Viability of Low-Power Architectures as Parallel File Systems

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Summary

- Motivation
- Methodology
- Result Analysis
- Conclusion

Motivation

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- The Increase of processing power comes along with the increase of power demand
- Great power demands are not desirable, both economically and ecologically
- The use of ARM processors are a common strategy to combat this
  - Sacrifice some processing power for the sake of better power efficiency

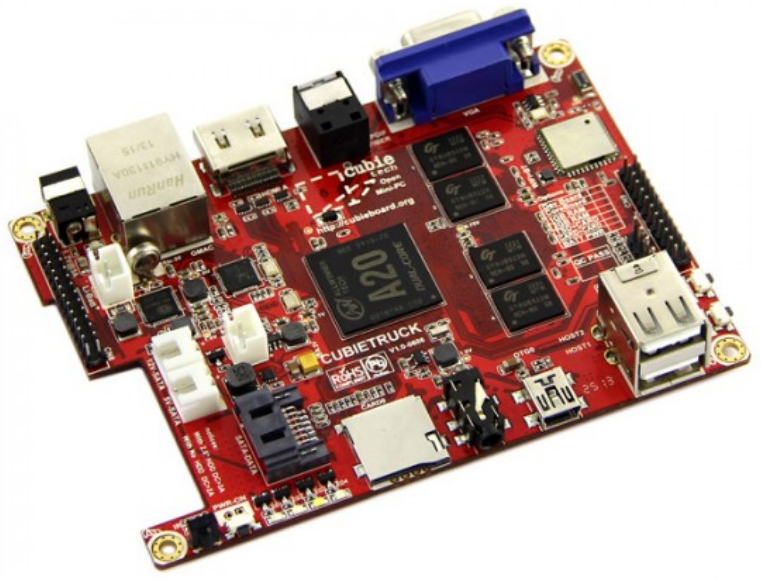
Motivation

- I/O operations also demand a lot of power
- Machines end up not using their full potential on Parallel File Systems (PFSs)
- Possible to use low power architectures instead
- We aim to compare these architectures with a traditional computer, with both working as PFSs

Methodology

Cubietrucks

- ARM architecture
- Low acquisition price
- Low power consumption



Complications

- Unable to run most popular PFSs
- Cubietrucks use a modified version of the Linux Kernel
- No equivalent module for this version of the kernel

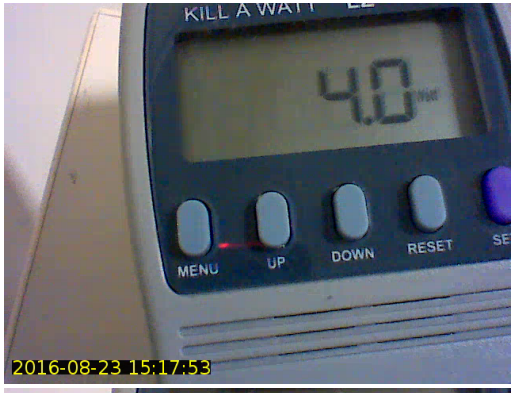
Alternative

- Parallel File System Emulator
- Implemented in C with MPI
- Modifications:
  - Use of trace files
  - Server-only simulations

More Complications

- Power Meters can be expensive
- We used a P4460 Kill A Watt EZ power meter
  - Accuracy of 0.5% in power measurement
- The meter does not have any means of communication with other devices
- We devised a method for data gathering

Fun times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Tests

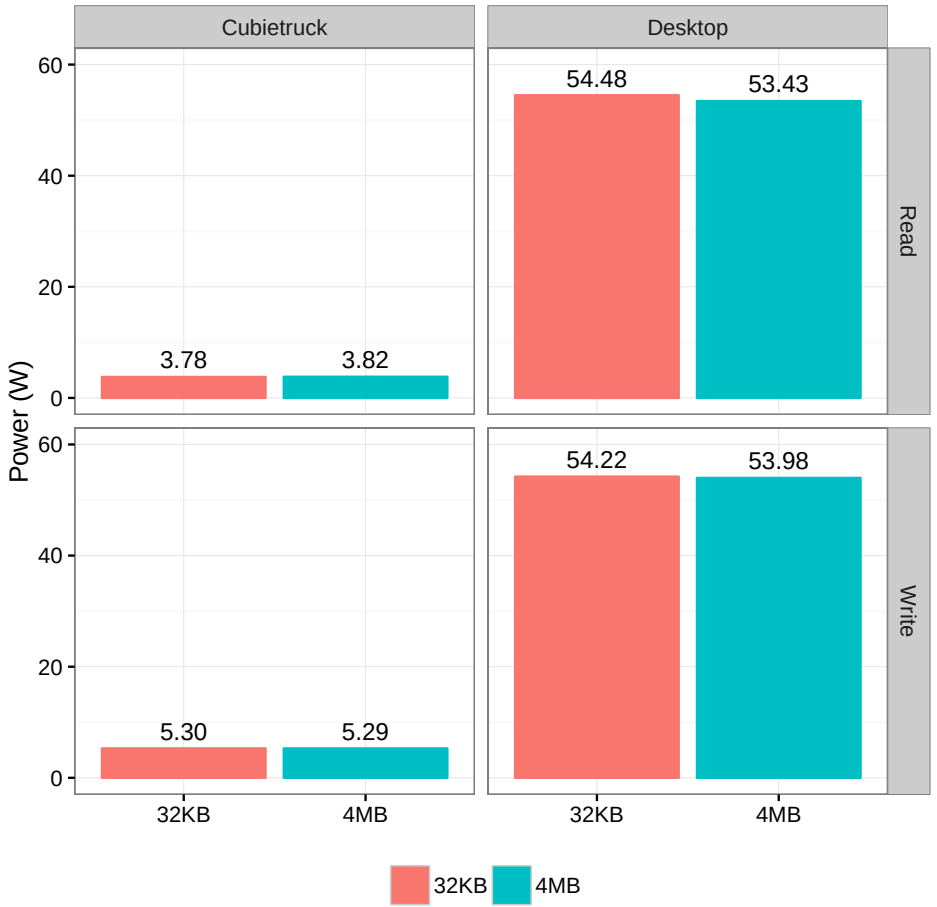
- 6GB contiguous files
- Request sizes: 32KB and 4MB
- Operations: Read and Write
- Each test was repeated five times

Tests' Environment

- Cubietruck
  - A20 Dual core ARM processor running at 1GHz
  - 2GB RAM
- Desktop
  - Intel I5 processor running at 3.2GHz
  - 8GB RAM
- SSD
  - Samsung 840 Series with 500 GB

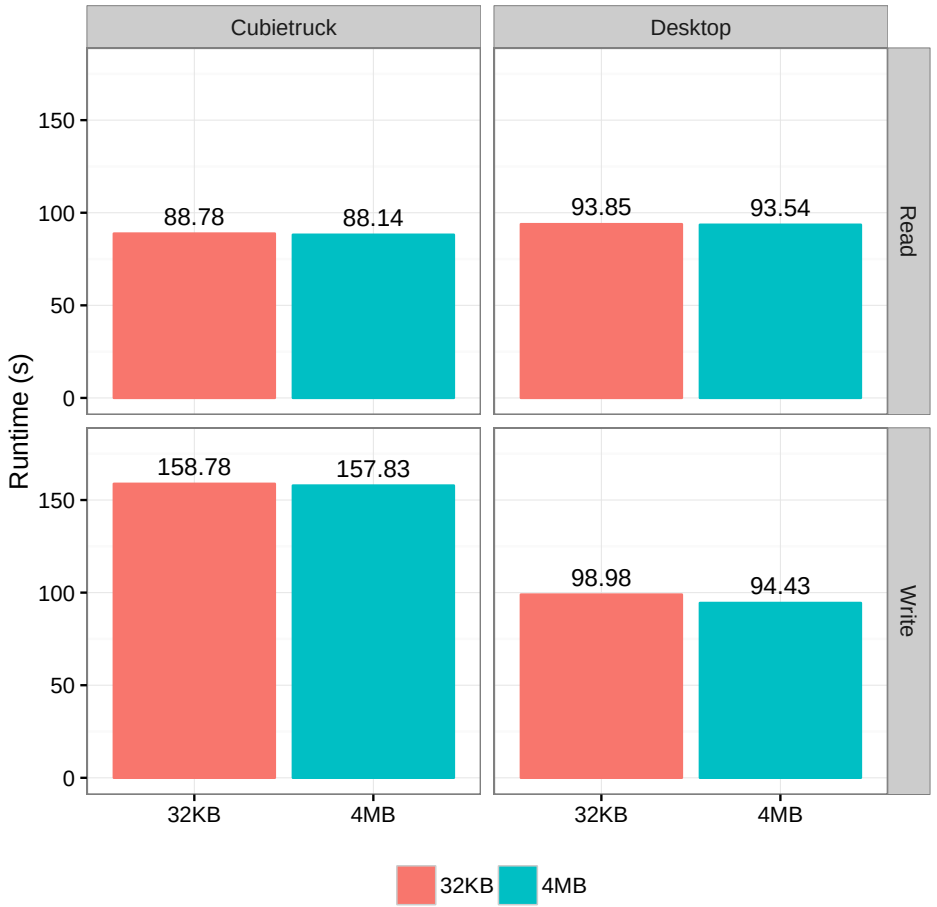
Result Analysis

Power Demand



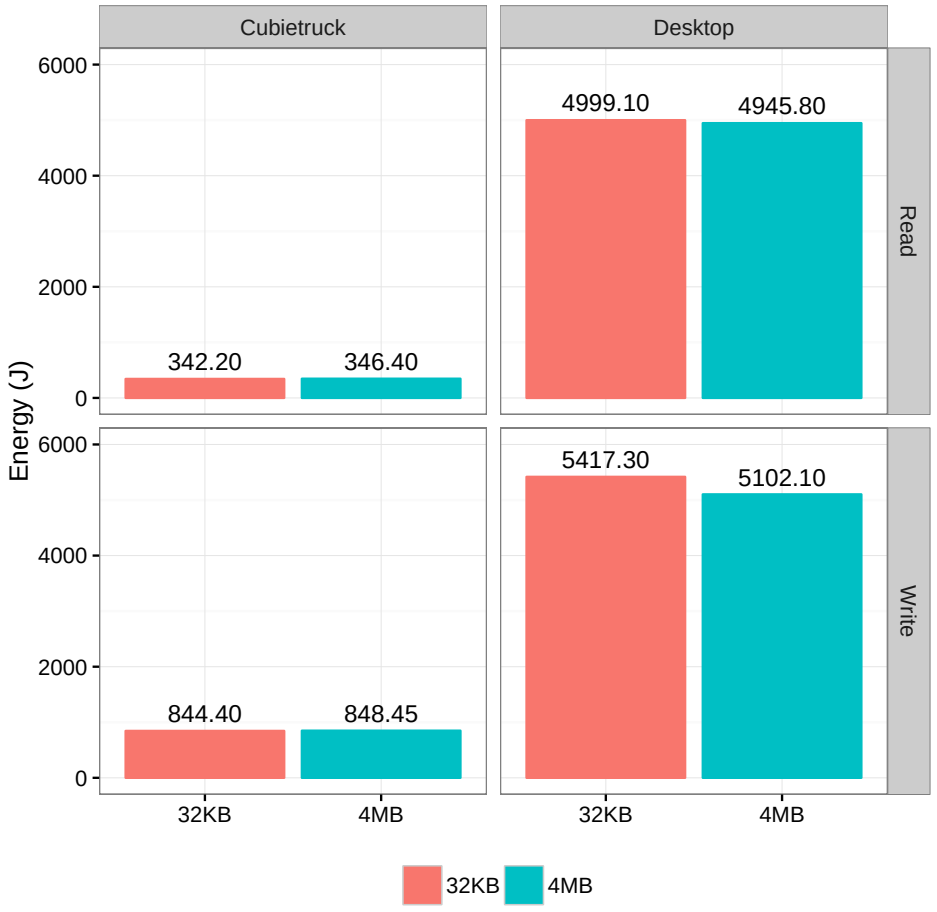
- Write: 90.2% decrease in power demand with Cubietrucks
- Read: 92.8% decrease in power demand with Cubietrucks

Runtime



- Write: Execution time increased by 68.8% with Cubietrucks
- Read: No significant difference in time execution

Energy Consumption



- Write: 83.4% less energy consumed with Cubietrucks
- Read: 93% less energy consumed with Cubietrucks

Conclusion

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- Low-power processors can save up to 83.4% energy demand in write operations and 93% in read operations
- Execution time goes 68% up in write operations, and stays the about the same in read operations
- Regular processors could be substituted by low-power architectures in order to decrease energy consumption in PFSs

Future Work

- Run different workloads
- Include the network
- Emulate real scientific applications