

Voice over IP and the Modern Web

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Outline

- Historical Overview
- Internet Telephony
- VoIP Service Providers and their Business Models
- Crucial Issues
- New Approaches

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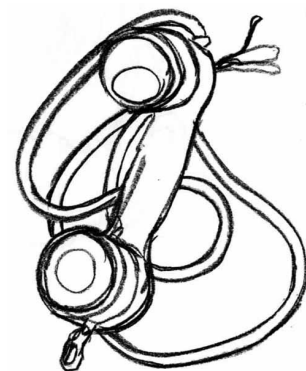
Historical Overview



- 7th March 1876, Alexander Graham Bell: U.S. Patent Number 174,465 covering "the method of, and apparatus for, transmitting vocal or other sounds telegraphically ... by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sound", the telephone.

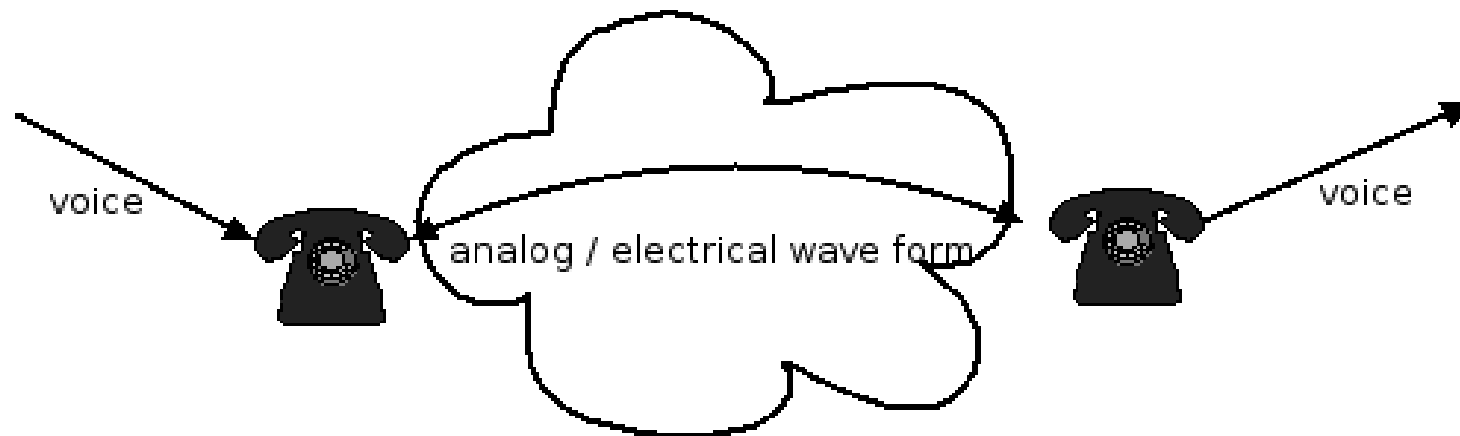
Historical Overview (cont'd)

- **until today:** voice carried by analog wave signal
- **early 1950s:** introduction of technology that converted speech into digital signals (T1 / E1 lines)
- **TDM:** placing multiple calls on the T1 line
- **since 1970:** increasing use of Packet networks for transmitting data
- **early 1990s:** introduction of fundamental technologies allowing initial efforts in VoIP



From circuit-switched to packet-switched voice networks

■ Analog networks:

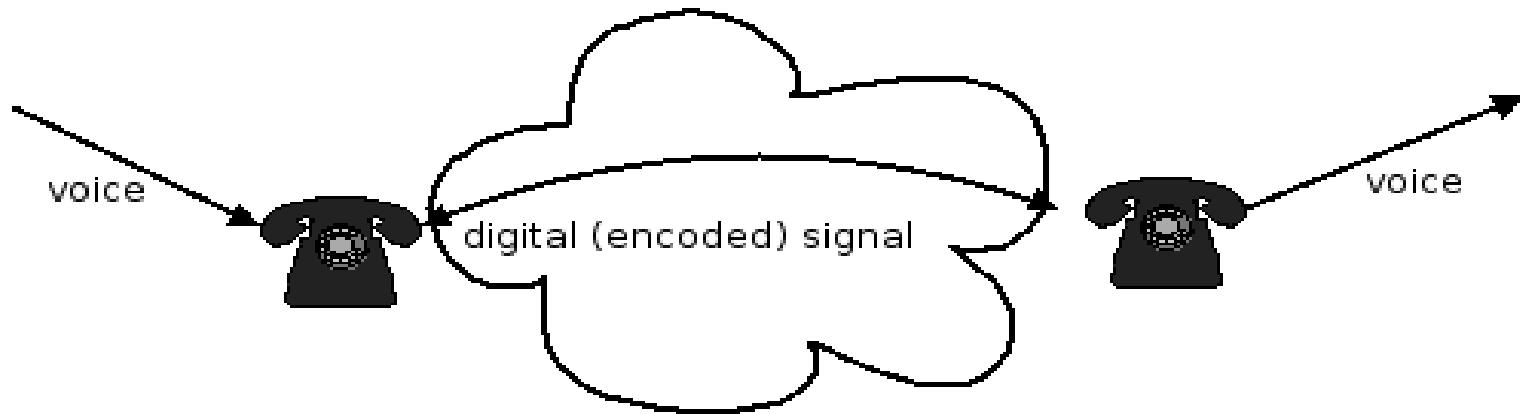


■ Problems:

- ❑ Noise increasing with distance
- ❑ After WWII bigger demand of communications

From circuit-switched to packet-switched voice networks (cont'd)

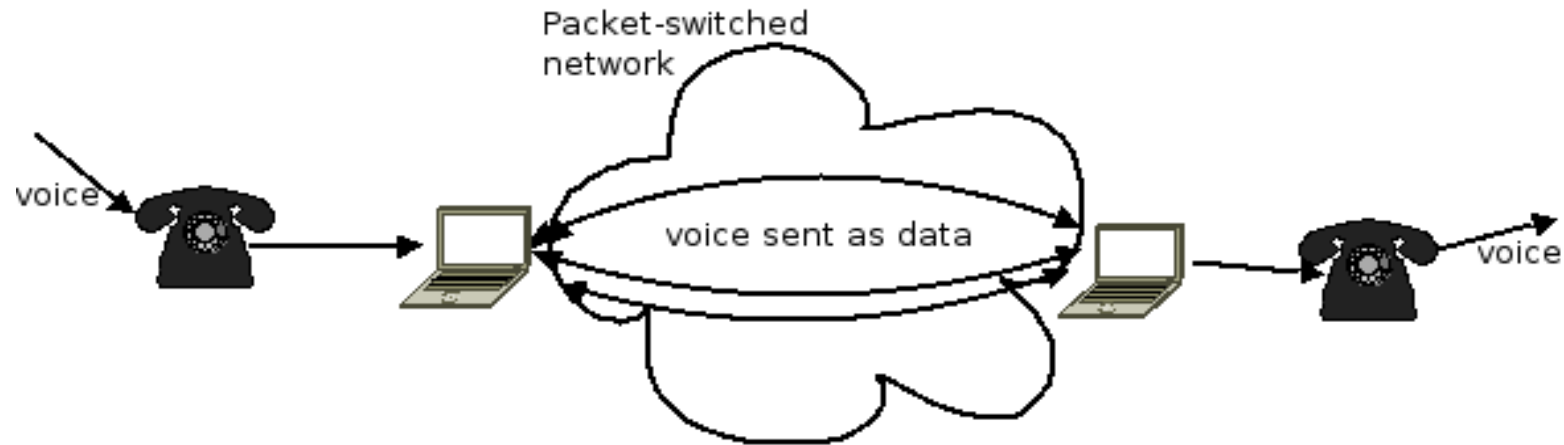
- Digital networks:



- Elimination of impact of distances
- Digital 'repeaters' regenerate 0's and 1's

From circuit-switched to packet-switched voice networks (cont'd)

- Packet networks:



- Solving limitations of TDM
- Voice sent over different routers
- Only necessary bandwidth used
- Simplification of management – fewer networks

Problems of traditional Phones

- implementation of new features (e.g. caller id)
- reprogramming of complex switches
- usage of unnecessary bandwidth



Advantages of traditional Phones

- high reliability (the five 9s – 99,999% uptime)
- 64 kbit/s devoted to a single call
(cellular – 10-15 kbit/s)

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Internet Telephony (Definition)

- **Internet Telephony or Voice over IP** is the process of routing of voice conversations through the Internet or any other IP-based network
- **Today's Internet:**
 - Convergence of data, voice and video using IP-based networks
 - Advanced services at lower cost

VoIP Pros

- Easy to add new features
- Access to different routers of the network
- Usage only of necessary bandwidth
- Voice and data carried over one network – less management issues
- Integration of voice services into new media
- Decreasing costs and increasing revenue
- IP topology: any node can act as a server
- Maintaining a single, unified telecom network

Disadvantages of Voice over IP

- Reliability: most VoIP providers cannot guarantee even three 9s (99,9% uptime) => QoS
- The signal goes through various cables, wires, routers
- Missing regulations
- Connectivity between VoIP networks and other VoIP networks / circuit-switched networks
- Emergency numbers access

Voice over IP – the technology

- Based on various protocols:
 - Two major standards:
 - H.323 (ITU)
 - SIP (IETF)
 - H.323 is using existing standards
 - derived from PSTN, ISDN model (same message sequences), TDM established model
 - protocol stack
 - SIP being the 'virtual dial tone'
 - method-based protocol, roots in HTTP
 - better NAT and firewall traversal



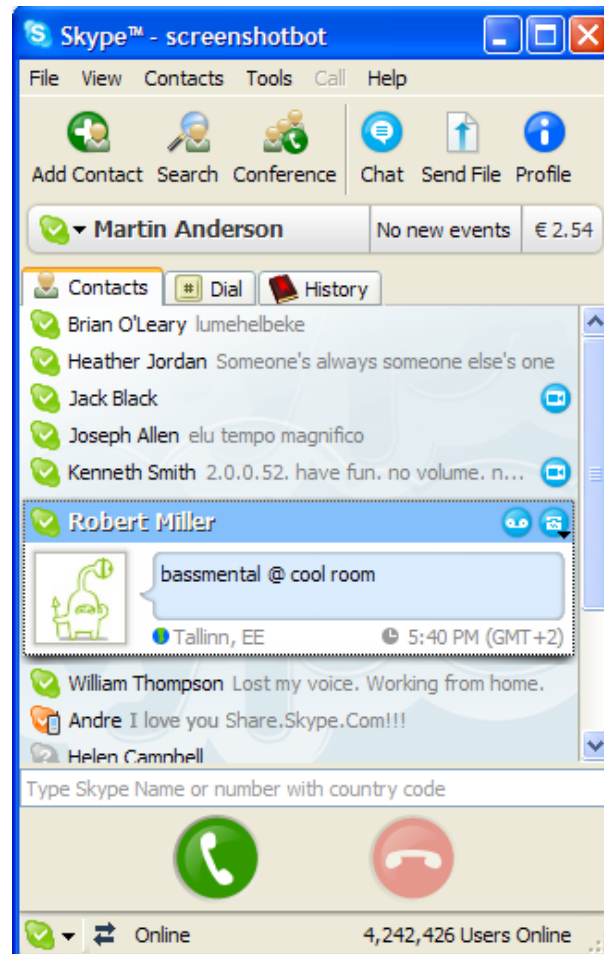
Voice over IP – the numbers

- 286 909 716 downloads of Skype (as of 1st Dec)
- more than 100 000 000 registered users (Skype)
- In the USA (source: IEEE Spectrum, 2005):
 - more than 400 VoIP service providers
 - around 1 Mil. out of 106 Mil. households using VoIP
 - 50% of the Market being held by Vonage & Cablevision
 - Revenue 2005: \$2,5 Bil.
 - Estimated for 2009:
 - 12 Mil. households will be using VoIP instead of conventional telephony
 - \$21 Bil. revenue only in the USA

Outline

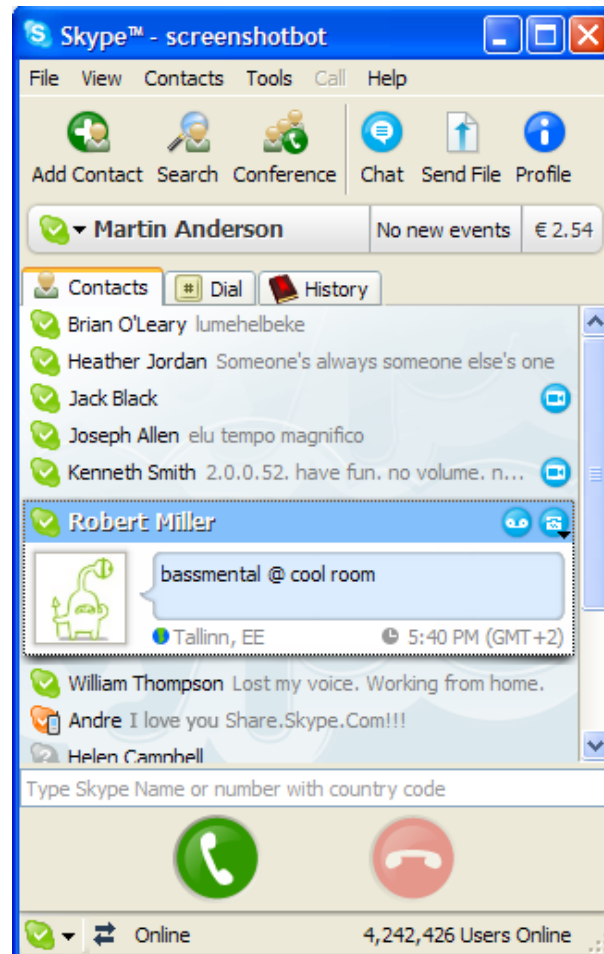
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Voice over IP – the services



- Free PC-to-PC video & voice calls
- Free IM
- SkypeOut, SkypeIn
- Other paid services:
 - voicemail
 - sms
 - call forwarding
 - ringtones

Voice over IP – the services



- Windows, Mac and Linux versions
- Skype for mobile devices
- Skype for Business
- various community-driven extras
- Free calls plan for North American users only

Voice over IP – the services



- Free PC-to-PC calls
- Free IM
- All Calls Free Plan
- Free Mobile phone and Landline Conference Calling
- Paid CallIn/CallOut
- Connectivity with other SIP based networks



Voice over IP – the services



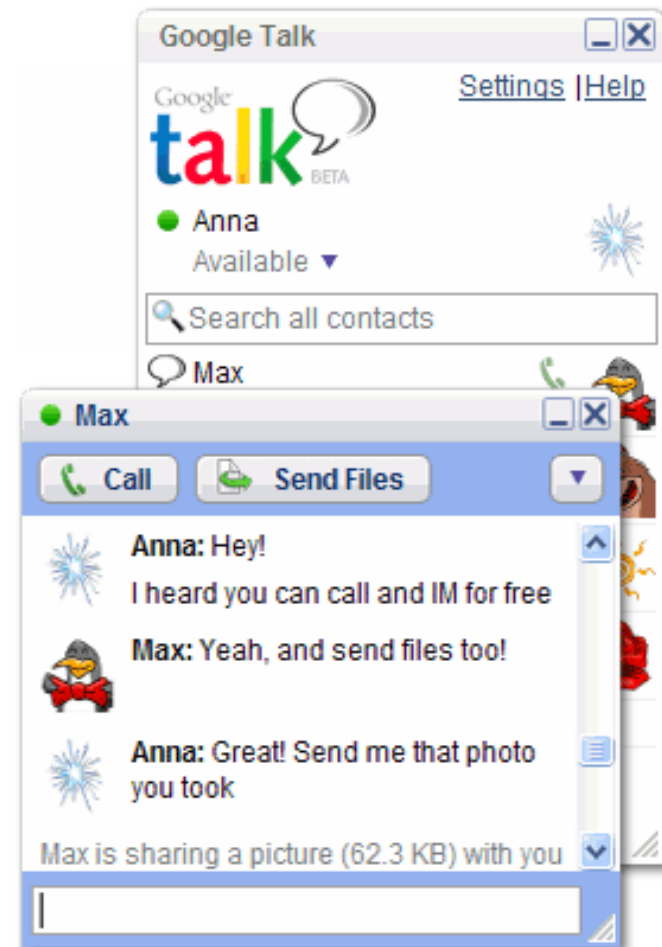
- Call Recording
- Calling some USA university networks for free
- Asterisk PBX Support
- Access numbers
- SIP adapters



Voice over IP – the services



- Integration of e-mail, IM and call service
- Only PC-to-PC calls
- File transfer opportunity
- Connectivity with Gizmo (IM)
- Expected connectivity with Skype



Voice over IP – the services



- offered in the USA and Canada
- all-inclusive phone service using existing internet connection
- Free calls to Europe
- Voicemail, Caller id, 911 Dialing, 3-Way calling
- Area Code selection
- Click-to-call service

Voice over IP – the services

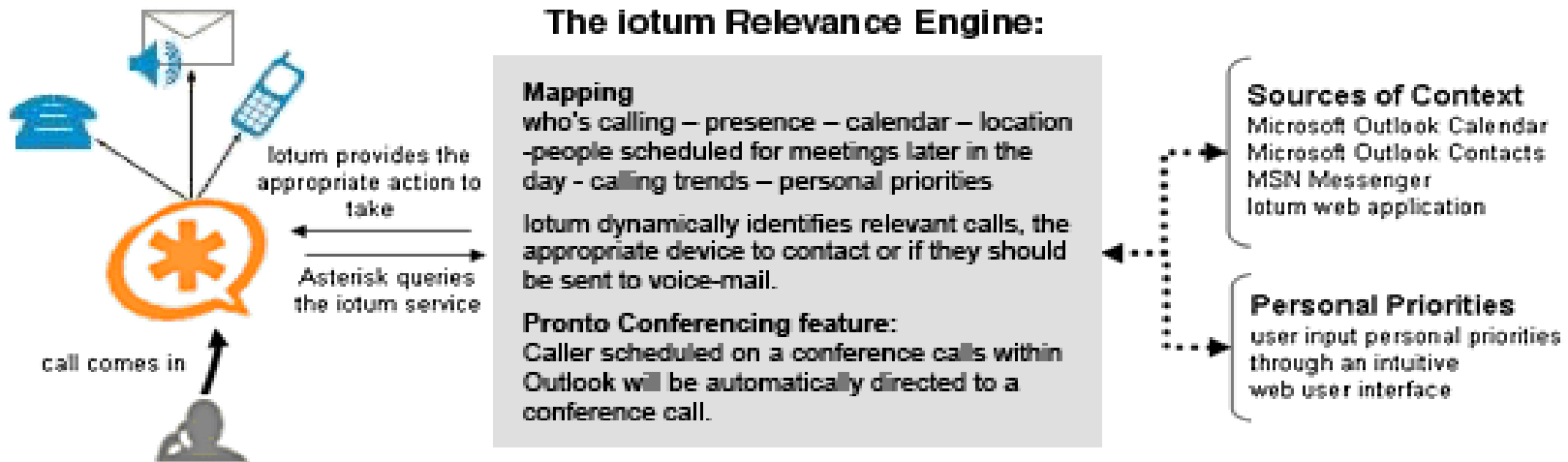


- PBX as a software
- Integrates Voice over IP protocols and services
- Provides interoperability among all standards-based telephony equipment
- Provides the hardware and software

Voice over IP – the services



- Web 2.0 call management application that utilizes the user's context information - who is calling and what the user is currently doing - and preferences to know which calls are important and which can wait.



Business Models

- The main question:

Who (if anyone) gets paid for VoIP?

- ❑ The real problem (and expense) of VoIP – the last few kilometers
- ❑ Local telephone companies are paid to ring the phone and complete the call
- ❑ Therefore: same rate for everyone, no matter if he lives next door or 5000 km away



Business Models (cont'd)

- Providers buy minutes from local phone companies:
 - about 1ct/min. at wholesale level
 - prepaid minute packages to be used over a period of time
- VoIP providers distribute to users:
 - minute packages
 - unlimited calls (flatrate) [monthly fee]
 - RNK Telecom: lifetime VoIP calls for one-time fee (\$999)

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Quality of Service

- Fundamental concern: voice quality
- Three main worries
 - Latency – packets delivered too slowly (network congestion)
 - Jitter – arrival time of packets
 - Packet loss – packets do not arrive / are dropped
- All this leads to silences, echoes, odd sound effects
- Voice codecs tolerant to packet loss, but above 2% to 5% => effect on quality
- Delay more than 150ms => strain of natural communication

Quality of Service (cont'd)

- Solutions:
 - jitter buffer
 - guarantee minimum bandwidth (MPLS, RSVP)
 - give priorities to ensure congestions affect other apps than VoIP (TOS) => Problem: network neutrality

Reliability and Emergency calls

■ Reliability:

- ❑ what happens when a power outage occurs?
 - use UPS
 - even PSTN have outages
 - 9/11 – VoIP 'survives' the crash, destroyed central plant of Verizon – no traditional voice communications

■ Emergency calls

- ❑ conventional phones: phone location sent to emergency personal
- ❑ 911, 112 – where to forward the call?



Connectivity with other services

- Until now no real connectivity between IP based services
 - No APIs in most applications
 - Connectivity not wanted (Skype)
 - Google deal with Ebay for connecting Google Talk and Skype
 - SIP Protocol and Jabber Protocol users – better connectivity
- IP – PSTN: good connectivity
- No integration into global telephone system

Security

- IP network – potentially intercept packets
- „It was always possible to tap a phone call, but you had to tap a physical line“
 - Jim Su (senior product marketing manager at Avaya)
- In fact: IP telephony more secure than traditional
- Cryptography (even in free services) – probabilistically impossible to hear the phone call



Network neutrality

- „If I pay to connect to the net with a given quality of service, and you pay to connect to the net with the same or higher quality of service, then you and I can communicate across the net, with that quality of service“
- Tim Berners-Lee

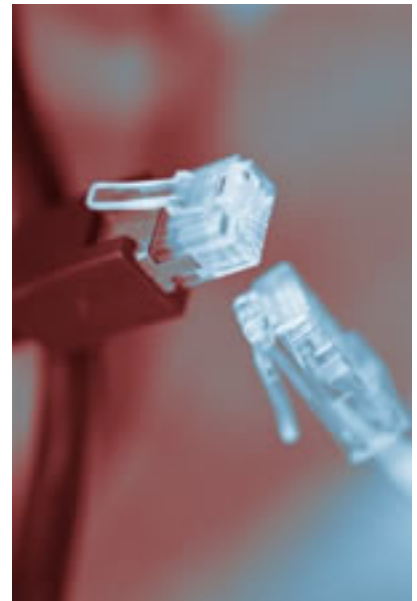


Network neutrality (cont'd)

- „...messages received from any individual, company, or corporation, or from any telegraph lines connecting with this line at either of its termini, shall be impartially transmitted in the order of their reception, excepting that the dispatches of the government shall have priority.“
 - An act to facilitate communication between the Atlantic and Pacific states by electric telegraph., June 16, 1860

Network neutrality and VoIP

- Traditional phone companies affected by VoIP. How do they survive in the new setting?
- Unequal competition when there is no neutral network – pay to have your service prioritized
- Filtering content (e.g. China)
- Ban of VoIP calls



Regulations

- Are regulations needed?



Regulations

- Are regulations needed?
- Universities banning Skype
 - Reasons
 - Usage of a 'grid-computing' like schema
 - 'Supernode' functionality – relay calls through your computer – p2p driven
 - Skype wants 'general usage rights' of network that might not belong to the Skype user

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The future of Voice over IP

- VoIP and Web 2.0
- Voice communications turn into multimedia, real-time communications
 - IM
 - desktop sharing
- Mash-up of voice and web content

VoIP and Web 2.0

- Web 2.0: it's all about collaboration, social networking
- Communications essential part of social life
- VoIP as a tool for podcasting
- Click-to-call features in websites
- Flash integration of VoIP
- Embedded VoIP: Livejournal and Gizmo
- Online Games
- Directories based on contact sharing



Real-time multimedia communication

- Providing Internet Telephony allows integration of existing online communication channels:
 - Instant Messaging can be used for presence handling/availability information, solving problems of unavailable called person
 - Desktop sharing for educational or business purposes
 - Conference calls for making real-time e-Learning

Semantic Web

- Semantic Web is referred to as Web 3.0
- Allows communication between machines
- Connection with VoIP
 - XML based APIs
 - access presence
 - initiate, accept, redirect calls (useful for example for call centres)
 - automatic processing of that information

Wireless Internet Telephony

- First steps already done
- **Paradox:**
„Today communications can offer seamless handover between cellular and WiFi, but not between WiFi and WiFi hotspots“
 - Henrik Levkowetz (software developer ipUnplugged)
- Real problem: how to move from one ISPs hotspot to another? How do I transfer the session?
- Billing issues



Summary and conclusions

- Voice over IP – disruptive technology
- Different services and business models possible
- Regulations are needed, but to what extend
- Conventional telephone companies need to change
- Data and voice over one network, integration of communication into multimedia
- Many implementation challenges

Questions?



Thank you for your attention!

