3.12.2 Video Card Facts

Video cards process graphical information for output to an external display.

This lesson covers the following topics:

- Integrated vs. dedicated video cards
- Characteristics of video cards

Integrated vs. Dedicated Video Cards

Video cards can be implemented as a dedicated expansion board or integrated with other components (e.g., the motherboard or CPU).

- Dedicated video cards:
    - Are installed in an expansion slot on the motherboard
    - Have a graphics processing unit (GPU) and a dedicated, high-speed video memory bank
    - Are more powerful than integrated video cards, but are also more expensive
- Integrated graphics:
    - Integrate the GPU with another hardware component (e.g., a motherboard or CPU)
    - Share system memory for graphic processing
    - Are much cheaper than dedicated video cards, but are also less powerful

Characteristics of Video Cards

When selecting a video card, keep in mind the following characteristics:

Characteristic	Description

Display Connectors	Video cards have one or more connectors for attaching an external display. Always try to select a video card with connectors that match your display.
	
	- VGA monitors use a VGA (DB-15) connector.
	- LCD and LED monitors use one (or more) of the following connectors:
	    - DVI-Integrated (DVI-I) connector
	    - HDMI connector (also used by HDTVs)
	    - DisplayPort connector
	
	DVI-I connectors are able to send either analog or digital signals. Older video cards might use DVI-A (analog) or DVI-D (digital) connectors.
	
	Some video cards have dual heads (two output connectors capable of displaying video simultaneously) and are able to support dual monitors.
	
	If necessary, you can use special connector adapters to convert from one connector type to another (e.g., DVI to HDMI). However, it's usually best to match the connector type of the video card with the display connectors.

Display Quality	The quality of images and animations is determined by both the video card and the external display. When selecting a video card, the following specifications should be considered: - The *resolution* is the number of pixels displayed on screen. A higher resolution means that more information can be shown on the screen. A video card is rated by its max resolution, which is the highest possible resolution it can display (e.g., 1920 × 1080 or 4096 × 2160). - The *refresh rate* is the number of times in one second that the GPU draws a frame. Refresh rates are measured in hertz. A refresh rate of 70 Hz or lower may cause eye fatigue. An optimal refresh rate is between 75 Hz and 85 Hz. For optimal image quality and graphic performance, it is best to select a display that matches the video card specifications, and vice versa.
Processing Capabilities	The graphics processing unit (GPU) handles all video rendering tasks. GPUs are much more efficient at processing graphic data than a traditional CPU. - Using the GPU to render graphics is often referred to as video hardware acceleration. - Settings in the operating system can be used to control how much video processing is offloaded to the GPU. - GPUs have a clock speed that is rated in MHz. A higher speed means better performance.

Memory	Dedicated video cards use high-speed memory to store graphic data. The amount of memory on the card affects performance as well as other characteristics.
	
	• The amount of memory on a card can be as low as 1 GB or as high as 12 GB.
	• Dedicated video cards use the following types of memory:
	    ▪ DDR, DDR2, and DDR3 memory are similar to system memory. This type of memory is cheaper, but provides less performance features than special graphics memory.
	    ▪ GDDR2, GDDR3, and GDDR5 are DDR memory specifically designed and optimized for graphical data. This memory is more expensive, but results in better performance.
	
	Integrated graphics (onboard video cards) share system memory with the CPU for video processing.

Bus type	Video cards must be compatible with the expansion slots on the motherboard. Common slot types used by video cards include the following: • PCIe x16 • PCI • AGP and VESA (used by older video cards) Motherboards with integrated graphics embed the functionality with the buses on the system (e.g., PCIe, AGP, or PCI).

Multi-GPU	Some video cards can be linked together and share the graphic processing load between the two GPUs.
	
	• Multi-GPU configurations are manufacturer-specific:
	    ▪ NVIDIA uses SLI (Scalable Link Interface).
	    ▪ AMD uses CrossFire.
	• Video cards are linked using a special bridge clip or through software (depending on the implementation).
	• The motherboard and each video card must use the same connection method (SLI or CrossFire). The motherboard must also have multiple PCIe x16 slots.
	• In most cases, both video cards must be identical.
	
	Some motherboards allow you to link an integrated graphics controller with a video card installed in the expansion slot; however, this offers a negligible performance boost.

HDMI audio	HDMI cables are able to carry both video and audio signals; however, most video cards send only a video signal. The following techniques can be used to send an audio signal through the video card: • With audio pass-through, an audio output cable is connected to the video card. The video card combines the audio signal with the video signal for HDMI output. This option is often called HDTV out. • A graphics card with an onboard audio processor can decode and process audio and send it out the HDMI port. This option is often referred to as onboard sound.
DirectX/OpenGL	DirectX is a collection of application program interfaces (APIs) that improves graphic, animation, and multimedia creations. • DirectX includes multiple components targeted to a different aspect of multimedia. For example, Direct3D is the 3D rendering component of DirectX. • Applications (typically games) are written using features included in specific DirectX versions. • To view content written to a specific DirectX version, your video card must also support that (or a higher) version. OpenGL is an alternative standard to DirectX that is used by some applications. Most video cards support both DirectX and OpenGL.
High-bandwidth Digital Content Protection (HDCP)	HDCP is a method for protecting digital media. The purpose of HDCP is to prevent the interception and copying of protected data streams as they are sent from a playback device to a display device (e.g., from a DVD player to an HDTV). • When playing protected content from a PC, the DVD player, video card, and display device must all support HDCP. • If you plan on watching protected content on your PC, or playing content from your PC to an external TV, make sure the video card supports HDCP.