

FUTURE **TECHNOLOGIES SYMPOSIUM**

OCP Global Summit

November 8, 2021 | San Jose, CA

Reliability of cloud scale hardware through performance and health monitoring using on-chip telemetry

Alex Burlak VP Test & Analytics, proteanTecs



proteanTecs Leading a New Category

Deep data health & performance monitoring for advanced electronics



Global Footprint





Challenges in High Performance Resilience



- HW failures and service disruption
- No in-mission monitoring solution
- Expensive redundancies
- Constant replacements

facebook.

"Silent data corruption due to silicon latent defects and aging. (1,000 DPPM!)"



"Frequent unexplained HW failures with "No Issue Found" at high rates"

Google

"Rare, short-term computational errors on systems that passed all manufacturing tests successfully"

🗭 CARIAD

"Current FuSa guidelines do not cover HW/system reliability during the operational lifetime"



"Silent Data Corruptions at Scale"; Harish Dattatraya Dixit Et. Al., Facebook, arxiv.org/abs/2102.11245, Feb. 2021 Cores that Don't Count". Peter H. hochschild Et. Al., Google Research. Jun. 2021 3. "Circuit Reliability Mitigation Techniques & EDA Requirements", Georgios Konstadinidis, Google, EDPS 2019

4. "Improving Cloud Scale Hardware Fault Diagnostics", Neeraj Ladkani, Rama Bhimanadhuni, Microsoft, Mar. 2020 OCP Virtual Summit

 *Automotive semiconductor reliability and its changed importance for complex system engineering, Andreas Aal, Volkswagen, Dr. Oliver Aubel, Globalfoundries, IRPS 2021

Visibility at Every Stage

Common data language



Chip Design

Variability Analysis Production Visibility

Chip Production

Higher Confidence Volume Ramp Outlier Detection Performance Yield

System Production

Performance Optimization Workload Analysis Environmental Monitoring

In-Field

Performance Monitoring Alert on Faults before Failures Predictive Maintenance

Faster Time to Market

10X Lower DPPM

Reduced Costs

Failure Prevention



Multi-Pillar Solution

Deep Data

Universal Chip Telemetry[™] (UCT) with on-chip Agents Machine Learning

Agent fusion and inference with ML algorithms

Analytics

Cloud & Edge

Advanced analytics for actionable insights

Automated insertion tools





Universal Chip Telemetry[™] (UCT)

On-chip Agents

- Parametric measurements
- High coverage & high resolution
- Minimal PPA penalty
- Operate in mission-mode
- Sense the surrounding electronics
- Application optimization to HW





Proteus Targeted Analytics

Chip Production

System Production



In-Field



Estimator Based Outlier Detection

In production

- Personalized chip assessment
- Multi dimensional outlier detection
- Yield reclamation
- Fast RMA with pinpoint Root Cause Analysis



(circled in red: outliers unidentified by BKM)

Additional dimension to identify outliers *within* PAT spec limits (circled in red: outliers identified by proteanTecs)

System Performance Monitoring

In production & In-Field

Bring up & production EOL software optimization and performance tuning

- Agent data recorded throughout multiple phases of system operation
 - Configure
 - Operation Start 1
 - Operation End 1
 - Idle 1
 - Idle 2
 - Operation Start 2
 - Operation End 2
 - Idle 3
 - Idle 4
- Correlation and merging of different Agent measurements
 - Margins of millions of paths
 - IR drop
 - Workload/stress: V*T*Toggle rate
 - Cycle to cycle clock jitter





Health Monitoring with Alerts on Faults Before Failure

- UCT-based continuous performance and health monitoring
 - In mission-mode
 - High coverage critical path monitoring based on millions of internal paths and low margin alert
 - Correlated to system environment and application induced stress
- Workload management for achieving longer product lifetime
- High reliability through personalized Predictive Maintenance



*Based on Physics-of-Failure and Time-to-Failure



High Demand in Multiple Markets

Serving customers in key industry segments

- Datacenters
- Communications
- Automotive
- Al
- Storage

In use and silicon proven



Trusted by industry leaders

- Hyperscalers
- Fortune 100 corporations
- OEMs
- Disruptive startups
- ASIC and IP vendors







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