Media for Packet Communication

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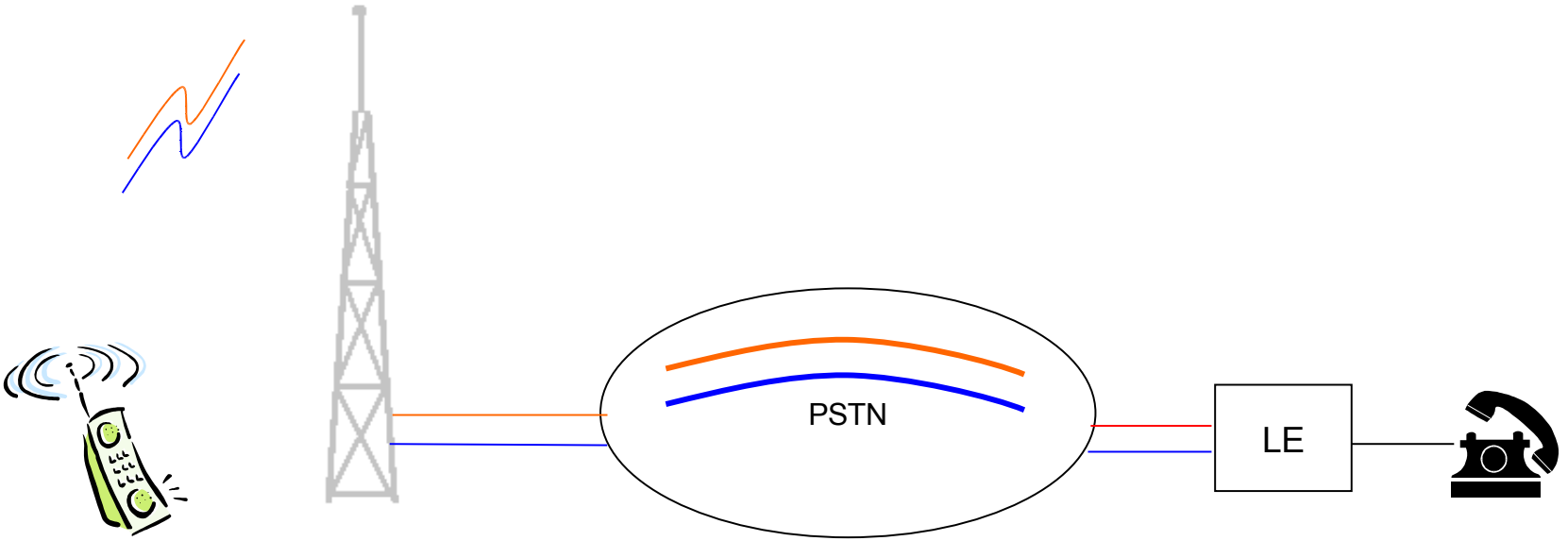
Outline

- Circuit switched and Packet Switched Telephony
- Media Processing
  - Speech Coding
  - Video Coding
- Some Applications

Circuit Switched Telephony

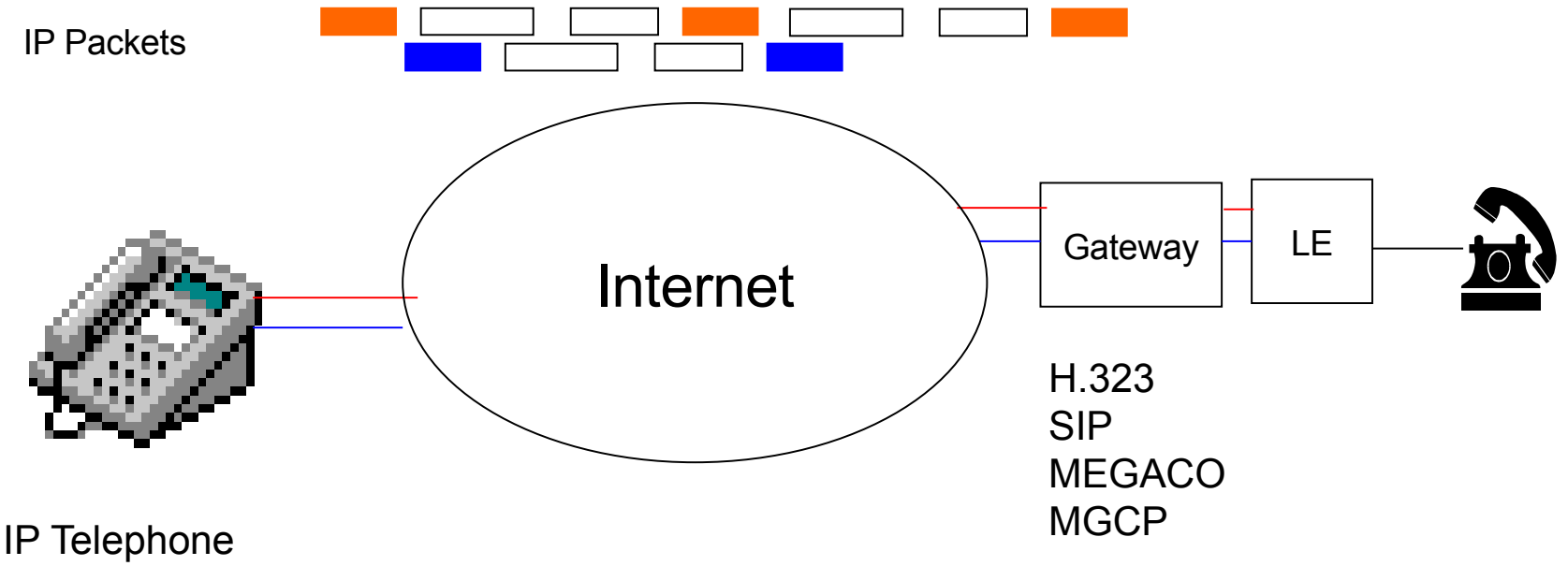


Circuit Switched Telephony contd ...

- Technology
  - Backhaul
    - Fiber
  - Exchange
    - Digital + Software
  - Local Loop
    - Wireless & Digital
- Operation & Economics
  - Phone Number
    - 91 044 2257 8384
  - Telco
    - Agreement for mutual benefit
    - 40M Land + 30M Wireless
- Innovation
  - SS7 Signaling, IN, Conferencing, CID, VoiceMail, Follow-me,Echo Cancellation
  - Payment
    - Toll free, Calling cards

Advantage	**Disadvantage**
Service Guarantees	Limited to Voice
Simplicity of use	

Packet Switched Telephony



Packet Switched Telephony contd ...

- IP Protocols
- IP Address
  - 202.144.22.63
- e-mail Address
  - dj@ee.itm.ernet.in
- Softswitch (Router)

- Gateway Functions
  - Telephone + IP Signaling
  - Voice Packetization
  - Voice Coding
    - G.723.1,G729 etc.
  - Service Guarantees
  - Directory Service
  - Call Admission & Call Center
  - Resource Allocation
  - Monitoring

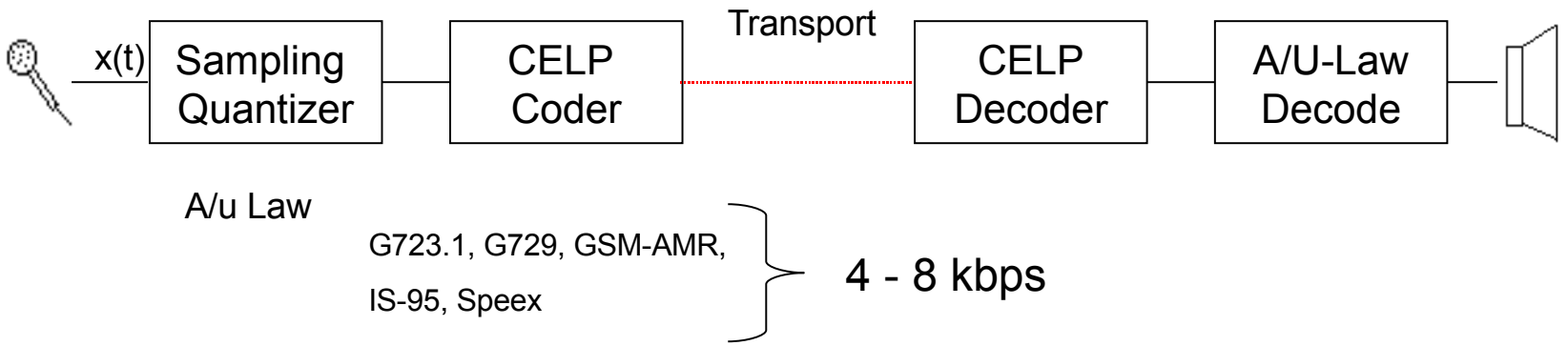
What VOIP gives and doesn't give

- It Gives
  - Intelligent Terminals
  - **Convergence**
    - Voice +Video+ Data
  - Mulitpoint Conferencing
  - Protection against eavesdropping
- It doesn't give
  - Efficiency
  - Costs less?
  - Operations & Economics
    - No Operator Agreement (as yet)

- Technical Challenges
  - Long Echos
  - Protocols to ensure service guarantees
- Problems of IP
  - Long setup times
  - Jitter
  - Network Security
    - Denial of service

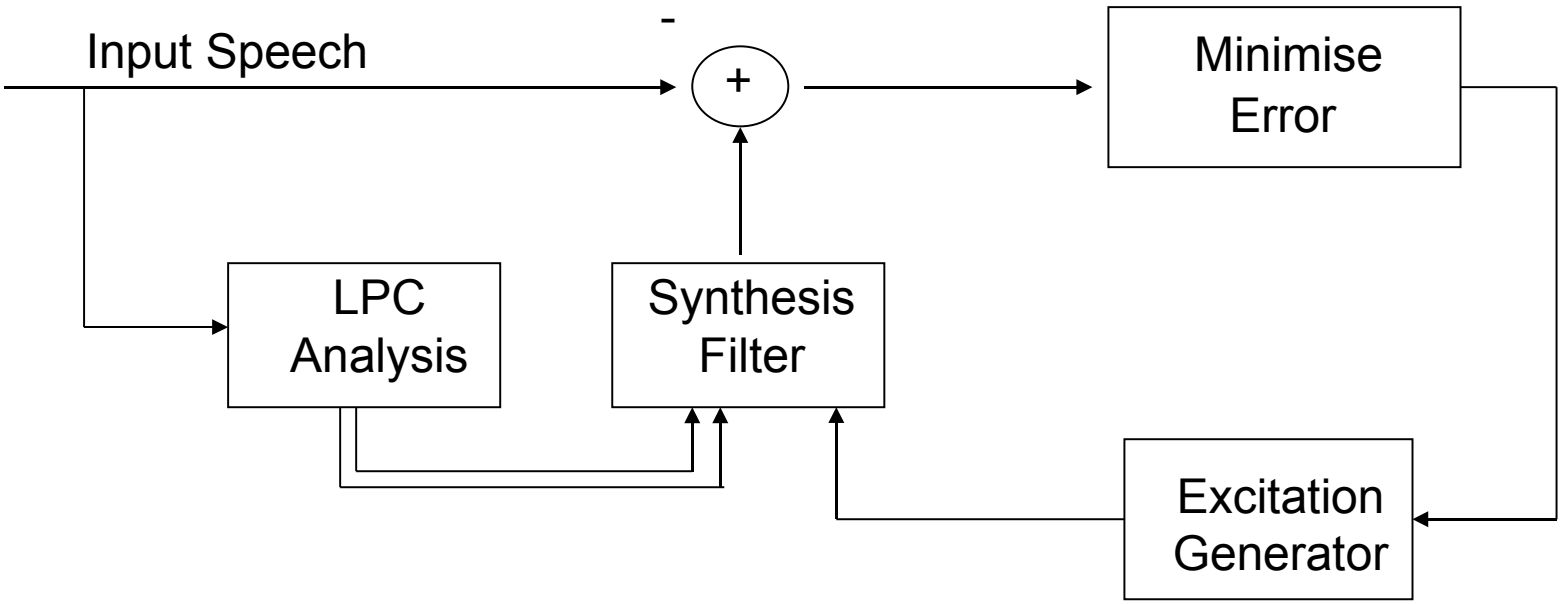
Media Processing

- Speech Codec
  - Bandwidth reduction
  - VAD, Discontinuous mode
  - Comfort noise insertion



Generic CELP Coder

- Based on LPC and Pitch information
- Uses some form of excitation



Voice and Audio Coding

Band	Sampling Rate	Bit-rate	Applications
Voice Band (330 –3300 Hz)	8 kHz	≤64 kbps	Wireline Wireless VoIP Voice Mail
Wideband (50 Hz-7 kHz)	16 kHz	≤64 kbps	Speaker Phone Video Conferencing
Audio (50 Hz-20 kHz)	44.1 kHz	128 kbps	MPEG Audio

Standard	kbps	Frame size (ms)	Look ahead (ms)
G.711 PCM	64	0.125	0
G.721, G.723 G.726ADPCM	16, 24, 32, 40	0.125	0
G.722 Wideband	48,56,64	0.125	1.5
G.728	16	0.625	0
G.729/A	8	10	5
G.723.1	6.3/5.3	30	7.5
IS-96	8.5/4.2	20	5
GSM	13	20	0

What Makes a good codec?

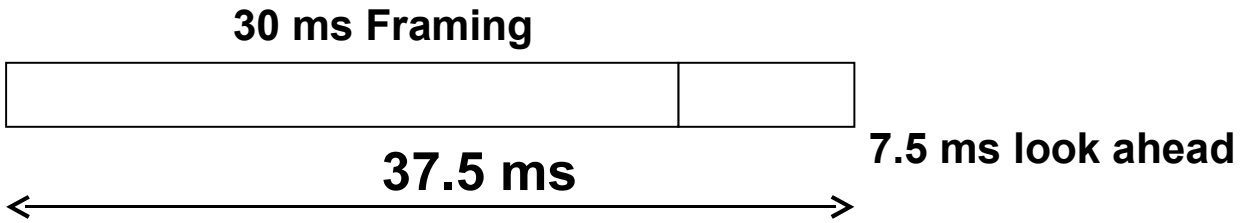
- Speech Quality (MOS)
  - Wireline, Wireless, noisy channels
  - Tandem Operation
  - Wide range of languages and speakers
- Bit Rate (kbps)
  - BW is limited
- Delay (ms)
  - 200-300 ms is max for telephony
  - algorithmic + processing + propagation delay
- Complexity (MIPS)
  - speed and requirements of RAM
  - power consumption

Silence Detection and CNG

- A person usually speaks *only* 40% of the time in a conversation
- Detect Silence
  - To reduce BW
  - To reduce storage
  - To Reduce power consumption
  - To effectively implement *statistical Multiplexing*
- Insert Comfort Noise at receiver during silence

Delays

- Algorithmic Delay
  - e.g. G723.1



- Processing Delay
  - e.g. 7.5 ms (assuming 4 channels/DSP)
- Propagation Delays
  - 3 us/km (fixed)
  - 250 ms in satellite
  - Variable and Unknown in Internet

Delays Contd.

- Multiple frames per packet
  - To increase payload to overhead ratio
  - To add redundancy
  - To aid error recovery/concealment
- Jitter Buffer Policy
  - To combat variable packet arrival timing at receiver
  - Too small a value results in dropped packets
  - Too large a value increases delays

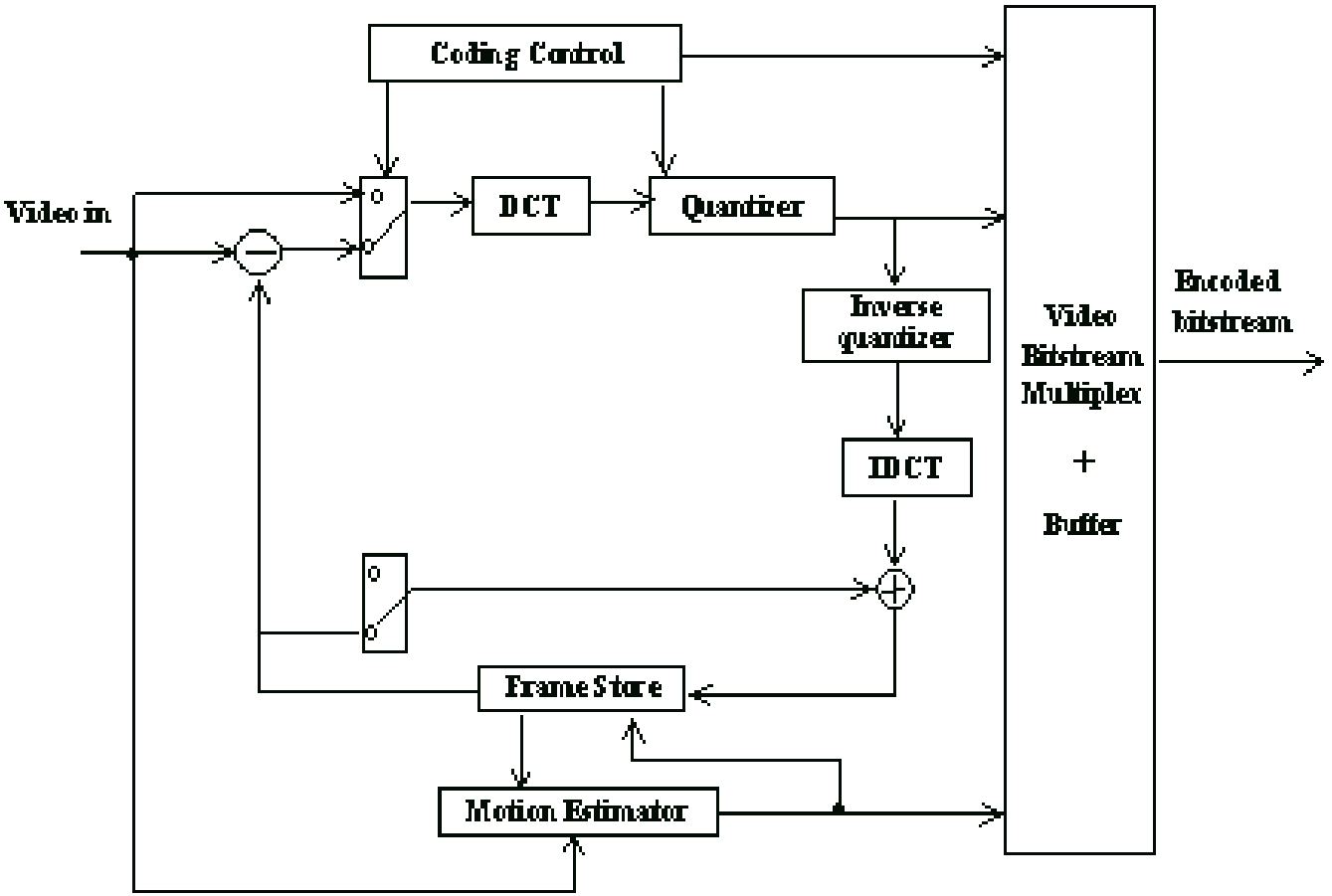
Echos in a Telephone Network

- Hybrid Echo (Electrical)
  - 2W to 4W conversion at the interface of PSTN and VoIP/Wireless
- Acoustic Echo
  - Speaker Phone
  - PC Phone
- Effect becomes noticeable with longer delays
- Need Echo suppressors/Echo cancellations
  - e.g. G.165/G.168

Video coding

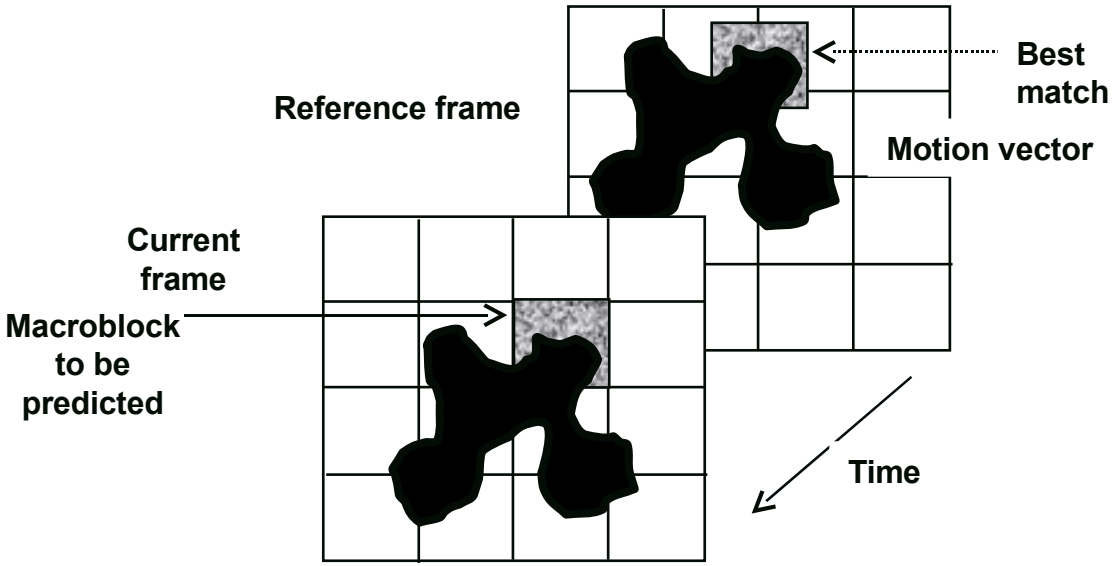
- Without codecs :
  - A typical 2-hour TV movie would need
    - 150 GB for storage
    - 160 Mbits/sec channel for streaming ~ 160 x DSL speed
      ~ 6000 x 28K modem
  - 1.5 hours for downloading ~ 2-min stereo song over 28K modem

Video Encoder



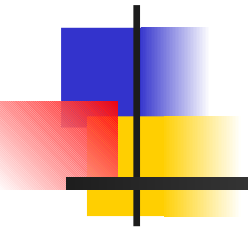
Motion Estimation

- Simplest prediction is to use pixels at the same location in reference frame,but very inefficient when motion is present.
- Current frame divided into non-overlapping ***macroblocks*** (16 x 16 pixels) for estimating motion between the two frames
- Each macroblock is matched with (16 x 16) blocks of the reference frame to locate the ***best match***
- Matching criterion: Sum of Absolute differences



Popular Video Codecs

- Recognizable by “brand-name”
- MPEG-1 ~ 1.5 Mbps, 352 X 288, 25 fps
  1993, Video CDs (better than VHS), MP3Audio
- MPEG-2 ~ 2-6 Mbps, Digital TV & DVD, 704 X 576, 25 fps, For HDTV 15 to 20 Mbps, 1995
- H.263 : Video Telephony, 15 kbps +, 176 X 144, 2fps, 1995
- MPEG-4 (AVC H264) ~ 64 kbps to 1 Mbps, Internet Video, 1999
- Windows Media Player, Real Player, QuickTime

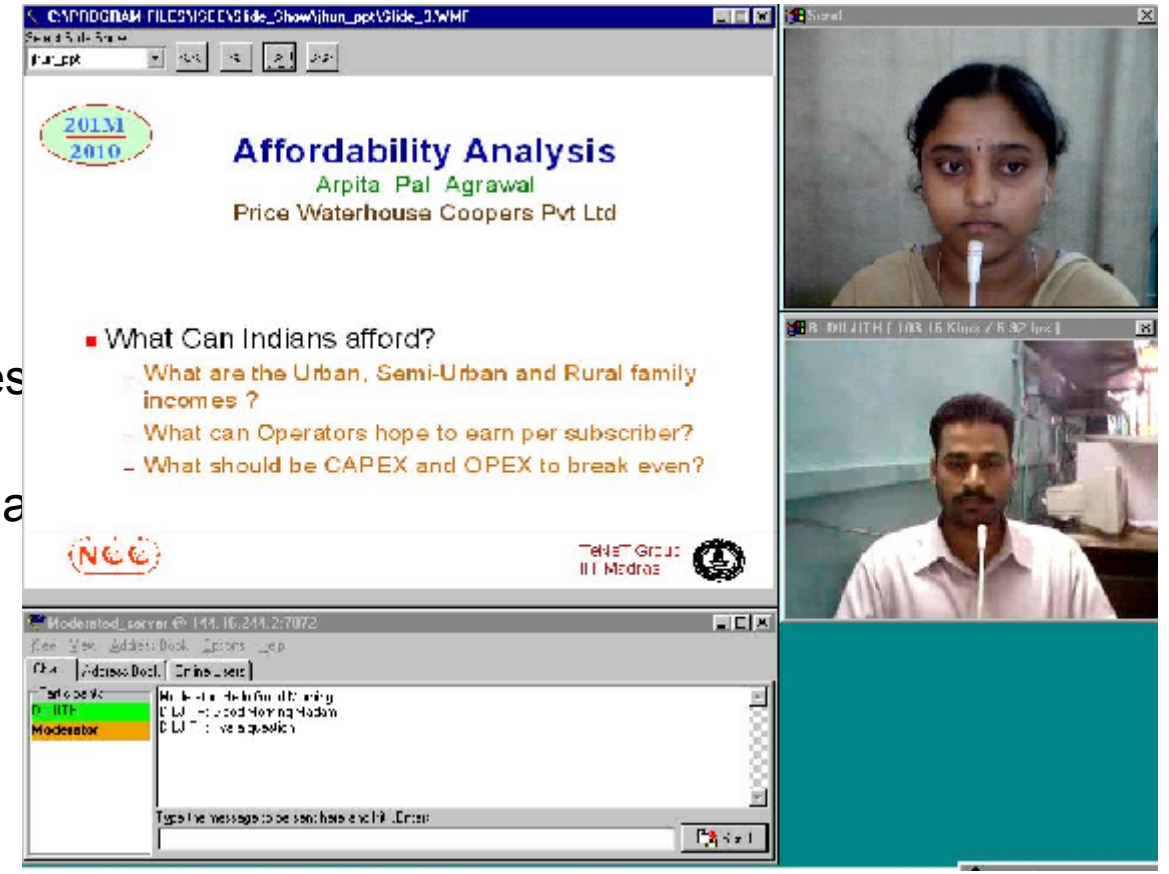


Some Applications from IIT Madras

Video Conferencing/Distance Education

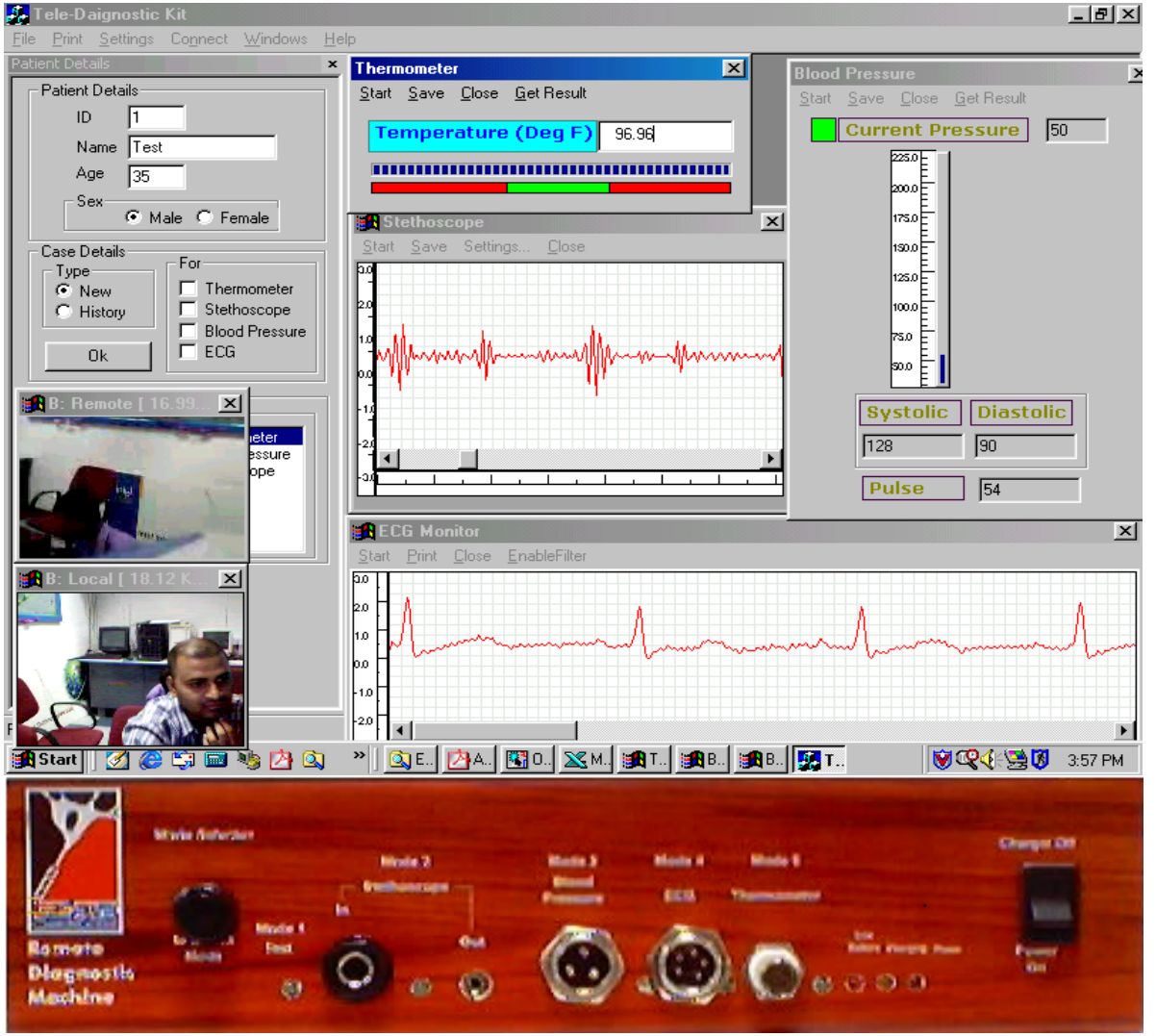
- Features
  - Both On-line and Off-line modes
    - Allows “Real-time” and “Streaming”
  - Supports a range of bitrates frame sizes,
  - Slides, cursor movements a text
  - Multipoint
  - “Question” mode

http://www.tenet.res.in/isee/downloads

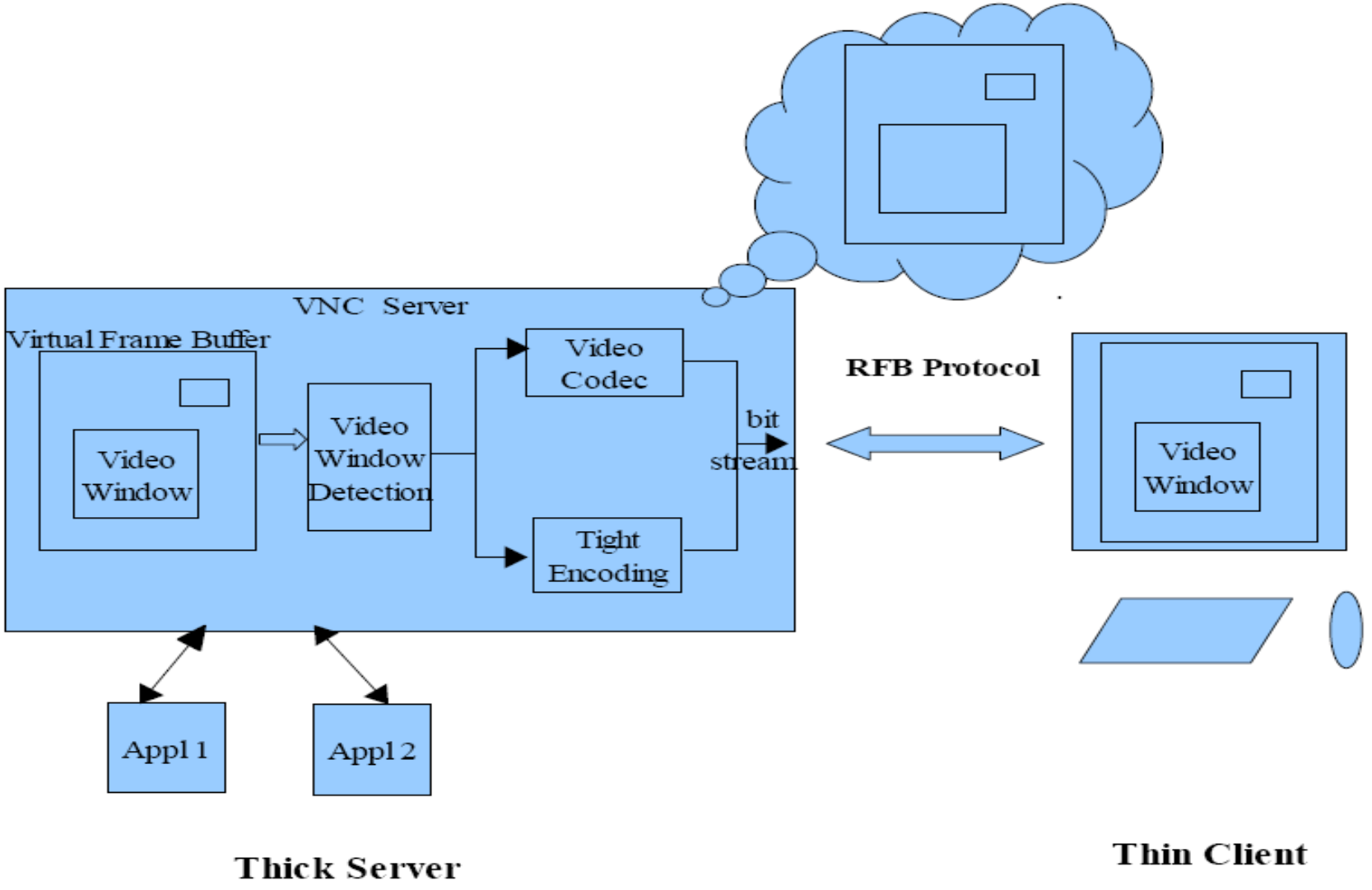


Health Care

- Used in RemoteHealth Care
- Basic Health Parameters
  - BP
  - Temperature
  - ECG
  - Stethoscope



Thin Clint Application



Conclusions

- Packet Communications leads to Convergence
- Low bit rate (~20 kbps) multimedia processing and transport is a possibility today
- Computational complexity is well within capabilities of today’s PC/Handheld Device
- Streaming is a challenge in packet loss situations