Transforming an SSD into a Cost-Effective Edge Server

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Who am I?

- 28 years' experience in embedded

- Lead the storage solutions team

- Work closely with the industry's top storage suppliers

- Previously in wireless at Texas Instruments

- BSc in Computer Science from Portsmouth University (UK)

- I enjoy brewing beer at home!

What will we cover today?

- Why compute is moving to the edge

- Design structure of servers and SSD storage

- Why run an SSD as an edge server?
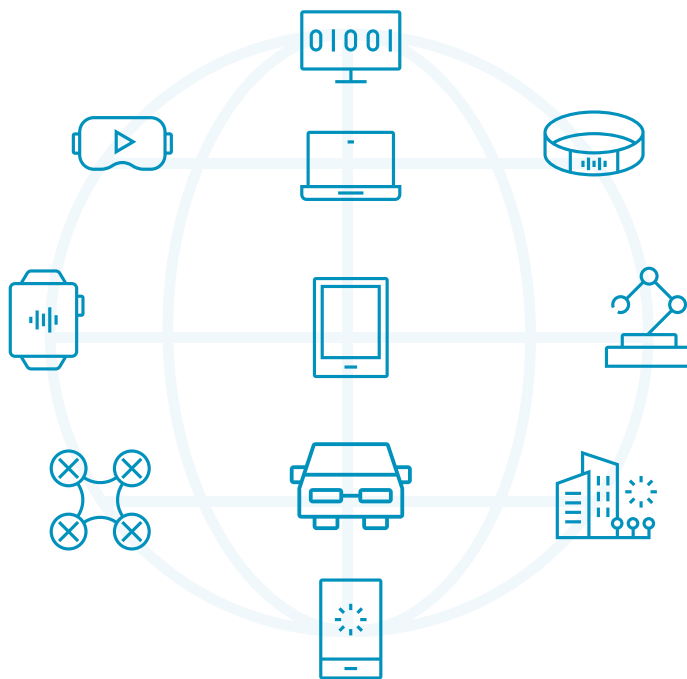
- Ecosystem support available

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Arm computing is everywhere

#1
shipping processor in storage devices

21Bn
Arm-based chips shipped in 2017

> 5Bn
people using Arm-based mobile phones

120Bn
Arm-based chips to date

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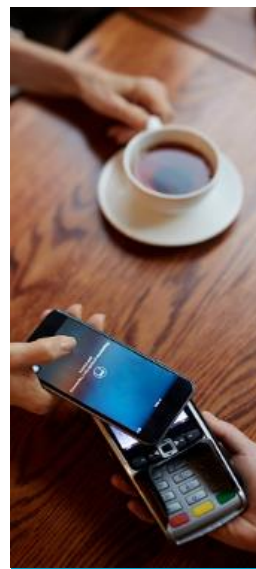# Why computation is moving to the edge

Bandwidth **Power** **Cost** **Latency** **Reliability** **Security**

Edge server

Compute:
- Arm Cortex-A series or Intel x86

Memory:
- DRAM
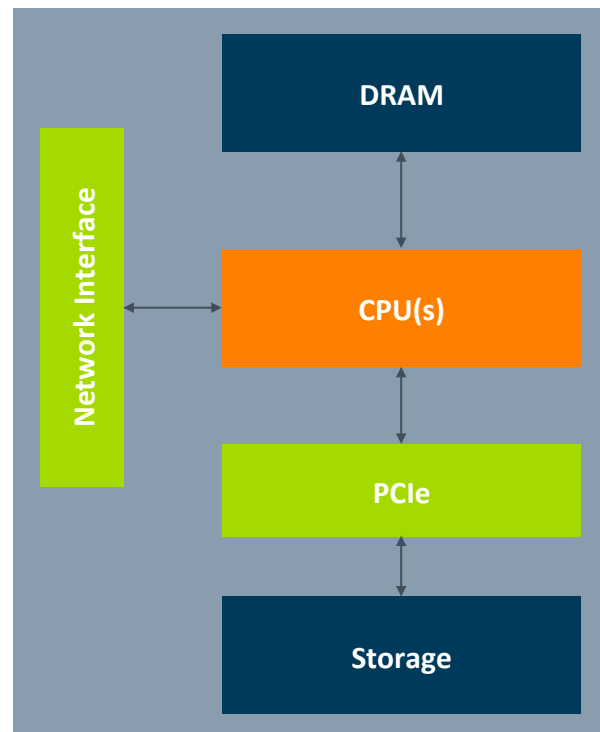
Storage:
- SSD/HDD

Interfaces:
- Ethernet + PCIe/SATA…

Basic Server:

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SSD storage

Compute:
- Arm Cortex-R series or Cortex-A series

Memory:
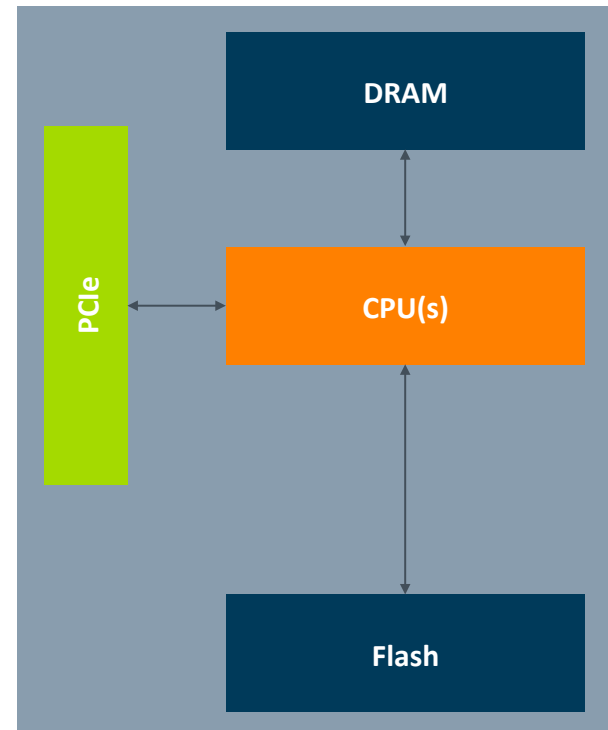- DRAM ~1GB for each 1TB of flash

Storage:
- Today 256GB to 64TB… flash storage

Interfaces:
- PCIe/SATA/SAS…

Basic SSD:

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Edge SSD

Compute:
- Arm-based system-on-chip (SoC)
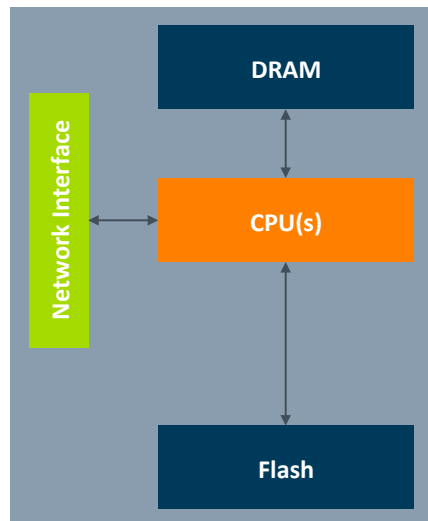
Memory:
- Shared DRAM

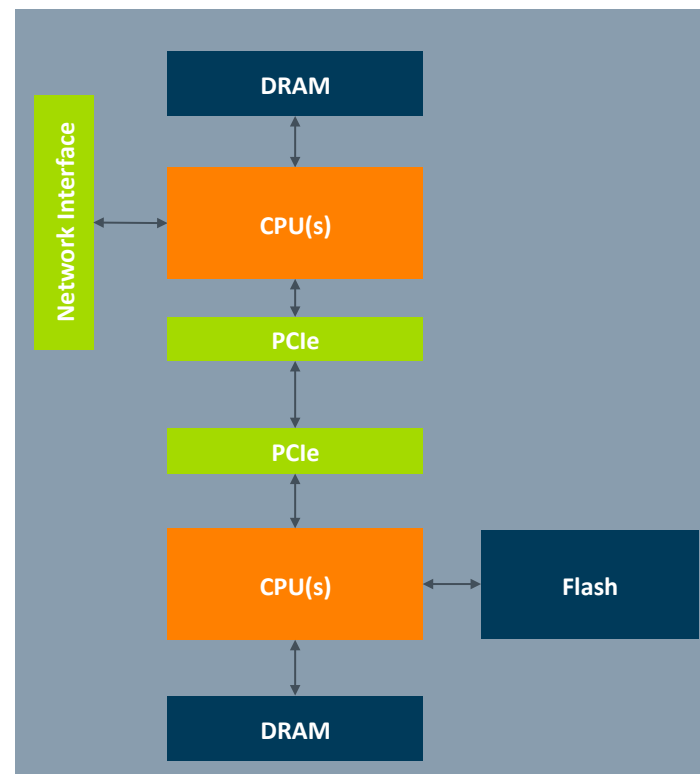Storage:
- Shared Flash

Interface:
- Ethernet…

SSD Based Edge Server:

Vs.

Classic Edge Server:
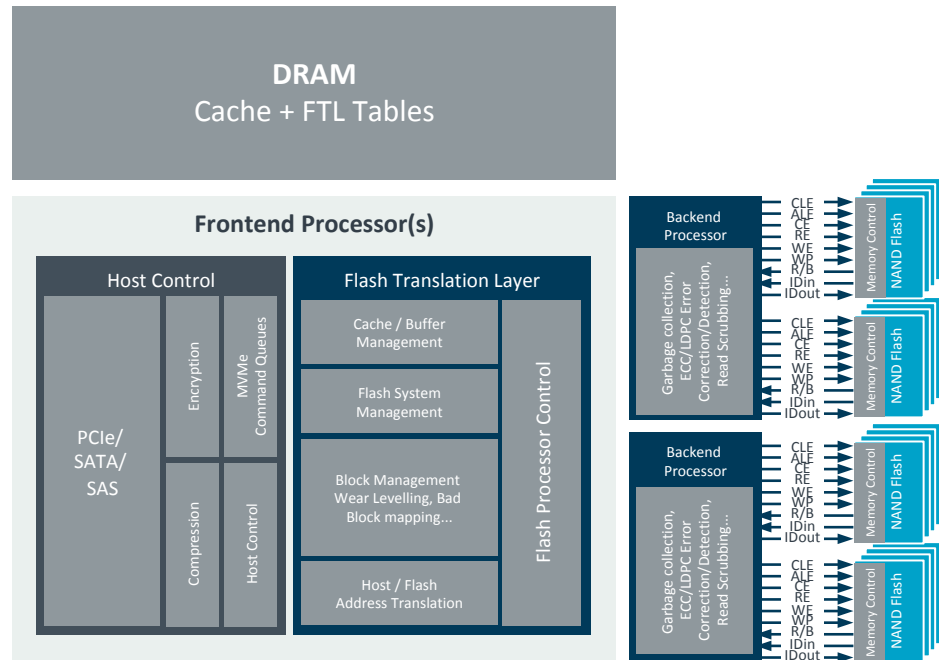
SSD controllers

Compute:

- Frontend: Host I/F + Flash Translation Layer
  - Typically Cortex-R or Cortex-A series
- Backend: Flash management
  - Typically Cortex-R or Cortex-M series
- Custom accelerators: encryption, LDPC,…

Memory:

- DRAM typically >1GB for each 1TB of flash

SSD SoC Functionality:

Adding HLOS for an Edge SSD server

Cortex-A series apps processor running:

- High-level OS such as Linux
- Networking protocols: Ethernet, TCP/IP, RDMA...
- Open source applications and workloads
- Standard administration functions

Edge SSD server:

- Single PCB and product housing
- Apps processor(s) added in to a SSD
- Ethernet network interface
- Internal interface to SSD controller SoC
  - PCIe or could be enhanced by chip-to-chip interface

Apps processor + SSD:

Optimizations

SSD Apps Processor Integration:
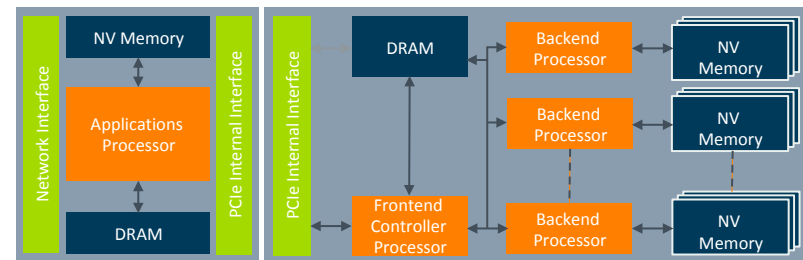
Separate Cortex-A series processor
- Enables any SSD (or HDD) to run Linux
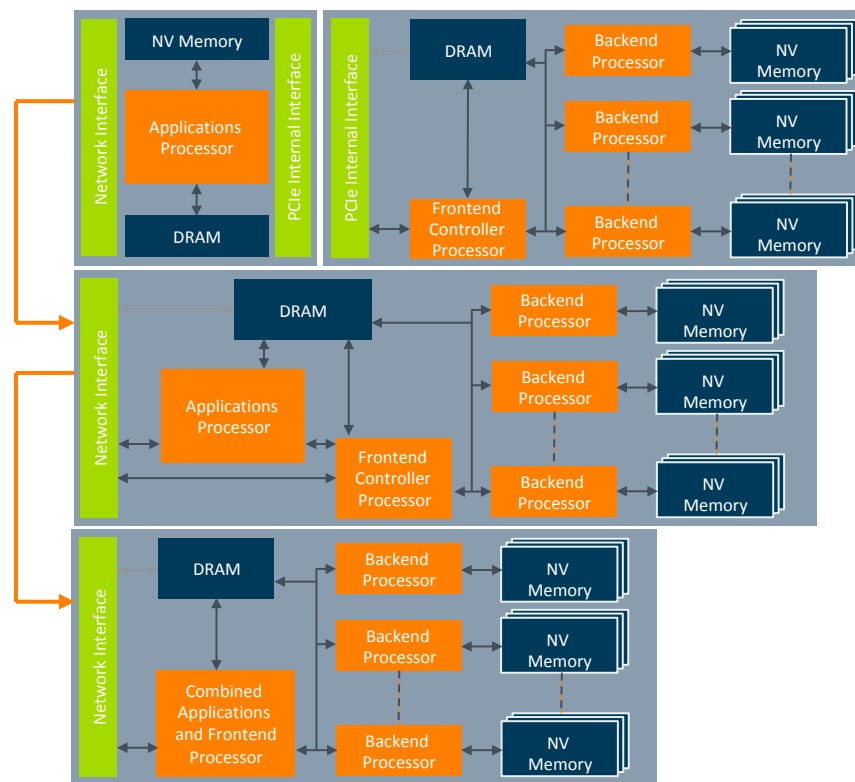- Wide performance range from Cortex-A5 to Cortex-A76

Single SoC for cost/latency reduction
- Lower latency by removing internal (PCIe) interface
- Separation of apps processor and the SSD processing
- Shared DRAM and other SoC resources

Combined into frontend/apps processor
- Hypervisor provides SSD frontend separation from Linux
- Lowest cost and tightest integration
- Lowest possible latency
- Highest internal bandwidth

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Why a SSD for an Edge server? (1 of 3)

An SSD SoC has flexible compute
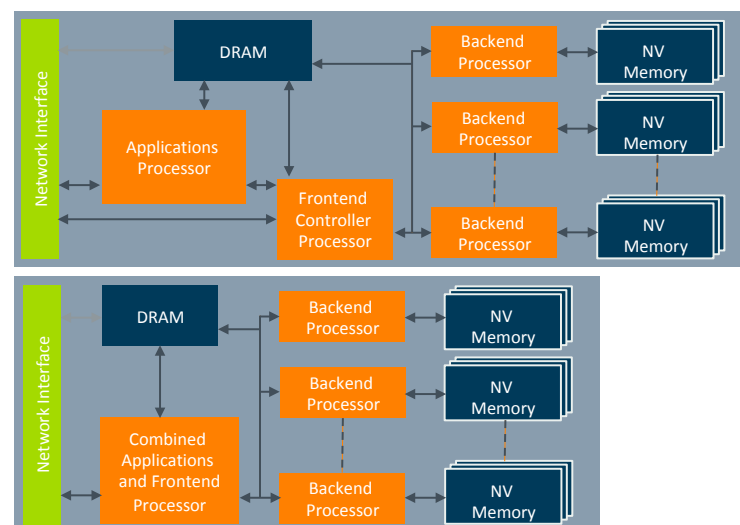- And an Edge server requires storage anyway

Lowest cost
- Adding 'additional' compute in SoC inexpensive
  - More, or larger, cores or additional clusters
- Custom acceleration easily integrated: ML, FPGA...
- Single DRAM reduces requirements

Robust
- Core SSD functionality unmodified
- SSDs can include power loss protection

Edge SSD Server:

Why a SSD for an Edge server? (2 of 3)

Lowest power
- Shared single DRAM
- Minimal data copying and movement
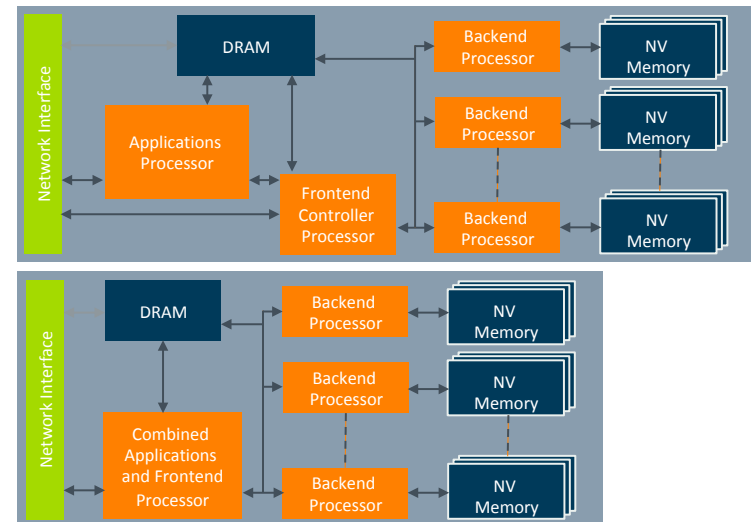- Less protocol processing

High bandwidths
- Ethernet to high bandwidth internal buses
- Parallelism of wide backend processing
- Removes bottleneck of PCIe lanes

Lowest latencies
- No internal cross interface latencies
- In-storage compute or inference all in DRAM

Edge SSD Server:

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Why a SSD for an Edge server? (3 of 3)

Scalability of compute and storage
- Single low power core to multiple clusters of high-performance cores

Flexibility
- One SoC that is suitable for:
  - Edge SSD, NVMe-oF, In-storage compute,…
- Arm NEON and Compute Library for ML…
  - Potential for additional Arm or 3rd party ML

Security
- TrustZone isolates Linux and SSD functionality
- Processing of data is all done on the drive
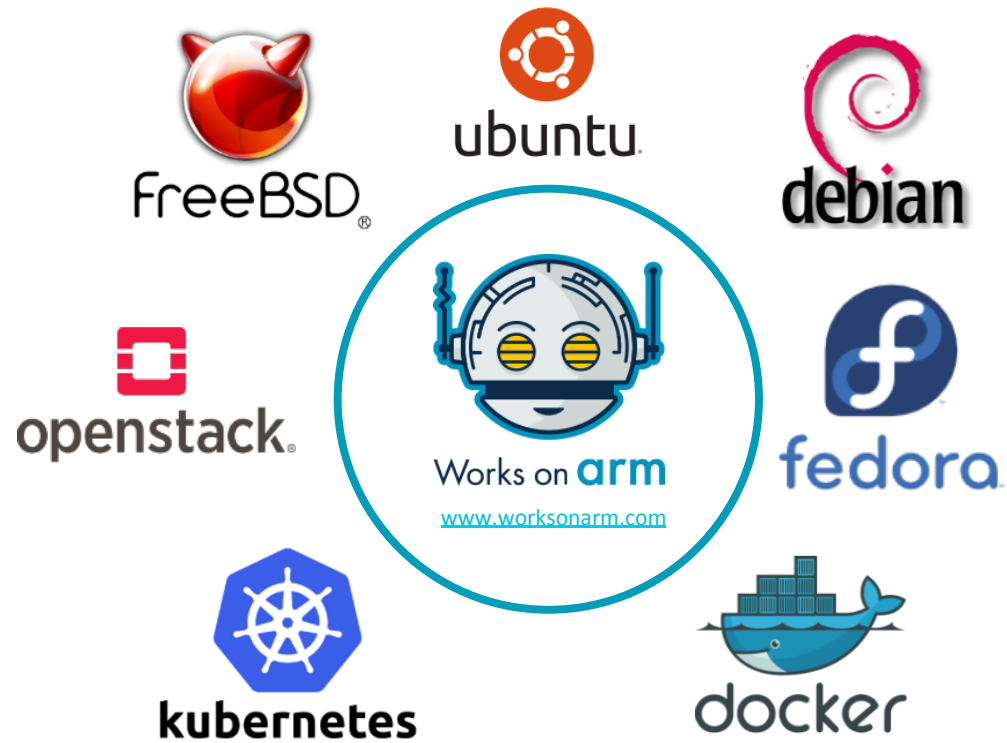- Decrypted data remains on the drive

Edge SSD Server:
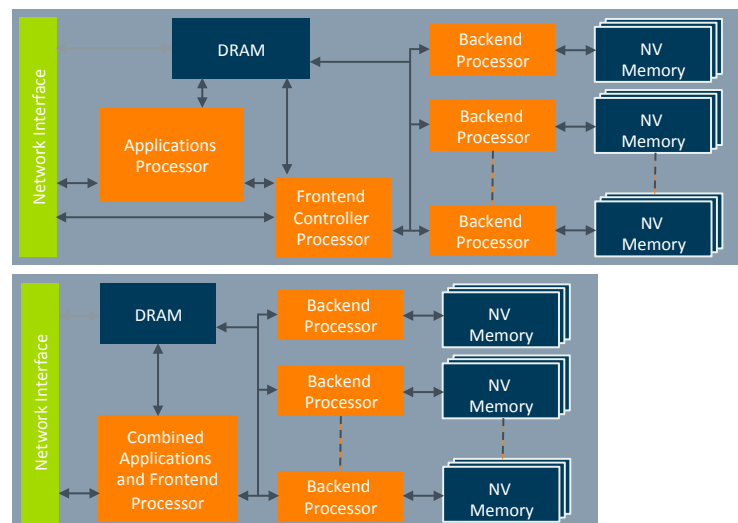
Linux ecosystem on Arm

A few 'Works on Arm' partners

www.worksonarm.com

Conclusions for Edge SSD

- Edge SSD is an evolution not a revolution

- Edge SSD delivers with low-cost, low-power and lowest-latency

- High-performance, high-bandwidth and highly flexible

- Edge SSD and In-storage compute opens up many possibilities
  - This presentation will be made available in FMS proceedings
  - Please come to my second talk on Thursday at 8:30am for more information…
    - COMP-301-1: "Bringing Intelligence to Enterprise Storage Drives"

To learn more…

I'll be here all week!

For more information, visit **storage.arm.com**.

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linkedin.com/nwerdmuller

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Thank You!

Danke!

Merci!

谢谢!

ありがとう!

Gracias!

Kiitos!

감사합니다

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