Preamble Format for IET

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Summary

- IET adds many changes to operation of 802.1/802.3 links
  - Frame fragmentation is just one of the aspects of IET operation
  - Negative impact on MacSec is recognized in 802.1Qbu D1.0, but does not have any solution (placed in Annex Z)
  - Negative impact on synchronization mechanisms (IEEE 1588 / IEEE 802.1AS) requires further study
  - Impact on stream-based FEC used in many 802.3 PHYs has not been assessed up to date
- Individual challenges are discussed in more detail in the following slides
- **Using the same preamble format as specified in 802.3ah and 802.3av for EPON will address many of these issues**
  - Single modified preamble format for multiple standards will be beneficial for implementations, testing, and simpler for specification
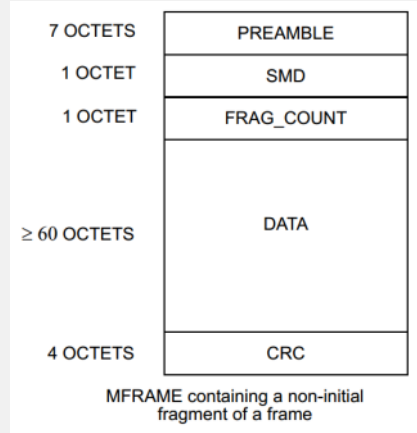
IET and Security

- IET does not specify any limits on the number of express frames that may interrupt a transmission of a preemptable frame
- A long train of express frames interrupting transmission of lower priority frames is possible on some links using IET mechanism
- Initial fragment of preemptable frame may be encrypted using one key, while the remainder is encrypted using another key
  - Encryption keys are switched periodically. If the key switch happens during preemption, fragmented frame becomes corrupt and needs to be retransmitted
  - A way to signal key change in IET preamble is needed
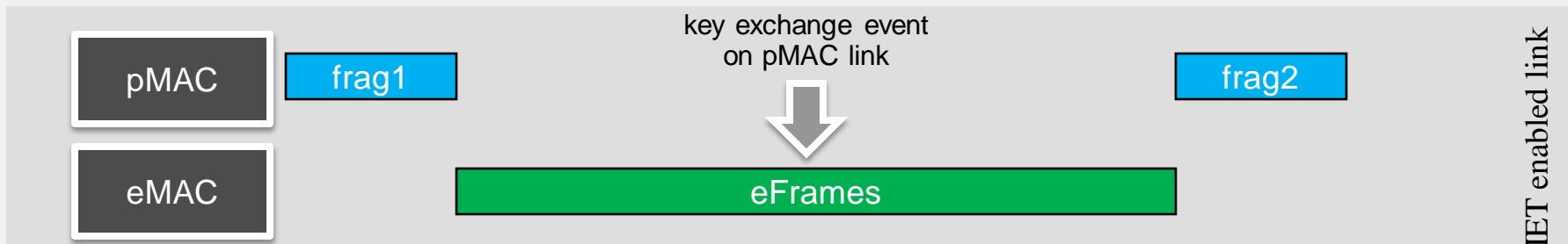
IET robustness

- Current fragment count is carried in a modulo-4 counter embedded into mFrame after SMD
  - We use a whole byte worth of data to carry just 4 values
- This counter can reliably detect loss of up to 4 fragments – after that, it rolls over
  - Link reliability is guaranteed by large Hamming distance between individual values
  - The rest of MAC frame does not have such a strong protection against bit errors
- Without loss for bit error detection, fragment and frame counters size can be increased to 16 positions and protected with CRC8 code
  - Similar approach is used in EPON for protecting modified preamble fields, including LLID

7 OCTETS	PREAMBLE
1 OCTET	SMD
1 OCTET	FRAG_COUNT
≥ 60 OCTETS	DATA
4 OCTETS	CRC

MFRAME containing a non-initial fragment of a frame

99.3.4 Frag_count

The frag_count field is only present in frames with an SMD-Cx. Frag_count protects against reassembling an incorrect frames if up to 3 fragments of a frame are lost. Frag Count is set to zero for the start of each pre-emptable frame. Therefore, for SMD-Sx mframes it is always 0 and those frames do not have a frag_count field.
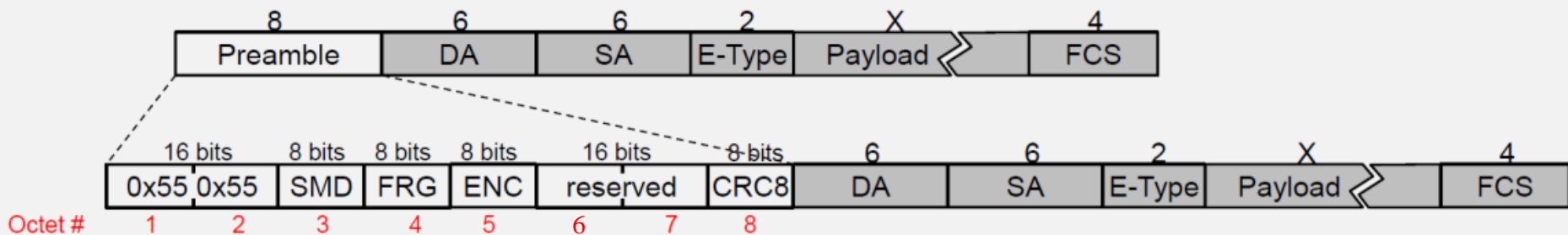
The frag_count is a modulo-4 counter that increments for each fragment of the frame.

The frag_count values are specified in Table 99–2.
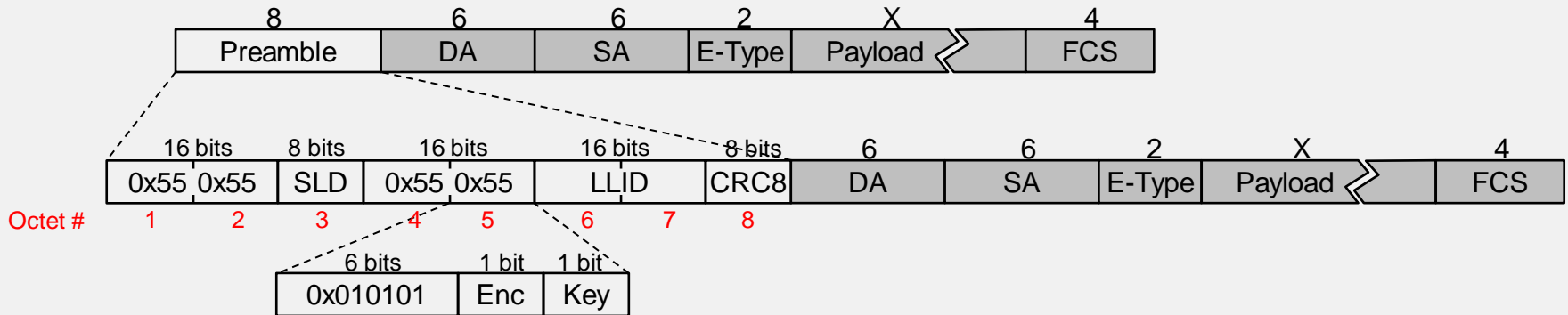
Table 99–2—Frag_count values

Frag_count	Encoding
0	0xE6
1	0x4C
2	0x7F
3	0x83

Proposal for IET preamble format

- Octets 1 and 2 are left unmodified (0x55)
- SMD is equal to 0xD5
- FRG field carries fragment counter and frame counter
  - Bits 0-3 carry modulo-16 fragment counter
  - Bits 4-7 carry modulo-16 frame counter
- ENC field carries indication whether frame is encrypted (bit 0) and what encryption key was used (e.g., bit 1 if only 2 keys are used)
- Octets 6 and 7 are reserved
- Octet 8 carries CRC8 calculated over octets 3 through 7

EPON preamble format

8	6	6	2	X	4
Preamble	DA	SA	E-Type	Payload	FCS

16 bits	8 bits	16 bits	16 bits	8 bits	6	6	2	X	4
0x55 0x55	SLD	0x55 0x55	LLID	CRC8	DA	SA	E-Type	Payload	FCS

Octet # 1 2 3 4 5 6 7 8

6 bits	1 bit	1 bit
0x010101	Enc	Key

- IET and EPON preambles have the same basic structure
  - The EPON-modified preamble format has been widely accepted in 802.3
  - Concept of using preamble fields in P2P links is non-controversial
- More reliable link due to larger fragment and frame counter
  - Can detect loss of up to 16 fragments
  - CRC8 guarantees protection against bit errors – no longer defined by Hamming distance
- Protection against change of encryption keys during preemption