Why you should burn down your datacenter

LISA21
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
It’s about controls
Agenda

1. Datacenter 101
2. Smart Infra
3. 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

- MSB1-SB1
- MSB1-SB2
- MSB2-SB1
- MSB2-SB2
- MSB3-SB1
- MSB3-SB2

AHU01
AHU02
AHU03
AHU04
So, how do these controls 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
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
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)
Breaker Trip Prevention

keep the lights on (literally)
Breaker Trip Prevention

keep the lights on (literally)

Breaker trip risk

MSB1-SB1 400kW Limit

dynamo!
control server state!
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

Collector Service

RPP1
192.168.0.11

RPP2
192.168.0.12

RPP3
192.168.0.13

CurrentPhaseA

CurrentPhaseB

CurrentPhaseC

Function Code?
Register?
Datatype?
Byte endian?
Word endian?
Scaling?
Precision?
Data Access

Tiers for every kind of user

Collector Service

RPP1 CurrentPhaseA 118.0A
RPP1 CurrentPhaseB 118.7A
RPP1 CurrentPhaseC 117.3A

Trending / “Big Data”

Infra Control Plane
Chapter 3: Burn it down
ICS Security - tl;dr
ICS Security

It’s worse than you can imagine
Time-to-change
From fastest to slowest

Software

From fastest to slowest:
- Hours/Days
- Years
- Decades

Servers

Building
Network Performance: ping

“The ping of death”

```bash
$ 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

lol my address is...
lol my address is...
lol my address is...
lol my address is...
plz stop
Network Performance: Latency

Turtle vs. the sensor

What's Total Power?

110kw!

Make a cup of tea
Network Performance: TCP connections

One TCP connection is all you need!

Everything is great!

Nooo you can’t just reset my connection!
Data Quality: Internal Caches

I’m all out of that fresh data you wanted

Cached results
Data is wrong
Data Quality: Totally Correct Values

Peak Flux Capacitance

What's Total Power?
100kw!

What's Total Power?
1 jigawatt!

What's Total Power?
110kw!
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!