

Hardware, Performance and Benchmarks



Motivation

What hardware do I need?

How should I configure my system?

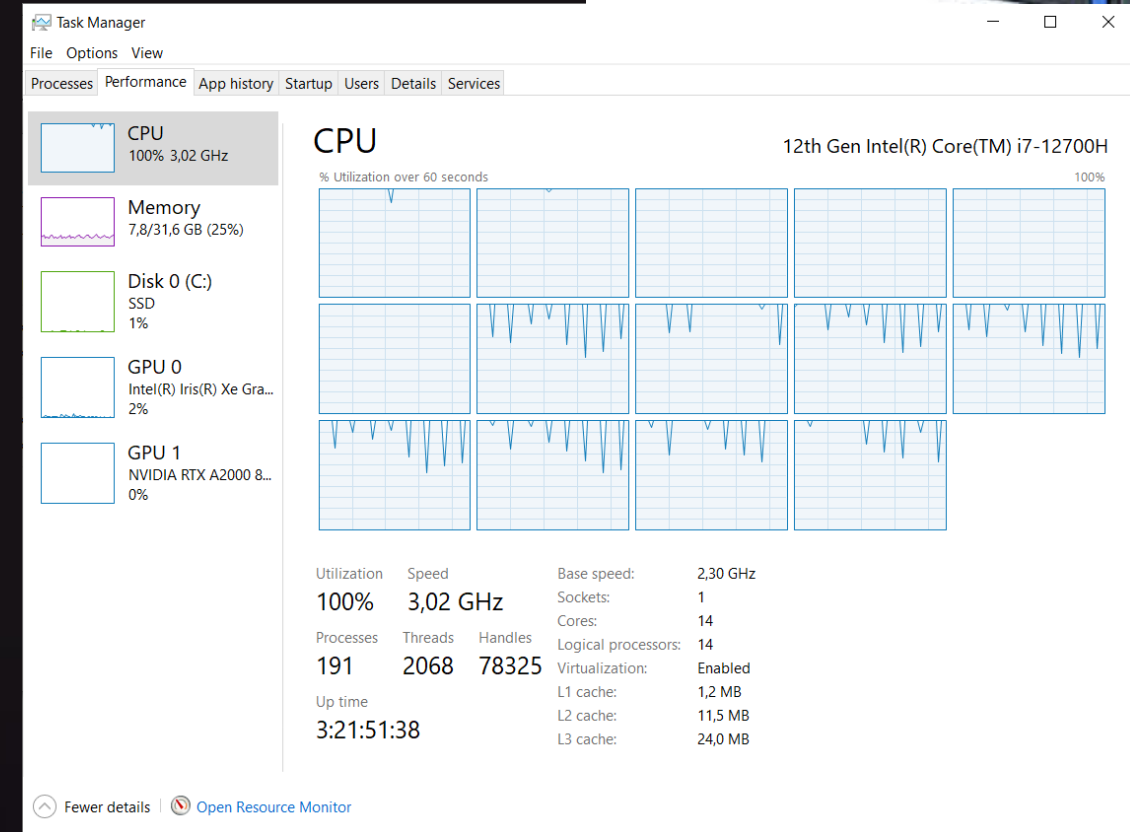
How fast is my MAGMASOFT® Simulation?

Agenda

- Hardware Configuration
 - CPU, RAM, GPU, Harddrive, ...
- Optimizing the Simulation time
 - Tuning BIOS & OS setups
 - Benchmarking

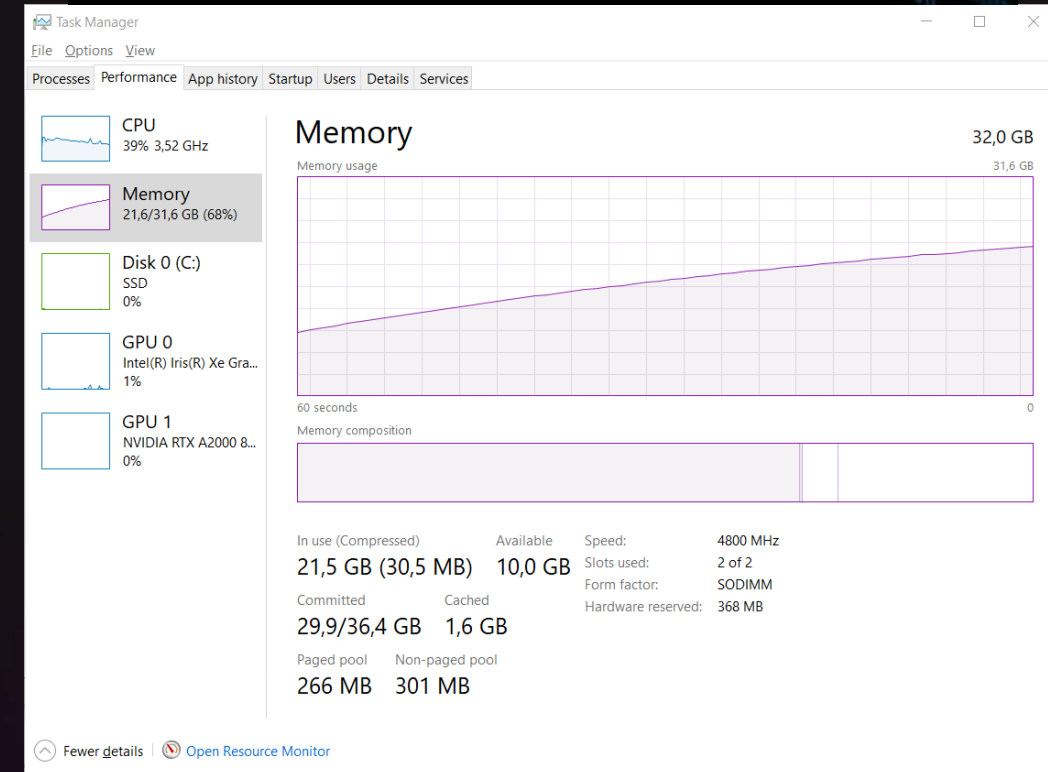
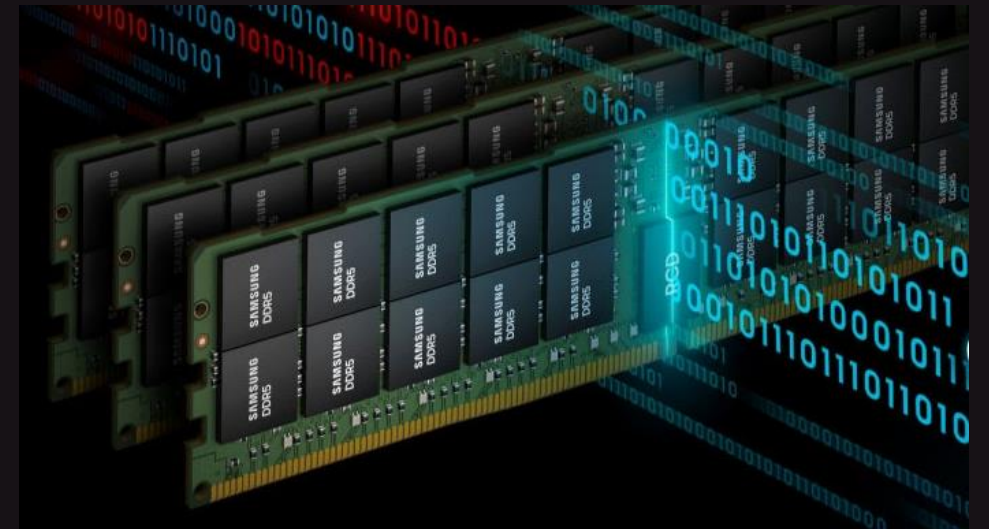
Hardware: CPU

- CPU
 - Current Hardware Generation (if possible)
 - Workstation or Server CPUs
 - AMD Epyc & Threadripper
 - Intel Xeon
 - Consumer CPUs (e.g. Intel i7) are not optimal.
 - #Cores > License (min. +2)
 - No Hyperthreading
 - Large Cache



Hardware: RAM

- Simulations require sufficient RAM.
 - Min. 128GB depending on your projects
- More memory modules are recommended
 - E.g. 8 * 16GB better than 2 * 64GB
 - Min. 1 module per memory channel
- DDR5 > DDR4 > DDR3
- High frequency
- Error correction „ECC“, better with „Reg ECC“



Hardware: GPU & Harddrive

- GPU
 - Nvidia Quadro RTX & Nvidia Datacenter GPUs
 - Large GPU Memory, min. 8GB
 - MAGMASOFT® 6.0 and future versions utilize the GPU more intensively
 - MAGMAInteract® works on all common GPUs
- Harddrive
 - A normal HDD is sufficient
 - SSDs are not that expensive...



Software: Operating System

Valid for MAGMASOFT® 6.1

- Microsoft Windows

- Windows 10 & 11
Pro and Enterprise
- Last two updates



- Linux

- Red Hat 8.6 or newer
- (Red Hat 9)
- SUSE SLED 15



The system is ready to go...

really?

Give me six hours to chop down a tree, and I will spend the first four sharpening the axe.

- Abraham Lincoln

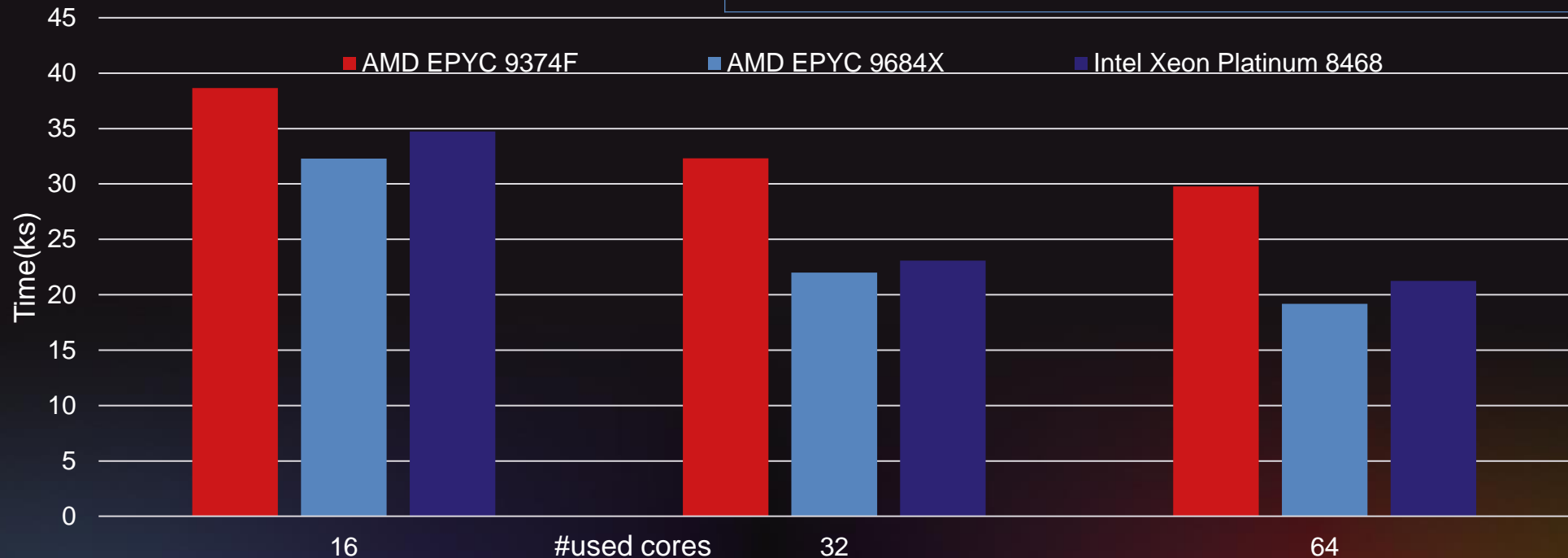
How do you sharpen your axe?

- ❑ AMD or Intel
- ❑ Intel P- and E- cores (consumer CPU)
- ❑ Non-Uniform Memory Access (NUMA)
- ❑ DRAM Population
- ❑ Local disk or network storage
- ❑ Computer power management
- ❑ Measurement setup
 - ❑ an HPDC project with 4.4 million cavity cells
 - ❑ Dual-socket systems
- ❑ In the following figures,
 - ❑ Simulation time in seconds is illustrated,
 - ❑ the lower the better.

Intel or AMD

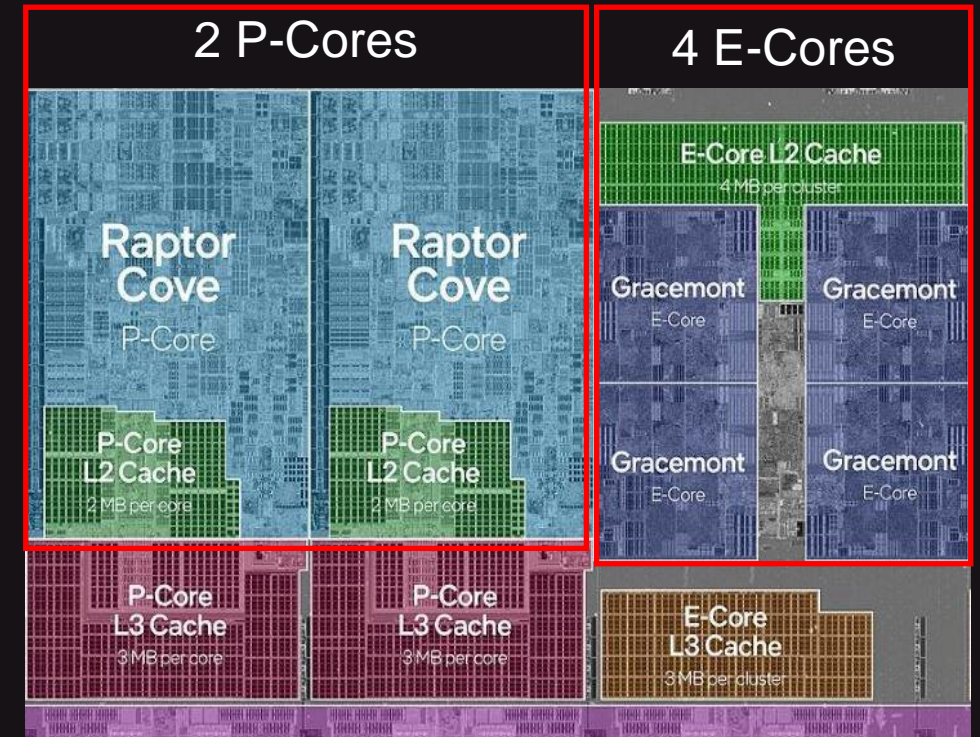
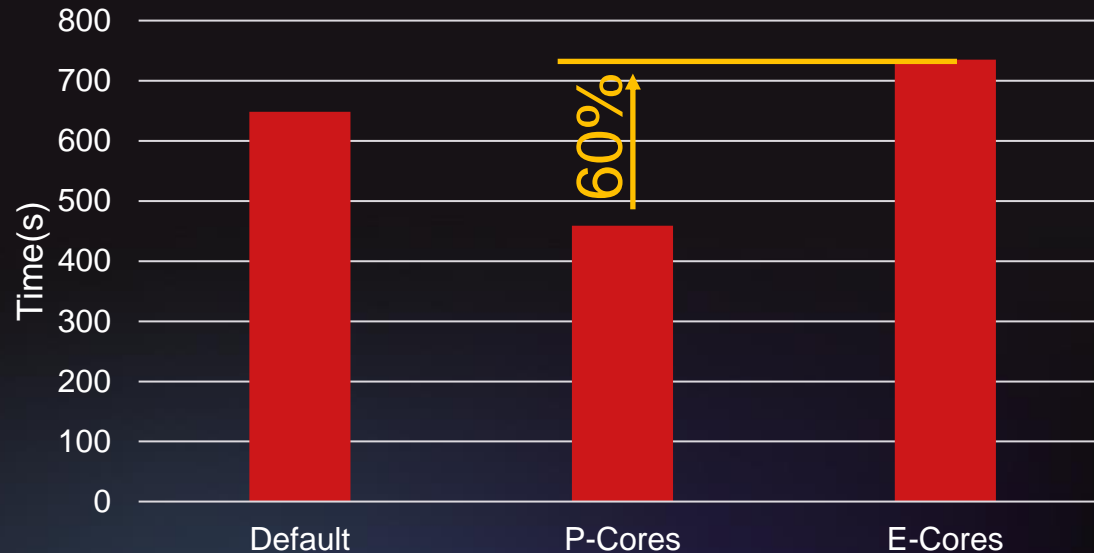
- MAGMASOFT® can run on CPUs from both manufactures.
- Intel and AMD CPUs have comparable performance.

	AMD EPYC 9374F	AMD EPYC 9684X	Intel Xeon platinum 8468
#cores	2*32	2*96	2*48
Frequency (GHz)	3.85 – 4.3	2.55 – 3.7	2.1 - 3.8
L3-Cache (MB)	2*256	2*1152	2*105
DRAM (GB)	768	-	1500



Intel P- or E-cores (Consumer CPU)

- Intel Desktop CPUs with P(erformance) cores and E(fficiency) cores
- Experimental setup
 - Intel Core I7-12700H for laptop
 - 6 P-cores + 8 E-cores
 - Simulations with 4 processes

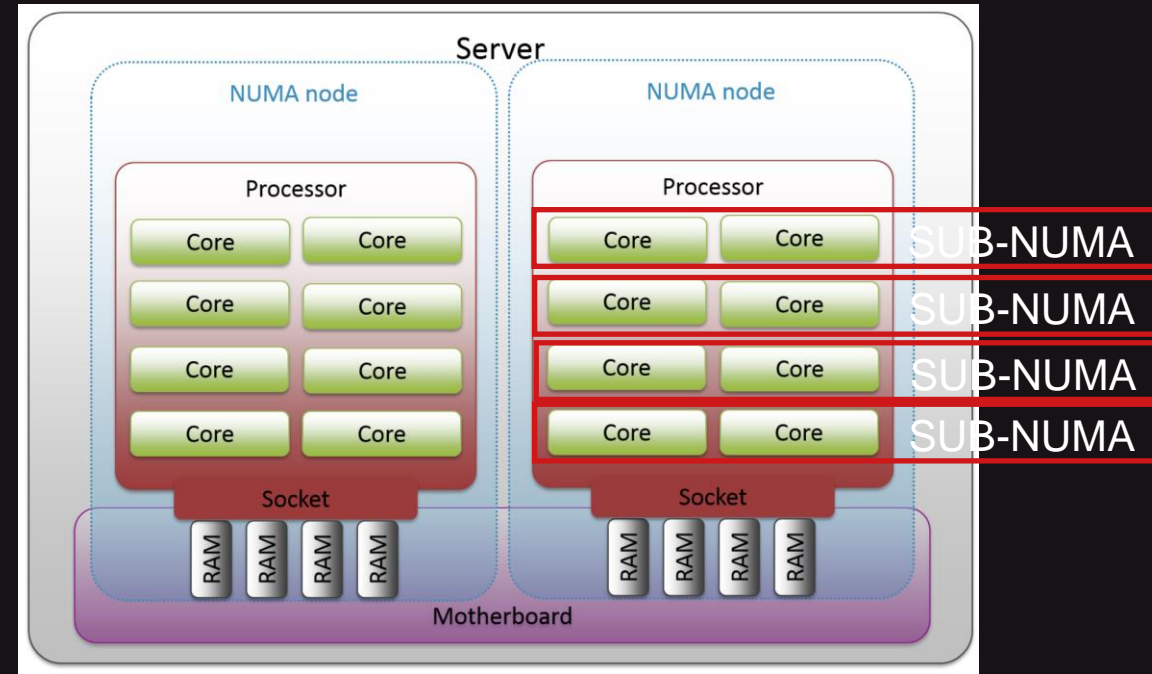


Chip layout

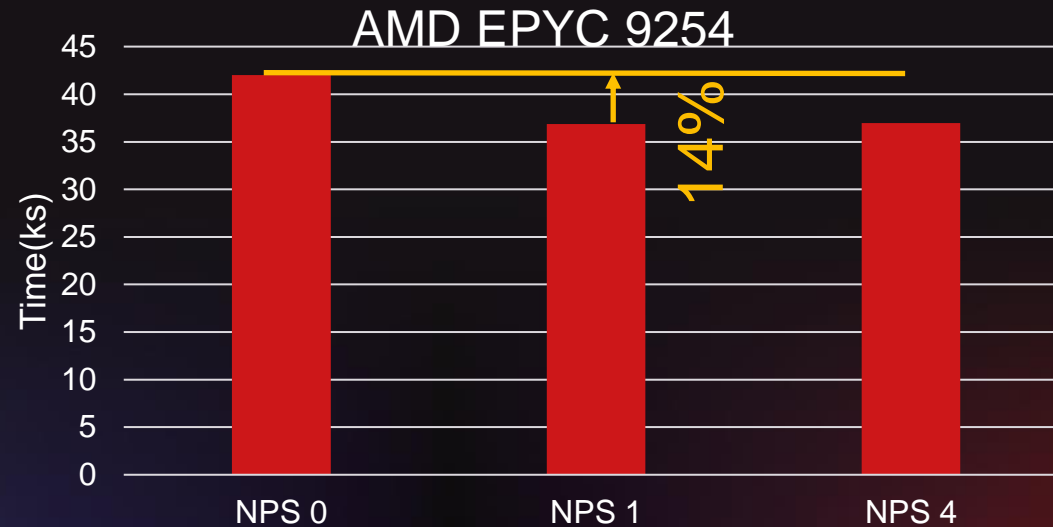
Ref. <https://de.wikipedia.org/wiki/Intel-Raptor-Lake-Mikroarchitektur>

NUMA Setup

- NUMA: non-uniform memory access
 - Access to nearby-attached DRAM is faster
- SuperMicro BIOS setups
 - NPS 0 = NUMA is disabled
 - NPS 1 = each CPU has one NUMA domain
 - NPS 4 = each CPU has four SUB-NUMA
- Please enable NUMA

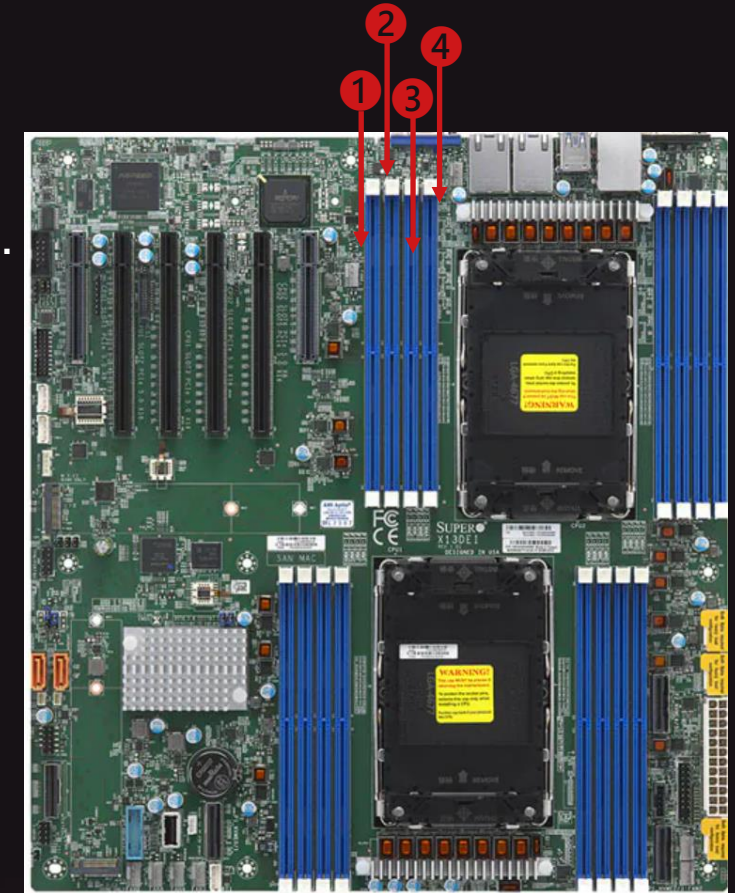
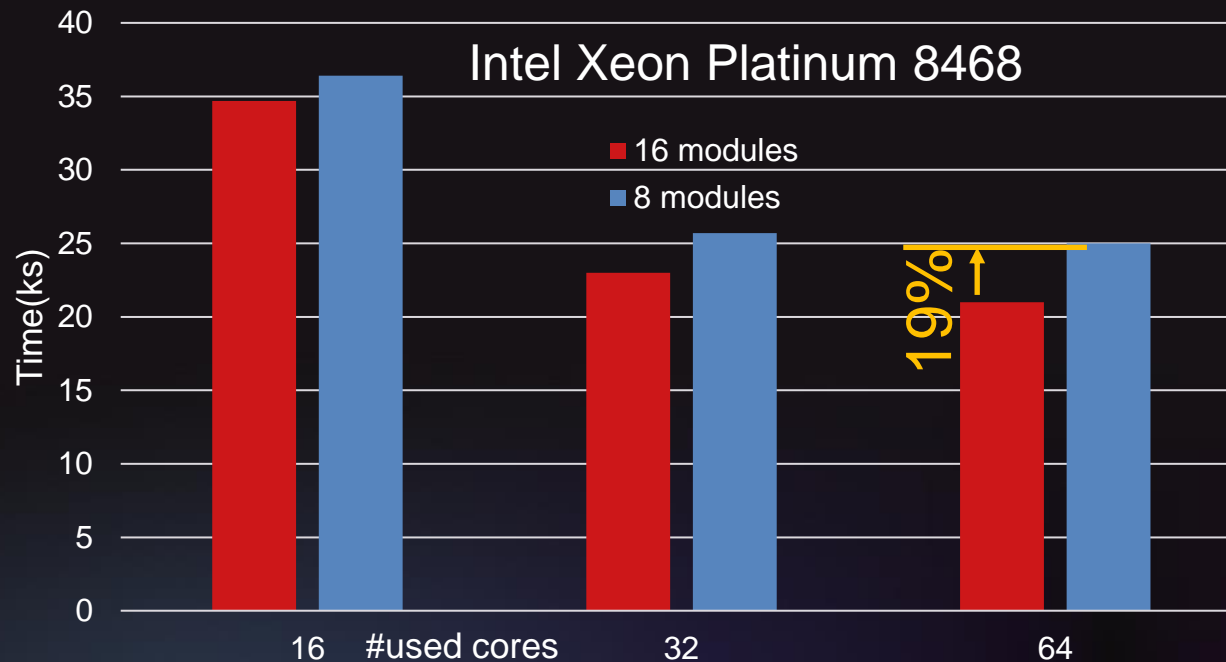


Ref: https://docs.pexip.com/server_design/numa_best_practices.htm



DRAM Population

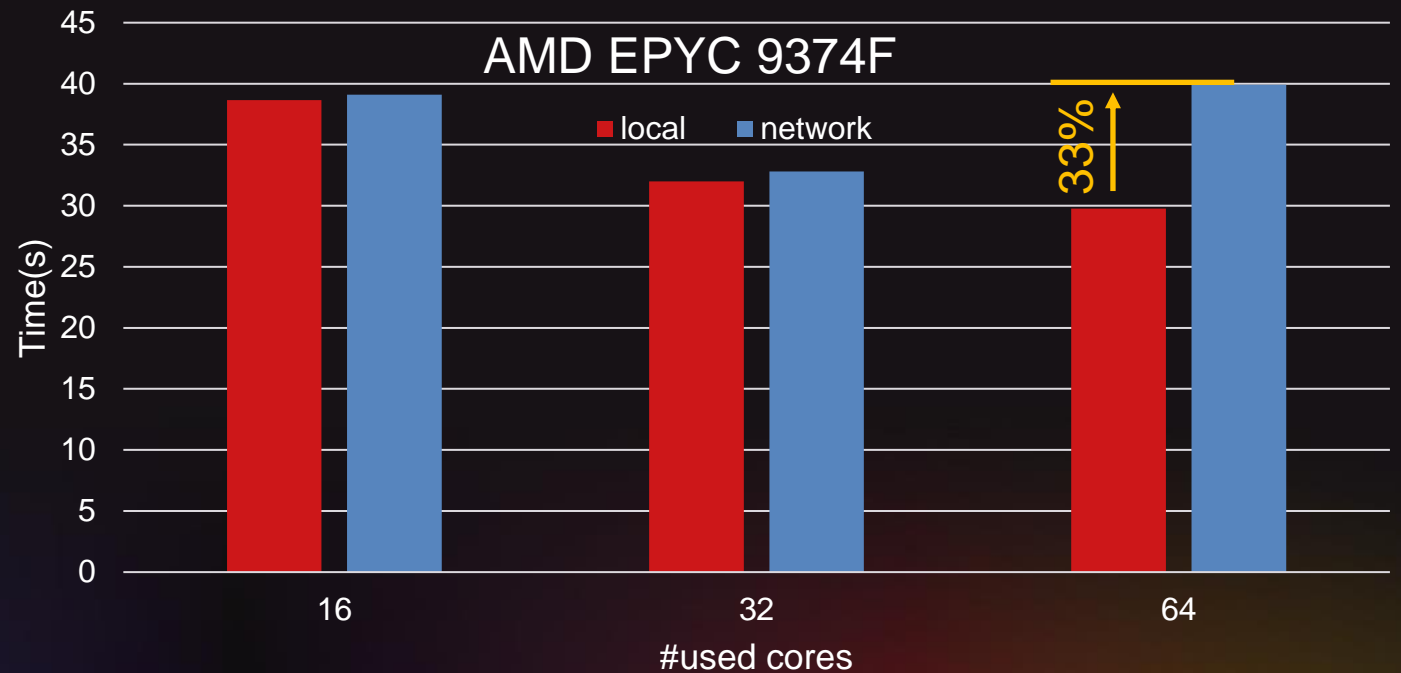
- Experimental setup
 - Two Intel Xeon CPUs need 16 DRAM channels / DIMM modules.
 - 8 modules are available.
- DRAM Slots should be fully occupied.



SuperMicro x13dei for
Intel Xeon Platinum 8468

Local Disk or Network Storage

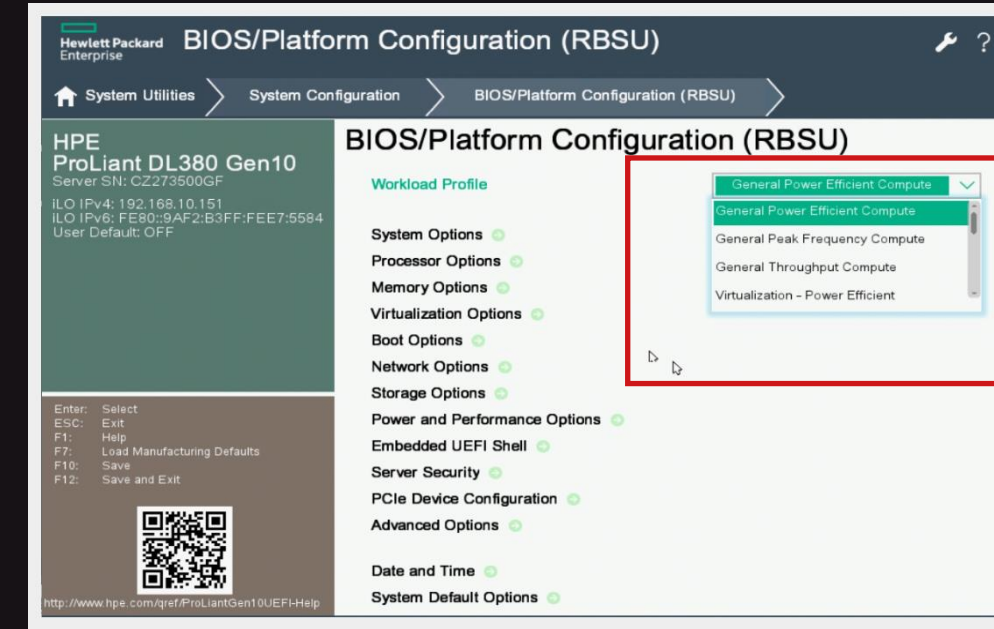
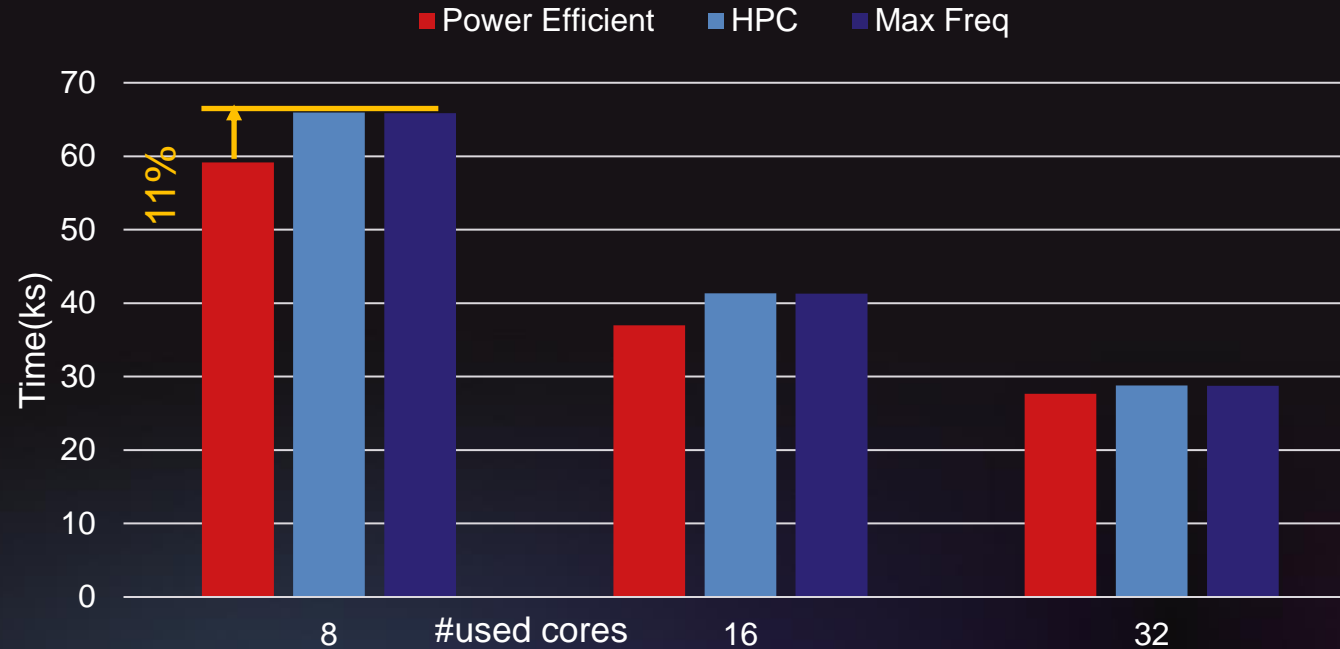
- Local: 2TB NVMe M.2 disk
 - Read/write speed of 3.6 GB/s
- Network: centralized storage connected using 1Gbps network
 - Read/write speed of 0.1 GB/s
- Please keep your projects on a fast storage.



Computer Power Management

- Power settings in BIOS and operating system
 - E.g. BIOS power-profile of HPE server
 - E.g. Windows „High-Performance“ power-profile

Intel Xeon Silver 4516Y+



How to reach the optimal simulation speed?

Measure! Measure! Measure!

Benchmarking

- ─ Diverse reference projects
 - ─ e.g. HPDC, Sandcasting, Stress...
- ─ Tools for Automatic Running
 - ─ only performance-relevant data
- ─ Many published results
 - ─ Live Demo
- ─ Benchmark and results download

The screenshot shows the MAGMASOFT Benchmarking application window. It has a title bar with the MAGMASOFT logo and the text 'MAGMASOFT Benchmarking'. The interface is divided into two main sections. The left section contains labels for various settings: 'Path to MAGMASOFT' (with a sub-label 'e.g. C:\MAGMASOFTv6.0.0\WINDOWS64\bin\'), 'Path to the decompressed files' (with a sub-label 'e.g. C:\Users\user\benchmarks'), 'Number of processes', 'Number of repeats', 'Ref. Project', 'Hosts', and 'Core Places'. The right section contains input fields and checkboxes corresponding to these labels. The 'Path to MAGMASOFT' field contains 'C:\MAGMASOFTv6.0.0\WINDOWS64\bin\' and has a 'Browse' button. The 'Path to the decompressed files' field contains 'C:\Users\user\benchmarks' and has a 'Browse' button. The 'Number of processes' field contains '16'. The 'Number of repeats' field contains '1'. The 'Ref. Project' section has checkboxes for 'HPDC', 'C+M', 'SandCasting', 'LPDC', 'GIGA', 'Stress_HPDC', 'Stress_Iron', and 'Test'. The 'Hosts' field contains 'ANB1DE105'. The 'Core Places' field contains 'allcores'. There is also a checkbox for 'Parsing results only' which is currently unchecked. A 'Run' button is located at the bottom right of the form.

Please send your benchmarking results to
support@magmasoft.co.in Thanks.
No Automatic Data Transfer

<https://www.magmasoft.co.in/en/support/hardware/>

Conclusion

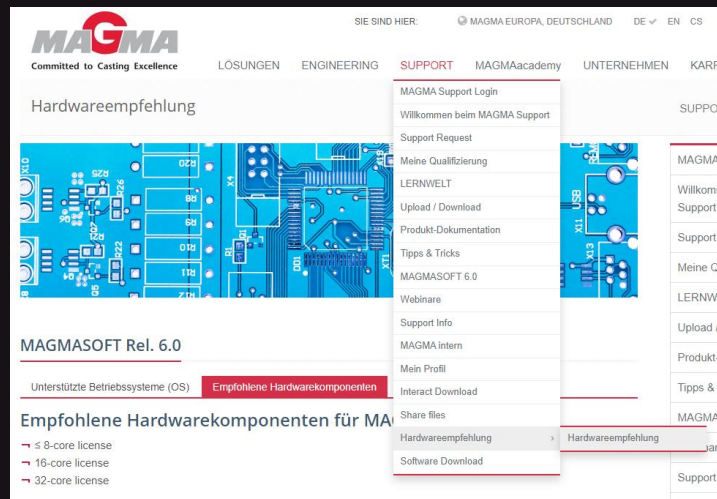
- MAGMASOFT® requires advanced Hardware and system setup for optimal Simulation Speed.
 - We suggest always the state-of-the-art Hardware.
- A „checklist“ for optimal Performance
- Benchmarking can validate your setup.

CPU	Server / Workstation
DRAM	Full slots
P- / E- cores	No
NUMA	Enable
Storage	Fast
Power Profile	Performance

More Information

- Important information and current hardware list on our website

<https://www.magma-software.co.in/en/support/hardware/>



16-core license		
	Setting 1	Setting 2
CPUs	Intel Xeon Gold 6140 (18 cores, 3.7GHz, 24.75MB Cache, HT Off)	AMD Ryzen Threadripper PRO 5955WX (16 cores, 4.5GHz, 64MB Cache, HT off)
RAM	6 * 32GB DDR4-2666MHZ, Reg ECC	8 * 16GB DDR4 3200MHz, ECC
Graphic Card	Nvidia RTX 4000, 8GB GDDR6, ECC	Nvidia RTX A2000, 12 GDDR6, ECC
Storage	OS: 1TB Samsung SATA SSD Data: 4TB Western Digital HDD(CRM)	OS: 1TB Samsung NVMe PCIE m.2 Data: 4TB Kioxia NVMe PCIE m.2
Operating System	Windows 10 22H2	Windows 10 22H2
Others	Dell Precision 7920 Rack	Dell Precision 7865 Tower

Thank you

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