



Voice Over Internet Protocol (VoIP) Issues and Challenges



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- VoIP Realizations
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Drivers Affecting Network Changes



- Network Simplification
- Lower start-up and operating costs
- Regulations
- Leap frog competition
- Fast service introduction and customization

Service Provider

End User

IP-based Network

Technology

- Lower LD voice service rate
- Multimedia services
- Data traffic exceeds voice traffic
- Corporate Networks

- Improved codec compression techniques
- Faster processing power
- Traffic control mechanism

The telecom network is undergoing extensive changes to meet new market and service demands.

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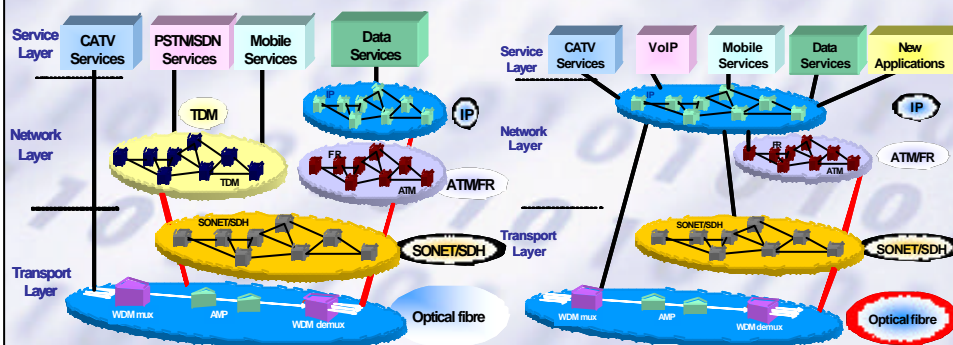


Network Architecture Evolution



Today – Single Service Networks

Future – Multi-Service Networks



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Enters VoIP...What is it?



- Many names, different meaning to different people:
 - Soft-switching
 - Next Generation Voice Network
 - IP Telephony
 - Voice over Internet
 - Voice over Internet Protocol
 - Voice over Packet
 - IP Communications

Various implementations of VoIP systems and user expectations.

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VoIP Network Architecture – 3 Key Functional Elements



Signalling Gateway

- Inter-works with the SS7 network for call control

Media Gateway Controller / Softswitch / Gatekeeper

- Instructs Media Gateways on how to set-up, handle, and terminate individual media flows

Media Gateway (MG)

- Translates between TDM voice and packet data
- Establish media path

- Different signalling and control standards between network elements:
 - H.323, MGCP, IETF Megaco/ITU-T H.248, SIP, SIP-T ...
- Different VoIP realizations and physical architectures

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VoIP Realizations

- PC Applications
- PSTN Bypass
 - Toll
 - Enterprise
 - Broadband VoIP
 - Cable VoIP
- Next Generation Network
 - Circuit-Switch Replacement
 - Service creation and customization

Smart Edge,
Dumb network
(Intelligence in CPE)

+

Smart Network,
Dumb Edge
(Centralized Intelligence)

↓

Smart Network,
Smart Edge
(Distributed Intelligence)


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- Combining network and CPE (edge) intelligence allows service customization and new service revenue
- Varieties of VoIP deployments

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PC Applications – PC to PC (Internet to Internet)



- User
 - Free calls between PCs
 - Low voice quality and reliability
- Technology
 - PC client software (e.g. Microsoft NetMeeting) for voice and multimedia communications between PCs with the same client software
 - VoIP processing performed in PCs
- Network
 - Network traffic carried in public Internet
 - No legacy PSTN

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PSTN Bypass – PC to Phone

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- **User**
 - Voice calls between PC and PSTN phone
 - A fee normally charged
 - Voice quality varies, depending on service provider networks
- **Technology**
 - PC client software
 - VoIP processing performed in PCs
- **Network**
 - Network traffic carried in public Internet or in managed IP network
 - Requires VoIP Gateway to interwork with PSTN

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PSTN Toll Bypass – Phone to Phone

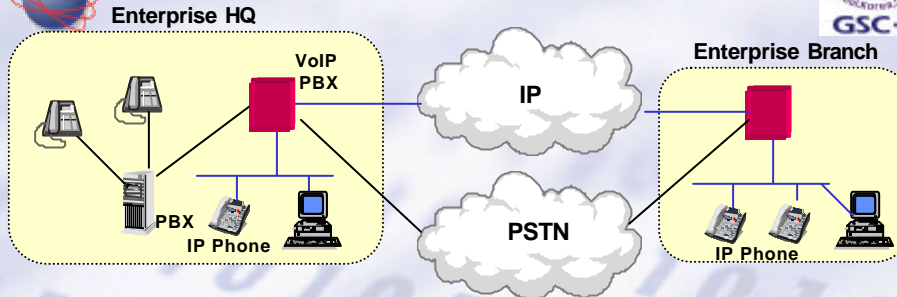
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- **User**
 - Cheaper long distance voice calls via pre-paid calling cards
 - Service offered since 1995 due to high international LD tariff
 - May require to dial up to 24-digits for call establishment
 - Voice quality varies
 - VoIP technology invisible to users
- **Network**
 - Global coverage and interconnection among allied VoIP service providers

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PSTN Bypass – Enterprise IP PBX



- VoIP PBX provides Media Gateway and router functions
- Supports voice and data services
- Voice and data traffic between enterprise sites is carried by the IP network.
- PSTN carries overflow voice traffic and off-net calls
- Well suited for road warriors
 - Access corporate network resources
 - Make VoIP long distance calls on any Internet access to corporate phones or public PSTN phones.

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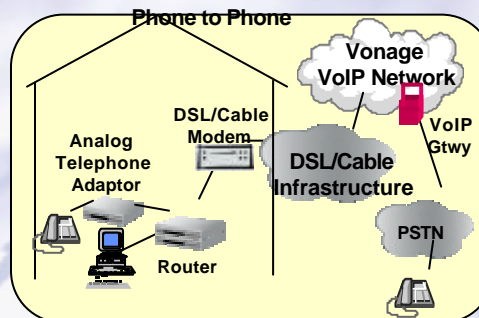
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PSTN Bypass – Broadband VoIP Service Provider



- New breed of VoIP service provider exploiting over providers' broadband access
- User Features:
 - Low local and LD residential rates
 - Free calls to Canada
 - Extensive call feature set
 - Choice of area codes independent of customer location
- Cons to users:
 - Reliability - best effort service
 - Dependent on access provider network reliability
 - Affected by power outage
 - Number Portability
 - 911

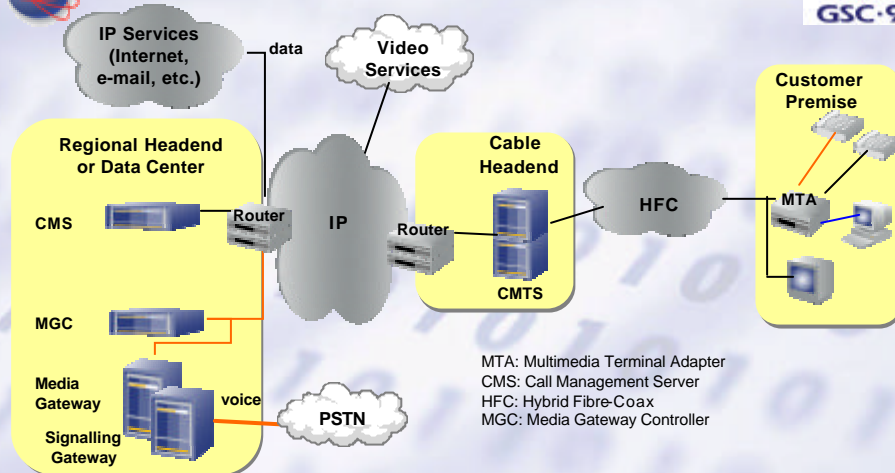


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Cable IP Telephony – Converged IP Architecture



Source: Lemur Networks

Cable Operator implements a single IP infrastructure and offers innovative new services (voice, data, video) to compete with telcos.

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Carrier PSTN Circuit Switch Replacement



- **Business Motivation**
 - New competitive carriers: leap frog incumbent carrier by deploying new packet technology
 - Incumbent carriers: evolve legacy circuit-switched networks to packet-based to reduce cost and compete with new carriers
 - Provides IP Centrex features and service customizations as competitive solution to IP PBX
- **Provides Phone - Phone communication**
 - Users can continue to use traditional voice phone set
 - IP phones are supported in IP Centrex
- **Stringent service and reliability requirements:**
 - Voice quality at least equal to wireless phones
 - Five 9's reliability

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Canadian Carriers and Cable VoIP Service Offering



Some examples....

- **Telus (2003-04)**
 - PSTN toll switch replacement as first step to VoIP migration,
 - IP Centrex (hosted IP services) offering targeting corporate customers
 - A voice-over IP (VoIP) service combining local and long-distance voice with new IP-enabled features.
- **Bell (2003-04)**
 - Provides IP Centrex features
 - Focus on service creation, customization, and integration
 - PSTN switch replacement in future
- **Rogers Cable (planned 2005)**
 - Full VoIP phone services offering, including 911
 - In direct competition with the telcos
- **Shaw Cable**
 - Filed for CLEC status

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Broadband Service Provider Offering



- **Vonage (2003-4)**
 - Vonage offers virtual second lines with Toronto area codes to customers with US billing addresses
 - Allows people in Toronto to call a Vonage customer's Toronto number without incurring long distance charges
 - Vonage started offering Canadians the same service it offers Americans in April 2004
 - Partnering with a Canadian CLEC who provides Canadian phone numbers and interconnection with the PSTN
- **Primus (2004)**
 - Partnering with a Canadian CLEC to offer VoIP Talk-Broadband™ service (PC-to- Phone)
 - Similar service offerings as Vonage

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Technical Challenges



- **Interoperability is the primary hurdle**
 - Interworking of VoIP islands
 - The default (and less efficient) inter-connection is legacy PSTN/TDM
- **Voice quality depends on engineering of managed IP network**
- **VoIP network security mechanism and implementation**
- **Lawful interception**
- **Local powering or network powering in case of power outages**
- **911**
- **Exhaustion of phone numbers**

Technical challenges and their solutions closely linked to policies and regulations.

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Policy and Regulation – Technical Issues



- **Interconnection architecture and tariff between IXC and IP CLEC**
 - Current definitions under the CRTC Telecom Decision are based on TDM switch technology. These definitions affect VoIP interconnection arrangements and the associated tariff.
 - On April 7, 2004, the CRTC initiated proceeding on VoIP Services and issued a preliminary view (CRTC 2004-2)

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Policy and Regulation – Technical Issues



- Interconnection architecture and tariff between IXC and IP CLEC (cont'd)
 - No agreement reached in CRTC on interconnection due to different views on the definition of “end-office” and “access tandem” under the IP network architecture:
 - Is Media Gateway an end-office?
 - Is the Media Gateway Controller an Access Tandem?
 - Is the Media Gateway Controller an end-office while the Media Gateways it controls are “remotes”?

Need to develop new technology independent definitions for End-Office and Access Tandem to accommodate VoIP networks.

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Policy and Regulation – Competitive Issues



- Overall impact on competition is still impossible to predict
 - Would greater competition through VoIP lead to deregulation, or require greater regulation?
 - Will a major overhaul of competitive framework be required?
- Should telephony services be regulated differently due to different technologies used?
 - TDM
 - VoIP as PSTN replacement
 - VoIP offered by ISPs
 - Cable Telephony
- Access charges for VoIP service providers
- Unbundling of access and network services:
 - Should competitive access be provided to choose VoIP service providers via Packer Cable or DSL access?

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Policy and Regulations – Consumers/Social Issues



- **Should VoIP have QoS or Grade of Service guarantee?**
- **E911 obligations**
- **Powering of CPE**
- **Universality of voice services expectations for VoIP?**
 - Carriers
 - ISPs
- **Lawful Intercept requirement: does it apply to all forms of VoIP architectures?**
- **Number Portability obligations**
- **Consumer education on limitations of VoIP**
 - VoIP service providers should specify VoIP technology limitations, e.g. No 911, no power outage protection, reliability not guaranteed, no number portability, etc.

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Thank You

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