Best Design Practices for Power Optimization in PCIe Gen5 EDSFF SSD

York Chen
Product Manager
Silicon Motion Technology Corp.

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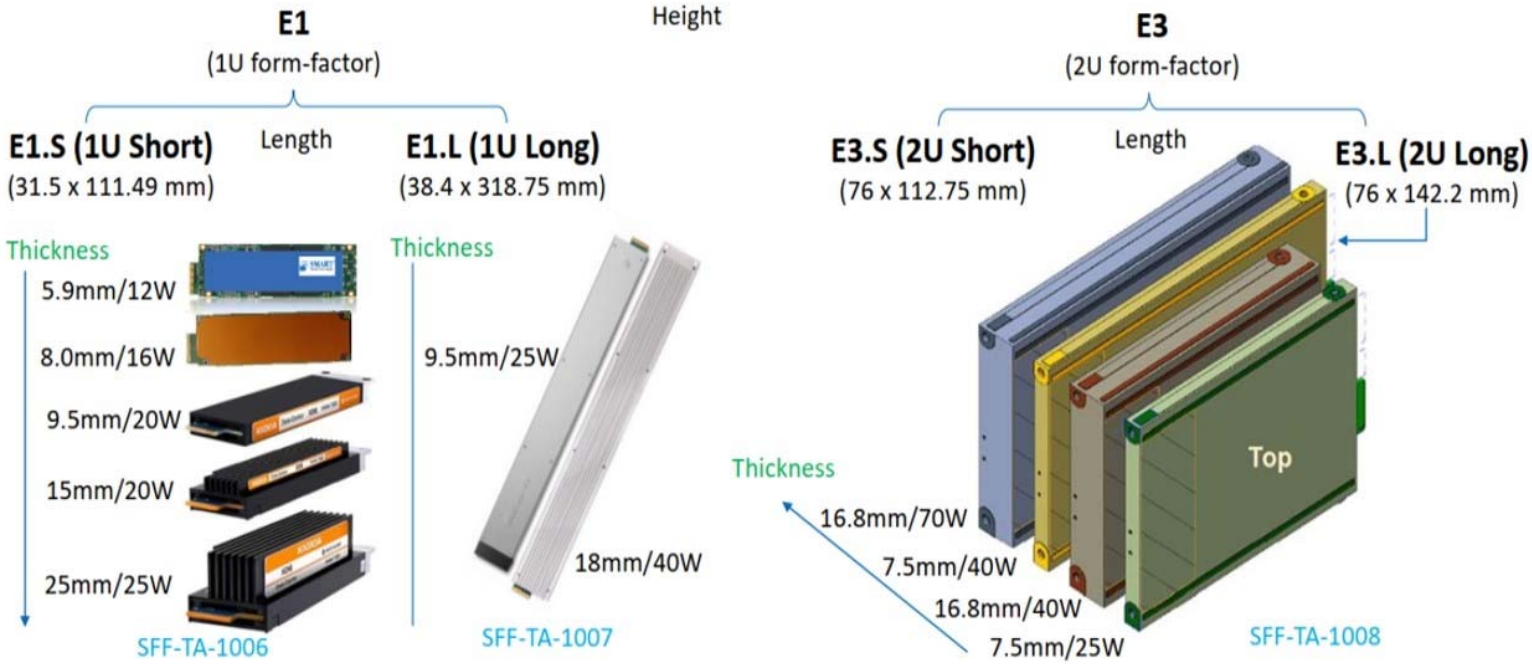
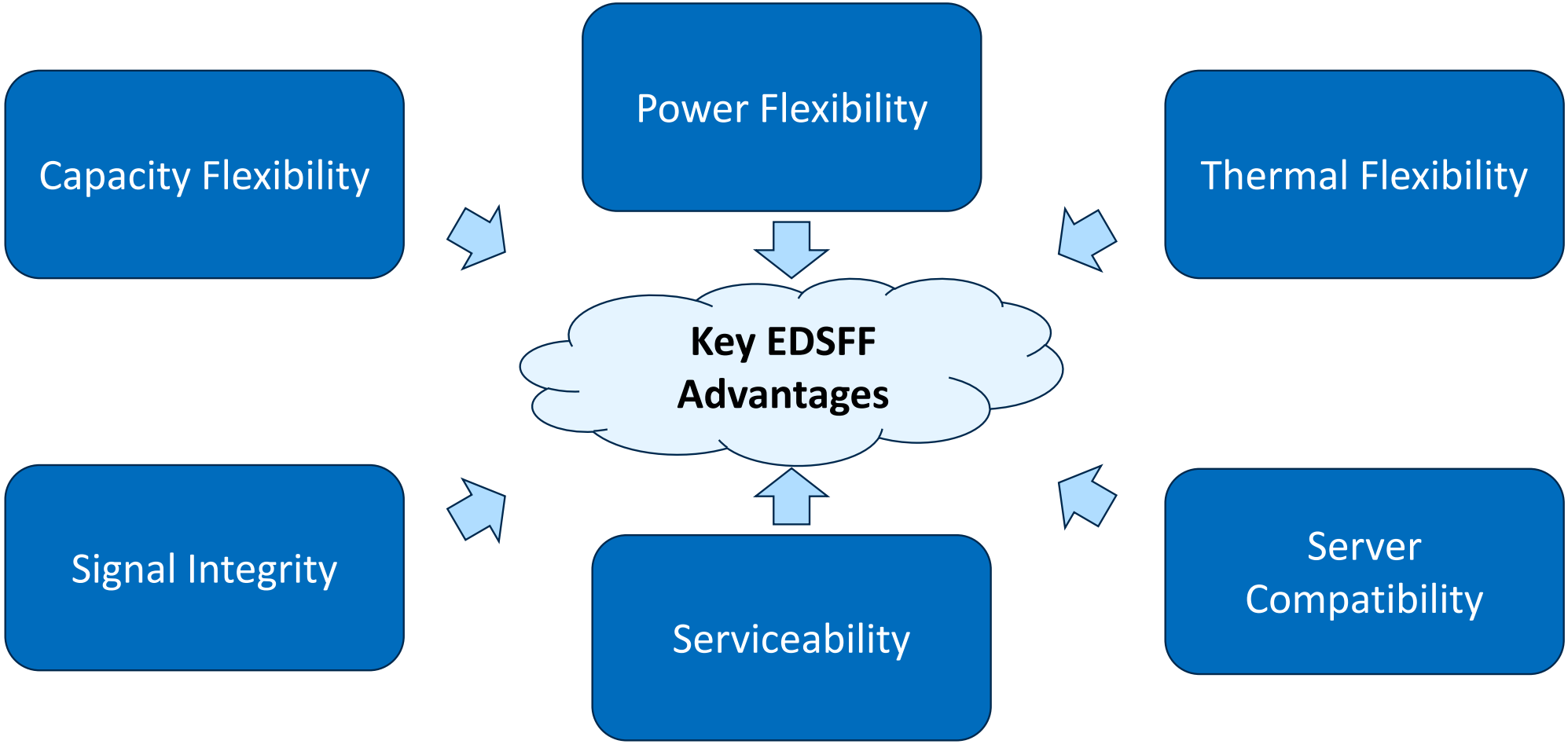
What is EDSFF

- EDSFF stands for **E**nterprise and **D**ata Center **S**SD **F**orm **F**actor
- SNIA maintains all EDSFF Specifications
  - https://www.snia.org/forums/cmsi/knowledge/formfactors



* Picture source : https://en.unionmem.com/news_detail-31-19.html

Why EDSFF



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Problem Statement

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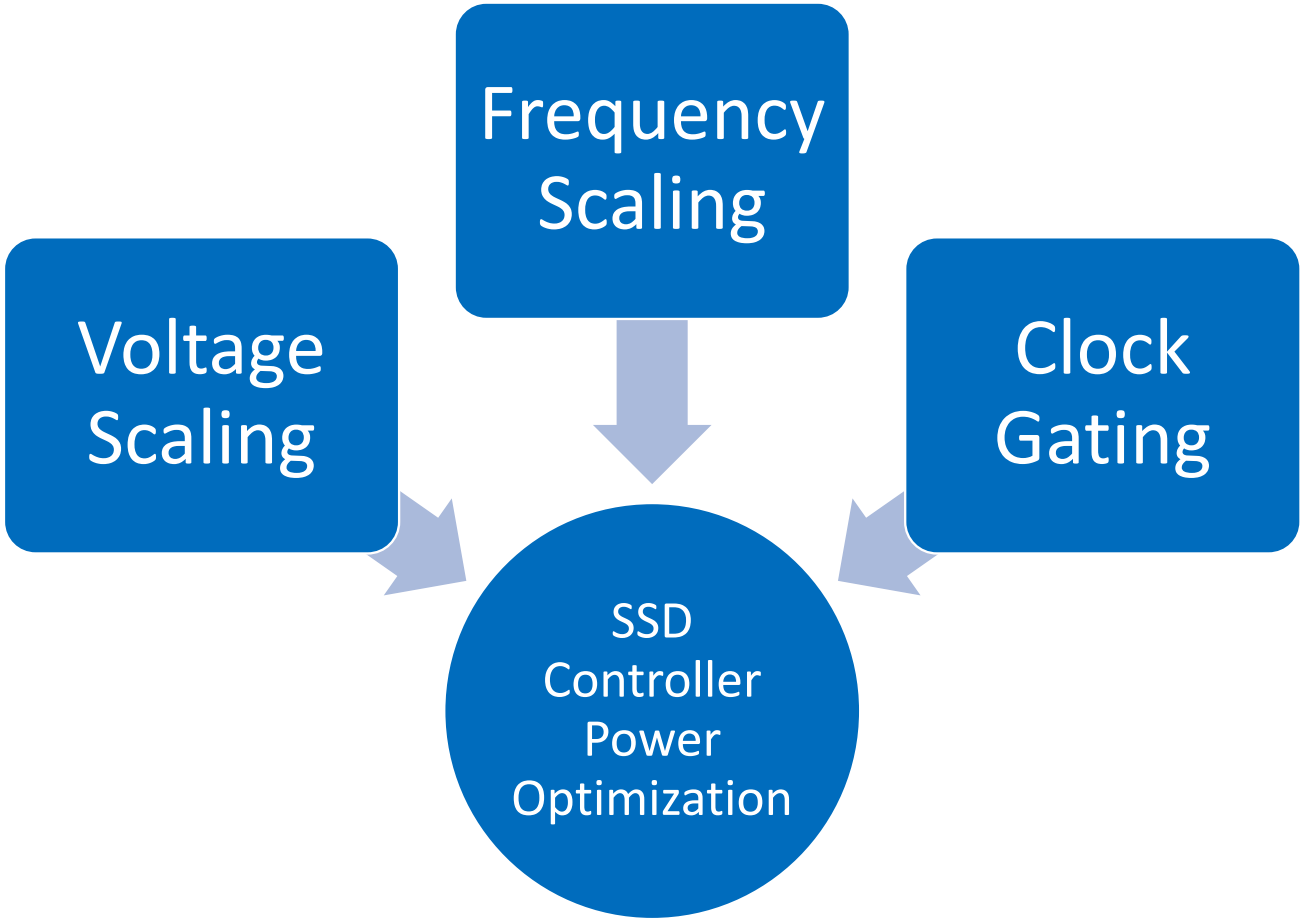
- EDSFF provides great flexibilities
- Power optimization remains an essential, yet challenging task
- Traditional power optimization techniques cannot provide fine-grained power control
- Need better control over SSD power consumption

Common Power Saving Techniques



SiliconMotion Advanced Power Optimization Method

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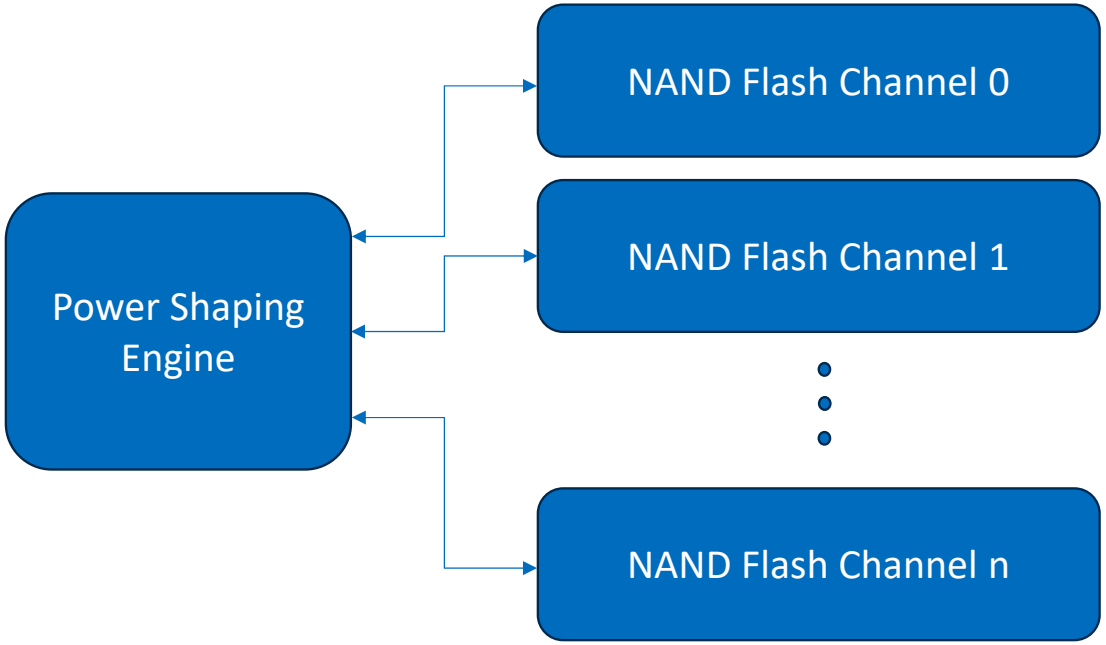
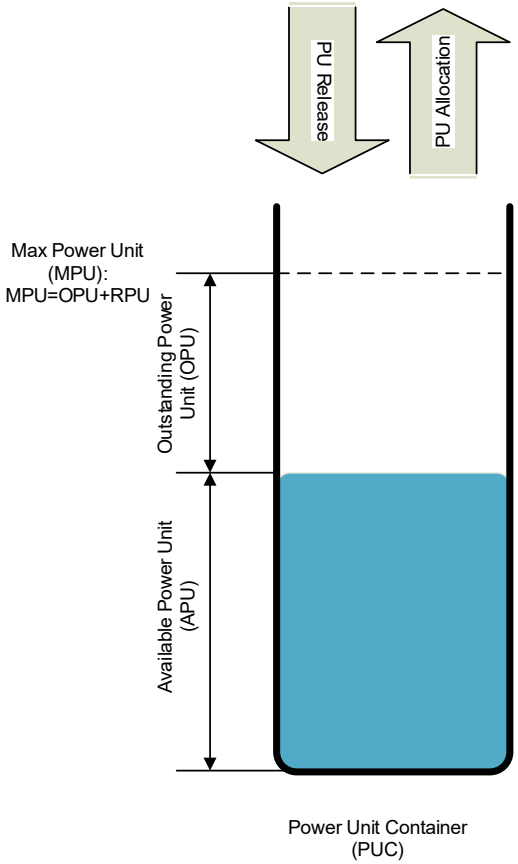
- Power Shaping in SSD controller
  - Central power management unit controlling power consumption of each NAND flash channel
  - Manages power budget of all NAND devices via power units
  - Power units are configured based on relative power consumption of different NAND operations
  - Each NAND flash channel submits power allocation and release requests for each NAND operation to Power Shaping engine
  - Power Shaping engine grants NAND operation permission based on power units availability and manage a central pool of power units



Power Shaping Mechanism



- Power Unit Container
  - Contains total power units available at any given time.
- Max Power Unit (MPU) = OPU + APU
  - Max Power Unit (MPU) is the maximum available power units can be consumed at any given time.
  - MPU is implemented as a configuration register programmed by FW.
- Outstanding Power Unit (OPU)
  - Outstanding Power Unit is the power units being allocated (consumed)
- Available Power Unit (APU)
  - Available Power Unit is the available power units can be consumed at the current moment
- Request Interface (from each Flash Channel to Power Shaping Engine)
  - PU Allocation Req (LID)
    - Grant if Power Units Requested < APU
  - PU Release (LID)
    - OPU = OPU + Power Units Released

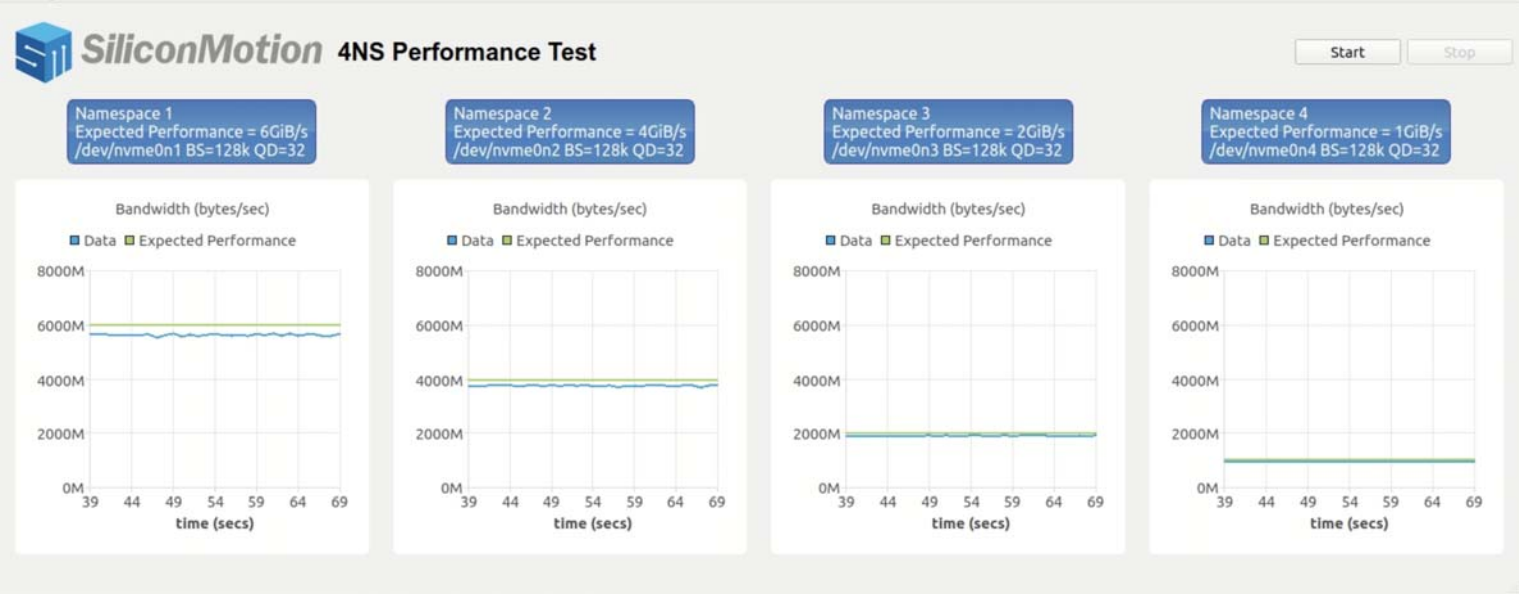
Recap of SSDS-102-1 Presentation

- Silicon Motion also presented “Shaping NVMe SSD IO Performance in Multi-Virtual Environments” in FMS on Tuesday
- Performance Shaping is another advanced performance optimization technique to shape IO requests per user defined **QoS set** within an SSD
  - A QoS set is a group of one or multiple host tenants, and/or internal tasks (reclamation, etc.), which initiates IO type operations.
- Performance Shaping can be used in conjunction with Power Shaping to optimize SSD power consumption
- Please refer to SSDS-102-1 for further details

PerformaShape™ Demonstration at FMS

NS	Measurement	Performance Shapping Engine		Host Setting
		SPS Setting	DPS – ID4	
NS0 – ID0	5.97GB	6GB/S (8083)	12.9 - 13GB/s	6GB/S (5723MiB)
NS1 – ID1 – Noisy	3.98GB	4GB/S (12125)		6GB/S (5723MiB)
NS2 – ID2	1.99GB	2GB/S (24250)		2GB/S (1908MiB)
NS3 – ID3 - Noisy	0.96GB	1GB/S (48500)		2GB/S (1908MiB)

- ✓ 16GB/S Read Requests from Host in 13GB/S system
- ✓ Isolates and Guarantees Performance per Tenant
- ✓ Removes Noisy Neighbors



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Conclusion

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- Power optimization remains an essential, yet challenging task
- Traditional power optimization techniques cannot provide fine-grained power control
- Power Shaping offers fine-grained power control via power units management based on actual power consumption of NAND operations
- Together, these techniques enable effective SSD power optimization

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Meet us at booth #315

Scan to learn more!