What is RSVP

- **RSVP is a network control protocol that will allow Internet applications to obtain special qualities-of-service for their data flows.**
  - This will generally require reserving resources along the data path(s).
  - RSVP is a component of the future "integrated services" Internet, which will provide both best-effort and real-time qualities of service
  - When an application in a host requests a specific QoS for its data stream, RSVP is used to deliver the request to each router along the path(s) of the data stream and to maintain router and host state to provide the requested service.
  - Although RSVP was developed for setting up resource reservations, it is easily adaptable to transport other kinds of network control information along data flow paths.

Quality of Service

- Marking
- Queuing
- Policing
- Admission Control

Diffserv:

- **Different classes of traffic marked appropriately (DSCP marking)**
- **Queue accordingly**

Quality of Service

- Marking
- Queuing
- Policing
- Admission Control

At the trust boundary:

- **per user, per interface**
- **per flow (RSVP)**

Quality of Service

- Marking
- Queuing
- Policing
- Admission Control

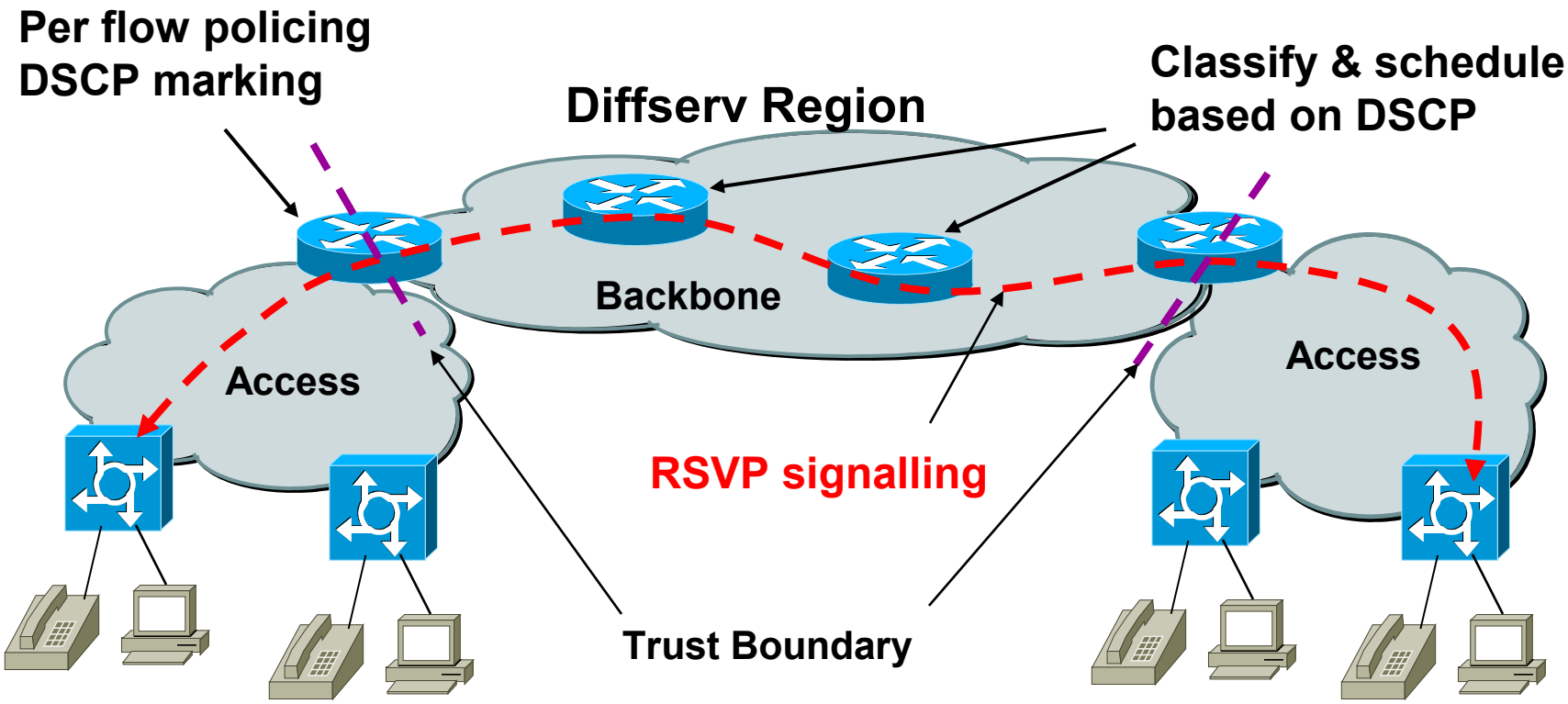
Is there over-subscription?:

- **of data (usually)**
- **of voice (maybe – if yes – admission control is required – i.e. RSVP)**

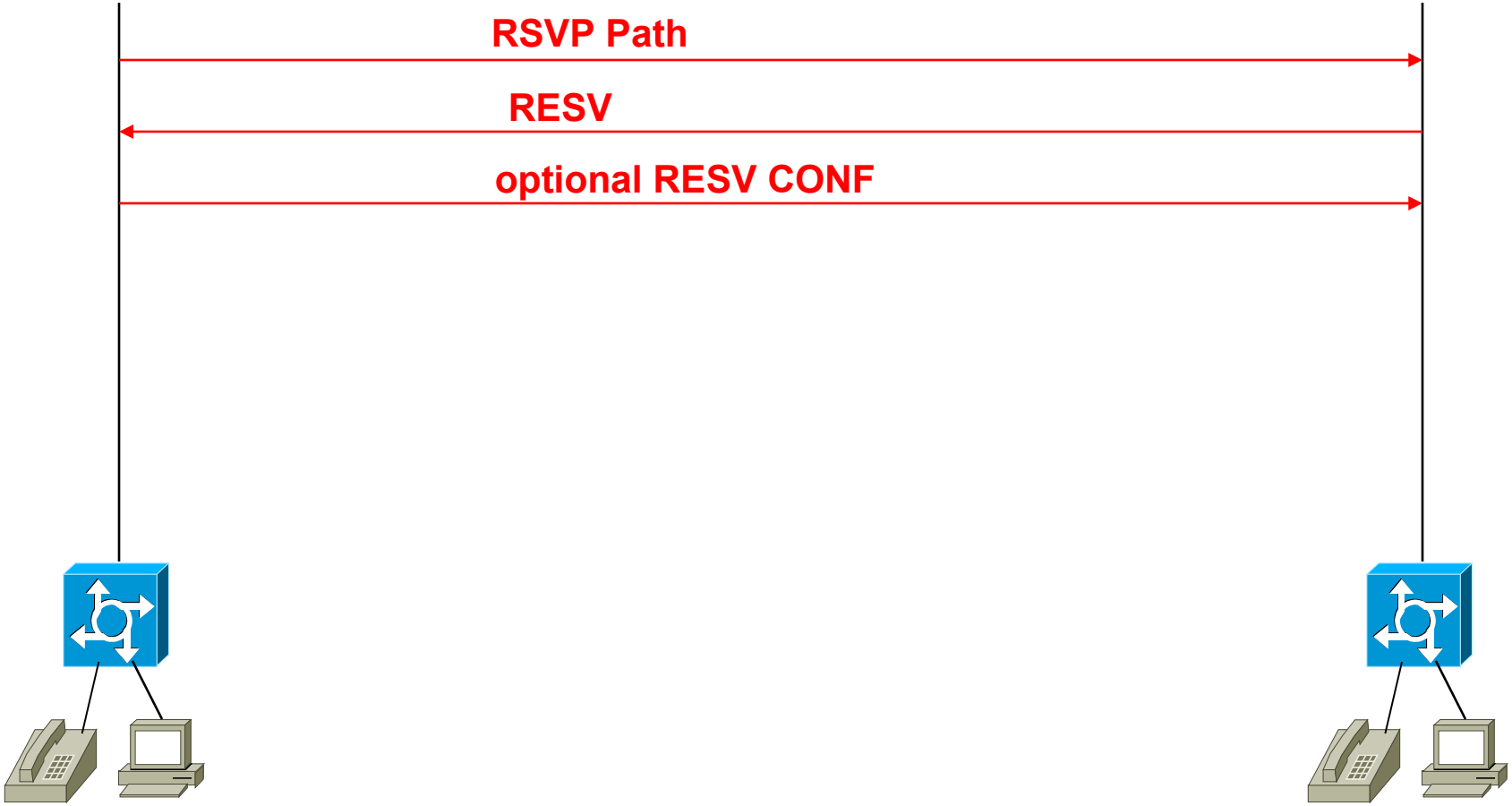
Admission Control - RSVP

- **RSVP is used for signaling end to end**
  (admission control based on bandwidth, QOS requirements)
- **Per-Flow policing is rarely done in the core/backbone Instead:**
  - In the access: Per flow reservation state is maintained; Per flow policing
  - At the edge of the backbone: per flow policing, marking
  - In the backbone: Queuing based on marking (DSCP, MPLS – i.e. reservation state is not maintained)

Quality of Service – Use of RSVP



RSVP Signaling



SoftSwitch and RSVP

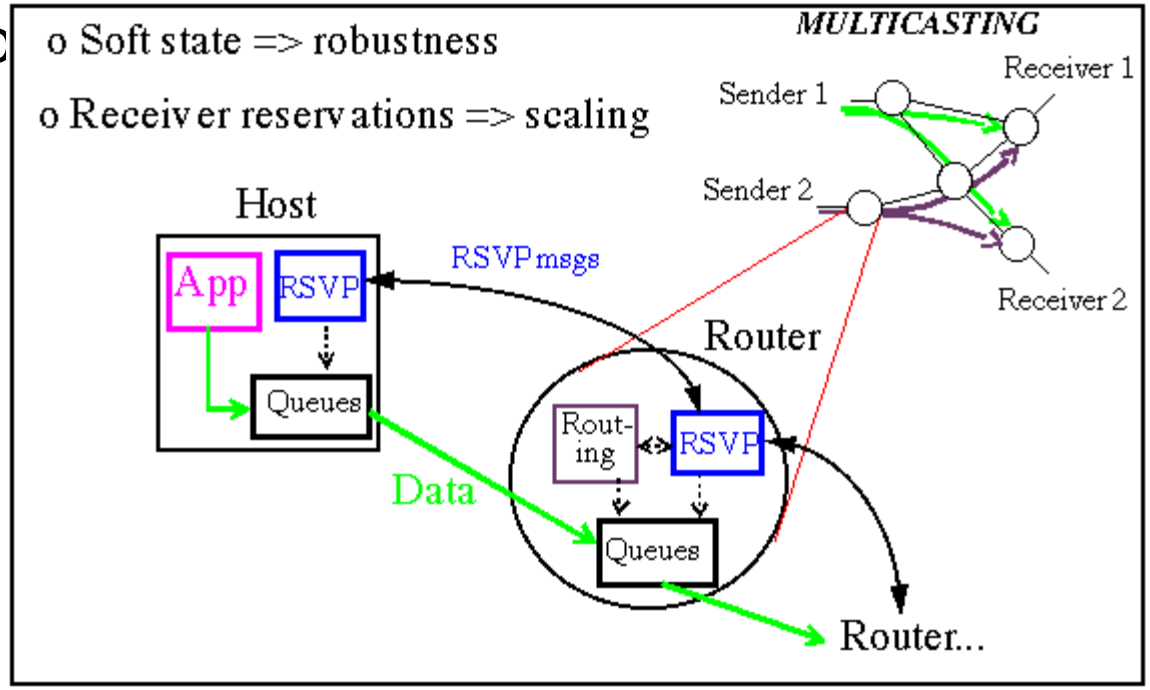
- Softswitch controls how RSVP is used while it controls call signaling i.e.:
  - Request reservations in both directions
  - Don’t ring the phone until I get confirmation that reservations have been obtained

RSVP Basic Functionality

- **RSVP handles heterogeneous receivers.**
  - Different hosts on the same multicast delivery tree may have different capabilities and therefore need different QoS.
- **RSVP adapts to changing group membership as well as changing routes.**
  - For dynamic adaptability and robustness, RSVP maintains “soft state” in the routers. The only permanent state is in the end systems, which periodically send their RSVP control messages to refresh the router state. In the absence of refresh, RSVP state in routers will time out and be deleted.
- **RSVP is not a routing protocol.**
  - The RSVP daemon consults the local routing protocol(s) to obtain routes. RSVP is designed to operate with existing and future unicast and multicast routing protocols. A host sends IGMP messages to join a multicast group, but it uses RSVP messages to reserve resources along the delivery path(s) from that group.

RSVP Operational Principles

- **A QoS request from an application is passed to the local RSVP implementation (user daemon). RSVP passes the request to all the nodes along the reverse data path to the destination.**
  - RSVP provides transparent operation through rc



RSVP Operational Principles

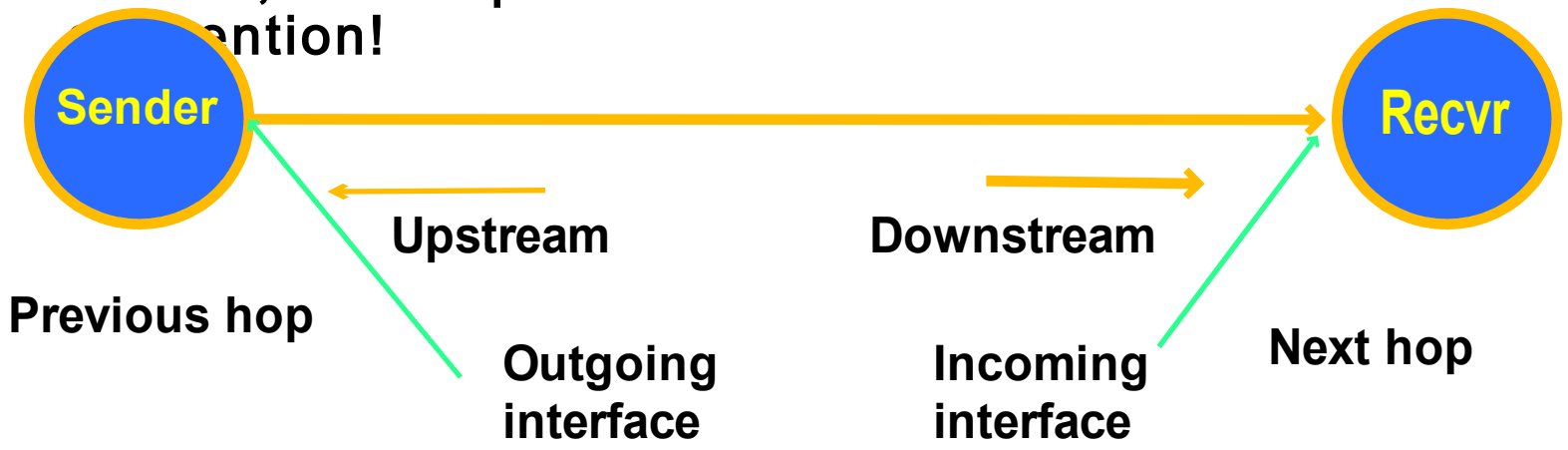
- **At each node, RSVP applies a local decision procedure (admission control) to the QoS request.**
  - If admission control succeeds, it sets the parameters to the Classifier and Packet Scheduler to obtain the desired QoS. If admission control fails at any node, RSVP returns an error indication to the application.
- **Each router in the path capable of resource reservation will pass incoming data packets to a Packet Classifier and then queue them in a Packet Scheduler.**
  - The Packet Classifier determines the route and the QoS class for each packet. The Scheduler allocates a particular outgoing link for packet transmission.
- **For QoS-active link-layer media the packet scheduler is responsible for negotiation with the link layer to obtain the QoS requested by RSVP.**
  - Mapping to the link layer QoS may be accomplished in a number of possible ways; the details will be medium-dependent. On a QoS-passive medium such as a leased line, the scheduler itself allocates packet transmission capacity. The scheduler may also allocate other system resources such as CPU time or buffers.

RSVP Operational Principles

- **RSVP is designed to scale well for very large multicast groups.**
  - RSVP uses "soft state" in the routers, i.e., RSVP sends periodic refresh messages to maintain the state along the reserved path; in absence of refreshes, the state will automatically time out and be deleted.
- **RSVP reserves resources for simplex data streams, i.e., it reserves resources in only one direction on a link**
  - A sender is logically distinct from a receiver. However, the same application may act as both sender and receiver.
- **RSVP mechanisms provide a general facility for creating and maintaining distributed reservation state across a mesh of multicast delivery paths.**
  - RSVP transfers reservation parameters as opaque data (except for certain well-defined operations on the data), which it simply passes to admission control and to the Packet Scheduler and Classifier for interpretation.

RSVP Reservation Model

- **An elementary RSVP reservation request consists of a "flowspec" and a "filter spec"; this pair is called a "flow descriptor".**
  - The flowspec specifies a desired QoS. It is used to set parameters to the node's packet scheduler, assuming that admission control succeeds.
  - The filter spec, together with a session specification, defines the set of data packets -- the "flow" -- to receive the QoS defined by the flowspec. Filter spec is used to set parameters in the packet classifier.
  - Data packets that are addressed to a particular session but do not match any of the filter specs for that session are handled as best-effort traffic.
- **Please, note "upstream" and "downstream" [illegible]ntion!**



RSVP Reservation Model

- **The flowspec in a reservation request will generally include a service class and two sets of numeric parameters:**
  - an "Rspec" (R for `reserve') that defines the desired QoS,
  - a "Tspec" (T for `traffic') that describes the data flow.
  - The formats and contents of Tspecs and Rspecs are determined by the integrated service model, and are generally opaque to RSVP.
- **Filter specs may select arbitrary subsets of the packets in a given session.**
  - Subsets might be defined in terms of
    - senders (i.e., sender IP address and generalized source port),
    - a higher-level protocol
    - any fields in any protocol headers in the packet.
      - Example: filter specs might be used to select different subflows in a hierarchically-encoded signal by selecting on fields in an application-layer header.
      - Current RSVP software does not yet support this option.
  - Because the UDP/TCP port numbers are used for packet classification, each router must be able to examine these fields.

RSVP Reservation Model

- **RSVP reservation request messages originate at receivers and are passed upstream towards the sender. At each intermediate node, two general actions are taken:**
  - Make a reservation
    - The request is passed to admission control and policy control.
      - If either test fails, the reservation is rejected and RSVP returns an error message to the appropriate receiver.
      - If both succeed, the node uses the flowspec to set up the packet scheduler for the desired QoS and the filter spec to set the packet classifier to select the appropriate data packets.
  - Forward the request upstream
    - The reservation request is propagated upstream towards the appropriate senders. The set of sender hosts to which a given reservation request is propagated is called the "scope" of that request.
  - Forwarded reservation request may differ from the request that it received from downstream:
    - reservations for the same sender from different downstream branches of the tree are "merged" as reservations travel upstream; a node forwards upstream only the reservation request with the "maximum" flowspec.
    - reservation might be purposefully modified by traffic control.

RSVP Protocol Mechanisms

- RSVP Messages
  - Two basic RSVP message types: Resv and Path.
    - Each receiver host sends RSVP reservation request (Resv) messages upstream towards the senders.
    - Resv messages must follow exactly the reverse of the routes the data packets will use, upstream to all the sender hosts included in the sender selection.
    - Resv messages are delivered to the sender hosts themselves so that the hosts can set up appropriate traffic control parameters for the first hop.

RSVP Protocol Mechanisms

- RSVP Messages
  - Two basic RSVP message types: Resv and Path.
    - Each RSVP sender host transmits RSVP Path messages downstream along the uni-/multicast routes provided by the routing protocol(s), following the paths of the data.
    - Path messages store "path state" in each node along the way. This path state includes at least the unicast IP address of the previous hop node, which is used to route the Resv messages hop-by-hop in the reverse direction.