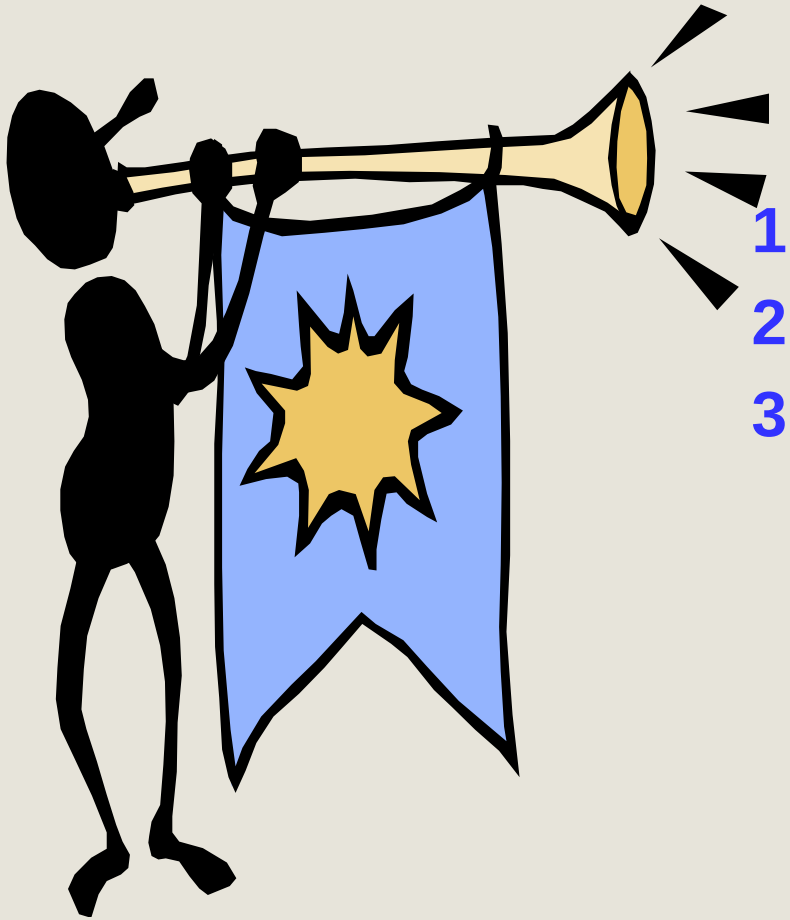
ERICSSON

Next Generation Networks

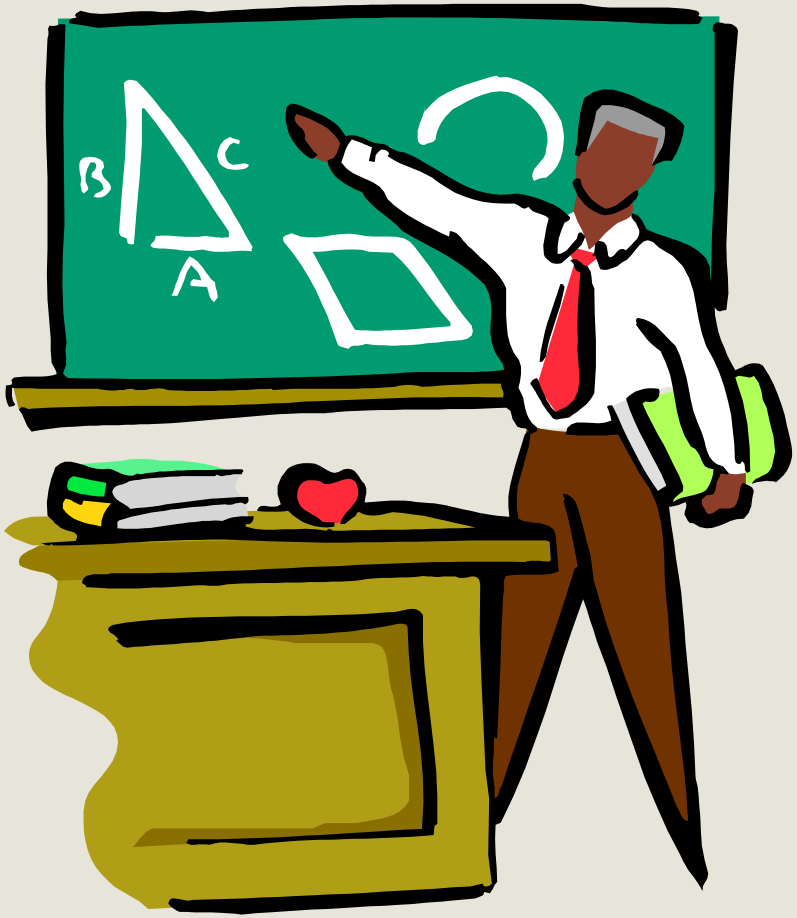
INSE 7110 – Winter 2007
Value Added Services Engineering in Next Generation Networks
Week #3

Outline



1. Basics
2. Media Handling
3. Quality of Service (QoS)

Basics



- Definitions
- History
- Standards

Definitions …

Next generation networks

Loosely used to refer to:

Third generation networks

Currently being deployed mainly in Europe and Asia

- Internet Telephony
- 3G

Or

Networks which will replace the third generation networks

- Beyond 3G
- 4G

Or both

- 3G and Beyond 3G (3GB)

Definitions …

Next generation networks

More formal definition (ITU-Definition – 3G focused definition):

- Packet based
- Use of multiple broadband technologies
- QoS Enabled
- Separation of service related functions and transport related functions (Not really new)
- Unrestricted access for users to networks and competing service providers (not really new)
- Generalized mobility (Not that new)

Definitions …

Next generation networks

A Use case (ITU-T)

Mobile tele-medecine

Remote clinic with limited staff and WLAN connected via broadband to main hospital

Multimedia conferencing between staff at remote clinic and experienced physicians at main hospital

Early examination report to main hospital

Information from medical report stored at main hospital sent to remote clinic

Vital health data sent from the ambulance to the main hospital

Definitions …

Key distinctive characteristics

1. Packet switching (instead of circuit switching in today's 2G networks)
2. QoS enabled (unlike the Internet best effort)
3. Voice + data (unlike today's 2G networks which focus on voice)

Definitions

Principal Criteria	Circuit switched	Packet switched
Dedicated Physical path	Yes/No	Yes/No
Derived criteria	Circuit switched	Packet switched
Call set up required	Yes/No	Yes/No
Possibility of congestion during communication	Yes/No	Yes/No
Fixed bandwidth available	Yes/No	Yes/No
Non optimal usage of bandwidth	Yes/No	Yes/No

Definitions …

The main components

1. Signaling
2. Media handling
3. Quality of service
4. Value added services

A brief history …

Milestones

- Late 70s:
  - First two party voice calls over Internet (Network Voice Protocol (NVP - RFC 741 - November 1977)
- 80s:
  - Emergence of proprietary systems for Internet Telephony
- 90s:
  - Emergence of standards (e.g. SIP, H.323, Megaco/H.248)
- Early 00s:
  - Backing by telcos (e.g. 3GPP specifications)
  - Backing by other new players (e.g. cable industry)

The standards: The dedicated bodies …

3GPP (Third Generation Partnership Project - 1)

- Established in 1998 as collaboration agreement between several standards bodies (e.g. ETSI, CCSA, ARIB,T1)
- Aim at establishing standards globally applicable to third generation mobile networks based evolved GSM core networks

3GPP2 (Third Generation Partnership Project – 2)

- Established in 1998 as collaboration agreement between several standards bodies (e.g. CCSA, ARIB,TIA)
- Aim at establishing standards globally applicable to third generation mobile networks based evolved IS-95 core networks

Packetcable (Formerly known as soft switch consortium)

- Established in 1997
- Aim at establishing standards for delivering real time multimedia services over two ways cable packet networks

The standards: The other bodies …

Internet Engineering Task Force (IETF)

- Focus on protocols

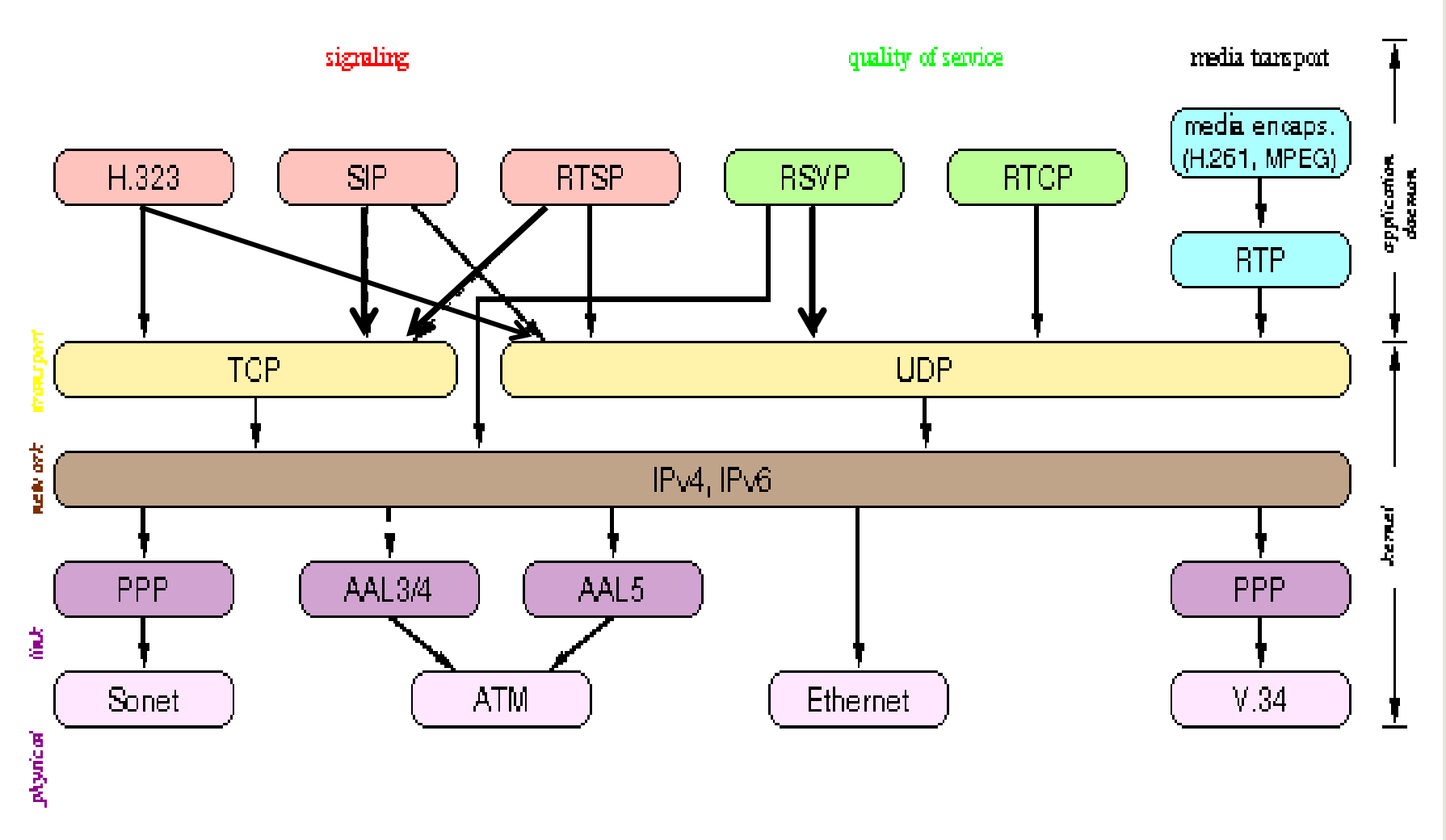
International Telecommunications Union (ITU)

- Focus on telephony networks

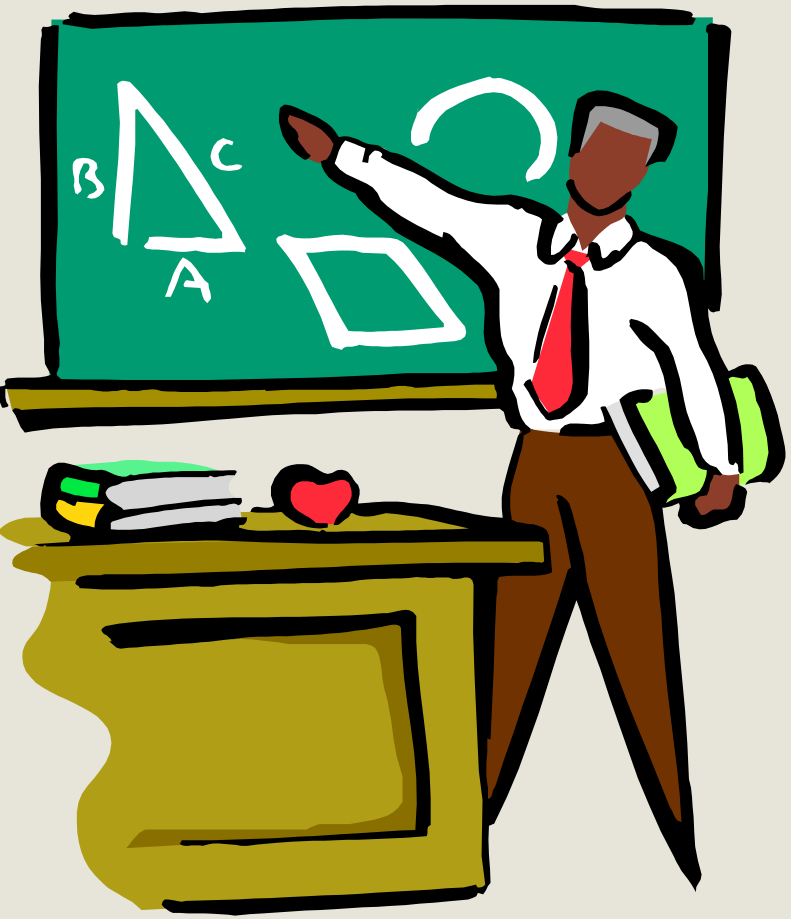
ITU-T

ITU-R

The standards: Protocols at the network level …



Media handling …



1. Introduction
2. Media transportation
3. The programmer's viewpoint

Introduction …

Media handling …

- Transportation …
  - Conversion
  - Mixing

Related concepts

- Media stream
  - Simple streams (e.g. voice)
  - Multiplexed streams (e.g. voice + video)
  - Ports or transport selectors
- Content type (I.e. format)
  - Examples: MPEG

Key issue: Real time delivery and processing

Media transportation …

Two complementary protocols

- Actual transportation:
  - Real-time Transport Protocol (RTP)
- Control of transportation:
  - RTP Control Protocol (RTCP)

Media transportation …

Main characteristics

RTP:

- No provision for Quality of service
- No guarantee for out of sequence delivery
- Typically runs on top of UDP but may run on top of other protocols

RTCP:

- Help in providing control

Media transportation …

Two party audio call

- Information required
  - Ports

Two party audio and video calls

- Information required
  - Ports

Media transportation …

Multicast audio conference on Internet

- Information required

Multicast address

Ports

Multicast audio / video conference on Internet

- Information distributed to the participants

Multicast address

Ports

RTP concepts …

Session

- Logical association between parties communicating with RTP
  - Identified for each participant by:
    - IP address (may be common for all participants)
    - RTP port
    - RTCP port

End system

- Application that generates the content to be sent and/or
- receive the content to be consumed
- Examples: IP phones, PCs, microphones …

RTP concepts …

Mixers / translators

- Intermediate systems
- Connect 2 or more transport level clouds
  - End systems
  - Mixers / translators
- Use cases
  - Centralized conference bridges
  - Heterogeneous conferences
    - Low speed connection
    - High speed connection
    - Different encoding schemes
  - Some participants behind firewalls

RTP concepts …

Synchronization source (SSRC)

- Grouping of data sources for playing back purpose (e.g. voice vs. video)
- An end system can act as several synchronization sources (e.g. IP phone with video capabilities)
- Translators forward RTP packets with their synchronization source intact

Contributing source (CSRC)

- A source of a stream of RTP packets that has contributed to the combined stream produced by an RTP mixer
- Mixers insert the list of contributing sources in the packets they generate

RTP packets: Structure

Header

- Fixed
- Maybe followed by one header extension if extension bit is set

Body

- Contains the actual data

RTP header – Selected fields

- Version :
- Extension:
- Payload type: Format of payload (e.g. encoding scheme)
  - Profile for audio and video conference
  - Other types
- Sequence number
- Time stamp
- CSRC lists

RTCP concepts …

Monitor:

- Application that receives RTCP packets sent by participants in an RTP session

Reports

- Reception quality feedback
- Sent by RTP packets receivers (which may also be senders)

Permanent RTP source identifier (CNAME)

- For keeping track of each participant

RTCP packets …

- Packet types
  - Simple
  - Compound
- Examples of packets
  - Sender reports
  - Receiver reports
  - Bye

RTCP packets …

- Receiver report (Selected fields)
  - Version
- Time stamp
- Sender's packet count
- Reception report blocks

Programmers viewpoint …

Standard APIs

- Ease application development by offering “high level” programmatic interfaces to protocols
- Enable the development of portable applications
- An example for media handling
  - Java Media Framework (JMF)

Programmers viewpoint …

JMF key design goals

- Be easy to use
- Support capturing media data
- Enable the development of media streaming and conferencing applications in Java
- Enable customized solutions based on the existing API (e.g. higher level API)
- Provide access to raw media data
- Enable the development of customized downloadable de-multiplexers, mixers/translators and so on …

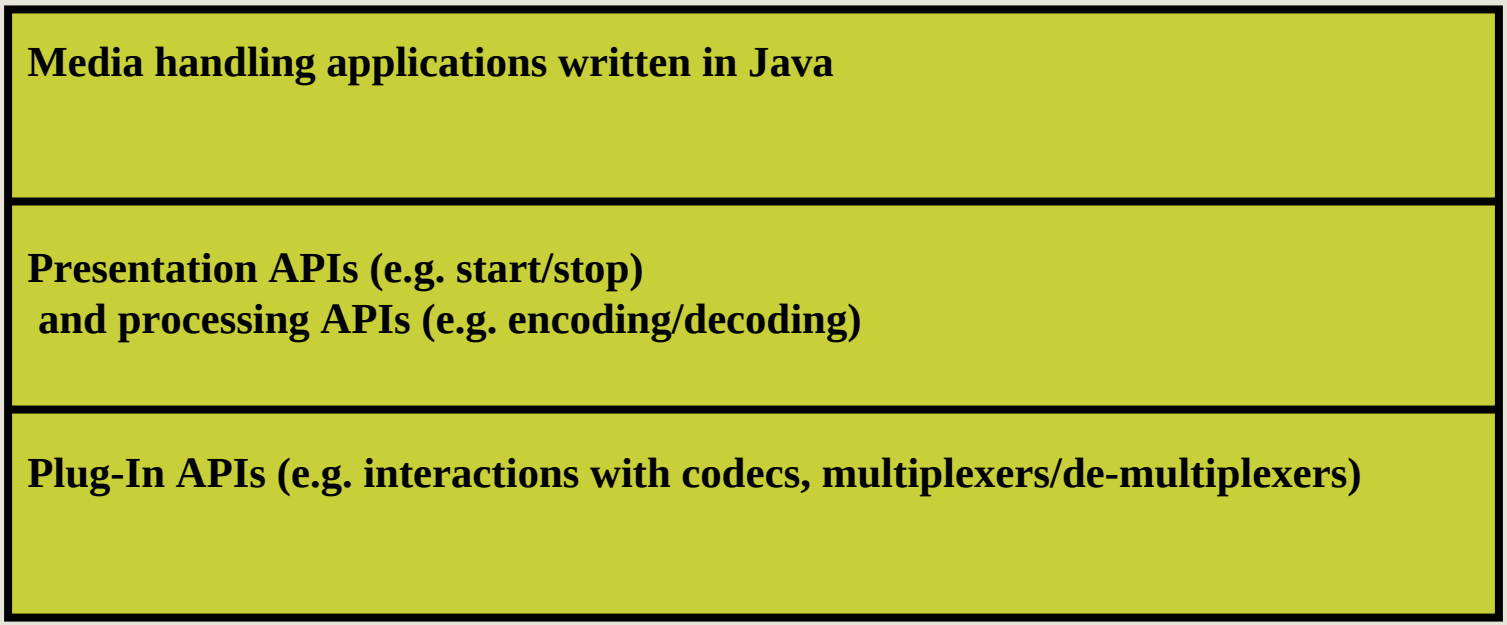
Programmers viewpoint …

JMF RTP/RTCP APIs key design goals

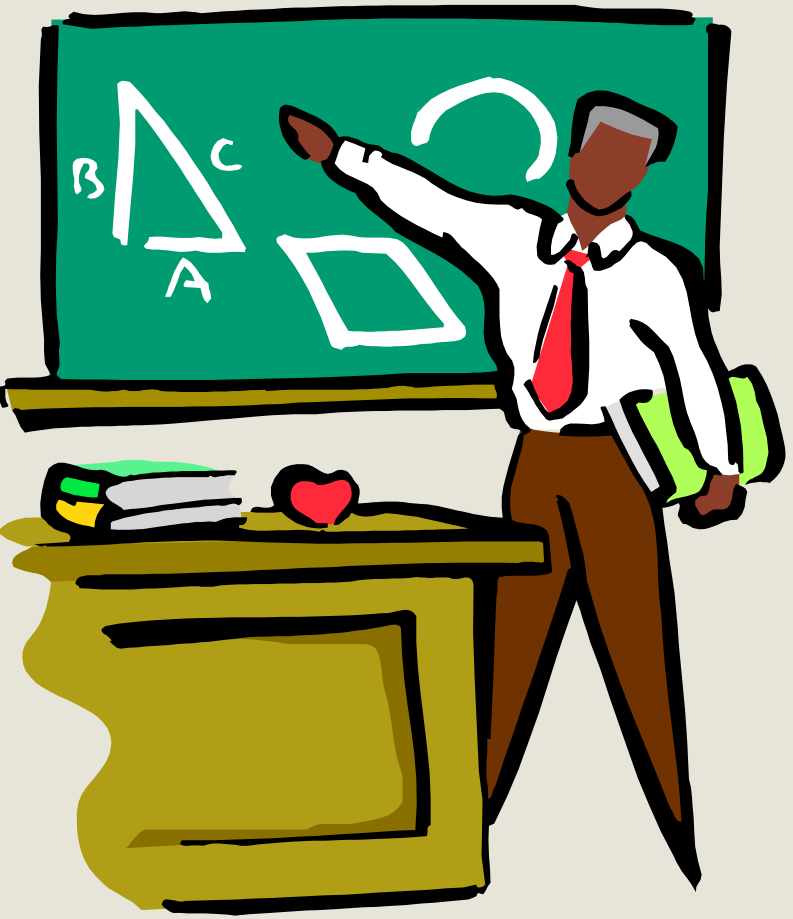
- Be easy to use
- Support media data reception and transmission using RTP/RTCP
- Enable the development of media streaming and conferencing applications in Java

Programmers viewpoint …

JMF high level architecture



Quality of Services



1. Introduction
2. Early attempts
3. Differentiated services

Introduction …

1. Circuit switched telephony

- Reserved path
- Single grade of service (The highest)

2. Classical Internet

- No reserved path
- Single grade of service (I.e best effort)
- Highly unsuitable for telephony

Early attempts …

IP Precedence and Type of Service

Type of service octet

Precedence: Indicate the priority

- O: lowest
- 7: highest

Type of service

- Low delay
- High throughput
- And others

Never got widely deployed: only anecdotal, ad hoc and experimental implementations

Early attempts: Integrated Service Architecture - IntServ …

Provide end to end QoS guarantees

Service classes

1. Guaranteed service

- Hard guarantee on delay and bandwidth
- Parameters provided by application
  - Peak rate
  - Packet size
  - Burst size

2. Controlled load

- Softer version of guaranteed service
- Guarantee that the QoS is equivalent to what it would have been if the network is not overloaded
- May not meet some of the hard requirements (e.g. delay)

Integrated Service Architecture - IntServ …

Requirements on each router in the path:

1. Policing
2. Admission control
3. Classification
4. Queuing and scheduling

Resource Reservation Protocol - RSVP …

Soft state signaling protocol used in InServ for uni-directional resource reservation

Rely on two messages:

PATH

- Propagated from sender to receiver

RESV

- Propagated in the opposite direction

Integrated Services ...

Disadvantages

- Require major new software and firmware in routers
- Major overhead due to flows management
  - Flows are quite similar to telephone calls
    - Set up
    - Tear down

Differentiated services - DiffServ …

Aim at addressing IntServ drawbacks by focusing on traffic aggregates instead of individual flows:

Scalability

- No need for router to maintain flow states
- No for refreshment messages due soft-state

Lack of general applicability

- Work even if every router in the path does not support it

No need for applications to support new APIs

Differentiated services - DiffServ …

Fundamental principle: A code point – Differentiated service code point (DSCP) to tell routers how to treat a packet relatively to other packets

Per hop behaviour (PHB)

- Default
- Expedited forwarding
- Assured forwarding

Routers use PHB to drop/ prioritize packets on their output queue

Differentiated services - DiffServ …

The two approaches:

Absolute service differentiation

- Try to meet IntServ goals, but:
  - **Without per-flow state**
  - **With static / semi-static resource reservation**

Relative service differentiation

- **Lower level of ambition**
- **Just ensure that relative priorities are respected**

References ...

1. Next Generation Networks

- C-S Lee and D. Knight, Realization of the Next Generation Networks, IEEE Communications Magazine, October 2005, Vol.43, No10
- K. Knightstonm N. Morita and T. Towle, NGN Architecture: Generic principles, Functional Architecture and Implementation, IEEE Communications Magazine, October 2005, Vol.43, No10

2. Media handling

RFC 1889 (RTP/RTCP)

JMF:

http://java.sun.com/products/java-media/jmf/index.jsp

2. QoS

B. Carpenter and K. Nichols, Differentiated Services in the Internet, Proceedings of the IEEE, Vol. 90, No9, September 2002

RFC 1633 (IntServ)

RFC 2205 (RSVP)

RFCs 2430, 2474 … (DiffServ)