To PC or Not To PC

Choosing a home automation system can be a daunting challenge. How do you decide between the many that are available? We believe the key step is to first decide whether or not you want a system that relies on a personal computer. Once you make this decision, you can narrow your focus to those systems that are suitable.

Home automation systems can be divided into three general categories based upon their need for a PC:

PC-based system:	Requires a PC to be running at all times
Standalone system:	Runs without a PC, although may use a PC for programming
Hybrid system:	Runs without a PC, but uses a PC to add more functions

If you've already decided that keeping a PC running all the time isn't an option for you, then you'll obviously choose a standalone system. However, if the PC is an option, then you'll want to consider all three system types. Each has advantages and disadvantages, and it's important to understand them. This article discusses the important characteristics of each type, including:

- Features
- Reliability
- Cost
- Power consumption
- Equipment size
- Noise

This article will help you understand these issues and choose a system that meets your needs. By the end, many readers will conclude that the most important difference between the three types is reliability, as it varies widely. No matter which type of system you want, you can probably find one with the desired features. Cost varies a lot, but is driven mainly by the features, not whether a PC is involved (except, of course, for the cost of the PC itself if you have to buy one). Power consumption, size, and noise are much lower with standalone systems, but these aren't driving factors for most users. This leaves reliability as the key factor in selecting the right system. Of course, this generalization may not apply to you, so read on and draw your own conclusions.

DESCRIPTION OF SYSTEM TYPES

This section describes the three system types.

PC-BASED SYSTEMS

A PC-based system is one that requires a PC to be running at all times. There are two types of PC-based systems, distinguished by whether the PC is used for other purposes besides home automation:

Dedicated PC*:* The computer is used *only* for home automation. No other programs are run.

Shared PC*:* In addition to running the automation software, the computer is used for other purposes.

Both system types have a lot in common, and are discussed together. Differences are noted when appropriate. Common PC-based automation products are shown below. Note that some of

these are just software, and require you to purchase separate hardware devices. Note also that some of these can also be used with a standalone hardware device to create a "hybrid" system.

- ActiveHome and Home Director (these are basically the same) *
- CyberHouse
- HAL2000
- HomAtion 2000
- Home Control Assistant
- HomeSeer
- HomeVision-PC
- LynxPort

* These could be considered hybrid systems since some functions will work without a PC. However, they are so limited when a PC is not used that we placed them in the PC-based category.

STANDALONE SYSTEMS

A standalone system is one that operates without a PC (although a PC may be required to initially program it). Common standalone systems include:

- CPU-XA/Ocelot
- HomeBase
- HomeVision
- HouseLinc
- JDS TimeCommander, TimeCommander Plus, and StarGate
- Omni and OmniPro

Note that some of these standalone systems can also fall into the "hybrid" category, as they can interact with PC software to perform additional functions.

HYBRID SYSTEMS

A "hybrid" system is one where a standalone system is used in conjunction with PC-based software. Usually, the standalone piece performs most of the basic home automation functions, and will operate even when the PC is off. The PC software is used to add capabilities that don't exist in the standalone equipment. Such systems combine the capabilities of the other systems, usually giving the maximum overall performance. Common standalone systems used in this fashion include:

- CPU-XA/Ocelot
- HomeBase
- HomeVision
- JDS TimeCommander, TimeCommander Plus, and StarGate

Commonly-used software to interface with these standalone systems includes:

- The software provided with the standalone system
- ACE (used with HomeVision)
- ECS (used with HomeVision and TimeCommander Plus)
- HAL2000 (used with HomeVision, HomeBase, and JDS product families)
- HomAtion 2000 (used with HomeVision)
- HomeSeer (used with CPU-XA/Ocelot)
- Home Voice (used with HomeVision, HomeBase, and JDS product families)

- Any software you want to write yourself

FEATURES

This section compares the possible features of the three system types. You can find systems with a wide range of features in each category. There are PC-based systems that can do pretty much anything you can imagine (for enough money). There are also mid-range standalone systems that do a lot more than most similarly priced PC-based systems. The key is that you should decide on the features you want, and then narrow down your options to those systems that provide them.

PC-BASED SYSTEMS

There are a wide variety of features available in today's PC-based systems. While there are very few features of PC-based systems that are impossible on standalone systems, many are easier and more common on PC-based systems. Examples are:

- Voice recognition
- Internet access (stock quotes, weather data, sports scores, news, etc.)
- E-mail capabilities
- Telephone/voice mail processing (although StarGate is a standalone system with some of these capabilities)
- PC-based control screens
- Accessing other PC programs
- Software customization

The last two bullets warrant more discussion. Some PC-based automation systems can communicate with other software. This enables users to add other programs (often shareware) or write their own software to add capabilities to the system. However, you should note that many PC-based automation software packages do not offer this ability, and instead require you to purchase their own add-ons. If you plan to add-on to a PC-based system, be sure to carefully review the core PC program to verify it supports this.

STANDALONE SYSTEMS

As mentioned above, there's nothing inherent about standalone systems that prevent them from having the same features as PC-based systems. Practically speaking, however, PC-based systems can often take advantage of the PCs abilities and do things that few, if any, current standalone systems do. However, if you can't find a standalone system that does everything you want and are considering a PC-based system instead, you may want to also consider a hybrid system.

HYBRID SYSTEMS

Many new home automation users like all the neat things that PCs can do, so they often initially think they need a PC-based system. What they may not realize is that there's a third option: the hybrid system. A hybrid system combines the features of both standalone and PC-based systems. This approach provides the ultimate in features. The standalone system can provide the main automation functions that it's ideally suited for. The PC software can then provide any missing features. We recommend that users considering a PC-based system seriously consider a hybrid system. You will often find that they can accomplish the same things as a PC-based system for less money and with higher reliability.

RELIABILITY

This section compares the reliability of the three system types. This is where the most dramatic differences exist.

PC-BASED SYSTEMS

This will be the longest section of the article because there are so many potential reliability problems with PC-based systems. They are divided into five categories for discussion.

1) Power Failures

A short power glitch can cause a PC to shut down, causing the home automation system to be inoperable. An Uninterruptable Power Supply (UPS) can eliminate this problem for short power glitches, but longer outages will eventually cause the PC to shut off. You might not care that the system is down while power is out, but you'll want the system to resume operation when power returns. Some PCs will automatically restart when power is restored, but many (especially older ones) will remain off. You can easily test your PC to see how it behaves. Some PCs can be configured to restart automatically (this is usually done by configuring the PC BIOS – refer to your PC's manual for details). If your PC won't restart automatically, don't expect to have a reliable automation system.

When the PC restarts, you obviously want the automation software to restart also. This can usually be accomplished by placing a shortcut to the program (or your automation file) into the Windows Startup directory. However, there are several things that can go wrong during the reboot process:

- A disk is left in the floppy drive. This problem is quite common, especially if your PC is used for other purposes. If you've left a disk in the drive, the PC will probably display the message "Non-system boot disk" and wait for you to remove it. If no one's around to do this, the PC will never reboot, and you have no automation system.

  You may be able to prevent this problem by reconfiguring the PC BIOS to boot from the hard drive *before* checking the floppy drive. However, this is risky to do, as it may prevent proper boot up in the event of corrupted files on the hard drive (in which case the only solution may be to disconnect the hard drive).

- A CD is left in the CD ROM drive. This problem is similar to the previous problem. Fortunately, however, most PCs can be configured to bypass booting from the CD if you don't press the "Enter" key to confirm it. Check your PC owner's manual for details.

- A hard disk or virus checking program uncovers a problem at startup. Many users have these types of programs that run at startup and check for problems. Hard disk problems are especially common when a PC crashes (problems are typically caused by certain files not being closed properly). Some programs will then display a message asking if it should repair the problem. If no one's around to click "OK", no other programs will load and you have no automation system. For example, the Norton Utilities program we use typically finds a disk problem about 25% of the time our PCs reboot after a crash or power failure. When this happens, the PC essentially stops until we click either "OK" or "Cancel". If you're using any programs that run at startup, you should check them carefully. Ideally, they should have an option to disable any user-required input, so they never wait for your response.

- The PC restarts in Windows "safe mode". Depending on what caused the PC to shut down, and what was happening when the shutdown occurred, some Windows files may be corrupt or out of sync with each other. In this case, Windows may start up in the "safe mode", and might not run your automation software. We're not aware of an automatic work-around for this problem.

Even if the automation software restarts after a power failure, will it be able to get the home into the proper state? For example, what if the system was off between 5:45PM and 6:15PM, and a light was scheduled to turn on at 6:00PM? Is the PC software smart enough to know that it wasn't running at 6:00PM and never turned the light on? If not, those actions will never get performed. We recommend you determine whether any software you consider has this capability.

2) Computer Crashes

Unfortunately, PC crashes are common. Will your automation system keep running after the crash? Obviously not if the automation program itself crashed. And not if the entire operating system crashed. If another program crashed, then maybe the automation software will keep running. Maybe …..

It's virtually impossible to write "crash-proof" software on Windows. Even the best-written program can crash (or otherwise be affected) by *other* software. Although Windows NT reduces the likelihood of one program affecting another, it's not perfect. If you're running any software in addition to the automation software, a crash is possible. If you use a dedicated PC, you can keep this probability low. But if you're using the PC for other purposes, crashes are inevitable.

If you can't avoid a crash, can your system automatically recover from it? The only way we know is to use a "watchdog timer" card in your PC. Watchdog timer cards must be repeatedly written to by software, or after a certain period of time, they will reset the PC. There are typically two ways to write to them. Most watchdog timer cards come with a software program that runs continually in the background, periodically writing to the card. If the PC locks up and the watchdog program stops running, the card will reset the computer. Assuming your PC is set up to automatically restart, your automation system can get back up and running. However, there's a big flaw in this: if only your automation software crashes, and not the watchdog program, you're out of luck. The watchdog program will continue to write to the card, and the PC will not be reset. Thus, "minor" crashes won't be caught by the watchdog card, and your automation system will be dead until you discover the problem and reboot manually.

This problem is avoided if the *automation program itself* writes to the card instead of having a separate watchdog program doing it. This is the ideal method, as anything that locks up the automation software will lead to a watchdog timeout and a computer reset. Unfortunately, this is only possible with an automation program that was written to work with a specific watchdog card. Check with the automation software supplier to see if they support any watchdog cards. We're not aware of any that do, although we suspect that some of the very high-end systems might.

3) Software is Shut Off

What if someone using the PC shuts down the automation program, either intentionally or accidentally, and doesn't restart it? Maybe your kids are playing a computer game that needs all the PCs performance, so they shut down the automation software. Your system is down until they restart it (if they remember to).

4) Computer Failure

If the PC fails, your automation system will obviously not function. Most modern PCs are well-built, but they're typically designed for a five year life, and failures do sometimes occur. A PC contains a lot of parts that can fail. There are many megabytes of RAM and thousands of connector contacts that are susceptible to problems. Hard disks and fans wear out, power supplies fail from overheating, etc.

A computer is also very susceptible to lightning damage because it is connected not only to the power line, but usually to the phone line also. You can add a surge suppressor, but most surge suppressors aren't designed to protect against a lightning strike. A UPS also does not normally protect against lightning.

5) Automation Hardware Problems

The PC software by itself won't accomplish much without hardware interfaces to communicate with your home. You'll probably have one device for X-10 communications. If you want capabilities like infrared, digital inputs, analog inputs, and so forth, you'll have more devices connected to your PC. All of these are susceptible to problems such as:

- Hardware failure
- Design bugs
- Problems communicating with the PC due to software/hardware timing issues
- Intermittent bugs due to the PC software not properly interfacing with the hardware (this is especially common when the hardware is designed by another company and not accurately documented or the software developer doesn't fully understand how the hardware works)

The more devices you connect to the PC, the greater the chances for problems. If you have to add more than two devices to get the capabilities you need, you should seriously consider a standalone system that integrates them into a single unit.

The bottom line on reliability of PC-based systems is that only a dedicated PC (with a UPS, a watchdog timer, etc.) can provide the reliability expected by most end users. Even then, there are many potential failure points in the system. This is why very few home automation installers will install a PC-based system, except on a dedicated PC. They cannot afford to have the system go down, especially while the homeowner is away and the system is controlling HVAC and security functions. On the other hand, users who are willing to put up with occasional downtime, and who don't rely on it for critical functions like HVAC and security, are often happy sharing the PC with the residents.

STANDALONE SYSTEMS

Standalone systems avoid most of the reliability problems associated with PC-based systems. There's no other software to crash and no need to worry about someone shutting down the automation program or leaving a disk in the floppy. The hardware itself is usually more reliable, as there are typically no large power supplies, fans, or hard drives. The total number of parts and the memory size is much smaller, meaning there are a lot less potential failure points. More features are typically integrated into a single unit, avoiding the multiple devices (and failure points) used for PC-based systems.

Since standalone systems are specifically designed for home automation, they often incorporate features to enhance reliability. For example, HomeVision has a built-in watchdog timer. If a major error occurs, the unit will restart within a few seconds. It also has power failure detection circuitry and an automatic recovery process. It will resume operating within a fraction of a second after power is restored. It is also smart enough to know what events should have happened while power was out, and will perform them when power is restored.

For the above reasons, standalone systems have *many* inherent reliability advantages over PC-based systems. A well-designed standalone system will be *much* more reliable than a well-designed PC-based system. No matter what you do to increase the reliability of a PC-based system (even if you add redundant processors and disk drives) you won't match the reliability of a good standalone system. There are still many more potential problem areas with a PC.

The above paragraphs aren't meant to imply that all standalone systems are reliable. In fact, there are some that are notoriously unreliable (just check the comp.home.automation newsgroup to hear the complaints about them). The main problem area is the "embedded" software. This software manages the entire automation system, including all the timing-critical interfaces, which is a complex task. For mid-range and high-end systems, it may be performing X-10, infrared, and serial communications simultaneously, requiring microsecond-accuracy control and response. In contrast, PC-based systems leave these low-level details to external hardware devices. Writing, testing, and debugging such embedded software is far more difficult than for PC-based applications running under Windows. Consequently, bugs are more likely. When selecting a standalone system, we recommend you choose one that's been around a while and has the bugs worked out. Of course, this same warning applies to selecting the hardware interfaces for a PC-based system, as those devices have the same potential problems as standalone devices.

HYBRID SYSTEMS

The reliability of hybrid systems is usually driven by the reliability of the standalone device. Since these are typically quite reliable, so are the core home automation functions they perform. The PC software portion faces all the same problems as with PC-based systems. However, there's one critical difference: *if the PC software stops running, the core automation functions (performed by the standalone system) still work*. Perhaps voice recognition or Internet access is lost, but at least your security, HVAC, and lighting systems continue normally.

COST

This section compares the cost of the three system types. In general, the cost isn't driven much by system type (unless you require a dedicated PC). Instead, cost is mainly a function of how many features the system provides and how much profit margin the manufacturer demands.

PC-BASED SYSTEMS

A variety of factors will determine the price of a PC-based system:

- The selected software is the most obvious cost. For low-end systems, commercial and shareware packages are available in the $50 range. More powerful packages may cost $100 to $400. Some of the higher-end packages are sold in pieces, so be sure to add in the cost of every feature you want, as the total can easily exceed $1000 just for the software.

- Hardware costs. The software by itself won't accomplish much without the hardware interfaces to communicate with your home. Some software packages come with an inexpensive X-10 interface device that attaches to the PC serial port. Others require a separate X-10 device (the ActiveHome CM11A or CP290 are commonly used, and are inexpensive).

  If you want to do more than X-10, you'll spend more money. There are add-on devices available for many functions, some of which are listed below. These devices typically cost from $100 to $200 each. Simple systems may require only one extra device, but more complex systems could require 8 or more boards.

- X-10
- Infrared output and/or input
- Digital/analog/relay output and/or input
- Video output (to a TV screen)

Most software programs only support a limited set of the available hardware devices. Be sure the software you're considering supports all the interfaces you may want in the future. It's less expensive to buy a more capable automation package now than to buy a cheaper one but scrap it later when you outgrow it.

- If you want multiple hardware interfaces, you'll probably need several serial ports to connect to them. Since most PCs have only one or two such ports, be prepared to add an extra serial port card ($50 - $250). Unfortunately, the additional serial ports increase the chance of hardware incompatibility and software bugs.

- Dedicated modem. If your automation software uses a modem, you may need a dedicated one for it. While it's possible to share a modem if it and all your software support TAPI (Telephony Application Programming Interface), this is the exception rather than the rule. If your automation software constantly accesses a modem for caller ID information, and it doesn't support TAPI, you'll have to shut it down when dialing your Internet service provider through the same modem (don't forget to restart it when you hang up!). A dedicated modem avoids this problem, and modems are inexpensive today.

- A UPS and/or watchdog timer card for your PC. These would typically cost around $100 each. If you need the UPS to keep your computer running for several hours, you'll need a more costly UPS.

- If you choose a dedicated PC, and don't have a spare one handy, you obviously must include the cost for it.

The bottom line on cost is that a PC-based system often initially *seems* to be the least expensive approach. It frequently is for low-end systems, and provides an inexpensive way to get your feet wet in automation. But as your needs expand, the costs quickly add up. In the long run, you'll often find that a standalone or hybrid system can do the same things for less money.

STANDALONE SYSTEMS

Standalone systems generally cost around $300 and up. This is more than the low-end PC-based systems. However, most standalone systems are similarly priced or lower priced than equivalent PC-based systems (this is especially true with systems in the $500 - $1000 price range). There are two main reasons for this:

1. Standalone systems usually integrate more features into a single circuit card. For example, HomeVision provides X-10, infrared, serial communications, 24 I/O ports, and video input/output in one card. PC-based systems usually require multiple cards, which cost a lot more to design and manufacture (although integrated add-ons like HomeVision-PC, LynxPort, and IR-X help keep costs down for PC-based systems by integrating multiple functions into one unit).

2. Standalone systems usually come with all the necessary PC software. In contrast, PC-based software and the required hardware devices usually come from different companies. Each company needs to charge enough to pay back their investment and make a sufficient profit (everybody expects to get rich off their business!). Standalone

systems involve only one company, so they can accept a lower overall markup and still make a satisfactory profit.

High-end standalone systems ($10,000 and up) are a different story. Their price is usually based on what their customers are willing to pay and the time it takes to install them (since they are rarely do-it-yourself systems). For these systems, standalone versus PC-based decisions are usually irrelevant as a cost-determining factor.

HYBRID SYSTEMS

Some standalone systems come with PC software that adds capabilities. For example, you can use the free HomeVision software to:

- Control it from the Internet
- Play wav files on the PC
- Run other programs
- Send keystrokes to other programs (which can then send an e-mail or fax, for example)
- Write and read text files
- Send and receive data from other PC serial ports

If you want other PC capabilities, you'll need to buy other PC software. Programs like HAL2000, Home Voice, ECS, ACE and other shareware programs typically cost between $50 and $300 and add a wide range of features.

POWER CONSUMPTION

PC-BASED SYSTEMS

A PC consumes a good deal of power while running. Fortunately the monitor can be shut off, and it draws the most power. Newer computers are more energy efficient than older ones, but can still cost a good bit to power continually. For example, a system drawing 50 Watts requires 438 kilowatt-hours per year. At a rate of, say, 10 cents per kilowatt-hour, this amounts to $44 a year.

STANDALONE SYSTEMS

Most standalone systems are extremely energy efficient. For example, systems like HomeVision, HouseLinc, and TimeCommander require less than 1 Watt of power, costing about $1 per year to operate. Because standalone systems consume such little power, you can easily power them from a UPS and keep them running for days while power is out. A PC-based system couldn't run nearly as long. Although there are some capabilities that obviously aren't needed when power is out (such as turning on lights), there are some instances it could be useful:

- The automation system can still communicate with your security system (which should run from a backup battery)
- The automation system could report the power failure using the phone line. This is especially useful while you're away from home or for a vacation home.

HYBRID SYSTEMS

Since hybrid systems require both a standalone device and a PC, their power will be a sum of the two.

EQUIPMENT SIZE

PC-BASED SYSTEMS

Using a dedicated PC requires space for it. If you're setting up a "wiring closet", be sure to leave enough room for the PC, keyboard, and monitor.

STANDALONE SYSTEMS

Most standalone systems are quite compact. For example, systems like HomeVision, HouseLinc, and TimeCommander are all about 2" X 5" X 6" in size and can fit most anywhere. They also typically provide easier access to wiring connectors than PCs do. Higher-end systems are larger, some about the size of a PC (in fact, some are really PCs in disguise).

HYBRID SYSTEMS

Since hybrid systems require both a standalone device and a PC, their size will be a sum of the two.

NOISE

PC-BASED SYSTEMS

Both the computer hard disk and fan make noise. Whether this is objectionable obviously depends on where the PC is located and how close the residents are to it. Some users have been known to disconnect the fan to reduce noise – after removing or cutting holes in the cover to keep the system cool. However, this can lead to dust collection and eventual failure.

STANDALONE SYSTEMS

Most standalone systems make no noise at all (expect perhaps when a relay is switching).

HYBRID SYSTEMS

Since hybrid systems use a PC, they will make the same noise as a PC.

CONCLUSION

Each user must evaluate the alternative system types and determine which best meets their needs. However, for many users, reliability will be the key factor.

Our experience with home automation newcomers is that they initially aren't too concerned with reliability. They don't mind if lights sometimes don't come on at the right time or if the thermostat doesn't change its setpoint. However, as time passes, reliability becomes more important to them. Maybe they simply get tired of all the time and money they've spent, only to have the system continue to fail occasionally. Or they realize it could be bad if the security or heating system fails while they're on vacation. Or their new spouse is tired of the lights not coming on when she tells them to. The bottom line is that a system that was initially considered fine is no longer acceptable due to insufficient reliability.

Any PC-based system will inevitably have many more problems than a well-designed standalone system. In the end, you'll probably find that you fall into one of these categories:

- “I can’t keep a PC running, so I need a standalone system.”
- “I need a very reliable system, and therefore should use a standalone system.”
- “I need a reliable system, and can use a standalone system or a hybrid system. If the PC portion of the hybrid system fails, at least the standalone part will work.”
- “I really want a PC-based system, but need pretty good reliability, so I’m willing to dedicate a PC to it.”
- “I’m not that concerned about reliability, and therefore can select any type of system.”

Once you’ve decided which system type(s) are suitable, you’re ready for the next step: Choosing the actual system. We’ll discuss that in another article …..