



# Use Cases and Best Practices Primer for SUSE® and ARM

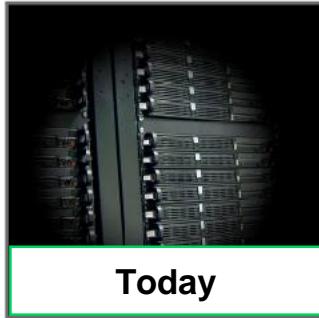
CAS91763

Andrew Wafaa  
Principal Engineer  
ARM Ltd

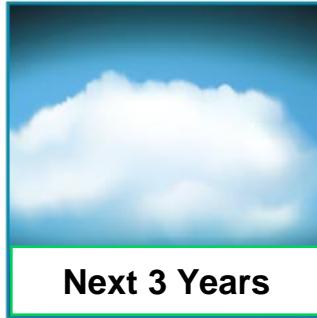
Alexander Graf

Dirk Mueller

# The Data Center is Evolving



Today



Next 3 Years



5 Years +

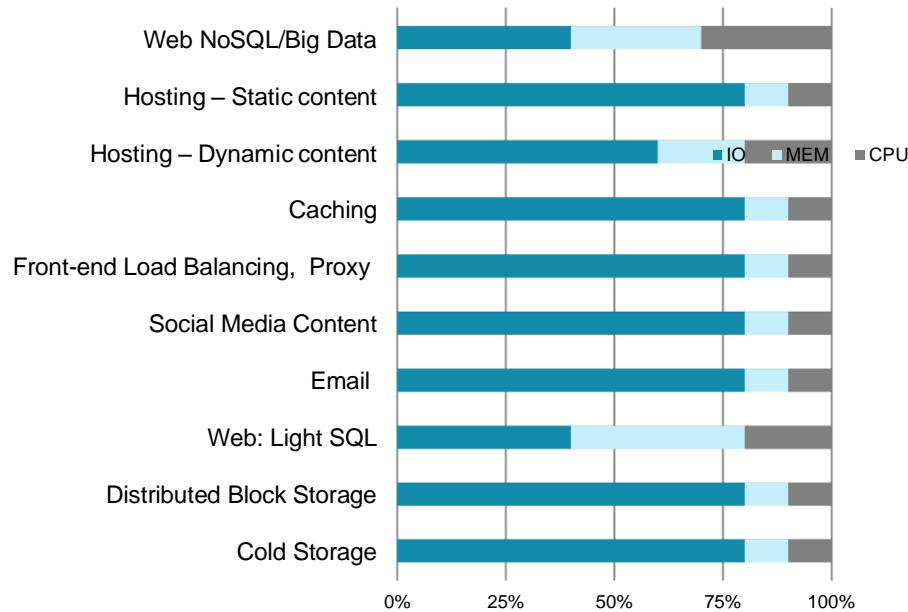
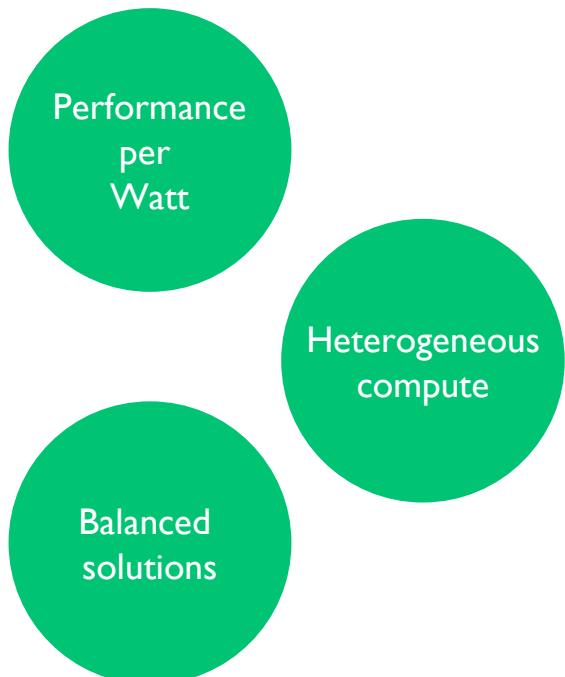
Data center workload characteristics are scaling out

Throughput

Workload  
optimized

Total cost  
of  
ownership

# Modern Workloads Driven by IO Performance



# **TODO: current / legacy state of things**

# Applicability of ARM for Server Workloads

2016-2017	2017-2018	2018-2019	2020

# Applicability of ARM for Server Workloads

2016-2017	2017-2018	2018-2019	2020
Storage			

# Innovation Delivering Value



3-7x  
lower end  
user cost

Nine  
9's data  
reliability

Enhanced  
end to end  
security

3x  
power  
savings

Self  
managing  
scalability

S3  
compatible  
APIs



[AppliedMicro Announces the Availability of its Mudan Storage Platform](#)

# Applied Micro (AMCC) Launches Mudan Storage Platform

 ZACKS June 29, 2016

t

f

Leading provider of integrated circuits (ICs), **Applied AMCC**, recently announced the availability of Mudan runs on its X-Gene Server on a Chip (SoC) solution, .

Mudan is the world's first fully integrated Ceph storage technology, which has been jointly developed by **Applied AMCC** and **Red Hat**. It is a highly advanced storage reference platform, which provides customers with maximum card configurability from a variety of vendors.

The growing demand for X-Gen based solutions to provide higher performance and reduce total cost of ownership was the driving force behind this collaboration.

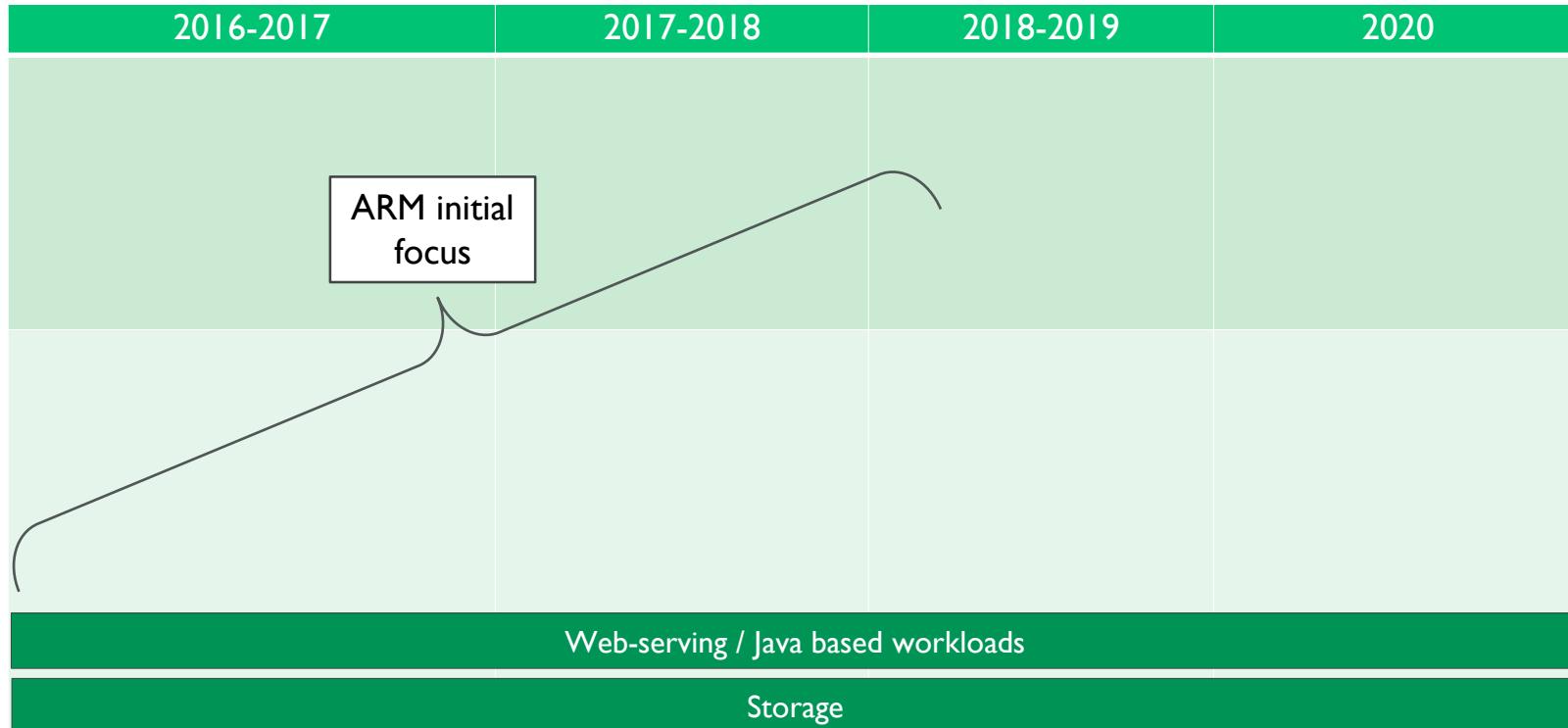


[Ceph extends tentacles to embrace ARM in Jewel release](#)



ceph

# Applicability of ARM for Server Workloads



# Delivering Value in the Traditional Data Center



10x compute  
density per  
rack

1.8x Lower  
system cost

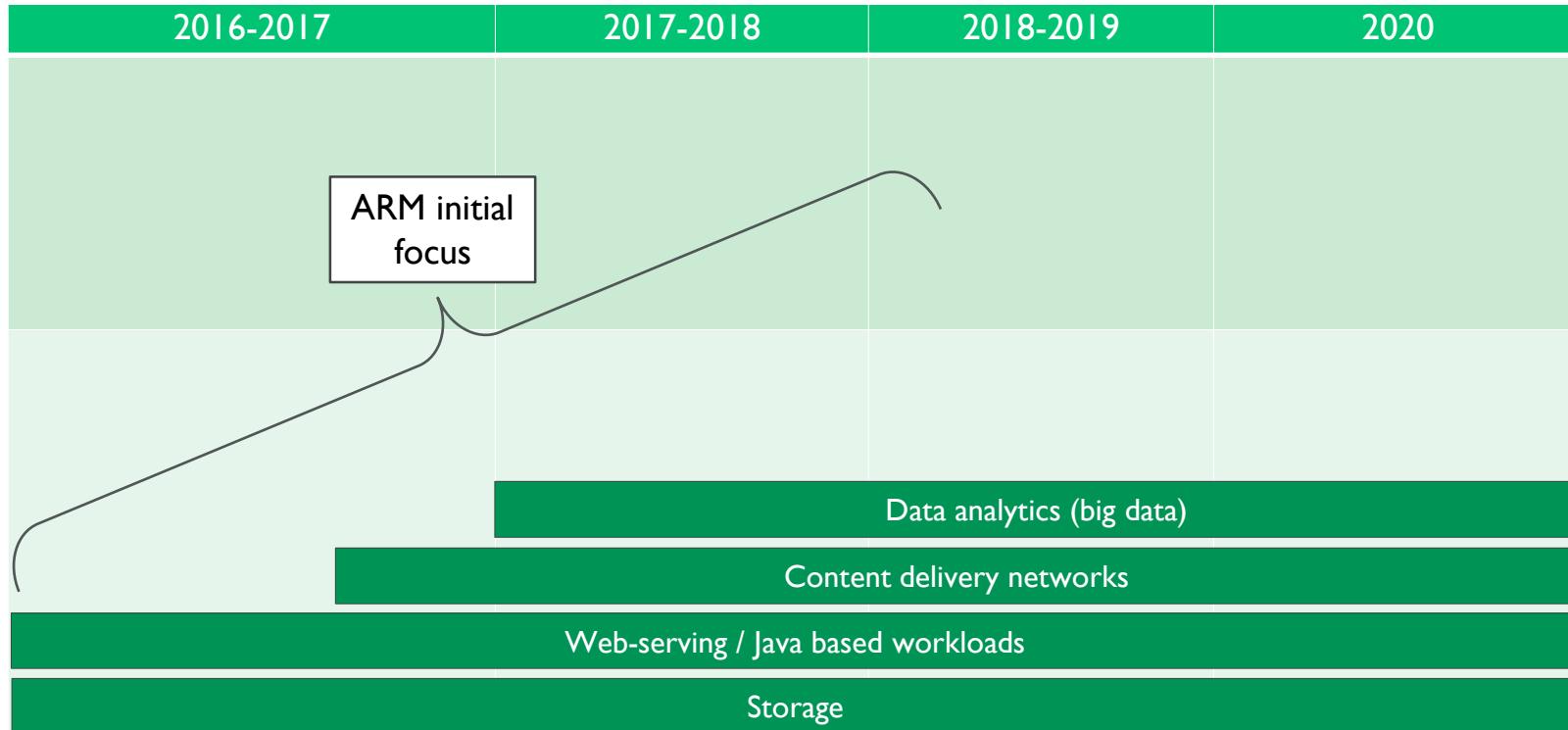
7x lower  
power  
consumption  
per year



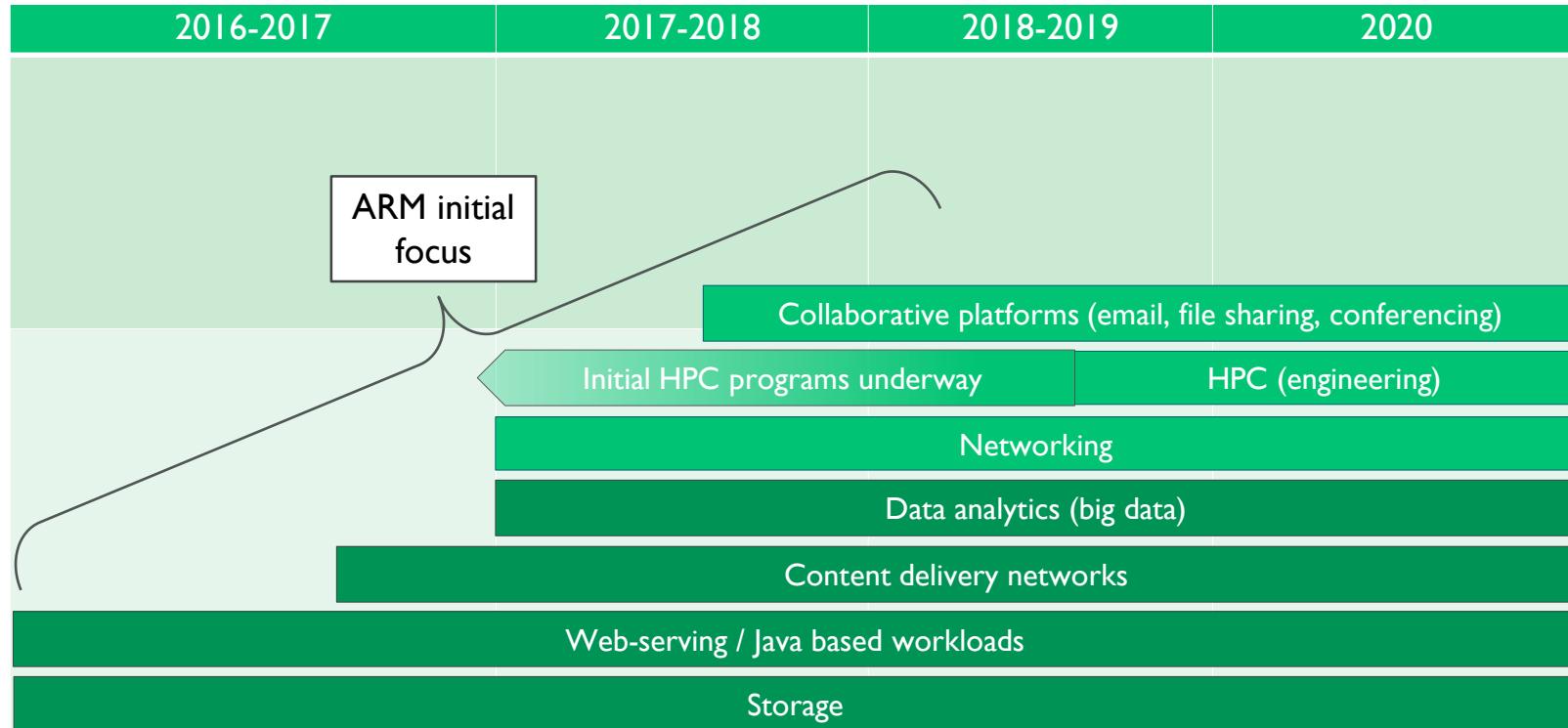
applied  
micro

PayPal

# Applicability of ARM for Server Workloads



# Applicability of ARM for Server Workloads



# Delivering Value From End to End



SymKloud 2910 with X-Gene

5x compute  
density per  
rack

2x Higher  
Network  
Connectivity

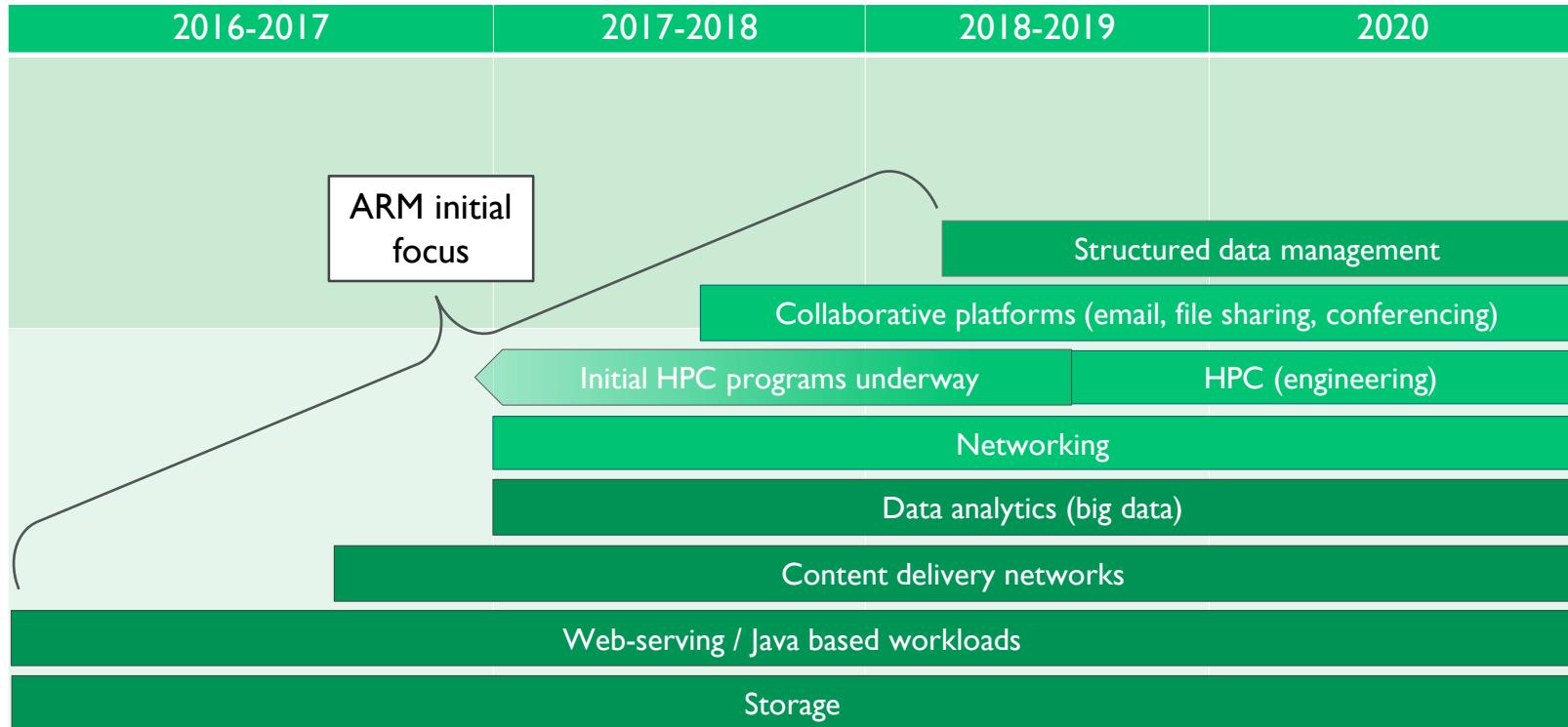
1.2x Lower  
system cost

>5 9's  
Data Reliability

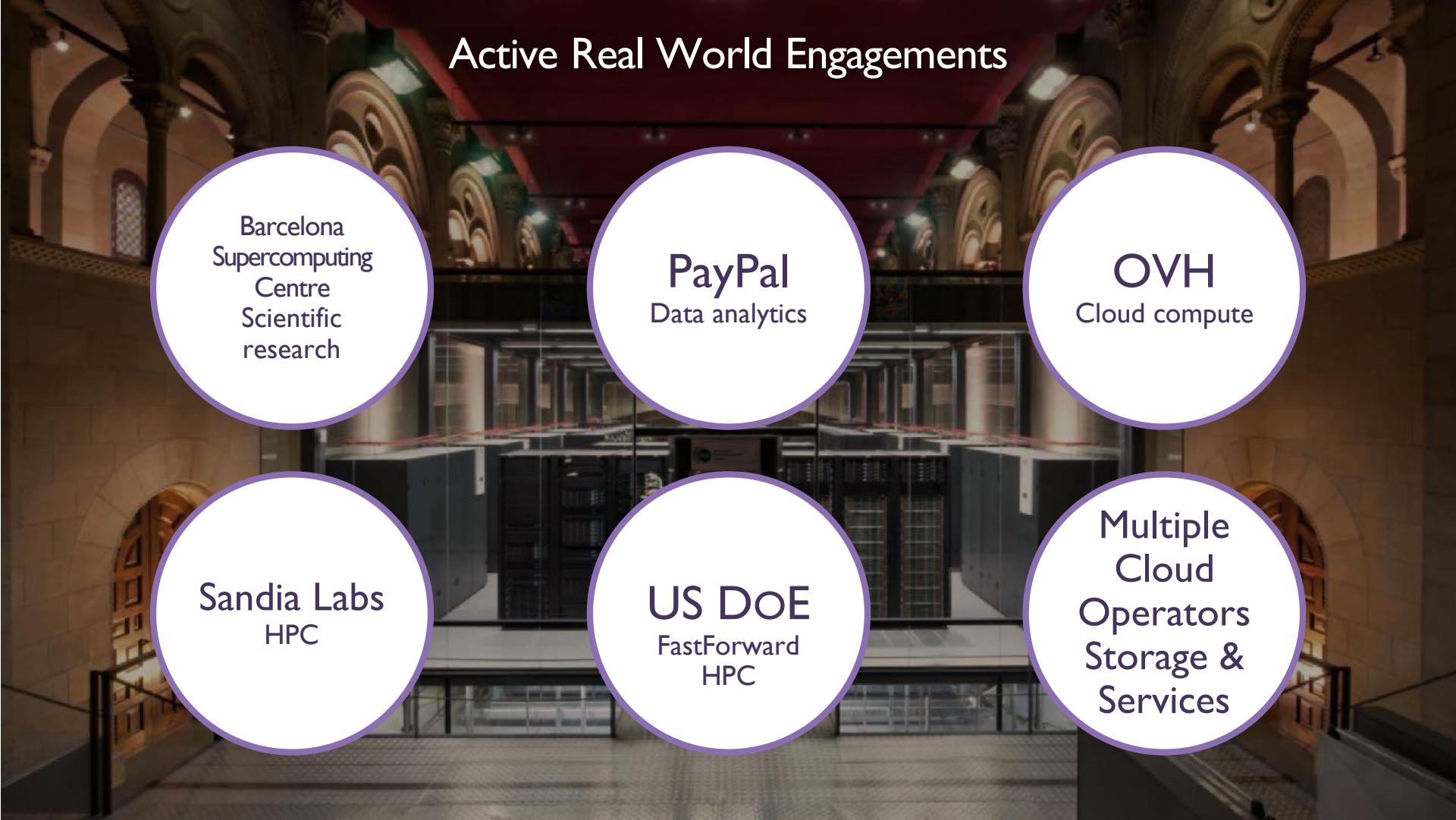
## ARM-based Hardware Designed for a Software-Defined World

A SYMKLOUD converged infrastructure platform is designed explicitly to support **operator services delivered on commercial-off-the-shelf (COTS) high availability infrastructure** deployed using software defined networking (SDN) and network functions virtualization (NFV) technologies. Its modular and short-depth footprint packs in **high density compute, storage and a 20GbE switch fabric** that supports bare metal SDN switching for legacy and OpenFlow traffic.

# Applicability of ARM for Server Workloads



# Active Real World Engagements



Barcelona  
Supercomputing  
Centre  
Scientific  
research

PayPal  
Data analytics

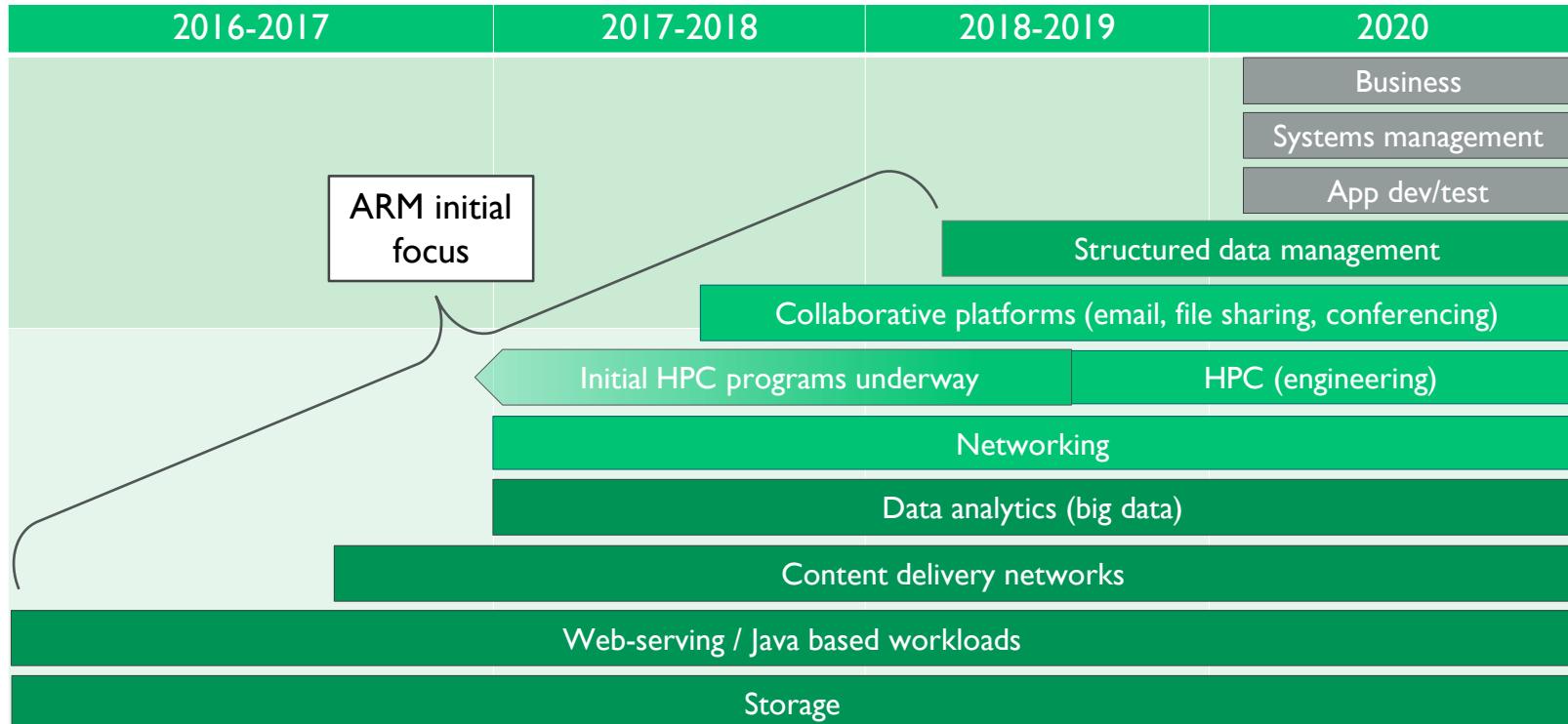
OVH  
Cloud compute

Sandia Labs  
HPC

US DOE  
FastForward  
HPC

Multiple  
Cloud  
Operators  
Storage &  
Services

# Applicability of ARM for Server Workloads





[TSMC, ARM Aim 7nm at Data Centers](#)

# TSMC, ARM Aim 7nm at Data Centers

## Cloud computing the next process driver?

Rick Merritt

3/15/2016 10:20 AM EDT

[4 comments](#)

NO RATINGS

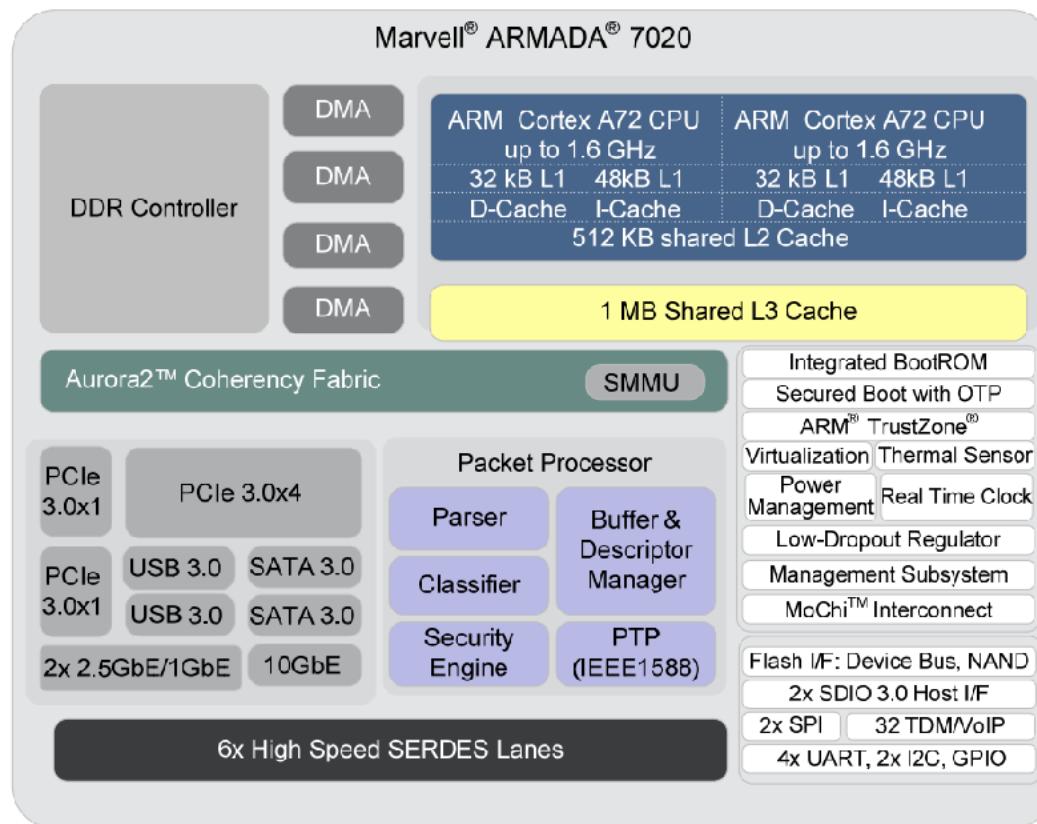
[LOGIN TO RATE](#)



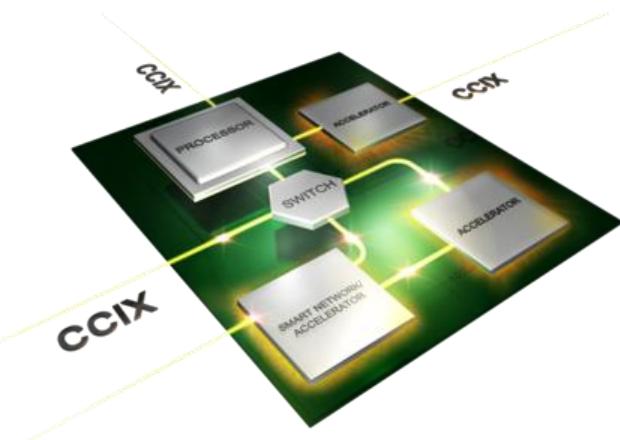
SAN JOSE, Calif. — TSMC and ARM announced the next phase of their collaboration on leading-edge semiconductor process technology. Interestingly, they suggest data center and networking chips will be drivers of their work on the 7nm FinFET node.



## Marvell Releases New ARMADA Hyperscale Virtual SoC Featuring ARM Cortex-A72



# CCIX – Cache Coherent Interconnect for Accelerators



Allows multiple processor architectures and accelerators to seamlessly share data

Open Acceleration Framework for Data Centers and Other Markets

Accelerating applications in the data center has become a requirement due to power and space constraints. Applications such as **big data analytics, search, machine learning, NFV, wireless 4G/5G, in-memory database processing, video analytics, and network processing**, benefit from acceleration engines that need to move data seamlessly among the various system components.





# Broadcom Announces Volume Production of Quad-core 64-bit 2GHz ARMv8 SoCs

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## Highly-integrated Communication SoC Platform with Industry's First Quad-core A57 CPU Delivering 34,000 DMIPS below 10 Watts

SAN JOSE, Calif., April 19, 2016 (GLOBE NEWSWIRE) -- Broadcom Limited (NASDAQ:AVGO), a leading designer, developer and global supplier of a broad range of analog and digital semiconductor connectivity solutions, today announced volume production of its new series of quad-core 64-bit 2GHz ARM® v8 Cortex®-A57 communication processors, the StrataGX™ BCM5871x, targeting a broad range of networking applications including virtual CPE (vCPE) and NFV appliances, 10G service routers and gateways, control plane processing for Ethernet switches, and network attached storage (NAS). The BCM5871x combines advanced computing, networking and virtualization functions on a single SoC with the industry's first quad-core A57 CPU delivering 34,000 DMIPS below 10 watts, providing unprecedented levels of integration and setting a new bar on performance and power efficiency.

Next generation customer premise equipment (CPE) use virtualization to collapse multiple dedicated appliances into single virtual CPE (vCPE) systems. These new vCPE platforms run several virtual network functions (VNF's) such as vFirewalls and vRouters simultaneously in software. This allows service providers to more rapidly deploy services, thus increasing their revenues, and also reduces both their Capex and Opex by consolidating equipment and reducing maintenance costs. The BCM5871x integrates a server-class network interface controller with virtualization, stateless offloads, and packet processing capabilities, which significantly improves overall system performance when running multiple VNFs on chip, providing an industry leading vCPE platform.



GIGABYTE Announces Official Release of Production-Ready Cavium ThunderX®-based Servers

**GIGABYTE™**

**THUNDERX®** Server Launch Event

ONE STEP AHEAD WITH  
**CERTIFIED SOLUTIONS**

The Certified & Workload Optimized Servers for  
Next Generation Data Center & Cloud Applications

## Post-K: Fujitsu HPC CPU to Support ARM v8



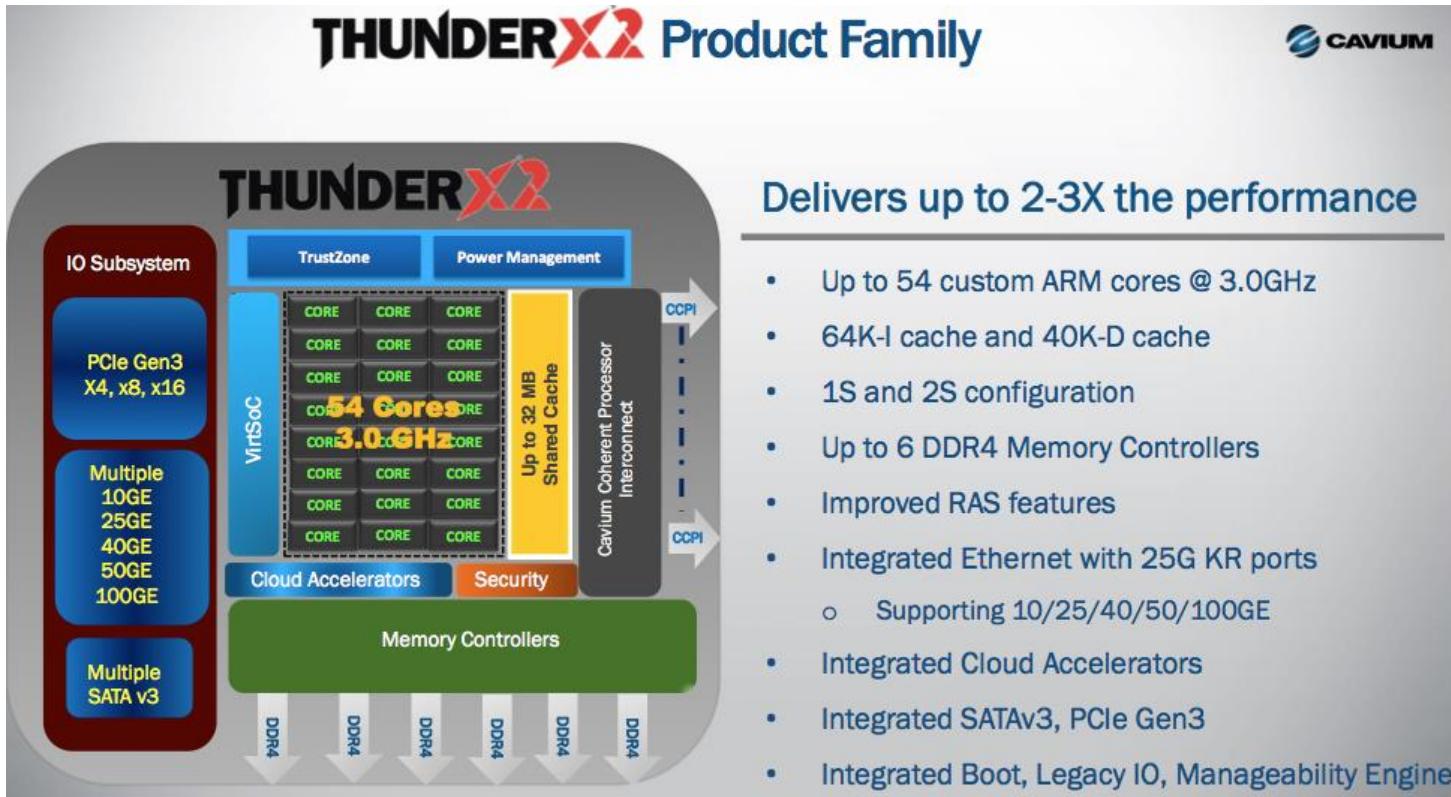
Post-K fully utilizes Fujitsu proven supercomputer microarchitecture

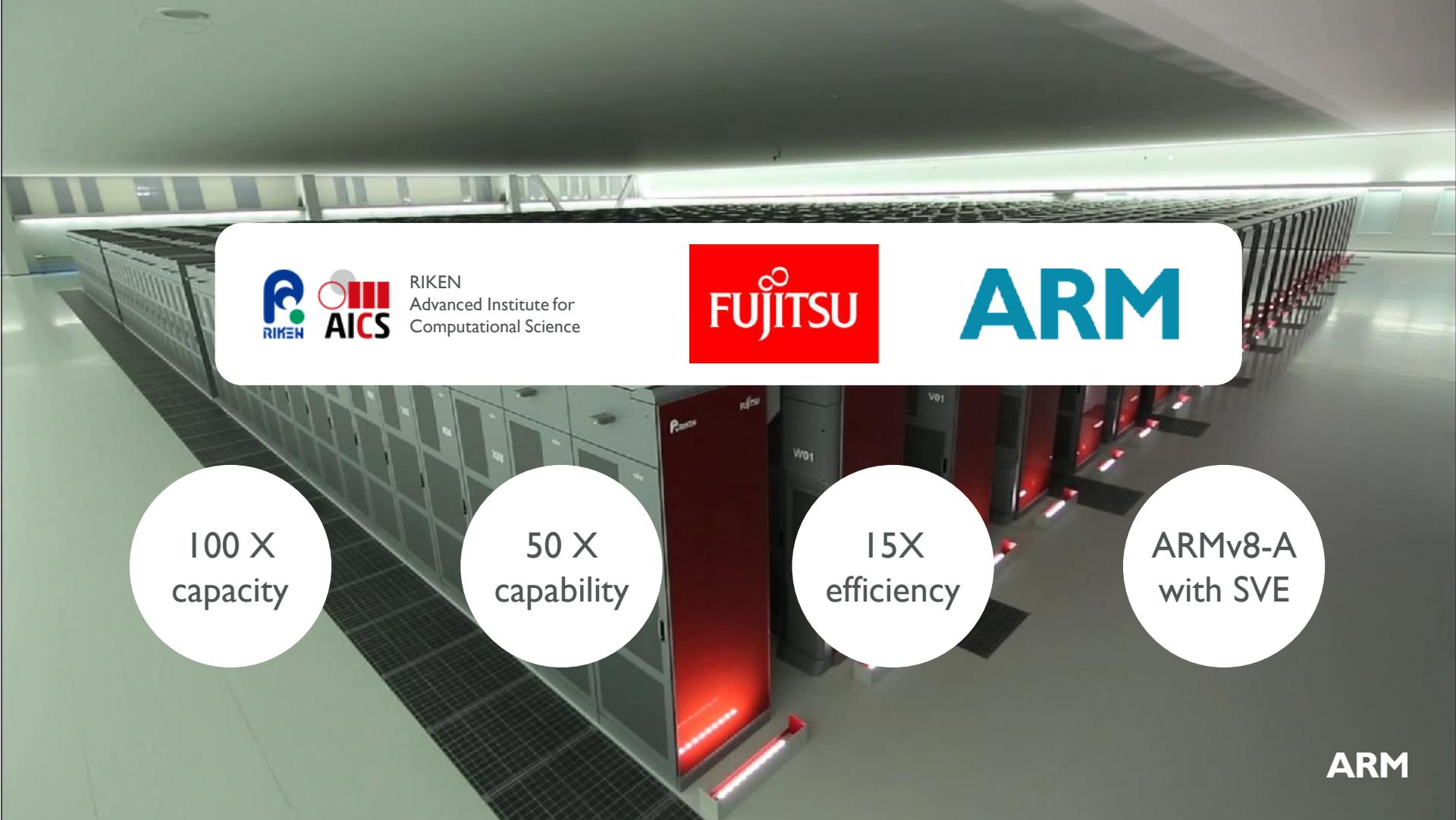
Fujitsu, as a lead partner of ARM HPC extension development, is working to realize ARM Powered® supercomputer w/ high application performance

ARM v8 brings out the real strength of Fujitsu's microarchitecture

HPC apps acceleration feature	Post-K	FX100	FX10	K computer
FMA: Floating Multiply and Add	✓	✓	✓	✓
Math. acceleration primitives*	✓ Enhanced	✓	✓	✓
Inter core barrier	✓	✓	✓	✓
Sector cache	✓ Enhanced	✓	✓	✓
Hardware prefetch assist	✓ Enhanced	✓	✓	✓
Tofu interconnect	✓ Integrated	✓ Integrated	✓	✓

\* Mathematical acceleration primitives include trigonometric functions, sine & cosines, and exponential...





RIKEN  
Advanced Institute for  
Computational Science

FUJITSU

ARM

100 X  
capacity

50 X  
capability

15X  
efficiency

ARMv8-A  
with SVE

ARM

# New: Scalable Vector Extension (SVE) for ARMv8-A



Portability

- ◆ Better target for HPC vendors' vectorizing compilers and open source compilers



Scalability

- ◆ Implementations can scale vectors from 128 to 2048 bits without requiring code to be rewritten or recompiled



Efficiency

- ◆ Co-design with HPC partners delivers increased compute density with enhanced vectorization and optimized software design

# Fujitsu's statement

“Fujitsu chose to adopt ARMv8-A with SVE in order to best position the Post-K computer to contribute to a wider user base and utilize the assets. This decision was also a natural result of collaboration with ARM on the development of the HPC extensions”

# Server Strategy - Key Points

- ARM Servers are in production now
- End Users are finding compelling TCO Benefits with ARM servers
- The ARM server Ecosystem continues to expand
- We are at the right point in our journey

## Revolutionizing Infrastructure – Integrated Silicon Platforms

System-on-chips incorporating common, scalable elements

Traditional Servers are  
General Purpose Systems



Traditional 2P Server

Traditional Network  
Equipment is Largely Fixed  
Function



Traditional networking  
equipment

## Revolutionizing Infrastructure – Integrated Silicon Platforms

System-on-chips incorporating common, scalable elements

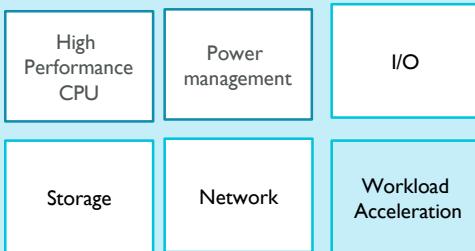
### Increased Server Specialization

Integrating more functional specific logic

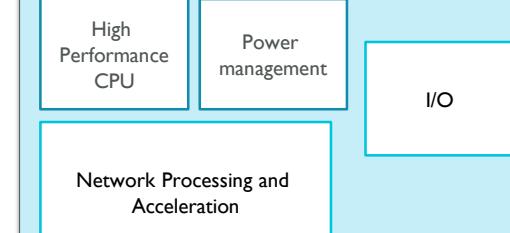
### Increased Network Flexibility

Integration of more general purpose compute

#### ARM SoC Interconnect



#### ARM SoC Interconnect



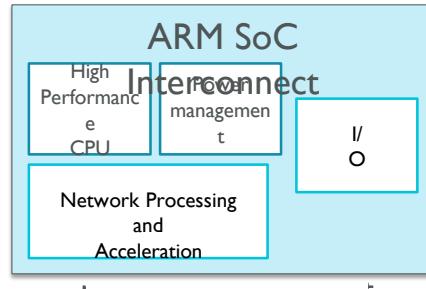
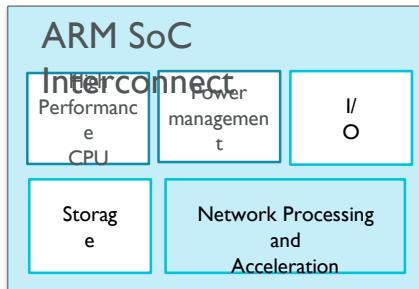
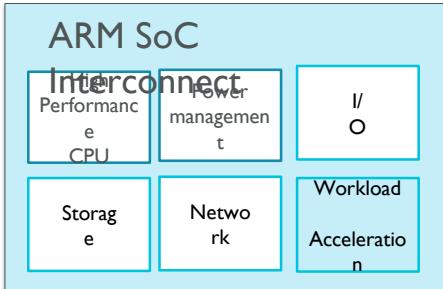
## Revolutionizing Infrastructure – Integrated Silicon Platforms

System-on-chips incorporating common, scalable elements

**Increased Server Specialization**  
Integrating more functional specific logic

**Software Defined**  
**<X>**  
**Accelerated innovation**  
**Flexibility**  
**Manageability**  
**Scalability**  
**Efficiency**  
**Choice**

**Increased Network Flexibility**  
Integration of more general purpose compute



Server

ARM & Partner IP

# Example: Phytium Unveils Speedy 64-Core ARM Processor

From the [FT-2000/64 product page](#):

Process : Manufacturing with 28nm process

Core : Integrating sixty-four FTC661 cores

Frequency : Running at 1.5GHz~2.0GHz

Cache : Integrating 32MB L2 cache and extending 128MB LLC

Extension Interface : 8 proprietary extension interfaces, 19.2GB/s ea

Memory : 16 x DDR3-1600 memory controllers, which can deliver 204.8GB/s memory access bandwidth.

I/O Interface : 2x16 or 4x8 PCIE Gen3 interface

Power : Max. power 100W

Package : FCBGA package with 2892 pins

Home > News > Chinese Chipmaker Unveils Speedy 64-Core ARM Processor

Chinese Chipmaker Unveils Speedy 64-Core ARM Processor

Michael Petcher, Aug. 26, 2014, 1:09 a.m.



Phytium Technology has announced a 64-core ARM server CPU, which according to the press release will deliver 512 gigaflops of performance. The new chip, known as FT-2000/64, is aimed at "high throughput and high performance servers."



Phytium is a Chinese design enterprise based in Beijing, China. In March 2013, the company released its first processor, the FT-1500A, with FT-1500A/16, 4 cores and 1.6GHz in statements about its 64-core design. The 4-core version was developed for PCs and lightweight servers, while the 16-core version is targeted at server-class servers for web, cloud and database applications. The new FT-2000/64 is an even faster 16-core of the chip, targeting the same server application space, in addition to high-performance computing.

The FT-2000/64 is manufactured on a 28nm process by the Arm Chipset symposium, which took place in Copenhagen, Denmark, earlier this week. At the event, the company displayed a prototype server that housed the new processor. Phytium actually previewed the FT-2000/64 design at last year's symposium, when the chip was under the code name Mars. That subsequently prompted some speculation that

the chip would replace the much-ballyhooed Xeon Phi processors in the 100-core upgrades to the Xeon-E 2.0 processor, which was expected to be revealed at the end of 2014. Given that the latter never happened, it's likely that the FT-2000/64 chips were not displayed, or if they were, did not meet expectations.

At 512 gigaflops though, the FT-2000/64 is certainly suitable for HPC gear. Assuming those FLOPS numbers are valid, the Phytium silicon would match up well with the current-generation Broadwell Xeon chips from Intel, at least from a raw performance standpoint. Also, with more than 200 GB/sec of memory bandwidth, the FT-2000/64 is well into Power8/Power9 territory. For just 100 watts, those are some impressive processor specs. And if those numbers hold up, that would mean Phytium's newest offering is the most powerful ARM server chip on the planet.

Here are the key chip features from the FT-2000/64 product page:

- Process : Manufacturing with 28nm process
- Core : Integrating sixty-four FTC661 cores
- Frequency : Running at 1.5GHz~2.0GHz
- Cache : Integrating 32MB L2 cache and extending 128MB LLC
- Extension Interfaces : Integrating eight proprietary extension interfaces, each delivering 19.2GB/s memory access bandwidth
- I/O Interfaces : Integrating two x16 or four x8 PCIe Gen3 interface
- Power : Max. power 100W
- Package : 2892 package with 2892 pins

No pricing was provided in the news story, and it's unclear from the news release if the product is available today. The next time we hear about the FT-2000/64 might very well be when it shows up in a TOP500 supercomputer. Stay tuned.

# Today's Scalable ARM-based Platforms

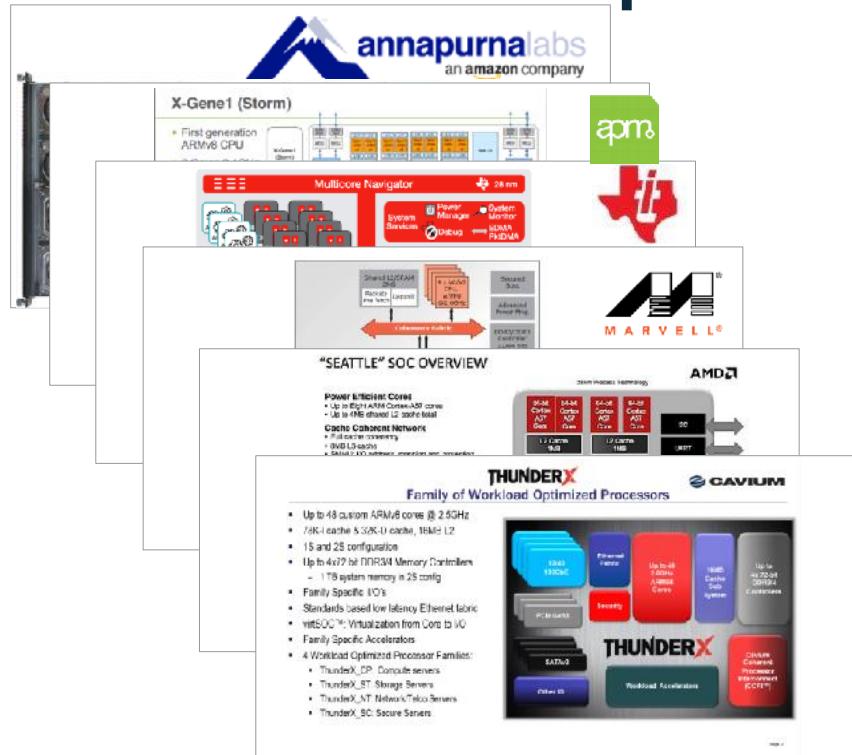


Shipping  
today

4-64  
core  
solutions

Up to  
**7x**  
demonstrated  
efficiency  
gains

# ARM-based Chips Powering Efficient Servers

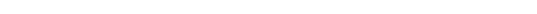
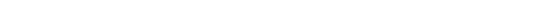
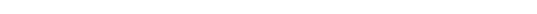
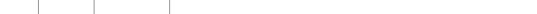


Shipping in 2015

## HiSilicon D02 Server

### Qualcomm to Build ARM-Based Server Chips

By Jeffrey Buff | Posted 2014-11-19 | Email | Print



# Example: ARM Servers Available from Multiple Manufacturers

ProLiant Cartridges  
for HP Moonshot  
(Applied Micro, TI)



Penguin Valkre  
(Cavium)



E4 ARKA  
(Applied Micro, Cavium)



Softiron Overdrive 3000  
(AMD)



Cirrascale RM1905D  
(Applied Micro)



Avantek UK  
(Cavium, Annapurna)



HPE StoreVirtual 3200

Wiwynn LN1148-10SL  
(Marvell)



Gigabyte R120-P30  
(Applied Micro)



Gigabyte MT70-HD0  
(Cavium)



Gigabyte D120-S3G  
(Annapurna)



 **kontron**  
SymKloud 2910  
(Applied Micro)

# Software Ecosystem Enablement Efforts

Participate in and Drive Linaro Ecosystem Enablement

- ARM & partners => 200+ engineers
- Develop common, core technology
- Develop & drive standards adoption

Expanded Engagement with Open Source Community

- Drive industry projects w/ partners
- E.g. ODP for NFV (SW Virtualization)
- Common Baseline DPDK cont.

Expanding Application Developer Ecosystem

- Invest in OpenFastPath., ODPI
- Invest in low-cost boards
- PoC/Engagements with ISVs
- Tools/Middleware enablement

Driving towards Deployment Readiness/Optimized Performance

- Drive Leading ISVs to GA on ARM
- Benchmarking/Optimization
- Virtualization etc. Optimizations
- Develop TCO proof points

# Infrastructure Ecosystem Gaining Momentum

ARM Ecosystem driving Optimized Solutions for Range of Use Cases:- via Community Engagement



# Linux Foundation: Linux Kernel Development 2016

The most active companies over the 3.19 to 4.7 development cycles were:

Company	Changes	Percent
Intel	14,384	12.9%
Red Hat	8,987	8.0%
none	8,571	7.7%
unknown	7,582	6.8%
Linaro	4,515	4.0%
Samsung	4,338	3.9%
SUSE	3,619	3.2%
IBM	2,995	2.7%
consultants	2,938	2.6%
Renesas Electronics	2,239	2.0%
Google	2,203	2.0%
AMD	2,100	1.9%
Texas Instruments	1,917	1.7%
ARM	1,617	1.4%
Oracle	1,528	1.4%

Company	Changes	Percent
Outreachy	1,524	1.4%
Vision Engraving Systems	1,456	1.3%
Free Electrons	1,453	1.3%
NXP Semiconductors	1,445	1.3%
Mellanox	1,404	1.3%
Atmel	1,362	1.2%
Broadcom	1,237	1.1%
NVidia	1,146	1.0%
Code Aurora Forum	1,033	0.9%
Imagination Technologies	963	0.9%
Huawei Technologies	937	0.8%
Facebook	877	0.8%
Pengutronix	790	0.7%
Cisco	692	0.6%
Qualcomm	656	0.6%

Linaro + ARM = Third largest commercial contributor to the Linux Kernel  
(removing 'none'/'unknown')

+TI + NXP + Broadcom + Huawei + Qualcomm = Ecosystem approach

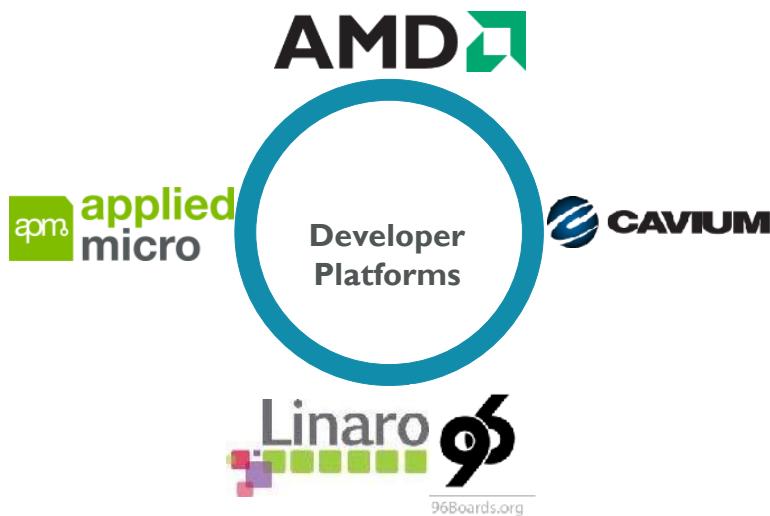
## ARM and NFV



*Brahmaputra Reference Stack*



# Empowering Server Software Developers



- Multiple options for software developers on ARM
- Physical platforms and cloud based services

# Summary

- **ARM 64-bit servers in production now!**
- End users finding compelling TCO Benefits with ARM servers
- ARM partners understand SoC integration and are uniquely positioned to deliver the best performance/watt/\$/Cu ft
- Collaborative business model supports “one size does not fit all approach,” rapid pace of innovation, choice and diversity
- **ARM server ecosystem continues to expand with new entrants Alibaba, Asus, Broadcom, Cray, GigaByte, Kontron, Pegatron, Lenovo and Qualcomm**

# Real world deployments

ARM®



ARM

# Growing the Ecosystem

# Choice of CPU vendor



## Choice of OEM/ODM vendor



FOXCONN<sup>®</sup>



CRAY

GIGABYTE™

lenovo™



HUAWEI



MITAC



PEGATRON

Inventec

wiwynn



SOFTIRON

STACK<sup>®</sup>  
VELOCITY

ZTE

ARM

# SUSE ARM Partners



**Hewlett Packard  
Enterprise**



**Success starts with the community**

# **Matching British Design with German Engineering**

# SUSE History of Innovation



# SUSE History of Innovation

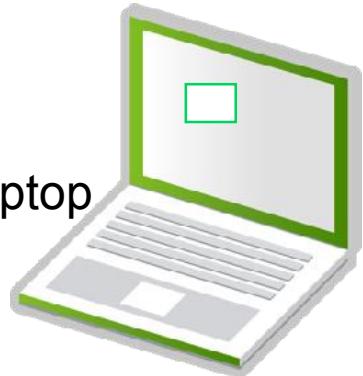


# SUSE History of Innovation

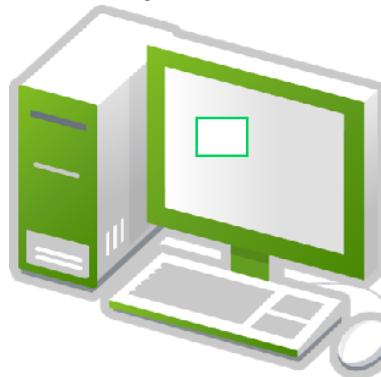


# SUSE® Runs on ...

... your laptop



... your desktop



... your server



# ARM-based Machines



Tablets



Tiny laptops



Smartphones

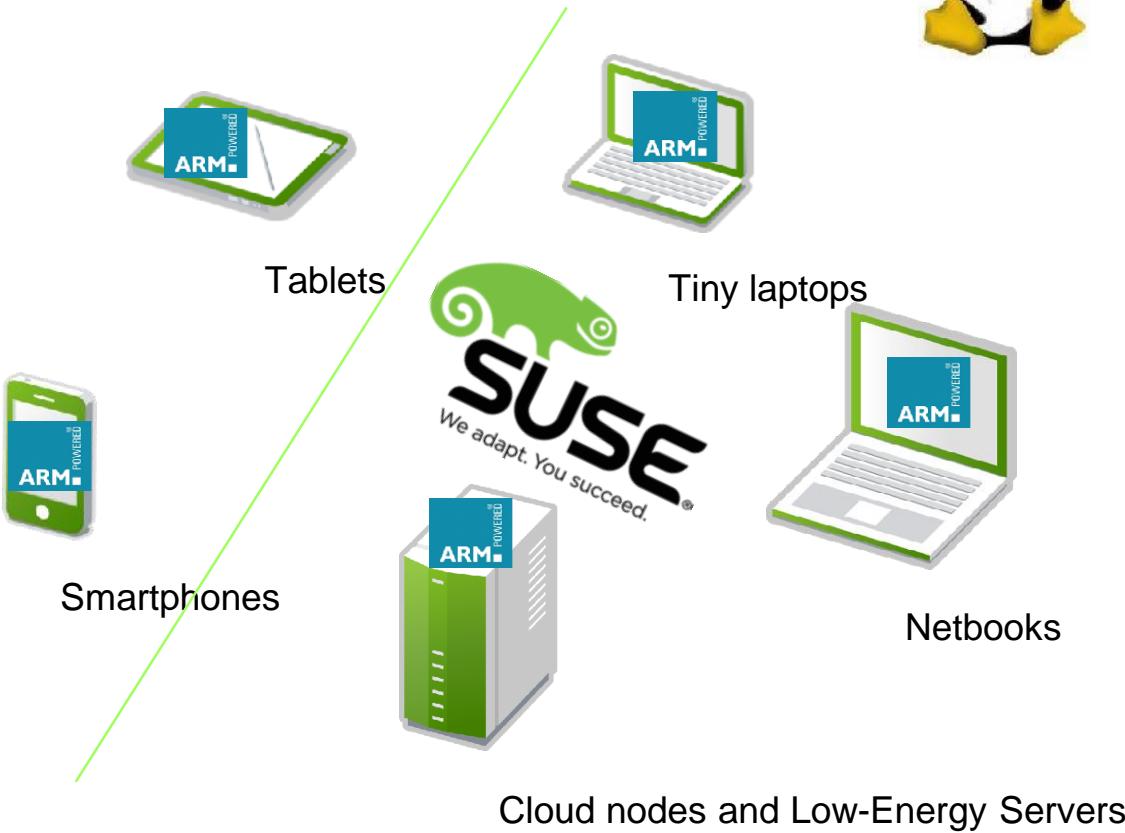


Cloud nodes and Low-Energy Servers

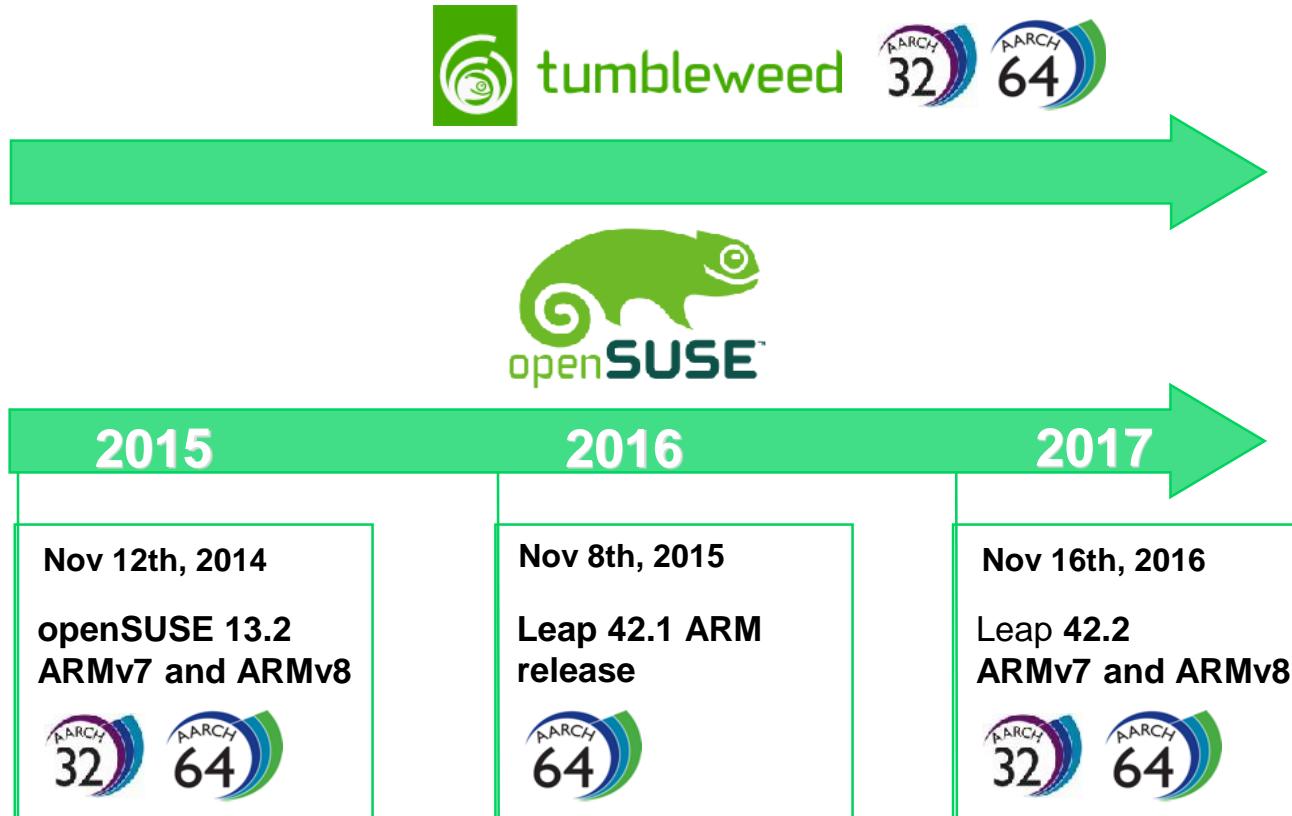


Netbooks

# ARM-based Machines



## openSUSE on ARM Timeline



# OpenQA for AArch64

All Tests Job Groups ▾

Logged in as dkrmueller ▾

## Welcome to openQA

Life is too short for manual testing!

LEARN MORE »



### Staging Projects

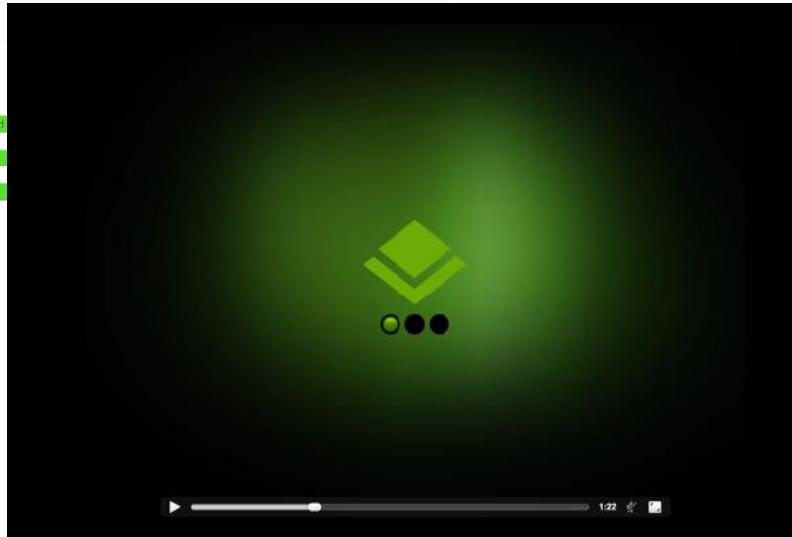
Build814.1 (about a month ago)

3 passed

Build592.1 (3 months ago)

2 passed

Build311.4 (about a year ago)





# SUSE® on ARM Team



**Virtual team of technical experts from SUSE and SUSE partners**



**Strong collaboration with technology providers**



**Started in Q1/2014**

# ARM Partner Program

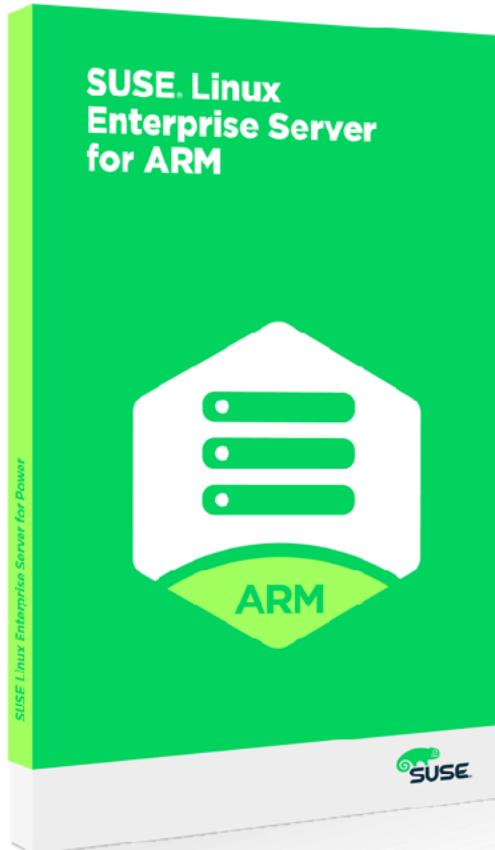
- On July 13<sup>th</sup>2015, **SUSE announced supported Partner Program for SLE on 64-bit ARM (AArch64)**



- **Partner-centric for initial offering**
- **Engagement with multiple silicon vendors**
- **Engaged with multiple system vendors**

# SUSE Linux Enterprise Server 12 for ARM

**SLES for ARM provides an enterprise-grade Linux distribution optimized for 64-bit ARM AArch64 systems that deliver outstanding performance, reliability and scalability for mission critical workloads.**



# SUSE Linux Enterprise SP2 Overview

- **What?**

- Upstream kernel version: 4.4 (kernel chosen specifically for ARM support)
- Over 3000 packages (additional features, bug fixes, security updates)

- **Supported architectures:**

- POWER (little endian only)
- Intel/AMD64-bit (x86\_64)
- IBM System z and Linux One (zSystem)
- *ARM 64 bit (AArch64)*

- **When?**

- First Customer Shipment: **November SUSECON 2016**

A large, bold, green 3D-style font spelling "SP2". The letters have a thick, rounded appearance with a slight shadow, giving them a three-dimensional look.

# SUSE Linux Enterprise for ARM overview

- **Included**

- Upstream kernel version: 4.4 (kernel chosen specifically for ARM support)
- Over 3000 packages (additional features, bug fixes, security updates)
- KVM with libvirt
- GCC
- Toolchain, HPC modules

- **Supported SoC vendors and chips:**

- Advanced Micro Devices (AMD) – Opteron A1100
- Applied Micro – X-Gene 1, X-Gene 2
- Cavium - ThunderX
- NXP/Freescale - LS208xA
- NXP QorIQ LS2085A / LS2045A, LS2080A, / LS 2040A
- Xilinx - UltraScale+ MPSoc



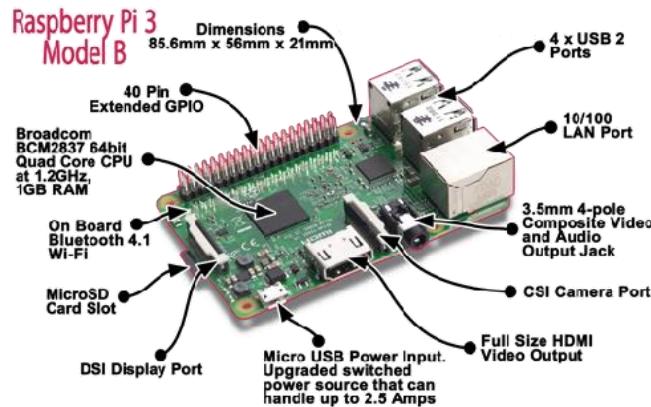
**One more thing..**

## What?

- SLES 12 distribution for the Raspberry Pi 3 Model B
- Packaged as an image ready to copy to an SD Card
- Includes compilers, development tools and source
- Comes with a free one year self service subscription
- Enabled for Wi-Fi, Bluetooth, HDMI, Ethernet, and GPIO
- Download from <https://www.suse.com/download-linux>
- Q&A support on <https://forums.suse.com/forum.php>

## Why

- To have a lot of fun!
- Leverages the work done on SLES for ARM
- Provides an easy to consume way to introduce SLES to potential new clients



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