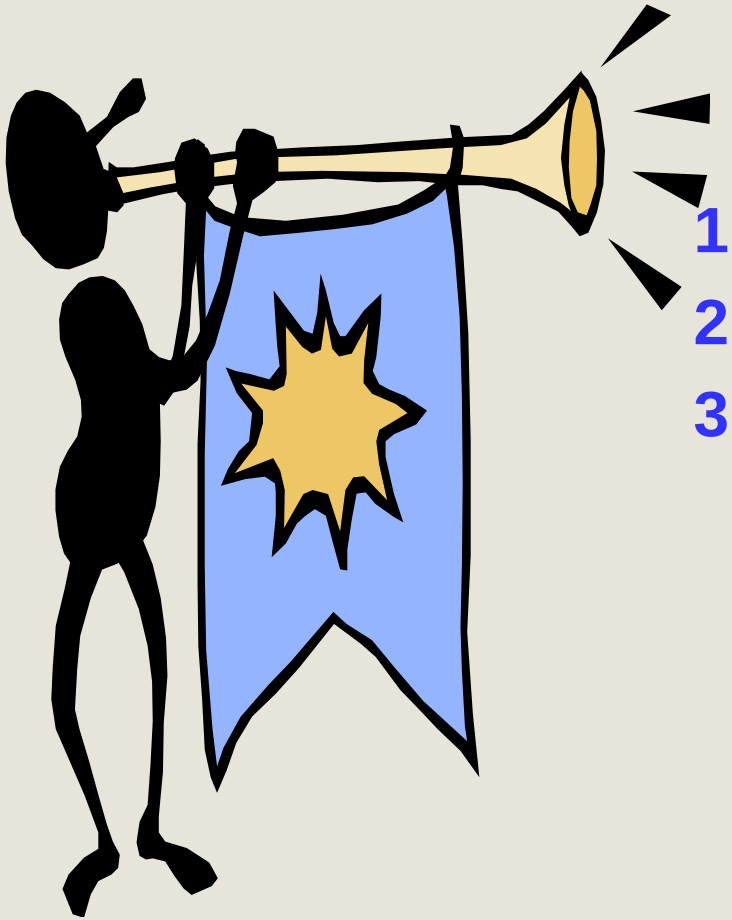
ERICSSON

Next Generation Networks

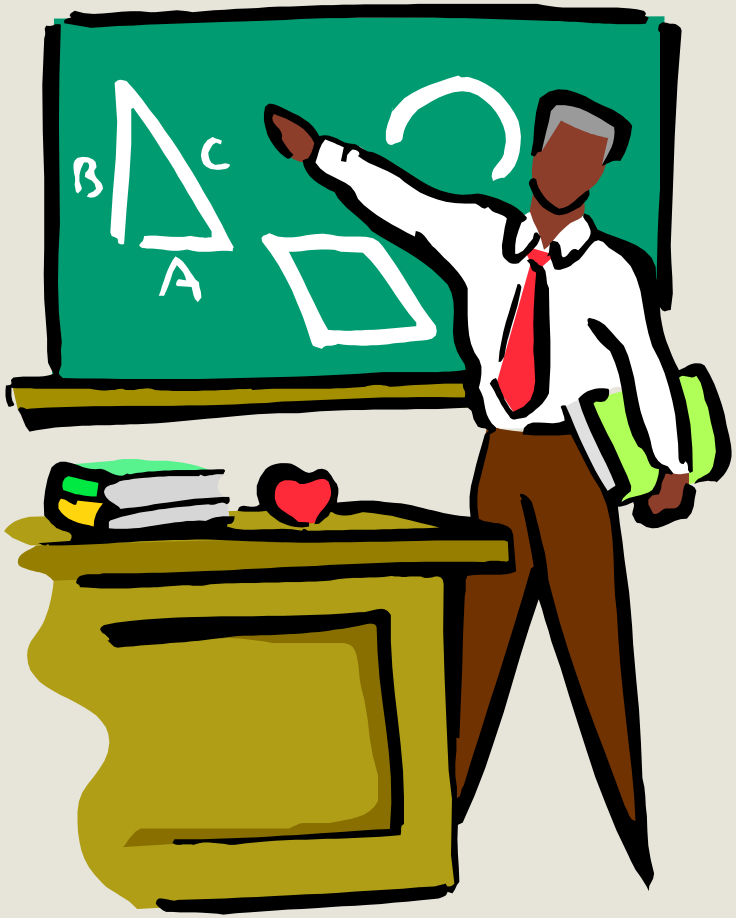
INSE 7110 – Winter 2006
Value Added Services Engineering in Next Generation Networks
Week #4

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

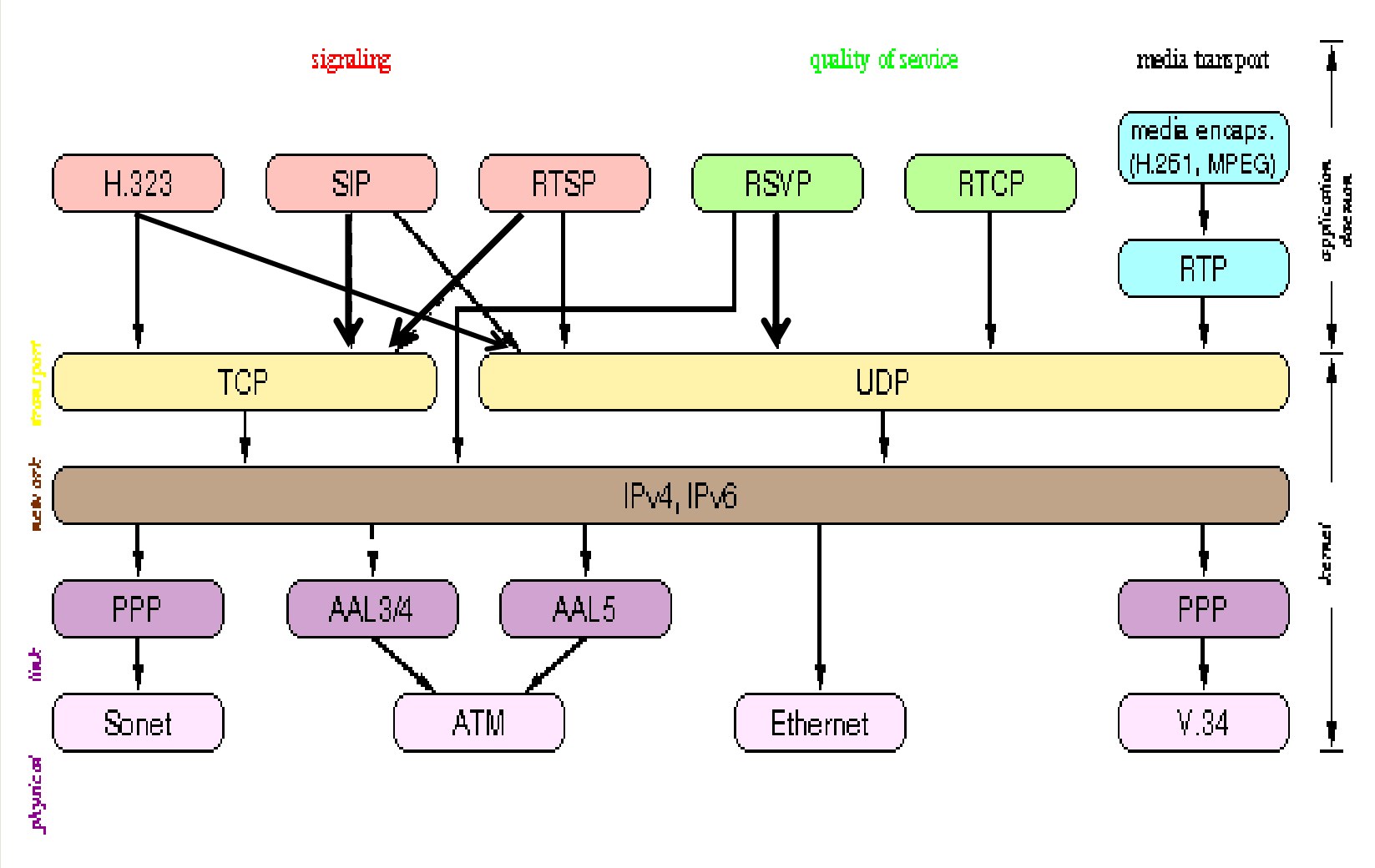
International Telecommunications Union (ITU)

- Focus on telephony networks

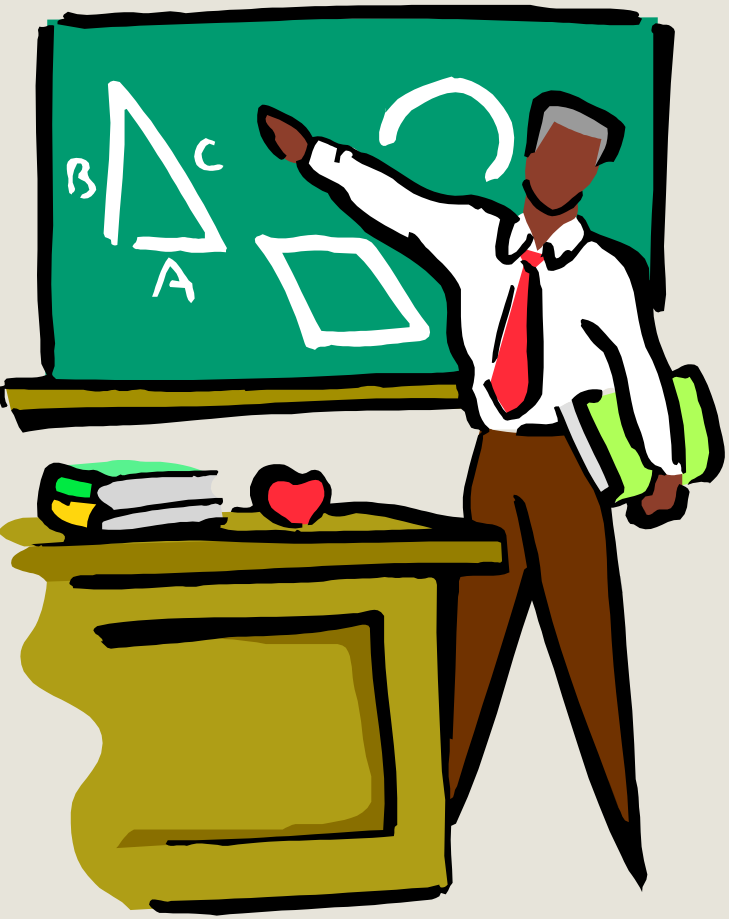
ITU-T

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 …

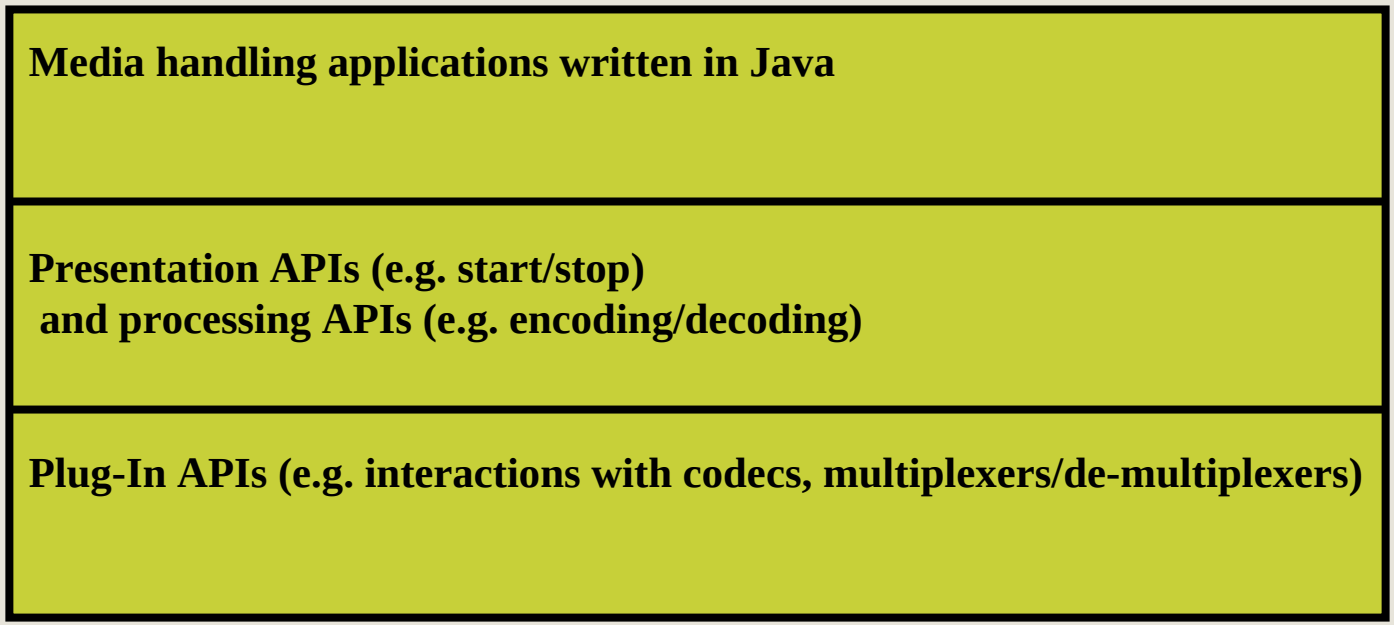
Programmers viewpoint …

JMF RTP/RTCP APIs key design goals

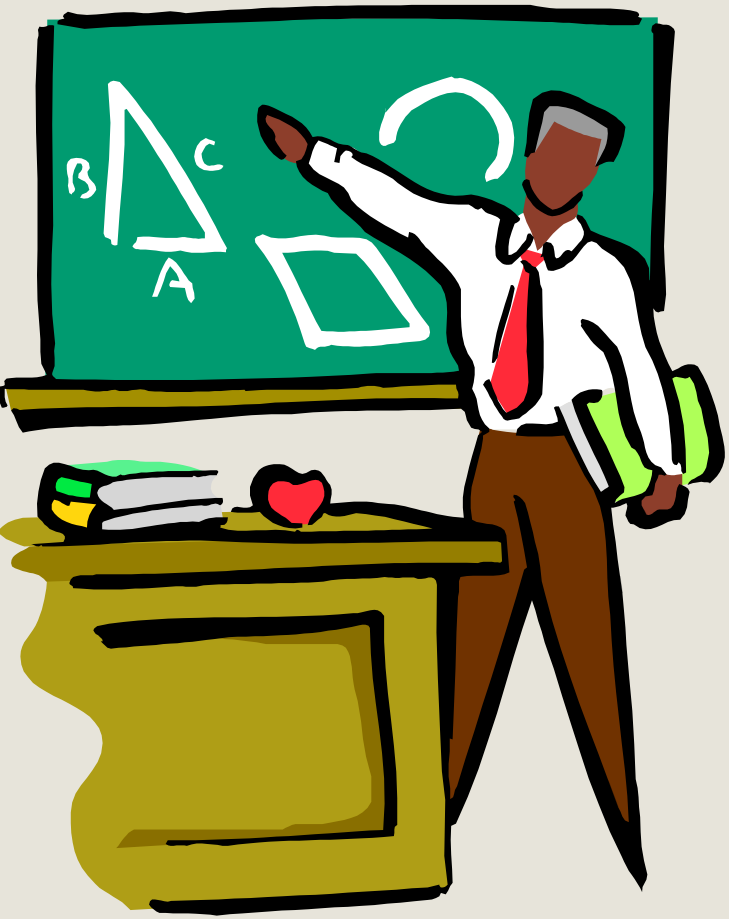
- Be easy to use
- Support media data reception and transmission using RTP/RTCP
- Enable the development of media streaming and conferencing applications in Java

Programmers viewpoint …

JMF high level architecture



Quality of Services



1. Introduction
2. Early attempts
3. Differentiated services
4. A more recent approach

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**

A more recent approach - NSIS …

Main design goals

- Separation of signaling message transportation from signaling applications
- Signaling: Establishment, modification and tearing down of control state in network nodes
  - Examples of control state
    - QoS: Reserved resources
    - Conferencing / multiparty sessions: Sessions (e.g. which ones are active, how many participants are in each one)

First application

- Resource reservation in QoS

A more recent approach - NSIS …

A New Extensible IP Signaling Suite:
QoS Signaling application basic protocol (Messages)

- RESERVE
  - Create, refresh, modify and tear down reservation state
- QUERY
  - Inquire without making a reservation
- RESPONSE
  - Response to a previous message
- NOTIFY
  - Convey spontaneous information (Usually related to error conditions)

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

X. Fu et al., NSIS: A New Extensible IP Signaling Protocol Suite, IEEE Communications Magazine, October 2005, Vol.43, No10

RFC 1633 (IntServ)

RFC 2205 (RSVP)

RFCs 2430, 2474 … (DiffServ)