INTEGRATING ARM DEVICES INTO CLOUD INFRASTRUCTURE

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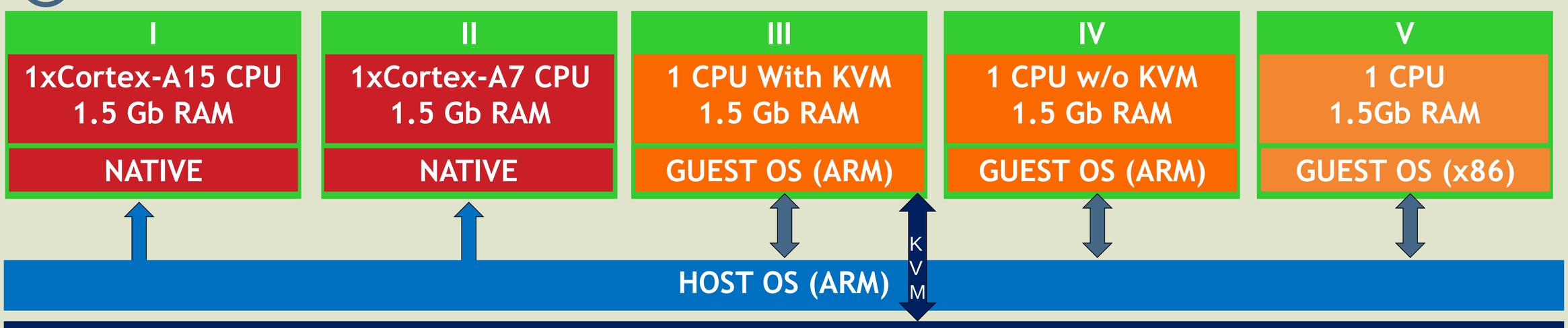
Abstract

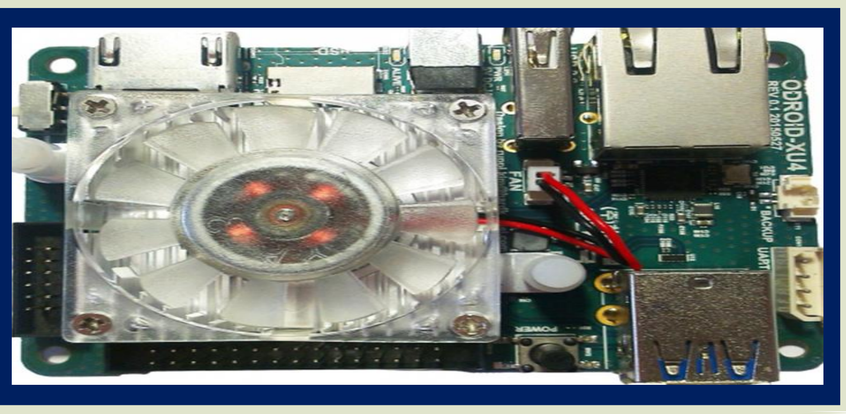
Increasing popularity of ARM-based boards with multi-core processors, along with commodity hardware components with cost-effective power consumption, yet smaller and compact design, has exposed a wide range of opportunities to positively impact computing infrastructure such as redefining building blocks for parallel computing, virtual computing, cloud computing, high performance computing, and real-time computing. With widespread availability of such hardware, nearly anyone can now build a specialized hardware solution to meet required application's performance, cost or power consumption. This work is undertaken to study and evaluate the use of virtualization to build a cloud system on ARM-based embedded boards. In particular, this work will focus on the understanding of how effectively virtualization works on embedded boards and how this idea could be further nurtured to develop a whole cloud based service that provides virtual machines (VMs) on demand. We will discuss various techniques for setting up VMs using open source and publicly available software and tools on ARM-based boards. Our goal is to provide a system that is able to run common desktop operating systems in currently standard architectures, such as Windows and Ubuntu on x86 as well as the capability of supporting native ARM-based operating systems with full KVM support.

Use Cases

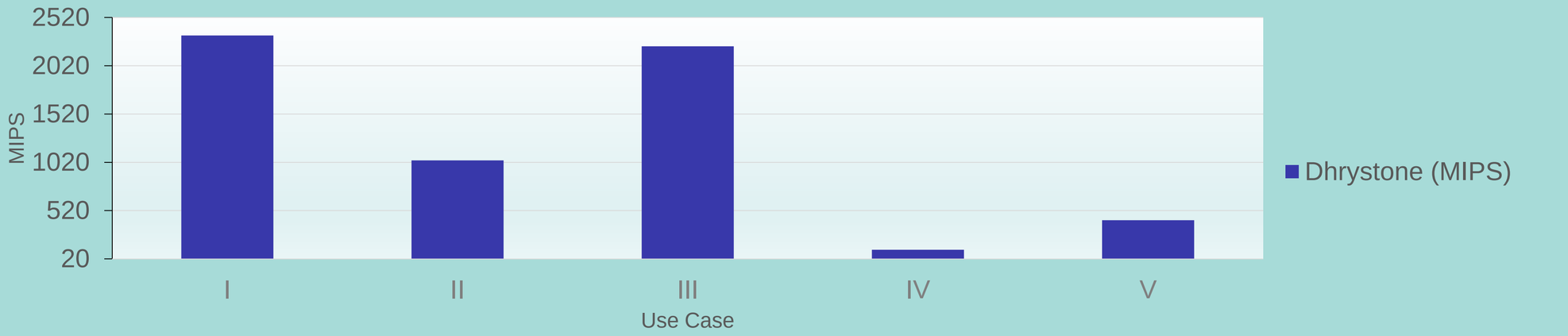


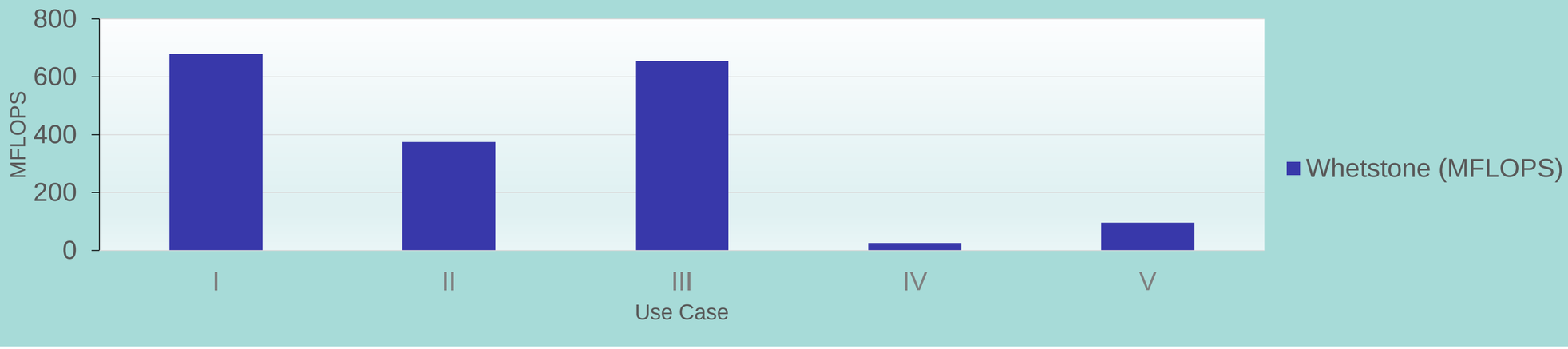
Specifications:

- 4xCortex A15 & 4xCortex A7 CPUs
- 2 Gbyte RAM
- 1XGigabit Ethernet
- eMMC5.0 Flash Storage,
- HDMI & 2xUSB 3.0



Benchmark Results





Conclusion

Our experiments suggest that the near native performance can be achieved in virtualized environment on such a specialized embedded hardware using KVM whereas standard x86 operating systems can also take advantage of performance to power trade-off and performance to cost trade-off. Further, the data provides a strong ground to use these boards as a foundation for building more complex ARM based virtual infrastructure for small to medium institutions.

Our next goal is to run and compare the query processing benchmarks such as TPC-C [9] and TPC-H [10] on this hardware natively and on supported virtual machines for ARM and x86 architectures. We are expecting our ODROID-XU4 performance under TPC-C and TPC-H to be following similar fashion to what we have seen in Dhrystone and Whetstone benchmark. With TPC-C and TPC-H results we would be able to conclude performance of ODROID-XU4 under real time transactional and analytical systems.

Combining virtualization with this commodity hardware, such as ODROID XU4 systems, we have an excellent platform to build a prototype of our proposed low-powered heterogeneous cloud solutions for commercial, as well as personal requirements to build a cluster and serve as a cloud infrastructure to deploy application servers or on-demand virtual machines.

References

1. Michael F. Cloutier, Chad Paradis and Vincent M. Weaver, “Design and Analysis of a 32-bit Embedded High-Performance Cluster Optimized for Energy and Performance” 2014 Hardware-Software Co-Design for High Performance Computing,doi:10.1109/Co-HPC.2014.7.
2. Zonghua Gu, Qingling Zhao, “ A State-of-the-Art Survey on Real-Time Issues in Embedded Systems Virtualization”, Journal of Software Engineering and Applications, 2012, 5, 277-290, http://dx.doi.org/10.4236/jsea.2012.54033 Published Online April 2012.
3. Geoffrey Papaux, Daniel Gachet, and Wolfram Luithardt, “Processor Virtualization on Embedded Linux Systems”,IEEE doi: 10.1109/EDERC.2014.6924360, (Published).
4. Online Technical/Hardware reference for ODROID-XU Board, http://www.hardkernel.com/main/products/prdt_info.php?g_code=G137510300620&tab_idx=1.
5. Ubuntu fork, ubuntu-14.04lts-server-odroid-xu3-20150714, for ODROID-XU, Source : http://www.odroid.in/ubuntu_14.04lts
6. QEMU download link, Online weblink/source https://en.wikibooks.org/wiki/QEMU
7. QEMU user documentation and commands, http://wiki.qemu.org/Download
8. Zhang, Yong, Beng, Dumitrel, Bogdan, A Performance Study of Big Data on Small Nodes”,Department of CS, National University of Singapore, (Published).
9. TPC-C : http://www.tpc.org/tpcc/
10. TPC-H : http://www.tpc.org/tpch/

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