

How to Design a Suitable Computer for your Needs

Note: This tutorial assumes you know how to assemble a PC. This tutorial was originally targeted at a particular forum, hence the references to 'Atomicans'.

Recognising the Uses of the Computer Build

When designing a computer, you cannot just decide on a budget and then throw whatever fits within the budget into the build. You must have an aim for the PC. Whether this aim is video editing, gaming or word processing, you must establish your goal before the design commences.

The Budget

After you have thought about the intended use of the PC, you must think about your budget. Your budget should generally be the highest you are willing to pay for the PC. Don't get too enthusiastic, if you can't afford it, lower your budget. Remember that you're not going to get a new PC for under \$500, and if you do manage to do it, don't expect quality. A good benchmark would be \$1000+ for a decent PC.

Recycle!

One of the major goals for a PC designer is to extend the budget as far as possible. One of the easiest methods of doing this is to recycle useful parts from a previous PC. These parts may include the case/tower, optical drives, peripherals etc. Please be careful with what you are keeping for the new system. One of the worst things you can do to a system is 'bottleneck' it. For those of you who don't know, 'Bottlenecking' is when a component in your system is slowing down other parts due to its lack of speed or efficiency. For example, a slow CPU (Central Processing Unit) can affect the GPU (Graphics Processing Unit), possibly the speed of optical drives, and maybe even the HDD (Hard Disk Drive). Essentially, you can spend thousands on an upgrade which is useless due to a 'bottleneck'.

Bottlenecking and How to Avoid It

The easiest way to avoid bottlenecking is to do some research. A quick Google search can provide a wealth of information. Another way is to ask other Atomicans if they have experienced any bottlenecking on certain parts. If you are keen, a bit of careful overclocking can ease some bottleneck issues. For more information on overclocking, see: <http://www.atomicmpc.com.au/forums.asp?s=2&c=6&t=510>

Getting into Gear - What parts should I get?

Going back to your aim for the PC, you base the specifications of the parts on the tasks you require the PC to perform. Here is a quick guide for what you should get for different systems:

Gaming

The main requirements for a gaming PC are decent specification GPU, CPU and RAM. If you desire a rig that caters for the highest settings and the latest games, a high performance GPU and CPU are in order. At present day, 2GB of RAM would be considered minimum and possibly a copy of Vista Home Premium/Ultimate for DirectX 10 gaming. The GPU should be from the latest generation e.g. Nvidia 8800GTX and the CPU should be minimum dual core with a decent cache and clock speed. An good example is the new E6300 for high performance gaming. When choosing a monitor, please keep in mind that the higher the resolution, the less FPS (Frames Per Second) you will get. Sometimes this will mean that you have to get better GPU than originally planned. Search Google for benchmarks using different resolutions. This will help you decide which card is best. Remember that this is a guide which includes some unnecessary high performance parts. This power may not be required for your design. Use research to find the "sweet spot" of performance/price.

Video Editing

Similar to gaming PCs, video editing requires a moderately powerful CPU, fairly recent GPU, a large amount of RAM and a huge HDD. 2GB of RAM would be considered minimum and a modern dual core CPU (a Core 2 Duo would be optimal at this stage). The sound processor can be either bought separately or inbuilt into the motherboard. Inbuilt sound is usually of a high standard, but for audiophiles a separate sound card is a must.

Word Processing/Office PC

These PCs are the cheapest to build due to the lower specification requirements. A single core CPU would suffice although the dual cores are fairly cheap presently anyway. The GPU can be inbuilt into the motherboard because it doesn't have to be powerful, as with the sound processor. The HDD can be as large as required, but is generally

smaller than gaming and video editing machines. Depending on the OS (Operating System), the PC should have 512MB+ of RAM minimum when running XP.

What am I looking for when researching?

When you are researching parts for your build, you need to consider a few critical factors. These factors are:

- **Cost vs performance** (also known as "The Sweet Spot")
- **Upgradeability**
- **Features** (such as extra USB ports etc.)
- **Freebies** (this is usually associated with GPUs)

They are the main elements to look out for. Below is a quick guide on what to look out for when buying different components:

Motherboard

The motherboard is where all your components connect to and communicate with each other. The upgradeability of this component is much sought after when designing a PC. The things to look out for are:

- The CPU socket type: Does it cater for future upgrading? Is the socket type already outdated?
- RAM frequencies supported: Can the motherboard support high end RAM if/when required?
- Type of expansion slots: Does the motherboard have PCI-e slots etc.?
- Amount of expansion slots: Is there enough slots to cater for your needs?
- Specific technology support: Does it support technologies such as SLI/Crossfire if required?
- BIOS options: Does it have advanced options if overclocking is desired?
- Inbuilt services: Does it have inbuilt audio and LAN if essential?
- Ports: Does it come with USB and Firewire ports built in?

RAM

RAM is fairly easy to research. The main things to look out for are frequency and latency. Latency is displayed in the form 'y-x-x-x' where 'y' and 'x' are numerals. Without getting into detail, all you have to remember is that the 'y' should be as low as possible. The 'y' is also referred to as CL (CAS Latency). The frequency of the RAM is opposite to this, the higher the number the better. As a benchmark, start with ~667Mhz RAM. If you plan to heavily overclock your system (and change FSB values), an 800Mhz or higher rating would be optimal.

HDD

Researching a HDD is fairly simple. The standard for PC HDDs is 7200RPM. Faster models are available which run at 10000RPM, but they run louder, hotter & generally use more power. When researching, look out for fast seek times and low noise output.

GPU

GPUs have become quite complex in design recently. The best way to find the GPU you need is to search Google for benchmarks. Try and acquire a DirectX 10 card (if your budget allows it). Make sure the card you choose can support the resolution of the monitor used in your rig. Benchmarks should help you with this decision. Make sure you focus on the minimum FPS not the maximum, after all you don't want any lag while playing games. Look out for added freebies which are bundled with some GPUs. Sometimes some expensive games/software are included which you may want/need. Be careful not to buy a card because it has expensive extras if you don't need them. An exception to this is if the GPU is cheaper than other brands anyway. Be sure to check if the GPU is SLI/Crossfire enabled if you need it (for a high resolution monitor).

Some companies such as XFX sell pre-overclocked GPUs. These cards are a good choice if you can spare the money. Generally these cards can be overclocked even further, which is a bonus. Don't invest in a SLI/Crossfire setup as an upgrade, it is better to get a new single card in most cases.

Case

There are 5 types of cases. Small Form Factor, Minitower, Midtower, Full Size Tower & Desktop. Full Size Towers are the best choice for upgradeability, but they take more room than the other cases. Midtowers are the most common choice because they use less room yet still have enough space for extra HDDs etc. A note to keep in mind is that some GPUs require a large case to fit. An example is the 8800GTX. If you are recycling an old case, make sure it suits the new ATX style motherboards and PSUs (Power Supply Units). Anything before 1995 will most likely not support this standard.

Some cases come with PSUs pre-installed. Make sure the PSU can handle your chosen components. (See the PSU section for more details).

CPU

The CPU is the 'brain' of the PC. Choosing the correct CPU for your components is a hard task, and requires more research than other components. The CPU must be able to keep up with all the other components to avoid the dreaded 'bottlenecking' problem. It is usually the GPU that strains the CPU the most so keep that in mind when doing your research. Google will help the most with research, look up benchmarks and reviews to guide you. Remember that clock speeds are not the only factor that determines a fast processor. Cache, multiple cores and architecture all play a part in performance.

Optical Drives

Optical drives are easy to choose. A DVD writer with 18x reading capabilities should suffice, although some have better features and are more efficient though. Again research is great to select the right one. Most drives come with OEMs (Original Equipment Manufacturer) CD/DVDs. Usually this software is Nero.

PSU

PSUs are easy to select. Try to steer clear of generic brands, after all this is powering your system. PSUs are rated by wattage, and it is vital to choose a PSU with enough grunt to power your components. Search Google to find the wattage required by each of your components, then add them up to find what it required. Just to be safe (and futureproof) get more than is required, but don't go over-the-top.

Monitor

Monitors are mostly personal preference. The two major types are CRT and LCD. LCD is the best option for most situations. LCDs are compact, crisp and comparable in quality to CRTs. The things to look out for in LCDs are contrast ratio, and refresh rate measured in ms (milliseconds). The lower the refresh rate, the faster the monitor reacts when pixels are 'told' to change colour. Try to get a 8ms or faster LCD to reduce ghosting. Obviously it is optimal to get the fastest as possible given your budget. Contrast ratio is the difference in luminosity between the highest and the darkest shades the monitor can display. This is displayed in the form 'x:1' where x is a numeral. The bigger the 'x', the better the contrast ratio is. Aim for 800:1 or higher, 500:1 would be minimum.

CRT monitors have very fast refresh rates compared to LCDs. The refresh rate in CRTs is measured in Hz (Hertz). The higher the Hz, the faster the refresh rate. 75hz is a good frequency; try not to go below 60hz. Good quality CRTs provide a better picture than LCDs, which may be essential for multimedia applications & possibly games.

You might want to look out for 'dot pitch' in monitors, this is the gap between pixels. It is measured in mm (millimetres). The smaller the better, BUT they can be misleading. Try to judge with your own eyes if possible.

All in all, the best thing to do is read reviews and try the monitors out yourself.

Have I chosen what's required?

You must remember your budget! Getting the best of everything will most likely kill the budget. This is where research is required. Again, Google & Atomic are great resources to find reviews and specifications on different components. A great little tip in Google for comparing different components is to write, for example, "8800GTS VS 8800GTX" (with or without the ""). Remember to look at multiple different sources to confirm your findings. If you believe you have designed a system worthy of being bought and constructed but need verification, don't hesitate to post your findings on Atomic where we can check it for you for mistakes/improvements.

What about cooling?

Stock cooling is generally enough for your PC to run without a problem. This situation can change if you have either:

- High performance parts
- Overclocked parts
- An obstructed airflow eg. Messy cabling

If you do experience overheating due to obstruction, try tying the cables together and place them out of the way. If the problem is due to high performance gear or overclocking, then extra cooling is required. This may be in the form of extra fans/heatsinks, better thermal paste or water cooling systems. Remember that water cooling can be louder than extra fans! Try and place the extra cooling systems where the heat is being generated for more efficiency.

Where do I get the parts?

A challenge when building a PC is finding cheap parts. Thankfully there are search engines that can do most of the

hard work for us. Atomic has its own component search engine which can be found here: <http://www.atomicmpc.com.au/shopping.aspx> Another popular search engine is: <http://www.staticice.com.au/index.html> Try and get all your parts from the least amount of different resellers as possible. It will make your life easier if parts don't arrive, or if you have any problems to follow up.

Can I start buying now?

Have you researched the compatibility of all the components? Can all the parts fit in the case you chose? Have you gone over the budget? Can you do more with your budget? Use these questions to make sure you are ready to spend your hard earned cash.

Now can I buy stuff?

Yes, but don't blame me if something bad happens. :P

I just realised that I don't know how to build a PC...

That's fine. Most computer stores can build your PC for a small fee. If you are fairly confident in doing it yourself but want guidance, there are many resources that can help:

- Your motherboard manual
- Online tutorials
- Atomic forums

I built the PC, but it isn't functioning properly...

There can be many reasons for this. A Google search can assist you, or this thread from these forums:

<http://www.atomicmpc.com.au/forums.asp?s=2&c=8&t=15955>