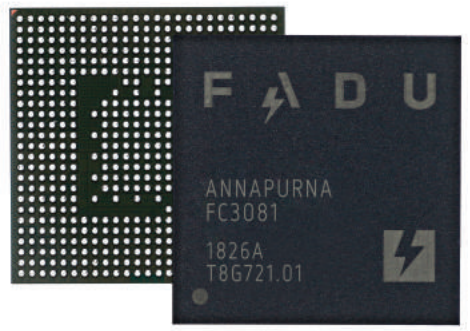
FADU ANNAPURNA FLASH MEMORY CONTROLLER

PCIe Gen 3.1x4 NVMe 1.3a SSD controller with RISC-V core



PRODUCT OVERVIEW

The FADU Annapurna is a NVMe SSD controller that provides support for PCIe Gen 3.1x4 host interface and 8 channel NAND interface. FADU reconstructs entire architecture of SSD to take full advantage of NVMe.
Annapurna is the most powerful, the most power efficient, and the most flexible solution in the industry. Annapurna supports all consumer and enterprise features with various form factors from M.2 2280 and M.2 22110 to NGSFF, and dual port U.2.
It will set the new standard of NVMe SSD controller.

HIGHLIGHTS

BEST PERFORMANCE

- 3.5GB throughput
- 800K IOPS
- 4KB LDPC engine

BEST EFFICIENCY

- <1.7W at active (controller)
- <3mW at L1.2 (SSD)
- Eliminate thermal issue

BEST USABILITY

- Dual port support
- Powerful consumer/ enterprise features
- TLC, QLC, and Low latency SLC support

KEY FEATURES

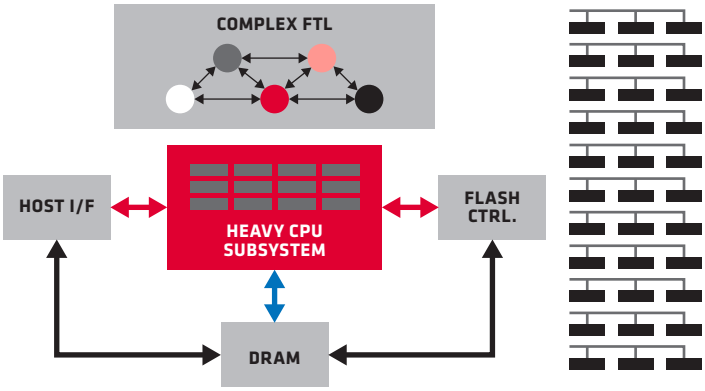
CATEGORY	FEATURES
Host Interface	- PCIe Gen 3.1 x 4 lanes (PCIe 3.1 X 2 for Dual port) - NVMe 1.3a support / Open Channel SSD 2.0 support
NAND interface	- Up to 8 NAND channel, each supporting up to 8 CE - Up to 800 MT/s Toggle and ONFI standards
DRAM Interface	- 32bit DRAM interface / Support DDR4 / LPDDR4, up to 8GB
Processor	- 64bit RISC-V core
Power	- Average <1.7W
Flash Memory Controller	- Extensive hardware automation to maximize the performance - Out of order execution of both flash controller and host controller - Low power and low thermal operation / budget based throttling - 4KB LDPC engine supports 3D TLC and QLC - Micro-code based architecture enables future NAND & NVM support - Low power features – ASPM L0s / L1 / L1.2 Latency Tolerance Reporting (LTR) - Enterprise features – SR-IOV (15VF/PF/Port), Multi-stream(up to 32), Multiple name space (up to 128), Dual port, End-to-end & per stream QoS
Security	- AES 256-bit for User Data Encryption, TCG/OPAL support - End to end data protection with dynamic internal RAID
Peripherals	- Temperature sensor support
Package	- 17x17mm with 0.65 ball pitch 556-ball FBGA

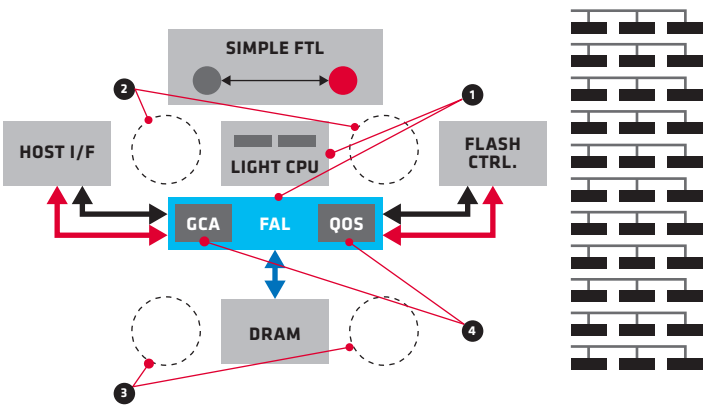
ARCHITECTURE OVERVIEW

Legacy architecture:
Complex FTL + Heavy RTL with multiple processors

VS

FADU's architecture:
Full hardware automation removing bottlenecks





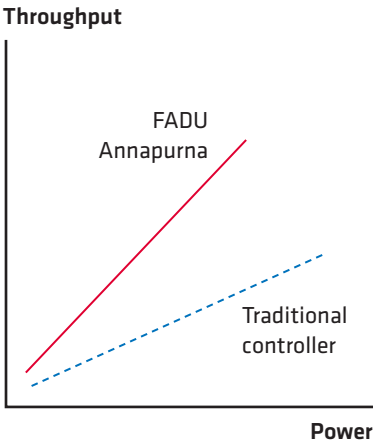
Control
Meta data
User data

1. Power & resource reduction by extensive HW automation via Flash Acceleration Layer (FAL)
2. Complete off-loading of common case control mechanism
3. Complete DRAM bypassing of data from host
4. A series of accelerators and scheduler for quality of service

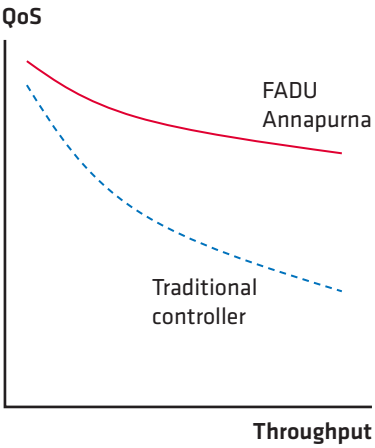
PERFORMANCE AND POWER CONSUMPTION

FADU Annapurna is true next generation SSD controller which solves the dilemma between power and performance. FADU achieves >30% less power consumption with >100% better IOPS.

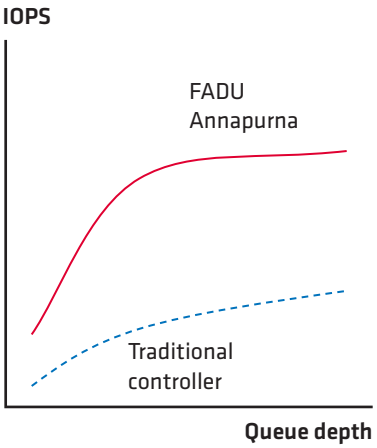
POWER EFFICIENT



RELIABLE QOS



SUPERIOR IOPS



ANNAPURNA LINE-UP

* The data can be varied by NAND characteristics

		FC 3081	FC 3082
Application		Enterprise (Server, Storage, Data center)	Consumer (Desktop, Laptop)
Performance *	**Sequential Read**	3.5 GB/s	3.5 GB/s
	Sequential Write	3.0 GB/s	3.5 GB/s (SLC Buffer on)
	4KB Random Read	800 K IOPS (sustained)	870 K IOPS (up to)
	4KB Random Write	210 K IOPS (sustained @ 28% OP)	870 K IOPS (up to @ 0% OP)
Power consumption * (SSD)	**Active**	Typ. < 4W (< 1.7W by controller)	Typ. <6W (<1.7W by controller)
	Standby	Typ. < 2W	
	Idle (PS3)		<50mW (<1ms exit time)
	Sleep (PS4; L1.2)		<3mW (<50ms exit time)
Features		Support full enterprise features including dual port	Support consumer features including L1.2