Chapter X
Quality of SERVICE

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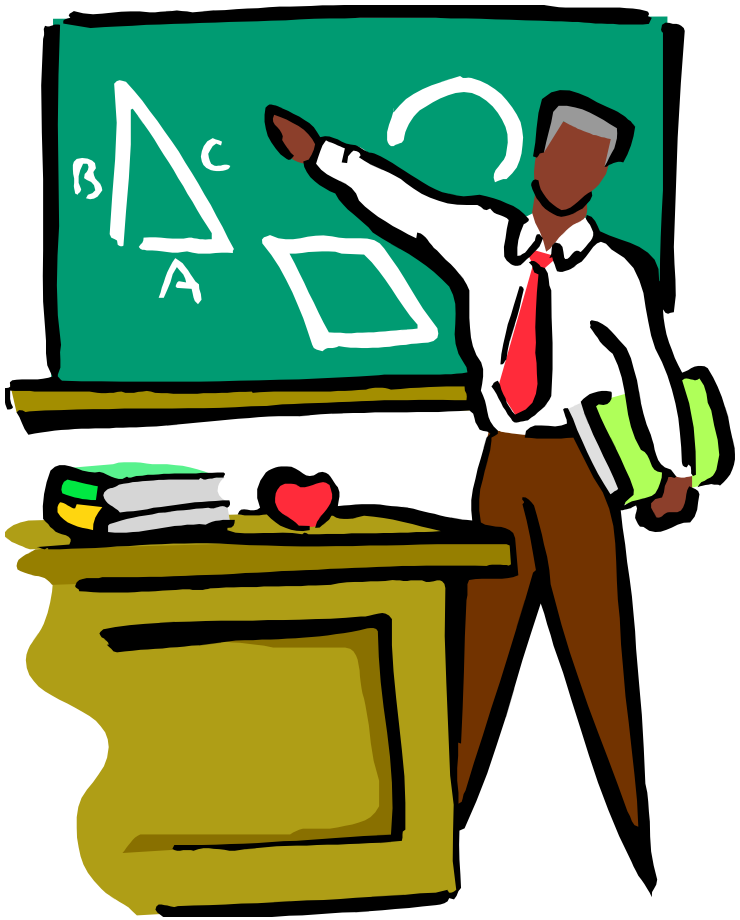
Quality of Services



1. Terminology
2. Technologies

Terminology

Quality of service

- Ability to control network performance in order to meet application and/or end-user requirements
- Examples of parameters
  - Packet loss
  - End-to-en delay (latency)
  - Delay variation (jitter)
  - Availability (Uptime)
  - Data transfer rate (throughput)

Terminology

Quality of service

- Recommendations for acceptable voice conversation over the Internet
  - Packet loss ratio: below 1 percent
  - End-to-en delay (latency): below 200 ms
  - Delay variation: about 30 ms

  Note:

  Average packet loss in Internet is 2 percent

  Conclusion:

  Internet as it currently stands is not suitable for voice conversation (QoS technologies are needed)

Terminology

Class of service and grade of service

- Class of service (CoS)
  - Set of priority levels
    - Flow aggregates of the same class are assigned the same priority
- Grade of service (GoS)
  - Used to categorize services with respect to higher level requirements
  - Examples of parameters
    - Survivability
    - Availability
  - Note:
    - “Carrier grade” is considered the highest grade

Terminology

Service Level Agreement (SLA)

- Negotiated agreement between a customer and a service provider on levels of service characteristics and the associated set of metrics
- Content varies depending on the service offering and includes the attributes required for the negotiation of the agreements
- Usually signed between corporate users and their ISPs

Terminology

Service Level Agreement (SLA) - An example (Ref. 2)

- Agreement between Nimsoft and its ISP. On a weekly basis ISP must ensure 98% of:
  - Connection to hosted server does not exceed 1.5 s
  - Web site home page download does not exceed 8s.

Terminology

Subscription based QoS vs. On-demand QoS

- Subscription based
  - Resource (e.g. bandwidth) allocated to subscriber
  - Subscriber pays even if resource is not used
  - Not suitable for sporadic traffic
- On-demand QoS
  - Resources allocated according to actual needs
  - Pay per use

Terminology

Soft QoS vs. hard QoS

- Soft QoS
  - No guarantee to get required QoS during abnormal network conditions (e.g. large scale attacks, major network failures)
- Hard QoS
  - Guarantee to always get required QoS
    - Very hard to put in practice in Internet

Terminology

Explicit QoS vs. Implicit QoS

- Explicit QoS
  - Customer explicitly requires a specific service level
- Implicit QoS
  - QoS is embedded in the service and there is no special QoS fe

Technologies

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

Technologies

Integrated Service Architecture - IntServ

Two classes of services

1. Guaranteed service

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

Technologies

Integrated Service Architecture - IntServ

Two classes of services

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)

Technologies

Integrated Service Architecture - IntServ

- Requirements on each router in the path:
  1. Policing
  2. Admission control
  3. Classification
  4. Queuing and scheduling

Technologies

Integrated Service Architecture - IntServ

Resource Reservation Protocol (RSVP): Soft state signaling protocol used in InServ for uni-directional resource reservation

Rely on two messages:

1. **PATH**
   - **Propagated from sender to receiver**
2. **RESV**
   - **Propagated in the opposite direction**

Technologies

Integrated Service Architecture - IntServ

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

Technologies

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

Technologies

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

Technologies

Differentiated Services – DiffServ

Per hop behaviour (PHB)

- Default
- Expedited forwarding
- Assured forwarding

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

Technologies

Differentiated Services – DiffServ

The two approaches:

1. Absolute service differentiation

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

2. Relative service differentiation

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

References

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2. A. Meddeb, Internet QoS: Pieces of the Puzzle, IEEE Communications Magazine, January 2010

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