

SPRINGFIELD AMAZON WEB SERVICES USER GROUP
APRIL 2021

#SGFAWS

AWS ON ARM: MIGRATING TO THE GRAVITON2 PROCESSOR

ABOUT SPRINGFIELD AWS

- ▶ **Meetup**

<https://meetup.com/sgfaws/>

- ▶ **YouTube**

<https://youtube.com/c/sgfaws>

- ▶ **Discord**

<https://sgf.dev/>



Springfield Amazon Web Services (SGF AWS) User Group is a community-based user group that promotes and advocates for Amazon Web Services in the Springfield Missouri region.

ABOUT JASON KLEIN

- ▶ **20+ years experience in IT (Networks and Linux) and Software Development (PHP/MySQL)**
- ▶ I have been an AWS user for 8+ years. First for DR, then forklift moved our Linux servers, before updating platform to use native AWS services (S3, RDS, SQS, SNS, SES, ECS/ECR, CP/CP (CI/CD)...
- ▶ I have been deploying projects to Intel Linux for 20+ years. Red Hat (2001-'12), Debian (2012-'18), Amazon Linux (2018-'20), Amazon Linux 2 (2020-)



- ▶ Follow me!  @JasnK  @jason-klein

AGENDA

- ▶ Terminology
- ▶ History
- ▶ Why ARM?
- ▶ Ecosystem
- ▶ AWS Processor History
- ▶ AWS Graviton2 (ARM64) vs AWS Intel (AMD64)
- ▶ Migrating AWS Services (EC2, ECS, CI/CD)

TERMINOLOGY

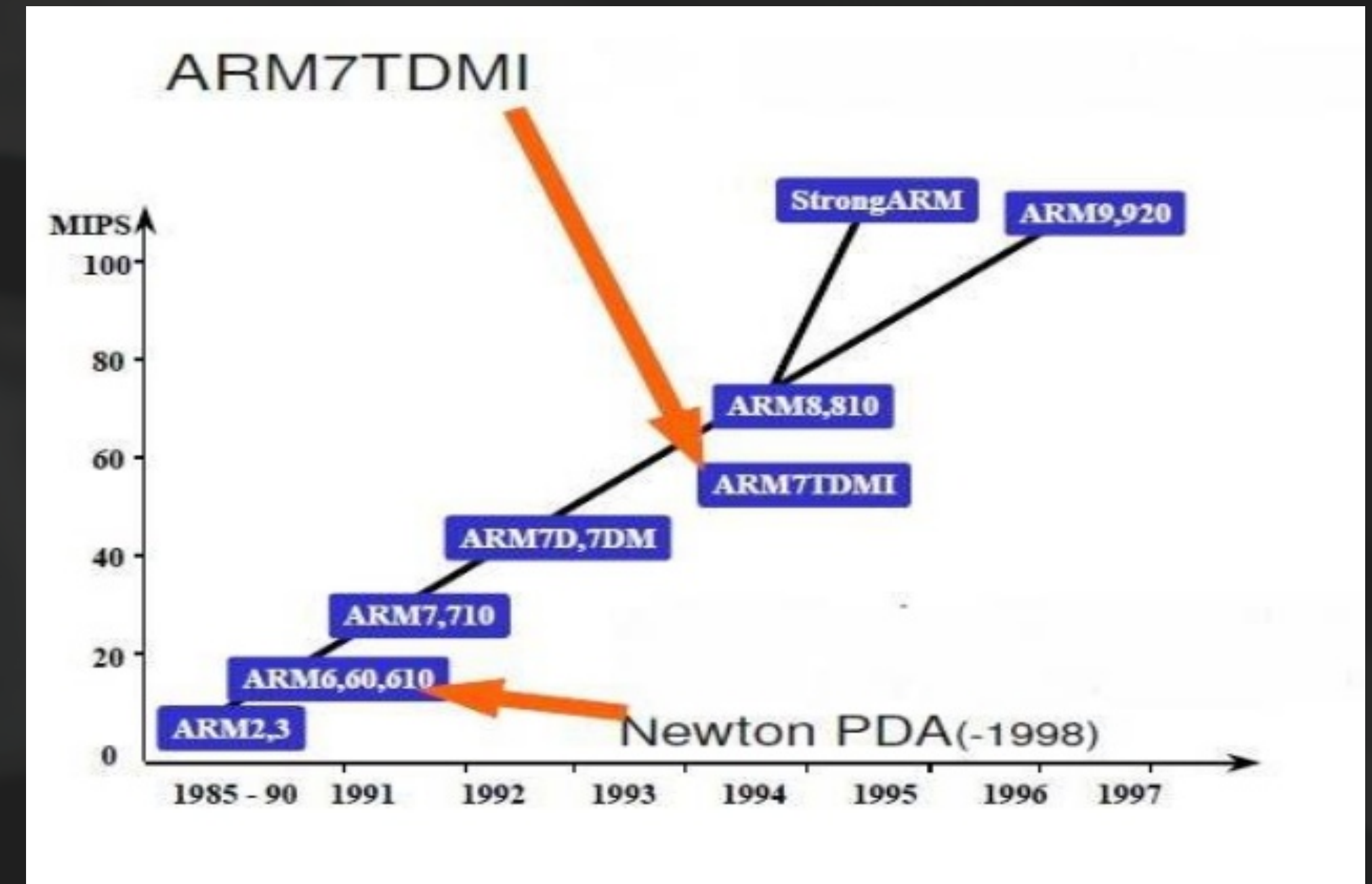
- ▶ **Advanced RISC Machine (ARM)**
- ▶ **Reduced Instruction Set Computer (RISC)**



Hackers 1995

HISTORY OF ARM PROCESSORS

- ▶ 1981 Acorn Computer introduced "BBC Micro" CPU
- ▶ 1983 Began Acorn RISC Machine (ARM)
- ▶ 1985 Completed "ARM1" processor design
- ▶ 1990 Advanced RISC Machines Ltd. (Arm, Ltd.) established by Acorn Computer Group, Apple Computers, and VLSI
- ▶ 1991 ARM (Arm, Ltd.) created and licensed the new ARM6 microprocessor standard (Apple Newton)
- ▶ 2005 98% of all mobile phones sold used at least one ARM processor



Early ARM History (1985-1997)

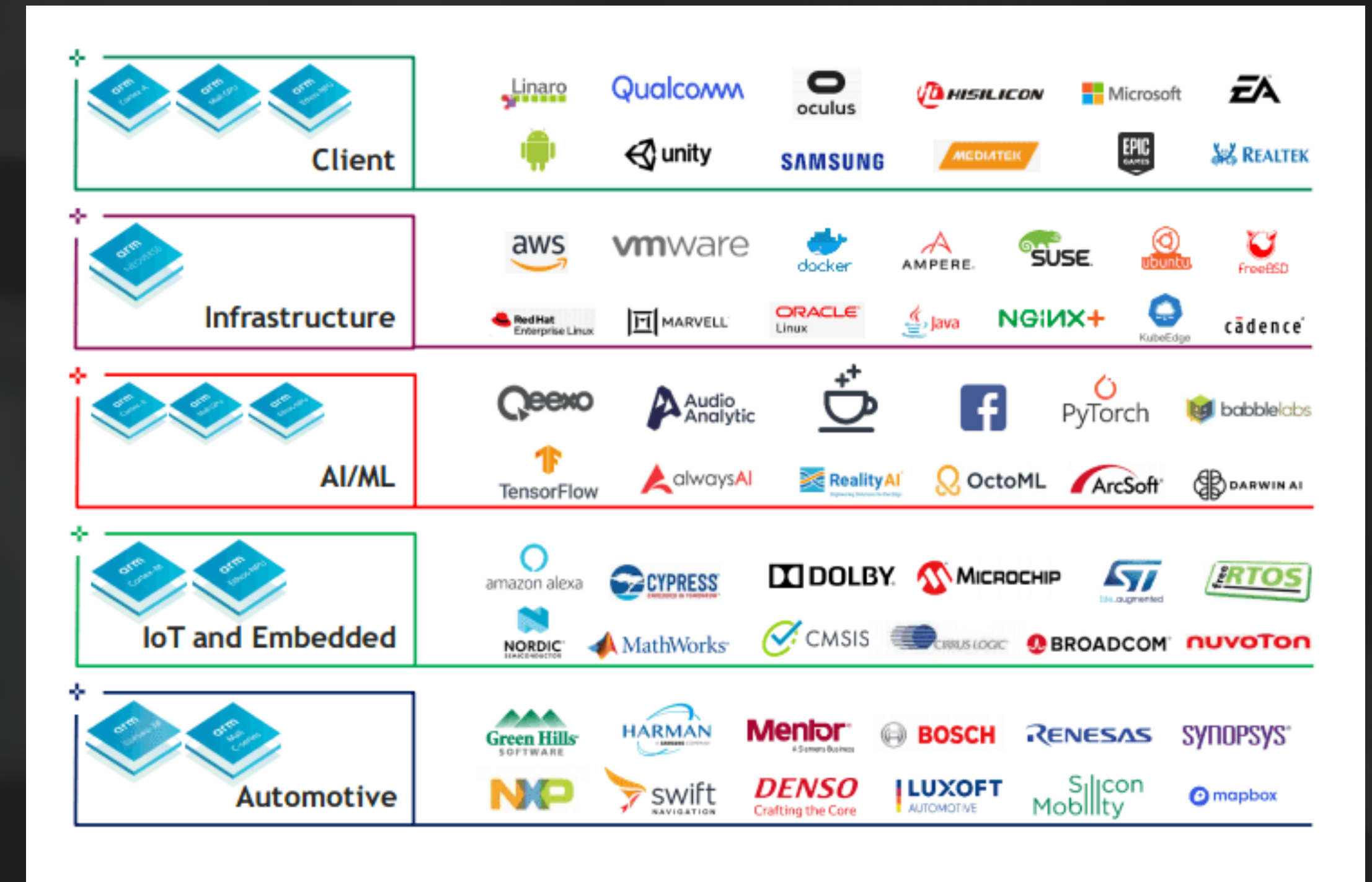
WHY USE ARM PROCESSORS?

- ▶ License architecture from Arm, Ltd., rather than purchasing processors from Intel or AMD. Licensees typically use reference architecture when designing their own Systems-on-Chips (SoC)
- ▶ Low costs, minimal power consumption, and lower heat generation than their competitors.

Learn More https://en.wikipedia.org/wiki/ARM_architecture

ECOSYSTEM

- ▶ Clients (Phone, Tablet, VR)
- ▶ Infrastructure (Hosting Servers)
- ▶ AI/ML (Super Computers)
- ▶ IoT and Embedded (Smart Speakers)
- ▶ Automotive (Infotainment, Navigation)



ARM Ecosystem

AMAZON WEB SERVICES ELASTIC COMPUTE CLOUD (EC2) PROCESSOR HISTORY

- ▶ **2006 32-bit Intel 1.7Ghz Xeon CPU:** "Small" at \$0.10/hr (\$72/mo) ^[1]
- ▶ **2007 64-bit Intel CPU:** "Large" at \$0.40/hr, "Extra Large" at \$0.80/hr ^[2]
- ▶ **2008 64-bit Intel "High CPU":** "Medium" at \$0.20/hr, "Extra Large" at \$0.80/hr ^[3]
- ▶ **2018 64-bit Graviton CPU** (16x Arm Cortex-A72 2.3 GHz) "A1" starting at \$0.0255/hr ^[4]
- ▶ **2020 64-bit Graviton2 CPU** (64x Arm Neoverse N1 2.5 GHz) "T4g" starting at \$0.0042/hr ^[5]

[1] https://aws.amazon.com/blogs/aws/amazon_ec2_beta/

[2] <https://aws.amazon.com/blogs/aws/amazon-ec2-gets/>

[3] <https://aws.amazon.com/blogs/aws/more-ec2-power/>

[4] <https://aws.amazon.com/blogs/aws/new-ec2-instances-a1-powered-by-arm-based-aws-graviton-processors/>

[5] <https://aws.amazon.com/blogs/aws/new-t4g-instances-burstable-performance-powered-by-aws-graviton2/>

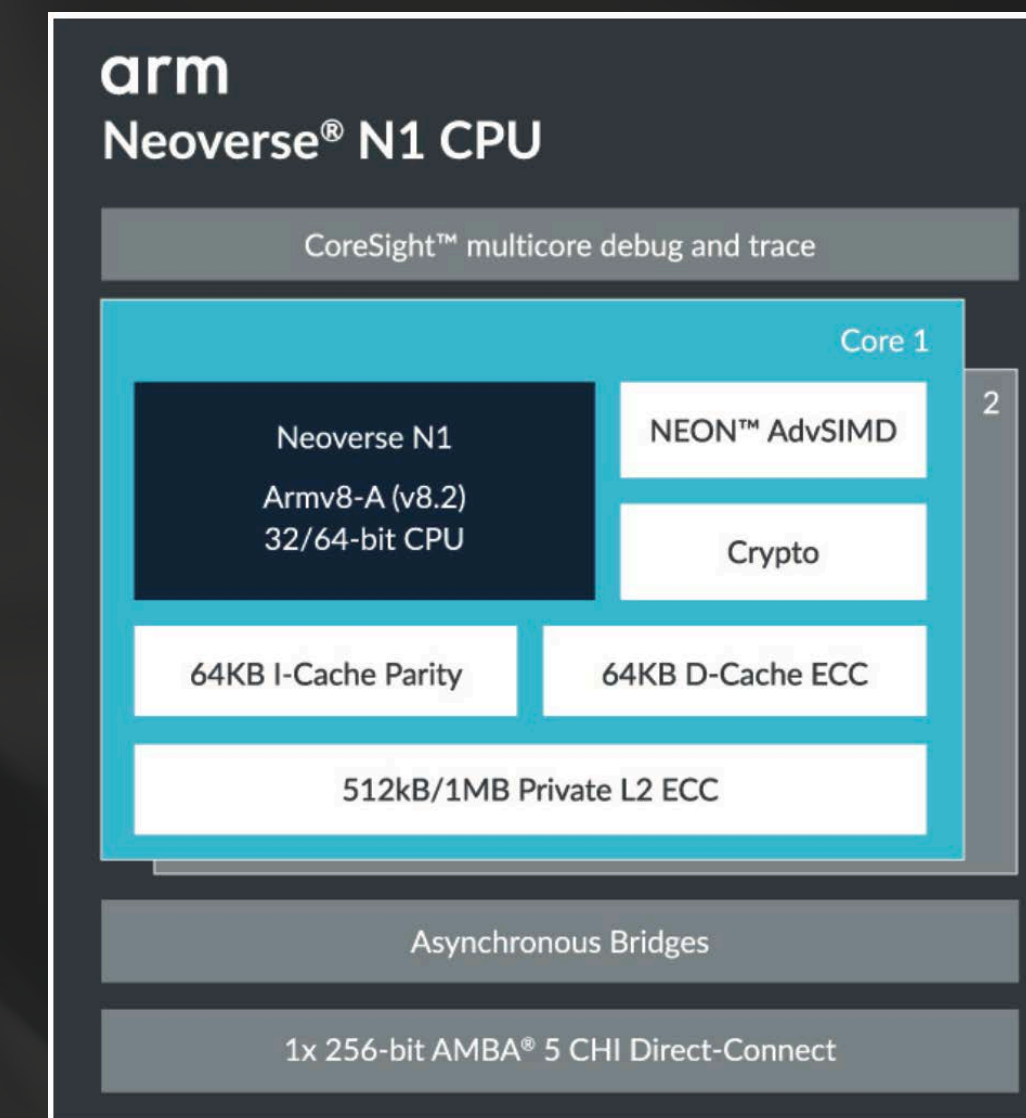
AWS GRAVITON2 (ARM) VS INTEL (X86)

- ▶ Up to 40% better price performance over comparable current gen x86-based instances [1]
- ▶ 7x more performance, 4x more compute cores, 5x faster memory, and 2x larger caches [1]
- ▶ Amazon Graviton2 CPU created by subsidiary "Annapurna Labs" (acquired 2015) [2]
- ▶ Amazon Graviton2 CPU implements Arm's Neoverse N1 reference architecture [3]

[1] <https://aws.amazon.com/ec2/graviton/>

[2] https://en.wikipedia.org/wiki/Annapurna_Labs

[3] <https://www.anandtech.com/show/15578/cloud-clash-amazon-graviton2-arm-against-intel-and-amd>



Arm Neoverse N1 Architecture

Geometric Mean Of All Test Results

Result Composite

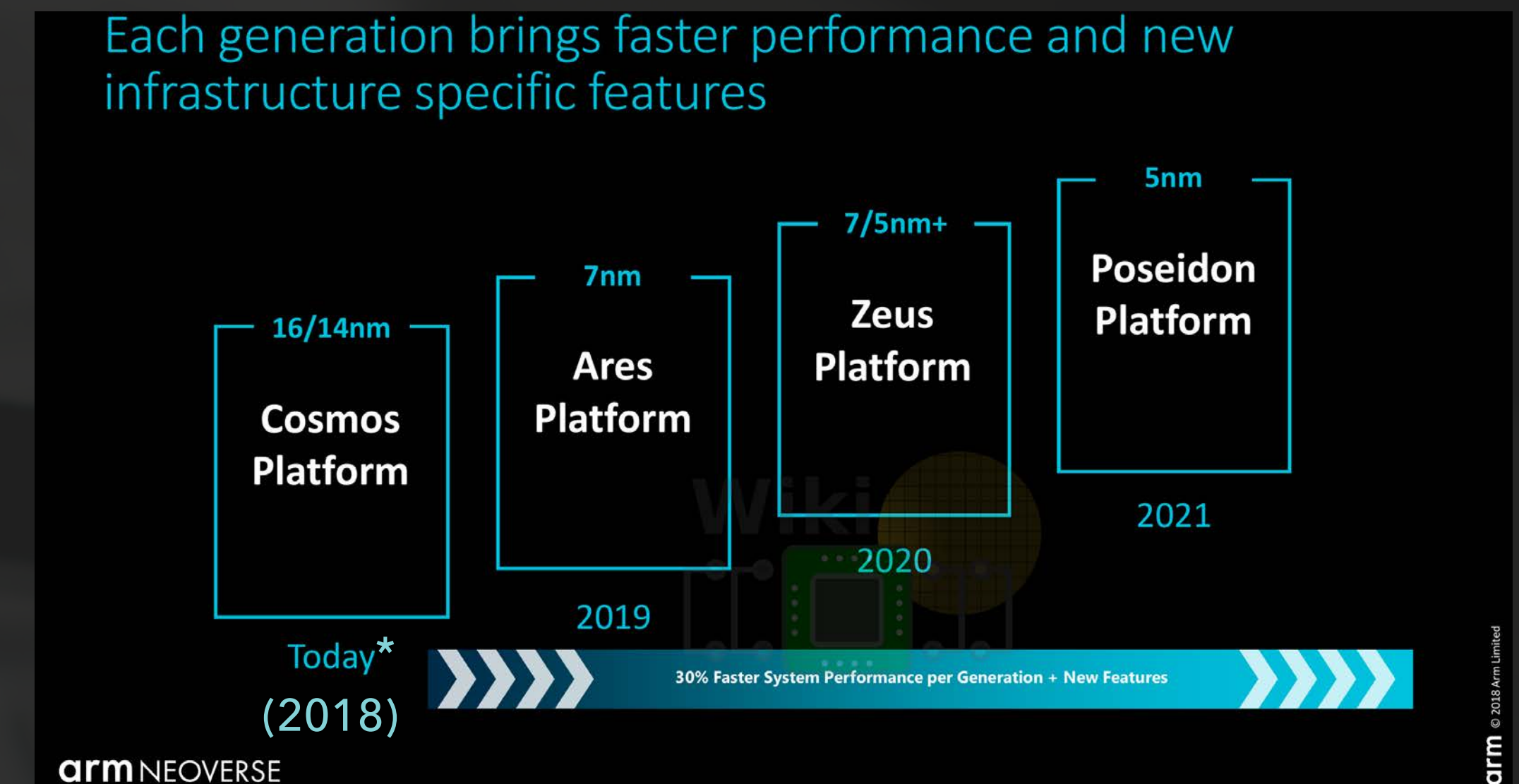


When taking the geometric mean of all these benchmarks, the EPYC 7742 without SMT enabled was about 46% faster than the Graviton2 bare metal performance. The EPYC 7742 with SMT (128 threads)

Phoronix Test Suite (PTS) Combined Benchmarks

FUTURE OF ARM ON AWS?

- ▶ Graviton based on Cosmos Platform?
- ▶ Graviton 2 (Neoverse N1) based on Ares (7nm)
- ▶ Future Graviton processors may be based on 2020 Zeus (7/5nm+) and 2021 Poseidon (5nm) platforms?
- ▶ Arm has released Neoverse N2 (Zeus 7/5nm) with up to 40% performance increase over Neoverse N1 at 5nm and 128 cores per socket.
- ▶ Arm is planning N3 (Poseidon 5/3nm) for 2022+



Arm Server Silicon Roadmaps ^[1]



[1] <https://www.arm.com/company/news/2020/09/accelerating-the-next-gen-cloud-to-edge-infrastructure>

MIGRATING EC2

- ▶ We rely heavily on many small burstable EC2 instances. We are moving many of our existing T2/T3 instances to T4g.
- ▶ We'll focus on migrating EC2 host instances for an ECS cluster from Intel to ARM.
- ▶ Next...

✔ Running	⊕ ⊖	t2.small	✔
✔ Running	⊕ ⊖	t2.small	✔
✔ Running	⊕ ⊖	t4g.small	✔
✔ Running	⊕ ⊖	t4g.small	✔
✔ Running	⊕ ⊖	t4g.small	✔
✔ Running	⊕ ⊖	t4g.small	✔
✔ Running	⊕ ⊖	t2.small	✔
✔ Running	⊕ ⊖	t4g.small	✔
✔ Running	⊕ ⊖	t4g.small	✔

When and Why to use ARM Graviton2 EC2 instead of Intel/AMD instances?
https://www.reddit.com/r/aws/comments/j1i7iz/when_why_to_use_arm_graviton2_ec2_instead_of/

MIGRATING ECS

- ▶ Docker images are usually available for Intel and ARM. Code deployed to an Intel image was easily redeployed to the ARM version of the same image (e.g. Alpine PHP)
- ▶ Must update ECR repos, ECS task defs, ECS services. We deployed new cluster with ECS/ECR naming convention "service-arch" (e.g. "app-web-arm64")
- ▶ AWS requires EC2 ARM instances use "Amazon Linux 2" images to host an ECS cluster.
- ▶ AWS does NOT provide ANY CloudFormation templates that use "Amazon Linux 2" to host ECS. Refer to the sample templates we created...

Service Name	Status	Service type	Task Definition	Desired tasks ▾	Running tasks ▾	Launch type
app-web	ACTIVE	REPLICA	app-web-arm64:66	3	3	EC2
app-worker-micros	ACTIVE	REPLICA	app-worker-micros-arm64:67	9	9	EC2
app-web-test	ACTIVE	REPLICA	app-web-test-arm64:67	1	1	EC2
qbwc-web-test	ACTIVE	REPLICA	qbwc-web-test-arm64:27	1	1	EC2
app-worker-cron	ACTIVE	REPLICA	app-worker-cron-arm64:66	2	2	EC2
qbwc-web	ACTIVE	REPLICA	qbwc-web-arm64:27	3	3	EC2
app-worker-legacy	ACTIVE	REPLICA	app-worker-legacy-arm64:65	2	2	EC2
app-worker-infor	ACTIVE	REPLICA	app-worker-infor-arm64:66	2	2	EC2
app-worker-s3	ACTIVE	REPLICA	app-worker-s3-arm64:65	2	2	EC2
cms-web	ACTIVE	REPLICA	cms-web-arm64:3	2	2	EC2
cms-web-test	ACTIVE	REPLICA	cms-web-test-arm64:3	1	1	EC2
app-worker-logic	ACTIVE	REPLICA	app-worker-logic-arm64:68	4	4	EC2

Example ECS Services for a Laravel Application

Sample CloudFormation Templates

<https://github.com/sgf-aws/aws-ecs-arm>

MIGRATING CI/CD

- ▶ CodeBuild must be configured for specific architecture. It may be possible to setup multi-architecture builds.
- ▶ CodePipeline does NOT care about Intel vs ARM architecture. Update pipeline to use new CodeBuild and new ECS services.
- ▶ DEMO

Name ▲	Source provider	Repository	Latest build status	Description	Last Modified
logic-app-arm64	AWS CodePipeline	-	✔ Succeeded	Build Docker image for Laravel PHP application	3 months ago
logic-cms-arm64	AWS CodePipeline	-	✔ Succeeded	Build Docker image for Wagtail CMS application	3 months ago
logic-qbwc-arm64	AWS CodePipeline	-	✔ Succeeded	Build Docker image for Laravel PHP application	3 months ago

Sample CodeBuild Projects

Name	Most recent execution	Latest source revisions	Last executed
logic-qbwc-arm64	⋮ In progress	Source – 8f24ef94 ↗: npm update	18 minutes ago
logic-cms-arm64	✔ Succeeded	Source – 261a6ad8 ↗: Docker - Add script to push images to AWS ECR	3 months ago
logic-app-arm64	⋮ In progress	Source – 5eb326da ↗: npm update	19 minutes ago

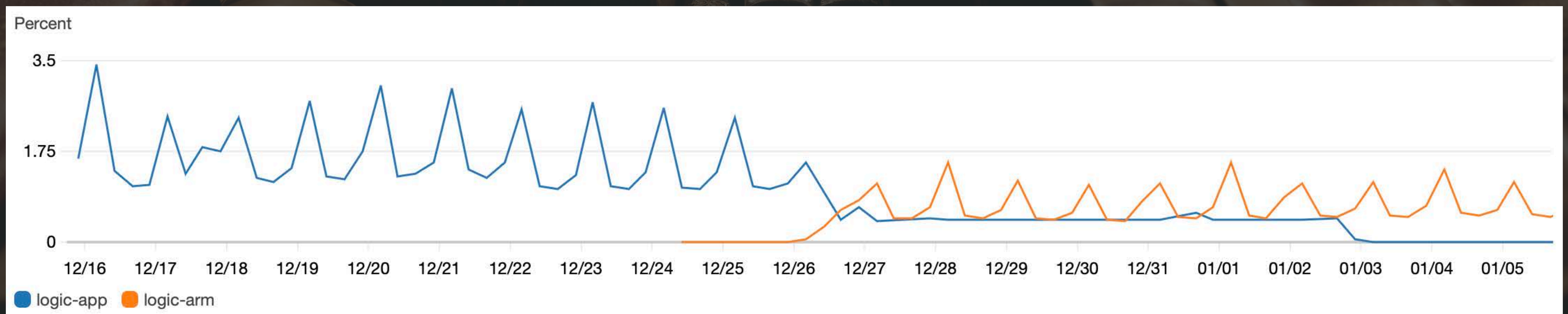
Sample CodePipeline Pipelines

AWS GRAVITON2 #WTF

- ▶ CloudFormation sample ECS templates for ARM? (Or for Amazon Linux 2 ECS hosts?)
- ▶ ECS console cannot update ECS agent on Amazon Linux 2 image? I toggle a value in the CloudFormation template to force CF to re-deploy all of our ECS hosts.
- ▶ CodeBuild limited to a single larger ARM processor/server option. \$\$\$
- ▶ CodeBuild initially VERY slow build. Waiting 7+ minutes for build to begin?? Resolved?

AWS GRAVITON2 #FTW

- ▶ **Lower Cost** (28% less; Partial Upfront 3-year RI; t2.small \$241/3yr; t4g.small \$173/3yr)
- ▶ **Better Performance** (lower response times; faster app; ECS cluster CPU decreased by 50%)
- ▶ **Great Linux image compatibility. No issues with Amazon Linux 2 for ARM64.**
- ▶ **Seamless transition of our entire ECS cluster from Intel to ARM**



RESOURCES

- ▶ AWS Graviton Processor
<https://aws.amazon.com/ec2/graviton/>
- ▶ Getting Started with AWS Graviton
<https://github.com/aws/aws-graviton-getting-started>

▶

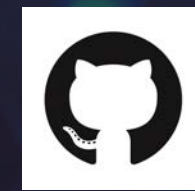
Questions?

Discuss in our Springfield Devs Discord channel .. #aws

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@jason-klein

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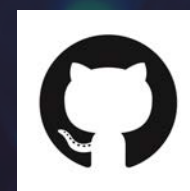
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Thank you!

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Next Month

Guest Speaker Adam Elmore

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MAY 2021

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HOW TO COMPLETE ALL 12 AWS CERTIFICATIONS IN 6 WEEKS!

<https://www.meetup.com/sgfaws/>