CS 414 – Multimedia Systems Design

Lecture 21 – Case Studies for Multimedia Network Support (Layer 3)

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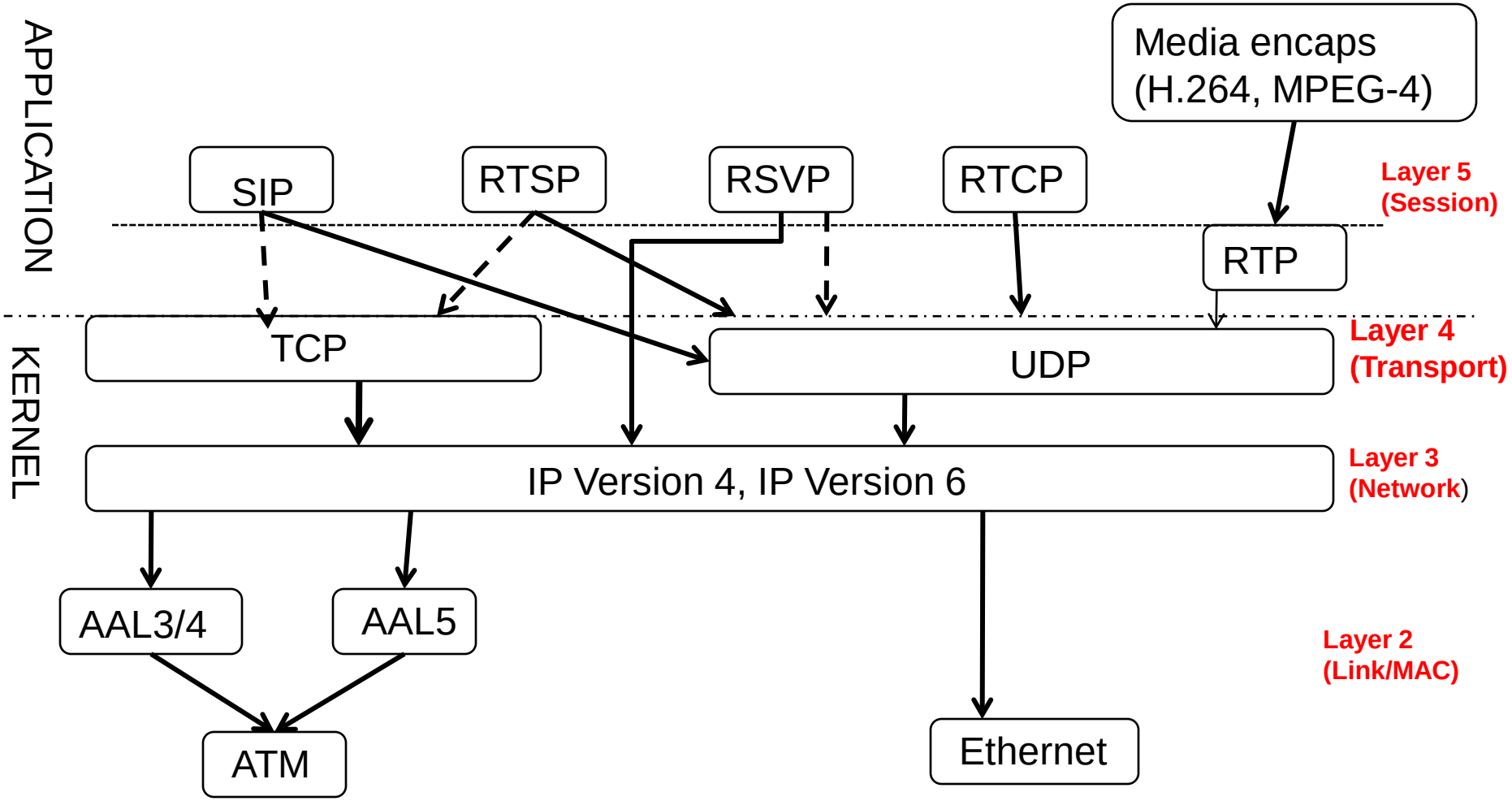
Spring 2009

Outline

- Multimedia Network Technologies at the Layer 3
  - Past/Current technologies: IPv4
  - Future technologies: IPv6, IntServ, DiffServ

Internet Multimedia Protocol Stack



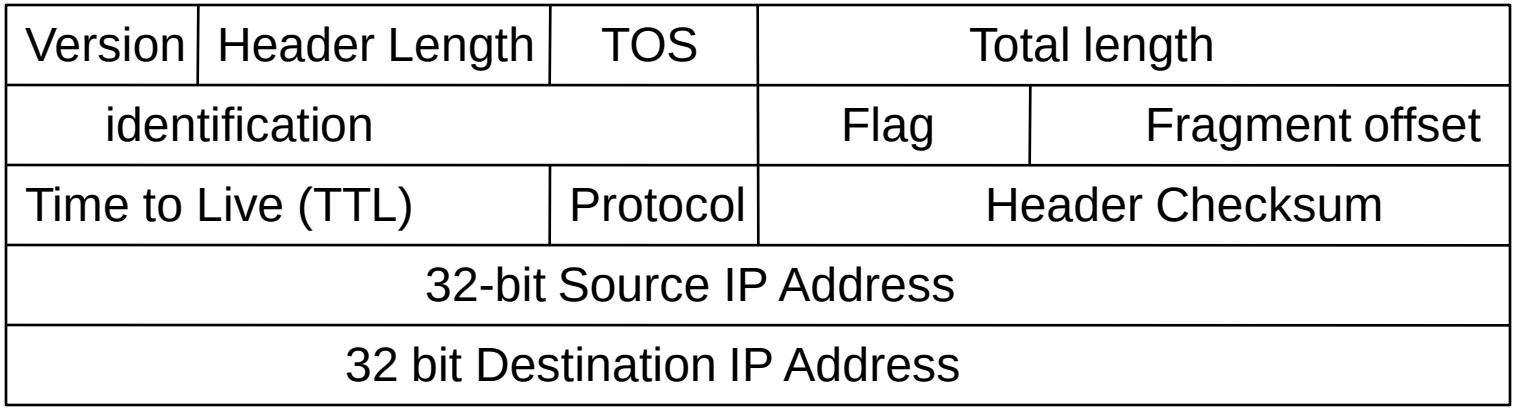
Layer 3 Internet Services

- **Internet Protocol (IP) – IP Version 4**
  - Provides unreliable deliver of datagrams in a point-to-point fashion
  - Runs on top of any Layer 2 technologies
  - Supports
    - IP address of 32 bits
    - Different types of services (TOS)
      - Precedence relation
      - Services such as minimization of delay, maximization of throughput
    - Multicast
      - Internet Group Management Protocol for managing groups

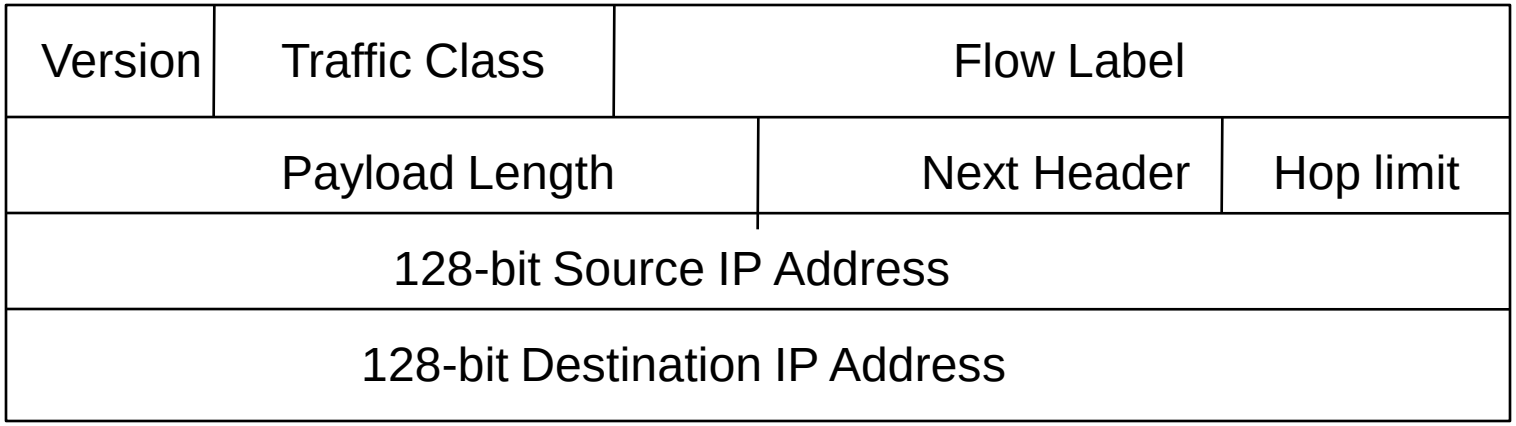
New Internet Protocol - IPng

- **Next Generation IP – IP Version 6**
  - Supports new features
    - New addressing and routing
      - IP Address 128 bits
      - Large hierarchical addresses, multicast addresses
    - More options of flow control and security
      - Real-time flows
      - End-to-end security
      - Provider selection
    - Host mobility
    - Auto-configuration/auto-reconfiguration
    - Traffic Classes

IP Packet Headers



IPv4

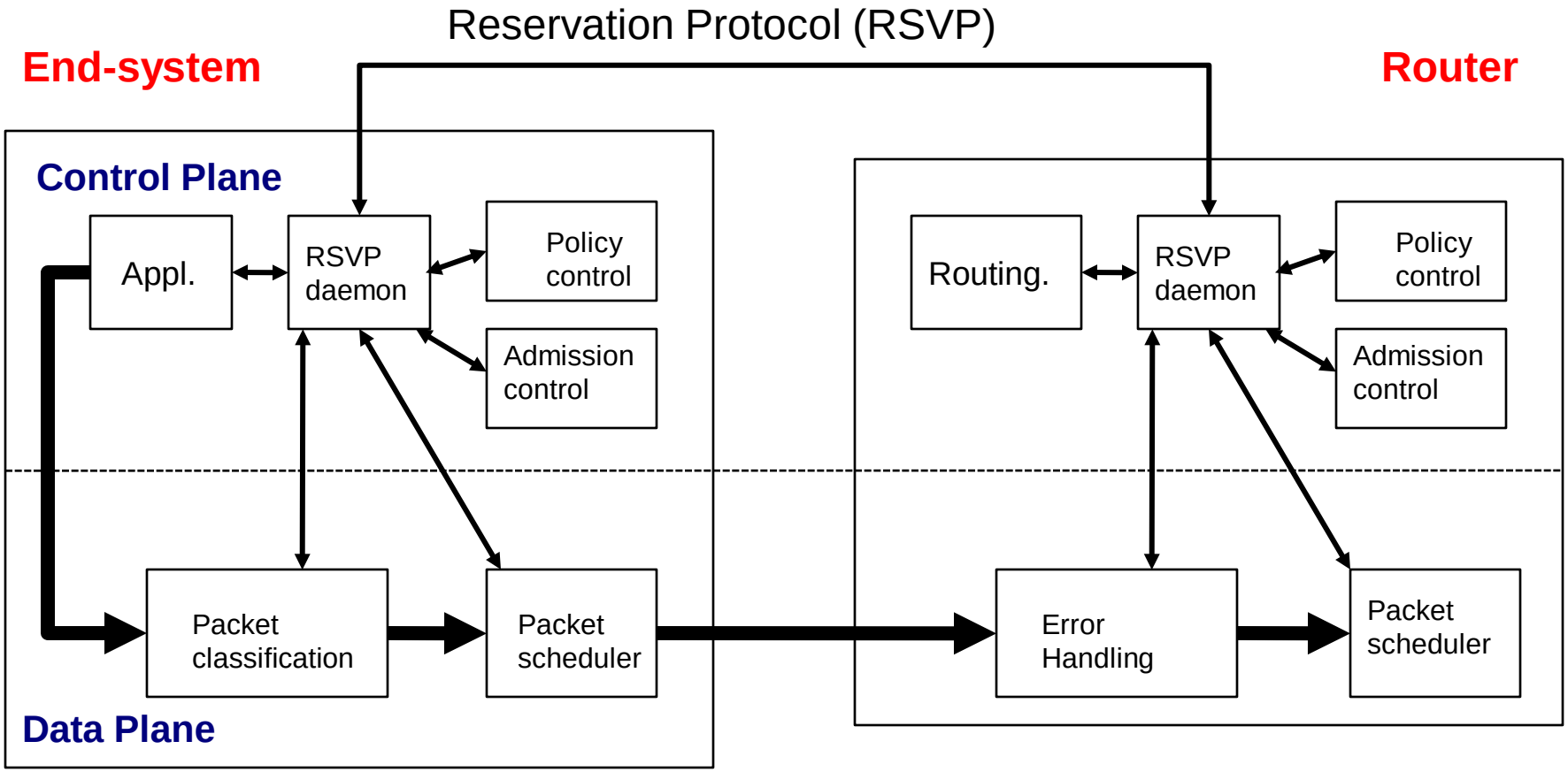


IPv6

QoS in Layer 3 - Internet Integrated Services

- To provide network QoS in the Internet, IETF reacted by
  - Creating Working Group (IntServ)
  - Deploying Internet Integrated Services
- Development of Control (Establishment) Protocol to reserve resources per flow
  - Resource Reservation Protocol (RSVP)
- Development of QoS-aware network services within IP
  - Guaranteed class-of-service
    - Deterministic QoS guarantees
  - Controlled-load class-of-service
    - Statistical QoS guarantees

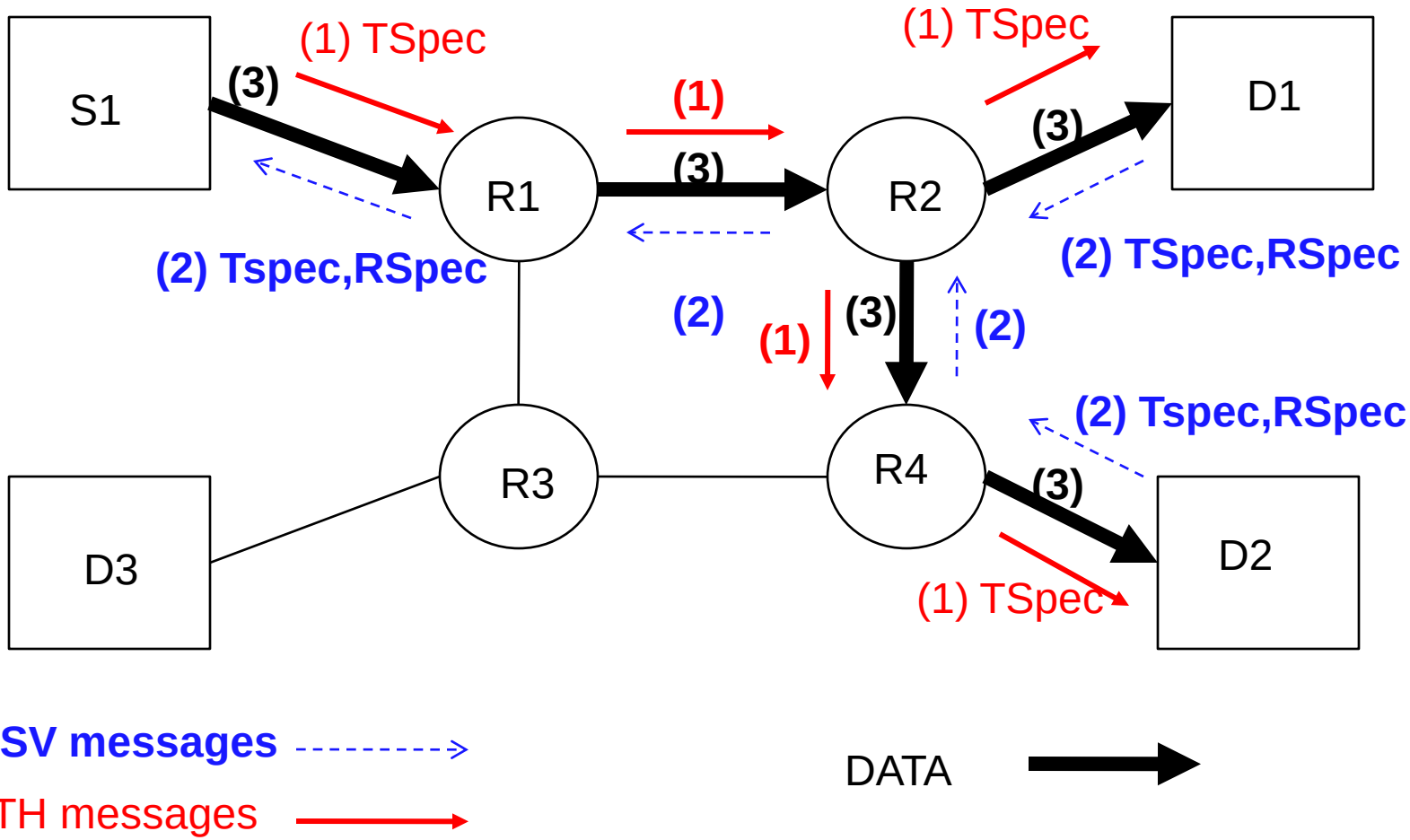
Integrated Services (IntServ) Architecture



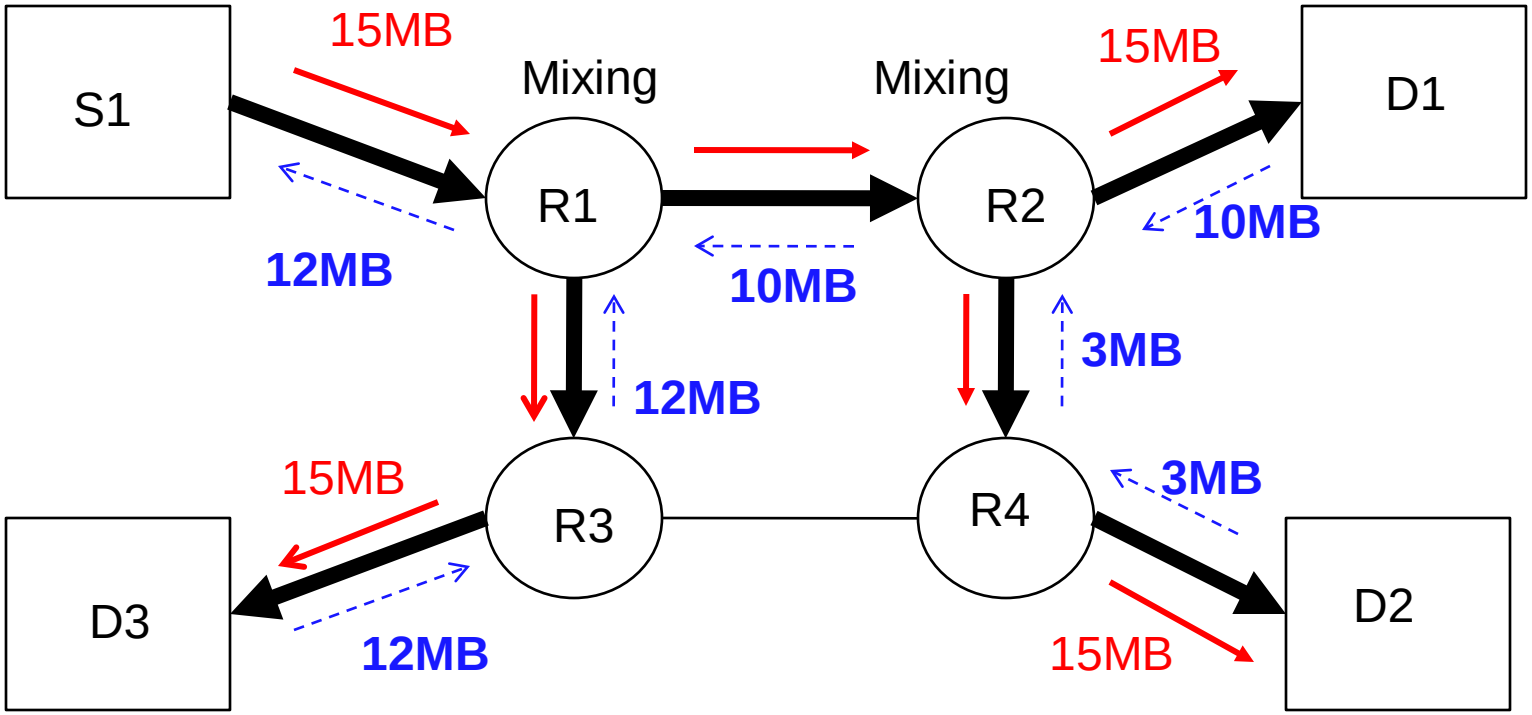
RSVP

- Provides reservation for data flows
  - Flow specification is represented via
    - Traffic specification, TSpec
      - Characteristics of the data flow
    - Request specification, Rspec
      - Description of required QoS (desired flow behavior)
- Is receiver-oriented and unidirectional
- Uses two types of messages:
  - PATH messages and RSVP messages
- Protocol
  1. Send PATH message with TSpec from Sender to Receiver(s)
  2. Send RESV message with Rspec from Receiver(s) to Sender
  3. Send DATA with resulting reserved QoS

RSVP Control and Data Flow



Mixing Reservations



Reservation Structures

- Resource Reservation Table
  - Stores admitted/reserved resources
- RSVP Messages

Version	Flags	Message Type	RSVP Checksum
Send TTL		Reserved	RSVP Length

RSVP Features

- Simplex Reservation
  - Reservation only in one direction (simplex flow)
- Receiver Oriented
  - Supports multicast communication
- Routing Independent
- Policy Independent
- Soft State
  - Reservation state has timer associated with the state
  - When timer expires, state is automatically deleted
  - RSVP periodically refreshes reservation state to maintain state along the path

Reservation Styles (1)

- Wild-card Filter Style
  - WF implies shared reservation and wild-card sender selection
  - All receivers share a single reservation whose size is the largest of the resource requests from the receivers
  - All upstream senders can use the reservation
  - **WF(*,{Q}),** where
    - * represents wild-card sender selection
    - {Q} represents Flow Spec.

Reservation Styles (2)

- Fixed-filter (FF) style
  - FF implies distinct reservation and explicit sender selection
  - Distinct reservation is established for specific sender
  - FF(S1(Q1), S2(Q2), … Sn(Qn)), where
    - S1, ..Sn are senders
    - Q1,…,Qn are corresponding flow specs

Reservation Styles (3)

- Shared explicit (SE) style (Dynamic filter)
  - SE implies shared reservation but explicit sender selection
  - SE creates a single reservation shared by specific senders
  - Receiver can explicitly list what senders are to be included in reservation
  - **SE((S1,..,Sn){Q}),** where
    - S1,…,Sn are senders
    - Q corresponding flow spec

Service Models

- Describe interface between network and its users in resource allocation architecture
- Describe what services users can ask from network and what kind of resource commitments the network can offer
- IntServ standard
  - Guaranteed Service
  - Controlled-load Service

Flow Specification (1)

(Traffic Shape General Parameters)

- Peak rate – highest rate at which a source can generate traffic
- Average rate – average transmission rate over a time interval
- Burst size – max amount of data that can be injected into network at peak rate

Flow Specification (2)
(in IntServ)

- Traffic described in terms of token bucket parameters
  - Token arrival rate ‘r’
  - Bucket depth ‘b’
- Amount of bits transmitted during any interval of length t: $A(t) \leq r * t + b$

Service Requirements
(Application-specific)

- Minimum Bandwidth - min. amount of BW required by application
- Delay – can be specified as average delay or worst case delay
  - Propagation delay + Transmission delay + Queuing delay
- Delay Jitter – specifies max. difference between the largest and smallest delays that packets experience
- Loss Rate – ratio of lost packets and total packets transmitted

Conclusion

- IntServ over Link Layers
  - IETF created Integrated Services over Specific Link Layers (ISSLL)
  - Keep in mind that one needs to do
    - Service mapping
    - Setup protocol mappings