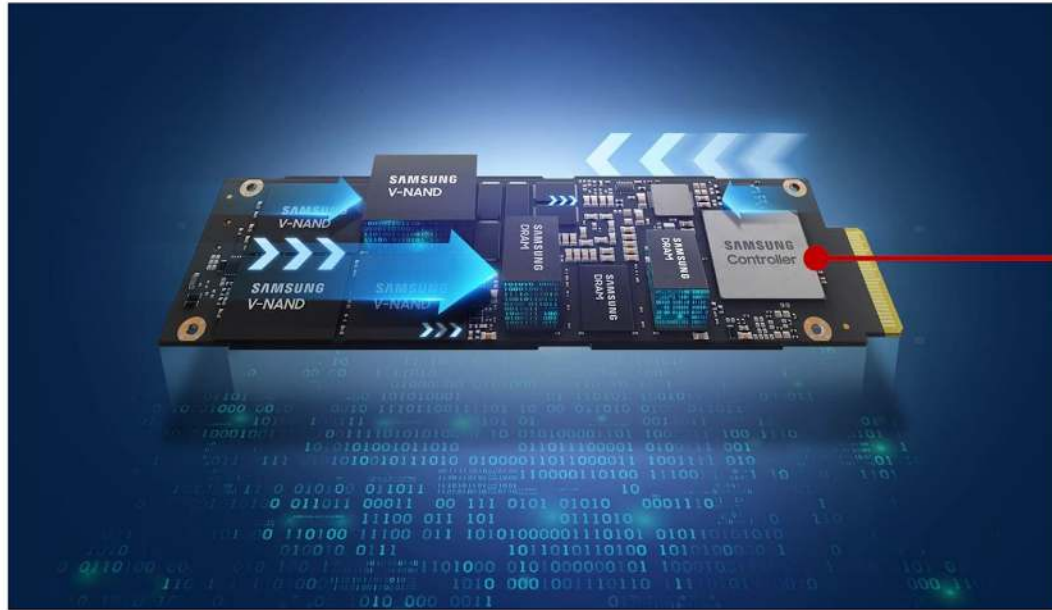# ELPIS

High Performance Low Power Controller for Data Center SSDs

Seungwon Lee, Juhyung Hong, Chulseung Lee, Sandeep Vallabhaneni, Soon-Gon Kim,

Yong Jin Shin, Mijung Noh, Soon-jae Won, Soonbok Jang and Yong Ho Song

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Samsung Electronics

Samsung SSD Controller Technology

New Architecture

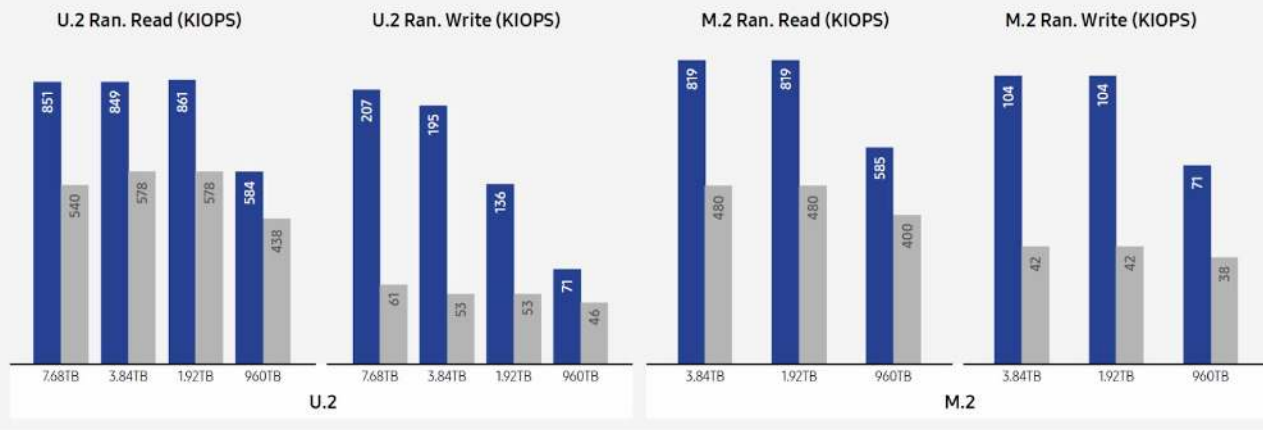High Performance

Low Power Consumption

More Performance

PCIe® Gen.3 Random Performance

PM9A3 shows up to 3.6x times better Ran. Write than its previous generation PM983 with PCIe® Gen.3 interface due to improved V6 NAND.

- For the case of Ran. Read, PM983 provides up to 48% better than PM983
- NAND characteristics affects random performances directly compared to seq. performances
  - V6 NAND speed is 33% faster than V4, PM983 is based on V4 NAND

■ PM9A3 ■ PM983

| | U.2 Ran. Read (KIOPS) | U.2 Ran. Write (KIOPS) | M.2 Ran. Read (KIOPS) | M.2 Ran. Write (KIOPS) |

Less Power Consumption
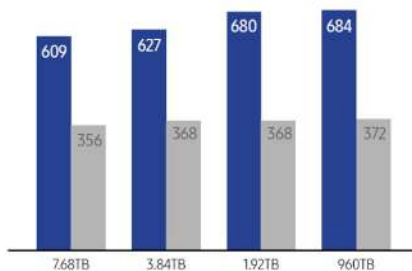
Efficient Power Management
Seq. Read

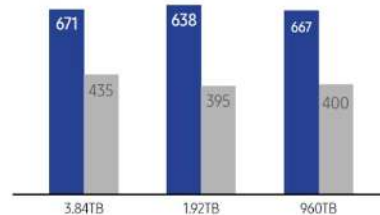PM9A3 provides up to 1.8x times better power efficiency than previous generation, PM983

- Even though PM9A3 is PCIe® Gen.4 based SSD, less power consumption with higher performance

■ PM9A3 ■ PM983

U.2 Seq. Read (MB/s per Watt)

	7.68TB	3.84TB	1.92TB	960TB
PM9A3	609	627	680	684
PM983	356	368	368	372

M.2 Seq. Read(MB/s per Watt)

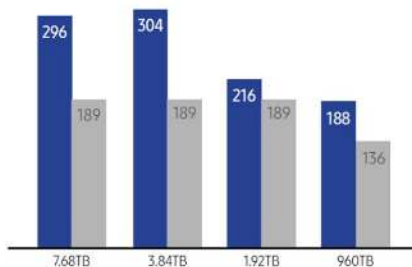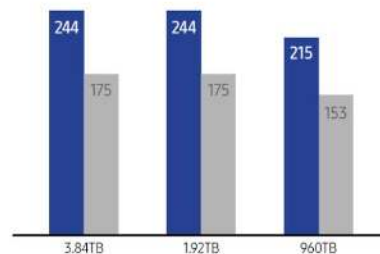|	3.84TB	1.92TB	960TB
PM9A3	671	638	667
PM983	435	395	400

Efficient Power Management
Seq. Write

PM9A3 provides up to 1.6x times better power efficiency than previous generation
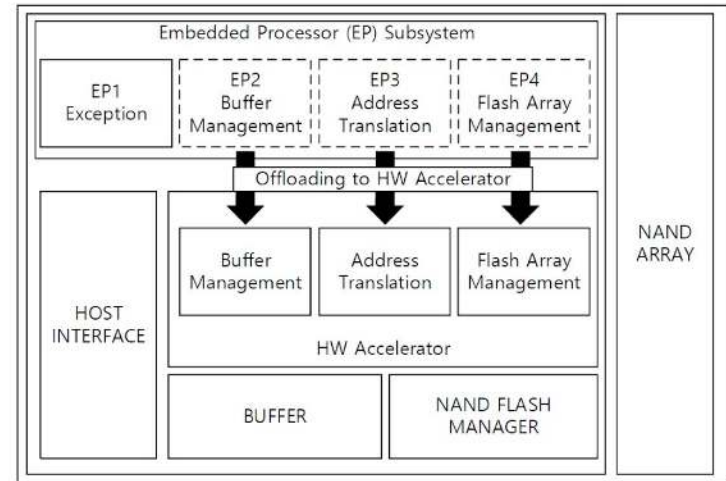
■ PM9A3 ■ PM983

U.2 Seq. Write (MB/s per Watt)

	7.68TB	3.84TB	1.92TB	960TB
PM9A3	296	304	216	188
PM983	189	189	189	136

M.2 Seq. Write (MB/s per Watt)

|	3.84TB	1.92TB	960TB
PM9A3	244	244	215
PM983	175	175	153

[New Architecture - performance]

Hardware Acceleration

- Offloading FTL (Flash Translation Layer) operations
  - Address Translation
  - Flash Array Management
  - Buffer Management

Clock Management Unit / Physical Imp.

- Control root of clock-tree

- Control each IP by its own status

- Physical Implementation
  - Samsung Foundry's 8nm process
  - Optimize CMU location
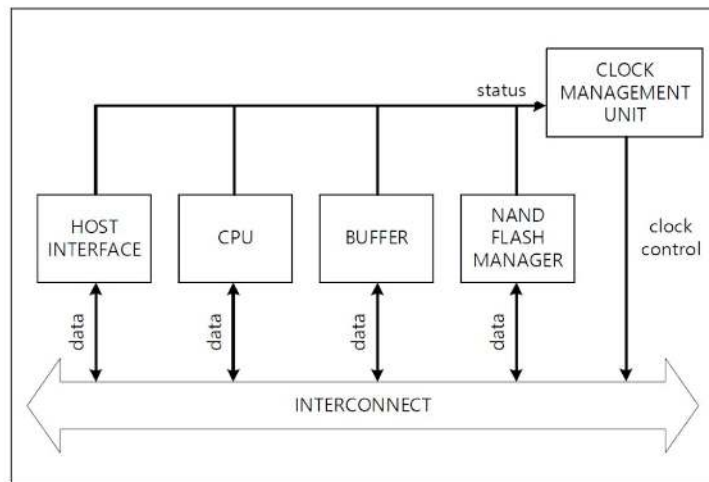
Portfolio

- Those SSDs are adopted ELPIS controller. Many data center customers are developing their servers using the SSDs.

    - PM9A3 U.3
    - PM9A3 U.2
    - PM9A3 M.2