Dynamic Bandwidth Reservation at Audio Video Bridging

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Needs of Dynamic Bandwidth Reservation

- **DLNAv2 (Use case 2.4 QoS clusters)**

<table>
<thead>
<tr>
<th>Use Case #</th>
<th>Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>QoS Cluster 3 (4 scenarios)</td>
<td>Availability of QoS Information</td>
<td>The network resource availability is constantly changing, especially with the existence of dynamic wireless segments. A number of use cases that aim to provide predictable user experience require information regarding network state to make consistent and meaningful decisions. This cluster describes scenarios where traffic streams adapt to changing network conditions or require user intervention when there is a degradation in network resource availability.</td>
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<thead>
<tr>
<th>Title</th>
<th>Summarized User Experience</th>
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<tr>
<td>End-user control over stream admission and quality 2</td>
<td>John is attending meetings. So he decided to record the SuperBowl on the PVR. His daughter Jill is looking at a soap in her bedroom. Then mother Sue wants to watch CSI in the digital living on a high definition tv. The system replies with a message: “Your network currently cannot maintain playback of this program at this quality since a recording is scheduled. Please choose: (1) Continue anyways, inform me again when the resource conflict occurs (2) Playback of CSI in normal TV resolution instead, (3) Cancel playback of CSI”. Sue decides for option (1). 10 minutes later the SuperBowl starts and the PVR wants to record the game. Sue gets a message from the system: “Your network currently cannot continue playback of this program at this quality as a recording is started. Please choose: (1) Reduce quality of CSI to normal TV resolution (2) Cancel playback of CSI (3) Stop the recording. Sue decides for (1) to reduce her quality to ensure that the recording has sufficient quality.”</td>
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(Ref. DLNAv2_Usage_Scenario_priority_voting_summaryr2 – techtf analysis.xls at www.dlna.org)

- **UPnP QoS 3**
  - PeakDataRate
  - MeanDateRate
Reference Model

**Fixed Bandwidth Reservation**

- Reservation with maximum bandwidth
- Reservation with minimum bandwidth
- Renegotiation with minimum BW

**Dynamic Bandwidth Reservation**

- Reservation with maximum bandwidth
- Reservation with minimum bandwidth

- Purpose: Increase possibility to provide service for users
- Assumption: Talker knows BW requirements of listeners through higher layer such as UPnP
Work of .1Qat

- Reservation field addition
  - Double resource requirement field (Min, Max)
  - “MINIMUM” reservation status field

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<tbody>
<tr>
<td>Stream Identifier</td>
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<tr>
<td>Resource Requirement (Min, Max)</td>
</tr>
<tr>
<td>Talker MAC</td>
</tr>
<tr>
<td>Reservation Status (with MINIMUM)</td>
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</tbody>
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Figure 1. Suggesting Reservation Message Structure
Work of .1Qav

1. Arrival of reservation message
2. Check reservation status field
   - SUCCEEDED
   - MINIMUM
   - FAILED, TIMEOUT
3. Check bandwidth availability with MAXIMUM bandwidth requirement
   - YES
   - MINIMUM ≠ MAXIMUM
   - NO
4. Check bandwidth availability with MINIMUM bandwidth requirement
   - YES
   - If bandwidth is available
     - Reserve bandwidth
   - NO
5. Change reservation status field if necessary
6. Update FDB and deliver reservation message to next hop

Cf. Having identical value for MINIMUM and MAXIMUM means reservation request of fixed bandwidth

Additional work to support dynamic bandwidth reservation
Considerable Extension (optional)

- **Suggestion**
  - Take resource of other streams, not by preemption but by agreement
    - If there is a stream getting service and agreeing downgraded service quality in advance, bridges are able to take the resource for new streams

- **Purpose**
  - In order to not drop new stream reservation request by degrading quality of servicing application

- **Extended part**
  - Look for stream which accepted downgraded quality
  - FDB should contain minimum and maximum bandwidth request per stream
  - Temporarily reserve bandwidth and fix it after receiving another reservation message which let bridges know the result of resource reservation
Work of .1Qav

Arrival of reservation message

- Check reservation status field
  - SUCCEEDED
  - MINIMUM
  - FAILED, TIMEOUT

  - Check bandwidth availability with MAXIMUM bandwidth requirement
    - YES: If bandwidth is available
      - MINIMUM ≠ MAXIMUM
        - NO: MINIMUM ≠ MAXIMUM
          - NO: Reserve bandwidth
            - NO: Change reservation status field if necessary
              - Update FDB and deliver reservation message to next hop
    - NO: Reserve bandwidth
      - YES: Temporarily reserve bandwidth and fix it after receiving another reservation message which let bridges know the result of resource reservation

  - Check bandwidth availability with MINIMUM bandwidth requirement
    - YES: Reserve bandwidth
      - NO: Change reservation status field if necessary
        - If there stream which accepted downgraded quality and can allow requiring BW
          - YES: Temporarily reserve bandwidth and fix it after receiving another reservation message which let bridges know the result of resource reservation
          - NO: Do not check bandwidth availability

Cf. Talker degrades quality of agreed stream which gave BW for new reservation request AFTER getting final response from listener.
Dynamic Bandwidth Reservation

- Use cases to manipulate suggested fields
  - Dynamic BW request: request BW with different MAXIMUM and MINIMUM values
  - Fixed BW request: request BW with the same MAXIMUM and MINIMUM value

- Applications
  - Applicable to unicast scenarios
  - Partially applicable to multicast scenario
    - When all listeners agree to degrade quality for servicing new streams
    - When only one listener is receiving multicast stream and the listener agree to degrade quality for servicing new streams

- UPnP interoperability
  - UPnP MeanDataRate matches to MINIMUM value of resource requirement of AVB
  - UPnP PeakDateRate matches to MAXIMUM value of resource requirement of AVB
Conclusion

- Needs of dynamic bandwidth reservation from upper layer

- Work of .1Qat
  - Use of min/max resource requirement field
  - Use of a reservation status field, called “MINIMUM”

- Work of .1Qav
  - Check bandwidth availability after confirming reservation status field
  - Bandwidth reservation by result of bandwidth availability confirmation
  - Change reservation status field if necessary

- (Optional) take resources of other streams which agreed to degrade quality of service when bandwidth is not available for new stream reservation
  - One method to increase possibility of stream bandwidth reservation
  - Augment complexity of stream reservation protocol
    - .1Qav: look for stream which accepted downgraded quality and temporarily store preempted stream ID and bandwidth
    - .1Qat: deliver another reservation message which let bridges know the result of resource reservation