

The SDR PC



The following article has been pulled from and adapted from the PC SDR Supplement Guide I wrote earlier this year. A link to the complete guide can be found at the bottom of this article. Again, some information in this version may be more up to date and generic than the content found in the guide.

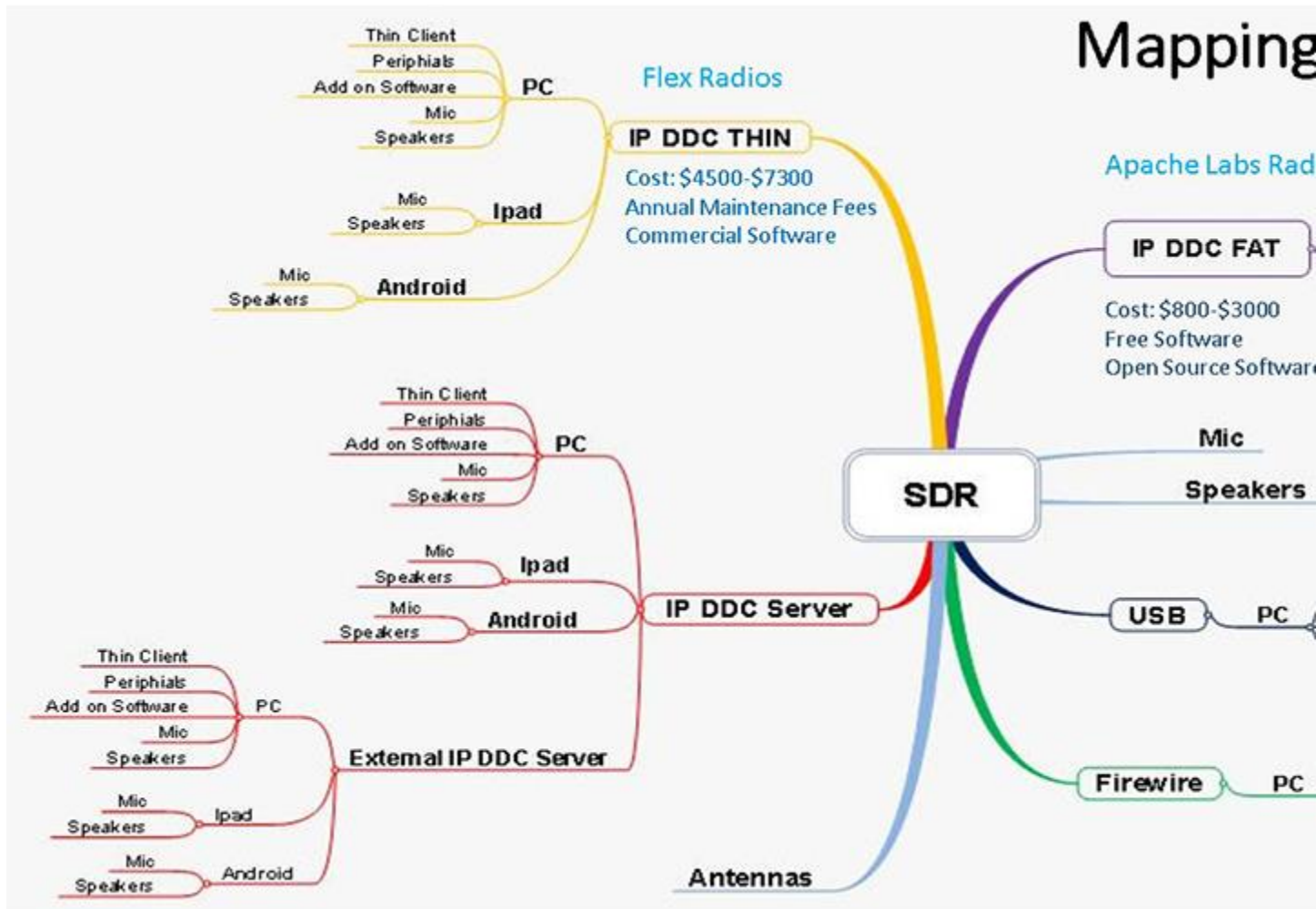
While this subject may be obvious for some I decided to cover it here on the site anyways. Feel free to skip it if you already understand this concept and move to the PC Building piece of the article if it interests you.

Currently we have a crop of NEW Direct Conversion predominate SDRs out in the market and they take slightly different approaches to processing RF. At a very high-level the new Flex radios take the signal in, filter it, convert it and completely process it within the radio. A thin client can then access the radio over an Ethernet Network connection to provide console functions which will include Panadaptors and Waterfall displays. This approach was taken to reduce the support costs that are associated with

the second type we see available. SDR's like this require very limited computing resources and will eventually represent the path for the future as it will open up SDR use to many more devices and users.

SDR's like the Anan's, SunSDR, Afedri and others have Open Source roots whereby the idea was to keep the cost of SDR's low. The new DDC radios take the signal in, filter it, convert it to digital and send the Digital RF data to the fat client on a PC for processing. The data is passed over an Ethernet Network connection to the FAT client console which in turn processes the signals and provides the functions which include Panadaptors and Waterfall displays. This approach was taken to reduce the overall costs of building SDRs. In some case that cost is transfered to the user in being able to provide an adequet PC.

There are a variety of FAT clients available and some SDRs provide a server client on the PC that can process signals and feed them to thin clients running on the Same PC or other PC's and eventually devices.



The Mind Map pictured below shows some of the variety of SDR types at a very high-level

The fact that the PC does a considerable amount of the heavy lifting in most of these models makes it important to have the right PC in order to have a smooth successful problem free operating experience. It's also very important that the end user of these type SDR's have some solid PC knowledge.

Considerations for the PC include the Operating System, the type of CPU, the amount of RAM, the Speed of Hard Drives, the Motherboard and the Network Cards/Interfaces.

The fact that there are so many variables is what in large part has driven Flex Radio to move the PC portion of the processing back into the radio.

As Hams though, we are often willing to forgo convenience for the sake of cost savings. And the reason you are reading this article is most likely because you are opting or seriously considering buying one of these other types of SDR radios. Also, it's more fun for some to build rather than buy!

A key to remember in your SDR purchase decision is that there are often limited support systems in these Open Source radios and so you as the user has to adapt and learn to ***DO For Yourself*** in many cases. Many Do-it-yourselfers own these radios and are going to think you're lazy and dumb if you don't read manuals before asking questions.

It is for that reason I have been writing guides to help users get up to speed on some subjects so they have better experiences buying, configuring and operating their radios.

We are going to assume that you're interested in or already own an Open Source or PC Centric SDR and that's why you're here reading this guide.

Next we'll cover choosing a PC for SDR Radio. By far the biggest mistake I have seen new SDR users make is thinking that simply buying a new 3Ghz PC is all they need for their radio. It's not that simple and the next section explains why and what to really look for in that new PC.

What do I really need?

In large part what you need is based on your operating intentions. I encourage SDR Users though to look ahead. If you see yourself wanting to do more and more progressively complicated operating and start integrating lots of software packages and or running multiple receivers on some of these to consider a more powerful computer. Its easy to get started but very frustrating when the PC starts limiting your ability to operate the way you want to. I knew I would be off the deep end and that why I personally built a powerhouse.

You can use the following as a very loose informal high-level starting selection guide!

Simple Operating Modes - SSB, CW, PSK31 = Light Modern Computer or Laptop

Covers Radios like the following in limited operations

Flex 6K Series, Afedri, KX3, QS1R, FunCube Dongle Pro Plus and similar

Moderate Operating Modes - Advanced Digital Modes and Limited Multi RX = Moderate Modern Computer or Laptop

Covers Radios like the following in modern operations where latency starts to become an issue.

Anan Series, Flex Legacy Series, SunSDR2, WinRadio and similar

Heavy Operating Modes - Advanced Digital Modes, Multiple Ham Radio Software packages running and Multi Receivers = Powerful Modern Computer

Covers Radios like the following in heavy operations, lots of multi tasking where latency needs to be minimal and stability is paramount.

Anan Series, Flex Legacy Series, SunSDR2, WinRadio and similar

What follows next is a small synopsis on understanding and choosing components in your future PC, whether you decide to buy it or build it.

Parts and Pieces of the PC

You are considering an awesome SDR Radio and now you need to understand your computer's role in your road for success in getting the most out of your SDR.

Computer selection is really subjective and I can guarantee that many Hams will disagree with a lot of what I am about to share with you. My goal is not to sell you a PC or even dictate what you get, it's to try and inform you and help steer you to success.

Windows 7 is the best bet for an OS right now. Windows 8 is not ripe yet as of this writing. May 2013.

Windows 7 in short was Microsoft's giant bug fix for Windows Vista. Today it's pretty mature and probably close to as stable as it will get. I personally am running Windows 8, but there were a few little tricks I had to learn about getting things to work. A lot of that has tapered off now and its better as newer versions of Ham software come out and better support it, but there are still driver quirks, ect. Again, if Windows 7 is there for you to use, use it. If not Windows 8 will do and as of today I have no Windows 8 specific issues in my own setup.

Why not Windows XP? Well, its out of support for one and second it has limits on how much memory you can actually address and use. You don't want to be limited to a few gigabytes of RAM. If not for that, you have many updates and optimizations today in the newer Windows. I believe you want to set yourself up on something you can use for a long while.

Let's take a brief moment to consider Linux as a base operating system. Linux is actually a very fine stable operating system available in a variety of flavors. I would say though that you need to be more adept with computers if you want to take on Linux. Some radios don't have software for Linux either so you may find yourself trying to compile code so you can operate your radio. Still, if you want to go with Linux, just do some research and make sure you will have all the software you want. Other than that I have no negative comments about it. You will find that Linux is actually faster overall and consumes less of your PC resources.

Let's talk hardware!

The more the better! Yup, here is where Hams often cheap out! Don't do it if you want to run these types of SDR's and have future room to grow and expand. And don't believe that the more expensive, the better! It's not true! Beware though that there is quite a bit of difference in some computers you buy verses others. The difference in CPUs can represent huge multiples of performance differences. One CPU might for example Benchmark out at 2000 on a passmark score and another might come in at 14000. The

difference here can be as little as \$200 - \$400 between the two. The latter of the two will give you a machine that will last a few years longer than the former in terms of keeping up with new software and new operating systems.

When choosing a PC go to Passmark.com and look at the CPU charts and compare the CPUs of the PC's you own or are looking to buy to each other and the chart. The passmark site is an awesome resource for PC buyers and Builders. They even have software you can download and install on a PC for free and test it and get reports on all of the components I am about to cover with you next.

The i7 3930K is a great value CPU! 6 cores and wicked fast for about \$500. 12,000 PassMark score. Usually more cores are better and the CPU will have a huge impact on your computers overall performance and ability to run lots of software and SDR receivers simulataneously.

PassMark - CPU Mark High End CPUs - Updated 30th of May 2013



Above you can see a small portion of the High End CPU chart and cost. Let's look at the Midrange Chart and see how different it looks in both performance and cost.

PassMark - CPU Mark High Mid Range CPUs - Updated 30th of May 2013



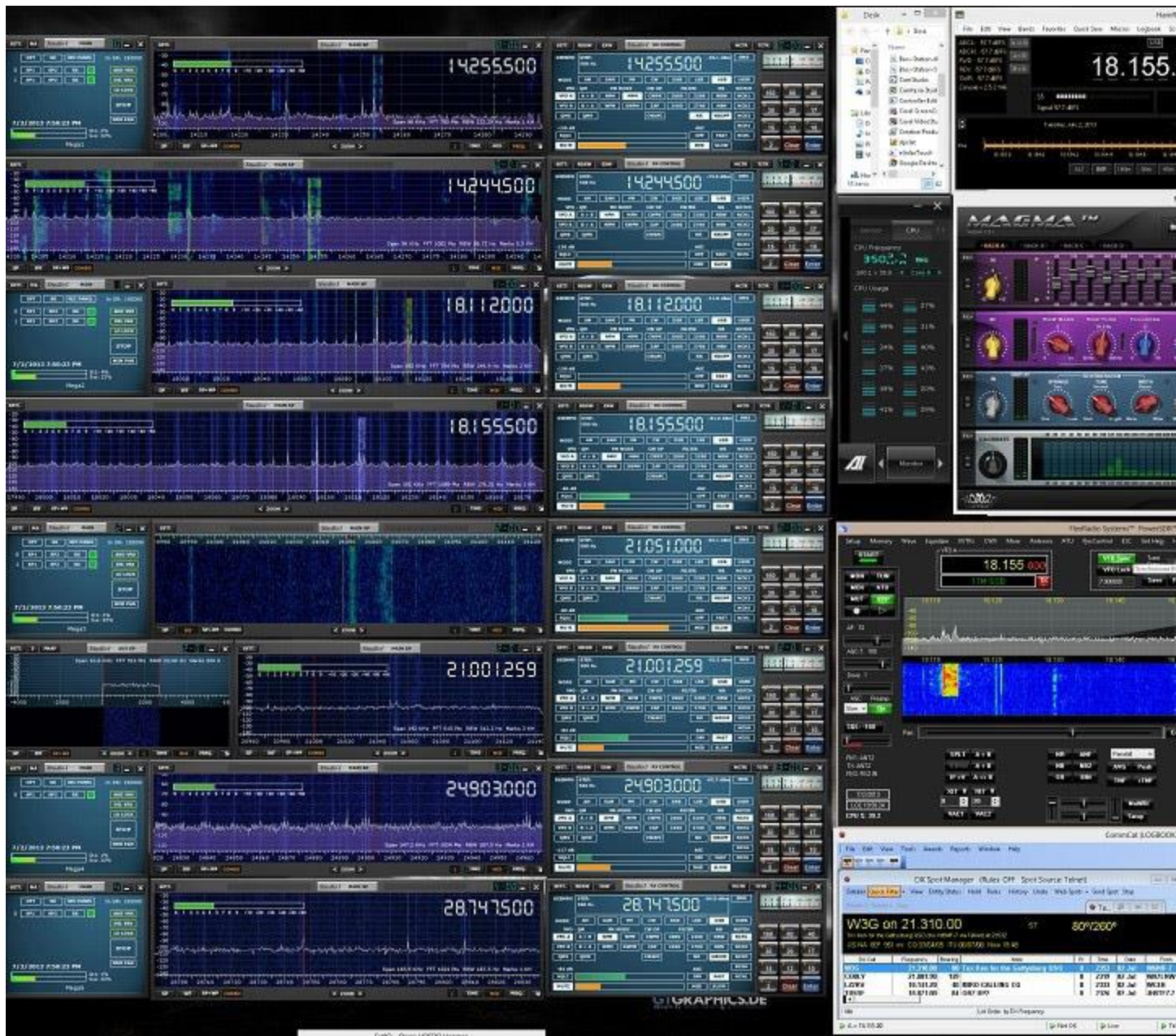
Many commercial PC's you buy from retailers will include CPUs from this second chart. Notice the seemingly high clock speeds but how much lower the performance scores are. This is one of the most confusing aspects of buying a good PC. I see many hams say I bought an i7 3ghz PC but I am having problems. Well, take a look, which i7 cpu is in the PC they bought, the one that scores 2000 or the one that scores 12000? There in lies part of the problem.

For an SDR computer with expandability to run multiple receivers and multiple Ham programs I recommend a CPU scoring 10,000 or higher.

Just to give you an idea, while the i7 3039K shows 12000 on the high end chart, mine scores about 14,300 in real life on a test on my PC using the same Passmark Software you can download and run.

You can easily get your radio to work with far less PC, so that is not my point here. It's about running with a nice bit of overhead room to grow. Many hams seeing my quad displays get lured into wanting to run quad displays as well. It's not as simple as buying a video card and monitors. What many hams fail to realize is that o leverage those displays they are likely going to run lots of software all at once to fill up the displays. That's where things really start to break down and where many hams suddenly find their PC lacking the power to do it all!

Recently I ran several receivers simultaneously to monitor conditions and signals across 5 Bands on one SDR while running Transmit and Receiver on a second SDR. See picture below. This managed to consume about ½ of Hamzillas CPU resources. Had I not overbuilt I would have had serious issues attempting something like this. Incidentally, I do plan to eventually really run band monitors while operating, so this is a real scenario for my station.



Buyer beware though, just because i was only using half the CPU doesnt mean I wont have latency or othe rissues. Wait before going out and buying a new PC and try your radio out on the one you have. If you see it straining the CPU then you can decide what to do from there. I guess what I am saying here is that you may need to be mentally prepared to buy a new PC to go with that cool new SDR you purchased depending on your own individual circumstances.

Baseline your PC with some of the tools shown in this PC SDR HELP GUIDE. Performance Test, Latency Checker or even performing Control Alt Delete and looking at resource usage in task manager. These tools can help you see ahead of times if your PC is having issues that will only get worse when you start using demanding SDR applications.

One factor to consider as well is that generally computers with better faster CPUs will have better faster Motherboards and integrated interfaces. These Motherboards also have all the interface ports which will also tend to be better. If they did not put better parts around a better CPU it would tend to create a very unstable system. This actually used to happen a lot where power consuming peripherals like high-end video cards would overwhelm the power supply in the PC.

You can also download Passmark for free and see how your CPU and overall computer scores to get an idea of where you sit.

The number of Cores, Processor Speed and Caching all are a factor in your decision if you want to get it right. Look for Hyperthreading and number of threads supported as well. Here is the link to the spec sheet on the i7 3930 for you to see what all is captured. Take a little time to learn what each spec means and how relevant it is. A great way to do that is to look at spec on the lower end processor and compare. You can see what starts to equate to higher performance.

http://ark.intel.com/products/63697/Intel-Core-i7-3930K-Processor-12M-Cache-up-to-3_80-GHz

Motherboards

Before you can finish choosing a CPU you need to understand a little bit about Motherboards first. Most of the heart of a PC is contained on the motherboard. All the IO control chips and processor support chips. The motherboard has different socket types for the CPU and so not any CPU can go on any motherboard. You have to match them. Granted, when you are looking to buy and already assembled PC you won't have to worry about that particular issue. I have had great luck and stability with Intel chipsets. More than likely they are going to match the Motherboard and chipset pretty well to the CPU you want.

Here is a link on chipsets if you want to learn more.

<http://www.hardwaresecrets.com/article/191>

One last note here on this because as I said before, all the IO [Input Output] is going to be managed and provided on the Motherboard. This will determine how many USB Ports and Ethernet Ports you get to name a few. Deepening on how you go it might also provide your video card and sound card built into the motherboard as most commercial PC's today already provide. Make sure you get some USB 3.0 ports, a Firewire Port if you can and two Ethernet Ports (each gigabit capable) if you can. All this allows for expandability. You might want to make sure you have some PCI 3 compliant PCI slots as well so if you want a better sound card or video card your computer is ready to add them.

Let's talk about RAM next!

You want a good amount and you want it to be fairly fast! The way PC's are architected is often the weakest link dictates your overall performance. If you have a lightning fast CPU and a slow slow hard disk your going to have bottlenecks. I will include some cool tips late on how to get around some of that, however let's stay focused on RAM.

As you might imagine, Passmark has scores on all kinds of RAM performance.

PassMark - Memory Latency Top DDR3 Memory Modules (w/ Intel CPUs) - Updated 31st of May 2013



Keeping this as simple as I can without explaining RAM in detail, go with about 16GB of DDR3 2022 RAM or better. You can ask your sales person about RAM speed when choosing your PC. Don't take a sluff off answer like "I assure you it's Really Fast!". Ask what specific type it has and compare it on Passmark to make sure it's up there in the faster but not crazy expensive realm. If you want to really get into it you can dig into latency and read and write times. This type of Ram is going to run you \$400-\$500 for the 16GB.

Here is a link to learn more about RAM if you want!

<http://www.hardwaresecrets.com/article/Understanding-RAM-Timings/26>

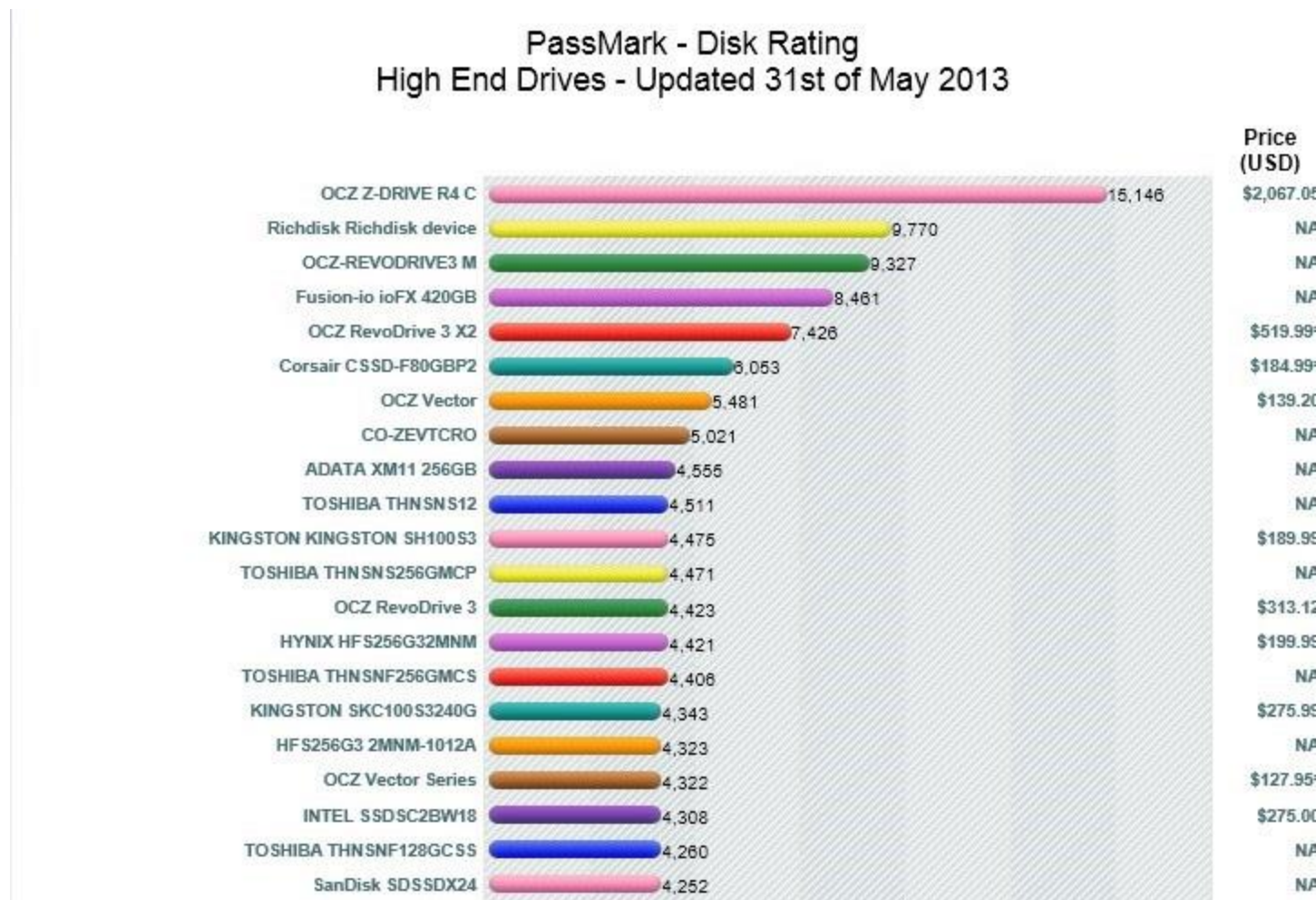
I know, it's adding up isn't it! But you likely have bought a great radio, at least get a good PC for it. And now at least you are starting to understand

what you are looking for and that if you start having performance problems where you can look and what to look for.

Hard Drives

Let's keep this simple. Fast is better. 7200 RPM or better is recommended and if you can get an SSD drive for the operating system, that's even better. Of course, faster is better and of course Passmark has information for you to look at. Here is a brief snapshot of the top Passmark scores. If you had a RAM drive it would be the fastest. Of course unless your RAMdrive is battery backed up, it goes away when you power off the PC.

Do be sure to research whatever you buy to make sure it's not so bleeding edge that it is unstable.



Fortunately you can get a good drive for around \$150 and use it for your operating system. You can use a slower drive to store files, documents, photos ect. I opted for some Samsung SSD Drives for Hamizilla.

Video Cards

Again there is a Passmark chart for Video Cards.



Your video card and hard drive and sound card are likely already chosen for you in your commercial PC you are likely to buy. More often than not unless your buying from a specialized custom PC builder sound and video will be built onto the motherboard. If you want to run multiple monitors like I do you will either want good video cards or you can opt for a display link

device that uses a USB port and allows you to connect up to 4 monitors to it. Don't expect to use a solution like the latter for gaming though.

You can cheap out here a little as far as your Ham PC goes as more than likely you're going to be viewing pretty static information on your monitors

Sound Cards

Again while your sound card is likely going to be chosen for you, you want a fairly decent one. If you are going to be working with SDRs that process IQ signals this is particularly true. On the newer DDC radios likely what you get with the PC will be fine. If it's a really cheap PC you may run into noise or ground loop issues. A simple Isolator from Radioshack for about \$20 can help you solve those issues.

More or less that's it for this section. We have walked through the parts and pieces of the typical windows based PC and some of the impacts.

In summary a good CPU and good amount of RAM will allow you to run more programs with your SDR. The RAM will also support some other tricks and tips I have for you to try later in this guide. Do your homework on your PC. Look at the Specs, make sure its got a good CPU, fast RAM, solid motherboard chipset, moderately fast hard drive and a video and sound card that suites your needs. Again, most PC's now though have the video, sound and chipset all covered on the motherboard.

Choosing a PC

So now you have a better idea of what to look for in a PC you might ask which one I should choose. I can't unfortunately tell you which one to go buy. The full guide includes a section on the one I recently built on my own affectionately called HamZilla for you to refer to, but you simply have to do the hard work on your own to get it right. PC's change daily! There is no way I can keep my eye on them all for you, however, you can use the passmark site yourself to help steer you towards the right PC for your needs.

The guide is designed to help you work potential issues. Of course it cannot be all encompassing so I am aiming to provide some help around the areas where you are likely to run into some issues and that I can help you be more prepared to address.

I am going to go out on a limb here and say that if you were smart enough to get yourself licensed for Ham radio your likely going to be able to build your own PC.

HamZilla after it was built managed to score at about number 22 on the top fastest PC's. I am sure that has dropped now as more CPUs come out and faster video cards, ect. But that shows you what you can build for under \$2000. Buying the equivalent from a custom game machine maker would set you back \$4500 to \$5000, so if performance is what you are looking for its worth your while to build verses buying. You can get most of the parts you need from NewEgg or even your local PC parts store.