Embedded Applications– How to Predict Failure Before They Happen for Embedded Applications

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Flash Memory Markets

Segment	Client	Enterprise	Embedded
Highlight 1.	Cost-driven	Sustained	Compatibility
Highlight 2.		Endurance	Reliability

Challenge: Maintain acceptable service-life for embedded systems

Embedded Segment

AUTOMOTIVE
Certification - TS16949 - AEC - Q100
Data Reliability
Wide Temp. + Extend Life Cycle (5-10 years)

FACTORY AUTOMATION
Vibration Resistance - MIL-STD 810G
Consistent performance for overnight operation
Healthcare Tools for early diagnosis

TRANSPORTATION VIDEO SURVEILLANCE
High Density (Write Intensive)
Power Loss Protection
Environmental Reliability (temp , vibration, ESD)

KIOSK/GAMING/ DIGITAL SIGNAGE
Commercial Temperature
Extend Life Cycle (3-5 years)
Specific features like Write Protect

Close Look As Deal With Evolving Technology

- Flash Limited P/E Cycle (SLC, eMLC, MLC etc.)
- Shrinking Flash Process Node (2xnm → 1Xnm → 1Ynm → 1Znm)
- Advantages: Cost, Density, Performance
- **Impact: Reliability, Endurance, Downtime**

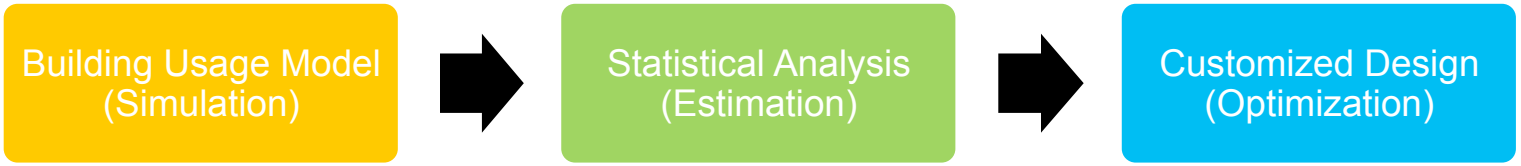
How to create customized fit SSD given flash limitation?

SSD Design Consideration

- Form Factor
- NAND Flash Type
- Fix BOMs
- Power Consumption
- Data Encryption
- Firmware/ Hardware Customization
- **Product Lifespan**

S.E.O. Process Help Tackle The Issue

- SSD life needs to be predicted before worn out
- No real world usage use JEDEC work load
- Variety of behavior result in different SSD lifespan



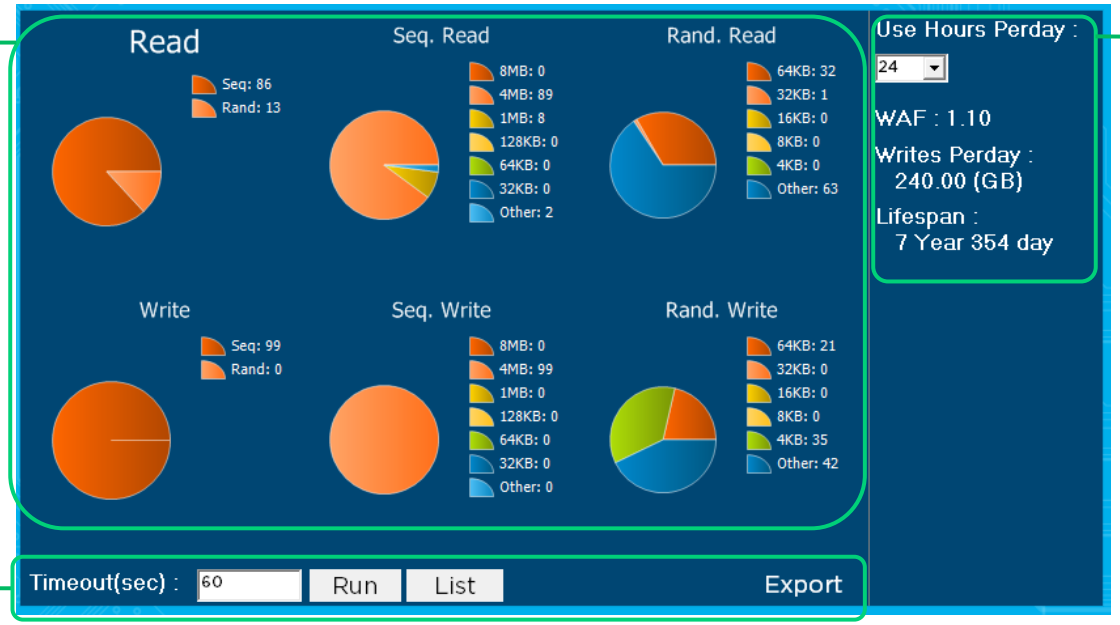
Building Usage Model (Simulation)

- Embedded usage is variant by applications.

  JESD 219 provide a good baseline but not address the majority of embedded application.
- Different usage behavior can impact SSD life cycle
- Build up customized usage model by different application

Statistical Analysis (Estimation)

- DMA Read/ Write #
- Categorizing Transection File Size



Estimation Drive Lifespan

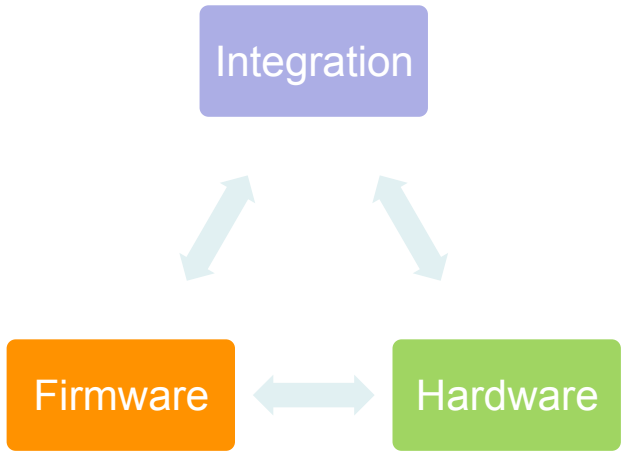
Time Stamp Function

Workload Interpretation

- SMART statistic
- Intensive read ➔ Read disturb management
- Heavy write 24/7 ➔ Flash selection, page mode FW, pFail
- Sustained random write ➔ Big DRAM required
- Sustained sequential write ➔ Vaulting application, GC optimization

Customized Design (Optimization)

- FW level: Page mode FTL, Background media scan scheme, GC etc.
- HW level: Flash selection, DRAM buffer size, PLP circuitry etc.
- Product Integration: Reliability, compliance, compatibility test etc.



Take-Aways

- Embedded storage is heavily customized-demanding market
- The traditional rule of thumb still intact- Keeping flexibility, responsive, adaptive
- S.E.O. is a systematic way to predict/ ensure drive endurance
- Modeling usage case can effectively simulate drive lifespan
- Phison embedded toolbox help partner for improving serviceability!

For more information on Phison SSD Controllers, please visit us at

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Thank You!