Adventures in Form Factors

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Too Many Form Factors Causing Market Confusion:

Notable problems with 22110 M.2s in the data center:
  - Power/ Thermal Does Not Scale
    - Unable to activate all dies (TLC, QLC, SCM) thus performance limited by power
  - No standard thermal solution
  - Poor serviceability
    - No hot plug support and no case for EMI/ ESD
  - Requires resource-intensive materials choices that don’t “add value”
    - Exotic PCB materials, high density polytantium capacitors, high Die NAND stacks, etc...
➢ 2018 Form Factor Conclusion
- None of the Industry form factors scale with power/thermal and meet compute/ storage needs
- Industry divergence/chaos will continue if market needs are not addressed
Hyperscale – Storage Form Factor Criteria

➢ Power and Thermal
  ▪ Power and Thermals need to scale
  ▪ Low airflow to cool: Fans are resource-intensive
  ▪ Full performance without power or thermal throttling
    • Scales for TLC, QLC and SCM

➢ Servicablity
  ▪ Needs to be easily servicable

➢ Standardization
  ▪ Needs to be standard

➢ Operationally efficient
2019 E1.S Industry Form Factor Convergence Path

Take E1.S PCB (no changes) add the following options:

- Case
- Case with Heat Sink Option

Allows E1.S with same PCB to support:

- Bare PCB
- Heat Spreader
- Case
- Case with Heat Sink

Power/Thermal Scale
Hot Plug Support
Case for improved EMI and ESD
Work for both storage and compute in 1U
Support 8 and 16 channel NAND controllers
Supports a large variety of PCIe applications:
  - Storage (NAND, Storage Class Memory), Computational Storage, Accellerators, etc...
Support for Gen 4 and Gen 5 PCIe
Fully standardized in SNIA/ SFF: SFF-TA-1006 Revision 1.2
2019: Industry Form Factor – Power/Thermal Landscape

2019 Form Factor Conclusion
- E1.S 25W Asymmetrical Case Significantly Improves LFM
- Promising for:
  - Storage Devices
  - Front and Rear of compute box placement
  - Generic PCI Devices

- ASIC placed next to connector
- Power concentrated in ASIC
- $T_{case} = 85^\circ C$
- Inlet Air = 35°C

- E1.S 25W with heat sink can support:
  - Up to 15W ASIC/FPGA with common heatsink solution
  - Up to 18.5W ASIC/FPGA with advanced heatsink solution

Note:
- ASIC placed next to connector
- Power concentrated in ASIC
- $T_{case} = 85^\circ C$
- Inlet Air = 35°C

Graph showing ASIC Power (W) vs. Velocity (LFM) with Common Heatsink: Al Extruded and Advanced Heatsink: Vapor Chamber regions.
### Power/ Thermal Scales
- Performance and Thermal
- Able to activate all dies (TLC, QLC, SCM) for full performance

### Standard thermal solution
- Scales for both front and back of the box solutions

### Serviceability
- Support hot plug
- Case for EMI/ ESD

### Resource Use
- Optimized for mainstream

### Dense
- Fits in dense 1U storage and server applications

**E1.S: Form Factor For The Future**

**E1.S: Scaling For The Next Generation Of Storage**