Data Networks – Signaling Resource Reservation Protocol (RSVP)

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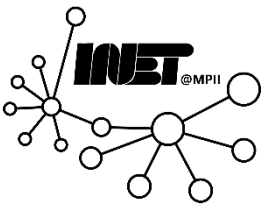
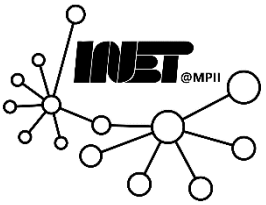


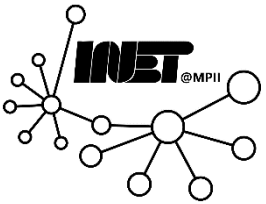
RSVP design goals

1. Accommodate heterogeneous receivers (different bandwidth along paths)
2. Accommodate different applications with different resource requirements
3. Make multicast a first class service, with adaptation to multicast group membership
4. Leverage existing multicast/unicast routing, with adaptation to changes in underlying unicast, multicast routes
5. Control protocol overhead to grow (at worst) linear in # receivers
6. Modular design for heterogeneous underlying technologies



RSVP does not …

- Specify how resources are to be reserved
  - Rather: a mechanism for communicating needs
- Determine routes packets will take
  - That's the job of routing protocols
  - Signaling decoupled from routing
- Interact with forwarding of packets
  - Separation of control (signaling) and data (forwarding) planes



RSVP: Overview of operation

Senders and receivers join a multicast group

- Done outside of RSVP
- Senders need not join group

Sender-to-network signaling

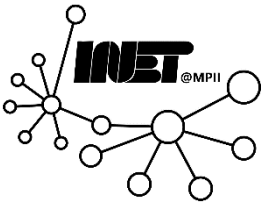
- *Path message:* make sender presence known to routers
- Path teardown: delete sender's path state from routers

Receiver-to-network signaling

- *Reservation message:* reserve resources from sender(s) to receiver (specified by the receiver)
- Reservation teardown: remove receiver reservations

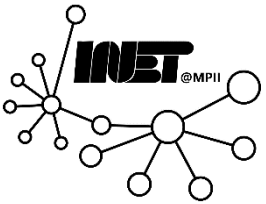
Network-to-end-system signaling

- Path error
- Reservation error



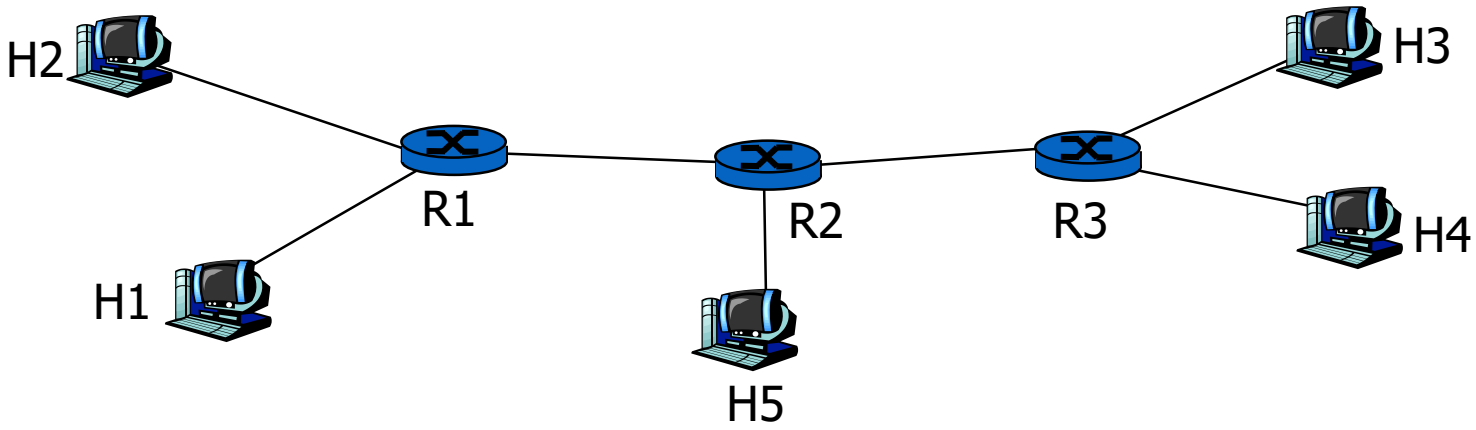
Path msgs: RSVP sender-to-network signaling

- Path message contents:
  - Address: Unicast destination, or multicast group
  - Flowspec: Bandwidth requirements spec.
  - Filter flag: If yes, record identities of upstream senders (to allow packets filtering by source)
  - Previous hop: Upstream router/host ID
  - Refresh time: Time until this info times out
- Path message: Communicates sender info, and reverse-path-to-sender routing info
  - Also: Upstream forwarding of receiver reservations (later)



RSVP: Simple audio conference

- H1, H2, H3, H4, H5 both senders and receivers
- Multicast group m1
- No filtering: Packets from any sender forwarded
- Audio rate: b
- Only one multicast routing tree possible

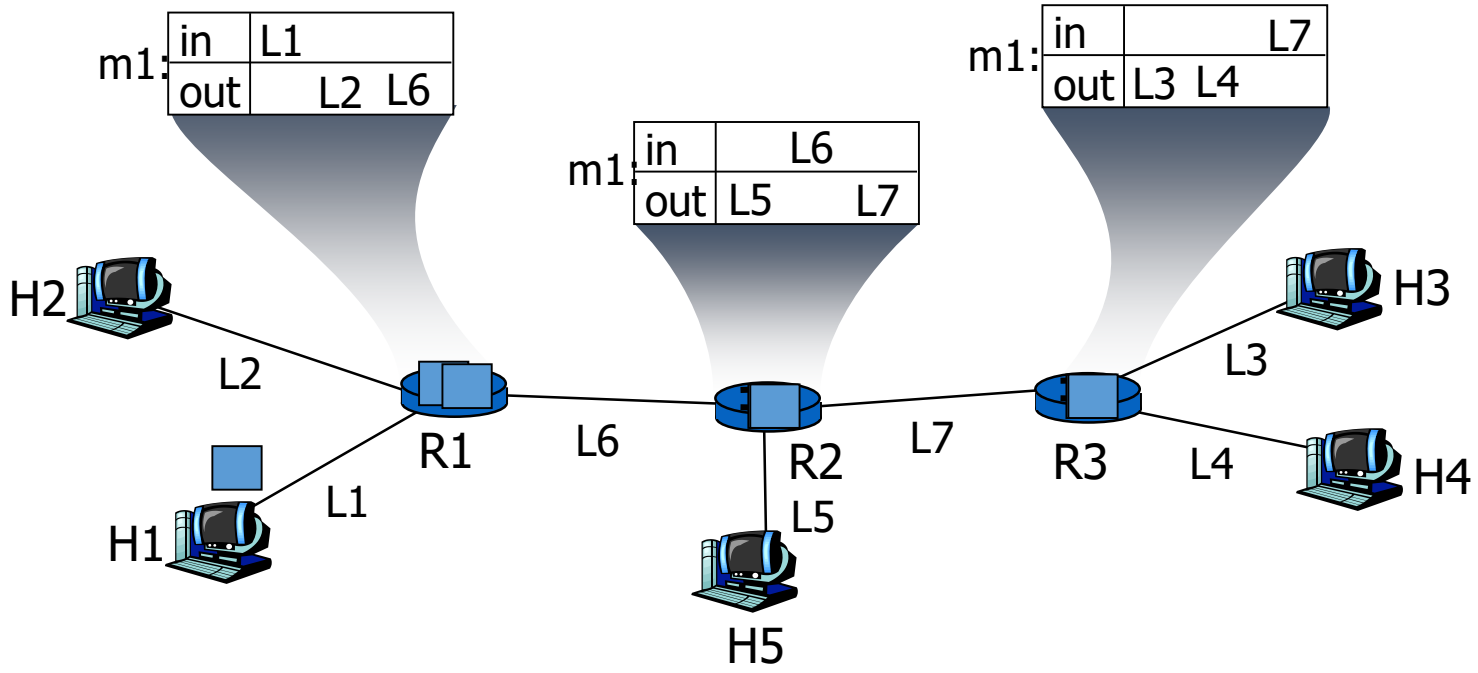


RSVP: Building up path state

- H1, …, H5 all send path messages on m1:

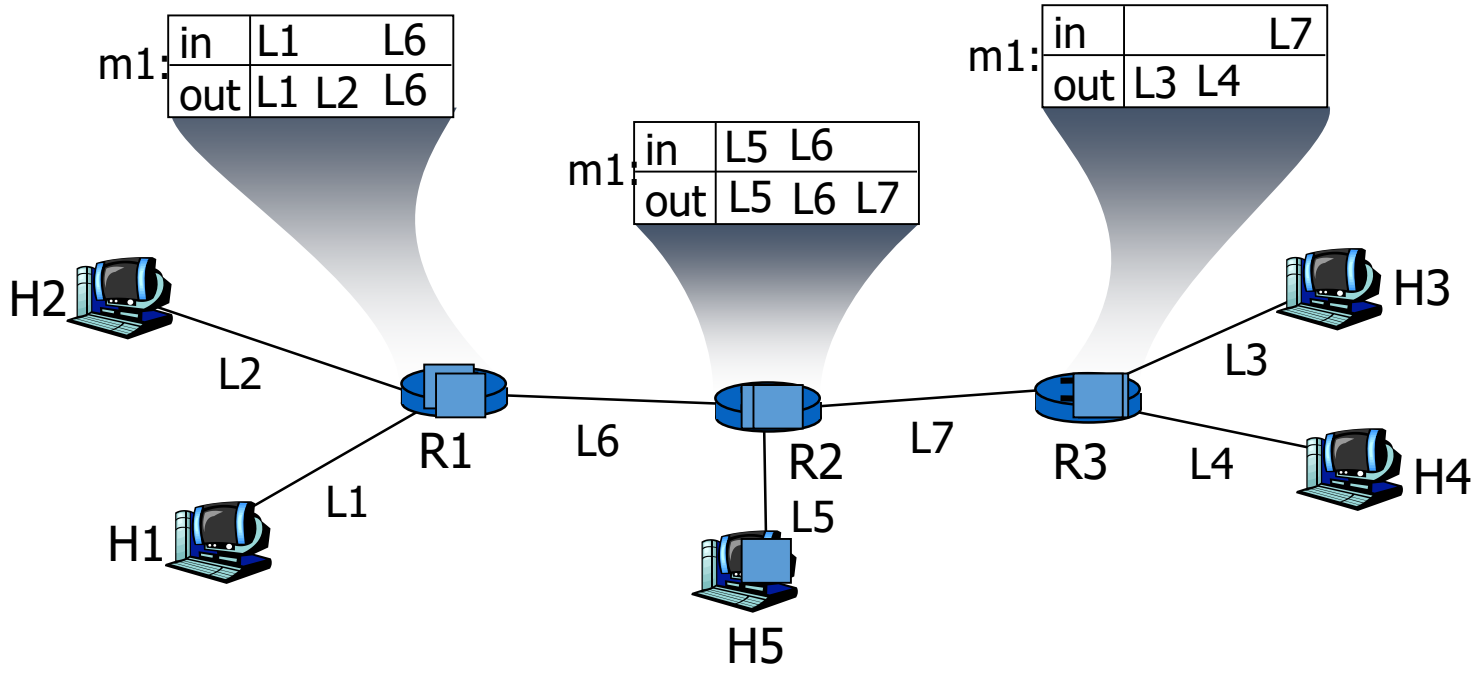
  (address=m1, Tspec=b, filter-spec=no-filter, refresh=100)

- Suppose H1 sends first path message



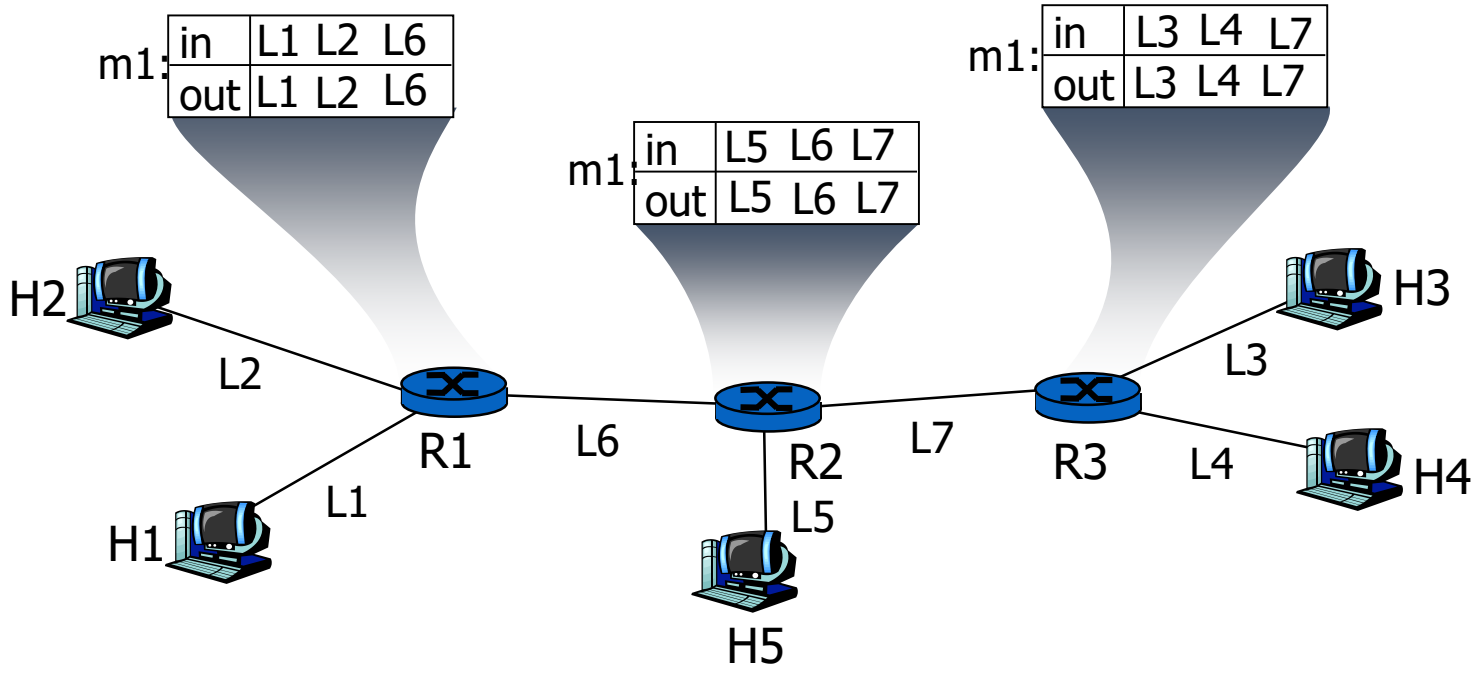
RSVP: Building up path state

- Next, H5 sends path message, creating more state in routers



RSVP: Building up path state

- H2, H3, H5 send path msgs, completing path state tables

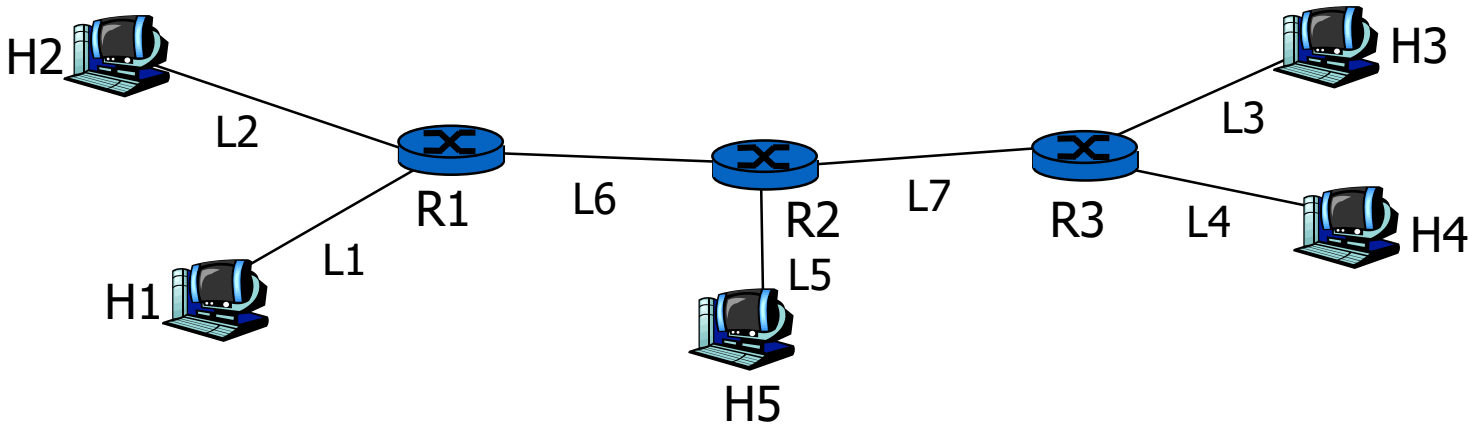


Reservation msgs: Receiver-to-network signal

- Reservation message contents:
  - Desired bandwidth
  - Filter type (who can use the reservation)
  - Filter spec (data for the filter, e.g., sender names)
- Reservations flow upstream from receiver-to-senders, reserving resources, creating additional, receiver-related state at routers

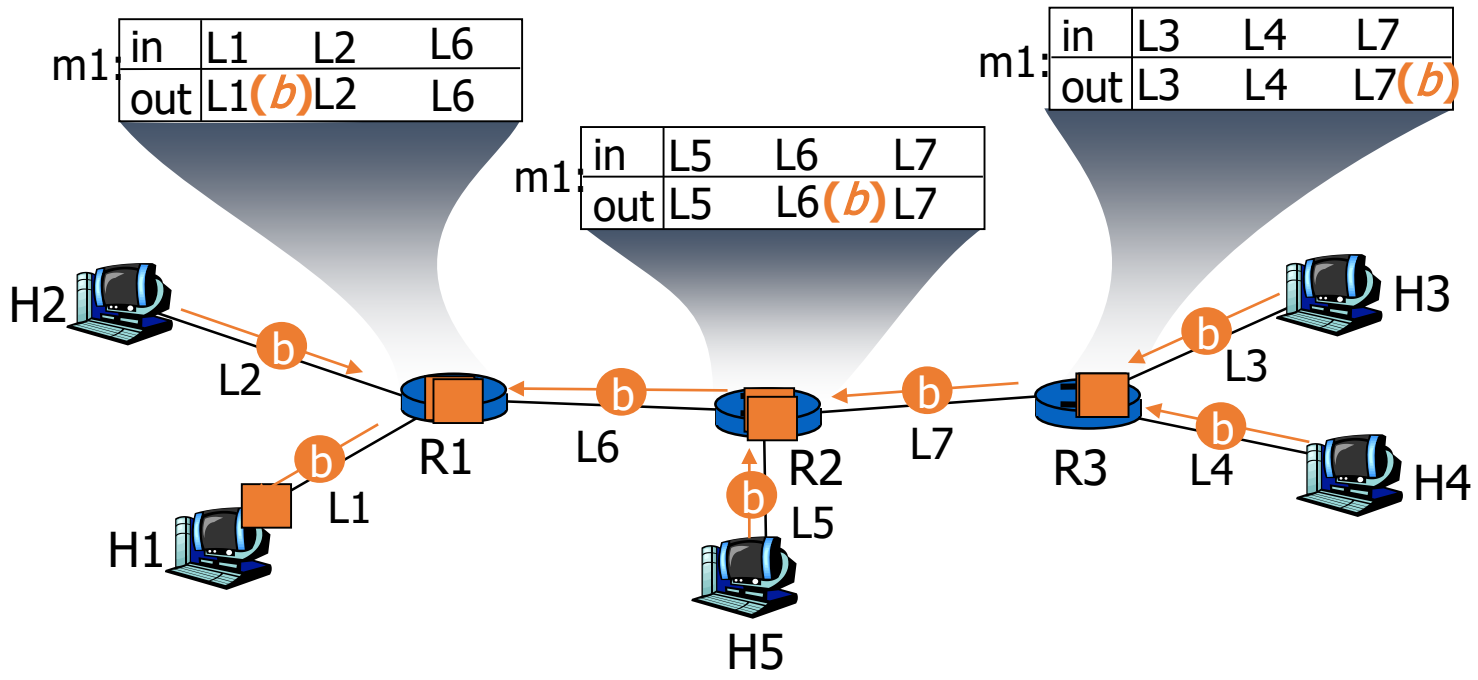
RSVP: Receiver reservation – example

- H1 wants to receive audio from all other senders
- H1 reservation msg flows uptree to sources
- H1 only reserves enough bandwidth for 1 audio stream
- Reservation is of type "no filter" – any sender can use reserved bandwidth



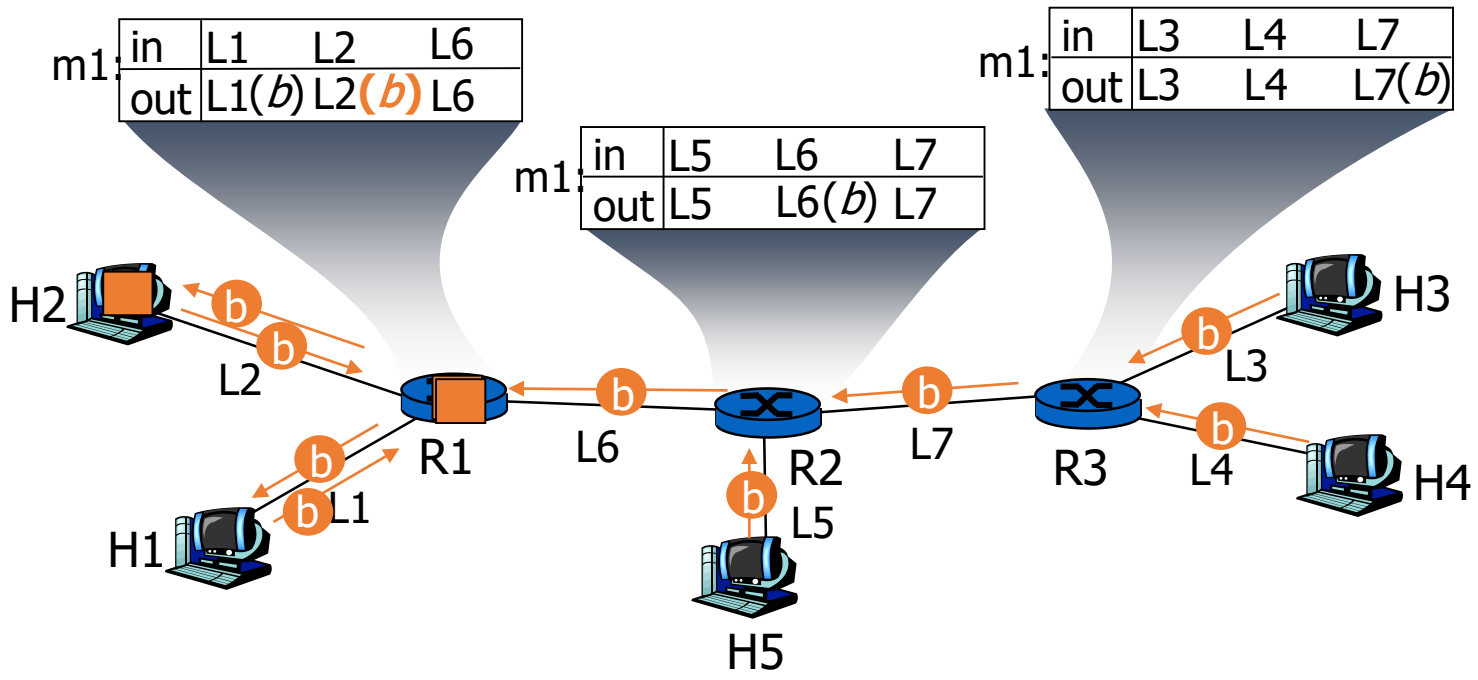
RSVP: Receiver reservation – example

- H1 reservation msgs flows uptree to sources
- Routers, hosts reserve bandwidth b needed on downstream links towards H1



RSVP: Receiver reservation – example

- Next, H2 makes no-filter reservation for bandwidth b
- H2 forwards to R1, R1 forwards to H1 and R2
- R2 takes no action, since b already reserved on L6

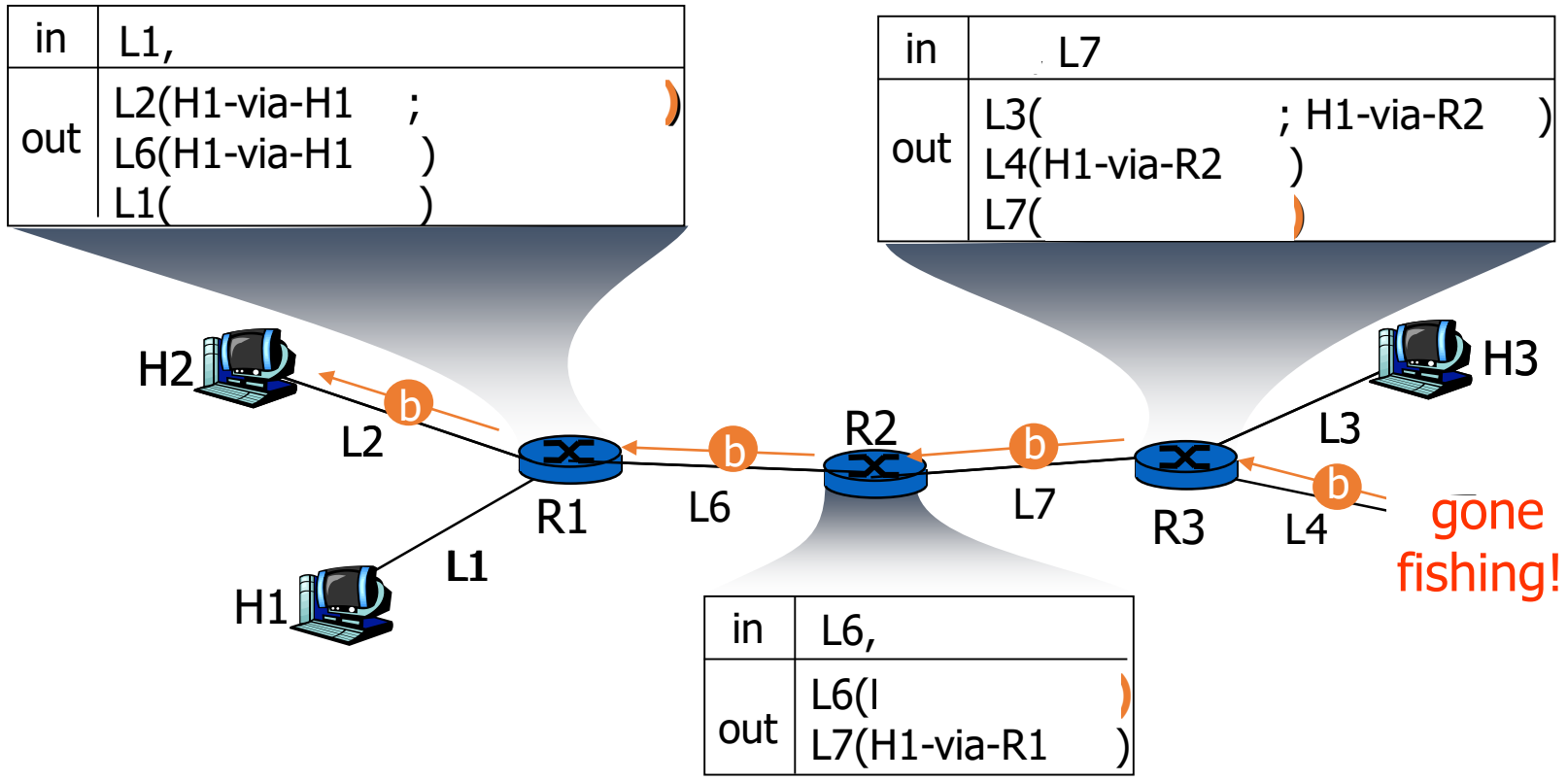


RSVP: Soft-state

- Senders periodically resend path msgs to refresh (maintain) state
- Receivers periodically resend resv msgs to refresh (maintain) state
- Path and resv msgs have TTL field, specifying refresh interval

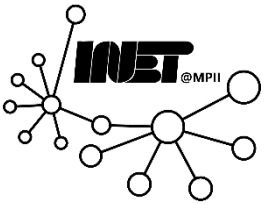
RSVP: Soft-state

- Suppose H4 (sender) leaves without performing teardown
- Eventually state in routers will timeout and disappear!



Use cases for reservation/path refresh

- Recover from an earlier lost refresh message
  - Expected time until refresh received must be shorter than timeout interval!
- Handle receiver/sender that goes away without teardown
  - Sender/receiver state will timeout and disappear
- Path changes will be reflected in the “new reservations”
- Reservation refreshes will cause new reservations to be made to a receiver from a sender who has joined since receivers last reservation refresh



RSVP: Some reflections

- Multicast as a "first class" service
- Receiver-oriented reservations
- Use of soft-state

Signaling

Signaling: Exchange of messages among network entities to enable (provide service) to connection/call

Before, during, after connection/call

- Call setup and teardown
- Call maintenance
- Measurement, billing

Between

- End-user <-> network
- End-user <-> end-user
- Network element <-> network element