



Flash Memory Summit

Transforming an SSD into a Cost-Effective Edge Server

Neil Werdmuller
Director Storage Solutions
Arm

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



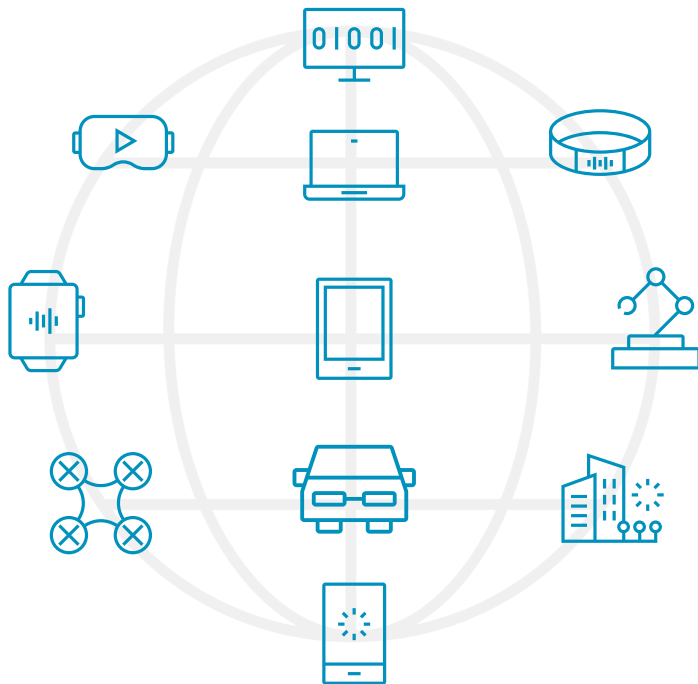
Arm computing is everywhere

#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

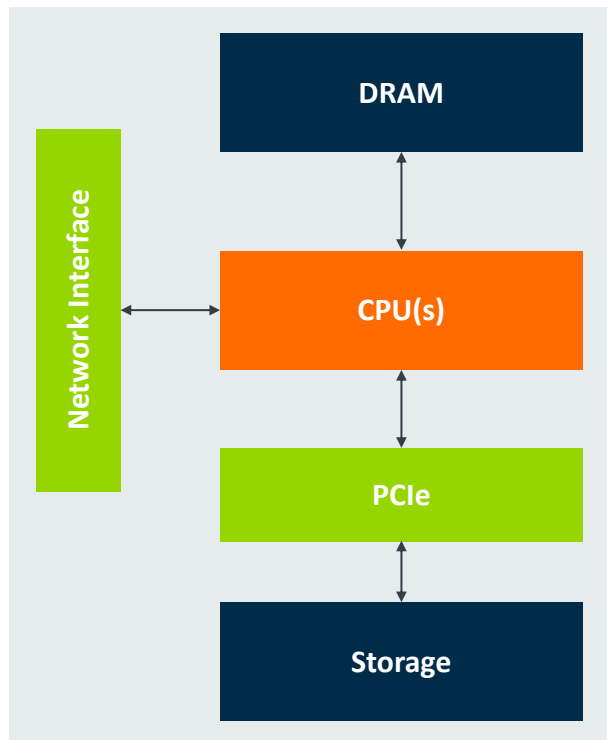
Storage:

- SSD/HDD

Interfaces:

- Ethernet + PCIe/SATA...

Basic Server:





SSD storage

Compute:

- Arm Cortex-R series or Cortex-A series

Memory:

- DRAM ~1GB for each 1TB of flash

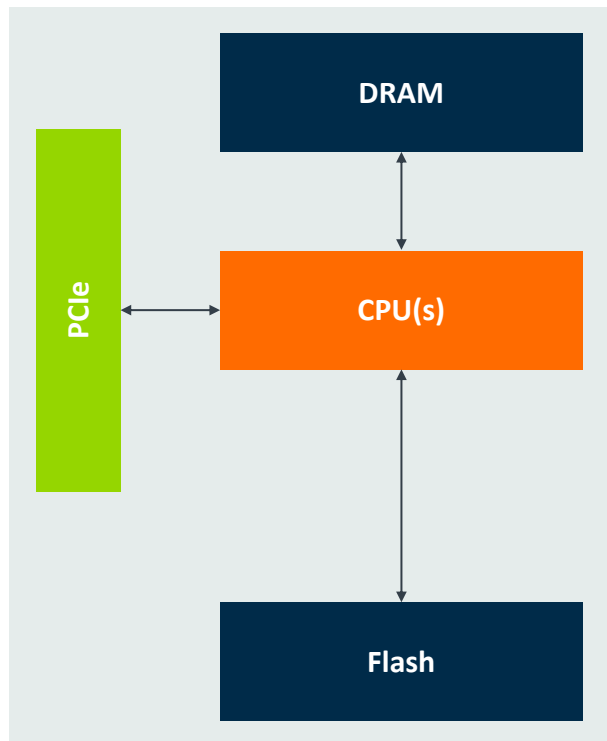
Storage:

- Today 256GB to 64TB... flash storage

Interfaces:

- PCIe/SATA/SAS...

Basic Server:





Edge SSD

Compute:

- Arm-based system-on-chip (SoC)

Memory:

- Shared DRAM

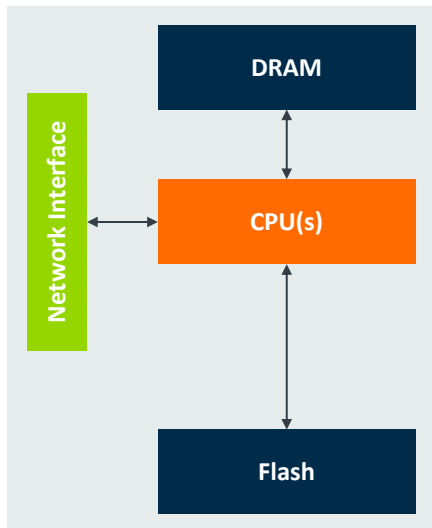
Storage:

- Shared Flash

Interface

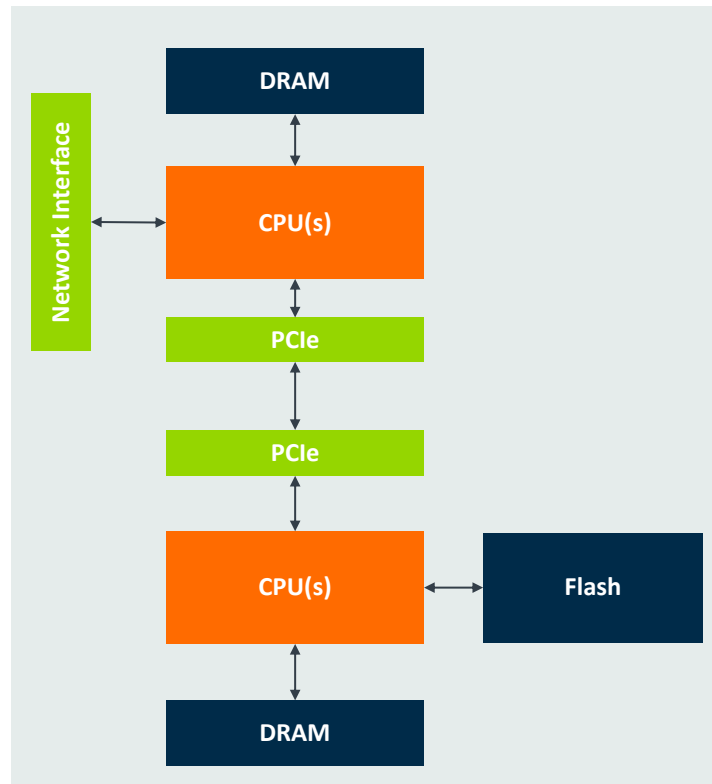
- Ethernet...

Basic Server:



Vs.

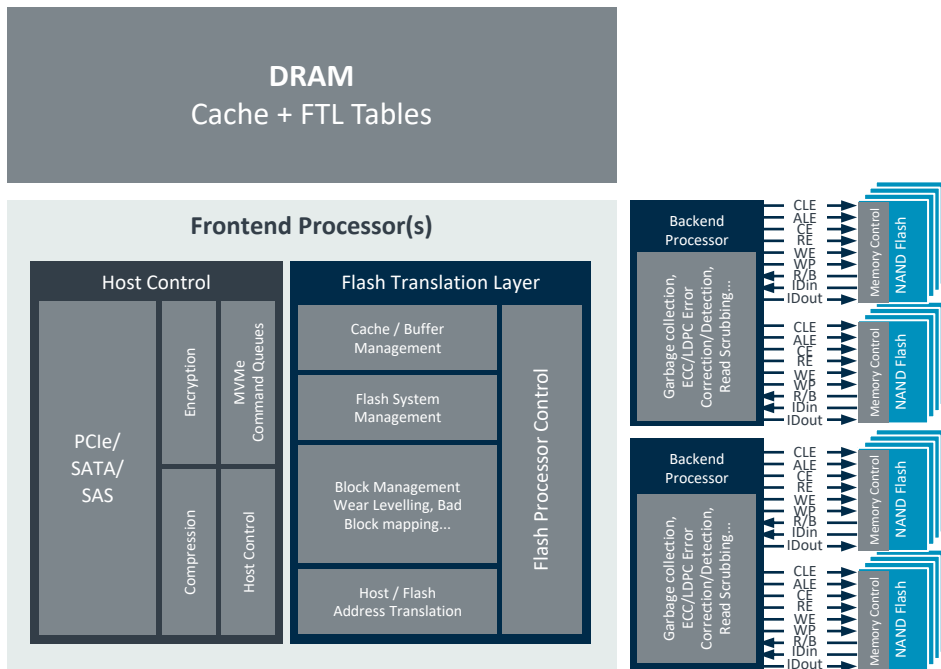
Classic Edge Server:





SSD controllers

SSD SoC Functionality:



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



Adding HLOS for an Edge SSD server

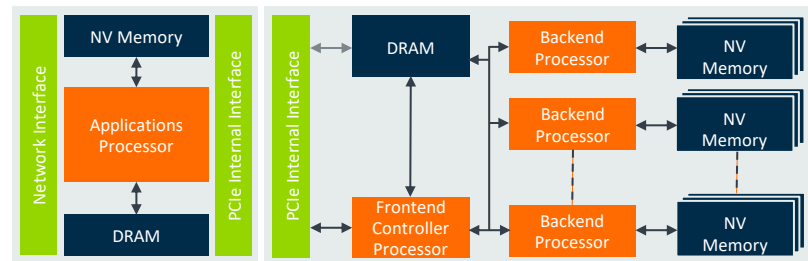
Cortex-A series apps processor running:

- 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

Separate Cortex-A series processor

- Enables any SSD (or HDD) to run Linux
- Wide performance range from Cortex-A5 to Cortex-A76

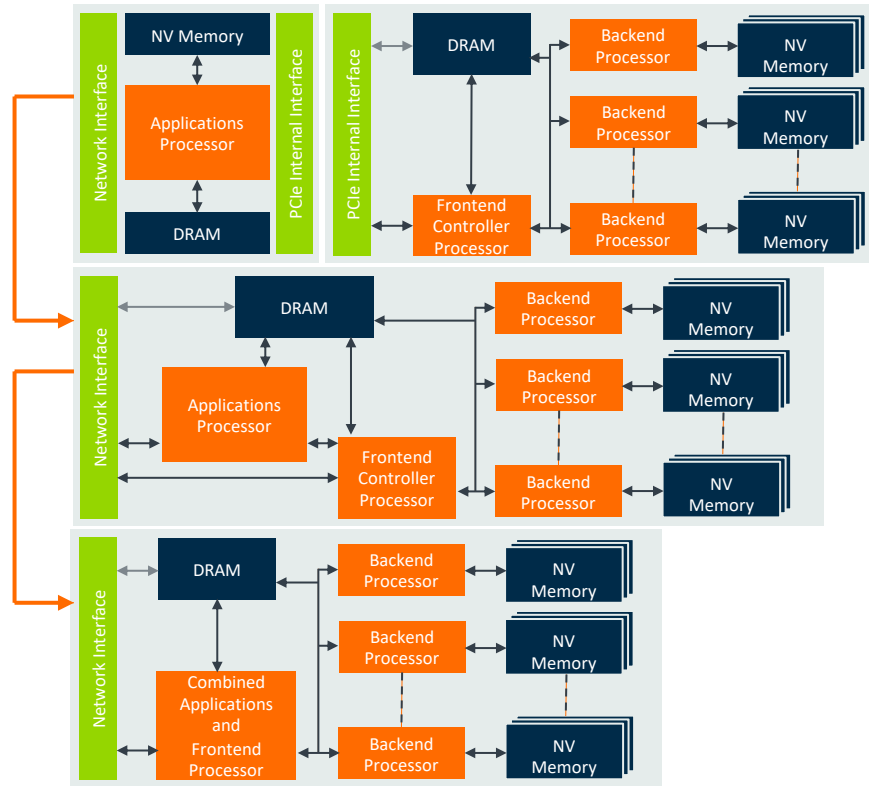
Single SoC for cost/latency reduction

- 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

SSD Apps Processor Integration:





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

An SSD SoC has flexible compute

- And an Edge server requires storage anyway

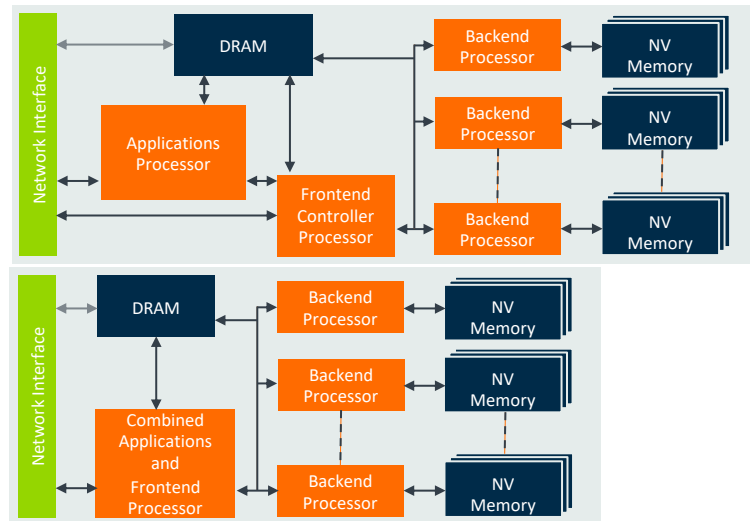
Lowest cost

- 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

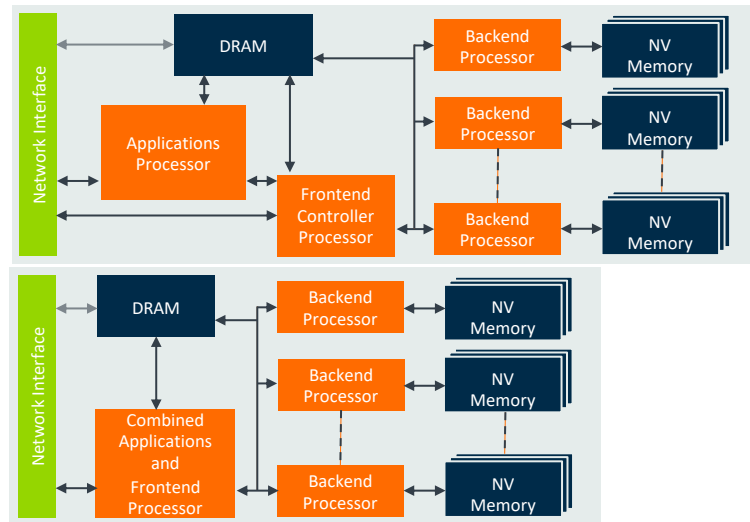
High bandwidths

- 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:





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

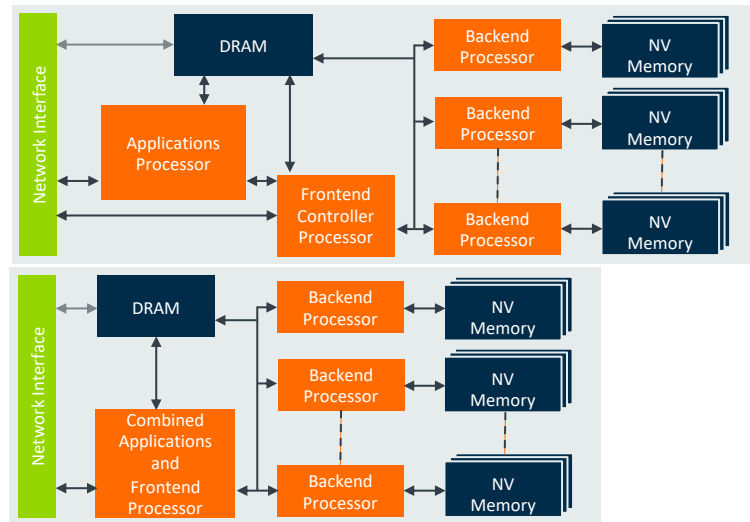
Flexibility

- 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:





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Linux ecosystem on Arm



ceph

arm



BeeGFS®



redhat.



OpenZFS

l.u.s.t.r.e.®



SUSE®



A few 'Works on Arm' partners



FreeBSD®



ubuntu.



debian



openstack.



Works on **arm**

www.worksonarm.com



fedora.



kubernetes



docker

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”



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To learn more...

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

neil.werdmuller@arm.com

linkedin.com/nwerdmuller

Thank You!

Danke!

Merci!

谢谢!

ありがとう!

Gracias!

Kiitos!

감사합니다

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