Why you should burn down your datacenter

LISA21

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Production Engineer

FACEBOOK Infrastructure

mikeelkin2 bio

- Not a…
  - Controls Engineer
  - Mechanical Engineer
  - Electrical Engineer
  - Chemical Engineer
  - Those kinds of engineers
- DCIM Program Tooling
- 14 years industry, 8 years @ FB
- Backend Infrastructure Focus


This is not a talk about
cloud computing
Photo source: @nimbus_vulpis

Photo source: @ibrahimboran

Agenda

Datacenter 101

Smart Infra

Burn it down

Datacenter 101

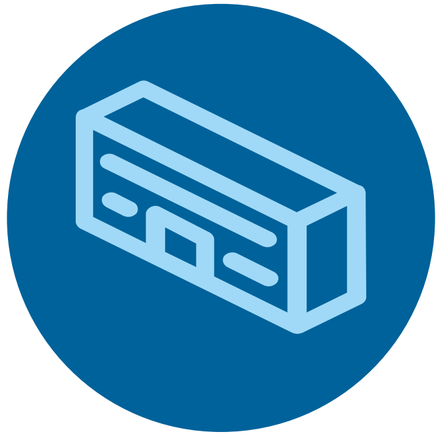
Why do we need DC’s?

Power

Without power, your servers are just expensive paperweights

Cooling

Without cooling, your equipment will overheat and you will not share cat pictures on the Internet today



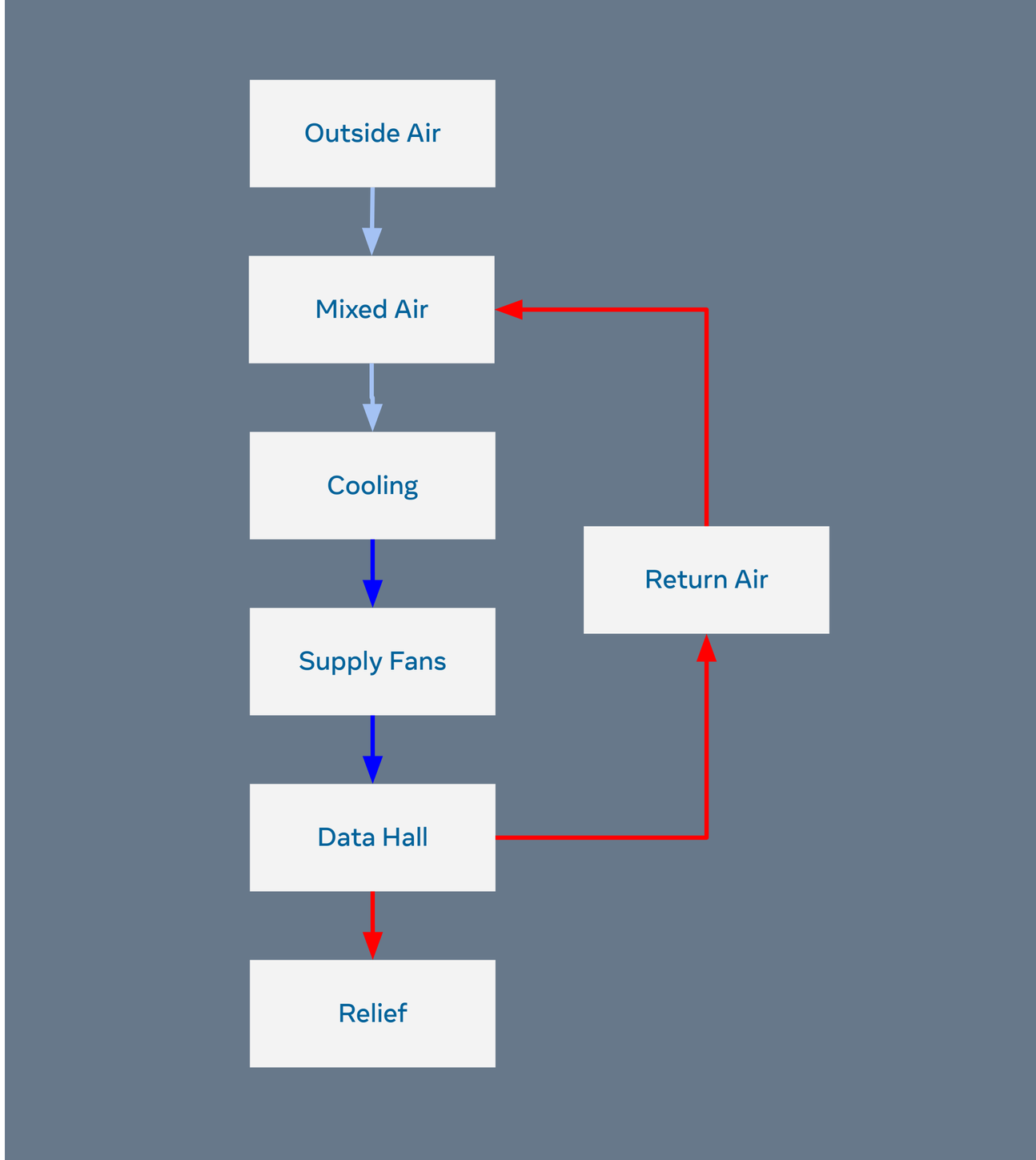
Space

We need a secured footprint to place all this awesome equipment (and cat pictures)

Cooling

Chillers, Misters, Coils, oh my!

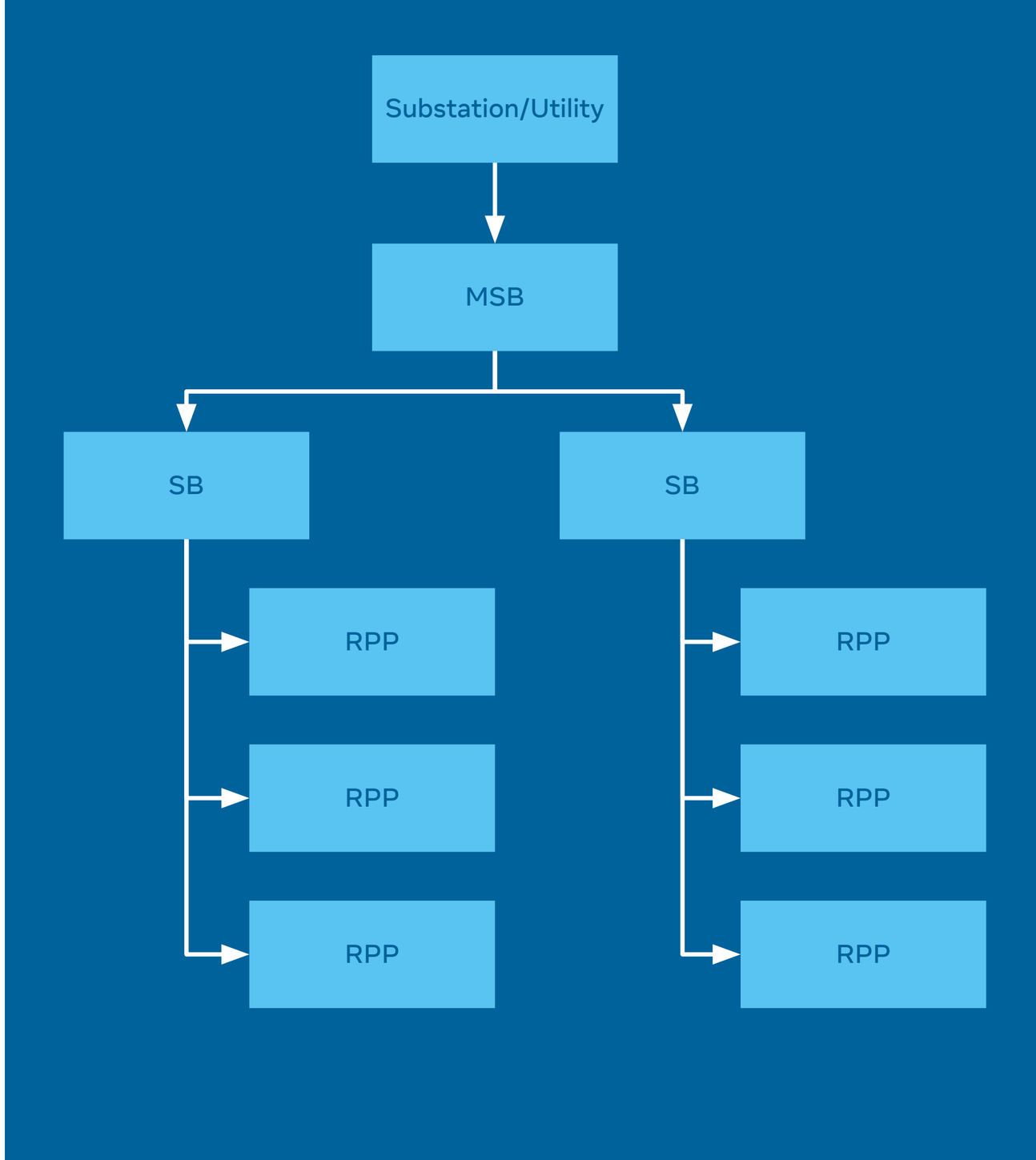
- **Direct air cooling** takes outside air and brings it to suitable temperature & humidity levels
- Both **energy and water** are required to keep servers happy
- The **performance** of the cooling system is limited by the environmental conditions and can be tracked through a psychrometric chart



Power

A finite resource

- The **Power Path** for a server follows all the electrical distribution from your utility all the way to a server rack
- Each **device in the power path** has different limits and characteristics
- The **coordination** of the electrical environment intends to trip breakers closest to the fault



PuE

(Total Energy) / (IT Load)

Values closer to 1 are “better”

WuE

(Annual Water Usage) / (Energy Consumed)

Lower water usage is better

Fault Domains

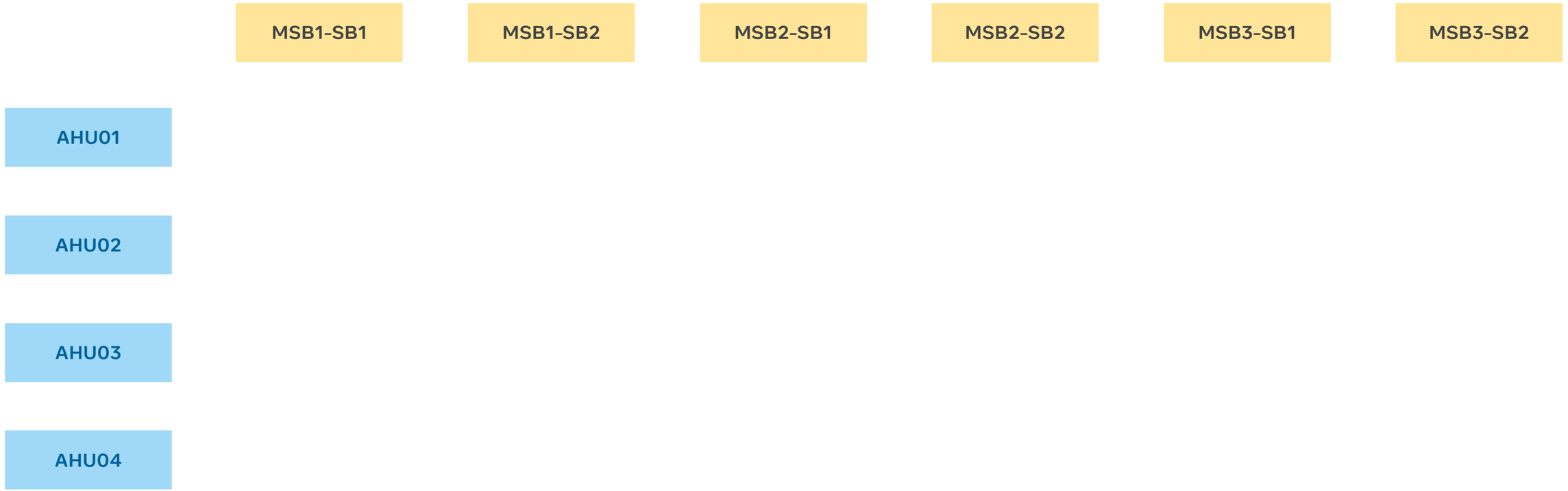
Not just your network

Fault Domains

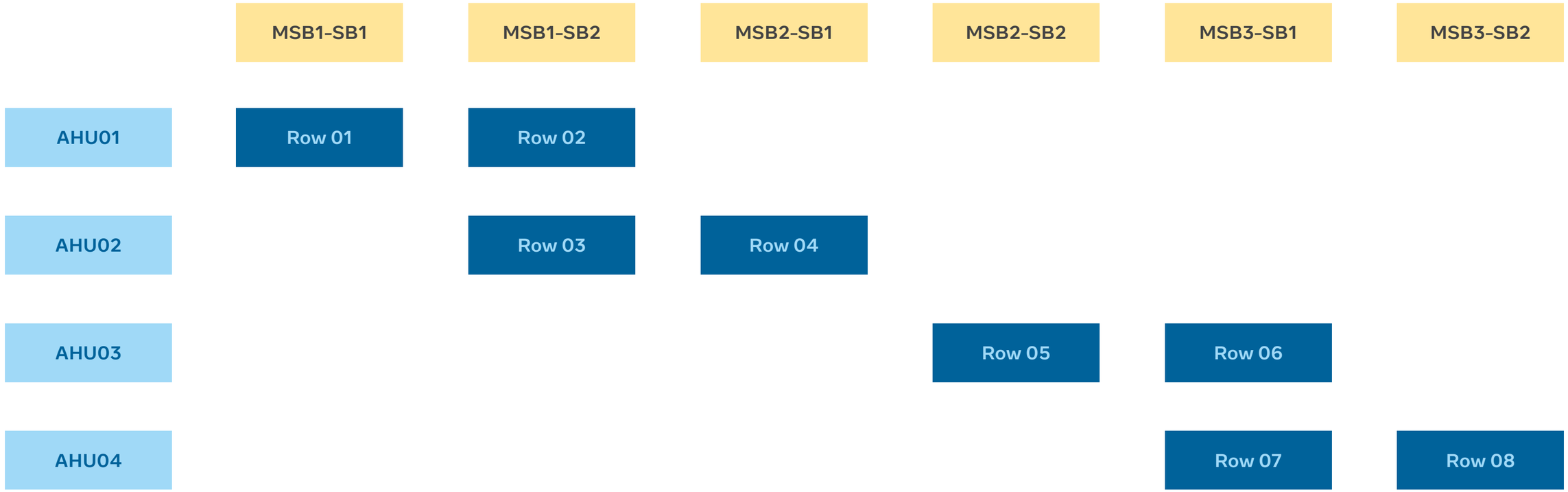
Not just your network

- Cooling (blue)
- Electrical (yellow)
- Servers (red)

Fault Domains



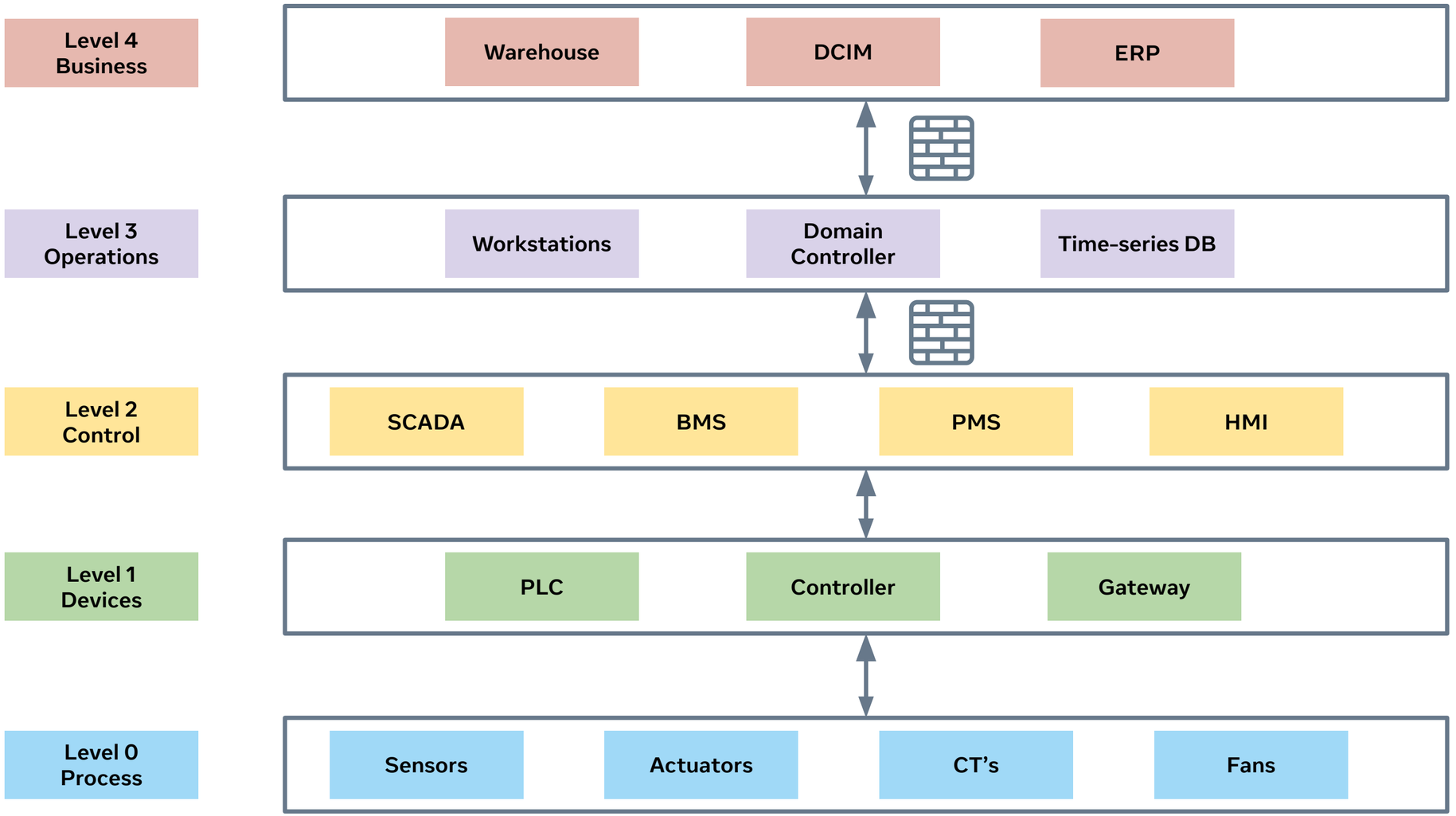
Fault Domains



So that's is a bit of high level - how do these controls environment actually work?

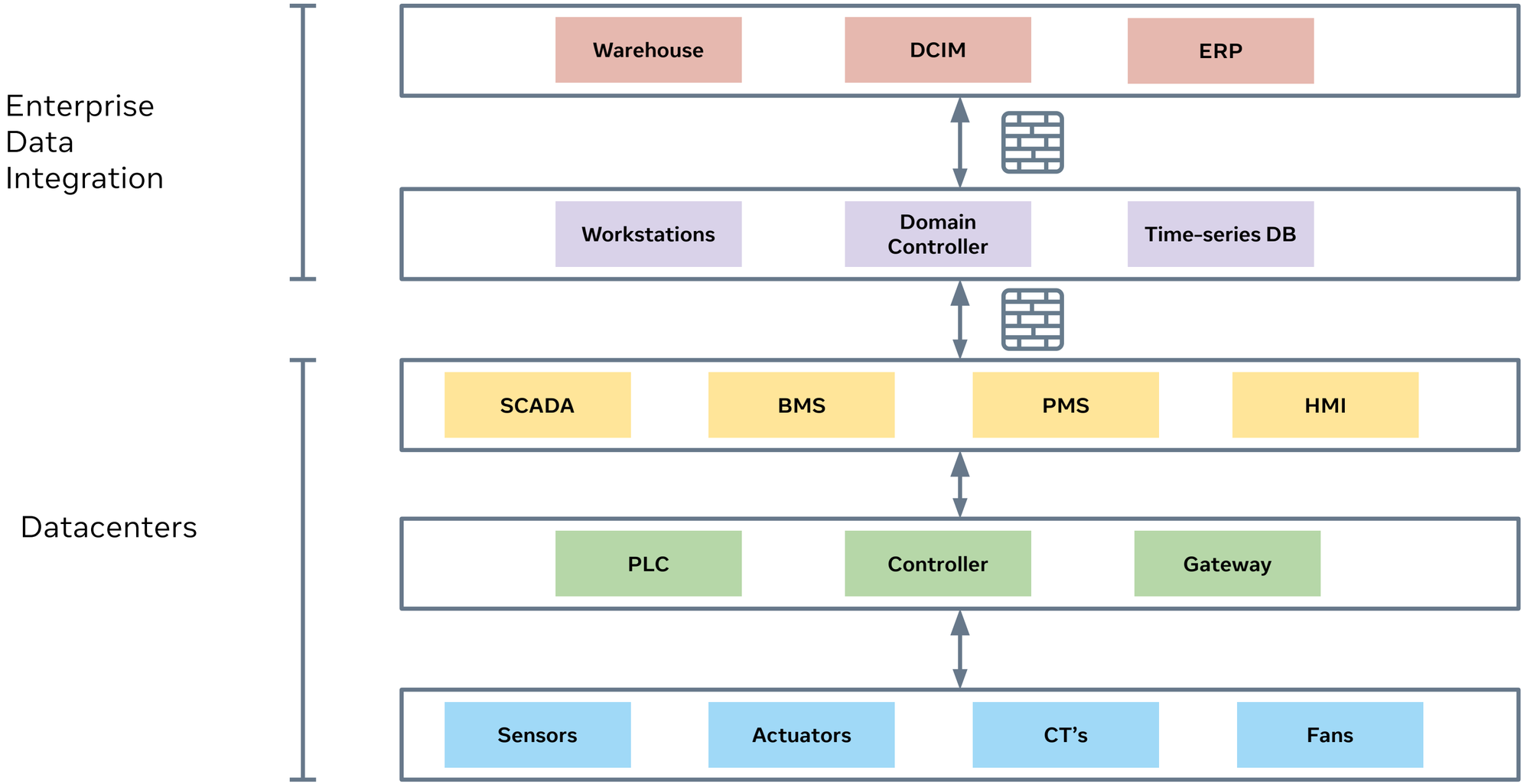
Purdue Model

Industrial Controls is just Input/Output at scale



Purdue Model

Many Datacenters, One Enterprise



Smart Infrastructure Opportunities

Many opportunities, handle it

- Electrical Breaker Trip Prevention
- Optimizing Service Placement
- Machine Learning
- Optimization for water/power
- Business Analytics
- Mechanical Analysis
- Colocation Billing

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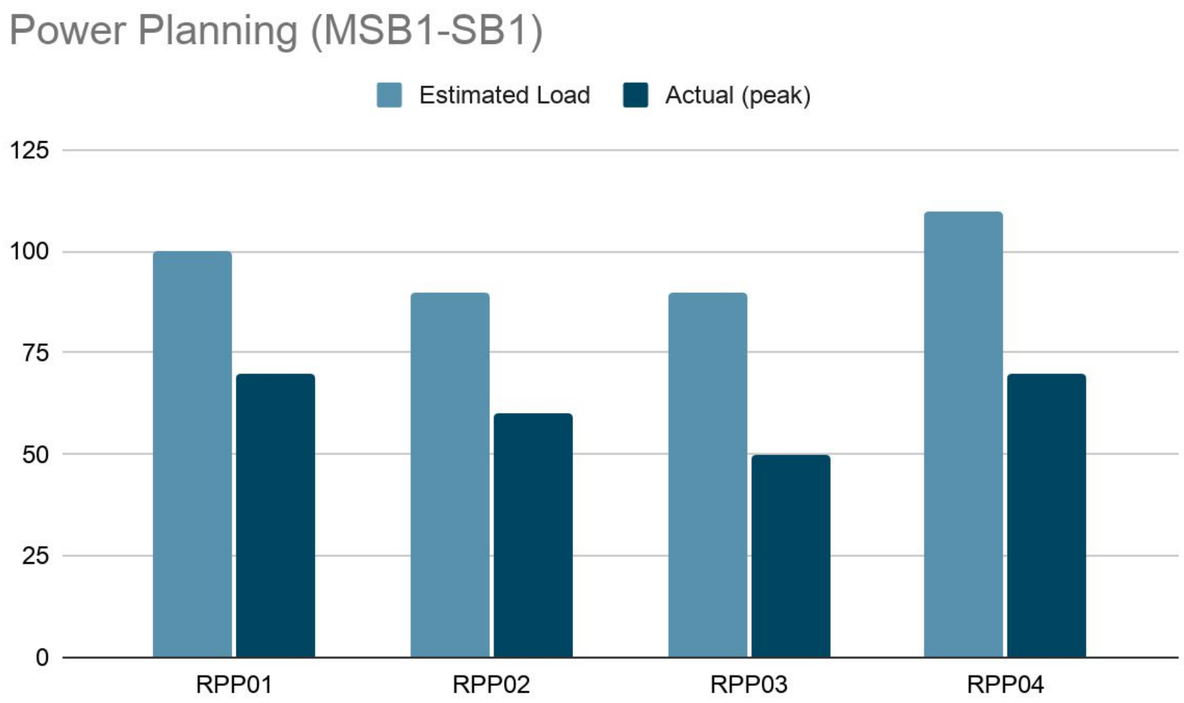
Breaker Trip Prevention

keep the lights on (literally)



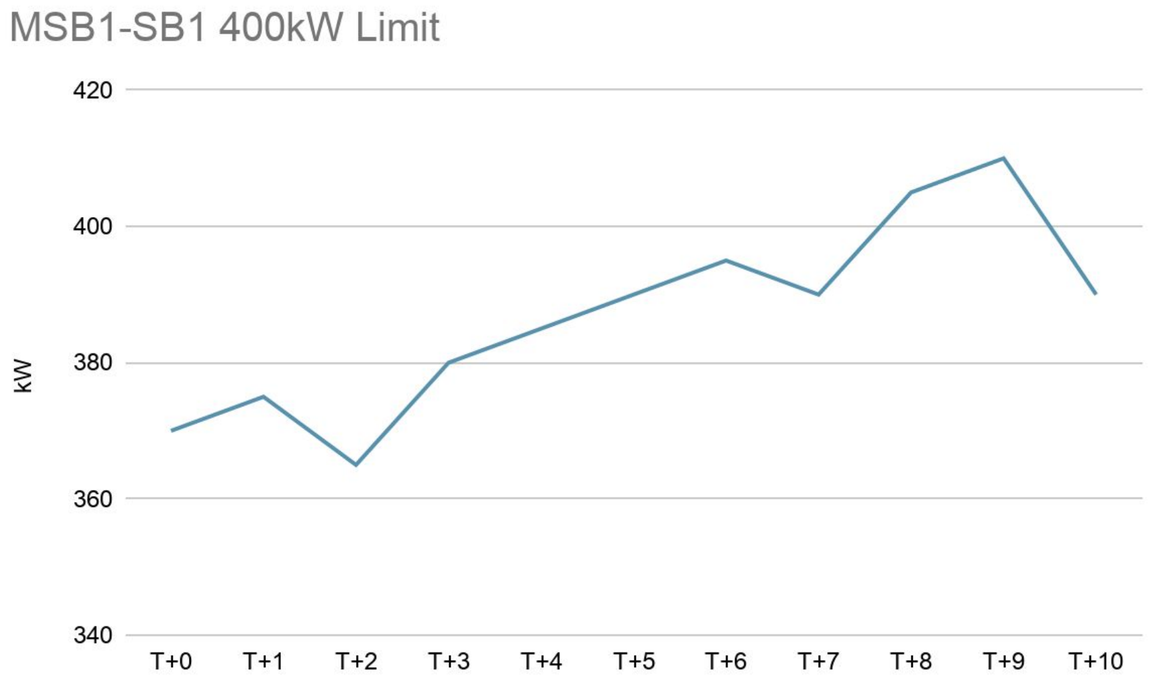
RPP limit: 125kW
SB breaker limit: 400kW

Planned load: 390kW
Actual load: 250kW

Opportunity: 150kW

Breaker Trip Prevention

keep the lights on (literally)



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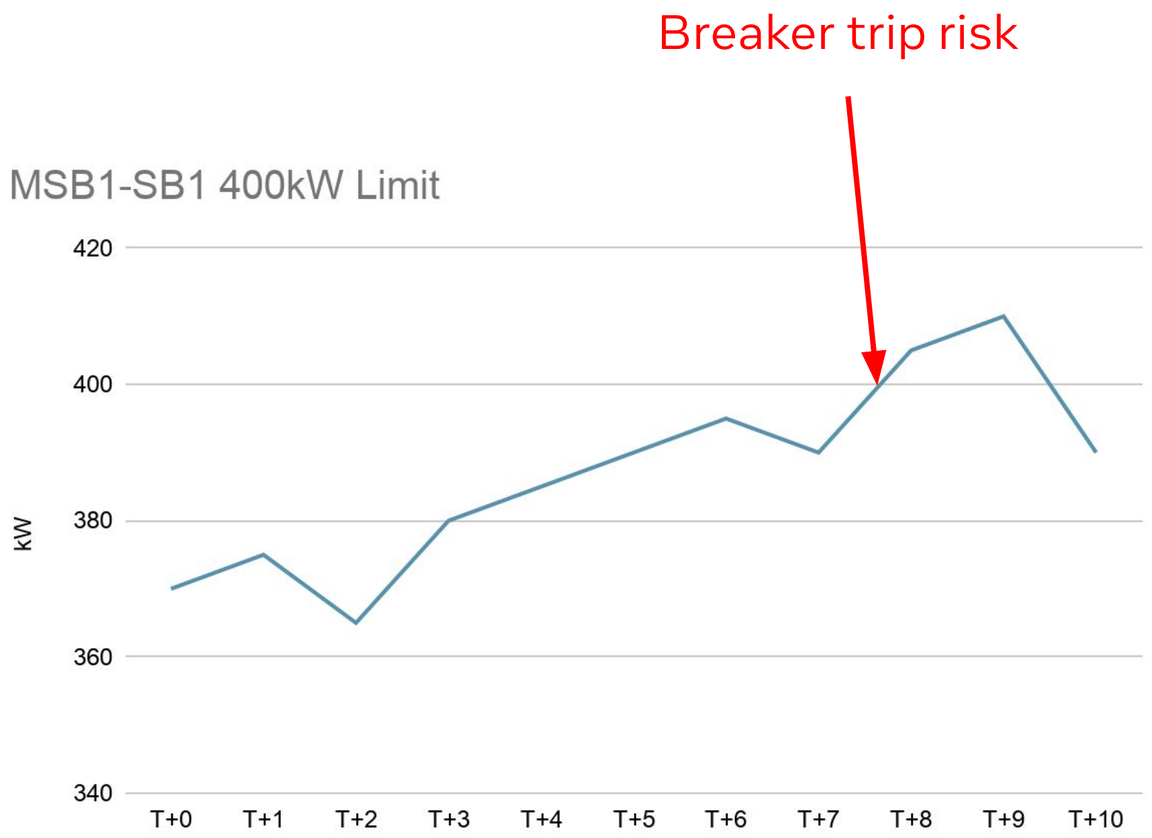

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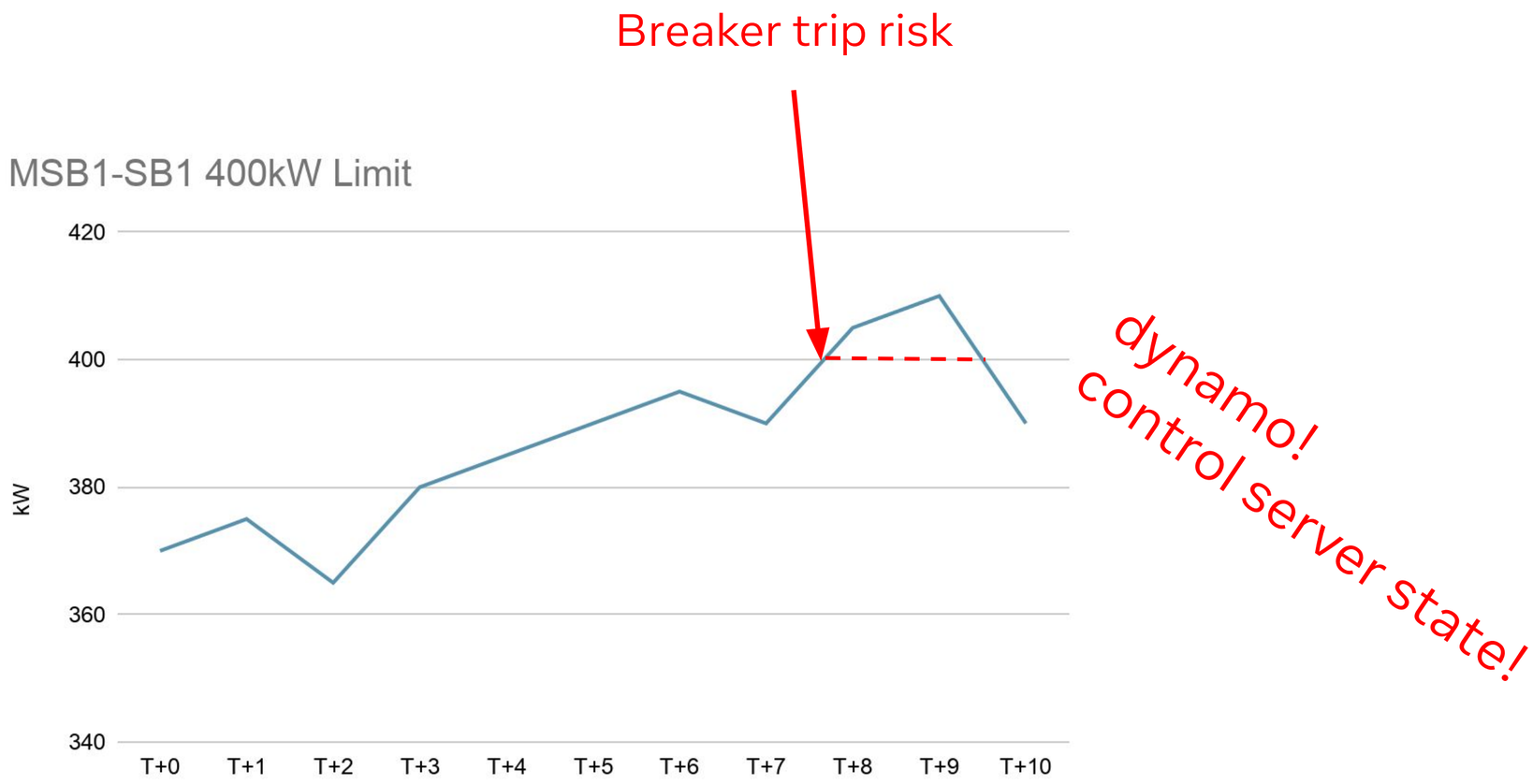
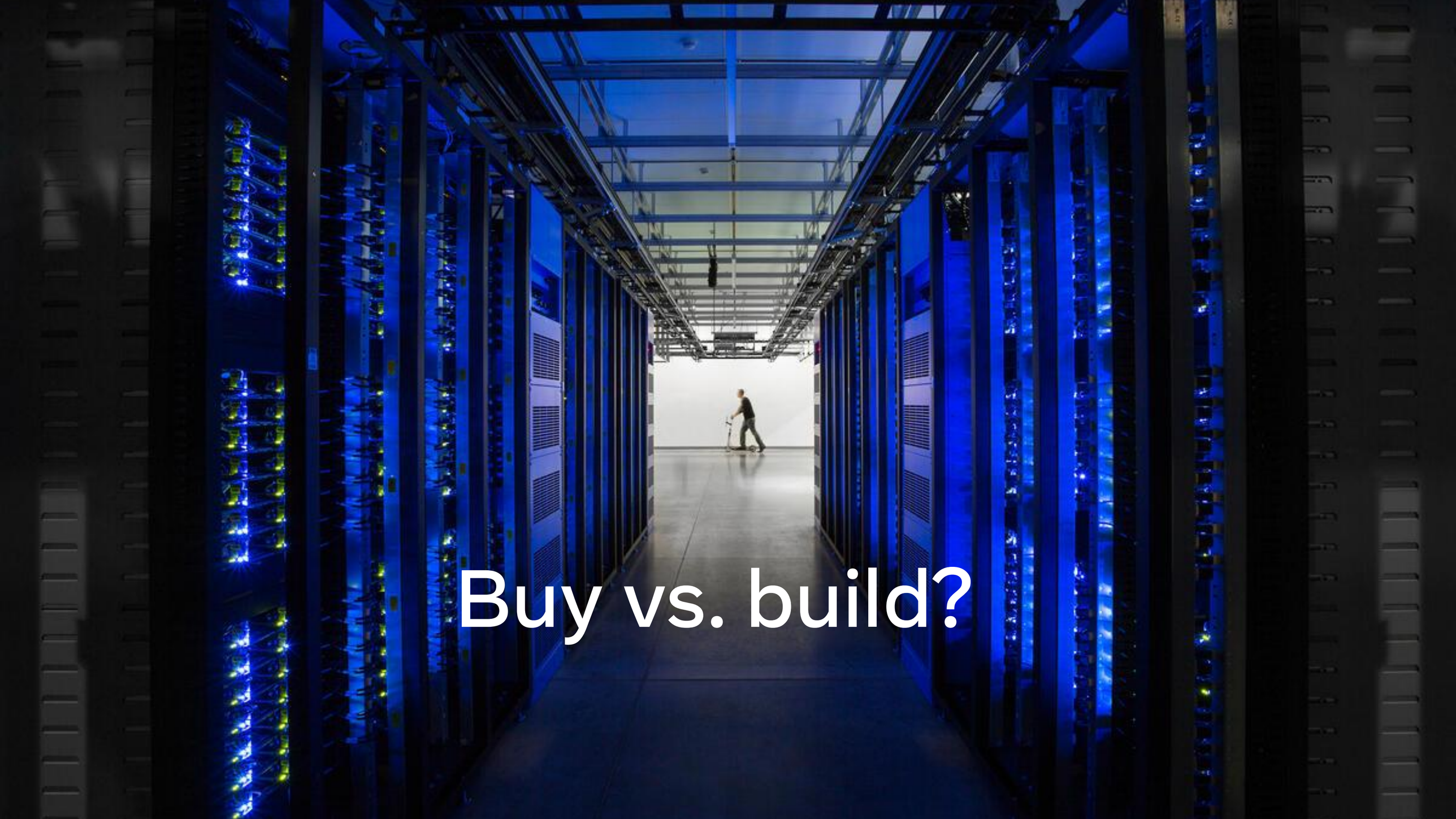


Smart Infra

ICS Environmental Differences

Never put us in charge of nuclear reactors

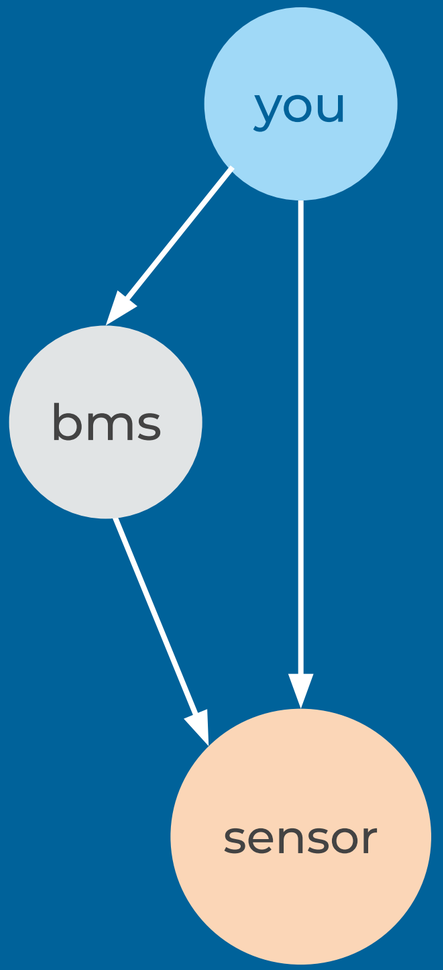
- Less regulatory intervention
- Hard to make equipment cause huge explosions
- Generally self-controlling
- Needs most/all sensor data
- Low (ish) latency data demands for real-time decisions


Buy vs. build?

Integration Options

My day job and also agony

- Your building system probably is already collecting most/everything you want
- Speaking industrial controls protocols is “fun”
- Can the sensors even handle the load?
- Does your building system give you everything you want, when you want it?



Achieving ICS Data Success

Something like Home Assistant on steroids

Asset Management

Knowing all the ICS devices on your network

Collection System

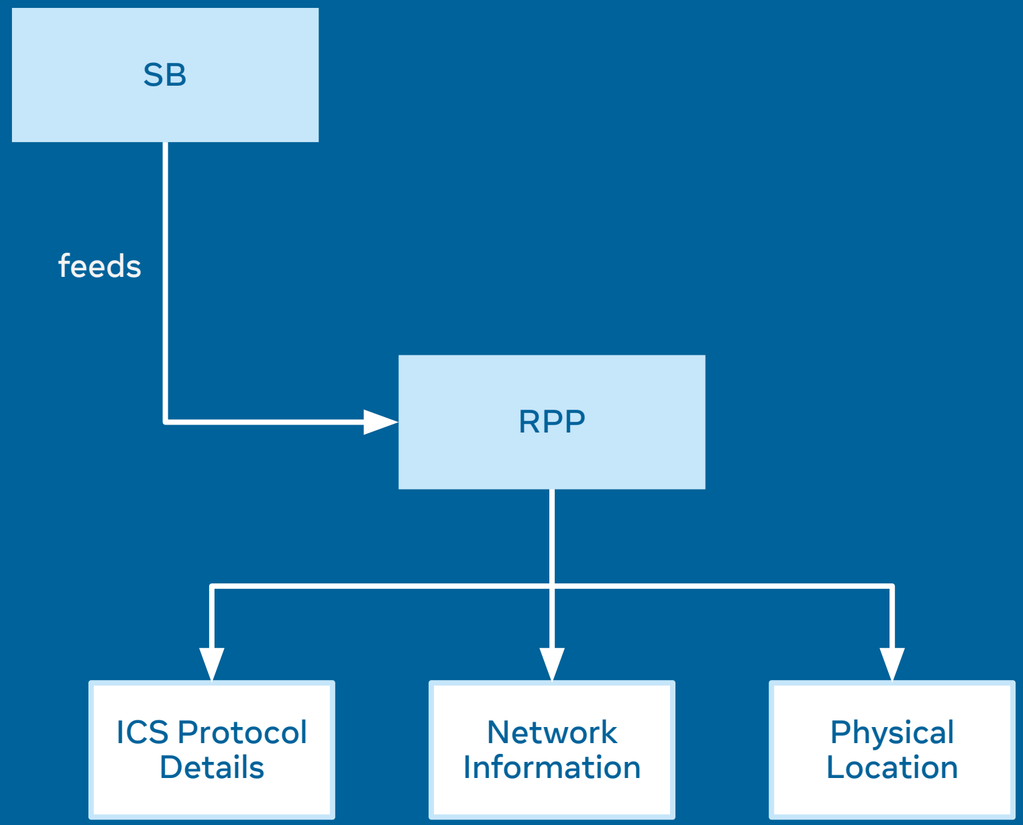
Pulling sensor data, sanitizing, and normalizing

Data Access

Delivering collected results to your infrastructure control plane

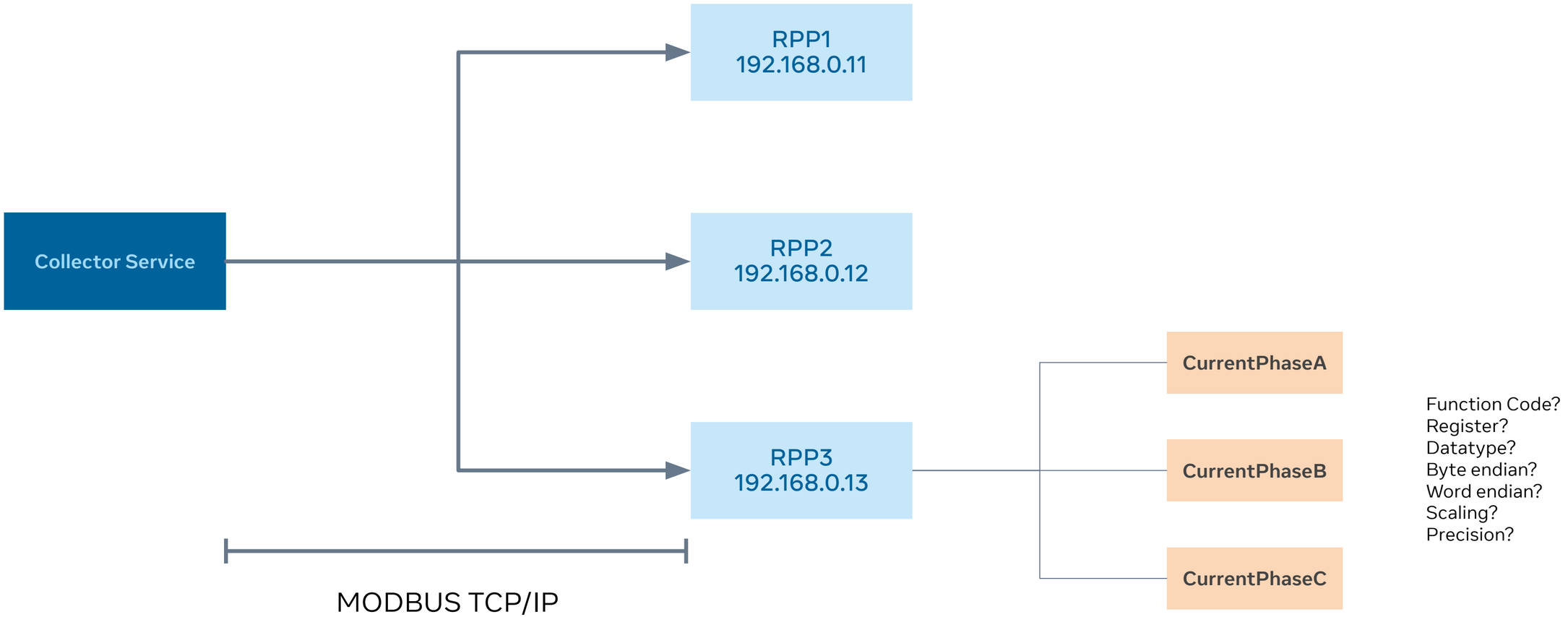
Asset Tracking

- Store important device data
- But the data model and device relationships too
- How do you get the asset data populated?
- How do you maintain data correctness over time?



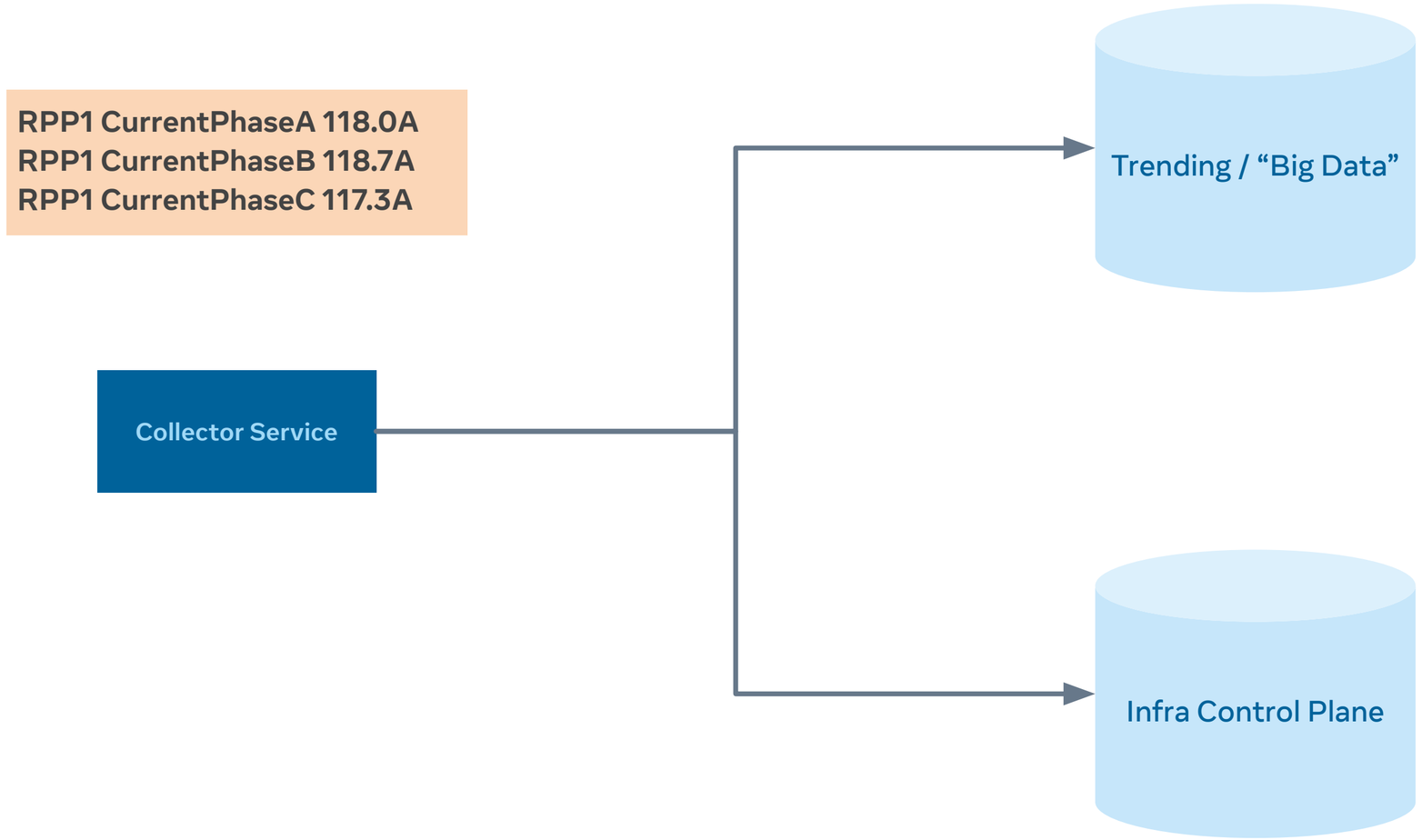
Data Collection

All your points are belong to us



Data Access

Tiers for every kind of user



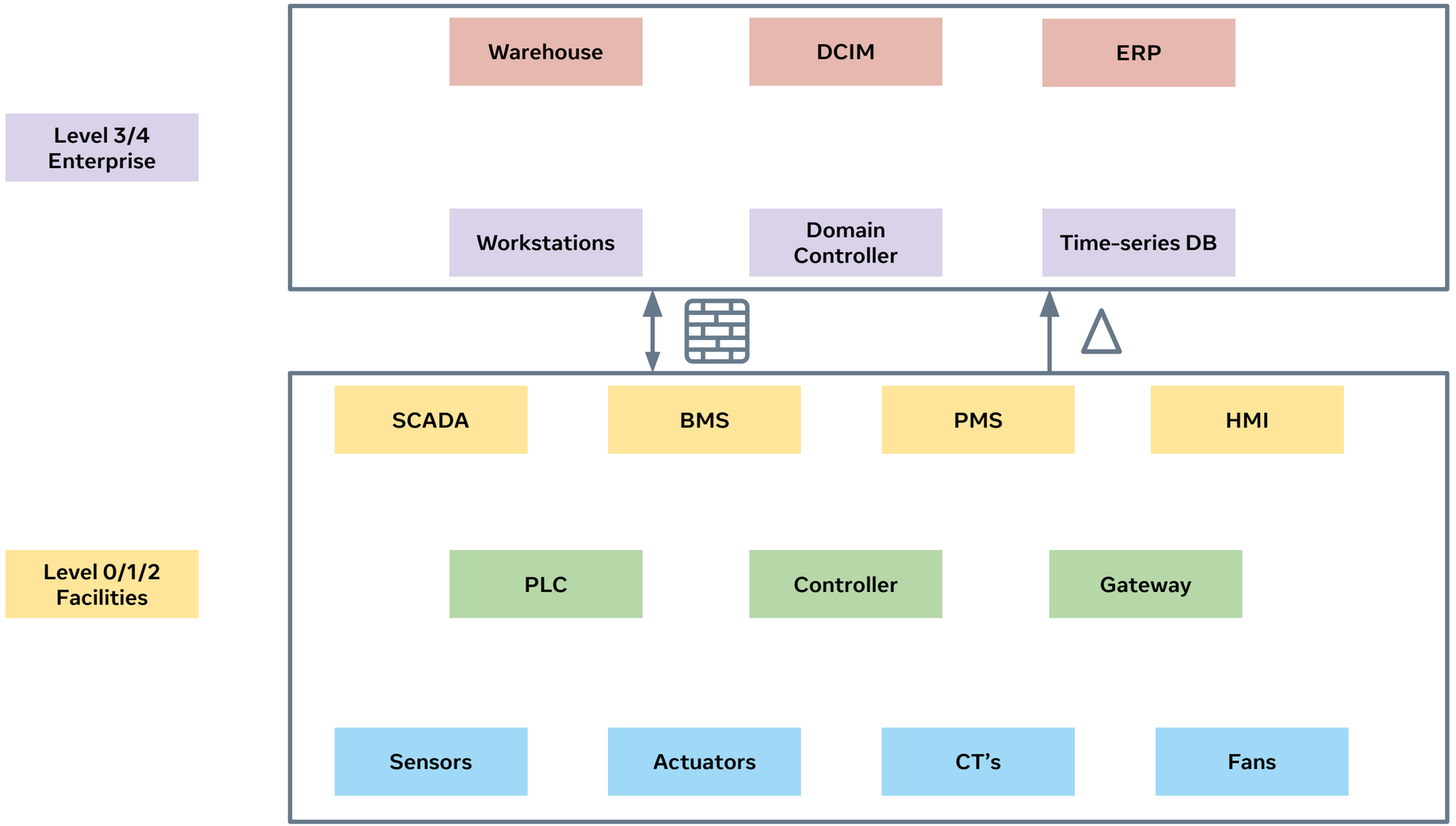
Chapter 3:
Burn it down

Photo source: @xxxxxyul

ICS Security - tl;dr

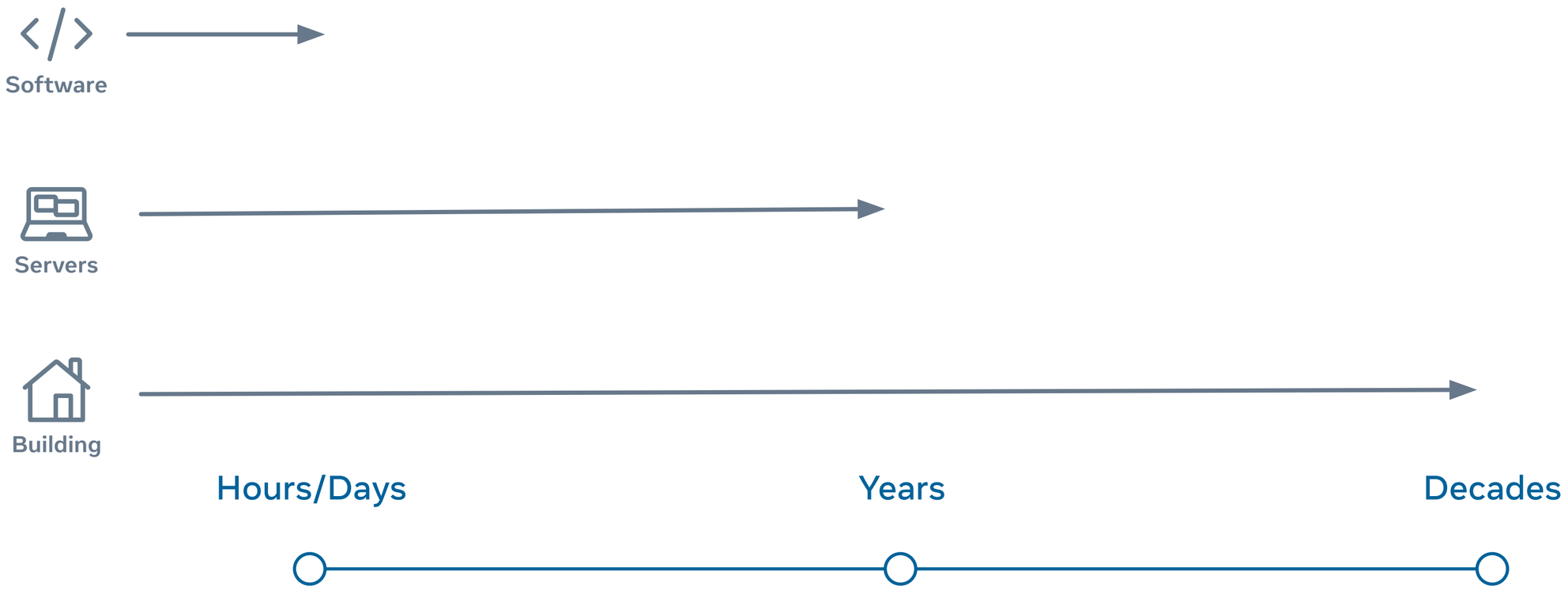
ICS Security

It’s worse than you can imagine



Time-to-change

From fastest to slowest



Network Performance: ping

“The ping of death”

$ ping 192.168.12.80

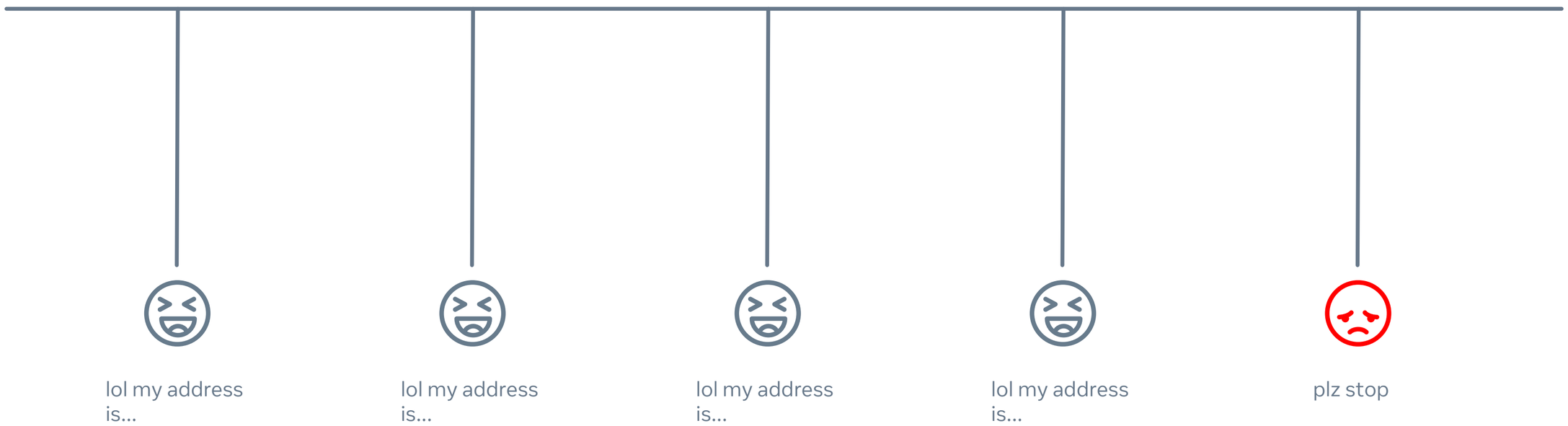
Request timeout for icmp_seq 0

Request timeout for icmp_seq 1

Request timeout for icmp_seq 2

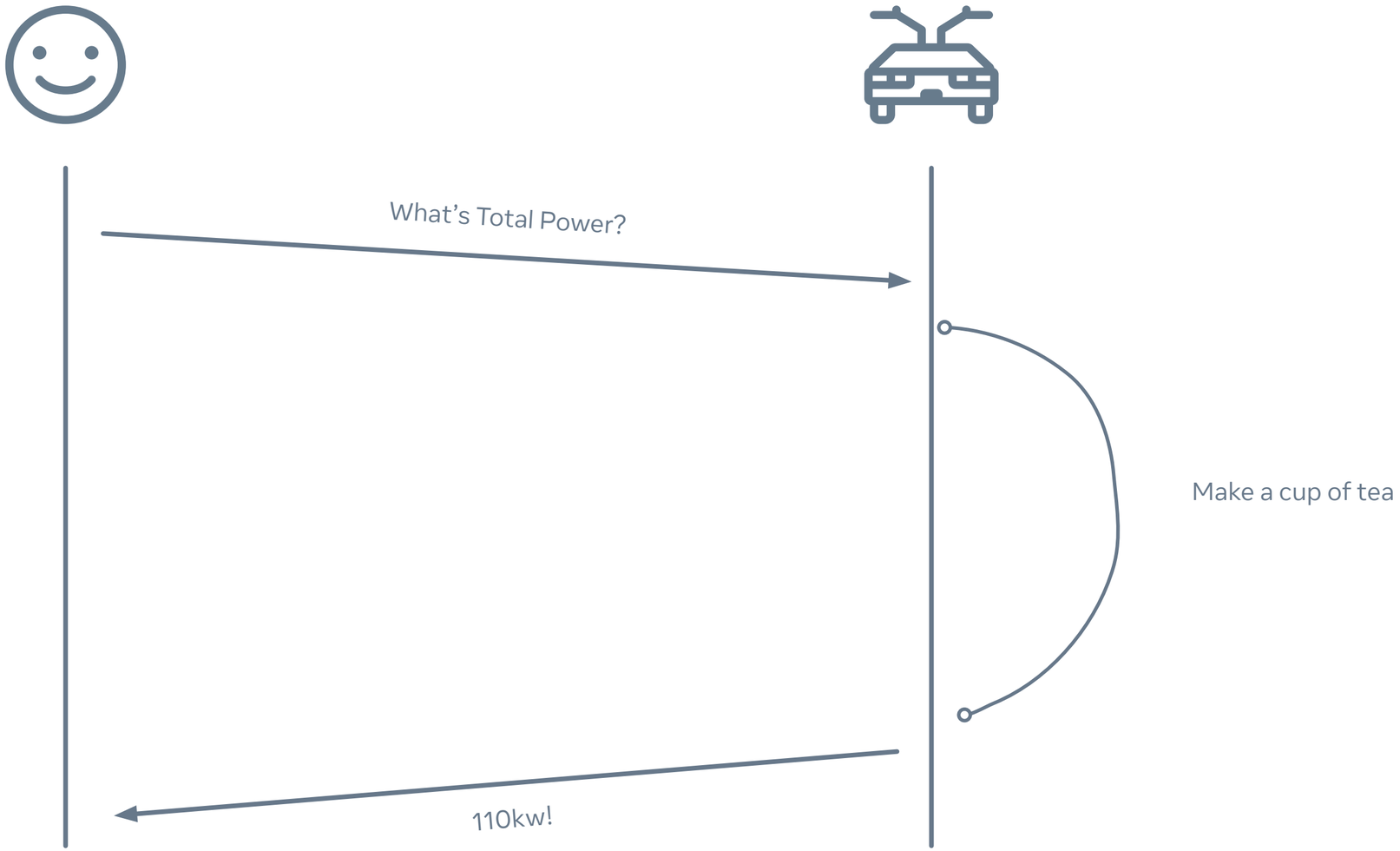
Network Performance: broadcast traffic

DDoS by any other means



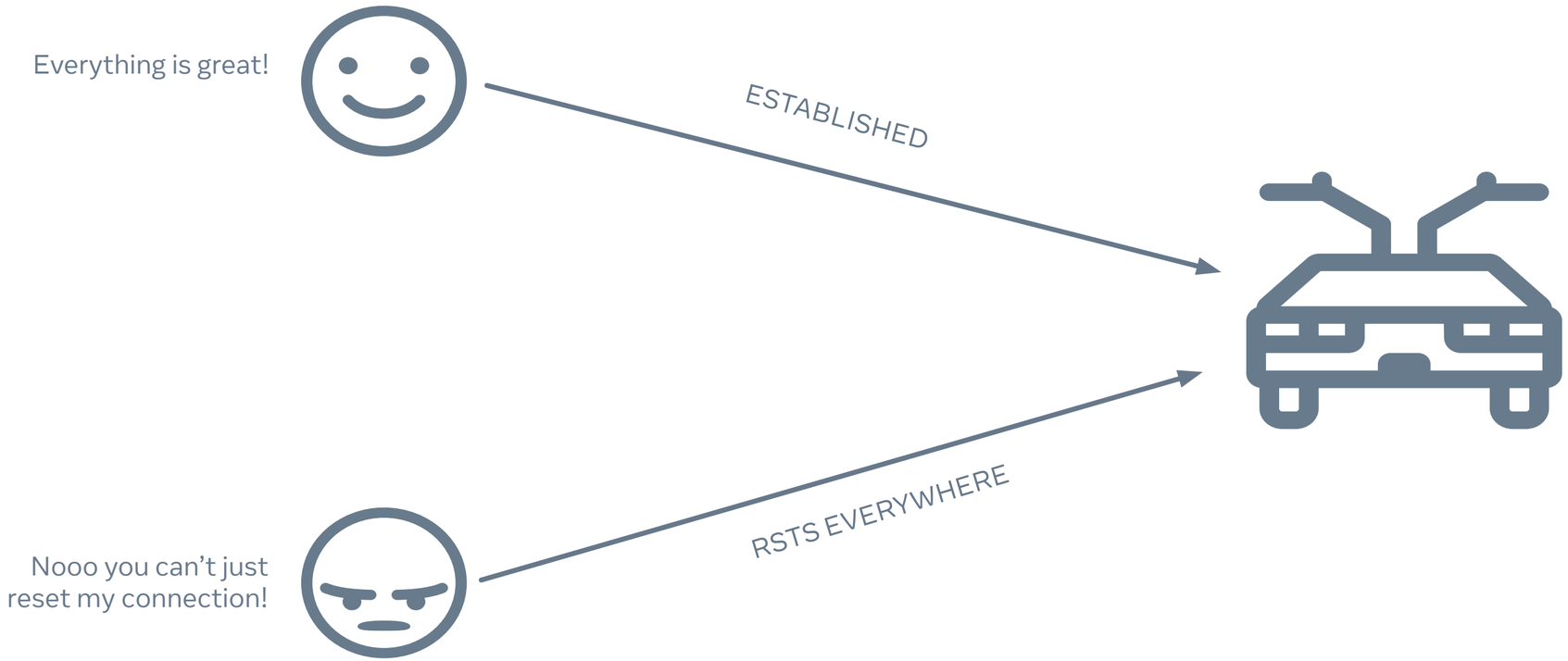
Network Performance: Latency

Turtle vs. the sensor



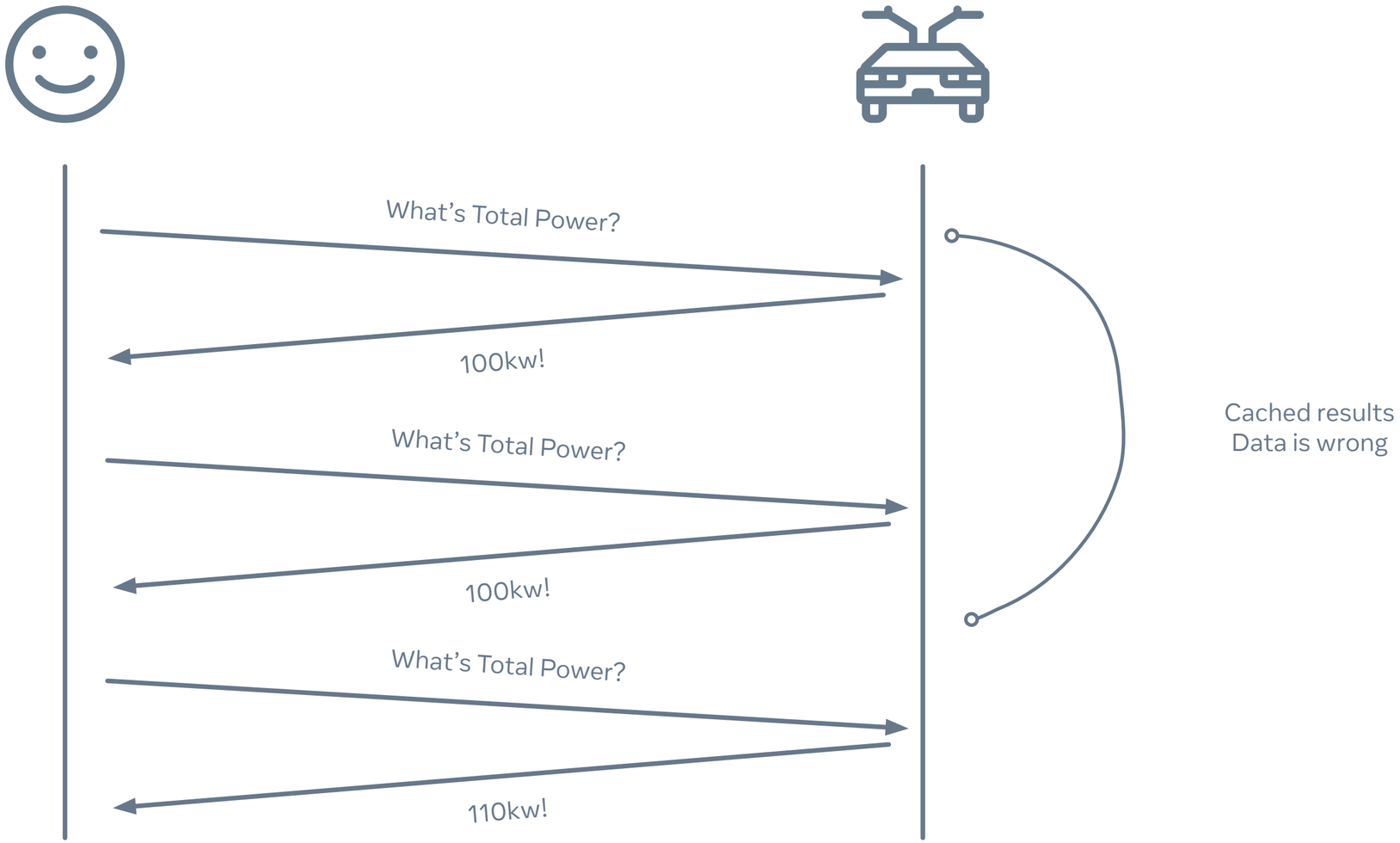
Network Performance: TCP connections

One TCP connection is all you need!



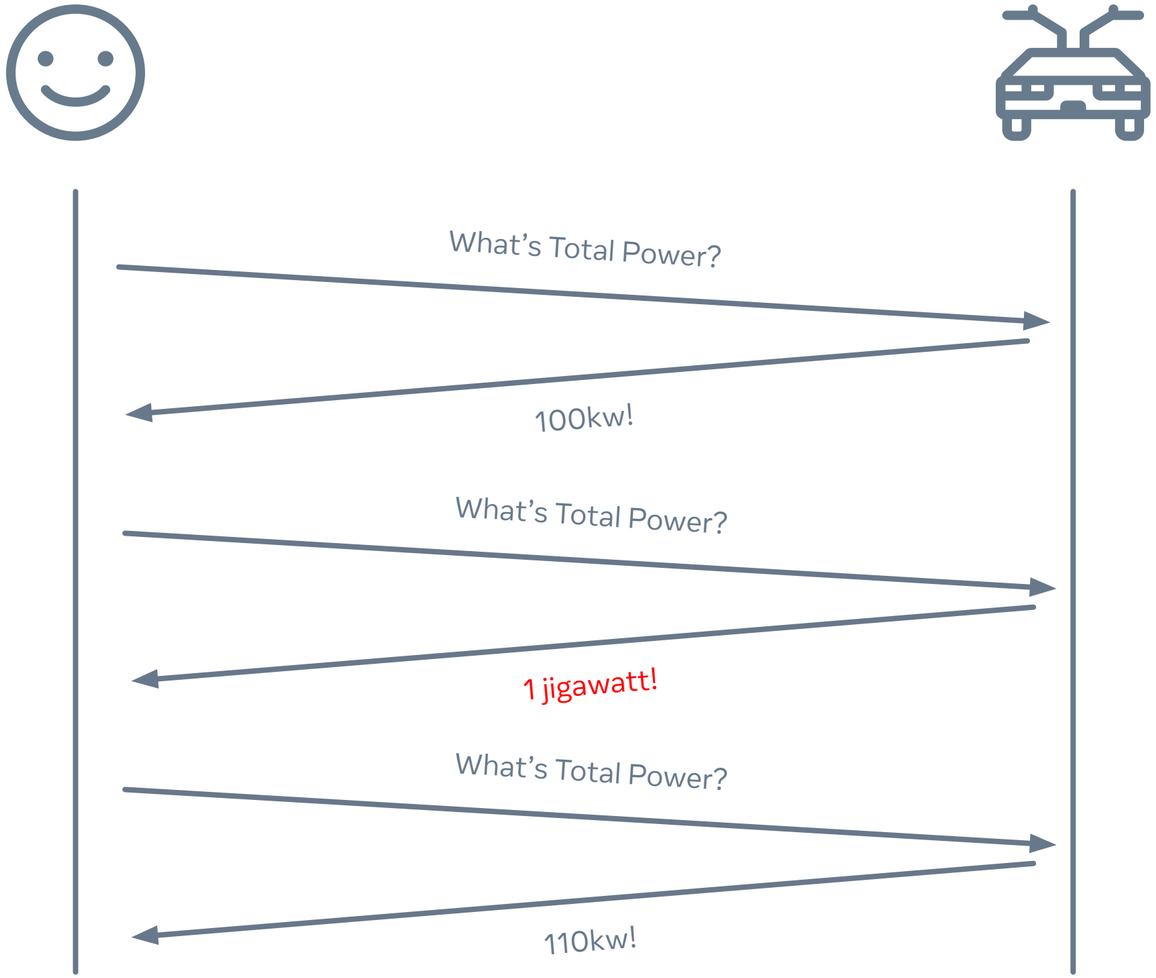
Data Quality: Internal Caches

I’m all out of that fresh data you wanted



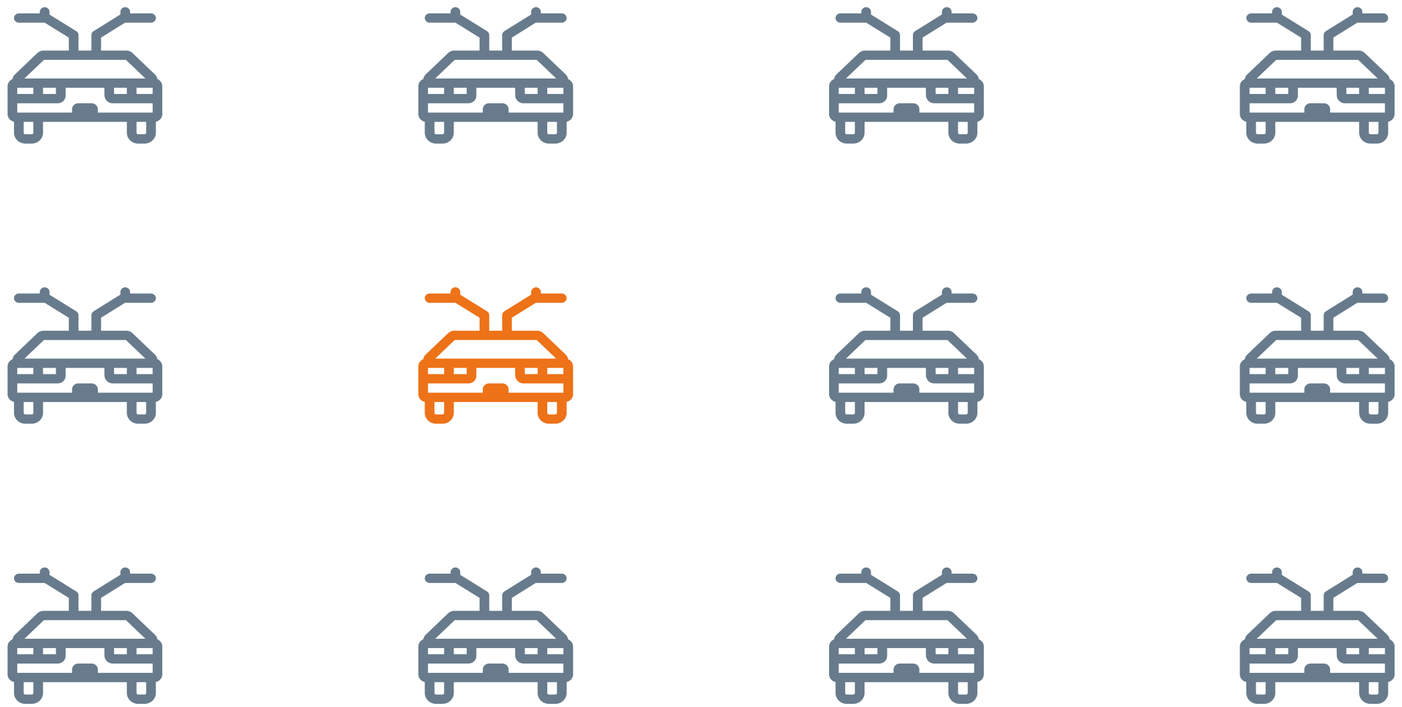
Data Quality: Totally Correct Values

Peak Flux Capacitance



Data Quality: Totally Consistent Configs

Humans never make mistakes



Don’t ragequit!

Takeaways

DC Data is <3

Facilities resources can be managed a lot better when we get integrate their data across our systems.

ICS is very frustrating

They work very different from what we're used to, and we need to adapt.

ICS needs to be modernized

Many systems & platforms use heavily outdated technology, we need vendors to build flexible platforms that can last.

Dynamo: Facebook’s Data Center-Wide Power Management System [whitepaper]

OpenCompute Facilities Security Incubator
https://www.opencompute.org/projects/operation-technology-security-incubation

Ask me anything!

Thank you!