How to Choose the Right Computer for Your Instrument Control System

Overview
It’s often easy to oversimplify the considerations when choosing a computer for your instrument control application. The computer can be the most crucial part of your instrument control system. It provides flexibility over traditional boxed systems by connecting to the instrument, running the software to control the instrument, analyzing the measurements, and saving the results. Ask yourself these six questions to uncover the right computer for your application.

► How Much Processing Power Do I Need?
► Do I Need My Computer to Be Portable?
► How Much Does the Computer Cost?
► How Rugged Do I Need My Computer to Be?
► Do I Need My Computer to Be Modular?
► Do I Need a Real-Time OS?

More Information for Selecting Your Computer
► Computer Selection Guide
► Overview of Computer Types
How Much Processing Power Do I Need?

Nearly every computer has three main components that affect data management capabilities: the processor, RAM, and hard drive. Think of the processor as the brain of your computer. It interprets and executes instructions. In most new computers, these are either dual- or quad-core, which means the computer can use two or more independent actual processors, called cores, to read and execute program instructions. The processing power for a computer also consists of the RAM, hard drive size, and processor speed. The more RAM available the better the speed and ability for more applications to run at the same time. More hard drive space means you can store more data. Finally, faster processors lead to faster operation of your application. In general, faster is better. However, processor speeds across brands may not be the same. If you need to analyze or save the data you acquired from your application, processing power is a key feature to consider for your computer.

Do I Need My Computer to Be Portable?

If you are frequently going back and forth between applications or locations, portability is a key feature to consider for your computer. For example, a portable computer is essential if you’re taking measurements in the field and then returning to the lab to analyze the data. It’s also an important feature if you need to monitor applications in different locations. Product size and weight are key considerations when assessing portability. You wouldn’t want to carry around a heavy computer that is difficult to hold.

How Much Does the Computer Cost?

Budget is a concern for nearly every project. More than likely your computer makes up a large portion of the total system cost. Features and form factor contribute the most to overall cost. Choosing a computer for your application becomes a trade-off between price and performance. Better features, like a faster processor, cost more and drive up the price. Form factor also makes a difference in the cost of the computer. Typically, between a laptop and a desktop with similar features, a laptop is more expensive because of the added portability. Finally, industrial specifications or optimizations for instrumentation may increase system cost with the added benefit of providing a rugged test platform.

How Rugged Do I Need the Computer to Be?

If you’re monitoring your application in an extreme environment, then the ruggedness of your computer can be crucial. The operating conditions are the specifications of a computer that refer to ruggedness. Standard off-the-shelf PCs are not designed to withstand the conditions of industrial environments. For example, the operating conditions for computers consist of operating and storage temperature, relative humidity, and maximum operating and storage altitude. Typical specifications are 50 °F to 95 °F (operating temperature), -13 °F to 113 °F (storage temperature), 10,000 feet (operating altitude), and 15,000 feet (storage altitude); therefore, any computers featuring specifications greater than these are considered rugged.
Do I Need My Computer to Be Modular?

Modularity is important if you are considering future applications or working on multiple applications. It describes the degree to which a system’s components may be separated and recombined. If you want to switch instruments in your system or modify your applications easily, you should have a modular system. The flexibility you can achieve with a modular computer is unmatched. You can modify and adapt the system to meet your particular needs, expand for the future, and upgrade individual components without having to buy a whole new system. You can also install a new hard drive for additional space or use a data acquisition device with a faster analog-to-digital converter for faster sampling. Keep in mind that laptops and netbooks provide portability, but they are more integrated, which makes them harder to upgrade.

Do I Need a Real-Time OS?

The OS is an important feature to consider when choosing a computer for data acquisition. By far the most common general-purpose OS is Windows, but data acquisition and control applications occasionally require a more specialized OS. With a real-time OS, you can operate deterministically, which means applications can execute according to precise timing requirements. A real-time OS is deterministic because the OS does not determine which process happens when. Instead, you define the order and timing of the processes. This gives you more control over your application and you can execute at faster rates than with a nondeterministic OS. If you need a computer with a deterministic OS, then you want to look for computers that meet those requirements.

► Learn more about a real-time OS
Computer Selection Guide
Based on the six questions previously examined, Table 1 shows a selection guide for the most common types of computers.

### Table 1
This computer selection guide is based on the six most important features.

<table>
<thead>
<tr>
<th></th>
<th>PXI System</th>
<th>Desktop</th>
<th>Industrial PC</th>
<th>Laptop</th>
<th>Netbook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing Power</td>
<td>Best</td>
<td>Best</td>
<td>Better</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>OS Compatibility</td>
<td>Best</td>
<td>Best</td>
<td>Good</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>Modularity</td>
<td>Best</td>
<td>Better</td>
<td>Better</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Ruggedness</td>
<td>Better</td>
<td>Better</td>
<td>Best</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Portability</td>
<td>Better</td>
<td>Good</td>
<td>Good</td>
<td>Best</td>
<td>Best</td>
</tr>
<tr>
<td>Cost</td>
<td>Good</td>
<td>Better</td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
</tr>
</tbody>
</table>

Figure 1.
Desktop computers often include the latest PC technology at a reasonable price.

Overview of Computer Types
The computer communicates with your data acquisition hardware and whichever one you choose depends on your data analysis needs, the environment that the system operates in, and the channel count needed for your system. Five different types of computers are typically used for instrument control: desktop, industrial PC, laptop, netbook, and PXI system.

Desktop
A desktop computer is a PC intended for regular use at a single location. You can use them in offices, labs, or anywhere that is not an extremely harsh environment. They consist of a monitor, a keyboard, a mouse, and the computer itself. There are many parts, so you don’t want to repeatedly move it to different locations. However, because desktop computers are larger, they can dissipate more heat, meaning they can house larger, more powerful processors. Therefore, the biggest attribute of the desktop computer is the processing power. If you need to analyze data or log data to disk at fast rates, but you don’t require mobility, then the desktop computer may be exactly what you need for your application.
Industrial PC
Industrial PCs are special computers optimized for use in industrial or harsh environments. They are mechanically stronger and environmentally rated for extreme vibration, shock, temperature, and humidity. These ratings are essential for many applications, so if you need to monitor applications in harsh environments, the industrial PC is a great choice for your application. However, because of their tough design, these PCs are more expensive than other types of computers.

Laptop
Laptop computers are PCs intended for mobile use. Because of their size, they are typically used with portable instrument control systems. All parts are housed together in one laptop, making it easy to move it from place to place. You have the freedom to monitor different applications at multiple locations with ease. But because all of the parts are together in one unit, make sure the environment you expose the laptop to is not going to damage it. For instance, most laptops may not be rated for dust or moisture. If you are looking for a portable, general-purpose computer with the ability to analyze and store data, then a laptop computer may meet your needs.

Netbook
Much like laptops, a netbook computer is a PC intended for mobile use. Netbooks are extremely small in size and low in cost due to lower cost components and lower power processors. With netbooks, you sacrifice processing ability and ports for connecting peripheral devices, but in the end you have an extremely portable computer for a fraction of the price of more powerful options. The netbook presents a trade-off between cost, size, and performance. It is ideal for your application if you need a low-cost, portable computer for data acquisition that can also perform minor analysis.
PXI System

PXI (PCI eXtensions for Instrumentation) is a modular, rugged, PC-based platform for measurement and automation systems. A PXI system consists of a controller, chassis, and instrumentation modules. The controller runs the OS and serves as the “computer” for the system. It contains the processor, RAM, hard drive, and so on. The chassis houses the controller and contains anywhere from four to 18 slots, which you can use to combine your computer and instrumentation into a single, compact package. If your application incorporates a variety of measurements and requires tight synchronization between instruments or your instrumentation needs to adapt to applications in the future, your best solution may be PXI. PXI is a powerful, flexible instrumentation platform, but the modularity of the system may involve a higher initial cost than a laptop or desktop with USB instrumentation. However, choosing a PXI system up front could save time and money in the future as your instrumentation needs change.

► Learn more about PXI systems