

ARQ proposal for 802.16 TG3/TG4 MAC

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Purpose:

This document is to be presented to 802.16 TG3, TG4 and MAC groups to be accepted as a baseline ARQ proposal for 802.16 MAC

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Issues to resolve

- ARQ Scope
- ARQ Invocation Procedure(s)
- Units of Retransmission (e.g. MSDUs)
- Algorithm (e.g. Selective Repeat)
- Format(s) of Sequential Numbers
- Format(s) of ARQ Feedback (ACK\, NACK)
- Interaction with Fragmentation, Packing

ARQ Scope

- Scope = connection
 - Both fragmented and non-fragmented MSDUs appear at the connection
 - Both packed and non-packed MSDUs appear at the connection
- Parameter = ARQ Indicator (ON/OFF)

ARQ Invocation

Process	Message(s) Carrying the ARQ Indicator Parameter
Configuration File encoding	N/A
Dynamic Service Addition	DSA-REQ DSA-RSP
Dynamic Service Change	DSC-REQ DSC-RSP

Interaction with Fragmentation and Packing Functions

- Any ARQ format (Sequential Number, ACK etc.) has to service simultaneously:
 - An MPDU with a single complete MSDU as a payload
 - An MPDU carrying a fragment of an MSDU
 - An MPDU with several packed complete MSDUs and / or MSDU fragments

Retransmission Units

- Retransmission units are **complete MSDUs or fragments of MSDUs**
- Motivation:
 - QoS requirements come with each MSDU from the upper protocol layers. Example: bounded delay
 - In the existing MAC (D2-2001) the payloads of MAC messages are either complete MSDUs or distinguishable MSDU fragments

Sequential Numbers

- Sequential Number = a pair {MSDU-SN, FSN}:
 - MSDU-SN = 8 bit Sequential Number of MSDU, assigned by MAC when the MSDU arrives from the Convergence Sublayer. The MSDU-SN never changes
 - FSN = Fragment Sequential Number (0 – 15 or 0 – 7), with D2-2001 fragmentation restricted to max 16 (8) fragments

ARQ and Fragmentation Control

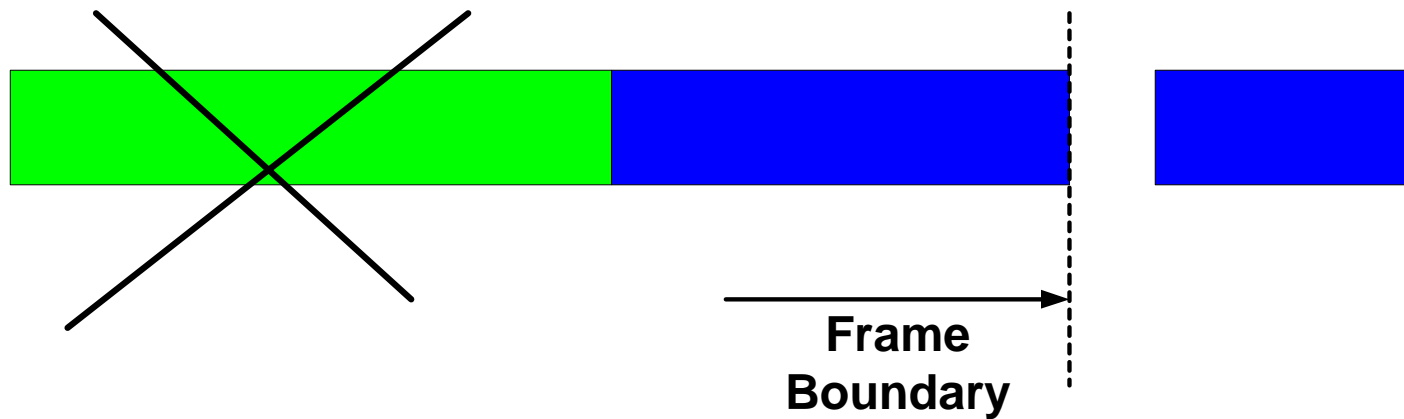
No changes comparatively to D2-2001

- Each MSDU / MSDU Fragment is accompanied by FC (Fragment Control) 2 bit field:
 - 00 = Not fragmented MSDU
 - 10 = First fragment
 - 11 = Continuation fragment
 - 01 = Last fragment
- When packed, same field appears in the Packing Header

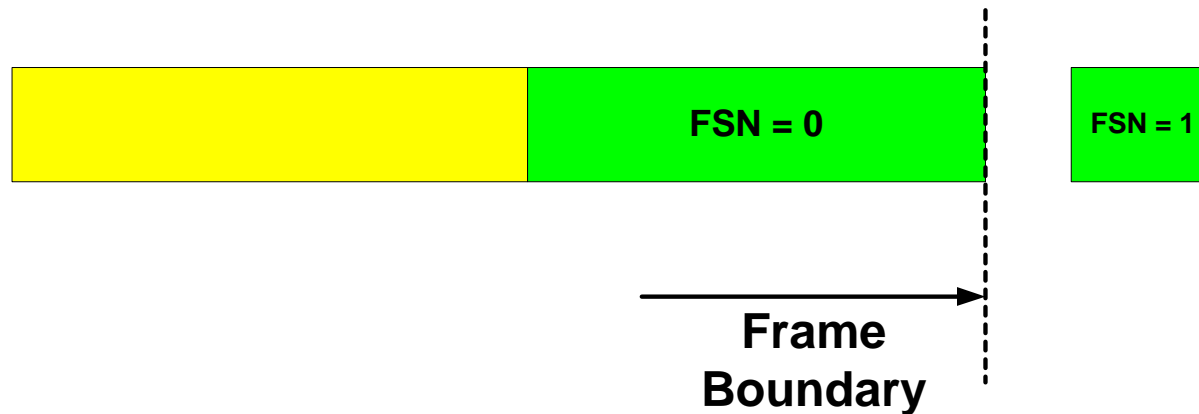
ARQ and Fragmentation – Cont.

Identification of Fragments

Original Transmission



Retransmission



ARQ Operations

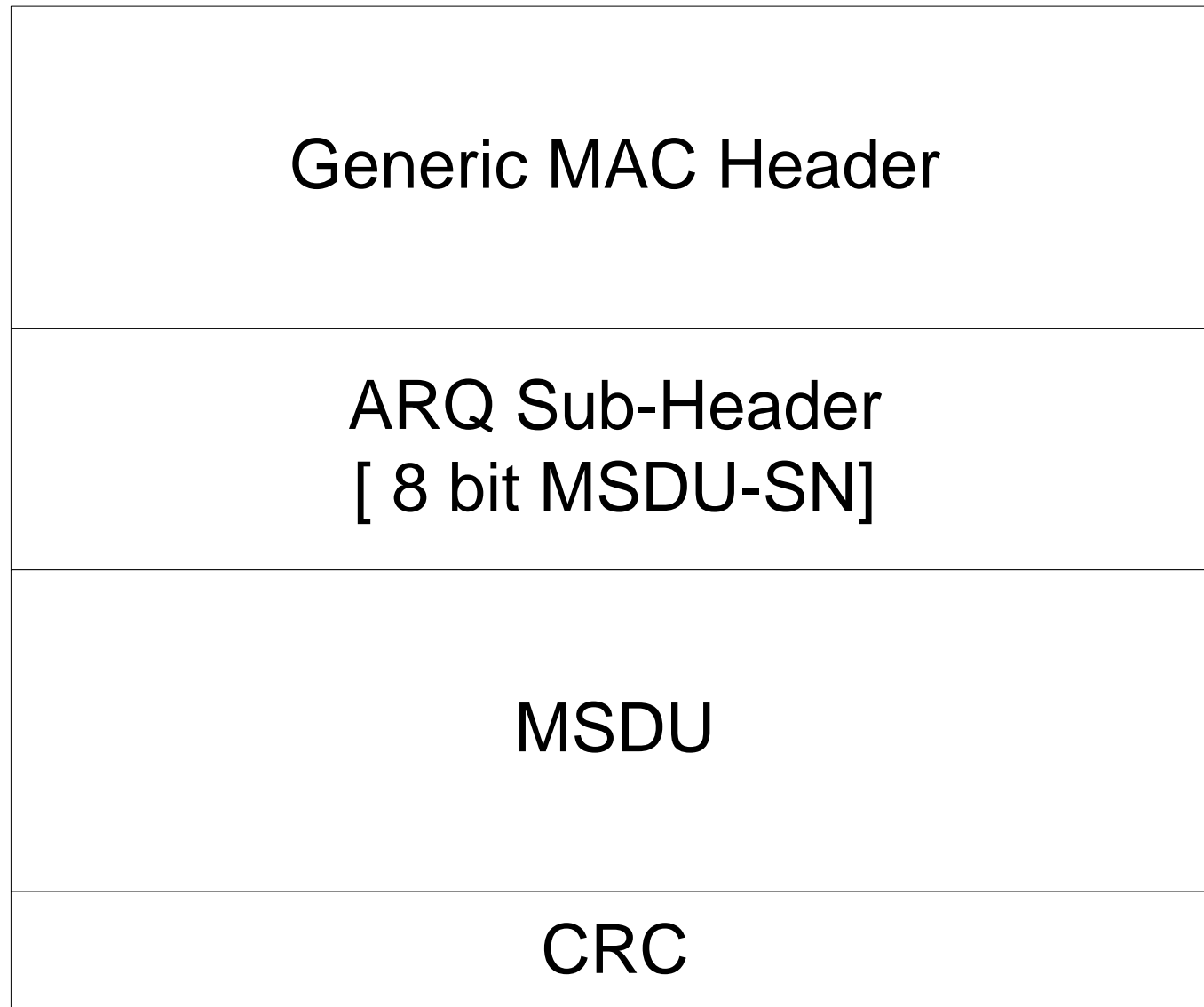
- Tx Window is employed. The correspondent Service Flow parameter is to be negotiated between the peers during the DSA/DSC process
- Selective Repeat algorithm is applied
- Explicit Discard operation is employed by Transmitter with acknowledgement from the Receiver

Building MPDU

- An ARQ sub-header should be appended to the Generic MAC Header
- The ARQ sub-header consists of a single 8 bit MSDU Sequential Number field that contains MSDU-SN
-

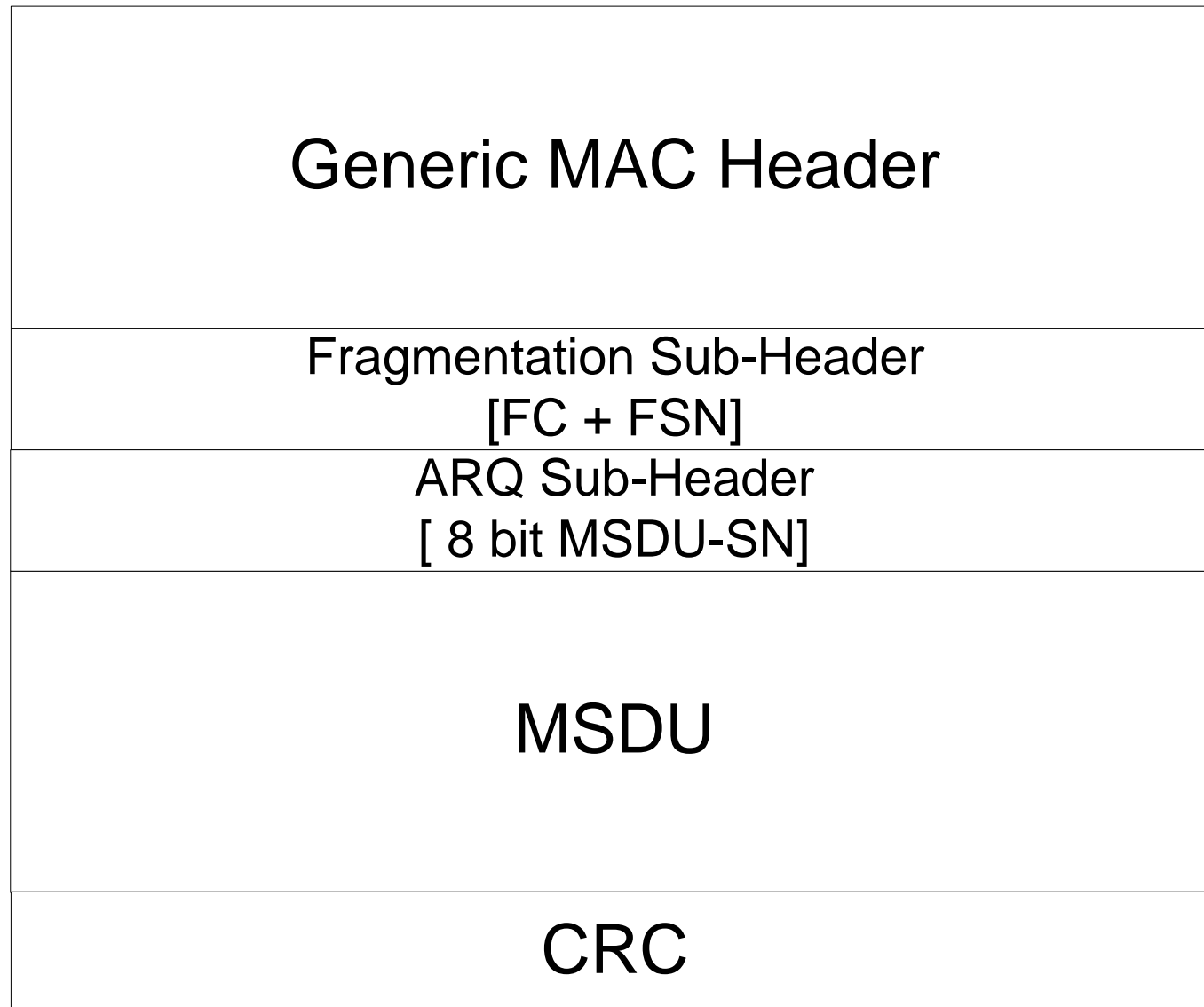
Building MPDU - Cont.

Single Complete MSDU as a Payload



Building MPDU - Cont.

MPDU Carrying a Single MSDU Fragment



Building MPDU - Cont.

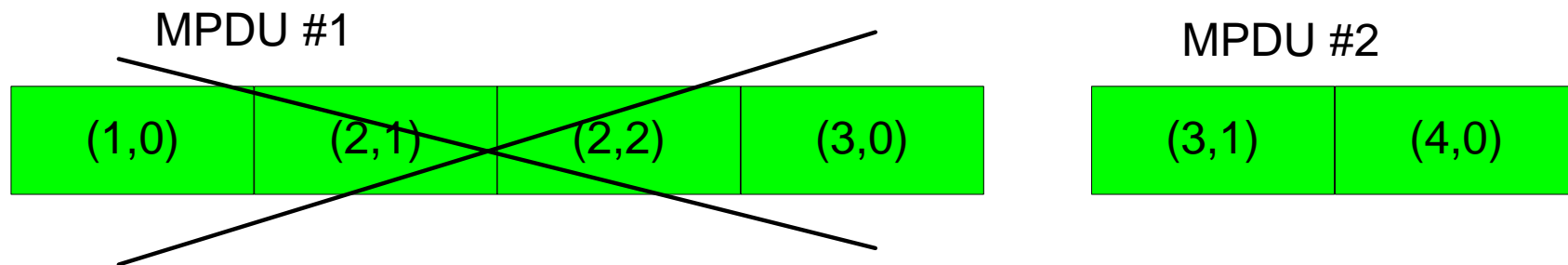
Multiple MSDUs / Fragments Packed in a Single MPDU

- The rule of assembling of the MSDUs / fragments in a single MPDU
 - Only the consequent MSDUs/fragments should be assembled
- Is this really restrictive?

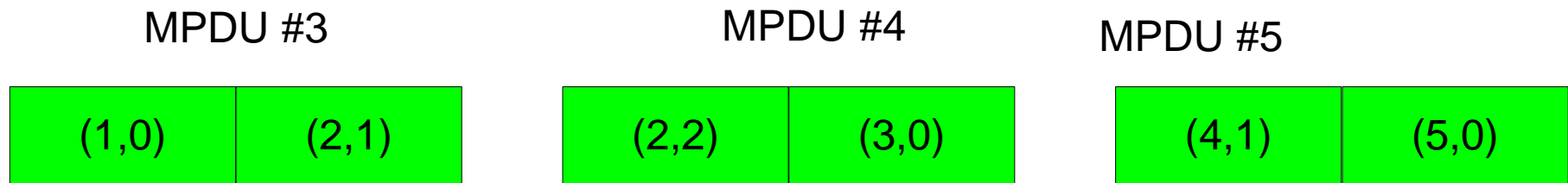
Building MPDU - Cont.

Multiple MSDUs / Fragments Packed in a Single MPDU

Original Transmission

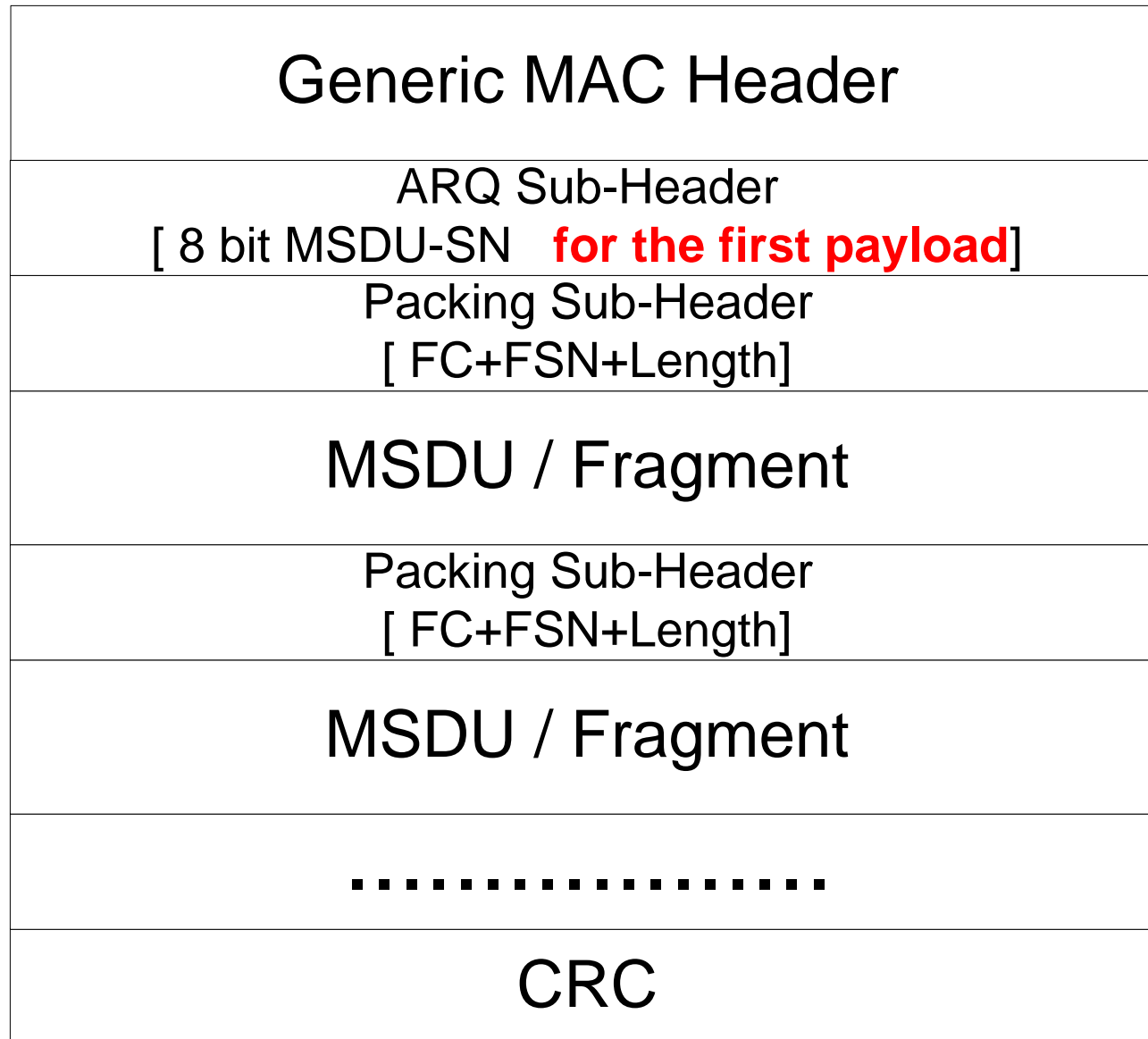


Retransmission



Building MPDU - Cont.

Multiple MSDUs / Fragments Packed in a Single MPDU



ARQ Feedback

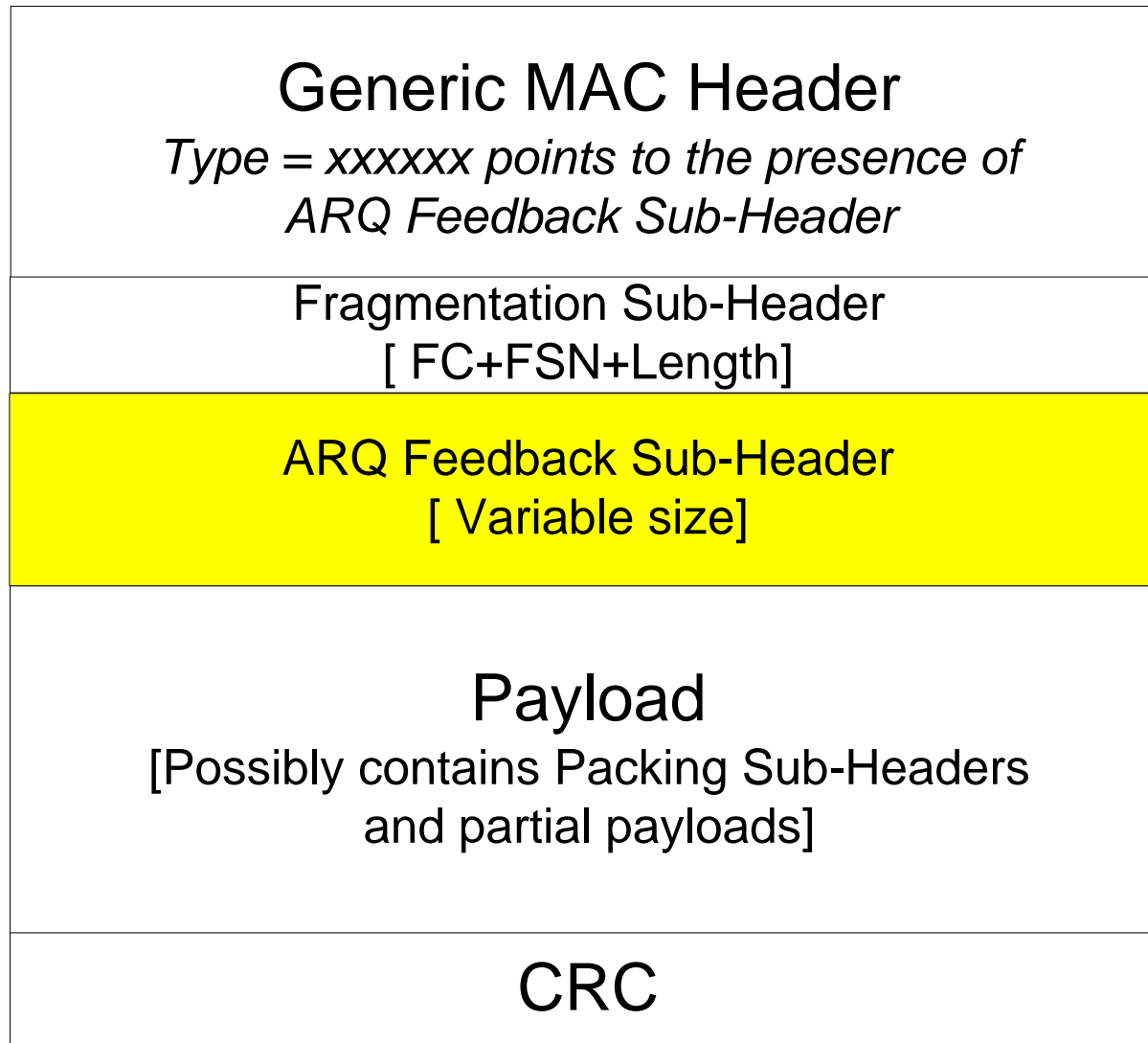
What connection to use for the ARQ feedback transmission?

- Option #1: A special connection, possibly Basic Connection
- Option #2: Any connection

ARQ Feedback Format: Where in MAC Message?

- Option #1: As a new type of Sub-Header = ARQ Feedback Sub-Header
- Option #2: Using the Packing Mechanism

ARQ Feedback Format



ARQ Feedback Format

SHORT

L (1)	Mode (3)	Res (4)
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MEDIUM

Last (1)	Res (1)	Mode (3)	FSN (3)	MSDU-SN (8)
CID (16)				

LONG

Last (1)	Mode (3)	Res (4)	MSDU-SN (8)
Mask (16)			
CID (16)			

ARQ Feedback Format

Mode value	Meaning	AFB Format
000	Everything is OK meanwhile	Short
001	ACK for all the units with the sequential numbers $< \{\text{MSDU-SN}, \text{FSN}\}$	Medium
010	The positive acknowledgements provided by the correspondent Mask bits for the units starting from MSDU-SN	Long
011	Acknowledges the fragments of the MSDU according to Mask bits	Long
100	Equivalent to 001 + 011	Long
101	ARQ Discard Acknowledgment Record	
110- 111	Reserved	

Discard Acknowledgement Format

L (1)	Mode = 101 (3)	Reserved (4)
MSDU-SN (8)		

Usage of Packing Mechanism

Change in Packing Sub-Header

FC (2)	FSN (3)	Partial Payload Type (2)	Length (9)
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Payload Type

00 = The payload is an SDU

01 = The payload is the ARQ Feedback