- when it has to be **right**

Leica Geosystems

Guideline on Computer Recommendations For Running HDS Software

Which Hardware do you Recommend?

We cannot recommend a single optimal hardware configuration. It depends on your typical work. Optimization can be done for many factors like cost, processing time or storage capacity. This is an individual matter.

Also, we cannot recommend specific hardware because we have no means to verify that it really works. Please refer to the respective product datasheets for the official recommendations. Consult your local system service for your hard- and software (operating system) configuration.

What are Typical Project Sizes That Require Other Hardware Settings?

Users in practice have project sizes like

- **small**: around 50 stations
- **medium**: around 200 stations
- **large**: 500+ stations

Particularly users with bigger projects will benefit from a hardware setting that is scaled to the need of larger projects.

What CPU Should I Purchase?

In general, buy a CPU that has **fast single cores**. The possibilities of parallelization are limited and it may in many cases be worthier to have fast single cores than many relatively slow cores. For functions with a high parallelization rate, **8 cores** are regularly well used.

Exotic server CPUs as for example some Xeon CPUs with 20+ cores may in most cases only be used to a low percentage. They are designed to run multiple tasks in parallel. A single software does not necessarily benefit from these very expensive CPUs.

small	medium	large
Even for small projects, a higher medium-class CPU makes sense. You will be able to process your data also with slow CPUs but you will greatly benefit from a faster CPU in your everyday work	Choose a fast CPU. You will greatly benefit in your daily work from 8 fast cores.	Choose the fastest CPU within your budget. If you are processing big data and want to run multiple processes parallelly you may benefit from an 8+ core CPU. (Running multiple software at the same time.)

Your local system service can advise you which CPU fits your system and which up-to-date CPU fits the performance requirements.

How Much RAM do I Need?

Both hardware and software need to be able to **manage large amounts of RAM**. Consult your local system service which hardware components you need (e.g. mainboard) and which operating system is able to manage your desired amount of RAM. Also, they should advise which type of RAM is proper for your system.

small	medium	large
Even for smaller projects, you will benefit from 64 GB RAM. High-resolution data with high-resolution images may not import on machines with only 32 GB RAM. If you do not import images you may be able to work with 32 GB RAM	Have at least 64 GB RAM. You will greatly benefit from 128 GB RAM	Take at least 128 GB RAM. Some tasks will benefit from 256 GB RAM. Especially data import. If time is a factor and you plan to run software parallelly you will benefit from more RAM.
64 GB	**64-128 GB**	**128 GB+ (better 256GB)**

Which Hard Disk Should I Buy?

There are different strategies to store data. They depend on personal taste, local possibilities, and application needs.

In general, there are

- **slow drives** like regular hard disks. Normally one can buy a lot of space for little money. They are a slow but economic solution.
- **medium-fast** drives like regular **SSD**s. They often achieve data rates up to 500 MB/s. They are a good choice also for data-intensive applications.
- **very fast** drives like **SSD**s that can process data with 3000+ MB/s. They are by far the fastest drives but also very expensive. They can access data not only very fast sequentially but also access many small files in a very short time.
- any type of **network storage**. This can be
    - NAS
    - SAN: some customers have a SAN. If the hardware is good, it is fast and reliable storage. They may appear to Windows as local drives and thus overcome network drive issues. Consult your local IT service.
    - DAS
    - any shared drive
- or other solutions like
    - external USB drives
    - tape drives

Consult your local system service which is the appropriate storage solution for you. Please consider the importance of speed and the stability of the connection for Leica HDS software.

It is impossible to say how much **space** a customer needs. It depends on the amount of data that is processed. The customer needs to make a guess how much data he needs to process concurrently and how much he needs to store for later access. He needs to scale his storage space to his needs. He may start with less space and purchase additional drives if necessary. Internal drives are by far the best solution.

A fundamental data organization principle for all software is to **spread** different **data sources** to **different drives** to increase the data access rates. SSDs, in general, are so fast that the effect of distributed data may not be much noticeable anymore. We do not have any knowledge what can be increased by how much if data is spread over multiple drives of a certain type. But we can say that the **use of SSD**s will dramatically speed up all data operations. Theoretically, the highest access rates can be achieved if drives are connected to different buses. Depending on the drive and bus speed this may have no practical effect.

We can separate data in roughly 4 categories.

- raw data
- databases
- temp files
- applications (software, Windows…)

Since **temp files** are always written and read and may be larger than the database itself it is a good strategy to have the temp files on the **fastest drives**. But also the operating system and applications benefit in general from being stored on fast drives. It is a matter of practical experience for specific use cases what the best distribution of the above-mentioned data types is. We can give only general statements of meaningful strategies. They may not be the best for a specific use case.

It is an economic decision to purchase **multiple drives**. Very large SSDs are normally expensive. Do not waste money by buying one very fast and very big drive. Make an economic decision to get the fastest drives with the most space within your budget. This is probably achieved by buying multiple drives. You will have a technical benefit from that economic decision.

small	medium	large
Having small projects and low budget one will be able to process data on a single slow drive. It will be slow in every case. Consider at least one 2nd slow drive to store e.g. temp files on it. You will benefit from that.	You will need at least **1 TB** of fast temp space. Do not make databases too large. Certain function like “Unify” in Cyclone need a lot of temp space. You will greatly benefit from 2 SSDs. Have a very **large internal storage**. It must not be fast but large and internal.	Take the combination of drives that gives you the most space and the fastest access rates, that you can get within your budget.

What Does That Mean for my Data Organisation?

- Never have databases on **external storage** locations.
- The use of **network locations** is often not possible or not recommended.
- Have your **temp files** on your fastest drives.
- Also, it is in general good to have the database - that is for example completely written to during import - on an at least fast drive.
- **USB connections** are relatively weak connections in terms of speed and reliability. The connectors are plugged in and out often. Small physical impacts can interrupt the connection to a USB device. This may be vibrations because something heavy falls on the floor. Multiple devices on the same hub (e.g. mouse and HDD) may lead to communication problems with the devices.
- However, depending on your time and your money, you may consider **storing raw data on an external drive** and import from a relatively fast, but in absolute terms still slow, external storage like a USB3 disk (or directly from a data stick). They are relatively fast in accessing sequential data and the amount of time saved by reading it from a very fast internal drive may be smaller than the time of copying.
  Keep in mind that import is a long process and it may fail if the USB connection is interrupted at any point for any reason.
- Consider **copying your raw data** before import on an at least slow internal drive. It is read only once but still, the slow internal drives are not so slow that the import happens really very slow. At least the data access will be stable.
- Consider **copying your raw data to a fast internal drive**, import from there and then later copy the raw data away in the background if this is necessary.
- You need to scale the hardware to your workflow.
  An example: The ratio between RTC360 raw data (3.1mm scan resolution, images with compression) to the imported Register 360 database is approximately 2:3. That means the database will be approximately 1.5 times larger than the raw data. The Cyclone .imp database will even be a little bit larger.

Which Network Requirements do I Have?

Besides the limitations which databases can be stored on network locations, it is normally **slow** to access data over the network. Also, raw data import is known to be **slow over the network** or may **simply fail** in different ways. If you plan to distribute files via the network have at least a 1 GB/s network connection. You will benefit from a 10 GB/s network.

What Graphics Card Should I Buy?

The graphics card will be used for **calculations** and **import** and of course for **displaying point cloud data**. The graphics card should be chosen depending on:

- processor class: it makes no sense to buy a low-end CPU and a high-end graphics card
- monitor resolution: (multiple) 4K monitors need higher speed and more RAM at the card

The graphics requirements do not fit to the scheme of project size but considering the fact that with increasing general computer power it makes more sense to take a better graphics card, the below scheme may still find practical application. But even for very large projects, you will not need the highest-end graphics card on the market. It can cause more trouble than benefit. Besides the economic impacts, there are technical reasons like the degree of capacity utilization.

This quote of an IT professional puts it in a nutshell: “Extra RAM doesn’t hurt, but it doesn’t necessarily help either!”

small	medium	large
medium gaming card	high-end gaming card or medium CAD card	Depending on graphics requirements (3rd party applications, screens, resolution)
2 GB RAM	**4 GB RAM**	**8 GB RAM**

Can you Summarize This in Short Practical Recommendations?

Clarify with your local IT service company what a proper hardware configuration is for your needs. The table gives you an idea which hardware is needed to work well with your projects of an approximate size.

	small (50 setups)	medium (200 setups)	large (500+ setups)
CPU	Intel i7-style, at least quad-core	Intel i9-style, 8-core	local IT service should choose one according to the software requirements and customer needs.
RAM	64 GB	64 - 128 GB	256 GB
Disks	One SSD. One hard disk.	Two SSDs. At least one big internal hard disk.	Fast to very fast SSDs. Enough fast and big internal disks to store data.
Graphics card	Medium gaming card, 2 GB RAM	High-end gaming card or medium CAD card, 4 GB RAM	Depending on graphics requirements (screens / resolution), 8 GB RAM

We recommend in general to purchase quality hardware for a reliable working environment.

Leica Geosystems HDS Support
(August 2019)