A Proposal on Simple Reservation Protocol

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Network Architecture Overview

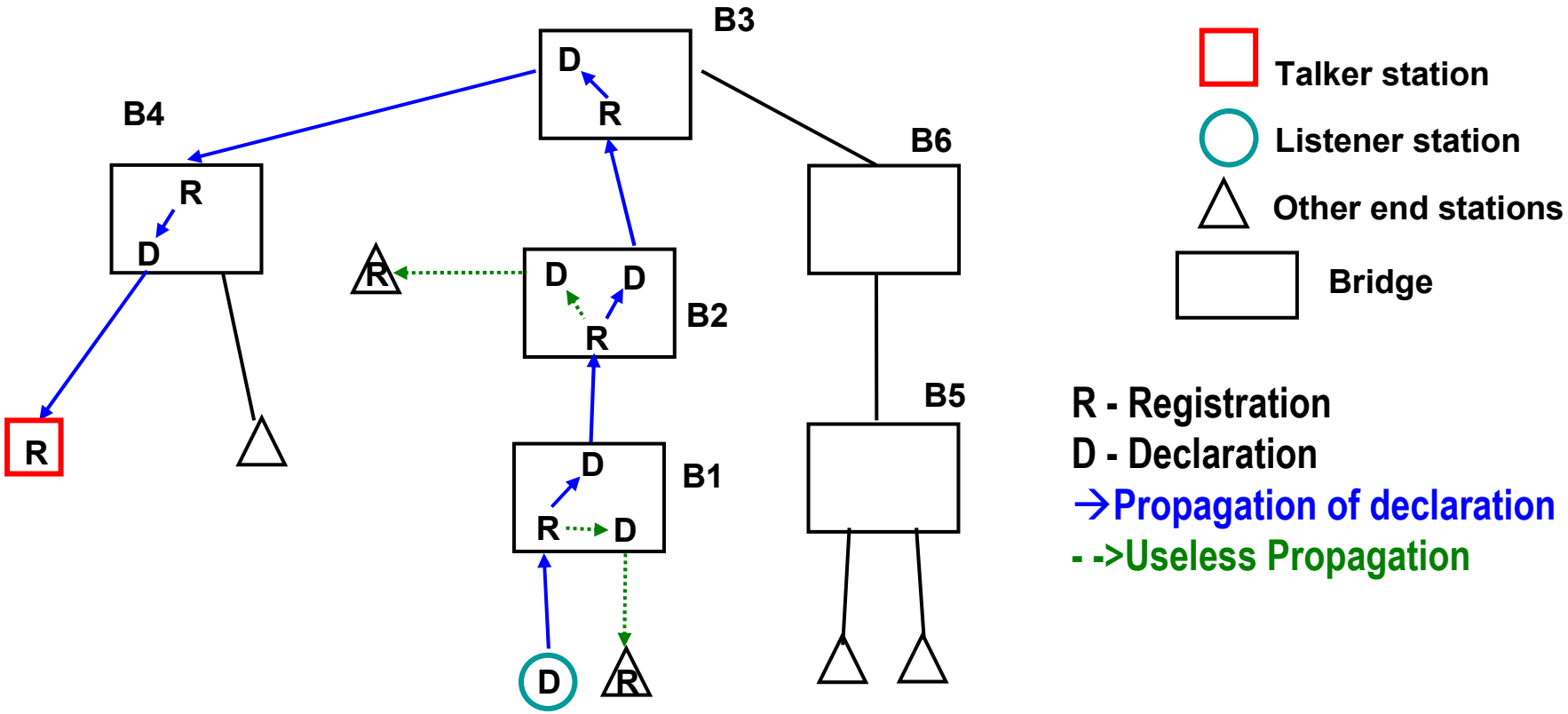
- Identifying and forwarding of isochronous stream data frames
  - Each isochronous stream will be assigned with a locally unique identifier
    - The identifier might use MAC addresses (multicast addresses or unicast addresses), VLAN tags, or other formats.
      - –Choosing among these formats is another discussing topic out of this document.
  - Bridge forwards isochronous stream data frames according to its isochronous filtering database (reservation state database)
    - Isochronous filtering database defines whether a certain port should forward or filter a certain isochronous stream data frames. The default value is “filtering”.
    - Isochronous data frames will be forwarded to outbound ports that are explicitly enabled in the isochronous filtering database
    - Isochronous data frames will never be aimlessly flooded
- SRP is employed to manage isochronous streams by updating isochronous filtering database of each bridge along the isochronous stream paths.

Protocol Framework

- The signaling is divided in to two parts→ a GARP based signaling part (GSRP) and a RESV signaling part:
  - Listener uses GARP to show its intention of joining specified isochronous stream
    - With GARP registration, the talker and intermediate bridges know where are potential listeners and how to get to them
  - Talker sends out RESV (reservation) signaling towards its listeners
    - RESV signaling triggers admission control operations in intermediate bridges, and locks resources if the admission control is successful.
    - RESV signaling servers as the end-to-end ACK/NACK signaling to listeners
- Both parts of signaling are based on soft-state mechanism. Both parts utilize signaling merging characteristic
  - GARP is a soft-sate based protocol with signaling merging function
  - RESV signaling is periodically refreshed. Talker multicast RESV signaling to listeners instead of individually sending one copy to each listener

Example: first stream

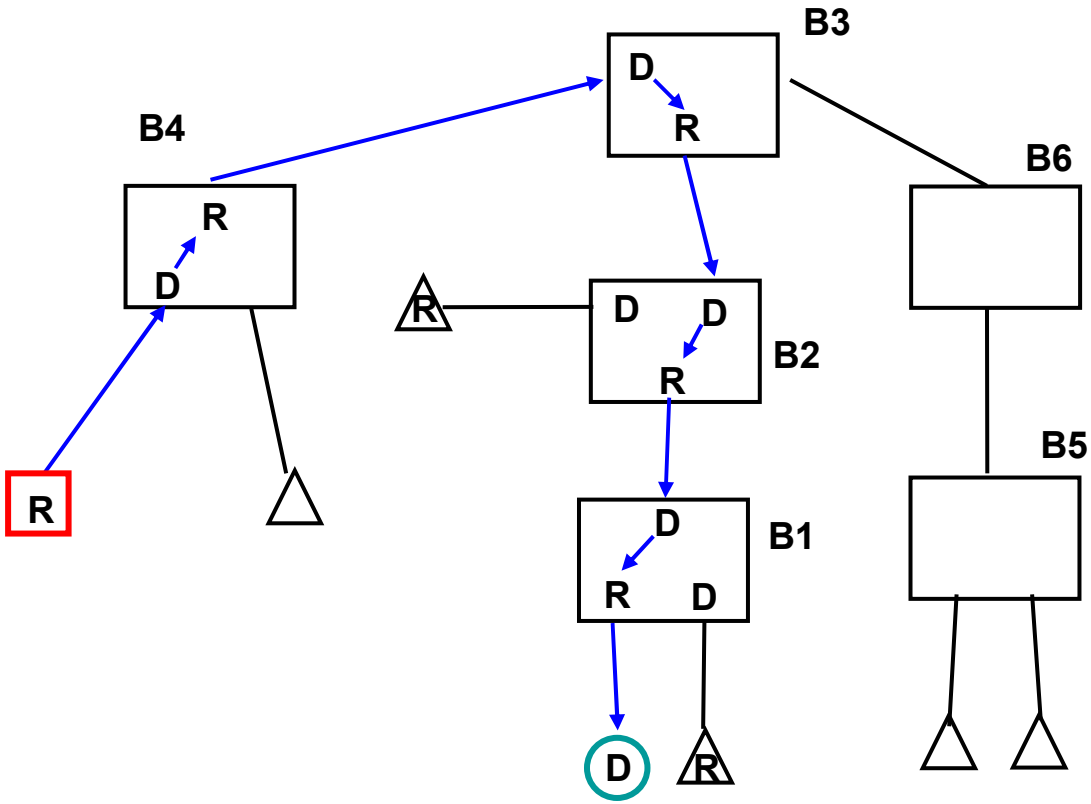
❑GSRP part



- With GSRP registration, the talker and intermediate bridges know where are potential listeners and how to get to them
- Assume in the above figure, B3/B4 have learnt the talker's address, and B1/B2 haven't, then:
  - GSRP floods the registration if the talker's address is not in the bridge FDB (eg. B1, B2)
  - GSRP relays the registration through specific outbound port if the talker's address is known by the bridge FDB (eg. B3, B4)

Example: first stream (cont.)

- RESV part: example of successful reservation

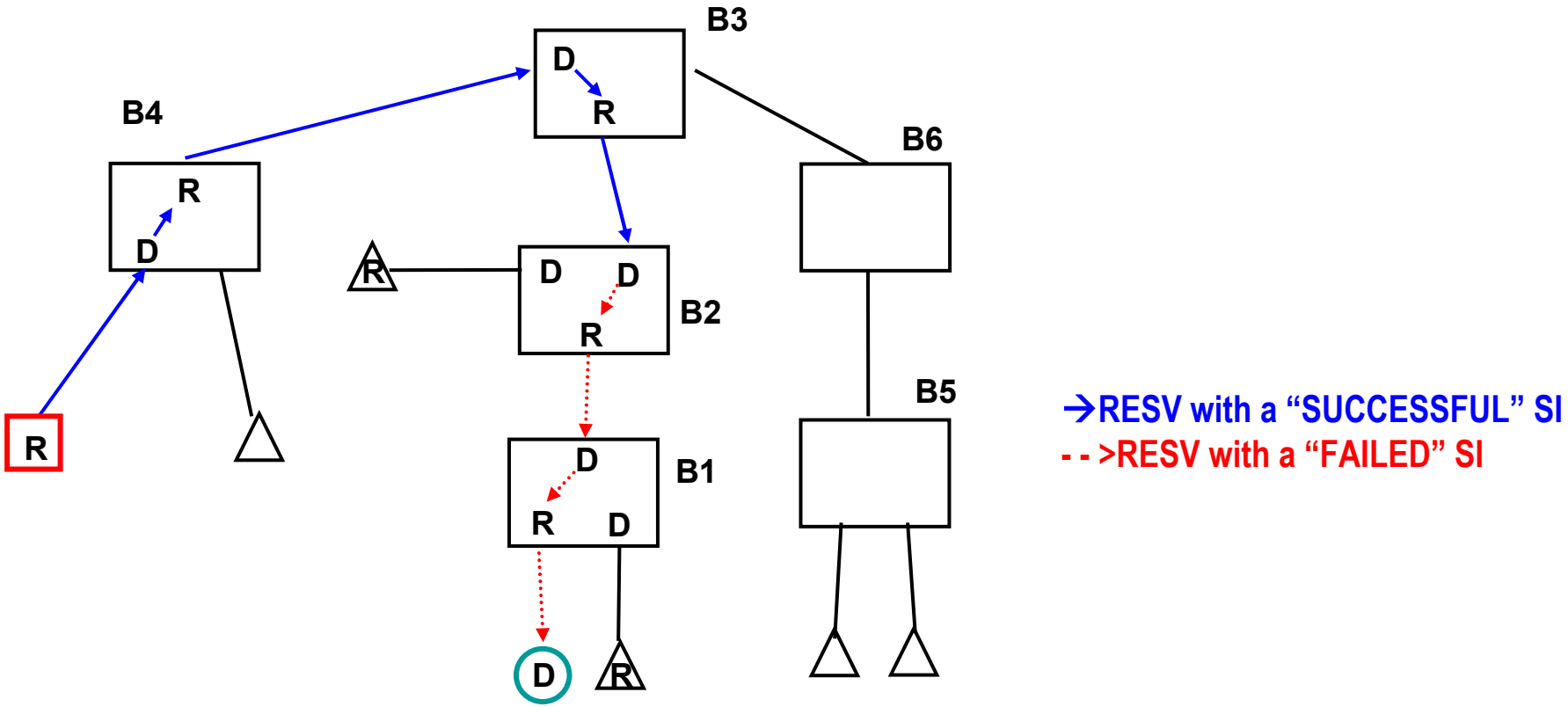


→Propagation of RESV

- RESV signaling triggers admission control operations in intermediate bridges. It also locks resources and updates isochronous filtering database if the admission control is successful.
- In this example, admission control is successful along the whole path. RESV signaling servers as the end-to-end explicit ACK signaling to listener.

Example: first stream (cont.)

- RESV part: example of failed reservation



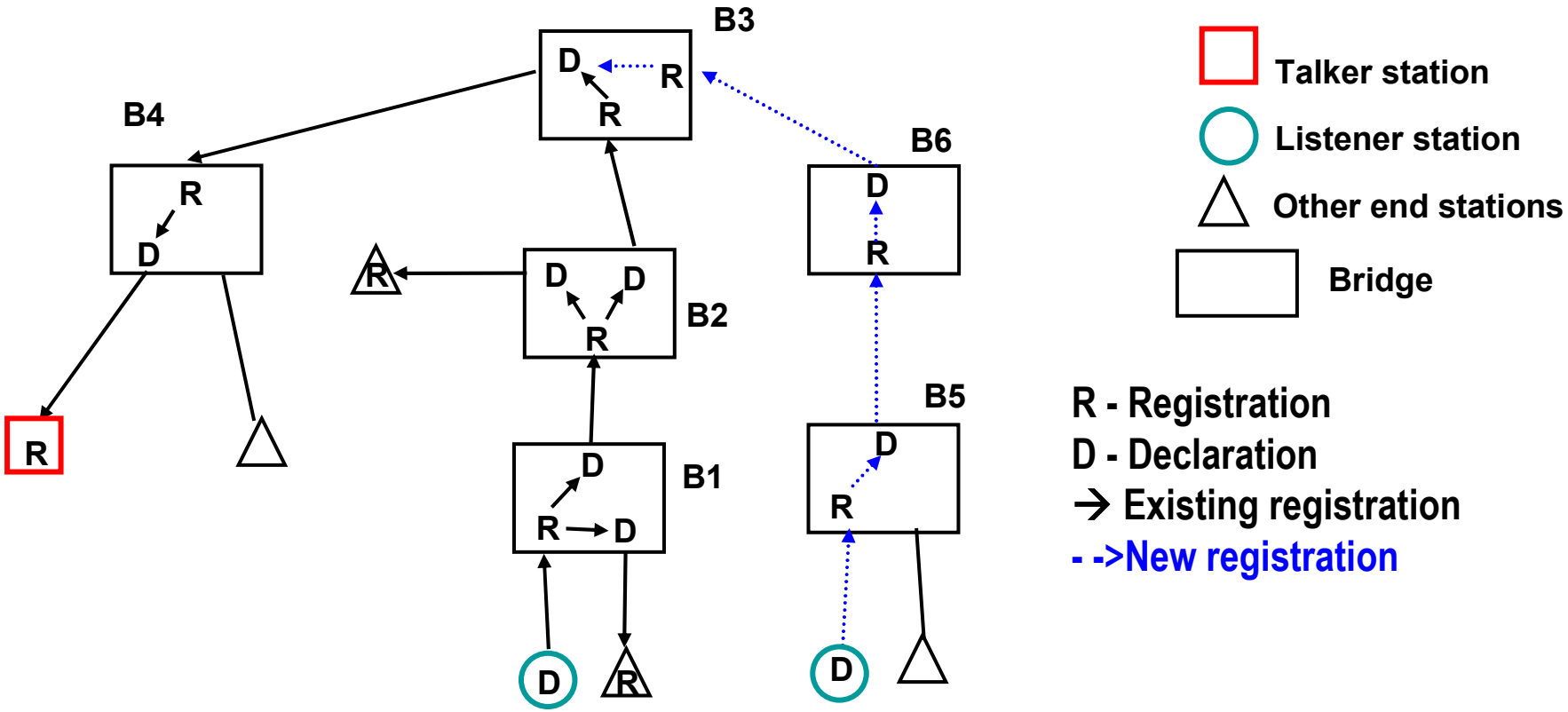
→RESV with a "SUCCESSFUL" SI

- - >RESV with a "FAILED" SI

- In this example, admission control is failed at B2. The SI (Status Indication) bit of RESV signaling will be set to FAILED.
- The RESV is still forwarded to the listener. However, downstream bridges (i.e., B1, B2) will not lock resources for the RESV signaling whose SI is set to FAILED.
- Listener is noted of the failure since RESV with FAILED SI serves as an end-to-end explicit NACK

Example: second stream

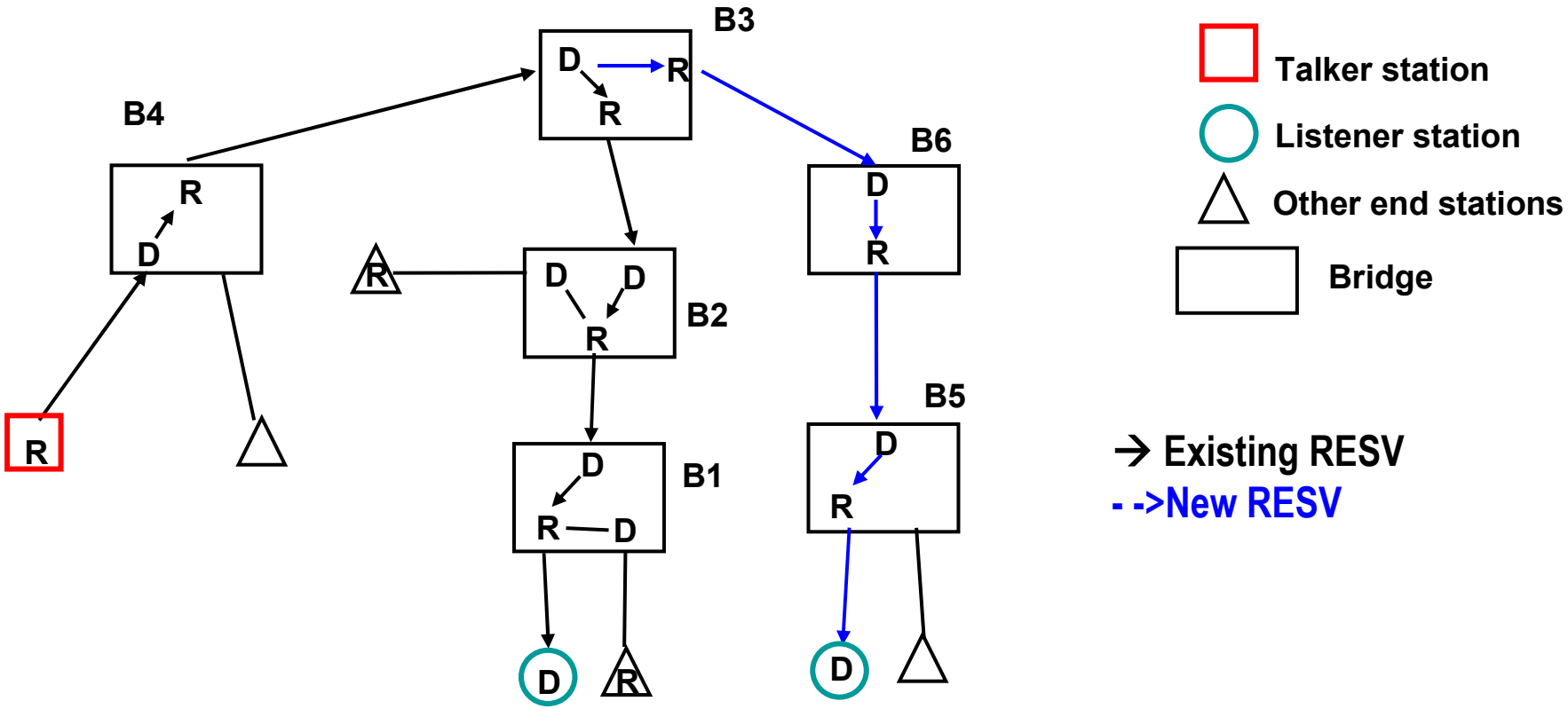
- The second listener joins stream using GSRP



- As per GARP, registration from different listeners in a stream session is merged in the intermediate bridges according to the multicast tree topology.

Example: second stream (cont.)

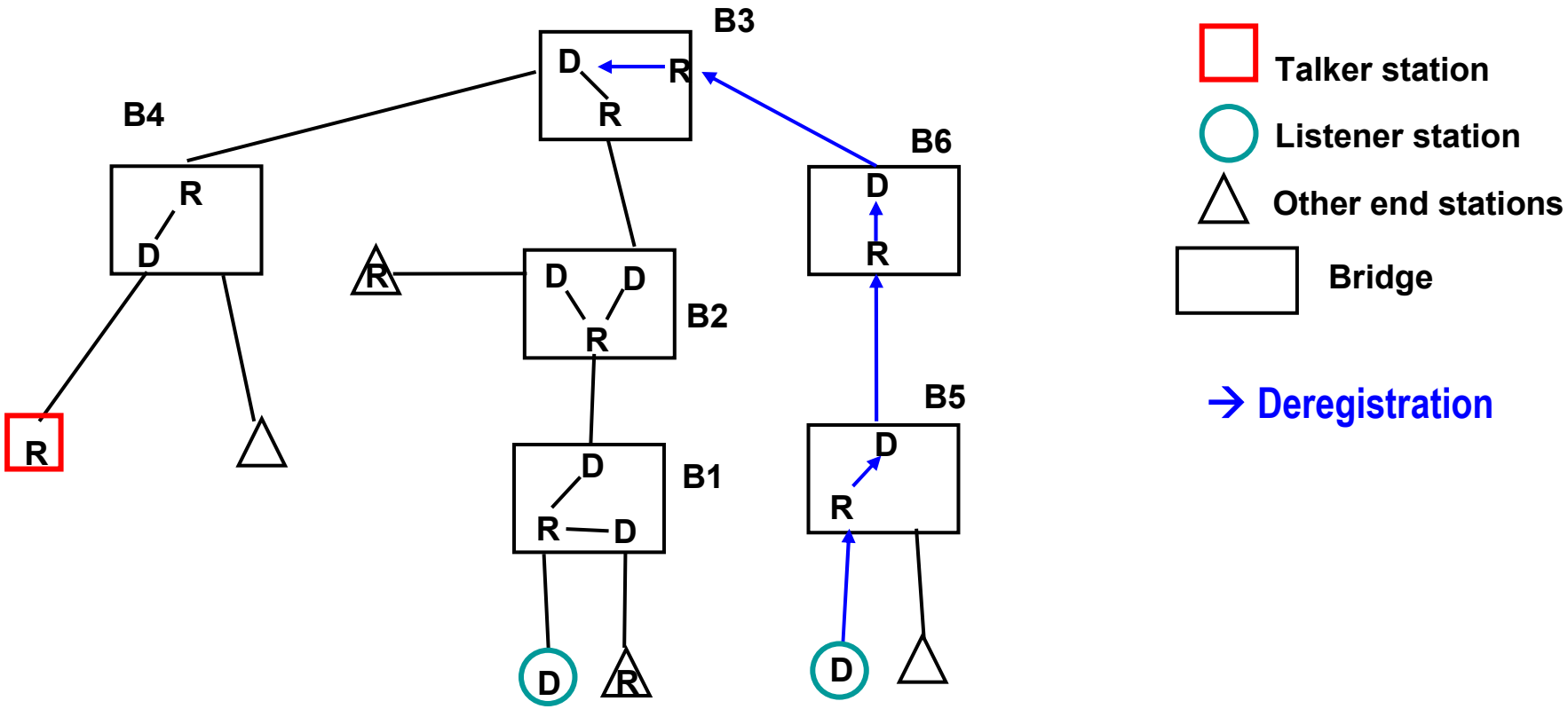
- Intermediate bridge issues new RESV



- The reservation response delay is then disassociated from the RESV refresh timer value
- SI (status indication) bit of this new RESV might be set to either SUCCESSFUL or FAILED according to the reservation state in upstream

Example: teardown stream

- Listener uses GARP de-registration to leave isochronous stream



- Upon GSRP deregistration, intermediate bridges release resources that were previously locked for this listener. Isochronous filtering (reservation state) database will be updated correspondingly.
- As per GARP, other listeners will not be affected.

GSRP outline

- GSRP is defined as a GARP application, like GMRP and GVRP
  - The information registered, de-registered, and disseminated via this GARP application are the isochronous stream identifier information, and other optional service requirement information (eg. reservation policy)
  - Registration of stream identifier information makes bridges/end-stations aware that reservation for this stream should only be forwarded in the direction of the registered members of the stream. Therefore, forwarding of RESV signaling frames for this stream occurs only on ports on which such identifier registration has been received. (Reservation and RESV signaling will be elaborated later)
- Use of GARP in point-to-point LANs
  - Since ResE is restricted to be point-to-point LAN, GSRP will use a simplified GARP state machine (see IEEE802.1D 2004 12.6.10)
- Signaling reducing in GSRP (see slide 4 as an example)
  - In the case of ResE, the address of the talker of a certain stream is known. Then the signaling overhead can be reduced by disseminating registration/deregistration information towards only the talker purposely, other than the aimlessly flooding mechanism. More specifically:
    - Any GID_Join.indication received by GIP from a given port is propagated as a GID_Join.request to the instance(s) of GID associated with each port who is a “forwarding” port for the corresponding talker address according to the bridge’s FDB.
    - Any GID_Leave.indication received by GIP from a given port is propagated as a GID_Leave.request to the instance(s) of GID associated with each port who is a “forwarding” port for the corresponding talker address according to the bridge’s FDB.

GSRP outline (cont.)

❑Message addressing and format

- As per GARP specification, each GARP application uses a unique group MAC address as the destination address of GARP PDUs, for example:
  - GMRP Address: 01-80-C2-00-00-20
  - GVRP Address : 01-80-C2-00-00-21
- IEEE802.1ak draft 1.0: Each MRP application uses a unique Ethertype value in order to identify the application protocol.
- GSRP message structure is conformance to GARP. Encoding of GSRP attribute values will be defined further:
  - Based on the format of stream identifier
  - Encoding of other affiliated attributes: talker address, reservation style, bandwidth etc.

❑Message relay

- The “forwarding” of registration/de-registration messages refers only to its logical meaning, since actually messages from different downstream bridges will be merged. Exact operations are defined by GARP state machines.

GSRP outline (cont.)

- End system registration and de-registration
  - The end system GSRP participant issues a GID_Join.request to join a stream
  - The end system GSRP participant issues a GID_Leave.request to leave a stream
- Registration and de-registration events
  - On receipt of a GID_Join.indication
    - The GSRP application element specifies the associated port as forwarding for the RESV frames of the associated stream
    - If reservation state has been established (successfully or failed) in this bridge, the GSRP application element execute admission control (and resource locking/ database updating if needed) on the associated port for the associated stream, then issues corresponding RESV out of the port.
      - This RESV can be set with either SUCCESSFUL or FAILED status indication bit according to the state of reservation in upstream
      - It disassociates the reservation response delay from RESV refresh timer value
  - On receipt of a GID_Leave.indication
    - The GSRP application elements specifies the associated port as filtering for the RESV frames of the associated stream
    - If reservation has been successful set up in this bridge for the associated port, the GSRP application element releases the locked resources, and updates the reservation state database

RESV: Actions of talkers

❑Source pruning

- Talkers are able to make use of the stream membership information registered via GSRP to allow them to keep track of the set of streams for which active listeners currently exist. This allow talkers to suppress the transmission of RESV frames if their registered stream membership information indicate that there are no valid recipients of those frames (i.e. Listeners) reachable via the LANs to which they are attached.

❑Periodically refreshing

- On the basis of soft-state mechanism, talkers periodically refresh their RESV signaling.
  - Otherwise, reservation states will age out. Resources will be released and RESV signaling with FAILED SI bit be sent downstream

❑Message format

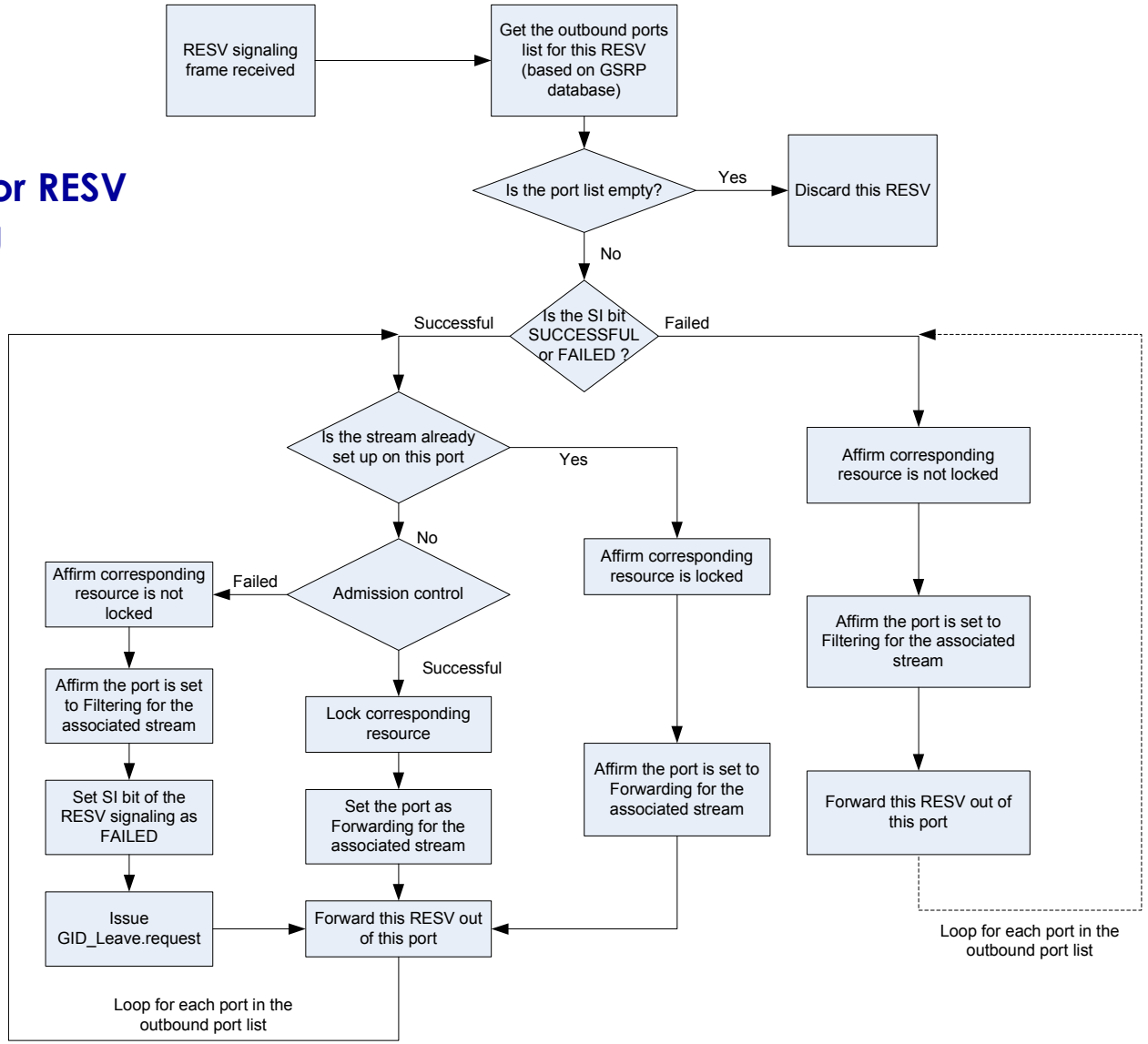
- RESV signaling PDU carries: Stream identifier, Talker address, Requested_Bandwidth, Reserved_Bandwidth, Status_Indiciation, Error_Code etc.

RESV: Actions of intermediate bridges

- On receipt of a RESV signaling
  - Get the list of outbound ports which are set by GSRP as forwarding for this RESV signaling
    - If the list is empty, the RESV signaling is discarded
  - If SI (status indication) bit of the RESV is SUCCESS, which means the reservation is successful in upstream, then the bridge checks on each outbound port whether the port has enough free resources for the this stream (admission control)
    - For ports on which admission control is successful
      - Lock corresponding resource, if it hasn't been locked
      - Set the port as forwarding for the associated stream, if it wasn't.
      - "Forward" the RESV signaling out of this port to the next hop
    - For ports on which admission control is failed
      - Affirm corresponding resource is not locked.
      - Affirm the port is set to filtering for the associated stream
      - Set SI bit of the RESV signaling as FAILED, and "forward" it out of this port to the next hop
  - If SI (status indication) bit of the RESV is FAILED, which means the reservation is failed in upstream
    - For each port in the outbound ports list
      - Affirm corresponding resource is not locked.
      - Affirm the port is set to filtering for the associated stream
      - "Forward" the RESV signaling with a FAILED SI bit out of this port to the next hop
- Message relay
  - The "forwarding" of RESV messages refers only to its logical meaning. The actual relay operations are similar with the PATH message operations in RSVP.

RESV: Flowchart

Example flowchart for RESV signaling processing



Evaluation

- Simplicity
  - A large part of signaling reuses the established GARP specifications
  - Only one new message (RESV) and corresponding processing need to be defined.
- Functionality
  - Explicitly ACK/NACK with the only one newly defined RESV message
  - Extendable to other scenarios, e.g, flexible reservation.
- Scalability
  - The GSRP signaling is scalable since registration/de-registration messages are merged in intermediate bridges
  - The RESV signaling is scalable since it utilizes multicast mechanism.
- Robustness
  - Dead branches are pruned out by GSRP dynamic de-registration or aging of reservation states
  - Occasionally packet loss is recovered by setting appropriate aging timer and refreshing timer.
  - Signaling always automatically adapts to updated network topology

Thank you!