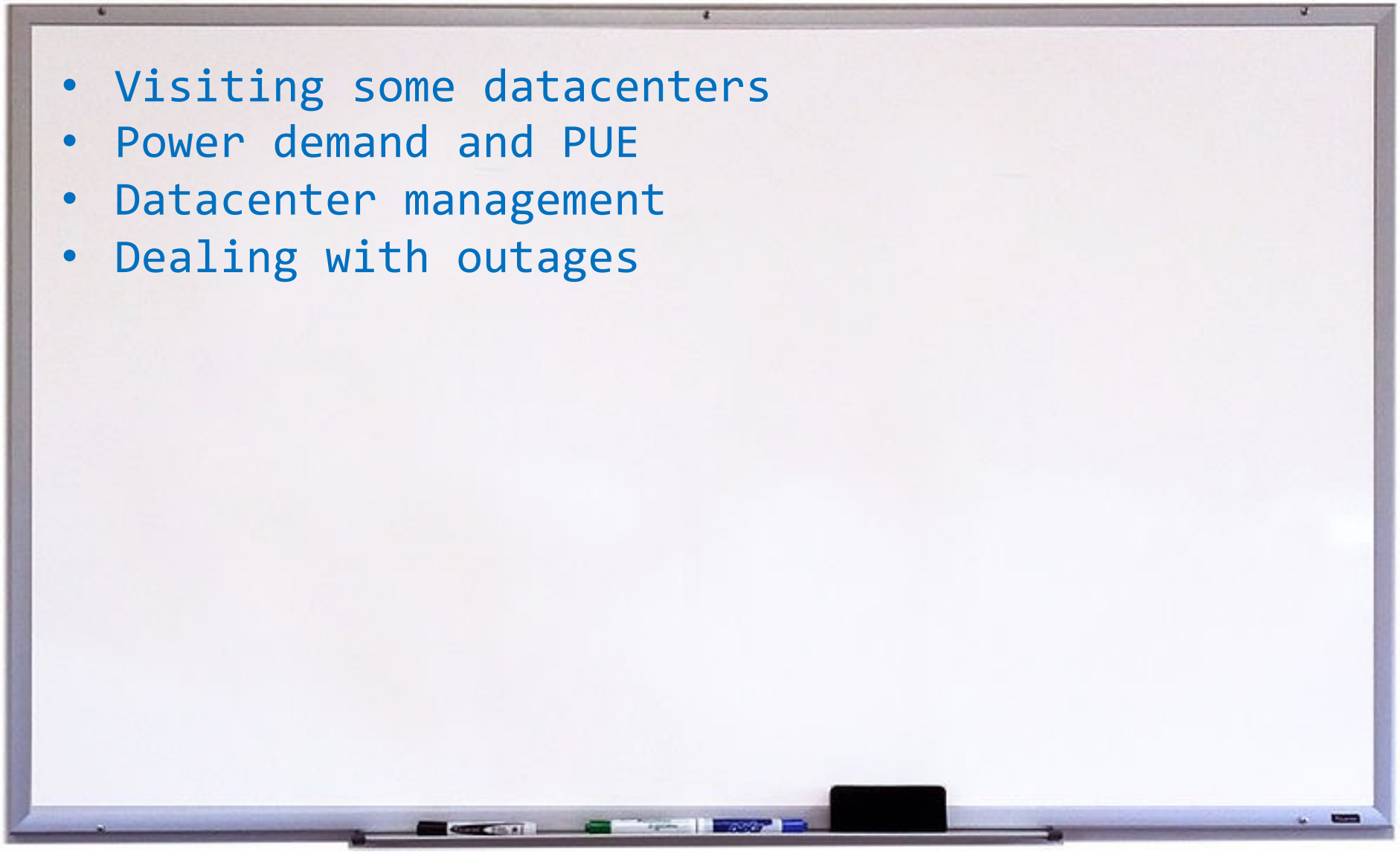
No food or beverages allowed in the data center

Documentation

How exactly did you map out that net?
What are the domain credentials?
Which server does what?
…

How many keys to your data center have you given out?
Do you have a spreadsheet with names associated with keys?
When is the last time you propped the exit door open so you could carry in all of those blades and cable? How much time was that open door left unattended?

Prevent electricity failures (e.g., due to accidentally shutting off power, lack of battery backups, no generator, pulling too much power from a single source)


• Visiting some datacenters
• Power demand and PUE
• Datacenter management
• Dealing with outages

- **Get available quickly: get up - get ready - get focused**
- **Handle your panic**
- **Follow the checklist(s)**

Why checklists?

Q: What would you do first in case of fire in the DC?

Example of checklist

Fire – Data Center Recovery Checklist

- Step 1: Assess nature and extent of fire.
- Step 2: Use existing fire suppression equipment to extinguish fire, e.g. sprinklers, hand-held extinguishers. Note: if fire is severe move quickly to call 911 and/or evacuate staff.
- Step 3: Dial 911, advise of situation.
- Step 4: Evacuate building staff.
- Step 5: If possible and safe activate data center backup measures to protect current data.
- Step 6: Once fire is out, begin damage assessment.
- Step 7: Update senior management on status.

https://evolvingsol.com/data-center-checklist/

Checklists are important

- To ensure quality of operation (whoever the operator)
- To reduce employees’liability

Business Continuity & Disaster Recovery: 6 lessons learned

1. **Maintain a full copy of your mission critical data outside your production region**
   150+ miles away and/or a separate power grid
2. **Test your BC/DR plan in a realistic way to ensure it actually works**
   An untested plan is a failed plan
3. **Ensure production changes are properly reflected in the BC/DR plan**
   Keep your BC/DC plan aligned with your production environment
4. **Have a plan that is consistent and accessible even in the event of a major disaster**
   E.g. even if primary infrastructure is destroyed
5. **Always have several people fully trained on the BC/DR plan … preferably some of whom are outside the production region.**
   People can get sick, leave company or become unavailable in a disaster
6. **Remember Murphy's Law: "Whatever can go wrong, will go wrong."**
   Try to have contingency plans "if this fails then …"

C. Burns McBeth. Business Continuity And Disaster Recovery Best Practices From The Availability Trenches.

Some of weirdest datacenter disasters

Life is what happens while you are busy making other plans [J. Lennon]

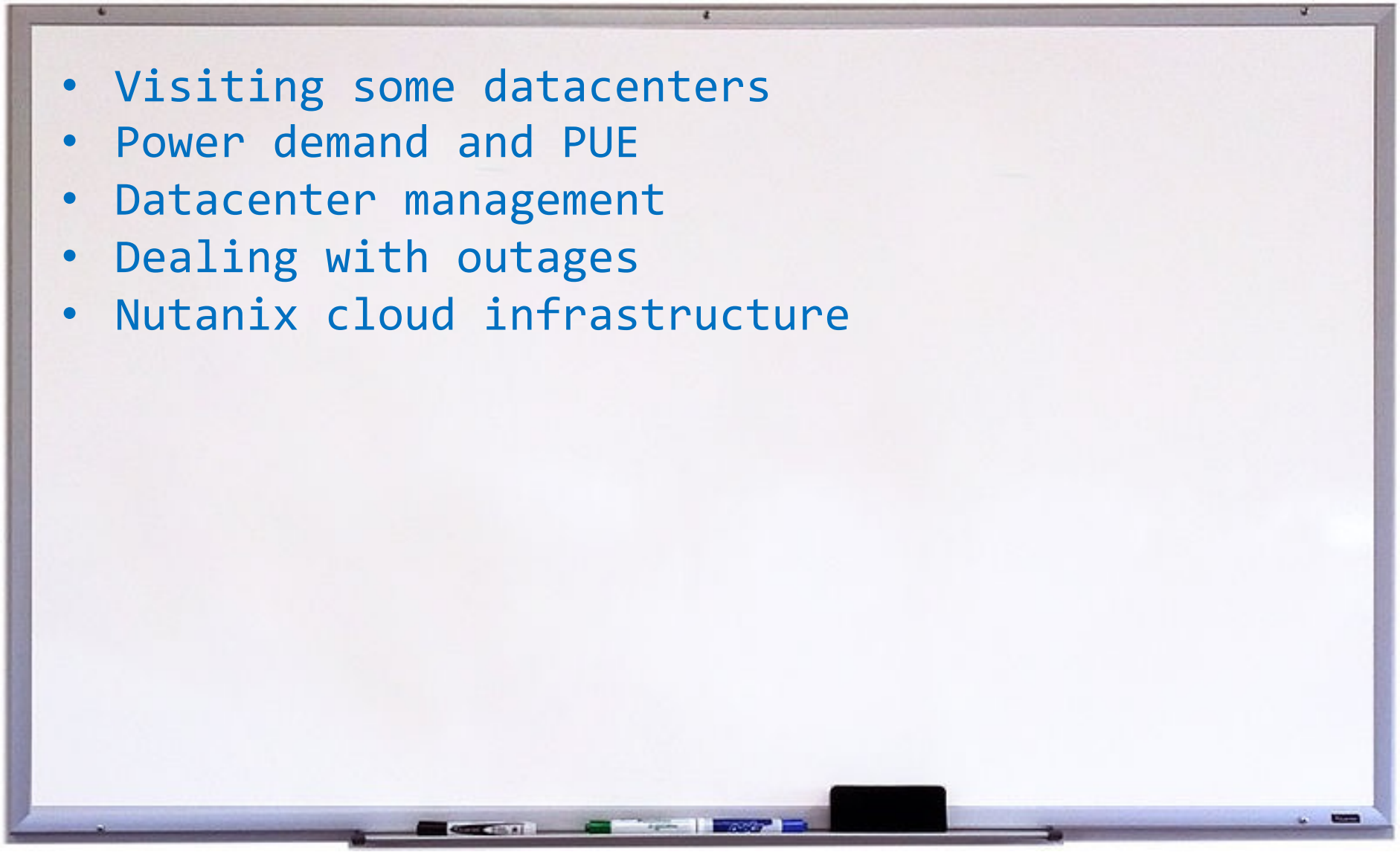
Lightning hit main power and backup generators of Amazon and Microsoft data centers in Dublin

Hurricane Sandy caused disrupted a number of businesses operating in and around Newark. Data center business was the worst hit among the businesses

Truck driver drove into power transformer at Rackspace data center in Texas

Yahoo's data center in Santa Clara witnessed a downtime for almost 12 hours. Squirrels chewed down the cables through which data got transferred

Ship accidently dropped its 2 tonne anchor on the under sea cables which carried traffic from continent to continent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• Dealing with outages
• Nutanix cloud infrastructure

https://www.youtube.com/watch?v=iTRrB8ck0fM

Nutanix Cloud Infrastructure

Industry-standard server building-blocks

Software-defined clusters of compute/storage/network resources
- virtualised and containerised compute resources
- storage resources combined and protected across the cluster
- zero trust and native security controls to protect network resources

Clusters adapt to workload changes

Users can create remote clusters as well as easily add physical servers

Data and workloads are moved within the cluster for performance and resiliency

Self-healing capability in case of drive/node/connection failures

→ Simplified management of applications and infrastructure