Hardware Lifecycle at Scale
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Facebook
Agenda

1. Facebook’s Infrastructure Evolution
2. Hardware Lifecycle
3. Learnings
4. Wrap Up
Facebook's Infrastructure Evolution
Facebook’s Scale Today

Each Day:

- Billions of photo and video uploads
- Trillions of user requests
- Tens of trillions of database queries
- 100s of trillions of cache queries

Huge demands on servers, storage, network, and power
Why Build Our Own Hardware?

Advantages

• Faster response to growth demands
• Optimize end-to-end (Application->Power->Thermal)
• Highest Operational Efficiency
• Commodity components

Be Open
The Facebook Datacenter
Infrastructure Evolution

2010
- Hardware Compute

2011
- Hardware Storage
  - PRN

2012
- Hardware Network
  - FRC

2013
- Fabric
  - LLA

2014
- FTW, CLN

2015

2016

Open Compute Project Launch
Hardware Evolution

- **2010**
  - Compute Freedom
  - Rack & Power Freedom triplet

- **2011**
  - Compute Windmill

- **2012**
  - Compute Winterfell

- **2013**
  - Rack & Power Open Rack V1

- **2014**
  - Compute Leopard
  - Storage Honey Badger
  - Network Switch Wedge
  - Storage BluRay

- **2015**
  - Compute Yosemite
  - GPU Big Sur
  - Network Back Pack
  - Storage Lightning

- **2016**
  - Rack & Power Open Rack V2
Facebook Datacenters
Hardware Lifecycle
Infrastructure @ Scale
Mass Production (MP)

New Product Introduction (NPI)

Hack → Design → Build → Deploy → Sustain → Decom
Sustain

Deploy

Build

Design

Hack

SERVER:

NO NUMA

HIGH PERF/W

PERF/RACK

BDW-DE

SHARED NIC

TOR

CPU

CPU

CPU

MH NIC
EVT
Finalize Hardware Design
Build Systems!

DVT
Full Systems Integration
Build Racks!!

PVT
Deployment Ready
Build Cluster(s)!!!

Pilot
Small Scale Deployment
Deploy Faster!!!!
EVT
Finalize Hardware Design
Build Systems!

DVT
Full Systems Integration
Build Racks!!

PVT
MFG & Deployment Ready
Build Cluster(s)!!!

Pilot
Small Scale Deployment
Deploy Faster!!!!
Component Level Manufacturing

Chassis + Rack Level Assembly (in Region)

Data Centers
Yosemite Deployment

SW Load Balancer
1S vs 2S Tuning
Perf Variations
Ensure smooth operation after deployment

Yosemite:
OpenBMC – OOM!
Hack | Design | Build | Deploy | Sustain | Decom

- EOL
- Drain and Migrate Cluster
- Wipe Disks & Crush
- Recycle Racks
- Upgrade Data Hall
- Build Out New Cluster
Learnings
Learnings - Sensors

**Issues:** BMC and PSU monitoring woes

**Learnings:** Improve monitoring of critical sensors.
Learnings – Supply Chain/Application


**Learnings:** Multi-source components, robust app testing @ scale, improve component monitoring.

- **2010**
- **2011**
  - Compute Freedom
  - Rack & Power Freedom triplet
  - Network Switch
- **2012**
  - Compute Windmill
  - Open Rack V1
  - Storage Honey Badger
- **2013**
  - Compute Winterfell
  - Storage Knox
  - Network Switch Wedge
- **2014**
  - Compute Leopard
  - GPU Big Sur
  - Network Six Pack
- **2015**
  - Compute Yosemite
  - Storage Lightning
  - Storage BluRay
Learnings – DC Tooling

Issues: Shipped hardware before all tooling was finished – Idle HW.

Learnings: Make tooling a first-class citizen for phase exit.
Hardware Eventually Fails
Robust Infrastructure

- Monitor
- Alarm
- Design Feedback
- Remediate
Robust Infrastructure

- Monitor
- Alarm
- Design Feedback
- Remediate
Monitoring

Many servers, components, services, and regions
Monitoring

Failure Rate
Monitoring

Error Types
Monitoring

Filters
Alarms
Anomaly Detection

Anomaly Within Cohorts

Gradual Increases And Sudden Spikes
Robust Infrastructure

- Monitor
- Alarm
- Design Feedback
- Remediate
Remediation

The Journey is 1% Finished

- Phase 1: Root Cause Analysis
- Phase 2: Review Remediation Plan
- Phase 3: Implement Remediation

Design Improvements

HDD Slot Temperature vs. Swap Rate

Higher temps. More swaps.
Wrap Up
Key takeaways

• FB scale is growing. Infrastructure needs to innovate
• Move fast and adapt with robust HW lifecycle
• Everything fails – minimize impact with tooling