OCP KOREA TECH WEEK

Open Reference System and Tool-less Design

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SAMSUNG

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- Samsung SSD Reference System " Poseidon"
  - Background
  - System Design
  - SSD Form Factor
  - System Characteristics

- Tool-less SSD Design

Poseidon Project

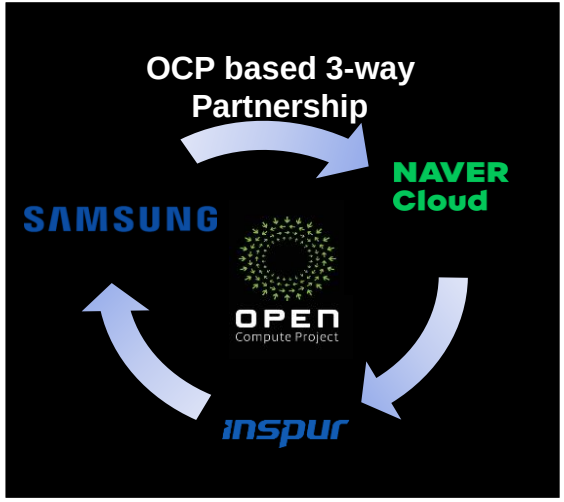
- Open-source HW & SW project for NVMe-oF based shared network storage system
- OCP based industrial collaboration b/w "Component Vendor↔ODM ↔Data Center"

Poseidon SW

Open-source Storage OS for NVMe-oF

Poseidon HW

PCIe Gen4 E1.S SSD Ref. System

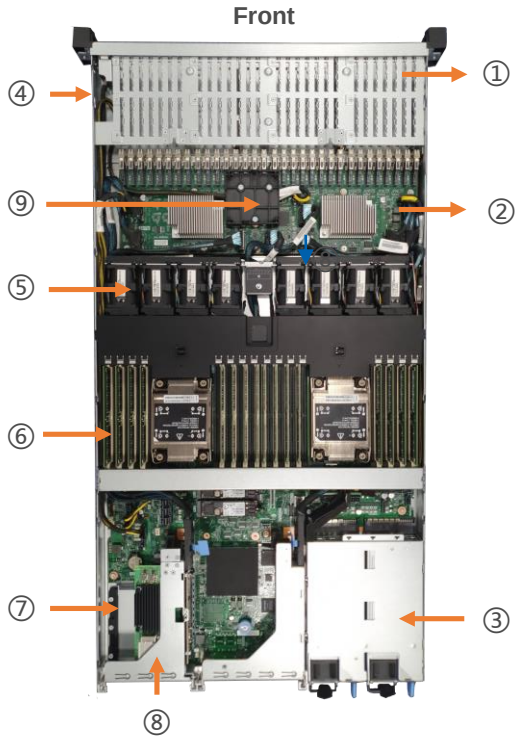


Poseidon System Characteristics

Open-source High Performance Shared Network Storage System for NVMe-oF

- **Open-source**
  - ✓ NVMe-oF & EDSFF E1.S SSD Eco-building …
- **High Performance**
  - ✓ High Bandwidth → PCIe Gen4 SSD & NIC, DDR4 3200 main memory etc.
  - ✓ Low Latency → NVMe SSD, RDMA, TOE, NVDIMM support
- **Shared Network Storage System**
  - ✓ High Density & Efficiency → 32x NVMe SSDs in 1U (max. 256TB), EDSFF E1.S SSD Form Factor
  - ✓ Datacenter-level Reliability → Hot-swappable SSD & PSU, Dual Port NIC, S/W Raid & Hot-Spare
- **for NVMe-oF**
  - ✓ NVMe/TCP Offloading, TOE, NVMe SSD

System Design Overview

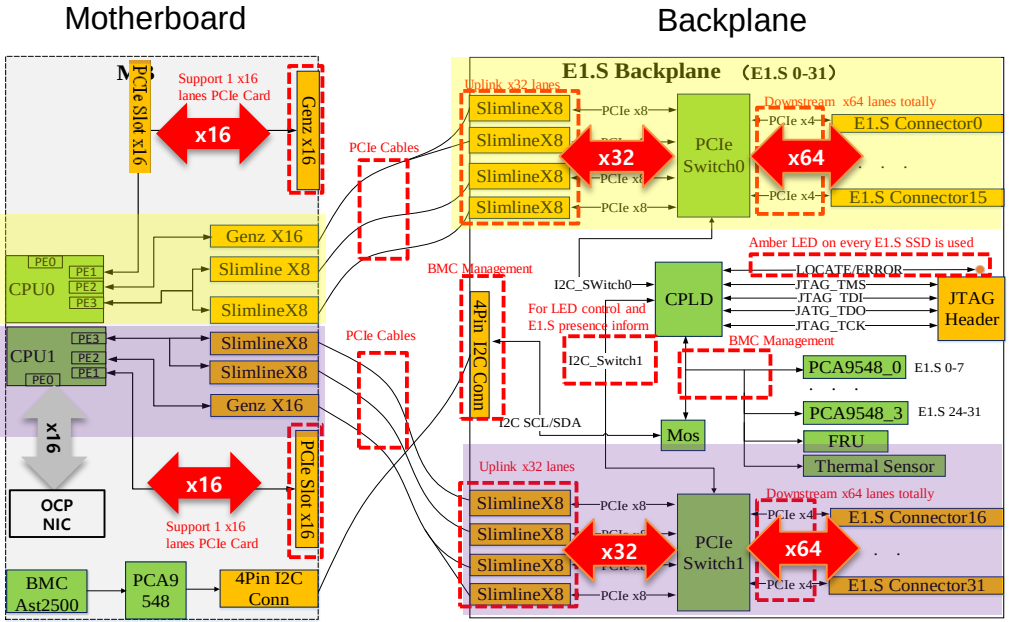


①	: E1.S SSD (5.9/8.01/9.5)	32ea
②	: 32 E1.S BP	1
③	: PSU	2ea
④	: IO Module	1ea
⑤	: FAN	8ea
⑥	: MB	1ea
⑦	: FHHL Card	2ea
⑧	: OCP NIC V3	1ea
⑨	: NVDIMM Power Module	2ea

Front View

Rear View

System Diagram



- Symmetrical PCIe topology to minimize socket to socket traffic (UPI)
- Each CPU provides 64 PCIe Gen4 lanes
- Each PCIe Switch provides PCIe Gen4.0 100 lanes (32W typical power)
- NIC (100GbE x 2 Ports) bandwidth limits the total IO bandwidth
- E1.S Connector (Orthogonal type) support PCIe4.0, connected to 32 pcs E1.S

System Design Targets

- Target Application
  - ✓Target node for NVMe-oF (Shared network storage)
  - ✓Storage system for high perf. applications like DB etc.

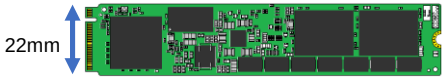
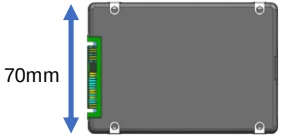
- Requirements & Targets
  - ✓PCIe Gen4 and higher generation suppor
  - ✓High Network B/W : > 200GbE
  - ✓SSD
    - Power consumption : < 13W (Single Drive)
    - Capacity : < 4TB (Single Drive)
    - Hot-swappable / Hot-pluggable
  - ✓Airflow (Meet the OCP SSD Spec. recommendation) : Inlet Airflow ≥ 1.5 m/s @ 35C

· Samsung PM9A3 Specification

Form factor	U.2	E1.S	M.2
Capacity	960 GB, 1.92 TB, 3.84 TB, 7.68 TB	960 GB, 1.92 TB, 3.82 TB, 7.68 TB	960 GB, 1.92 TB, 3.84 TB
Sequential read	Up to 6,500 MB/s	Up to 6,500 MB/s	Up to 4,500 MB/s
Sequential write	Up to 3,500 MB/s	Up to 3,200 MB/s	Up to 1,750 MB/s
Random read	Up to 900,000 IOPS	Up to 900,000 IOPS	Up to 550,000 IOPS
Random write	Up to 200,000 IOPS	Up to 150,000 IOPS	Up to 70,000 IOPS
Physical Dimensions	70 x 100 x 7 mm	31.5 x 111.49 x 5.9 mm	22 x 110 x 3.8 mm
Power consumption	Read: <= 9.4W, Write: <= 14.5W	Read: <= 9.7W, Write: <= 11.7W	Read: <= 6.4W, Write: <= 7.8W
Host interface		PCIe Gen 4 x4	

SSD - Conventional SSD Form Factor

- EDSFF is designed for overcome conventional form factor limitations

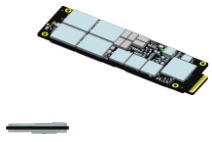
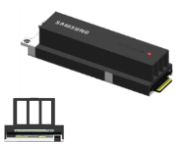
	M.2	U.2
		
Characteristic	• The initial spec. proposal was for client use • Used as a boot drive in server systems • Compact size and high flexibility	• Evolved from 2.5” HDD Form factor • Most general Form Factor • Two different thicknesses: 7mmT, 15mmT • Mostly used for storage device
Limitation	• Limited Performance and Scalability because of compact size • Doesn’t support front-loading and hot-plug • Vulnerable to warpage because of thin PCB • Low input power (3.3V)	• Power limitation (typical 25W) • Disadvantageous for high speed interface like PCIe Gen4/5

SSD - EDSFF E1.X

- E1.S 9.5mmT satisfied the requirements and offers the highest density

System Density → Power Capacity

Capacity ↓

E1.S up to 8 NAND Landing					
Size	31.5 x 111.49 x **5.9mm**	31.5 x 111.49 x **8.01mm**	33.75 x 118.75 x **9.5mm**	33.75 x 118.75 x **15mm**	33.75 x 118.75 x **25mm**
Recommended Power(W)	12W	16W	20W	20W	25W
E1.L up to 16 NAND Landing					
Size	38.4 x 318.75 **x 9.5mm**		38.4 x 318.75 x **18mm**		
Recommended Power(W)	25W		40W		

: Poseidon supported form factor

SSD - Thermal Characteristics

- E1.S 9.5mmT and higher meet the OCP NVMe SSD airflow recommendation

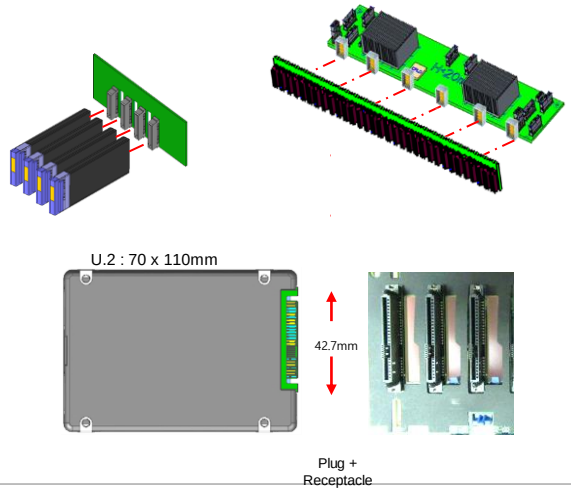
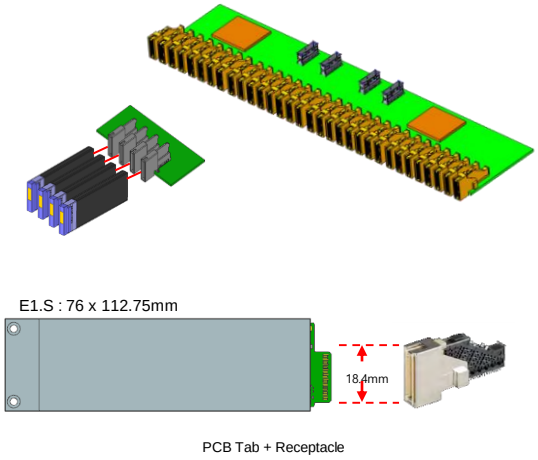
SSD	Samsung PM9A3 E1.S	
F/F	5.9mmT(w/o Enclosure)	9.5mmT(/w Enclosure)
Power(Gen4)	12.6W	12.6W
Max Temperature Spec	NAND 85℃	Case 80℃
Airflow Recommendation (OCP : 35℃, airflow ≤ 1.5m/s)	Inlet Airflow ≥ 2.5 m/s	Inlet Airflow ≥ 1.5 m/s

F/F [mmT]	Airflow [m/s]	MAX TEMPERATURE[℃] NAND
5.9	1.0	X
	1.5	X
	2.0	X
	2.5	O

F/F [mmT]	Airflow [m/s]	MAX TEMPERATURE[℃] Enclosure
9.5	1.0	X
	1.5	O
	2.0	O
	2.5	O

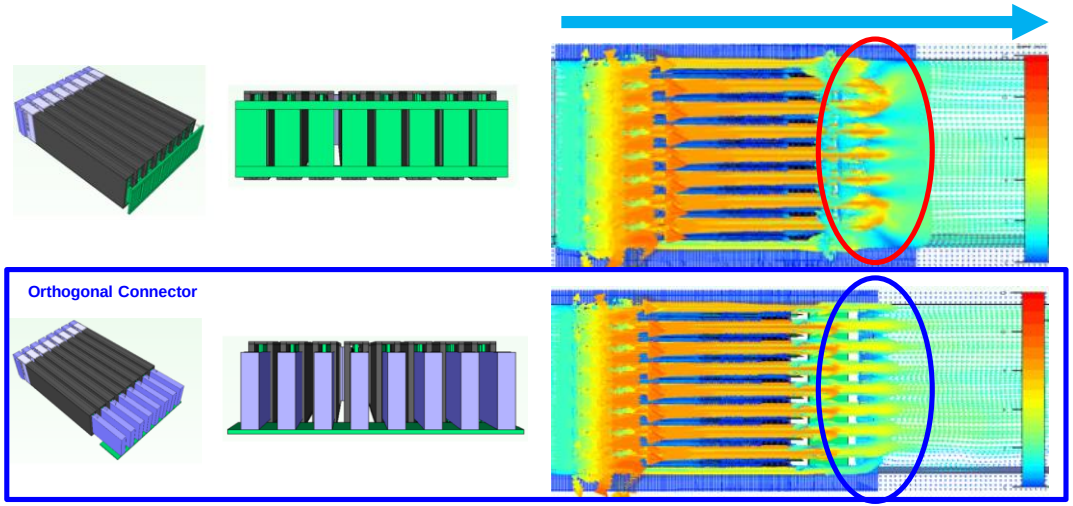
Backplane & Connector Design

- The horizontal BP and orthogonal connectors provide more space for air to pass through

U.2 + Vertical BP	E1.S + Horizontal BP + Orthogonal Connector
	

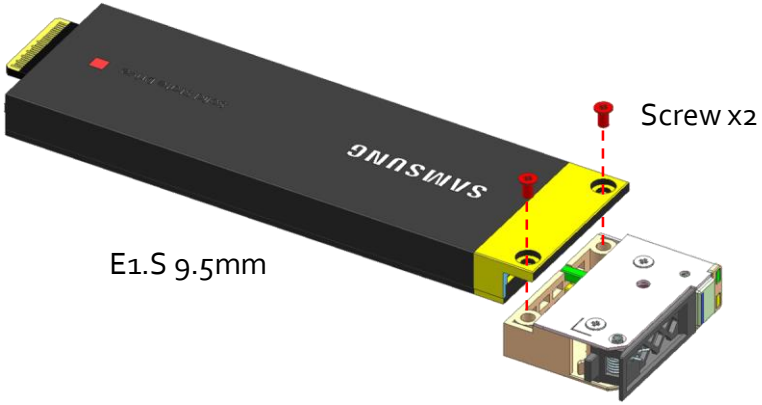
Backplane & Connector Design

- Horizontal BP with orthogonal connector reduce air-flow impedance
  - Lower the SSD temperature by 1~2℃
  - Improve air flow after SSD connectors

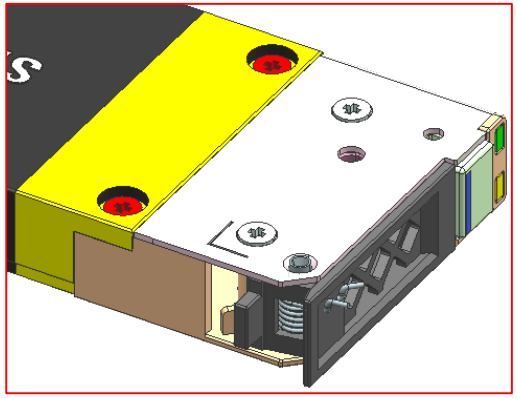


Tool-less Ext. Kit - Background

- Poseidon announced at the OCP Virtual Summit and received various feedbacks from DC customers
- DC customers want to improve serviceability in their datacenter by removing the screws
- E1.S + extension kit with screws are the only option in the market, and we developed the innovate new tool-less ext. kit design to satisfy the requirements

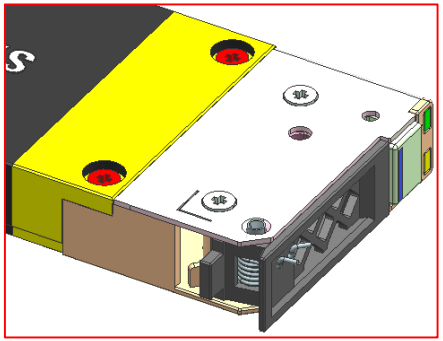


Current ext. kit assembly

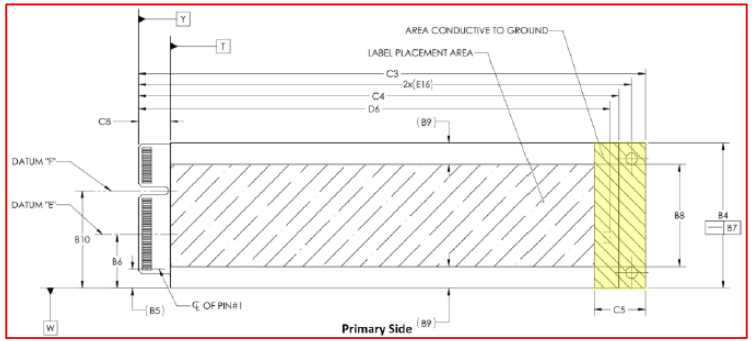


Tool-less Ext. Kit - Problem definition

- Need to meet the spec. (enclosure & SSD spec) : There are several mechanical design limitation
- FIPS physical security required by customers restricts further design modification
  - ➢ Show evidence of tampering and protect against unauthorized physical access
- Current ext. kit assembly with screws should be compatible with the proposed enclosure design



Current ext. kit assembly

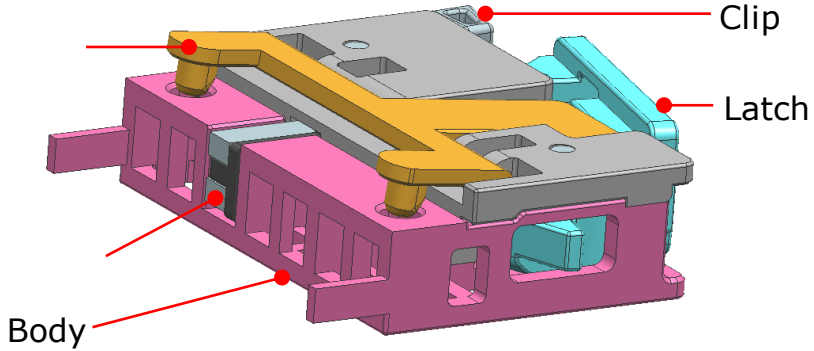


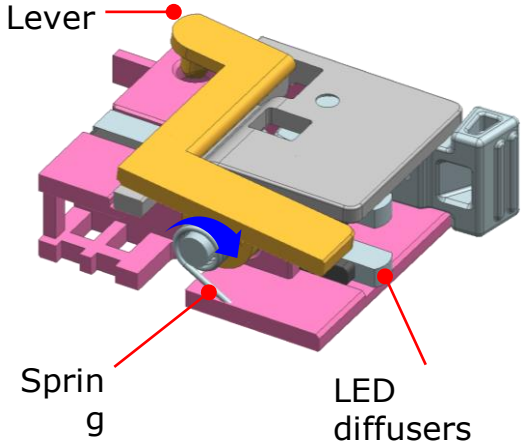
E1.S specification *

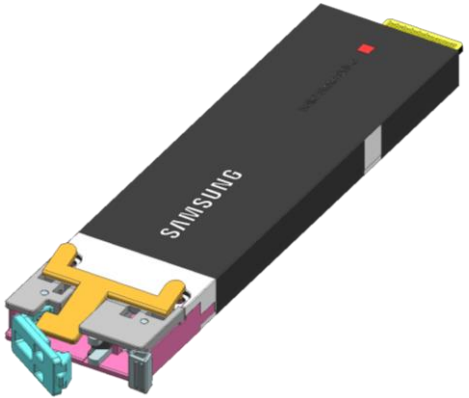
* SNIA SFF-TA-1006, Enterprise and Datacenter 1U Short SSD Form Factor(E1.S), Rev1.4, March 27, 2020

Tool-less Ext. Kit - Design Proposal

- Easy to use locking mechanism with component addition (lever with a spring) and design revision
  on ext. kit body are proposed
- The proposed ext. kit can be assembled to the enclosure quickly and easily thanks to clip type design concept

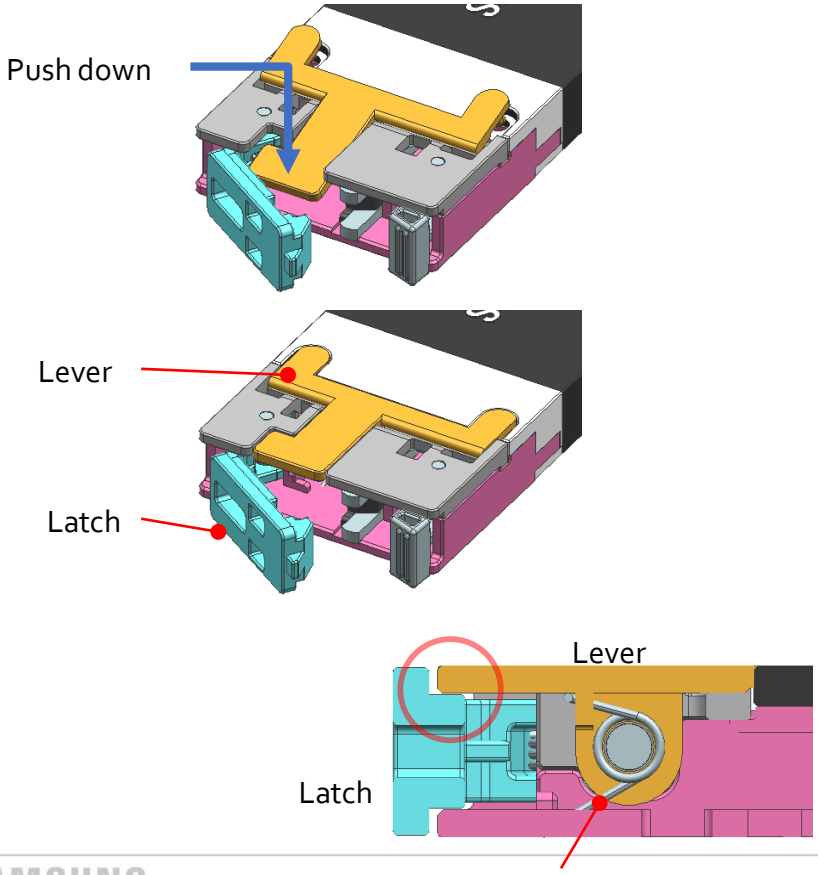






Proposed ext. kit assembly

Tool-less Ext. Kit - How it works



- If the end of lever is push down, the force will lift the other end to place the tool-less ext. kit into the assembly position

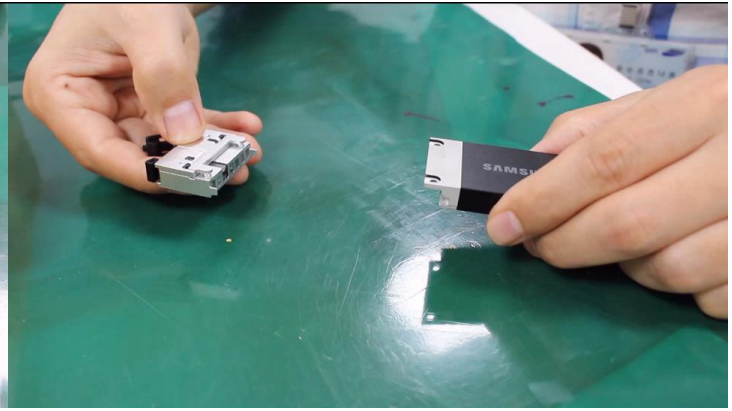
- Releasing the lever will lock the ext. kit on mounting area of the enclosure due to spring force (1st stage locking)
- The tool-less ext. kit can be assembled or disassembled easily & quickly when latch is open

- Closing the latch locks the E1.S + ext. kit assembly into the system
- On this position, the ext. kit cannot be removed from the enclosure because the latch supports the lever [red circle] (2nd stage locking)

Tool-less Ext. Kit SSD Concept in Action

Current Ext. Kit (w/ Tool)

Proposed Ext. Kit (Tool-less)

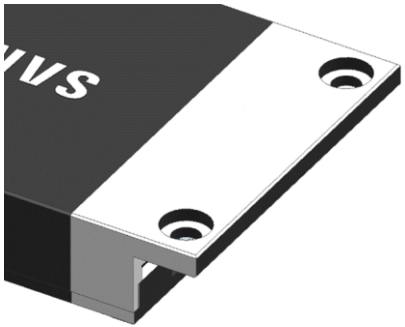


# of drives	Time saved		Cost saved
	per drive	Total	
10M device	36 sec	100,000 h	$2.5M

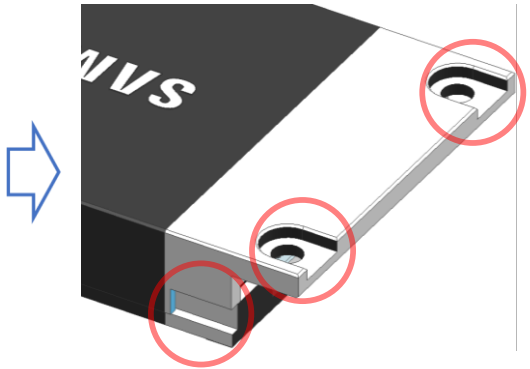
* Average salary of data center technician is assumed to be $25/h

Tool-less Ext. Kit – Enclosure modification

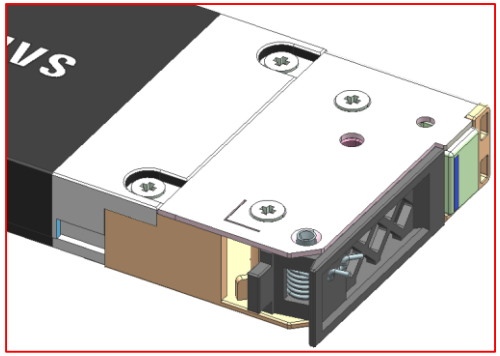
- Current ext. kit (with screws) is fully compatible with the proposed enclosure design



Current design



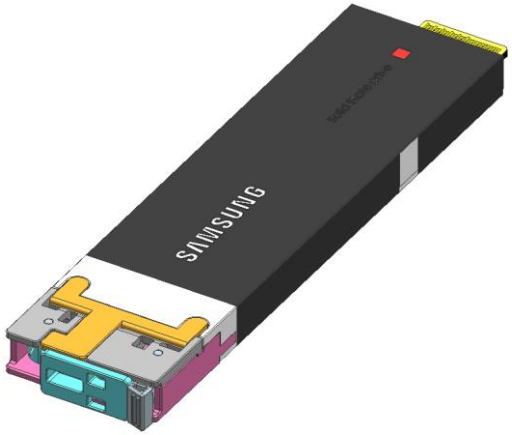
Proposed design



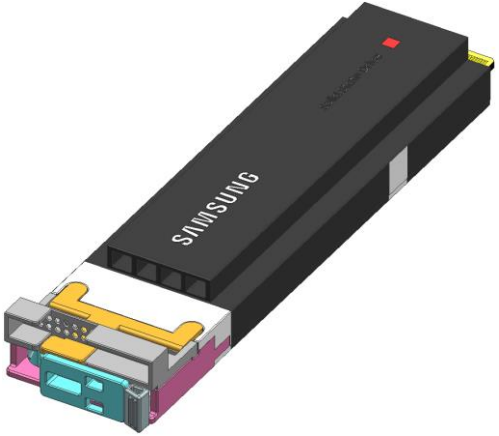
Proposed enclosure
w/ current ext. kit assembly

Tool-less Ext. Kit – Enclosure Form Factor

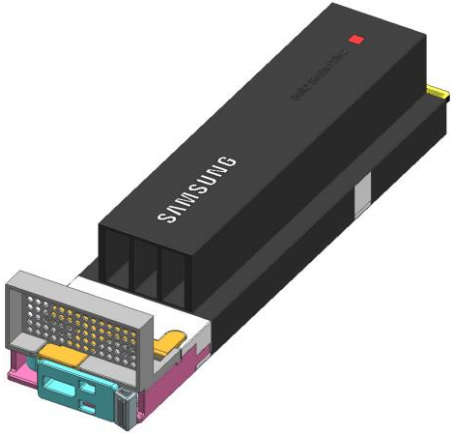
- Tool-less ext. kit concept can be adopted by E1.S device with different enclosure thickness



9.5mm



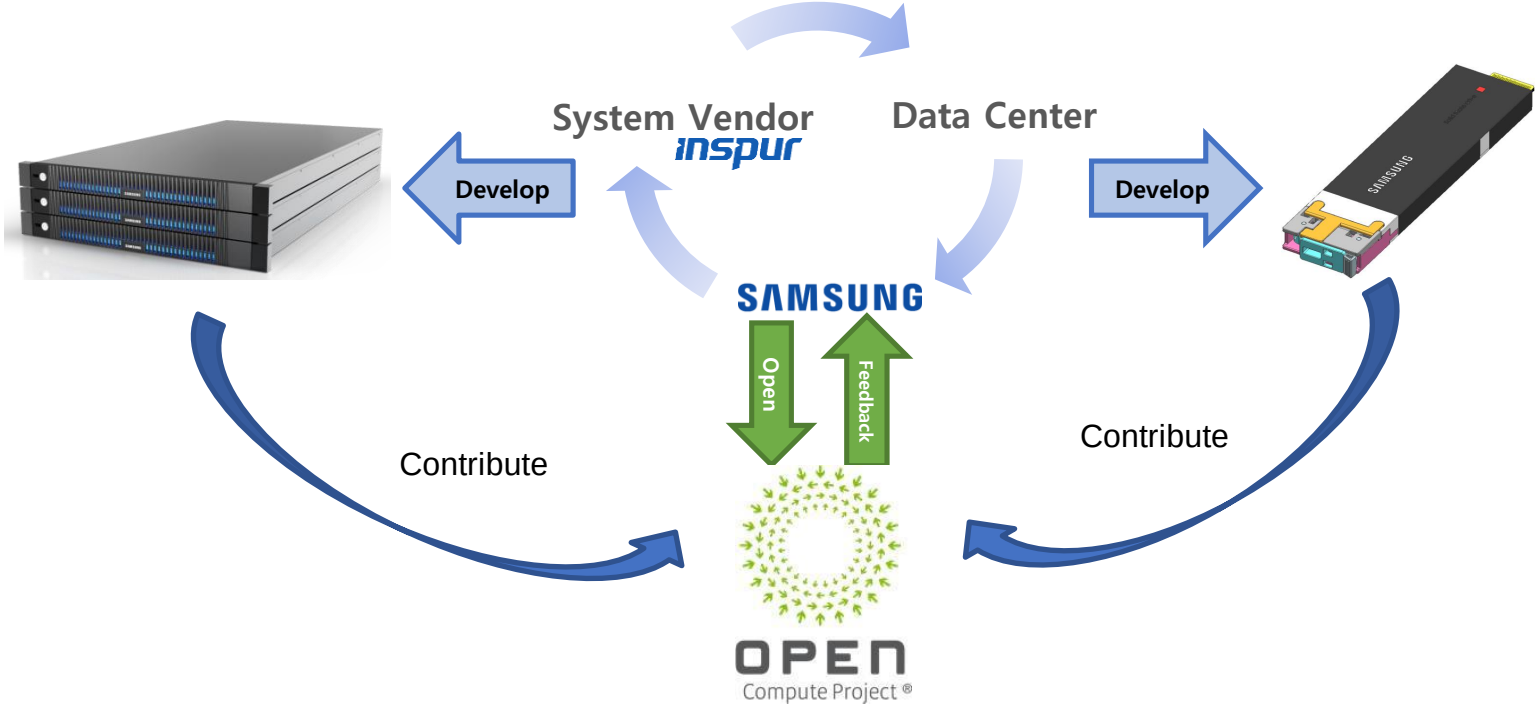
15mm



25mm

Open Innovation

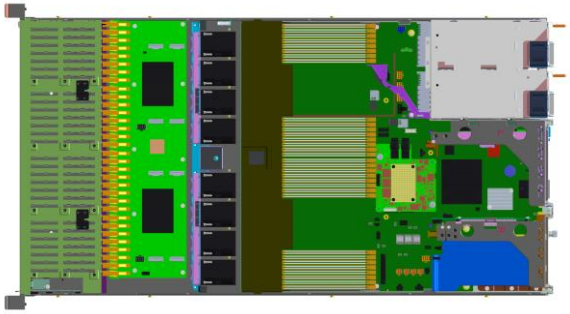
- Solving industrial problems based on the **OPEN** philosophy



Next Step

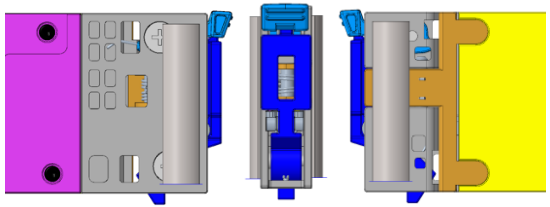
Poseidon System

- Plan to run PoC test at the datacenter
- Run benchmark tests and real world applications
- Plan to contribute the whole design package



Tool-less SSD Ext. Kit Design

- Feasibility test with data centers
- Community feedback based design update
- Plan to contribute the design



Call to Action

- **NVMe-oF & E1.S SSD Eco-system building**
  - ✓ Looking for more collaboration partners to test & develop the Poseidon solution
  - ✓ E1.S SSD – new use cases and system design
- **Tool-less SSD Ext. Kit design**
  - ✓ Expect good feedbacks from community
  - ✓ Work together to make better design and finalize the spec.

SOLUTION

CORE VALUES

Speciality

Ownership

Leadership

Upgrowth

Together

Integrity

Openness

Now

Thank You

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