

FLEX-FEC

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Motivation

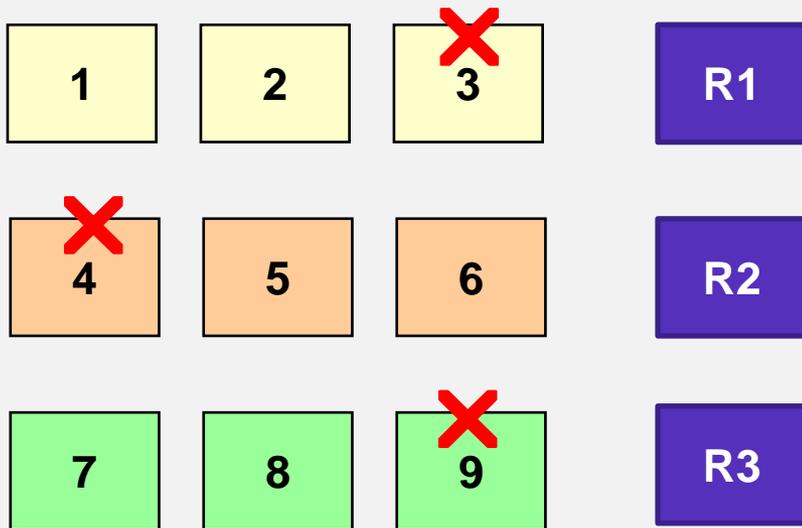
- Current FEC standards lack sufficient flexibility to be usable for many use cases, including RTCWEB
- RFC 2733 XOR with 24-bit mask: obsoleted by 5109
- RFC 5109 XOR with 48-bit mask and ULP:
 - SSRC multiplexing not supported
 - draft-lennox-payload-ulp-ssrc-mux proposes a=ssrc-group:FEC
 - 48-bit mask insufficient for interleaved FEC to recover from burst loss, and requires >2% FEC
- RFC 6015 XOR with fixed 1D interleaved FEC:
 - Non-standard RTP header prevents general use
 - Fixed parameters not suited for adaptive real-time cases
- RFC 6682 Raptor FEC: IPR declarations exist
- RFC 6865 Reed-Solomon FEC: no RTP format

Proposed Solution

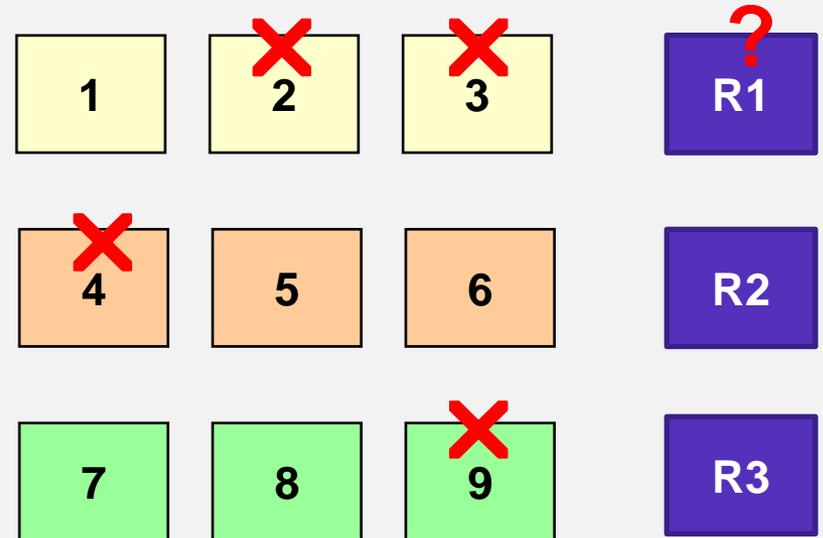
- New flexible FEC payload format 'flexfec'
- Flexibility for sender to adapt FEC scheme based on dynamic network conditions (e.g. RTCP)
- Flexibility to use different multiplexing:
 - SSRC multiplexing (e.g. BUNDLE, Unified Plan)
 - RTP session multiplexing (e.g. multicast, legacy SIP)
 - PT multiplexing within the same RTP stream
 - RED multiplexing within the same RTP packet
- 16, 48 or 112-bit mask for irregular FEC patterns
 - 112-bit mask allows larger source blocks and <1% FEC
- Virtual bit mask for larger, regular FEC patterns up to:
 - 255 non-interleaved (1D row) source packets, or
 - 255x255 interleaved (2D column*row) source packets

Row FEC (1D non-interleaved)

Recoverable loss pattern

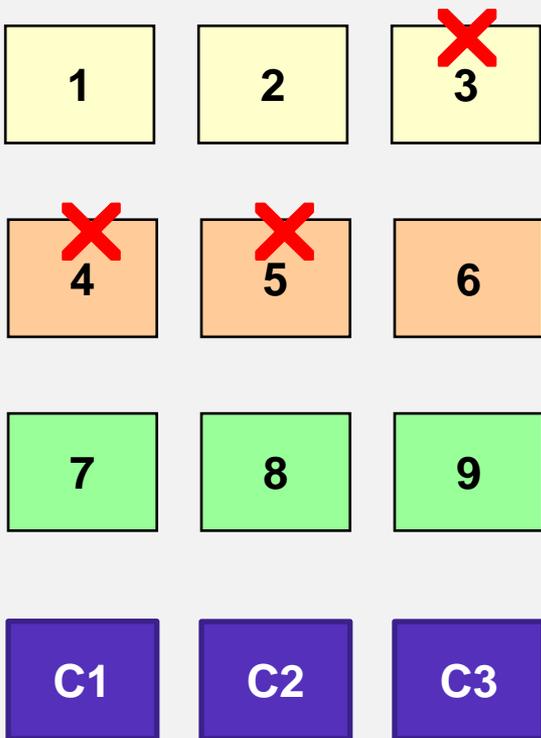


Unrecoverable loss pattern

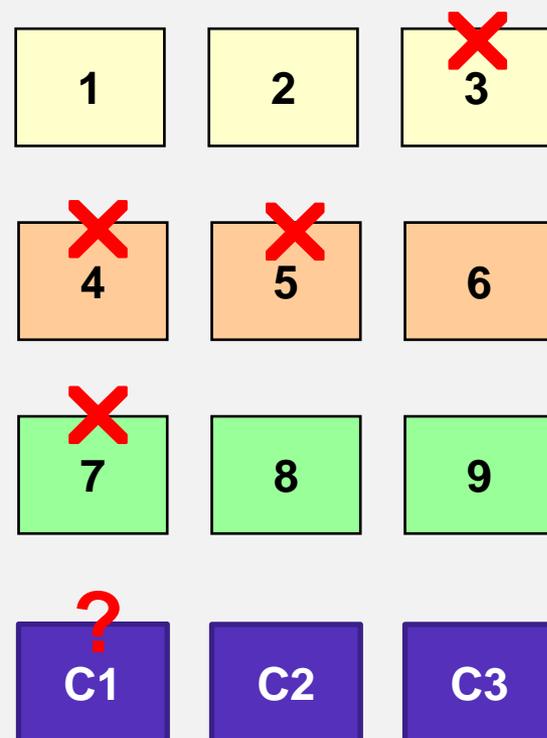


Column FEC (1D interleaved)

Recoverable loss pattern

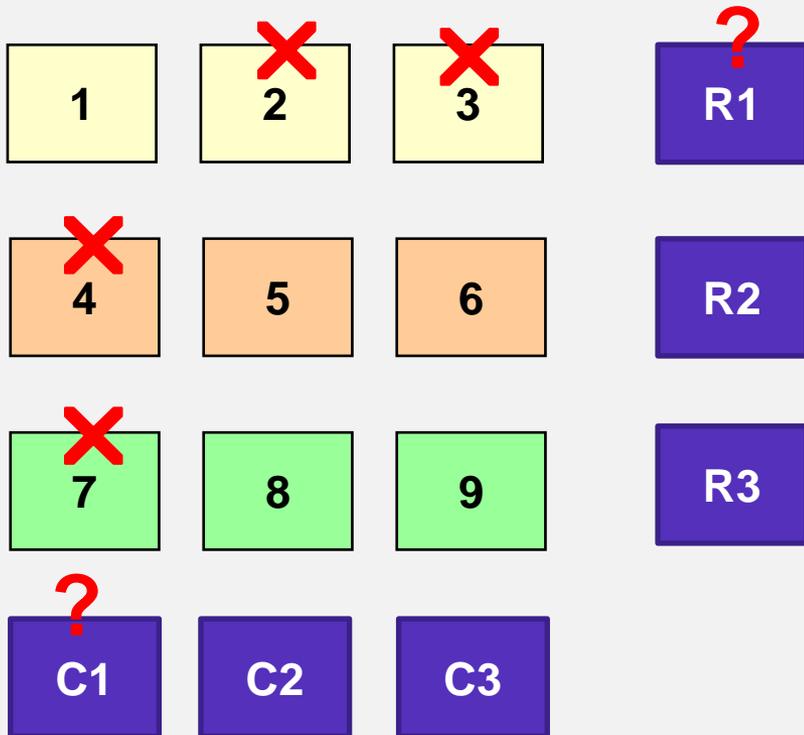


Unrecoverable loss pattern

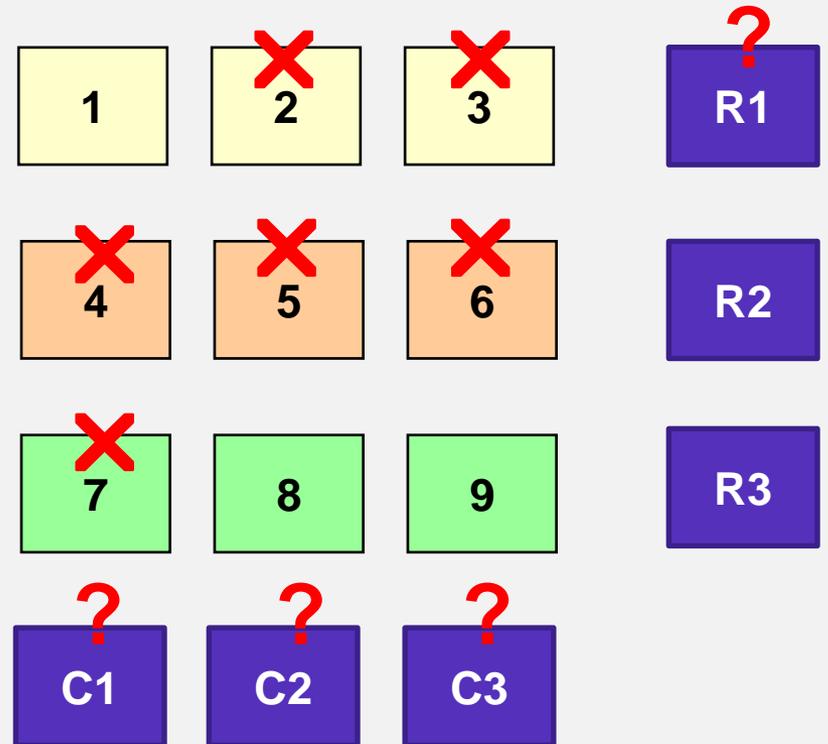


2D Row+Column FEC

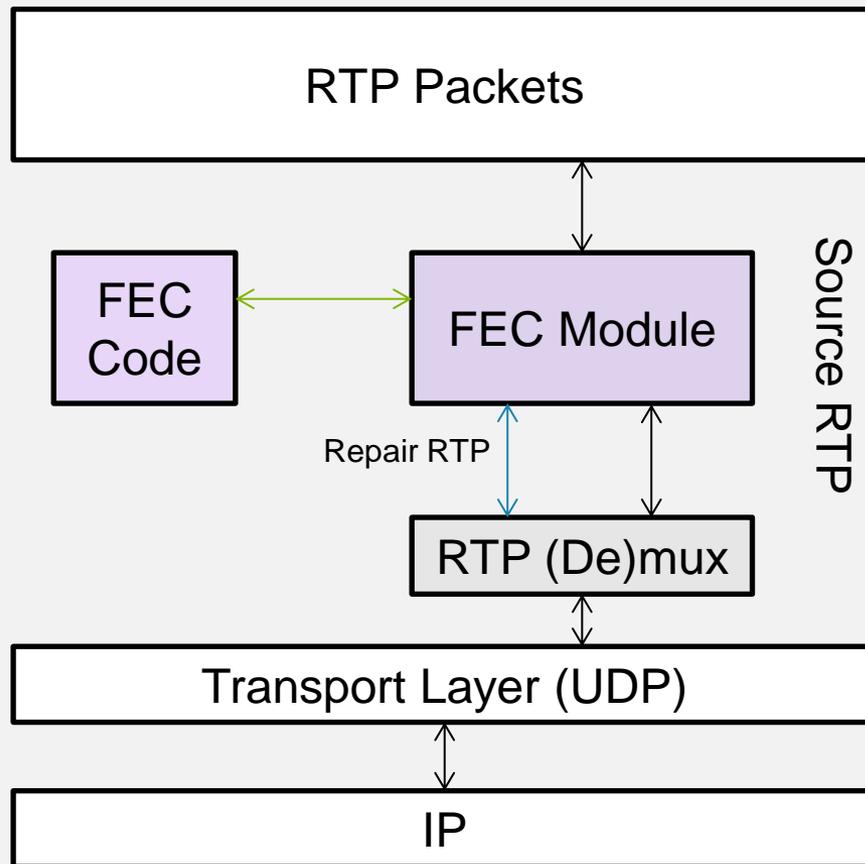
Recoverable loss pattern



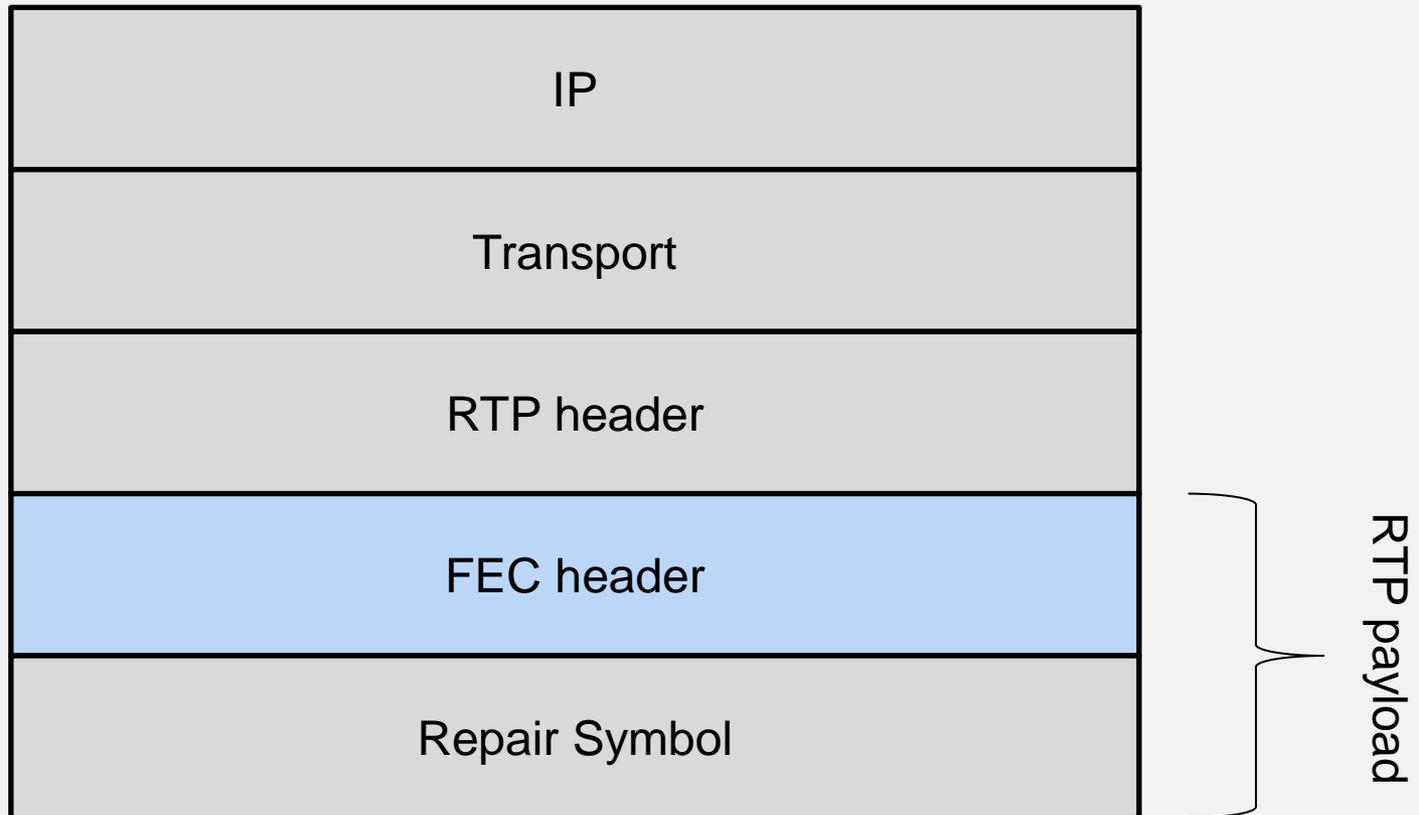
Unrecoverable loss pattern



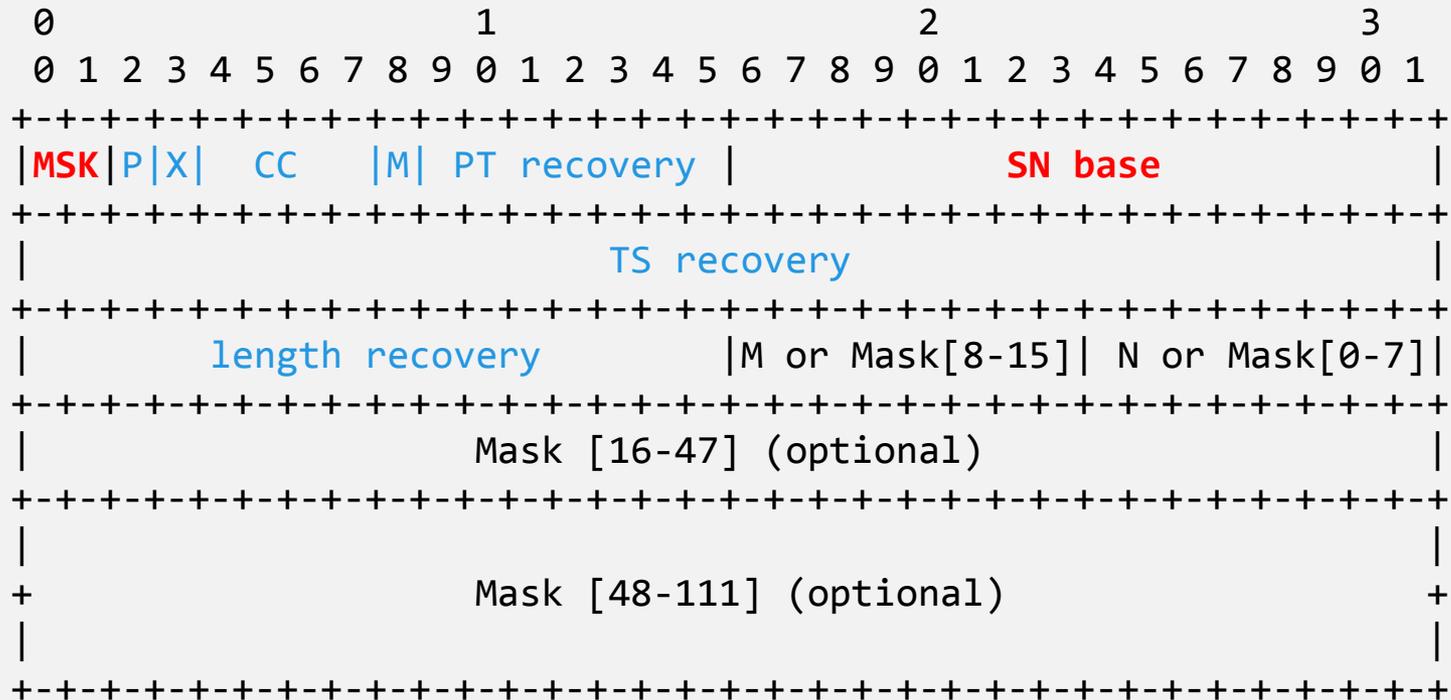
RFC 6363: FEC Framework



Format of repair packets



FEC header



MSK values (1/2)

- 00 → 16-bit mask
- 01 → 48-bit mask
- 10 → 112-bit mask
- 11 → virtual mask, see M and N values

MSK values (2/2)

- $M=0, N=0 \rightarrow$ fixed values indicated in SDP
- $M>0, N=0 \rightarrow$ row of M non-interleaved packets starting from SN_base :
 $SN, SN+1, SN+2, \dots, SN+(M-1)$
- $M>0, N>0 \rightarrow$ column of N packets interleaved by every M packets starting from SN_base :
 $SN, SN+(1 \times M), SN+(2 \times M), \dots, SN+(N-1) \times M$

Next steps

- Discussion in MMUSIC about SDP
- Adoption as PAYLOAD WG-item