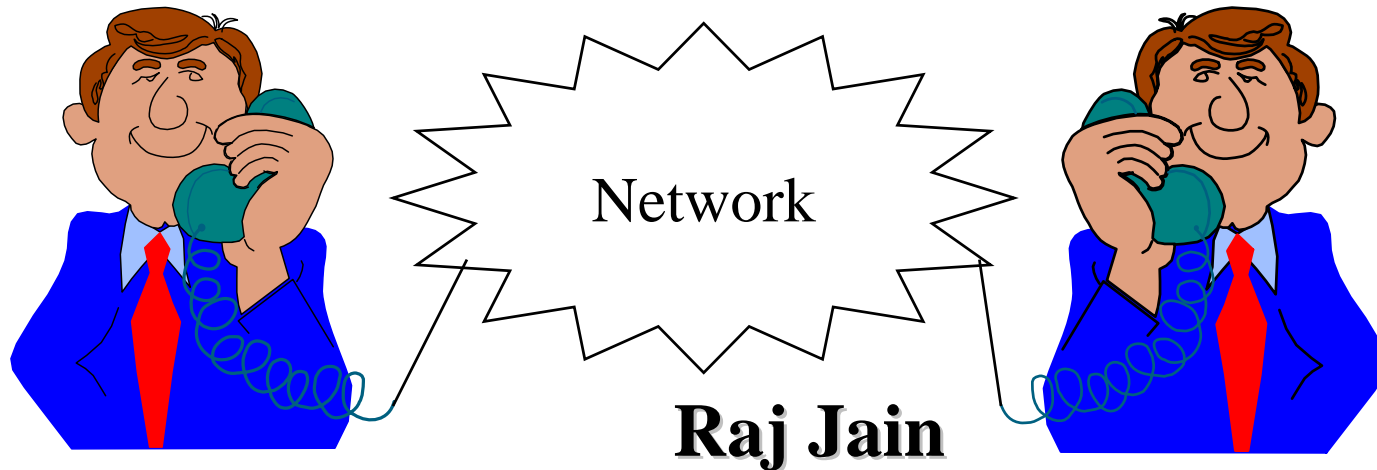


# Protocols for Multimedia on the Internet



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- ❑ Integrated services
- ❑ Resource Reservation Protocol: RSVP
- ❑ Problems with Integrated services and RSVP
- ❑ Differentiated Services

# Multimedia

Application	Video Conferencing, Telephony, Fax
Transport	Timing Sync, payload id, error recovery
Network	QoS, Multicast, Signaling
Datalink	Access Control, Multicast, signaling
Physical	Multiple channels via SDM, FDM, TDM

# IETF Groups

Application	Iptel, fax, pint
Transport	Avt (RTP), mmusic (RTSP)
Network	Qosr, MPLS, IntServ, Issl, Diff-serv, RSVP
Datalink	IEEE 802.1p
Physical	Broadband Ethernet 10Broad36, Iso Ethernet

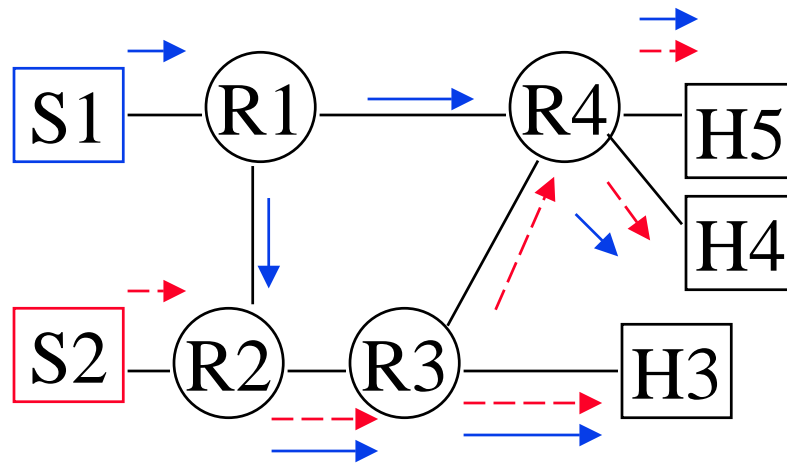
# Integrated Services

- ❑ Best Effort Service
- ❑ Controlled-Load Service: Performance as good as in an unloaded datagram network. No quantitative assurances. (Min throughput)
- ❑ Guaranteed Service: rt-VBR
  - Firm bound on data throughput and delay.
  - Delay jitter or average delay not guaranteed or minimized.
  - Every element along the path must provide delay bound.
  - Is not always implementable, e.g., Shared Ethernet.

# RSVP

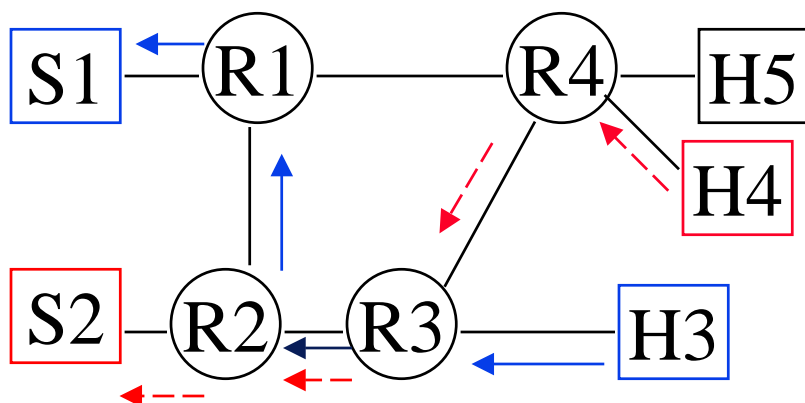
- ❑ Resource ReSerVation Protocol
- ❑ Internet signaling protocol
- ❑ Carries resource reservation requests through the network including traffic specs, QoS specs, network resource availability
- ❑ Sets up reservations at each hop
- ❑ RSVP does not find routes.  
Multicast routing protocols do.

# Path Messages



- ❑ Sources send quasi-periodic PATH messages to multicast address
- ❑ Path message contain:
  - Sender Template: Data format, Src Address, Src Port
  - Sender TSpec: Traffic Characteristics. Not changed.
  - ADSpec: Network path resource/service availability Accumulated along the path.

# Reservation Requests



- ❑ Receivers must join multicast address to receive path messages
- ❑ Receivers generate reservation (RESV) requests
- ❑ RESV messages contain resources to be reserved
- ❑ RESV messages are forwarded along the reverse path of PATH messages

# Reservation (Cont)

- ❑ Requests are checked for resource availability (admission control) and administrative permissions (policy control)
- ❑ Two or more RESV messages for the same source over the same link are merged.
- ❑ Routers maintain a soft state.  
The receivers have to refresh periodically.
- ❑ Heterogeneous Receivers: Sources divide traffic into several flows. Each flow is a separate RSVP flow. Receivers join one or more flows. Each RSVP flow is homogeneous.

# Problems with RSVP and Integrated Services

- ❑ Complexity in routers: packet classification, scheduling
- ❑ Scalable in number of receivers per flow but Per-Flow State:  $O(n)$   $\Rightarrow$  Not scalable with # of flows. Number of flows in the backbone may be large.  $\Rightarrow$  Suitable for small private networks
- ❑ Need a concept of “Virtual Paths” or aggregated flow groups for the backbone
- ❑ Need policy controls: Who can make reservations? Support for accounting and security.  $\Rightarrow$  RSVP admission policy (rap) working group.

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# Differentiated Services

Ver	Hdr Len	Precedence	ToS	Unused	Tot Len
4b	4b	3b	4b	1b	16b

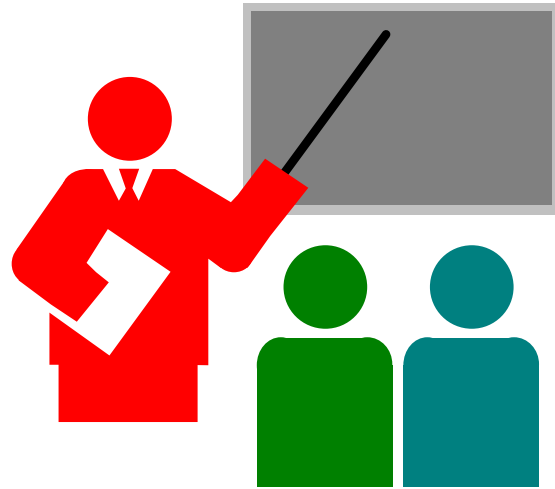
- ❑ IPv4: 3-bit precedence + 4-bit ToS + 1-bit unused = DS byte (differentiated services byte)
- ❑ Diff-Serve Charter: Define DS byte
- ❑ August 97: BOF started
- ❑ Feb 98: Working group formed
- ❑ Archive: <http://www-nrg.ee.lbl.gov/diff-serv-arch/>
- ❑ Per-Hop Behavior (PHB): Mechanisms - Drop threshold, Queue assignment, Service priority, Service Rate

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# Sample PHB Allocation

- ❑ ppp i 00
- ❑ ppp = Precedence (Higher is generally better)
- ❑ i = in/out bit  $\Rightarrow$  In profile/out Profile  
 $\Rightarrow$  Drop preference. Allows in/out pkts in same Queue  
Out-of-profile traffic uses higher RED thresholds
- ❑ Compatible with current usage
- ❑ Precedence is used as an index to select a queue, or VC, ...
- ❑ In IEEE-802 switches, only 1, 2, or 3 msbs used
- ❑ Unrecognized code points  $\Rightarrow$  Default forwarding

# Summary



- ❑ TCP/IP suite is being extended to allow multimedia
- ❑ Integrated Services: GS = rtVBR, CLS = nrt-VBR
- ❑ Signaling protocol: RSVP
- ❑ For Scalability: Differentiated services

# References

- ❑ For a detailed list of references see:

[http://www.cse.ohio-state.edu/~jain/refs/mul\\_refs.htm](http://www.cse.ohio-state.edu/~jain/refs/mul_refs.htm)

[http://www.cse.ohio-state.edu/~jain/refs/ipm\\_refs.htm](http://www.cse.ohio-state.edu/~jain/refs/ipm_refs.htm)

[http://www.cse.ohio-state.edu/~jain/refs/ipqs\\_ref.htm](http://www.cse.ohio-state.edu/~jain/refs/ipqs_ref.htm)

[http://www.cse.ohio-state.edu/~jain/refs/ref\\_voip.htm](http://www.cse.ohio-state.edu/~jain/refs/ref_voip.htm)

- ❑ RFC 2212, "Specification of Guaranteed Quality of Service", 9/97
- ❑ RFC 2211 "Specification of the Controlled-Load Network Element Service", 9/97
- ❑ RFC 2205, "Resource ReSerVation Protocol (RSVP) -- Version 1 Functional Specification", 9/97