Sega Game Gear on a Chip

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Underlying Goal

Reimplement all the digital components of a legacy computer system in a FPGA

Purpose

Why?

- **Maintainability** - You can no longer buy parts to service legacy computer systems
- **Upgradability** - Reimplementation gives an opportunity to add additional features
- **Portability** - Do not need all the original big clunky hardware. Reimplementation can be embedded in new designs.

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Sega Game Gear

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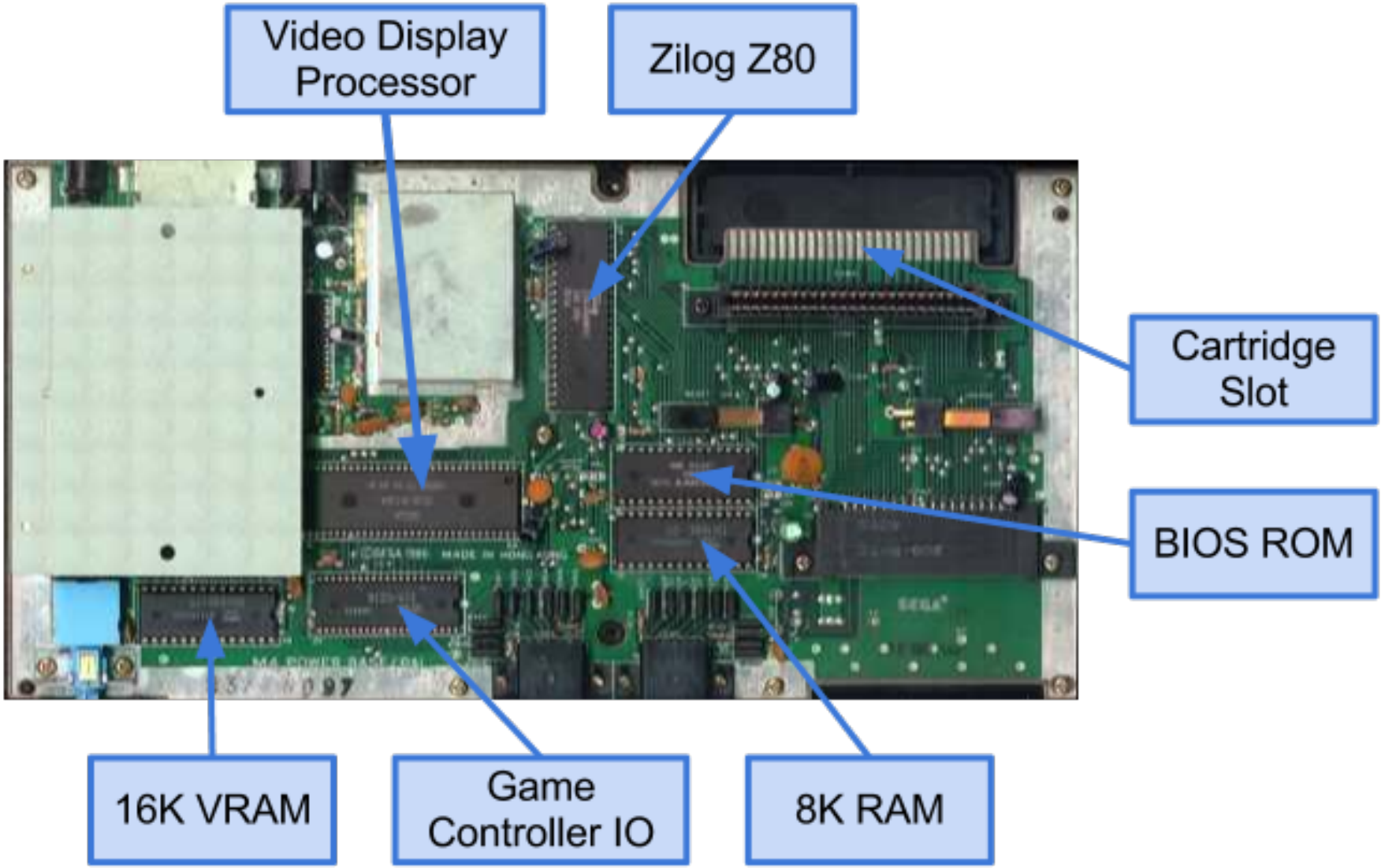
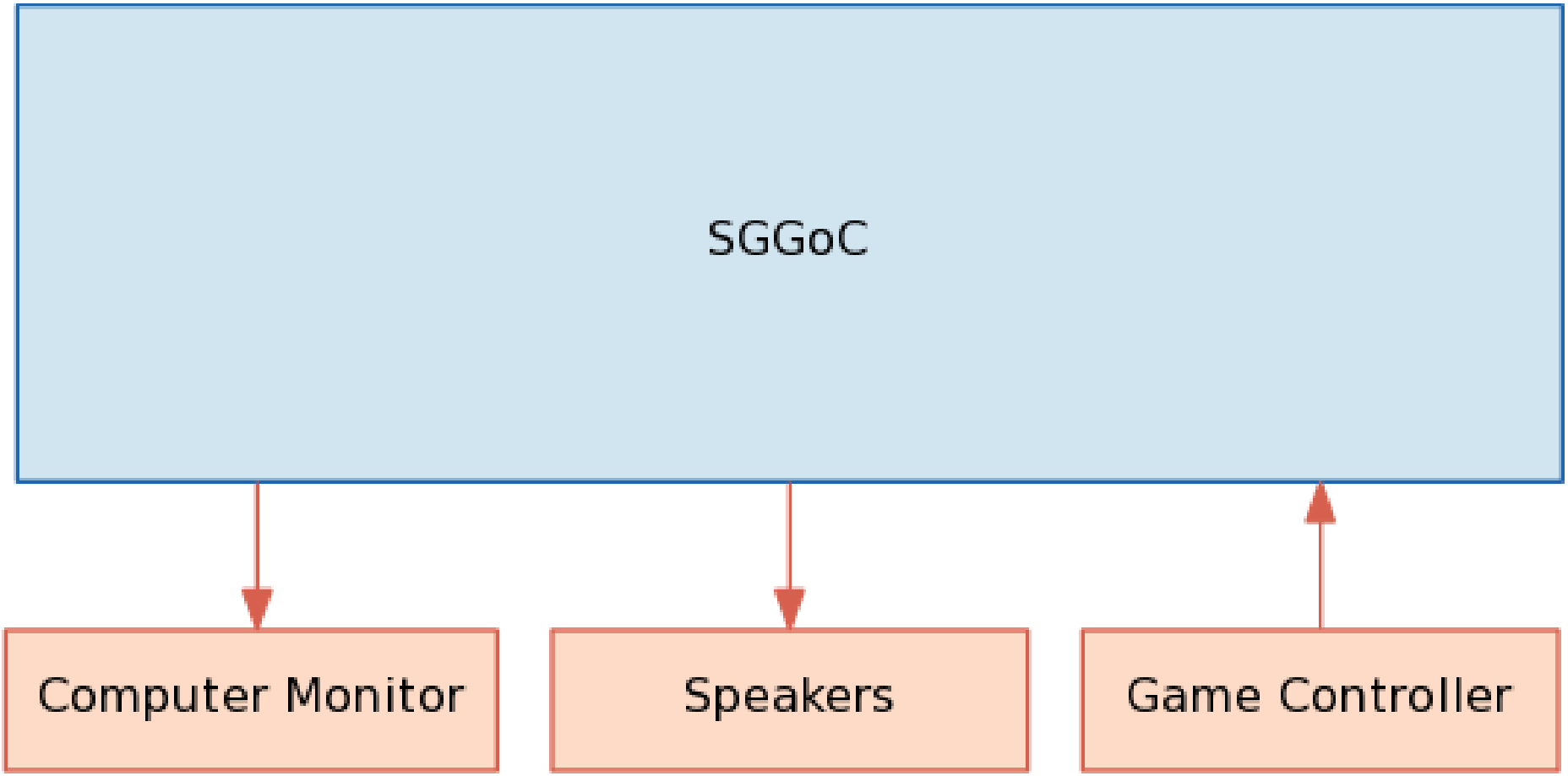
- Released April 1990
- Mobile version of the Sega Master System (functionally identical)
- Standard system architecture for the time (Z80 CPU, tri-state buses, etc...)

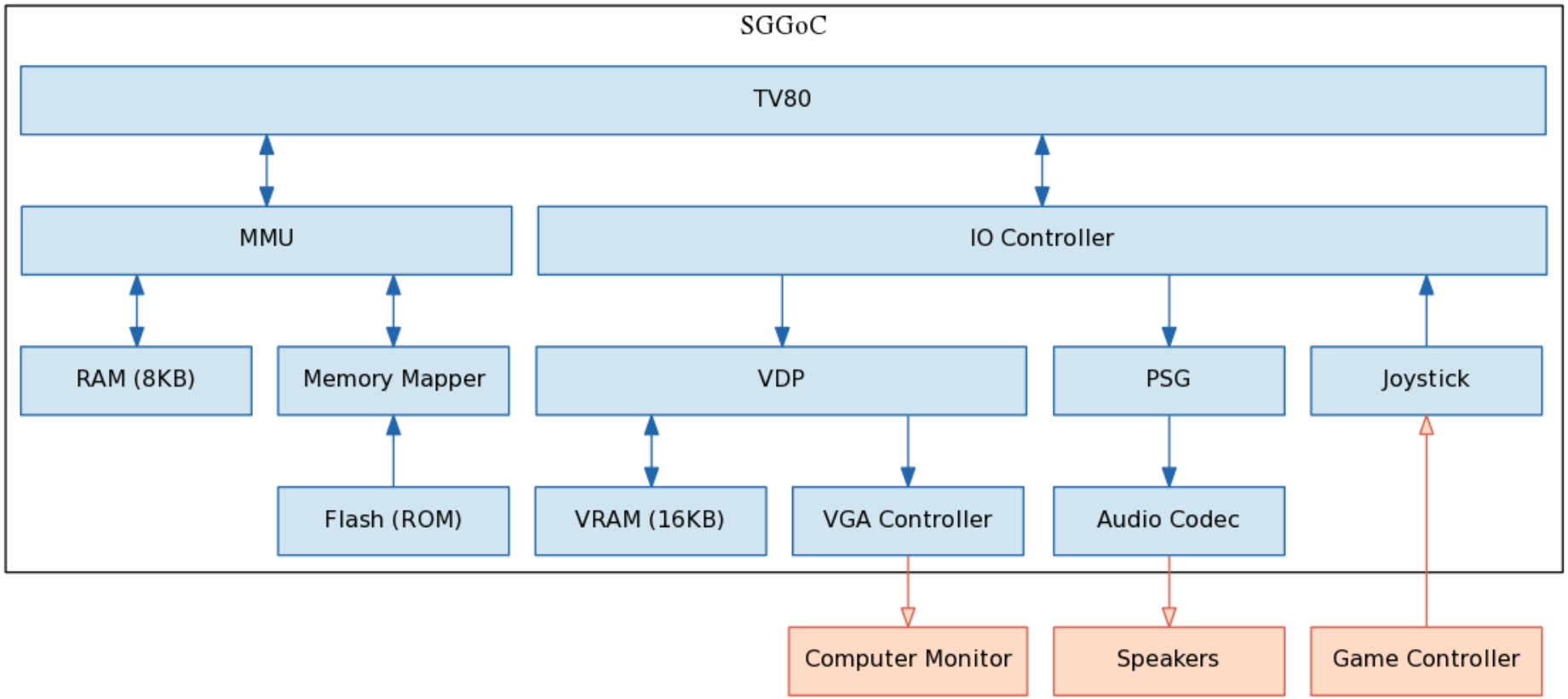
Sega Master System PCB



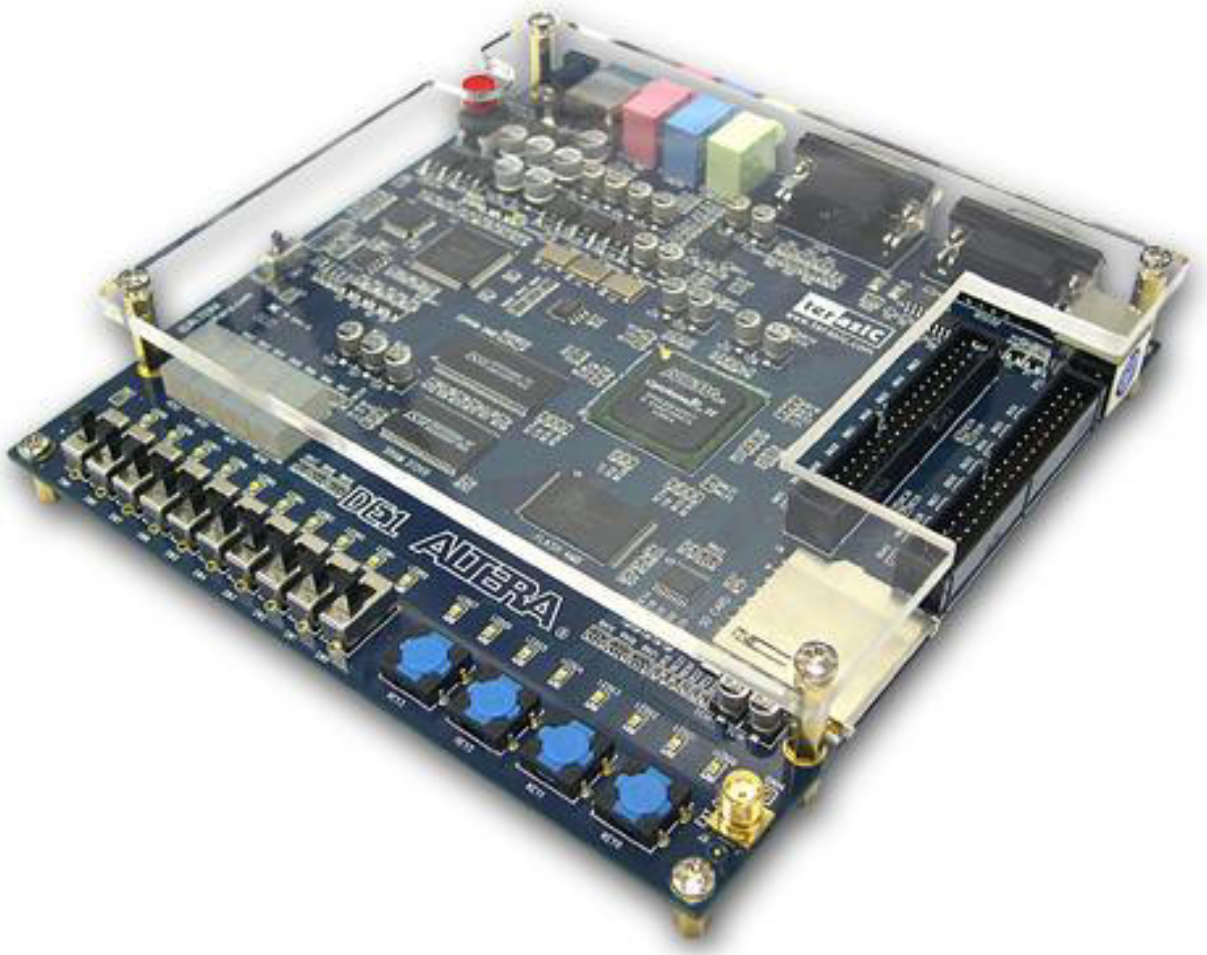
Black Box Diagram



Transparent Box Diagram

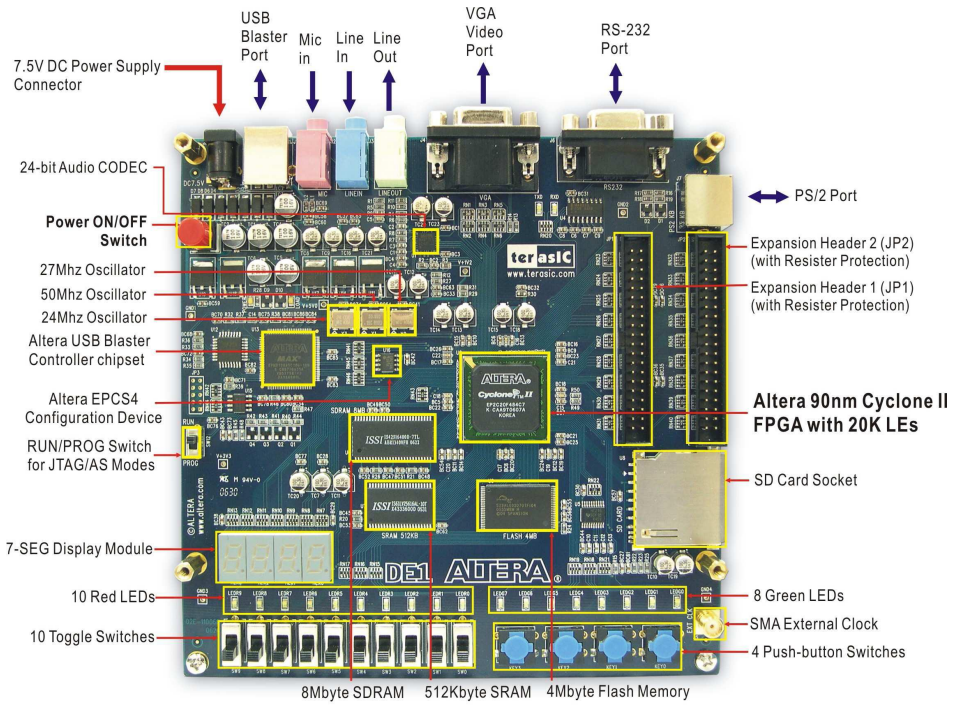


FPGA Development Board



Altera DE1

- Cyclone II EP2C20F484C7
- VGA, Audio, SD Card, 4 MB Flash
- Command line development environment
- Extremely good documentation



Game Cartridge

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Each game cartridge made up of at least two components:

- Game data ROM
- Memory Mapper

Practically every game ROM has been dumped as is available online

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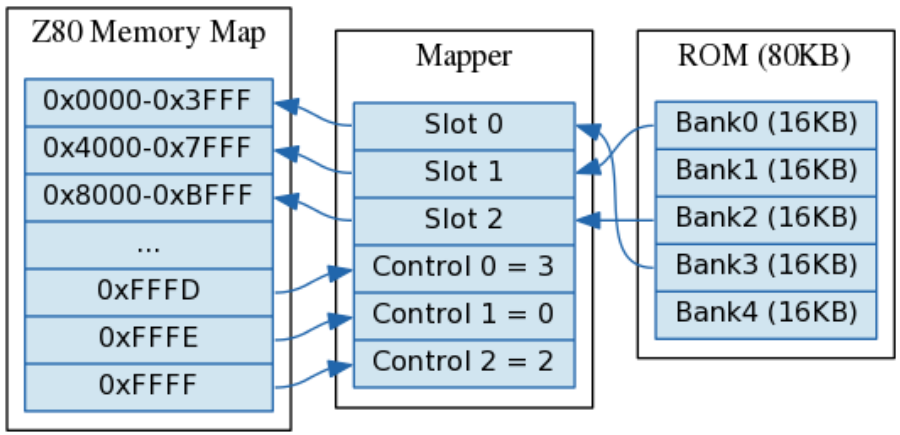

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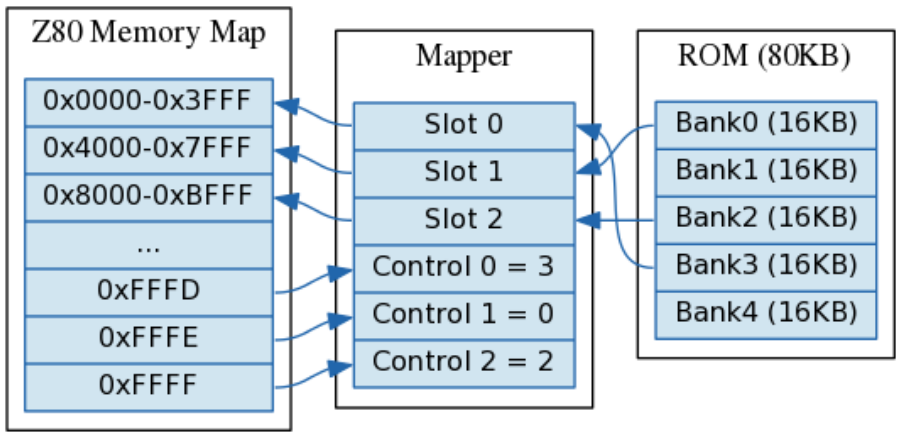

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Storing Game ROMs

A few options to store game ROMs:

1. Hookup the actual cartridge
   - Straight forward
   - Don't have to re-implement the memory mappers
   - Defeats most the point of the project
2. Store them on a SD card
   - Extremely portable / convenient
   - Even more complicated
3. Store them on the 4MB flash chip
   - Fairly straightforward
   - Extremely non-portable
   - Flash chip looks just like original ROM chips

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ROM Flasher Tool

Need a tool to load a ROM file into the flash chip from the PC

1. Load RS232-to-ROM bridge into the FPGA
2. PC waits for FPGA to request a byte
3. PC send the next byte of ROM file
4. FPGA writes byte to flash
5. Go back to 2

Can also do the reverse to read back and verify the flash contents against ROM file

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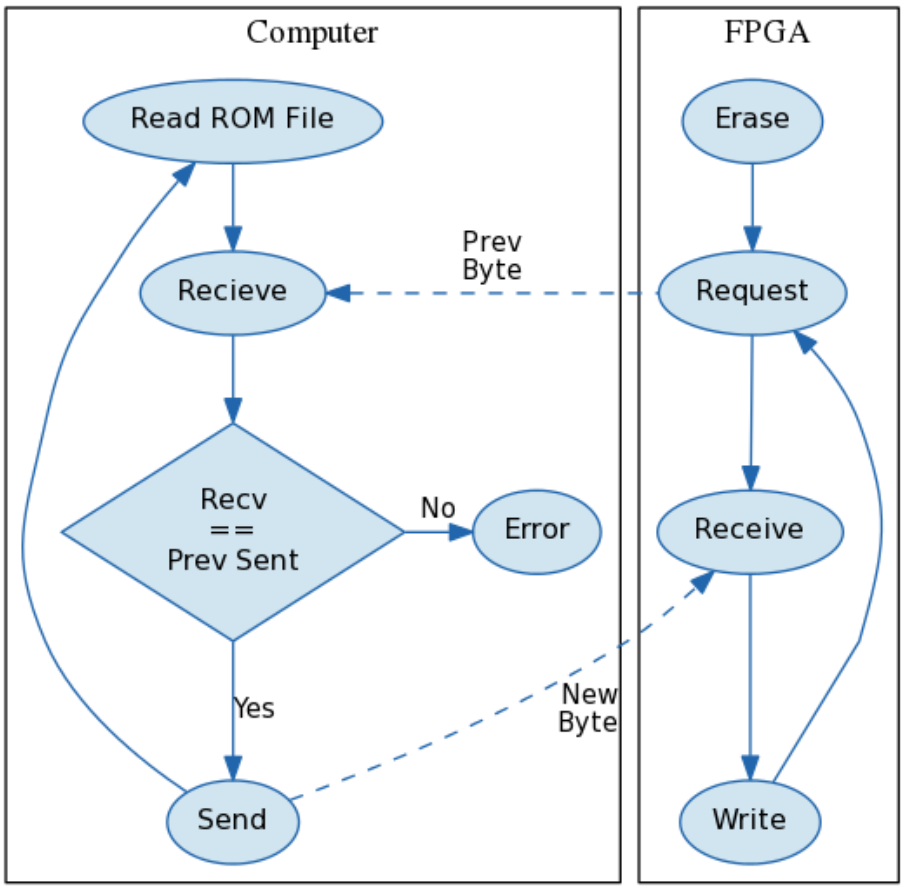
Writing



Reading