EE 122: Integrated Services

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Integrated Services (Intserv)

- Provide three services (see last lecture)
  - Best-effort ("elastic" applications)
  - Hard real-time ("real-time" applications)
  - Soft real-time ("tolerant" applications)
An Intserv Node Architecture

- Routing
- RSVP
- Admission Control

Routing Messages
Control Plane
- RSVP messages

Data Plane
- Forwarding Table
- Per Flow QoS Table

Data In
- Route Lookup
- Classifier
- Scheduler

Data Out

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Data Plane

- **Input interface:**
  - Lookup: use forwarding table to select the router’s output interface to forward the packet

- **Output interface:**
  - Classification: classify each packet to the flow it belongs to
    - A flow identified by source and destination IP addresses, source and destination port numbers, protocol type
  - Buffer management
  - Scheduling: schedule each packet such that each flow achieves the promised service
    - E.g., Weighted Fair Queueing
Control Plane: Resource Reservation Protocol (RSVP)

- Signaling protocol for establishing per flow state required for
  - Admission control
  - Classification, buffer management, and scheduling
- Carry resource requests from hosts to routers
- Collect needed information from routers to hosts
- At each hop
  - Consult admission control and policy module
  - Set up admission state or informs the requester of the failure
RSVP Design Features

- IP Multicast centric design
- Receiver initiated reservation
- Different reservation styles (we skip this…)
- Soft state inside network
- Decouple routing from reservation
The Big Picture

Network

Sender

Receiver

PATH Msg
The Big Picture

Network

Sender

Receiver

PATH Msg

RESV Msg
RSVP Basic Operations

- Two message types: PATH and RESV
- Sender sends PATH message via the data delivery path
  - Set up the path state each router including the address of previous hop
- Receiver sends RESV message on the reverse path
  - Specify the reservation style, QoS desired
  - Set up the reservation state at each router
- Things to notice
  - Receiver initiated reservation
  - Decouple the routing from reservation
  - Two types of state: path and reservation
Route Pinning

- Problem: asymmetric routes
  - You may reserve resources on $R \rightarrow S_3 \rightarrow S_5 \rightarrow S_4 \rightarrow S_1 \rightarrow S$, but data travels on $S \rightarrow S_1 \rightarrow S_2 \rightarrow S_3 \rightarrow R$!

- Solution: use PATH to remember direct path from $S$ to $R$, i.e., perform route pinning
PATH and RESV messages

- PATH also specifies
  - Source traffic characteristics – use token bucket
  - Reservation style – specify whether a RESV message will be forwarded to this server

- RESV specifies
  - Queueing delay and bandwidth requirements
  - Source traffic characteristics (from PATH)
  - Filter specification, i.e., what senders can use reservation
  - Based on these routers perform reservation
Soft State

- Per session state has a timer associated with it
  - Path state, reservation state
- State lost when timer expires
- Sender/Receiver periodically refreshes the state, resends PATH/RESV messages, resets timer
- Claimed advantages
  - No need to clean up dangling state after failure
  - Can tolerate lost signaling packets
    - Signaling message need not be reliably transmitted
  - Easy to adapt to route changes
- State can be explicitly deleted by a Teardown message
RSVP and Routing

- RSVP designed to work with variety of routing protocols
- Minimal routing service
  - RSVP asks routing how to route a PATH message
- Route pinning
  - Addresses QoS changes due to “avoidable” route changes while session in progress
- QoS routing
  - RSVP route selection based on QoS parameters
  - Granularity of reservation and routing may differ
- Explicit routing
  - Use RSVP to set up routes for reserved traffic
Recap of RSVP

- **PATH message**
  - Sender template and traffic spec
  - Advertisement
  - Mark route for RESV message
  - Follow data path

- **RESV message**
  - Reservation request, including flow and filter spec
  - Reservation style and merging rules (relevant in the case of IP multicast)
  - Follow reverse data path

- **Other messages**
  - PathTear, ResvTear, PathErr, ResvErr