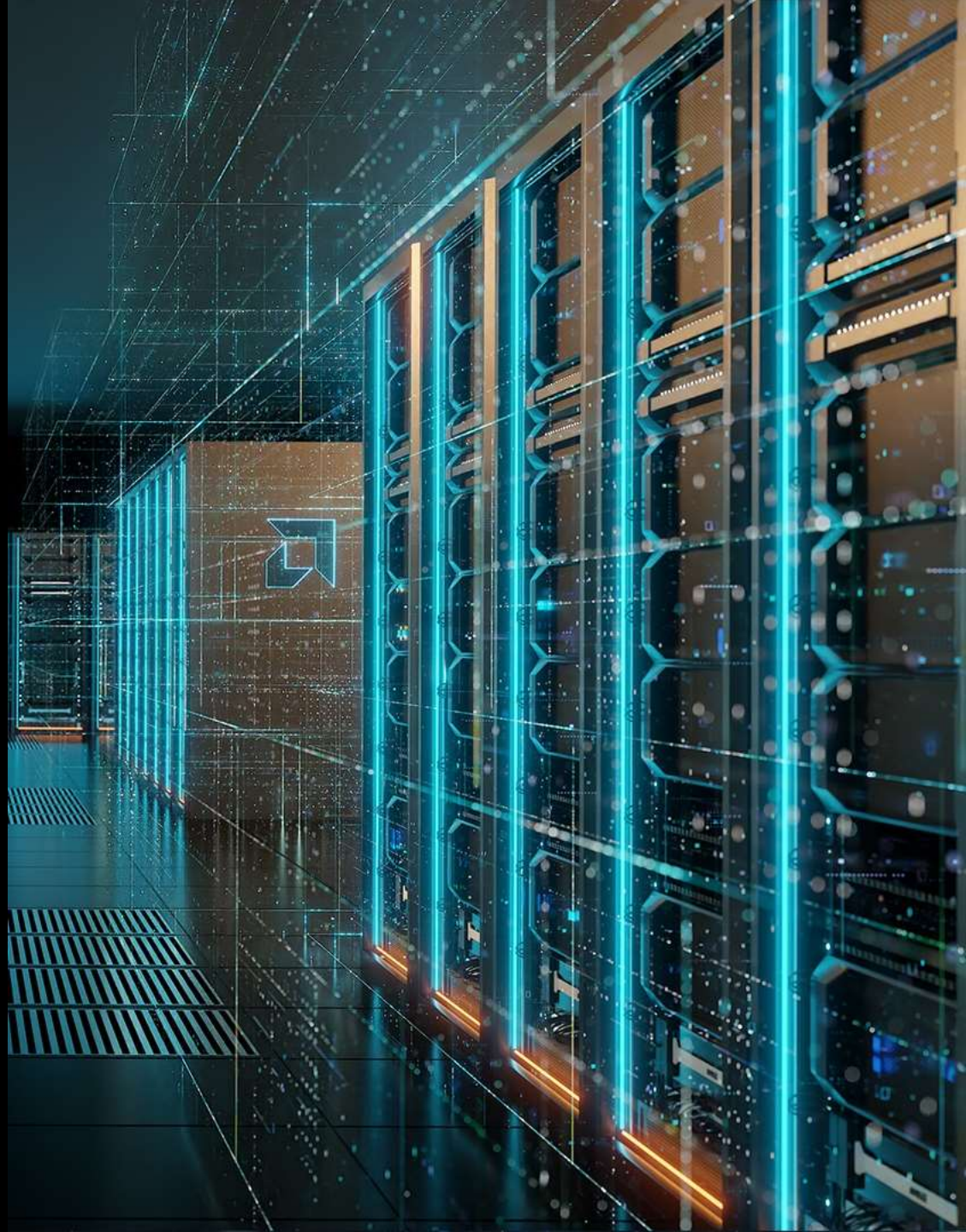
AMD Genoa-Training for Thomas Krenn, public Version, September 2023

Jan Baumann
senior Field Application Engineer Client / Datacenter
DACH-Region



Cautionary Statement

This presentation contains forward-looking statements concerning Advanced Micro Devices, Inc. (AMD) such as the features, functionality, performance, availability, timing and expected benefits of AMD products as well as AMD product roadmaps, which are made pursuant to the Safe Harbor provisions of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are commonly identified by words such as "would," "may," "expects," "believes," "plans," "intends," "projects" and other terms with similar meaning. Investors are cautioned that the forward-looking statements in this presentation are based on current beliefs, assumptions and expectations, speak only as of the date of this presentation and involve risks and uncertainties that could cause actual results to differ materially from current expectations. Such statements are subject to certain known and unknown risks and uncertainties, many of which are difficult to predict and generally beyond AMD's control, that could cause actual results and other future events to differ materially from those expressed in, or implied or projected by, the forward-looking information and statements. Investors are urged to review in detail the risks and uncertainties in AMD’s Securities and Exchange Commission filings, including but not limited to AMD’s most recent reports on Forms 10-K and 10-Q.

AMD does not assume, and hereby disclaims, any obligation to update forward-looking statements made in this presentation, except as may be required by law.

AMD COMPUTING NOW POWERS THE DAILY LIVES OF BILLIONS

Smarter Client Devices & Edge

Cloud, Enterprise and HPC

5G & Comms Infrastructure

Artificial Intelligence

Automotive

Gaming, Simulation & Visualization

AMD Server Strategy

Highest performing general purpose server CPU in the world

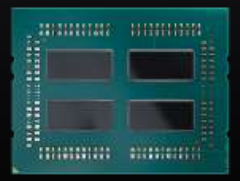
Optimized silicon for diverse workloads

Full stack solutions, ecosystem scale & partnerships to accelerate time-to-value

AMD EPYC™ JOURNEY

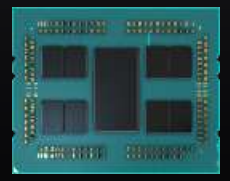
Four Generations of On-Time Execution

1st Gen EPYC™



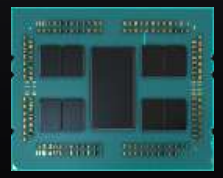
General Purpose
"Naples"

2nd Gen EPYC™

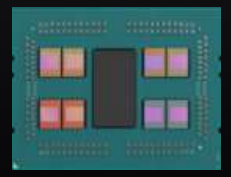


General Purpose
"Rome"

3rd Gen EPYC™

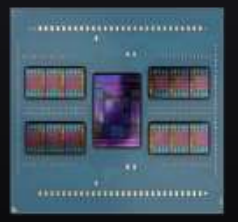


General Purpose
"Milan"

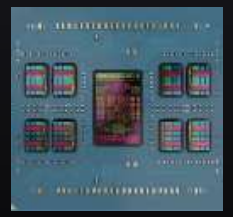


Technical
"Milan-X"

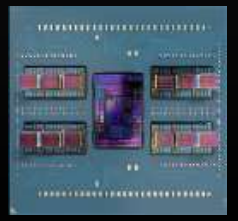
4th Gen EPYC™



General Purpose
"Genoa"



Cloud Native
"Bergamo"

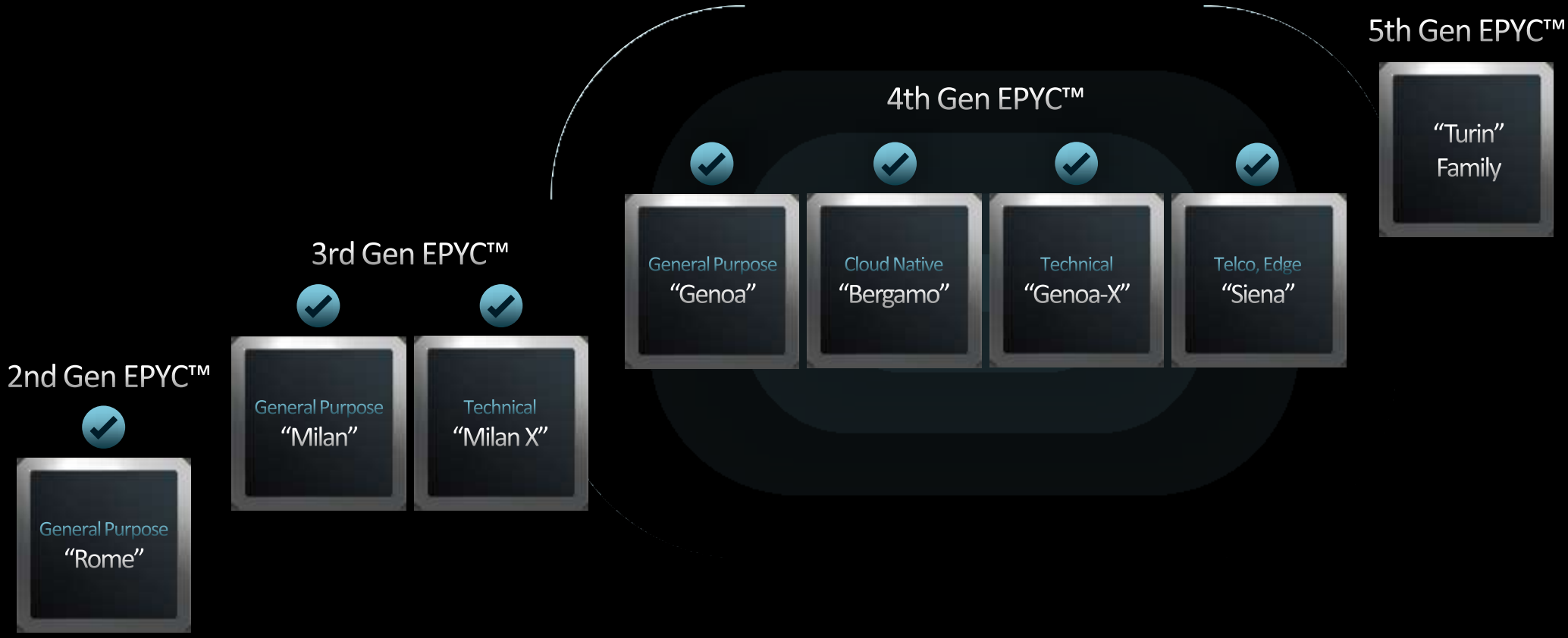


Technical
"Genoa-X"

Telco/Edge
"Siena"

2017 → 2023

Strong Execution on Strategy and Roadmap



All roadmaps are subject to change.

EPYC™ "Zen4" CPU Portfolio Expansion

- Server segments splintering with multiple optimization points for cloud & enterprise
- "Zen4" portfolio expansion built on common core/L1/L2 and platform compatibility
- "Genoa" and "Bergamo" designed for compelling performance gen-to-gen and versus competition

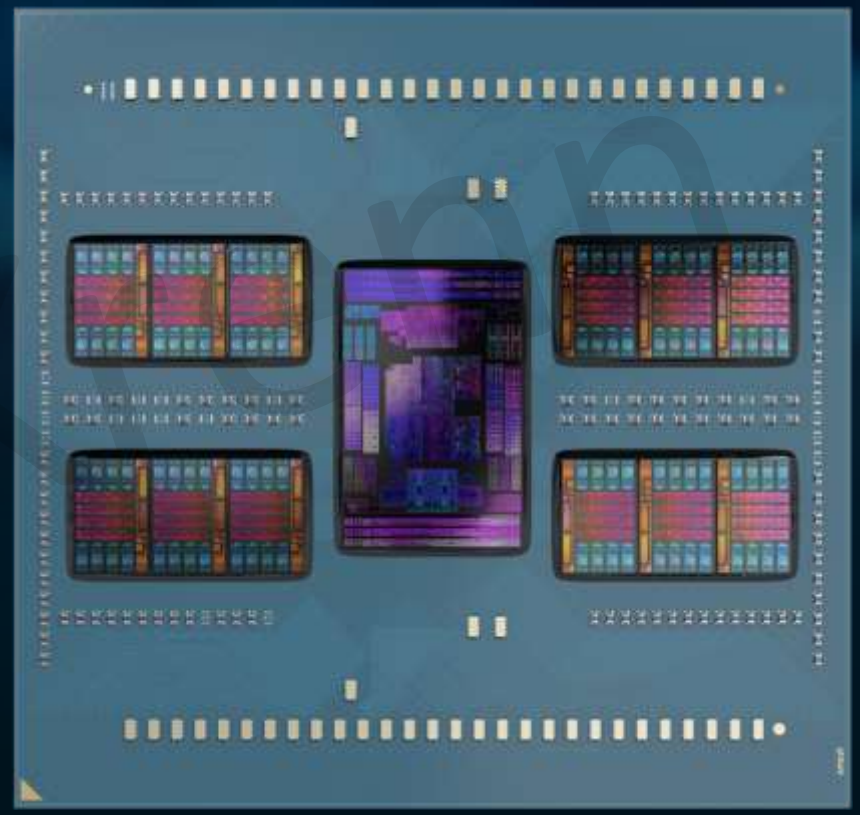
Use Cases	Cloud "Scale Out"	Supercompute/ Capacity HPC	Cloud "Scale Up"	Core Apps & Commercial HPC	Enterprise IT	Value Enterprise & SMB	Edge Compute
Customer Care Abouts	High Core Density	FLOPs / Socket Throughput	High Perf per Core	Highest Perf per Core	Balanced TCO	Good Price & Perf	Perf / Watt Form Factor
"Zen4" Solution	'Bergamo' SP5 *("Zen4c", SP5, Up to 128C)*		'Genoa' / 'Genoa-X' SP5 *("Zen4", SP5, Up to 96C)*			'Siena' SP6 *("Zen4c", SP6, Up to 64C)*	

Preliminary Guidance – Roadmap, features & schedules subject to change

4th Gen AMD EPYC™ CPU

Extending Compute Leadership

- Leadership Socket and Per-Core Performance
  Up to 96 “Zen 4” Cores in 5nm
- Leadership Memory Bandwidth and Capacity
  12 Channels DDR5
- Next Generation I/O
  Up to 160 Lanes of PCIe® Gen 5 | Memory Expansion with CXL
- Advances in Confidential Computing
  ~2X SEV-SNP Guests | Direct and CXL Attached Memory Encryption



See Endnotes EPYC-032, EPYC-034A, SP5-013A, SP5-014. Preliminary data and projections subject to change

AMD EPYC™ 9004 "GENOA" - AT A GLANCE

COMPUTE

- AMD "Zen4" x86 cores (Up to 12 CCDs / 96 cores / 192 threads)
- 1MB L2/Core, Up to 32MB L3/CCD
- ISA updates: BFLOAT16, VNNI, AVX-512 (256b data path)
- Memory addressability with 57b/52b Virtual/Physical Address

- Updated IOD and internal AMD Gen3 Infinity Fabric™ architecture with increased die-to-die bandwidth

- Target TDP range: Up to 400W (cTDP)

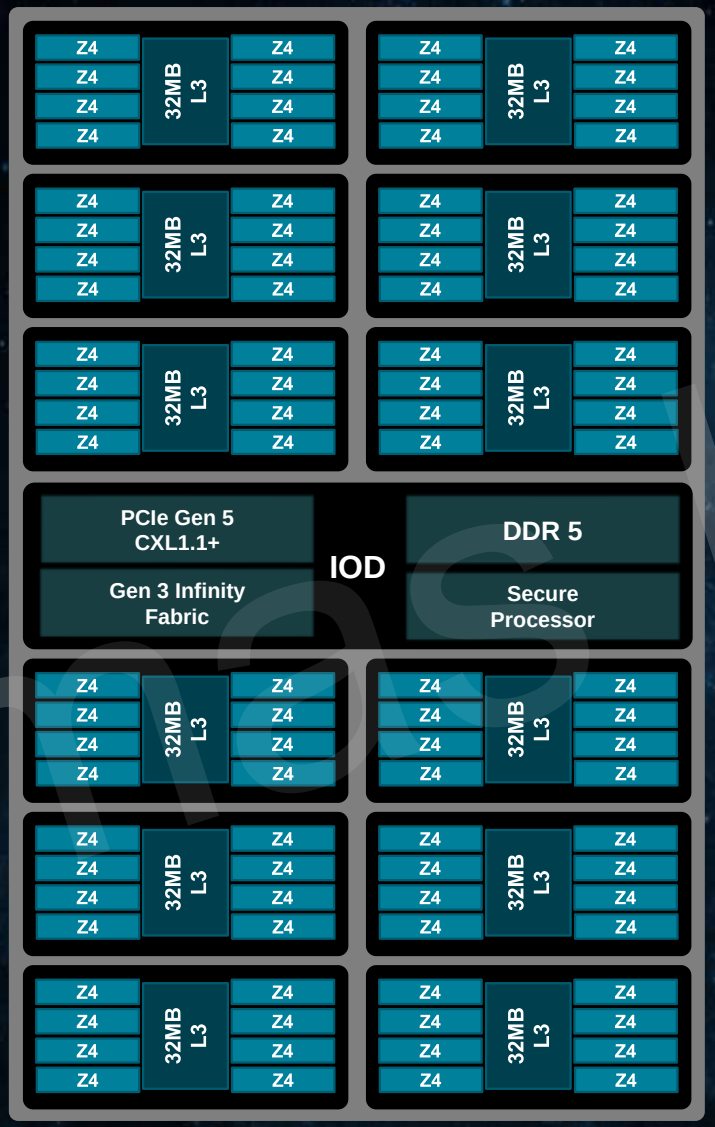
- Updated RAS

MEMORY

- 12 channel DDR5 with ECC up to 4800 MHz
- Option for 2,4,6, 8, 10, 12 channel memory interleaving[1]

- RDIMM, 3DS RDIMM

- Up to 2 DIMMs/channel capacity with up to 12TB in a 2 socket system (2DPC, 256GB 3DS RDIMMs)[1]



BLUE font indicates significant upgrades with EPYC 9004.

SP5 PLATFORM

- New socket, increased power delivery and VR
- Up to 4 links of Gen3 AMD Infinity Fabric™ with speeds of up to 32Gbps
- Flexible topology options

- Server Controller Hub (USB, UART, SPI, I2C, etc.)

INTEGRATED I/O – NO CHIPSET

Up to 160 IO lanes (2P) of PCIe® Gen5

- Speeds up to 32Gbps, bifurcations supported down to x1
- Up to 12 bonus PCIe Gen3 lanes in 2P config (8 lanes–1P)
- Up to 32 IO lanes for SATA

- 64 IO Lanes support for CXL1.1+ with bifurcations supported down to x4

SECURITY FEATURES

Dedicated Security Subsystem with enhancements

Secure Boot, Hardware Root-of-Trust

SME (Secure Memory Encryption)

SEV-ES (Secure Encrypted Virtualization & Register Encryption)

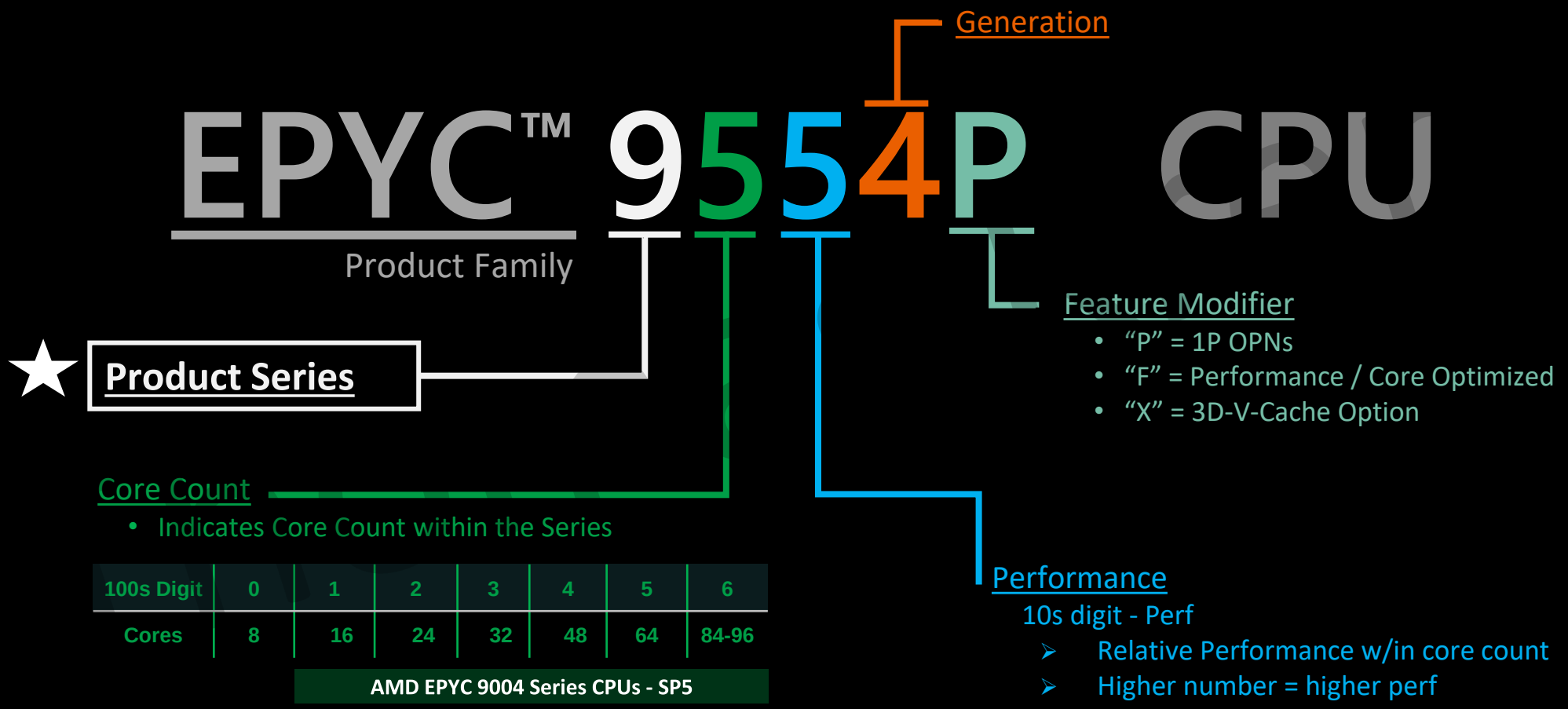
SEV-SNP (Secure Nested Paging), AES-256-XTS with more encrypted VMs

1 - With certain DIMM population rules.

* Post launch feature.

AMD EPYC™ Processor Naming Convention

EPYC 9004 Series CPUs



AMD EPYC™ 9004 Series Processor

All-in Feature Set support

- **12 Channels of DDR5-4800**
- **Up to 6TB DDR5 memory capacity**
- **128 lanes PCIe® 5**
- **64 lanes CXL 1.1+**
- **AVX-512 ISA, SMT & core frequency boost**
- **AMD Infinity Fabric™**
- **AMD Infinity Guard**

Cores	AMD EPYC	Base/Boost* (up to GHz)	Default TDP (w)	cTDP (w)
96 cores	9654/P	2.40/3.70	360w	320-400w
84 cores	9634	2.25/3.70	290w	240-300w
64 cores	9554/P	3.10/3.75	360w	320-400w
64 cores	9534	2.45/3.70	280w	240-300w
48 cores	→ **9474F**	**3.60/4.10**	360w	320-400w
	9454/P	2.75/3.80	290w	240-300w
32 cores	→ **9374F**	**3.85/4.30**	320w	320-400w
32 cores	9354/P	3.25/3.80	280w	240-300w
32 cores	9334	2.70/3.90	210w	200-240w
24 cores	→ **9274F**	**4.05/4.30**	320w	320-400w
	9254	2.90/4.15	200w	200-240w
	9224	2.50/3.70	200w	200-240w
16 cores	→ **9174F**	**4.10/4.40**	320w	320-400w
	9124	3.00/3.70	200w	200-240w

*SEE ENDNOTES: EPYC-018, GD-183

EPYC™ 9004 Series CPU Positioning

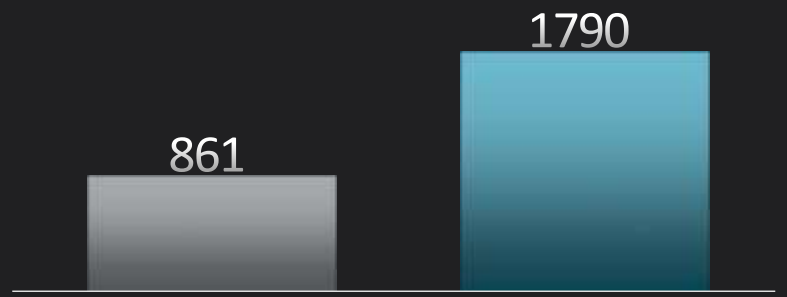
	Processor Groups	
Core Performance High frequency with large cache/core ratio	9474F (48C-360W)	9374F (32C-320W)
	9274F (24C-320W)	9174F (16C-320W)
Core Density Highest core and thread count	9654/P (96C-360W)	9634 (84C-290W)
	9554/P (64C-360W)	9534 (64C-280W)
	9454/P (48C-290W)	
Balanced and Optimized Performance and TCO	9354/P (32C-280W)	9334 (32C-210W)
	9254 (24C-200W)	9224 (24C-200W)
	9124 (16C-200W)	

Advancing AMD EPYC™ CPU Leadership

Cloud

SPECrate®2017_int_base

107% higher performance



Integer Throughput

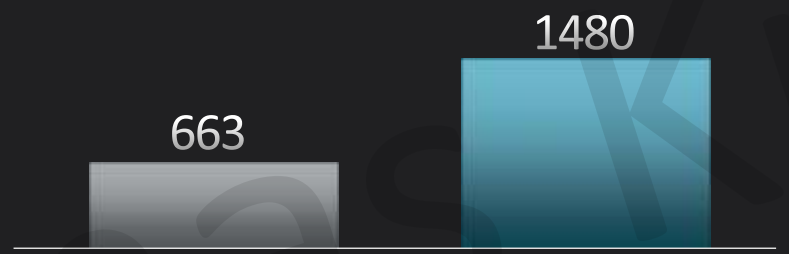
Cloud Service Providers

IaaS/PaaS | Search | Social | SaaS

HPC

SPECrate®2017_fp_base

123% higher performance



Floating-Point Throughput

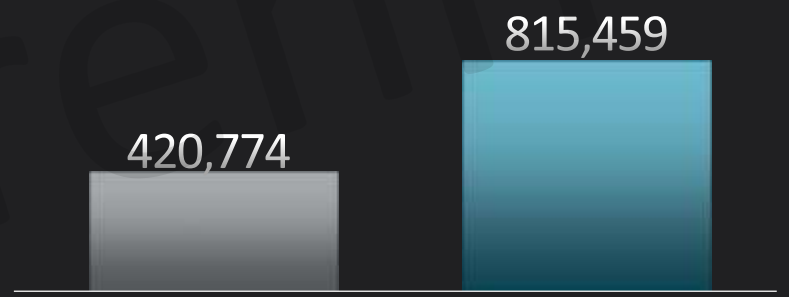
High Performance Computing

Design & Simulation | Research & Academia | Machine Learning | Super Computing

Enterprise

SPECjbb®2015 MultiJVM max-jOPS

94% higher performance



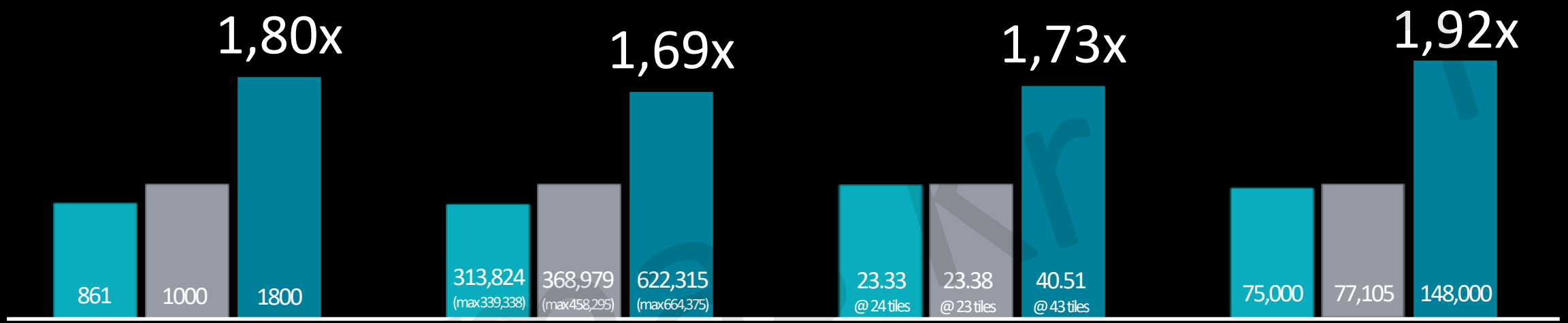
Server-Side Java® Max Throughput

Enterprise IT

Virtualization | SDS/HCI | Hadoop | NoSQL

See endnotes: SP5-001C, -002C, -005C.

4TH GEN AMD EPYC™ CPU PERFORMANCE LEADERSHIP



2P SPECrate®2017_int_base
Integer Throughput

2P Enterprise Server-Side Java®
SPECjbb®2015 Multi-JVM critical-jOPS

2P VMmark® 3.1.1
Matched Pair

2P SAP® Sales & Distribution
2-tier

3rd Generation AMD EPYC™ **7763**

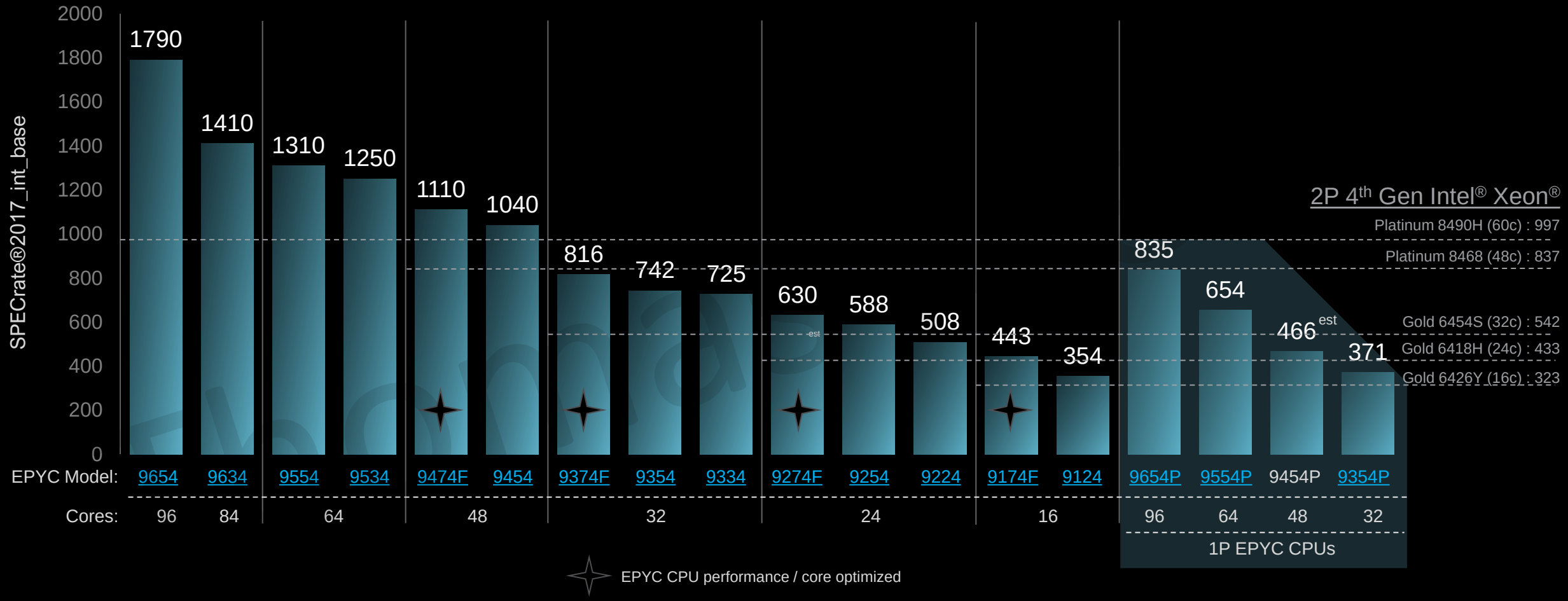
4th Generation Intel Xeon® Platinum **8490H**

4th Generation AMD EPYC™ **9654**

As of 6/13/2023, see SP5-013D,SP5-104A, SP5-049C, SP5-056B

EPIC PERFORMANCE TO FIT YOUR NEEDS

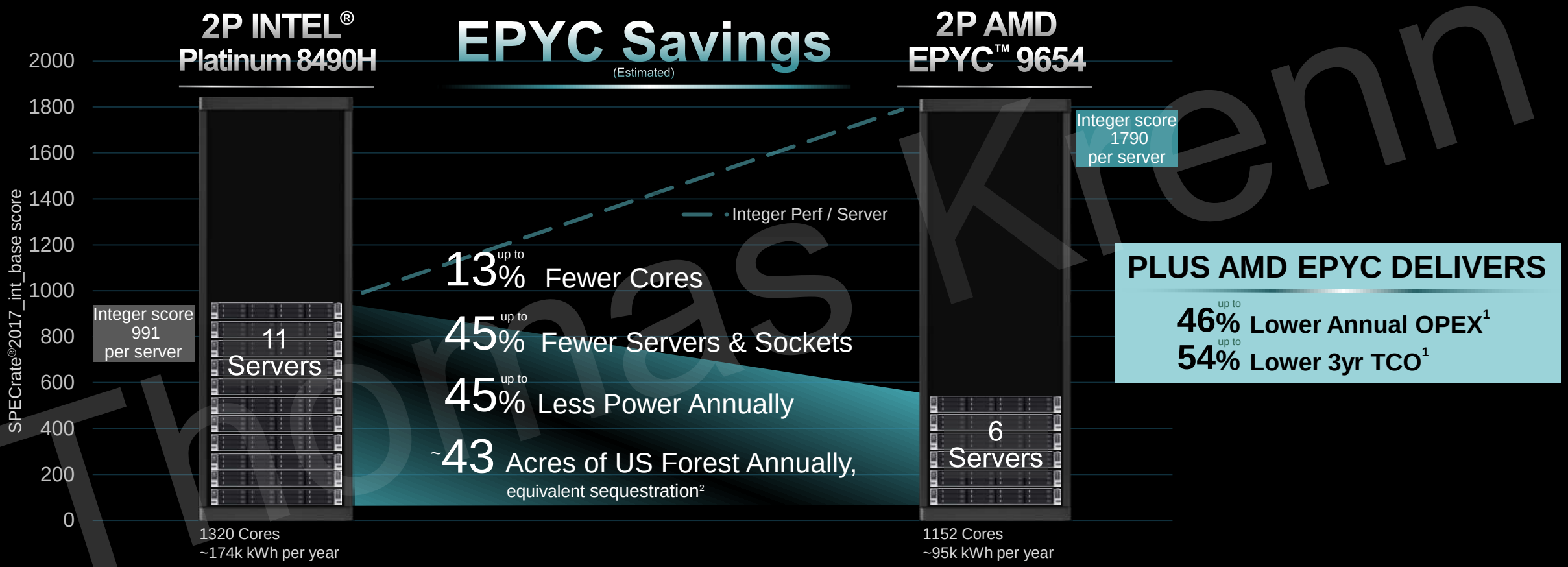
EPYC™ 9004 Series – Performance That Scales



As of 02/01/2023. Results may vary. See endnote SP5-023C.

Fewer Servers, Less Power, Leading to Lower Emissions

10,000 SPECrate® 2017_int_base
Top of Stack – Head to Head Comparison



PLUS AMD EPYC DELIVERS

up to **46%** Lower Annual OPEX[1]

up to **54%** Lower 3yr TCO[1]

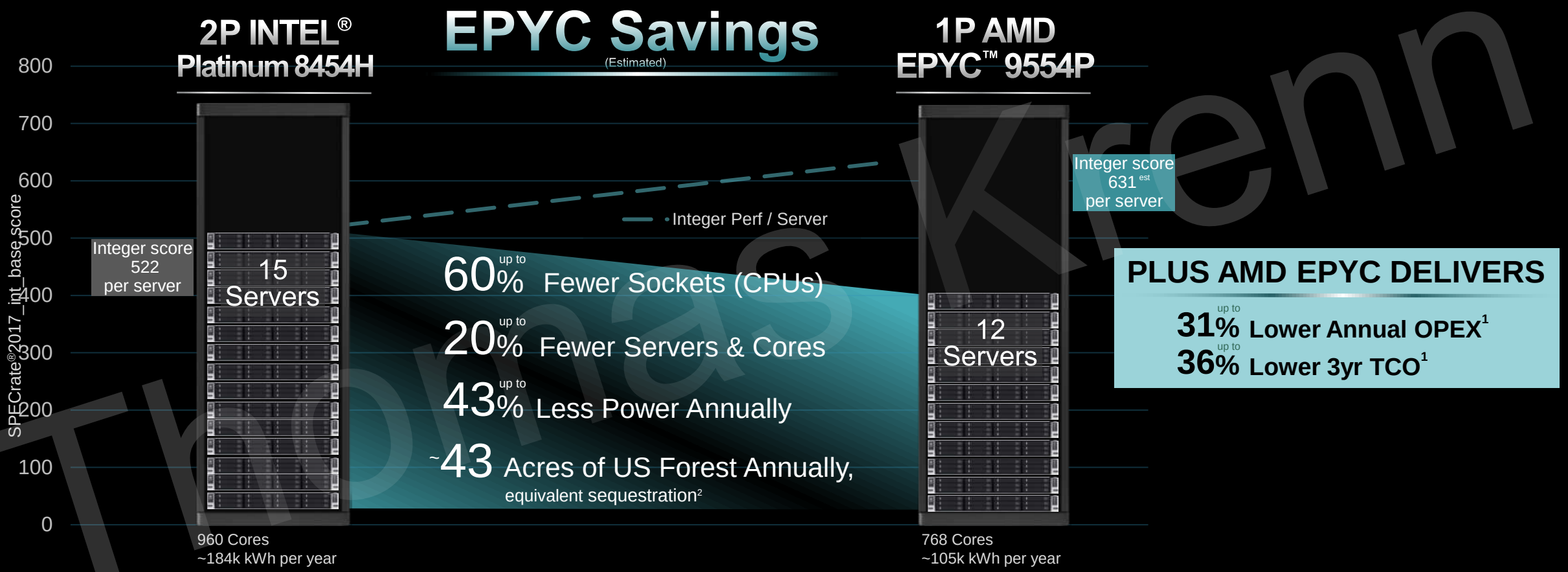
SPEC®, SPECrate® and SPEC CPU® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

Analysis based on the AMD EPYC™ Bare Metal Server & Greenhouse Gas Emission TCO Estimation Tool - version 6.80.
AMD processor pricing based on 1KU price as of Jan 2023. Intel® Xeon® Scalable CPU data and pricing from https://ark.intel.com as of Jan 2023. All pricing is in USD.
[1] TCO time frame of 3-year and includes estimated costs for real estate, admin and power with power @ $0.16/kWh with 8kW / rack and a PUE of 1.7. Software cost as well as networking and storage power external to the server are not included in this analysis. [2] Values are for USA.

See endnote SP5TCO-032

Fewer Servers, Less Power, Leading to Lower Emissions

7,500 SPECrate® 2017_int_base
64 Cores / Server – Head to Head Comparison



PLUS AMD EPYC DELIVERS

- 31% up to Lower Annual OPEX[1]
- 36% up to Lower 3yr TCO[1]

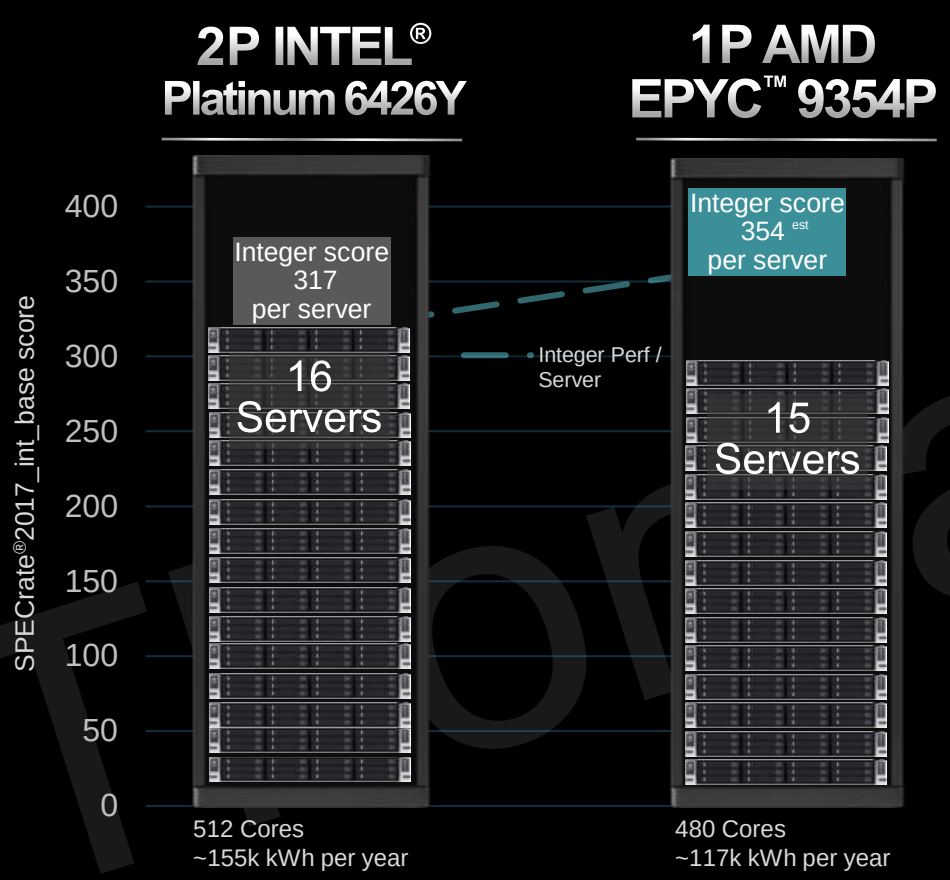
SPEC®, SPECrate® and SPEC CPU® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

Analysis based on the AMD EPYC™ Bare Metal Server & Greenhouse Gas Emission TCO Estimation Tool - version 6.80.
AMD processor pricing based on 1KU price as of Jan 2023. Intel® Xeon® Scalable CPU data and pricing from https://ark.intel.com as of Jan 2023. All pricing is in USD.
* Estimated AMD EPYC performance scores are based on AMD internal testing, Aug 2022 on AMD reference platforms.
[1] TCO time frame of 3-year and includes estimated costs for real estate, admin and power with power @ $0.16/kWh with 8kW / rack and a PUE of 1.7. Software cost as well as networking and storage power external to the server are not included in this analysis. [2] Values are for USA.

See endnote SP5TCO-029

Fewer Servers, Less Power, Leading to Lower Emissions

5,000 SPECrate®2017_int_base
32 Cores / Server – Head to Head Comparison



Concerned with

- SW License Costs?
- Space?
- Power?

EPYC Solutions Enable

(Estimated)

53% up to Fewer Sockets & 6% up to Fewer Cores ➡ **Lower Licensing and Less Space**

38k kWh up to (24% up to) Less Power Annually ➡ **Lower Power Bills, Reduce OPEX**

~20 Acres of US Forest Annually, equivalent sequestration[2] ➡ **Lower Carbon Emissions**

Plus 17% up to (~$16,000) Lower Annual OPEX[1]

30% up to (~$66,000) Lower 3yr TCO[1]

Analysis based on the AMD EPYC™ Bare Metal Server & Greenhouse Gas Emission TCO Estimation Tool - version 6.80.
AMD processor pricing based on 1KU price as of Jan 2023. Intel® Xeon® Scalable CPU data and pricing from https://ark.intel.com as of Jan 2023. All pricing is in USD.
* Estimated AMD EPYC performance scores are based on AMD internal testing, Aug 2022 on AMD reference platforms.
[1] TCO time frame of 3-year and includes estimated costs for real estate, admin and power with power @ $0.16/kWh with 8kW / rack and a PUE of 1.7. Software cost as well as networking and storage power external to the server are not included in this analysis. [2] Values are for USA.

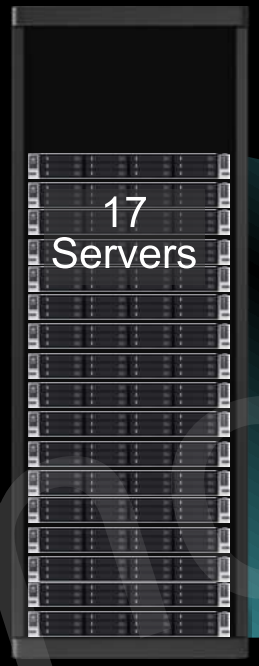
See endnote SP5TCO-025

Fewer Servers, Less Power, Leading to Lower Emissions

2,000 VMs

EPYC 96c 9654 to Intel 60c 8490H CPUs – Head to Head Comparison

2P INTEL® Platinum 8490H



Integer score 991 per server

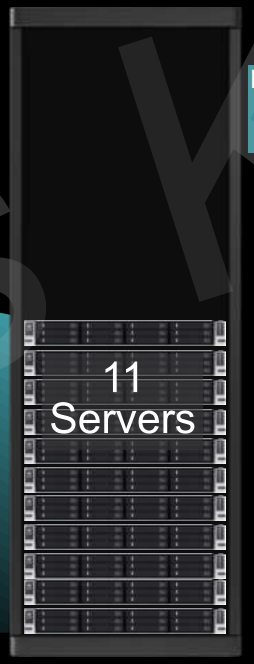
2040 Cores
~245k kWh per year

EPYC Savings

(Estimated)

- 35% up to Fewer Servers & Sockets
- 29% up to Less Power Annually
- ~38 Acres of US Forest Annually, equivalent sequestration[2]

2P AMD EPYC™ 9654



Integer score 1790 per server

2112 Cores
~175k kWh per year

PLUS AMD EPYC DELIVERS

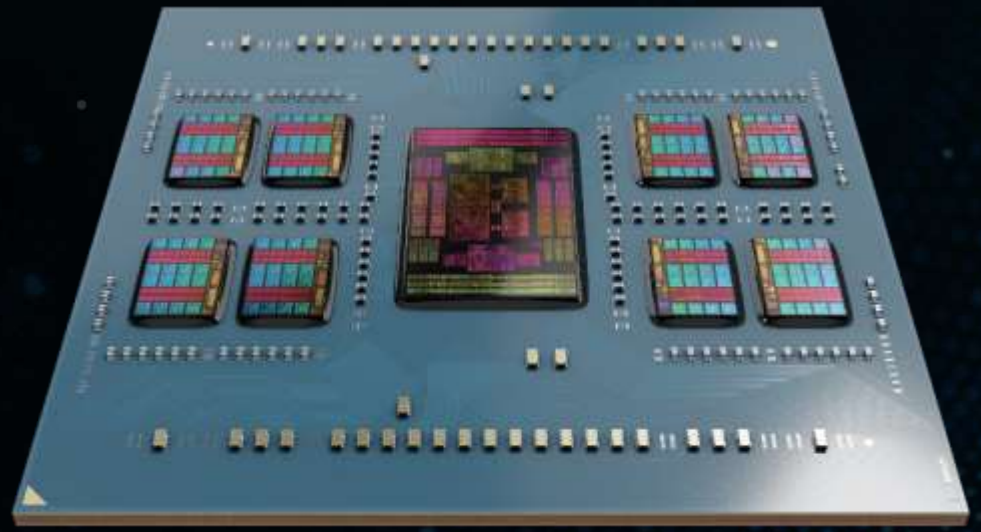
- 33% up to Lower Annual OPEX[1]
- 46% up to Lower CAPEX[1]
- 29% up to Lower 1st yr TCO / VM[1]

Analysis based on the AMD EPYC™ Server Virtualization & Greenhouse Gas Emission TCO Estimation Tool - version 12.00.
AMD processor pricing based on 1KU price as of Jan 2023. Intel® Xeon® Scalable CPU data and pricing from https://ark.intel.com as of Jan 2023. All pricing is in USD.
[1] TCO time frame of 3-year and includes estimated costs for real estate, admin and power with power @ $0.16/kWh with 8kW / rack and a PUE of 1.7. Software cost as well as networking and storage power external to the server are not included in this analysis. [2] Values are for USA.

See endnote SP5TCO-035

4TH Gen AMD EPYC™ 97X4 CPU "Bergamo"

Optimized for Cloud Native Workloads



Greatest vCPU Density	Leadership Cloud Performance	Best Energy Efficiency	Consistent x86 ISA	Up to 128 "Zen 4c" Cores

See Endnotes – EPYC-049 and https://www.amd.com/system/files/documents/amd-epyc-9004-pb-spec-power.pdf for Energy Efficiency

AMD EPYC 97x4 “Bergamo” - At a Glance

COMPUTE

- AMD “Zen4c” x86 cores (Up to 8 CCDs / Up to 128 cores / 256 threads)
- 1MB L2/Core, 2x 16MB L3 8-Core-CCX per CCD
- ISA updates: BFLOAT16, VNNI, AVX-512 (256b data path)
- Memory addressability with 57b/52b VA/PA

- Updated IOD and internal AMD Gen3 Infinity Fabric™ architecture with increased die-to-die bandwidth

- Target TDP range: up to 400W (cTDP)

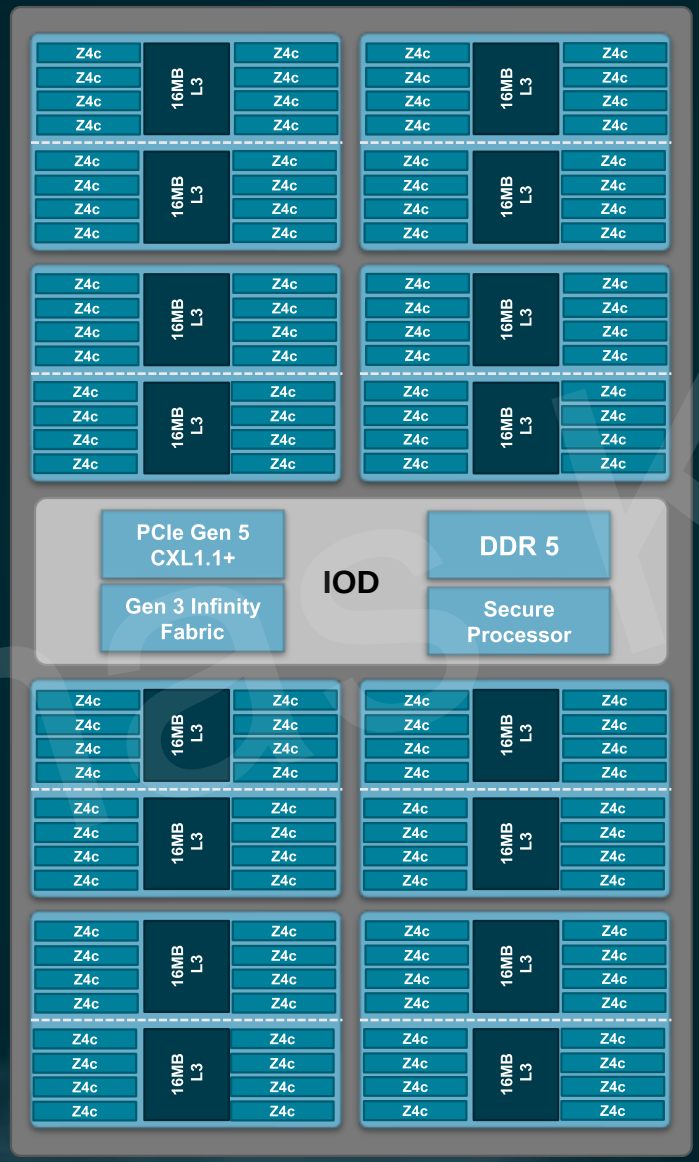
- Updated RAS

MEMORY

- 12 channel DDR5 with ECC up to 4800 MHz
- Option for 2, 4, 6, 8, 10, 12 channel memory interleaving

- RDIMM, 3DS RDIMM

- Up to 2 DIMMs/channel capacity of 12TB per 2 socket system (based on 256GB 3DS DIMMs with 2 DIMMs per Channel support)



I/O

- Up to 160 IO lanes (2P) of PCIe® Gen5, with speeds up to 32Gbps, bifurcations supported down to x1
- Up to 12 bonus PCIe Gen3 lanes in 2P config (8 lanes 1P)
- 32 IO lanes for SATA
- SDCI (SMart Data Cache Injection)

- 64 IO Lanes support CXL1.1+ with bifurcations supported down to x4

SP5 PLATFORM

- New socket, increased power delivery and VR
- Up to 4 links of Gen3 AMD Infinity Fabric™ with speeds of up to 32Gbps
- Flexible topology options

- Server Controller Hub (USB, UART, SPI, I2C, etc.)

SECURITY FEATURES

- Dedicated Security Subsystem features with enhancements

- Hardware Root-of-Trust

BLUE indicates significant update from “Zen 3” / “Milan”
ORANGE indicates difference from “Zen 4” / “Genoa”

4TH GEN AMD EPYC™ 97X4 "Bergamo" CPU PRODUCT STACK

MODEL	CORES	THREADS	DEFAULT TDP (W)	cTDP RANGE (W)	Fbase / Fboost*	SMT Configurable	L3 CACHE (MB)	DDR5 CHANNELS	PCIe Gen 5
9754	128	256	360	320 - 400	2.25 / 3.1	Y	256	12	x128
9754S	128	128	360	320 - 400	2.25 / 3.1	N (SMT OFF ONLY)	256	12	x128
9734	112	224	340	320 – 400	2.20 / 3.0	Y	256	12	x128

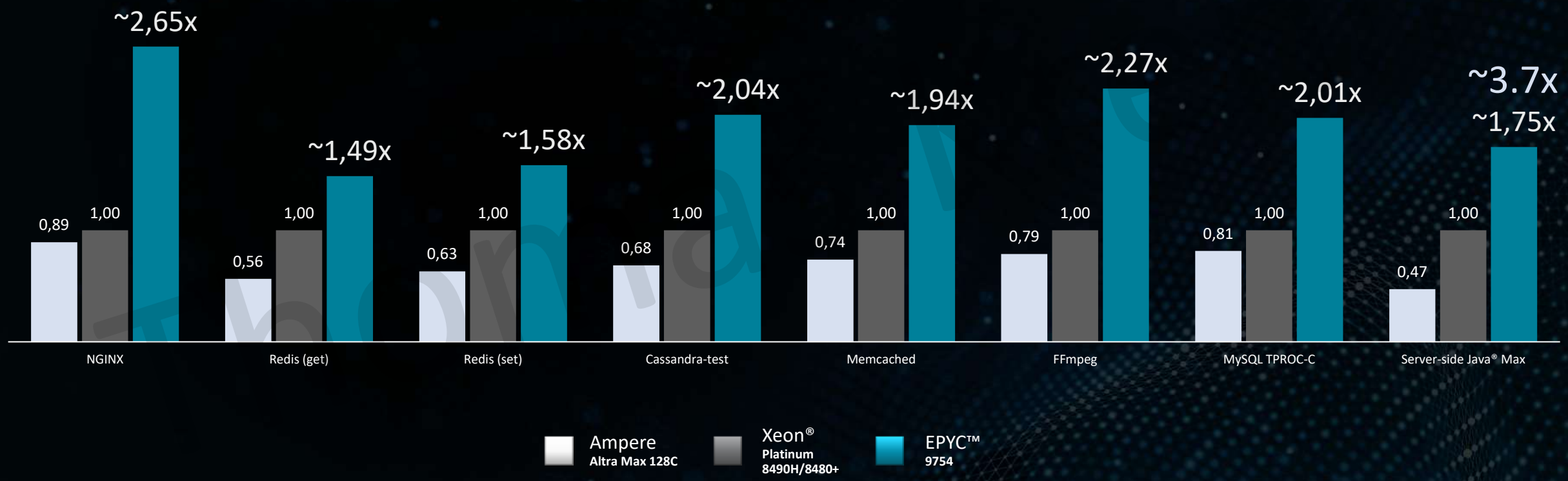
*Preliminary Guidance – Roadmap, features & schedules subject to change

AMD

Optimized Cloud Native Performance

Up to

3.7x vs ampere throughput performance (~2.9x avg.) for a wide variety of cloud native workloads



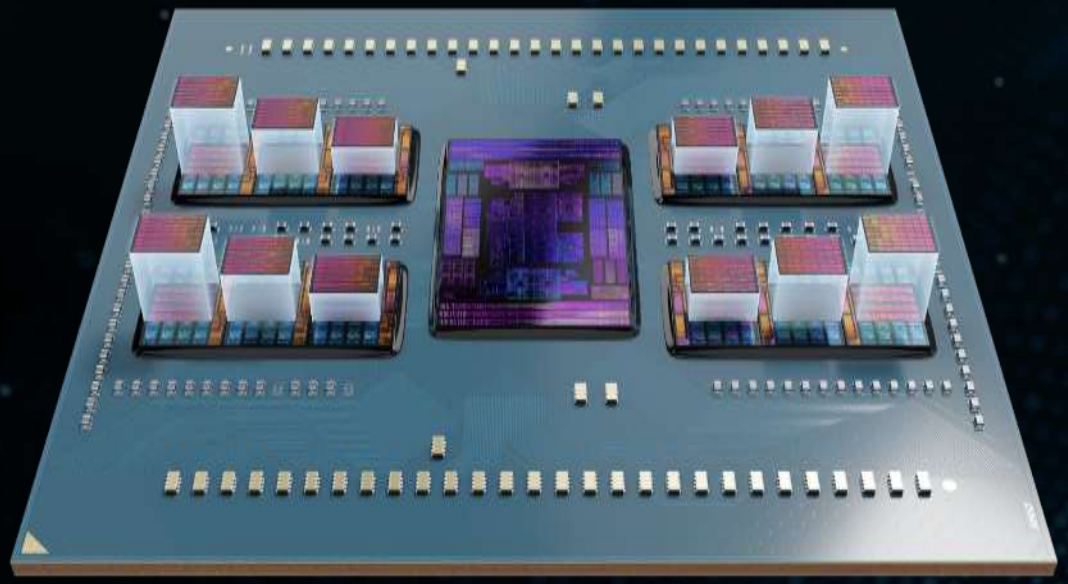
2P servers: 128C AMD EPYC™ 9754 vs. Ampere Altra® Max M128-30 and 56C/60C Intel Xeon Platinum 8480+/8490H

Results may vary due to factors including system configurations, software versions and BIOS settings. As of 6/13/2023, see Cloud Native Workloads https://www.amd.com/system/files/documents/amd-epyc-9004-pb-cloud-native-workloads.pdf.

4TH GEN AMD EPYC

With AMD 3D V-Cache® Technology

"Genoa-X"



Leadership 5nm Process Node	High Performance "Zen 4" cores	Up to 1.1 GB of L3 Cache	AMD Infinity Guard	Rich Ecosystem of Solutions

World's highest performance x86 server CPU for technical computing

As of 6/13/2023, see SP5-165, GD-183.

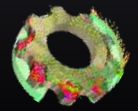
4TH GEN AMD EPYC™ 9x84X "Genoa-X" CPU PRODUCT STACK

MODEL	CORES	THREADS	DEFAULT TDP (W)	cTDP RANGE (W)	Fbase / Fboost*	L3 CACHE (MB)	DDR5 Channels	DDR5 CHANNELS
9684X	96	192	400	320 - 400	2.55 / 3.7	1,152	12	x128
9384X	32	64	320	320 – 400	3.1 / 3.9	768	12	x128
9184X	16	32	320	320 – 400	3.55 / 4.2	768	12	x128

*Preliminary Guidance – Roadmap, features & schedules subject to change

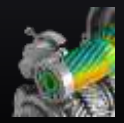
4TH Gen EPYC™ with AMD 3D V-Cache™ Technology Workload Mapping

Electronic Design Automation



Computational Fluid Dynamics

Finite Element Analysis



Structural Analysis

16 Core | EPYC™ 9184X

32 Core | EPYC™ 9384X

96 Core | EPYC™ 9684X

Leadership EDA Performance

~26.2
JOBS/HOUR

16-CORE 4th GEN AMD EPYC™
WITHOUT AMD 3D V-CACHE™

Up to 73%

FASTER RTL VERIFICATION

SYNOPSYS® VCS®

AMD graphics card

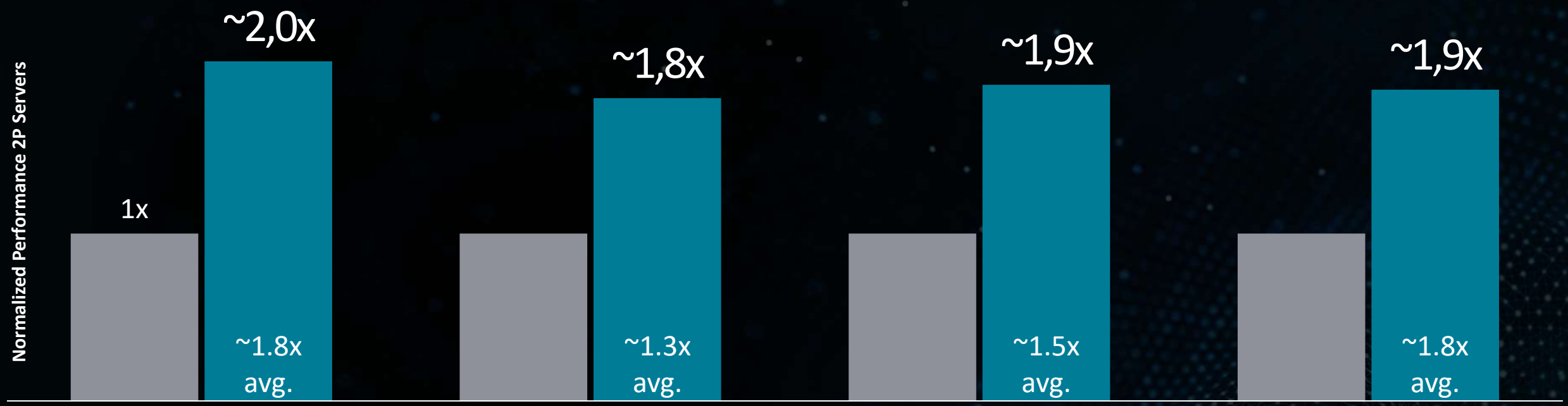
~45.4
JOBS/HOUR

16-CORE 4th GEN AMD EPYC™
WITH AMD 3D V-CACHE

As of 4 May 2023. 1P servers: EPYC 9174F vs. EPYC 9184X. Results may vary due to factors including system configurations, software versions and BIOS settings. See SP5-050.

Performance Leadership
Technical Computing

CFD and FEA | 32-core Max/Avg. Result Comparison



ANSYS® CFX®
Airfoil 10m

ANSYS® Fluent®
Pump 2m

ANSYS® LS-DYNA®
3-cars

OpenFOAM®
100x40x40 mesh

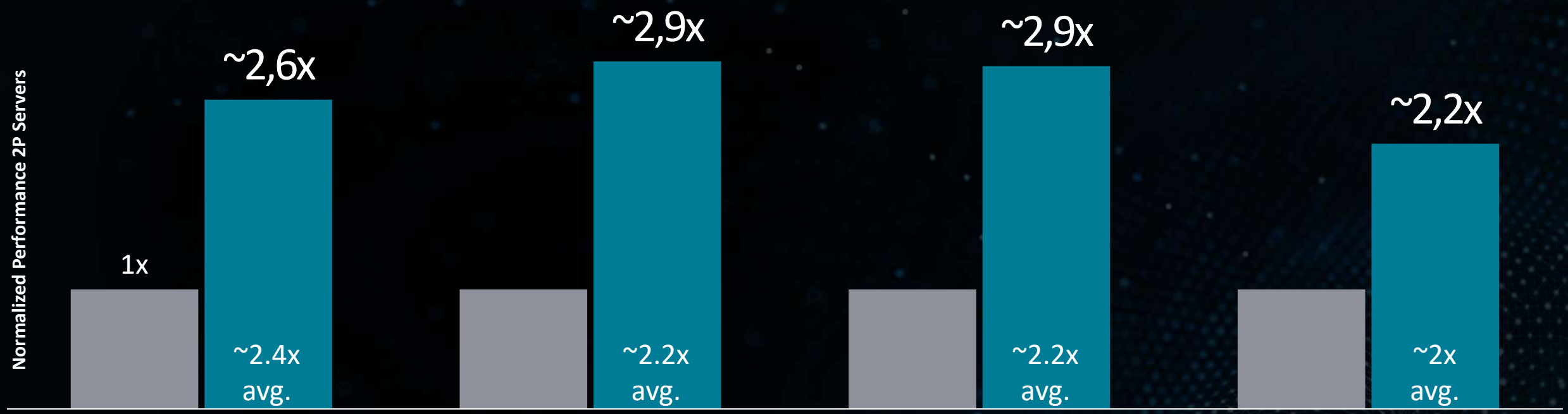
4th Gen Intel™ Xeon® Platinum **8462Y+ 32 Core**

4th Gen AMD EPYC™ **9384X 32 Core**

Results may vary due to factors including system configurations, software versions and BIOS settings.
As of 6/13/2023, see ANSYS CFX https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-ansys-cfx.pdf, ANSYS LS-DYNA https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-ansys-ls-dyna.pdf, ANSYS Fluent https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-ansys-fluent.pdf and OpenFOAM https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-openfoam.pdf.

Performance Leadership Technical Computing

CFD and FEA | Top-of-Stack Max/Avg. Comparison



Results may vary due to factors including system configurations, software versions and BIOS settings. As of 6/13/2023, see ANSYS CFX https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-ansys-cfx.pdf, ANSYS LS-DYNA https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-ansys-ls-dyna.pdf, ANSYS Fluent https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-ansys-fluent.pdf and OpenFOAM https://www.amd.com/system/files/documents/amd-epyc-9004x-pb-openfoam.pdf.

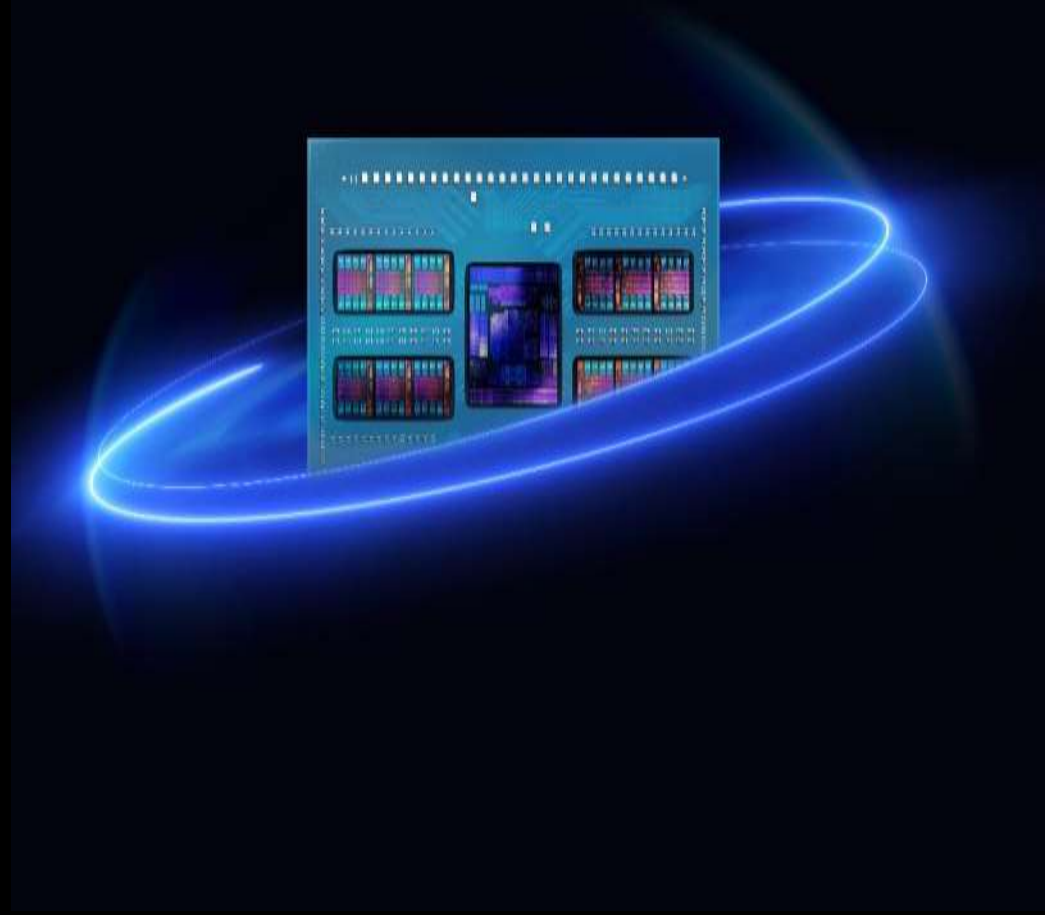
Workload Optimized
4th Gen EPYC™ CPU Portfolio

AMD EPYC™ 9004 Series

4th Gen EPYC™ (“Genoa”) → World’s best data center CPU

AMD EPYC™ 97X4 (“Bergamo”) → Best cloud native optimized CPU

4th Gen EPYC™ with AMD 3D V-Cache® Technology (“Genoa-X”) → Best technical computing optimized CPU



See Endnotes: SP5-013D, **SP5-149,** SP5-165

AMD

TOOLS AND RESOURCES

PARTNER ENABLEMENT

AMD EPYC™ Processor Selector Tool

AMD EPYC™ Server Virtualization TCO Estimation Tool

AMD EPYC™ Bare Metal and Greenhouse Gas Emissions TCO Estimation Tool

AMD Cloud Cost Advisor

AMD EPYC Online Tools
amd.com/en/processors/epyc-tools

AMD Arena Training Courses
arena.amd.com/courses/processors/epyc

Technical Documents Library
amd.com/en/processors/server-tech-docs/search

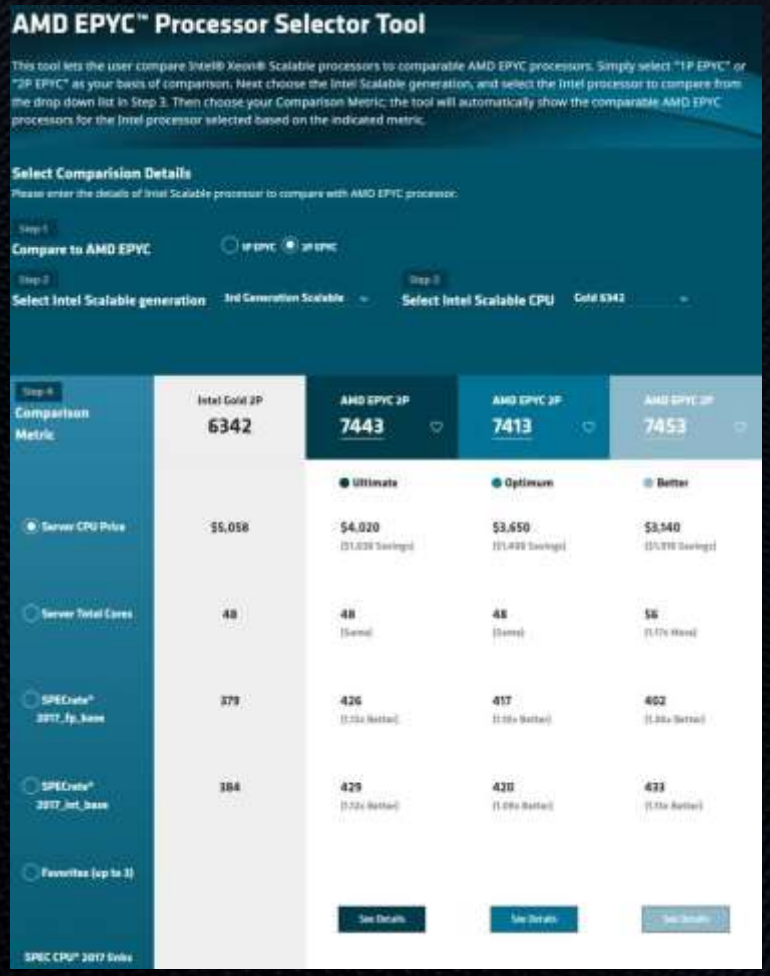
AMD Meet The Experts Webinars
amd.com/en/partner/meet-experts-webinars

AMD Security (SEV)
developer.amd.com/sev

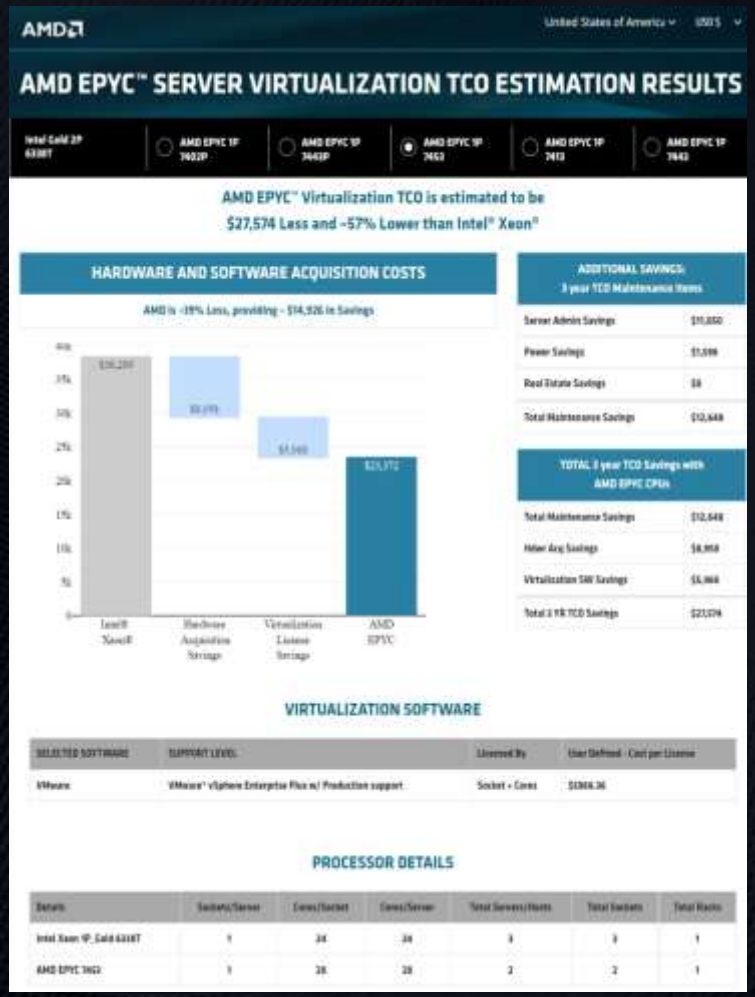
AMD Digital Library
library.amd.com

AMD

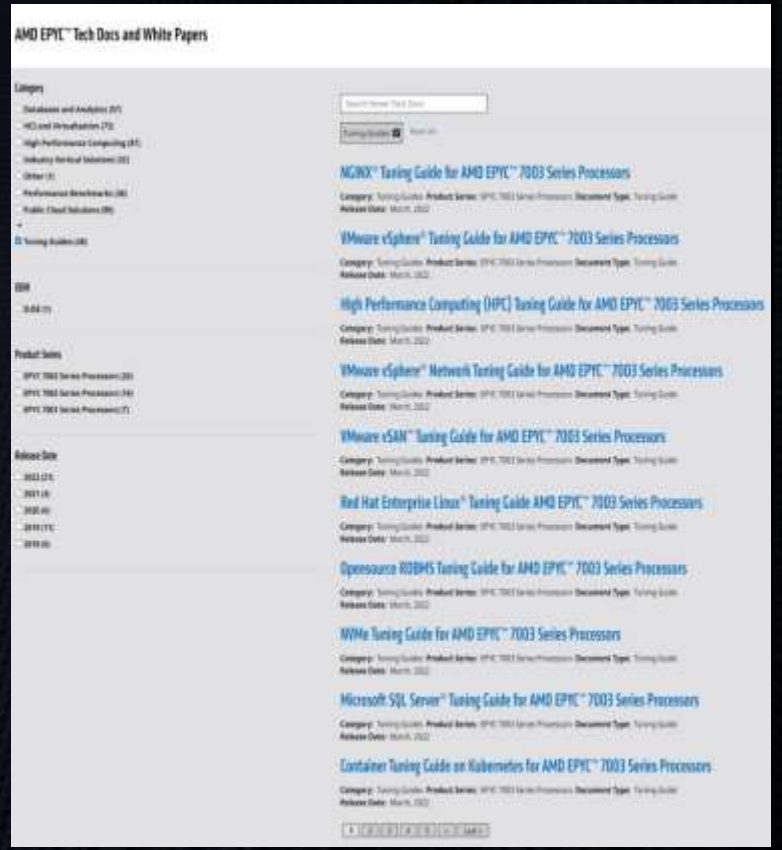
AMD EPYC™ processor Selector Tool
https://www.amd.com/en/processors/epyc-cpu-selector



AMD EPYC™ server virtualization TCO estimation tool
https://www.amd.com/en/processors/epyc-VirtTCOtool



Tech Docs and White Papers - reference infrastructure
https://www.amd.com/en/processors/server-tech-docs/search?f%5B0%5D=server_document_category%3A1401



VMWARE ARCHITECTURE MIGRATION TOOL (VAMT)

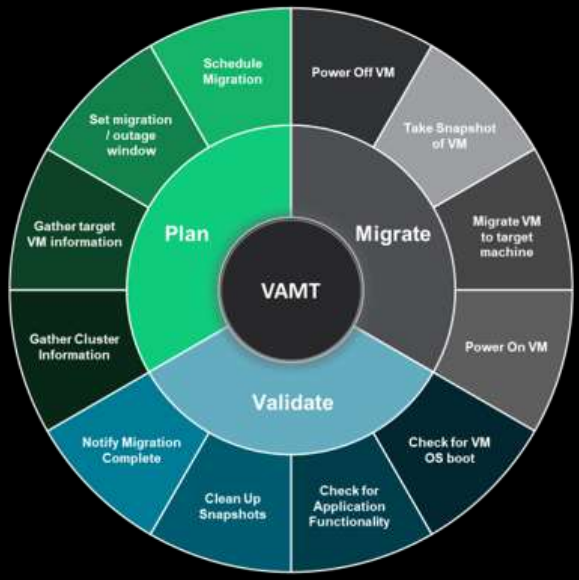
IT Challenge:

VM migration can be challenging and time consuming as many tasks need to be done in serial and manually

Solution:

AMD and VMware jointly developed an open-source tool to automate VM Migration - making it easy to migrate VM's from your existing infrastructure to AMD EPYC. Features include:

- Fully Automated Cold Migration
- VM Success Validation
- Process Throttling
- Change Window Support
- Idempotent
- Email and Syslog Support
- Audit Trail
- Rollback



https://github.com/vmware-samples/vmware-architecture-migration-tool

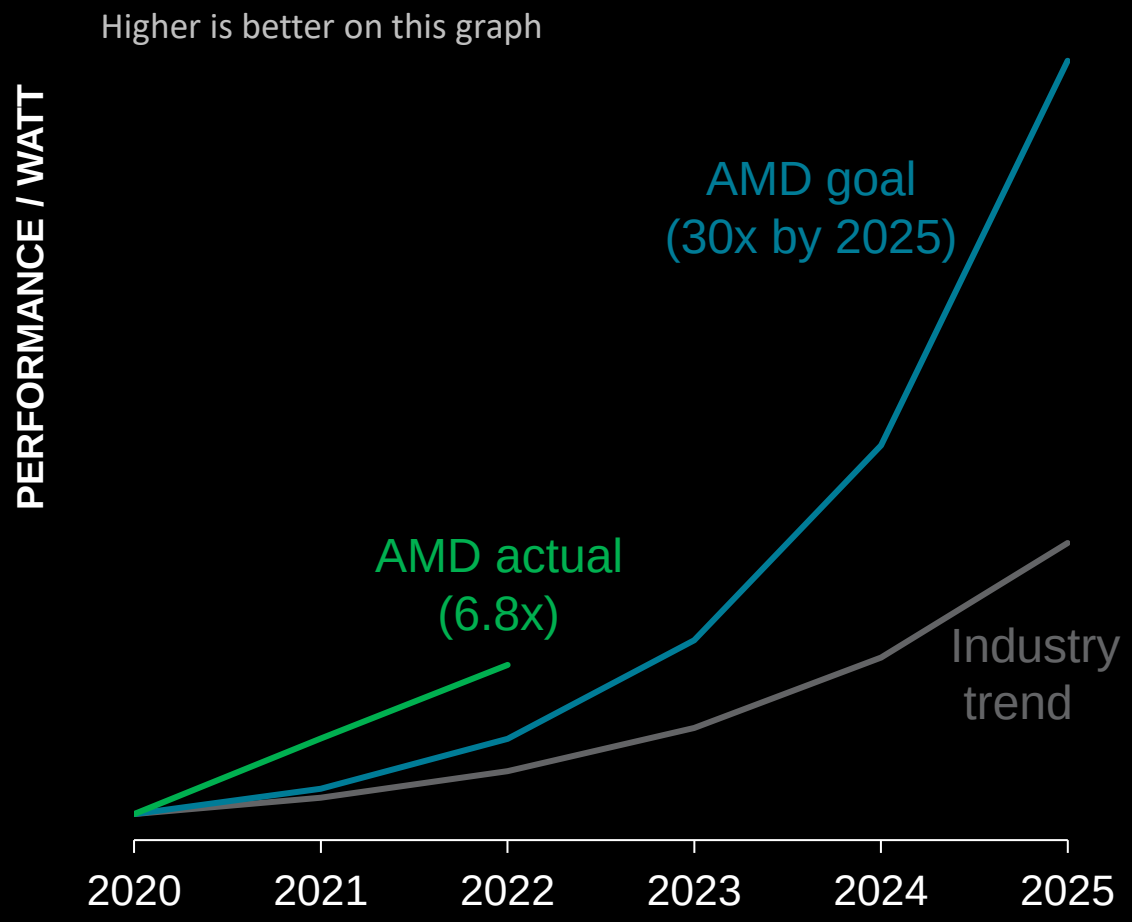
Server energy efficiency

The bigger picture

AMD
together we advance_

NEXT TARGET : THE 30 X 25 GOAL

Accelerating Data Center Sustainability



Goal: 30x increase in energy efficiency for AMD processors and accelerators for AI-training and HPC from 2020-2025

This represents more than a 2.5x acceleration of the industry trends from 2015-2020 as measured by the worldwide energy consumption for these computing segments[1] and equates to a 97% reduction in energy use per computation.

AMD is ON-TRACK to achieve the 30x goal, at 6.8x improvement, and well above the industry improvement trend from 2015-2020, using an accelerated compute node powered by one 3rd Gen AMD EPYC CPU and four AMD Instinct MI250x GPUs.

https://www.amd.com/en/corpor6ate-responsibility/data-center-sustainability

Leadership high performance efficiency

	AMD "Zen 4" Core	Intel Ice Lake Sunny Cove Core
Node	TSMC 5nm	Intel 10 Process
Core + L2 Area	3.84 mm²	~6.5mm²
SOC perf-per-watt	1.48x	1.0x

~40%
less area
vs. competitor

Up to
48%
more energy efficient
vs. competitor

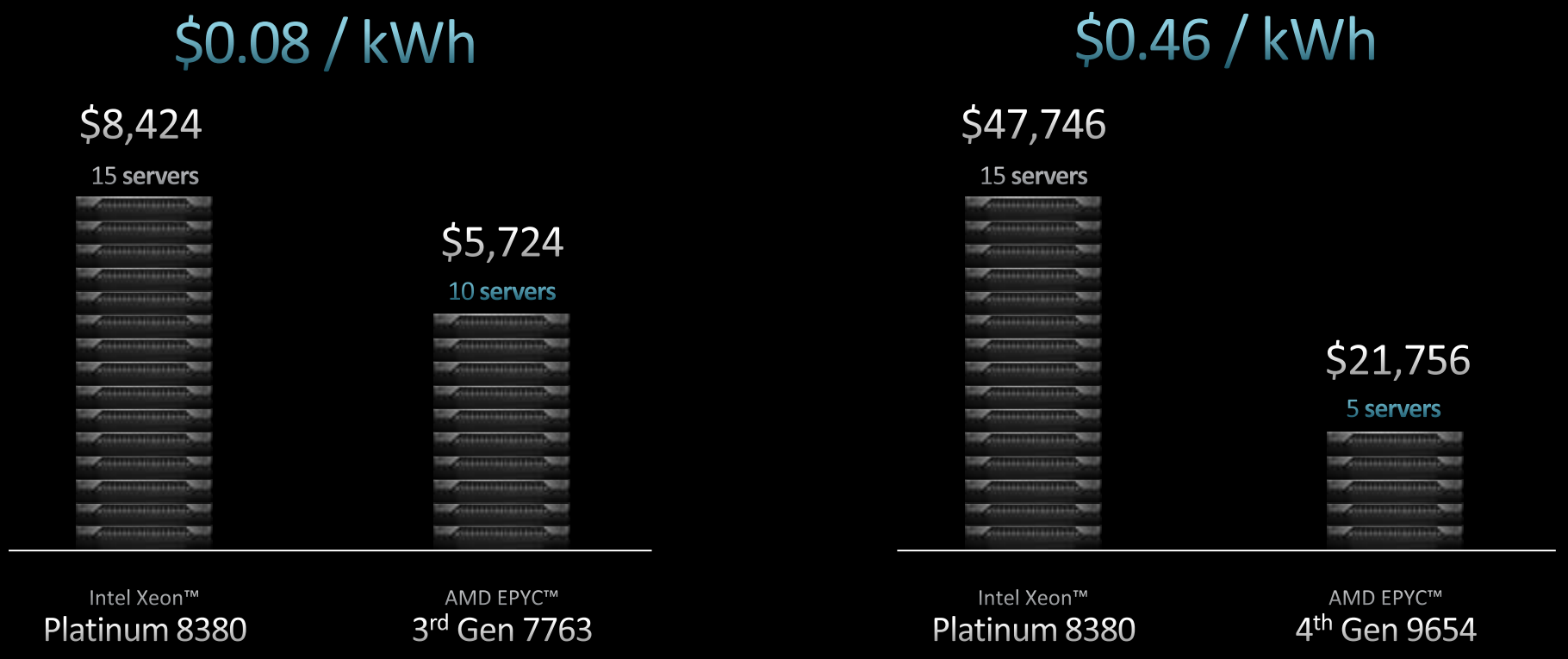
Illustrative purposes only

Endnote: EPYC-041

Incredible impact from EPYC™ CPU energy savings

Estimated annual energy costs*

8500 SPECrate®2017_int_rate (2P)



*Based solely on power consumption by the server only and using power costs in Germany in August 2021 and Dec 2022. Endnote: SP5TCO-020K,-023K

Sustainability benefits of energy efficiency

1M
Intel 8380 servers

vs.

0.318M
AMD 9654 servers

=

4.3B
kWh saved with AMD per year - server power only

2.2M
tons of CO_2 emissions reduced with AMD per year

2.4M
acres of forest **to remove this CO_2 from atmosphere**

Endnote: SP5TCO-021K

Delivering What Customers Are Asking

World's highest performance x86 server processor

Outstanding TCO across workloads and industries

Leadership x86 energy efficiency to support sustainability goals

Assurance of confidential computing

Rich ecosystem of solutions

1. SP5-013A: A 2P 96-core EPYC 9654 CPU powered server is higher than all other 2P SPECrate®2017 Integer Throughput (Base) scores published on www.spec.org/cpu2017 as of 11/10/2022;; 2. SP5TCO-009K; 3. SP5-011B

Thank you !

AMD

together we advance_

Enabling Complete Software Ecosystem

Complete Ecosystem of AMD EPYC™ Solutions

ENDNOTES

EPYC-18: Max boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems.

EPYC-028B: SPECpower_ssj® 2008, SPECrate®2017_int_energy_base, and SPECrate®2017_fp_energy_base based on results published on SPEC's website as of 11/10/22. VMMark® server power-performance (PPKW) based results published at https://www.vmware.com/products/vmMark/results3x.1.html?sort=score. The first 74 ranked SPECpower_ssj®2008 publications with the highest overall efficiency overall ssj_ops/W results were all powered by AMD EPYC processors. For SPECrate®2017 Integer (Energy Base), AMD EPYC CPUs power the first 4 of 5 SPECrate®2017_int_energy_base performance/system W scores. For SPECrate®2017 Floating Point (Energy Base), AMD EPYC CPUs power the first 8 of 9 SPECrate®2017_fp_energy_base performance/system W scores. For VMMark® server power-performance (PPKW), have the top two results for 2- and 4-socket matched pair results outperforming all other socket results. See https://www.amd.com/en/claims/epyc3x#faq-EPYC-028B for the full list.

EPYC-032: AMD EPYC 9004 CPUs support 12 channels of up to 4800 MHz DDR5 memory which is 460.8 GB/s of maximum memory throughput per socket. Intel Scalable "Ice Lake" CPUs support 8 channels of up to 3200 MHz DDR 4 (per https://ark.intel.com/) have a maximum 204.8 GB/s. EPYC 9004 CPUs have 2.25x the memory throughput per CPU. 460.8 ÷ 204.8 = 2.25x the max throughput or 125% more max throughput.

EPYC-034A: AMD EPYC 9004 CPUs can support 12 memory channels with 2 DPC (DIMMs / channel) 12 x 2 = 24 DIMM slots x 256GB DIMMs = 6,144GB of standard DRAM (DDR) memory or 6TB per CPU. The highest supported total memory (not just DRAM) on https://ark.intel.com/ is the Intel Xeon Ice Lake is 6 TB per CPU - but with standard DRAM the limit is 4TB: 8 memory channels x 2 DPC = 16 total DIMM slots x 256GB DIMMs = 4,096GB of DRAM (DDR) memory, or 4TB per CPU. EPYC 9004 Series supports 50% more DRAM than Intel Ice Lake CPUs.

EPYC-38: Based on AMD internal testing as of 09/19/2022, geomean performance improvement at the same fixed-frequency on a 4th Gen AMD EPYC™ 9554 CPU compared to a 3rd Gen AMD EPYC™ 7763 CPU using a select set of workloads (33) including est. SPECrate®2017_int_base, est. SPECrate®2017_fp_base, and representative server workloads.

GD-83: Use of third-party Marks / logos/ products is for informational purposes only and no endorsement of or by AMD is intended or implied.

GD-183: AMD Infinity Guard features vary by EPYC™ Processor generations. Infinity Guard security features must be enabled by server OEMs and/or Cloud Service Providers to operate. Check with your OEM or provider to confirm support of these features. Learn more about Infinity Guard at https://www.amd.com/en/technologies/infinity-guard.

SP5-001C: SPECrate®2017_int_base comparison based on published results as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (1790 SPECrate®2017_int_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32607.html) vs. 2P AMD EPYC 7763 (861 SPECrate®2017_int_base, 128 total cores, www.spec.org/cpu2017/results/res2021q4/cpu2017-20211121-30148.html).

SP5-002C: SPECrate®2017_fp_base comparison based on published results as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (1480 SPECrate®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32605.html) vs. 2P AMD EPYC 7763 (663 SPECrate®2017_fp_base, 128 total cores, www.spec.org/cpu2017/results/res2021q4/cpu2017-20211121-30146.html). ormation.

SP5-005C: SPECjbb® 2015-MultiJVM Max comparison based on published results as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (815459 SPECjbb®2015 MultiJVM max-jOPS, 356204 SPECjbb®2015 MultiJVM critical-jOPS, 192 total cores, http://www.spec.org/jbb2015/results/res2022q4/jbb2015-20221019-00861.html) vs. 2P AMD EPYC 7763 (420774 SPECjbb®2015 MultiJVM max-jOPS, 165211 SPECjbb®2015 MultiJVM critical-jOPS, 128 total cores, http://www.spec.org/jbb2015/results/res2021q3/jbb2015-20210701-00692.html). ormation.

SP5-008: 4th Gen EPYC CPUs (96c) support up to 12 channels of DDR5-4800 memory (460.8 GB/s) versus 3rd Gen EPYC CPUs (64c) that support up to 8 channels of DDR4-3200 (240.8 GB/s) memory.

SP5-009C: SPECrate®2017_fp_base based on published scores from www.spec.org as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (1480 SPECrate®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32605.html) is 2.52x the performance of published 2P Intel Xeon Platinum 8380 (587 SPECrate®2017_fp_base, 160 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221010-32542.html).Published 2P AMD EPYC 7763 (663 SPECrate®2017_fp_base, 128 Total Cores, http://spec.org/cpu2017/results/res2021q4/cpu2017-20211121-30146.html) is shown at 1.13x for reference. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

ENDNOTES

SP5-010B: SPECrate®2017_int_base based on published scores from www.spec.org as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (1790 SPECrate®2017_int_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32607.html) is 2.97x the performance of published 2P Intel Xeon Platinum 8380 (602 SPECrate®2017_int_base, 80 total cores, http://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.html). Published 2P AMD EPYC 7763 (861 SPECrate®2017_int_base, 128 total cores, http://spec.org/cpu2017/results/res2021q4/cpu2017-20211121-30148.html) is shown at 1.43x for reference. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. NOTE: Red text only needs to be included with charts that show the 7763.

SP5-011B: SPECpower_ssj®2008 comparison based on published 2U, 2P Windows® results as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (27501 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01194.html) vs. 2P Intel Xeon Platinum 8380 (13670 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20220926-01184.html). 2P AMD EPYC 7763 (23505 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2021q2/power_ssj2008-20210324-01091.html) shown at 1.72x for reference. SPEC® and SPECpower_ssj® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. NOTE: Red text only needs to be included with charts that show the 7763.

SP5-012B: SPECjbb® 2015-MultiJVM Max based on published scores from www.spec.org as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (815459 SPECjbb®2015 MultiJVM max-jOPS, 356204 SPECjbb®2015 MultiJVM critical-jOPS, 192 Total Cores, http://www.spec.org/jbb2015/results/res2022q4/jbb2015-20221019-00861.html) is 2.85x the performance of published 2P Intel Xeon Platinum 8380 (286125 SPECjbb®2015 MultiJVM max-jOPS, 152057 SPECjbb®2015 MultiJVM critical-jOPS, 80 Total Cores, http://www.spec.org/jbb2015/results/res2021q4/jbb2015-20211006-00706.html). 2P AMD EPYC 7763 (420774 SPECjbb®2015 MultiJVM max-jOPS, 165211 SPECjbb®2015 MultiJVM critical-jOPS, 128 total cores, http://www.spec.org/jbb2015/results/res2021q3/jbb2015-20210701-00692.html) shown at 1.47x for reference. SPEC® and SPECjbb® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. NOTE: Red text only needs to be included with charts that show the 7763.

SP5-013A: 96-core EPYC 9654 CPU processors results as of 11/10/2022 using SPECrate®2017_int_base. The AMD EPYC scored 1790 SPECrate®2017_int_base which is higher than all other 2P scores published on the SPEC® website. 2P AMD EPYC 9654 (1790 SPECrate®2017_int_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32607.html). SPEC®, SPECrate® and SPEC CPU® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-014: Estimated 16-core 4th Gen EPYC CPU processors results as of 08/31/2022 using SPECrate®2017_int_base. The AMD EPYC scored ~418 or ~13.06/core (measured on AMD internal reference platform and Marked estimate per SPEC Fair Use) which is higher performance-per-core than all other 2P scores published on the SPEC® website. SPEC®, SPECrate® and SPEC CPU® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-015A: SPECrate®2017_int_base comparison is based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9474F (1090 SPECrate®2017_int_base, 64 Total Cores, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 1.81x the performance (51% per core adjusted) of published 2P Intel Xeon Platinum 8380 (602 SPECrate®2017_int_base, 540 Total TDP W, $17332 Total CPU $, http://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.html). Published 2P AMD EPYC 7643 (683 SPECrate®2017_int_base, 450 Total TDP W, 96 Total Cores, $9990 Total CPU $, http://spec.org/cpu2017/results/res2021q3/cpu2017-20210831-29186.html. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-016A: SPECrate®2017_int_base comparison is based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9374F (815 SPECrate®2017_int_base, 64 Total Cores, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 1.55x the performance of published 2P Intel Xeon Platinum 8362 (526 SPECrate®2017_int_base, 64 Total Cores, http://spec.org/cpu2017/results/res2021q3/cpu2017-20210802-28469.html). Published 2P AMD EPYC 75F3 (596 SPECrate®2017_int_base, 64 Total Cores, http://spec.org/cpu2017/results/res2021q2/cpu2017-20210409-25541.html) is shown for reference. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-018A: SPECrate®2017_int_base comparison based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9174F (428 SPECrate®2017_int_base, 32 Total Cores, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 1.47x the performance of published 2P Intel Xeon Gold 6346 (291 SPECrate®2017_int_base, http://spec.org/cpu2017/results/res2022q2/cpu2017-20220419-31532.html). Published 2P AMD EPYC 73F3 (352 SPECrate®2017_int_base, 480 Total TDP W, 32 Total Cores, $7042 Total CPU $, http://spec.org/cpu2017/results/res2021q4/cpu2017-20211207-30371.html) shown at 1.2x for reference. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-021A: As of 11/10/2022, the Intel exponential trendline from top SPECrate®2017_int_base published scores to date for 2P 1st, 2nd and 3rd Gen Intel based Xeon SP (LGA socketed) servers for each of 2015-2022 (expected). The AMD log trendline from top SPECrate®2017_int_base published score to date, for 2P Intel based AMD EPYC servers for each of 2017, 2018, 2019, 2020, 2021, and as of claim date for 2022. The lines below are organized as: Year, CPU model, SPEC score, URL. Intel: 2017, Intel Xeon Platinum 8180, 302, https://spec.org/cpu2017/results/res2017q4/cpu2017-20170928-00070.pdf; 2018, Intel Xeon Platinum 8180, 304, https://spec.org/cpu2017/results/res2018q3/cpu2017-20180709-07701.pdf; 2019, Intel Xeon Platinum 8280L, 364, should be 8280L https://spec.org/cpu2017/results/res2019q2/cpu2017-20190429-12779.pdf; 2020, Intel Xeon Gold 6258R, 397, https://spec.org/cpu2017/results/res2020q3/cpu2017-20200915-23981.pdf; 2021, Intel Xeon Platinum 8380, 602, https://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.html; 2022, Intel Xeon Platinum 8380, 602, https://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.html. AMD: 2017, AMD EPYC 7601, 275, https://spec.org/cpu2017/results/res2017q4/cpu2017-20171211-01594.pdf; 2018, EPYC 7601, 282, https://spec.org/cpu2017/results/res2018q3/cpu2017-20180827-08666.pdf; 2019, EPYC 7742, 701, https://spec.org/cpu2017/results/res2019q4/cpu2017-20191125-20001.pdf; 2020, EPYC 7H12, 717, https://spec.org/cpu2017/results/res2020q2/cpu2017-20200525-22554.pdf; 2021, EPYC 7763, 861, http://spec.org/cpu2017/results/res2021q4/cpu2017-20211121-30148.html; 2022, EPYC 9654, 1790, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32607.html; SPEC®, SPECrate® and SPEC CPU® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

ENDNOTES

SP5-022: Neural Magic measured results on AMD reference systems as of 9/29/2022. Configurations:2P EPYC 9654 "Titanite" vs. 2P EPYC 7763 "DaytonaX" running on Ubuntu 22.04 LTS, Python 3.9.13, pip==22.12/deepsparse==1.0.2. BERT-Large Streaming Throughput items/sec (seq=384, batch 1, 48 streams, INT8 + sparse) using SQuAD v1.1 dataset; ResNet50 Batched Throughput items/sec (batch 256, single-stream, INT8 sparse) using ImageNet dataset; YOLOv5s Streaming Throughput ([image 3, 640, 640], batch 1, multi-stream, per-stream latency <=33ms) using COCO dataset. Testing not independently verified by AMD.

SP5-023: Estimated SPECrate®2017_int_base comparison based on internal AMD reference platform measurements/projections and best published scores at www.spec.org as of 11/10/2022. AMD internal measurements or projections* 2x AMD EPYC 9654 1550, 2x AMD EPYC 9634 1325*, 2x AMD EPYC 9554 1250, 2x AMD EPYC 9534 1070, 2x AMD EPYC 9474F 1040, 2x AMD EPYC 9454 820, *2x AMD EPYC 9374F 765, 2x AMD EPYC 9354 700, 2x AMD EPYC 9334 645, 2x AMD EPYC 9274F 550, *2x AMD EPYC 9254 480*, 2x AMD EPYC 9224 450, 2x AMD EPYC 9174F 419, 2x AMD EPYC 9124 340. Referenced: 2P Intel Xeon Platinum 8380 (602 SPECrate®2017_int_base, http://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.html) and 2P Intel Xeon Platinum 8362 (526 SPECrate®2017_int_base, http://spec.org/cpu2017/results/res2021q3/cpu2017-20210802-28469.html) SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. OEM published scores will vary based on system configuration and determinism mode used (default cTDP performance profile except EPYC 9654/9554 cTDP=400W)

SP5-024A: SPECrate®2017_fp_base comparison is based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9474F (1110 SPECrate®2017_fp_base, 96 Total Cores, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 1.89x the performance (78% per core adjusted) of published 2P Intel Xeon Platinum 8380 (587 SPECrate®2017_fp_base, 540 Total TDP W, $17332 Total CPU $, http://spec.org/cpu2017/results/res2022q4/cpu2017-20221010-32542.html). Published 2P AMD EPYC 7643 (576 SPECrate®2017_fp_base, 450 Total TDP W, 96 Total Cores, $9990 Total CPU $, http://spec.org/cpu2017/results/res2021q4/cpu2017-20210928-29636.html) shown at 0.98x for reference. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-025A: SPECrate®2017_fp_base comparison is based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9374F (954 SPECrate®2017_fp_base, 64 Total Cores, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 1.96x the performance of published 2P Intel Xeon Platinum 8362 (486 SPECrate®2017_int_base, 64 Total Cores, http://spec.org/cpu2017/results/res2022q3/cpu2017-20220729-32239.html). Published 2P AMD EPYC 75F3 (546 SPECrate®2017_fp_base, 560 Total TDP W, 64 Total Cores, $9720 Total CPU $, http://spec.org/cpu2017/results/res2021q2/cpu2017-20210409-25543.html) is shown at 1.12x for reference. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information

SP5-027A: SPECrate®2017_fp_base comparison is based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9374F (579 SPECrate®2017_fp_base, 32 Total Cores, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 1.78x the performance of published 2P Intel Xeon Gold 6346 (325 SPECrate®2017_fp_base, 410 Total TDP W, 32 Total Cores, $5416 Total CPU $, http://spec.org/cpu2017/results/res2021q3/cpu2017-20210802-28471.html). Published 2P AMD EPYC 73F3 (398 SPECrate®2017_fp_base, 480 Total TDP W, 32 Total Cores, $7042 Total CPU $, http://spec.org/cpu2017/results/res2021q3/cpu2017-20210816-28714.html) shown at 1.22x for reference. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-028A: SPECrate®2017_fp_base comparison based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9554 (1200 SPECrate®2017_fp_base, 800 Total TDP W, 128 Total Cores, $18174 Total CPU $, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 2.04x the performance (28% per core adjusted) of published 2P Intel Xeon Platinum 8380 (587 SPECrate®2017_fp_base, 540 Total TDP W, 80 Total Cores, $18718 Total CPU $, http://spec.org/cpu2017/results/res2022q4/cpu2017-20221010-32542.html). SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-029A: SPECrate®2017_int_base comparison based on a compliant ASUSTeK run and published scores from www.spec.org as of 11/10/2022. Comparison of compliant 2P AMD EPYC 9554 (1300 SPECrate®2017_int_base, 800 Total TDP W, 128 Total Cores, $18174 Total CPU $, compliant run ASUSTeK RS700A-E12, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0) is 2.16x the performance (35% per core adjusted) of published 2P Intel Xeon Platinum 8380 (602 SPECrate®2017_int_base, 540 Total TDP W, 80 Total Cores, $18718 Total CPU $, http://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.html). SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-031: Black-Scholes European Option Pricing benchMark comparison based on AMD measurements for 100, 200, 400, 800, and 1600M options as of 10/4/2022. Max score is based on 200M options. Configurations: 2x 40-core Intel Xeon Platinum 8380 vs. 2x 64-core EPYC 9554 all systems on Ubuntu 22.04 and compiled with ICC 2022.1.0. Results Mar vary.2x 32-core EPYC 75F3 (shown for reference) at ~1.1x.

ENDNOTES

SP5-032: WRF® CONUS 2.5KM workload benchMark comparison based on AMD measurements as of 10/4/2022. Configurations: 2x 40-core Intel Xeon Platinum 8380 vs. vs. 2x 96-core EPYC 9654 for ~2.5x the time-step function performance. Results may vary.

SP5-033: WRF® CONUS 2.5KM workload benchMark comparison based on AMD measurements as of 10/4/2022. Configurations: 2x 32-core Intel Xeon Platinum 8362 vs. vs. 2x 32-core EPYC 9374F for ~1.98x the time-step function performance. Results may vary.

SP5-034A: Fluent® Release 2022 R2 test cases benchMark comparison based on AMD measurements as of 10/19/2022. Configurations: 2x 40-core Intel Xeon Platinum 8380 vs. vs. 2x 96-core EPYC 9654 for ~2.46x the rating performance. Results may vary.

SP5-035A: Fluent® Release 2022 R2 test cases benchMark comparison based on AMD measurements as of 10/19/2022. Configurations: 2x 32-core Intel Xeon Platinum 8362 vs. vs. 2x 32-core EPYC 9374F for ~1.75x the rating performance. Results may vary.

SP5-036: Radioss™ neon workload benchMark comparison based on AMD measurements as of 10/4/2022. Configurations: 2x 40-core Intel Xeon Platinum 8380 vs. vs. 2x 96-core EPYC 9654 for ~2.59x the solver speedup performance. Results may vary.

SP5-037: Radioss™ neon workload benchMark comparison based on AMD measurements as of 10/4/2022. Configurations: 2x 32-core Intel Xeon Platinum 8362 vs. vs. 2x 32-core EPYC 9374F for ~1.73x the solver speedup performance. Results may vary.

SP5-039: Autodesk® Arnold gtc_robot workload comparison based on internal AMD reference platform measurements as of 11/10/2022. Comparison of 2P AMD EPYC 9654 (99 avg. seconds/872.73 ray-traces/day) is ~2.4x the performance of 2P Intel Xeon Platinum 8380 (235 avg seconds/367.66 ray-traces/day). Results may vary.2P EPYC 7763 shown for reference (167 avg seconds/517.37 ray-traces/day) at ~1.4x.

SP5-049B: VMMark® 3.1.1 matched pair comparison based on published results as of 11/10/2022. Configurations: 2-node, 2P 96-core EPYC 9654 powered server running VMware ESXi 8 RTM (40.19 @ 44 tiles/836 VMs, https://www.vmware.com/content/dam/digitalMarketing/vmware/en/pdf/vmMark/2022-10-18-HPE-ProLiant-DL385Gen11.pdf) versus 2-node, 2P 40-core Xeon Platinum 8380 running VMware ESXi v7 U2 (14.19 @ 14 tiles/266 VMs, https://www.vmware.com/content/dam/digitalMarketing/vmware/en/pdf/vmMark/2021-04-20-Fujitsu-PRIMERGY-RX2540M6.pdf) for 2.8x the score and 3.1x the tile (VM) capacity. 2-node, 2P EPYC 7763-powered server (23.33 @ 24 tiles/456 VMs, https://www.vmware.com/content/dam/digitalMarketing/vmware/en/pdf/vmMark/2022-02-08-Fujitsu-RX2450M1.pdf) shown at 1.6x the performance for reference. VMMark is a registered tradeMark of VMware in the US or other countries.

SP5-065: SPECrate®2017_int_energy_base comparison based on published results as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (1890 SPECrate®2017_int_energy_base/1190 SPECrate®2017_int_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32633.html) vs. 2P Intel Xeon Platinum 8380 (725 SPECrate®2017_int_energy_base/531 SPECrate®2017_int_base, 80 total cores, www.spec.org/cpu2017/results/res2021q2/cpu2017-20210412-25603.html). 2P AMD EPYC 7713 (1610 SPECrate®2017_int_energy_base/576 SPECrate®2017_int_base, 128 total cores, www.spec.org/cpu2017/results/res2021q1/cpu2017-20210301-25148.html) shown at 2.22x for reference. NOTE: Red text only needs to be included with charts that show the 7763.

SP5-067: SPECjbb® 2015-MultiJVM Max based on published scores from www.spec.org as of 11/10/2022. Configurations: 2P AMD EPYC 9374F (359294 SPECjbb®2015 MultiJVM max-jOPS, 167272 SPECjbb®2015 MultiJVM critical-jOPS, 64 total cores, http://www.spec.org/jbb2015/results/res2022q4/jbb2015-20221005-00856.html) is 1.71x the performance of published 2P Intel Xeon Gold 6338 (210635 SPECjbb®2015 MultiJVM max-jOPS, 111971 SPECjbb®2015 MultiJVM critical-jOPS, 64 total cores, http://www.spec.org/jbb2015/results/res2022q1/jbb2015-20220209-00717.html). 2P AMD EPYC 75F3 (276317 SPECjbb®2015 MultiJVM max-jOPS, 116628 SPECjbb®2015 MultiJVM critical-jOPS, 64 total cores, http://www.spec.org/jbb2015/results/res2021q2/jbb2015-20210408-00637.html) shown at 1.310x for reference. SPEC® and SPECjbb® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. NOTE: Red text only needs to be included with charts that show the 75F3.

SP5-068: SPECrate®2017_int_base, SPECrate®2017_fp_base, and BERT-large estimates based on internal AMD reference platform measurements of 11/3/2022. Floating-point throughput comparison: 2P AMD EPYC 9534 (1030 est. SPECrate®2017_fp_base, 560 Total TDP W, 128 Total Cores) is 1.66x the performance/W of 2P AMD EPYC 7763 (622 est. SPECrate®2017_fp_base, 560 Total TDP W, 128 Total Cores). Integer throughput comparison: 2P AMD EPYC 9534 (1070 est. SPECrate®2017_int_base, 560 Total TDP W, 128 Total Cores) is 1.34x the performance/W of published 2P AMD EPYC 7763 (800 est. SPECrate®2017_int_base, 560 Total TDP W, 128 Total Cores). Bert-Large NLP sparse INT8 comparison: 2P AMD EPYC 9534 (345.6 items/sec, 560 Total TDP W, 128 Total Cores) is 2.67x the performance/W of published 2P AMD EPYC 7763 (129.7 items/sec, 560 Total TDP W, 128 Total Cores). SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. OEM published scores will vary based on system configuration and determinism mode used (default cTDP performance profile).

ENDNOTES

SP5-069: SPECrate®2017_int_base estimate based on internal AMD reference platform measurements and published score from www.spec.org as of 11/10/2022. Comparison of estimated 1P AMD EPYC 9554P (631 SPECrate®2017_int_base, 400 Total TDP W, 64 Total Cores, $7104 Total CPU $, AMD Est) is 1.05x the performance of published 2P Intel Xeon Platinum 8380 (602 SPECrate®2017_int_base, 540 Total TDP W, 80 Total Cores, $18718 Total CPU $, http://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.html) [at 1.42x the performance/W] [at 2.76x the performance/CPU$]. AMD 1Ku pricing and Intel ARK.intel.com specifications and pricing as of 8/22/22. SPEC®, SPEC CPU®, and SPECrate® are registered tradeMarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. OEM published scores will vary based on system configuration and determinism mode used (default cTDP performance profile)

SP5-070: MySQL® 8.0.17 DSS comparison based on AMD measured median scores on 2P 96-core EPYC 9654 compared to 2P 40-core Xeon Platinum 8380 running virtualized HammerDB TPROC-H SF1 (KVM Hypervisor Virtualization server environment with 4 streams, 4 virtual units, calculating throughput with 4 streams x 22 queries x 3600 divided by the slowest VU completion time in seconds) as of 11/10/2022. Configurations: 2x AMD EPYC 9654 (~126,980 TPROC-H tpm) vs. 2x Xeon Platinum 8380 (~47452 TPROC-H queries/hour) for ~2.68x the tpm performance.

SP5-071: MySQL® 8.0.17 OLTP comparison based on AMD measured median scores on 2P 96-core EPYC 9654 compared to 2P 40-core Xeon Platinum 8380 running virtualized HammerDB TPROC-C (KVM Hypervisor Virtualization server environment with 400 WH and 64 users) as of 11/10/2022. Configurations: 2x AMD EPYC 9654 (~126,980 TPROC-C tpm/~531,183 NOPM) vs. 2x Xeon Platinum 8380 (~47452 TPROC-C tpm/~224,126 NOPM) for ~2.37x the tpm/NOPM performance.

SP5TCO-009K: As of 11/10/2022 based on AMD Internal analysis using the AMD EPYC™ Bare Metal Server & Greenhouse Gas Emission TCO Estimation Tool - version 6.35 estimating the cost and quantity of 2P AMD EPYC™ 9654 powered servers versus 2P Intel® Xeon® 8380 based server solutions required to deliver 8500 units of integer performance. Environmental impact estimates made leveraging this data, using the Country / Region specific electricity factors from the '2020 Grid Electricity Emissions Factors v1.4 – September 2020', and the United States Environmental Protection Agency 'Greenhouse Gas Equivalencies Calculator'. This scenario contains many assumptions and estimates and, while based on AMD internal research and best approximations, should be considered an example for information purposes only, and not used as a basis for decision making over actual testing. The analysis includes both hardware and virtualization software components. For additional details, see https://www.amd.com/en/claims/epyc3x#faq-SP5TCO-009K.

SP5TCO-010K: This scenario contains many assumptions and estimates and, while based on AMD internal research and best approximations, should be considered an example for information purposes only, and not used as a basis for decision making over actual testing. The Bare Metal Server Greenhouse Gas Emissions TCO (total cost of ownership) Estimator Tool compares the selected AMD EPYC™ and Intel® Xeon® CPU based server solutions required to deliver a TOTAL_PERFORMANCE of 8,500 units of integer performance based on the estimated or published scores for Intel Xeon and AMD EPYC CPU based servers. This estimation reflects a 1-year time frame. This analysis compares a 1P AMD EPYC 64 core 9554P CPU powered server with an estimated SPECrate®2017_int_base score of 631, performance estimated using AMD reference platform; compared to a 2P Intel Xeon 40 core Platinum_8380 based server with a SPECrate®2017_int_base score of 602 https://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.pdf.

SP5TCO-011k: This scenario contains many assumptions and estimates and, while based on AMD internal research and best approximations, should be considered an example for information purposes only, and not used as a basis for decision making over actual testing. The Bare Metal Server Greenhouse Gas Emissions TCO (total cost of ownership) Estimator Tool compares the selected AMD EPYC™ and Intel® Xeon® CPU based server solutions required to deliver a TOTAL_PERFORMANCE of 8,500 units of integer performance based on the estimated or published scores for Intel Xeon and AMD EPYC CPU based servers. This estimation reflects a 1-year time frame. This analysis compares a 1P AMD EPYC 96 core 9654P CPU powered server with an estimated SPECrate®2017_int_base score of 895, performance estimated using AMD reference platform; compared to a 2P Intel Xeon 40 core Platinum_8380 based server with a SPECrate®2017_int_base score of 602 https://spec.org/cpu2017/results/res2021q2/cpu2017-20210521-26364.pdf.

SP5TCO-012K: As of 10/10/2022 based on AMD Internal analysis using the AMD EPYC™ SERVER VIRTUALIZATION and GREENHOUSE GAS EMISSIONS TCO ESTIMATION TOOL - version 10.75 estimating the cost and quantity of 2P AMD EPYC™ 9654 (96 core/CPU) powered server versus 2P Intel® Xeon® 8380 (40 core/CPU) based server solutions required to deliver 200 total virtual machines (VM), requiring 8 core and 16GB of memory per VM, for the 1st year. Environmental impact estimates made leveraging this data, using the Country / Region specific electricity factors from the '2020 Grid Electricity Emissions Factors v1.4 – September 2020', and the United States Environmental Protection Agency 'Greenhouse Gas Equivalencies Calculator'. This scenario contains many assumptions and estimates and, while based on AMD internal research and best approximations, should be considered an example for information purposes only, and not used as a basis for decision making over actual testing. For additional details, see https://www.amd.com/en/claims/epyc4#-SP5TCO-012K.

SP5TCO-019K: As of 11/10/2022 based on AMD Internal analysis using the AMD EPYC™ SERVER VIRTUALIZATION and GREENHOUSE GAS EMISSIONS TCO ESTIMATION TOOL - version 10.75 estimating the cost and quantity of 2P AMD EPYC™ 9654 (96 core/CPU) powered server versus 2P Intel® Xeon® Gold 8380 (40 core/CPU) based server solutions required to deliver 1995 total virtual machines (VM) based on VMMark tiles in published results, for 1st year. Environmental impact estimates made leveraging this data, using the Country / Region specific electricity factors from the '2020 Grid Electricity Emissions Factors v1.4 – September 2020', and the United States Environmental Protection Agency 'Greenhouse Gas Equivalencies Calculator'. This scenario contains many assumptions and estimates and, while based on AMD internal research and best approximations, should be considered an example for information purposes only, and not used as a basis for decision making over actual testing.For additional details, see https://www.amd.com/en/claims/epyc4#SP5TCO-019K.

DISCLAIMER AND ATTRIBUTION

The information contained herein is for informational purposes only and is subject to change without notice. While every precaution has been taken in the preparation of this document, it may contain technical inaccuracies, omissions and typographical errors, and AMD is under no obligation to update or otherwise correct this information. Advanced Micro Devices, Inc. makes no representations or warranties with respect to the accuracy or completeness of the contents of this document, and assumes no liability of any kind, including the implied warranties of noninfringement, merchantability or fitness for particular purposes, with respect to the operation or use of AMD hardware, software or other products described herein. No license, including implied or arising by estoppel, to any intellectual property rights is granted by this document. Terms and limitations applicable to the purchase or use of AMD's products are as set forth in a signed agreement between the parties or in AMD's Standard Terms and Conditions of Sale.

Timelines, roadmaps, and/or product release dates shown in these slides are plans only and subject to change. "Rome", "Milan", "Genoa", "Zen", "Zen2", "Zen3", and "Zen4" are codenames for AMD architectures, and are not product names.