

# How Video Game Systems Work

by [Jeff Tyson](#)

Home video game systems, also known as **consoles**, are a popular form of entertainment. In 2000, [Sony](#) estimated that one out of every four households in the United States had a **Sony PlayStation**.

That's a huge number! And then there are the homes with one of the many other game systems.

## Special Thanks

Our thanks to the staff at [Buy-Rite Video](#) for assisting with the articles in this series.



[Microsoft Xbox](#)



[Nintendo GameCube](#)



[Sony PlayStation 2](#)



[Sony PS One](#)

In this edition of [HowStuffWorks](#), you will learn what video game systems are, a little about the history of game consoles, what is inside a game console and what the future holds for these systems. You will also learn a little about the games these systems play.

Let's start with the most basic question: What exactly is a video game console?

## Game Consoles!

- [How PlayStation Works](#)
- [How PlayStation 2 Works](#)
- [How N64 Works](#)
- [How Game Boy Advance Works](#)
- [How Dreamcast Works](#)
- [How Xbox Works](#)
- [How GameCube Works](#)

## In Essence...

At its core, a video game system is a highly specialized computer. In fact, most systems are based on the same [central processing units](#) (CPUs) used in many [desktop computers](#). To keep the cost of the video game system within reasonable limits, most manufacturers use a CPU that has been widely available for long enough to undergo a significant decrease in cost.

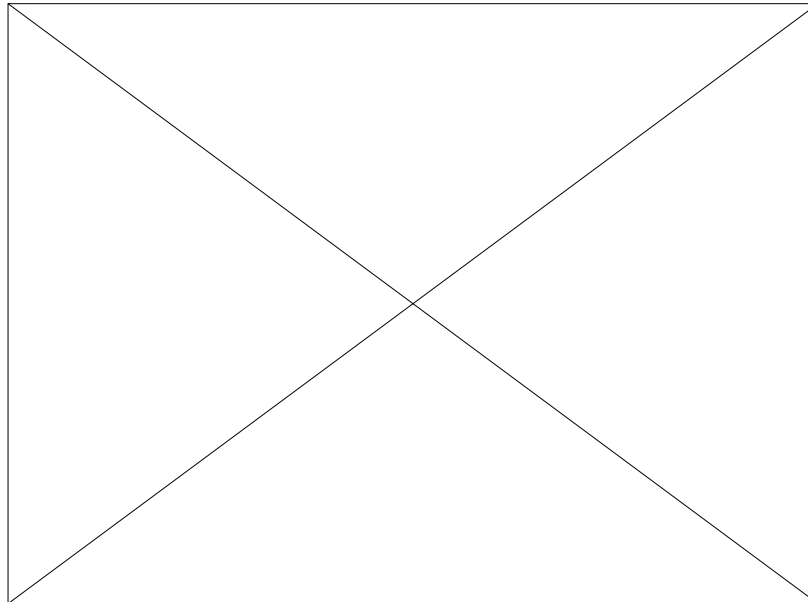
Why would people buy a game console instead of a computer? There are several reasons:

- It's usually much cheaper. Prices range from a high end of about \$200 for the Sony PlayStation 2, to less than \$30 for an older, used system.
- There's no long wait for the game to load.
- Video game systems are designed to be part of your entertainment system. This means that they are easy to connect to your [TV](#) and stereo.
- There are no compatibility issues, such as [operating system](#), DirectX drivers, correct audio card, supported game controller, resolution and so on.
- Game developers know exactly what components are in each system, so games are written to take full advantage of the hardware.
- The degree of technical knowledge required to set up and use it is much lower. Most game consoles are truly "plug and play."
- Most video game systems have games that allow multiple players. This is a difficult process with a typical home computer.

Check out the next section for a short history of the video game (remember Pong?), or skip it and jump right into [Game System Basics](#).

## A Short History

Video games have been around since the early 1970s. The first commercial arcade video game, **Computer Space** by **Nutting Associates**, was introduced in 1971. In 1972, **Atari** introduced **Pong** to the arcades. An interesting item to note is that Atari was formed by **Nolan Bushnell**, the man who developed Computer Space. He left Nutting Associates to found Atari, which then produced Pong, the first truly successful commercial arcade video game.



Pong was a great hit when it came out. Move your cursor to get the slides to bounce back the moving square -- it will speed up as you progress.

That same year, **Magnavox** offered the first home video game system. Dubbed the **Odyssey**, it did not even have a microprocessor! The core of the system was a board with about four-dozen transistors and [diodes](#). The Odyssey was very limited -- it could only produce very simple graphics, and required that custom plastic overlays be taped over the [television](#) screen. In 1975, Atari

sold exclusively through Sears, and even carried the Sears logo. Pong was a phenomenal success, opening the door to the future of home video games.

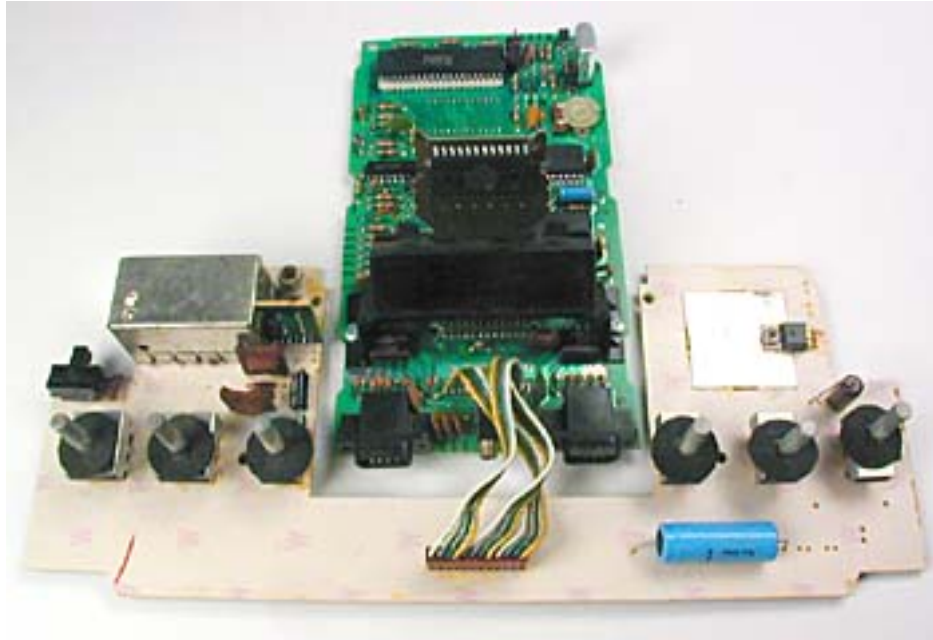


The Atari 2600

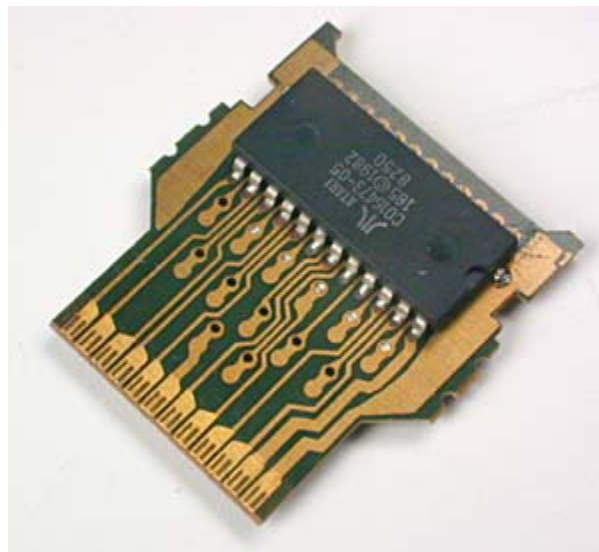
Although the **Fairchild Channel F**, released in 1976, was the first true removable game system, Atari once again had the first such system to be a commercial success. Introduced in 1977 as the Atari **Video Computer System** (VCS), the 2600 used removable cartridges, allowing a multitude of games to be played using the same hardware.

The hardware in the 2600 was quite sophisticated at the time, although it seems incredibly simple now. It consisted of:

- MOS 6502 microprocessor
- Stella, a custom graphics chip that controlled the synchronization to the TV and all other video processing tasks
- 128 bytes of RAM
- 4-kilobyte ROM-based game cartridges



The chips were attached to a small **printed circuit board** (PCB) that also connected to the joystick ports, cartridge connector, power supply and video output. Games consisted of software encoded on ROM chips and housed in plastic cartridges. The ROM was wired on a PCB that had a series of metal contacts along one edge. These contacts seated into a plug on the console's main board when a cartridge was plugged into the system. When power was supplied to the system, it would sense the presence of the ROM and load the game software into memory.



Systems like the Atari 2600, its descendant, the **5200**, Coleco's **ColecoVision** and Mattel's **IntelliVision** helped to generate interest in home video games for a few years. But interest began to wane because the quality of the home product lagged far behind arcade standards. But in 1985, Nintendo introduced the **Nintendo Entertainment System** (NES), and everything changed.

The NES introduced three very important concepts to the video game system industry:

- Using a pad controller instead of a joystick
- Creating authentic reproductions of arcade video games for the home system
- Using the hardware as a **loss leader** by aggressively pricing it, then making a profit on the games themselves

Nintendo's strategy paid off, and the NES sparked a revival in the home video game market that continues to thrive and expand even now. No longer were home video game systems looked upon as inferior imitations of arcade machines. New games that would have been impractical to create for commercial systems, such as **Legend of Zelda**, were developed for the home markets. These games enticed many people who had not thought about buying a home video game system before to purchase the NES.

Nintendo continued to develop and introduce new game consoles. Other companies, such as [Sega](#) and Sony, created their own home video game systems. Let's look at the core parts of any current video game system.

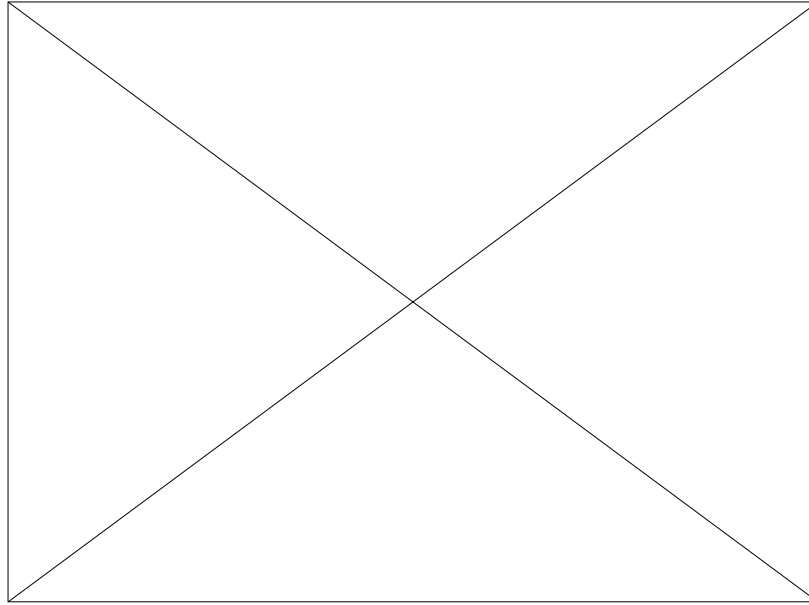
## Game System Basics

The basic pieces really haven't changed that much since the birth of the Atari 2600. Here's a list of the core components that all video game systems have in common:

- User control interface
- CPU
- RAM
- Software kernel
- Storage medium for games
- Video output
- Audio output
- Power supply

The user control interface allows the player to interact with the video game. Without it, a video game would be a **passive** medium, like [cable TV](#). Early game systems used **paddles** or **joysticks**, but most systems today use sophisticated controllers with a variety of buttons and special features.

Ever since the early days of the 2600, video game systems have relied on [RAM](#) to provide temporary storage of games as they're being played. Without RAM, even the fastest CPU could not provide the necessary speed for an interactive gaming experience.



The software **kernel** is the console's [operating system](#). It provides the interface between the various pieces of hardware, allowing the video game programmers to write code using common software libraries and tools.

The two most common storage technologies used for video games today are [CD](#) and ROM-based cartridges. Current systems also offer some type of [solid-state memory cards](#) for storing saved games and personal information. Newer systems, like the [PlayStation 2](#), have [DVD](#) drives.

All game consoles provide a video signal that is compatible with [television](#). Depending on your country, this may be NTSC, PAL or possibly even SECAM. Most consoles have a dedicated graphics processor that provides specialized mapping, texturing and geometric functions, in addition to controlling video output. Another dedicated chip typically handles the audio processing chores and outputs stereo sound or, in some cases, [digital surround sound](#)!

In the next section, you'll learn a bit about the games you can play on these systems.

## The Games

The software used on these dedicated computer systems has evolved amazingly from the simple rectangular blips used in Pong. Games today feature richly textured, full-color graphics, awesome sound and complex interaction between player and system. The increased storage capacity of the cartridges and discs allows game developers to include incredibly detailed graphics and CD-quality soundtracks. Several of the video game systems have built-in special effects that add features like unique lighting or [texture mapping](#) in real-time.

There is a huge variety of games available. Here are just a few of the games you can play on the most popular consoles:

**Nintendo 64**





[Perfect Dark](#)



[Goldeneye 007](#)

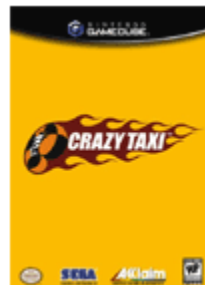


[Pokemon Stadium](#)



[Resident Evil 2](#)

## GameCube



[Crazy Taxi](#)



[Madden 2002](#)



[Star Wars Rogue Leader: Rogue Squadron II](#)



[SSX Tricky](#)

## Xbox



[Tony Hawk's Pro Skater 2X](#)



[Dead or Alive 3](#)



[Amped: Freestyle Snowboarding](#)



[NHL 2002](#)

## PlayStation 2



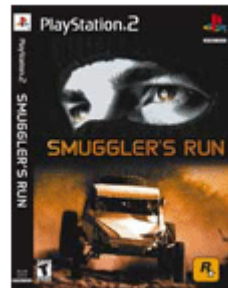
[NCAA Final Four 2002](#)



[WWF Smackdown: Just Bring It](#)



[Gran Turismo 3](#)



[Smuggler's Run](#)

Now let's compare console specs.

## Comparing Consoles



Just like the world of computers, video game systems are constantly getting better. New technology developed specifically for video game systems is being coupled with other new technologies, such as DVD. Here are some system specs:

#### When You Shop

We've created a Video Game System Feature Comparison chart for you to use as you research various game systems. The chart is available to you as a PDF. You will need the free [Adobe Acrobat Reader](#) to view it.

- [Download the comparison chart!](#)

### Sony PlayStation 2

- [Processor](#): 128-bit "Emotion Engine"
  - 300 MHz
  - Floating point unit (FPU) co-processor
  - Maximum bus transfer rate of 3.2 GB per second
  - Includes current PlayStation CPU core
- [Graphics](#): "Graphics Synthesizer"
  - 150 MHz
  - Embedded [cache](#)
  - 4 MB VRAM
  - 75 million polygons per second
- Audio: SPU2 (+CPU), 48 channels, 44.1- or 48-kHz sampling rate, 2 MB memory
- [RAM](#): 32 MB RDRAM
- Game medium: Proprietary 4.7-GB DVD and original PlayStation CDs
- Drive bay (for hard disk or network interface)
- Controller: Two controller ports, "Dual Shock 2" analog controller
- Other features:
  - Two [memory card](#) slots
  - Optical digital output
  - Two [USB](#) ports
  - [FireWire](#) port
  - Support for audio CDs and DVD-Video

### Nintendo GameCube

- Processor: "Gekko" IBM Power PC microprocessor
  - 485 MHz
  - Cache:
    - level 1: 32 KB Instruction and 32 KB Data
    - level 2: 256 KB
  - 32-bit address, 64-bit data bus
  - Maximum bus transfer rate of 2.6 GB per second
  - 0.18 micron copper interconnects
- Graphics: "Flipper" ATI graphics chip
  - 162 MHz
  - 1 MB embedded texture cache
  - 3 MB Mosys 1T-SRAM (This [static RAM](#) uses a single transistor per cell, like [DRAM](#).)
  - Approximately 12 million polygons per second
- Audio: Special 16-bit digital signal processor, 64 channels, 48-kHz sampling rate
- RAM: 40 MB (24 MB 1T-SRAM, 16 MB of 100-MHz DRAM)
- Game medium: Proprietary 1.5-GB optical disc
- Controller: Four game controller ports, Wavebird wireless game controller
- Other features:
  - Handle for carrying
  - Two slots for 4-MB Digicard Flash memory cards or a 64-MB SD-Digicard adapter
  - High-speed [parallel port](#)

- Two high-speed serial ports
- Analog and digital audio-video outputs

## Microsoft Xbox

- Processor: Modified [Intel](#) Pentium III
  - 733 MHz
  - Maximum bus transfer rate of 6.4 GB per second
- Graphics: Custom [nVidia](#) 3-D graphics chip
  - 250 MHz
  - Approximately 125 million polygons per second
- Audio: Custom 3-D audio processor
- RAM: 64 MB (Xbox has a unified memory architecture -- the memory can be allocated to graphics, audio, textures or any other function as needed.)
- Game medium: Proprietary 4.7-GB DVD
- Modem/network: Media communications processor (MCP), 10/100-Mbps [Ethernet](#), broadband enabled, 56K modem (optional)
- Controller: Four game controller ports
- Other features:
  - 8-GB built-in [hard drive](#)
  - 5X DVD drive with movie playback
  - 8-MB removable memory card
  - Expansion port

## Cool Facts

- The **Sega** [Dreamcast](#) was the first console to implement online play over a phone line, calling the system [Sega Net](#).
- The **Microsoft Xbox** is the first video game system to completely support [HDTV](#).
- **Popular Science** recognized the Sega Dreamcast as one of the most important and innovative products of 1999.
- The **Magnavox Odyssey**, released in 1972, contained 40 transistors and no [microprocessor](#). The new Pentium 4 microprocessor contains 42 million transistors on the chip itself!
- The PlayStation 2 is the first system to have graphics capability better than that of the leading-edge [personal computer](#) at the time of its release.
- The **Nintendo N64** marked the first time that computer graphics workstation manufacturer **Silicon Graphics Inc.** (SGI) developed game hardware technology.
- While the original **Atari Football** game was first created in 1973, it wasn't released until 1978. It was delayed because the game couldn't **scroll** the screen -- players couldn't move beyond the area shown on the monitor. When the game was finally released, it became the first game to utilize scrolling, a key part of many games today.
- The Atari **Pong** video game console was the No. 1 selling item for the holiday season in 1975.
- The first console to have games available in the form of add-on cartridges was the Fairchild **Channel F** console, introduced in August 1976.
- The PlayStation 2 is the first video game system to use [DVD](#) technology.
- On the original Magnavox Odyssey, players had to keep score themselves because the machine couldn't.
- The Nintendo GameCube's proprietary disc can hold 1.5 gigabytes of data -- 190 times more than what an [N64](#) game cartridge can hold.
- On the market from 1977 till 1990, the Atari [2600](#) lasted longer than any other game system in history.

- The Sega **Genesis** featured a version of the same Motorola processor that powered the original Apple Macintosh computer.
- Mattel's **Intellivision** system, introduced in 1980, featured an add-on called "PlayCable," which delivered games by cable TV.
- Nintendo's **Game Boy** is the most successful game system ever, with more than 100 million units sold worldwide.
- The word **atari** comes from the ancient Japanese game of **Go** and means "you are about to be engulfed." Technically, it is the word used by a player to inform his opponent that he is about to lose, similar to "check" in **chess**.
- In the 1980s, a service called Gameline allowed users to download games to the Atari 2600 over regular phone lines. It was not a success, but did form part of the foundation for America Online, the world's largest Internet service provider.
- The first color portable video game system was the Atari **Lynx**, introduced in 1989 and priced at \$149.
- Introduced in 1993, the **3DO** was the first video game system to be based entirely on [CD technology](#).
- The Sony PlayStation was originally intended as a CD add-on to the Super Nintendo. When licensing problems and other issues arose, Sony decided to develop the PlayStation as a machine of its own.