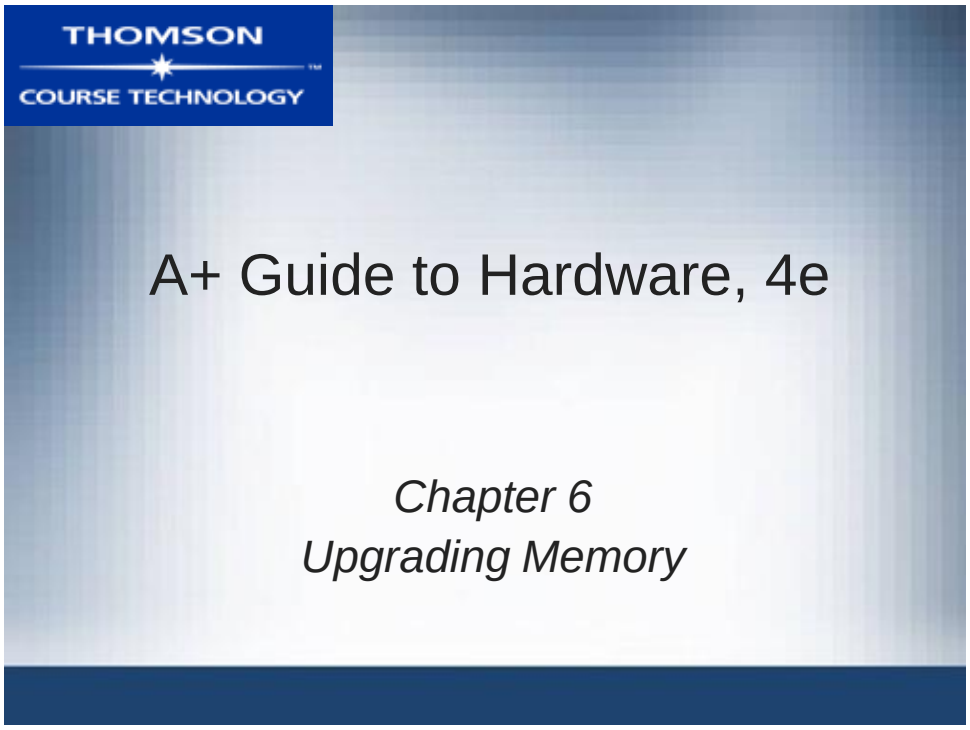


Brief Summarization

Table of Contents

Objectives

- Learn about the different kinds of physical memory and how they work
- Learn how to upgrade memory
- Learn how to troubleshoot problems with memory

Introduction

- Memory technologies have evolved rapidly
- Study development to grasp current technology
- Memory-related tasks performed by a PC technician
  - Upgrading memory
  - Adding more memory to a system
  - Troubleshooting problems with memory

RAM Technologies

RAM (random access memory)

- Holds data and instructions used by CPU
- Volatile (data does not persist after PC is turned off)

ROM (read-only memory)

- In firmware on motherboard; e.g., ROM BIOS
- Non-volatile (retains data after PC is turned off)

Reviewing other salient features of RAM

- RAM is stored in modules: DIMMs, RIMMs, SIMMs
- Types: static RAM (SRAM) and dynamic RAM (DRAM)
- Memory cache is made up of SRAM (it is faster)

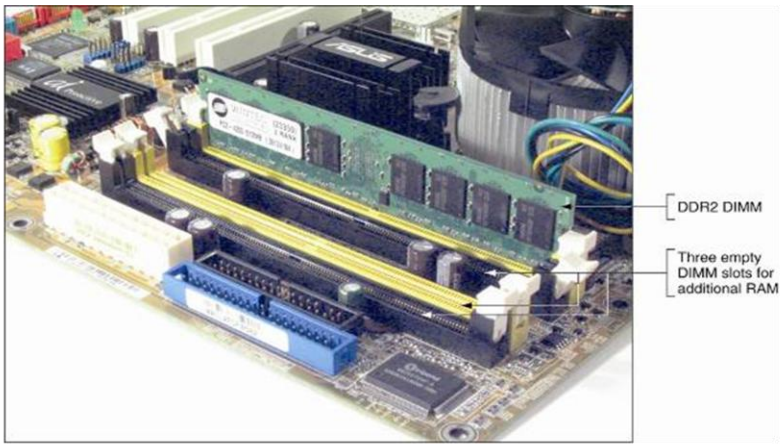


Figure 6-1 DRAM on most motherboards today is stored on DIMMs

- Differences among DIMM, RIMM, and SIMM modules
  - Width of the data path each module accommodates
  - The way data moves from system bus to the module
- Older DRAM worked asynchronously with system bus
- Newer DRAM works synchronously with system bus
  - Retrieves data faster as it keeps time with system clock
- Goal of each new technology
  - Increase overall throughput while retaining accuracy

Description of Module	Example
240-pin DDR2 DIMM is currently the fastest memory. Can support dual channels or be installed as a single DIMM. Has one notch near the center of the edge connector.	
184-pin DDR DIMM can support dual channeling or be installed as single DIMMs. Has one offset notch.	
168-pin SDR DIMM has two notches that are positioned on the edge connector to indicate buffered, registered, unbuffered, and voltage requirements.	
RIMM has 184 pins and two notches near the center of the edge connector.	
72-pin SIMM must be installed two modules to a bank of memory.	
30-pin SIMM must be installed four modules to a bank of memory.	

Figure 6-2 Types of memory modules

SIMM Technologies

- SIMMS have a 32-bit data path
- Speeds (access times): 60, 70, 80 nanoseconds (ns)
  - Smaller number indicates greater speed
- Components making up the access time
  - Processor requests the data
  - Memory controller locates data on the SIMM
  - Data is placed on the memory bus
  - The processor reads the data off the bus
  - Memory controller refreshes memory chip on SIMM

DIMM Technologies

DIMM (dual inline memory module)

- Has independent pins on opposite sides of module
- Can have memory chips on one or two sides
- Has 168, 184, or 240 pins on edge connector
- Has a 64-bit data path and holds 8 MB - 2 GB RAM

Synchronous DRAM (SDRAM)

- Has two notches, and uses 168 pins

DDR (Double Data Rate) and DDR2 DIMM

- DDR SDRAM runs 2 x faster than regular SDRAM
- DDR2 SDRAM is faster than DDR, uses less power

Buffered and registered DIMMs

- Hold data and amplify a signal before data is written
- Unbuffered DIMM: no support of buffers or registers
- SDRAM modules use registers
- FB-DIMM is fully buffered
- Notches on module indicate supported technologies

Dual channeling

- Controller communicates with 2 DIMMs at same time
- Example: two 64-bit DIMMs form 128-bit data path
- DIMM pairs must have same size, speed, features

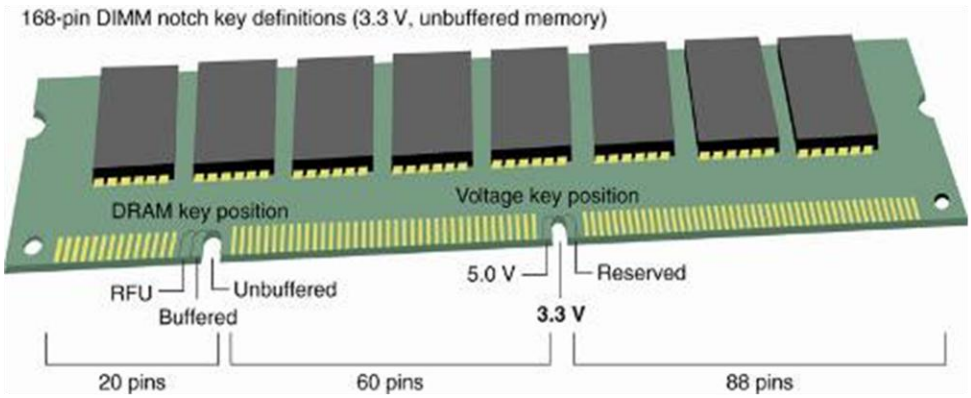


Figure 6-3 The positions of two notches on a SDRAM DIMM identify the type of DIMM and the voltage requirement and also prevent the wrong type from being installed on the motherboard

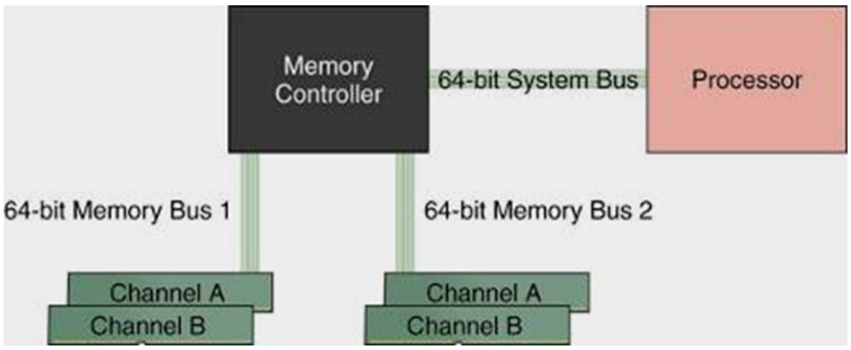


Figure 6-4 Using dual channels, the memory controller can read from two DIMMs at the same time

RIMM Technologies

Direct Rambus DRAM (RDRAM or Direct RDRAM)

- Uses RIMM memory modules
- Expensive and slower than current DIMMs

C-RIMM (Continuity RIMM): placeholder module

- Concurrent RDRAM: not as fast as Direct RDRAM
- Rambus does not actually make RIMMs
  - Licenses technology to memory manufacturers

Error Checking and Parity

- Bank: smallest group of working memory chips
  - Example: eight memory chips used in 8-bit data path
- Parity: error-checking based on an extra (ninth) bit
  - Odd parity: parity bit is set to make odd number of ones
  - Even parity: parity bit set to make even number of ones
- Parity error: number of bits conflicts with parity used
  - Example: odd number of bits read in even parity system
- ECC (error-correcting code)
  - Detects and corrects an error in a single bit
  - Application: ECC makes 64-bit DIMM a 72-bit module

Figure 6-6 Eight chips and a parity chip hold nine bits that represent the letter A in ASCII with even parity

CAS Latency and RAS Latency

- Two ways of measuring speed
- CAS stands for “column access strobe”
- RAS stands for “row access strobe”

- Both types measure read/write clock cycles
  - Two or three clock cycles per column or row of data
- CAS latency is used more than RAS latency

Tin or Gold Leads

- Connectors inside memory slots are tin or gold
  - Edge connectors on memory modules follow suit
- Tin leads should match tin connectors
- Gold leads should match gold connectors
  - Prevents corrosive chemical reactions between metals

Memory Speeds

- Measures: ns, MHz, PC rating, CAS or RAS Latency
  - Example: SDRAM, DDR, and RIMM measured in MHz
- PC rating: total bandwidth between module and CPU
  - Example: 200 MHz x 8 bytes = 1600 MB/sec = PC1600
- Factors to consider when looking at overall speed:
  - How much RAM is installed and the technology used
  - Speed of memory in ns, MHz, or PC rating
  - ECC/parity or non-ECC/nonparity
  - CL or RL rating
  - Use of dual channeling

How to Upgrade Memory

- The basic technique: add more RAM modules

Problems solved with new memory:

- *Slow performance*
- *Applications refusing to load*
- *An unstable system*

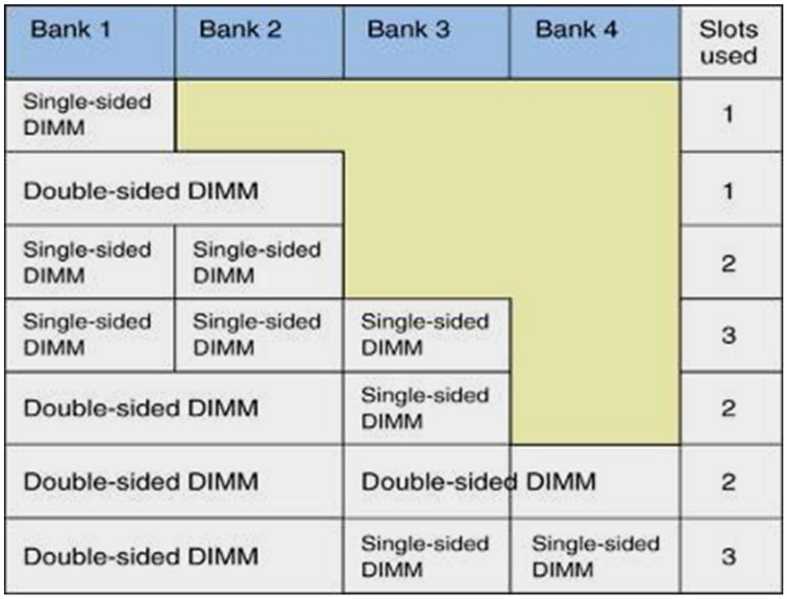
- Note empty memory slots on most new computers
  - Accommodate new DIMM or RIMM

How Much and What Kind of Memory to Buy

Questions to ask before performing an upgrade:

- *How much memory do I need?*
- *How much RAM is currently installed in my system?*
- *How many memory modules are currently installed?*
- *What kind of memory modules are currently installed?*
- *How much memory can I fit on my motherboard?*
- *What kind of memory can I fit on my motherboard?*
- *How do I select and purchase the right memory?*

- Refer to system utilities to determine capacity
- Motherboard documentation guides choice of add-ons



Bank 1	Bank 2	Bank 3	Bank 4	Slots used
Single-sided DIMM				1
Double-sided DIMM				1
Single-sided DIMM	Single-sided DIMM			2
Single-sided DIMM	Single-sided DIMM	Single-sided DIMM		3
Double-sided DIMM		Single-sided DIMM		2
Double-sided DIMM		Double-sided DIMM		2
Double-sided DIMM		Single-sided DIMM	Single-sided DIMM	3

Figure 6-14 How three DIMM slots can use four 64-bit memory banks supported by a motherboard chipset

Installing Memory

- Follow safety procedures when installing RAM
  - Example: always use a ground bracelet as you work

Installing SIMMs

- Module slides into slot at an angle
- Make sure each module is secured to slot
- Verify that POST memory count includes new module

Installing RIMMs

- Install modules in this order: bank 0, bank 1
- Remove the C-RIMM (placeholder) filling the slot
- Use notches to help orient module in the socket

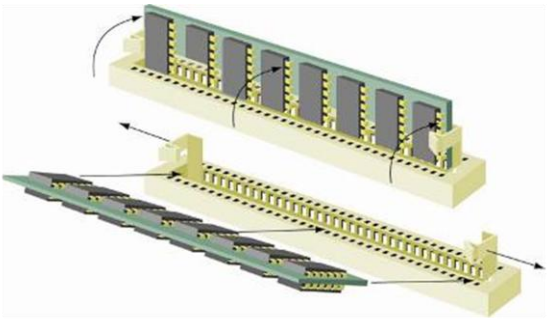


Figure 6-18 Installing a SIMM module

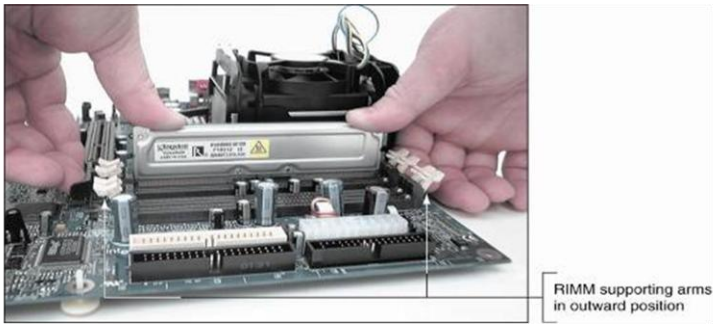


Figure 6-19 Install RIMM modules in banks beginning with bank 0

Installing DIMMs

- Pull out the supporting arms on the sides of the slot
- Use notches on the DIMM edge connector as a guide
- Insert the DIMM straight down into the slot
- Ensure that supporting arms lock into position
- New installations are generally uncomplicated
  - Usually involves just placing memory on motherboard
- Older computers may need change to CMOS setup
- If new memory not recognized, try reseating device

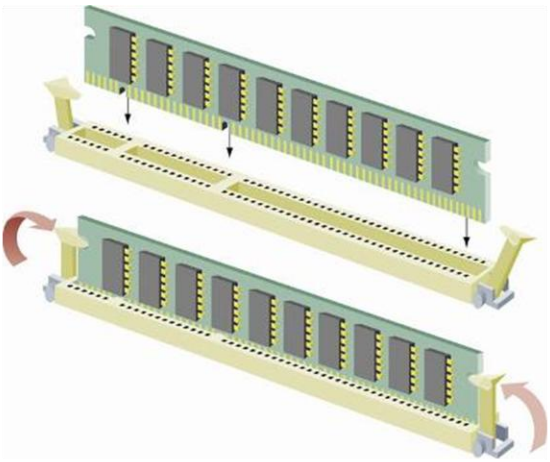


Figure 6-20 Installing a DIMM module

Troubleshooting Memory

Common problems:

- Boot failure
- A system that hangs, freezes, or becomes unstable
- Intermittent application errors

General Protection Fault (GPF) errors

- Caused by memory errors in Windows
- Upgrade Problems

Dealing with unrecognized add-on or error message

- Remove and reinstall the module
- Check for the suitability of the module for the board
- Ensure that the module is the correct size
- Remove the module and check for error message
- Test the module in another socket
- Clean the module edge connectors
- Try flashing BIOS

Recurring Problems

Symptoms of an unreliable memory:

- The system locks up
- Error messages about illegal operations often display
- General Protection Faults occur during normal operation

Some troubleshooting tasks

- Run updated antivirus software to check for viruses
- Replace memory modules one at a time
- Try uninstalling the new hardware
- Test, reseat, or replace RAM
- Verify that virtual memory settings are optimized

Summary

- RAM categories: static RAM (SRAM), dynamic RAM (dRAM)
- Modules used to store DRAM: SIMM, DIMM, RIMM
- Synchronous DRAM (SDRAM): moves to the beat of the system clock
- Simple parity checks identify one corrupted bit
- Error correcting code (ECC) detects and corrects one flipped bit
- Memory speeds are measured in ns, MHz, PC rating, CAS or RAS Latency
- When upgrading memory, use the type, size, and speed the motherboard supports
- New modules should match those already installed
- Install new modules by inserting them into the appropriate slots
- When troubleshooting, first try the simple technique of reseating the module

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