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Introduction to EDSFF

*Delivering the Building Blocks for the Next Decade of **E**nterprise & **D**atacenter **S**torage **F**orm **F**actors*

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The Challenge

- Dynamic time for NVM in the modern Datacenter
  - Flash proliferation in compute and storage (JBOD -> JBOF)
  - PCIe – Transitioning from Gen3 to Gen4. Gen5 coming!
  - New storage technologies are challenging NAND
- Existing form factors are constrained
  - Rotating media form factors constrain density and cooling
  - Lack of hot plug support constrains serviceability
  - Divergence of FFs constrains system design flexibility

Existing form factors are a limited fit in today's Datacenter

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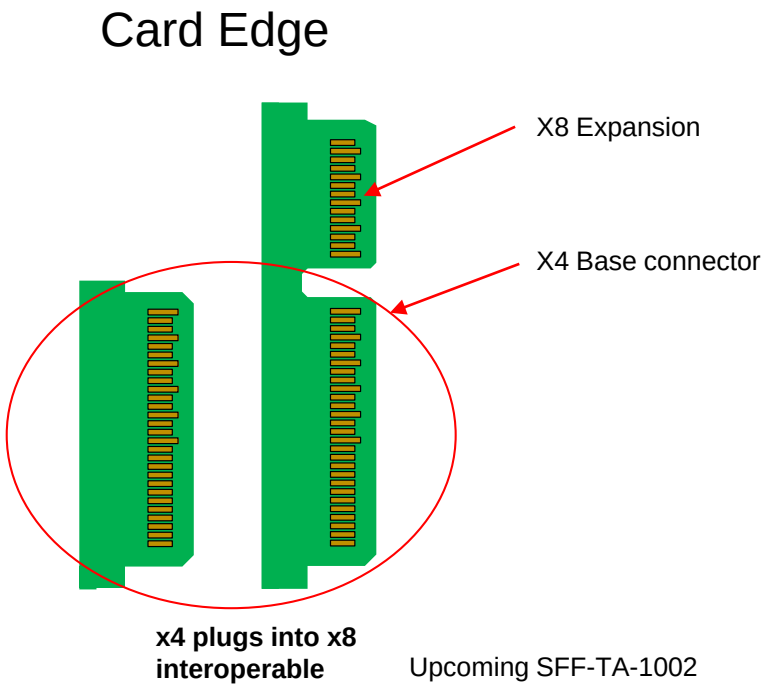
Flexible Building Blocks fit for Scalable Solutions

- The Enterprise & Datacenter SSD Form Factor Workgroup formed by industry leaders
- Common connector and pinout with a family of form factors optimized for Datacenter
- Flexibility & scalability paramount as tomorrow's workloads are ***unknown***
- Sandbox for innovation

Invest for the next decade with building blocks for today's NAND-based SSDs and next gen NVM technologies.

The Common EDSFF Connector

- One Flexible Connector Solution with headroom for the future
  - Gen3 / Gen4 / Gen5 (and beyond)
  - x4, x8, expandable to x16
  - 12V (50W+)
- Common with other standards
  - Reduce unique endpoints
  - Fewer stranded lanes
- Specification publicly available in SFF
- EDSFF shared pinout developed for NVMe drives



Design your system with flexibility – storage and beyond

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EDSFF SSD Key Characteristics

Attribute	Capability
Connector Type	Card Edge – Leveraged across the industry
NVM support	8 to 64+ NVM sites (NAND & emerging NVM)
Hot Plug	Full support, front or back
Orientation	1U or 2U as vertical or horizontal
PCIe Support	Gen 3/4/5 up to 16 lanes
Power	12V, Up to 50W+

Flexibility for today's and future storage devices.

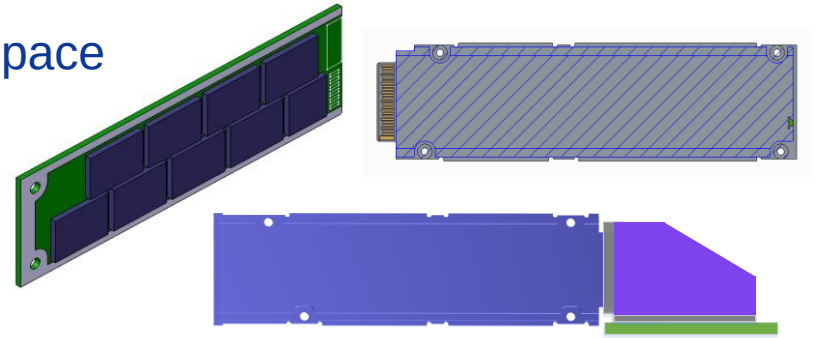
EDSFF SSD Key Goals

- Datacenter system-optimized design
  - Fits in common datacenter system chassis: 1U, 2U, etc.
  - Cost benefit to system designs with 12V only for main power
- Meets common customer needs for storage devices
  - Drive is easily accessible to the user
  - Supports Hot-plug insertion and removal
- Cost-optimized card edge drive interconnect
- High density, capacity and performance options
  - Family of form factors to meet key use cases
  - Compatible connector options to support x4 and x8 NVMe drives

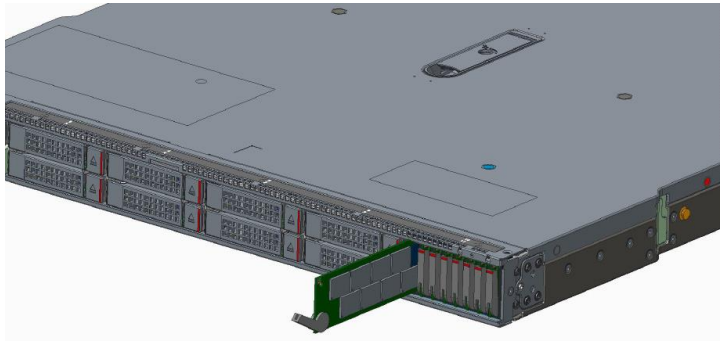
Common capabilities across family of SSD form factors

FF Concept Optimized for Servers

Lenovo Research Prototype Concept



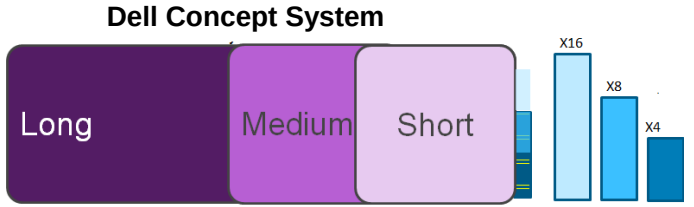
- System-optimized NVMe drives for 1U rack space
  - Vertical fit in 1U: existing system height
  - Fits in depth of traditional 2.5” HDD
  - Common single building block drive across systems (1U, 2U, 4U, etc.)
- Key Benefits:
  - 2-4x drive density increase (16+ in ½ wide 1U)
  - Significantly improved system cooling for TCO
  - Low cost storage scaling (Low-Power NVMe)
  - Enables small servers with full feature set
  - Lower base system infrastructure cost



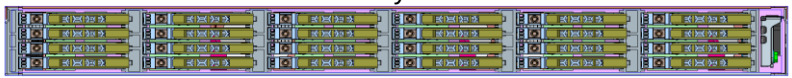
Optimized for scale-out main storage in servers

FF Concept Optimized for Enterprise

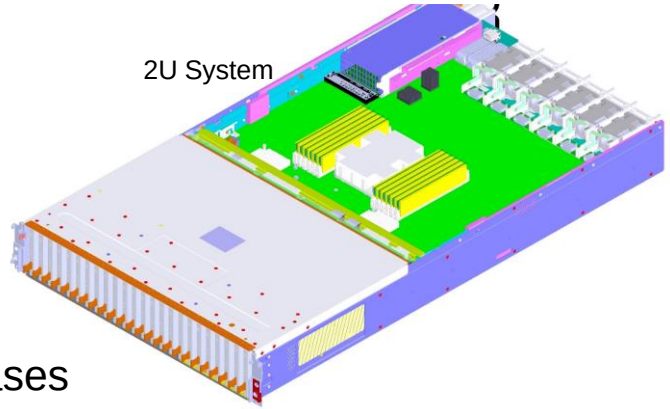
- System-optimized SSDs for 1U/2U designs
  - Horizontal fit in 1U – matches 2.5” quantity in 2U
  - Vertical fit in 2U – more density w/ lower cooling needs
  - Up to 3 lengths satisfying server/storage uses
  - Height optimized for ½ or ⅓ width servers



1U System



2U System



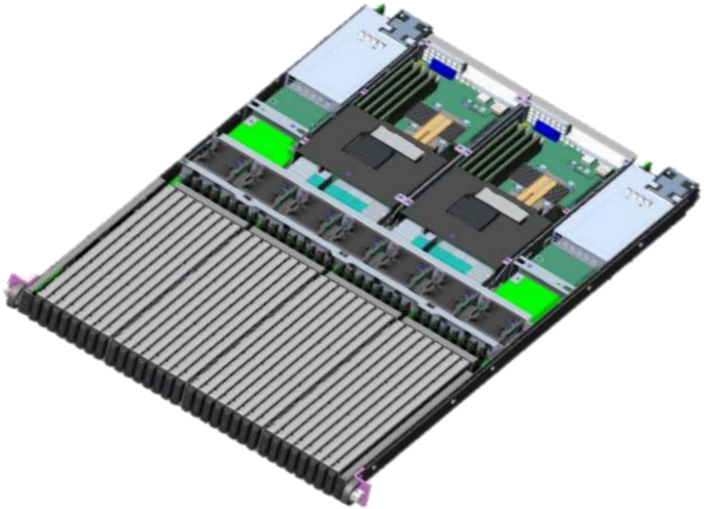
- Key Benefits:
  - Balanced capacity/density increase
  - Improved cooling for lower TAM better acoustics
  - Balanced height to length for future SSD designs
  - Larger FF for performance/x16/SCM next gen use cases

Modernize today’s mainstream server for fast NVM

FF Concept Optimized for Storage

- System-optimized for 1U server
  - Vertical 1U support, Scalable to 2U
  - 48+ NVM sites
- Key Benefits:
  - Optimal density, High Capacity
  - Higher performance
  - Optimal cooling
  - Hot Plug Support
  - Scalable Capacity

Intel JBOF Concept System



Enable the ultimate NVM density in 1U. 1PB in 1U and more

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Summary

- Optimize NVM for Datacenter building blocks
  - Capacity, Cooling, Cost
  - Promote common ecosystem across the industry
  - Enable innovation through upcoming technology disruptions
  - Optimized solution *for that system* including cost, airflow, and capacity
- The EDSFF connector specification draft is now available in the SFF organization for broader industry review.
- New EDSFF specification drafts of SSD pinout and form factors will be created and submitted for industry standardization in 4Q17 timeframe.
- To provide usage model feedback, please send to: feedback@edsffspec.org

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