

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

Submission Title: [MAC for IEEE802.15.6]

Date Submitted: [April 29, 2009]

Source: [Hyung-il Park¹, Sung-weon Kang¹, Youngmi Kwon²]

Company [ETRI¹, Chungnam National University (CNU)²]

Address [138 Gajeongno, Yuseong-gu, Daejeon, 305-700, Korea]¹, [220 Gung-dong,
Yuseong-gu, Daejeon, 305-764, Korea]²

Voice:[], FAX: [+82-42-823-5586]

E-Mail: [hipark@etri.re.kr, kangsw@etri.re.kr, ymkwon@cnu.ac.kr]

Abstract: [HBC MAC Proposal for BAN]

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

Notice: This document has been prepared to assist the IEEE P802.15. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.

Release: The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15.

HBC MAC Proposal for BAN

Hyung-il Park, Sung-weon Kang, Youngmi Kwon

Electronics and Telecommunications Research Institute (ETRI)
Chungnam National University (CNU)

Adaptive HBC MAC for Wide-Range Bit-Rates Applications

Outline

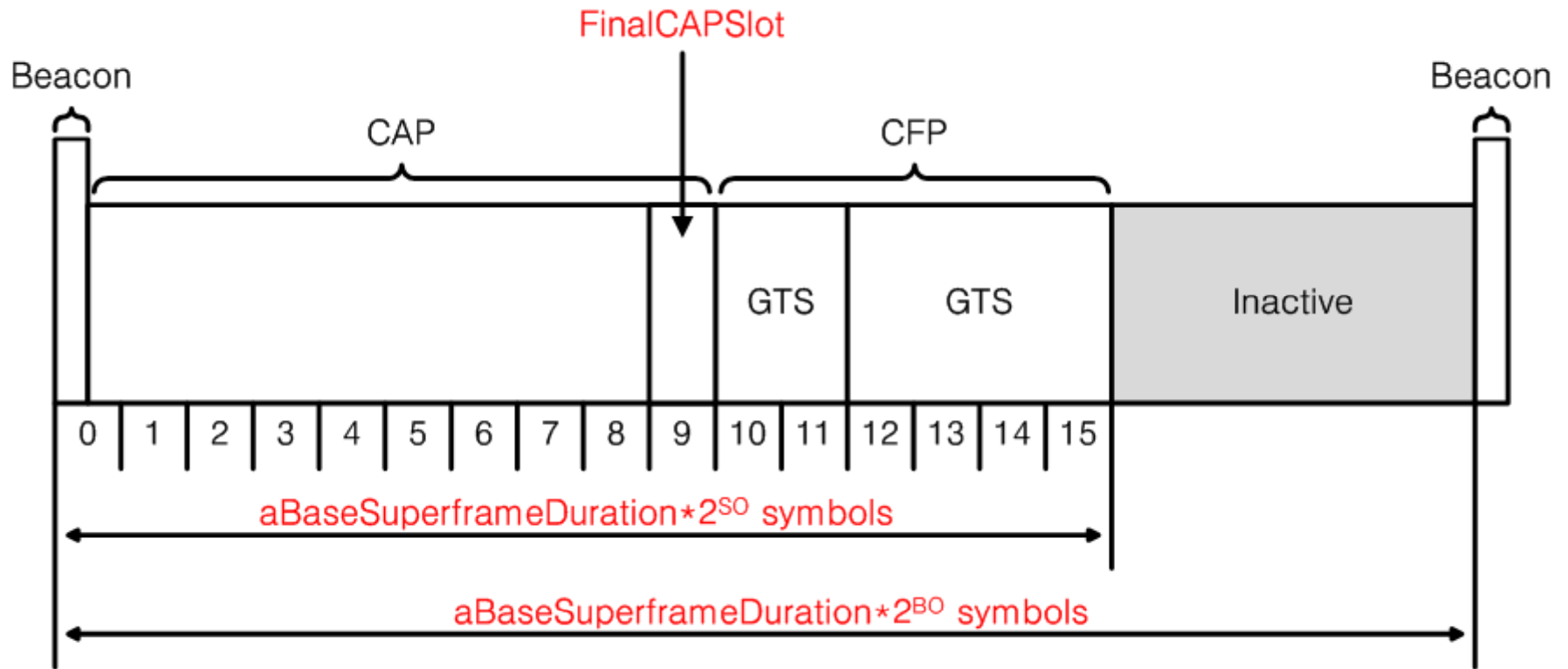
- TG6 Technical Requirements
- Low Data Rate AND High Data Rate WBAN
- Frame Structure
- Multicast
- QoS
- Conclusion

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 WBAN

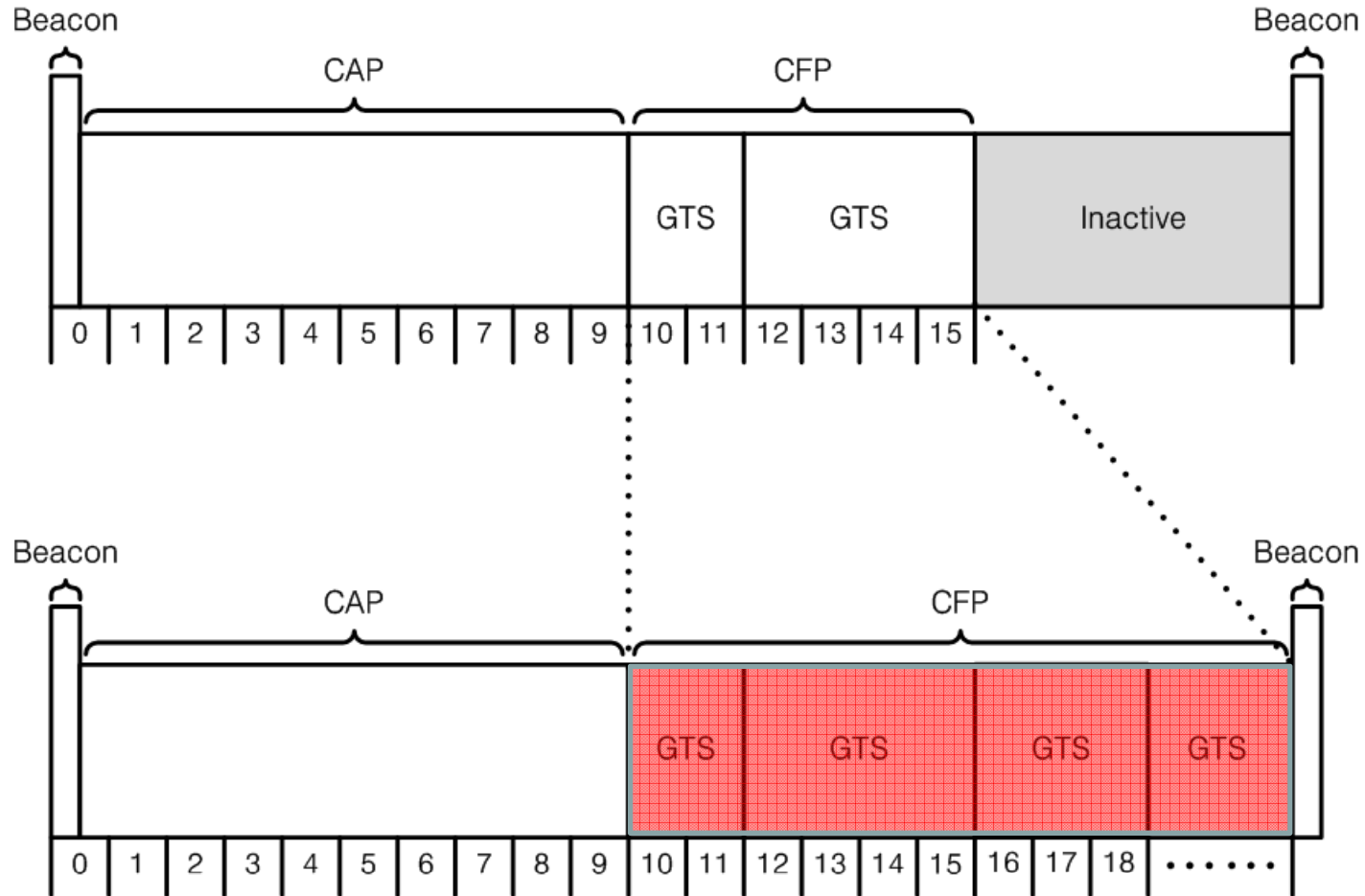
- Inherited from IEEE 802.15.4 LR-WPAN
- **Low** duty-cycle based operation



High-Rate WBAN

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

Expansion of CFP in Superframe

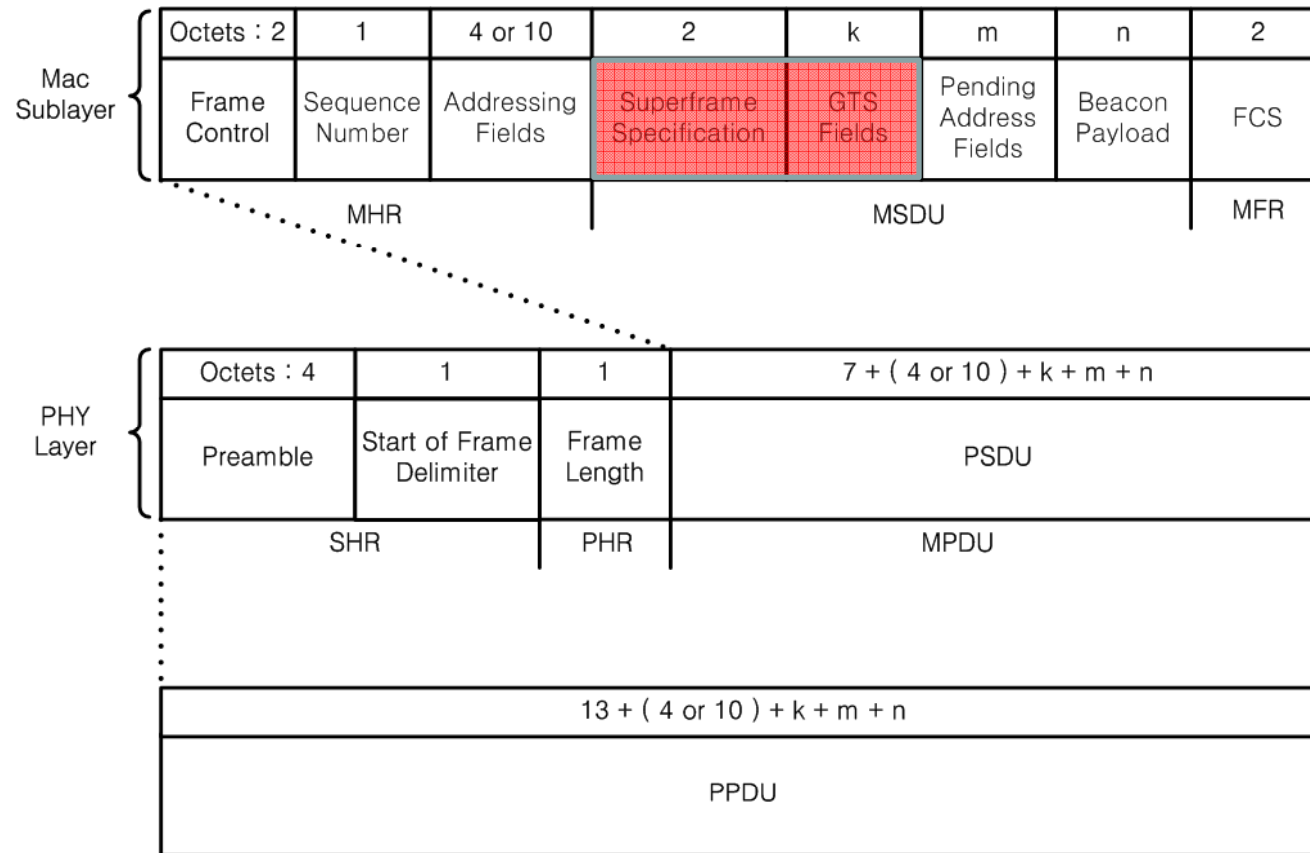


Limitations of GTS in 802.15.4

- 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

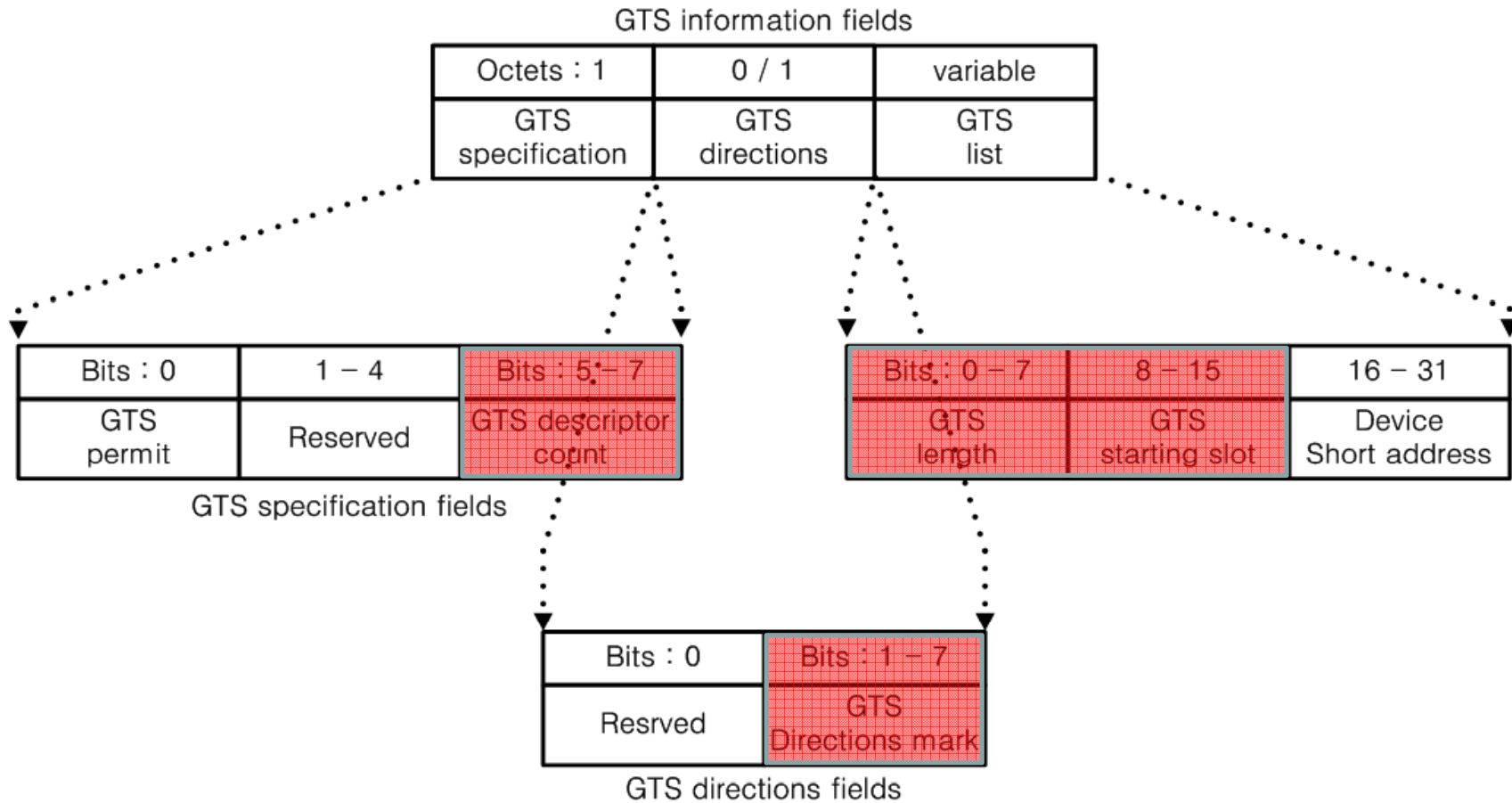


– Superframe Specification

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

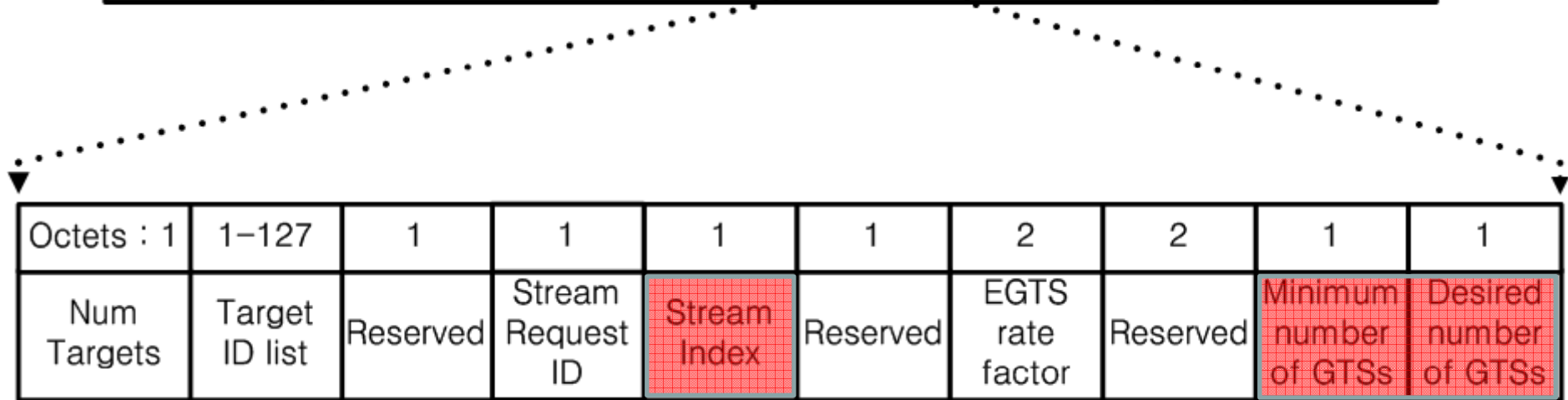
Superframe specificatin field

- 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



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
- 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)

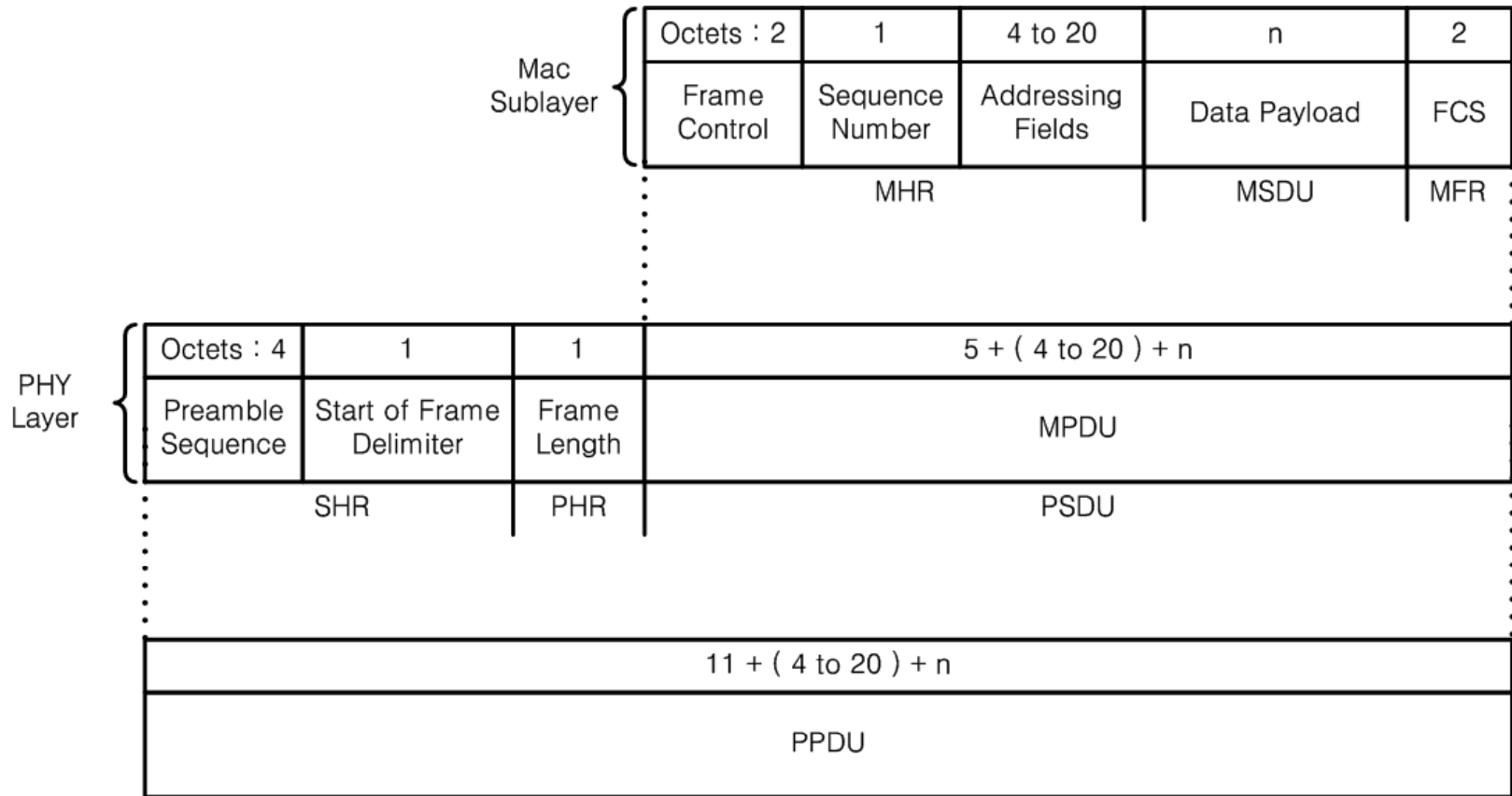
Frame Structure

- ❖ Payload

- ❖ Frame Check Sequence : 2 bytes
 - 16 bit ITU-T CRC
 - $G^{16}(x) = x^{16} + x^{12} + x^5 + 1$

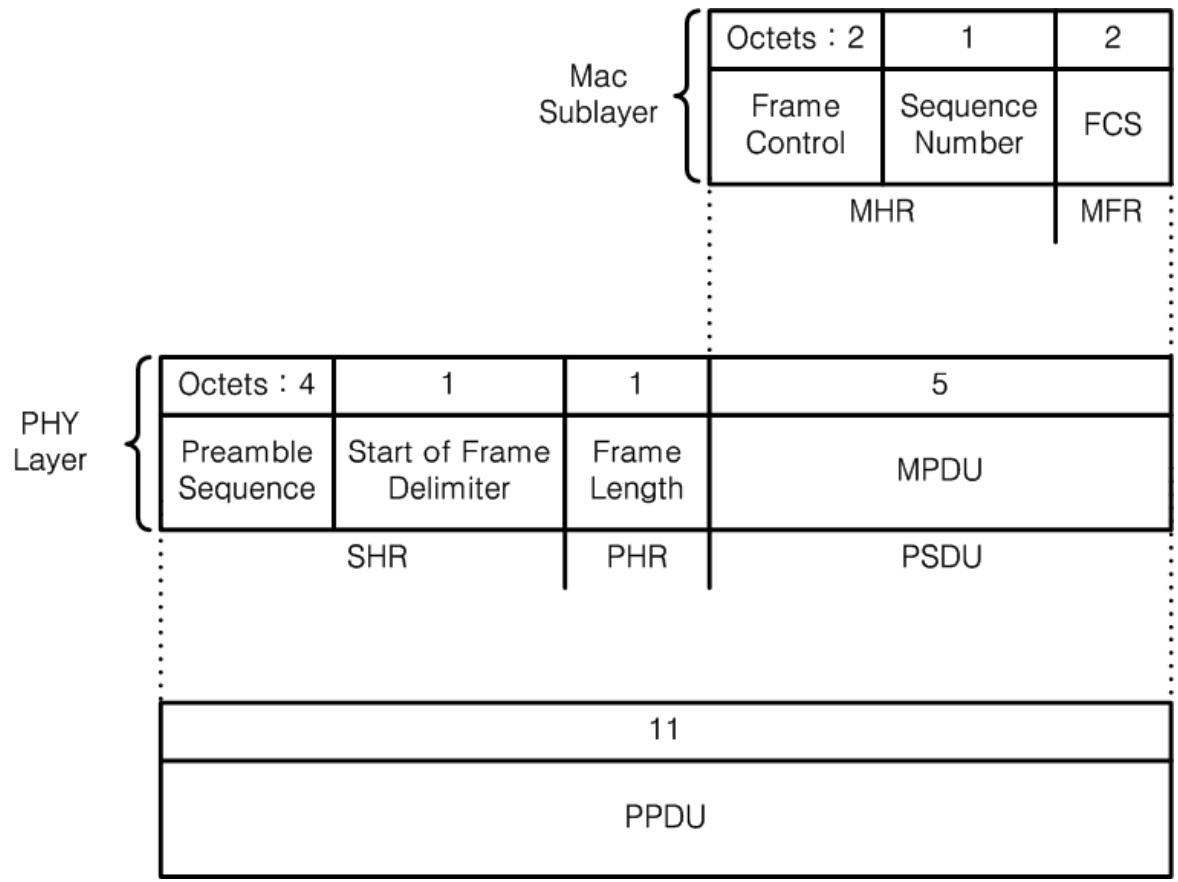
Frame Structure (Data)

- Data Frame



Frame Structure (ACK)

- ACK Frame

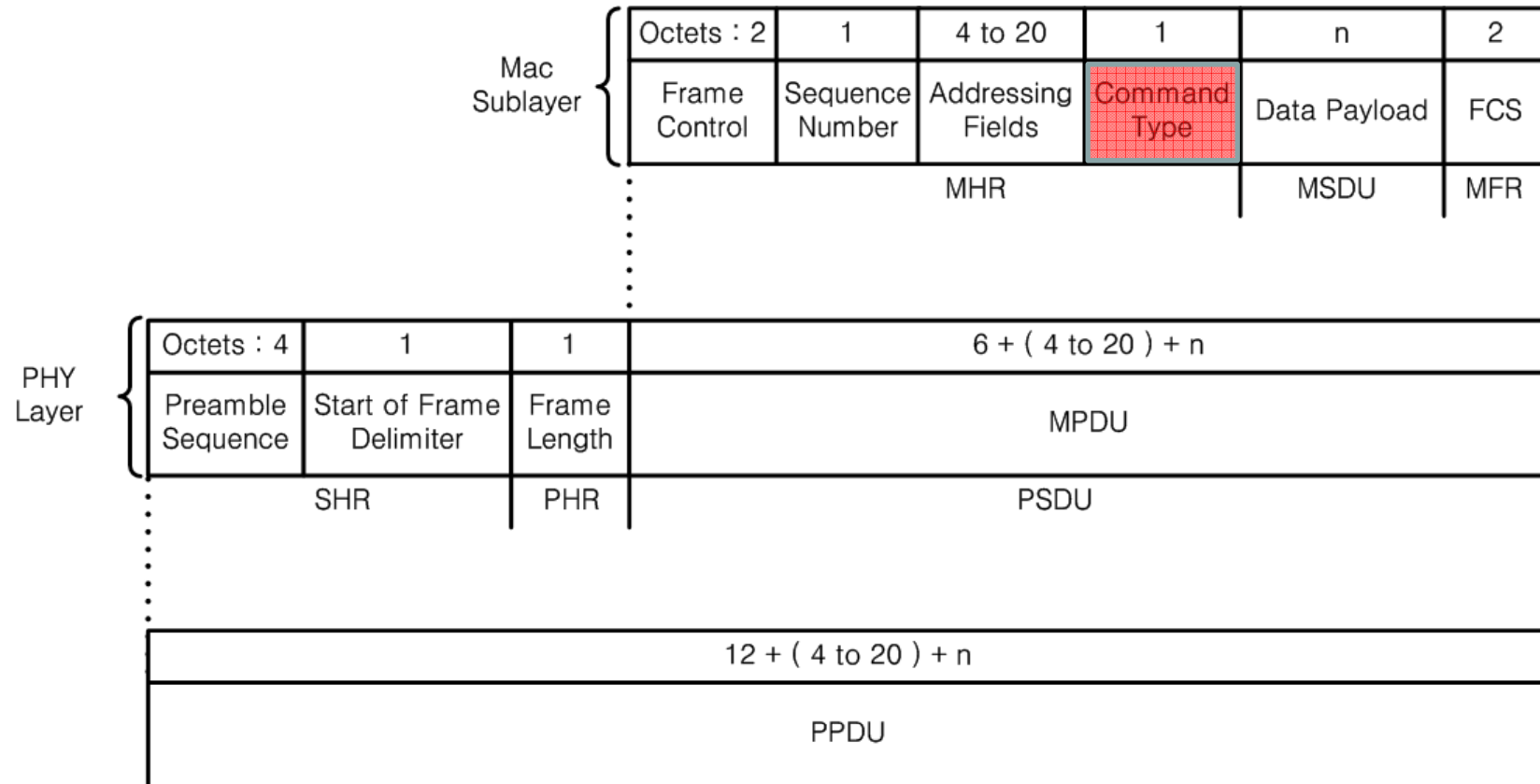


ACK Types

- 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.

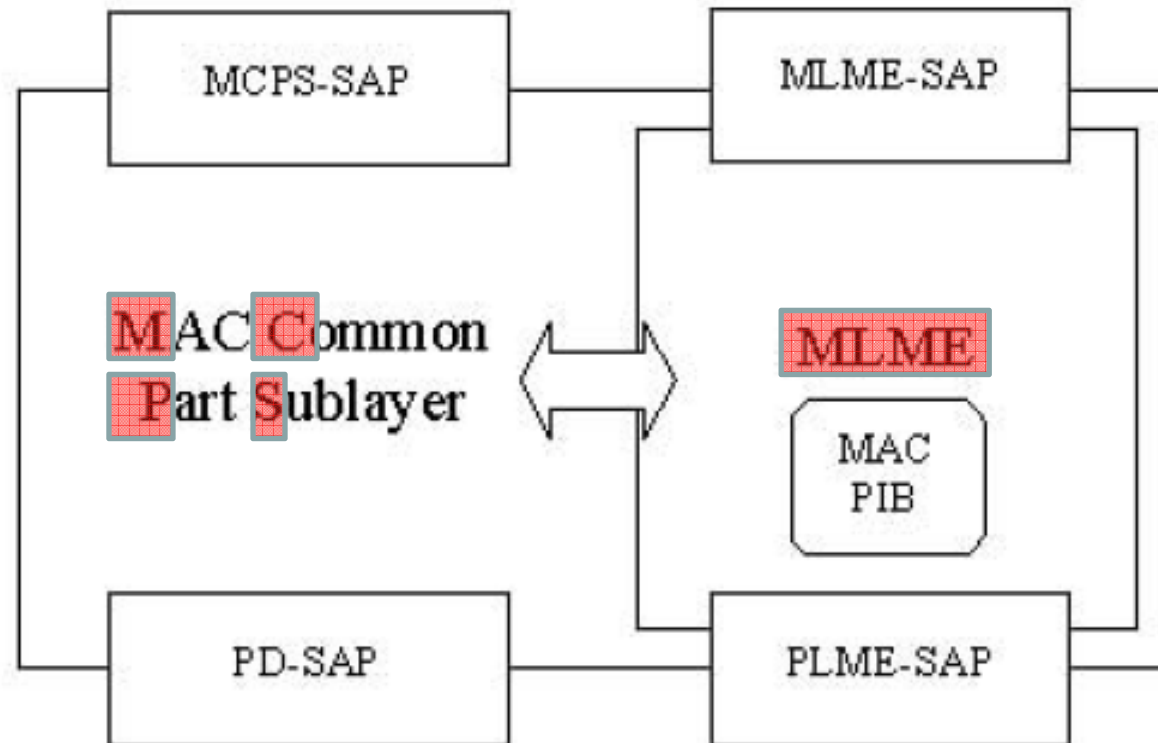
Frame Structure (MAC Command)

- MAC Command Frame



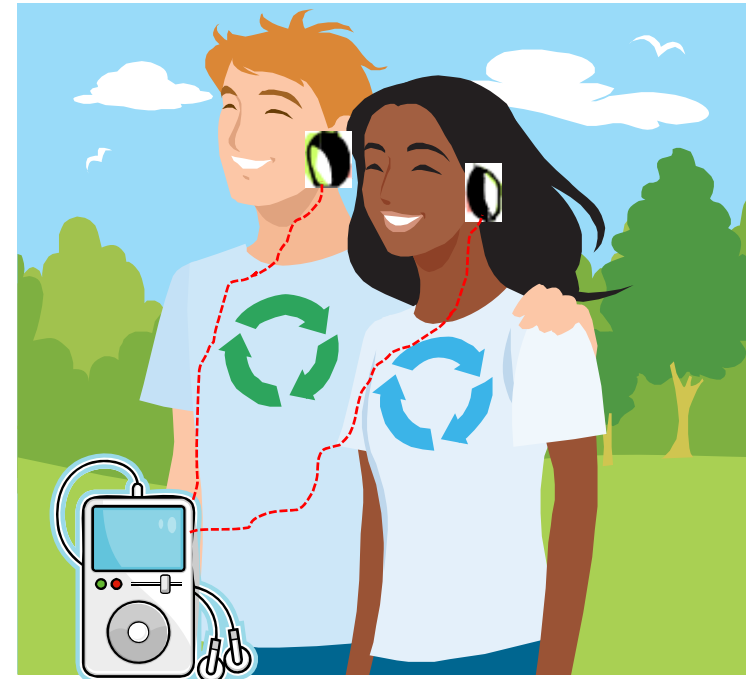
MAC Commands

- 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 search for the coordinator with which it associated
 - Req/Ind/Conf
- **Etc.**

Multicast



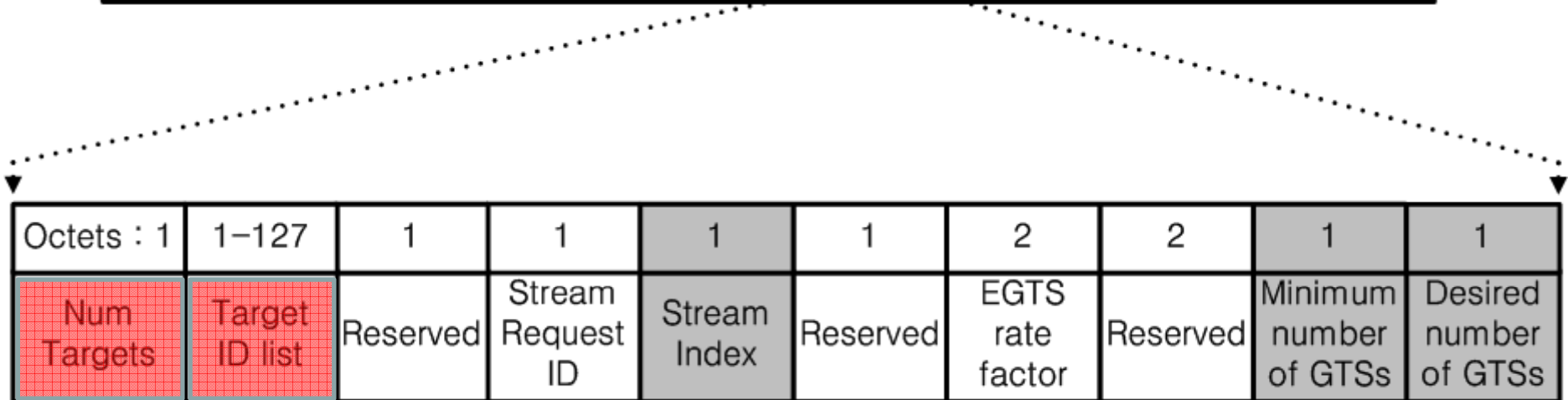
Connections in WBAN (HBC)

- 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



QoS

- GTS : For isochronous streams (priority 4, 5, and 6)
- CAP : For Normal data or command frames (priority 0 and 7)

<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	CAP

Conclusion

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

Thank You !

Any Questions ?