Adventures in Form Factors

Ross Stenfort
Hardware System Engineer, Facebook

2018: Industry Form Factor Status Report

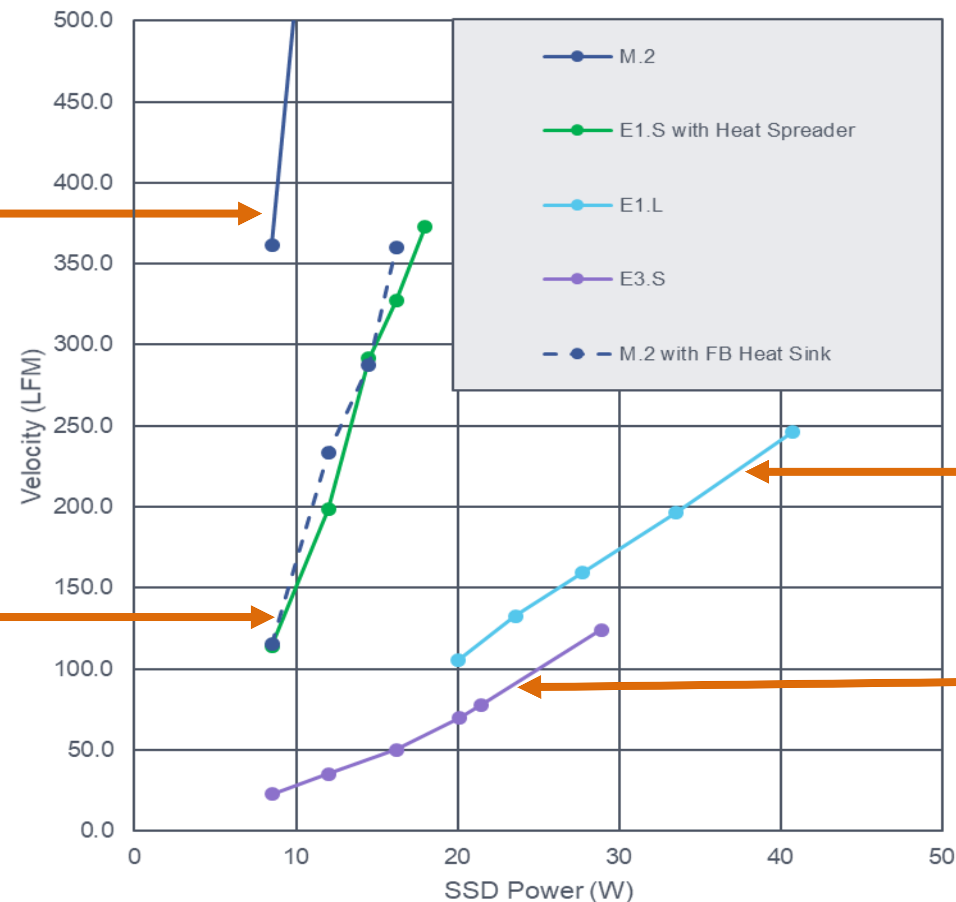
- Too Many Form Factors Causing Market Confusion:
  - M.2, U.2, U.3, E1.S, E1.L, E3.S, E3.L, NF1, etc...

- 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 serviceablity
    - 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: Industry Form Factor – Power/ Thermal Landscape

Standard M.2

M.2 with FB heat sink and E1.S with heat spreader is almost identical



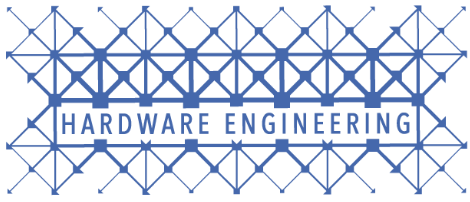
Too large if there is a processor in storage/ compute box

2U tall which does not scale across the data center echo system due to 1U is the standard building block which things are built from

- 2018 Form Factor Conclusion
  - None of the Industry form factors scale with power/themal 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

Improvement

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

- Case
- Case with Heat Sink Option

Benefits

Allows E1.S with same PCB to support:

- Bare PCB
- Heat Speader
- 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

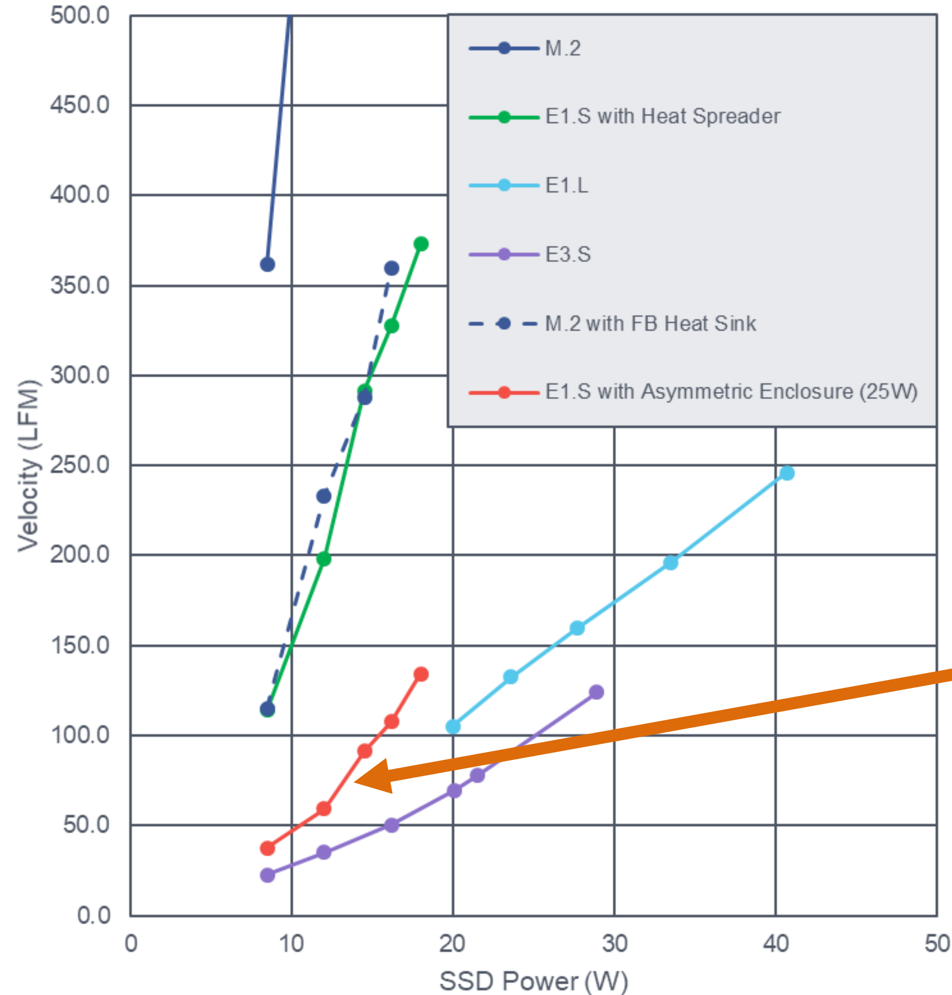
Supports a large variety of PCIe applications:

- Storage (NAND, Storage Class Memory), Computational Storage, Accellerators, etc...

Support for Gen 4 and Gen 5 PCIe

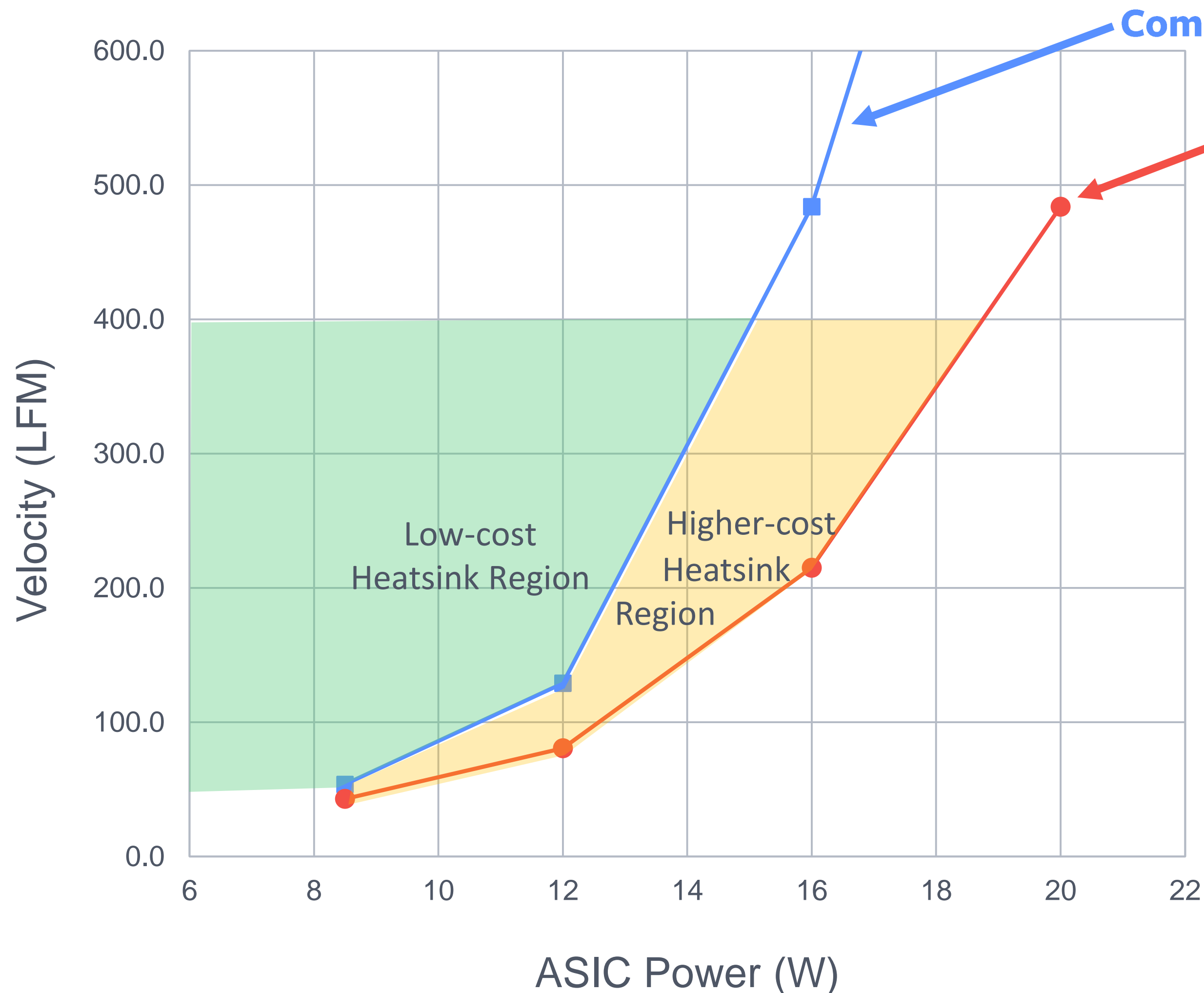
Fully standardized in SNIA/ SFF: SFF-TA-1006 Revison 1.2

2019: Industry Form Factor – Power/ Thermal Landscape



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

E1.S 25W Thermal Curve: High Power ASIC/FPGA Application



Common Heatsink: Al Extruded

Advanced Heatsink: Vapor Chamber

- 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
- Tcase = 85C
- Inlet Air = 35C

E1.S: Form Factor For The Future

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

Serviceablity

- Support hot plug
- Case for EMI/ ESD

Resource Use

- Optimized for mainstream

Dense

- Fits in dense 1U storage and server applications

E1.S: Scaling For The Next Generation Of Storage