AMD DATACENTER SOLUTIONS

AMD EPYC™ and ESI PAM-CRASH

Power and Flexibility for Crash Simulation

Solution Brief
March, 2019

Exceptional Memory Bandwidth
AMD EPYC server processors deliver 8 channels of memory with support for up to 2TB of memory per processor.

Standards Based
AMD is committed to industry standards, offering you a choice in x86 processors with design innovations that target the evolving needs of modern datacenters.

No Compromise Product Line
Compute requirements are increasing, datacenter space is not. AMD EPYC server processors offer up to 32 cores and a consistent feature set across all processor models.

ESI PAM-CRASH
PAM-CRASH, ESI's first packaged software, originated from research aimed at simulating aerospace and nuclear applications.

Power HPC Workloads
Tackle HPC workloads with leading performance and expandability. Innovate faster with up to 48% higher Computational Fluid Dynamics performance.

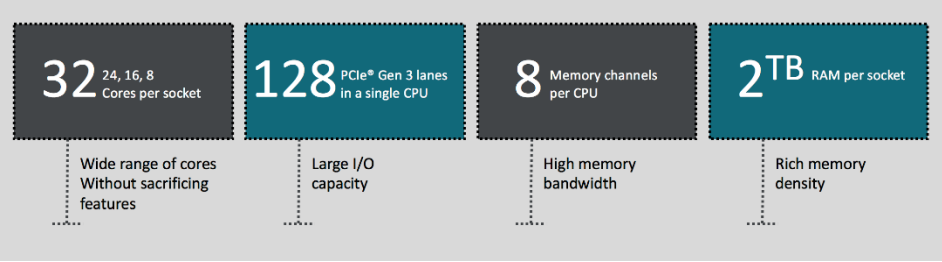
Optimize Productivity
Increase productivity with tools, resources, and communities to help you "code faster, faster code." Boost application performance with Software Optimization Guides and Performance Tuning Guidelines.

Security Features
Help safeguard your software and data with the industry's first x86 processor with an embedded security processor.

AMD EPYC: The right choice for Computer Aided Engineering

Designed from the ground up for a new generation of solutions, AMD EPYC server processors implement a philosophy of choice without restriction. Choose the number of cores and sockets that meet your needs without sacrificing key features like memory and I/O.

Each EPYC processor can have from 8 to 32 cores with access to an exceptional amount of I/O and memory regardless of the number of cores in use, including 128 PCIe® lanes, and support for up to 2 TB of high speed memory per socket.



AMD EPYC's innovative architecture translates to tremendous performance. I/O intensive workloads can utilize the plentiful I/O bandwidth with the right number of cores – avoiding overpaying for unneeded power – while compute-intensive workloads can make use of fully loaded core counts, dual sockets and plenty of memory.

AMD EPYC for Finite Element Analysis

Memory bandwidth is a critical factor in maximizing performance of explicit Finite Element Analysis (FEA) workloads. AMD EPYC server processors' exceptional memory bandwidth ensures that you get the most out of your system, minimizing execution time and increasing overall utilization of your deployment.

Many High-Performance Compute (HPC) workloads require a balance between performance and per-core license costs in order to manage your overall cost. AMD EPYC processors offer a consistent set of features across the product line, allowing users to optimize the number of cores required for their workloads without sacrificing features, memory channels, memory capacity, or I/O lanes. Whether you need 8, 16, 24, or 32 physical cores per socket, you will have access to 8 channels of memory per processor across all EPYC server processors

PAM-CRASH

PAM-CRASH is a software package from ESI Group used for crash simulation and the design of occupant safety systems, primarily in the automotive industry. The software enables automotive engineers to simulate the performance of a proposed vehicle design and evaluate the potential for injury to occupants in multiple crash scenarios.

As ESI's flagship software, PAM-CRASH is a unique solution allowing manufacturers to face emerging design challenges including those related to lightweight, green and autonomous vehicles, while avoiding over-engineering. It enables design and simulation engineers to rapidly test their innovations on virtual prototypes, rather than real ones. Virtual Performance Solution (VPS) also offers a distinctive approach, allowing the virtual testing of product performance across multiple domains using a single core model.

Performance Benchmarks and Testing

PAM-CRASH benchmarks provide a basis for evaluating hardware performance. PAM-CRASH has a single benchmark, known as NEON, an industry standard for crash test simulations based on a standard Chrysler model car. The standard model is provided and represents typical usage.

PAM-CRASH testing was performed on a cluster of dual-socket servers. Tests were run using:

- AMD EPYC 7351 processors (16-core, 2.4GHz),
- AMD EPYC 7371 processors (16 core, 3.1GHz), and
- AMD EPYC 7451 processors (24-core, 2.3GHz) processors.

Both the AMD EPYC 7351 processor and the AMD EPYC 7371 processor have 16 cores. However, the AMD EPYC 7371 processor runs at a higher frequency.

The AMD EPYC 7351 processor has a base frequency of 2.4 GHz and a boost frequency of 2.9 GHz. The AMD EPYC 7371 processor runs at a base frequency of 3.1 GHz and a boost frequency of 3.6 GHz.

Each AMD EPYC 7451 processor has 24 cores with a base frequency of 2.3 GHz and a boost frequency of 2.9 GHz. Each system has a total of 16 channels of dual-rank DDR4-2666 memory, 8 channels per processor.

The EPYC Advantage: AMD EPYC server processors offer 8 memory channels of DDR4-2666 and support for up to 2TB of memory per processor, yielding exceptional memory bandwidth and capacity.

Tested Hardware & Software Configuration

PAM-CRASH testing was performed on a cluster of dual-socket servers. The hardware and software configuration is shown in Table 1.

Compute Nodes	
CPUs	a) 2 x AMD EPYC 7351 processors (16-core, 2.4GHz) b) 2 x AMD EPYC 7371 processors (16 core, 3.1GHz) c) 2 x AMD EPYC 7451 processors (24-core, 2.3GHz)
Cores	a) 16 cores per CPU, 32 cores per system b) 16 cores per CPU, 32 cores per system c) 24 cores per CPU, 48 cores per system
Memory	256GB (16x 16GB Dual-Rank) DDR4-2666
NIC	Mellanox ConnectX-5 EDR 100Gb Infiniband x16 PCIe
Storage: OS	1 x 256 GB NVMe
Storage: Data	1 x 1 TB NVMe
Software	
OS	RHEL 7.5 (3.10.0-862.el7.x86_64)
Mellanox OFED Driver	MLNX_OFED_LINUX-4.3-3.0.2.1 (OFED-4.3-3.0.2)
MPI Version	Embedded PlatformMPI
Application	PAM-CRASH
Network	
Switch	Mellanox EDR 100Gb/s Managed Switch (MSB7800-ES2F)
Configuration Options	
BIOS Setting	SMT=OFF Boost=ON SMEE=Disabled Determinism Slider = Power SVM=Disabled Global C State Control=Enabled
OS Settings	Governor=Performance, CC6 Disabled

Table 1: Hardware & Software Test Configuration

PAM-CRASH Performance Benchmark Results

PAM-CRASH testing was performed on a cluster of dual-socket servers. Tests were run using the following processors:

- AMD EPYC 7351 processors (16-core, 2.4GHz)
- AMD EPYC 7371 processors (16 core, 3.1GHz)
- AMD EPYC 7451 processors (24-core, 2.3GHz)

One set of tests was run using a single node, while a second set of test was run using a small cluster of two nodes. In all cases, the NEON benchmark was performed. The benchmark results follow.

Single Node Performance Benchmark

Single node performance was compared between the AMD EPYC 7351 processors (16-core, 2.4GHz), AMD EPYC 7371 processors (16 core, 3.1GHz), and AMD EPYC 7451 processors (24-core, 2.3GHz). There is only one benchmark for PAM-CRASH, called NEON.

Figure 1 shows the performance of the NEON model. Each is run on the same single, two-socket server utilizing three different AMD EPYC processors. The AMD EPYC 7351 processors (16-core, 2.4GHz) and AMD EPYC 7371 processors (16 core, 3.1GHz) both have 16 cores per socket, however the clock speeds on the AMD EPYC 7371 processors are higher. The AMD EPYC 7451 processors (24-core, 2.3GHz) have 24 cores per processor.

The results show that on a single node the higher core count 7451 processor delivers the best overall system level performance. For the lower core count processors, the higher frequency 7371 performs better than the lower frequency 7351.

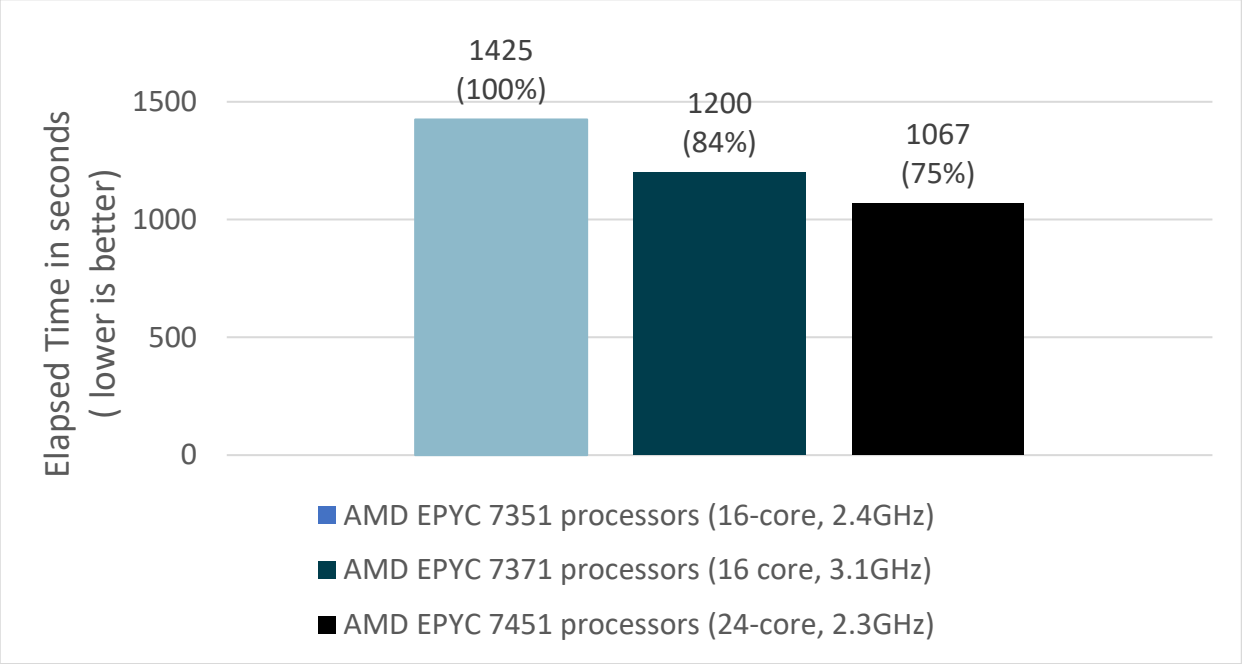


Figure 1: PAM-CRASH NEON Performance (single-node)

PAM-CRASH Scaling on AMD EPYC Processors

The NEON model was then run on two nodes to demonstrate the scalability of the system.

AMD EPYC 7351 processors: Multi Node Scaling NEON

Figure 2 details the scaling of NEON when run on 16-core AMD EPYC 7351 processors (16-core, 2.4GHZ). Two servers of AMD EPYC 7351 processors (16-core, 2.4GHZ) were used to show scaling up to 64 cores.

The results show that the model scales well from one to two nodes and from 32 to 64 cores.

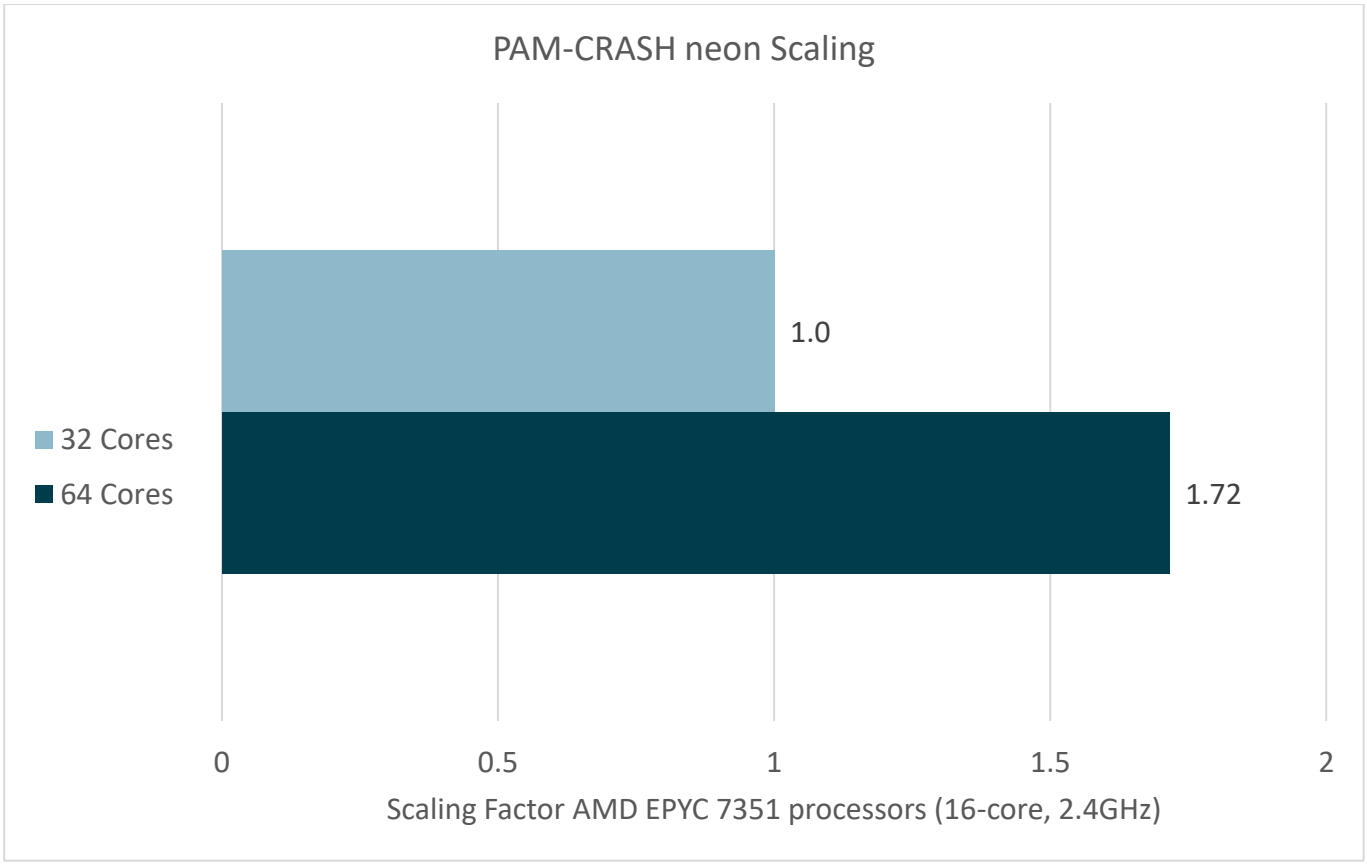


Figure 2

AMD EPYC 7371 processors: Multi Node Scaling NEON

Figure 3 details the scaling of NEON when run on 16-core AMD EPYC 7371 processors (16 core, 3.1GHZ). Two servers of AMD EPYC 7371 processors (16 core, 3.1GHZ) were used to show scaling up to 64 cores.

The results show that the model scales well from one to two nodes and from 32 to 64 cores. The scaling is slightly higher than the 7351 due to the significantly higher clock speeds.

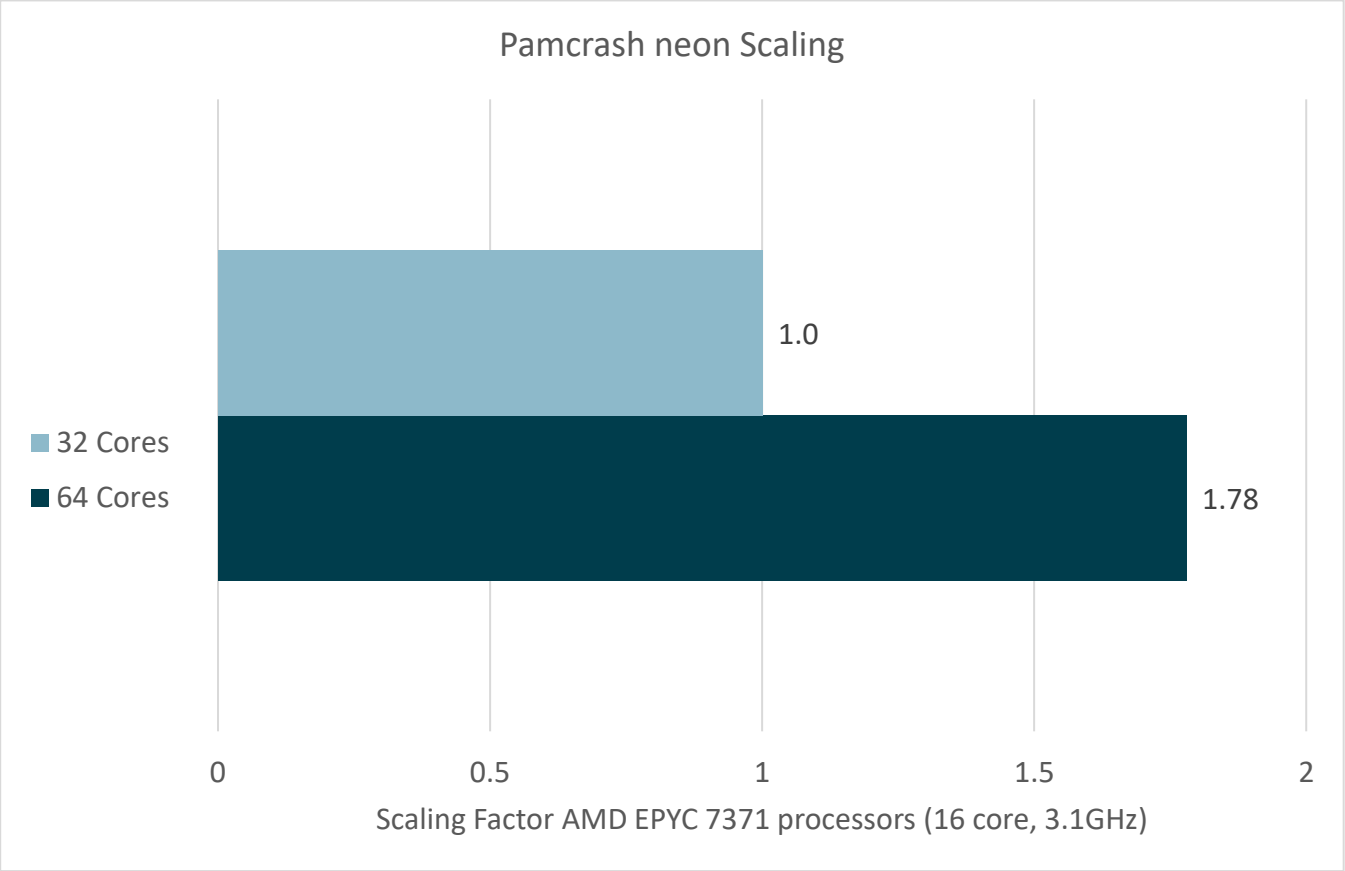


Figure 3

AMD EPYC 7451 processors: Multi Node Scaling NEON

Figure 4 details the scaling of NEON when running on 24-core AMD EPYC 7451 processors (24-core, 2.3GHz). Two servers of AMD EPYC 7451 processors (24-core, 2.3GHZ) were used to show scaling on the 24-core processors up to 96 cores.

The results show that the model scales well from one to two nodes and from 48 to 96 cores. The scalability is very close to that of the 7351 processor. This demonstrates the scalability of PAM-CRAHS on EPYC is consistent across the board.

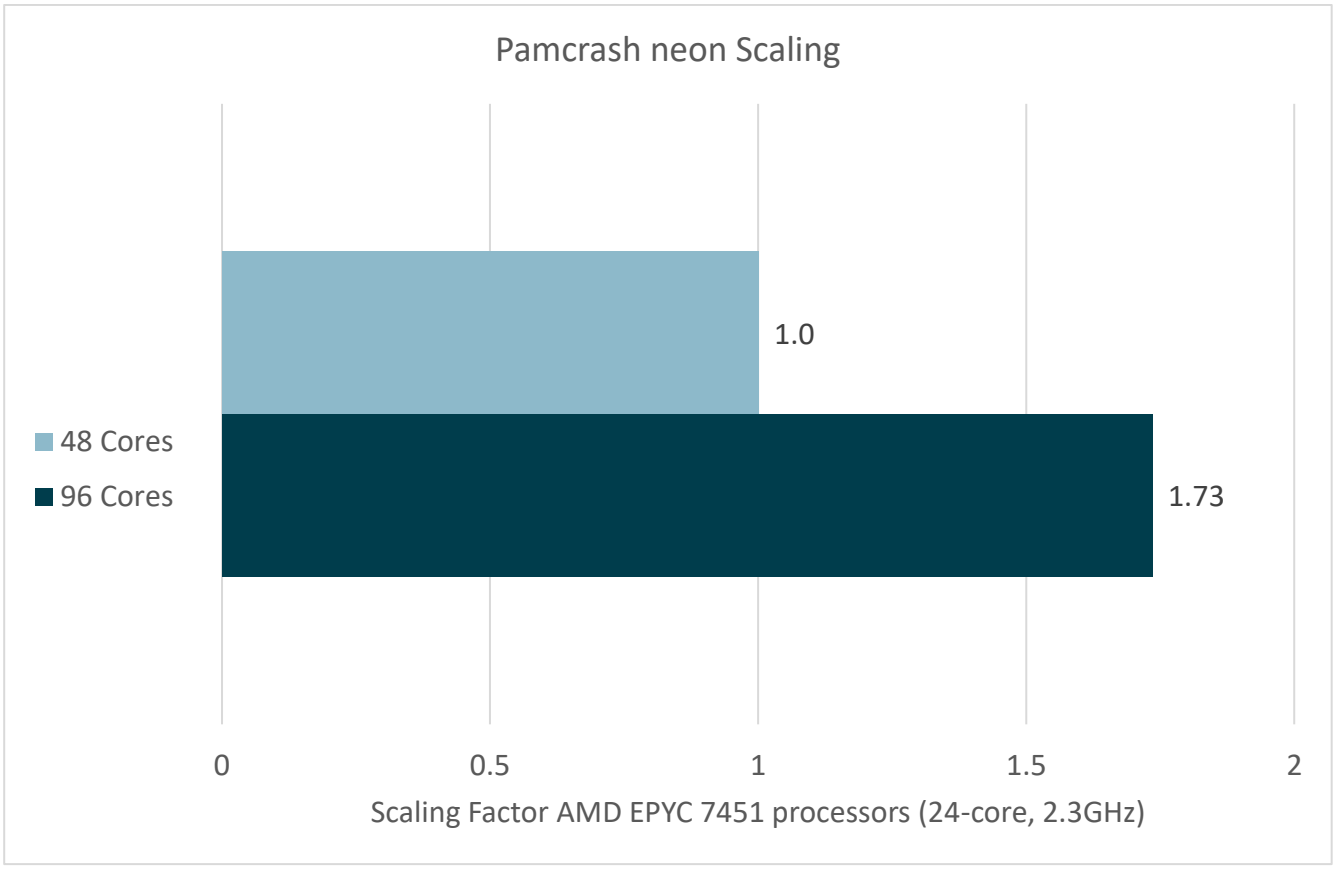


Figure 4

Summary

PAM-CRASH benchmarks were first conducted on a single-node, two-socket server using AMD EPYC 7351 processors (16-core, 2.4GHz), AMD EPYC 7371 processors (16 core, 3.1GHz), and AMD EPYC 7451 processors (24-core, 2.3GHz).

The test was then scaled out to two servers using the same processors. Results were as expected with higher core frequencies and more cores resulting in better overall performance. PAM-CRASH scales well across the benchmarks.

Conclusion

PAM-CRASH testing on the AMD EPYC processor-based cluster shows impressive results on these benchmarks. System level performance was highest with the 24-core AMD EPYC 7451 processors (24-core, 2.3GHz). Whether you need the dominating system level performance and density of the AMD EPYC 7451 processors or the equally dominating per-core performance of the AMD EPYC 7371 processors, all products offer exceptional core IPC and memory bandwidth, and both provide your organization a significant advantage. Customers can pick the most optimal part based on their unique requirements.

AMD empowers the development of fast, accurate crash simulations.

For more information about AMD EPYC server processors visit: https://www.amd.com/en/products/epyc-server

For more information about ESI and PAM-CRASH visit: https://www.esi.com.au/software/vps/

Authors

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