

200G/400G FR4 Large-Scale Deployment in Meta's Data Centers

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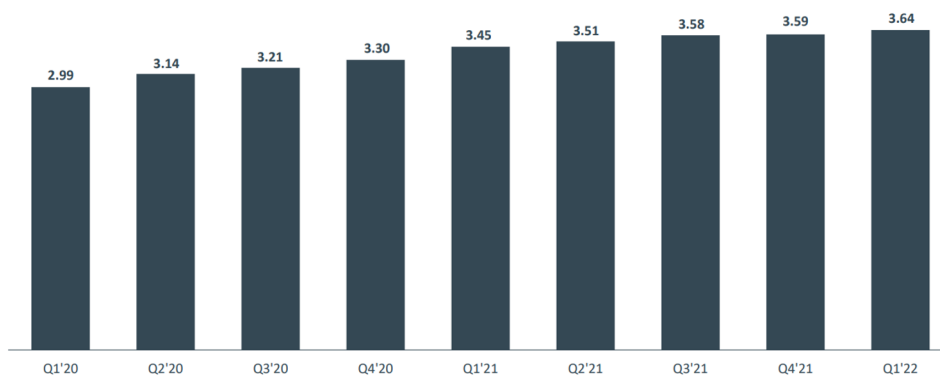
Agenda

- Meta DC Growth/Monthly Active Users (MAU)
- Mass production: 200G/400G FR4 Optics (lessons learned)
- Fleet Tooling & Performance Monitoring @Meta Data Center
- Long-Term Reliability Plan (Pluggable Optics)
- Global Material Crisis & Risk Mitigation Effort
- Future opportunities & Next Gen

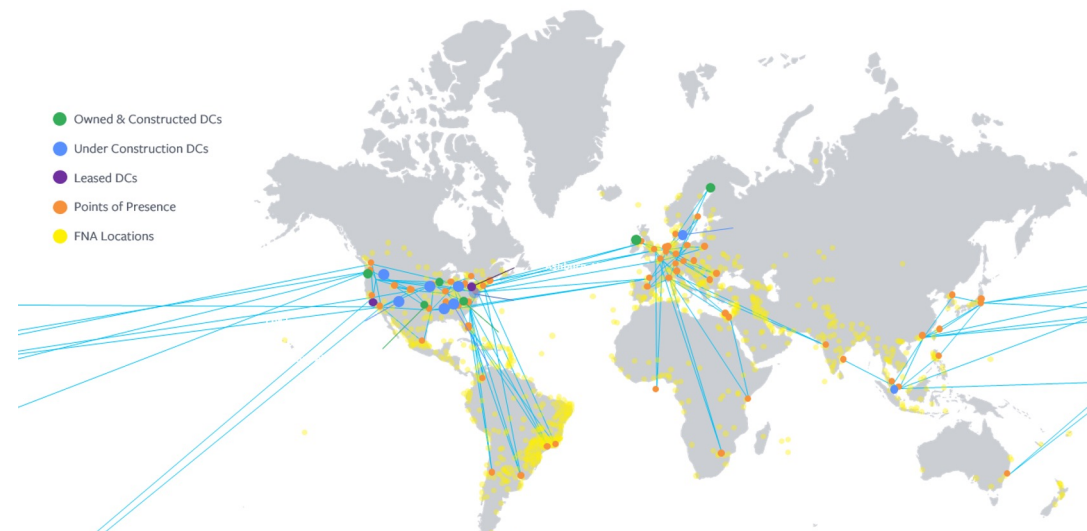
Meta User and DC growth

Family Monthly Active People (MAP)

In Billions

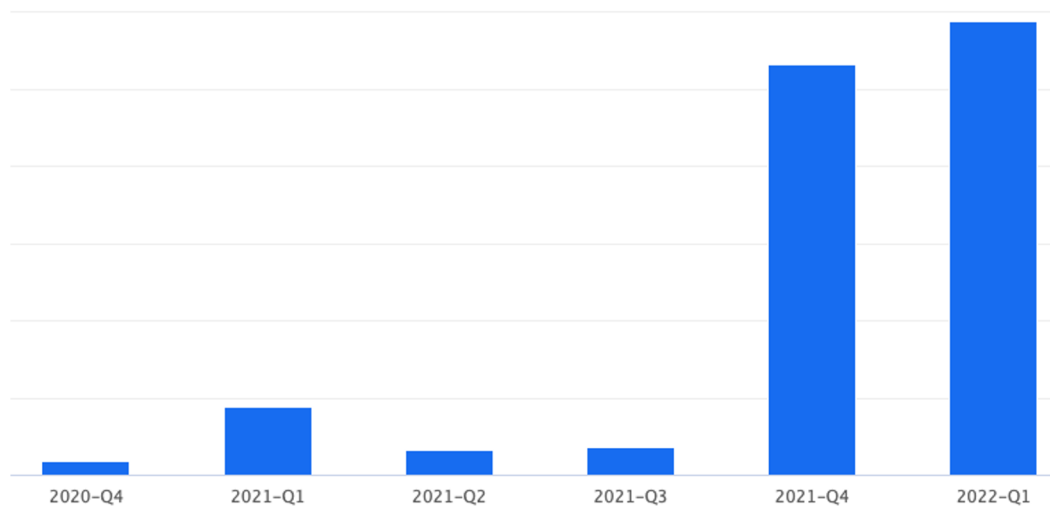


Meta

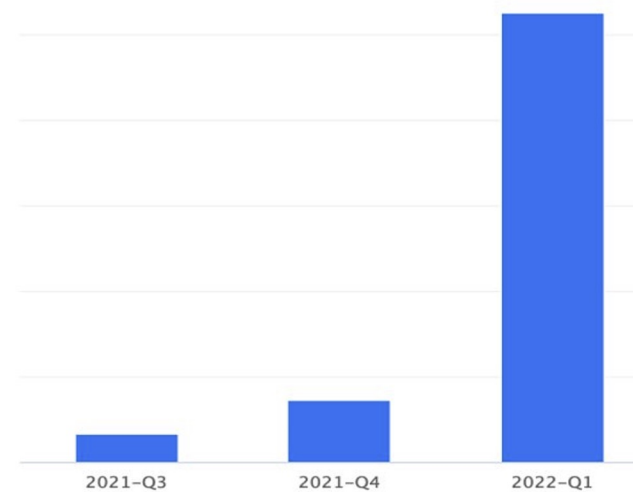


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200G/400G Deployment by Quarter

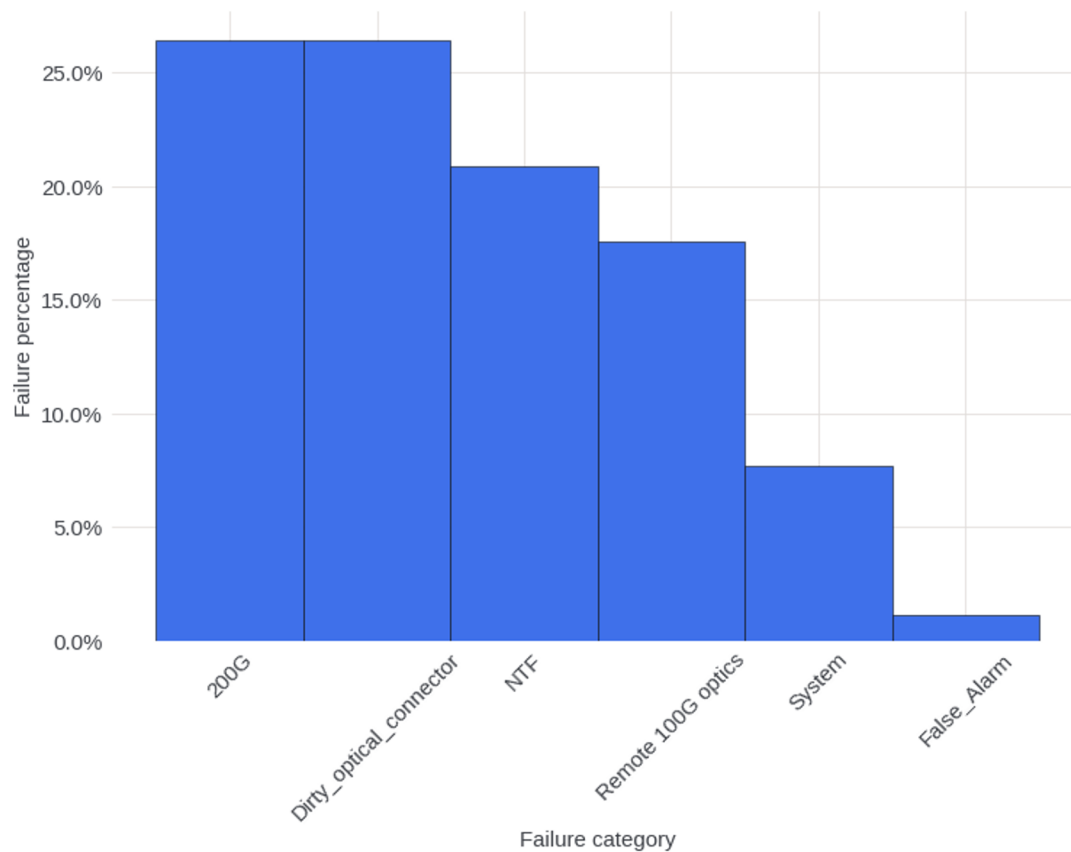


200G FR4 Deployment



400G FR4 Deployment

200G Optics Link Failure Modes



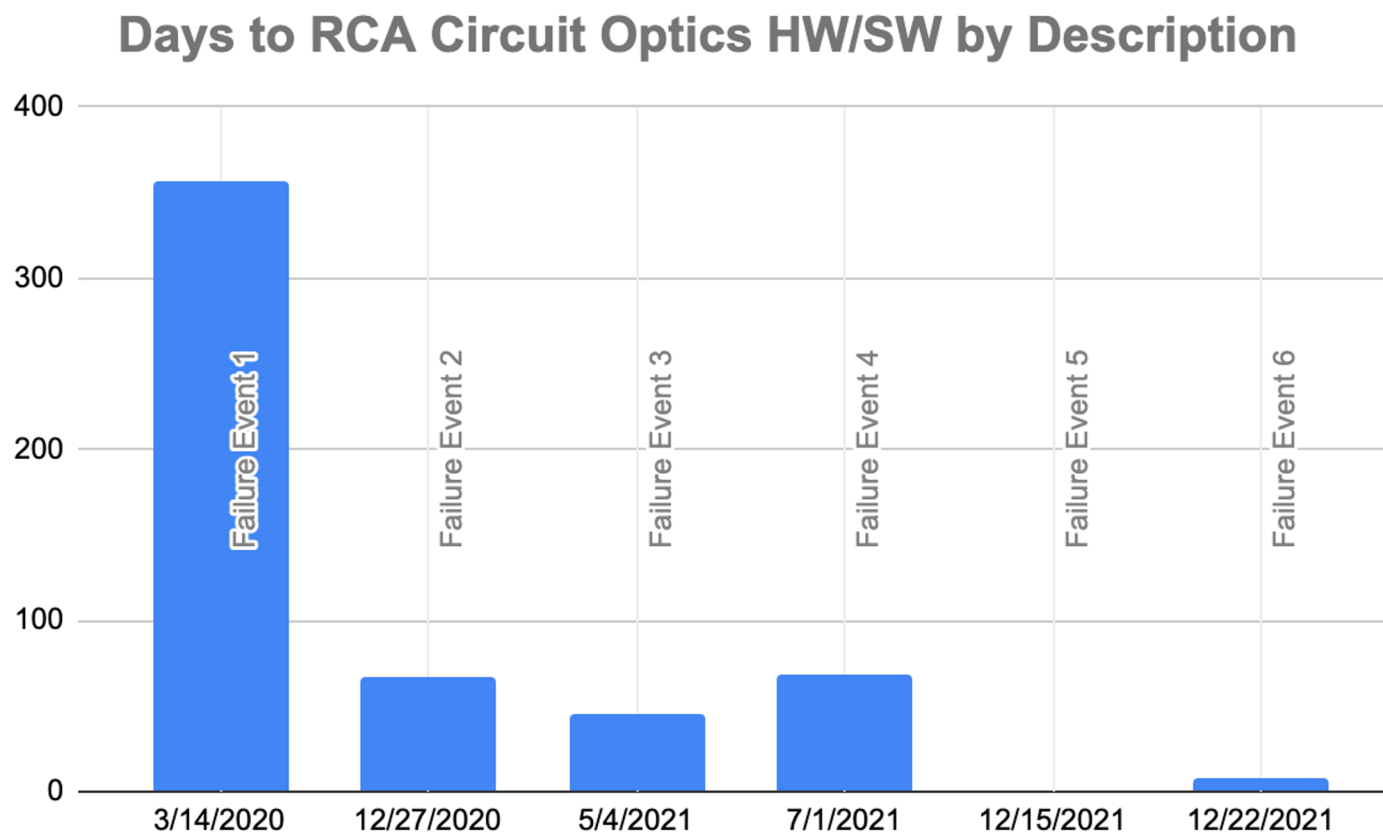
- 26% of the link failures are real 200G optics failures
- 26% of the link failures are caused by dirty fiber connectors
- The 200G optics failure rate is well below our requirement

200G/400G - Lessons Learned



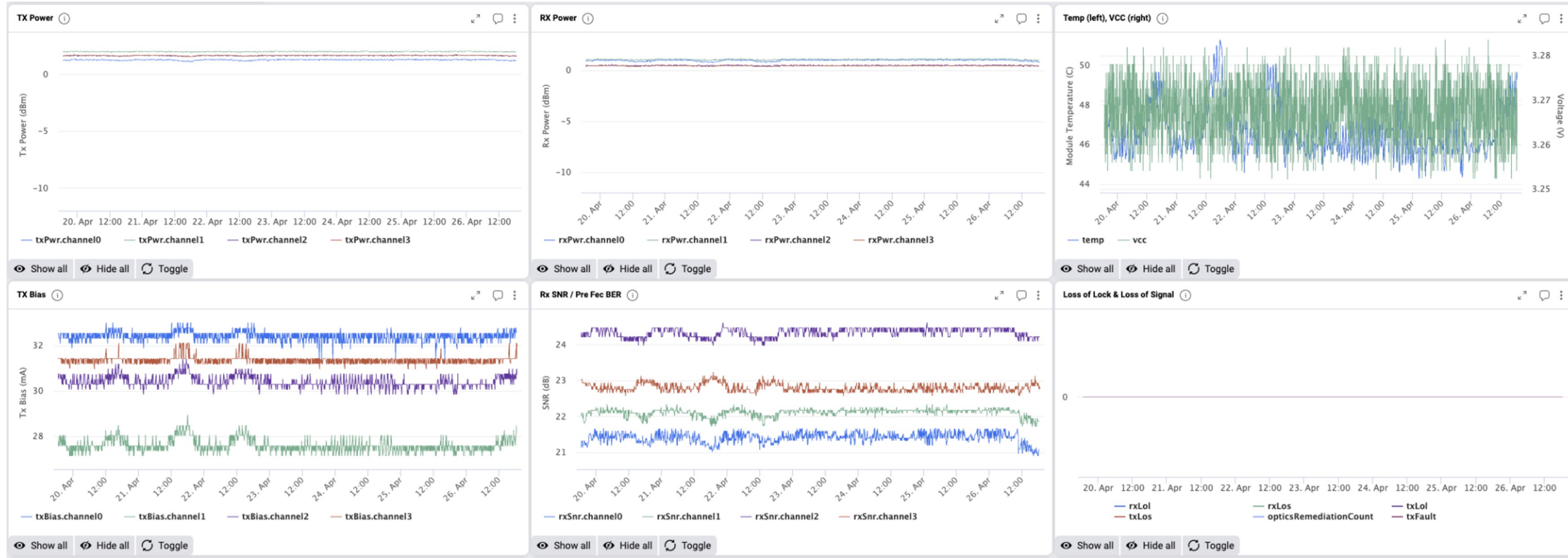
- Solid NPI process helped capture the module failures at early stages – No real module performance issue observed in the operation.
- Detailed PRD and validation for both performance and diagnostic support
- Efficient operational tooling and process provided a timely and accurate triaging of link issues
- Need to improve the internal reliability regression testing capability
- Resilience to the "black swan" events (e.g. Covid-19, natural disasters)
- Need to improve suppliers' MFG site monitoring processes

Efficient RCA with Improved Tooling and Processes



- We have significantly improved RCA process over the last 2 years on optical and non-optical link failure events

Key Module Performance Monitoring in Operation



- The optical DDM information is monitored in operation and used for link triaging
- Operation tooling such as performance dashboards provides various ways of checking the link performance

Tooling and Performance Monitoring: Meta Defined Supplier Mfg. Test Data

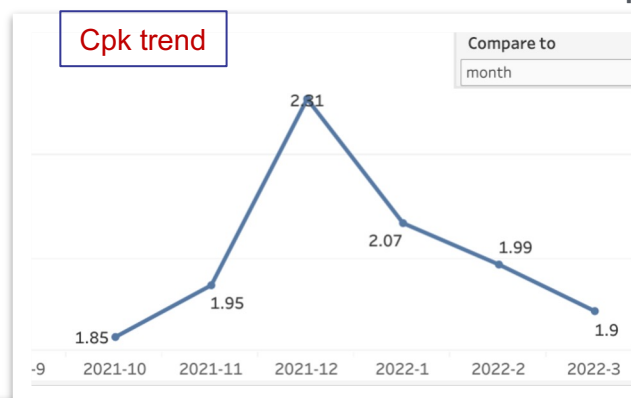
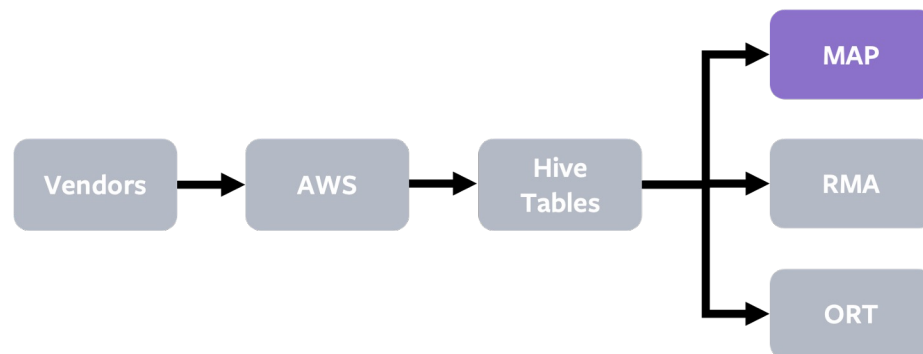
Mfg. Analytic Platform (MAP)

What

- Out of box module test data
- Monitor distribution of parameter with an eye for outliers.

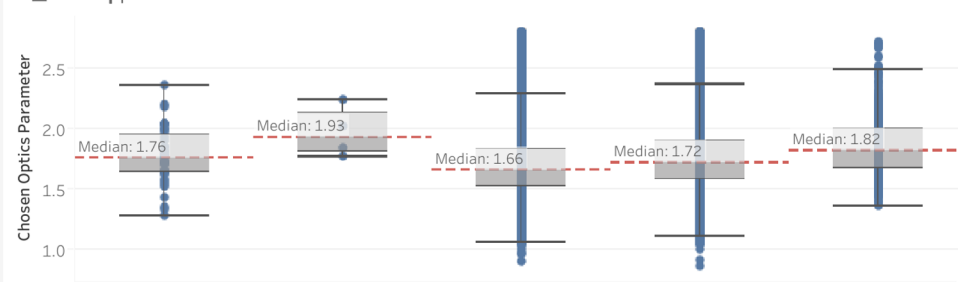
Why

- Cpk (process capability index) trends
- On time delivery
- Data variation, Channel dependence, MPN dependence



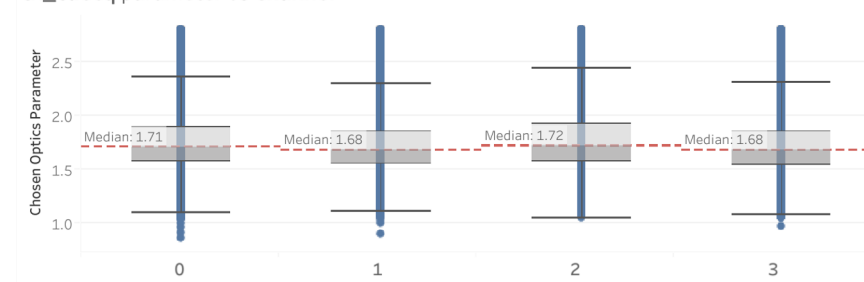
PN dependence

tx_tdecq parameter vs MPN

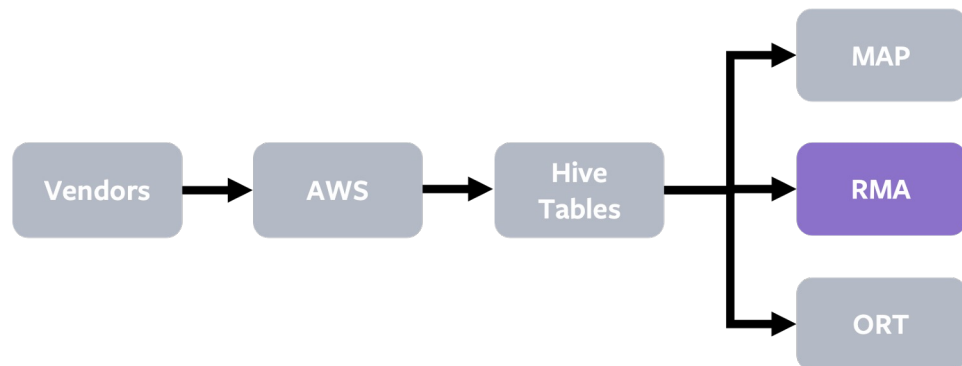


Ch dependence

tx_tdecq parameter vs Channel



Tooling and Performance Monitoring: RMA



RMA

What

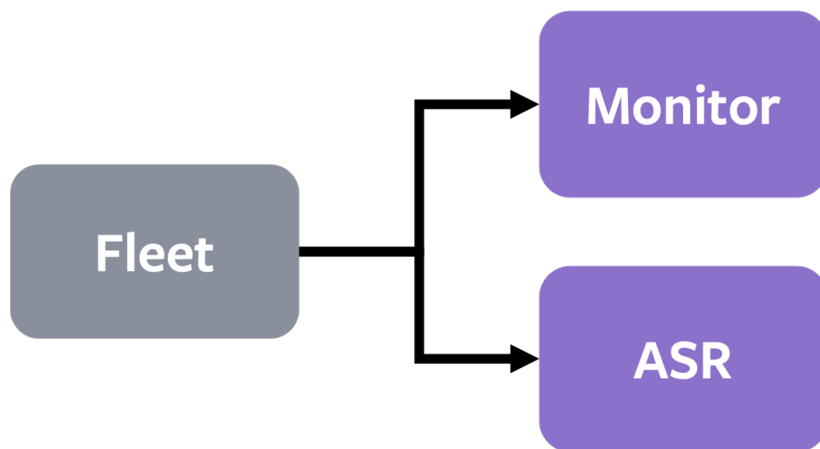
- Track NTF vs Real failures
- DPPM, FIT, Corrective actions

Why

- Main failure mode
- Track RMA TAT
- Effectiveness of CA



Tooling and Performance Monitoring: Meta Data Center



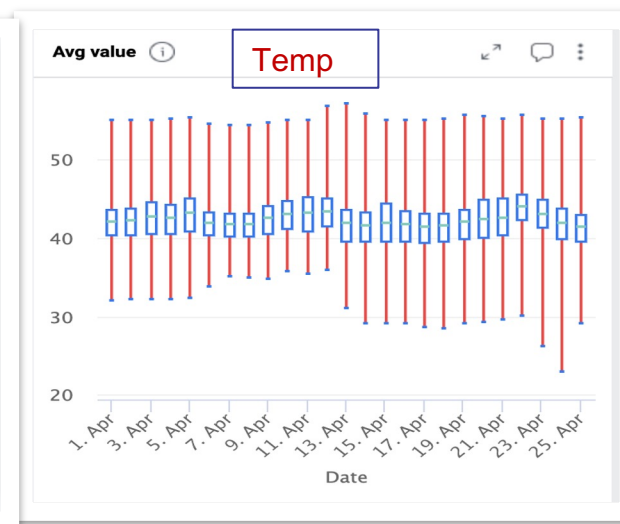
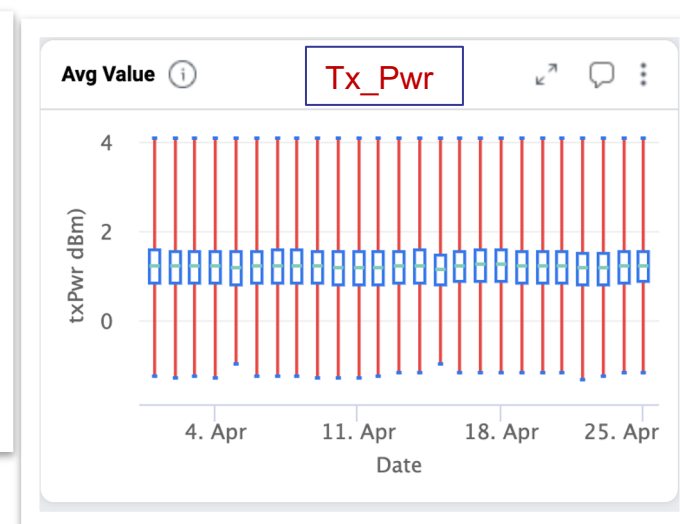
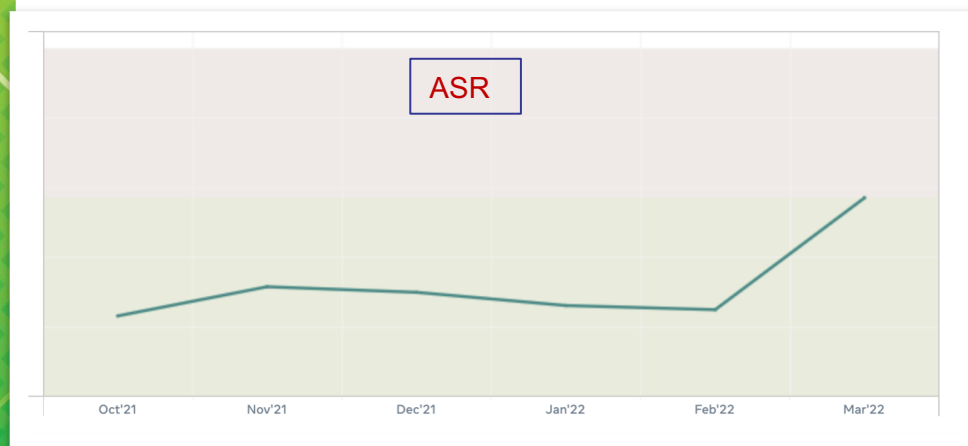
Inline monitor

What

- Module parameter tracking
- Swap rate

Why

- Track fleet health



Tooling and Performance Monitoring: ORT

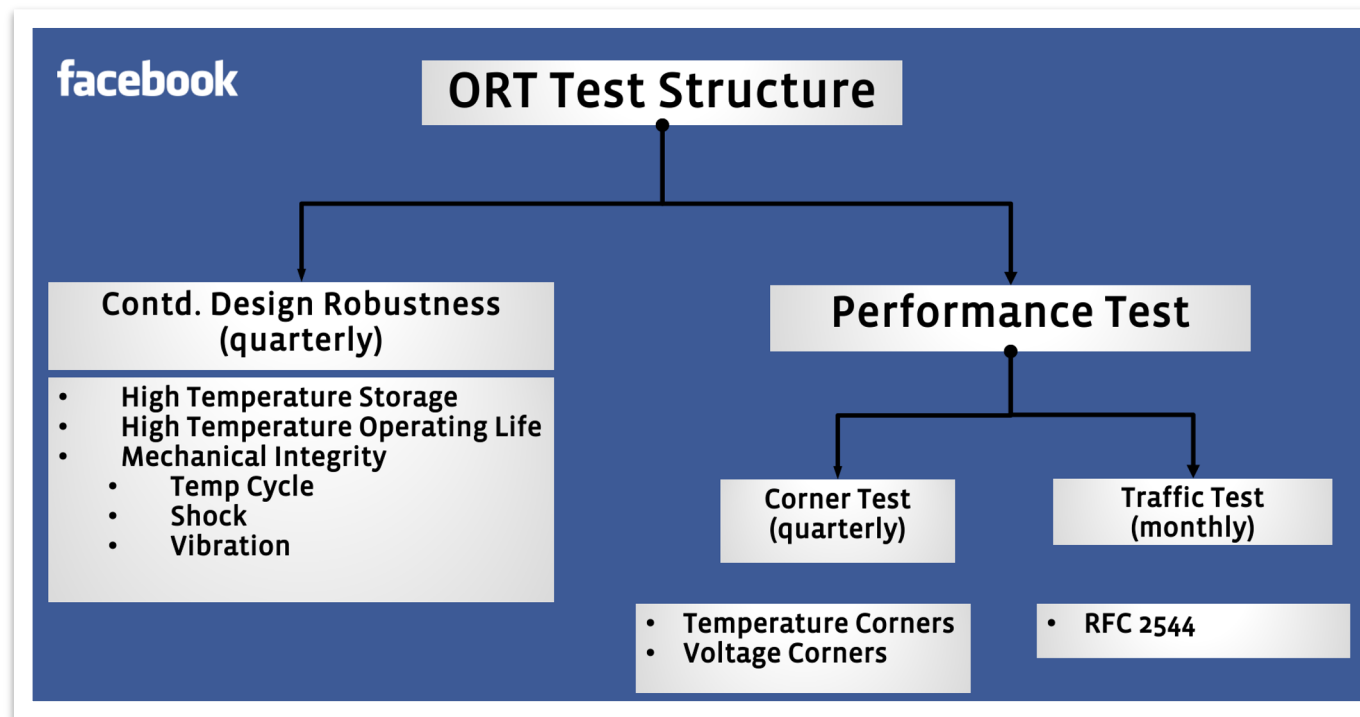
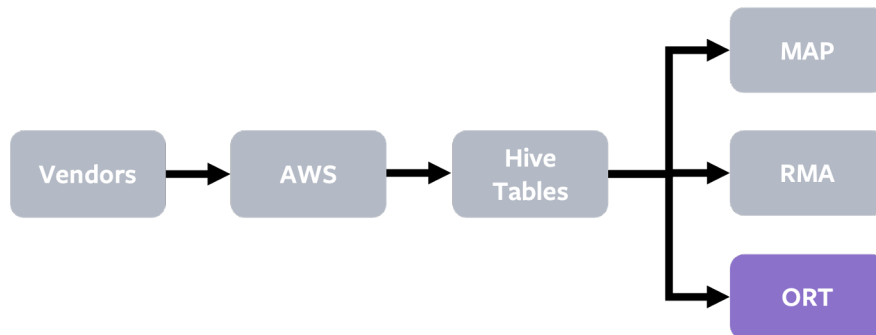
ORT

What

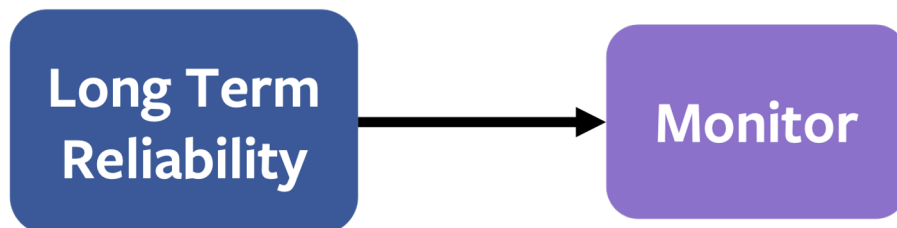
- Design robustness and corner tests
- Performance Test/Traffic

Why

- Track vendor ongoing reliability



Tooling and Performance Monitoring: Reliability



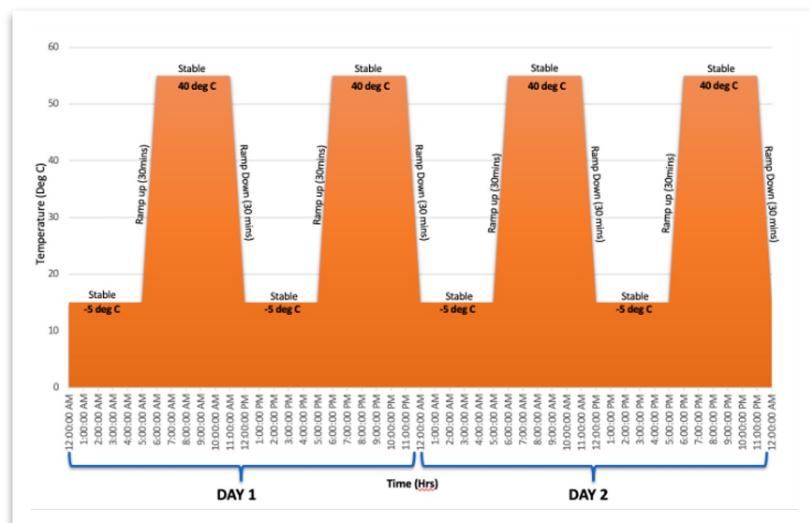
Long Term Reliability

What

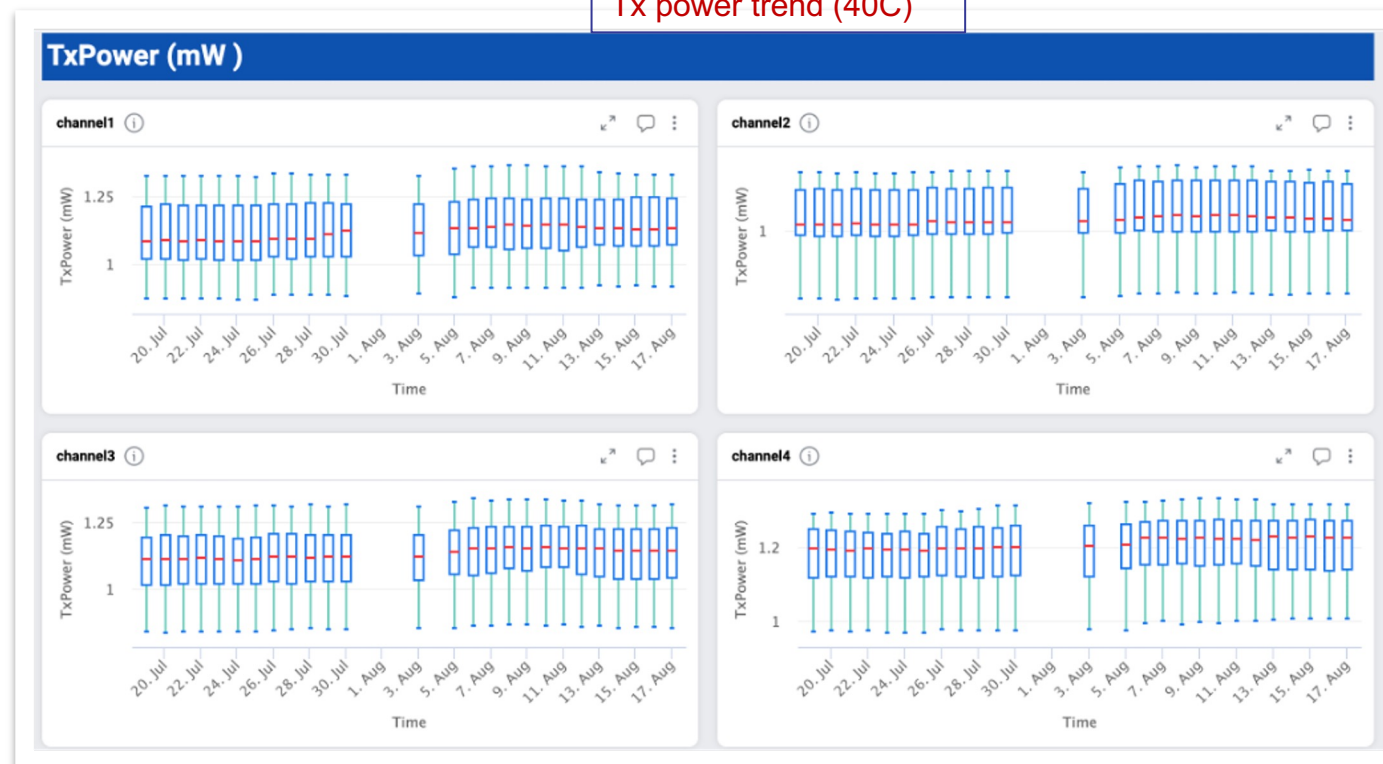
Traffic data in oven with temp cycling

Why

Determine long term reliability



Tx power trend (40C)



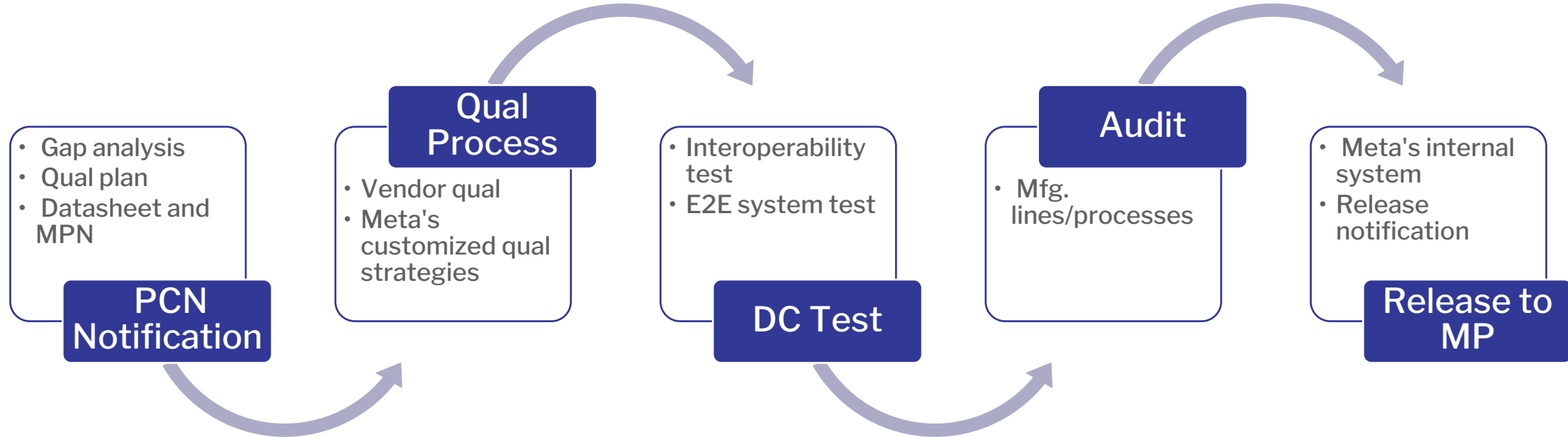
Global Supply Shortage and Mitigation

CONTRACT	TIER1 (FG) Operations	TIER 1 (FG) Quality & Capacity	TIER2 (Sub-components)
<p>Tier 1 (Source) LTA commitments</p> <p>Tier2 (Source) Sub-comp LTA</p>	<p>POs & Commitments (Global Supply Chain) Drive PO coverage and commitment review</p> <p>Ops Standardize & Forecasting (Global Supply Chain) Standardization & ongoing ramp forecasting & commitment process across Tier1 suppliers</p> <p>Deployment Impact (Global Supply Chain, Planning) Determine impact to deployment in case of delays</p>	<p>Mfg. Ramp Enablement (Quality) Mfg. and test capacity ramp analysis, yield improvement, production line throughput and utilization assessment, audits</p> <p>Risk Mitigation (Quality) Quality control process Milestone review</p> <p>Tariff Mitigation (Quality, HW Eng, Source) Qualifying non-COO supplier sites</p> <p>Qual Schedules (Program Mgmt)</p> <p>Early Deployments Monitoring (HW Eng., Quality)</p>	<p>Dual Sourcing (HW Eng, Quality, Source) (1) Drive decision (2) Dual source critical components via ECN/PCN</p> <p>Tier2 Supply Coverage (Global Supply Chain, Source) Open orders, LT, Inventory <u>mgmt</u></p> <p>ECN/PCN Roadmap & Qual Schedule (Program Mgmt, HW Eng, Quality) Develop qualification plan with key milestones</p>

Takeaways:

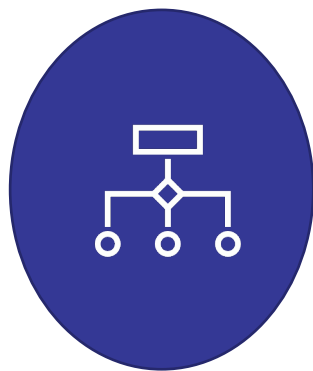
- Cross-functional resources across 4 workstreams required to navigate unprecedented supply shortages
- Multi-sourcing strategy expanded to address key sub-components

Global Material Crisis/Meta's PCN Process



- Unprecedented component shortages, de-commits, and potential impact to deployment
 - ~3X-4X additional PCNs in 2021 & 2022
- Unique PCN test structures to optimize Meta's internal qualification time
- Virtual mfg. line audits to improve production throughput and quality control
- New mfg. site qualification strategies in record time

Future Opportunities



Supply Chain Flexibility

Drive dual-qualification of key components during NPI



Continuous Improvement

Leverage PCN process to drive continuous improvement in process and design

Feature rich diagnostics for optics and switch HW



Diversify Manufacturing Footprint

Collaborate with supplier partners and leverage Meta PCN process to qualify manufacturing in multiple geographies

Connect. Collaborate.
Accelerate.

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