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]
Date Submitted: [15 Nov, 2009]
Source: [C.S. Sum, H. Harada, F. Kojima, R. Funada, Z. Lan]
Company [NICT]
Address [3-4, Hikarino-oka, Yokosuka, 239-0847, Japan]
Voice: [+81-46-847-5092], FAX: [+81-46-847-5440], E-Mail: [sum@nict.go.jp]
Re: []

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 (CS) for Multi-PHY-Mode (MPM) Management in a single 802.15.4g WPAN
- This document also:
  - outlines the mandatory rules for MPM Management
  - proposes the suitable PHY specification for CS
  - presented the basic procedures of the MPM Management
  - specifies the new frame format required to support the MPM Management
- This document reflects NICT's preference in multi-PHY mode management solution

Presentation Outline

- Motivation
- Proposed MPM Management Solution
- MPM Management Main features
- MPM Management Rules
- PHY-layer Specification for CS
- BPAN Basic Operation Procedures and Flows
- NBPAN Basic Operation Procedures and Flows
- Format for Newly Added Frame
- Path Ahead…
- Conclusion

Abbreviations

- MPM: Multi-PHY-Mode
- CS: Common Signaling
- NC: Network Coordinator
- 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

Proposed MPM Management Solution

- This document specifies a CS design as the bridge among three PHY modes
- The CS is a PHY layer specification that has to be supported by all three candidate PHY modes
- Several CS-related rules are specified to facilitate the coexistence and interoperability among candidate PHY modes
- Supports different levels of coexistence and interoperability
  - Basic coexistence support: Only the NCs shall support the CS. Negotiation among NCs (of different PHY modes) using the CS before deploying respective network (in respective PHY modes)
  - Advanced interoperability support: All NCs and normal DEVs shall support the CS. All DEVs are capable of communicating with all NCs regardless of their respective PHY modes

MPM Management Main Features

- One mandatory PHY-layer-specific CS
- Five corresponding MAC rules
- Specification of a new coex-beacon (CB) frame
- Capability to transmit and receive CS required only in NCs, not in low complexity battery-powered DEVs
- Advanced level of interoperability may be further supported if all DEVs support the CS
- Different levels of coexistence with Normal NC and MPM-Management-NC

MPM Management Rules

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

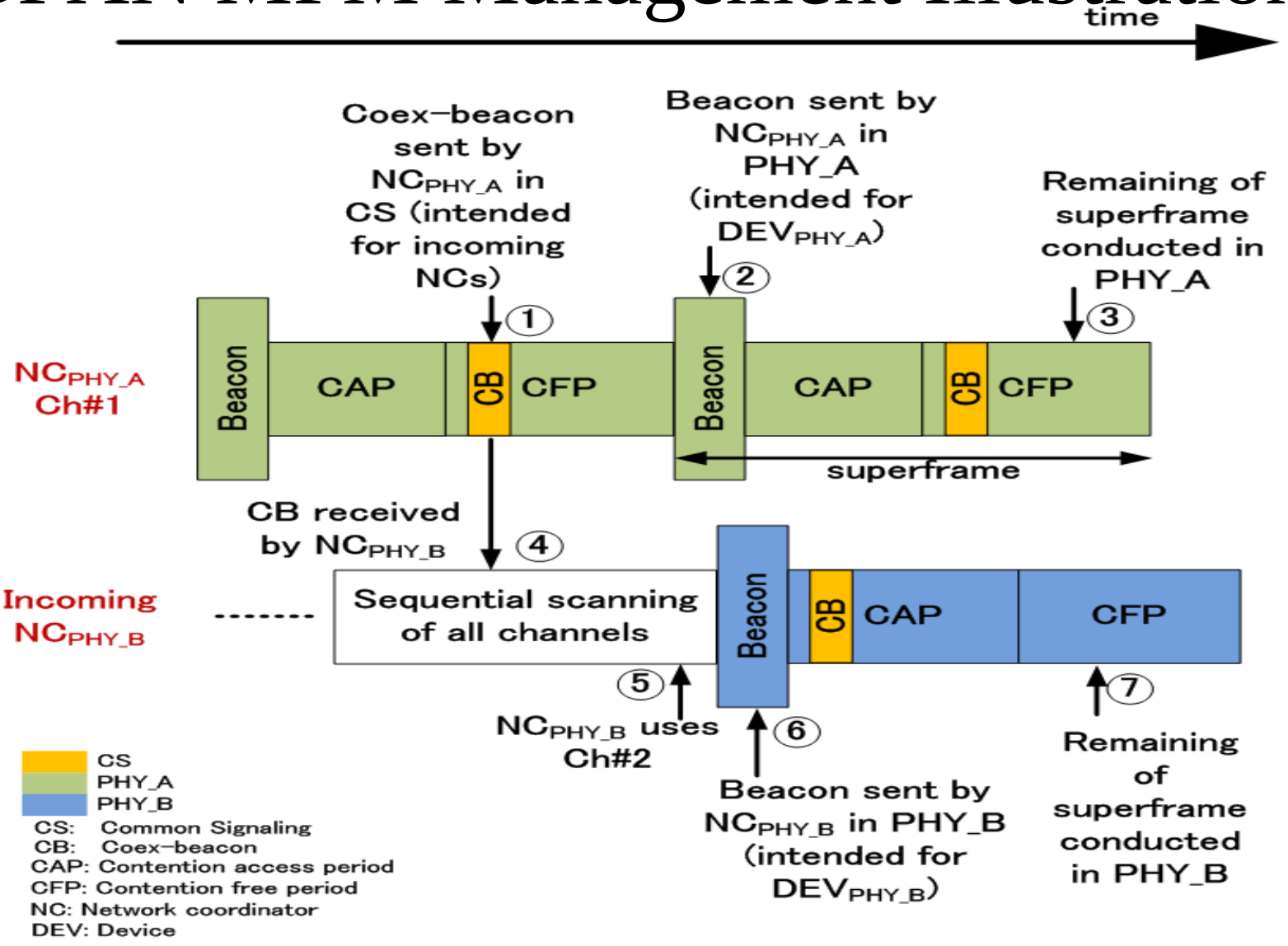
PHY-layer Specification for CS ~Typical Features~

- Robust performance
- Lowest symbol rate
- Simple modulation and coding scheme
  - Example: one of the existing FSK modes
- Flexibility in receiver implementation
  - Example: flexibility to or not to implement a decoder
- Further discussions needed

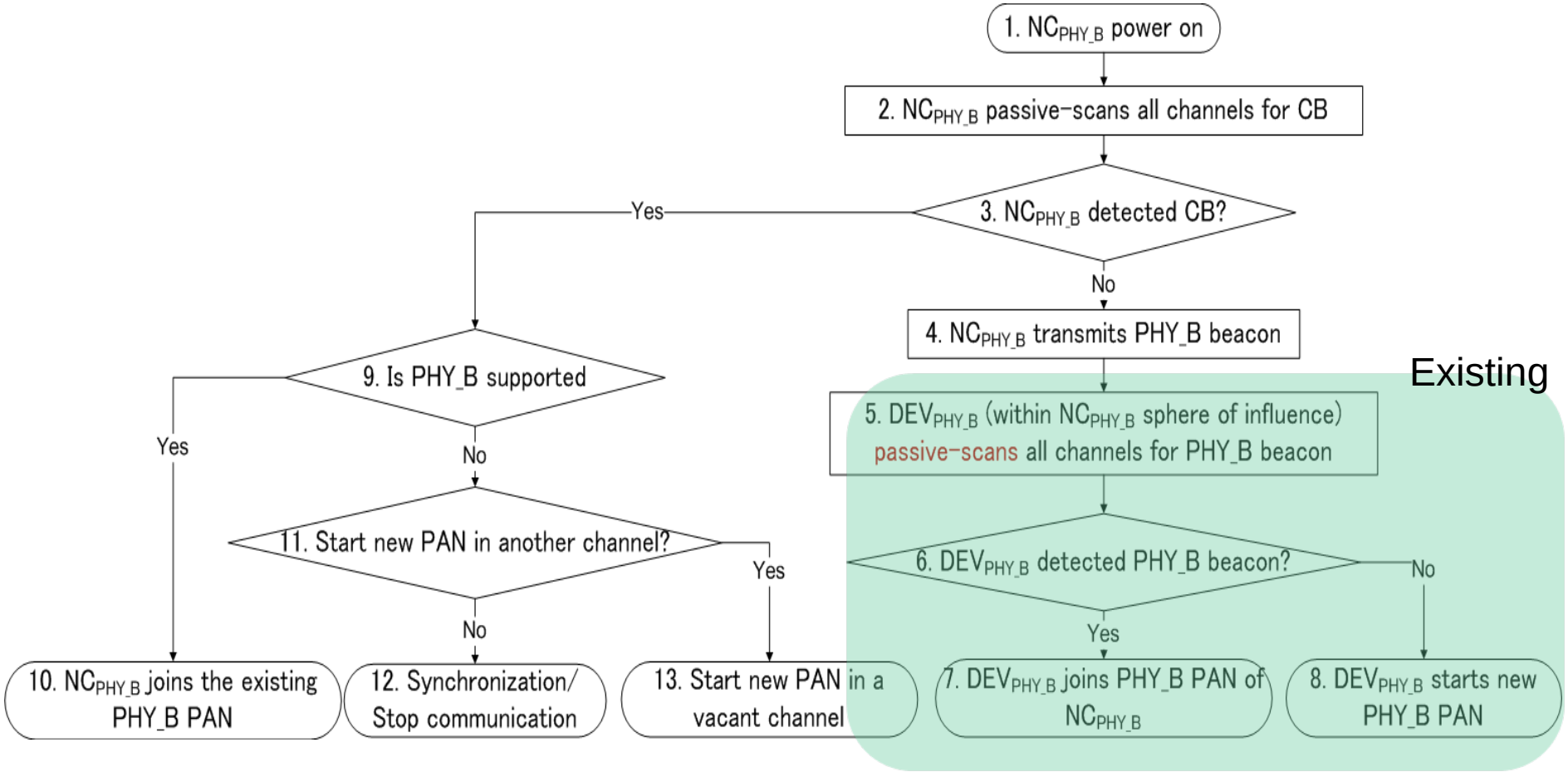
BPAN Basic Operation Procedures

- Existing NC_{PHY_A} coordinating a BPAN in current channel
  - Coex-beacon transmitted using the **CS** 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 **CS**
- 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
    - Use inactive portions of NC_{PHY_A}
    - Request GTS from NC_{PHY_A}
  - Try another channel
  - Stop communication
- NC_{PHY_A} and NC_{PHY_B} can now coordinate respective PANs

BPAN MPM Management Illustration



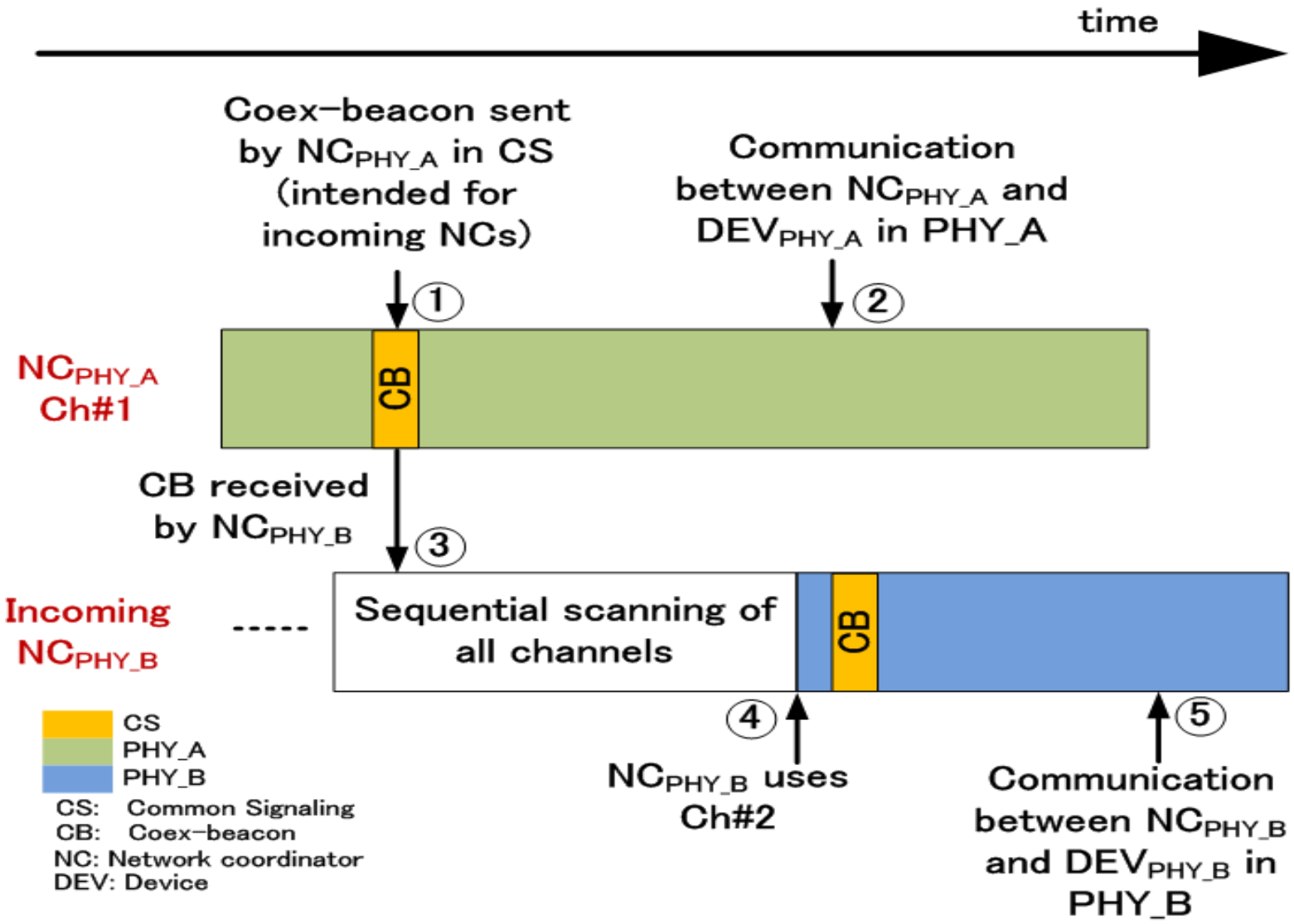
BPAN MPM Management Flow



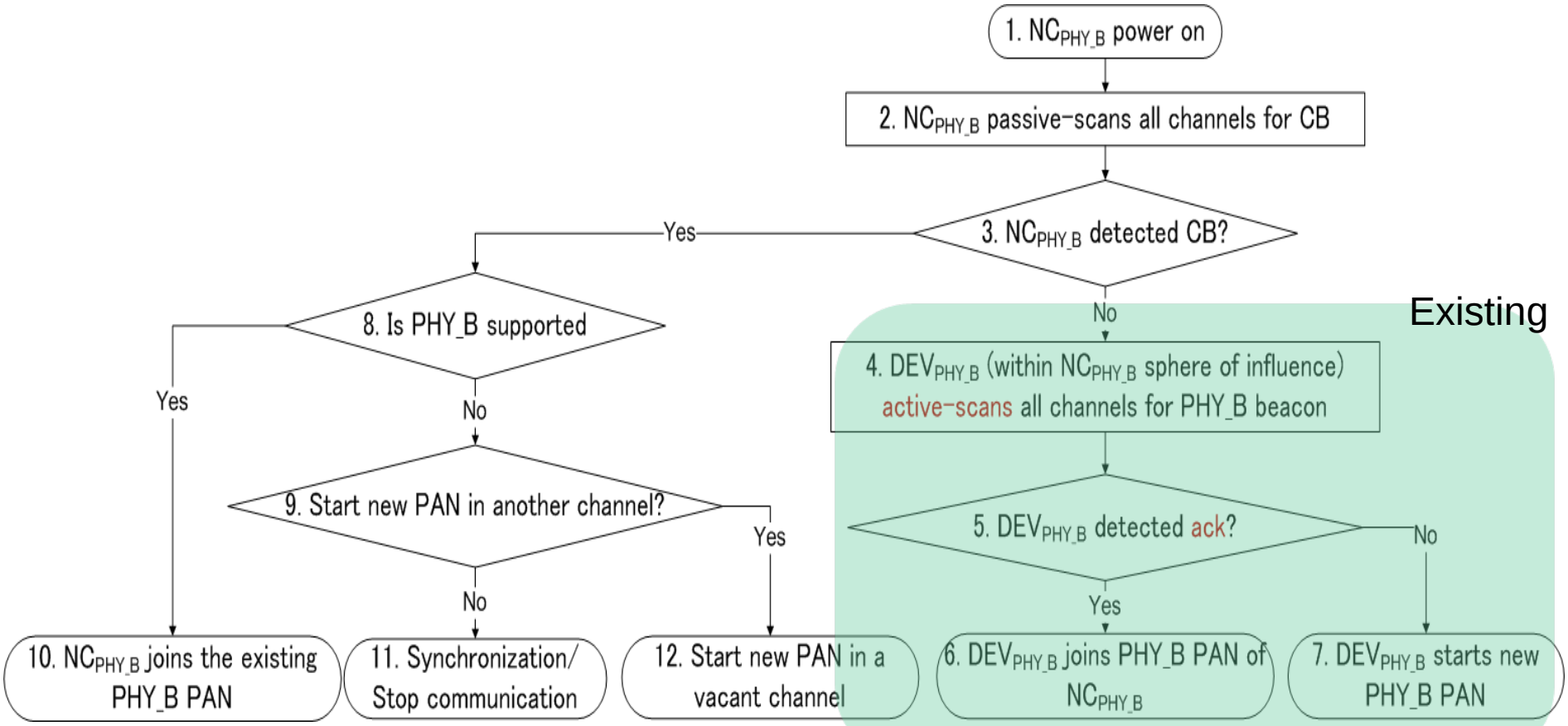
NBPAN Basic Operation Procedures

- Existing NC_{PHY_A} coordinating an NBPAN in current channel
  - Coex-beacon transmitted using the **CS** periodically
- Prospective NC_{PHY_B} enters the channel, performs scanning
  - NC_{PHY_B} receives coex-beacon in the **CS**
- 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

NBPAN MPM Management Illustration



NBPAN MPM Management Flow



Format for the Newly Added Frame ~Coex-Beacon Frame~

- The Coex-beacon frame shall as much as possible reuse the format of the conventional beacon frame
- Several additional information needs to be added:
  - PHY mode information
  - Coex-beacon timing information
  - Optimization parameters
- Further discussions needed

Path Ahead…

- First step: Basic concept of the MPM Management scheme through the CS to be accepted
- Next step: Unfinished business
  - Detailed PHY layer specification of the CS design
  - Detailed fields of the Coex-beacon frame
  - Required MAC and PHY modifications to support the MPM Management scheme
  - A standalone sub-clause in the TG4g draft standard where all PHY modes can refer to

Conclusion

- This document proposes the employment of Common Signaling for Multi-PHY-Mode-Management in a single 802.15.4g WPAN
- The proposed Multi-PHY-Mode-Management is capable of supporting basic coexistence and advanced level of interoperability
- It is recommended that the 802.15.4g WPAN system to employ the Multi-PHY-Mode-Management to at least enable basic coexistence among different PHY modes