

IP Telephony – Where are we today?

Aarti Iyengar
Solutions Architect
Polycom



Connect. Any Way You Want.

- **Technology**
- **Performance challenges**
- **Policies**
- **Deployment**
- **The Indian Scene**



Technology

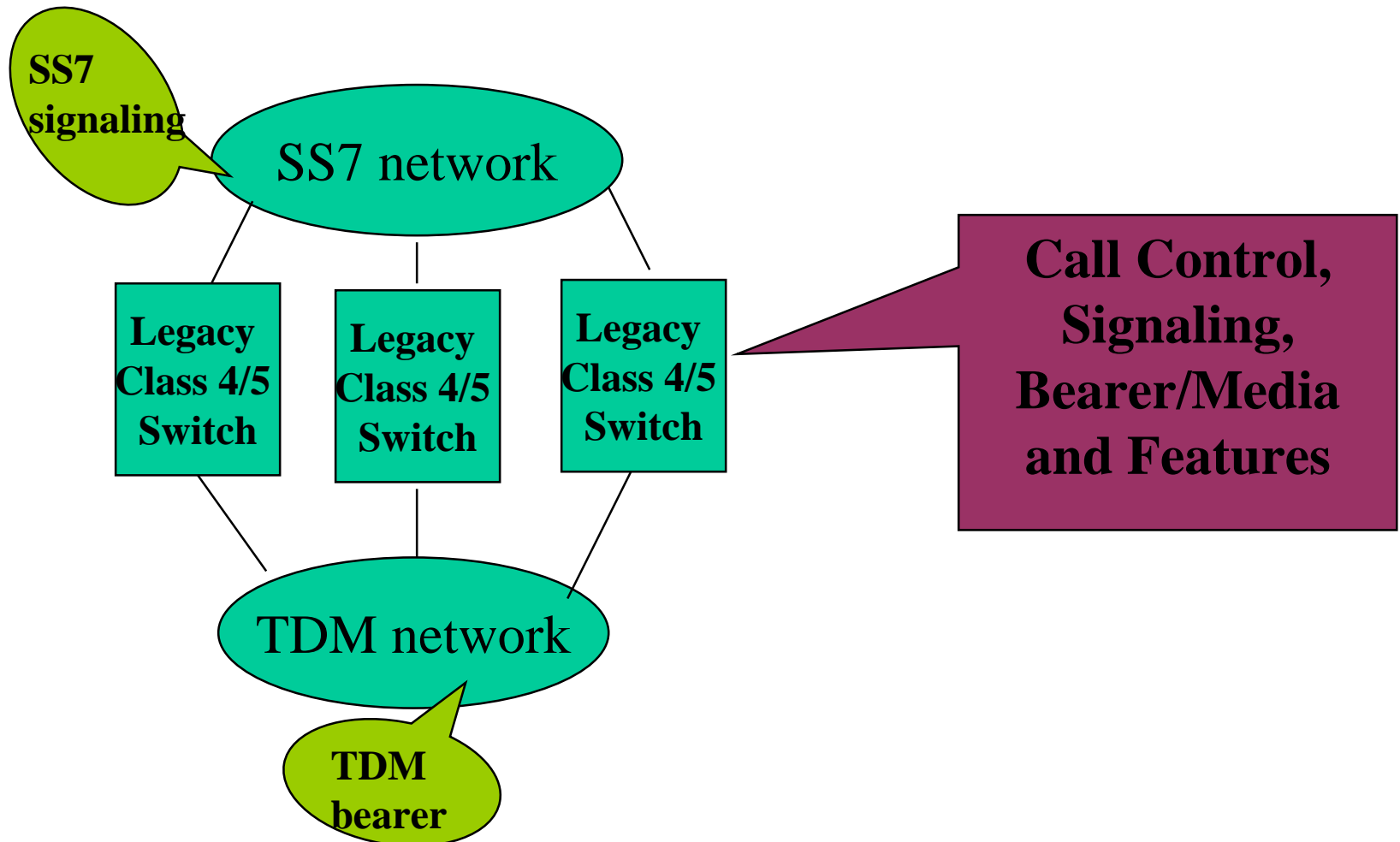


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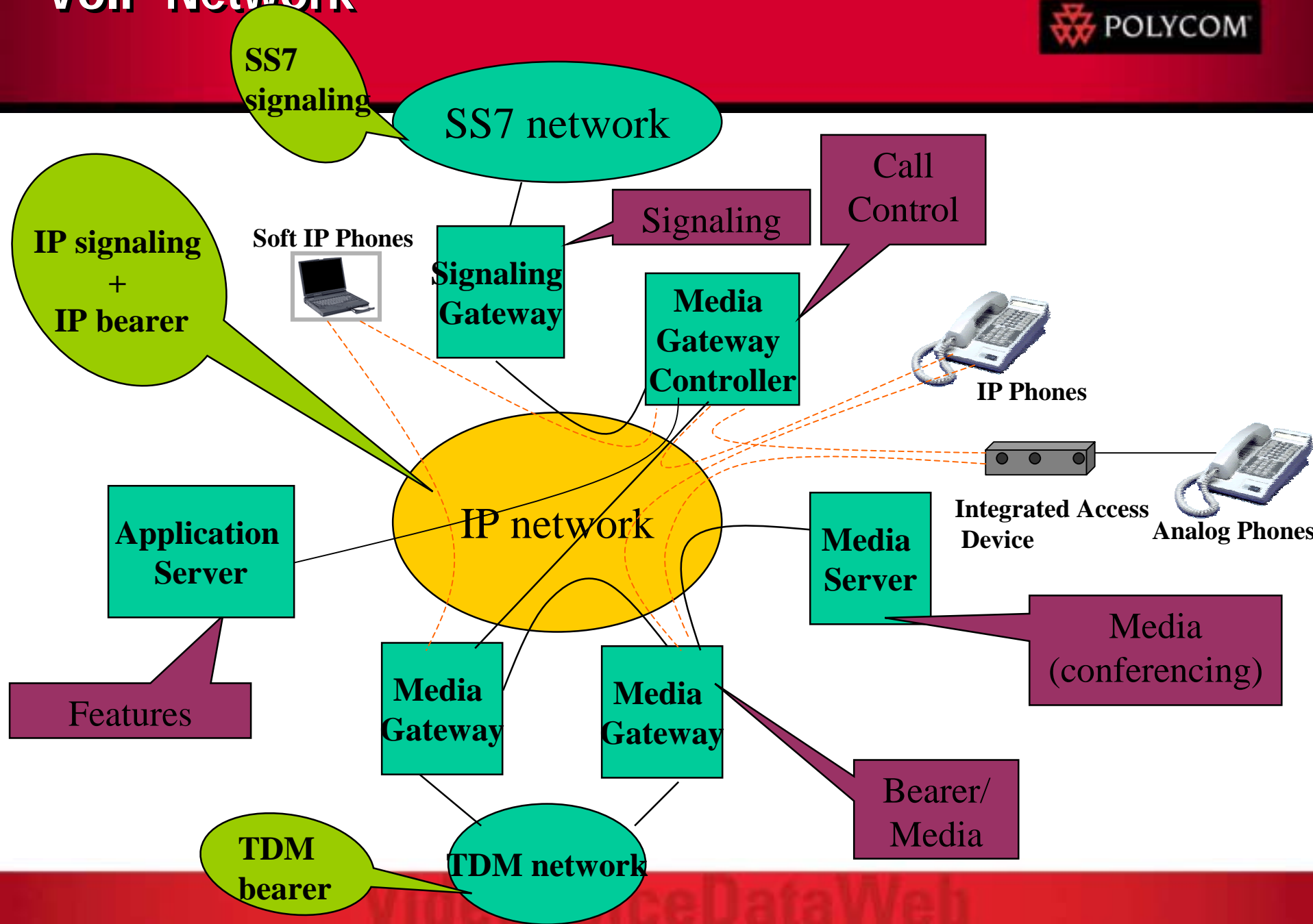
Brief Introduction ...

- **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



VoIP Network

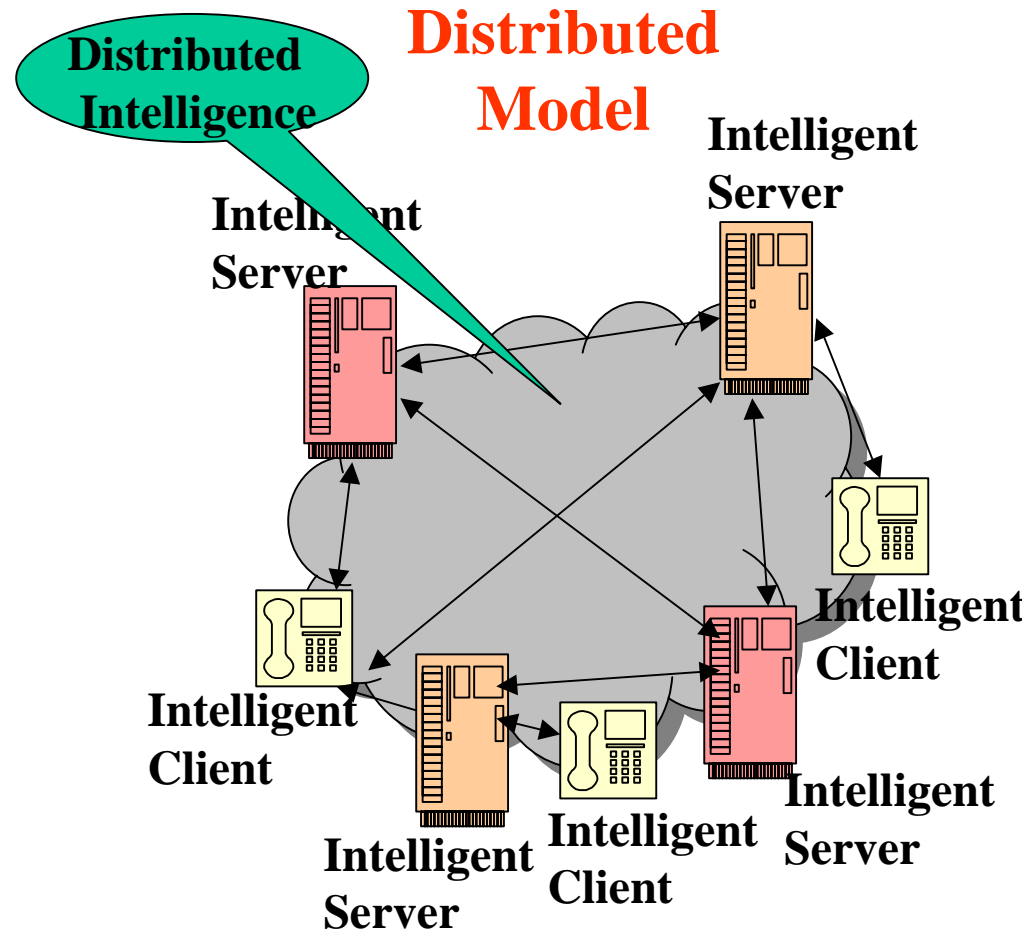
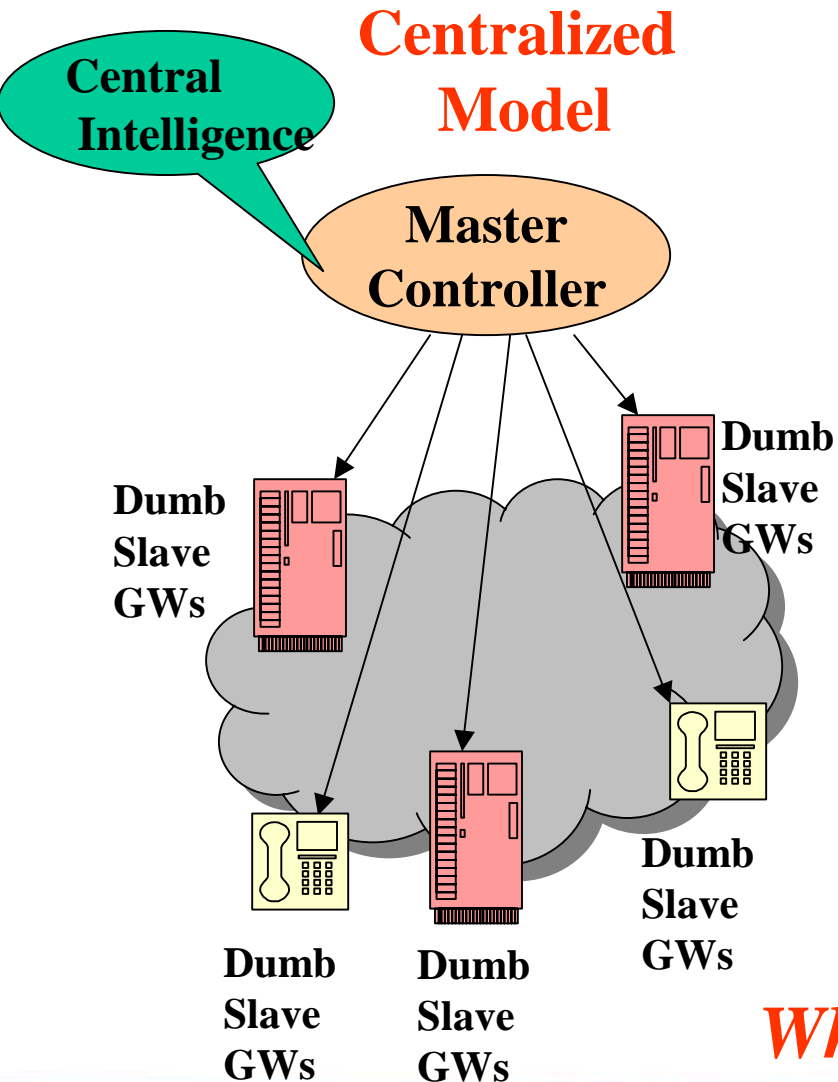


The Elements ..

- **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**

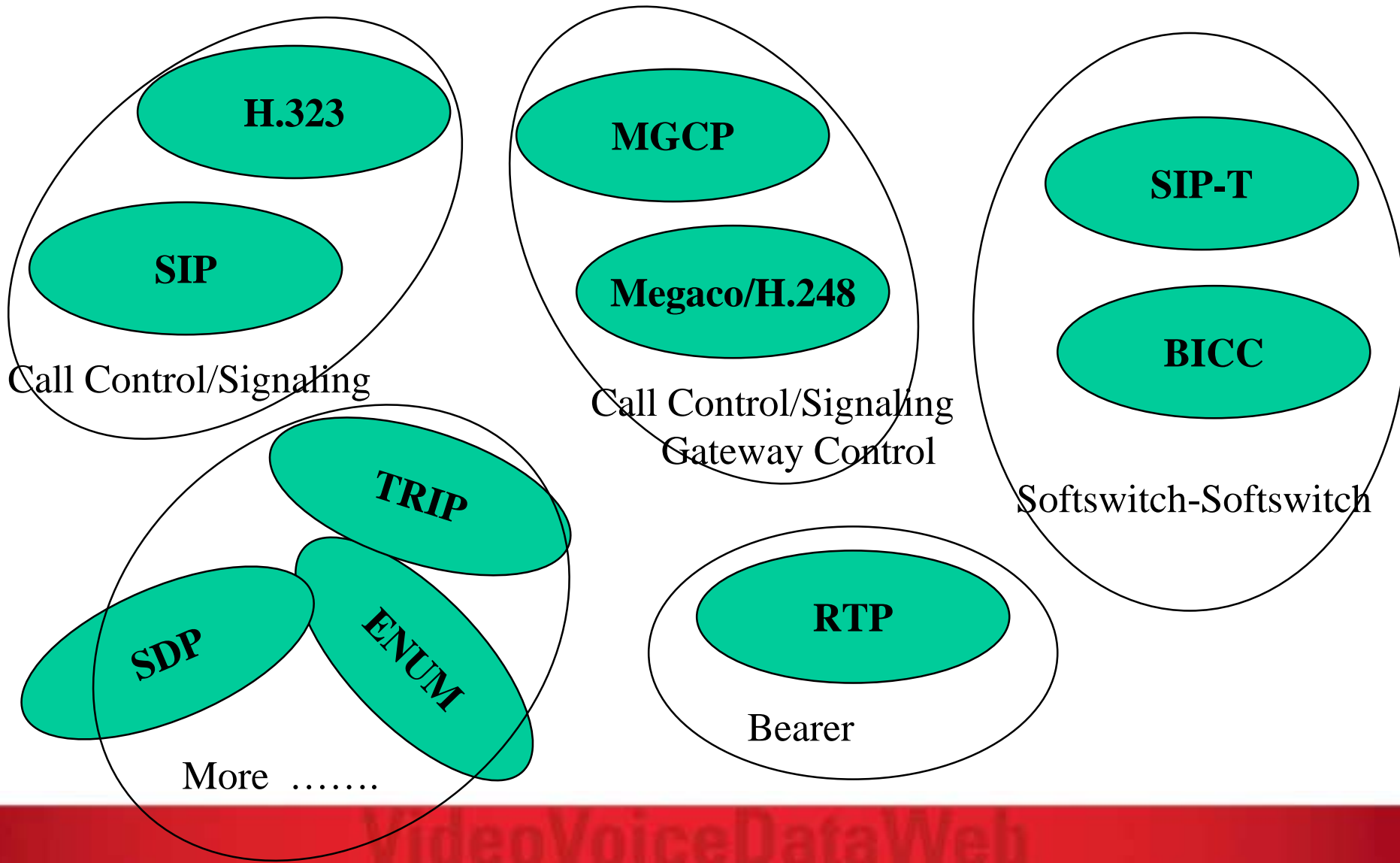


Network Paradigms



Which paradigm suits your network?

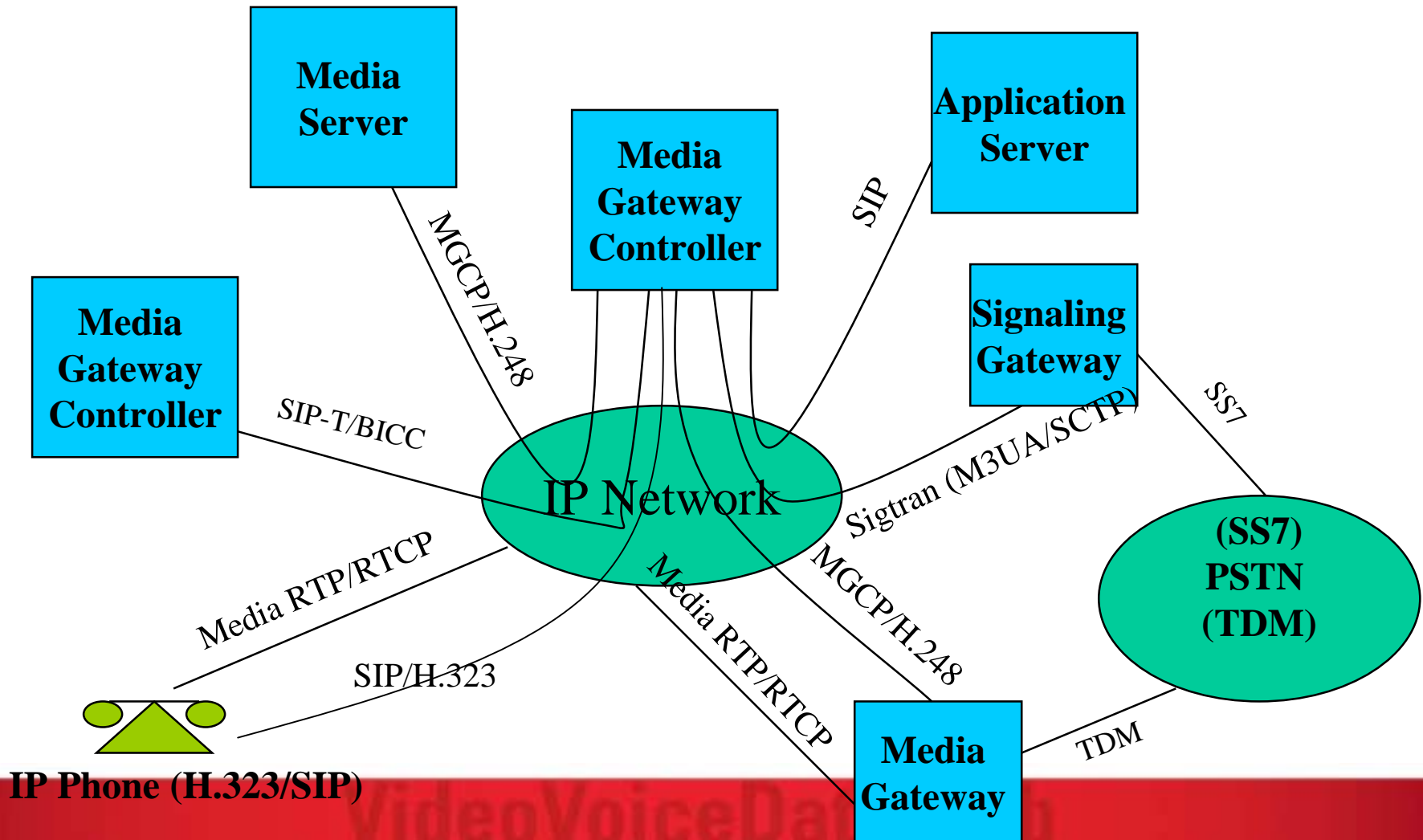
IP Telephony Protocol Soup



Putting All Ingredients of the Soup together !

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



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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



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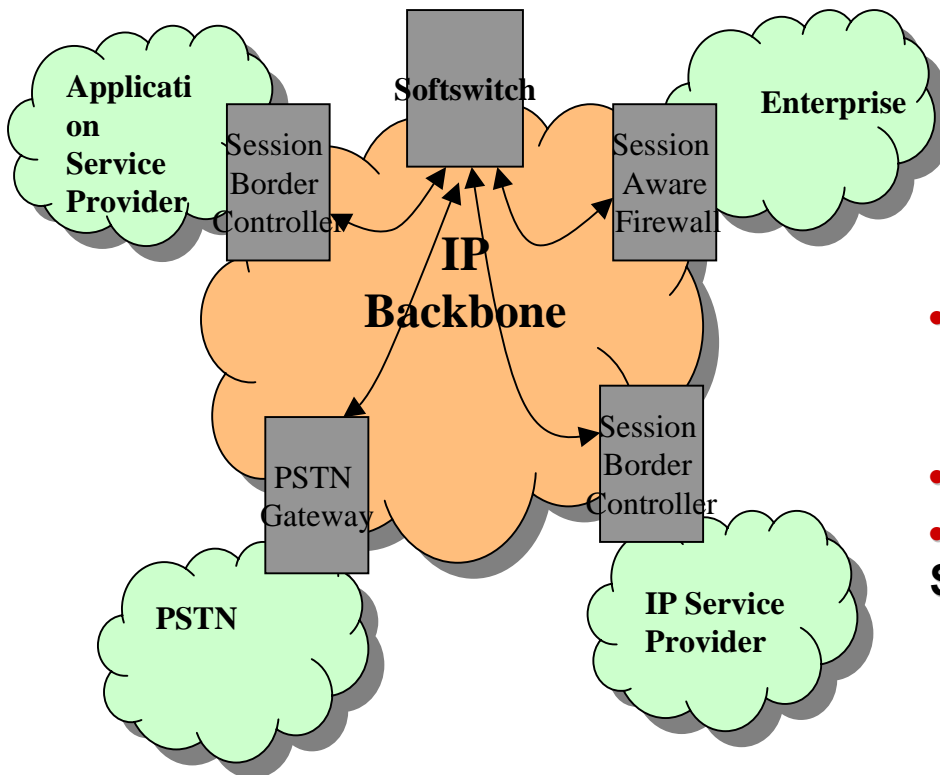
Security: Issues to Ponder....

- **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**



Security: What change is required...

*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

- **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 or ...))
 - 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 tarified**
 - **Incumbents can also offer IP Telephony services**
 - **VoIP based toll quality service offered by Facility based carrier, will be tarified**

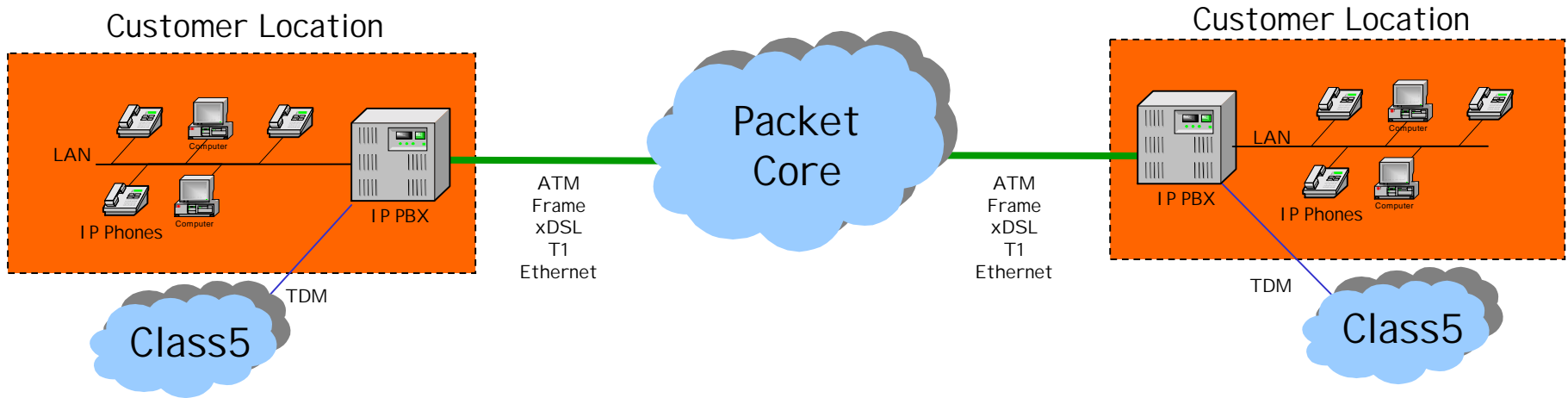
Deployment Scenarios



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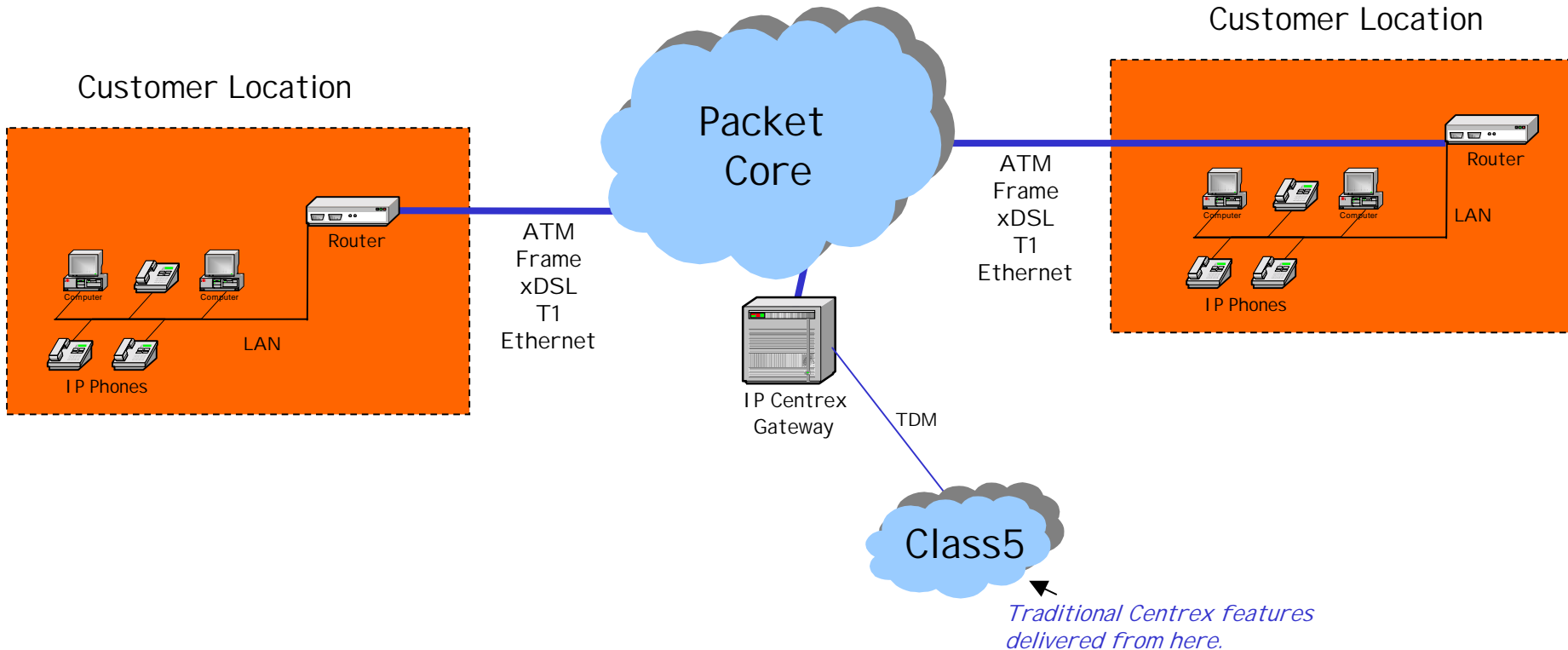
IP PBX

- Initially Popular among enterprises



Traditional IP Centrex

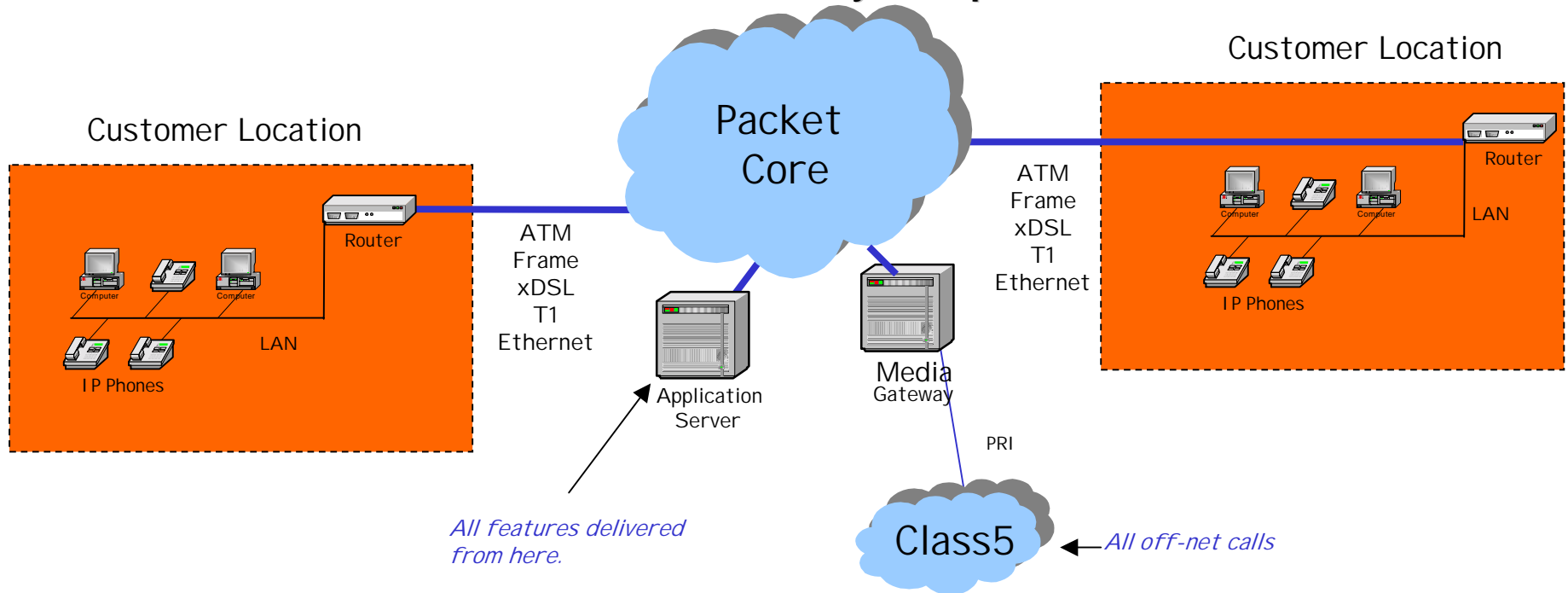
- **Network-hosted solution**
- **Leverages traditional Class 5 based Centrex service to provide Class 5 based Centrex features**



Enhanced IP Telephony

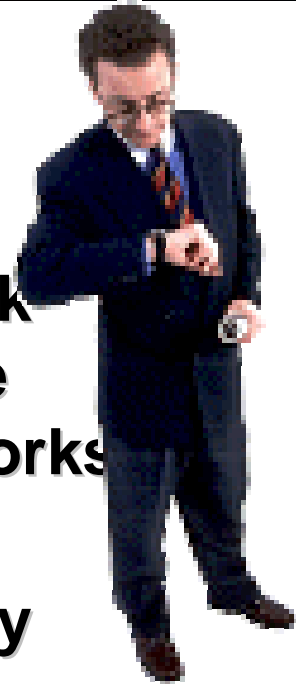


- **Fast gaining popularity among enterprises, small-medium businesses**
- **Network-hosted**
- **Provides multi-media voice over an IP network, in addition to basic Centrex features.**
- **Increased demand for this service by enterprises in India!**

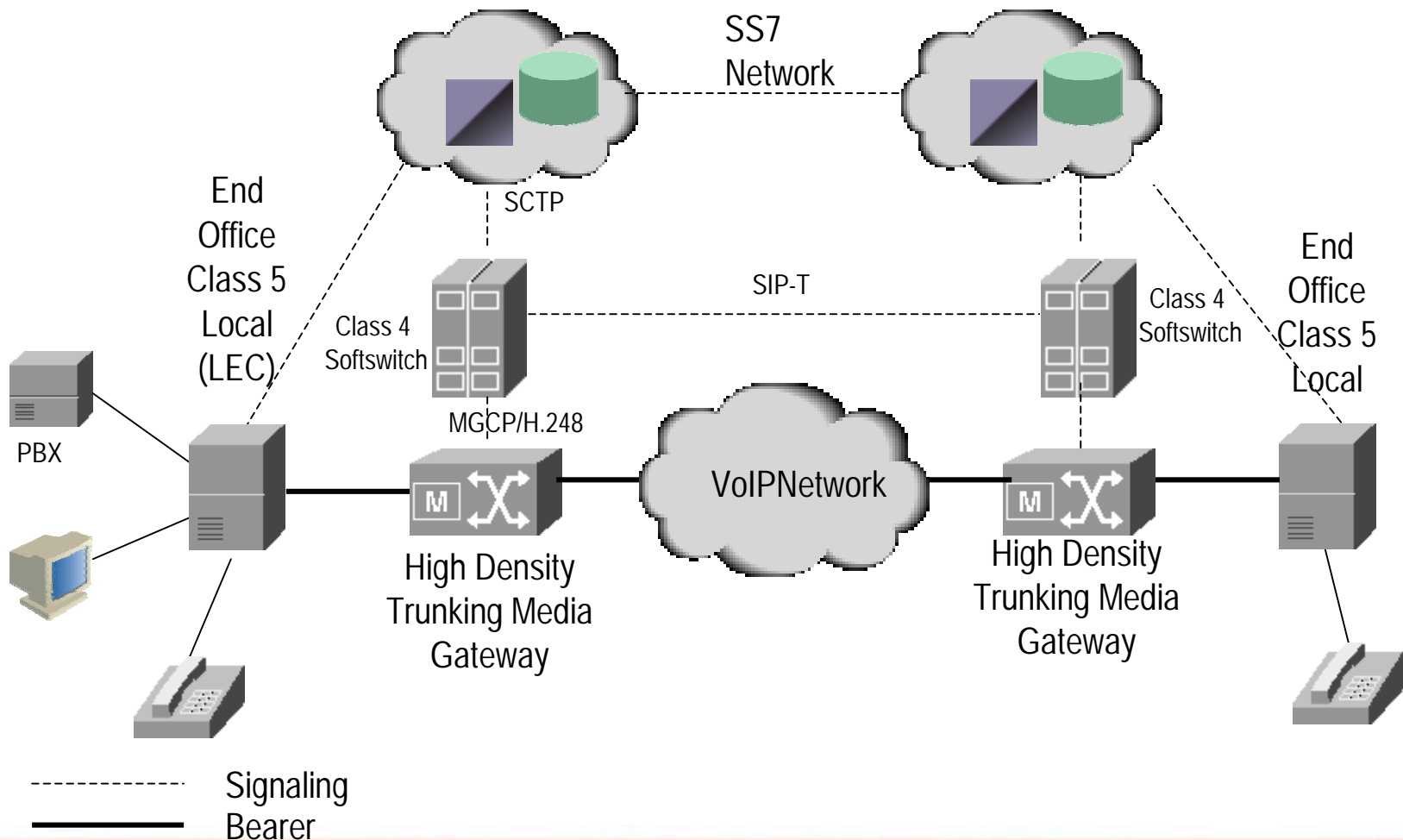


Class 4 replacement

- ILECs, CLECs, IXC, 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



Class 5 Replacement

ILECs, CLECs

Benefits

Flexibility - Enable Rapid Deployment of New Services

Distributed Architecture rather than Hierarchical Class Model

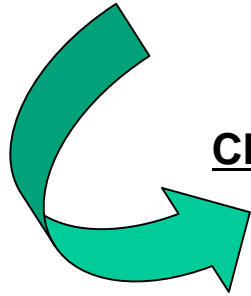
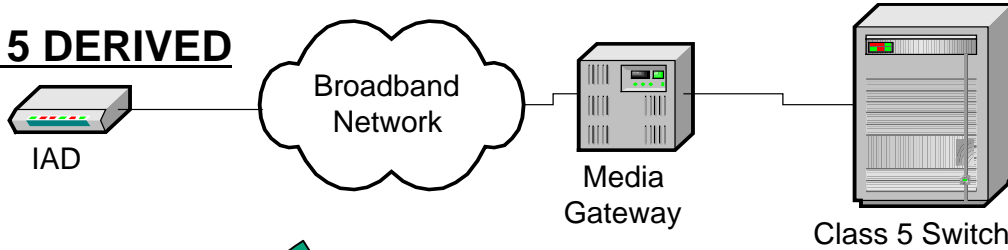
Issues

Maturity of softswitch technology

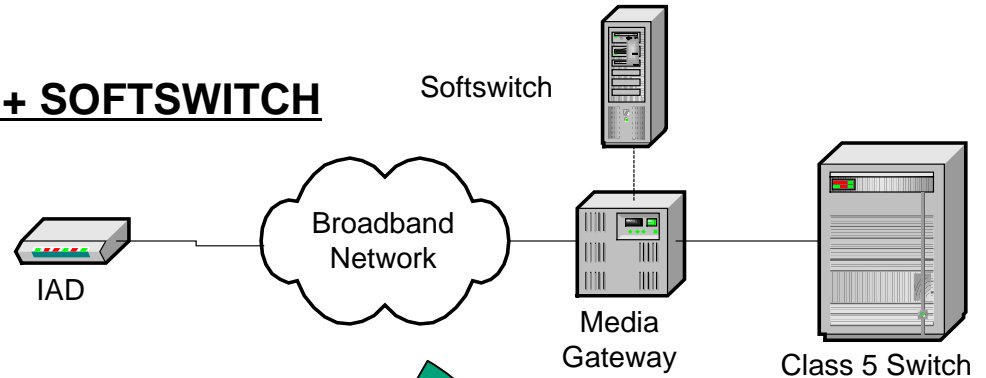
Ability to support all legacy systems supported by a Class 5 switch

Conservative Migration and Evolution

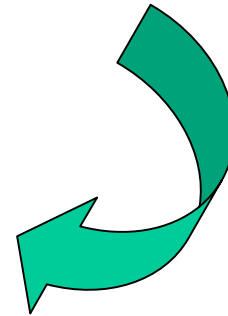
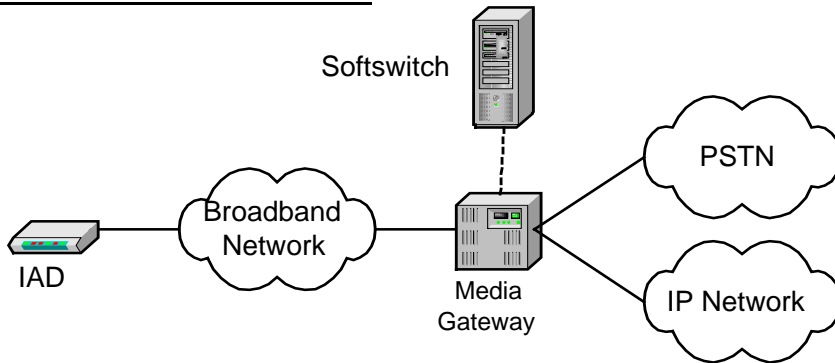
CLASS 5 DERIVED



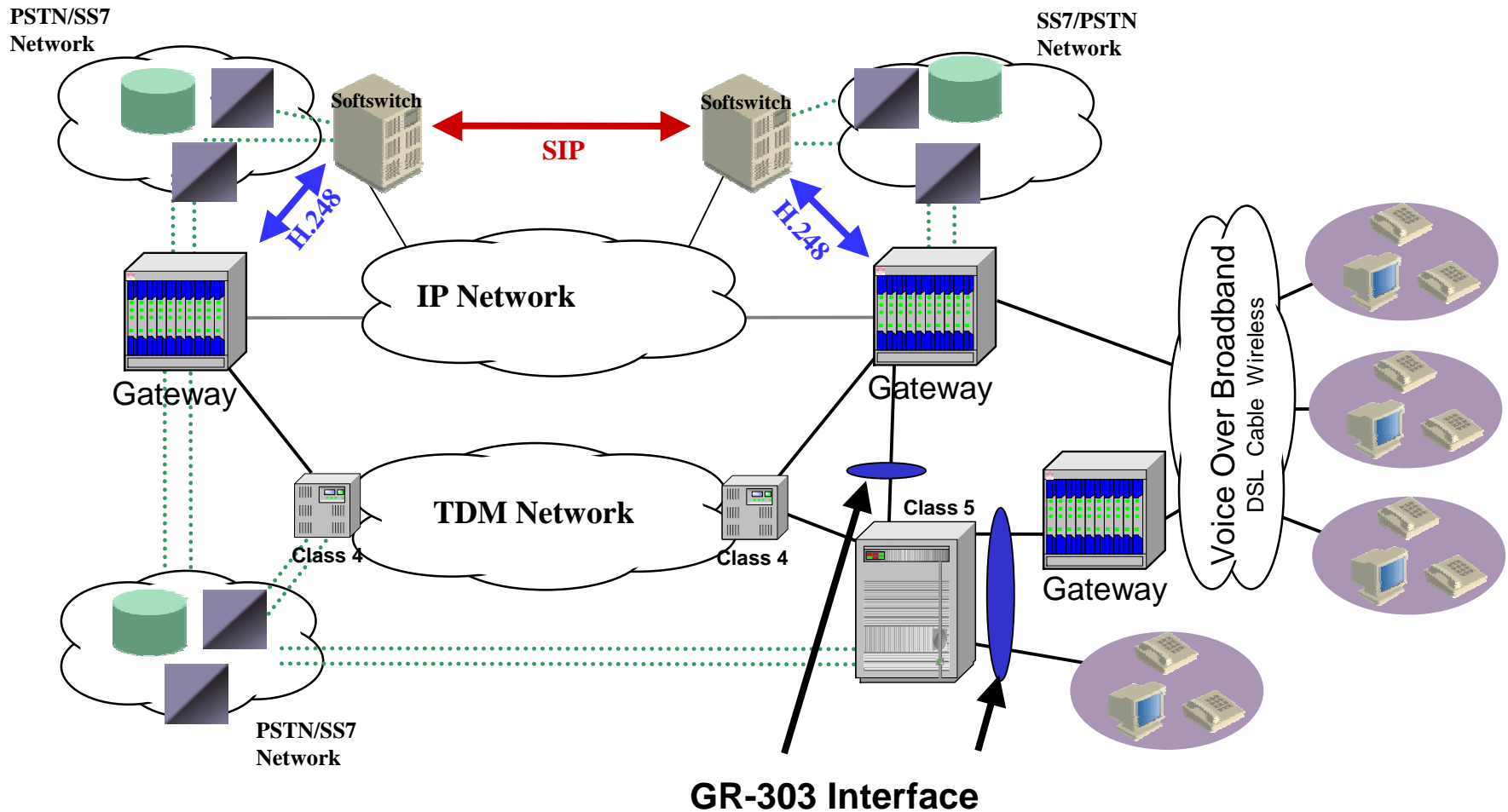
CLASS 5 + SOFTSWITCH



SOFTSWITCH ONLY



Voice over Broadband Network Architecture



The Indian Scene



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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-consulation 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)**

