Guide To... Memory

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Hypertec Guides: Memory

All computers require memory to operate, but understanding the different types and how much you should have can sometimes cause problems.

Memory, or more specifically Random Access Memory (RAM), is a type of computer storage which allows the information to be accessed in any order; providing quick access to the data that programs need to operate. The contrasting format would be sequential access memory (for instance a tape drive), that forces the system to go through all preceding data in order to reach the specific data required.

As computers have advanced, the memory requirements have also evolved. The newest Microsoft operating system - Windows Vista - needs 1GB of memory for its Business version; whilst a Linux system can be powered with as little as 16MB. Minimum recommended figures for software can often be misleading, as these may allow the system to operate, but usually not to perform at anywhere near full capacity.

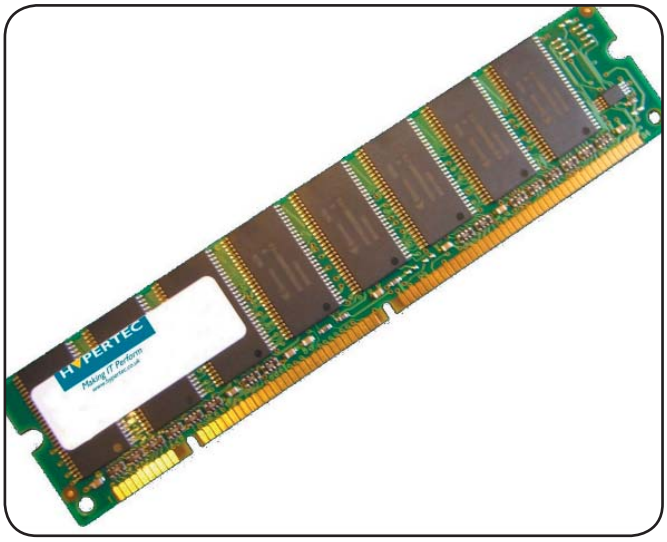
SDRAM

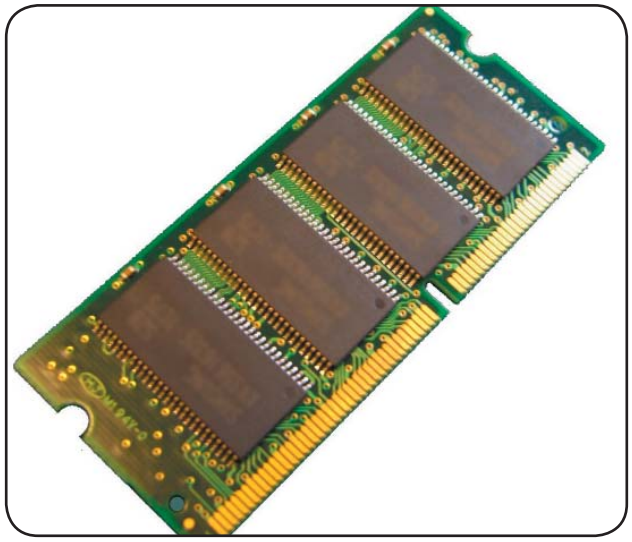
SDRAM, or Synchronous Dynamic Random Access Memory, is a few generations old by now, but can still be found in a good number of computers.

This type of memory is available in speeds of 66 MHz, 100 MHz, and 133 MHz, and is sold based on these speeds ratings, ie. PC66, PC100, and PC133.

SDRAM for desktop computers features 168 pins for data transfer on a module measuring roughly 5.25" long. whilst SDRAM for notebook computers features 144 pins for data transfer on a module measuring roughly 2.5" long.

SDRAM was a big improvement over previous generations of computer memory, as the memory and processor were now "synchronized" and data was available as needed. Later generations of system memory (DDR and DDR-2) are built off of the foundation laid by SDRAM, while obviously adding more speed and greater performance.





Pictured: SDRAM modules

RIMM

RIMM (Rambus Inline Memory Module), also known as Rambus or RDRAM, was a format launched by Rambus as a successor to SDRAM. Desktop RIMM modules feature 184 pins for data transfer on a module measuring roughly 5.25" long. The rating for RIMM memory is based on the maximum theoretical bandwidth (in MHz) and included speed ratings of 800 MHz, 1066 MHz, 1200 MHz, 1333 MHz, and 1600 MHz.

Early Intel Pentium 4 processors adopted the technology, but that was about the extent of RIMM's desktop popularity. Some server applications and home electronics devices (such as the PlayStation II) also utilize RIMM memory, but DDR memory was launched at about the same time and eventually stole the show.

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DDR

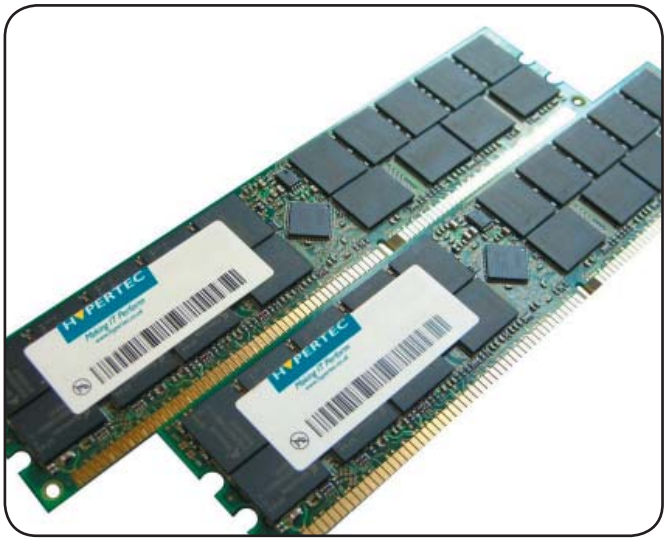
DDR, or Double Data Rate SDRAM, was the follow up to SDRAM.

The "Double" part of DDR comes from its ability to transfer twice the data of an SDRAM module operating at the same speed. This is accomplished by the fact that DDR technology can send data on both the rise and the fall of a clock pulse, while SDRAM only sends data on the rise.

DDR uses its maximum theoretical bandwidth (in MHz) to describe the various speeds available.
Standard speeds of DDR include PC1600, PC2100, PC2700, and PC3200. The bandwidth can be tied directly to a memory clock speed, with the following correlation: PC1600 - 100 MHz, PC2100 - 133 MHz, PC2700 - 166 MHz, and PC3200 - 200 MHz. These speeds are often referenced by a DDR rate instead of these straight clock speeds, so PC3200 would actually be called 400 MHz DDR, for example.

Though these are the offical speeds, DDR can be run at speed other from those above.
Memory standards are governed by a group called JEDEC, but manufacturers can design products outside of these specifications for computing enthusiasts. This non-standard DDR may be capable of much higher speeds, and products carrying ratings such as PC4000 or PC4400 are readily available.

DDR memory for desktop computers features 184 pins for data transfer on a module measuring roughly 5.25" long. DDR for notebook computers features 200 pins for data transfer on a module measuring roughly 2.5" long. A module of DDR and a module of SDRAM are therefore the same length; in order to prevent a user from installing the wrong type of memory in their system, the modules are notched differently to act as a key: SDRAM features 2 notches, while DDR features 1 notch at a different location.



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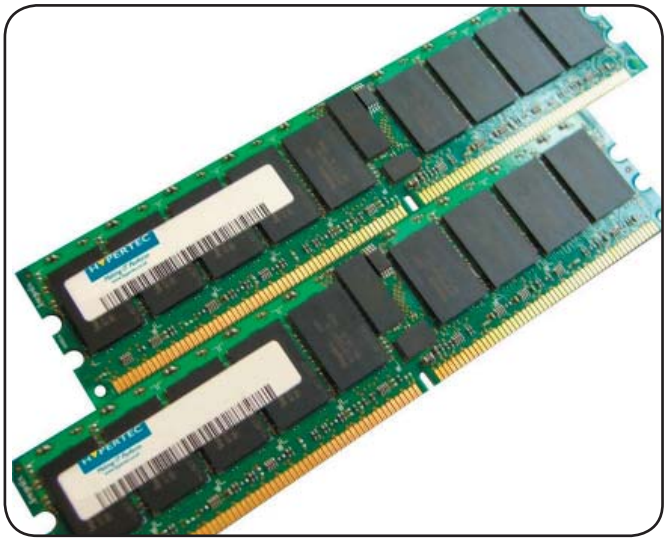
DDR-2

DDR-2, or Dual Data Rate Two SDRAM, is the second generation of DDR memory and is just now reaching a price and performance level to make it more viable for mainstream computer systems. DDR-2 provides almost double the (theoretical) data transfer as DDR, but it still sends data on the rise and fall of the clock pulse. The improvements are achieved through an increased number of memory buffers, lower electrical consumption, improved physical design, and an improved prefetch. The problem with most present DDR-2 is that these improvements are wiped out by a higher latency within the memory, and the actual improvements over DDR at the same speed may only be 5% or so.

DDR-2 uses a similar naming structure to DDR, in that the maximum theoretical bandwidth is the typical method of describing a module. Instead of just a "PC" prefix, we now have a "PC2" to describe modules such as PC2-3200, PC2-4200, and PC2-5300. PC2-3200 has a DDR-2 speed of 400 MHz (4x100 MHz), PC2-4200 has a DDR-2 speed of 533 MHz (4x133 MHz), and PC2-5300 has a DDR-2 speed of 667 MHz (4x166 MHz). As with DDR (and others), overclocking memory is available in DDR-2, such as Corsair's DDR-2 PC2-8000, which operates at 1000 MHz!

DDR-2 for desktop computers features 240 pins for electrical/data transfer on a module measuring roughly 5 1/4" long. DDR-2 for notebook computers features 200 pins for electrical/data transfer on a module measuring roughly 2 5/8" long. Like DDR, DDR-2 is keyed with one notch (located at a different position than the one DDR notch) to prevent using the wrong type of memory.



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Within these categories of memory, there are many terms which you will hear used:

RAM
Random Access Memory - a type of memory chip which provides direct access to any location on the chip. The contents of any byte can be read or written without regard to the bytes before or after it. The most common is the dynamic RAM (DRAM).

DRAM
Dynamic Random Access Memory - the most common type of memory, DRAM chips lose their content when the power is turned off.

SDRAM
Synchronous Dnamic Random Access Memory - a type of DRAM chip which divides the chip into two cell blocks and interleaves data between them. While a bit in one block is accessed, a bit in the other is prepared for access.

DDR
Double Data Rate - an SDRAM chip that increases performance by doubling the data rate of the frontside bus.
DDR uses a 184-pin DIMM module; and 200-pin for laptops.

DDR2
Double Data Rate 2 - uses technology to increase DDR data rates.
DDR2 uses 240-pin DIMM modules.

DDR3
Double Data Rate 3 - uses technology to increase DDR2 data rates.
DDR3 uses 240-pin DIMM modules.

SIMM
Single Inline Memory Module - an earlier printed motherboard that holds memory chips and plugs into a SIMM socket on the motherboard.

DIMM
Dual Inline Memory Module - a printed circuit board that holds memory chips and plugs into a DIMM socket on the motherboard.

SODIMM
Small Outline Dual Inline Memory Module - a DIMM module with a thinner profile, commonly used in laptop computers.

ECC Memory
Error Correcting Code Memory - a memory system that tests for and corrects errors automatically. ECC memory is recommended for use in servers.

FB
Fully Buffered - FB memory introduces an Advanced Memory Buffer (AMB), which can compensate for signal deterioration by buffering and resending the signal to the memory controller.

REG
Registered Memory - modules have a register between the SDRAM modules and the system's memory controller. They place less electrical load on the memory controller and allow single systems to remain stable with more memory modules than they would have otherwise. Used especially in servers where stability is key.

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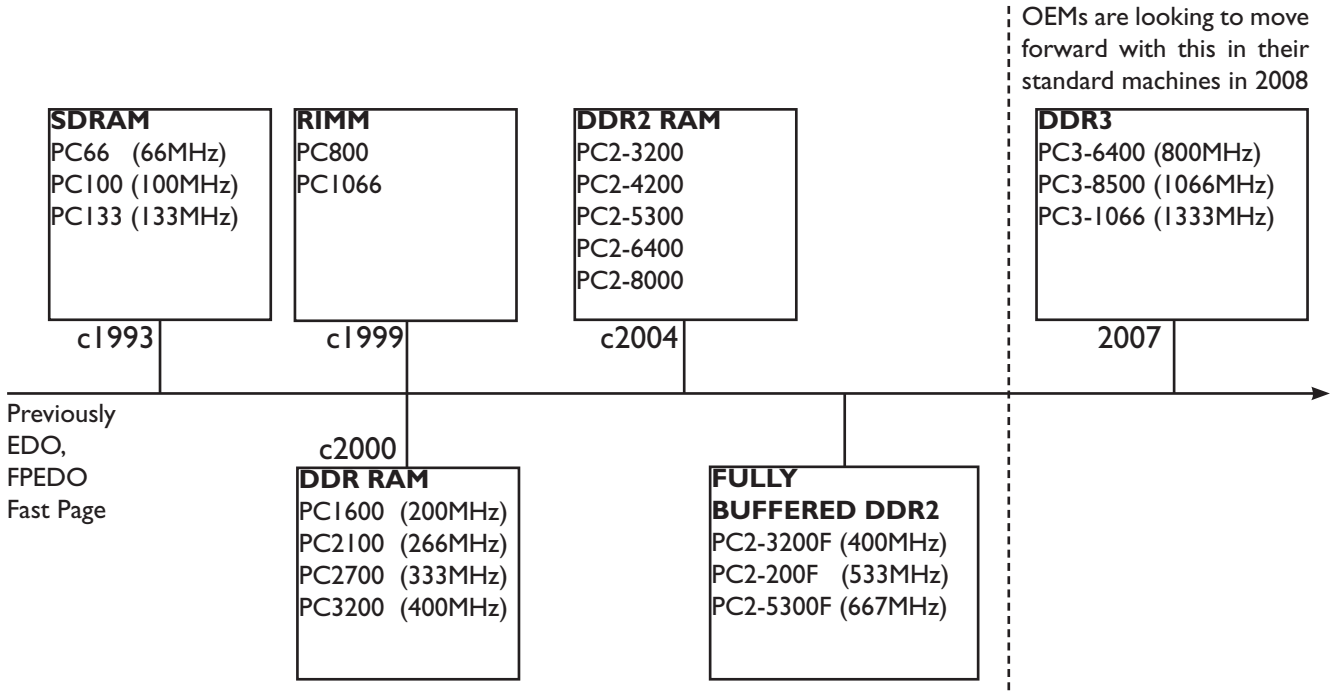
Memory - a Timeline



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