Solid State Solutions for IoT Applications

Value-add SSD Technologies Overcome Embedded/Industrial Design Challenges

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Agenda

- The Internet of Things (IoT)
- Common IoT Issues/Challenges
- The Essence of “Value”
- (Value-add) Solid State Storage for IoT
- Summary

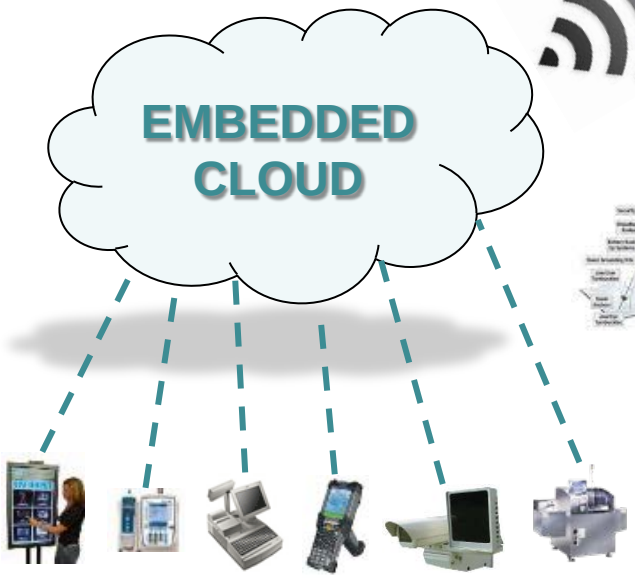
The Internet of Things (IoT)

- Billions of “intelligent” devices deployed into global infrastructure by end of the decade
- Key challenges:
  - Compute footprint and power reqs will shrink
  - Ruggedness, reliability and endurance will rise
- Application-specific SSD solutions required to address challenges

Size Weight Power/Heat ↓	Ruggedness Reliability Endurance ↑

Infrastructure: *"Feeding the Cloud"*

Acquisition ➔ "Big Data" Analytics



Kiosk, Signage, Medical, POS, Terminal, Security, Energy, Automation, Transportation

Base Station

VPN

Firewall

Router/Switch

Datacenter Monitor

Server (backup module)

Storage Appliance (boot)

INFRASTRUCTURE

IoT Storage Requirements

	Client	Enterprise	Data Center	**IoT** (Infrastructure)
Application	OS and user data	persistent back-end for DRAM or high perf. cache for tiered storage	OS and user data, dedicated server	OS and system data; single-source user data
Market driver	**Read IOPS** for instant-on, better user experience	R/W IOPS and low latency for **100's or 1000's of VM users**	Build-your-own boxes (Google/Amazon, etc.)	Ruggedness, reliability, limited re-qualification
Main Interfaces	**eMMC** for tablets/phones **SATA 6G → PCIe**	**SAS, PCIe x8 or x16**, mixed workloads	SATA 6G → PCIe	SATA 3G, 6G; USB 2.0, PATA/CF; PCIe just starting
Capacity	**128 GB to 1TB**	**200GB to 1.6TB**	**120GB to 1TB**	**128MB to 512GB**
Form factors	2.5", mSATA → M.2, BGA	2.5", PCIe card, rack appliances	2.5" 7mm, mSATA → M.2	All SATA, 10-pin eUSB, CF, SD
Endurance	< 20GB/day	5-10 full drive writes per day	3 full drive writes per day	Read only to 300GB per day
Years of operation	**2-3 years**, 8 hours/day	**5 years**, 24 hours/day	**3 years**, 24 hours/day	**10 years**, 24 hours/day
Operating temperature	0° to 70° C	0° to 60° C	0° to 70° C	0° to 70° C **-40° to 85° C**

Common IoT Issues/Challenges

Issue / Challenge	"Standard" SSDs	"Infrastructure" SSDs
Systems getting smaller	2.5" SSD larger than some systems	60%+ smaller than 2.5" SSD
Low power/heat reqs (green, no fans)	Typically 3+ watts (perf over power)	Typically under 2W (balance perf/power)
Extreme temps, humidity, shock/vib	Temps 0C/60C, controlled environment	Designed/tested to -40C/85C, ruggedized
24x7 uptime with some power loss	Designed for "graceful" shutdown	Built-in power-fail protection
5+ year uninterrupted performance	1-2 year warranty, 1M hour MTBF	3-5 year warranty, 2M+ hour MTBF
<64GB capacities with low budgets	100GB+ min capacity (overkill)	8GB – 512GB for high/low capacity needs
Parts available thru application life	1-2 year product lifecycle	5+ year product lifecycle

Common Design Concerns

GOAL: SOLVE PROBLEMS AND ALLEVIATE CONCERNS

The Essence of Value

VALUE

- relative worth, ***utility***, or importance

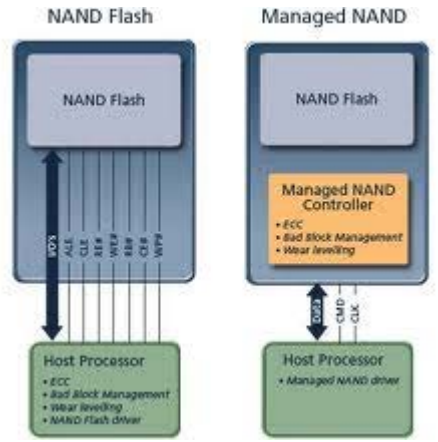
VALUE ADDED

- of, relating to, or being a product whose ***value has been increased*** especially by special manufacturing, marketing, or processing

General Value-Add Examples

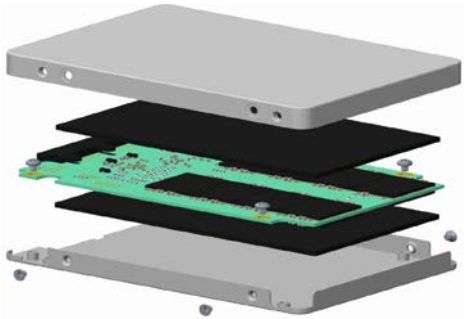
Managed NAND

- Most basic
- Controller manages basic host I/O and NAND flash function



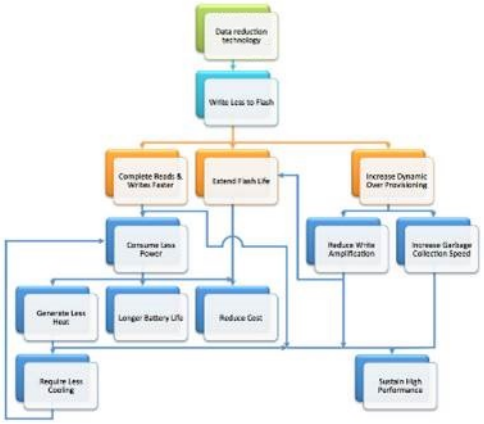
Hardware Features

- Design mods for form-factor, power, security, reliability, environmental, etc.



Software Features

- Firmware mods for endurance, data integrity, performance, compatibility, etc.



Specific Value-Add Technology

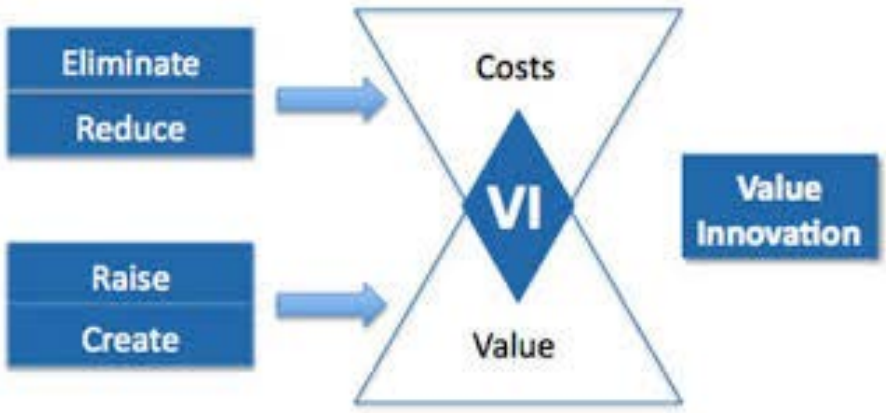
Feature	Benefit
Small Designs	Less than half the size of 2.5” SSD/HDD for space-constrained apps
Low Power/Heat	Under 2W for “green” and/or sealed, fan-less systems
Ruggedized	Tolerant to -40C to 85C temps, high humidity, mil-grade shock/vib, etc.
High Reliability	Built-in power-fail protection to protect against unexpected power-loss
Long Endurance	Flash management to extend NAND well beyond mfg stated P/E cycles
Performance	Performance optimized/tuned to host application workload
Workload Monitoring	Provide insight into host data workloads for system/application tuning
Reporting	Real-time health and lifespan monitoring to reduce potential downtime
Security	Built-in levels of data security for select applications
Availability	5+ year product availability for long-term application deployments

CONCEPT: “Value Innovation”

GOAL: increase value while reducing cost

HOW: focus on solving problems, not just tech

- Cost savings achieved by eliminating or reducing traditional spec-based factors
- Value increased by raising or creating new factors that solve problems and increase utility



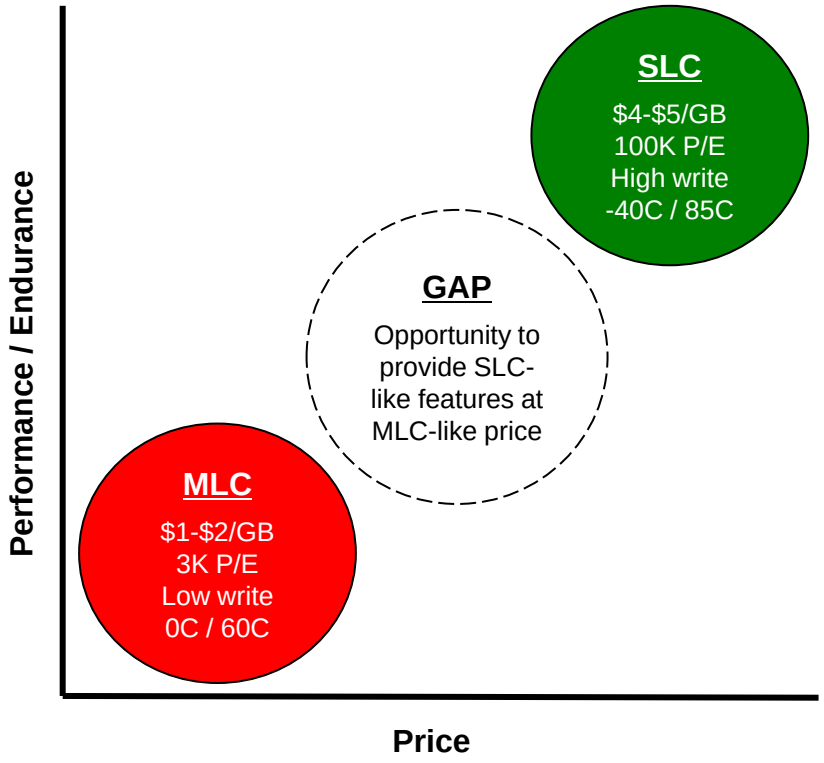
Value Innovation Example

Issue / Problem

- SLC endurance/temp good but $$$ too high
- MLC endurance/temp not sufficient

Value Innovation

- Offer SLC-like features at MLC-like price



Summary

- IoT is a huge and fast-growing opportunity….but presents challenges
- Standard “off-the-shelf” SSD technology not good enough

Deliver value-add features that solve real-world customer problems, while reducing cost