SIZE YOUR HARDWARE FOR YOUR PCVUE PROJECT

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Content :	Sizing the hardware characteristics to run a PcVue system can be challenging, especially because we may be required to do so at a time when not all project details are known. This document aims to discuss some rules to be applied and provides advice and tips to better size your hardware configuration !
Confidentiality :	C0

Content

1. Introduction

In this first part of the discussion, we will not make much distinction between running on a PC or a physical server (bare metal) or in a virtualized environment, but we will focus primarily on the main characteristics that guide the sizing of both, namely:

- The amount of RAM
- The number of CPU cores
- The type of disk space

It is worth noting that in this discussion we will refer to a system designed exclusively to run PcVue – and that what is written is similar to the "Thumb Rules" followed in aviation, i.e., very quick calculations that – although not accurate – can give us an estimate of how to proceed. Fortunately, with Virtual Machines (but also with physical servers), it is relatively easy to install any expansions.
During the project testing phase, it will still be good to monitor all these parameters to check that there are no bottlenecks and that we stay within the available "resource budget."

2. Size the RAM

2.1 Premise

We will not dwell on the details of RAM (type, whether ECC or not, frequency, etc.), as these will be automatically addressed in the subsequent CPU sizing section. The chosen RAM must obviously be compatible with the selected CPU, which will be the responsibility of the hardware provider.

2.2 Basic Requirements for the Operating System

A modern Microsoft operating system, such as Windows Server or Windows 10/11, without any specific roles installed, requires at least 4 GB of RAM to ensure smooth operation of system components.

2.3 PcVue-Specific Requirements

To this baseline, we need to add the memory required by PcVue, which varies based on the specific characteristics of the project:

- The number of I/O tags,
- The complexity of the displayed synoptics,
- And most importantly, the number and type of communication channels enabled.

PcVue primarily consists of two executables at runtime, both 32-bit:

- **sv32.exe**: runs the PcVue instance,
- **hds.exe**: manages the interface with the SQL Server database (this will be discussed in more detail later).

Using general thumb rules, we can estimate that the RAM consumption by these two processes will rarely exceed 4 GB. PcVue uses LBA (Large Block Address) technology, allowing it to utilize up to approximately 3 GB of RAM, even though a standard 32-bit executable is limited to 2 GB. Similarly, hds.exe could theoretically allocate up to 2 GB but typically uses only a few hundred MB.
As a result, a system composed of Windows and PcVue alone will rarely require more than 8 GB of RAM.

2.4 Additional Software and Components

To this 8 GB, we need to add the memory used by any other software, such as OPC server software installed in the same environment.

2.5 SQL Server Requirements

SQL Server installation requires special consideration, as it demands a significant amount of RAM to operate efficiently. The amount of RAM needed depends on several factors, including:

- The number and type of database queries,
- The maximum size of the database.

SQL Server requires approximately 4 GB of RAM to run. Adding this to the 8 GB calculated earlier brings the total to 12 GB.
Additionally, SQL Server requires approximately 4 GB of RAM for every 100 GB of database size. The more RAM available, the faster historical data retrieval will be, such as trend plotting.
For example, a PcVue system with an SQL Server instance and 500 GB of historical data will require approximately 32 GB of RAM.

2.6 RAM Sizing for Different Configurations

The above calculation can be adjusted to various configurations, such as:

- SQL Server running on a dedicated machine: **28 GB**,
- A pair of redundant servers, each hosting an SQL Server instance: **32 GB each**.

2.7 Remote Desktop Service (RDS) Considerations

In a Remote Desktop Service (RDS) setup, RAM sizing needs to account for the memory used by each client instance. We can estimate approximately 6 GB of RAM per client (4 GB for the client instance + 2 GB for overhead).
For instance, with 10 concurrent RDS clients, we need approximately 60 GB of RAM for the clients, in addition to the memory required by the main operating system (4 GB). If a main PcVue instance is running on the same server, its 4 GB must also be included.

2.8 Web Component Considerations

For web components such as WebVue, SnapVue, or TouchVue, RAM requirements depend on several factors. However, as a general estimate, plan for approximately 1 GB of RAM per concurrent user. From experience, the "idle" consumption of Microsoft IIS (without connected users) is negligible.

3. Size the CPU Cores

3.1 Premise

A common misconception is that Intel processor types (i3, i5, i7, i9, Xeon – and similarly for AMD) follow a linear power scale. This belief stems from the era of Intel's 286, 386, and 486 processors in the 1990s, when it was evident that an i486 was more powerful than an i386. However, this is no longer true today.

3.2 Evaluating Processor Generations

The most critical factor when assessing a CPU for a PC or server is its generation, often tied to the year of release. For instance, Intel processors are now in their

14th generation. To illustrate, older third-generation i7 processors are now obsolete and practically unusable.
Newer CPU generations provide better performance for two main reasons:

1. **Advanced Manufacturing**: Modern CPUs use smaller and denser transistors, increasing clock speed while reducing power consumption and heat production.
2. **Microarchitecture Optimizations**: These improve instruction execution efficiency by supporting broader and more specialized instruction sets for technologies such as encryption, graphics, and AI. Additionally, newer CPUs include faster and larger cache memory, which accelerates access to essential data.

When evaluating an Intel processor, its generation can be identified via its nomenclature (e.g., i7-6820HQ). Searching this model number on Google with the keyword "ark" (Intel's database) provides detailed processor specifications. For example, an i7-6820HQ – a sixth-generation processor – is obsolete compared to a 14th-generation i5, which is superior due to the factors outlined above.

3.3 The Role of CPU Cores

The key metric for CPU sizing, especially in virtualized environments, is the number of available cores. On desktop and laptop CPUs, the number of "Total Threads" (as shown on Intel Ark) can help assess performance. However, some threads may correspond to "Efficient cores," which are slower and less suitable for heavy workloads. This issue is not present in Intel Xeon processors, which exclusively use performance cores.
In virtualized environments, Virtual Machines (VMs) can use portions of the physical host CPU cores, which can number several dozen in modern server processors. In Bare-Metal installations, all CPU cores are directly available to the operating system and applications like PcVue.

3.4 CPU Core Sizing Guidelines

Using thumb rules:

- **2 cores** are required for the operating system.
- **2 cores** are needed for PcVue.
  Thus, a standard machine should have at least **4 CPU cores**.

If an SQL Server instance is installed on the same Virtual Machine, an additional 4 cores are required, bringing the total to 8 cores.

3.5 Remote Desktop Service (RDS) Setups

In RDS setups, additional CPU cores must be allocated for each concurrent remote desktop client:

- Plan for approximately **1 CPU core per client**.

This value is indicative since clients typically connect at different times. The key consideration is the average CPU load when the system operates "at full capacity." Occasional peaks are usually handled by the operating system and PcVue without issues. This estimate may be conservative for simple projects with many clients and insufficient for complex projects. Fortunately, in virtualized environments, CPU allocation can be adjusted later.

3.6 WebVue and Mobile App Clients

For WebVue clients or mobile app access (e.g., SnapVue, TouchVue), the CPU demand is lower. Allocate approximately 0.5 cores per concurrent user since these connections do not duplicate the operating system session.

4. Size the Storage

Disk architecture is one of the most neglected aspects of system sizing. While the amount of disk space is critical, the type of disk architecture plays an equally significant role in ensuring reliable and efficient performance.

4.1 Disk Requirements for a PcVue client :

For a physical PC running a PcVue client instance, the requirements are straightforward. A 100 GB hard disk is sufficient for most cases. However, given the affordability of solid-state drives (SSDs), it is strongly recommended to opt for SSDs in SATA, NVMe, or M.2 formats. These provide faster data access and improved reliability compared to traditional hard drives.

4.2 Disk Requirements for Servers and Standalone Stations

Disk needs become more complex for servers or standalone HMI stations, especially when PcVue stores data in its high-performance binary format. Here, a base space of 120 GB is required for the operating system, PcVue setup, and

project folders. Additional space must be allocated for native storage, which can range from several hundred GB to more, depending on the application and data volume.

For WebVue and applications like SnapVue or TouchVue, disk space is less critical. However, for Remote Desktop Service (RDS) clients, each user's Windows profile requires at least 5 GB, regardless of whether access is concurrent. These profiles include project files, libraries, logs, and other user-specific data.

4.3 SQL Server Disk Architecture

For use with SQL Server, when the database size exceeds about 100 GB, it is advisable to provide a slightly more complex disk architecture and server-grade hardware – for example, creating 3 RAID 1 (Mirroring) disk arrays with two disks each:

- An array of disks for the operating system (aforementioned 120 GB)
- An array of disks for the data file (double the size + 20% compared to the maximum database size, in case space is needed to restore a corrupted DB)
- An array of disks for the transaction logs (which can be small, a few tens of GB, but the important thing is that they are very fast disks).

Given the still significant cost of server-grade solid-state drives, instead of two solid-state drives per array, you can use four mechanical SAS hard drives in RAID10 for each array. This option is particularly convenient at least for creating the array of disks for the database data file, as a fairly large capacity is needed, which could significantly impact the budget.

RAID10 (Composed of two pairs of disks – total 4 – in mirroring + striping) is very interesting because it allows for quadrupling the read performance of hard disks and doubling the write performance – maintaining a fault tolerance level of at least one, up to two disks failing simultaneously out of 4.

Equally important, especially for installations on server-grade hardware and regardless of whether a hypervisor (thus a virtualization layer) is used, is the type of RAID controller: in particular, there are two characteristics to check. The first is the cache memory reserved for the RAID controller, which should typically not be less than 1 GB. The second, very important, is that the RAID controller must be backed by a local lithium battery to prevent data corruption in case of sudden power outages.

5. Other characteristics to remember

When considering the purchase of server-class hardware, there are some highly recommended features:

- The presence of a pair of redundant power supplies on board.
- The presence of a remote server management module (DELL IDRAC or HP iLO) that allows remote operation as if you were physically sitting in front of the server (turning on, turning off, configuring BIOS, updating firmware, etc.).
- A sufficient number of network cards (at least one for the OT network and one for the SCADA client interface network) – or to create redundancies (Teaming) between multiple interfaces.

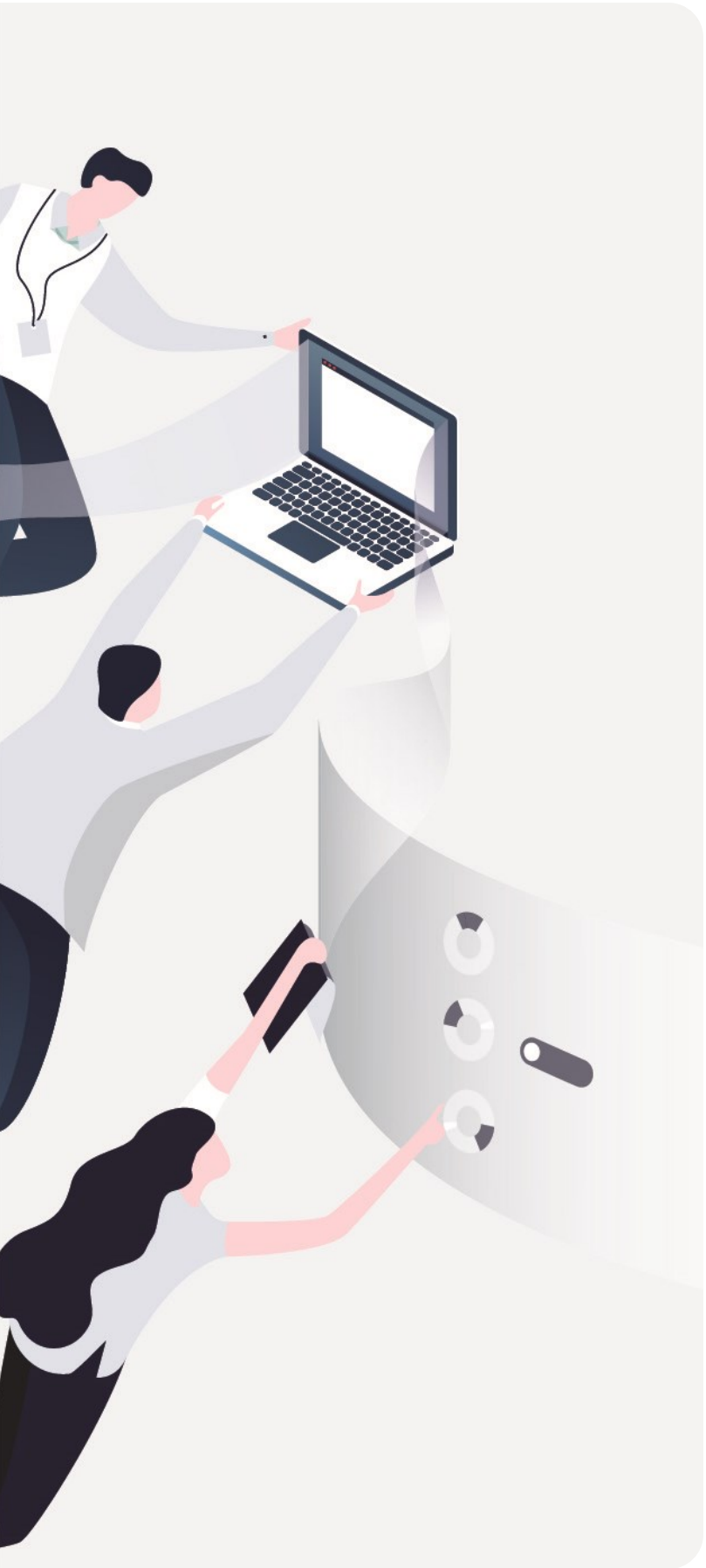
Good expandability in terms of disks (chassis with at least 8 slots for hard disks) and at least 2 slots for RAM still free.

6. The Hypervisor

There are numerous virtualization platforms on the market. The most suitable, in our opinion, for small installations such as SCADA system servers based on PcVue, can be Microsoft Hyper V or Proxmox.

In both cases, it is highly recommended to request PcVue usage licenses in software license format, thus not requiring a USB key physically connected to the server.

In truth, there is an overhead introduced by the virtualization environment – but for the purposes of the document and the sizing proposed here, it is negligible.
It is still important to configure a server that has space for future expandability of at least one virtual machine, useful in case, for example, updates or field tests need to be performed.



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