IP/ATM Network Architectures - IPANA

Is a three year project TEKES project
Partners: Sonera, Finnet, NTC, NRC, (Miratel, Tellabs)
Laboratory of Telecommunications Technology

Sample results by Subprojects on

IP -Voice &

IP Switching

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

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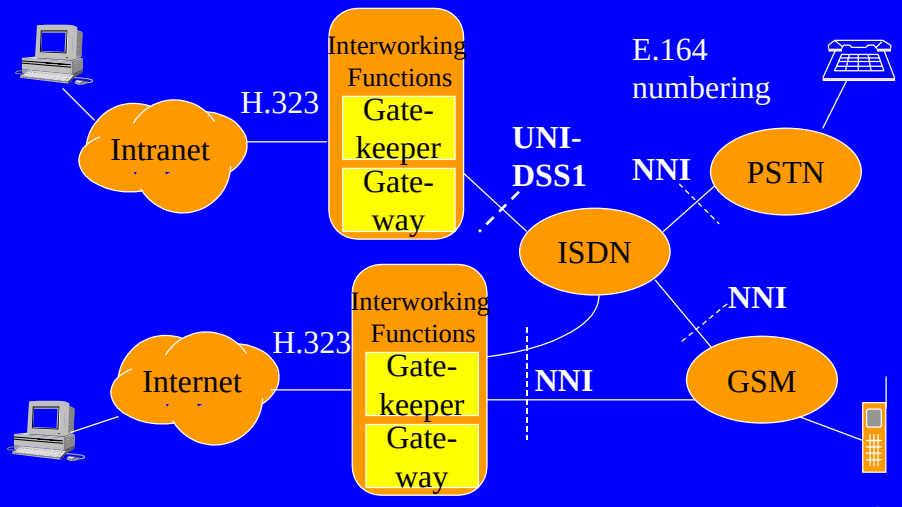
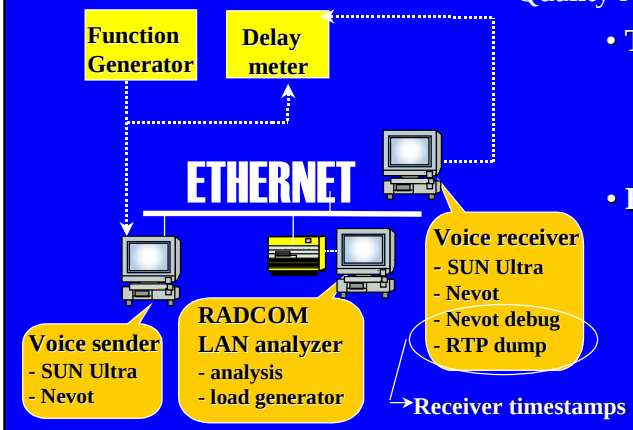
TIPHON specifies IP Voice to PSTN/ISDN/GSM Interworking



IP Voice in Ethernet - Delay is in the Workstation



Quality requires < 200 ms delay.

- **Terminal delay:**

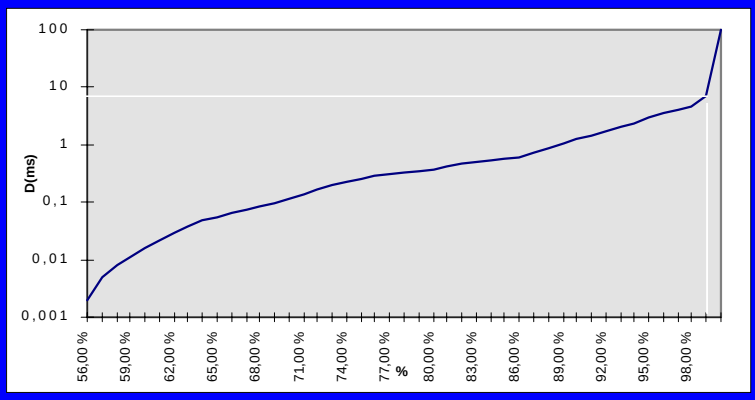
	Delay
HW	8.9 ms
VoIP Client	103.9 ms

- **End-to-end delay**

Packet lenght	Delay
0.02 s	104.5 ms

Difference = network delay

Packet spacing difference in a campus network



- In the public Internet lack of bandwidth, congested routes/links and underdeveloped charging are blockers to IP Voice.

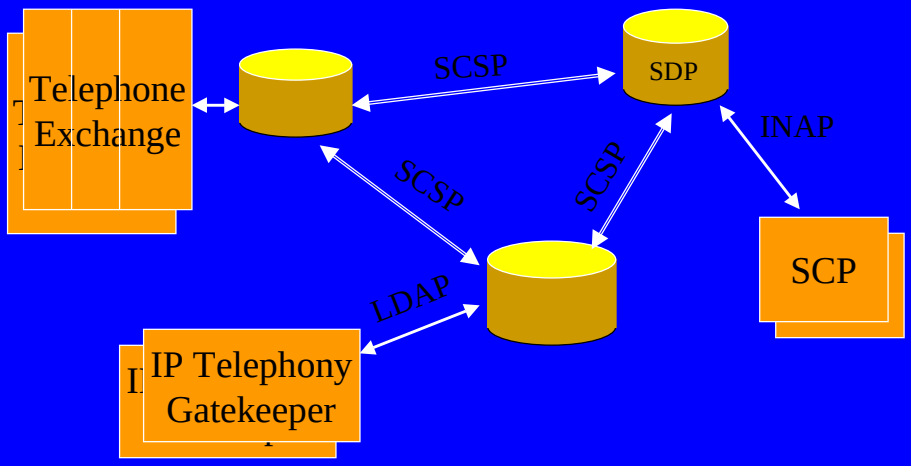
Delay breakdown in a Nevot SunOS Workstation

- End to end delays of 30…40 ms in a campus intranet are achievable.
- A buffering bug caused most of the 100ms in previous slide.
- Processing delay is 1 - 10% of CPU time depending on the coder.

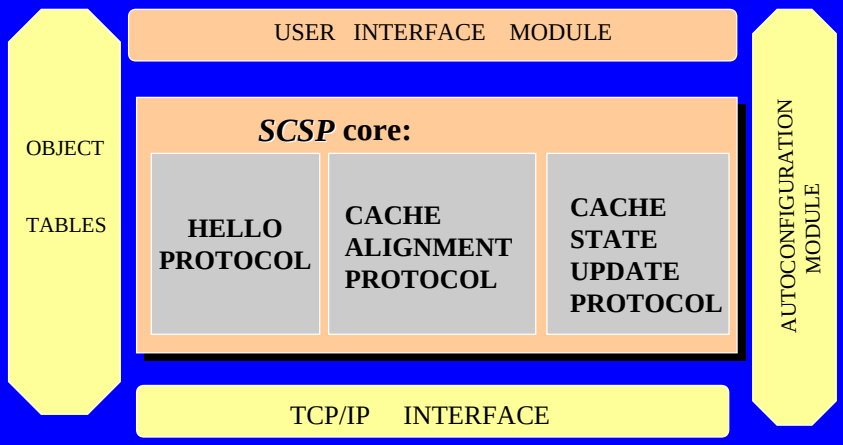
Conclusions from measurements

- Edge-router performance critical in our measurements
- Packet spacing differences in campus and metropolitan networks are small.
- Quality of Terminal software can be improved.
- IP switching slightly better in network Delay
  - IP switching increases throughput
  - packet spacing differences smaller
- Long packets increase packet spacing differences
  - bursty traffic and small packets not a problem

Server Cache Synchronization Protocol can be applied to Number Portability across Technology boundaries



SCSP Protocol Structure



IP/ATM Network Architectures IPANA

IP Switching subproject

Switching&Forwarding architectures

Automatic traffic classification

Applications of Classification

How to achieve x Gbit/s wirespeed economically in a packet network

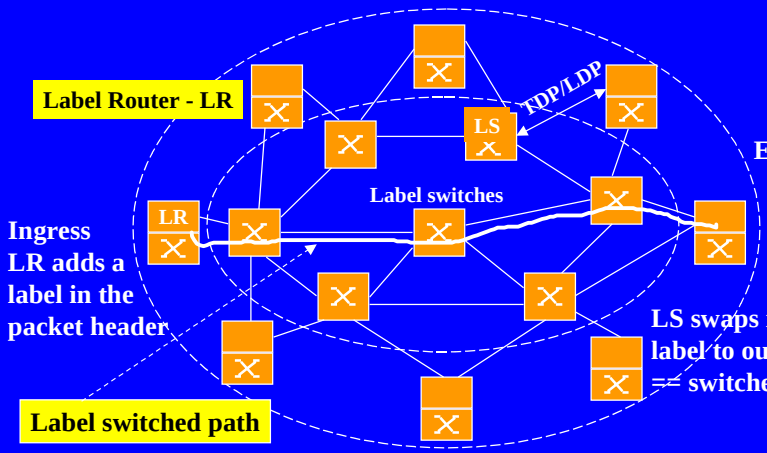
- Packet forwarding speed is the bottleneck
- In addition QoS is required from the Router
- Alternative approaches
  - Packet forwarding is avoided and replaced by switching in hardware (ATM, Label Switching, IP -switching, MPOA etc.)
  - Speed up the packet forwarding itself: Gigabit router using e.g. FPGA -technology.

We started from IPSILON's IP-switching

- MPLS -includes also the traffic driven switching option
- Based on the concept of a Packet Flow
- Several flow types were suggested
  - Source IP-address, Destination-IP-address + many packets
  - Source IP-addr, Dest-IP addr, TCP/UDP-port

Topology based label switching creates a (full) mesh VCC configuration between all nodes in a domain

Label switcing replaces Packet forwarding



Traffic Driven vs. Topology Based Switching

Traffic Driven

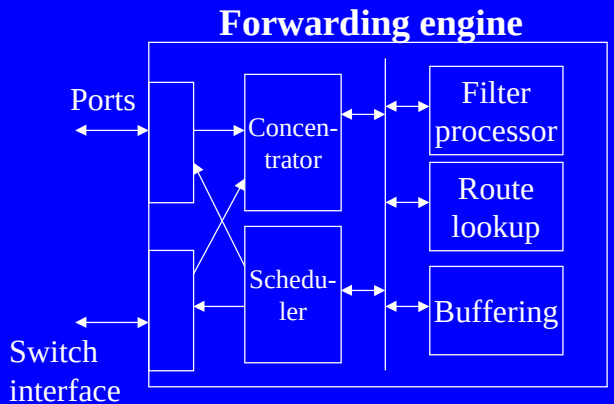
- End-to-end, hop-by-hop solution
- Applicability in ISP networks=? Reason: millions of flows/link
- Policy based QoS is easy
- At its best for relatively long lived QoS-guaranteed traffic
- Network robustness?

Topology based

- hop-by-hop and explicit routing across a network domain
- routing and label allocation take place independently of traffic => layer 2 determines performance
- At its best for best effort traffic
- Complexity

Independent of ATM - both principles can be applied to Packets-over-Sonet (POS) - leading to new router hardware

Packet Forwarding speed can be increased by parallel processing



Example based on Bell Labs prototype.

Boxes are 33MHz… 66MHz FPGAs.

Can process all headers prior to buffering at 1Gbit/s line speeds!

--> can provide QoS.

Forw time = 40 x 8 b/1G/s = 320 ns.

⇒ Direct implementation of Gigabit router providing QoS is possible!

Traffic driven control requires automatic classification

- IPSILON -classifier recognizes a flow by calculating packets prior to switching
- IPANA's LVQ-classifier partitions services into flow-oriented and non-flow oriented. Control decision is based on port number.
- LVQ-classifier is as efficient as counting packets but provides a better service from the end users point of view.

There are many possible applications of automatic service classification beyond IP-Switching

- Traffic driven switching in an MPLS network.
- Classifier controlled routing
- Differentiated services based on service classification
- Visualization of traffic for network management

Summary

- IPANA has
  - evaluated new IP networking technologies.
  - studied Automatic Traffic Classification - a new multi-purpose tool for intelligent service control in packet networks.
- In IP Voice we have
  - explored the basic issues of packet voice
  - developed architecture elements into Directory Enabled Networks