Circuit Switched Video Conferencing

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HEPNRC Video Workshop

- Introduction
- Some basics
- Circuit switched video
- Video services
- Some futures
- How do I become a participant
- References
- Questions

Introduction

- A view from 5,000 ft., not a detailed look at ITU-T specs.

- Circuit based video conferencing is a combination of
  - » local (RBOC) and interexchange carrier (IXC) facilities
  - » broadcast video technology (NTSC or PAL)
  - » video/audio compression units (i.e. - codecs)
  - » multipoint control unit (MCU)

- Really a modern version of the AT&T videophone of the 1950's

- Attendees can read and understand vendor product spec. sheets

Some Basics

- Telephony

- Video broadcast

- Codecs

- Applicable standards

Telephony

- Analog
- Digital
- ISDN
- Leased facilities
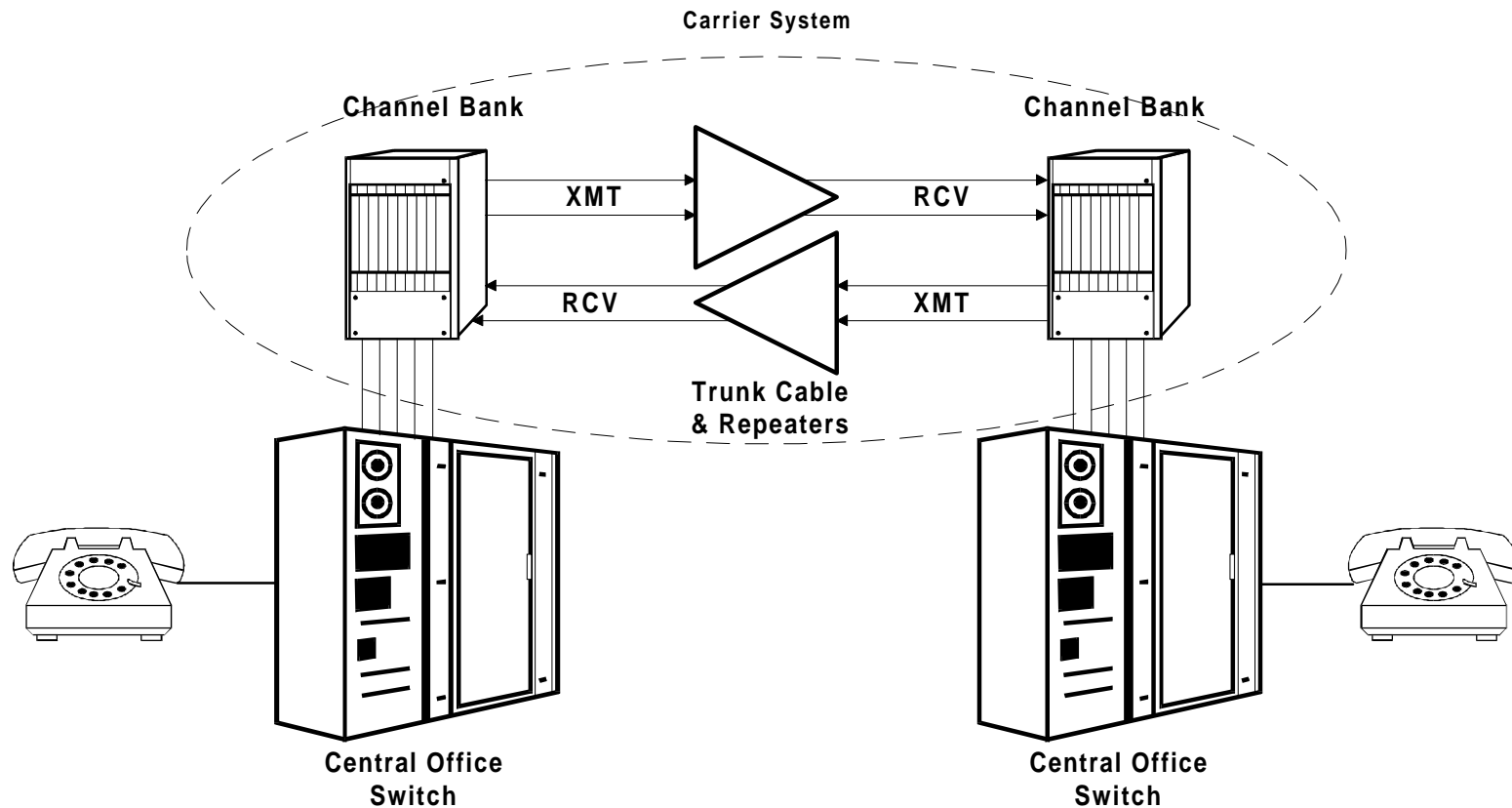 - » ATM
  - » Frame relay

Analog

- POTS (Plain Old Telephone Service)
- Conversations on interoffice trunks are multiplexed
- Analog carrier facilities (FDM systems) were the norm by the mid-1950's
- Audio is a close approximation in capability to ITU-T digital G.711 standard
  - » 300 Hz to 3.4 kHz
  - » transmitted in an 8 kHz channel
  - » two kinds of companding (*u*-law and A-law)
    - $|y| = \log(1 + u|x|) / \log(1 + u)$; $|x| < 1$ (voice amplitude); $u = 255$
  - » *u*-law in North America and Japan; A-law in Europe

Carrier Systems

Diagram of Inter-office Call

Carrier System

Channel Bank

XMT

RCV

RCV

XMT

Channel Bank

Trunk Cable
& Repeaters

Central Office
Switch

Central Office
Switch

Digital

- Digital carrier becomes the norm in the late 1960's (TDM systems - natural replacement for analog predecessors)

- Analog signal is sampled 8,000 times/sec and is eight bits wide (64 Kbit/sec)

- North American T-carrier (24 voice channels on four wires - 1.544 Mbit/sec)

- European E-carrier (32 channels on four wires - 2.048 Mbit/sec)
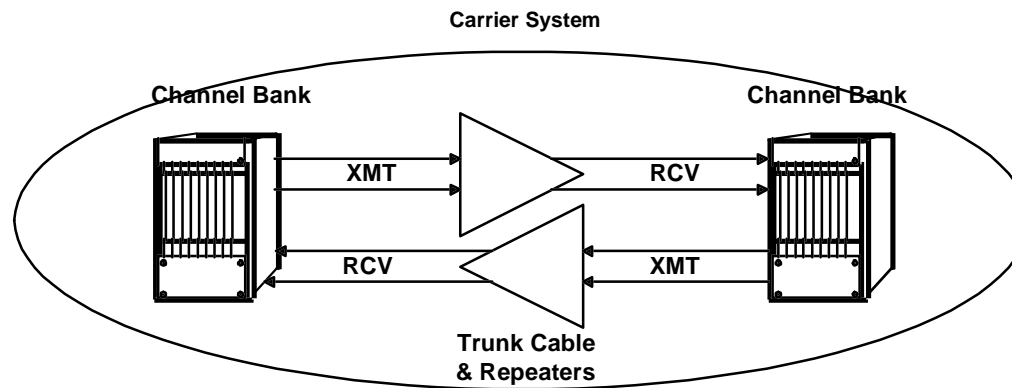
Digital (continued)

- Uses in-band call supervision - immaterial for voice but limits data to 56 Kbit/sec (in the U.S. / Canada)

- In Europe, in-band call supervision was never an issue (always capable of 64 Kbit/sec)

- Provided the impetus for the development of digital switching systems (DMS-100, 5ESS, EWSD)

Robbed Bit Signaling

Carrier System

Channel Bank   Channel Bank

XMT   RCV

RCV   XMT

Trunk Cable & Repeaters

DS0   DS0   • • •   DS0   DS0

DS1 (193 bits)   n * DS1   DS1 (193 bits)

Frame Synch Bit   DS0 - 8 bit sample, 8000 samples/sec

Call Supervision Bit   DS1 - 193 bit frame, 8000 frames/sec

ISDN

- Provide digital connectivity (and higher bandwidth) to the end user

- Uses 4 level encoding (2B1Q) at 80 KBaud to provide a 160 Kbit/sec link

- Two 64 Kbit/sec B channels, one 16 Kbit/sec D channel, 16 Kbit/sec for link synchronization, etc.

- Call set-up, tear-down, etc. is provided by sending messages (Q.931 format) over the D channel

- Uses the same wire pair that was used for POTS service

Video Broadcast

- Standard video broadcast uses approx. 90 Mbit/sec of bandwidth (digital representation - 16-bit color)

- NTSC (National Television Standards Committee)
  - » circa 1953
  - » 30 frames/sec
  - » 640 pixels/line
  - » 480 viewable lines

- PAL (Phased Array Line)
  - » 25 frames/sec
  - » 768 pixels/line
  - » 576 viewable lines

Codecs

- Codec - a composite word (en**co**der / **dec**oder)
- Operation governed by the ITU-T H.320 umbrella standard
- Operation in N*56 (U.S/Canada) or N*64 bandwidth increments
- Uses Discrete Cosine Transform (DCT) video compression (part of H.261 standard)
- Standards operation is a "compromise" - vendor proprietary algorithms *do* produce better results

Codecs (continued)

- Best resolution is Full Common Intermediate Format (FCIF) - 352x288 pixels

- Required resolution is only Quarter Common Intermediate Format (QCIF) - 176x144 pixels

H.320 Standards Suite

- H.320 (visual telephone)
- H.261 (video encoding)
- G.711 (audio encoding - ADPCM)
- G.722 (audio encoding - SB-ADPCM)
- G.728 (audio encoding - LD-CELP)
- H.221 (frame structure, protocol)
- H.242 (communication procedure)
- H.230 (muxing audio, video, etc. on comm. channel)
- H.243 (chair control & bridging)

Circuit Switched Video

- Point-to-point
- Multipoint
- MCU restrictions
- NTSC-to-PAL problem
- G.711 audio problem

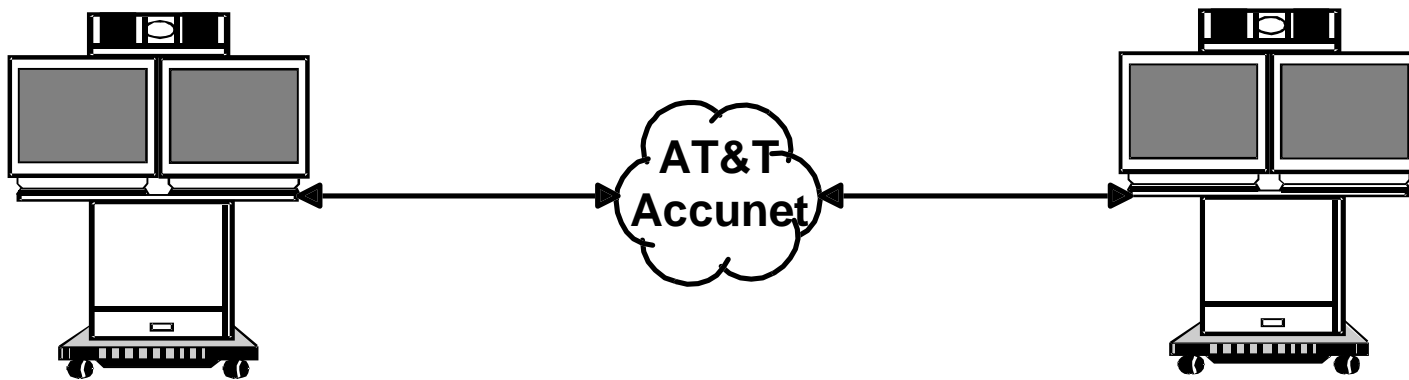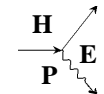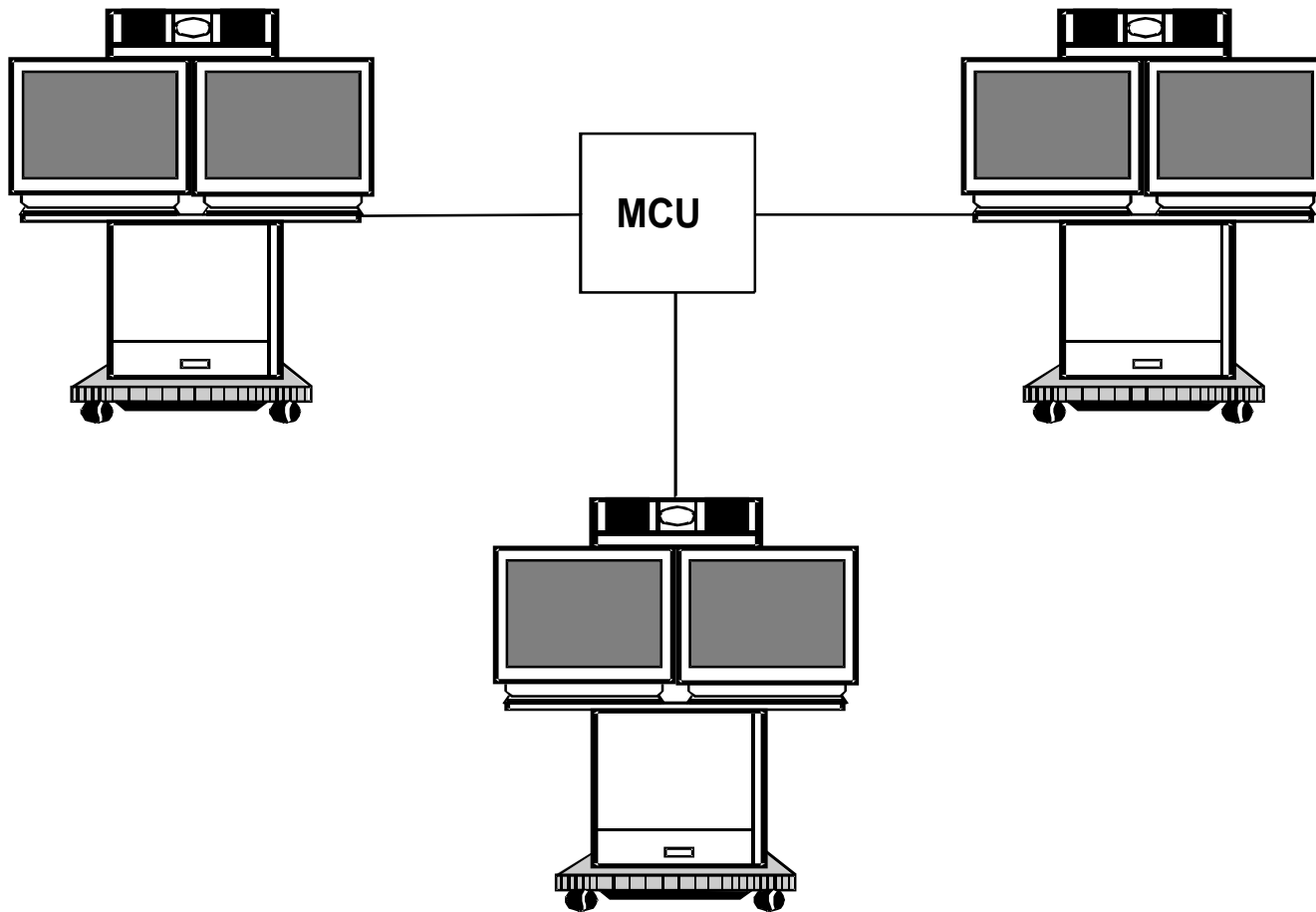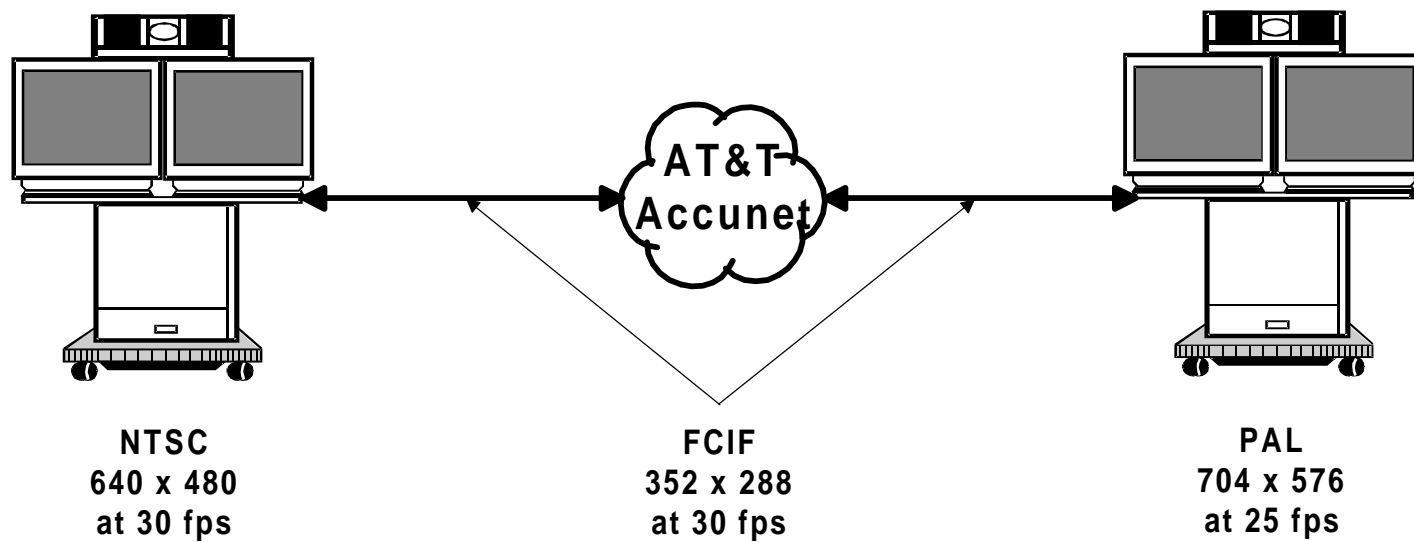# Point-to-point Conference

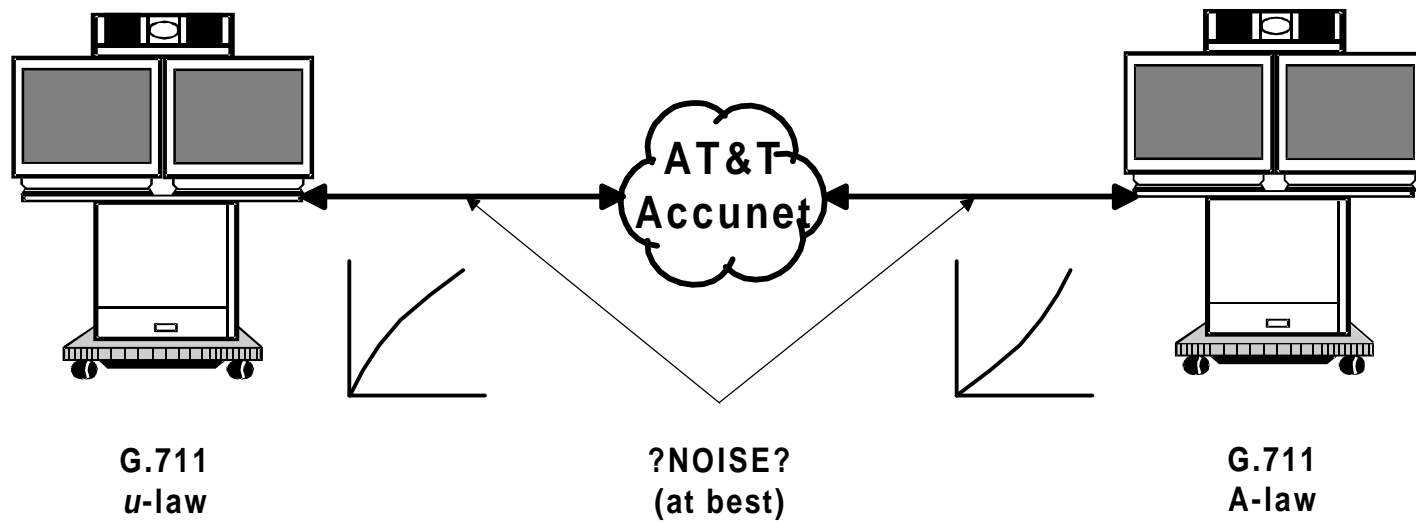**AT&T Accunet**

Multipoint Conference

MCU Restrictions

- It's just a switch - it doesn't do any conversions
- Each participant must use same video encoding algorithm (e.g. - H.261)
- Each participant must use same audio encoding algorithm (e.g. - G.728)
- Each participant must do so at same speed (e.g. - 128 Kbit/sec)
- Video switching schemes - polling, chair control, picture follows voice, continuous presence

NTSC-to-PAL problem

NTSC
640 x 480
at 30 fps

FCIF
352 x 288
at 30 fps

PAL
704 x 576
at 25 fps

G.711 audio problem

G.711
u-law

?NOISE?
(at best)

G.711
A-law

Video Services

- ESnet services
- HEPNRC services
- FNAL services
- Commercial MCU services

ESnet Services

- Operate a VTel MCU-II multipoint control unit (20 port)

- In process of bringing a PictureTel Montage multipoint control unit on-line (40 port)

- Operate E-mail / w**3 based video reservation system
  - » http://vcs.es.net/vcss

- Adding audio-only bridging capability

- Adding Mbone gateway (packet to circuit)

- Do substantial vendor interoperability testing

HEPNRC Services

- HEPNRC codec loaner program
- Chair ESnet Remote Conf. Working Group (RCWG)
- Function as ombudsman for HEP with ESnet & DOE
- Provide consulting and testing to HEP sites
  - » resolve communications problems (talk to telco's)
  - » use of ESnet conf. reservation system
- Track video conferencing technology in a rapidly changing market (e.g. - H.323, T.120, …)
  - » trying to achieve technical improvements
  - » trying to achieve reductions in cost

FNAL Services

- Schedule FNAL circuit meetings in ESnet VCSS

- Schedule, configure, and operate FNAL MSB

- Assist in video conference problem resolution

- Presently involves:

  » five room codec systems,

  » MSB requests from CDF and D0 collaborations

  » and the list keeps growing

Commercial MCU Services

- **What they offer**
  - » MCU operation
  - » codec-to-codec conversion
  - » meeting rooms for rent
- **The big three**
  - » Sprint Meeting Channel (generally N*56)
  - » AT&T Global Business Video Services (GBVS)
  - » MCI VideoNet
- **Drawbacks**
  - » expensive
  - » cancellation charges
  - » reservations aren't Internet (w**3, E-mail) centric

Some Futures

- Increase in number of MCU's
- T.120 standard and possible impact
- H.323 standard and possible impact
- Video over ATM and possible impact

Increase in Number of MCU's

- Reservation system must be aware of multiple MCU's
- Currently two MCU's operational (Japan, LBL)
- Growth plans / predictions
  - » an MCU in Europe (probably at CERN)
  - » ESnet site needs dictate an MCU for local meetings - BNL, FNAL, ???
  - » need to bridge to commercial service providers
- Need to manage conferences with cascaded MCU's

T.120 Standard

- Building block for new range of collaborative applications (desktop data conf., multiplayer gaming, etc.)

- Network independent (H.320, H.324, voice/data modems)

- T.120 features
  - » conference control
  - » point-to-point, multipoint
  - » still image transfer (JPEG, G.3 FAX, etc.)
  - » white board (real-time annotation)
  - » real-time application sharing

T.120 Standards Suite

- T.120 (data sharing terminal)
- T.121 (generic application template)
- T.122 (multipoint communications services)
- T.123 (network specific transport - PSTN, ISDN, TCP/IP, etc.)
- T.124 (generic conference control)
- T.125 (data transmission protocol)
- T.126 (still image exchange)
- T.127 (multipoint file transfer)

H.323 Standard

- H.323 (video over local area networks with no guaranteed QoS - TCP/IP, IPX)
- Uses the same video codec (H.261) used in H.320
- Uses the standard audio encodings (G.711, G.722, G.728)
- Makes possible low delay connections between LANs and ISDN
- Support for voice is mandatory (data & video are optional)
- Media independent (802.3, 802.5, 802.10, FDDI)

H.323 Standards Suite

- H.323 (visual telephone systems for local area networks)

- H.261 (video encoding)

- G.711 (audio encoding)

- G.722 (audio encoding - ADPCM)

- G.728 (audio encoding - LDCELP)

- H.245 (logical channel signaling procedures)
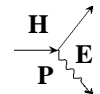
- H.22* (packet and synchronization procedures)

Video Over ATM

- Video codec should support 30 frames/sec.
- Video codec should have a V.35 interface
- MCU's with ATM connectivity will be required (none at present)
- In near future, feasible for ESnet backbone sites
- Does it really make sense?

How Do I Become a Participant

- Basic requirements
  - » H.320 compliant codec
  - » ISDN BRI line
  - » interested users

- HEPNRC loaner program (PC equipped with a video codec)

- Assistance with ISDN line configuration, installation, problem resolution

- Assistance with equipment selection, discount schedules

- Assistance in registering site with ESnet VCS

References

- Videoconferencing, the Whole Picture by Toby Trowt-Bayard (ISBN-936648-48-1)

- Mainstream Video Conferencing by C. Sauer & J. Duran (ISBN 0-201-84747-7)

- Mbone: Multicasting Tomorrow's Internet by Savetz, Randall, & LePage (ISBN-1-56844-723-8)

Questions

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