IP Telephony

Operator Framework

Technology Framework

Quality of Voice over IP

Threats and Opportunities

Raimo.Kantola@hut.fi

http://keskus.hut.fi/tutkimus/ipana/paperit

Conclusions

- IP Telephony together with growth of Internet drive Integration of IP to ISDN/PSTN/GSM networks
- IP telephony introduces a rich set of new attractive services
- Collision of IP and Telephony is a major technology and market shift and creates industry upheaval among operators and vendors

Operator's Competitive Advantage is a three legged stool

Operator's KSFs are the customer relationship, service session control and network coverage
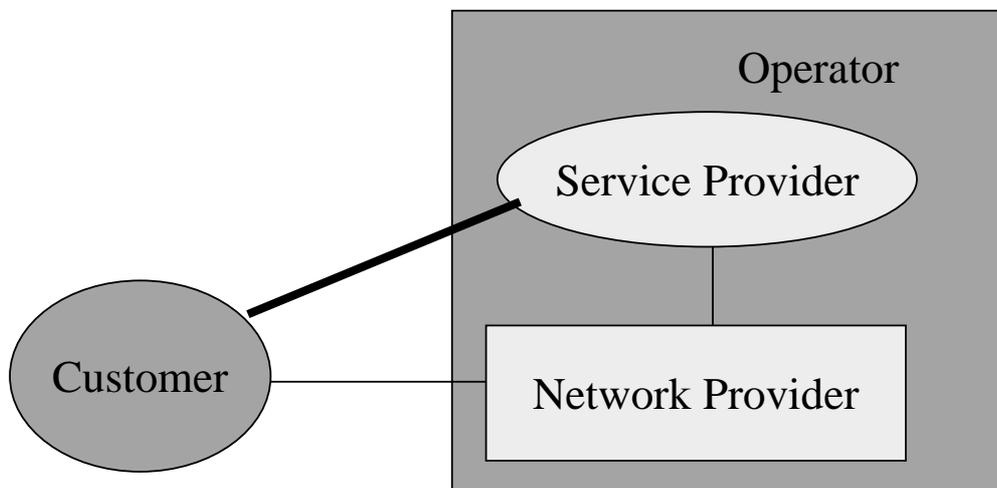
Key Issues to an Operator in IP Telephony are

- Is it a threat to Key Success Factors?
- How to balance SP vs. NP functions?
- When is the right time-to-market?
- How does IP Telephony/IP Voice influence revenues?
- How to build a Quality Offering?

Network Development, Architecture and Standards form the Technology Framework

- Is IP Telephony on the Technology trend or does it make you loose focus?
- How does Network Architecture change?
- How does Service Architecture change?
- What are the key standards?

Data traffic overtakes voice. The future WAN is optimized for Data not Voice.
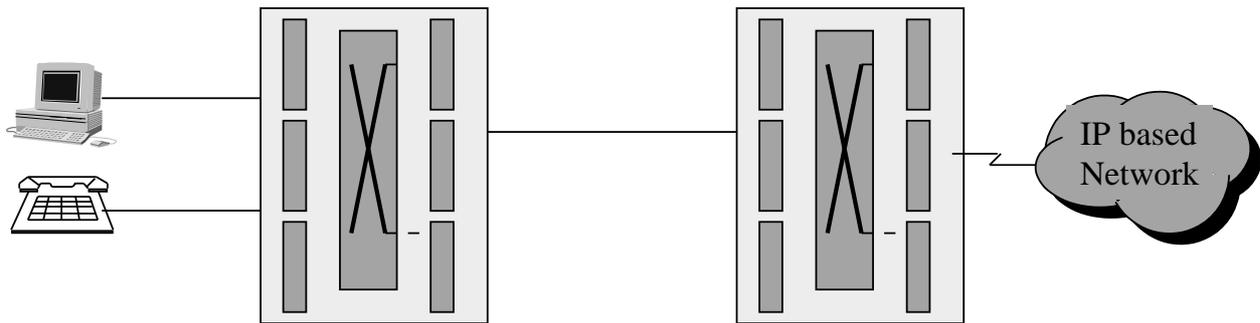


Packetization point moves closer to the customer

- We move from Circuit Switching to Packet Switching
- Starting point for building the future Packet Net is the Internet
- Each deployment step pays for itself.

IP Telephony is like a Moon Rocket

(analogy by Tom Evslin, ITXC)

Rich Service set

Engineering Economics
- compression, innovation

International Calling based on Arbitrage
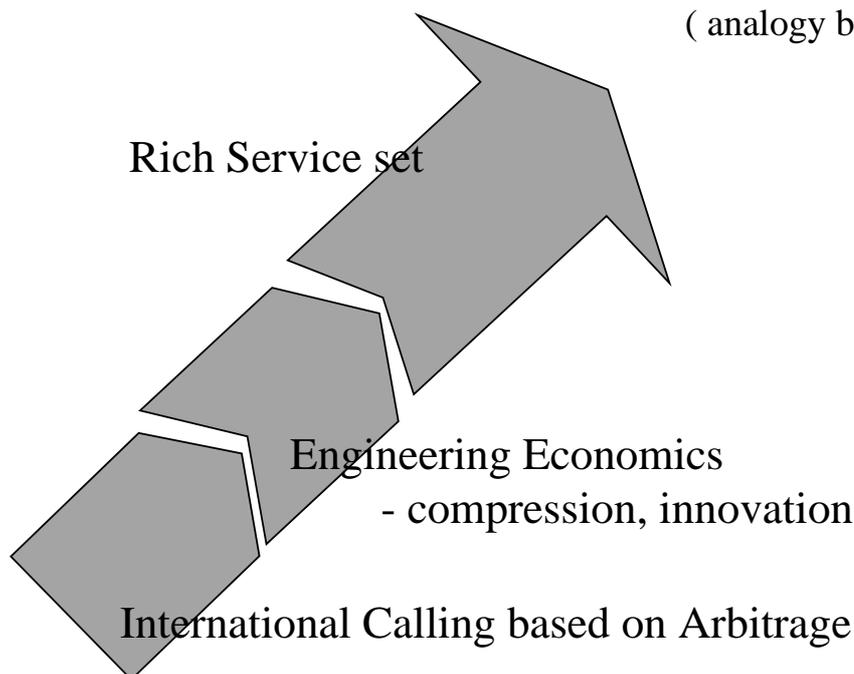
Network turns Broadband

Integration of Voice
to Data networks

SDH, WDM

Corporate
network

Backbone

Access

xDSL
CATV modems
(ATM)
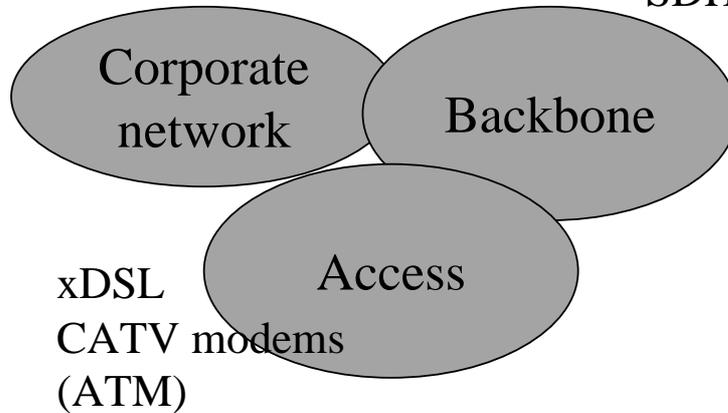
IP Voice and IP Telephony accelerate the development!

By Service Architecture Development Operators pursue Service Differentiation

Top-down

TINA,
ATM

Internet/
ISDN
Conversion

Intelligent
Network

Bottom-up

PSTN
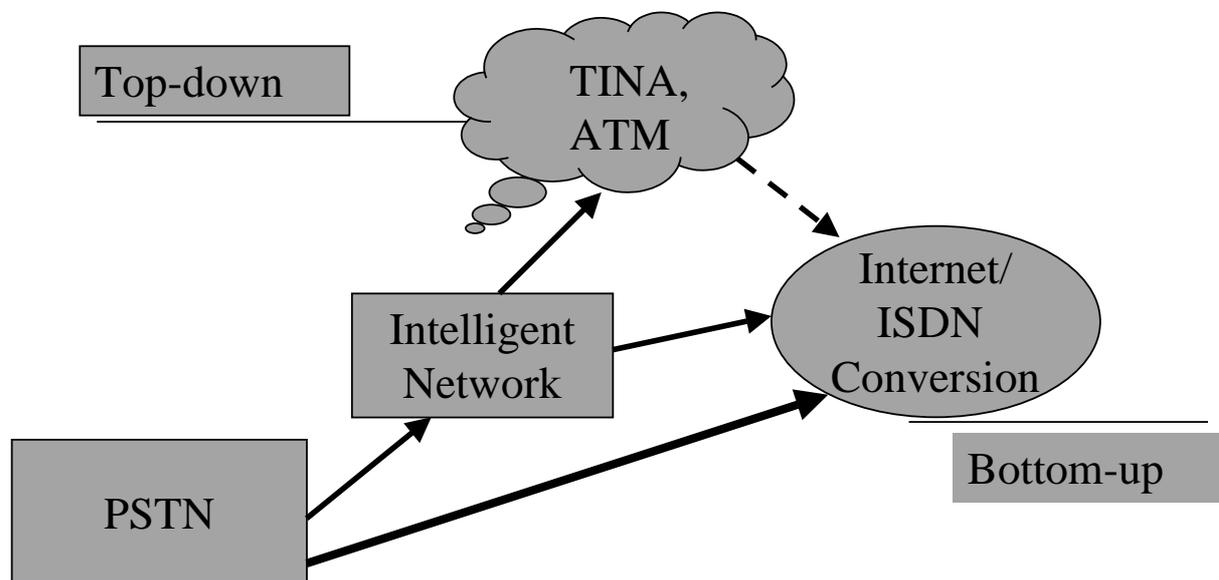
IP Telephony Standardisation takes place on many fora

- ITU-T - H.3xx protocols
- ETSI - TIPHON project - Telecommunications and Internet Protocol Harmonisation over Networks
- MMUSIC - WG of the IETF (Multiparty Multimedia Session Control)
- PINT and IPTEL - WGs of the IETF
- VOIP - Voice over IP by IMTC - Int'l Multimedia Teleconferencing Consortium

TIPHON Specifies four Service Scenarios

Phase 1: IP Terminal initiated Call

IP based Network — Gateway — PSTN/ISDN GSM — E.164 numbering

Phase 2: PSTN/ISDN/GSM initiated Call

E.164 numbering — ISDN GSM — Gate-way — IP based Network — Gate-way — ISDN GSM — E.164 numbering

Phase3: IP transit Calling

Phase 4: PSTN transit Calling
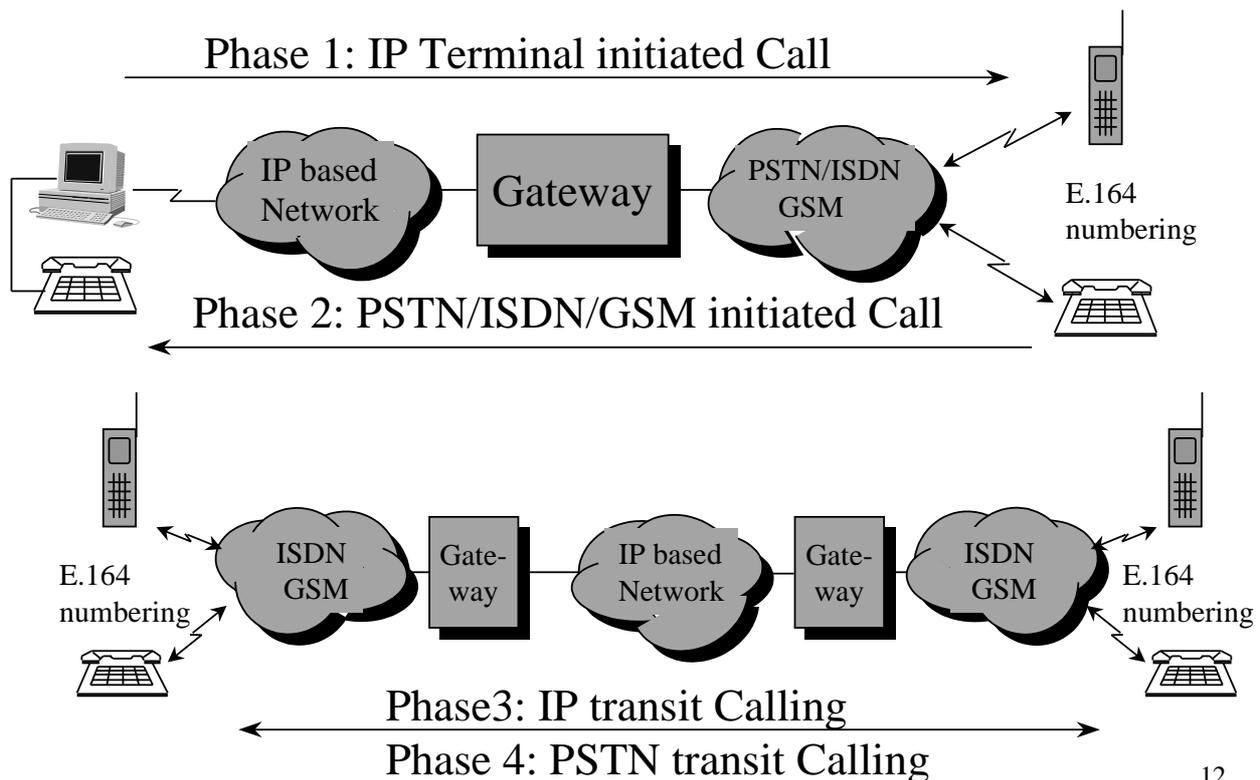
Gatekeepers and Gateways are key components for Interworking

Interworking Functions
- Gate-keeper
- Gate-way

Intranet — H.323 —

UNI-DSS1

ISDN

PSTN

NNI

NNI

Internet — H.323 —

Interworking Functions
- Gate-keeper
- Gate-way

NNI

GSM
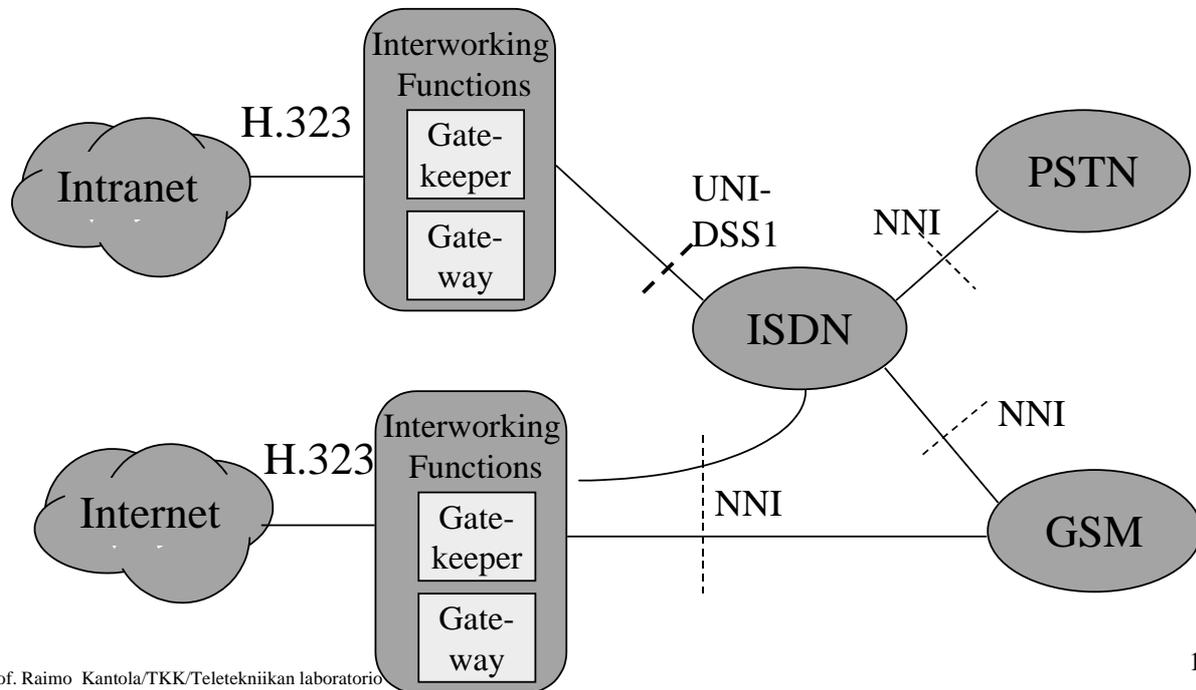
SIP - Session Initiation Protocol competes with H.323

Redirect Server

Proxy server

Client

User Agent
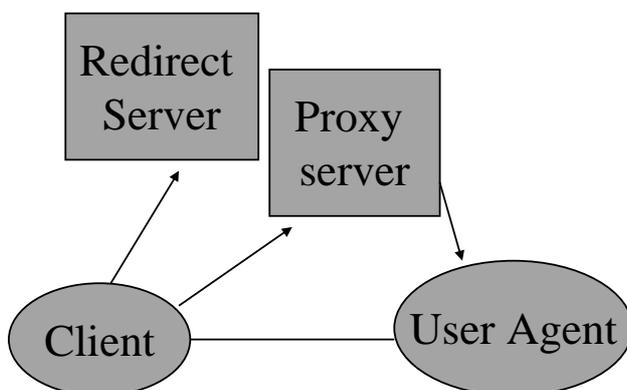
- SIP comes from MMUSIC/IETF
- SIP is based on HTML/HTTP
- SIP is open and modular
- SIP is designed for the Global Internet

# PINT - IETF:n WG integrates WWW with Voice Services

Click-to-dial, Click-to-fax
Click-to-fax-back,
Voice-access-to-content

Internet

Content Provider's
WEB-Server

SSTP - Service Support Transfer Protocol

SN or SCP

SMS

SSP-
Service Switching
Point

PSTN/ISDN subscriber

GSM subscriber
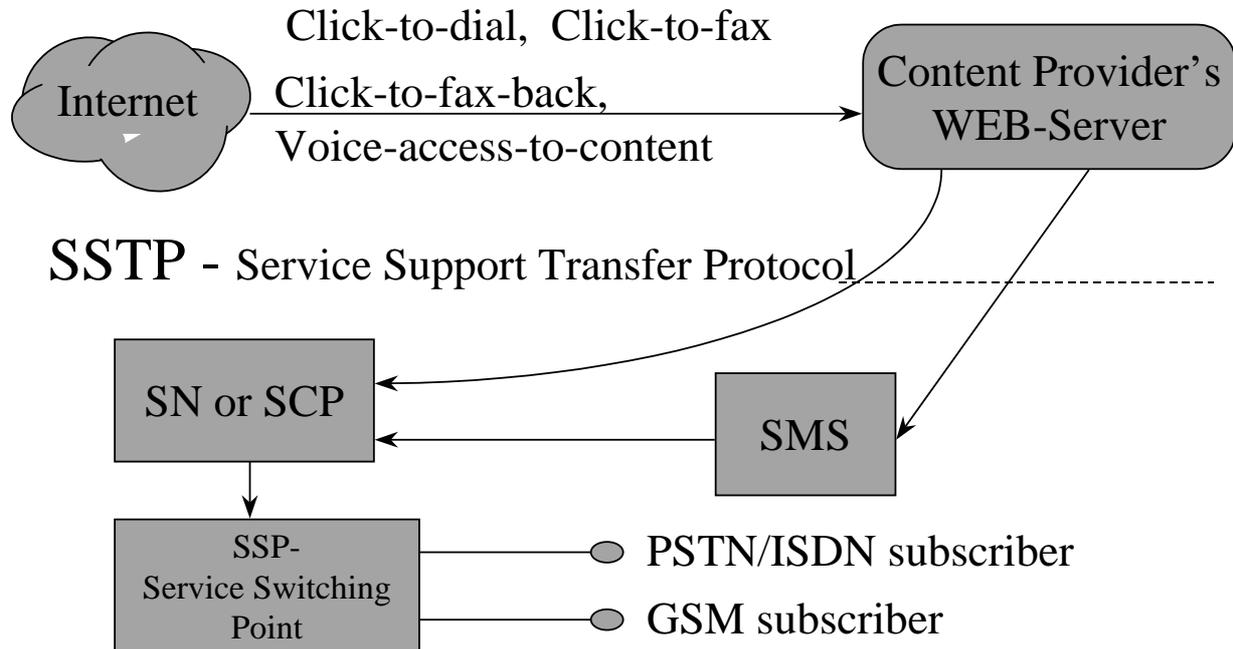
SCTP - Simple Computer-Telephony Protocol is the CTI initiative

Client

Internet

Server

lines
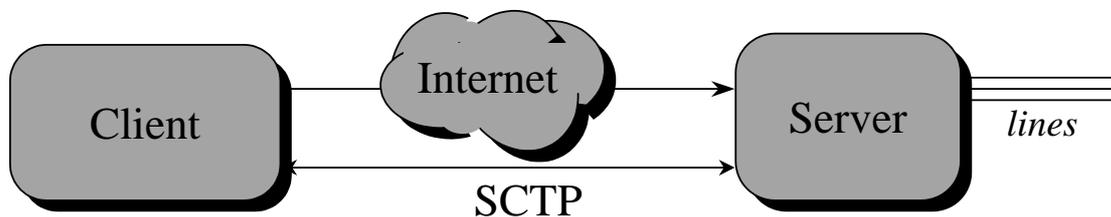
SCTP

- SCTP runs on TCP/IP:n and is based on HTTP/HTML
- Includes first and third party services
- SCTP can manage Voice Mail
- Users can manage their Service profiles
- Targets Corporate Call Centers

IP Voice in Ethernet - Delay is in the Workstation!

Function Generator

Delay meter

ETHERNET

Voice receiver
- SUN Ultra
- Nevot
- Nevot debug
- RTP dump

Voice sender
- SUN Ultra
- Nevot

RADCOM LAN analyzer
- analysis
- load generator

→ **Receiver timestamps**
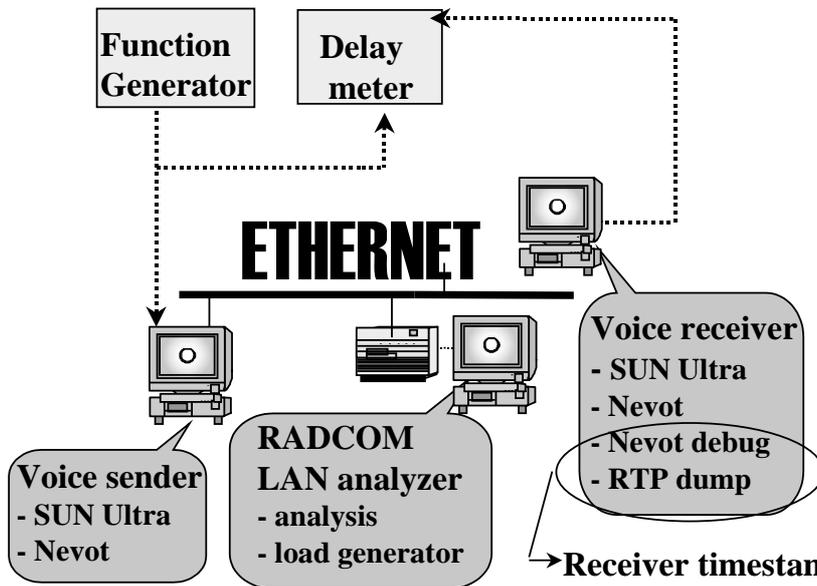
- **Terminal delay:**

	Delay
HW	8.9 ms
VoIP Client	103.9 ms

- **End-to-end delay**

Packet lenght	Delay
0.02 s	104.5 ms

Difference=Network Delay!

VoIP over IP switching

•**End-to-end delay**
> **IP forwarding 116,2 ms**
> **IP switching 113,8 ms**
- **Network (ping)**
> **both 1-2 ms**

10BaseT   **ATM 155Mbit/s**

IP Switch Gateway

ATM Switch

- flood ping
- kilent-server 4

Voice sender
- SUN Workstation
- Nevot

IP switch processor

Voice receiver
- SUN Workstation
- Nevot
- Nevot debug
- RTP dump

Delay meter

→ **Receiver timestamps**
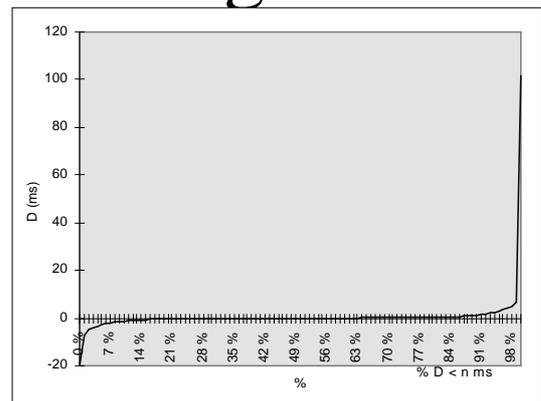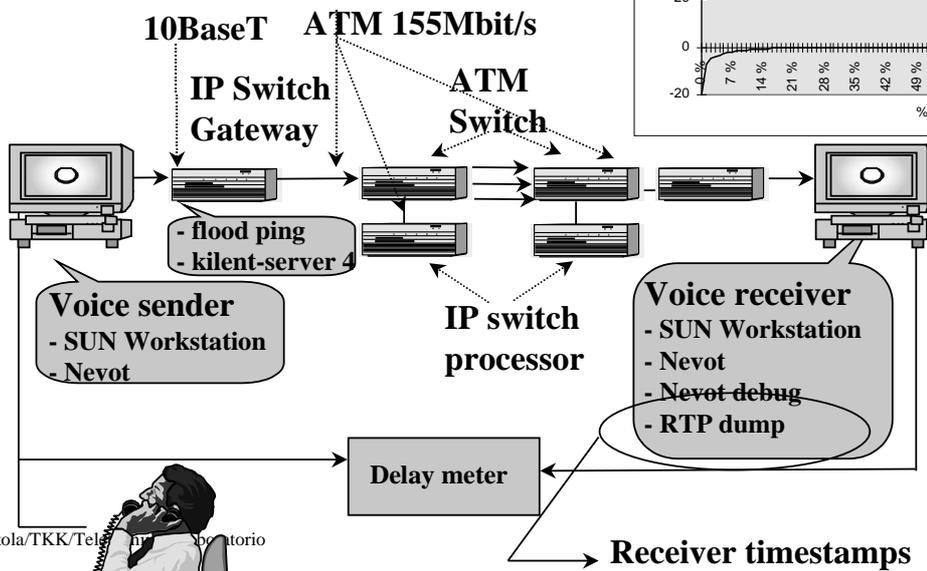
Packet spacing difference in a Campus Network
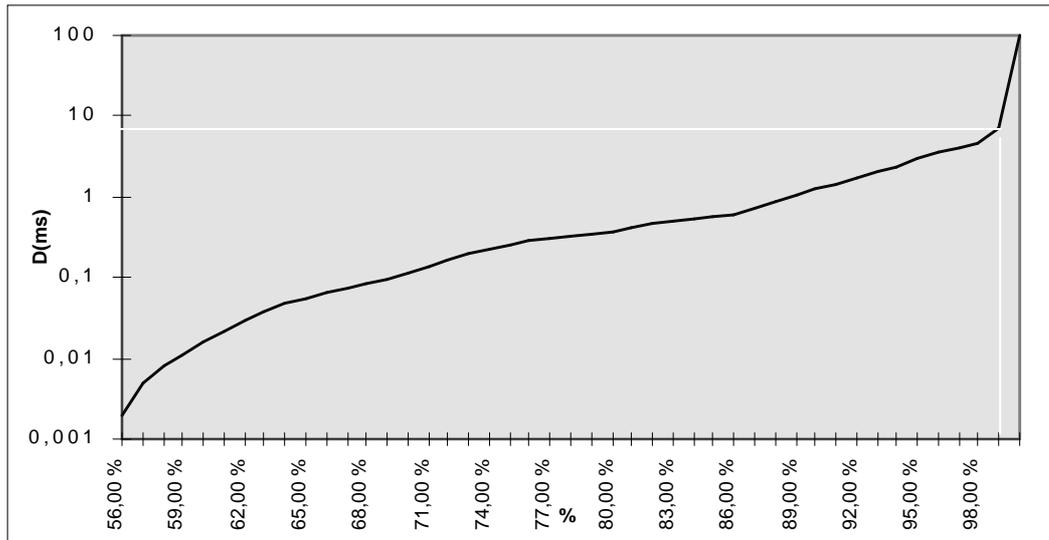
- Lack of Bandwidth, congested routes, lack of a reasonable usage based charging model are key problems in the global Internet for IP Voice.


Packet loss rates of up-to 15-20% can be tolerated without degradation in voice quality

- Counter measures to loss include
  - *Receiver only methods* Silence / white noice substitution or repeating the last packet content (small packets & little loss)
  - *Redundant (linear predictive) coding* for high loss and longer packets (> 40ms)

Key Issue to the future of IP Voice is QoS support

WWW Voice

IP

Differentiated Services

Physical layer (SDH…)

QoS routing is an open issue!

QoS -at the Link layer simplifies the Network!

- Quality requires usage based billing.

- QoS support -->
  IP Voice can share Internet resources
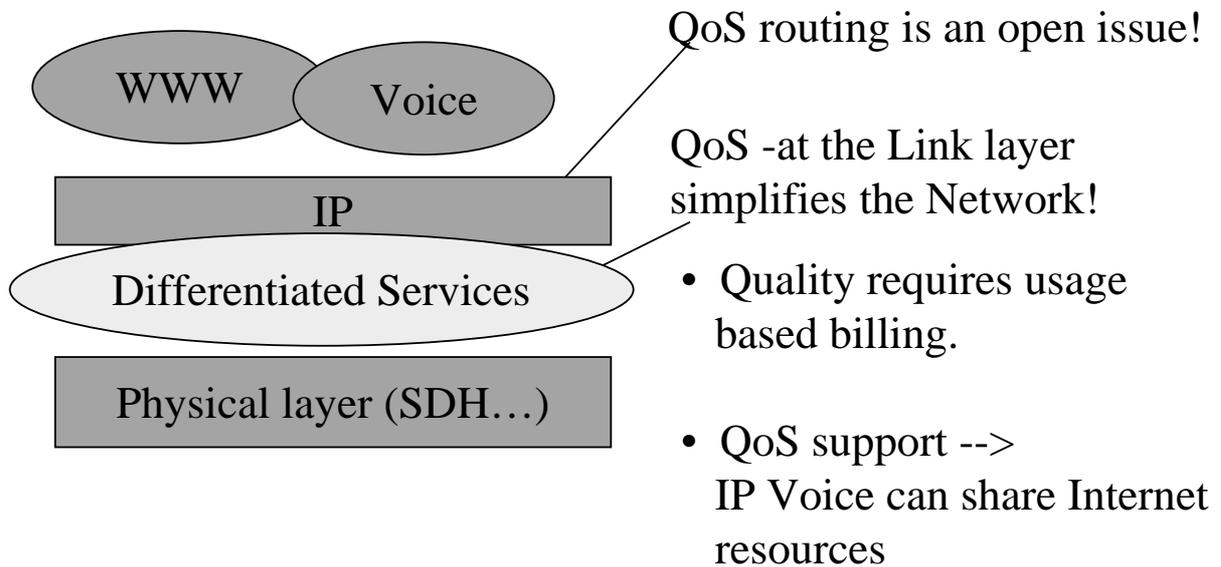
Business Impact

- Telephony believers: "Internet can never do this or that" - mainly in the past!

- Pragmatists: Can you do money with it?
  - √ Voice solutions in Intranets
  - √ Interworking IP voice with ISDN
  - √ Web interface to telephony services
  - √ Telecom Vendors launching Integrated IP/ISDN/PSTN products, Gateways and Gatekeepers

Will IP telephony change the world?

- International Internet calling is a likely to stay a niche market
- Integrated Corporate Data/Voice solutions and networks
- Integrated Internet/PSTN/ISDN networks-->Broadband
- Signaling is moving on top of IP
- Service Architecture is changing
  - Highest impact on information rich services
  - Accelerates service introduction rates
  - Increases usage of communication services

Prof. Raimo Kantola/TKK/Teletekniikan laboratorio

Conclusions

- IP Voice and IP Telephony together with growth of Internet drive Integration of IP to ISDN/PSTN/GSM networks
- IP telephony introduces a rich set of new attractive services
- Collision of IP and telephony is a major technology and market shift and creates industry upheaval among operators and vendors

Prof. Raimo Kantola/TKK/Teletekniikan laboratorio