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

Submission Title: [Multi-PHY-Mode Management through Common Signaling for 802.15.4g WPAN System]
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Abstract: [Proposal for Multi-PHY Mode Management]

Purpose: [This document provides a list of the editing staff that will be working on 802.15.4g.]

Summary

- This document proposes the employment of Common Signaling Mode (CSM) for Multi-PHY-Mode (MPM) Management in a single 802.15.4g WPAN
- This document also:
  - outlines the rules for MPM Management
  - presented the basic procedures of the MPM Management
  - proposes the suitable PHY specification for CSM
  - specifies the new frame format required to support the MPM Management

Presentation Outline

- Part 1: Introduction
  - Motivation
  - Proposed MPM Management Solution
  - MPM Management Main features
  - MPM Management Rules
- Part 2: How it works
  - BPAN Basic Operation Procedures and Flows
  - NBPAN Basic Operation Procedures and Flows
- Part 3: Essential Elements
  - Common Signaling PHY specifications
  - Format for Coex-Beacon Frame
- Conclusion

Abbreviations

- MPM: Multi-PHY-Mode
- CSM: Common Signaling Mode
- NC: Network Coordinator
- MPMNC: Multi-PHY-Mode NC
- DEV: Device
- Coex-beacon: Coexistence-beacon
- BPAN: Beacon-enabled-PAN
- NBPAN: Non-beacon-enabled-PAN

Motivation

- A total of 3 PHY modes are proposed as potential candidates for the TG4g PAN
  - FSK
  - OFDM
  - DSSS
- A mechanism that enables coexistence among the three PHY modes in a single PAN must be specified to avoid mutual co-channel interference
- A mechanism that provides room for different levels of implementation-dependent optimization may be specified

Proposed MPM Management Solution

- As a solution to the multi PHY mode problem, the MPM management scheme is proposed
- The MPM management scheme specifies a mechanism to bridge among three PHY modes to avoid co-channel interference
- The MPM management scheme requires NCs (of different PHY modes) to negotiate among each other before starting a network by using a common language known as the CSM
- The CSM is a PHY layer specification that has to be supported by all NCs in the three candidate PHY modes
- Several CSM-related rules are specified to facilitate the negotiation among NCs

MPM Management Main Features

- A relatively simple mechanism for multi-PHY networks
- One mandatory PHY-layer-specific CSM
- Five corresponding MAC rules
- Specification of a new coex-beacon (CB) frame
- Capability to transmit and receive CSM required only in NCs, not in low complexity battery-powered DEVs
- Alternatively, different levels of coexistence:
  - MPMNC: mandatory to support MPM management
  - Normal NC
- Advanced level of interoperability may be further supported if all DEVs support the CSM

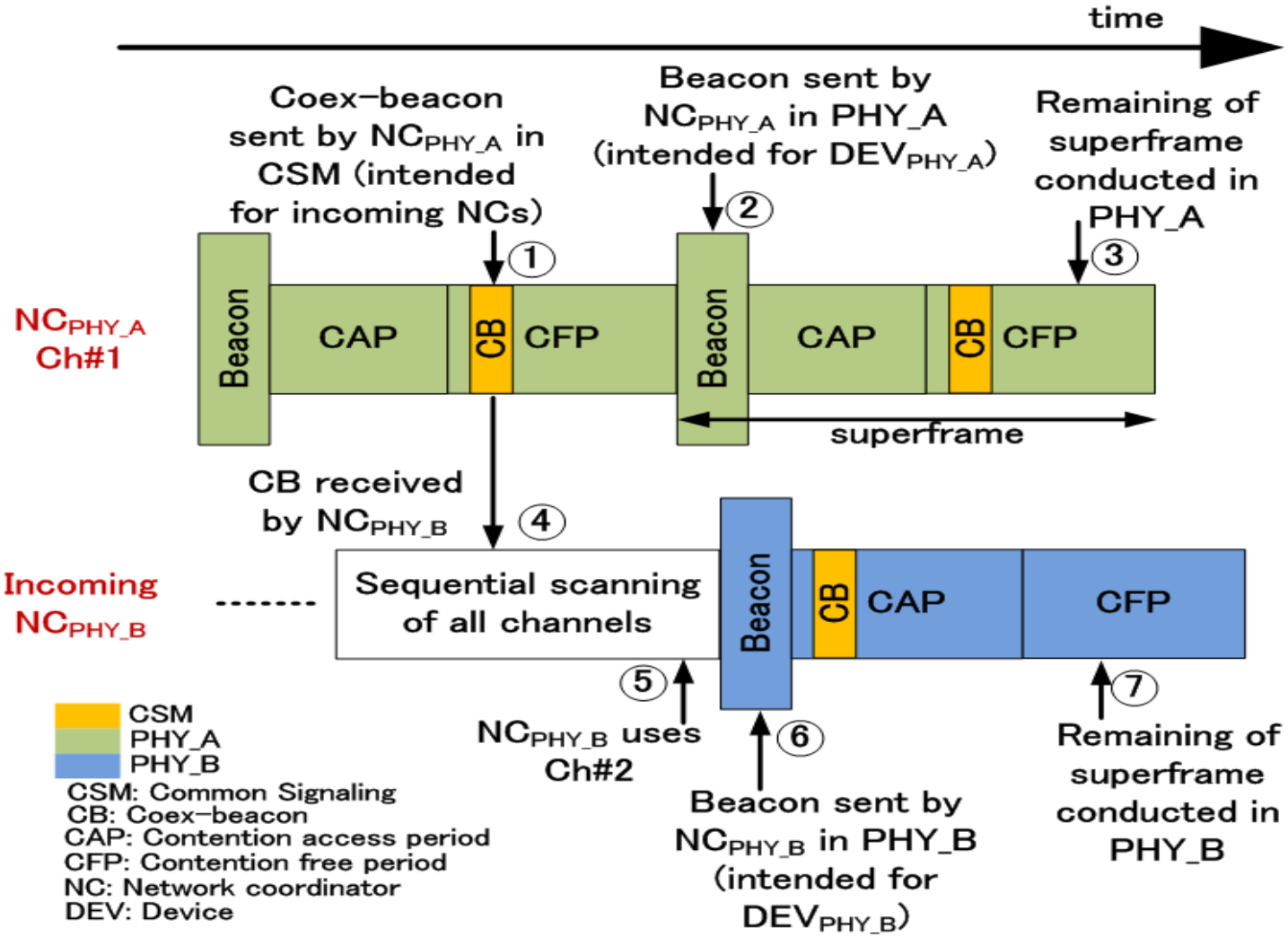
MPM Management Rules

- An NC shall be capable of transmitting and receiving the CSM
- An NC shall scan for the coex-beacon before starting a new PAN
- An NC operating a BPAN shall transmit a coex-beacon using the CSM in every/ every multiple superframe(s)
- An NC operating an NBPAN shall transmit a coex-beacon using the CSM periodically
- A DEV may optionally support the CSM for higher level of interoperability

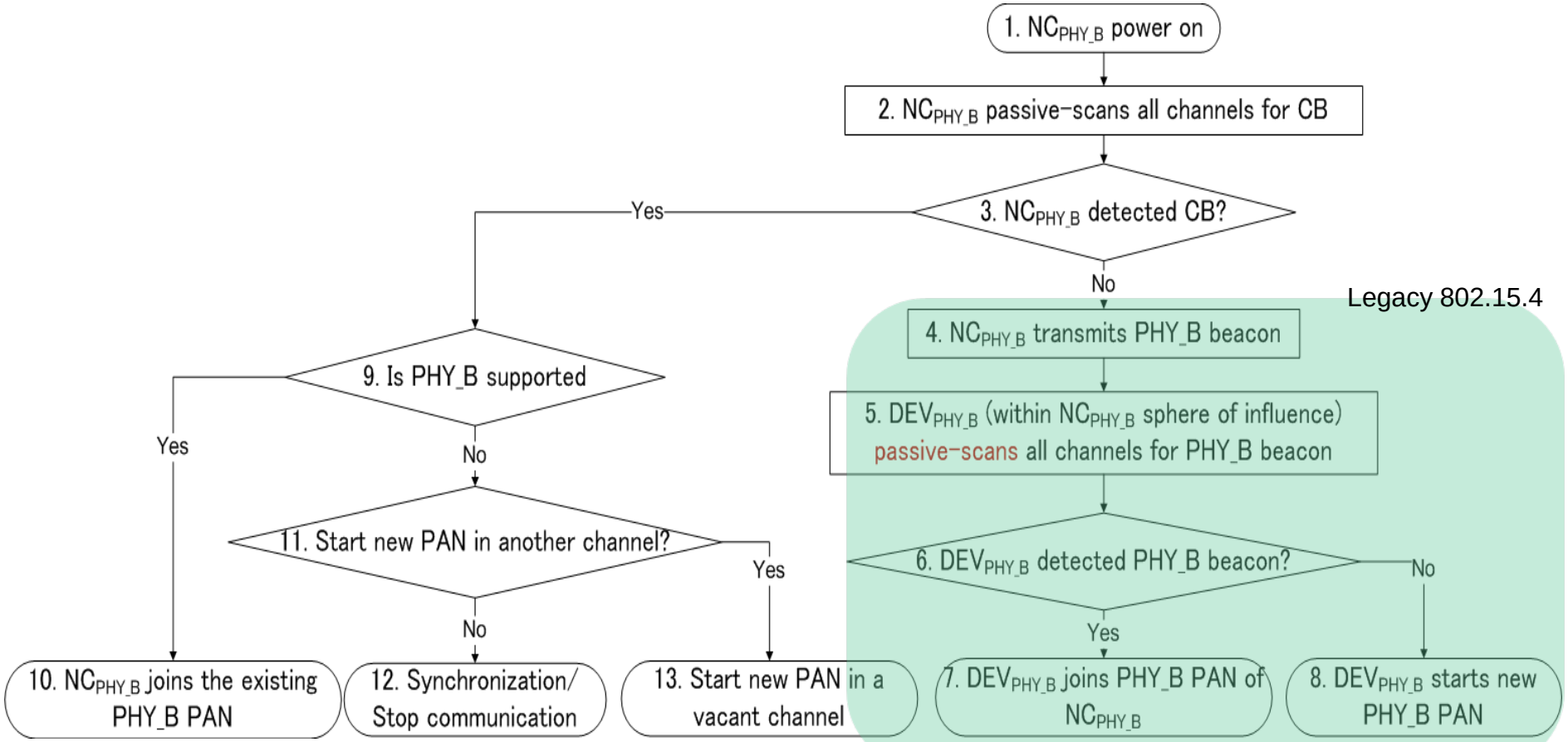
BPAN Operational Procedure Description

- A BPAN is a PAN that where beacons are sent by the NC in every superframe
- Existing **NC_{PHY_A}** coordinating a BPAN in current channel
  - Coex-beacon transmitted using the **CSM** in each/multiples of superframe duration
  - Beacon transmitted using **PHY_A** in every superframe
- Prospective **NC_{PHY_B}** enters the channel, performs scanning
  - **NC_{PHY_B}** receives coex-beacon in the **CSM**
- **NC_{PHY_B}** detects the existence of **NC_{PHY_A}**, therefore subjected to following options:
  - Decode and extract information in coex-beacon from **NC_{PHY_A}** for synchronization
  - Try another channel
  - Stop communication
- **NC_{PHY_A}** and **NC_{PHY_B}** can now coordinate respective PANs in the same location

BPAN Operation Procedure Illustration



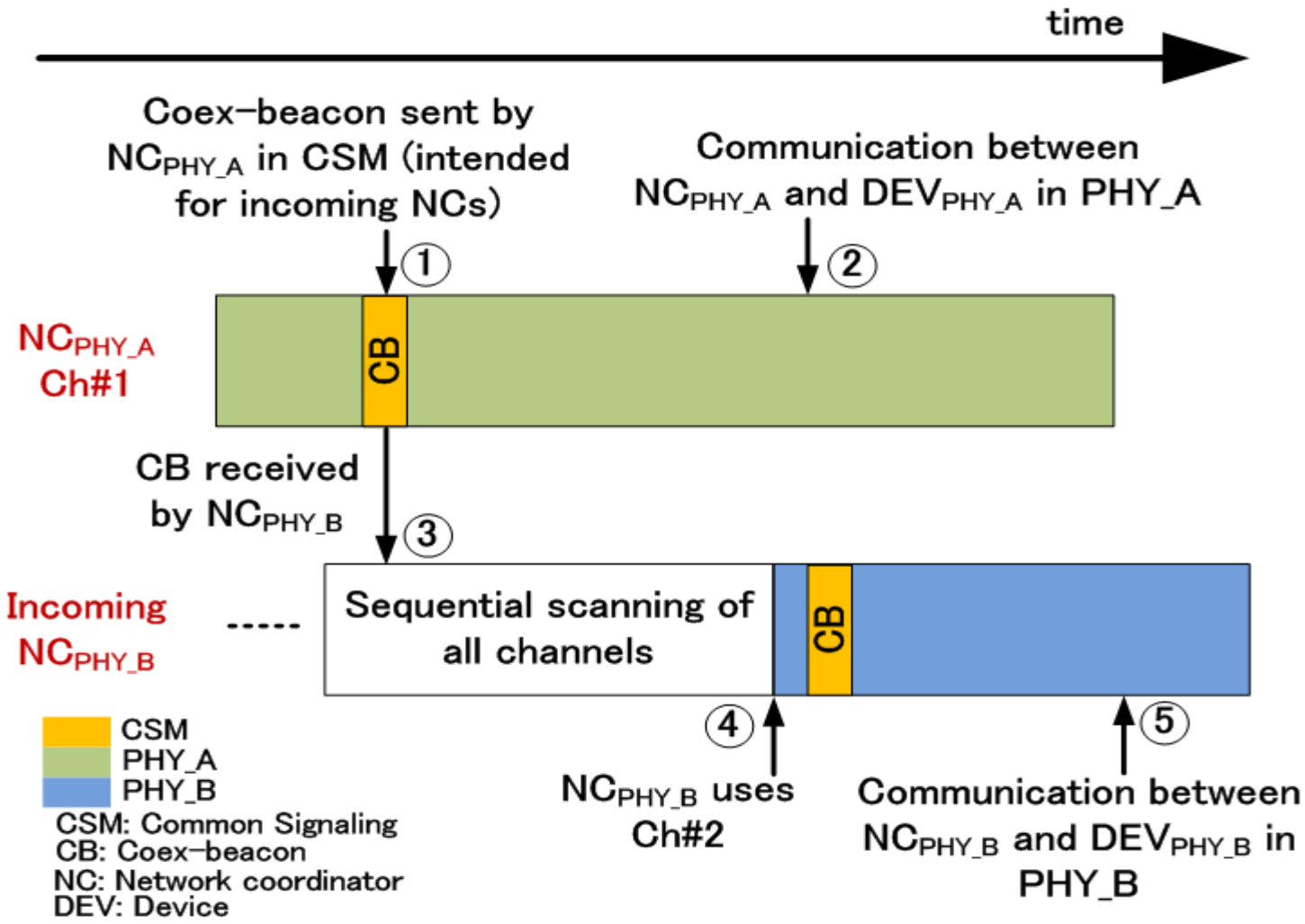
BPAN Operation Procedure Flow Chart



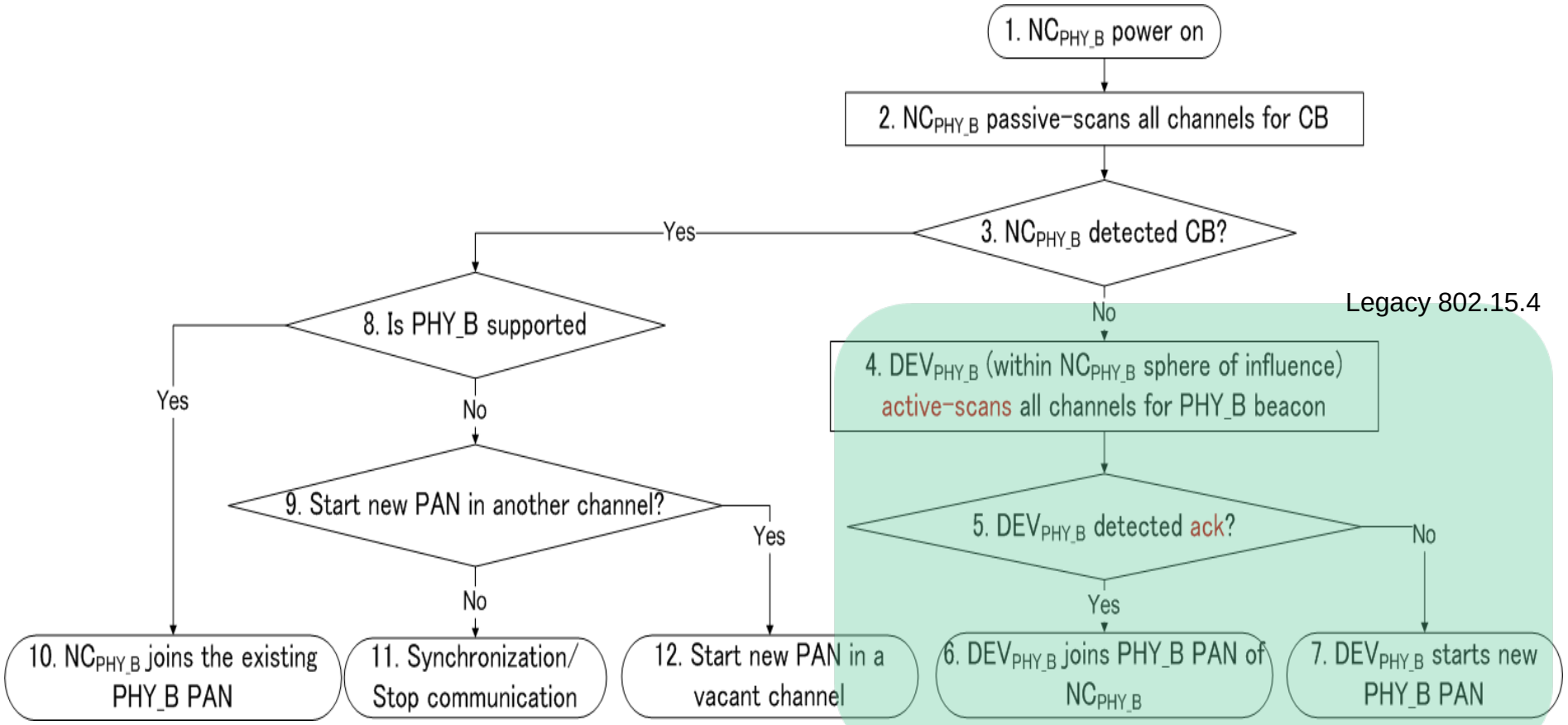
NBPAN Operational Procedure Description

- An NBPAN is a PAN that where beacons are not sent by the NC or are only sent upon request by DEVs
- Existing **NC_{PHY_A}** coordinating an NBPAN in current channel
  - Coex-beacon transmitted using the **CSM** periodically
- Prospective **NC_{PHY_B}** enters the channel, performs scanning
  - **NC_{PHY_B}** receives coex-beacon in the **CSM**
- **NC_{PHY_B}** detects the existence of **NC_{PHY_A}**, therefore subjected to following options:
  - Try another channel
  - Stop communication
- **NC_{PHY_A}** and **NC_{PHY_B}** can now coordinate respective PANs in the same location

NBPAN Operation Procedure Illustration



NBPAN Operation Procedure Flow Chart



Essential Components for MPM Management Scheme

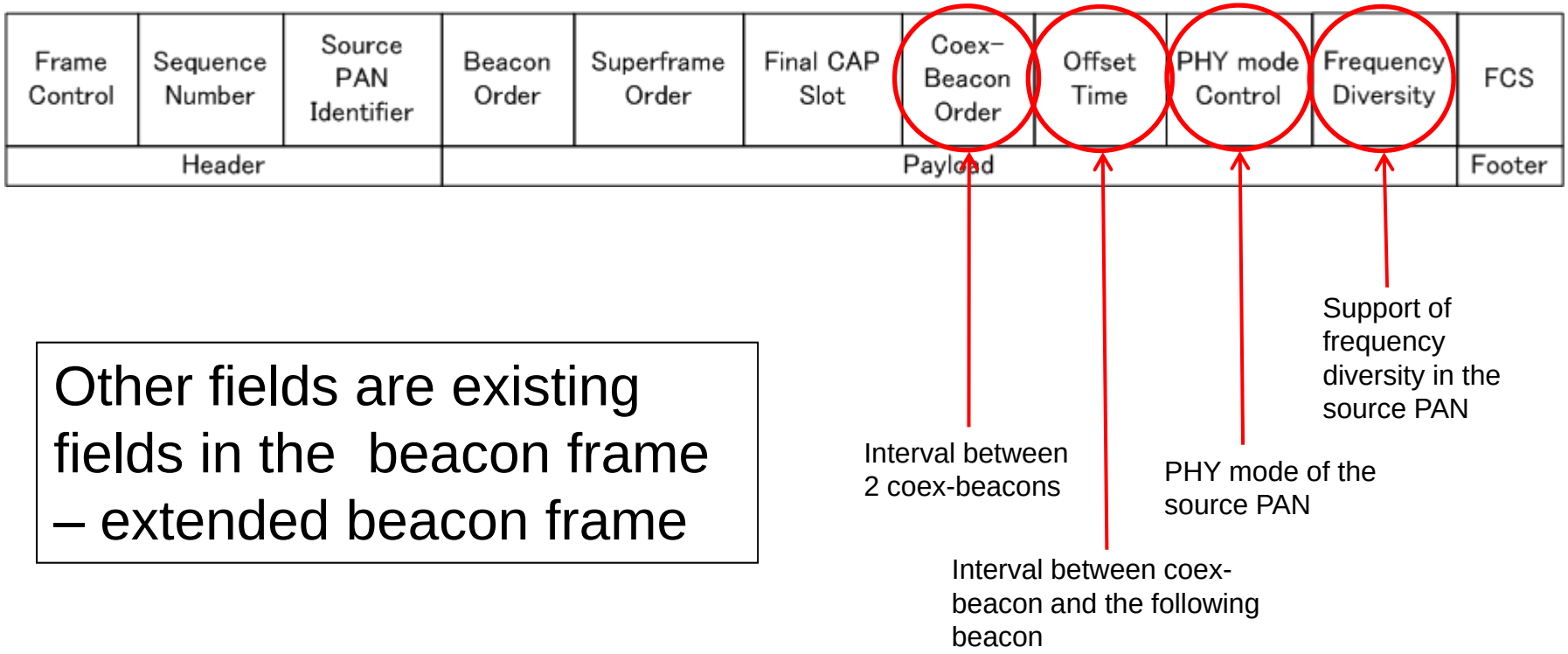
- For the MPM Management scheme, two elements are required:
  - PHY-specific CSM
  - Coex-beacon frame
- The two elements are given in the following slides

PHY-layer Specification for CSM

Frequency Band	Data Rate (kbps)	Modulation	Modulation Index	Channel Spacing (kHz)	BT	FEC
902-928 MHz (US) 2.4 GHz (Worldwide) 400-430 MHz (Japan) 950.1-955.7 MHz (Japan) 863-870 MHz (Europe) 470-510 MHz (China)	50*	(G)FSK	1	200	0.5for GFSK N/A for FSK	N/A

*The FSK PHY specification may be variable for respective regions

Format for Coex-Beacon Frame



Other fields are existing fields in the beacon frame – extended beacon frame

Conclusion

- This document proposes the employment of Multi-PHY-Mode-Management to handle the multi-PHY-mode issue in the 802.15.4g WPAN
- The proposed Multi-PHY-Mode-Management is capable of supporting coexistence among systems with different PHY modes