FECFRAME – extension
Adding sliding window codes support to FECFRAME

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https://tools.ietf.org/html/draft-ietf-tsvwg-fecframe-ext/

November 2017, IETF100, Singapore

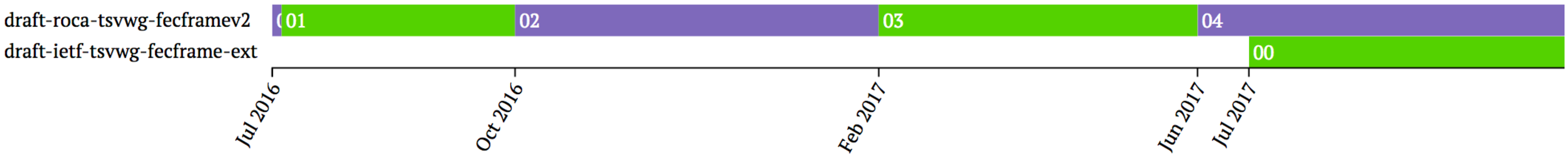
Note well for FECFRAME-ext + RLC I-Ds

- **we, authors, didn't try to patent** any of the material included in this presentation/I-D
- **we, authors, are not reasonably aware** of patents on the subject that may be applied for by our employer
- if you believe some aspects may infringe IPR you are aware of, then fill in an IPR disclosure and please, let us know

Reminder: this I-D is about…

- …an **EXTENSION** of the FEC Framework (or FECFRAME) / RFC 6363
- goal of FECFRAME is to add AL-FEC protection to real-time unicast or multicast flows
- goal of this FECFRAME-extension is to add support for **Sliding Window AL-FEC codes**
    - **better suited to latency constrained data flows than block codes (e.g. Reed-Solomon, LDPC, Raptor(Q))**

Situation and next step



- individual I-D -00: July 2016
- WG item I-D -00: July 2017

- authors' opinion:
  - a small update needed to fix typos
  - then ready for WG Last Call

Sliding Window Random Linear Codes (RLC) FEC Scheme …for FECFRAME - extended

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https://datatracker.ietf.org/doc/draft-ietf-tsvwg-rlc-fec-scheme/

November 2017, IETF100, Singapore

Main changes: two FEC Schemes

- CHANGE 1: new co-author
  - **added Belkacem who's working with me on RLC…**

- CHANGE 2: two FEC Schemes
  - OLD: **a single FEC Scheme for GF(2), GF(2^4) and GF(2^8)**
    - drawback: a compatible codec must support all three variants even if a single one is used
  - NEW: **two separate FEC Schemes (for the moment)**
    - one for GF(2): for very large encoding windows
    - one for GF(2^8): for small encoding windows
    - simplifies a little bit a compatible codec by removing unrequired compliancy

Main changes: add density parameter

- CHANGE 3: add a density parameter
  - **OLD: a repair symbol is the sum of all source symbols**
  - **NEW: a repair symbol is either the sum of all source symbols or a subset of them**

OLD or NEW

$$repair_1 = \alpha_1 * src_1 + \ldots src_2 + \alpha_3 * src_3 + \alpha_4 * src_4 + \alpha_5 * src_5 + \alpha_6 * src_6$$

density 1

+ potentially sparse equations

NEW

$$repair_1 = \alpha_1 * src_1 + \quad + \quad 0 \quad + \alpha_4 * src_4 + \alpha_5 * src_5 + \quad 0$$

density 1/2

Main changes: add density parameter (2)

- motivation for change 3: **increase applicability** with larger window size support

  - **small encoding windows with maximum density**
    - algorithmic complexity is not an issue
    - dense equations enable maximum loss recovery performance

  - **larger encoding windows with reduced density**
    - reduces algorithmic complexity (limiting factor)
    - loss recovery performance remains good because larger encoding windows compensate

Main changes: add density parameter (3)

- made possible with a new parameter
  - **Coding coefficients Density Threshold, DT (4-bit field)**
    - 0 (density 1/16) up to 15 (density (15+1)/16=1)
  - **added to each FEC repair packet**
    - DT value may change dynamically if loss conditions evolve

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Repair_Key              |  DT   |NSS (# src symb in ew) |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            FSS_ESI                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
           Figure 7: Repair FEC Payload ID Encoding Format
```

  - **an input parameter to the** `generate_coding_coefficients()` **function**

Main changes since IETF'99 (4)

- does it work?
  - clear benefits at the encoder
    - **density ½ → reduce complexity almost by half**
  - at a decoder, interesting but we expect higher gains
    - **work in progress…**

Encoding **window size=200 symbols**, decoding window size=266, linear system size=532

density 1(old)

- 120Kmh, 20% : encoding: 165 Mbps decoding: 341 Mbps

density ½ (new)

- 120Kmh, 20%: encoding: 291 Mbps (+76.4% bitrate increase) decoding: 408 Mbps (+19.6% bitrate increase)

MacBook Pro 15,4" Retina Core i7 quad-core, 2.5 GHz

Next steps

- finish to assess the benefits of the density threshold parameter
    - **ready for IETF 101**
- finalize document…
    - **ready for IETF 101 (?)**