Video Conferencing Unit

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Video Conferencing Standards

- H.320 (ISDN)
  - Popular in small business sector
- H.323 (Internet)
  - More common with advancing cable modem and broadband access to homes
- H.324 (POTS)
  - Enormous installed base
Why support more than 1 standard?

- Increase customer trust for future
- Keep up with competition
- True compatibility
- International use
  - i.e. not what happened with cellular technologies
- Keeps design general
**Data Standards**

- Set by ITU-T (International Telecommunications Union – Telecommunication Standardization Sector)

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R = ITU Requirement, O = ITO Option, X = Supported by videoconferencing unit
Design Strategies

- Hardware
- Software
- Hybrid
Hardware Approach

- ASICs (Application Specific Integrated Circuits)
- Time consuming
- Expensive Development
- Can be VERY fast!!
- Often used in high performance devices
  - Military devices
Software Approach

• Runs on general purpose microprocessors
• Little computers
• Development time fast – assume correctness of CPU
• Inexpensive
• Can be VERY slow!!
• Industry trend for software to grow beyond control
  • Trying to implement too many functions...
Hybrid Approach

- Hardware/Software Co-Design
- Use ASICs or focused microprocessors
- Need to divide system functionality between HW and SW
Method Used for Videoconferencing Unit

- Hybrid approach taken
- Two basic processors with many attached smaller ASICs
- VPU (Video Processing Unit) handles video only
- DSP (Digital Signal Processor) handles audio and control
MC149570
H.261 and H.263 VIDEO PROCESSOR IN/OUT SCALING, PRE-/POST PROCESSING, PIP, SELF-VIEW

24-BIT DSP
H.320, H.323, H.324 SW G.7xx AUDIO PROCESSOR NETWORK I/F AUDIO FEATURE SET

PROCESSING UNITS

VOICE I/F
MIC/ LINE IN
LINE OUT

AUDIO CODEC

USER INTERFACE

COMMUNICATIONS INTERFACE

NETWORK

FILE DRAM
256K x 32

FAST PAGE DRAM
1M x 24

FLASH
2M x 8

T₂C
4:2:2

COMPUTER/ VIDEO IN

VIDEO INPUT (NTSC/PAL DECODER)

VIDEO OUTPUT (NTSC/PAL ENCODER)

4:2:2

DSP Port A

I₂C

CAMERA/ VIDEO IN

LCD/ VIDEO OUT
24-Bit DSP

- Motorola DSP56300 core family
- Large instruction set
- Keeps with core instructions
  - In case unit is updated with newer processor, old code should still work
- Handles all audio processing
- Handles all control (UI, networking, muxing/demuxing, etc.)
MC149570 Multi-Standard Video Processor

- Sustains over 7 billion instructions per second
- Encodes/Decodes CIF (352 x 288) images at 15 fps
- Encodes/Decodes QCIF (176 x 144) images at 30 fps
- Can handle fast and slow data rates (for many standards)
- Requires EDO RAM for frame buffering
- Operates as a memory mapped device through the DSP
MC149570 Multi-Standard Video Processor

- Accepts NTSC/PAL inputs
  - 16-bit 4:2:2 data stream
- Outputs NTSC/PAL signals
  - 16-bit 4:2:2 data stream
- Allows for many input/output options
- PIP, scaling to different screen sizes
- Overscan flicker prevention, noise control
- Motion estimation
MC149570 Multi-Standard Video Processor

- NTSC/PAL DECODER
- NTSC/PAL ENCODER
- PRE-PROCESSOR
- POST-PROCESSOR
- VIDEO ENCODER
- VIDEO DECODER
- HOST INTERFACE
- EDO DRAM 2 X 256K X 16
- DSP

ANALOG VIDEO
Video Input

- Texas Instruments’ TVP5020 NTSC/PAL Video Decoder
- Supports composite and S-Video inputs
- Helps lower problems from weak, noisy, or unstable signals
- Has many output formats in case MC149570 is changed
- Controlled from DSP via I²C
- Built-in camera input, video line-in inputs
  - Supports external cameras (good for meetings)
Video Output

- Texas Instruments’ TVP6000 NTSC/PAL Video Encoder
- Supports composite and S-Video outputs
- Helps lower problems from weak, noisy, or unstable signals
- Has many input formats in case MC149570 is changed
- Controlled from DSP via I²C
- Multiple video line-out options, so TVs and monitors can be attached as well as built-in screen
Audio Codec

- Texas Instruments’ TLC320AD77
- 16, 20, 24-bit input and output lines
- Sampling range of 16 kHz to 95 kHz
- Connects to DSP via ESSI (Enhanced Synchronous Serial Interface)
  - Provides high-speed, reliable connection
Voice Interface

- Analog device that accepts multiple input lines
  - Built-in microphone
  - Line-in jacks
- and multiple output lines
  - Built-in speaker
  - Line-out jacks
Memory

- MC149570 requires 256K x 32 EDO RAM
  - Available directly to VPU as frame buffers
- Fast Page DRAM and FLASH connected to DSP Port A
  - MC149570 also connected to DSP Port A
  - Operates as a memory-mapped device
  - FLASH stores system software
Communications Interface Unit

- Why include a modem that might be out of date soon?
- Too expensive and difficult to include numerous modems/NICs
- Solution:
  - External modems/NICs
  - Base unit has ESSI port, CIUs plug directly in
  - Software handles detection and protocol changes
Communications Interface Unit

- One device for each of the videophone standards
- Devices can be made to handle conversions
  - e.g. cellular to H.323 format
- Makes device dynamic to handle technological growth
- Makes consumers feel safe purchasing unit
  - Will work in home now, and in future, upgraded home
Camera/Display Unit

- Can be cheap or high quality
- Since external lines are available, save cost by including only medium grade devices
- Cameras with NTSC/PAL outputs can be found as low as $80
- Displays with NTSC/PAL inputs can be found as low as $80
System Software

• Motorola’s Qorus Video Conferencing Software kit
• Modular design
• Well-defined interfaces
• Software easily written to apply to PC Cards to make home computers operate as videoconferencing unit
Answering Machine Component

- No need to make separate answering machine
  - Will need new set of processors
- No need to include answering machine functions
  - Will drive cost up for what might be unused feature
- Solution:
  - Hardware add-on
Answering Machine Component

- Attach to DSP Port A (memory) bus through connector at bottom of base unit
- Only needs to be memory repository
- Can be ultra-thin
- Has DRAM and FLASH
  - DRAM acquires video output, then mapped to FLASH
  - Keeps up with output
Answering Machine Component

- Software controlled
- Answering machine functions stored in small FLASH area
- When plugged in DSP maps memory addresses and now operates with updated answering machine functionality
- Shows power of integrated hardware/software approach
- Other units can be stacked (top and bottom ports) as well
  - Videogame consoles, fax machines
  - Will need own processors, but are accessed same way
Top View of Video Conferencing Unit

- Display Screen
- Camera
- User Interface Control
- to Power Line
- Pivot/Fold Line
- Standard Dialing Buttons
- Handset

Built-in microphone and speaker not visible
Unit is to be wall mounted, or can pivot and fold up
Back/Side View of Video Conferencing Unit

BACK VIEW:
- Power Link for Communications Interface Unit
- Serial Link for Communications Interface Unit

SIDE VIEW:
- Video Input Lines
- Audio Input Lines
- Video Output Lines
- Audio Output Lines
Bottom View of Video Conferencing Unit

- Memory Link for Answering Machine and other Peripheral Units
- Power Link for Answering Machine and other Peripheral Units
Component Addition to Video Conferencing Unit

Base Unit (Side View)

Answering Machine Unit

Other Peripheral Unit

Communications Interface Unit to wall jack for network connection
One Time Design Costs

- Cost for Development Kits
- Salaries for Engineers (4)
- Year-long design process
- Various physical molds for prototypes
- Ranges between $500,000 to $2,000,000
Construction Costs

- Approximately $500 total in parts cost and labor
Final Costs and Marketing

- With 20% profit, final price comes to about $600 (low-end)
- Still very cheap compared to competition
- Most phones with same features and support still cost above $800
- Price drop can be attributed to more general hardware design (relying more on SW)
- Price does not include answering machine unit or communications interface unit (maybe V.90 for H.324 can be thrown in)