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Essential Criteria to Consider When Choosing RAM

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When looking for a new computer, there are many important factors to consider before beginning your project – one of the most essential being the specifications of the RAM that will be included. Storing and transmitting the data used to function, RAM is a critical component of any computer. However, due to the variety of options available, picking the right specifications for your system can be an extremely time consuming task. To help with this process, one Computer Design Engineer at CCS has compiled a checklist of essential criteria to consider. Reference the list below to guide your decision-making process when beginning your next project.

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- Capacity

  The maximum amount of system memory (RAM) a computer will support is limited by two factors: the operating system and the system board. A modern computer with a 32-bit operating system (OS) is typically restricted by the 4 GB limit set by the OS, while a computer running a 64-bit operating system is usually constrained by the system board limitation. Contrasting widely from one model to another, the limitations on system boards depend on a variety of factors. If capacity is an issue, almost all computer systems allow the use of several smaller capacity modules as a means of increasing system memory. Combining these modules is generally a slightly cheaper solution than using one large module, and can help to achieve desired performance.

- Technology

  All RAM modules are based on a certain design technology. This electronic technology dictates the communication style the RAM and the rest of the computer use to interface with each other. Due to this functionality, each computer system is capable of working with one specific type of technology. To aid in designation, each type of memory comes with its own unique connector to prevent accidental installation of the wrong version. Currently, the most popular technology is the third Generation of Double Data Rate, abbreviated DDR3. DDR3 memory combines pairs of memory modules into one virtual module. Although having a pair of modules allows the memory controller to talk to the virtual module twice as fast, there is some debate as to how much this process helps system performance.

- Package

  The RAM package refers to the physical construction of the stick of RAM and is the second most important factor in terms of system compatibility. Today, there are only two commonly used packages: Small Outline Dual In-line Memory Modules (SO-DIMMs) and Dual In-line Memory Modules (DIMMs). SO-DIMM modules, electrically, are almost identical to the equivalent capacity and technology DIMM modules. However, as the name implies, SO-DIMM modules are significantly smaller. This decrease in size makes them the de facto standard in laptops and other small or space efficient computers. Since DIMM modules are larger and tend to be the less expensive of the two packages, they are usually found in locations where space isn't a concern (like a desktop PC), or in scenarios where a large number may be needed (as in a server).

- Error Correction

  System memory and RAM modules are occasionally affected by random electrical fluctuations, which can cause the information stored to be slightly damaged or altered.

Since this issue rarely occurs and affects so little with most systems, it is not considered to be a major problem. However, in certain types of work (such as financial and scientific), even minuscule errors are considered unacceptable. To combat this problem, Error Correcting Code (ECC) is a special feature that can be found in high-end memory. ECC memory has an extra mechanism built into the RAM modules to detect, and in some instances fix, random errors in information. As ECC is a hardware feature, both the system and the memory must be designed around this specification in order for it to be enabled.

- Registers

Registered memory, sometimes referred to as buffered memory, is designed for situations in which the computer system wants to include more RAM modules than the memory controller is capable of electrically supporting. The extra power load is supported by a register, or buffer, that is placed between the memory and the controller. The main drawbacks of the buffer are the additional delay when accessing the system memory, as well as the extra cost of the additional components. Similar to ECC, registers are usually only found in high-end systems, and both the system and the memory must be designed to support the additional register for the system to function.

- Bus Speed

The bus speed is the rate that the memory modules use to communicate with the memory controller and the rest of the computer. In general, the faster the bus speed, the higher the performance and the more data that can be transmitted in a given time period. Barring cost and availability concerns, it is almost always desirable to operate memory at a higher bus speed. In order to function at a given speed, both the system board and the memory need to be designed to work at that frequency. This is complicated by the fact that system boards and memory are typically rated using different methods. System boards will detail every speed at which they are capable of running, while memory generally lists the maximum supported speed, but will run at lower speeds as well.

- Memory Timings

Memory timing refers to the amount of delay in clock cycles that it takes from the moment a command is issued until the output is available from the memory module. Although a variety of different memory timings are available, CAS Latency (the time it takes to output read data), is the most commonly used for comparisons. When judging similar modules and settings, a lower timing will allow faster access to data and increased performance. However, the same is not always true across different technology generations. It is possible for the latency to worsen while still achieving an overall performance boost based on a bus speed increase or other architectural changes.

- Memory Rank

Memory rank refers to the electrical arrangement of the actual memory chips onboard the RAM modules. Current configurations come in single, dual, and quad ranks. If compatibility is an issue, single modules tend to work with the widest variety of systems. In its simplest form, dual rank memory is composed of two separate memory modules built into one physical module. From the memory controller's point of view, there is little difference between a dual rank module and two single modules. Since dual and quad rank modules are able to use a higher quantity of smaller and cheaper memory chips than their single rank equivalents, one advantage of these modules is that they can be used in systems with lower RAM requirements. In addition, dual and quad rank modules allow significantly higher capacity modules to be installed for those systems with large memory requirements. Once a system is up and running, there is no significant drawback to higher

ranked memory. Since the hardware differs from one rank to another, it is important to make sure the system supports the modules.

Interested in receiving a second opinion on what specifications would be best suited for your application? Want to learn more about RAM? If so, the CCS team can help. Contact us today to discuss your project in detail.