MAXIMIZING SIEMENS® CALIBRE® NMDRC PERFORMANCE WITH AMD EPYC™ 7XF3 PROCESSORS

SIGN-OFF DESIGN RULE CHECKING

The 3rd Gen AMD EPYC™ 75F3, 74F3, AND 73F3 processors demonstrate superior performance compared to 2nd Gen AMD EPYC 7F72 and 7F52 processors running Siemens® Calibre® nmDRC.

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AMD EPYC™ PROCESSORS

Designed with leading-edge 7nm technology, 2nd and 3rd Gen AMD EPYC™ SoCs offer a consistent set of features across a range of choices from 8 to 64 cores, including 128 lanes of PCIe® Gen 4 and 8 memory channels with access to up to 4TB of high-speed memory. The balanced set of resources found in EPYC processors means more freedom to match the right size of server configuration to each workload.

GEN	MODEL	CORES	BASE FREQ (GHZ)	BOOST FREQ (GHZ)[1]	L3 CACHE (MB)
2nd	7F52	16	3.5 GHx	~3.9 GHz	256
2nd	7F72	24	3.2 GHz	~3.7 GHz	192
3rd	73F3	16	3.5 GHz	~4.0 GHz	256
3rd	74F3	24	3.2 GHz	~4.0 GHz	256
3rd	75F3	32	2.95 GHz	~4.0 GHz	256

Table 1: Sample 2nd Gen and 3rd Gen AMD EPYC™ processor configurations used in these tests

AMD has released three generations of EPYC processors (7xx1, 7xx2, and 7xx3). Both AMD EPYC 2nd Gen 7Fx2 and 3rd Gen 7xF3 processors bring high per-core performance optimized for frequency sensitive and single threaded workloads. The rich portfolio of EPYC high-core-density products can vastly boost the run time performance of applications in the modern data center.

STANDARDS BASED

AMD is committed to industry standards, offering you a choice in x86 architecture. x86 compatibility means you can run x86 based applications on any AMD EPYC processor generation.

"ZEN 3" CORE & SECURITY FEATURES

Support for up to:

- 64 physical cores, 128 threads
- 256MB of L3 cache per CPU
- 32 MB of L3 cache per core
- 4 TB of DDR4-3200 memory
- 128-160 PCIe® Gen 4 lanes

Infinity Guard security features[2]

- Secure Boot
- Encrypted memory with SME

SIEMENS® EDA

Siemens EDA is the electronics division of Siemens Digital Industries Software charged with helping companies deliver IC innovations and accelerate digital transformation. Siemens EDA delivers a comprehensive portfolio of electronic design automation (EDA) software, hardware, and services to enable their customers to deliver innovations faster.

SIEMENS® CALIBRE® NMDRC

Siemens® Calibre® nmDRC is the internal sign-off DRC solution for all major foundries, thanks to both continuous functionality innovation and industry-leading performance and capacity. Foundries use this technology for process definition, resulting in rule files and rule decks that define process requirements and set the benchmark for other companies' DRC tool qualifications.

SIEMENS® CALIBRE® NMDRC

The Siements® Calibre® nmDRC platform[3] reduces cycle time via innovative capabilities that differentiate the Calibre nmDRC technology from traditional DRC tools. All major foundries use Calibre nmDRC technology internally by for process definition, resulting in rule files and rule decks that define process requirements and set the benchmark for other companies' DRC tool qualifications. Calibre nmDRC platform has served as their internal sign-off DRC solution for over 25 years because of its continuous functionality innovation to meet complex rule needs, industry-leading performance, and capacity

Calibre nmDRC is continually evolving to meet the demands of shrinking geometries and complex manufacturing methodologies. Designers who need new ways to assess the quality of their designs in light of more complex process constraints and larger process variations use Calibre nmDRC for its comprehensive analysis capabilities while minimizing cycle time and confidently managing physical verification for every design at every node.

BENEFITS

- Used by every major foundry for process development and validation.
- Fast, scalable, flexible resource usage.
- Direct access to the Milkyway, LEF/DEF, OpenAccess, OASIS and GDSII design databases.
- Calibre eqDRC provides precise characterizations and simplifies debugging of complex multi-variate design issues.
- Calibre Fast XOR enables fast, accurate LVL comparisons.
- Comprehensive fill support, including fill back annotation to Milkyway, LEF/DEF, OpenAccess, OASIS and GDSII design databases.
- Pattern matching support.
- Double patterning layout analysis support.
- Comprehensive, accurate, and proven signoff physical verification for advanced technology nodes and designs at all major foundries.
- Industry-leading speed minimizes runtime and resource usage.
- Enhanced DRC debugging provides the fastest results with the highest accuracy.

BENCHMARKING METHODOLOGY

AMD engineering created a synthetic benchmark called *Performance* to compare the relative performance of different processors and systems. Performance is the ratio of the average application run time on the reference system (*ref*) to the average application run time on the system under test (*sut*), or *ref/sut*. For the purposes of this paper, reference application performance will always be normalized to 1.00, because if *ref=sut*, then *ref/sut*=1.00. Ratios greater than 1.00 (*sut>ref*) mean that the system under test performs higher than the reference system, with *ref>sut* indicating the test system underperforming the reference.

The tests described in this brief compared the relative performance of systems powered by different pairs of AMD EPYC processors. Each test used the slower system as the reference system for that test.

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AMD used eight processor cores to run each copy of the full Siemens Calibre nmDRC application application. Thus, total processor cores/8 simultaneous copies of the full application used all of the processor cores. For example, a system with a 32-core AMD EPYC 75F3 ran four simultaneous copies of the application because 32 CPU cores/8 cores per copy = 4 copies. These tests captured the elapsed application run time (in seconds) three times for each benchmark on each running copy. These three run times were then summed and the mean obtained for each application copy. Finally, these means were summed and then divided by the number of running application copies, as follow (2 on a 16-core system, 3 on a 24-core system, and 4 on a 32-core system) to yield the average mean application performance on a fully-loaded system.[4]

Table 1 and Figures 1, 2, and 3 show the data for these results and calculations with the corresponding average application performance on a fully-loaded system.

COMPARISON ANALYSIS

First, AMD compared the performance of the 2nd Gen EPYC 7F52 and 3rd Gen EPYC 73F3 16-core, high frequency processors. Figure 1 shows that the performance increased generation on generation as a direct result of the improved frequency, IPC, and larger 32MB L3 cache available to a single core on the 73F3 compared to the 7F52.[5]

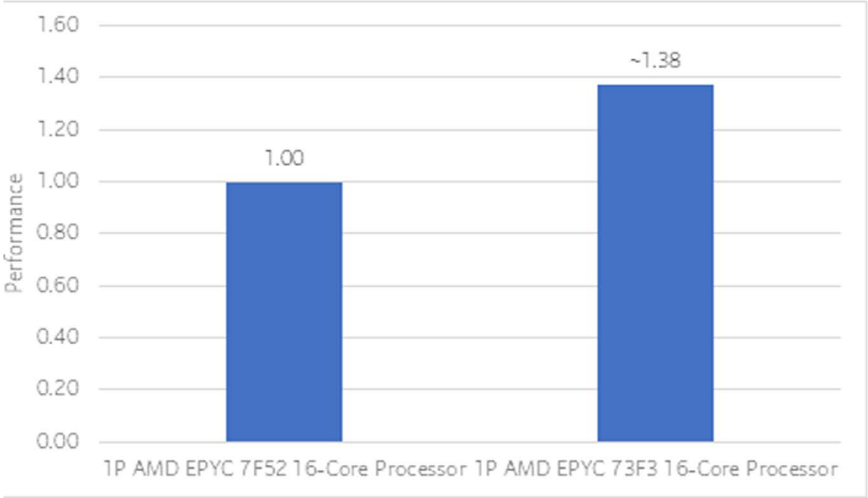

Figure 1: 1P AMD EPYC 7F52 (reference) and 1P AMD EPYC 73F3 16c average performance comparison

Next, AMD examined the performance of the 2nd Gen AMD EPYC 7F72 3rd Gen AMD EPYC 74F3 24-core high frequency processors. Again, there is improvement in performance beyond the already excellent EPYC 7F72 results.

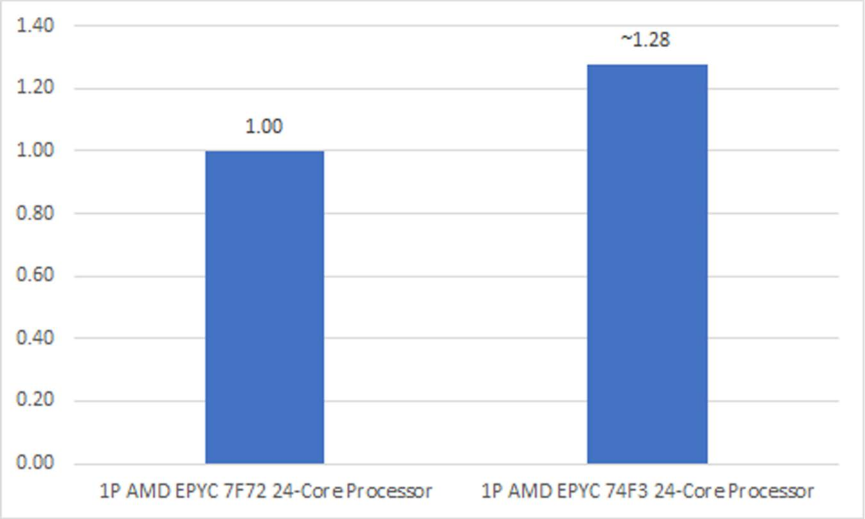

Figure 2: 2P AMD EPYC 73F3 16c and 1P AMD EPYC 75F3 32c average performance comparison

Lastly, AMD explored the workload in terms of socket configuration. AMD has found that some applications prefer the closer topology of a single socket, while others prefer the additional bandwidth offered by a two-socket solution. The following chart compares the performance of this workload on two third-generation platforms with the same total number of cores, one using a 2P configuration and the other a 1P configuration. In this case, Calibre responds well to the higher frequencies provided by a two-socket solution.

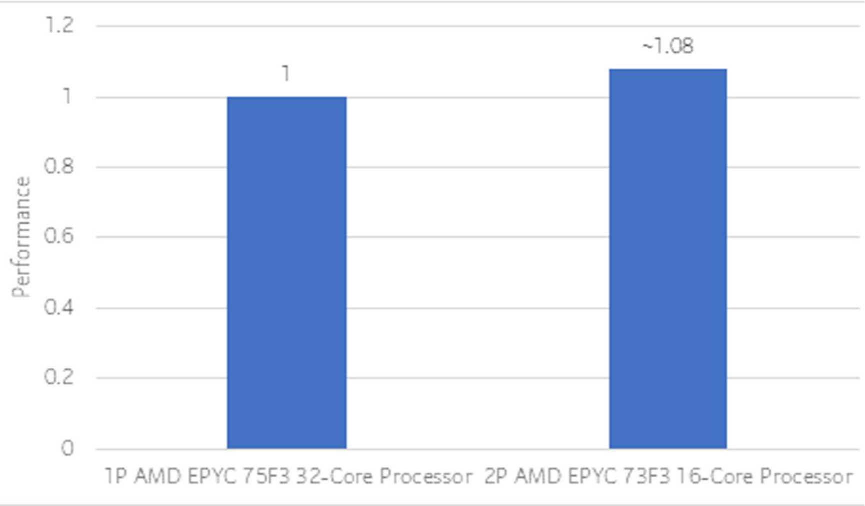

Figure 3: 2P AMD EPYC 73F3 16c and 1P AMD EPYC 75F3 32c average performance comparison

AVERAGE ELAPSED RUNTIME FOR AMD EPYC 2ND GEN AND 3RD GEN PROCESSORS

AVERAGE ELAPSED RUNTIME	1P AMD EPYC 7F52 16-CORE PROCESSOR	1P AMD EPYC 73F3 16-CORE PROCESSOR	1P AMD EPYC 7F72 24-CORE PROCESSOR	1P AMD EPYC 74F3 24-CORE PROCESSOR	2P AMD EPYC 73F3 16-CORE PROCESSOR	1P AMD EPYC 75F3 32-CORE PROCESSOR
Physical DRC	5,306.5	3,857.8	5,226.1	4,106.9	4,141.6	4,472.4

Table 2: Average elapsed runtime for 2nd Gen and 3rd Gen AMD EPYC processors, in seconds, on a fully-loaded system

CONCLUSION

AMD 3rd Gen EPYC 7xF3 processors show exceptional per-core and per-node performance across all load levels with compelling single-socket and dual-socket solutions. In addition, the 32-core AMD EPYC 75F3 extends the product range and unlocks even higher total performance and compute density. Together, these capabilities make the AMD EPYC 7xF3 family of processors an excellent choice for running Siemens Calibre nmDRC.

ACKNOWLEDGEMENTS

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- Sylvester Rajasekaran is a PMTS S & A Engineer for AMD.
- Brian Malley is a Senior Silicon Design Engineer for AMD.

REFERENCES

1. Maximum 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-18
2. 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. GD-183
3. Per https://eda.sw.siemens.com/en-US/ic/calibre-design/physical-verification/nmdrc/.*
4. Siemens® Calibre® nmDRC - Performance measured with Siemens® Calibre® nmDRC Version v2021.1_16.10 on RHEL 8.3 (4.18.0-240.10.1.el8_3.x86_64), running in a fully-loaded condition (1 application copy/8 CPU cores running simultaneously with 8 threads and 3.8 GB per copy). Test systems:
   - TEST 1 (16-core): 1x 7F52 CPU, 8x 64GB DDR4-2933 DR 1DPC vs. 1x 73F3 CPU, 1 8x 64GB DDR4-3200 DR 1DPC; testing concluded on 07/30/2021.
   - TEST 2 (24-core): 1x 7F72 CPU, 16x 32GB DDR4-2933 DR 2DPC vs. 1x74F3 CPU, 16x 32GB DDR4-3200 DR 2DPC; testing concluded on 05/06/2021.
   - TEST 3 (32-core): 1x75F3 16x 32GB DDR4-3200 DR 1DPC vs. 2x73F3 CPU, 32x 32GB DDR4-3200 DR 2DPC; testing concluded on 06/13/2021.

   All systems share the following configurations: 1.6TB NVMe™ SSD. BIOS settings: BIOS v. RYM1001D (02/04/2021), Defaults, plus NPS=NPS4 (7F52,73F3,74F3,75F3), NPS=NPS2 (7F72), SMT = Off, Boost = On, APBDIS=1, Fixed SOC P state=P0, DLWM=off, X2APIC = On, Determinism Slider = Performance, Preferred IO=Enabled; OS Settings: Use “throughput-performance” tuned-adm profile. RAM: Quantities populate all memory channels; speeds are coupled at 2x CPU fabric speed (1467MHz on 7xx2 and 1600MHz on 7xx3) for optimal performance.
5. IPC uplift based on AMD internal testing as of 02/1/2021, average performance improvement at ISO-frequency on an AMD EPYC™ 72F3 (8C/8T, 3.7GHz) compared to an AMD EPYC™ 7F32 (8C/8T, 3.7GHz), per-core, single thread, using a select set of workloads including SPECrate®2017_int_base, SPECrate®2017_fp_base, and representative server workloads. SPEC® and SPECrate® are registered trademarks of Standard Performance Evaluation Corporation. Learn more at spec.org. MLN-003

RELATED LINKS

- Siemens® Calibre® nmDRC*
- Siemens® Calibre® nmDRC Datasheet*
- AMD EPYC™ Processors
- AMD EPYC Technical Briefs and Tuning Guides

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