

RTP Frame Acknowledgement

<https://github.com/sprangerik/frame-acknowledgement>

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Draft Status

- Progress on GitHub
 - Open issues: 9
 - Closed issues: 15
- Notable Topics
 - **Receiver-triggered resynchronization request [#19](#)**
 - **Update Frame ID from 8 to 16 bits [#23](#)**
 - **Include an example flow in the appendix [#25](#)**
 - **SDP Negotiation [#6](#)**

SDP Negotiation #6

- New URI in extmap attribute for RTP header extension
e.g. `a=extmap:4 urn:ietf:params:rtp-hdext:frame-acknowledgement`
- New rtcp-fb attribute for RTCP feedback
e.g. `a=rtcp-fb:3 frame-acknowledgement;resync-timeout=<timeout-ms>`
- resync-timeout parameter
 - Receiver **MAY** trigger resync request after this timeout in milliseconds

Explicit Feedback Request

Scenario: Media Sender transmits several frames and then requests feedback to confirm which frames have been decoded by the Media Receiver.

Media Sender	Media Receiver
--- Frame TS=0 (FFR=00, ID=0) ----->	
--- Frame TS=100 (FFR=00, ID=1) ----->	
--- Frame TS=200 (FFR=00, ID=2) ----->	
--- Frame TS=300 (FFR=10, ID=3, ----->	
FbStart=0, FbLen=4)	
<--- RTCP Feedback (R=0, FbStart=0, -----	
FbLen=4, Vector=1111)	

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Implicit Feedback Request

Scenario: Media Sender transmits several frames without Frame ID, then one with Frame ID and also requests feedback to confirm it has been decoded by the Media Receiver.

Media Sender	Media Receiver
--- Frame TS=400 (no extension) ----->	
--- Frame TS=500 (no extension) ----->	
--- Frame TS=600 (no extension) ----->	
--- Frame TS=700 (FFR=01, ID=4) ----->	
<-- RTCP Feedback (R=0, FbStart=4, ----->	
FbLen=1, Vector=1)	

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Sender Side Recovery from Frame Loss

Scenario: Media Sender keeps requesting feedback for last 3 frames. It detects receiver's inability to decode frames and can encode the next frame with a long term reference frame

Media Sender	Media Receiver
--- Frame TS=1000 (FFR=10, ID=10, ----->	
FbStart=8, FbLen=3, refs TS=900)	
<-- RTCP Feedback (R=0, FbStart=8, -----	
FbLen=3, Vector=111)	

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Last 3 marked frames were reported as decoded

Sender Side Recovery from Frame Loss

Scenario: Media Sender keeps requesting feedback for last 3 frames. It detects receiver's inability to decode frames and can encode the next frame with a long term reference frame

Media Sender	Media Receiver
--- Frame TS=1000 (FFR=10, ID=10, ----->	
FbStart=8, FbLen=3, refs TS=900)	
<-- RTCP Feedback (R=0, FbStart=8, -----	
FbLen=3, Vector=111)	
--- Frame TS=1100 (FFR=10, ID=11, -----X	
FbStart=9, FbLen=3, refs TS=1000) LOST	

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Frame TS 1100 is lost

Sender Side Recovery from Frame Loss

Scenario: Media Sender keeps requesting feedback for last 3 frames. It detects receiver's inability to decode frames and can encode the next frame with a long term reference frame

Media Sender	Media Receiver
--- Frame TS=1000 (FFR=10, ID=10, ----->	
FbStart=8, FbLen=3, refs TS=900)	
<-- RTCP Feedback (R=0, FbStart=8, -----	
FbLen=3, Vector=111)	
--- Frame TS=1100 (FFR=10, ID=11, -----X	
FbStart=9, FbLen=3, refs TS=1000) LOST	
--- Frame TS=1200 (FFR=10, ID=12, ----->	
FbStart=10, FbLen=3, refs TS=1100)	
<-- RTCP Feedback (R=0, FbStart=10, -----	
FbLen=3, Vector=100)	

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Sender detects frame loss from
next feedback

Receiver-Triggered Resync Request

Scenario: Receiver requests resync when it is unable to decode frame

```

Media Sender                               Media Receiver
|                                           |
| --- Frame TS=2000 (FFR=01, ID=20) -----> |
|                                           |
| <-- RTCP Feedback (R=0, FbStart=20, -----|
|      FbLen=1, Vector=1)                   |

```

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Frame TS 2000 was reported as
decoded

Receiver-Triggered Resync Request

Scenario: Receiver requests resync when it is unable to decode frame

```

Media Sender                               Media Receiver
|                                           |
| --- Frame TS=2000 (FFR=01, ID=20) -----> |
|                                           |
| <--- RTCP Feedback (R=0, FbStart=20, -----|
|      FbLen=1, Vector=1)                   |
|                                           |
| --- Frame TS=2100 (no extension, -----> |
|      refs TS=2000)             (partial)   |
|                                           |

```

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Frame TS 2100 is only partially received. Cannot be decoded

Receiver-Triggered Resync Request

Scenario: Receiver requests resync when it is unable to decode frame

```

Media Sender                               Media Receiver
|-----> Frame TS=2000 (FFR=01, ID=20) -----|
|-----> RTCP Feedback (R=0, FbStart=20, -----|
|         FbLen=1, Vector=1)                   |
|-----> Frame TS=2100 (no extension, ----->|
|         refs TS=2000)             (partial)   |
|-----> Frame TS=2200 (no extension, ----->|
|         refs TS=2100)                   |
|-----> RTCP Feedback (R=1, FbStart=20, -----|
|         FbLen=1, Vector=1)                   |

```

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Frame TS 2200 can't be decoded
Receiver requests resync

Receiver-Triggered Resync Request

Scenario: Receiver requests resync when it is unable to decode frame

```

Media Sender                                     Media Receiver
|----->|
|--- Frame TS=2000 (FFR=01, ID=20) ----->|
|----->|
|<--- RTCP Feedback (R=0, FbStart=20, -----|
|      FbLen=1, Vector=1)                   |
|----->|
|--- Frame TS=2100 (no extension, ----->|
|      refs TS=2000)             (partial)   |
|----->|
|--- Frame TS=2200 (no extension, ----->|
|      refs TS=2100)                   |
|----->|
|<--- RTCP Feedback (R=1, FbStart=20, -----|
|      FbLen=1, Vector=1)                   |
|----->|
|--- Frame TS=2300 (FFR=01, ID=21, ----->|
|      refs TS=2000)                   |
|----->|
|<--- RTCP Feedback (R=0, FbStart=21, -----|
|      FbLen=1, Vector=1)                   |
|----->|

```

- **TS:** RTP timestamp
- **FFR:** FrameID / Feedback Request field
 - 00 = Frame ID only
 - 01 = Frame ID + implicit feedback request
 - 10 = Frame ID + independent feedback request
- **ID:** Frame ID
- **refs:** RTP timestamp of the referenced frame
- **FbStart:** Feedback Start
- **FbLen:** Feedback Length
- **R:** Resync Request flag
 - 0 = normal feedback, 1 = resync request
- **Vector:** Status vector

Sender encodes next frame
referencing TS 2000

Next Steps

- Close remaining github issues
- Address any new feedback
 - Contributions on github are welcome
- Call for adoption

Thanks!