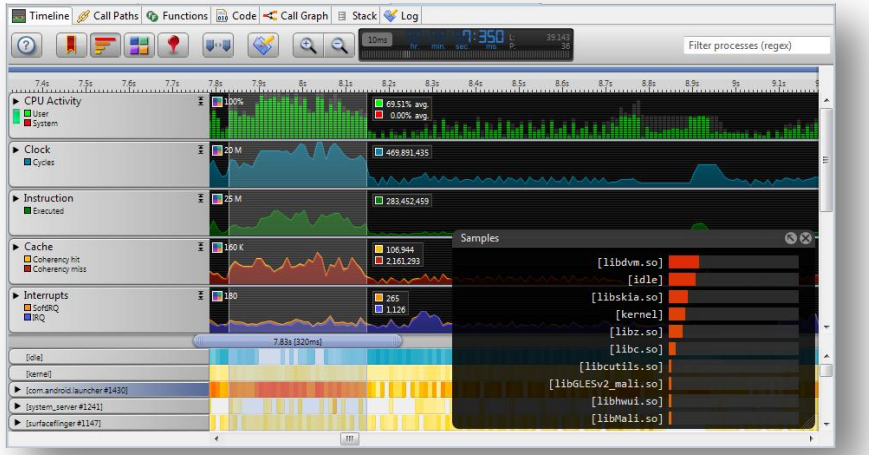


Datacenter Java Developers Start your ARMv8 Engines! CON11179

Jeff Underhill
ARM - Director Server Programs

Christian Thalinger
Oracle - Principal Member of Technical Staff

The Architecture for the Digital World®
ARM®

Agenda

- ARM overview - who we are / what we do
- Evolution of ARM as an architecture - sensors to servers
- Why ARM servers and why now?
- ARM ecosystem overview

- History of Java on ARM
- Java SE 8 – evolving the Java platform
- History of SE-ARMv8 port

- Java at the heart of many server workloads
- Developer access to ARMv8 boards / remote instances
- Demo: Cavium ThunderX in OVH cloud running Cassandra on Oracle Java
- Call to action – try for yourself & visit our booth

ARM®

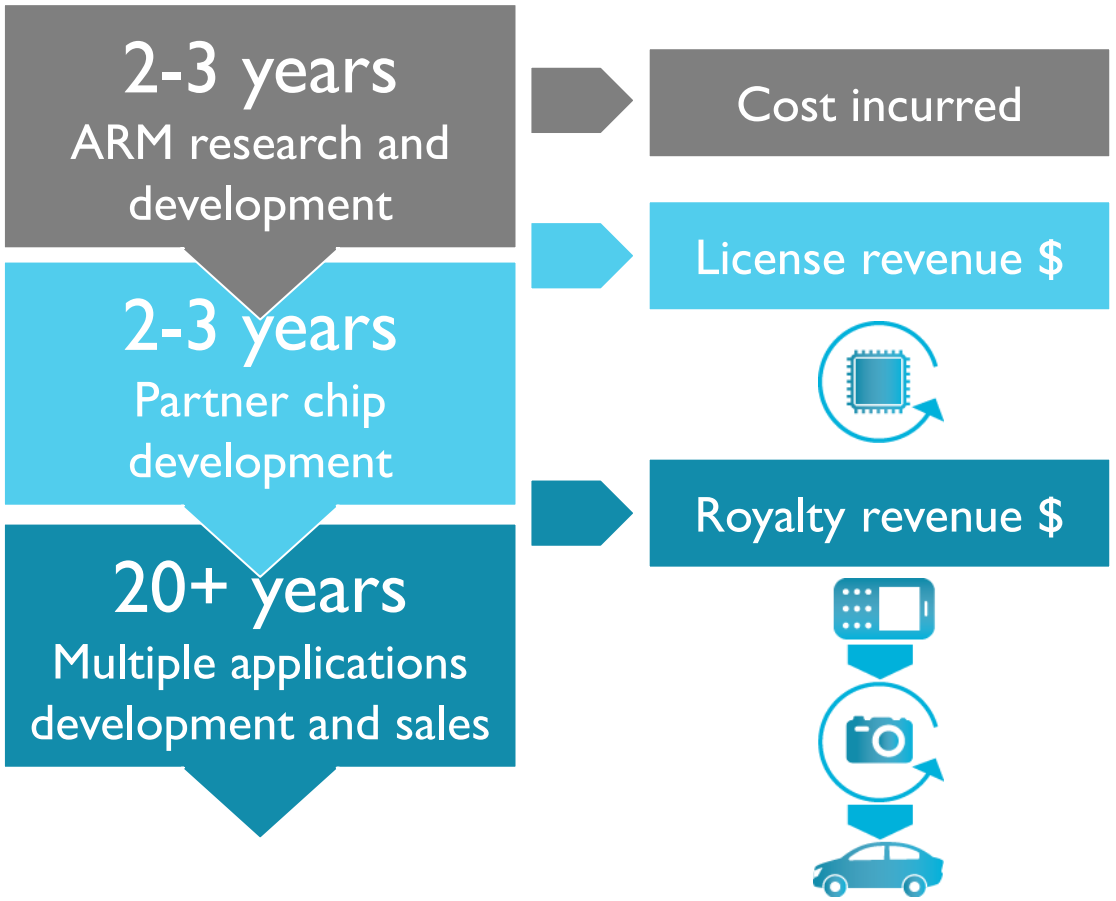
ARM's Vision

Technology that invisibly enables opportunity for a globally connected population

ARM®

The ARM Business Model

- Global leader in the development of semiconductor IP
  - R&D outsourcing for semiconductor companies
- Innovative business model yields high margins
  - Upfront license fee – flexible licensing models
  - Ongoing royalties – typically based on a percentage of chip price
  - Technology reused across multiple applications
- Create and transform markets



Approximately 1250 licenses
Grows by ~100 every year

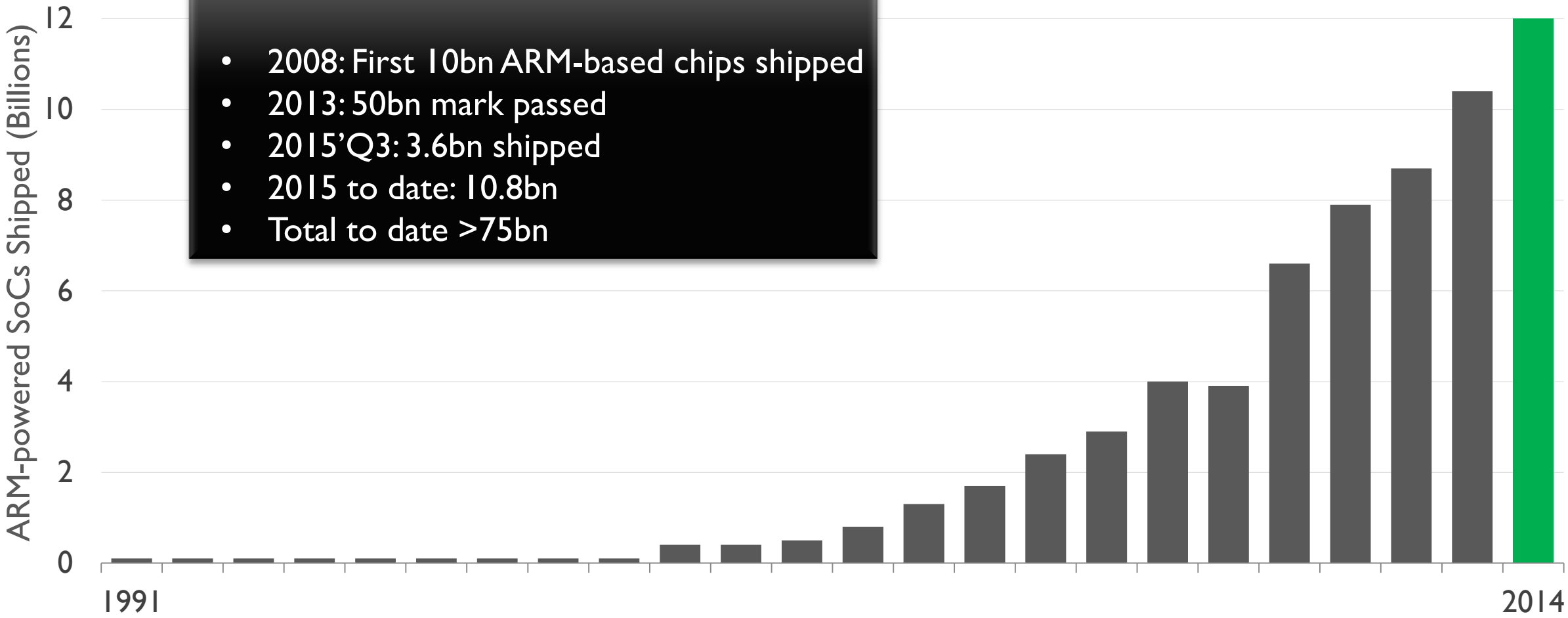
More than 350 potential royalty payers

12bn+ ARM-powered chips in 2014
>25% CAGR over last 5 years

ARM Partnership: Building for the Long Term

Update from Q3'15 Earnings:

- 2008: First 10bn ARM-based chips shipped
- 2013: 50bn mark passed
- 2015'Q3: 3.6bn shipped
- 2015 to date: 10.8bn
- Total to date >75bn



The Face of Computing in the 20th Century

By NASA [Public domain], via Wikimedia Commons

By Emiliano Russo, Associazione Culturale VerdeBinario [Public domain], via Wikimedia Commons

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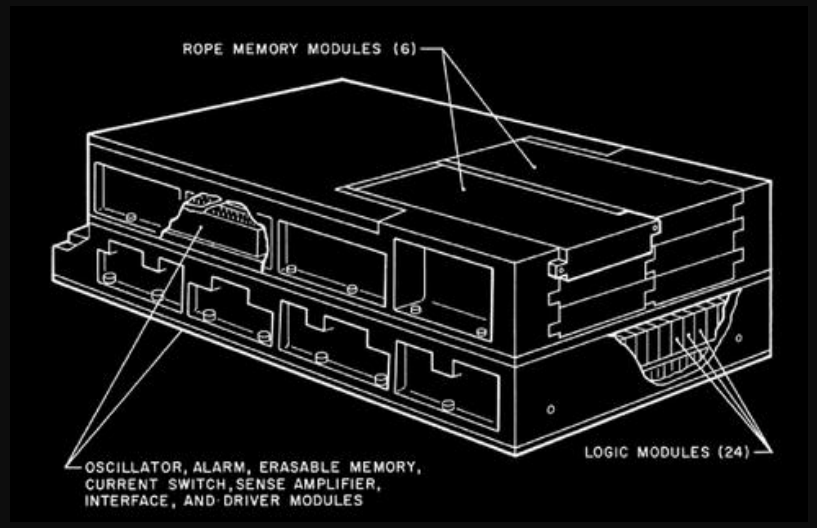
Embedded Computing in the 20th Century

Margaret Hamilton, lead software engineer on the Apollo Moon Project, stands next to the code she wrote by hand that was used to get humanity to the surface of the moon in 1969. #oldschool #code

Source: NASA



Apollo Guidance Computer

61 cm x 32cm x 17cm

2 MHz clock source

~72KB ROM, 8KB RAM

55 watts active power

32kg (70 lbs)

The Face of Computing Has Changed

ARM®

Future Cloud Infrastructure Will Require Intelligence Everywhere

Wearables & IoT driving intelligence at the edge → new network and server opportunities

Smartphones, tablets and smart devices drive increased cloud based data & services

Network and datacenter infrastructure converging and evolving to be scalable & configurable

Big data starts with little data → end to end security, storage & servers in new locations

New applications increasingly 'mobile first' as consumption models shift → VMI interest

Driving scale out economies and new technologies (SDN & NFV)

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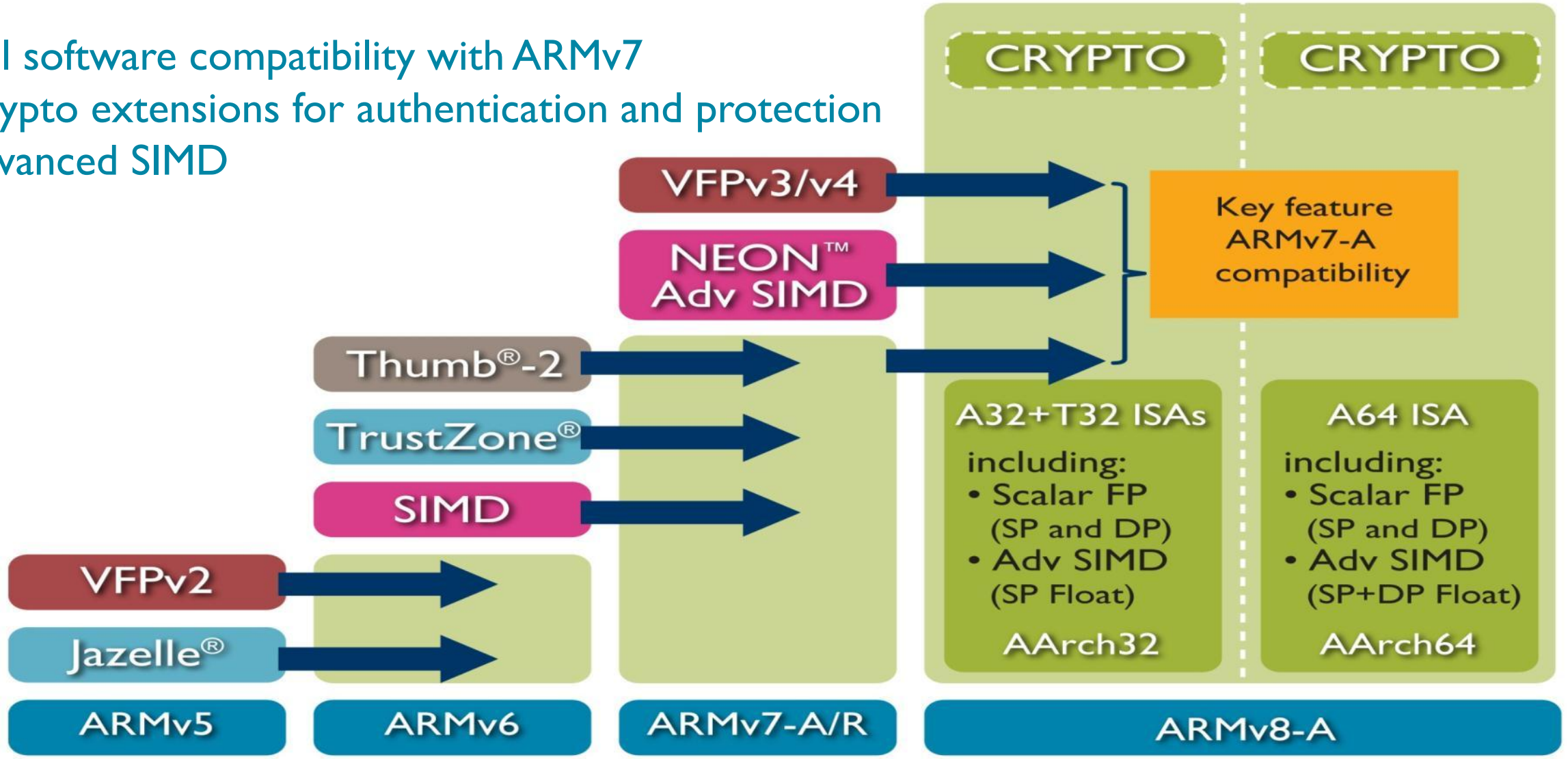
ARMv8: Architecture Progression

- Full software compatibility with ARMv7
- Crypto extensions for authentication and protection
- Advanced SIMD



ARMv8: Designed for Efficiency

- Fully compatible with existing ARMv7 32-bit code
- Addressing emerging software trends
- AARCH**32:** Evolution of 32-bit
  - Ideal for concurrent programming
  - C11, C++11 & Java
  - Efficient, high-performance thread-safe software
  - Enhanced security and encryption
- AARCH**64:** Efficient 64-bit execution
  - Clean instruction set
  - Modern compiler & JIT friendly
  - Reduced complexity for operating systems, hypervisors
  - Designed to maximize reuse of existing hardware

ARM

Why ARM-based Servers? And Why Now?

- Need for decreased TCO → workload optimized solutions
  - **One size doesn't fit all (anymore) – TCO is king at large scale**
  - New workloads and web/cloud scale forced re-evaluation of what's optimal
- Value chain evolving, requiring increased innovation and choice
  - **Many ARM solutions coming to market - competition is healthy!**
  - Faster innovation needed by cloud & web leaders
- ARM business model enables innovation & differentiation (64-bit inflection point)
  - **It's not just about a low power processor – it's what you put around it**
  - ARM cores already used in networking & storage components
    - **Experts in those fields can leverage their existing IP**

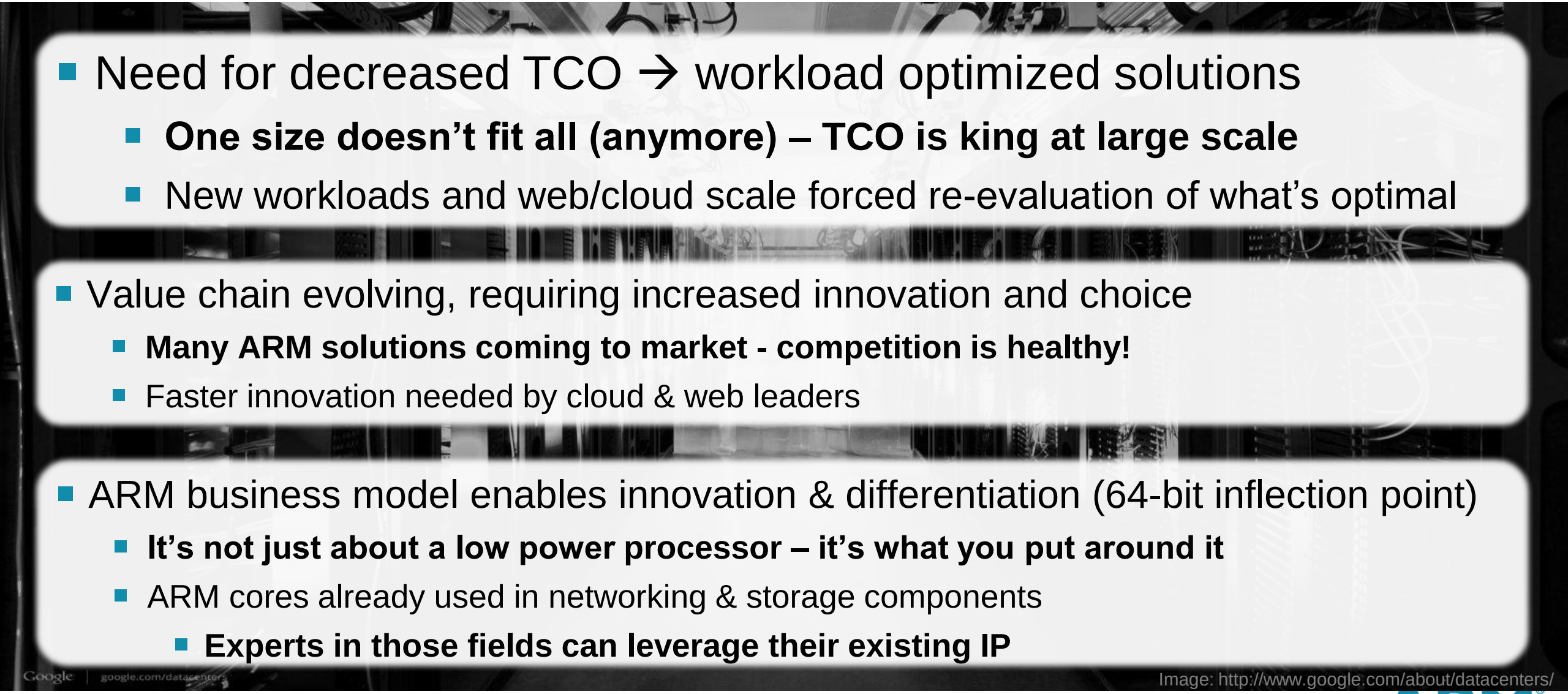


Image: http://www.google.com/about/datacenters/

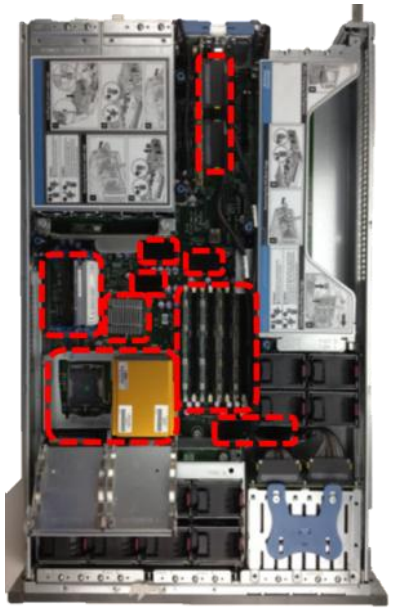
ARM

Revolutionizing Infrastructure – Integrated Silicon Platforms

System-on-chips incorporating common, scalable elements

Traditional Servers are General Purpose Systems

(Jack of all trades, masters of none)



Traditional 2P Server

Traditional Network Equipment is Largely Fixed Function

Traditional networking equipment

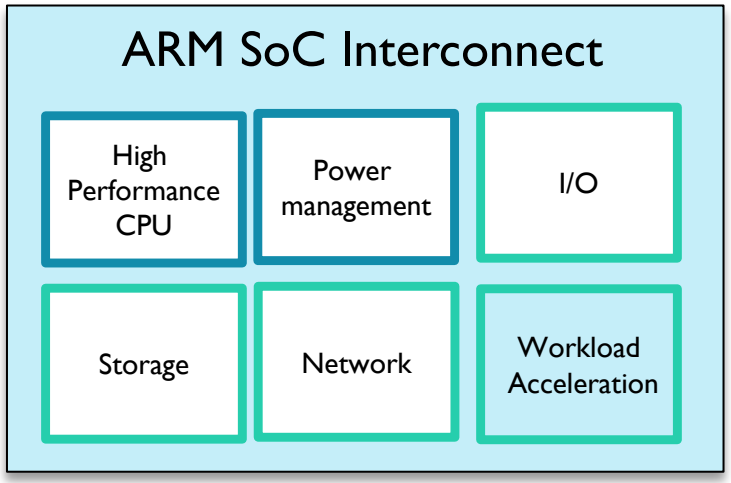
ARM®

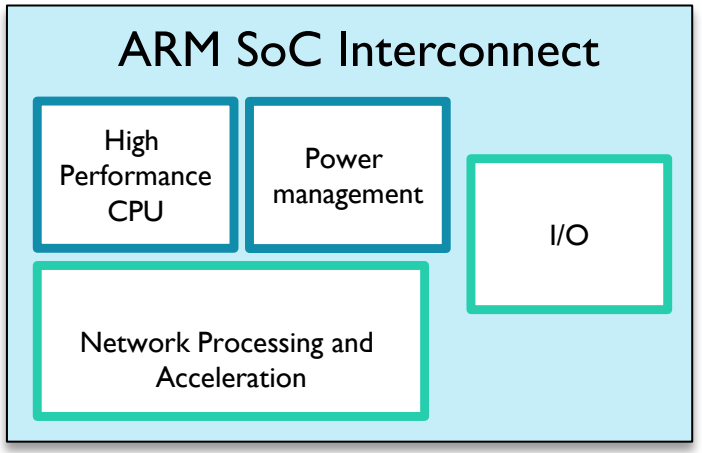
Revolutionizing Infrastructure – Integrated Silicon Platforms

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®

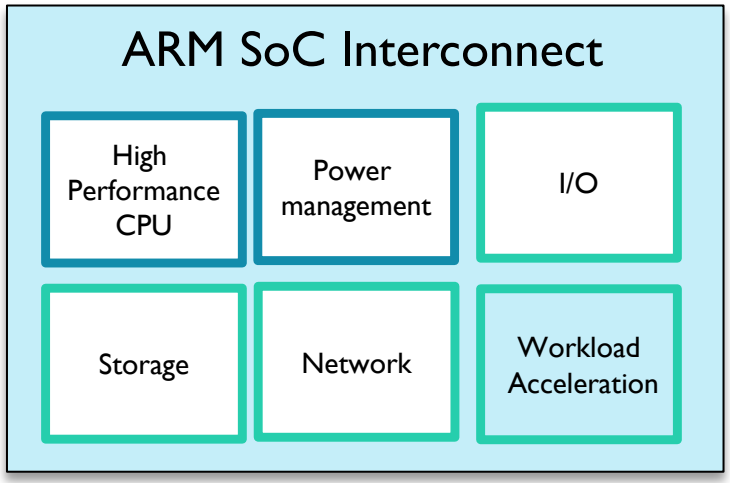
Revolutionizing Infrastructure – Integrated Silicon Platforms

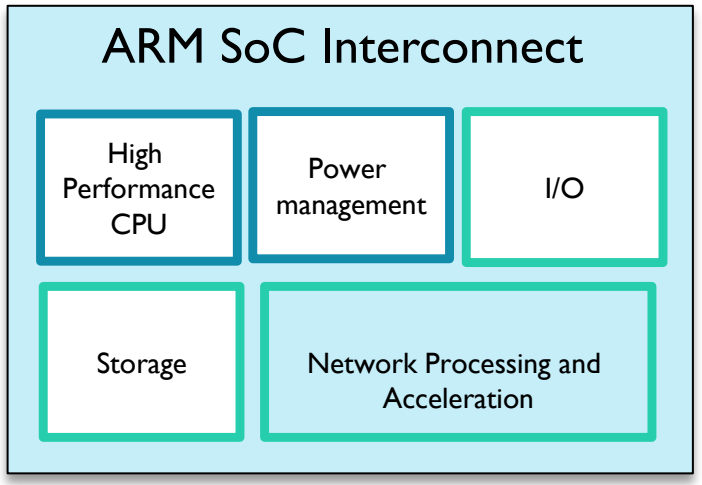
System-on-chips incorporating common, scalable elements

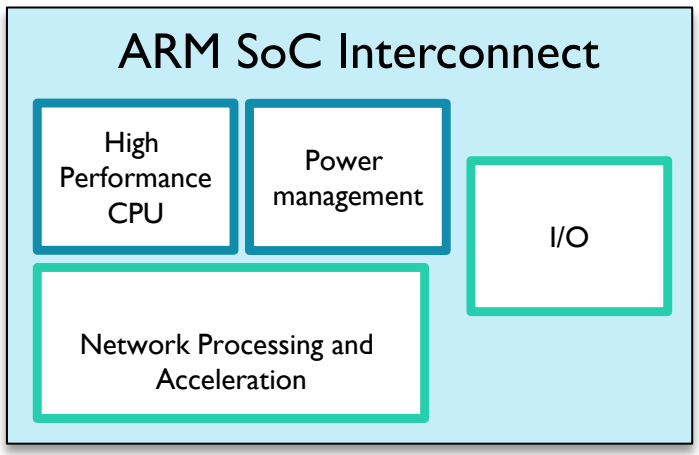
Increased Server Specialization
Integrating more functional specific logic

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

Increased Network Flexibility
Integration of more general purpose compute



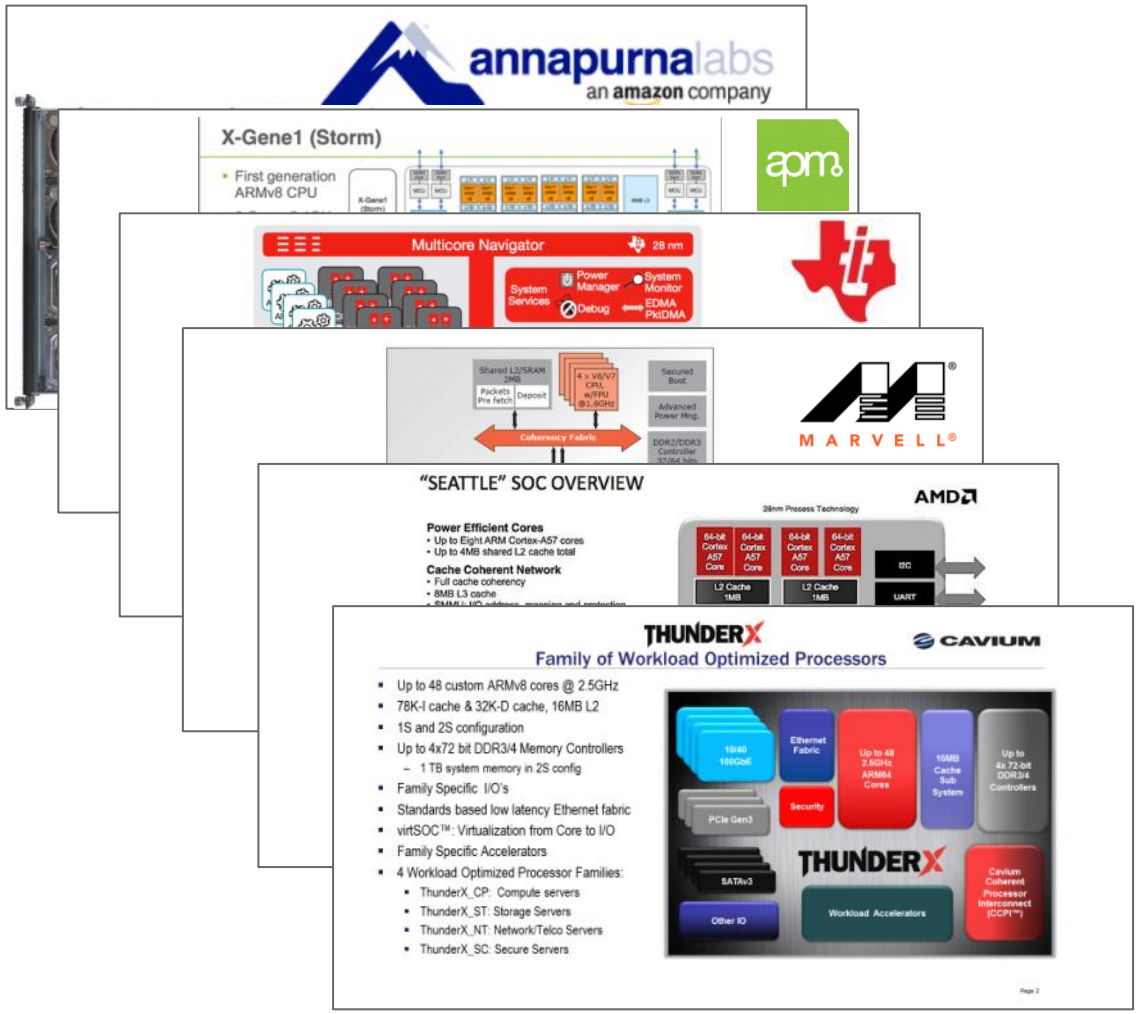




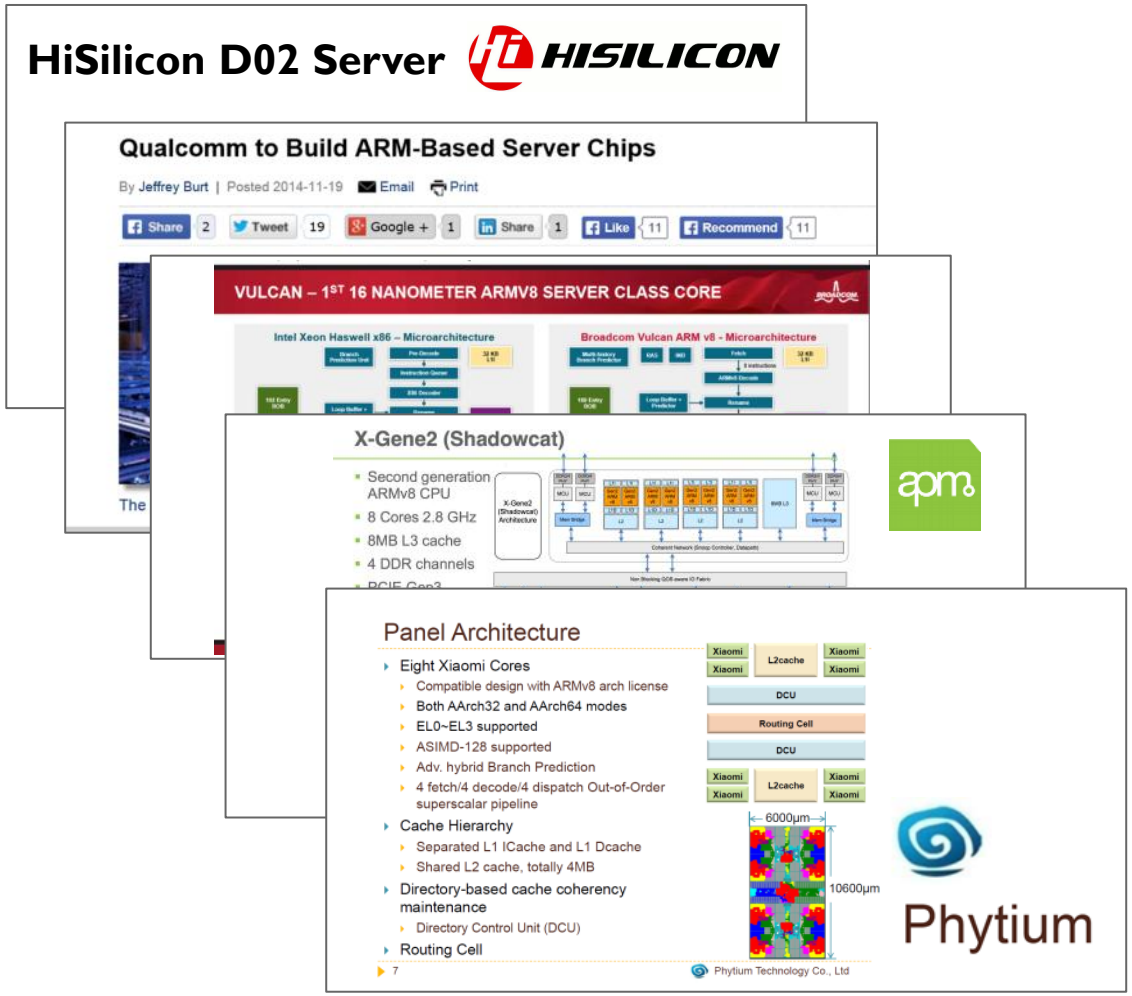
ARM & Partner IP

ARM®

ARM-based Chips for More Efficient Servers



Shipping in 2015



….More 64-bit solutions on the horizon

ARM®

ARM Servers Available From Multiple Manufacturers

HP ProLiant
(Applied Micro, TI)

Softiron Overdrive 3000
(AMD)

Wiwynn LN1148-10SL
(Marvell)

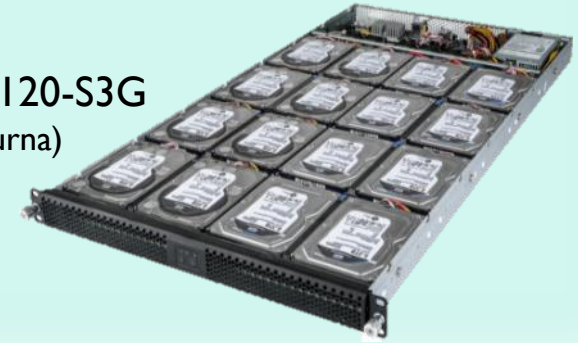
Cirrascale RM1905D
(Applied Micro)

Mitac Datun
(Applied Micro)

Gigabyte R120-P30
(Applied Micro)

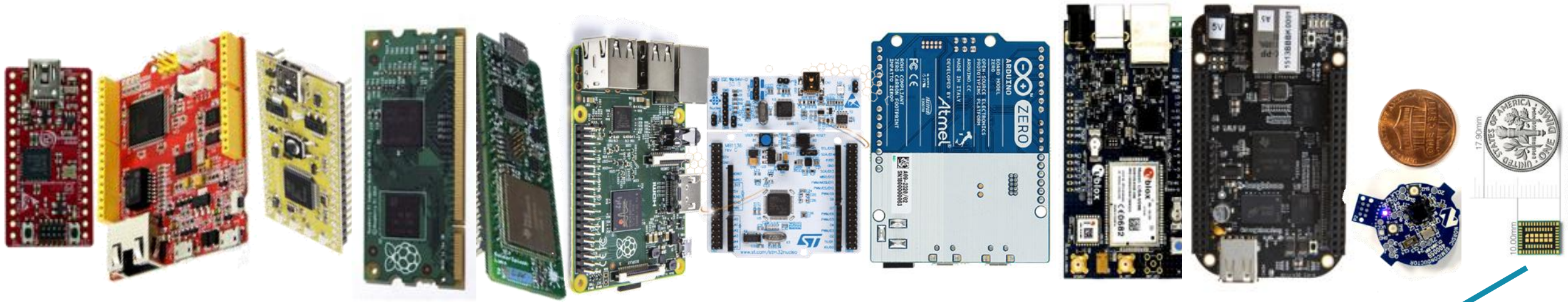
Gigabyte MT70-HD0
(Cavium)

Gigabyte D120-S3G
(Annapurna)



ARM®

Embedded: All Shapes and Sizes Making Anything Possible



ARDUINO

ARM mbed IoT Device Platform

electric imp

ARM

Computing: Still Out of this World

- Raspberry Pi based "Astro Pi" project
- School children's experiments to run in space
- Astronaut Tim Peake & UK space organizations
- Joins international Space Station (ISS) in 2016
  - More Info: http://astro-pi.org/

Hardware Without Software

ARM®

ARMv8-A Server Ecosystem Building Momentum

ARM

Operating Systems – Linux / FreeBSD

Debian 8 adds AARCH64 (April 25th)

12.04LTS & 14.04LTS ← Also 14.10 & 15.04 releases released

CentOS Linux for AArch64
Released (August 2015)
http://lists.centos.org/pipermail/centos-announce/2015-August/021275.html

fedora 23 Alpha released – Aug 2015
https://dl.fedoraproject.org/pub/fedora-secondary/releases/test/23_Alpha/Server/aarch64/

Red Hat Enterprise Linux Server for ARM 7.2 Developer Preview
September 2nd 2015

https://access.redhat.com/articles/1598783

Nov 2014 – OpenSUSE 13.2
with AARCH64 Support
https://en.opensuse.org/openSUSE:AArch64

SUSE Launches Partner Program to Bring
SUSE Linux Enterprise 12to 64-bit ARM Processors
July 14, 2015 @ ISC
https://www.suse.com/company/press/2015/suse-launches-partner-program-to-bring-suse-linux-enterprise-12-to-64-bit-arm-processors.html

FreeBSD® ← Engaged with FreeBSD foundation / Semi-half & Cavium to get FreeBSD on ARMv8

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Java on ARM – High Level Status

OpenJDK

- OpenJDK is an open source implementation of the Java Platform, Standard Edition (Java SE)
- OpenJDK AArch64 project (Lead by Red Hat and Linaro)
  - http://openjdk.java.net/projects/aarch64-port/
- **March 2015: AArch64 port upstreamed - http://hg.openjdk.java.net/jdk9/dev**
  - **Major milestone - first time ARM architecture in upstream OpenJDK project!**

ORACLE

- **GA Support for the 64-bit ARMv8 architecture is now available**
  - JDK™ 8u60 GA Release here: http://www.oracle.com/technetwork/java/javase/downloads/index.html

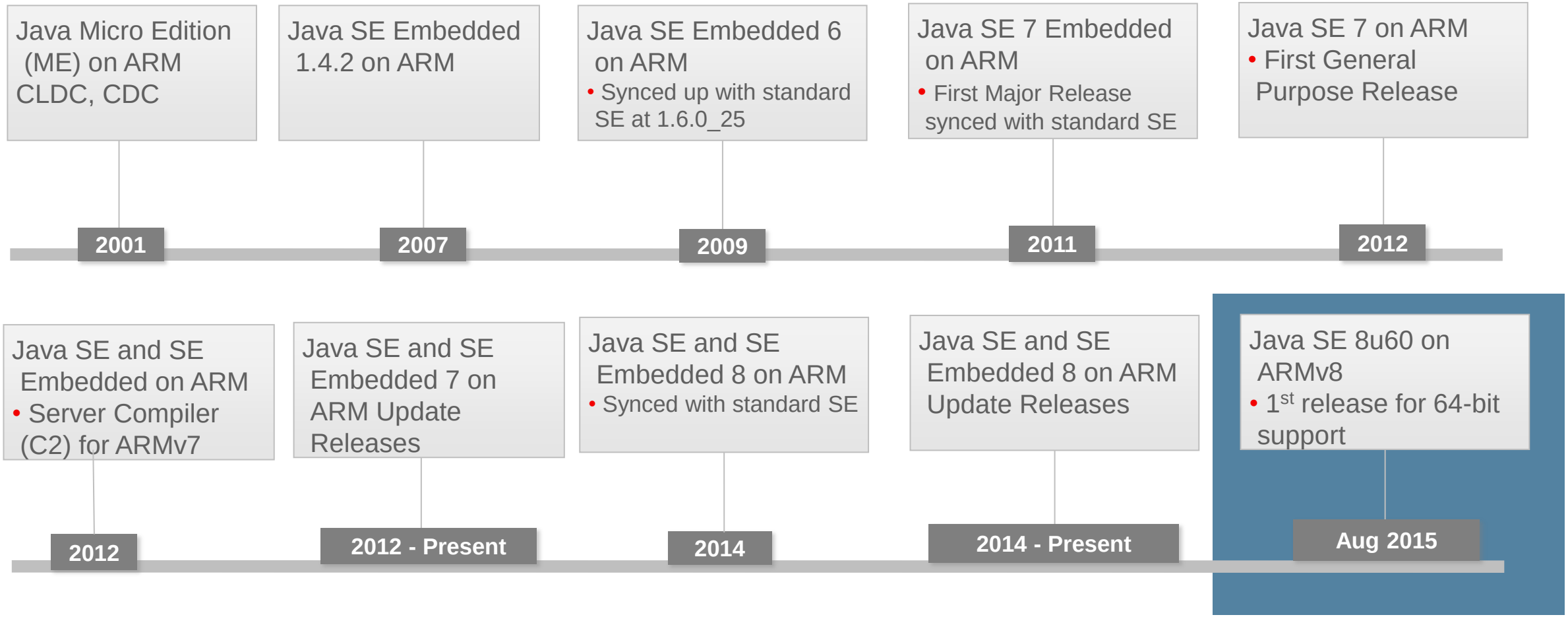
ARM

Christian Thalinger
Principal Member of Technical Staff

JavaOne™

ORACLE®

History of Java on ARM



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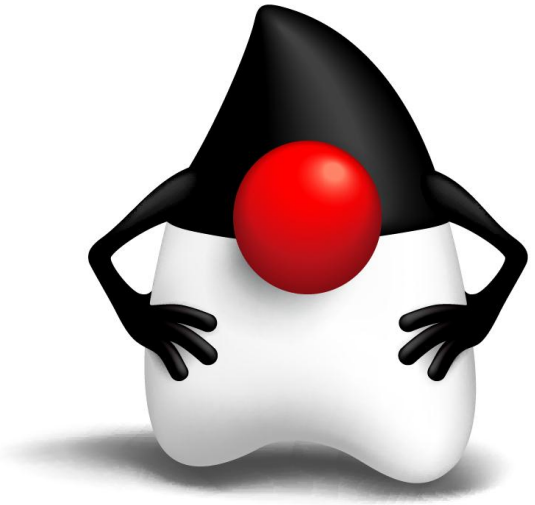
Java SE 8 – Evolving the Java Platform



- Language evolution
  - Lambdas & Default methods
- Library evolution
  - Streams framework for parallel computing
  - New Date/Time API's
- Hotspot evolution
  - PermGen removal; JSR-292 enhancements, Native Memory Tracking
  - Minimal VM
- Configuration evolution
  - Compact Profiles

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Java SE 8u65 – Oct 20, 2015

- Latest SE 8 update – for both SE and SE Embedded on ARM
- SE on ARM
  - ARMv7 Linux, 32-bit, hard-float ABI, little endian, headful
  - ARMv8 Linux, 64-bit, little endian, headless
    - Certified Operating Systems ARMv7: Ubuntu 12_04 LTS; ARMv8: Ubuntu 14_04 LTS
- SE Embedded on ARM
  - ARMv5/v6/v7 Linux, 32-bit, soft-float ABI, little endian, headless
  - ARMv6/v7 Linux, 32-bit, VFP, hard-float ABI, little endian, headful
    - Minimum config for both releases: Linux kernel 2.6.28 and above; glibc 2.9 and above

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History of SE-ARMv8 Port

ARM

- Collaboration started about 2 years ago
  - *"By working closely with ARM to enhance the JVM, adding support for 64-bit ARM technology and optimizing other aspects of the Java SE product for the ARM architecture, enterprise and embedded customers can reap the benefits of high-performance, energy-efficient platforms based on ARM technology."*
    Henrik Stahl in ARM Press Release, July 22, 2013
  - Assistance with development resources
  - Working with key ARMv8 64-bit partners

64-bit

- Goal: Java SE 8 on ARMv8
  - Release targeted for emerging ARMv8 server/enterprise systems
  - Optimized for ARMv8

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Oracle Java SE on 64-bit ARMv8

- Initially shipped as Early Access
  - Private: 2 SE-8 based Betas (Sep 2014, Feb 2015)
  - Public: Weekly 8u60 and 9 builds on java.net
- First public GA release
  - 8u60 Aug 18, 2015
    - JDK- headless port targeted for servers, Ubuntu 14_04 LTS
- Oracle SE Demo in the Java Exhibition Hall
  - JDK 8u60 on Cavium's ThunderX

ARM

Booth # 5615

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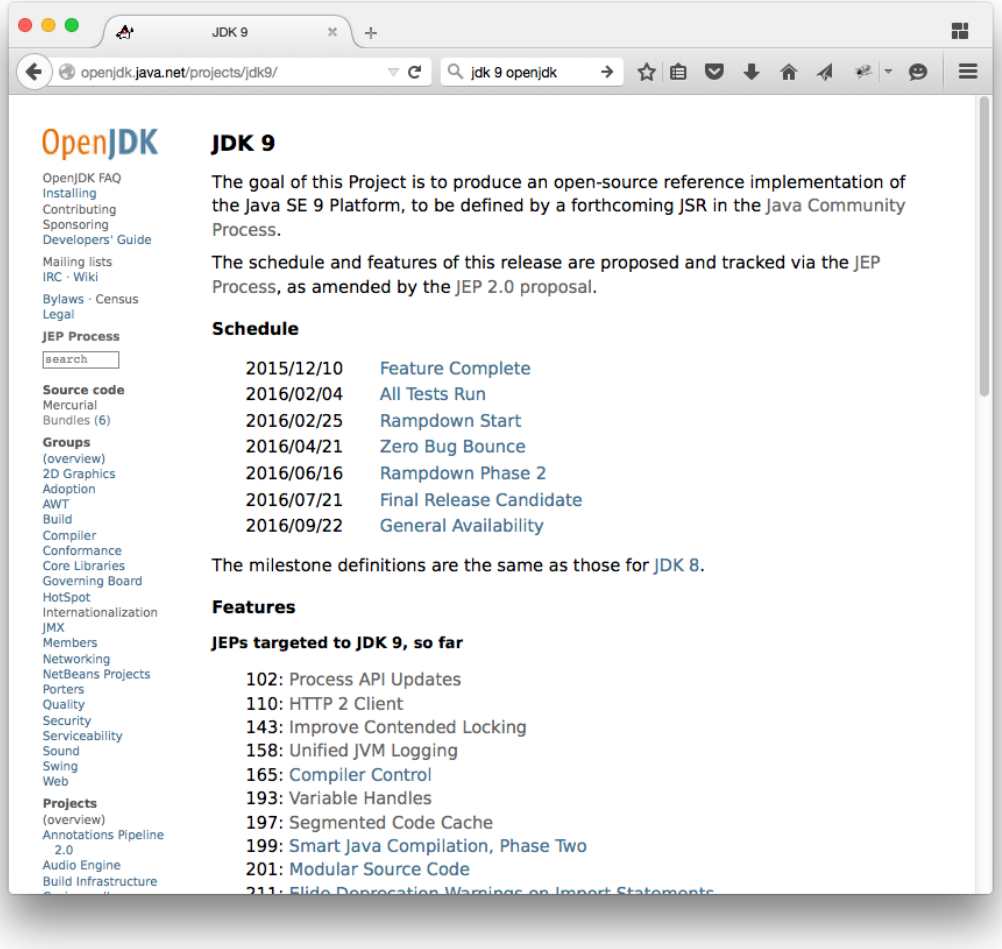
JDK 9 Content, schedule, process, etc.

It's all in the open at http://openjdk.java.net/projects/jdk9/

- The big ticket item for JDK 9 is Modularization (aka Jigsaw)
- Currently 61 enhancements (JEPs) targeted, several other candidates
  - email aliases for discussing each proposal
- New EA build available every other week
- Oracle JDK schedule is the same



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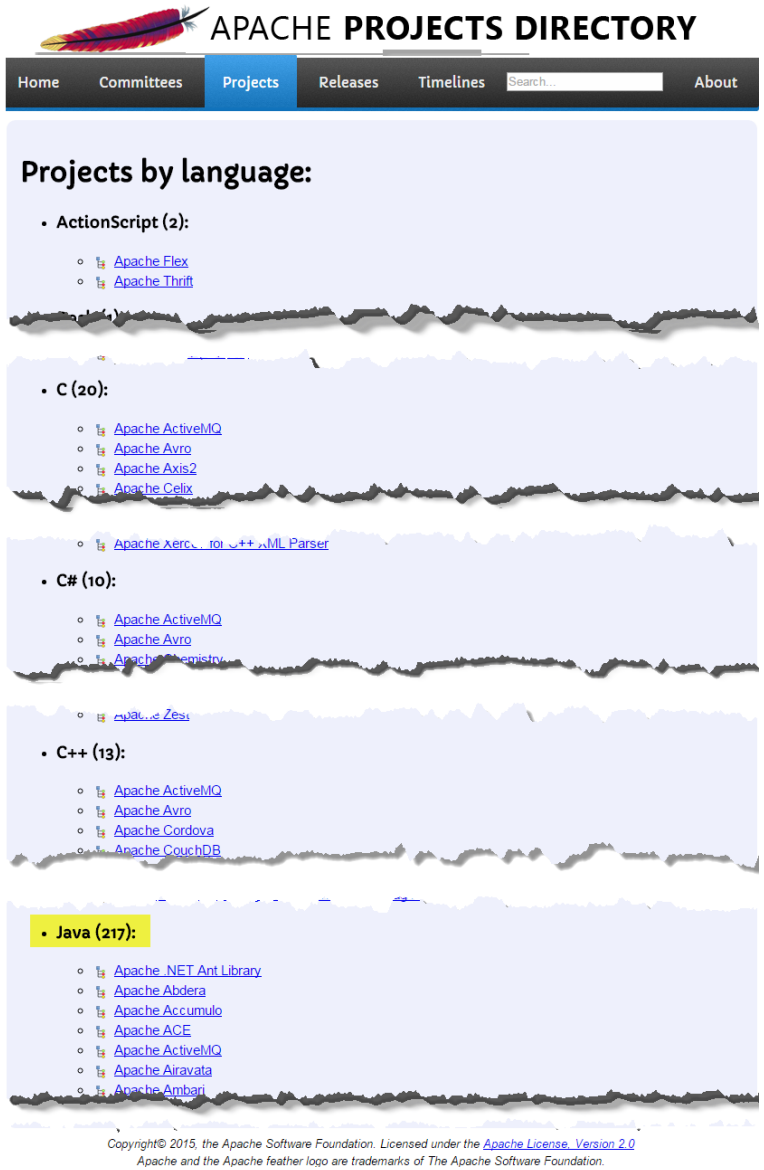
Jeff Underhill
Director Server Programs

JavaOne™

ORACLE®

Java: Many Server Workloads – E.g. Apache Software Foundation



Apache Ambari

Source: https://projects.apache.org/projects.html?language

Empowering Server Software Developers

- Multiple options for software developers on ARM.

ARM®

Enterprise Edition

The 96Boards Enterprise Edition (EE) specification targets the networking and server segments. A first version of this specification is available here. Please subscribe below if you wish to be notified when the first board becomes available.

96Boards Enterprise

EE Specification

96Boards Enterprise Edition

Request Form

First Name

Last Name

Email Address

Company

I would like to receive notification when 96Boards Enterprise Edition products become available.

Submit

Never submit passwords through Google Forms.

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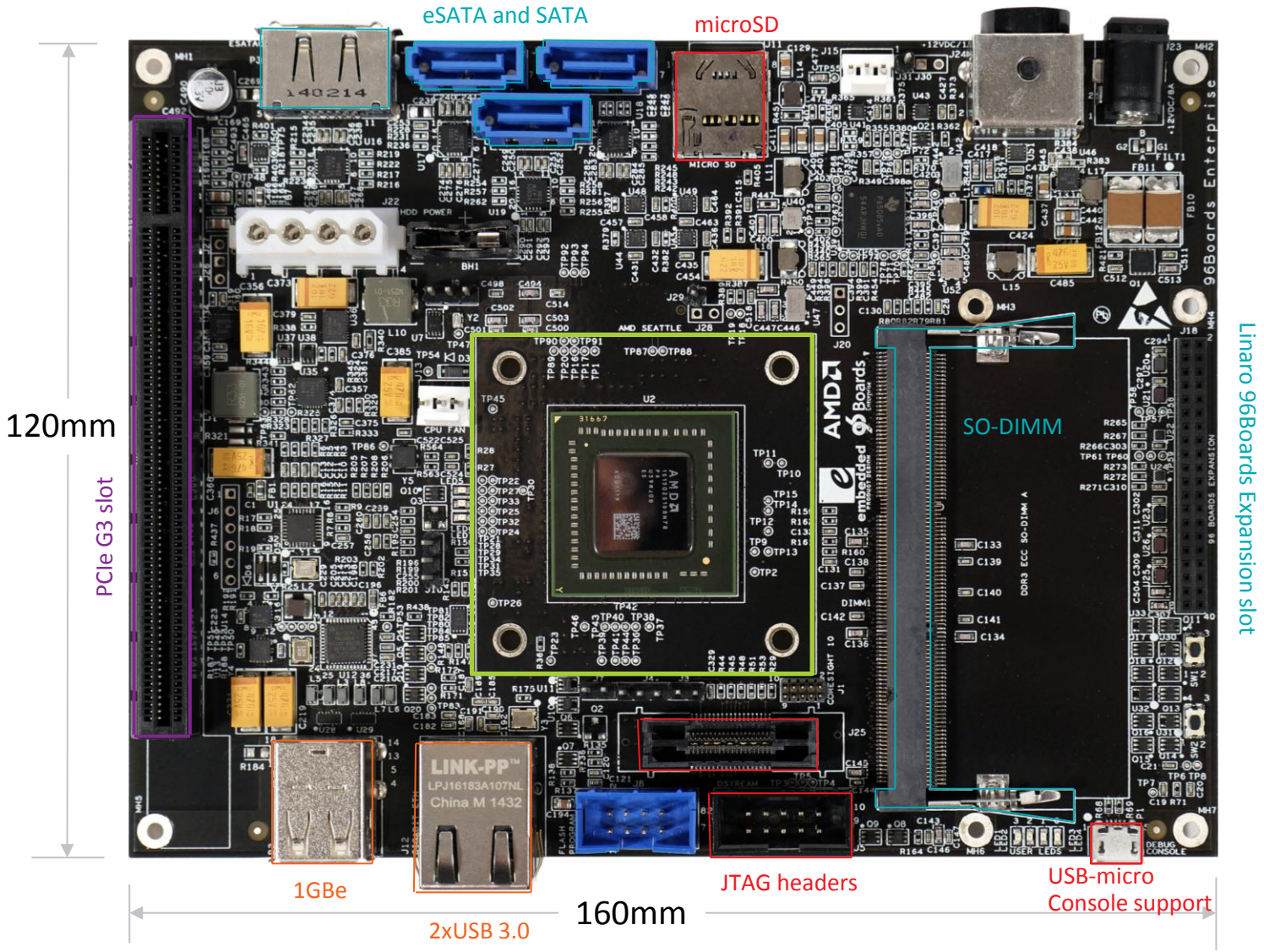
HUSKYBOARD: 96BOARDS ENTERPRISE EDITION PLATFORM

BASED ON AMD OPTERON A1100 ARM-BASED PROCESSOR



- Targeted at low-cost 64-bit ARM server software development
- Available 2H 2015
- 96Boards.org for updates
- Features
  - Quad-core AMD Opteron A1100 Series CPU
  - Two DDR3 SO-DIMM sockets
  - One eSATA + three SATA ports
  - Two USB 3.0 ports
  - 1GBe Ethernet
  - x16 PCIe G3 slot
  - 10-Pin and 38-PIN JTAG headers
  - USB-micro port for console support
  - Linaro 96Boards Expansion slot
  - Standard 160 x 120mm 96Boards EE form factor

SOFTIRON PRODUCTS

ARM DEVELOPMENT

STORAGE

OVERDRIVE 3000

OVERDRIVE 3000

The OverDrive 3000 combines the hardware and software needed to generate portable code and test it in a production environment. Having an enterprise class development system will allow developers to take their code base to the next level and make the ARM ecosystem thrive.The SoftIron Overdrive 3000 is an ARM Developer System powered by an 8-core AMD Opteron™ A1100 series processor combined witha complete development environment for ARM-based applications.
The Overdrive 3000 comes pre-installed with Linux from either SUSE enterprise or OpenSUSE, and it has a complete GNU tool chain.

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Data Center

X-C1 Development Kits

The X-Gene Server on a Chip™ platform represents a completely new, grounds-up server processor architecture tailored for the emerging growth of cloud computing and next-generation data centers. Featuring custom high-performance ARMv8 cores, the device is the first to couple an advanced 64-bit ARM architecture with unique network and storage offload engines, as well as integrated Ethernet. The highly integrated, purpose-built X-Gene solution delivers the highest performance and lowest total cost of ownership (TCO) for private cloud, public cloud, and enterprise applications.

For non-US orders, please click here.

Stay Informed

News

AppliedMicro and Vapor IO Partner to Deliver New Data Center Telemetry with Vapor Edge Controller
September 28, 2015 | in Press Releases

E4 Computer Engineering and AppliedMicro Demonstrate the Effectiveness of Power-Efficient X-Gene(R)
September 14, 2015 | in Press Releases

Applied Micro Circuits Corporation Announces Chief Financial Officer Transition
August 14, 2015 | in Press Releases

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THUNDERX™ ARM Processors

A 2.5 GHz, 48 Core Family of Workload Optimized Processors for Next Generation Data Center and Cloud Applications

CAVIUM

ThunderX™ Family of Workload Optimized Processors Reference Platform

CAVIUM THUNDERX

1U/1S Reference Platform (StratusX) (CN8800-1S-CDK) Product Brief

- **Processor:** CN8890-Series 48 core workload optimized ARMv8 server SoC
- **Configuration:** Single Socket
- **Chassis:** 1U Rack Mount
- **IO Configuration:**
  - 2 x 10GE SFP+
  - 1 x 40GE QSFP+
  - 2 x8 Gen3 PCIe slots
  - 4 x HDD drive slots – can accommodate 2.5" and 3.5" HDDs and SSDs
  - Ships with 1 x 3.5" 400 GB HDD
- **Memory:**
  - Supports standard DDR3 RDIMMs
  - 8 DDR3 slots, upto 1866MHz
- **Mother board Form Factor:** Micro-ATX (9.6" x 9.6")
- **Power Supply:** Supports dual redundant power supply
- **Management**
  - Aspeed 2400 Baseband management controller (BMC) with AMI MegaRAC BMC software
  - Managed through IPMI 2.0
  - Supports all the standard BMC functions such as serial over LAN (SOL), vMedia, KVM etc.
  - Supports both in-band out of band management
- **BIOS/Boot:** Standard UEFI Boot environment
- **Compliant with SBSA and SBBR specifications**
- **OS Support:** Preloaded with Ubuntu 14-04
- **SW SDK Contents:**
  - RedHat Early Access for ARMv8
  - Fedora F20 and later
  - OpenSUSE V13 and later
  - Standard GNU tool chain
  - Platform device drivers
- **Configurations**
  - Standard memory config: CN8800-1S-64G-2.0-CDK: 64 GB memory
  - High memory config: CN8800-1S-128G-2.0-CDK: 128GB memory

CAVIUM
2315 N. First Street
San Jose, CA 95131
T 408-943-7100
F 408-577-1992
E sales@cavium.com
www.cavium.com

CAVIUM

ThunderX™ Family of Workload Optimized Processors Reference Platform

CAVIUM THUNDERX

2U/4N (½ SSI) - CirrusX Reference Platform (CN8800-2S-CDK) Product Brief

- **Processor:** CN8890-Series 48 core workload optimized ARMv8 server SoC
- **Configuration:** Dual Socket
- **Chassis:** 2U Rack Mount
- **IO Configuration:**
  - 1 x 40GE QSPF+ and 2 x 10GE SFP+
  - 1 x16 (wired for x8) and 1 x 8 PCIe slots
  - Up to 3x3.5" or 6x2.5" HDD and SDD drive slots per sled
  - Ships with 1 x 3.5" 400 GB HDD
- **Memory:**
  - Supports standard DDR4 RDIMMs
  - 8 DDR4 slots per sled
- **Mother board Form Factor:** ½ SSI (18.9" x 6.79") sled
- **Power Supply:** Supports dual redundant power supply
- **Management**
  - Aspeed 2400 Baseband management controller (BMC) with AMI MegaRAC BMC software
  - Managed through IPMI 2.0
  - Supports all the standard BMC functions such as serial over LAN (SOL), vMedia, KVM etc.
  - Supports both in-band out of band management
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  - RedHat Early Access for ARMv8
  - Fedora F20 and later
  - OpenSUSE V13 and later
  - Standard GNU tool chain
  - Platform device drivers
- **Configurations**
  - CN8800-2S1N-64G-2.0-CDK – Chassis with 1 sled with 64 GB memory, 1 x 3.5" HDD
  - CN8800-2S4N-64G-2.0-CDK – Chassis with 4 sleds, each with 64 GB memory, 1 x 3.5" HDD
  - CN8800-2S1N-128G-2.0-CDK – Chassis with 1 sled with 128 GB memory, 1 x 3.5" HDD
  - CN8800-2S4N-128G-2.0-CDK – Chassis with 4 sleds, each with 128 GB memory, 1 x 3.5" HDD

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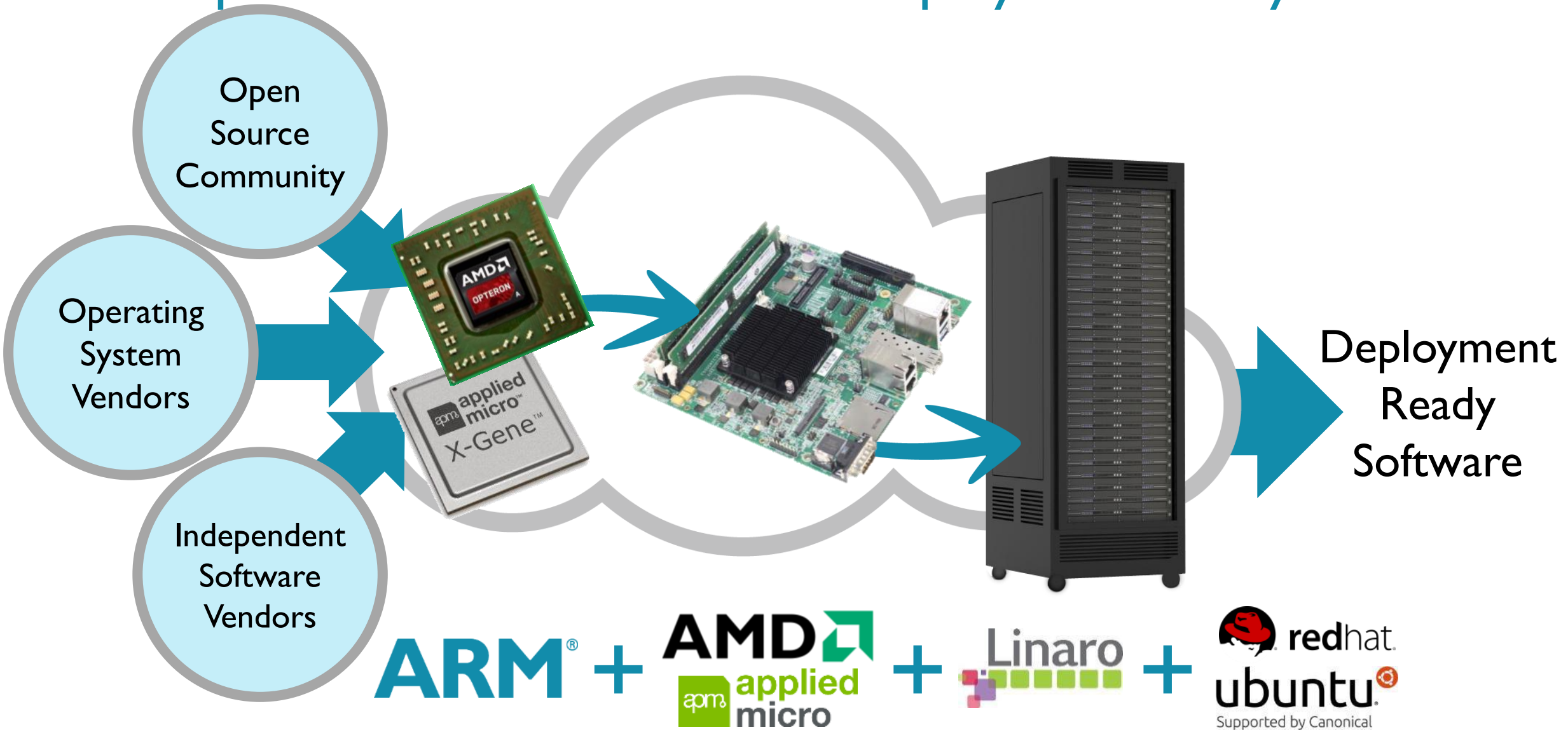
Empowering Server Software Developers

- Multiple options for software developers on ARM.

ARM®

Developer Cluster to Accelerate Deployment-ready Software



Request access: http://www.linaro.org/leg/servercluster/

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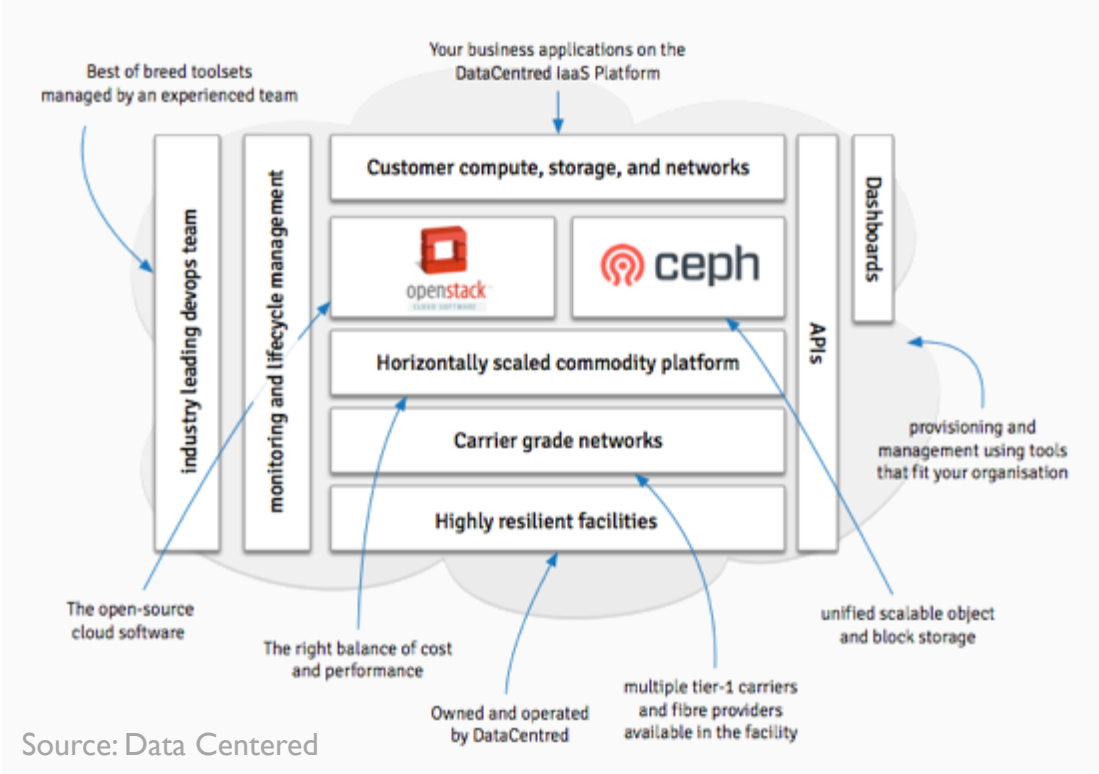
OpenStack Cloud Based on ARM



Source: Data Centered

- Open Stack Managed Cloud
  - OpenStack Juno - Nova
- Virtualized little endian ARM AArch64 instances
- HP Moonshot m400 Cartridges
  - AppliedMicro's X-Gene
- Try it now: http://www.datacentred.co.uk/signup/

DataCentred

applied micro

CodeLink

hp

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The ARMV8 architecture is the first ARM 64 bits architecture. It allows to manage great size o...

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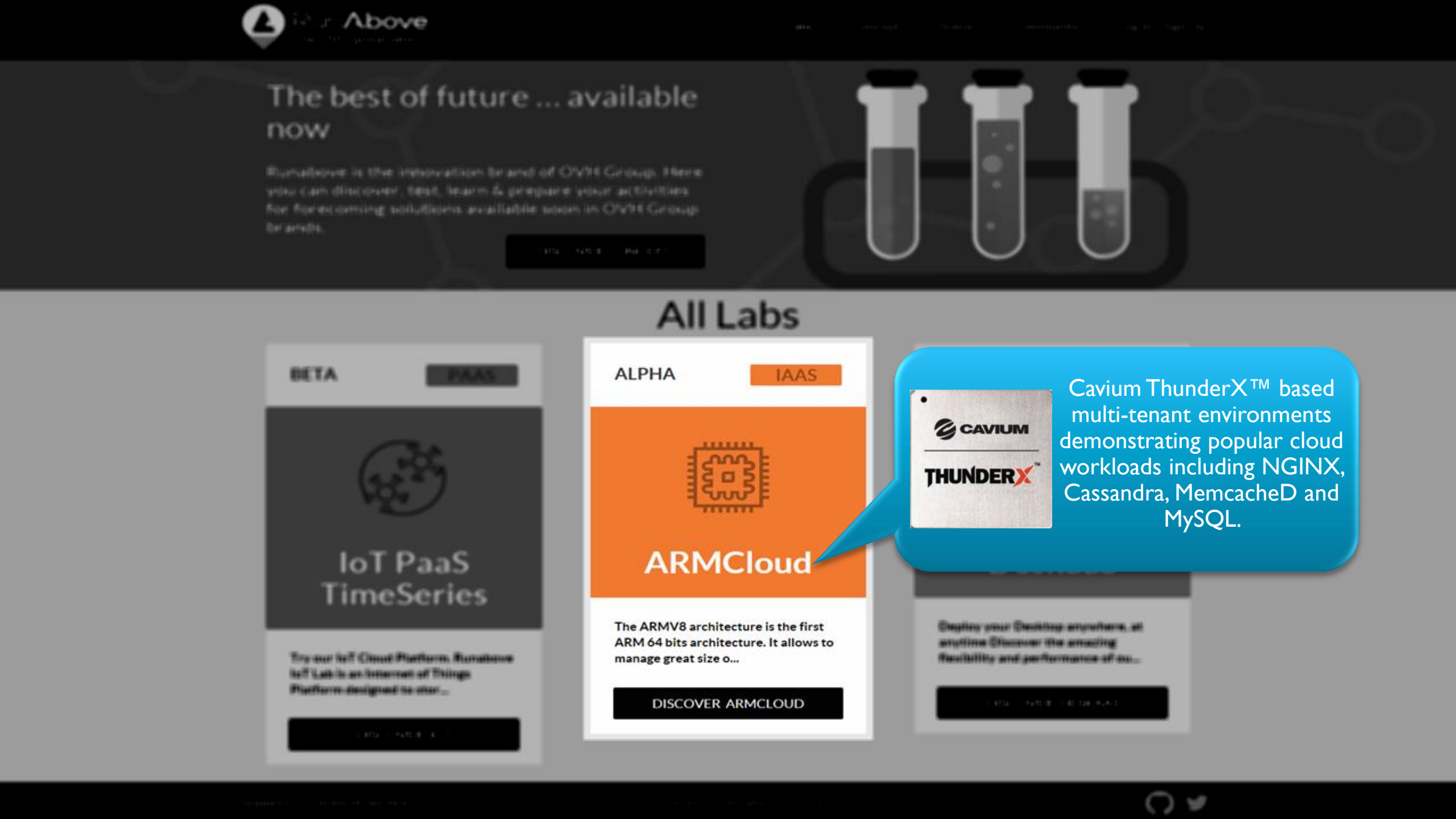
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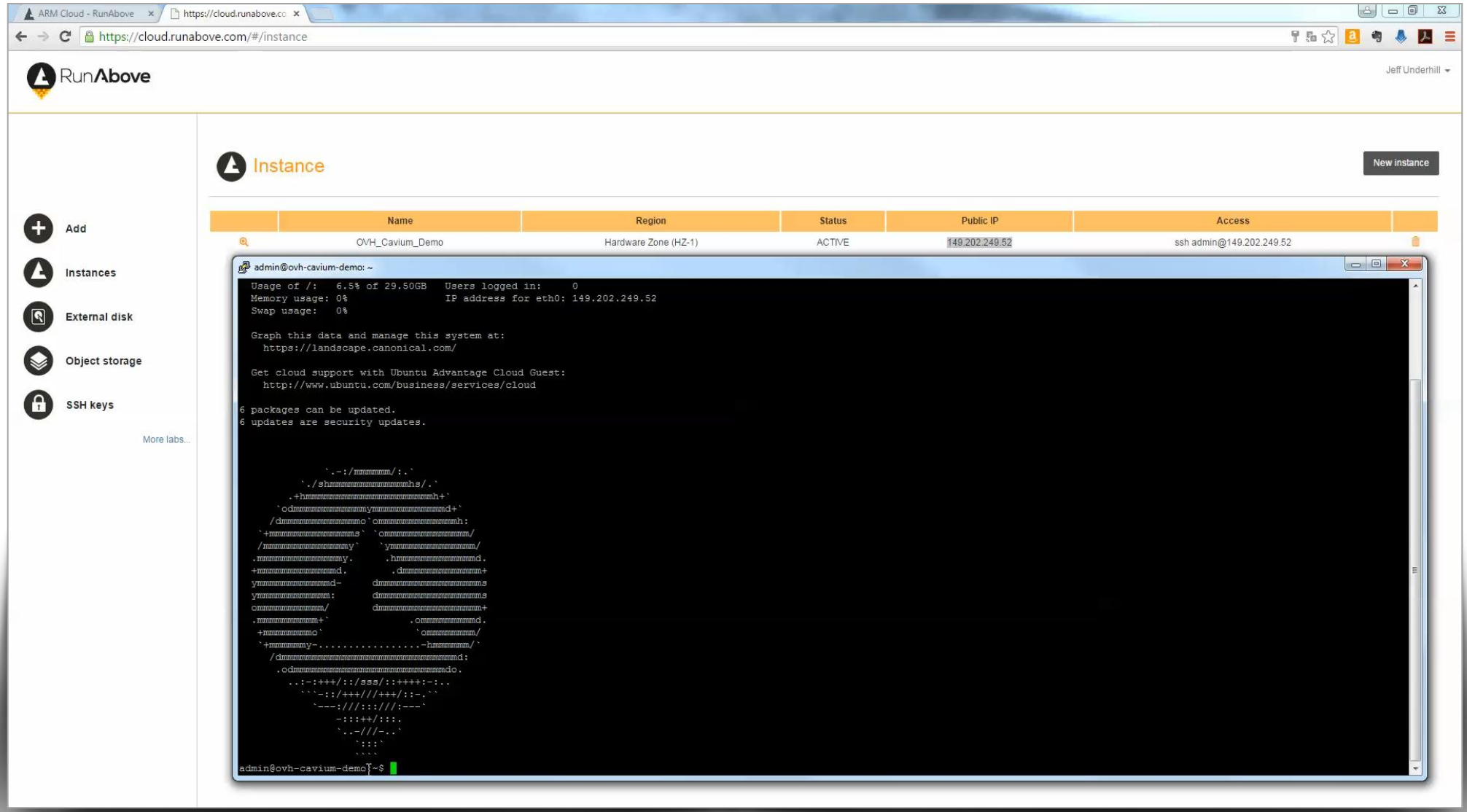
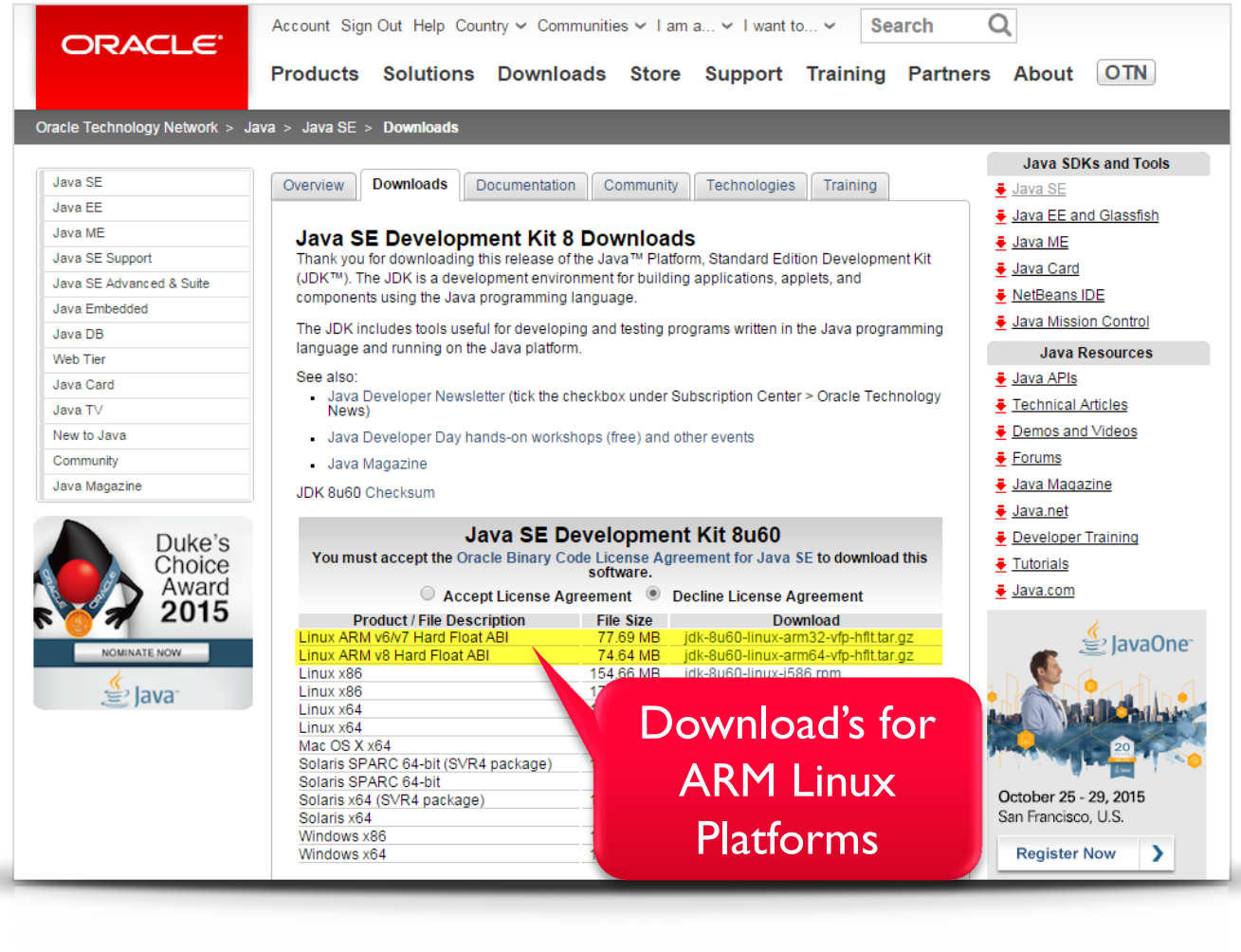
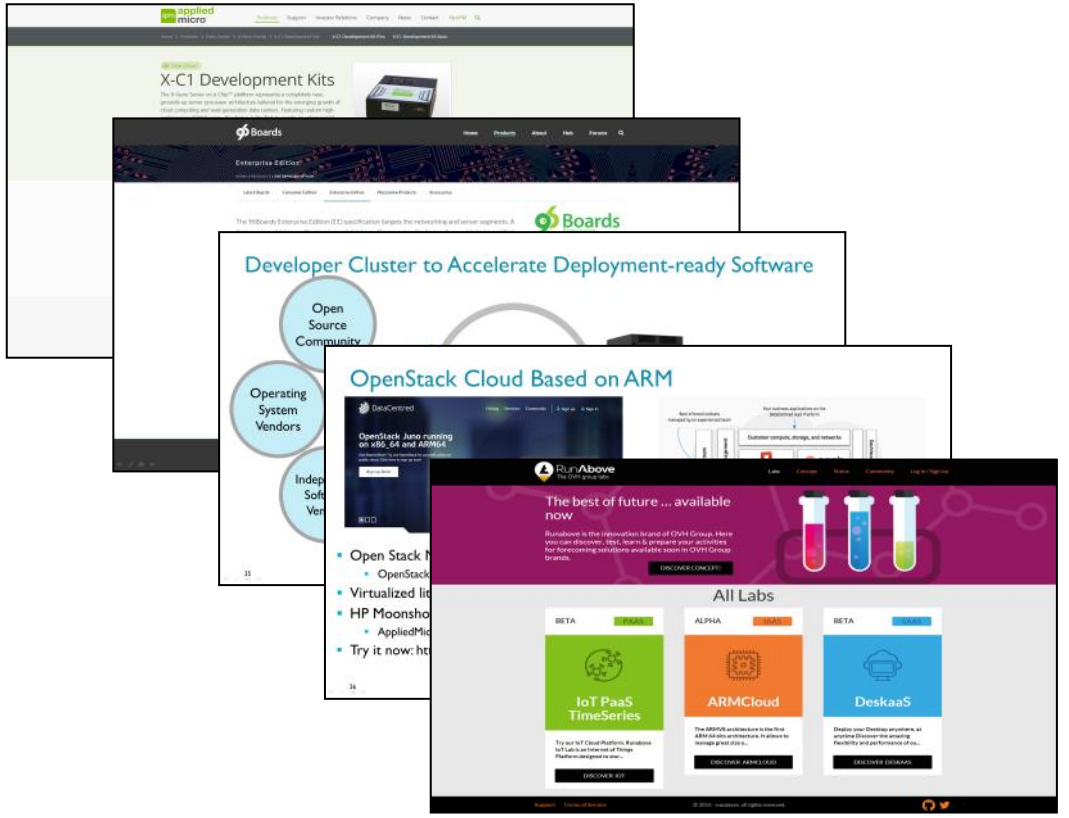
Cavium ThunderX™ based multi-tenant environments demonstrating popular cloud workloads including NGINX, Cassandra, MemcacheD and MySQL.

OVH Labs RunAbove – Oracle JDK8 Cassandra Demo…



Call to Action… Try it for Yourself!





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Thank You – Come Visit Us at the Exhibit Floor!

Jeff Underhill
ARM - Director Server Programs

ARM
Booth #5615

Christian Thalinger
Oracle - Principal Member of Technical Staff

Special thanks to Pankaj Garg @ Cavium for the Cassandra Demo!

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