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)

	VIDEO		AUDIO				MULTIPLEX AND CONTROL					NETWORK INTERFACE		
VIDEO COMMUNICATION STANDARDS	H.261	H.263	G.711	G.722	G.723.1	G.728	H.221	H.223(A)	H.225.0	H.242, H230	H.245	I.400	TCP/IP	V.34
H.320 (ISDN)	R		R	O		O	R			R		R		
H.323 (INTERNET)	R	R	O	O	R	O			R		R		R	
H.324 (POTS)	R	R			R			R			R			R
MY SYSTEM	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	VPU		DSP											

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

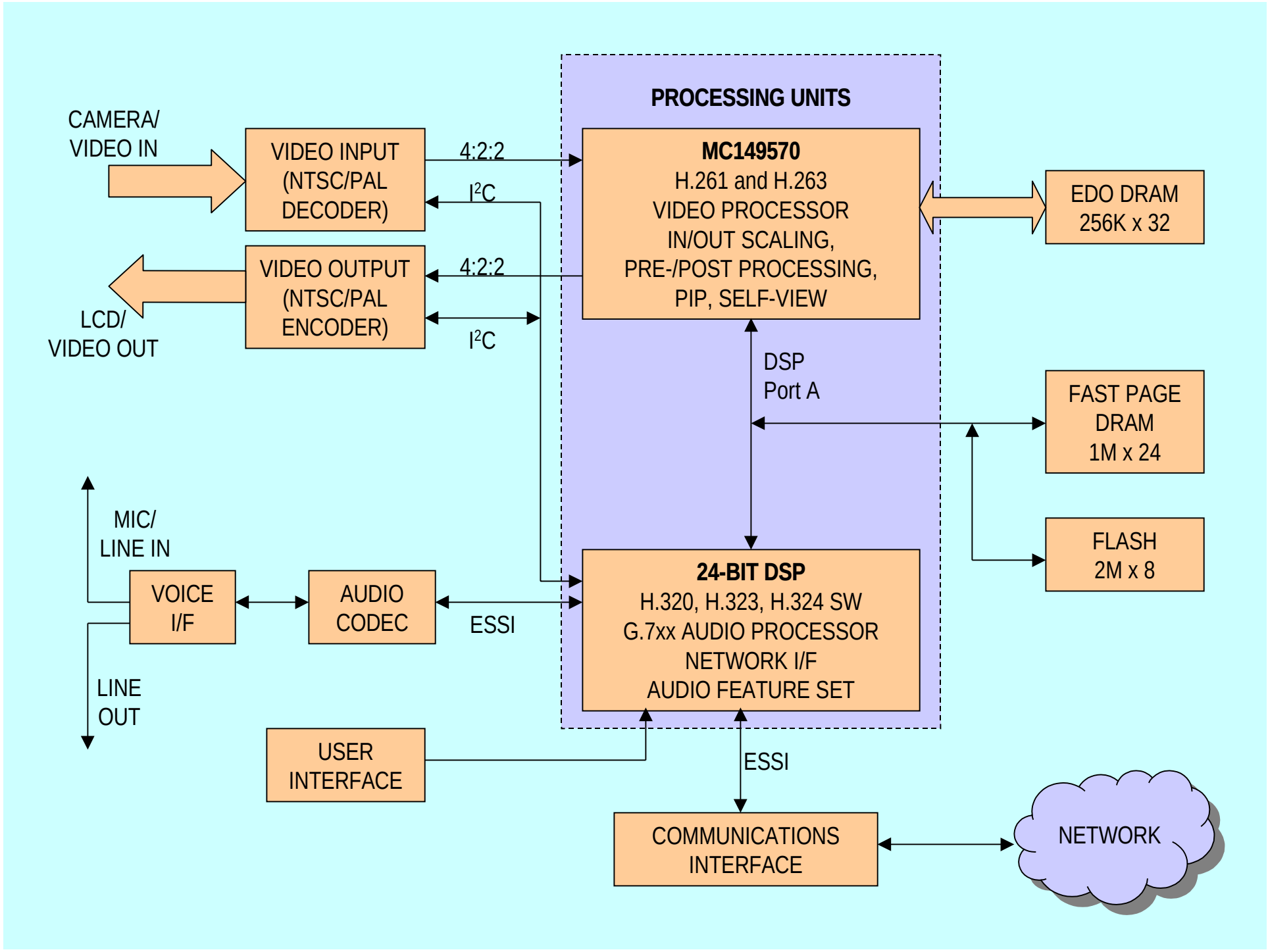
- Runs on general purpose microprocessors
- Little computers
- Development time fast – assume correctness of CPU
- Inexpensive
- Can be *VERY* slow!!
- Industry trend for software to grow beyond control
    - Trying to implement too many functions...

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


PROCESSING UNITS
CAMERA/
VIDEO IN
VIDEO INPUT
(NTSC/PAL
DECODER)
4:2:2
I2C
MC149570
H.261 and H.263
VIDEO PROCESSOR
IN/OUT SCALING,
PRE-/POST PROCESSING,
PIP, SELF-VIEW
EDO DRAM
256K x 32
VIDEO OUTPUT
(NTSC/PAL
ENCODER)
4:2:2
I2C
LCD/
VIDEO OUT
DSP
Port A
FAST PAGE
DRAM
1M x 24
MIC/
LINE IN
VOICE
I/F
AUDIO
CODEC
ESSI
24-BIT DSP
H.320, H.323, H.324 SW
G.7xx AUDIO PROCESSOR
NETWORK I/F
AUDIO FEATURE SET
FLASH
2M x 8
LINE
OUT
USER
INTERFACE
ESSI
COMMUNICATIONS
INTERFACE
NETWORK

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.)

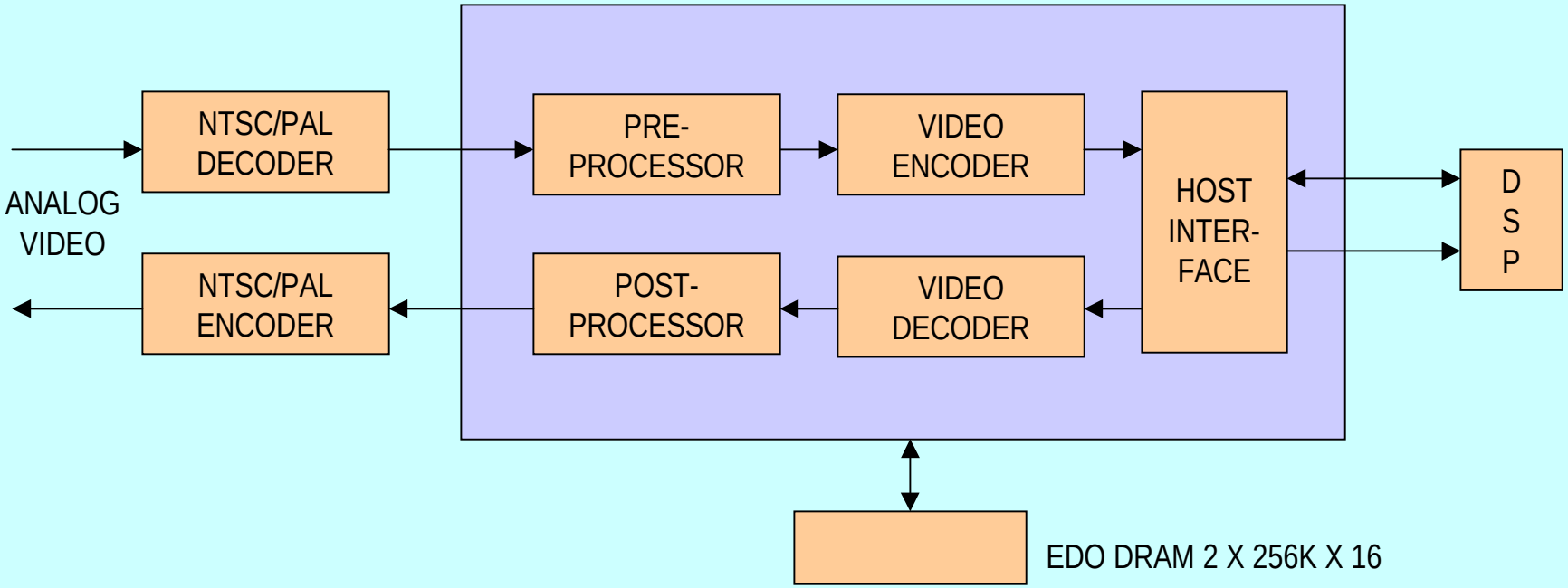
MC149570 Multi-Standard Video Processor

- 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



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 I^2C
- 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 I^2C
- 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

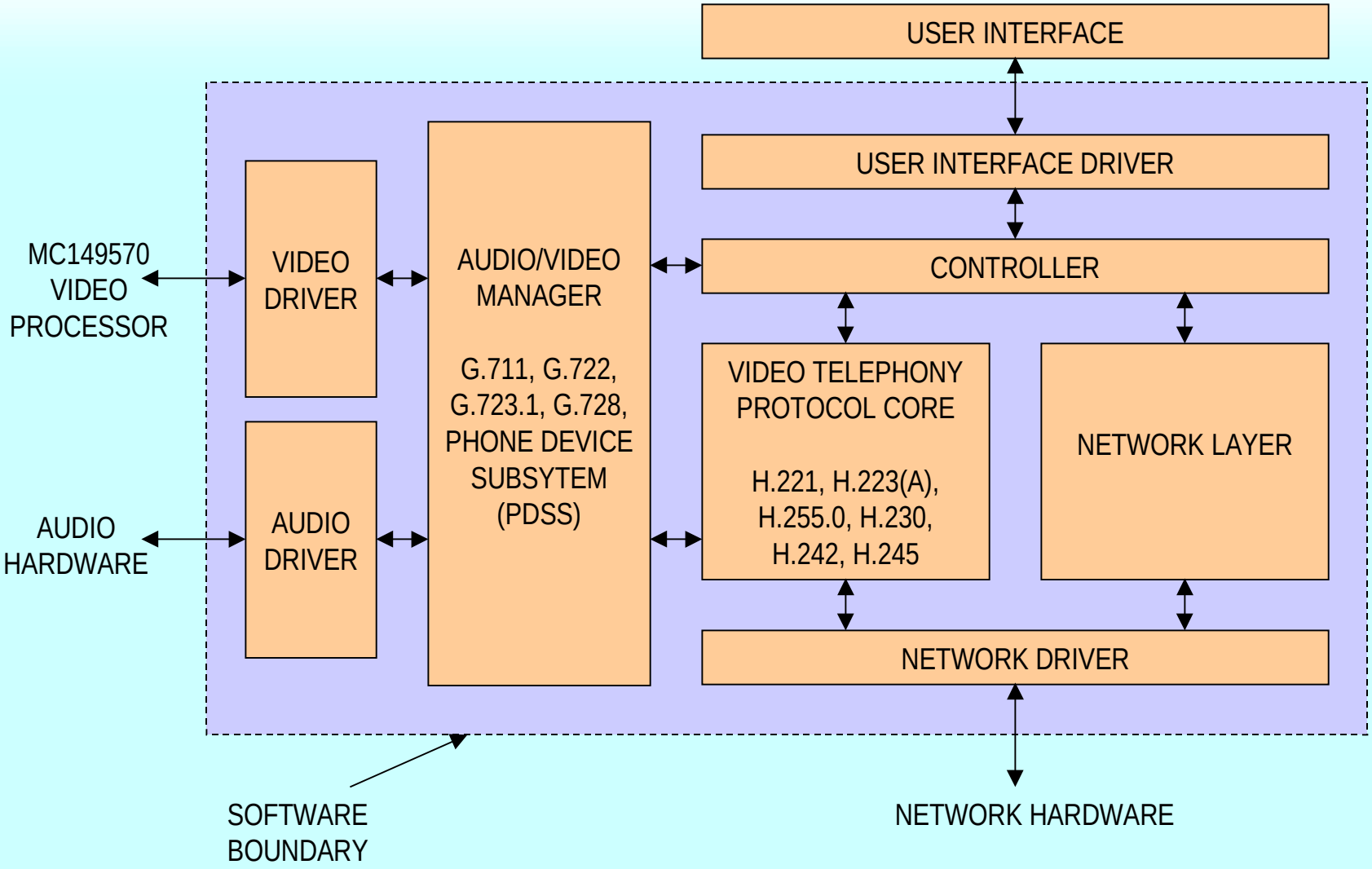
Camera/Display Unit

- 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

Software Block Diagram



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

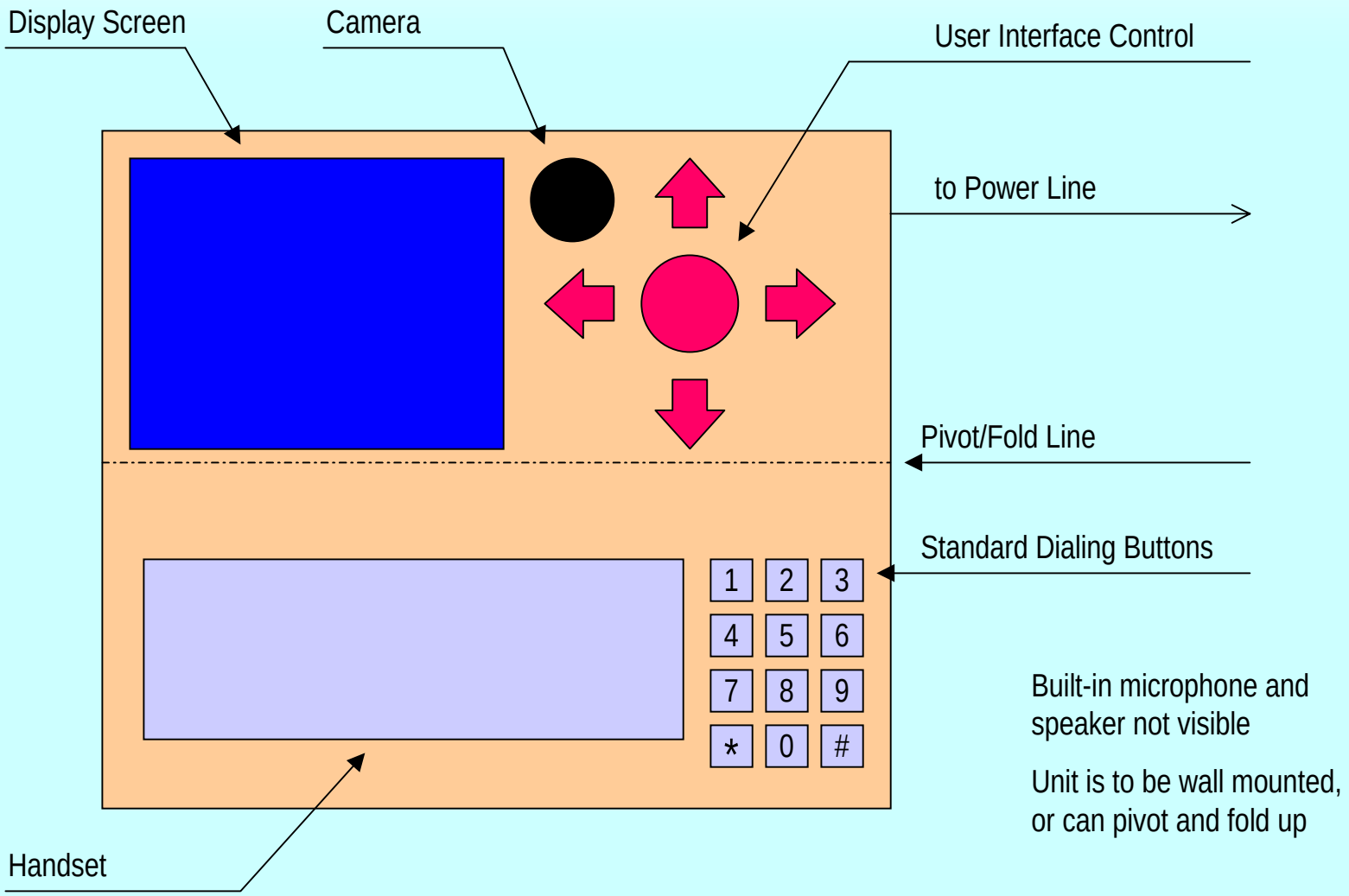
Answering Machine Component

- 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

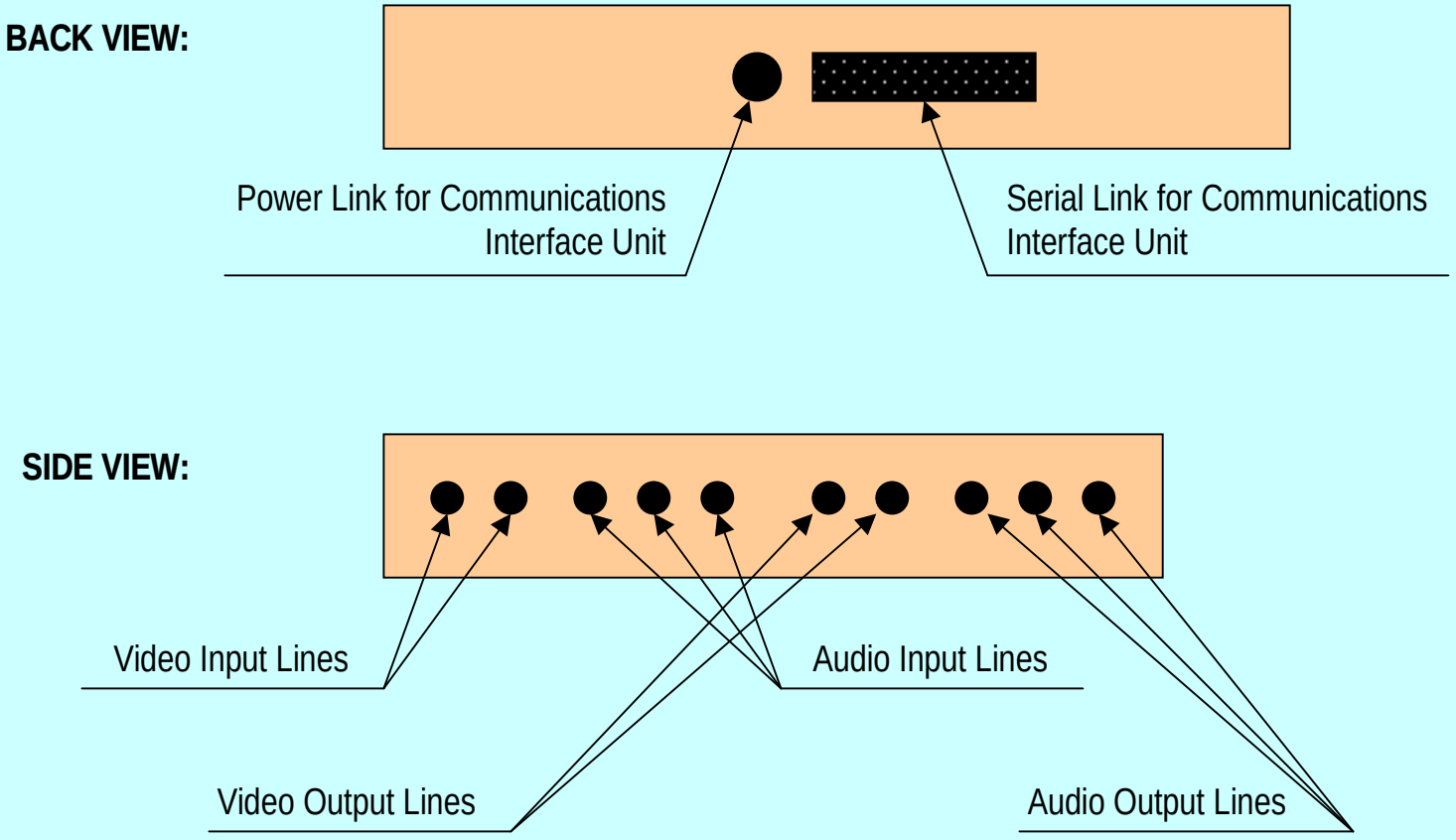
Answering Machine Component

- 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

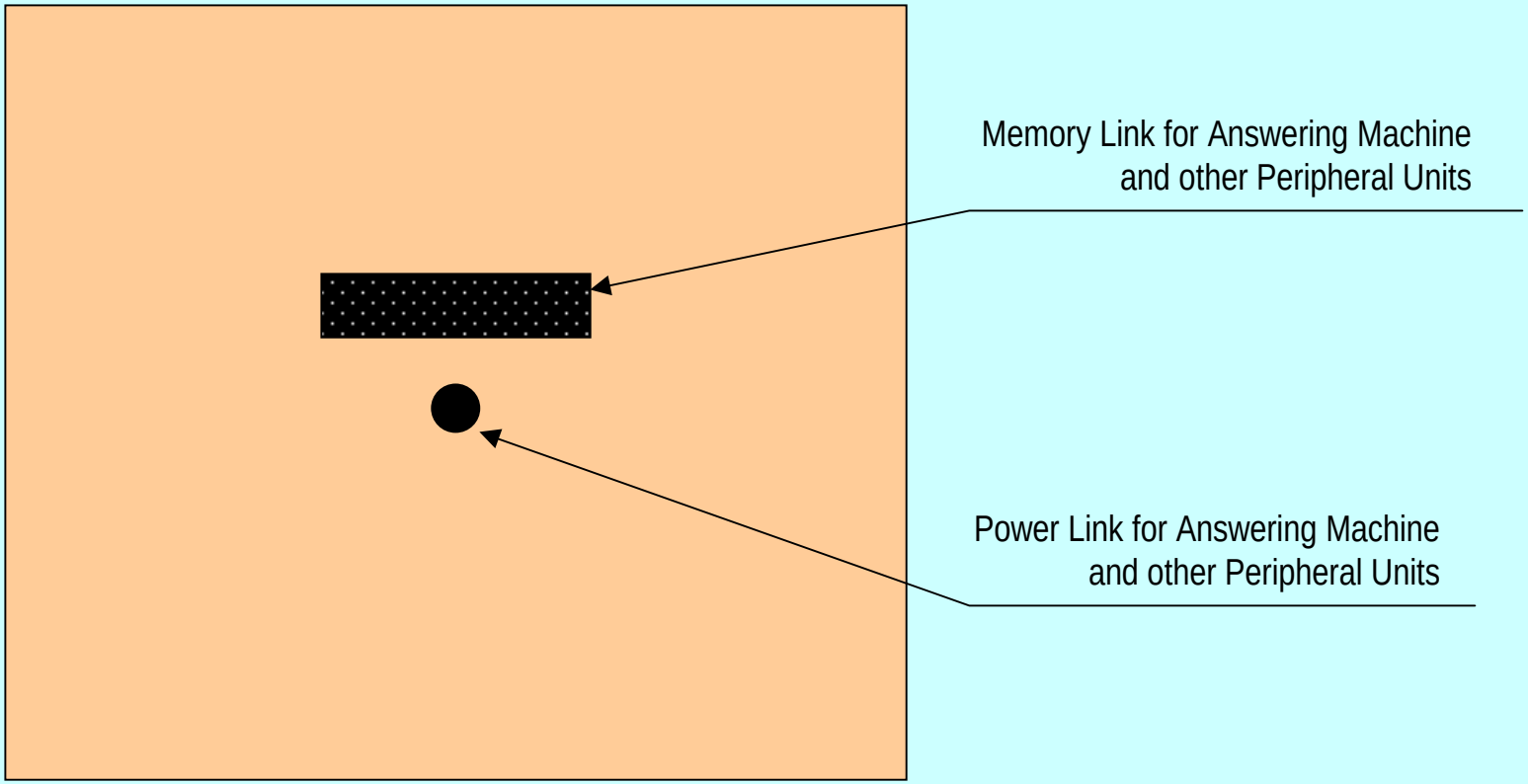
Top View of Video Conferencing Unit



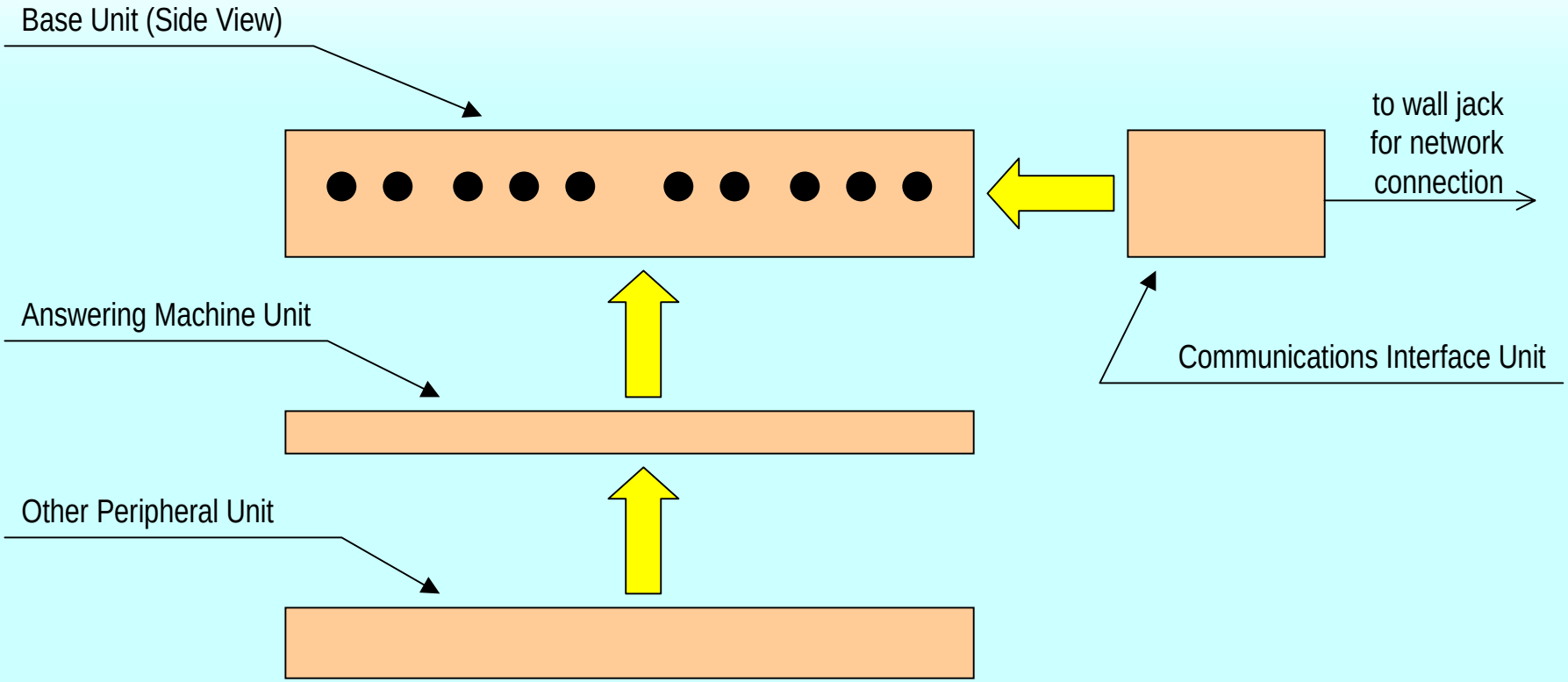
Back/Side View of Video Conferencing Unit



Bottom View of Video Conferencing Unit



Component Addition to Video Conferencing Unit



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)