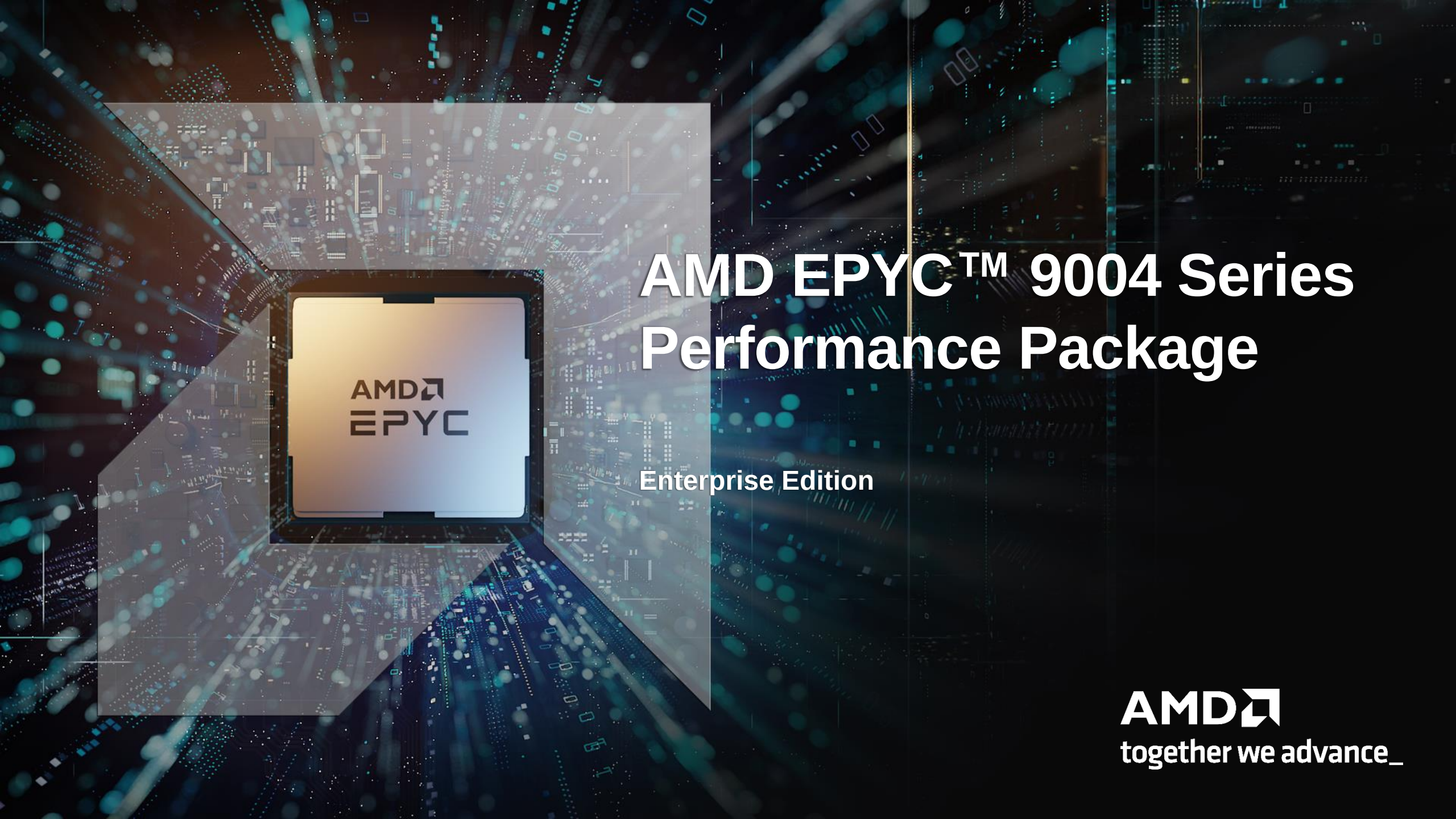


The background of the entire image is a dark, abstract digital space filled with glowing blue and teal lines, dots, and patterns that resemble a complex circuit board or data network. In the center-left, there is a large, semi-transparent square frame. Inside this frame is a smaller, glowing square with a gradient from yellow to blue, containing the AMD EPYC logo. To the right of this frame, the main title is displayed in large, white, sans-serif font. Below the title, the words 'Enterprise Edition' are written in a smaller, white, sans-serif font. In the bottom right corner, the AMD logo is shown in white, followed by the tagline 'together we advance_' in a white, sans-serif font.

AMD EPYC™ 9004 Series Performance Package

Enterprise Edition

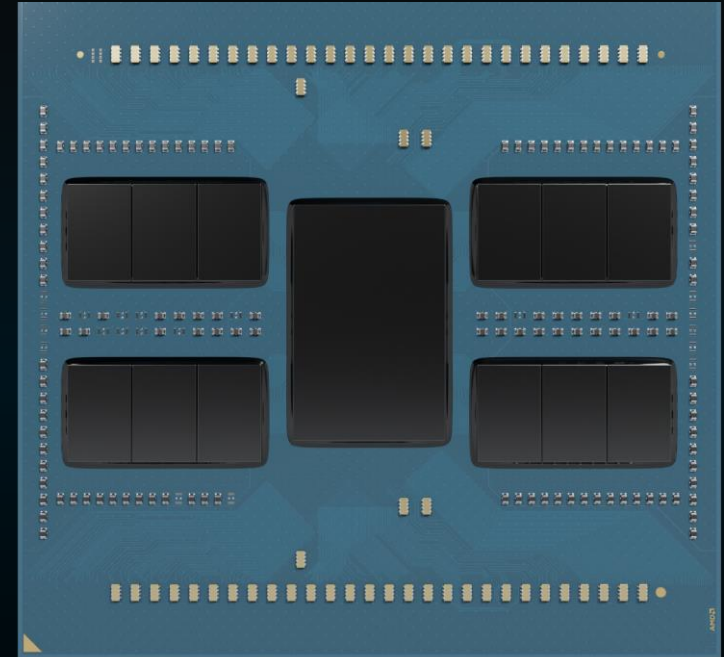
AMD
together we advance_

4th Gen AMD EPYC™ CPU

Extending Compute Leadership

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 (2P) |
Memory Expansion with CXL™
- Advances in Confidential Computing
~2X SEV-SNP Guests | Direct and CXL Attached Memory Encryption



4th Gen AMD EPYC™ CPU

Performance Pillars

Socket
Performance
Leadership

Per-Core
Performance
Leadership

Leadership Across
Workloads,
Market Segments

Leadership TCO and
Supporting Enterprise
Sustainability Goals

Energy Efficiency Leadership

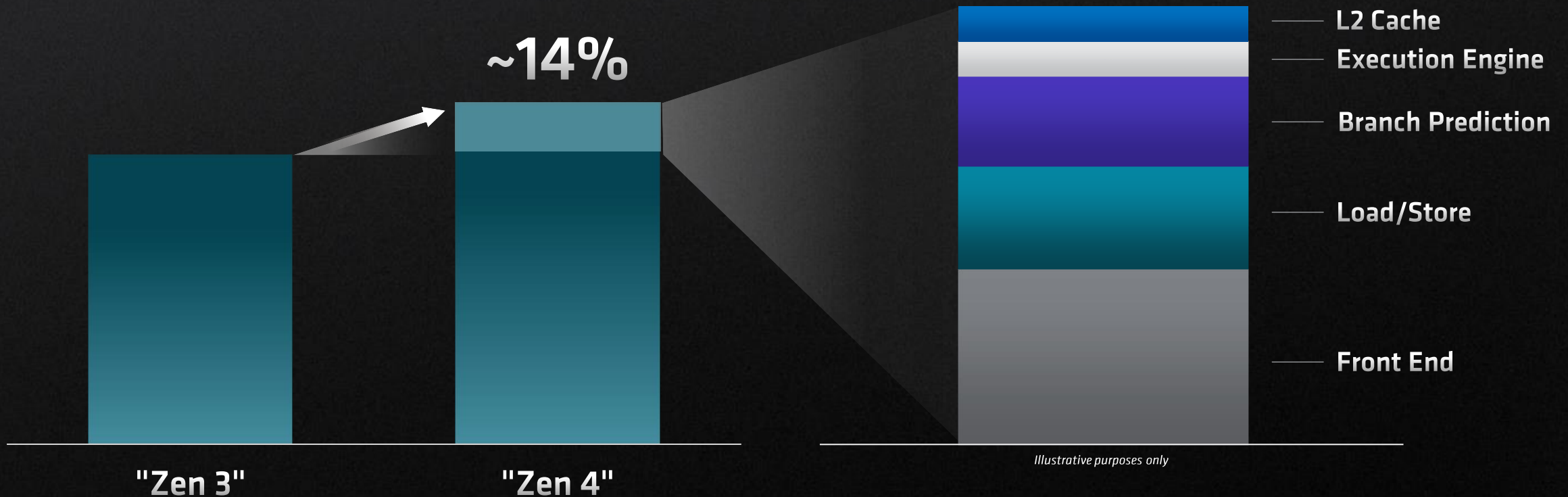
Generational Improvements

"Zen 4" ~14% IPC Uplift for Server CPUs¹

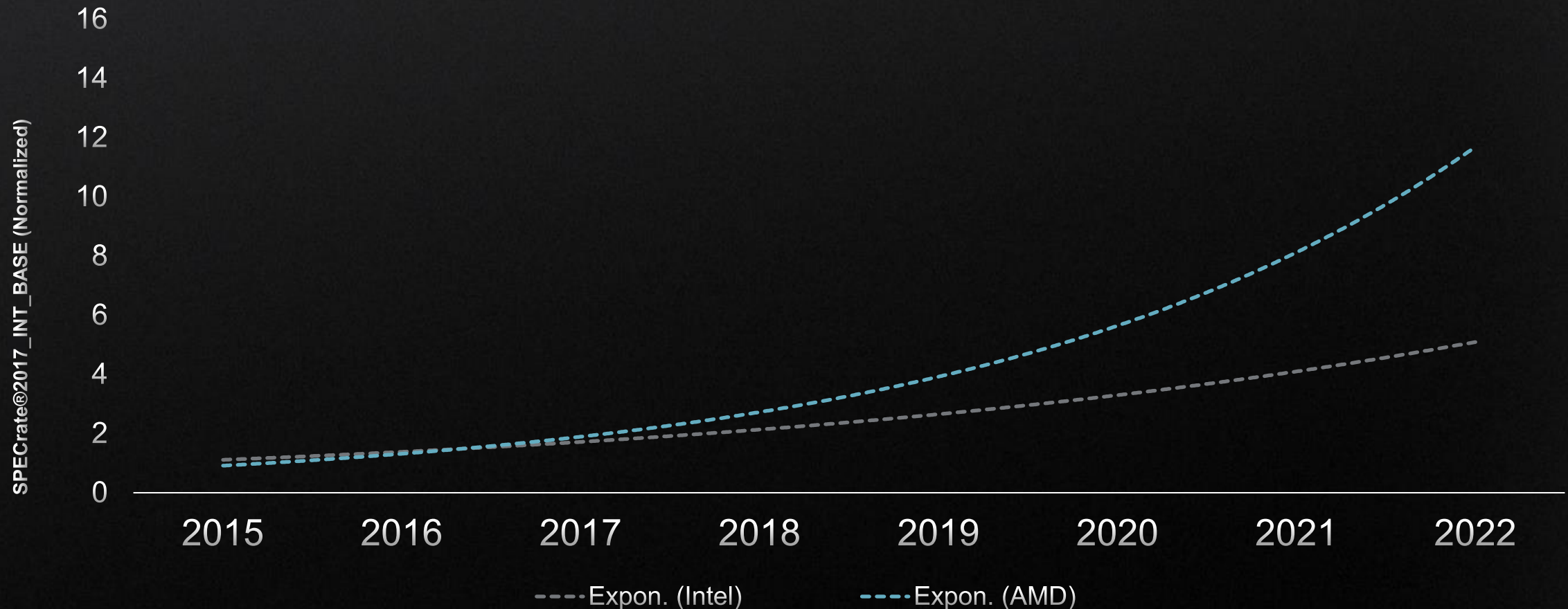
Geomean of 33 Server Workloads

(Fixed Frequency, 8+1 CCD)

"Zen 4" Performance Contributors



Advancing Data Center Performance



See endnotes: SP5-021A
SPEC CPU® are registered trademarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.
All scores are the highest published 2P socketed scores through the year indicated. SPEC CPU® data as of 11/10/2022



THE BEST GETS ^{EVEN} BETTER

300+ WORLD RECORDS AND *STILL* COUNTING



BUSINESS APPS

- 8 ERM/SCM Business
- 48 Enterprise server-side Java®
- 18 Enterprise Energy Efficiency
- 4 FinTech



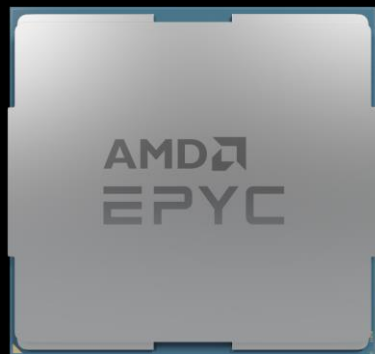
DATA MANAGEMENT & ANALYTICS

- 16 Business Intelligence
- 6 Structured Database Management
- 2 Unstructured Analytics Database
- 9 AI Platform/Text & Media Analytics



ENGINEERING/TECHNICAL

- 73 Massively Parallel applications
- 37 Modeling & Simulation
- 16 Floating Point Compute Intensive apps
- 12 HPC Energy Efficiency



INFRASTRUCTURE/HCI/SDI

- 23 Cloud and Virtualization
- 15 Integer Performance/General Purpose
- 8 Integer/General-Purpose Energy Efficiency
- 3 VM Energy Efficiency



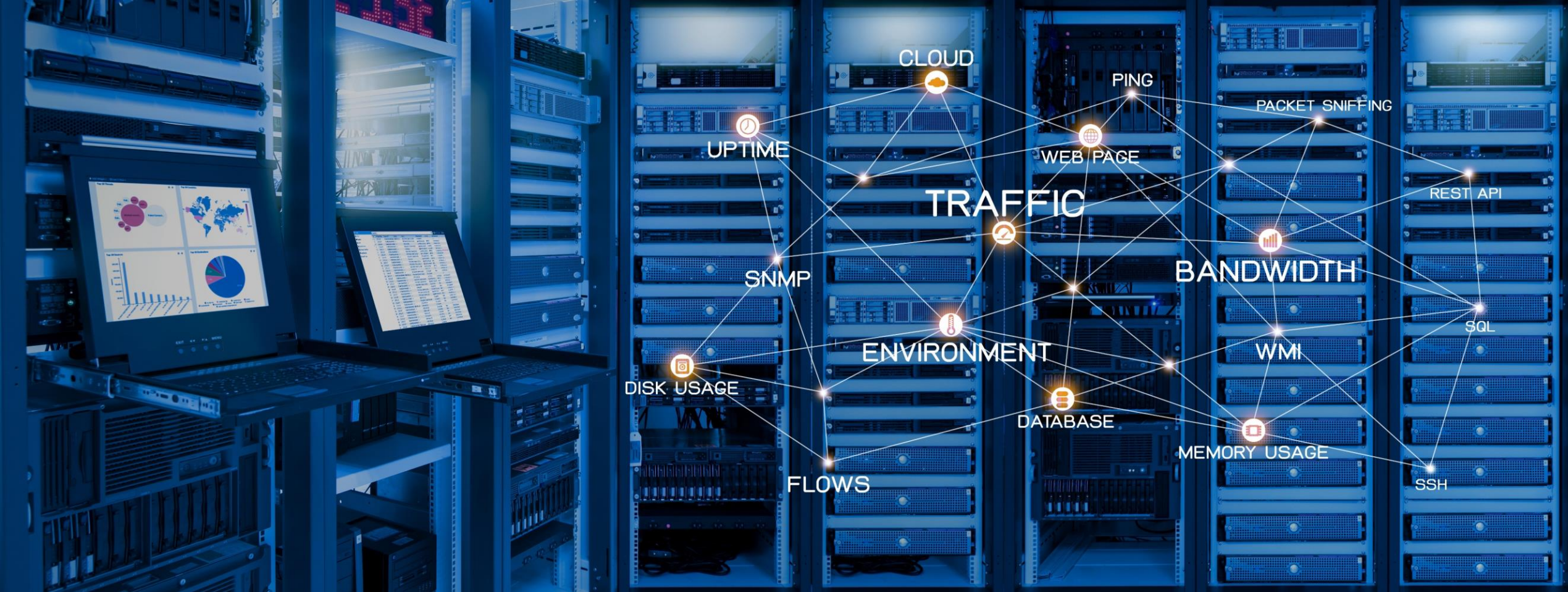
CONTENT APPS

- 5 Rendering



DIGITAL SERVICES

- 1 Social Networking BI



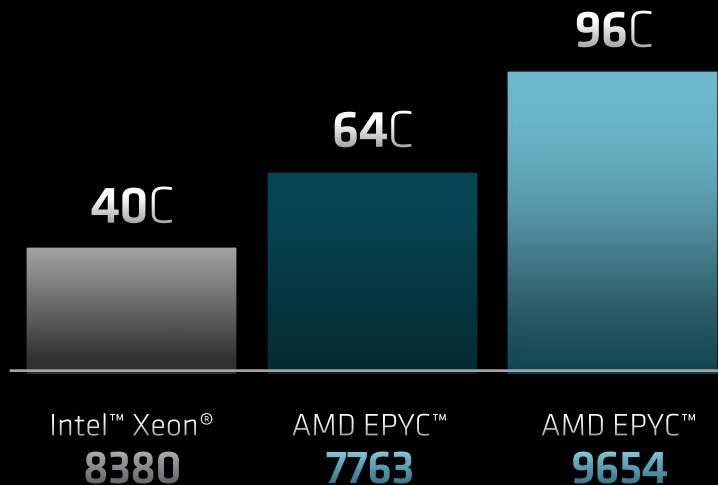
COMPETITIVE PERFORMANCE COMPARISONS

4th Gen AMD EPYC™

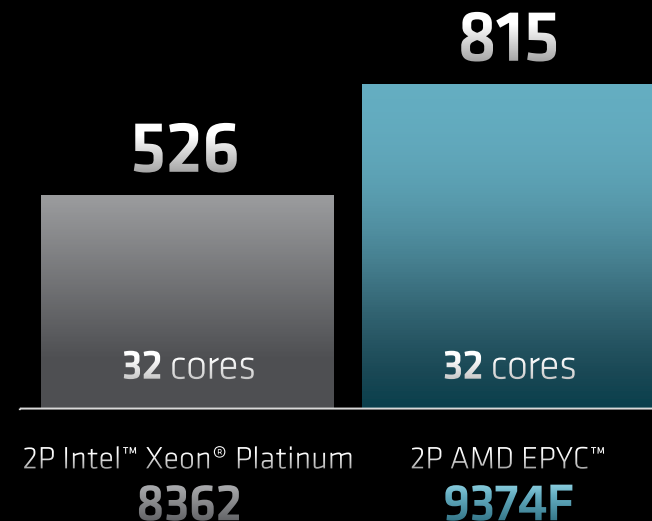
Performance leadership

Core density

Up to
96 cores
192 threads



Per-core performance



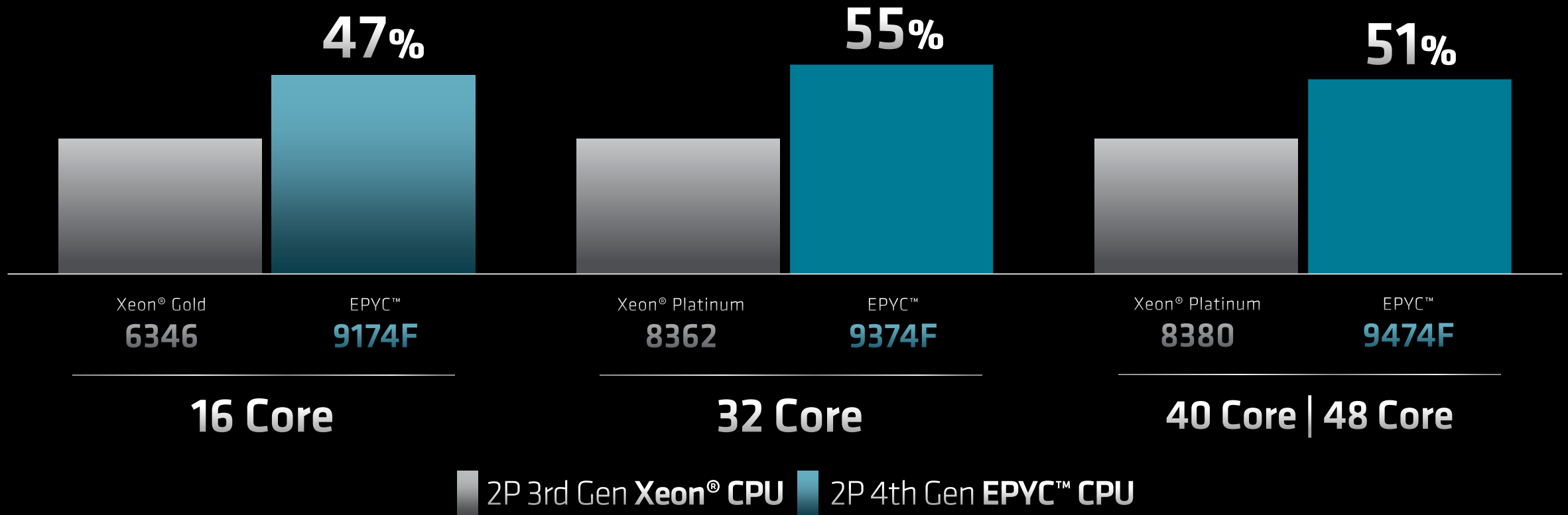
55% faster

SPECrate®2017 integer
throughput performance uplift

Per-Core Integer Performance Leadership

4th Gen EPYC™ CPUs Outperform 3rd Gen Xeon® Scalable Options

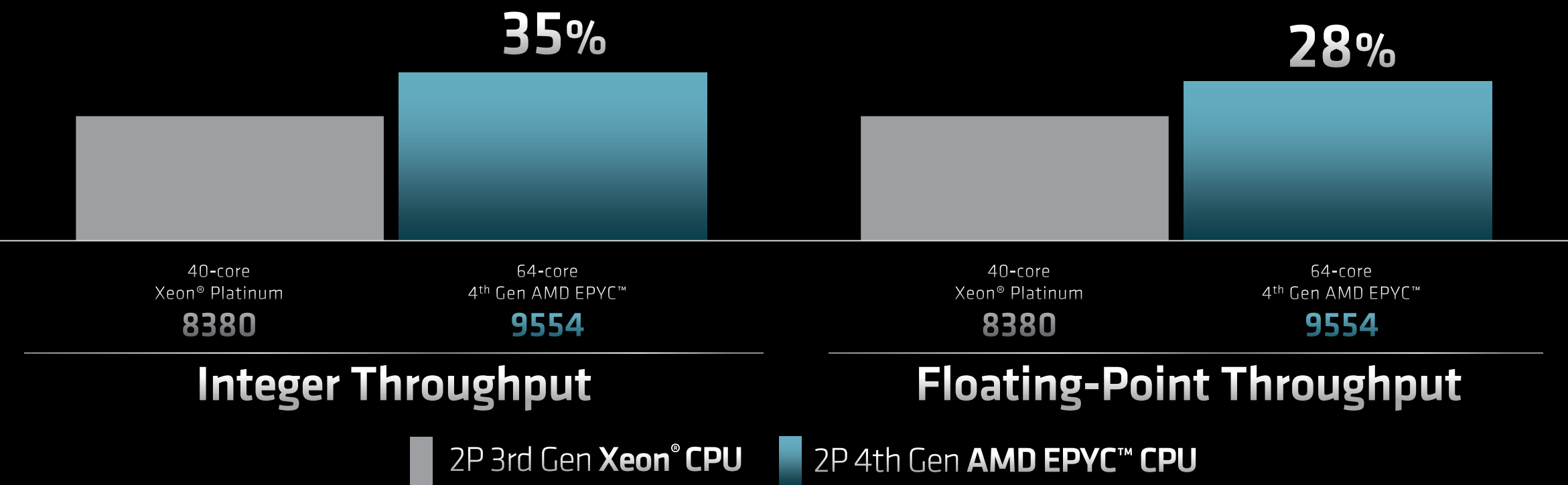
SPECrate®2017 Integer Throughput Performance Uplift



Driving Per-Core Performance Leadership Higher Up Stack

Exceptional Integer and Floating-Point Performance/Core

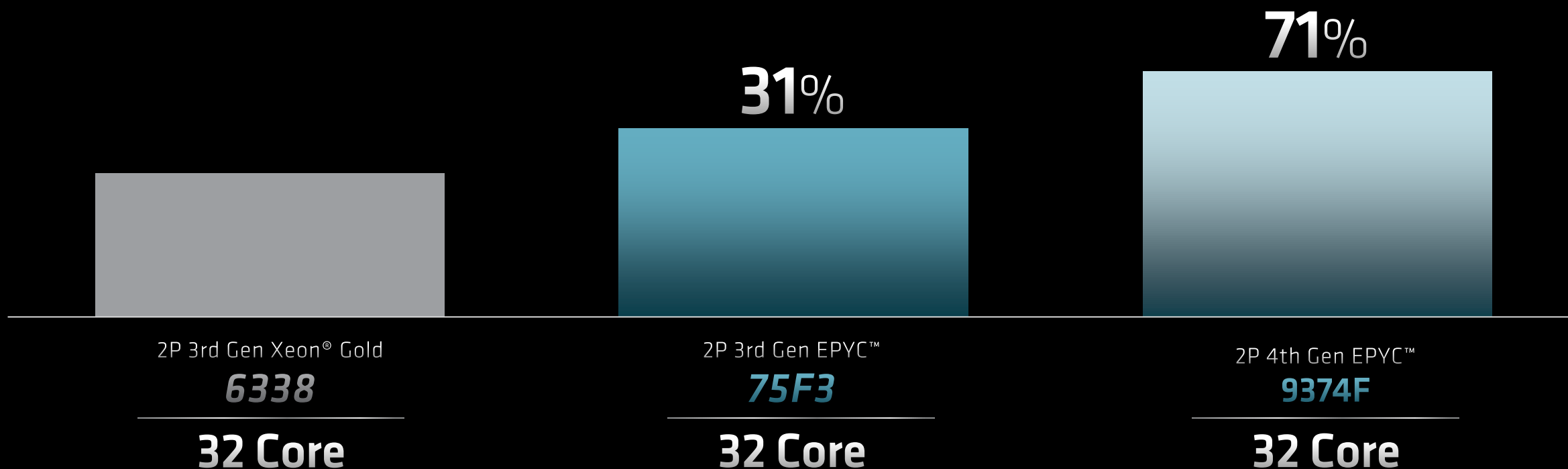
Estimated SPECrate®2017 Integer and Floating-Point Throughput Performance Uplift



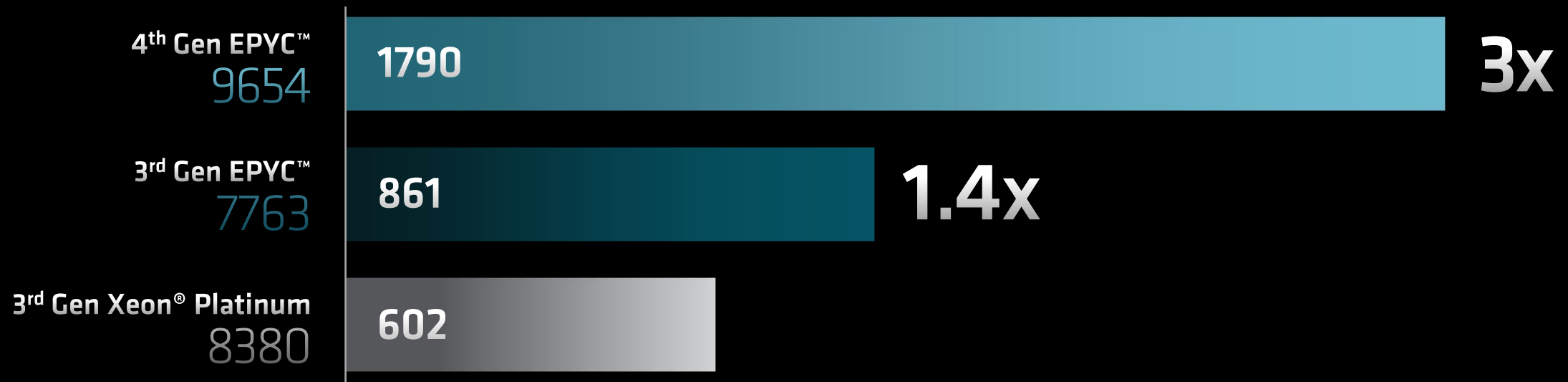
Driving Per-Core Enterprise Performance Leadership

Enterprise Server-side Java® Application Performance/Core

SPECjbb® 2015 MultiJVM max-jOPS



General Purpose Performance Leadership



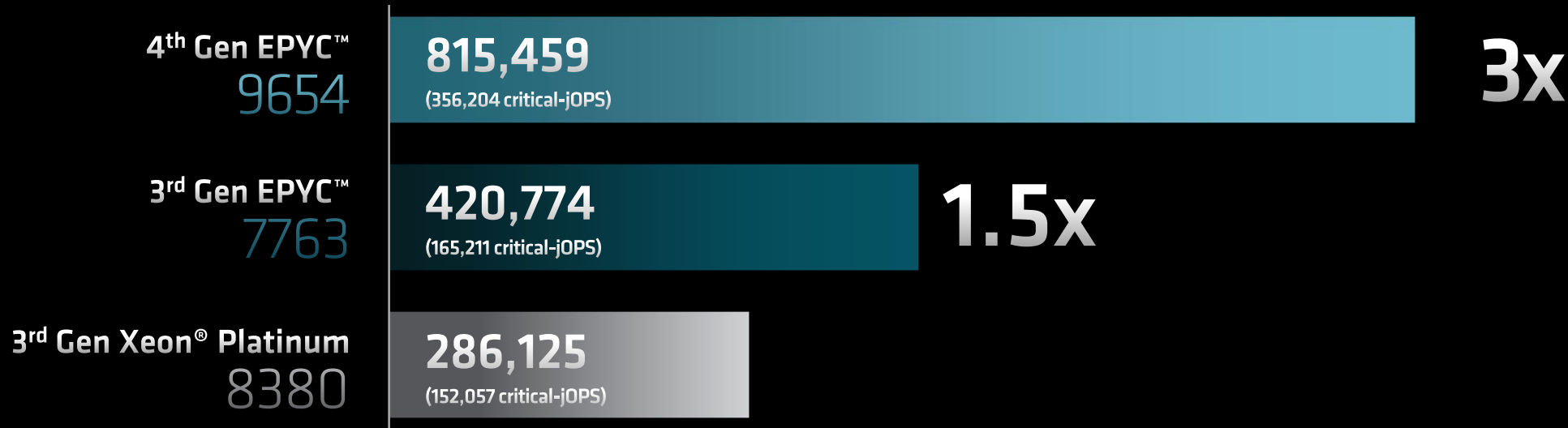
2P Integer Throughput
SPECrate®2017_int_base

Advancing General Purpose Efficiency



2P Integer Energy Efficiency, Performance-per-watt Score
SPECrate®2017_int_energy_base

Enterprise Performance Leadership



2P Enterprise Sever-Side Java
SPECrate®2015 Multi-JVM max-jOPS (critical-jOPS)

Advancing Enterprise Efficiency



2P Enterprise Server-Side Java / System Watt
SPECpower_ssj®2008 overall ssj_ops/W

Top Virtualization Performance



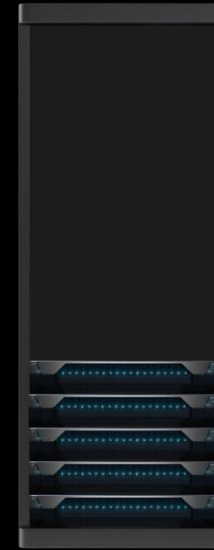
2P Infrastructure Virtualization
VMmark® 3.1.x (Score @ # of Tiles/VMs)

15 servers

2P Intel Platinum 8380



vs.



5 servers

2P AMD EPYC™ 9654

3-Year TCO Infrastructure Consolidation Benefits

67%^{Up to}

fewer servers

52%^{Up to}

less power

60%^{Up to}

OPEX reduction

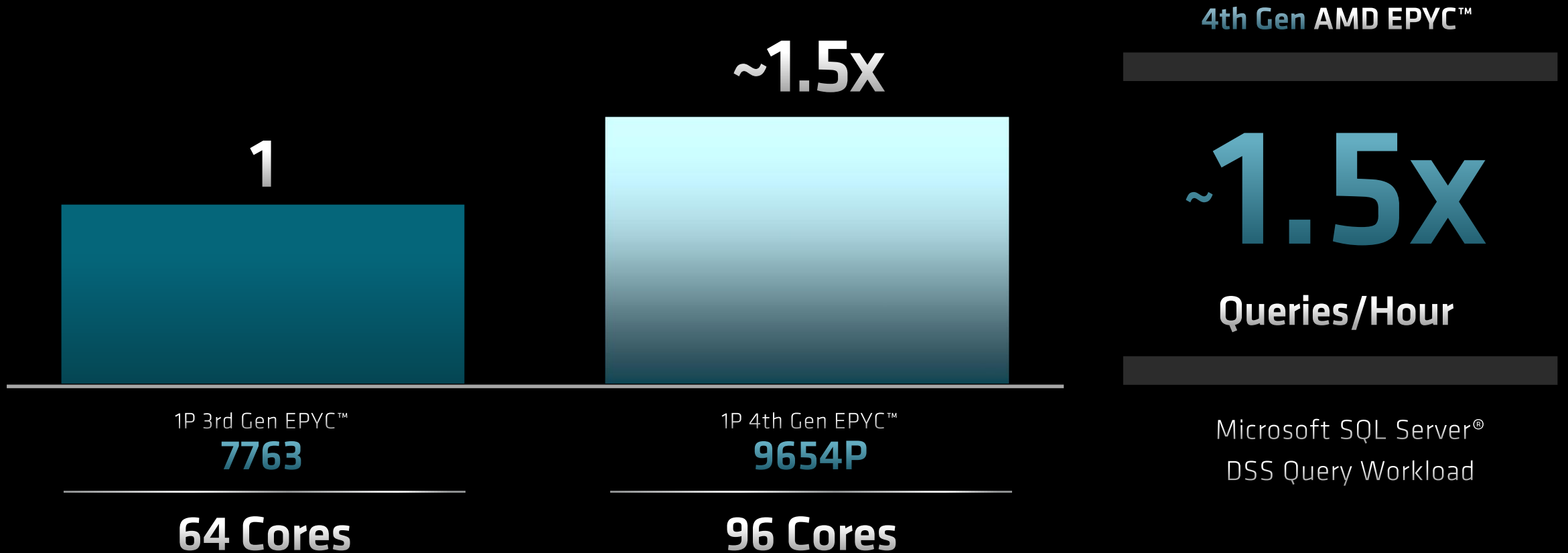
40%^{Up to}

CAPEX reduction

Decision Support System Performance Leadership

SQL Server® Business Queries

64-core 1P 3rd Gen EPYC™ vs. 96-core 1P 4th Gen EPYC™ CPUs



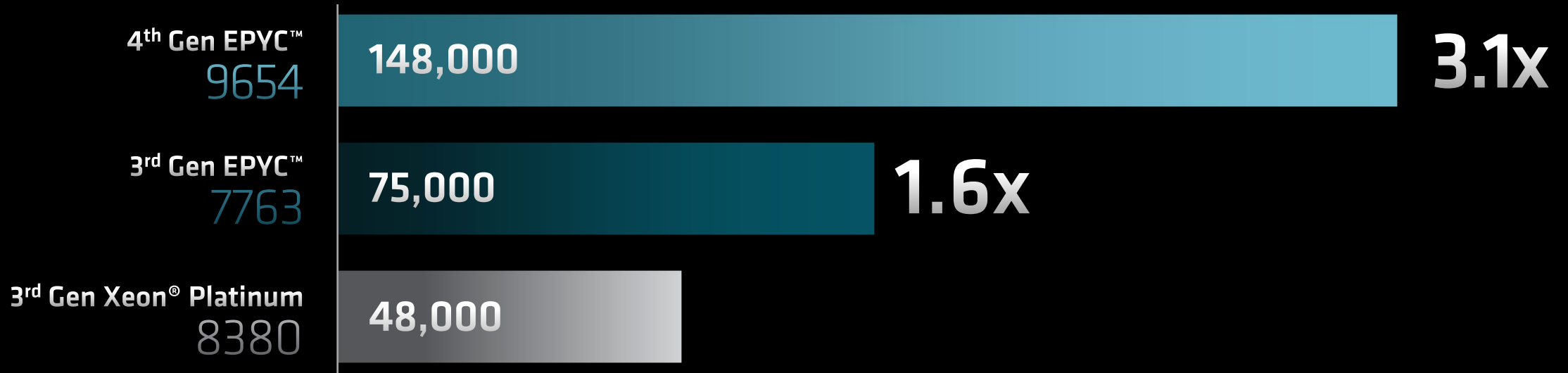
Decision Support System Performance Leadership

Oracle® Business Queries

16-core 2P 3rd Gen EPYC™ vs. 16-core 2P 4th Gen EPYC™ CPUs



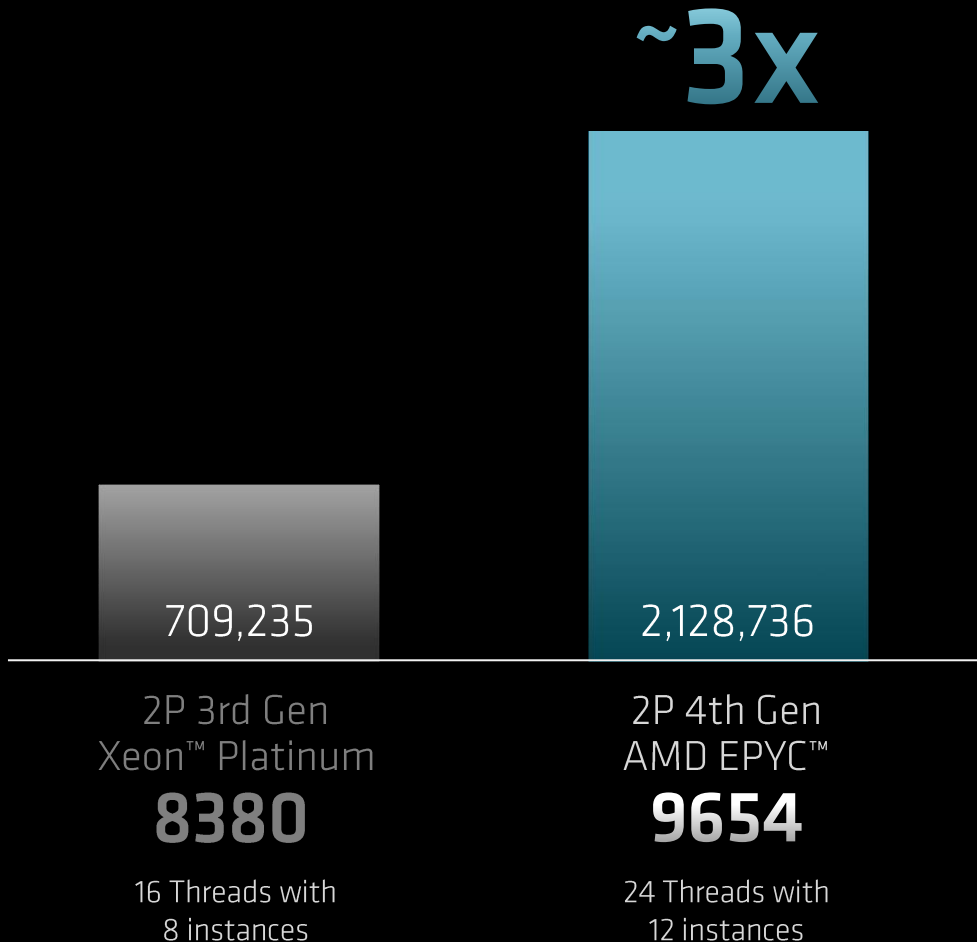
Advancing Enterprise Business Apps



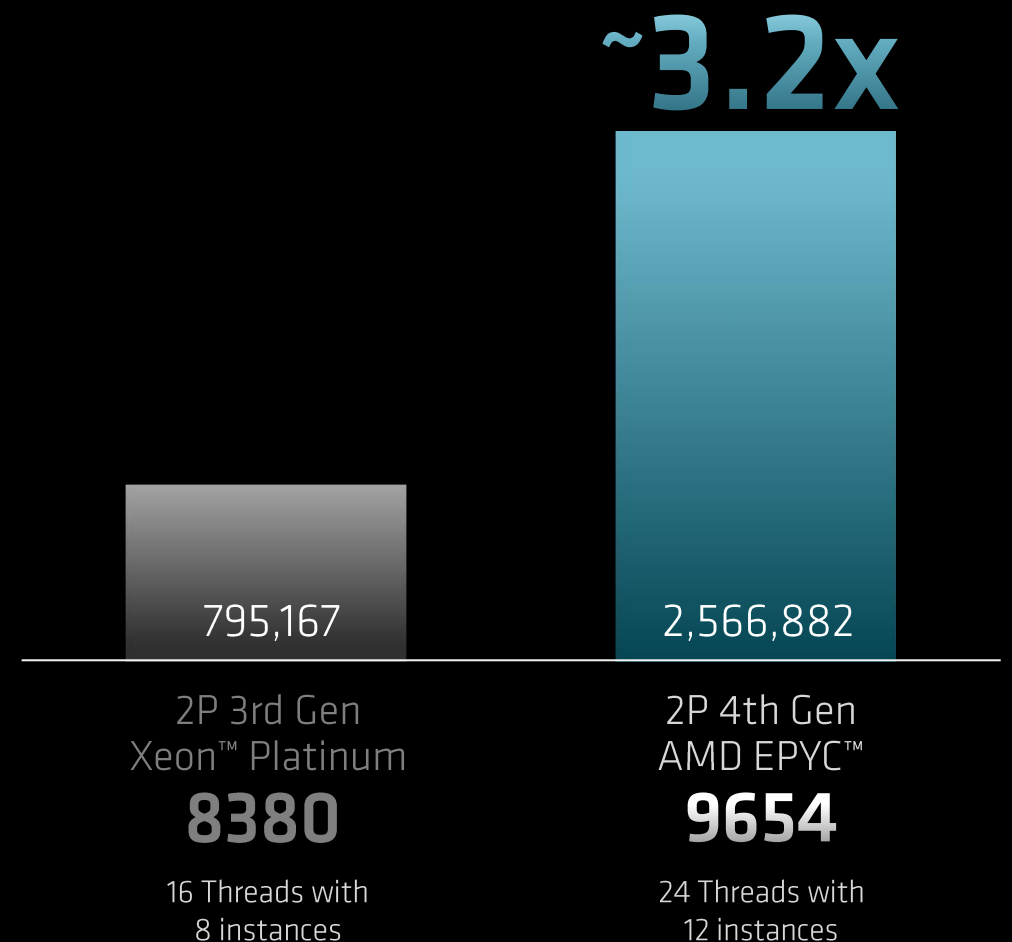
2P Enterprise Resource Planning (ERP/ERM/SCM)
SAP® SALES AND DISTRIBUTION 2-TIER - SAP ASE 16 DATABASE

Top Key-Value Database Performance

SET REQUESTS/SECOND USING REDIS® BENCHMARK



GET REQUESTS/SECOND USING REDIS® BENCHMARK

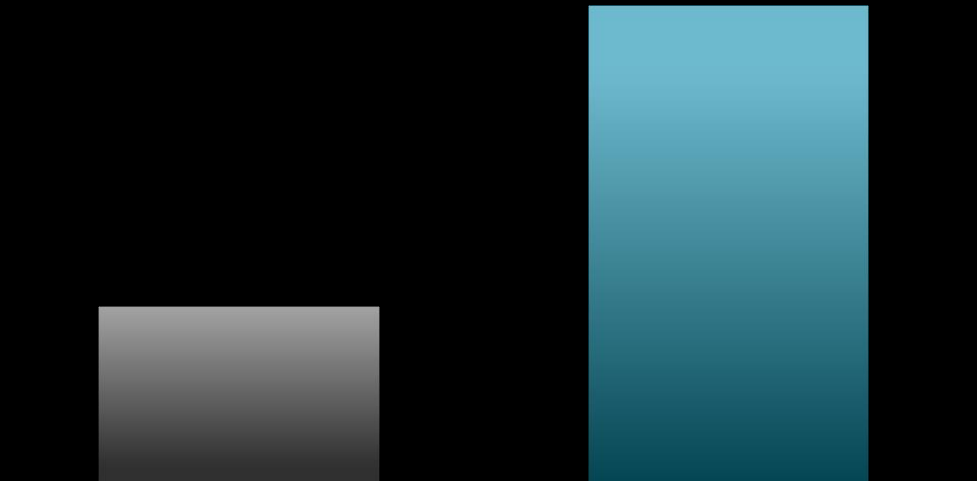


Faster Business Insights

DECISION SUPPORT WORKLOAD DERIVED FROM
TPC BENCHMARK™ H WITH MYSQL™

~2.7x

Decision support queries



2P 3rd Gen
Xeon™ Platinum

8380

10 Containers of
8 cores each

2P 4th Gen
AMD EPYC™

9654

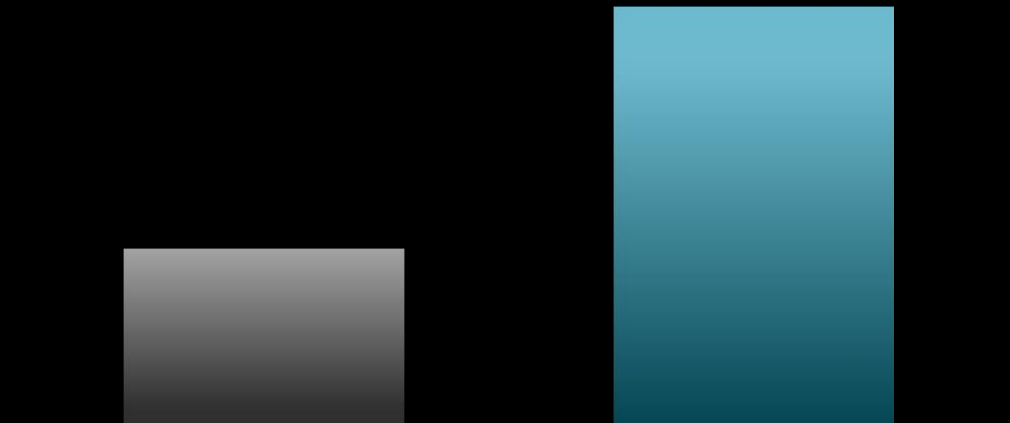
24 Containers of
8 cores each

More Customer Transactions

TRANSACTION PROCESSING WORKLOAD DERIVED FROM
TPC BENCHMARK™ C WITH MYSQL™

~2.4x

Online business transactions



2P 3rd Gen
Xeon™ Platinum

8380

10 Containers of
8 cores each

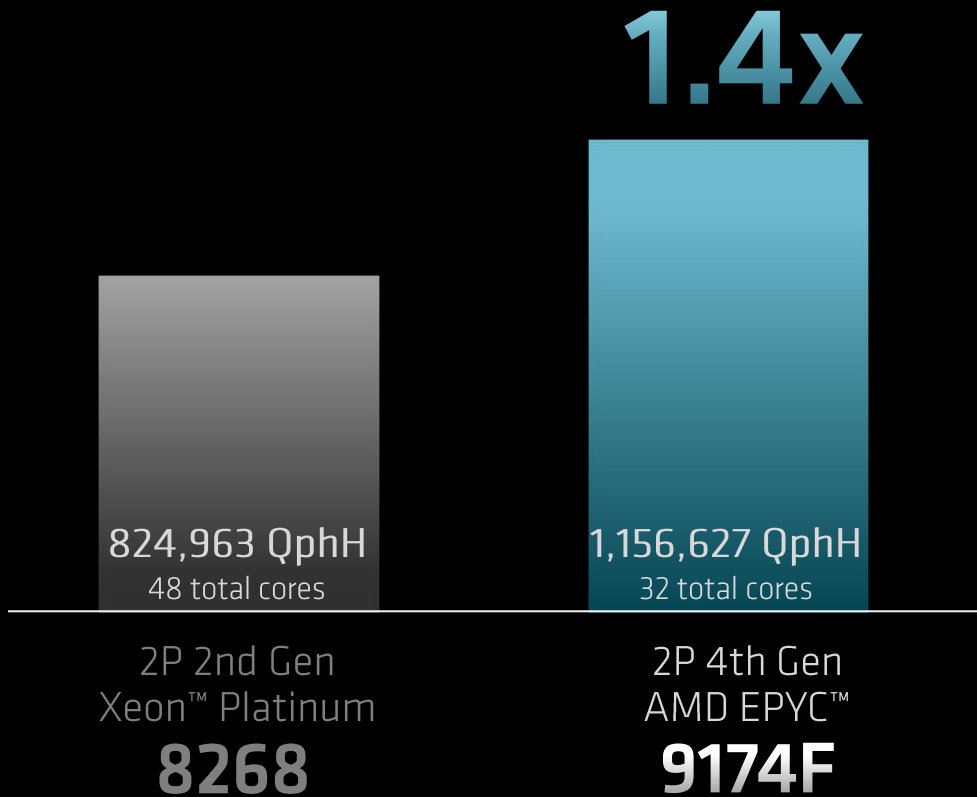
2P 4th Gen
AMD EPYC™

9654

24 Containers of
8 cores each

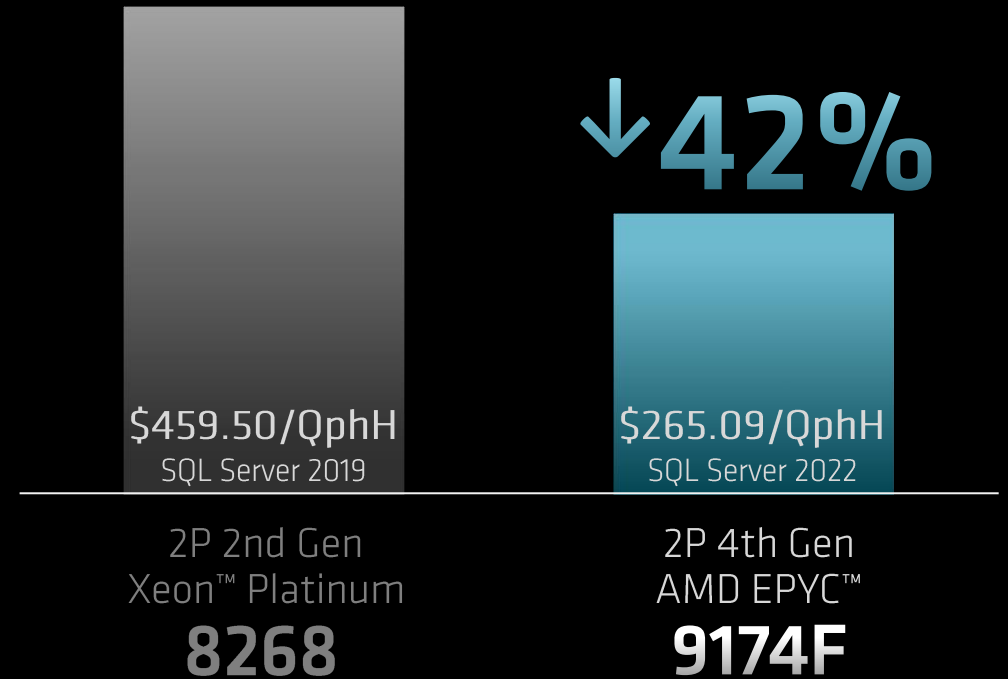
Advancing Business Insights

DECISION SUPPORT TPC BENCHMARK™ H @ 1000GB SF
WITH SQL SERVER® 2022
(higher is better)



At 42% Lower Cost per Query

PRICE/TPC BENCHMARK™ H @ 1000GB SF
WITH SQL SERVER® 2022
(lower is better)

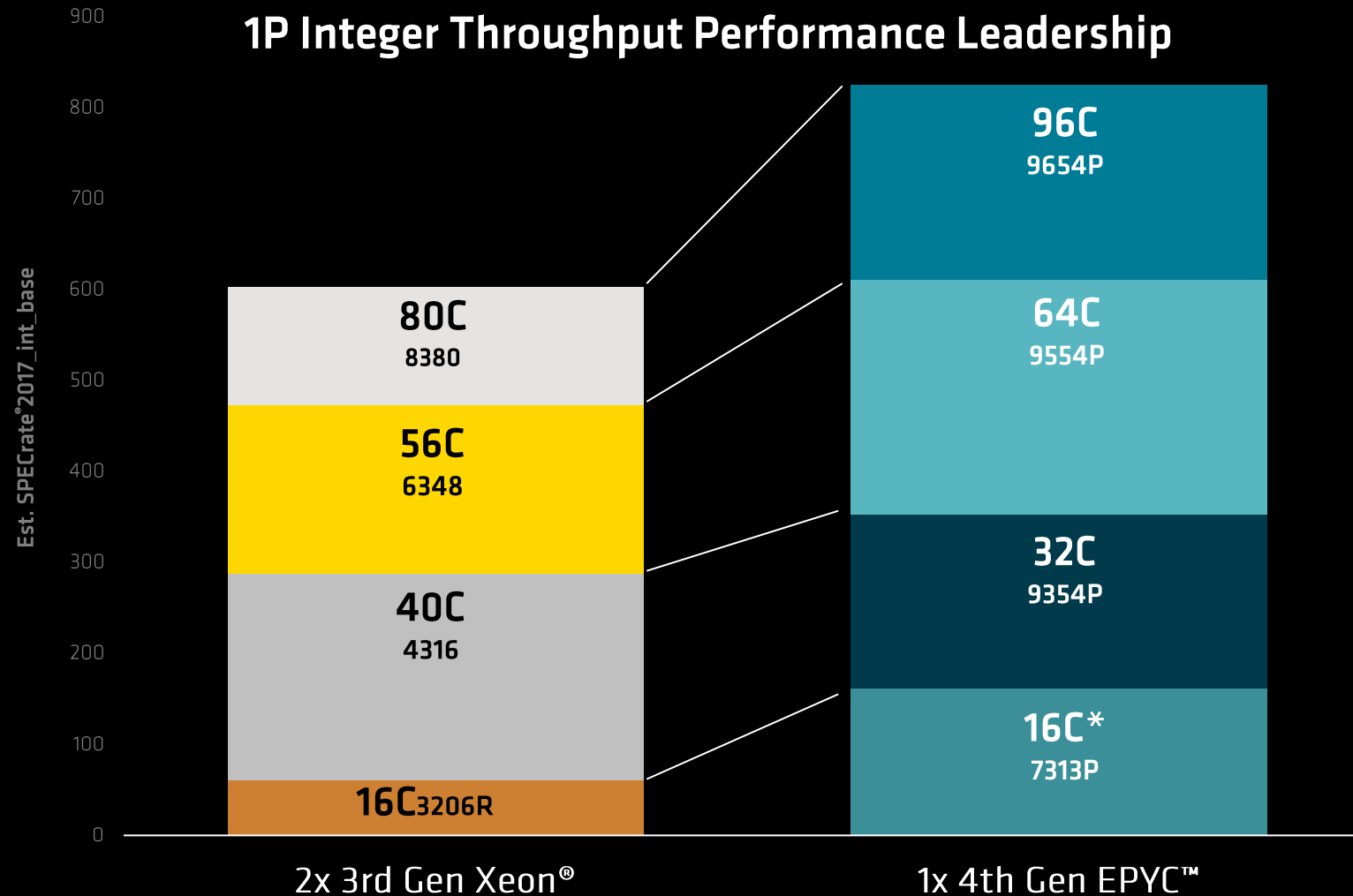




DUAL-SOCKET TO NO COMPROMISE, SINGLE-SOCKET

ADVANCING ONE-SOCKET LEADERSHIP

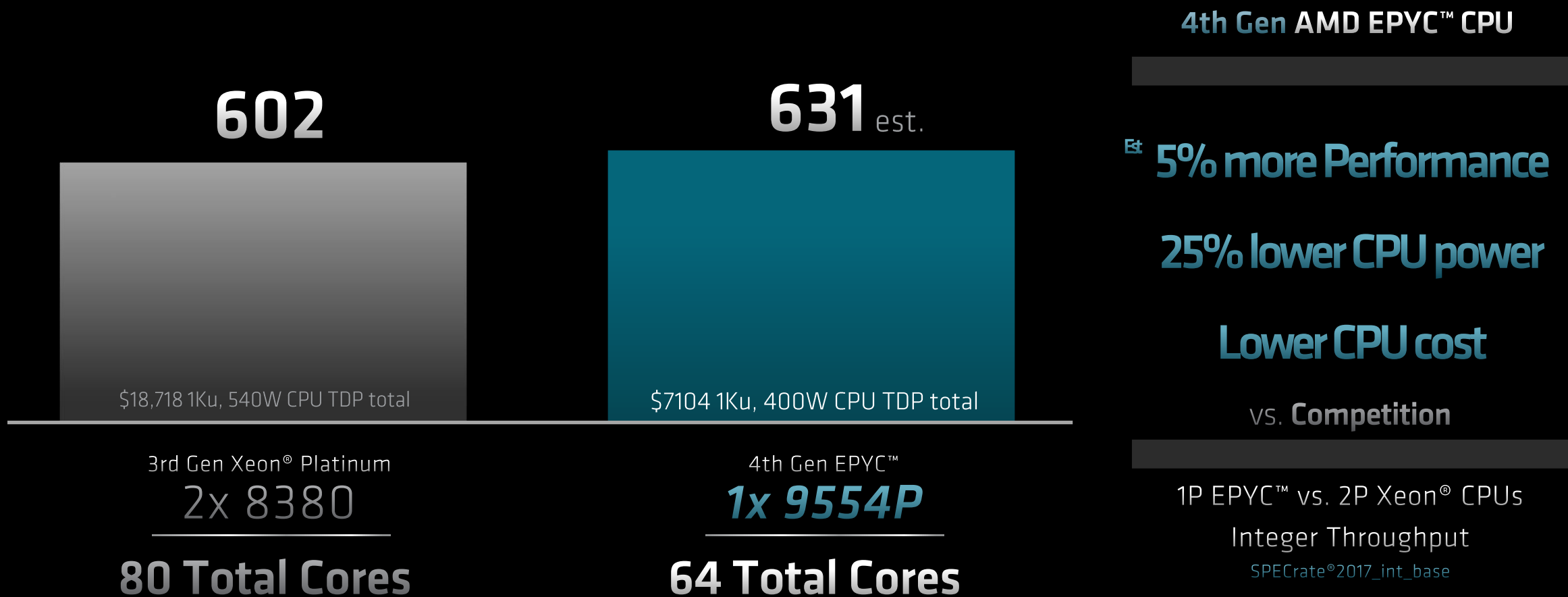
1P EPYC™ CPUS > 2P XEON® PERFORMANCE AT EACH “METAL-LEVEL”

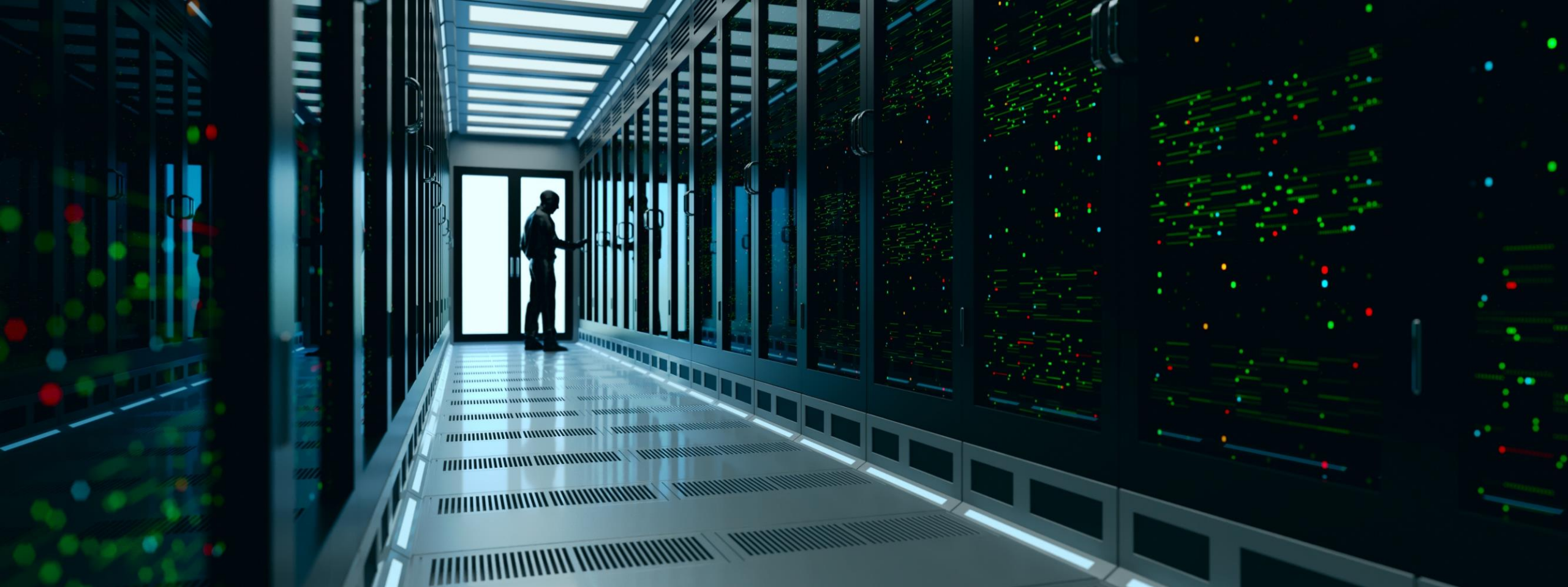


* 3rd Gen EPYC 7313P as 4th Gen EPYC does not have a 16C “P” model and 2nd Gen Xeon 3206R added as 3rd Gen Xeon does not have an 8C model. Results may vary. As of 11/10/2022, see endnote SP5-081.

No Compromise, Single-Socket Leadership

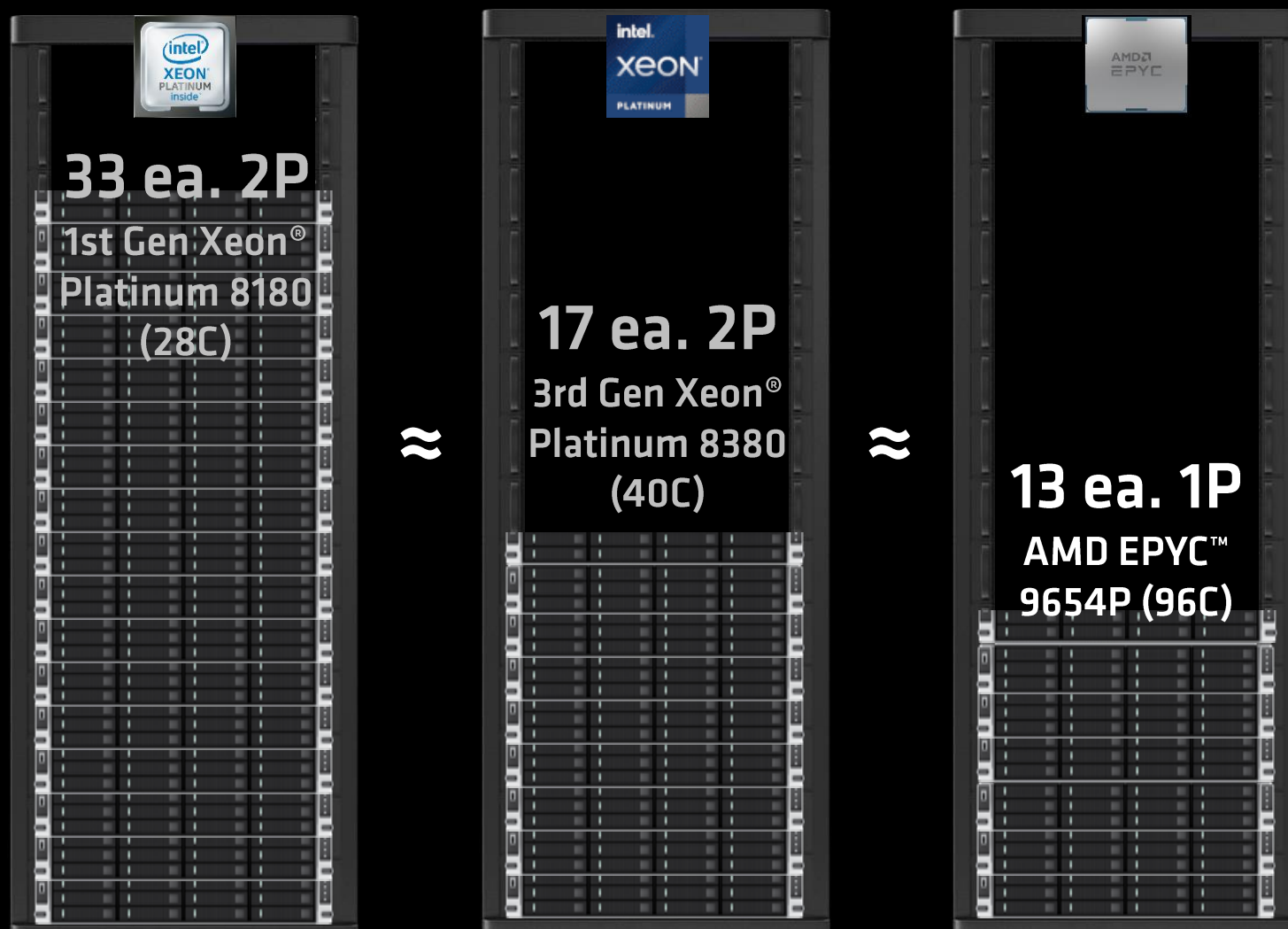
1P 64C EPYC™ VS. 2P 40C XEON® 8380 INTEGER THROUGHPUT PERFORMANCE





RACK LEVEL / TCO COMPARISONS

ADVANCING REFRESH WITH FEWER 1P SERVERS



Servers needed >10,000 total SPECrate® 2017_int_base score

Is it time to upgrade old 28C
1st Gen Xeon® Platinum 8180
("Skylake-SP") servers?

For comparable performance*:

- Buy 17x 40C 2P 3rd Gen Xeon Platinum 8380-based servers

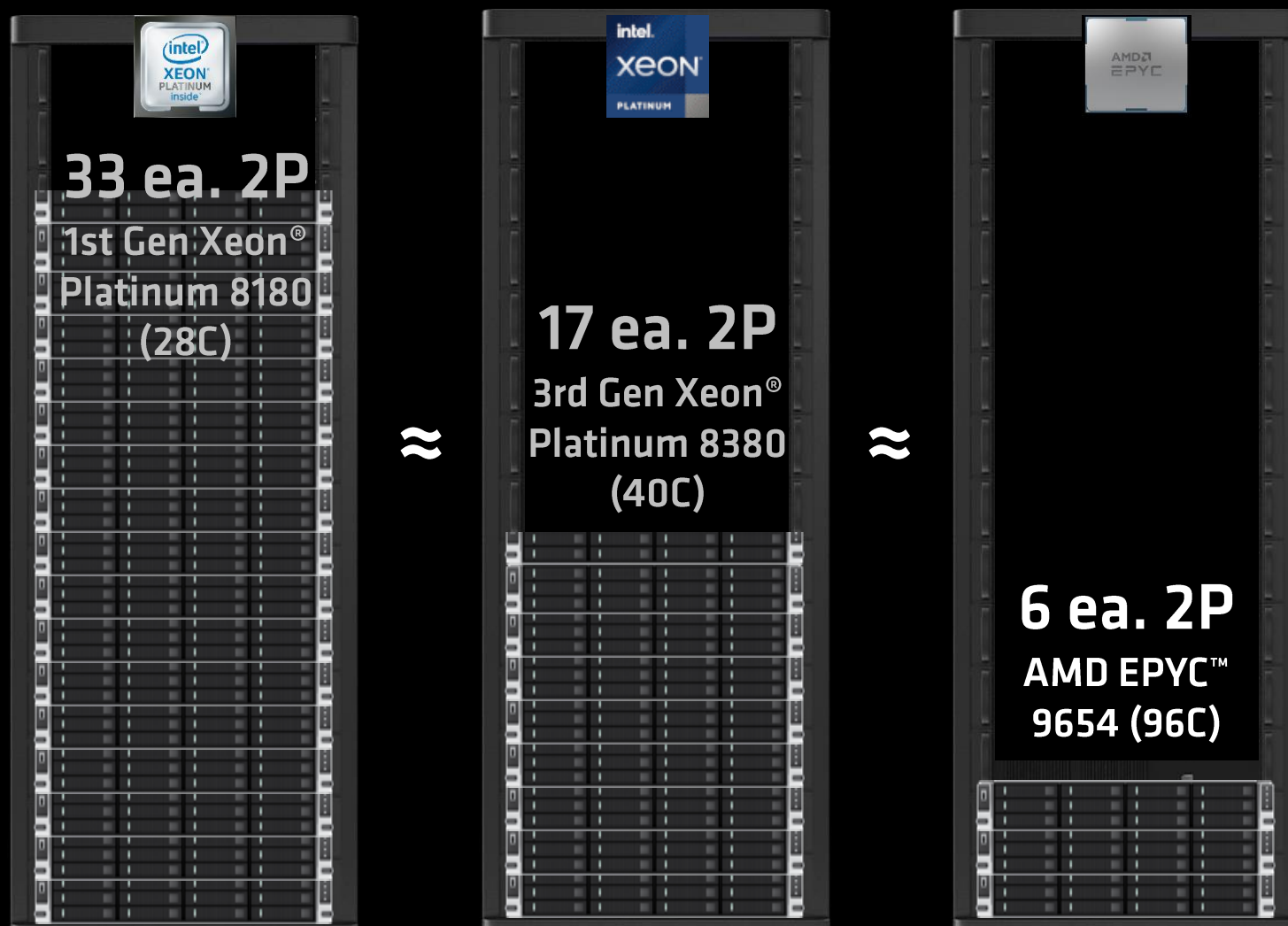
OR

- Buy only 13x 1P 96C 4th Gen EPYC™ 9654P-based servers

Additional potential benefits:

- Lower OpEx power/cooling & admin costs
- Rack room for new revenue opportunities

ADVANCING REFRESH WITH FEWER 2P SERVERS



Servers needed >10,000 total SPECrate® 2017_int_base score

Is it time to upgrade old 28C
1st Gen Xeon® Platinum 8180
("Skylake-SP") servers?

For comparable performance*:

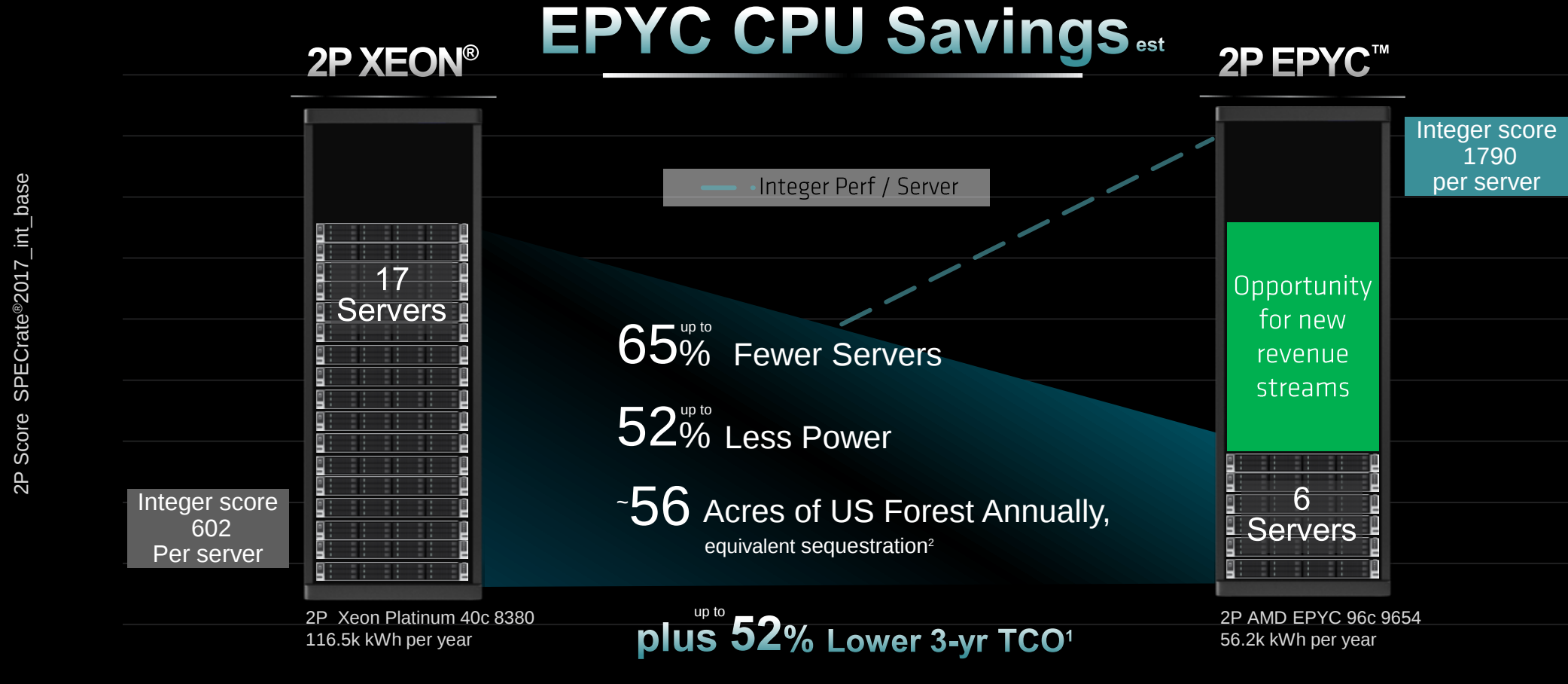
- Buy 17x 40C 2P 3rd Gen Xeon Platinum 8380-based servers
- OR
- Buy only 6x 96C 4th Gen EPYC™ 9654-based servers

Additional potential benefits:

- Lower OpEx power/cooling & admin costs
- Rack room for new revenue opportunities

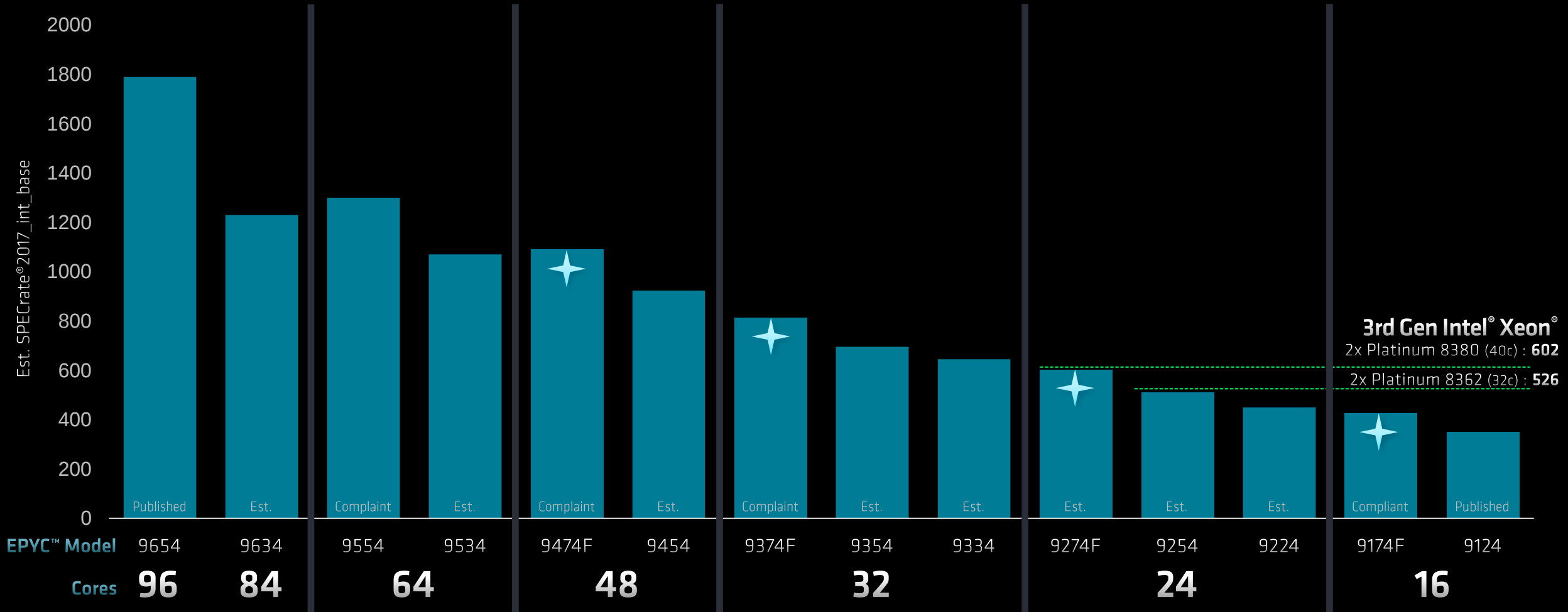
FEWER SERVERS, LESS POWER → LOWER EMISSIONS

10,000 SPECrate®2017_int_base TOTAL



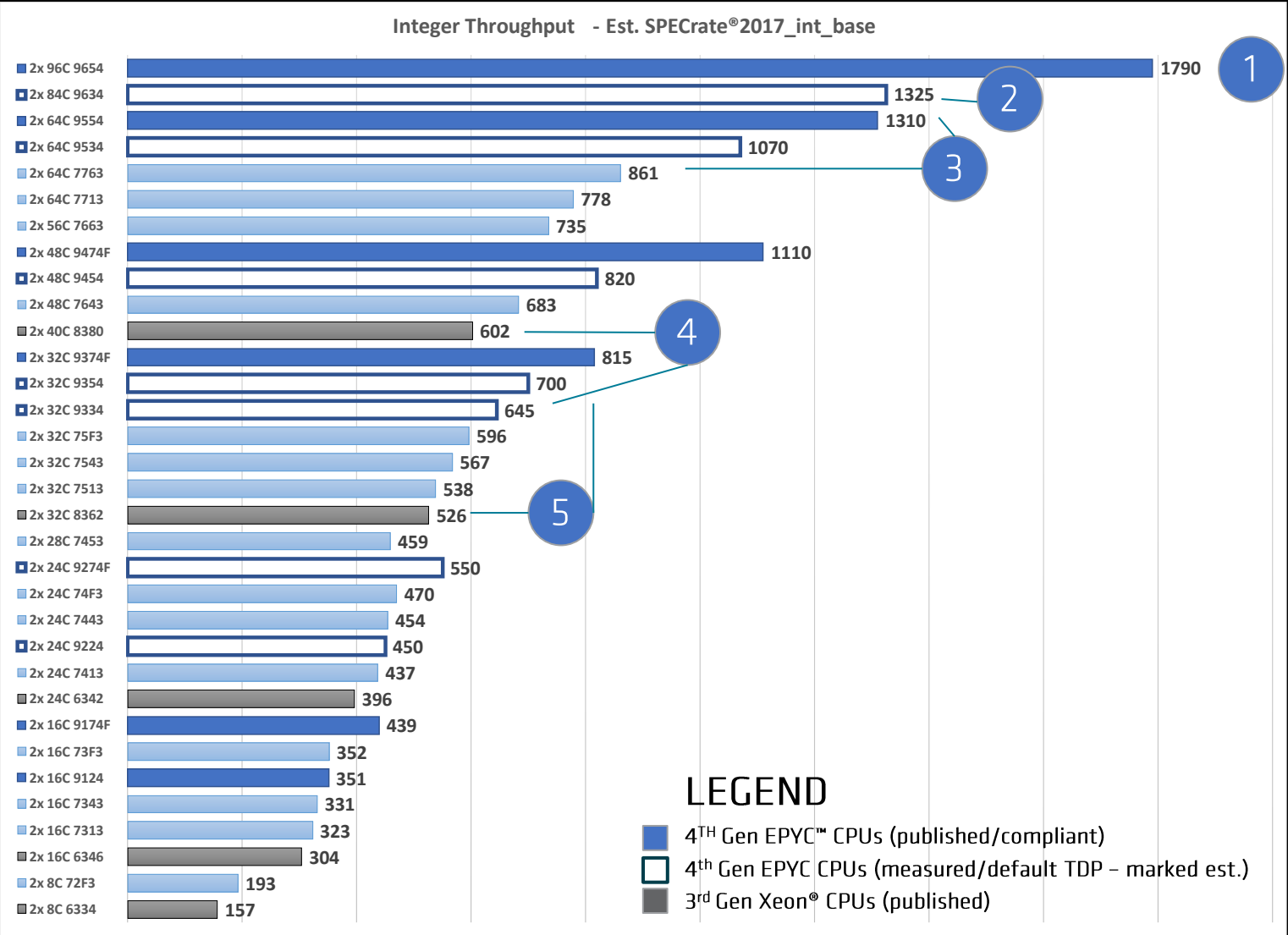
AMD EPYC™ 9004 SERIES

GENERAL PURPOSE COMPUTING PERFORMANCE SUMMARY



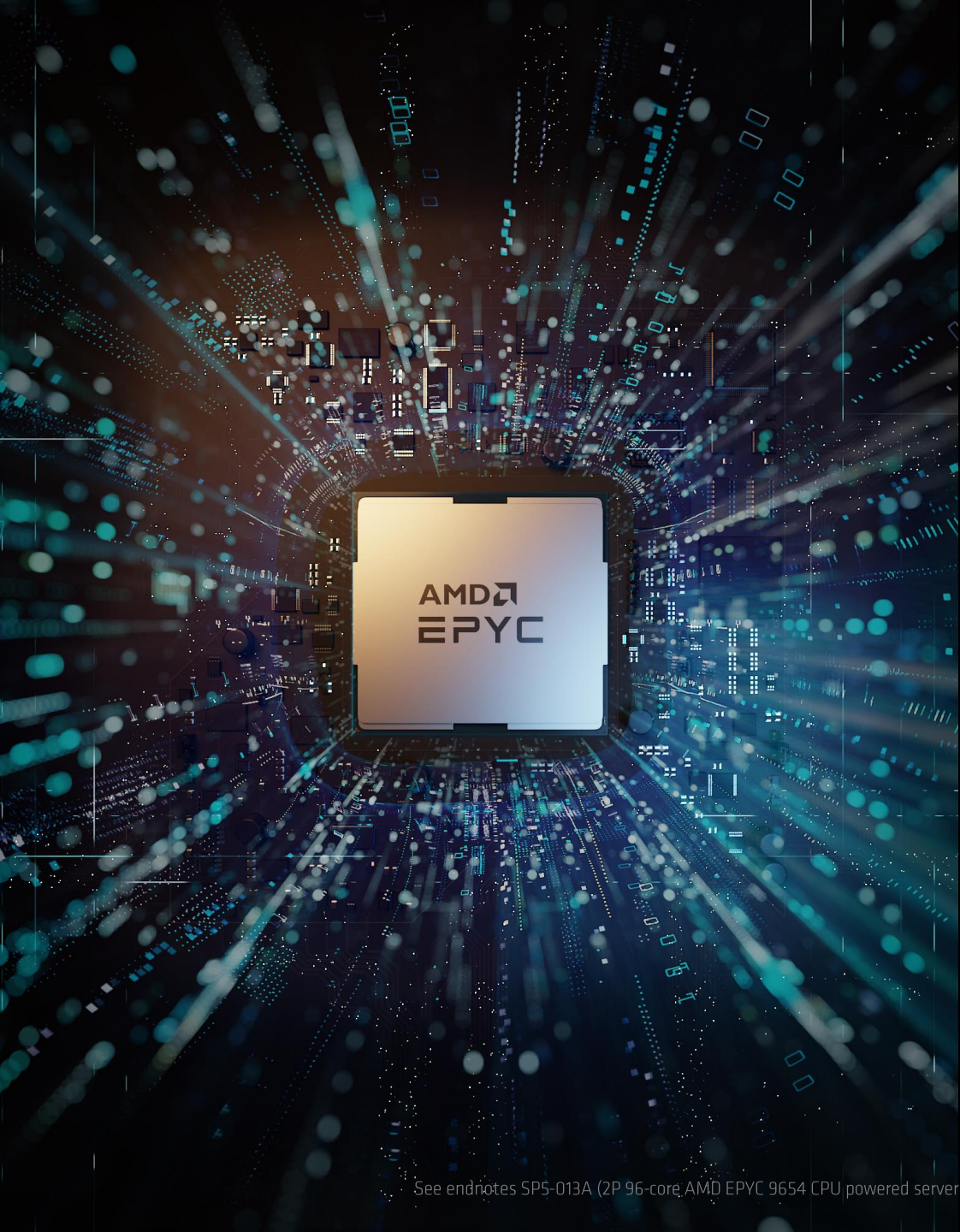
*F = Performance / Core Optimized. 2x 4TH Gen AMD EPYC™ CPU estimates, complaint runs or published results and top performing 2x Intel Xeon Platinum processors results published at www.spec.org as of 11/10/22.
3rd Gen Intel Xeon URLs: 2x Xeon Platinum 8380 and Platinum 8362.

AMD EPYC™ 9004 Series Integer Throughput Performance



Five key takeaways

- 1 96C outshines for densest x86 industry option
- 2 84C expected to be a great performance/W option
- 3 64C 9554 outperforms 7763 by 52%
- 4 4th Gen 32C CPUs are/ expected > 40C Xeon 8380
- 5 All 32C 3rd/4th Gen EPYC CPUs > 32C Xeon 8362



Delivering What Customers Are Asking

World's highest performance data center CPU

Outstanding TCO across workloads and industries

Transformative energy efficiency to support sustainability goals

Assurance of confidential computing

Rich ecosystem of solutions

See endnotes SP5-013A (2P 96-core AMD EPYC 9654 CPU powered server is higher than all other 2P SPECrate®2017_int_Base scores published on www.spec.org/cpu2017 as of 11/10/2022) and SP5-072.

Additional Resources

- Blog: <https://community.amd.com/t5/corporate/amd-ecosystem-poised-and-ready-for-the-4th-gen-amd-epyc/ba-p/556860>
- Technical Briefs: https://www.amd.com/en/processors/server-tech-docs/search?f%5B0%5D=product_type%3Aepyc_9004&f%5B1%5D=server_document_category%3A19736
- Performance World Records: amd.com/worldrecords
- Tuning Guides: https://www.amd.com/en/processors/tuning-guides-server?f%5B0%5D=product_type%3Aepyc_9004&f%5B1%5D=server_document_category%3A14321&f%5B2%5D=server_document_category%3A18706
- Developer Tools: <https://developer.amd.com/amd-aocc/> & <https://developer.amd.com/amd-aocl/>



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ENDNOTES

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. AMD EPYC 9004 CPUs have 2.25x the memory throughput per CPU. $460.8 \div 204.8 = 2.25x$ the max throughput or 125% more max throughput.

EPYC-034A: AMD EPYC 9004 CPUs can support 12 memory channels with 2 DPC (DIMMs / channel) $12 \times 2 = 24$ DIMM slots $\times$ 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 $\times$ 2 DPC = 16 total DIMM slots $\times$ 256GB DIMMs = 4,096GB of DRAM (DDR) memory, or 4TB per CPU. AMD EPYC 9004 Series supports 50% more DRAM than Intel Ice Lake CPUs.

EPYC-038: 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.

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.

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.

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.

SP5-013A: 96-core AMD 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 9174F CPU processors results as of 08/31/2022 using SPECrate®2017_int_base. The 2P AMD EPYC 9174F powered reference server scored ~418 or ~13.06/core (measured on AMD internal reference platform and marked estimate per SPEC Fair Use) which is higher than all other 2P scores published on the SPEC® website. Sources: SPEC.org/ CPU2017 <https://spec.org/cgi-bin/osgresults?conf=rint2017&op=form9174F> - <https://devhub.amd.com/download/amd-socket-sp5-power-and-performance-optimization-guide-for-family-19h-models-10h-1fh-nda/> p. TBD. OEM published scores will vary based on system configuration and determinism mode used (default performance profile).

SP5-015A: SPECrate®2017_int_base comparison is based on a compliant 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 Supermicro A+ Server AS-2125HS-TNR, 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. NOTE: Red text only needs to be included with charts that show the 2P EPYC 7643

SP5-016A: SPECrate®2017_int_base comparison is based on a compliant 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 Supermicro A+ Server AS-2125HS-TNR, 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. NOTE: Red text only needs to be included with charts that show the 2P EPYC 75F3

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SP5-018A: SPECrate®2017_int_base comparison based on a compliant 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 Supermicro A+ Server AS-2125HS-TNR, 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. NOTE: Red text only needs to be included with charts that show the 2P EPYC 73F3

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, <http://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.

SP5-023A: SPECrate®2017_int_base (est. where not compliant or published) comparison based on 2P AMD EPYC processors and select core count, top scoring Intel Xeon Scalable processors as of 11/10/22. URLs: [9654](#), [7773X](#), [7763](#), [7713](#), [7663](#), [7643](#), [8380](#), [75F3](#), [7543](#), [7513](#), [8362](#), [7453](#), [74F3](#), [7443](#), [7413](#), [6342](#), [73F3](#), [9124](#), [7343](#), [7313](#), [6346](#), [72F3](#), and [6334](#). 2P EPYC 9554, 9474F, 9374F, and 9174F scores based on compliant runs using a Supermicro A+ Server AS-2125HS-TNR, 1536 GB - 24x 64 GB 2Rx4 PC5-4800B-R, SUSE Linux Enterprise Server 15 SP4, AOCC 4.0. 2P EPYC 9634, 9534, 9454, 9354, 9334, 9274F, 9254, and 9224 are based on AMD internal measurements (marked as estimates). SPEC® 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 for AMD estimates & power determinism cTDP=400W for compliant results).

SP5-028A: SPECrate®2017_fp_base comparison based on a compliant 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 Supermicro A+ Server AS-2125HS-TNR, 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 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 Supermicro A+ Server AS-2125HS-TNR, 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.

SP5-030: Oracle 19c DSS comparison base on AMD measured scores on 2P 16-core EPYC 9174F compared to 2P 16-core EPYC 73F3 running HammerDB TPROC-H as of 9/29/2022. Configurations: 2x AMD EPYC 73F3 (535246 avg TPROC-H @ 1000SF) vs. 2x AMD EPYC 9174F (690226 avg TPROC-H @ 1000SF) for ~1.3x the performance. Results may vary.

SP5-040: SQL Server® DSS workload comparison based on internal AMD reference platform measurements as of 9/27/2022. Comparison of 1P EPYC 9654 (1777 avg throughput) is ~1.5x the query throughput scores of 1P EPYC 7763 (1190 avg throughput). Results may vary.

SP5-041A: SPECrate®2017_int_base based on published scores from www.spec.org as of 11/10/2022. Comparison of published 2P AMD EPYC 9654 (1790 SPECrate®2017_int_base, 800 Total TDP W, 192 Total Cores, \$23610 Total CPU \$, <http://spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32607.html>) is 5.74x the performance of published 2P Intel Xeon Platinum 8180 (312 SPECrate®2017_int_base, 410 Total TDP W, 56 Total Cores, \$20018 Total CPU \$, <http://spec.org/cpu2017/results/res2019q2/cpu2017-20190429-13037.html>) [at 2.94x the performance/W] [at 4.86x the performance/CPU\$]. 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>) is shown for reference. 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.

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SP5-049A: 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/2022-11-10-HPE-ProLiant-DL385-Gen11_2-Hosts.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.

SP5-056: SAP® SD 2-tier comparison based on published results as of 11/10/2022. Configurations: 2P 96-core EPYC 9654 powered server (148,000 benchmark users, <https://www.sap.com/dmc/benchmark/2022/Cert22029.pdf>) versus 2P 40-core Xeon Platinum 8380 (48,000, <https://www.sap.com/dmc/benchmark/2021/Cert21026.pdf>) for 3.08x the number of SAP SD benchmark users. 2P EPYC 7763 powered server (75,000 benchmark users, <https://www.sap.com/dmc/benchmark/2021/Cert21021.pdf>) shown at 1.79x the performance for reference. For more details see <http://www.sap.com/benchmark>. SAP and SAP logo are the trademarks or registered trademarks of SAP SE (or an SAP affiliate company) in Germany and in several 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. SPEC® 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.

SP5-067: 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.

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.

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SP5-078: Redis-Benchmark comparison based on AMD measured median scores on 2P 96-core EPYC 9654 compared to 2P 40-core Xeon Platinum 8380 running Redis-Benchmark workload on Redis 6.0 as of 11/10/2022. Configurations: 2P AMD EPYC 9654 (2128736 set rps/2566882 get rps using 24 threads/12 instances) vs. 2P Xeon Platinum 8380 (709235 set rps/795167 get rps using 16 threads/8 instances) for ~3x the set and ~3.2x the get rps performance. 2P EPYC 7763 (1393626 set rps/1728928 get rps using 24 threads/8 instances) shown at ~1.96x the set rps and ~2.17x get rps the performance for reference. Results may vary.

SP5-072: A 4th Gen EPYC 9654 powered server has highest overall scores in key industry-recognized energy efficiency benchmarks SPECpower_ssj®2008, SPECrate®2017_int_energy_base and SPECrate®2017_fp_energy_base. EPYCWR-392: 2P AMD EPYC 9654 (1950 SPECrate®2017_fp_energy_base/899 SPECrate®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32630.html) has the best overall SPECrate®2017_fp_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-394: 2P AMD EPYC 9654 (1950 SPECrate®2017_fp_energy_base/899 SPECrate®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32630.html) has the best 2P SPECrate®2017_fp_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-395: 2P AMD EPYC 9654 (2010 SPECrate®2017_fp_energy_base/1000 SPECrate®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32634.html) has the best overall SPECrate®2017_fp_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-397: 2P AMD EPYC 9654 (2010 SPECrate®2017_fp_energy_base/1000 SPECrate®2017_fp_peak/954 SPECrate®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32634.html) has the best 2P SPECrate®2017_fp_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-407: 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) has the best overall SPECrate®2017_int_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-409: 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) has the best 2P score on www.spec.org as of 11/10/2022. EPYCWR-410: 2P AMD EPYC 9654 (1990 SPECrate®2017_int_energy_base/1280 SPECrate®2017_int_peak/1190 SPECrate®2017_int_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32633.html) has the best 2P SPECrate®2017_int_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-420: 2P AMD EPYC 9654 (688 SPECspeed®2017_fp_energy_base/317 SPECspeed®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32632.html) has the best 2P SPECspeed®2017_fp_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-423: 2P AMD EPYC 9654 (718 SPECspeed®2017_fp_energy_base/681 SPECspeed®2017_fp_base, 192 total cores, www.spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32631.html) has the best 2P SPECspeed®2017_fp_energy_base score on www.spec.org as of 11/10/2022. EPYCWR-509: 2P AMD EPYC 9654 (27501 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01194.html) has the best overall ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-510: 2P AMD EPYC 9654 (25333 overall ssj_ops/W, 1U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01186.html) has the best 1U ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-511: 2P AMD EPYC 9654 (27501 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01194.html) has the best 2U ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-514: 1P AMD EPYC 9654P (23299 overall ssj_ops/W, 1U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01188.html) has the best 1 CPU 1U Linux ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-515: 1P AMD EPYC 9654P (25537 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01187.html) has the best 1 CPU 2U Linux ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-517: 1P AMD EPYC 9654P (22178 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01191.html) has the best 1 CPU 2U Windows ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-520: 2P AMD EPYC 9654 (25333 overall ssj_ops/W, 1U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01186.html) has the best 2 CPU 1U Linux I ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-521: 2P AMD EPYC 9654 (27118 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01193.html) has the best 2 CPU 2U Linux ssj_ops/W score on www.spec.org as of 11/10/2022. EPYCWR-523: 2P AMD EPYC 9654 (27501 overall ssj_ops/W, 2U, http://www.spec.org/power_ssj2008/results/res2022q4/power_ssj2008-20221020-01194.html) has the best 2 CPU 2U Windows ssj_ops/W score on www.spec.org as of 11/10/2022."

SP5-081: SPECrate®2017_int_base comparison based on published scores from www.spec.org and AMD estimates as of 11/10/2022. Comparison of published 2P Intel Xeon Bronze 3206R (61 SPECrate®2017_int_base, 170 Total TDP W, 16 Total Cores, \$654 Total CPU \$, <http://spec.org/cpu2017/results/res2020q4/cpu2017-20200925-24017.html>), published 2P Intel Xeon Silver 4316 (288 SPECrate®2017_int_base, 300 Total TDP W, 40 Total Cores, \$2252 Total CPU \$, <http://spec.org/cpu2017/results/res2022q1/cpu2017-20220114-30769.html>), published 2P Intel Xeon Gold 6348 (473 SPECrate®2017_int_base, 470 Total TDP W, 56 Total Cores, \$7166 Total CPU \$, <http://spec.org/cpu2017/results/res2022q4/cpu2017-20221007-32530.html>), and 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>) compared to published 1P AMD EPYC 7313P (162 SPECrate®2017_int_base, 155 Total TDP W, 16 Total Cores, \$913 Total CPU \$, <http://spec.org/cpu2017/results/res2022q1/cpu2017-20211220-30553.html>), estimated 1P AMD EPYC 9354P (354 SPECrate®2017_int_base, 260 Total TDP W, 32 Total Cores, \$2730 Total CPU \$, AMD est), estimated 1P AMD EPYC 9554P (656 SPECrate®2017_int_base, 400 Total TDP W, 64 Total Cores, \$7104 Total CPU \$, AMD est), and published 1P AMD EPYC 9654P (825 SPECrate®2017_int_base, 400 Total TDP W, 96 Total Cores, \$10625 Total CPU \$, <http://spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32608.html>). AMD 1Ku pricing and Intel ARK.intel.com specifications and pricing as of 11/10/22. SPEC®, SPEC CPU®, and SPECrate® are registered trademarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

SP5-089: TPC Benchmark™ H @ 1000GB SF comparison based on published scores at tpc.org as of 11/10/2022. Configuration: 2P EPYC 9174F (1,156,627 QphH@1000GB, \$265.09/QphH@1000GB, avail 12/05/22, 32 total cores, tpc.org/3386) is 1.4x the QphH performance and 42% lower price/QphH versus 2P Xeon Platinum 8268 (824,693 QphH@1000GB, \$459.50/QphH@1000GB, avail 3/03/21, 48 total cores, tpc.org/3369). TPC, TPC Benchmark and TPC-H are trademarks of the Transaction Processing Performance Council.

ENDNOTES

SP5-090: SPECrate®2017_int_base based on published scores from www.spec.org as of 11/10/2022. Comparison of published 2P Intel Xeon Platinum 8180 (312 SPECrate®2017_int_base, 410 Total TDP W, 56 Total Cores, \$20018 Total CPU \$, <http://spec.org/cpu2017/results/res2019q2/cpu2017-20190429-13037.html>), 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>), and published 1P AMD EPYC 9654P (825 SPECrate®2017_int_base, 400 Total TDP W, 96 Total Cores, \$10625 Total CPU \$, <http://spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32608.html>). 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.

SP5TCO-002B: 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 10000 units of integer performance based on the published scores for Intel Xeon and AMD EPYC CPU based servers. This estimation reflects a 3-year time frame. This analysis compares a 2P AMD 96 core EPYC 9654 CPU powered server with a SPECrate®2017_int_base a score of 1790, <https://spec.org/cpu2017/results/res2022q4/cpu2017-20221024-32607.pdf>; 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-019A: As of 11/15/2022 based on AMD Internal analysis using the AMD EPYC™ Bare Metal Server & Greenhouse Gas Emission TCO Estimation Tool - version 6.40, 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. 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-019A>.

EPYC™ 9004 “Genoa” - Transition Recommendations (simplified)

Standard Roadmap	EPYC 7003 “Milan”	Core count	TDP	EPYC 9004 “Genoa”	Core count	Default TDP
				9654	96c	360w
				9634	84c	290w
	7763	64c	280w	9554	64c	320w
	7713	64c	225w	9534	64c	280w
	7663	56c	240w			
	7643	48c	225w	9454	48c	290w
	7543	32c	225w	9354	32c	260w
	7513	32c	200w	9334	32c	210w
	7453	28c	225w	7453	28c	225w
				9254	24c	200w
	7443	24c	200w			
				9224	24c	200w
	7413	24c	180w			
	7343	16c	190w	9124	16c	200w
	7313	16c	155w			

1P	EPYC 7003 “Milan”	Core count	TDP	EPYC 9004 “Genoa”	Core count	Default TDP
	7713P	64c	225w	9654P	96c	360w
				9554P	64c	320w
	7643	48c	225w	9454P	48c	290w
	7543P	32c	225w	9354P	32c	260w
	7443P	24c	200w	7443P	24c	200w
	7313P	16c	155w	7313P	16c	155w

HF	EPYC 7003 “Milan”	Core Count	TDP	EPYC 9004 “Genoa”	Core count	Default TDP
	75F3	32c	280w	9474F	48c	360w
				9374F	32c	320w
	74F3	24c	240w	9274F	24c	320w
	73F3	16c	240w	9174F	16c	320w
	72F3	8c	180w	72F3	8c	180w