Architecture of the Super NES and its Peripherals

A journey into one of the greatest gaming consoles of all time

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Overview

- History
- CPU
- PPU
- APU
- Cassettes
- Controllers
- Official Nintendo Extra Hardware

image: http://upload.wikimedia.org/wikipedia/commons/8/82/USA-SNES_-_JPN-SuperFamicom.png
Manufactured 1991 - 1999
49.1 million units sold worldwide
Most popular game: Super Mario World
Successor to the Nintendo Entertainment System
Predecessor to the Nintendo 64
## NES vs SNES

<table>
<thead>
<tr>
<th>Specification</th>
<th>NES</th>
<th>SNES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Speed</td>
<td>1.79 MHz</td>
<td>2.86 MHz (up to 10.74 MHz)</td>
</tr>
<tr>
<td>Number of bits</td>
<td>8 bits</td>
<td>16 bits</td>
</tr>
<tr>
<td>Units sold</td>
<td>61.91 Million</td>
<td>49.1 Million</td>
</tr>
</tbody>
</table>
Central Processing Unit (CPU)
SNES CPU

- Custom CPU based on a 16-bit 65c816 core
- Input clock rate: 21.47727 MHz
- Bus clock rate: 3.58 MHz (High Speed mode), 2.86 MHz (normal mode)
- 24 bit bus - used for general accesses
- 8 bit bus - used for APU and PPU register accesses
## SNES CPU

<table>
<thead>
<tr>
<th>CPU Specification</th>
<th>SNES</th>
<th>Sega Genesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Clock Rate</td>
<td>3.58 MHz</td>
<td>7.6 MHz</td>
</tr>
<tr>
<td>Number of bits</td>
<td>16</td>
<td>16/32</td>
</tr>
<tr>
<td>Peak Instructions per second</td>
<td>1.79 MIPS</td>
<td>1.4 MIPS</td>
</tr>
</tbody>
</table>
Picture Processing Unit (PPU)

- Comprised of 2 units: PPU1 and PPU2
- PPU1 generates background character data, rotation, and scaling
- PPU2 performs special effects
Picture Processing Unit (PPU)

- 64 kB of SRAM
- 32,768 colors (15 bit RGB color space)
- Clocked with the same signal as CPU
- 7 different video modes
- Supported resolutions: 256x224, 512x224, 256x239, 512x239, 512x448, 512x478
Video Modes

Mode 0: 4 layers, all using 4-color palettes. Each BG uses its own section of the SNES palette.
Mode 1: 3 layers, two using 16-color palettes and one using 4-color palettes.
Mode 2: 2 layers, both using 16-color palettes. Each tile can be individually scrolled.
Mode 3: 2 layers, one using the full 256-color palette and one using 16-color palettes. The 256-color layer can also directly specify colors from an 11-bit (RGB443) colorspace.
Mode 4: 2 layers, one using the full 256-color palette and one using 4-color palettes. The 256-color layer can directly specify colors, and each tile can be individually scrolled.
Mode 5: 2 layers, one using 16-color palettes and one using 4-color palettes. Tile decoding is altered to facilitate use of the 512-width and interlaced resolutions.
Mode 6: 1 layer, using 16-color palettes. Tile decoding is as in Mode 5, and each tile can be individually scrolled.
Mode 7: 1 layer of 128x128 tiles from a set of 256, which may be interpreted as a 256-color one-plane layer or a 128-color two-plane layer. The layer may be rotated and scaled using matrix transformations. HDMA is often used to change the matrix parameters for each scanline to generate perspective effects.

(http://www.8-bitcentral.com/nintendo/snes.html)
Audio Processing Unit (APU)
SNES APU

Sony SPC700 Series CMOS 8-bit CPU
  2 8-bit IO ports
  3 timers
DSP Unit
D/A Converter
64 KB RAM
Cartridges

- Super FX chip
- Super Accelerator System

image: http://www.i64x.com/i6img/sfc25.jpg
Super FX Chip

- RISC CPU
- Used to render graphics the normal CPU couldn’t
- Processed mainly 3D polygons
- Clocked at 10.5 MHz
- Required additional pins in the cartridge
Super Accelerator System (SA-1)

- Improved CPU that would be placed in the game cartridge
- 16-bit processor
- Clock rate: 10.74 MHz
- Works in parallel with original processor to yield 5x performance
- 2kB of internal RAM, 2MB of external RAM
- 64 MB of external ROM
Super Accelerator System

SA-1 CPU
(65C816)

I-RAM
16 Kbit

Super NES CPU I/O

Super NES CPU

Game Pak ROM

BW-RAM

SA-1

SAS

Super NES Control Deck

Figure 1-2-1 SA-1 Block Diagram

Figure 1-1-1 Super Accelerator System Configuration
Extras

2 extra pieces of hardware were
Satellaview satellite internet connection
Super Gameboy cartridge
Satellaview

- St. Giga Radio
- BS Zelda no Densetsu
  - BSゼルダの伝説
  - (BS Legend of Zelda)
  - SoundLink
- Sore wa Namae o Nusumareta Machi no Monogatari
  - それは名前を盗まれた街の物語
  - (The Story of the Town Whose name was Stolen)
- Ran From April 1995 - March 2000
Super Gameboy
End of Life

- Best selling console of its generation
- Games live on through emulation and cartridge mods
- Predecessor to the N64
- Developers continued to release games for SNES through 1998
- One of the best selling consoles of all time
- CNET declared SNES as greatest console of all time (2008)
Any Questions?