

# Hardware, Performance and Benchmarks

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MAGMA-IT

# Motivation

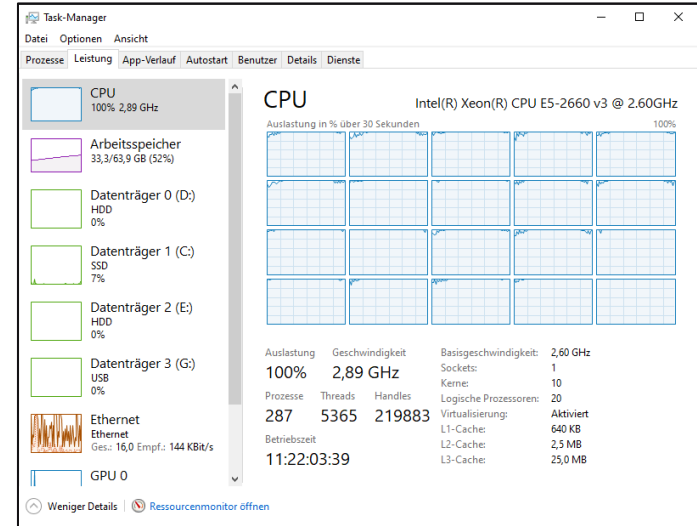
- ▮ „What hardware do I need?“
- ▮ „How should I configure my system?“
- ▮ „How fast is my MAGMASOFT® simulation?“

# Agenda

- ▢ Hardware configuration
  - ▢ CPU, RAM, GPU, Harddrive, ...
- ▢ Optimizing the simulation time
  - ▢ Tuning BIOS & OS setups
  - ▢ Benchmarking

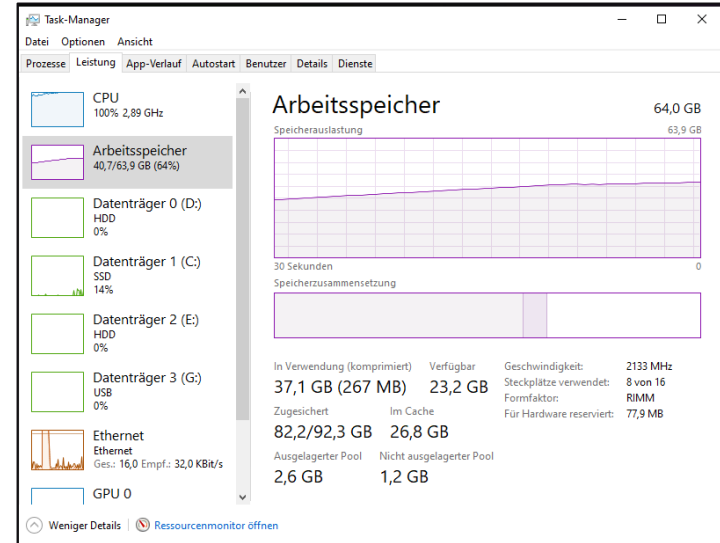
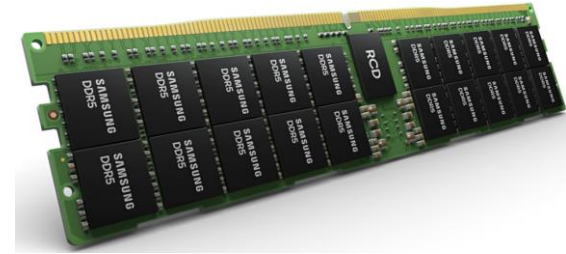
# Hardware: CPU

- ❑ 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

- GPU
- Nvidia Quadro & 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...



**HDD**

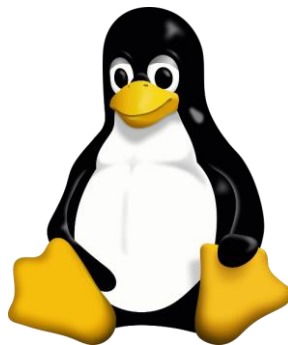


**SSD**

# Software: Operating System

Valid for MAGMASOFT® 6.1

- Microsoft Windows
  - Windows 10 & 11
  - Pro and Enterprise
  - Last two updates
- Linux
  - SUSE SLED 15
  - Red Hat 8.6 or newer
  - (Red Hat 9)



**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**

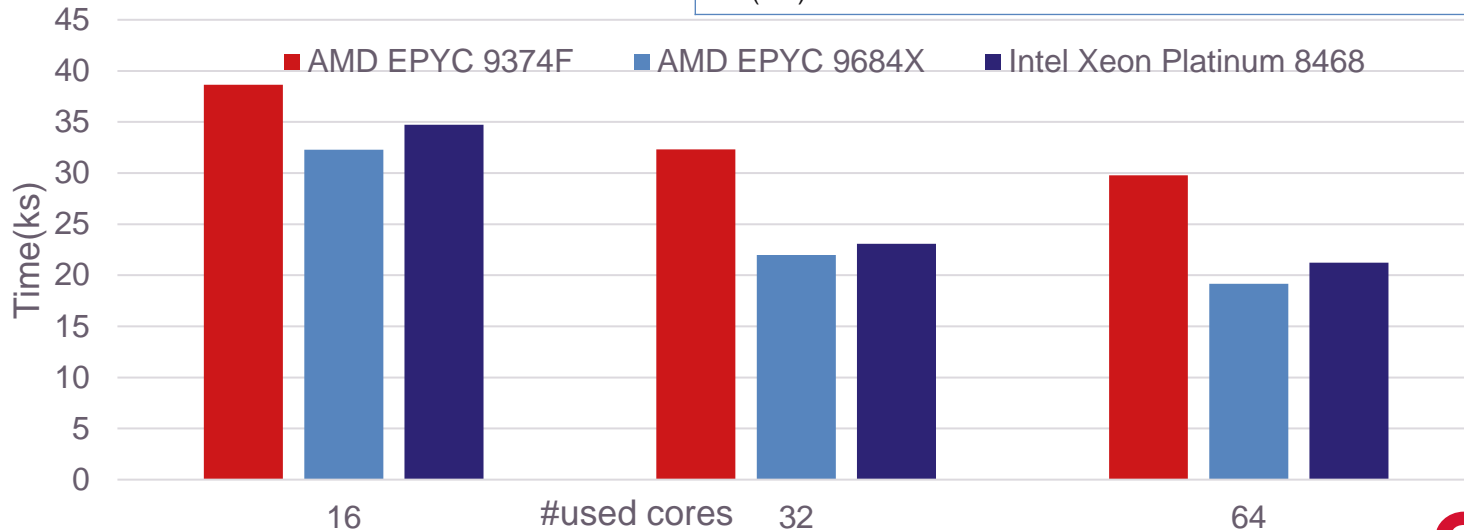
# How do you sharpen your axe?

- AMD or Intel
- Windows or Linux
- 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.

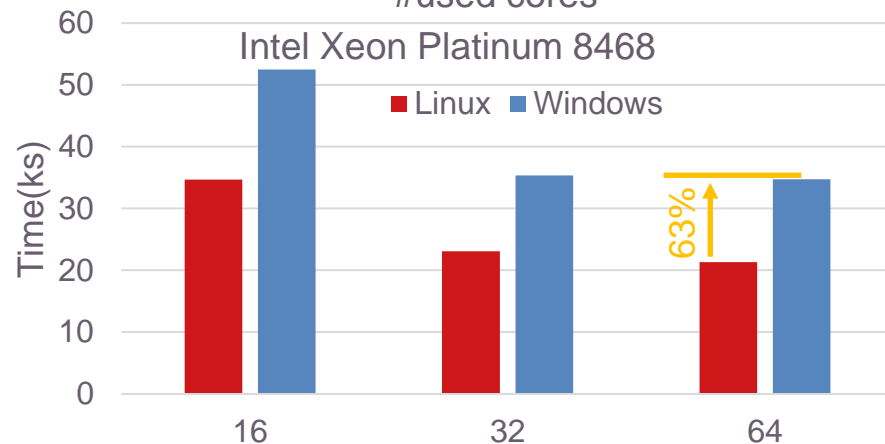
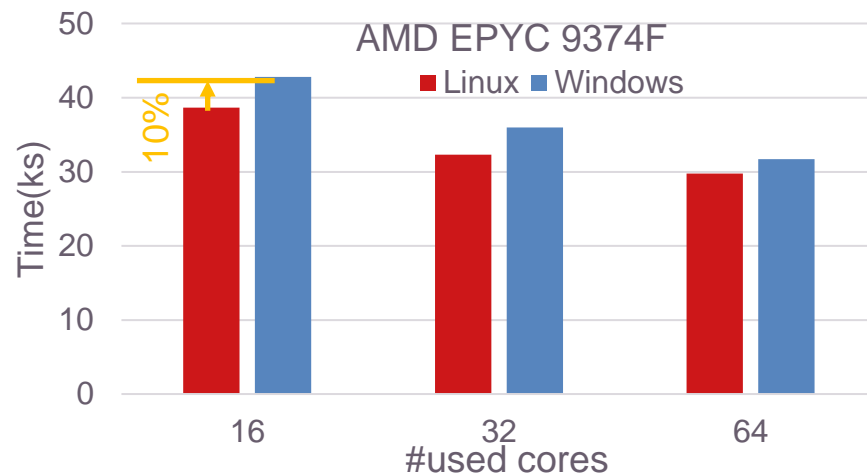
	AMD EPYC 9374F	AMD EPYC 9684X	Intel Xeon platinum 8468
#cores	2*32	2*96	2*48
Frequency (GHz)	3.85 – 4.3	2.55 – 3.7	2.1 - 3.8
L3-Cache (MB)	2*256	2*1152	2*105
DRAM (GB)	768	-	1500



# Windows or Linux

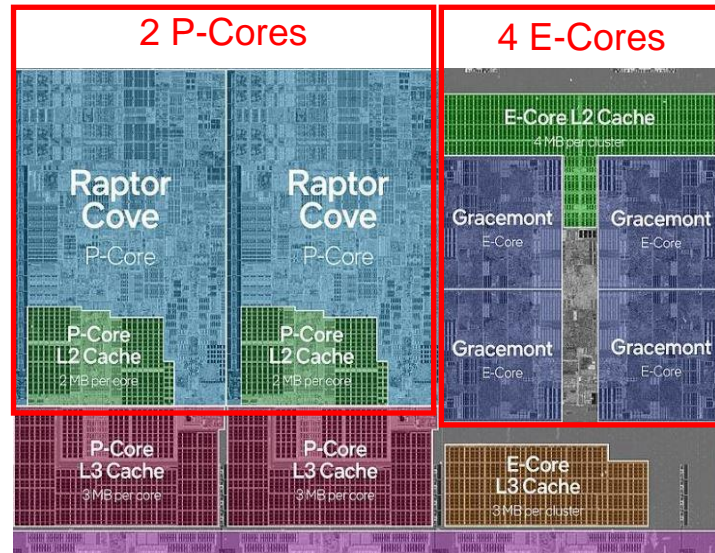
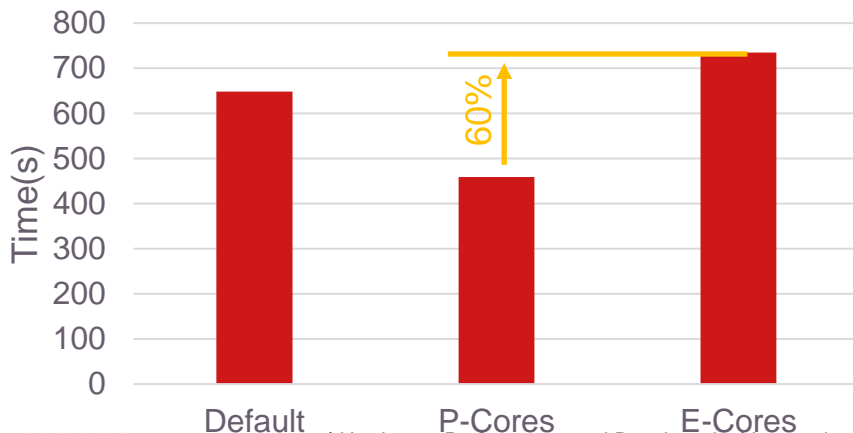
- Linux is recommended for AMD and Intel CPUs in terms of performance.
- Especially for many-core CPUs

	AMD EPYC 9374F	Intel Xeon Platinum 8468
#cores	2*32	2*48



# 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

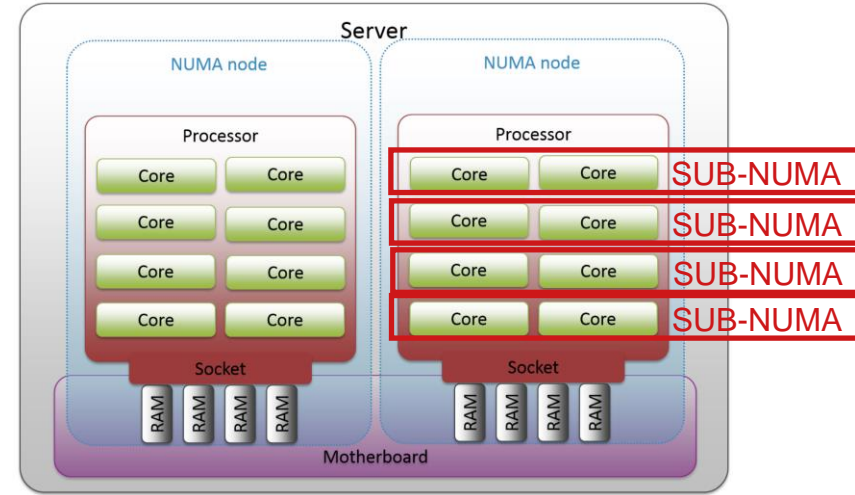


Chip layout

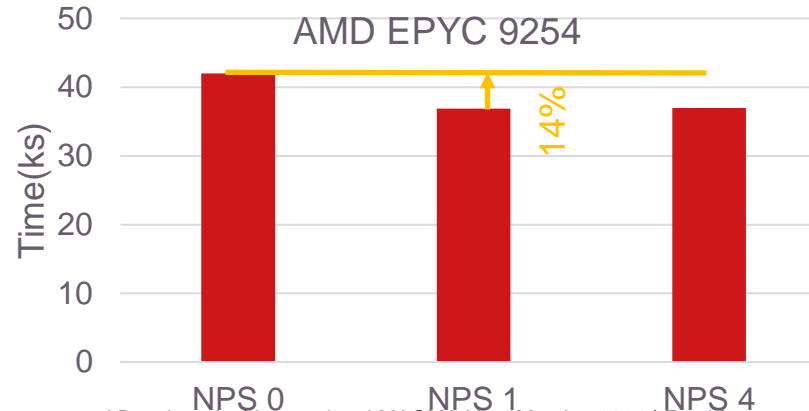
Ref. <https://de.wikipedia.org/wiki/Intel-Raptor-Lake-Mikroarchitektur>

# NUMA Setup

- NUMA: non-uniform memory access
  - Access to nearly-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

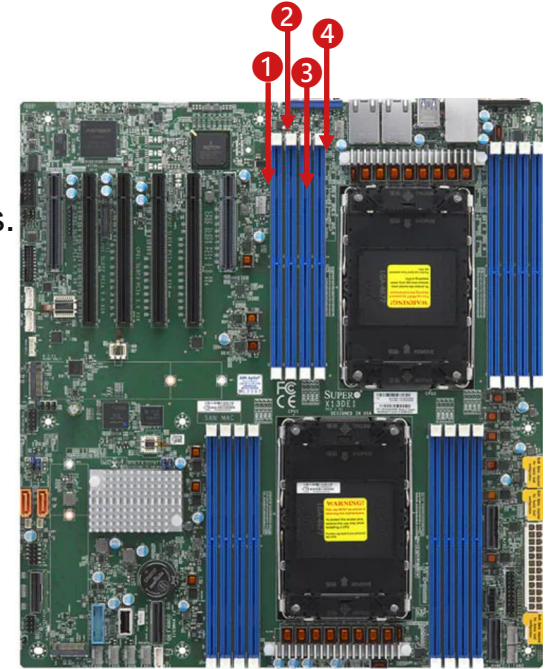
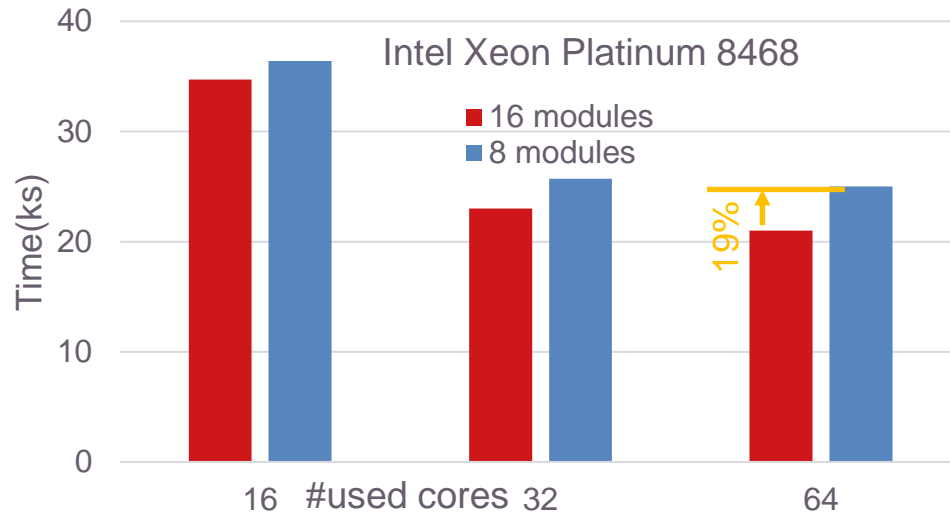


Ref: [https://docs.pexip.com/server\\_design/numa\\_best\\_practices.htm](https://docs.pexip.com/server_design/numa_best_practices.htm)



# DRAM Population

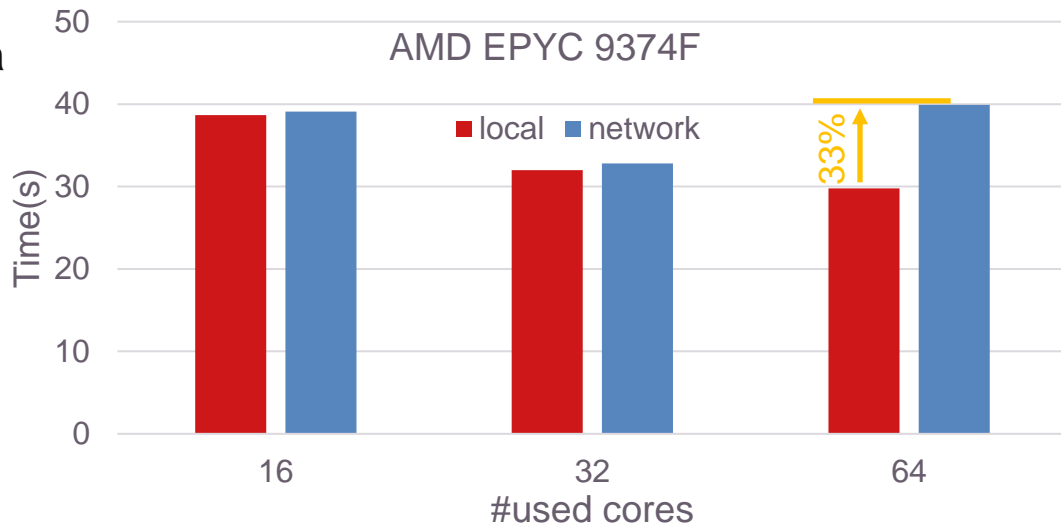
- Experimental setup
  - Two Intel Xeon CPUs need 16 DRAM channels / DIMM modules.
  - 8 modules are available.
- DRAM Slots should be fully occupied.



SuperMicro x13dei for  
Intel Xeon Platinum 8468

# Local Disk or Network Storage

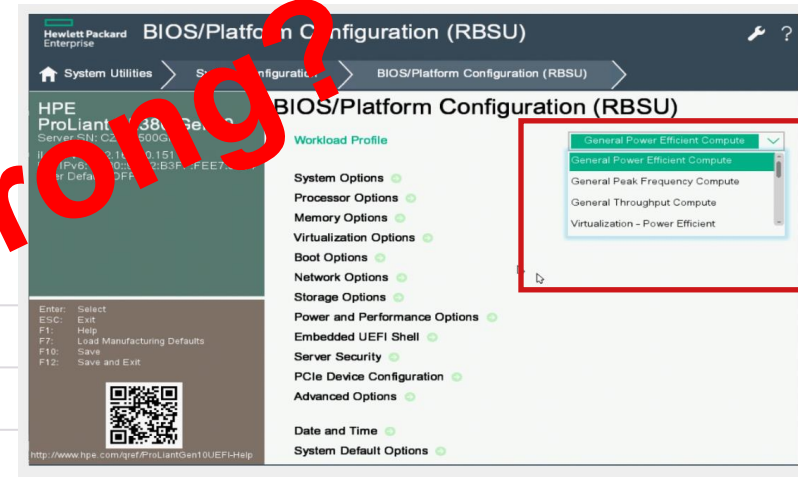
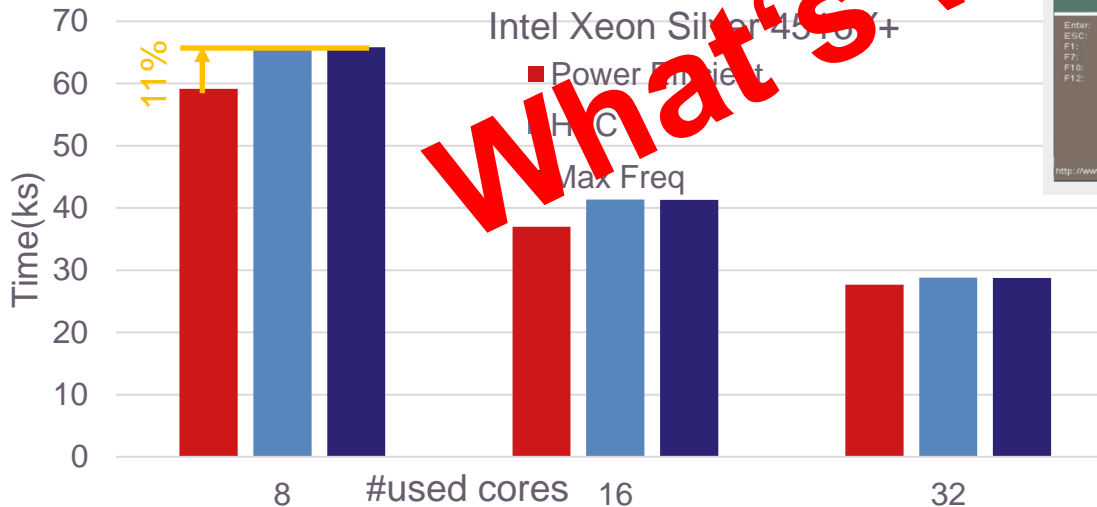
- Local: 1TB NVMe M.2 disk
  - Read/write speed of 3.6 GB/s
- Network: centralized storage connected using 1Gbps network
  - Read/write speed of 0.1 GB/s
- Please keep your projects on a storage with fast access.





# 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



**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 features a dark blue background with white text and input fields. The interface includes the following elements:

- Path to MAGMASOFT:** A text field containing 'C:\MAGMASOFTv6.0.0\WINDOWS64\bin\' with a 'Browse' button to its right.
- Path to the decompressed files:** A text field containing 'C:\Users\user\benchmarks' with a 'Browse' button to its right.
- Number of processes:** A numeric input field with the value '16'.
- Number of repeats:** A numeric input field with the value '1'.
- Ref. Project:** A row of checkboxes for 'HPDC', 'C+M', 'SandCasting', 'LPDC', 'GIGA', 'Stress\_HPDC', 'Stress\_Iron', and 'Test'. The 'HPDC' checkbox is currently selected.
- Hosts:** A text field containing 'ANB1DE105'.
- Core Places:** A text field containing 'allcores'.
- Parsing results only:** A checkbox that is currently unchecked.
- Run:** A blue button at the bottom right of the form.

Please send your benchmarking results to  
[support@magmasoft.de](mailto:support@magmasoft.de) Thanks  
No automatic data transfer

<https://www.magmasoft.de/en/support/hardware/>

# Conclusion

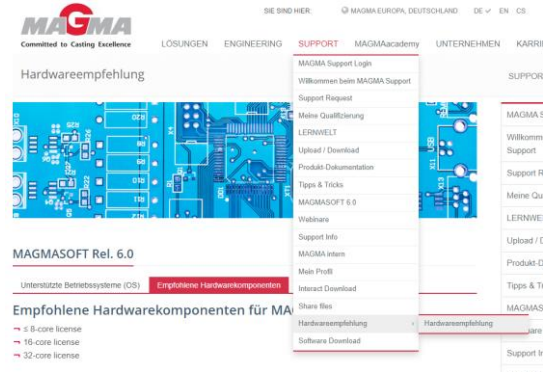
- MAGMASOFT® requires advanced hardware and system setup for optimal simulation speed.
  - We suggest always the state-of-the-art hardware.
- A „checklist“ for optimal performance
- Benchmarking validates your setup.

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-soft.de/en/support/hardware/>



16-core license		
	Setting 1	Setting 2
<b>CPUs</b>	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)
<b>RAM</b>	6 * 32GB DDR4-2666MHz, Reg ECC	8 * 16GB DDR4 3200MHz, ECC
<b>Graphic Card</b>	Nvidia RTX 4000, 8GB GDDR6, ECC	Nvidia RTX A2000, 12 GDDR6, ECC
<b>Storage</b>	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
<b>Operating System</b>	Windows 10 22H2	Windows 10 22H2
<b>Others</b>	Dell Precision 7920 Rack	Dell Precision 7865 Tower

- Regular meeting for hardware and optimization
  - MAGMA® Support, Development and IT

## We help you!

# Thanks for your Attention

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