AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

XNT303

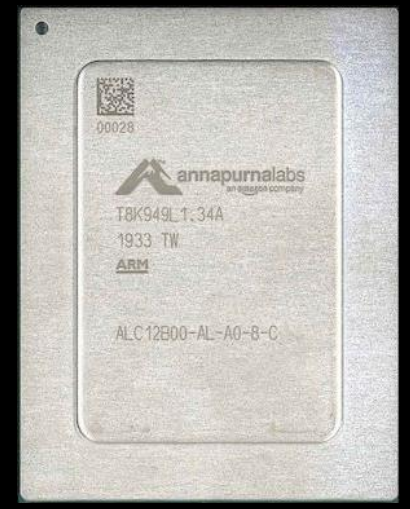
Accelerate .NET 6 performance with Arm64 on AWS Graviton2

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What is Graviton2?



Graviton2 is a CPU used in some Amazon EC2 instances

- Arm64 architecture
- 64-bit Arm Neoverse N1 cores
  - Up to 64 vCPUs per instance
  - 7 nm fabrication process
- Original Graviton instances launched in 2018 in A1 instance family
- Graviton2 is second generation
  - 7x more performance than first generation
  - 5x faster memory
- Graviton2 instance families announced in 2019
  - Graviton2 instances use “g” suffix: t4g.large, c6g.2xlarge, etc.
  - Roughly ~20% less expensive than comparable Intel-based instances

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Jan. 5, 2021

Apple’s New MacBook Pro Will Deliver A Powerful Shock

Now Apple has established its ARM-powered beach-head with the M1 processor, the next step will be to deliver more power over more machines to more consumers. And that step could happen in March.

Dec. 21, 2020

Microsoft Surface Pro X (2020) Review: ARM laptops are the future

From the new Apple M1 powered Macs to the Microsoft Surface Pro X I've been using, ARM-based computers are the new craze in mobile computing. The Surface Pro X was Microsoft’s second big consumer push to get into the ARM platform and it really nails the essentials.

Apr. 19, 2020

ARM in the Datacenter

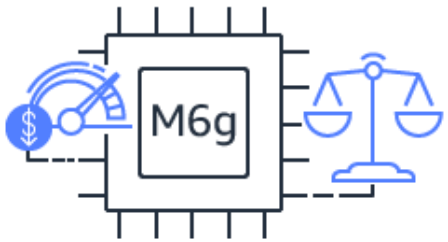
Tom Fenton highlights some different ARM devices and discusses ways that they have made their way into the datacenter.

ARM processors have seen unprecedented growth in the last three years and are now being used in everything from smart watches to Apple’s new M1 desktop and laptop systems . . .

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General Purpose



Best price performance for general-purpose workloads with balanced compute, memory, and networking

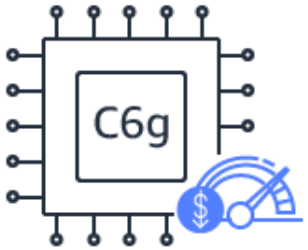
Built for: General-purpose workloads such as application servers, mid-size data stores, microservices, and cluster computing



Best price performance for burstable general-purpose workloads

Built for: Broad range of burstable general-purpose workloads such as large-scale microservices, small and medium databases, virtual desktops, and business-critical applications

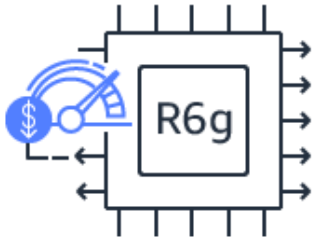
Compute Optimized



Best price performance for compute-intensive workloads

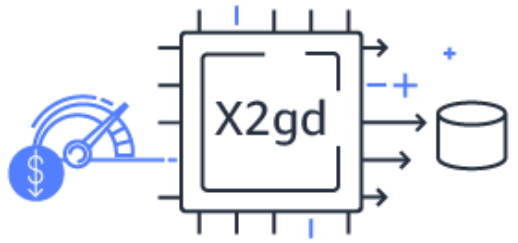
Built for: Compute-intensive applications such as high performance computing, video encoding, gaming, and CPU-based machine learning inference acceleration

Memory Optimized



Best price performance for memory-intensive workloads

Built for: Memory-intensive workloads such as open-source databases (MySQL, MariaDB, and PostgreSQL) or in-memory caches (Redis, KeyDB, Memcached)



Lowest cost per GiB of memory in Amazon EC2

Built for: Memory-intensive workloads such as open-source databases (MySQL, MariaDB, and PostgreSQL) or in-memory caches (Redis, KeyDB, Memcached), electronic design automation (EDA) workloads, real-time analytics and real-time caching servers

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Graviton2 instances vs. x64 instances

Graviton2 (Arm64)

- vCPU = physical core
- Sample Amazon EC2 costs
  - t4g.large: $0.0672
  - m6g.large: $0.077
- Amazon RDS cost (Amazon Aurora MySQL-Compatible Edition)
  - db.r6g.large: $0.260
  - db.r6g.8xlarge: $4.153

Intel/AMD (x86-64)

- vCPU = logical core (hyperthread)
- Sample Amazon EC2 costs
  - t3.large: $0.0832
  - m5.large: $0.0960
- Amazon RDS cost (Amazon Aurora MySQL-Compatible Edition)
  - db.r5.large: $0.29
  - db.r5.8xlarge: $4.64

Costs for Ohio Region as of October 2021

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Graviton2 customers















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.NET on Graviton2

.NET versions that can run on Graviton2 EC2 instances

- .NET Core 2.1 runtimes only, no SDK (not recommended)
- .NET Core 3.1 runtimes, SDK
- .NET 5.0 runtimes, SDK (includes Arm64 optimizations)
- .NET 6.0 runtimes, SDK (macOS Arm*, Windows on Arm*)

Remember

- ✓ .NET Core 3.1 and .NET 6.0 are LTS (3 years support by MSFT)
- ✓ .NET 5 is a “current” release (18 months support by MSFT)

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Arm64 performance improvements for .NET 5/6

Arm64 hardware intrinsics	x86/64 introduced in .NET Core 3.0, Arm64 in .NET 5
	`System.Runtime.Intrinsics.Arm`
Optimized BCLs using intrinsics	Optimized libraries that use hardware intrinsics

	`System.Collections.BitArray`
	`System.Numerics.BitOperations`
	`System.Numerics.Matrix4x4 / Vector2 / Vector3 / Vector4`
	`System.SpanHelpers`
	`System.Text.Unicode / ASCIIUtility / Encodings.Web`
	`System.Buffers`

Volatile memory caching	Caching volatile variables in local var

	`System.Collections.Concurrent.ConcurrentDictionary`
	`System.Threading.ThreadPool`
	`System.Diagnostics.Tracing.EventCount`

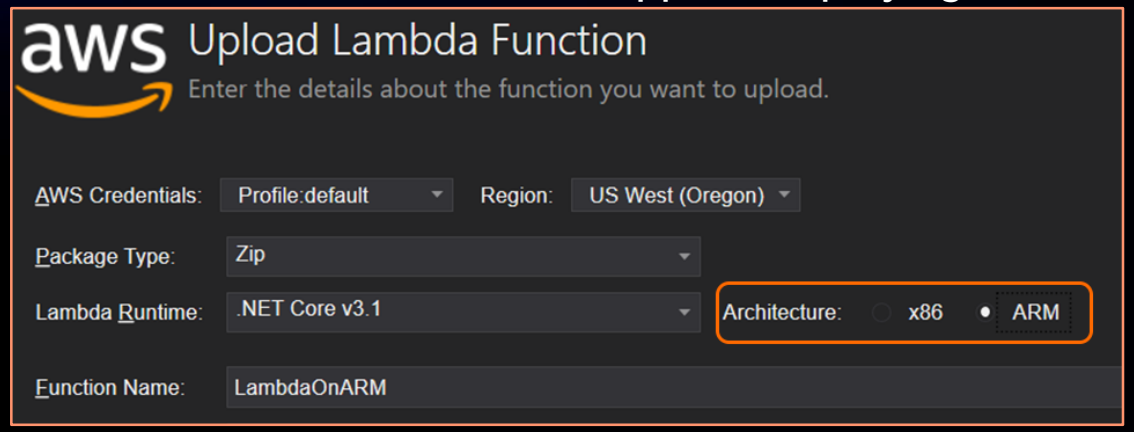
Source: “ARM64 Performance in .NET 5,” bit.ly/3bToJ4r

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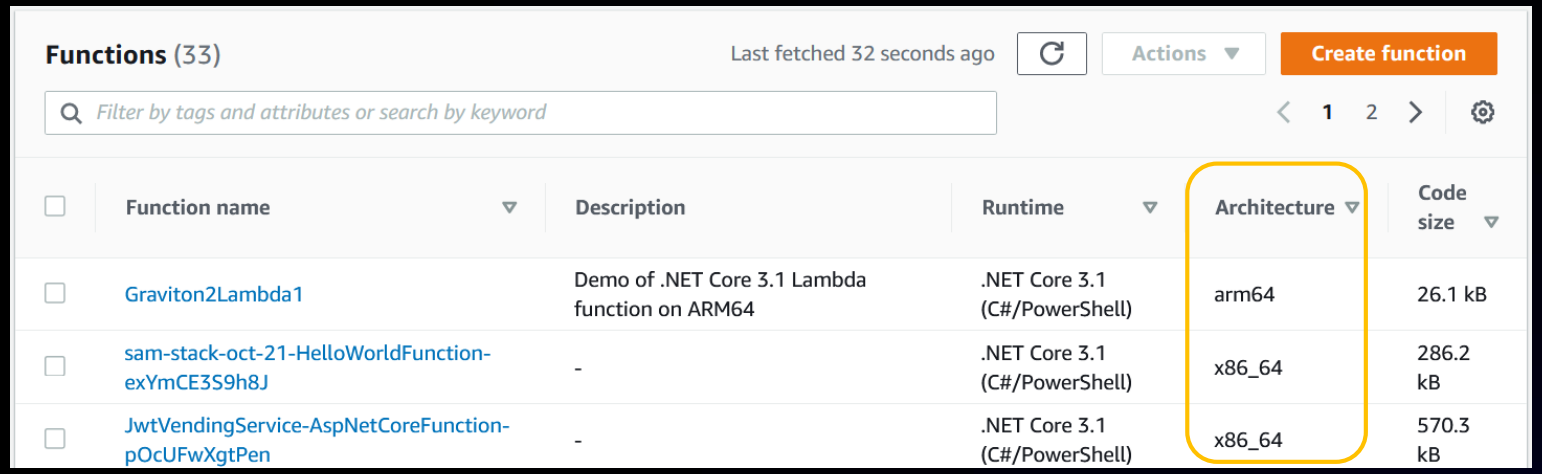
.NET AWS Lambda on Graviton2

AWS Toolkit for Visual Studio supports deploying to Arm





Lambda console now has **Architecture** column (add with ⚙)

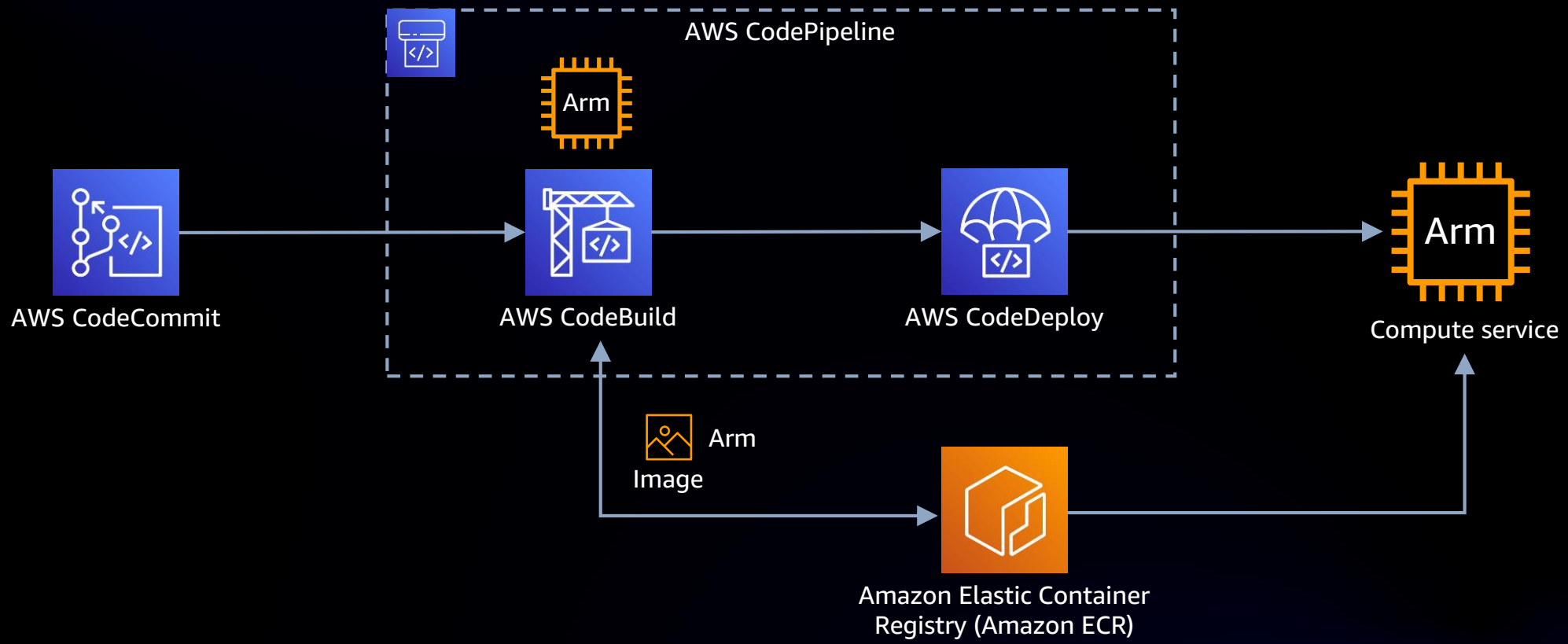


Source: bit.ly/3EZabwz

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CI/CD pipeline – Using Arm



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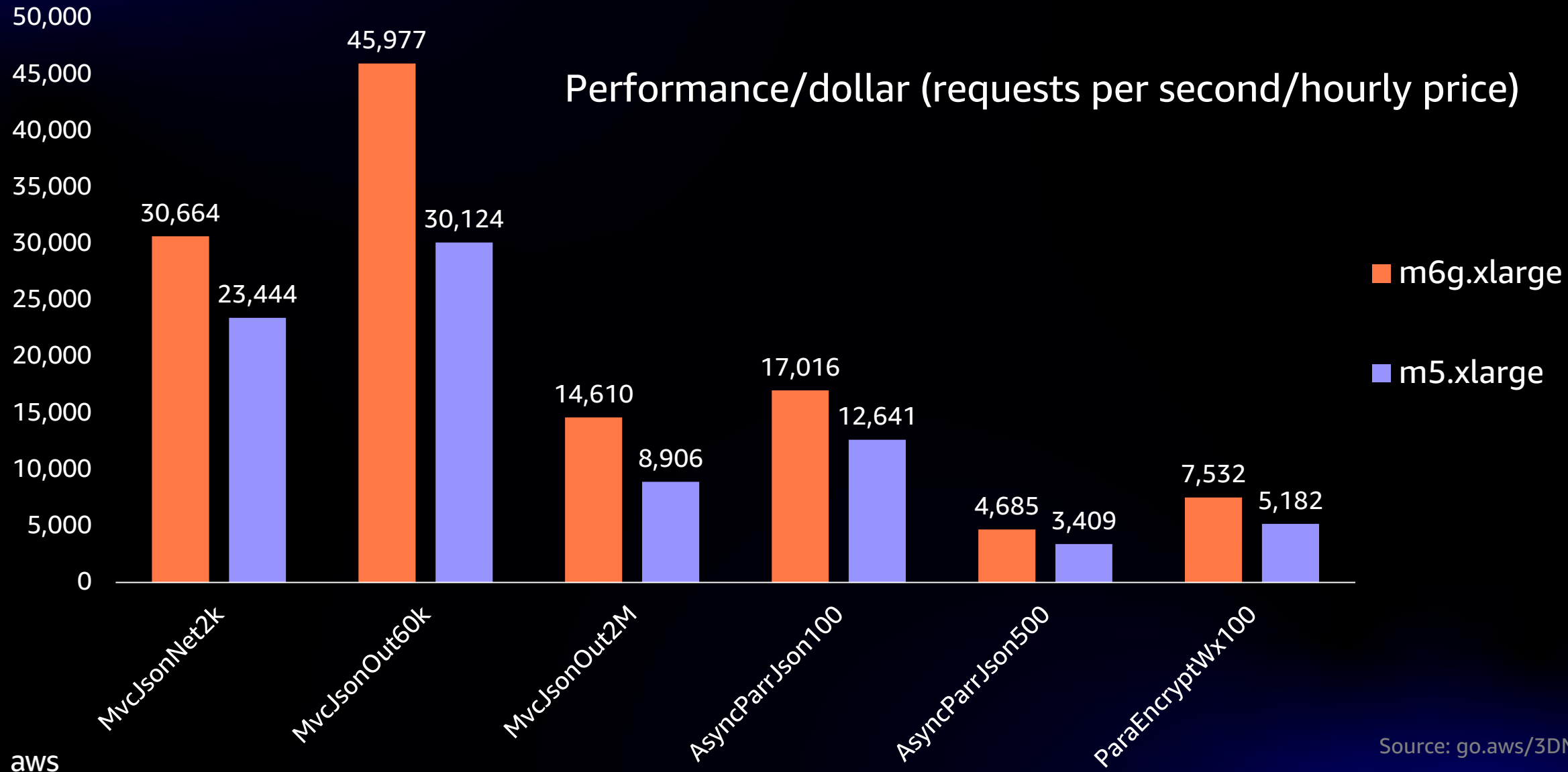
Performance & cost advantages

SIGNIFICANTLY BETTER PRICE/PERFORMANCE



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Powering .NET 5 with AWS Graviton2 blog



Source: go.aws/3DNuJb3

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Other AWS services supporting Graviton2

- AWS Lambda
- Amazon ECS (EC2 hosts)
- Amazon EKS (EC2 hosts)
- AWS Batch (managed batch processing)
- Amazon RDS (relational database service)
- Amazon ElastiCache (managed Redis and Memcached)
- AWS CodeBuild (managed build service for CI/CD)
- Amazon EC2 Image Builder
- And more!

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Other resources

Workshop: Running ASP.NET Core on EKS with Graviton2
bit.ly/3bVieOv

Walkthrough: Build & deploy Razor app to ECS with Graviton2 using AWS CDK
bit.ly/3bSdV6K

AWS Graviton getting started GitHub – .NET on Graviton
bit.ly/2Ywgd8z

AWS .NET Developer Center
go.aws/3kgQYPd

Code used in this session
bit.ly/3c27FsV

@dotnetonaws 

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Thank you!

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