

Wireless Video Chat System

EECS 488

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State of the Art

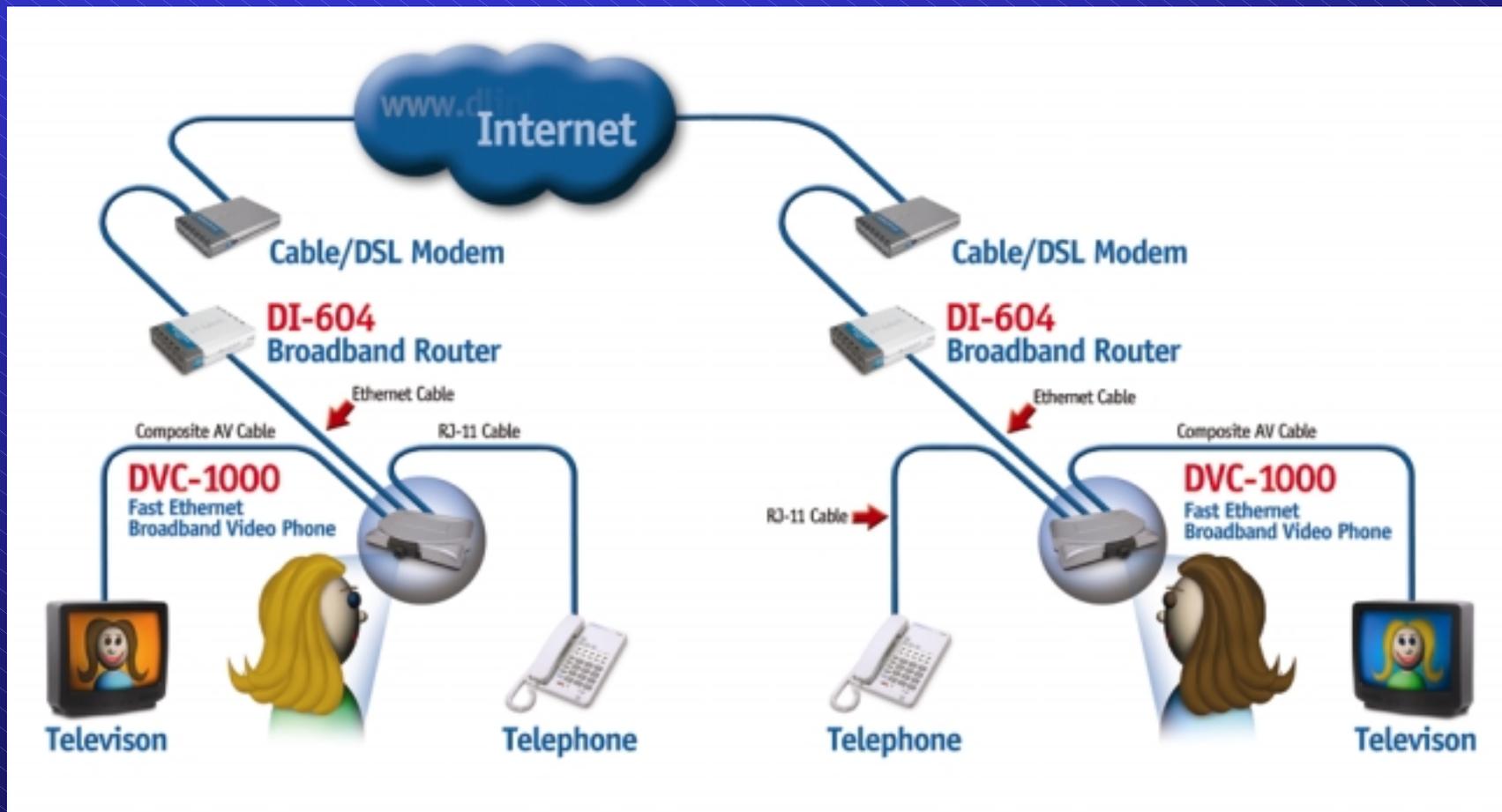
- D-Link's "i2eye" videophone
 - 30 fps
 - Remote Control
 - Caller ID
 - Standalone (no PC required)



i2eye Drawbacks

- Not wireless
- Requires broadband Internet connection
 - \$40/month * 12 months = \$480/year
- Requires a TV and telephone
 - The user must use a telephone handset to send and receive audio
- No storage capability
- \$299

D-Link's Drawbacks, con't.



What would a device need in order to compete with D-Link?

- Wireless
- Integrated display
- Integrated speaker
- Integrated storage
- Low power
- Lightweight

...and inexpensive



Marketing Feasibility Study

- GOAL: Priced \$399 or less
- Justification: with products like the D-Link selling for \$299, it is unlikely that consumers would pay more than \$399 for the convenience of a portable device.
- Considerable market share will be lost to PDAs



Product Specifications

- Modes of Operation:
 - Wireless
 - Storage capability
 - Remote surveillance
- Features:
 - Integrated LCD display
 - Low power consumption

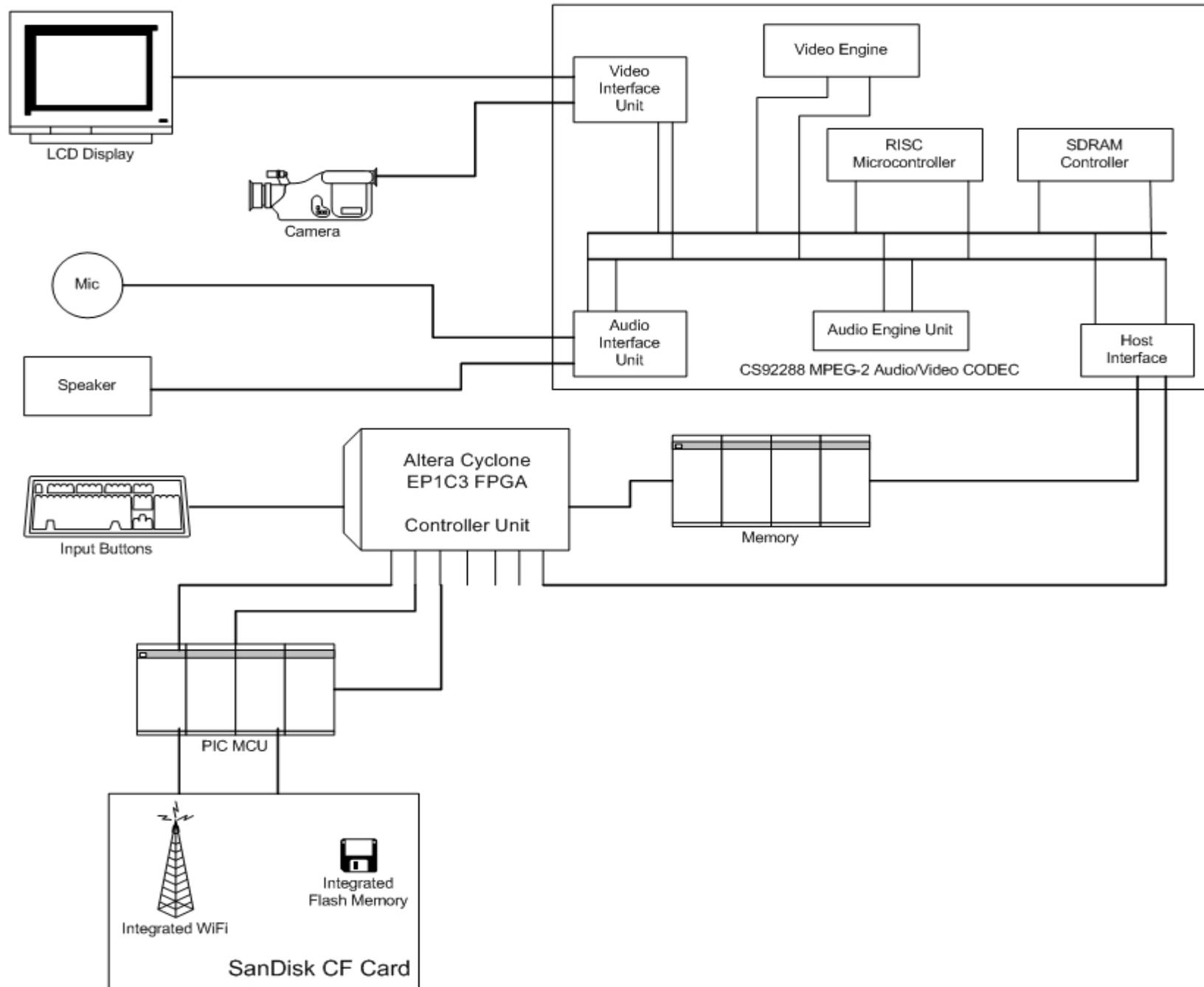
...how is it possible to keep the net cost below \$400?

The FPGA Solution

- Allows for IP Core implementation
- An effective way of minimizing development and retail costs
- Reliable, proven designs
 - OpenCores.org
- Upgrade potential
 - EPROM



Wireless Video Phone Block Diagram



MPEG Codec: Cirrus Logic CS92288

- Programmable RISC core
 - Provides customized multiplexing/demultiplexing for a variety of applications (VCD, SVCD, DVD, etc)
- Programmable DSP core
 - Supports dual-channel Dolby Digital encoding and MPEG (all layers) audio encoding and decoding
- Real time MPEG-2
- Constant and one-pass variable bit rate
- Supports multiple resolutions and scan rates
- Based on embedded ARC core
 - Stands apart from traditional RISC processors because its instruction set can be configured to match the customer's exact requirements.

Video Compression Engine

- MPEG-2 Video
- NTSC formats (required for our LCD)
 - 352x240, 176x112, etc
- Programmable encoding parameters:
 - User defined quantization matrices
 - Average bit rate

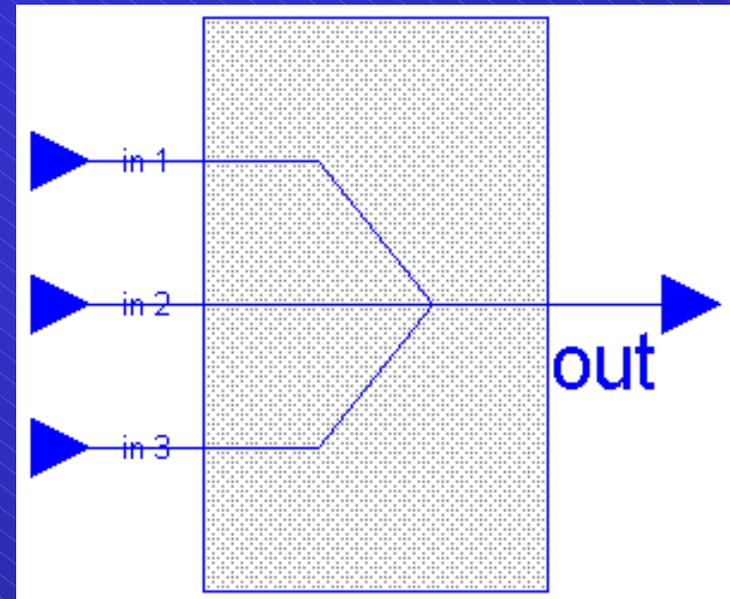
Audio Compression Engine

- Programmable DSP provides several choices:
 - MPEG-1
 - MPEG-2 (all layers)
 - Dolby Digital
 - MP3
 - Additional enhancements (not needed for our device)
 - DTS
 - Dolby Pro Logic



Cirrus Integrated Multiplexer

- Programmable
- Supports encoding and decoding of:
 - DVD
 - VCD, SVCD
 - Elementary streams
 - Program streams
 - Transport streams
 - Useful for environments where errors are likely



Bill of Materials

- CCD Camera
 - \$42.95
 - 1/3" CCD image sensor
 - Horizontal resolution: >350 lines
 - Sensitivity: 0.7 lux/F2.0
 - Video output: 1Vp-p, composite video 75 ohms
 - Power supply: 12VDC
 - Power consumption: 110mA
 - Size: 1.3"L x 1.3"W x 1.2"H



Bill of Materials, Con't.

- 2.5" TFT LCD Module
 - \$55.00 (quantities of 1000+)
 - Resolution: 480 x 234 dots
 - Backlight: cold cathode fluorescent lamp
 - Power source: 12VDC @ 400mA
 - Tint, color and brightness adjustable



Bill of Materials, Con't.

- Speaker -- \$0.65
- Microphone -- \$0.39
- Altera Cyclone EP1C3 FPGA -- \$4.00
 - Configuration PROM -- \$0.49
- Sandisk WiFi/Flash combination card
 - Provides 802.11b and 128MB Flash memory in a single card
 - \$129.95 retail, unknown volume discount
 - (est. \$119.95)
- PIC16F877 Microcontroller -- \$7.50
- Cirrus Logic CS92288 -- \$29.00



Bill of Materials, Total

- All Components, plus \$10.00 for PCB and packaging (housing) costs
= \$269.93

...batteries not included, of course!

Controller Unit and Memory: Specification, Implementation, and Simulation

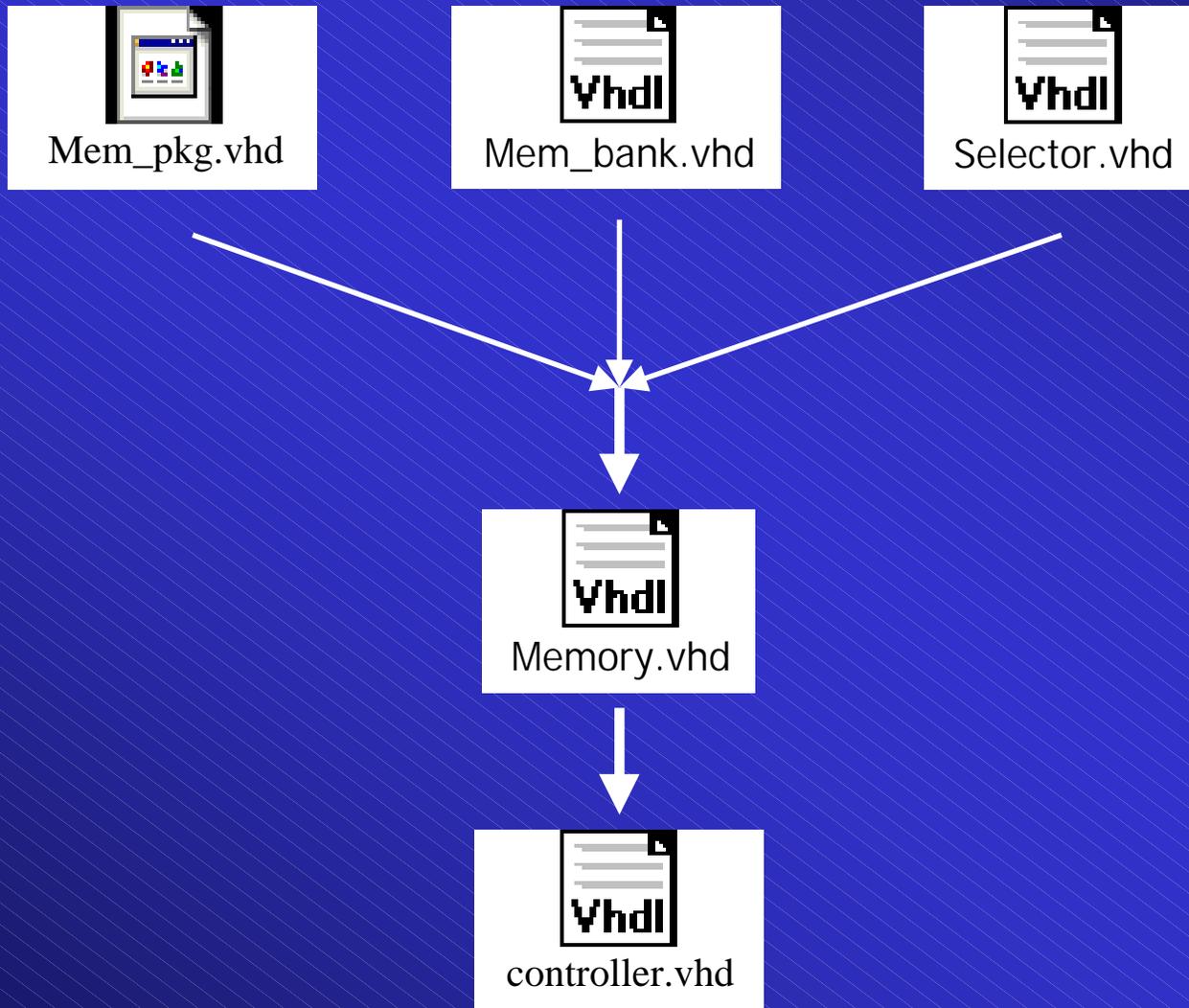
- Controller
 - Coordinates and supervises activities of subunits
- Memory
 - Records incoming messages
 - Organized into pages



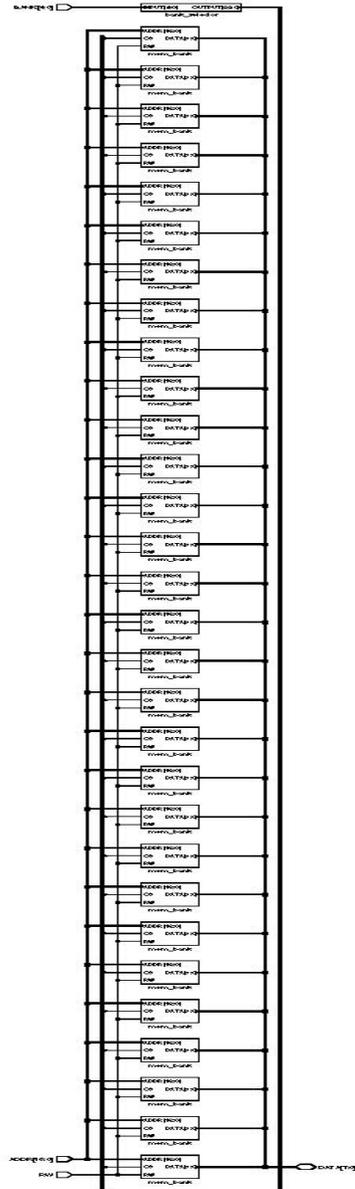
Specification

- Basic Functions
 - Respond to user commands (play, delete, etc)
 - Interact with APU/VPU
 - Interact with memory
 - Interact with Flash/802.11b module

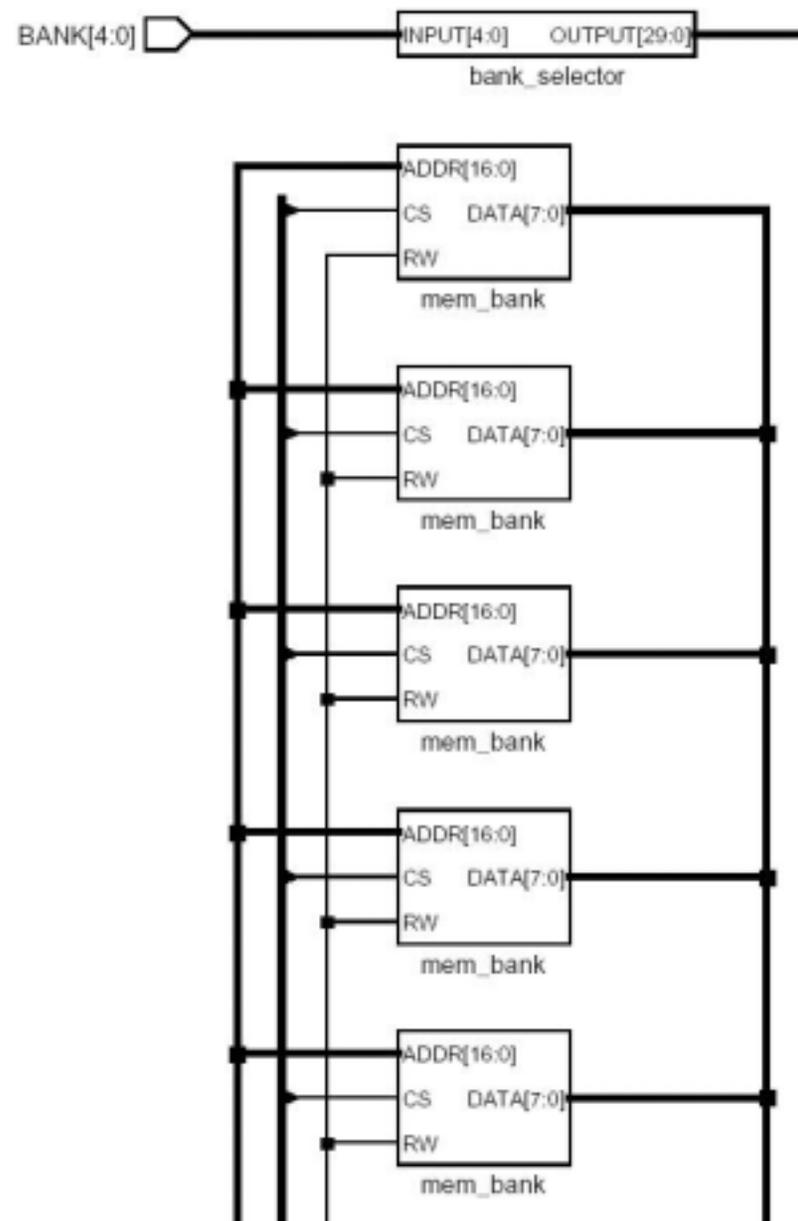
VHDL Implementation



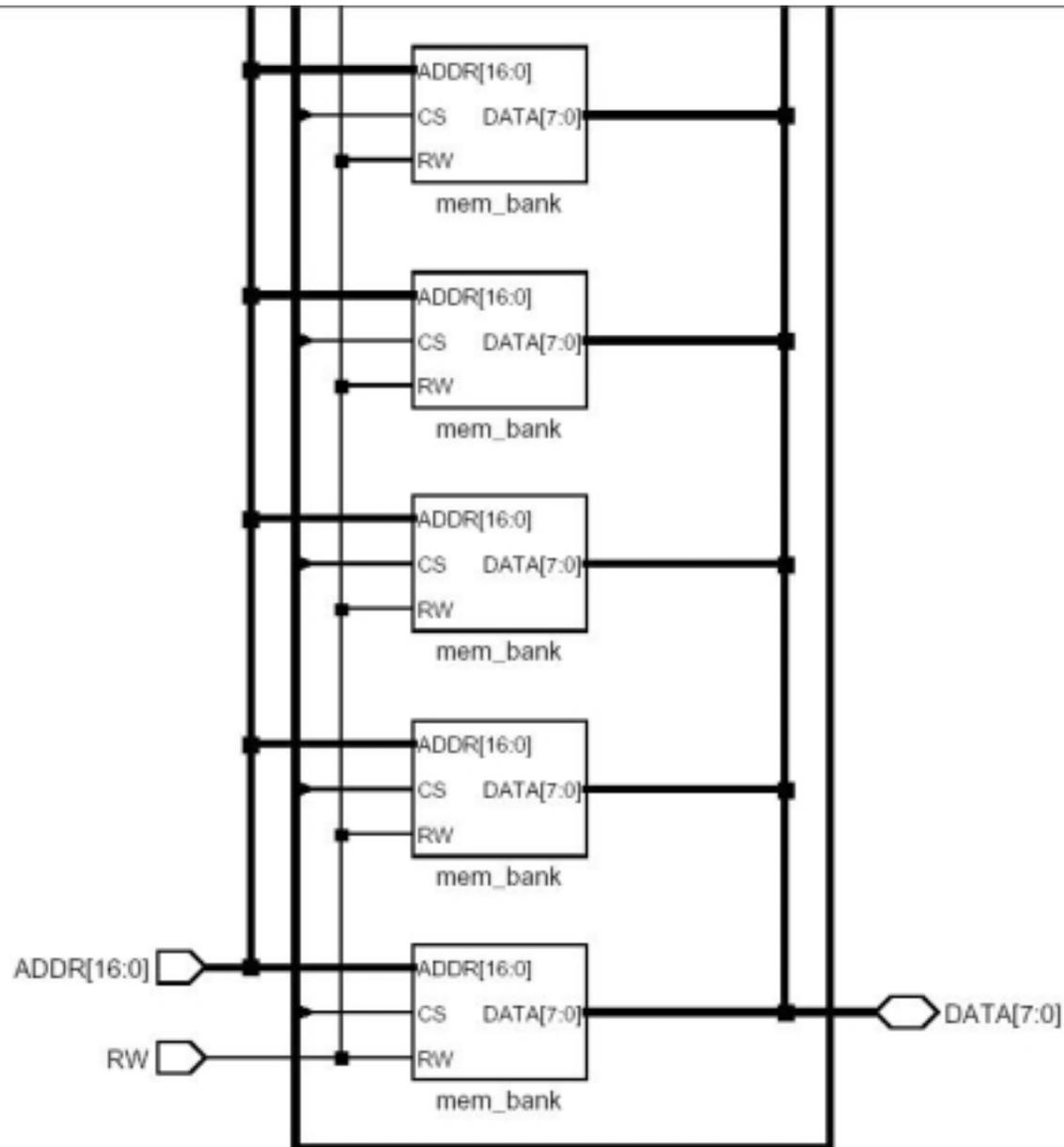
Synthesis (Memory)



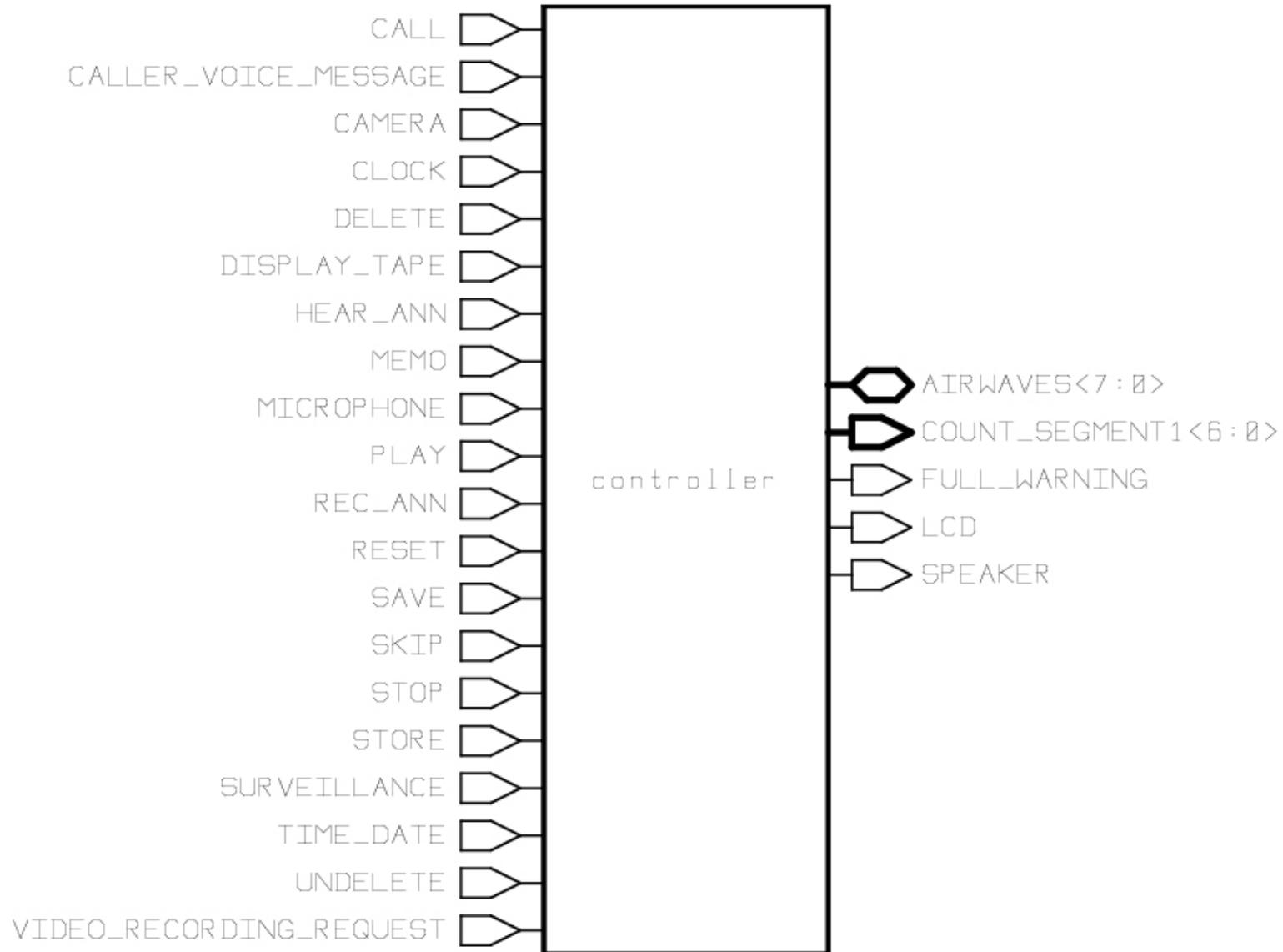
Memory (detail)



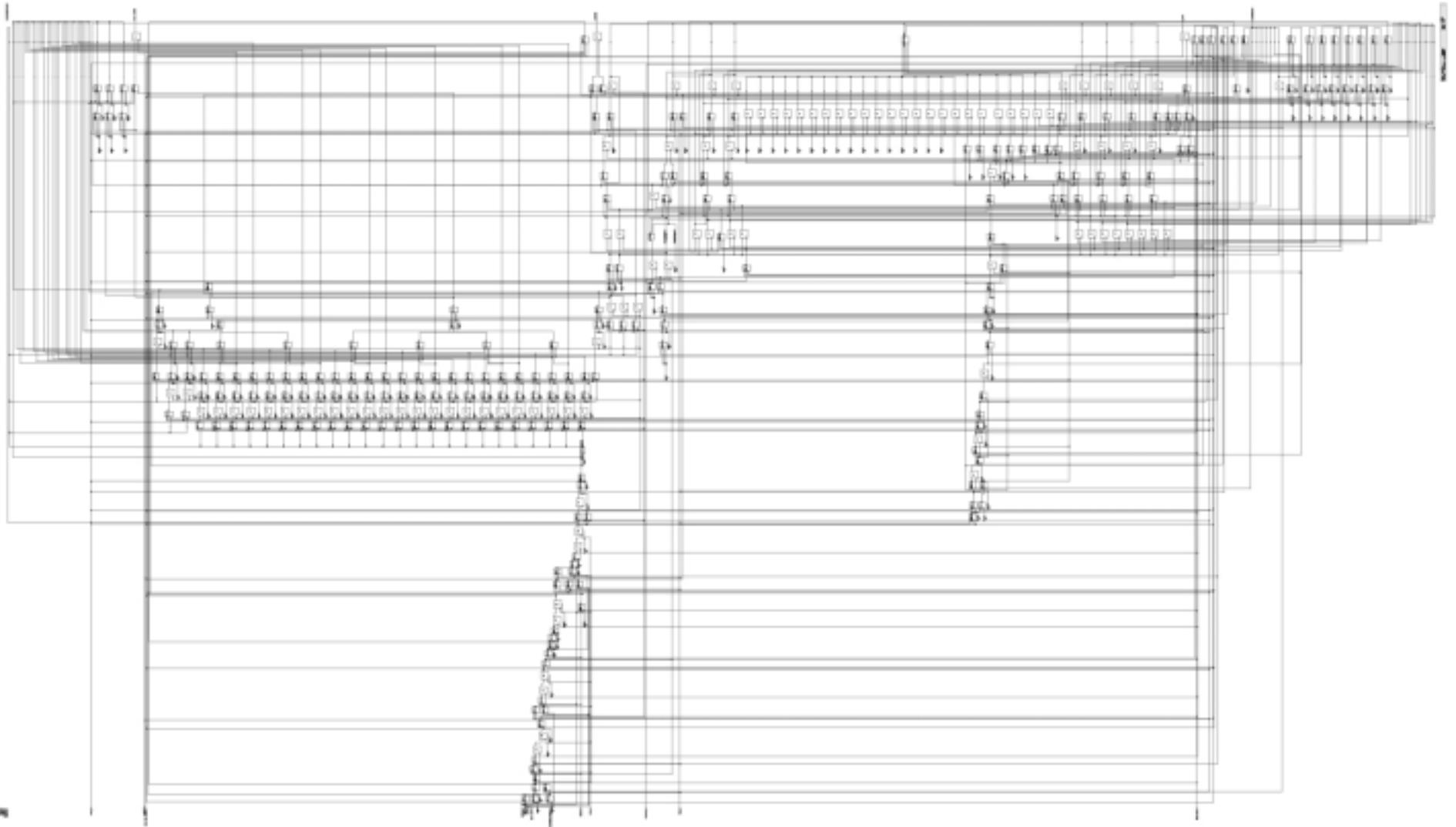
Memory (detail)



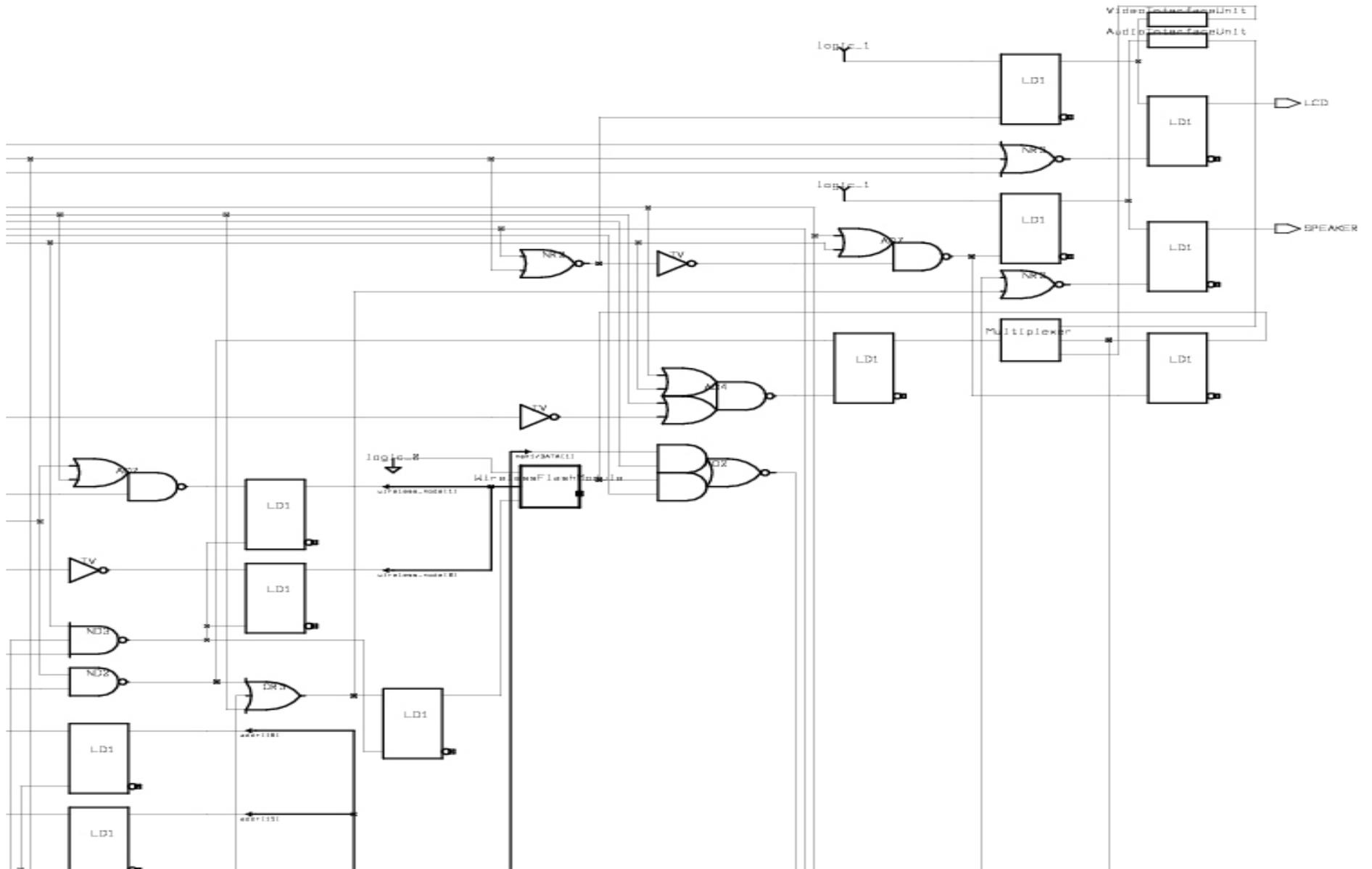
Controller – Block Diagram after Synthesis



Controller – RTL Schematic after Synthesis



Controller – RTL Detail

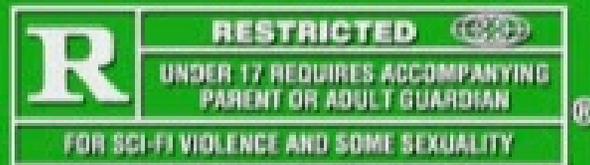


Encoding Demo

- Original Hi-Res MPEG (26.3 megabytes)
- 29.97 fps

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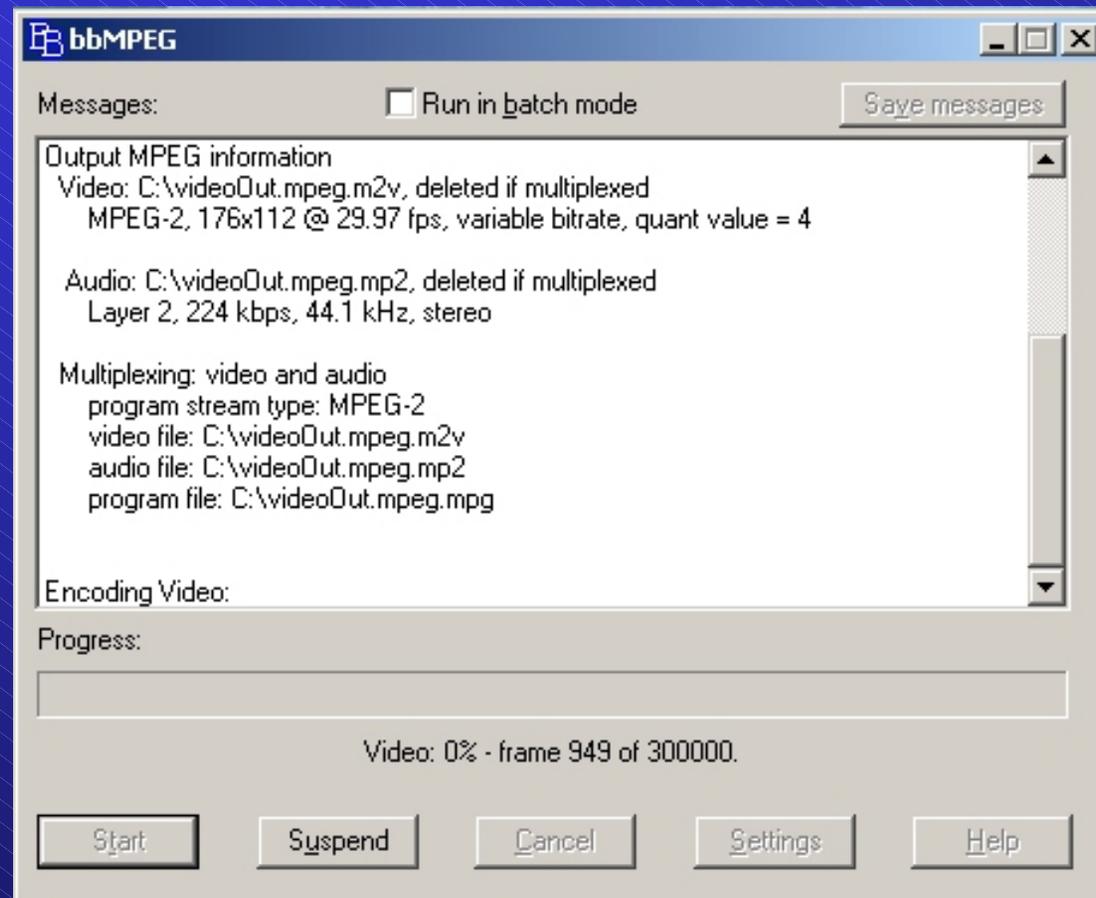
THE FILM ADVERTISED HAS BEEN RATED



Compression Simulation

Output:

- 176x112 @ 30 fps
- 5.5 megabytes



Compressed Video

- 5.5 megabytes (compare to 30 megabytes for the original)
- Still 29.97 fps @ the same resolution
- Video quality is only marginally degraded
- Audio quality is noticeably degraded, but it would be sufficient for speech quality

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