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
Arm computing is everywhere

#1 shipping processor in storage devices

> 5Bn people using Arm-based mobile phones

21Bn Arm-based chips shipped in 2017

120Bn Arm-based chips to date
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...
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...
Edge SSD

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

Memory:
- Shared DRAM

Storage:
- Shared Flash

Interface
- Ethernet...

Basic Server:
- DRAM
- CPU(s)
- Flash

Classic Edge Server:
- DRAM
- CPU(s)
- PCIe
- Flash

Vs.
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
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
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
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
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
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
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...

For more information, visit storage.arm.com.

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Thank You!
Danke!
Merci!
谢谢！
ありがとうございます!
Gracias!
Kiitos!
감사합니다
धन्यवाद