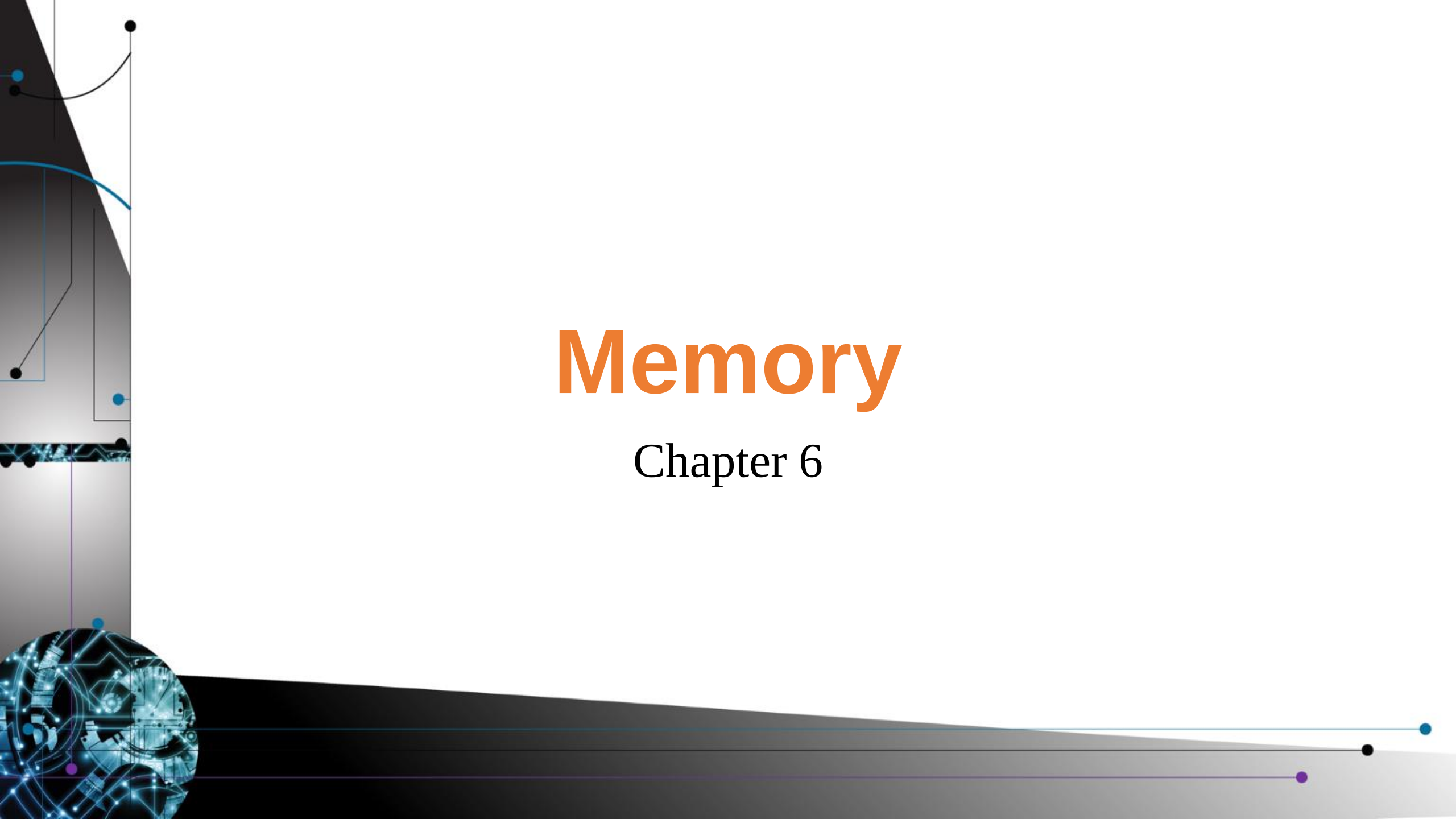


Memory

Chapter 6

This presentation covers:

- Teamwork
- Memory
- Memory Physical Packaging
- Planning the Memory Installation
- Installing Memory Overview
- Removing/Installing Memory
- Monitoring Memory Usage under Windows
- Flash memory

Qualities of a Good Technician

"Soft skills" as they are known across many industries are essential

Teamwork

- Avoid tunnel vision in a technical support job
- Focus on solving the customer's problems to ensure his or her problem is solved professionally and efficiently
- You are part of a team; customers, supervisors, and colleagues
- Be punctual, avoid taking off early
- Avoid chatting too much with customers and blaming others
- See yourself as a reflection of the company
- Teamwork is part of the skill set that employers seek

Memory

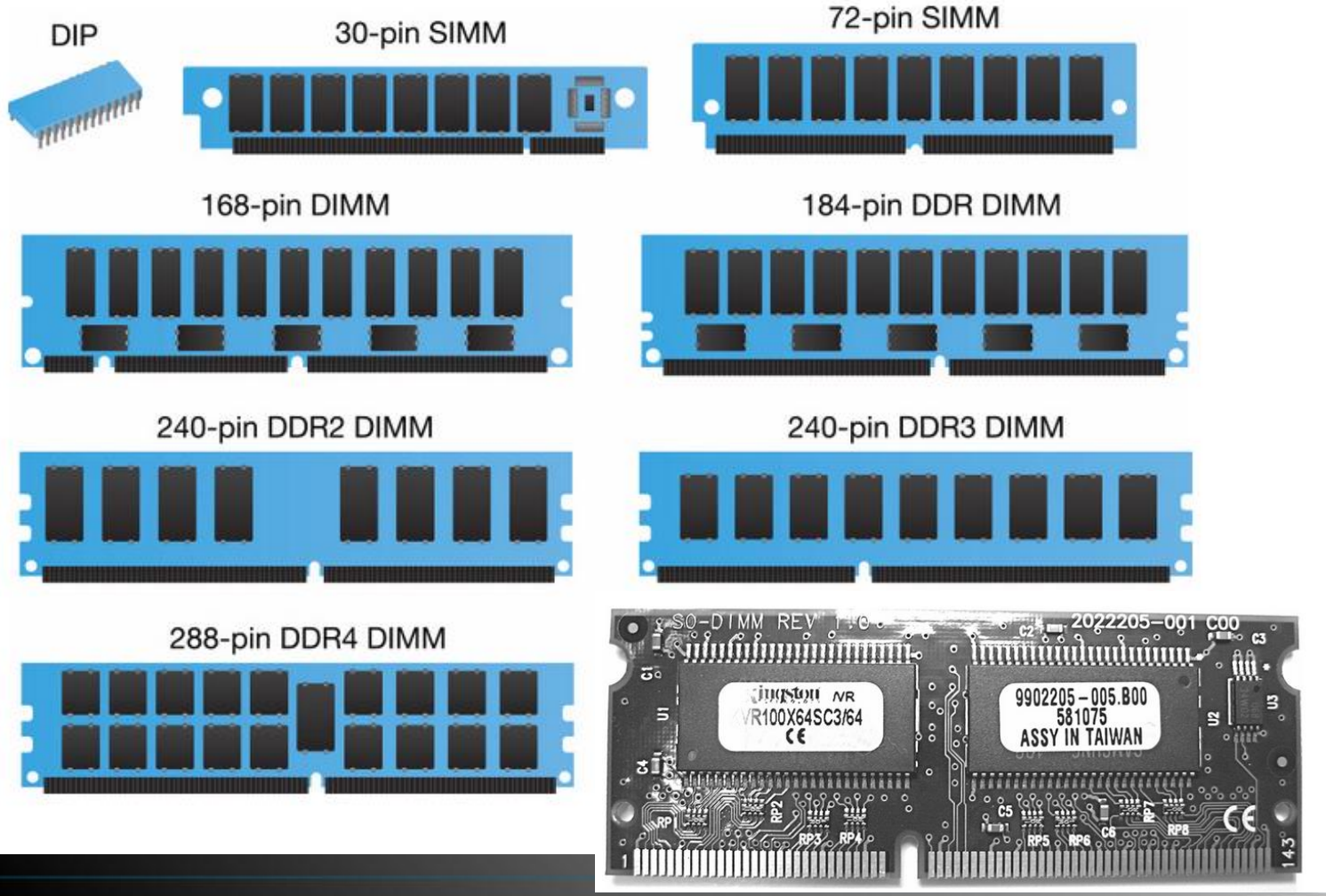
Memory Overview

- Computer systems need software to operate
- Software must reside in computer memory
- The two main types of memory are:
  - RAM (random-access memory) – two major types
    - DRAM (dynamic RAM) - less expensive but slower than SRAM
    - SRAM (static RAM)
      - DRAM chips are slower than SRAM
      - SRAM is also known as cache memory
  - ROM (read-only memory)

Memory Physical Packaging

- DIP (dual in-line package) chip has a row of legs running down each side
- SIMM (single in-line memory modules) - e.g. memory in laser printers
- **DIMM** (dual in-line memory module) - found in today's motherboards and have 168, 184, 240, or 288 pins
- RIMMs are used in older Intel Pentium 4 computers and have two notches in the center
- Memory can also be called a memory stick, memory module a stick of memory, or RAM

Memory Chips/Modules



Planning the Memory Installation

Key points follow:

- Refer to the system or motherboard documentation to see what type of memory is supported
- Determine what features are supported
- Determine how much memory is needed
- Determine how many of each memory module is needed
- Research prices and purchase memory module(s)

Planning the Memory Installation: Memory Module Types

Technology has provided faster DRAM speeds without increasing the cost too greatly. Table 6.1 lists some of the memory technologies available today.

Table 6.1 Memory module types

Technology	Explanation
Synchronous DRAM (SDRAM)	Performs very fast burst memory access. New memory addresses are placed on the address but before the prior memory address retrieval and execution is complete. SDRAM synchronizes its operation with the CPU clock signal to speed up memory access. Used with DIMMs.
Double data rate (DDR)	Sometimes called DDR SDRAM or DDR RAM and developed from SDRAM technology. DDR memory can send twice as much data as the older PC133 SDRAM because data is transmitted on both sides of the clock signal (that is, on the rising and falling edges instead of just on the rising edge).
DDR2	Sometimes called DDR2 RAM. DDR2 uses 240-pin DIMMs and is not compatible with DDR.
DDR3	An upgrade from DDR2 (8-bit prefetch buffer compared to 4-bit with DDR2). DDR3 uses 240-pin DIMMs and is not compatible with DDR2 or DDR. The technology better supports multicore processor-based systems and more efficient power utilization.
DDR3L	A DDR3 module that runs at a lower voltage (1.35 V) than the 1.5 V or higher DDR/DDR2/DDR3 modules. Less voltage means less heat and less power consumed.
DDR4	Operates at a lower voltage and faster speeds than DDR3 modules. DDR4 uses 288-pin DIMMs and is not compatible with DDR, DDR2, or DDR3. Allows for storage up to 512 GB on a single module.
DDR4L	Uses a lower voltage (1.05 V) than a standard DDR4 module.

Planning the Memory Installation: Memory Module Types

Table 6.2 **DIMMs**

Memory type	Alternative name	Clock speed	Data rate
PC2-9200	DDR2-1150	575 MHz	1.15 GT/s
PC2-9600	DDR2-1200	600 MHz	1.2 GT/s
PC3-6400	DDR3-800	400 MHz	800 MT/s
PC3-8500	DDR3-1066	533 MHz	1.06 GT/s
PC3-10600	DDR3-1333	666 MHz	1.33 GT/s
PC3-12800	DDR3-1600	800 MHz	1.6 GT/s
PC3-16000	DDR3-2000	1000 MHz	2 GT/s
PC3-17000	DDR3-2133	1066 MHz	2.13 GT/s
PC4-1866	DDR4-1866	933 MHz	1.86 GT/s
PC4-2400	DDR4-2400	1200 MHz	2.4 GT/s
PC4-2666	DDR4-2666	1333 MHz	2.66 GT/s
PC4-3000	DDR4-3000	1500 MHz	3 GT/s
PC4-25600	DDR4-3200	1600 MHz	3.2 GT/s

Planning the Memory Installation: Memory Features

Table 6.3 **Memory features**

Feature	Explanation
Parity	A method for checking data accuracy. (See the tech tip "How parity works.")
Non-parity	Chips that do not use any error checking.
Error correcting code (**ECC**)	An alternative to parity checking that uses a mathematical algorithm to verify data accuracy. ECC can detect up to 4-bit memory errors and correct 1-bit memory errors. ECC is used in higher-end computers and network servers. **Non-ECC** memory modules are simply modules that do not support ECC.
Unbuffered memory	The opposite of registered memory, used in low- to medium-powered computers. Unbuffered memory is faster than registered or fully buffered memory.
Buffered memory (registered memory)	Memory module that has extra chips (registers) near the bottom of the module that delay all data transfers by one clock tick to ensure accuracy. Buffered memory is used in servers and high-end computers. If you install a registered memory module into a system that allows both registered and unbuffered memory, all memory must be registered modules. These modules are sometimes advertised as fully buffered DIMMs (FBDIMM).
Serial presence detect (**SPD**)	A module that has an extra EEPROM that holds information about the DIMM (capacity, voltage, refresh rates, and so on). The BIOS/UEFI reads and uses this data for best performance. Some modules have **thermal sensors** (sometimes listed as TS in an advertisement) used to monitor and report memory heat conditions.
Single-sided memory	A memory module that has one "bank" of memory, with 64 bits transferred out of the memory module to the CPU. A better term for single-sided memory is single-banked memory. The module might or might not have all of its "chips" on one side.
Double-sided memory	A single memory module developed in such a way that it actually contains two memory modules in one container (two banks). If the motherboard slot has been designed to accept this type of memory module, data is still sent to the CPU 64 bits at a time. This is a way to have more banks of memory on the motherboard without requiring more memory slots. These modules normally have memory chips on both sides, but all modules with chips on both sides are not double-sided memory.
Dual-voltage memory	A module that can operate at a lower voltage level (thus with less heat) if the motherboard supports this feature. Note that all installed modules must also support the lower voltage for the system to operate in this mode.
Extreme memory profile (XMP)	A type of memory module that allows the BIOS to configure voltage and timing settings in order to overclock the memory.

Planning the Memory Installation: How Much Memory to Install

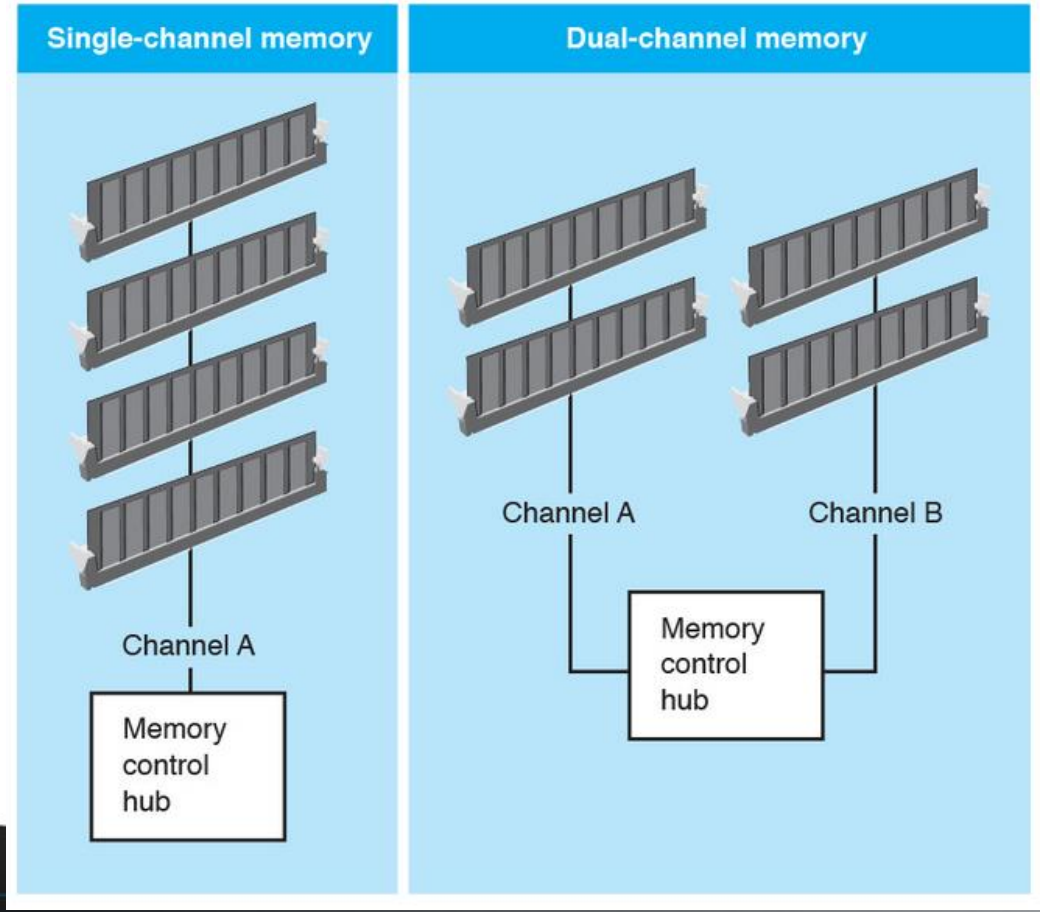
Table 6.4 Minimum operating system starting memory recommendations

Operating system	Minimum amount of RAM to start calculations
Windows 7	1 GB
Windows 8/10	1 GB (32-bit)/2 GB (64-bit)
macOS Mavericks/Yosemite/El Capitan/Sierra/High Sierra/Mojave	2 GB
Linux	Depending on the version, from 64 MB

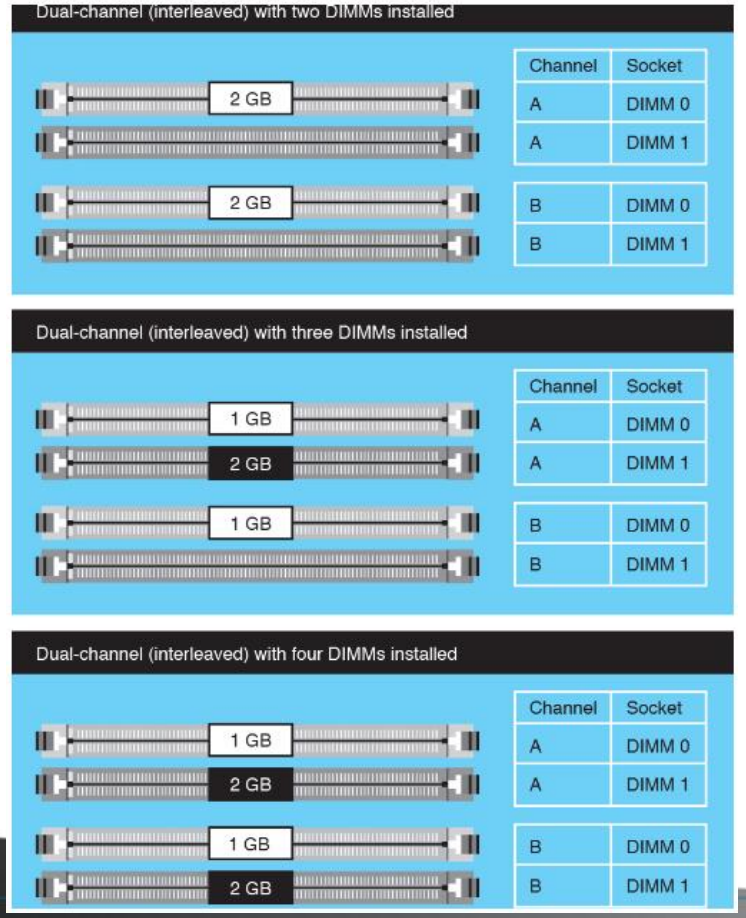
Table 6.5 Windows 7/8/10 memory limits

Operating system	32-bit version limit	64-bit version limit
Windows 7 Starter edition	2 GB	N/A
Windows 7 Home Basic	4 GB	8 GB
Windows 7 Home Premium	4 GB	16 GB
Windows 7 Business/Professional/Enterprise/Ultimate	4 GB	192 GB
Windows 8	4 GB	128 GB
Windows 8 Professional/Enterprise	4 GB	512 GB
Windows 10 Home	4 GB	128 GB
Windows 10 Pro/Enterprise	4 GB	2 TB

Planning the Memory Installation: How Many of Each Memory Type



Planning the Memory Installation: How Many of Each Memory Type

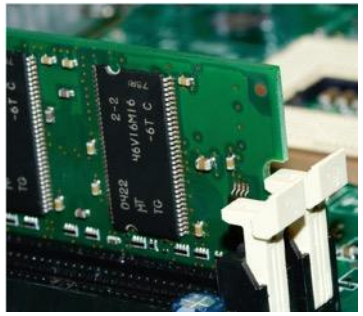


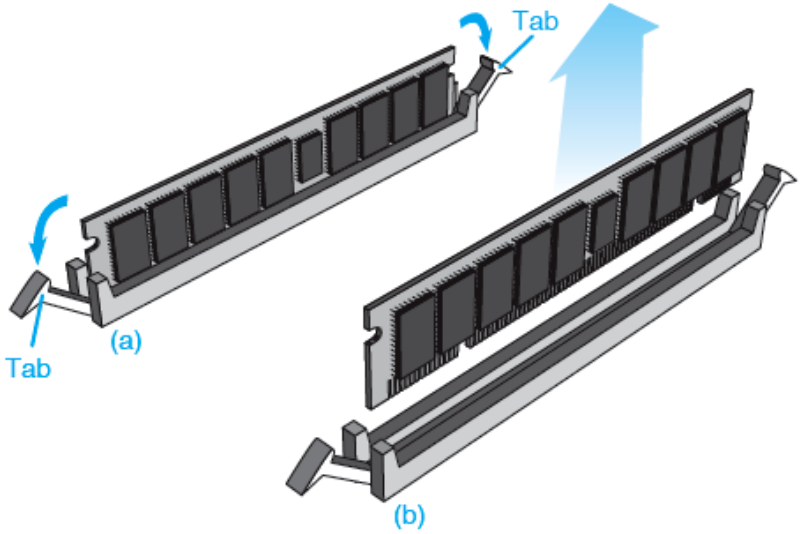
Installing Memory Overview

- Step 1. Determine which chip capacities can be used for the system. Look in the documentation included with the motherboard or computer for this information.
- Step 2. Determine how much memory is needed based on the operating system being used and applications installed.
- Step 3. Determine the capacity of the chips that go in each bank by drawing a diagram of the system, planning the memory population on paper, and referring to the documentation of the system or motherboard.

Removing/Installing Memory

- When removing a DIMM and using proper ESD-prevention techniques, push down on the retaining tabs that clasp over the DIMM
- Be careful not to overextend the tabs when pushing on them
- The DIMM lifts slightly out of the socket
- Always ensure you are grounded to prevent ESD by using an anti-static wrist strap
- Lift the module out of the socket once it is released

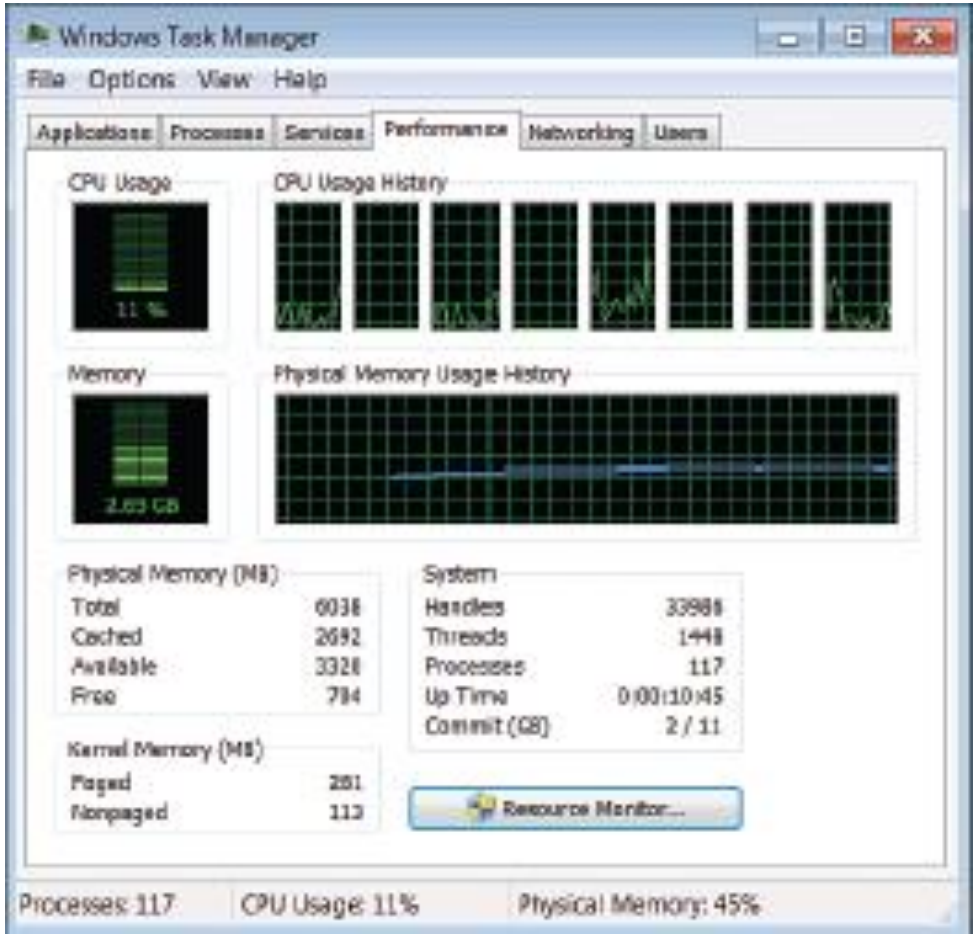




Monitoring Memory Usage under Windows

Windows has a Performance utility in Task Manager to monitor memory usage

- To access Task Manager, press Ctrl+Alt+Delete
- Select the Performance tab, which has graphs that visually demonstrate the CPU and memory usage



Monitoring Memory Usage under Windows 7

Table 6.8 Windows 7 Task Manager Performance tab fields

Field	Description
Total Physical Memory	The amount of RAM installed.
Cached Physical Memory	Memory pages that could be written to disk and be made available.
Available Physical Memory	The amount of memory (physical and paged) for application use.
Free Physical Memory	The amount of available physical RAM.
Paged Kernel Memory	Memory that can be used by applications as needed that can be copied to the paging file (to free up RAM).
Nonpaged Kernel Memory	Memory available only to the operating system that stays in RAM.
Handles	The number of resources the operating system is currently dealing with.
Threads	The number of objects contained within currently running processes that are executing program instructions.
Processes	A running executable program, such as Notepad or a service that is currently running.
Up Time	How long the system has been up.
Commit (GB)	A snapshot of virtual memory requests. Note that if the commit charge exceeds the total physical memory, the system is probably paging to the hard drive too much, and it is time to add more RAM.

Monitoring Memory Usage under Windows 8/10

Table 6.9 Windows 8/10 Task Manager Performance tab memory-related fields

Field	Description
In Use	The amount of memory currently being used by applications, the operating system, drivers, and processes.
Available	The amount of physical memory for application/operating system use.
Committed	This is shown as two numbers. The first number is how much memory the operating system has identified that needs memory (and that might get removed or paged out of RAM if other, more important, processes need the space). The second number is the amount of physical and virtual memory available.
Cached	The memory space that includes data that needs to be written to disk before being available, as well as cached data that is currently not being used.
Paged Pool	Memory set aside for operating system functions or device drivers that could be written to disk, if necessary.
Non-Paged Pool	Memory set aside for operating system functions or device drivers that must remain in physical memory (that is, cannot be paged out).
Speed	Speed of the RAM chips.
Slots Used	Number of memory slots used for memory modules and total number of slots.
Form Factor	Type of memory module, such as DIMM or SODIMM (used in laptops). Chapter 11, "Computer Design and Troubleshooting Review," covers mobile devices and SODIMMs.
Hardware Reserved	Memory reserved for device drivers or firmware that cannot be used by Windows for any other function.

Older Applications in Windows

Flash memory

- Flash memory is a type of nonvolatile, solid-state memory that holds data even when the computer power is off
- PCs use flash memory as a replacement for the BIOS chip
- Network devices, smart-phones, and tablets use flash memory to store the operating system and instructions
- Some tablets can use external flash media for storage

Flash memory

- Digital cameras use flash memory to store pictures; scanners use flash memory to store images; printers use flash memory to store fonts
- Flash memory does not have to be refreshed like DRAM, and it does not need constant power like SRAM

Computer Terms

Refer to the glossary terms at the end of the textbook chapter. Review Chapter 6 and become familiar with the terms.

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The Complete CompTIA A+ Guide to IT Hardware and Software 7th Ed.