IP Telephony – Where are we today?

Aarti Iyengar
Solutions Architect
Polycom
Table of Contents

• Technology
• Performance challenges
• Policies
• Deployment
• The Indian Scene
Technology
Brief Introduction ...

- **Legacy Telephony**
  - TDM/SS7 based infrastructure
  - Traditional Class 5/Class 4 switches

- **Voice over IP**
  - IP-based packet infrastructure for PSTN voice transport
  - Analog voice encapsulated in IP packets
  - New elements that collectively perform traditional telephony functions and more

- **And what is IP Telephony?**
  - Voice + Messaging + Video + Data over IP networks = IP Telephony
  - Public Internet: Best Effort Service
  - Managed IP Network: SLA based Service
Traditional PSTN Network

- SS7 signaling
- SS7 network
- Legacy Class 4/5 Switch
- Legacy Class 4/5 Switch
- Legacy Class 4/5 Switch
- TDM network
- TDM bearer
- Call Control, Signaling, Bearer/Media and Features
VoIP Network

- **SS7 network**
- **IP signaling + IP bearer**
- **Soft IP Phones**
- **Signaling Gateway**
- **Media Gateway Controller**
- **Call Control**
- **Application Server**
- **Features**
- **TDM bearer**
- **TDM network**
- **IP Phones**
- **Integrated Access Device**
- **Analog Phones**
- **Media (conferencing)**
- **Media Server**
- **Bearer/Media**

VoIP Network components and interconnections.
The Elements ..

- **Terminals or Endpoints**
  - IP Phones
  - Soft Phones/PC Phones

- **Media converter**
  - Media Gateway/PSTN Gateway

- **Call Processor**
  - Media Gateway Controller or Gatekeeper or Proxy Server or Softswitch

- **Signaling Gateway**

- **Application Server**

- **Media Server**
Which paradigm suits your network?
IP Telephony Protocol Soup

- H.323
- SIP
- MGCP
- Megaco/H.248
- SIP-T
- BICC
- RTP
- Bearer
- TRIP
- SDP
- ENUM

Call Control/Signaling
Call Control/Signaling
Gateway Control
Softswitch-Softswitch

More ……. 
Protocol selection is a strategic decision. Depends on existing network and future services planned.

Ultimately, one winner will make it easy for all!
Performance Challenges
IP Telephony Performance Challenges

• Need to engineer network appropriately for good quality IP Telephony services (voice, video)
  • Adequately provisioned core with proper traffic and congestion management methods
  • Sufficient bandwidth in the access
    • Video is a bandwidth hog. Require about 384 kbps for a good quality video connection

• Reliability/Availability
  • ~ 99.999% availability through implementation methods yielding Redundancy, Resilience, Survivability, Robustness
IP Telephony Performance Challenges

• Network requirements for high performance
  • Coding Algorithms: what codec, what bit rate?
    • Greater the compression, more the encoding delay
    • Determine appropriate packetization times and packet length
  • VAD and CNG (for voice)
    • At the transmitter: Detection of voice activity, silence suppression
    • At the receiver: Comfort Noise generation, Voice playback
  • Latency/Delay
    • Components: Packetization, Propagation, Network Processing, Jitter buffer delay and speech playback delay
    • PLCs add about 5ms-10ms delay in multimedia transmission
  • Impact on perceived audio/video quality
    - Echo (RT delay > 50ms), Talker overlap (RT delay > 250ms)
    - Loss of audio-video synchronization, checker-celled picture, hazy motion

Latency Benchmark: Toll quality PSTN-like voice: 150ms RTT (ITU G.114)
Occasional packet loss is tolerable; Delay > 300ms completely unacceptable
IP Telephony Performance Challenges

- **Jitter**
  - Jitter = Delay Variation *(MUST AVOID in multimedia networks!)*
  - Jitter Buffer compensates for jitter on the receiver side: Choose optimal size!!

**Rule of thumb: Jitter Buffer size = atleast 2 x speech frame size**

- **Packet loss**
  - Packet loss should be < 1% for acceptable quality
  - Use Codecs with packet loss concealment algorithms (E.g G.729, G.723.1, H.263/H.264 – built-in PLC; G.711, G.726 - add-on PLCs)
  - Packet loss is mostly bursty in nature. Hence, packet loss performance is directly related to packet size, the shorter the better
  - Impact on perceived audio/video quality: Clipped speech and distorted image
IP Telephony Performance Challenges

- **Transcoding/Tandeming: Parameters to transcode**
  - Audio codecs (G.729A, G.711)
    - Audio Transcoding: Two or more encodings of a signal through different types of non-G.711 codecs separated by G.711 e.g. G.726 to G.711 to G.729A
    - Audio Tandeming: Two or more encodings of a signal through same types of non-G.711 codecs separated by G.711 e.g. G.729A to G.711 to G.729A
  - Video Codecs (H.261, H.263, H.264)
  - Bandwidths (128 kbps, 384 kbps, 512 kbps etc.)
  - Video formats (CIF, QCIF etc.)
  - Video frame rates (30 fps, 14 fps etc.)
  - *Every participant must get his optimal capability!!*

*Transcoding increases distortion and delay.*

*Beyond one transcode, network performance drops to unacceptable levels for most codec combinations.*
Performance: The Key Parameters

- **Quality of Service**
  - Real time voice/video packets must receive higher priority than non-real time data packets
  - Significant delay/jitter events can be avoided only by implementing a proper QoS Strategy
    - Best Effort: no guarantees provided
    - Overprovisioned Network: Throw Bandwidth
      - Need to constantly keep upgrading as more and more real-time services are offered. Easy but not the best thing!
    - Prioritized Queuing
      - Differentiation in the queuing of traffic for various classes of traffic
      - Assigns a priority or classification to every IP packet
      - packets sent in order of priority
    - Traffic Engineered Tunnels
      - Constraint-based (traffic sensitive) connection-oriented paths through a routed network (MPLS Label Path, ATM VC)

Prioritized queuing with Traffic Engineered tunnels in the core are a must for offering SLA-based IP Telephony Service!
Policies

Security
Regulatory
Security: Issues to Ponder....

- **New IP Requirements**
  - Viewing voice packets as part of sessions
  - Policies are required for Sessions
  - New IP Services are enabled to handle
    - Routing sessions between different networks, carriers and domains
    - Session packet flow anchoring
    - Detect failures and reroute
    - Usage based Billing/reporting at session flow level
    - Session aware borders for security
Need for Session Aware Firewalls!!
“Session Border Controllers”

VoIP Firewall Traversal Solution for Carrier to Carrier Peering
- Integrated SIP Application Layer Gateway (ALG)
- Overcome NAT/NAPT problem
  - Signaling messages exchanged on fixed port; Modify signaling message to permit bearer traffic flow
  - Dynamic ‘pinhole’ opening/closing
- Topology Hiding
  - Provide an address normalization boundary
- VoIP Media Anchoring Solution
- VoIP Session QoS / Service Level Agreement Solution
  - Per session based policing
  - Guaranteed service in congested environments
- VoIP Session Admission Control Solution
Regulation

- Numbering Services
  - Rate Centre Association of Numbers
  - Impact on Number Conservation
  - Number Portability Compliance for VoIP providers?

- Information service versus Telecommunications service
  - Access charges at Origination and Termination points?
  - Non compliance of today’s “Computer” and “Telephone” to traditional definitions (e.g. PDAs)
  - ENUM – dial an E.164 number to reach any type of endpoint

- CALEA
  - Requires North American telecommunications carriers to modify their equipment, facilities, and services to ensure that they are able to comply with authorized electronic surveillance.

- Availability
  - Available at all times
  - Telephone service available even if power cut - Separate power?
**Countries prohibiting IP Telephony**
- Albania, Botswana, Burundi, Cuba, Cyprus, Kenya, Mauritius, Mexico, Nepal, Pakistan, Panama, Slovakia, South Africa, Thailand, Vietnam, and Yemen

**Countries restricting IP Telephony**
- Hungary (quality restrictions – delay > 250ms and packet loss > 1%, Colombia (too many permits), Paraguay (fax only))
- India (elaborated in the next slide)

**Countries permitting IP Telephony**
- Australia, European Union, Singapore, Switzerland, USA
Milestone – Deregulation of Telecommunications in April 2002

- ISPs permitted to offer IP Telephony services
- PC to PC (anywhere), PC to PSTN phone located outside India, IP phone to IP phone (anywhere)
- IP Addressing scheme, no E.164 addresses
- ISP IP Telephony services viewed as non-real time application services to differentiate from offerings of Facility based carriers
  - ISP VoIP based services are not “telecommunication” services and so will not be tariffed
- Incumbents can also offer IP Telephony services
  - VoIP based toll quality service offered by Facility based carrier, will be tariffed
Deployment Scenarios
• Initially Popular among enterprises
Traditional IP Centrex

- Network-hosted solution
- Leverages traditional Class 5 based Centrex service to provide Class 5 based Centrex features

Traditional Centrex features delivered from here.
Enhanced IP Telephony

- Fast gaining popularity among enterprises, small-medium businesses
- Network-hosted
- Provides multi-media voice over an IP network, in addition to basic Centrex features.
- Increased demand for this service by enterprises in India!
Class 4 replacement

- ILECs, CLECs, IXCs, Large Corporations
- Benefits
  - By-pass traditional long distance toll network (Class 4) carriers and their per-minute usage rates and run their voice traffic over IP networks for a reduced cost.
  - Lower costs with higher bandwidth efficiency
- Issues
  - Traffic engineering of IP network for PSTN QoS
  - Migration from Circuit to Packet-based Network
Class 4 Replacement

End Office
Class 5
Local (LEC)

SS7 Network

SCTP

MGCP/H.248

VoIPNetwork

High Density Trunking Media Gateway

End Office
Class 5
Local

PBX

SIP-T

Class 4 Softswitch

Class 4 Softswitch

VideoVoiceDataWeb
Class 5 Replacement

ILECs, CLECs

Benefits
- Flexibility - Enable Rapid Deployment of New Services
- Distributed Architecture rather than Hierarchical Class Model

Issues
- Maturity of softswitch technology
- Ability to support all legacy systems supported by a Class 5 switch
Conservative Migration and Evolution

CLASS 5 DERIVED

IAD

Broadband Network

Media Gateway

Class 5 Switch

CLASS 5 + SOFTSWITCH

IAD

Broadband Network

Media Gateway

Softswitch

CLASS 5 DERIVED

IAD

Broadband Network

Media Gateway

Class 5 Switch

SOFTSWITCH ONLY

IAD

Broadband Network

Media Gateway

Softswitch

PSTN

IP Network

VideoVoiceDataWeb
The Indian Scene
The Indian Scene.

- **A View of some Statistics**
  - Post IP Telephony legalisation in 2002, to-date about 15 ISPs in India have licenses for offering IP Telephony services
  - Voice market in India estimated at ~ 33 crores (330 million)
  - ~ 1.5 million overseas calls are made from India everyday
  - Calling rate to US has fallen from to ~ 20% of 3-5 years ago

- **Almost Every Biz doing some form of IP Telephony**
  - Corporates/Enterprises incorporating IP Telephones within network (LAN/WAN for intra/inter-office calling) for cost savings
    - Over 100,000 IP Phones have been sold in India across various vendors!
  - Increasing use of Audio/Video conferencing over IP for business communication with colleagues/vendors across the globe
  - Vertical segments like Educational institutions, Banks, Health Sector, Hospitality demanding Audio/Video/Data Collaboration services for E-education, E-consultation etc.
  - Spurt in Call Centres/BPOs has increased IP PBX/Centrex usage
Almost every Service provider is trying to get a piece of this revenue
- Softswitches being evaluated for Class 4/5 functionality
- IP phones tested for broadband rollout to large/medium/small businesses and residential customers as bundled offerings
- Push-to-talk over wireless being implemented
- Multimedia collaborative services for enhanced communication
- Value added services like Internet call waiting, Unified Messaging, Fax over IP
- Virtual Call Centres
- PC penetration in India is low, hence non-PC IP devices being tapped extensively
- Communication Kiosks (Reliance’s webworlds, Satyam’s iway) to host value-added IP based services
- Partnerships (e.g. Data Access partnership with Dialpad for IP Telephony services to its customers)