

**Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)**

**Submission Title:** [HBC MAC Proposal for IEEE802.15.6]

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**Abstract:** [HBC MAC Proposal for BAN]

**Purpose:** [Response to “TG6 Call for Proposals” (IEEE P802.15-08-0811-02-0006).]

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# HBC MAC Proposal for BAN

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# **Adaptive HBC MAC for Wide-Range Bit-Rates Applications**

## Outline

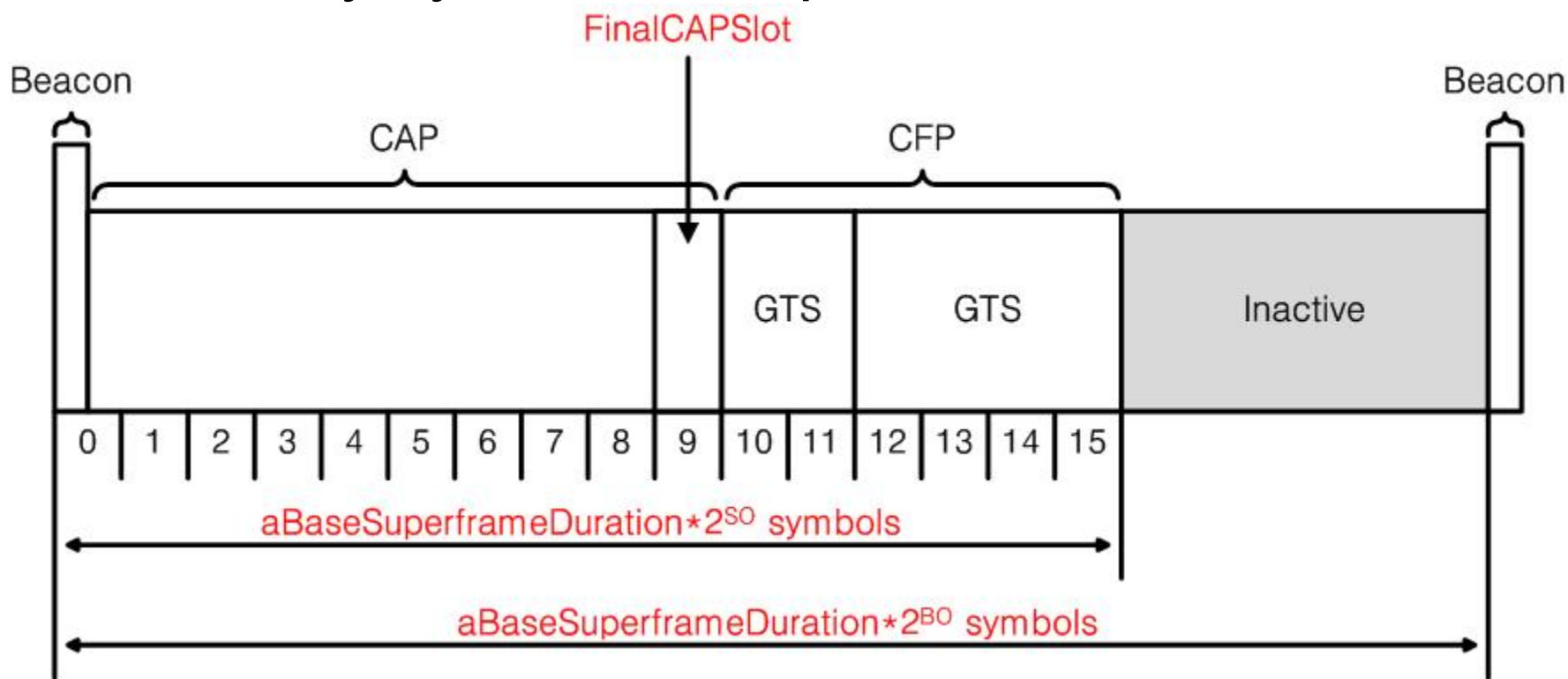
- TG6 Technical Requirements
- Low Data Rate AND High Data Rate BAN
- Frame Structure
- Multicast
- QoS
- Conclusion

## TG6 Technical Requirements

- Data rate: 10 kbps ~ 10 Mbps
- Power Efficiency: several hours ~ several yrs.
- Transmission range: at least 3 m (in and around the body area)
- Applications
  - medical/healthcare applications
  - Non-medical (entertainment)
- QoS

# Low-Rate BAN

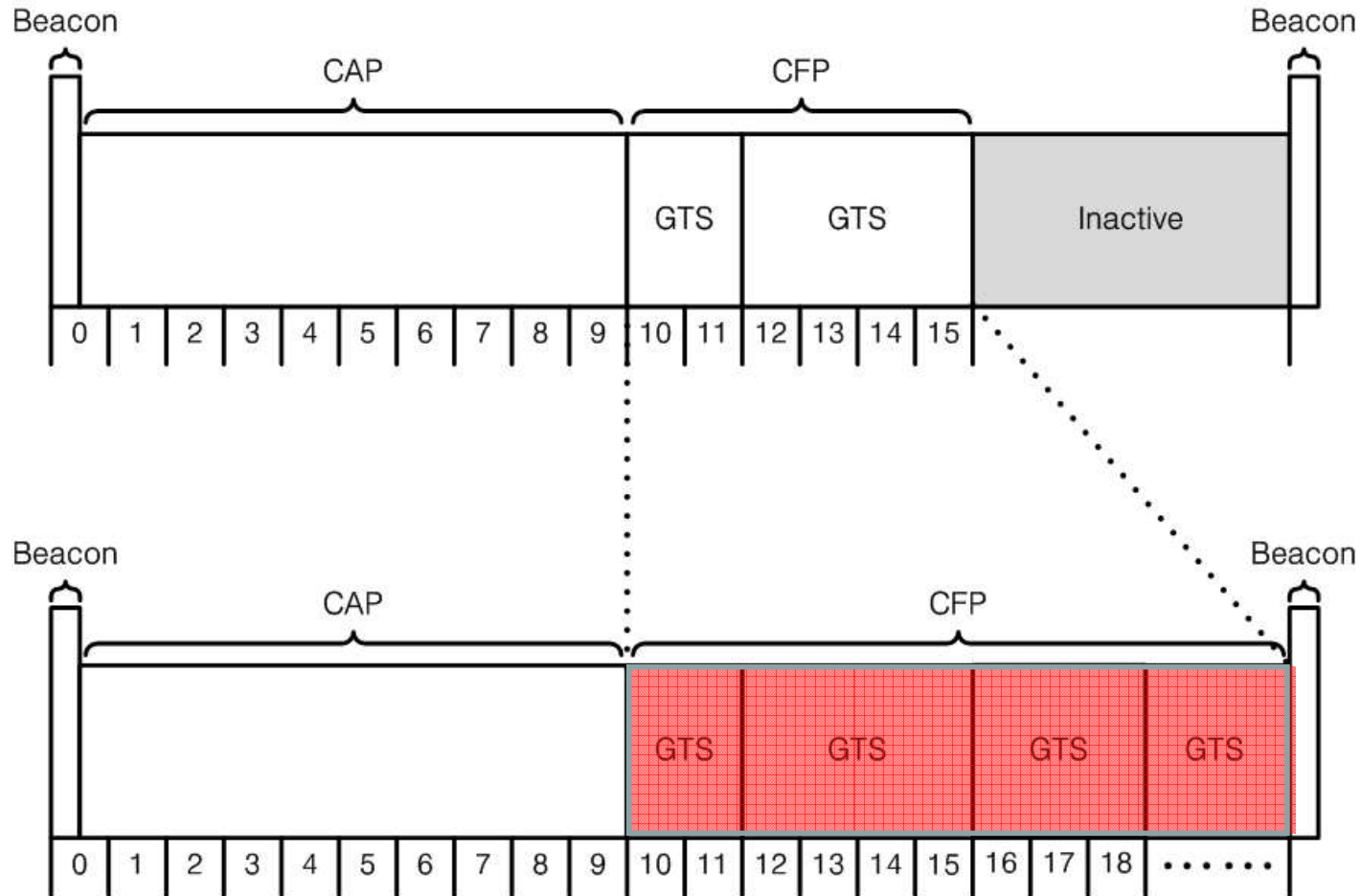
- Inherited from IEEE 802.15.4 LR-WPAN
- **Low** duty-cycle based operation



## High-Rate BAN

- Inherited from IEEE 802.15.3 HR-WPAN
- **Full** duty-cycle based operation

# Expansion of CFP in Superframe



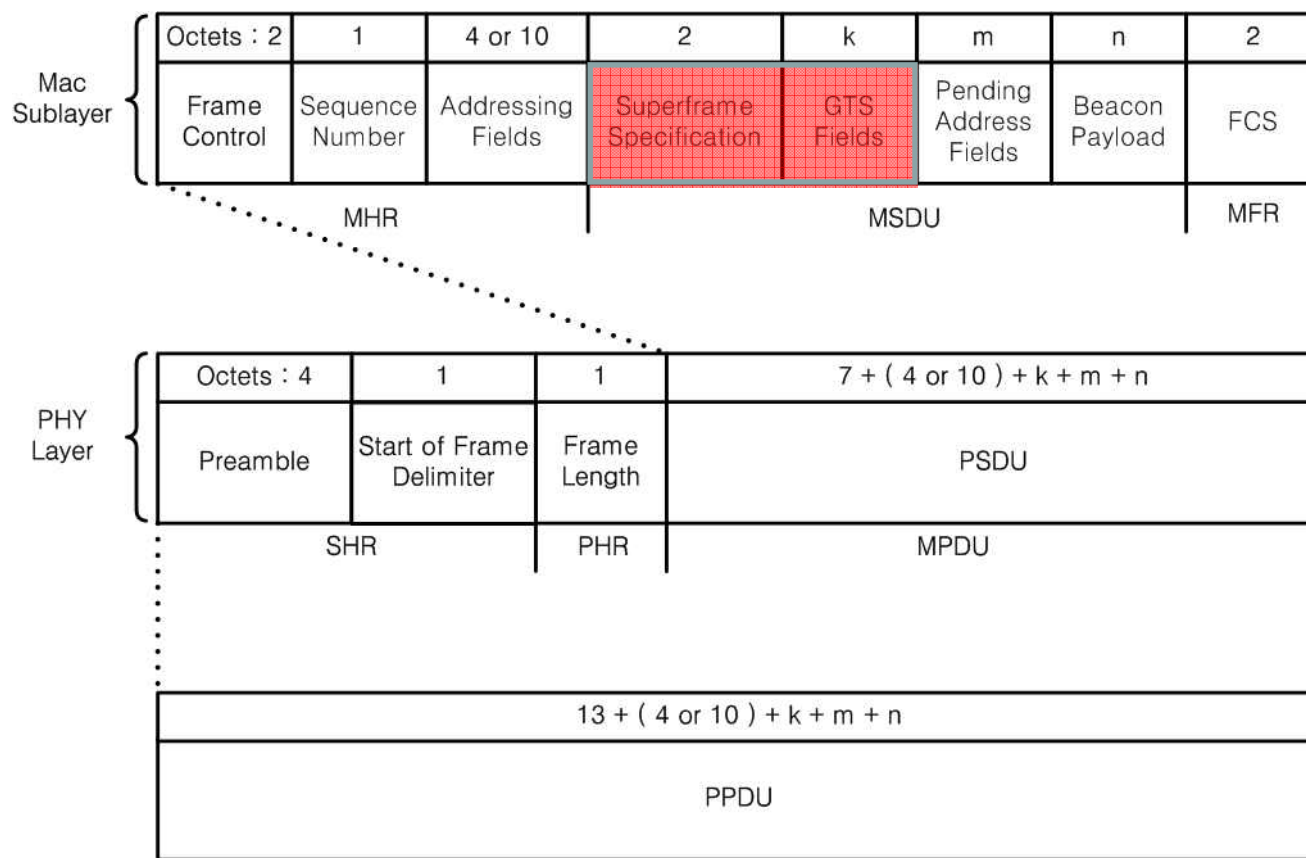


## Limitations of GTS in 802.15.4

- The number of GTS is limited up to 7.
    - : the max number of simultaneous isochronous data transmission
    - In Beacon Frame,
      - GTS descriptor count : 3bits
      - GTS directions : 7 bits mask
  - But, the number of slots per GTS is prolonged up to 255 slots.
    - GTS starting slot : 4 bits → **8 bits**
    - GTS length : 4 bits → **8 bits**
- ➔ Adequate for Bulky Multimedia Data Stream

# Frame Structure (Beacon)

- Beacon Frame

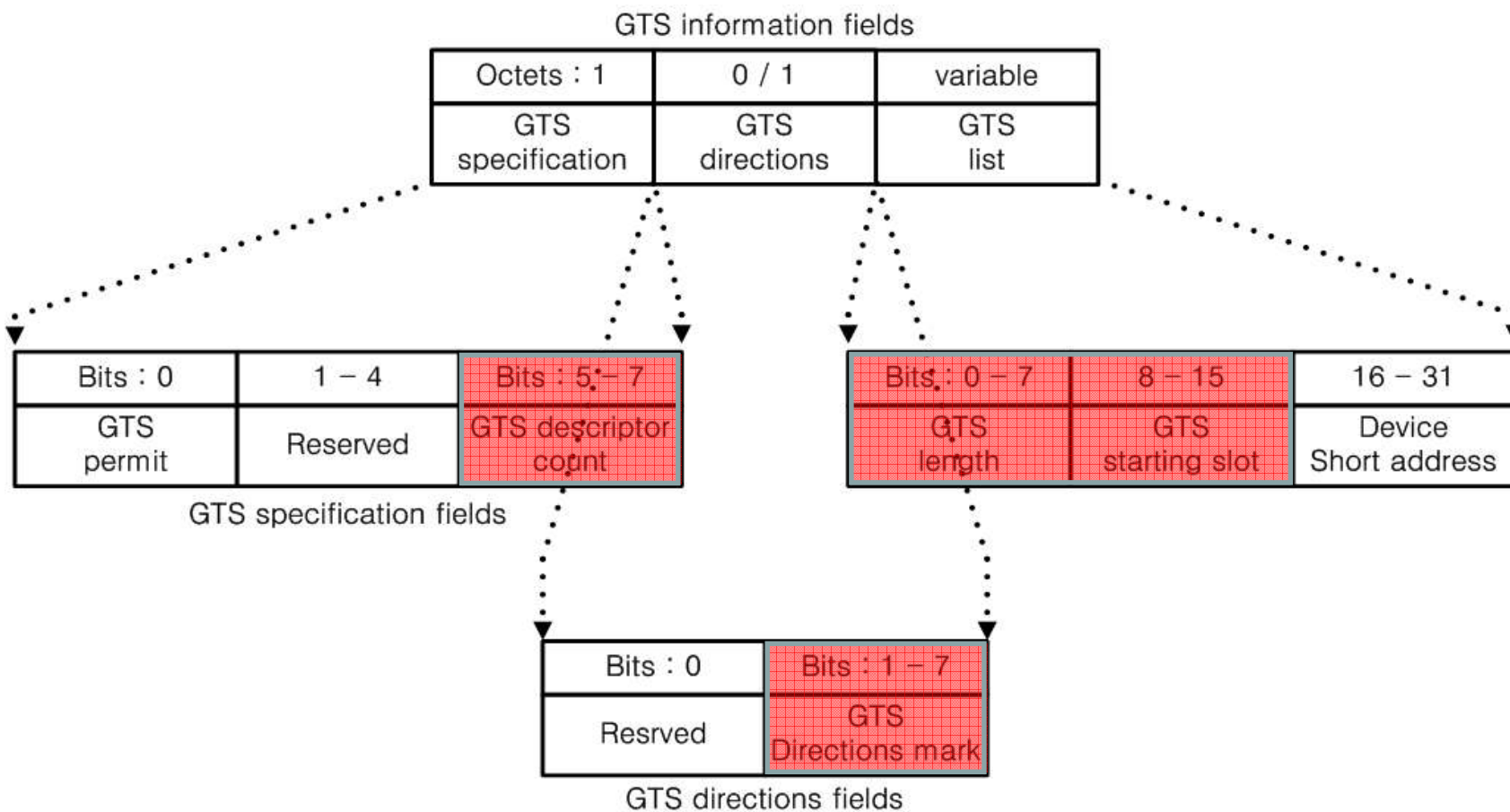


– Superframe Specification

Bits : 0 – 3	4 – 7	8 – 11	12	13	14	15
Beacon order	Superframe order	Final CAP slot	Battery life extension	Reserved	PAN coordinator	Association permit

Superframe specificatin field

## - GTS Fields



# GTS Request Command

Octets : 2	2	12 - 138	12 - 138	...	12 - 138
Command type	Length(=sum of n GTSRqBs)	GTSRqB-1	GTSRqB-2	...	GTSRqB-n

Octets : 1	1-127	1	1	1	1	2	2	1	1
Num Targets	Target ID list	Reserved	Stream Request ID	Stream Index	Reserved	EGTS rate factor	Reserved	Minimum number of GTSs	Desired number of GTSs

# Frame Types

- Beacon Frame
- Data Frame
- Imm-ACK Frame
- Dly-ACK Frame
- MAC Command Frame

# Frame Structure

## ❖ Header

- Frame Control : 2 octets
  - Frame type: 3 bits
  - ACK type: 2 bits
  - Dest. Addressing mode: 2 bit (Coordinator/16bits/64bits)
  - Src. Addressing mode: 2 bits (Coordinator/16bits/64bits)
  - **Stream Index** : 7 bits → 128 different isochronous data streams
    - \* identify current GTS streams
- Sequence Number: 8 bits
- Addressing Fields
  - Source PAN identifier (0/2 octets)
  - Destination PAN identifier (0/2 octets)
  - Source address (0/2/8 octets)
  - Destination address (0/2/8 octets)

## Frame Structure

❖ Payload

❖ Frame Check Sequence : 2 bytes

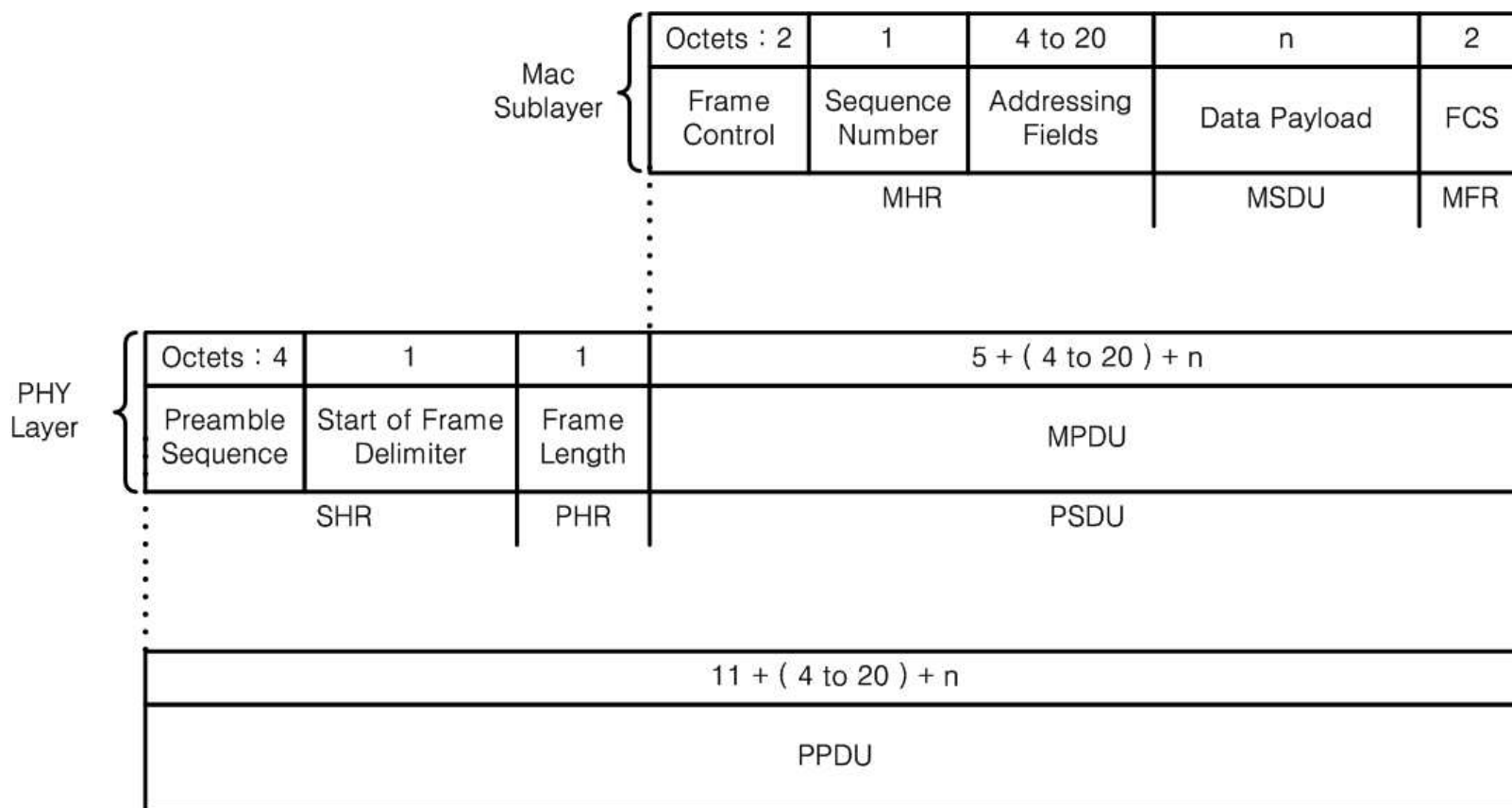
– 16 bit ITU-T CRC

–  $G^{16}(x) = x^{16} + x^{12} + x^5 + 1$



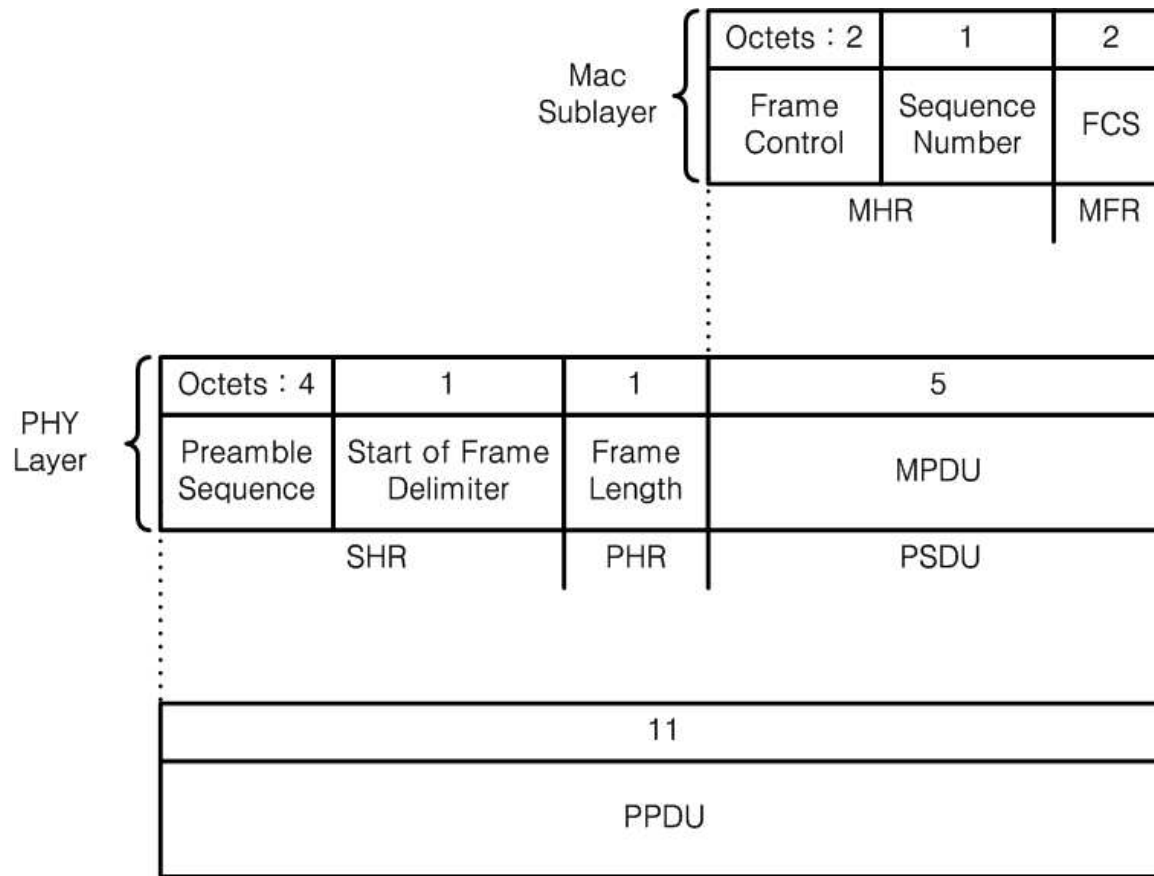
# Frame Structure (Data)

- Data Frame



# Frame Structure (ACK)

- ACK Frame

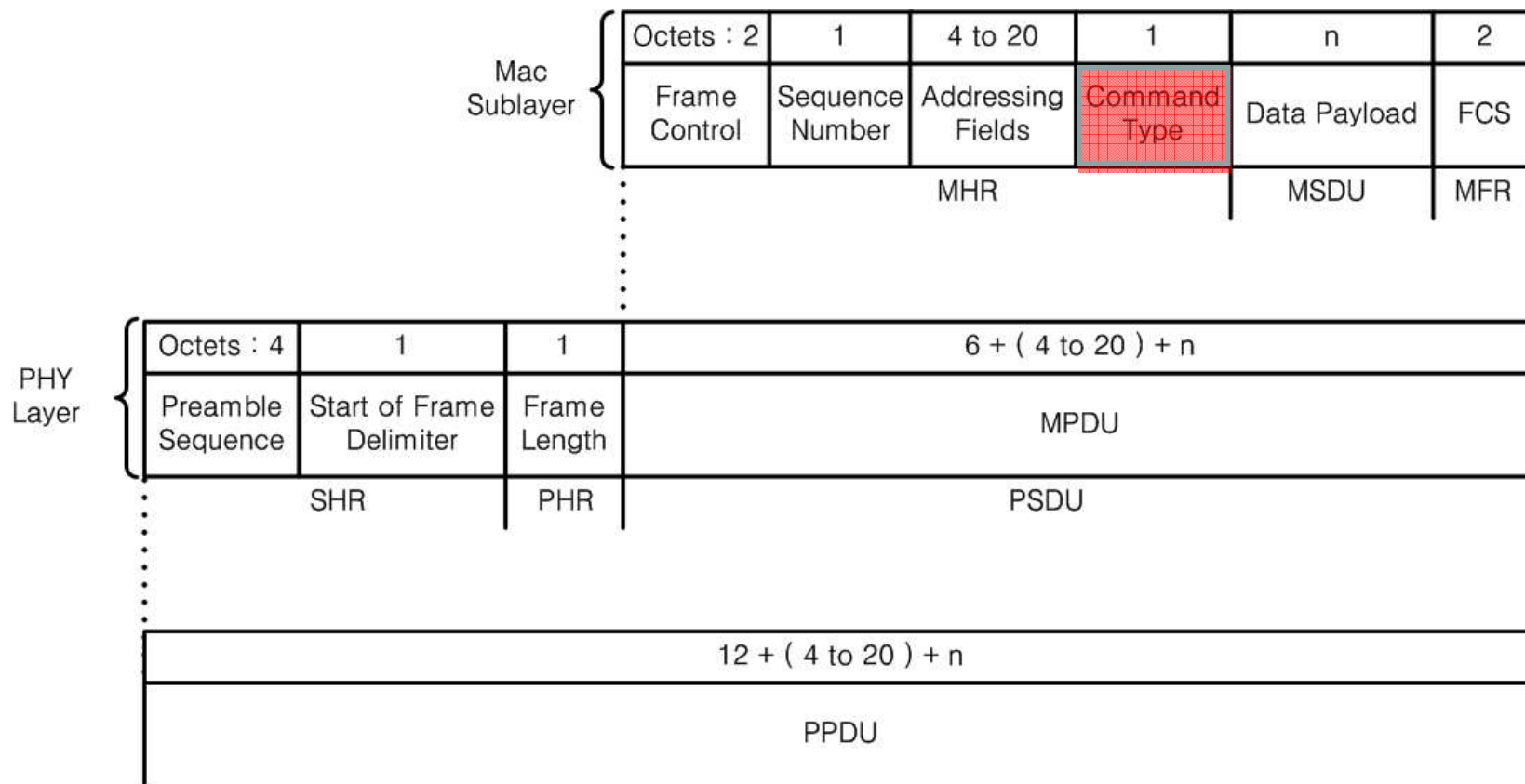


## ACK Types

- No ACK
  - Broadcast/multicast frames
- Immediate ACK (Imm-ACK)
  - Point-to-point (directed) frames
- Delayed ACK (Dly-ACK)
  - For directed stream data frames  
(i.e. isochronous connections)
  - The Dly-ACK mechanism is initiated by the source DEV sending a single data frame with the ACK Policy field set to Dly-ACK Request.

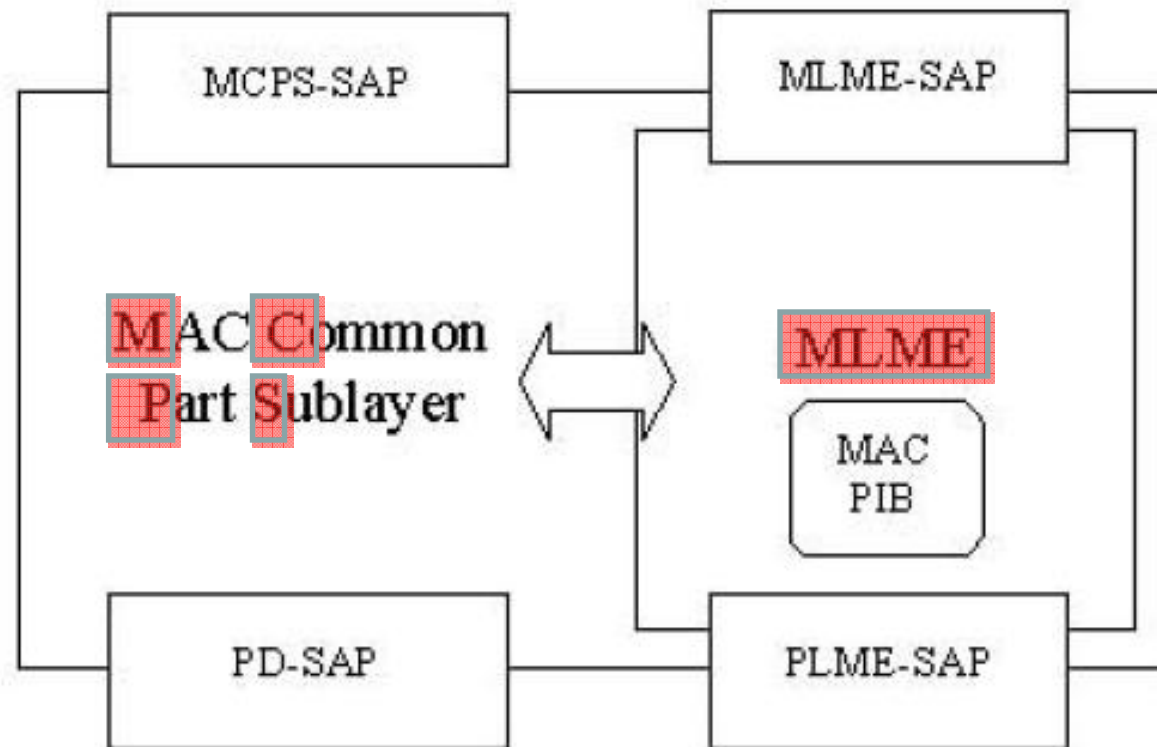
# Frame Structure (MAC Command)

- MAC Command Frame



# MAC Commands

- Commands through MLME-SAP



- **MLME-ASSOCIATE**
  - Only devices that have a valid short address shall send the command
  - Req/Ind/Res/Conf
- **MLME-DISASSOCIATE**
  - Req/Ind/Conf
- **MLME-GTS**
  - Define how GTSs are requested and maintained
  - Req/Ind/Conf
- **MLME-SCAN**
  - To measure the energy on the channel
  - To search for the coordinator with which it associated
  - Req/Ind/Conf
- **Etc.**

# Multicast



## Connections in WBAN (HBC)

- Combinations of
  - One to one : directed
  - One to many : multicast
  - Broadcast



# Multicast Destinations

- GTS Request Command

Octets : 2	2	12 - 138	12 - 138	...	12 - 138
Command type	Length(=sum of n GTSRqBs)	GTSRqB-1	GTSRqB-2	...	GTSRqB-n

Octets : 1	1-127	1	1	1	1	2	2	1	1
Num Targets	Target ID list	Reserved	Stream Request ID	Stream Index	Reserved	EGTS rate factor	Reserved	Minimum number of GTSs	Desired number of GTSs

## QoS

- EGTS : For highest priority frame
- GTS : For high priority frame
- CAP : For Normal priority frame

### <IEEE 802.1p traffic types>

User priority	Traffic type	Used for :	Comments	Container
0(default)	Best effort(BE)	Asynchronous data	Sensor data, command	CAP
1	Background(BK)	Asynchronous data		
2		A spare	Currently not assignend	
3	Excellent effort (EE)	Isochronous	For valued customers	
4	Controlled load (CL)	Isochronous	Traffic will have to conform to some higher protocol layer admission control	GTS
5	Video (VI)	Isochronous	< 100ms delay and jitter multimedia	GTS
6	Voice (VO)	Isochronous	< 10ms delay and jitter multimedia	GTS
7	Network control (NC) Emergency		Urgent command Emergency data	EGTS

## Conclusion

- Beacon-mode Superframe
  - Supporting low duty cycle / full duty cycle
- Frame Structures (Beacon, ACK, Data, Command)
- Support QoS compliant with IEEE 802.1p through CAP, GTS and EGTS
- Support Multicast applications with Directed applications simultaneously

**Thank You !**

**Any Questions ?**