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# An Integrated Circuit/Packet Switched Video Conferencing System

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# Two Types of Video Conf. Technology

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- Circuit switched systems
  - » Many commercial systems
  - » Transport: circuits from common carriers
    - e.g., ISDN
  - » Protocols: H.320 suite
  - » e.g., ERVN (Energy Research Video Network)
- Packet switched systems
  - » Mostly public domain technology
  - » Transport: many use the Internet
  - » Protocols: IP, multicast IP, nv, vat, vic, ...
  - » e.g., What is called “MBONE” (although this is a misnomer)
    - Widely used but still experimental

# VUPAC

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- Neither circuit nor packet systems fully adequate
- Integrating technologies plus additional functions more fully meets needs
- HEPNRC at Fermilab and CDF developed and are using an integrated system
- Called VUPAC (Video conferencing Using PAckets and Circuits) which consists of:
  - » Existing circuit switched system (ERVN)
  - » Existing packet switched system and tools (MBONE plus its tools)
  - » MSB (Multi Session Bridge)
  - » A circuit/packet interface

# Needs and Limitations - Cost

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- Circuit Switched
  - » \$20K - \$50K for room-based systems plus the room
  - » \$5K - \$7K for desktop-based systems
  - » Must pay for communications
    - In U. S. ISDN costs about \$30/hour
- Packet Switched
  - » Given a UNIX workstation, immediate cost to user is:
    - Zero for passive participation
    - \$1K - \$2K frame grabber for active participation
  - » Hidden cost: the use of the Internet resources
    - Packet video conf. uses significant Internet resources
    - Eventually will probably need to pay for these

# Needs & Limitations - Privacy

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- Circuit Switched
  - » Privacy good since circuits are used and bridged for > 2 sites
  - » Outsiders cannot easily eavesdrop
- Packet Switched
  - » If MBONE is used
    - Must publicly announce conferences
    - Conference is broadcast -- anyone can listen
  - » If only video and audio tools are used (MBONE not used)
    - Privacy by obscurity is one way
    - Encryption possible but
      - Not all tools do it
      - Can still be copied and decrypted off line
    - Can also provide bridging functionality similar to ERVN (i.e., MSB)

# Needs & Limitations - Connectivity

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- Circuit Switched
  - » ISDN not ubiquitous yet to all sites of interest
  - » Must pay for it explicitly
- Packet Switched
  - » Ubiquitous to almost all sites of interest
  - » Internet was not designed for time-critical packet delivery
    - Quality suffers

# Needs & Limitations - Scaling, Congestion

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- Circuit Switched
  - » Practical limit per conference is a few active or passive sites
  - » Multiple simultaneous conferences possible
    - Total number of sites limited by number of ports on conf. bridge
    - Bridge cost per port presently about \$8K
- Packet Switched
  - » Practical limit per conference
    - A few active sites
    - Hundreds of passive sites
  - » Network “hot spots” often result in poor video and unintelligible audio

# Needs & Limits-Internet Compressed Rates

Image Resolution (pixels)	Frame Rate (frames/sec.)	Video Bit Rate (Kbps)	Audio Bit Rate PCM2 (Kbps)	Total Bit Rate Needed (Kbps)
640 x 480	2	130	70	200
352 x 288 (full CIF)	4	130	70	200
~352 x 288 (NTSC)	30	---	---	~40,000

# Needs & Limitations - Quality

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- Circuit Switched

- » Video: best resolution 352 x 288 (full CIF) in U. S.
  - Not good enough
- » Video frame update: several frames a second
- » Audio: excellent

- Packet Switched

- » Video: best resolution is 640 x 480
- » Video frame update: a frame a second for “good citizen” bit rates
  - depends on movement in image and all traffic on the Internet
- » Audio: Fair to unintelligible
  - Depends on traffic on the Internet

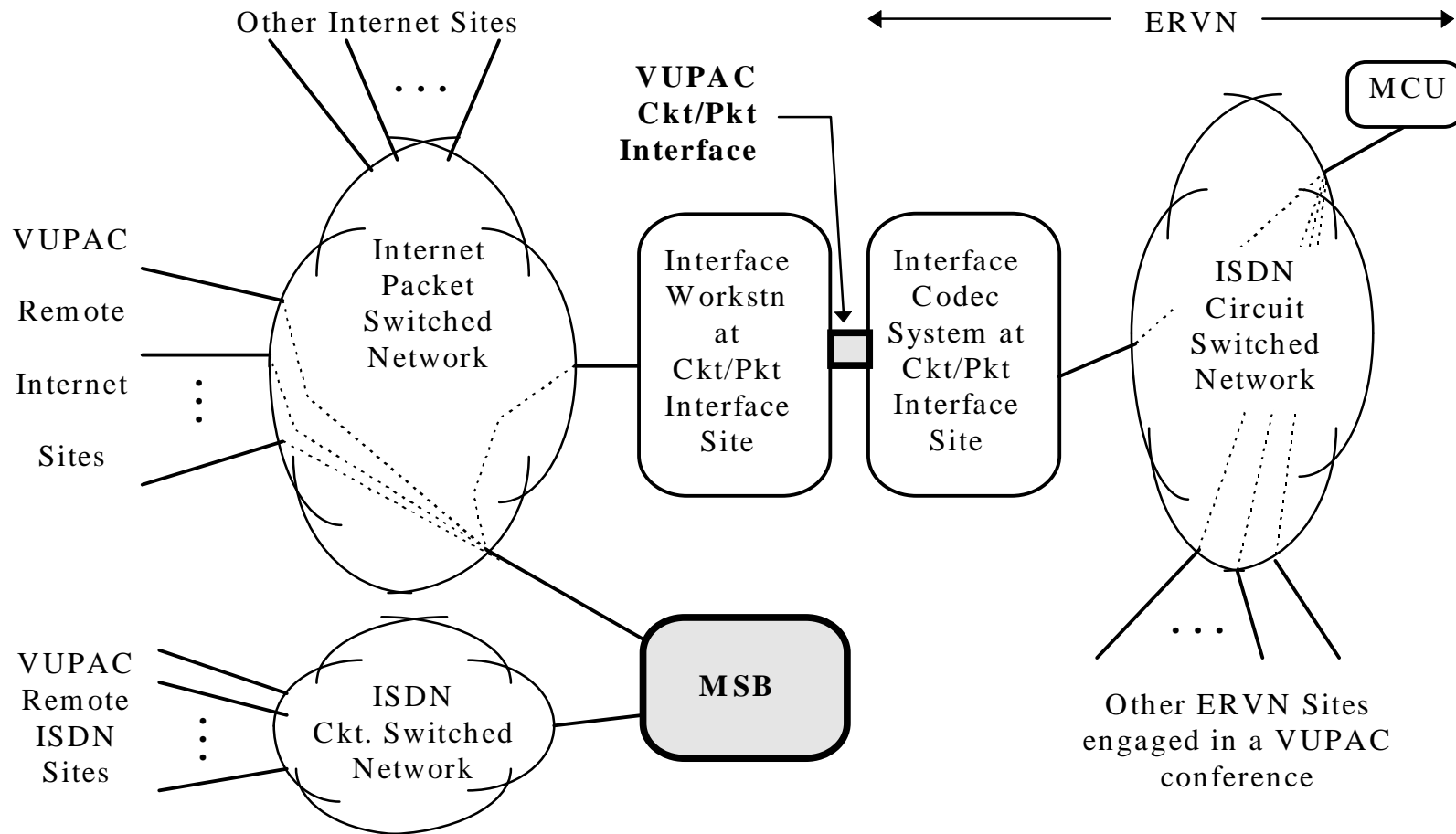
# VUPAC

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- Interfaces ERVN to the Internet packet network
- Adds a bridge (the MSB) to augment or circumvent limitations
- MSB
  - » Code running in a workstation
  - » Supports both video and audio packet streams
    - Connect any MSB port to any other MSB port(s)
    - Each stream is simplex (full duplex handled as 2 simplex)
  - » Provides both Internet and ISDN connections
  - » Remote site access is password protected
- Ckt/Pkt Interface
  - » Complexity largely audio issues involving echo cancellation

# VUPAC System



# Current Usage

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- Used for 11 months by CDF in selected conferences
- Recently DZero has begun using the MSB with the packet video and audio tools to conduct conferences
- Both ERVN sites and anyone with a UNIX workstation and either decent Internet or ISDN connectivity can attend the same private video conference.