It's finally time for Arm in the Datacenter- and beyond

[TUT1143]
Agenda

• Current state of the Arm server market
• Deployed Arm solutions
• The challenge of Arm processor diversity
• New SUSE pricing model for Arm
• Arm pricing examples
• What is next?
Arm industry events

2016

- SLES 12 SP2 for Arm
  - First commercial release for Aarch64
  - Linux 4.4 kernel
  - Include ThunderX, Xgene2, Opteron A1100
- Cavium develops ThunderX
  - Dual socket 48 cores/socket 64 bit Arm SoC
- Broadcom exits Arm server market
  - Vulcan processor shelved
- Cavium purchases Broadcom IP
  - Vulcan processor becomes ThunderX2
  - Dual socket 32 cores/socket
- Ampere Computing formed
  - Purchases Applied Micro Arm IP
  - eMAG processor released

2017

- SLES 12 SP3 for Arm
  - Include ThunderX2, Centriq 2400
- SUSE Enterprise Storage 5 for Arm
  - X86 and Arm fully supported
- First ThunderX2 benchmarks
  - Comanche Early Access program
  - First revealed at SC 2017
  - 33% improvement over X86-64
- First Catalyst UK system ships
  - 64 node systems
  - University of Edinburgh
- Sandia Labs Astra Top 500
  - 2,592 Apollo 70 nodes
  - 1.529 Petaflops - #203 on Top 500

2018

- SLES 15 for Arm
  - Linux 4.12 kernel
  - Added Raspberry Pi+ and Compute
  - New, separate HPC product for X86 and Arm
- Raspberry Pi support
  - SLES 12 SP3
  - Raspberry Pi 3 Model B
- HPE Apollo 70
  - First “Yes” certified
- Qualcomm announces Centriq 2400
  - Single socket Arm server for hyperscalers

2019

- SLES 12 SP4 for Arm
  - Linux 4.12 kernel
- SLE HPC 12 SP3
  - Arm and X86
- Cavium ThunderX2 GA
- Cavium purchased by Marvell
- HPE, SUSE, Arm announce Catalyst UK
  - 64 node systems
  - Edinburgh, Leicester, Bristol Universities
- Qualcomm pauses Arm server market
  - Centriq 2400 future unclear
- First Catalyst UK system ships
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Arm for data center and beyond
SUSE Linux Enterprise Server for Arm
provides customers with an enterprise-grade Linux distribution optimized for 64-bit Arm servers to deliver outstanding performance, reliability and scalability for data intensive, mission-critical workloads.

- SUSE Linux Enterprise Server for ARM enables solution developers and adopters to:
  - Accelerate innovation and improve deployment times for a broad choice of open source and partner solutions.
  - Provide a rock solid mission-critical foundation for emerging 64-bit ARM servers while exploiting unique ARM capabilities for storage, networking and high performance computing
  - Deliver a high-performance platform to meet increasing business demands with improved application performance, scalability for growth and instant access to data.

SLES for Arm releases
- SLES 12 SP2 in November 2016
- SLES 12 SP3 in August 2017
- SLES 15 in July 2018
- SLES 12 SP4 in December 2018
SUSE Linux Enterprise Server ARM

Offering commercial Linux support for ARM AArch64 since November 2016

SUSE Enterprise Storage 5
- Ceph software defined storage
- X86 and ARM

SLES for ARM (SP1)
- Initial commercial release AArch64
- SoC: Cavium, Xilinx, AMD, others
- Focus on solution enablement
- Kernel 4.4
- Toolchain gcc 6.2.1

SLES 15 for Arm
- Available for X86, ARM, Power, system z
- Bi-modal: traditional and CaaSP
- Simplified management
- Kernel 4.12
- Toolchain gcc 7+

SLES 12 for ARM (SP2)
- Second SUSE release for AArch64
- Additional SoC enablement
- Expand to early adopters
- Kernel 4.4
- Toolchain gcc 6.2.1 -> gcc 7

SLES 12 for ARM (SP3)
- Second SUSE release for AArch64
- Additional SoC enablement
- Expand to early adopters
- Kernel 4.4
- Toolchain gcc 6.2.1 -> gcc 7

SLES for ARM Raspberry Pi
- Commercial support focused on IoT

SUSE Manager for Arm
- Lifecycle Management

SLES 12 for ARM (SP4)
- Kernel 4.12
- gcc 8

Arm for data center and beyond
SUSE Linux Enterprise For Arm Continuum

• SUSE Linux Enterprise for ARM and SLE HPC for Arm
  - Fully supported by SUSE
  - HPC Module supports Arm and X86-64

• PackageHub
  - SUSE curated, community supported packages https://packagehub.suse.com/
  - Over 500 packages available for Aarch64

• OpenSUSE LEAP
  - Free, community supported Linux
  - Free Developer subscriptions

• Related Products
  - SUSE Enterprise Storage
  - SUSE Manager
  - SUSE OpenStack Cloud (tech preview)
Sandia National Labs - Astra

- Largest Arm HPC cluster deployed
  - 1.59 Petaflops – #203 in the HPC TOP 500
  - 2,592 Compute nodes
  - 145,152 Armv8 cores – Marvell (Cavium) ThunderX2
Marvell ThunderX2 – Memory Bandwidth


ThunderX2 is 33% higher performance compared to Skylake
Isambard – UK Tier 2 HPC service from GW4

• Cray “Scout” XC50 series system
  – 10,000+ Armv8 cores – Cavium ThunderX2
  – Cray Aries interconnect
  – Cray Linux Environment based on SUSE Linux
Catalyst UK project:

HPE, Arm, SUSE, and three leading UK universities establish one of the largest Arm-based supercomputer deployments in the world

Goal: Propel the Arm HPC ecosystem and exascale computing in the UK

- More than 12,000 Arm-based cores running across three universities
- 64 Apollo 70 systems per site
- Two 32 core Marvell (Cavium) ThunderX2 processors per system
- Running SUSE Linux Enterprise for High Performance Computing
Catalyst UK – Arm based High Performance Computing

• **Current Status:**
  – Three 64 node HPE Apollo 70 HPC clusters deployed
  – SUSE Linux for HPC 12 SP3
  – HPE High Performance Computing Cluster Management (HPCM)
  – Slurm workload scheduler from SUSE HPC Module
  – Initial qualification and performance testing

• **Plans:**
  – Upgrade to SLES 15
  – Testing of SUSE Enterprise Server for Arm
  – BOF session at ISC 2019
SUSE Linux Enterprise for Arm: Raspberry Pi support

- Commercial support for Raspberry Pi (SLES 12 SP3)
  - Raspberry Pi 3 Model B
  - Raspberry Pi 3 Model B+ (SLES 15)
  - Raspberry Pi Compute Module (SLES 15)
- Response to customer demand
  - Customers needed secure and supported Linux
- Enabled for Wi-Fi, Bluetooth, HDMI, Ethernet, and GPIO
- Download from https://tinyurl.com/slespi
- Quick start guide: bit.ly/sles4piquickstart
- Q&A support on https://forums.suse.com/forum.php
Customer demand for SLES on the Raspberry Pi

– Initial use cases for industrial & manufacturing
  • Monitor capital equipment with long life span and little or no built-in monitoring
    • Alert when equipment is broken or idle
  • Low cost PC for assembly line operators
    • Allow operators to communicate problems quickly via a touch screen

– Other known use cases
  • Distributed network monitoring
    • Watch for DDOS or other network problems
  • Restaurant kiosk
    • Easy ordering via touch screen
  • Digital signage

– Why the Raspberry Pi?
  • Inexpensive
  • Widely available
  • Good enough
SLES for Arm on Raspberry PI Deployments

• Industrial manufacturing (Knorr-Bremse)
  – Monitor long lived capitol equipment
  – Provide line outage communications from workers

• Automotive manufacturing
  – Monitor production line for outages
  – Proactive failure avoidance
  – Target: 8,000 units

• Environmental monitoring
  – Monitor water levels and environmental conditions
  – Battery operated outdoor deployment
  – Target: 4,000 units
Knorr-Bremse Success story

- Knorr-Bremse, a global leader in braking and commercial transport systems, needed to get real time insight to improve their manufacturing.
- Many of the machines they use are extremely long lived and had no provision for remote monitoring.
- Knorr-Bremse worked with SUSE to develop an IoT gateway solution based on SUSE Linux for Arm running on Raspberry Pi 3 Model B single board computers to provide the infrastructure for device monitoring and real time feedback from manufacturing workers.
- SUSE Manager is used to manage and update the deployed IoT devices.

SUSE Linux Raspberry Pi Environmental Monitoring

• **Problem:**
  – Monitoring water levels and other environmental conditions across thousands of remote locations

• **Solution:**
  – SUSE Linux for Arm running on a MyPi Industrial IoT Integrator board with a Raspberry Pi Compute Module 3
  – Ruggedized case, solar power, & multiple network protocols for communication
  – Back office analytics of environmental data

• **Status:**
  – Early deployment and acceptance testing with SLES 15 SP1 beta
SUSE Linux Enterprise 15 for Arm

SLES 15 Includes enablement for these Arm SoCs*

Advanced Micro Devices (AMD) – Opteron A1100
Broadcom – BCM2835 Raspberry Pi 3 Model B, B+, and Compute Module 3
Marvell/Cavium - ThunderX
Marvell/Cavium - ThunderX2 CN99xx
Cavium - Octeon TX
NXP - QorIQ LS2085A / LS2045A, LS2080A / LS2040A
NXP - QorIQ LS1043A
Ampere Computing - XGene 1, XGene 2
Ampere Computing - eMAG
Marvell - Armada 7040/8040
Huawei Kunpeng 920
Rockchip - RK3399
Qualcomm - Centriq 2400
Xilinx – Zynq UltraScale+ MPSoc

• Upstream kernel version: 4.12
• KVM with libvirt
• GCC 8
• HPC module

HPE Apollo 70 with Marvell ThunderX2 processors is the first Arm server to receive SUSE “YES” certification

* Please check with your specific hardware vendor. Due to the rapidly evolving availability of ARM System on a Chip hardware, not all platforms have undergone the same degree of hardware testing.
Other SUSE Products for Arm

SUSE Enterprise Storage
Available 2017

SUSE Manager
Available 2018

SUSE OpenStack Cloud*
Technology preview

Arm for data center and beyond
SUSE PackageHub

Community Packages for SLES

• Built and maintained by the community of users
• Approved and supported by SUSE
• High-quality, up-to-date packages delivered by openSUSE Factory
• No additional charge to use packages
• Packages available for the life of the product, including multiple releases

About 1000 packages available for X86-64
More than 500 packages available for ARM

<table>
<thead>
<tr>
<th>Package</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>clustershell</td>
<td>Administrative</td>
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<tr>
<td>robinhood</td>
<td>Administrative</td>
</tr>
<tr>
<td>singularity</td>
<td>Runtime</td>
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<td>TensorFlow</td>
<td>ML framework</td>
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Arm for data center and beyond
# Arm Diversity

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<tr>
<th>Max core per SOC</th>
<th>Max # Cores</th>
<th>Sockets</th>
<th>System on a Chip (SOC)</th>
<th>Usage</th>
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<td>Cavium Octeon TX 1-24 processors (SP3)</td>
<td>NFV / Networking Infrastructure</td>
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<td>Xilinx – Zynq UltraScale+ MPSoC</td>
<td>Embedded networking, surveillance</td>
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<td>NXP - QoriQ LS2085A / LS2045A, LS2080A / LS2040A</td>
<td>Consumer NAS, Smart Home, Gateway</td>
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<td>Qualcomm - Centriq 2400 (SP3)</td>
<td>Hyperscalers, General datacenter</td>
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<td>Cavium - ThunderX2 CN99xx (SP3)</td>
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<td>48</td>
<td>96</td>
<td>2</td>
<td>Cavium - ThunderX</td>
<td>Previous generation – shown for context</td>
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</table>

Arm for data center and beyond
SLES for Arm pricing model – Effective Dec 2018

• **Pricing Summary**
  – Less than 16 system cores: Charge per group of four cores (stackable to 15 cores)
    • $50 for Physical price, $100 Unlimited VM Standard (Priority will follow the same approach)
  – 16 or more system cores: Charge 1-2 socket price (stackable to more sockets)
    • $799 for Physical, $1598 Unlimited VM Standard (Priority will follow the same approach)

• **Available on Corporate MLA/VLA, ISV/IHV, and Appliance price lists**
  – Appliance/Embedded deals can use as a starting point for negotiating individual deals
  – Also provide L3 prices on ISV/IHV and Appliance price lists

• **Same model used for SUSE Manager**
The Raspberry Pi 3 Model B has 4 Broadcom processor cores. Because the total number of cores in the server is less than 16 cores, you use the 4-core group-based pricing.

Raspberry Pi 3 Model B

Number of cores = 4
Number of cores / 4 = 1
Number of 4-core subscriptions required = 1
Systems based on the Marvell Octeon TX can have from 1 to 24 processor cores. In this example, we use a 14 core Octeon TX processor. Because the total number of cores in this server is less than 16 cores, you use the 4-core group-based pricing. This example also demonstrates how the number of cores is rounded up to the nearest integer multiple of 4.
The Raspberry Pi 3 Model B has 4 Broadcom processor cores. Because the total number of cores in the server is less than 16 cores, you use the 4-core group-based pricing for SUSE Manager Lifecycle for Arm.

Raspberry Pi 3 Model B

Number of cores = 4

Number of cores / 4 = 1

Number of 4-core subscriptions required = 1
What’s next for SLES for Arm?
Questions?

STUMP the CHUMP
SUSE Linux for Arm

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