Downlink Control Signaling for Frame Structure Design of IEEE 802.16m

IEEE 802.16 Presentation Submission Template (Rev. 9)

Document Number: IEEE S802.16m-08/91
Date Submitted: 2008 – 01- 22
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Venue: Levi, Finland
Base Contribution: IEEE C802.16m-08/91r2
Purpose: To be discussed and adopted by TGm for use in the IEEE 802.16m SDD

Introduction

- Downlink Control Signaling
  - System Information (DCD/UCD)
  - Management Messages (Inband Message)
  - Configuration Information (DL/UL MAP)
  - Scheduling (DL/UL MAP)

- TGm Requirements
  - Low Latency Transmission
    ➔ Shorter Frame Size (Subframe) ➔ Increase Control Overhead
  - High Spectral Efficiency
    ➔ Small Control Overhead
  - Efficient Control Mechanism

  ➔ Latency & Overhead Trade-off

  ➔ Require New Frame and Control Structures

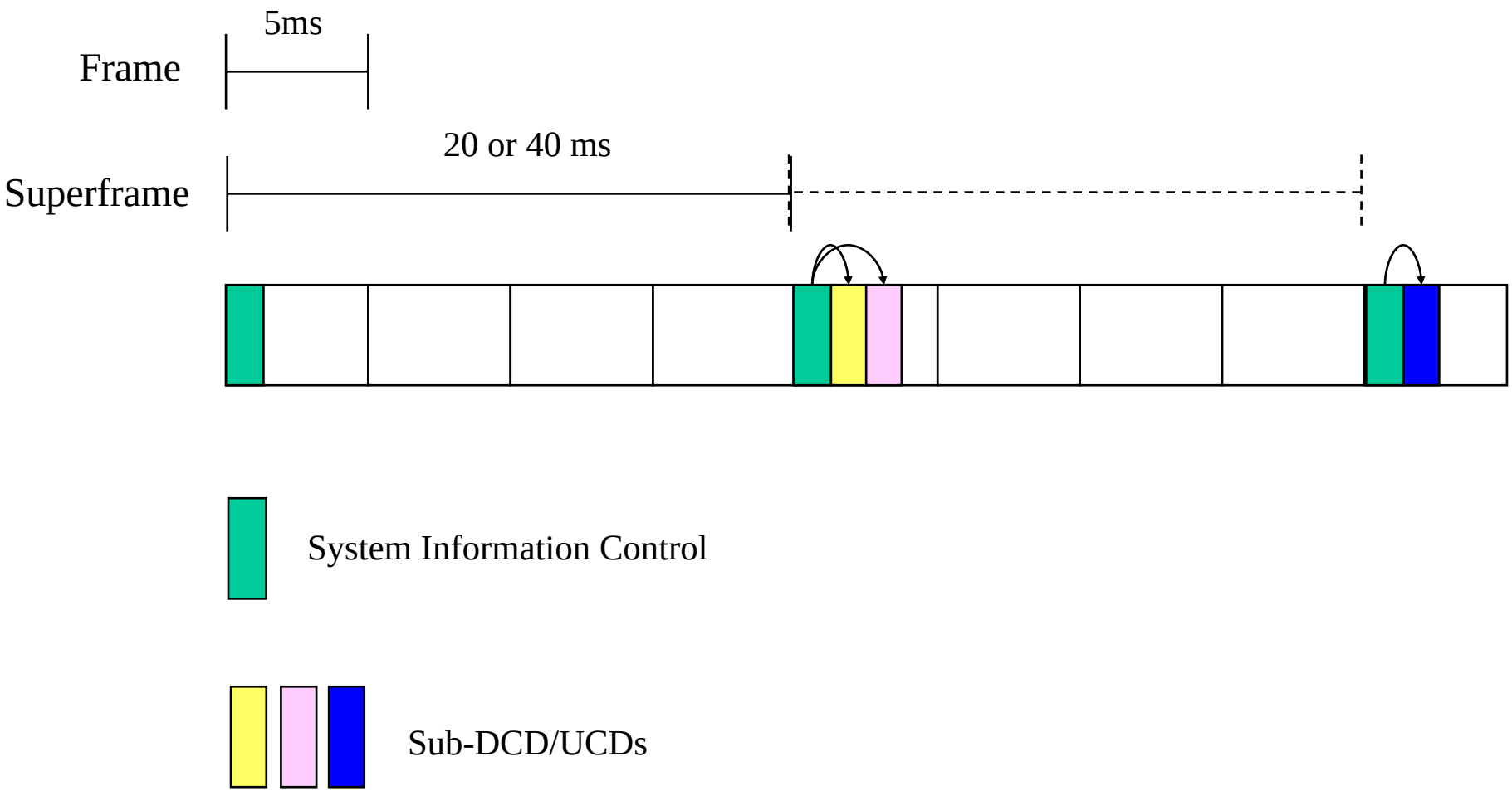
Broadcasting of System Information

- Limitations of the Legacy System
  - Long repetition period (0.5~10s)
    - Require long delay for the Network Entry Procedures
    - Hard to apply the flexible update of the system information for BS
    - Static, Semi-static, Dynamic System Information are transmitted by the same manner (with same periods)
  - Heavy Decoding Overhead for MS
    - Heavy overheads
    - Even with Small Change of the System Information, MS should decode all of the DCD/UCD

Broadcasting of System Information

- Divide DCD/UCD into sub-DCD/UCDs with smaller size
  - Dividing Rule
    - Related network procedures
    - Repetition Periods
  - Multiple repetition periods
    - Each Sub-DCD/UCDs have their own repetition periods
    - Different repetition periods according to their characteristics
    - Long Period (0.5~10s) : Static Part (similar with Legacy DCD/UCDs)
    - Medium Period (100~200ms): Semi-static Part
    - **Short Period (20 ~ 40 ms) : Basic Period ➔ Superframe**
      - Basic System Information (For fast initial Entry)
      - Dynamic Part (For Flexible BS control)

Broadcasting of System Information



Hierarchical MAP

- Broadcasting Channel
  - Cover full cell coverage
  - Lowest Rate Channel Coding ➔ Require High Spectrum Usage
  - Efficient for transmitting Common Control Information
    - System Information, System Configuration Info
  - Reliable transmission and flexible extension are more important factors

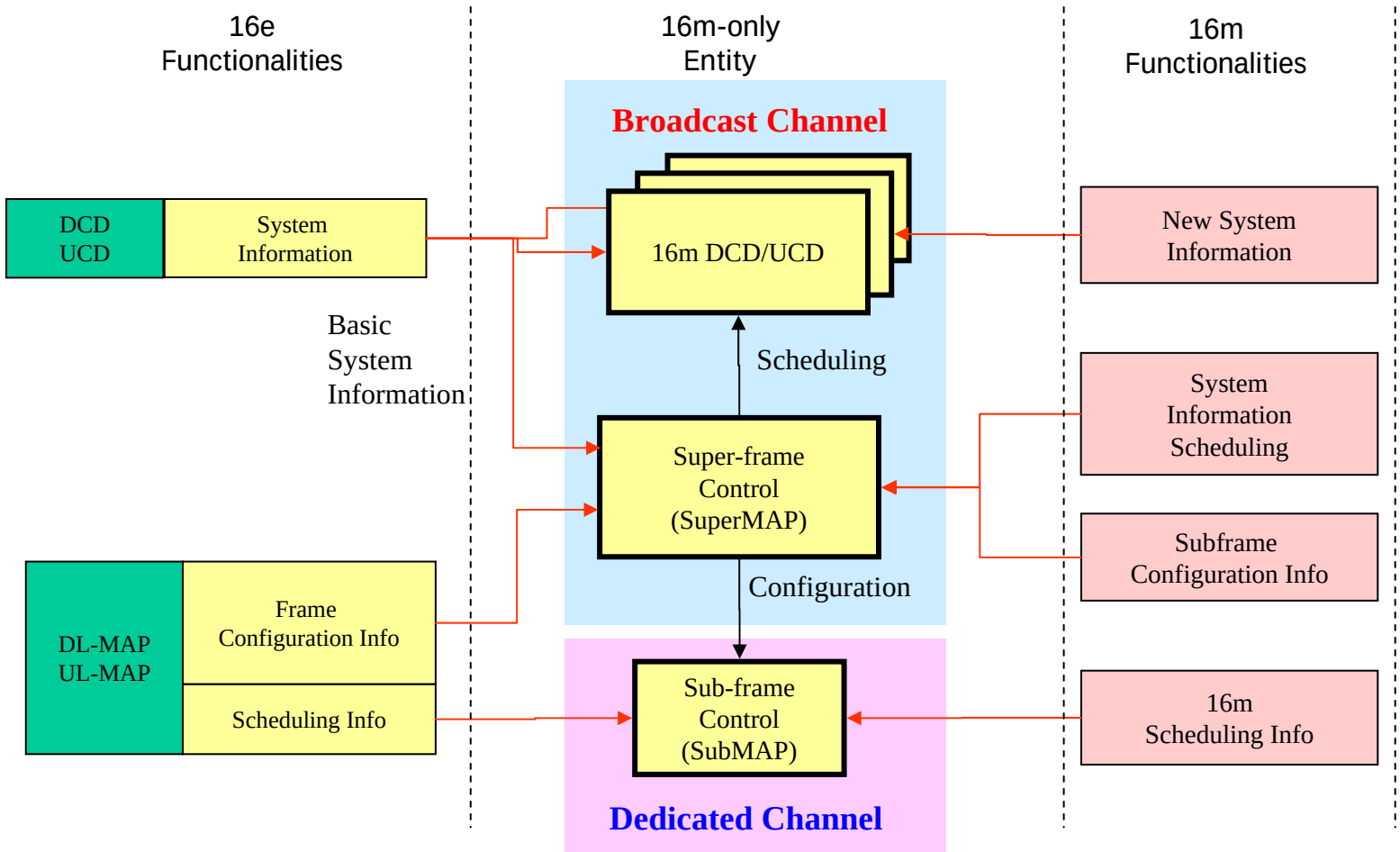
- Dedicated Channel
  - Optimize for the corresponding MS (Different MCS for each MS)
  - Efficient for transmitting the Dedicated Control Information
    - Scheduling Info
  - Low latency and Low decoding complexity are more important factors

- Direction of MAP Enhancement
  - Minimize the Common Control Information
  - More Active Use of the Dedicated Control Channel

  ➔ Use Hierarchical Control Channel Structure

Hierarchical MAP

- Enhancement Concept



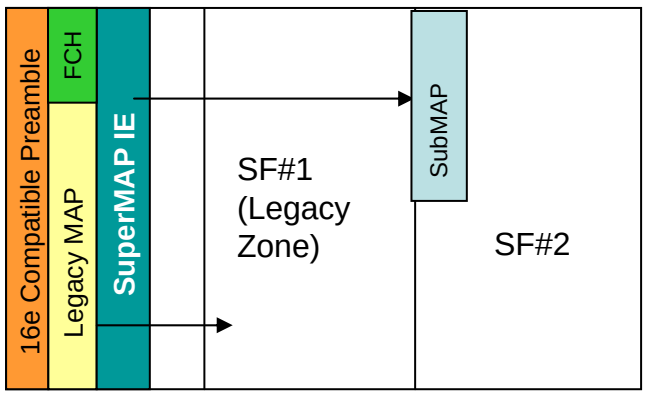
Hierarchical MAP

SuperMAP (Control Information)	SubMAP (Scheduling Information)
• Every 20 or 40 ms • Lowest Rate Channel Coding	• Every Subframe • Dedicated MCS for each MS or Burst

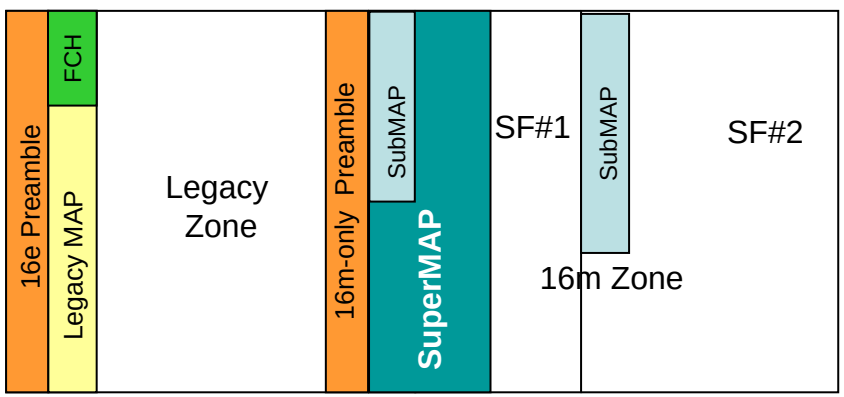
• Basic System Information
  ▪ System Frame Number
  ▪ [BS Status Information]
  ▪ [Frame Configuration]
  ▪ [Multiple Bandwidth info]
  ▪ etc
• Sub-DCD/UCD Scheduling Info
• System Configuration
  ▪ Resource Allocation Info
  ▪ Subframe Control Channel Info
  ▪ etc
• Etc
	• Channel Type Info
	• [CID or Scheduling ID for subframe]
	• Resource Allocation
	• Transmit Format info
	• HARQ info
	• [Enhanced Scheduling Info]
	• Etc

Frame Structure with Hierarchical MAP

- Legacy Support

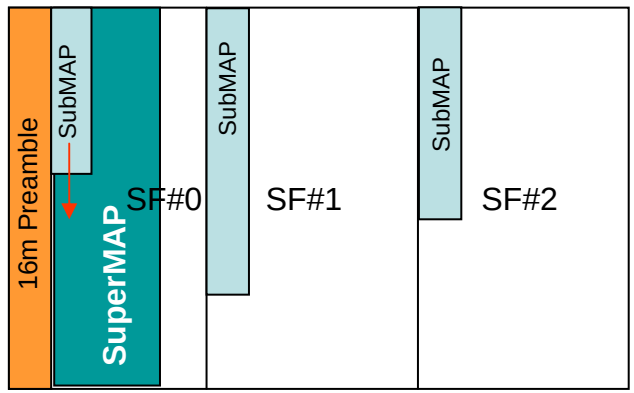


- Special Design of SuperMAP IE for Legacy Support
(Minimize Duplicated overhead)



-Separate Control Channel for 16e and 16m each
(Same Design with legacy-disabled mode)

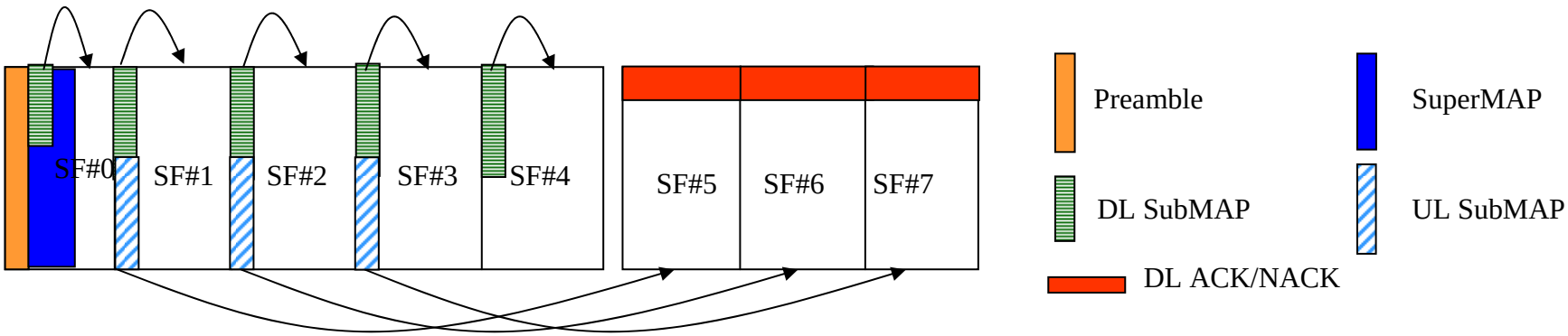
- Legacy Disabled



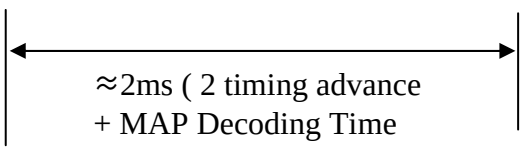
Indicated by SubMAP for the flexibility
- Variable Size
- Variable MCS
- Variable Periods (20ms or 40ms : Operators Choice)

Frame Structure with Hierarchical MAP

- The Relative Location of the SubMAP in a Frame
  - DL SubMAP : Same subframe with data
  - UL SubMAP : DL subframe with the fixed Subframe offset with data



The Location of the UL SubMAP in the DL Subframes
(In case of the fixed subframe offset of 4)



Text Proposal

- **11.x. Frame Structure**

For more flexible and efficient use of the spectrum, the hierarchical frame structure based on the “super-frame” and “sub-frame” is used for 802.16m system.

To support the hierarchical frame structure, a super-frame control and several sub-frame controls are applied for the downlink signaling.

Figure 1 shows the basic concept of the downlink control channel of 802.16m system.

Text Proposal

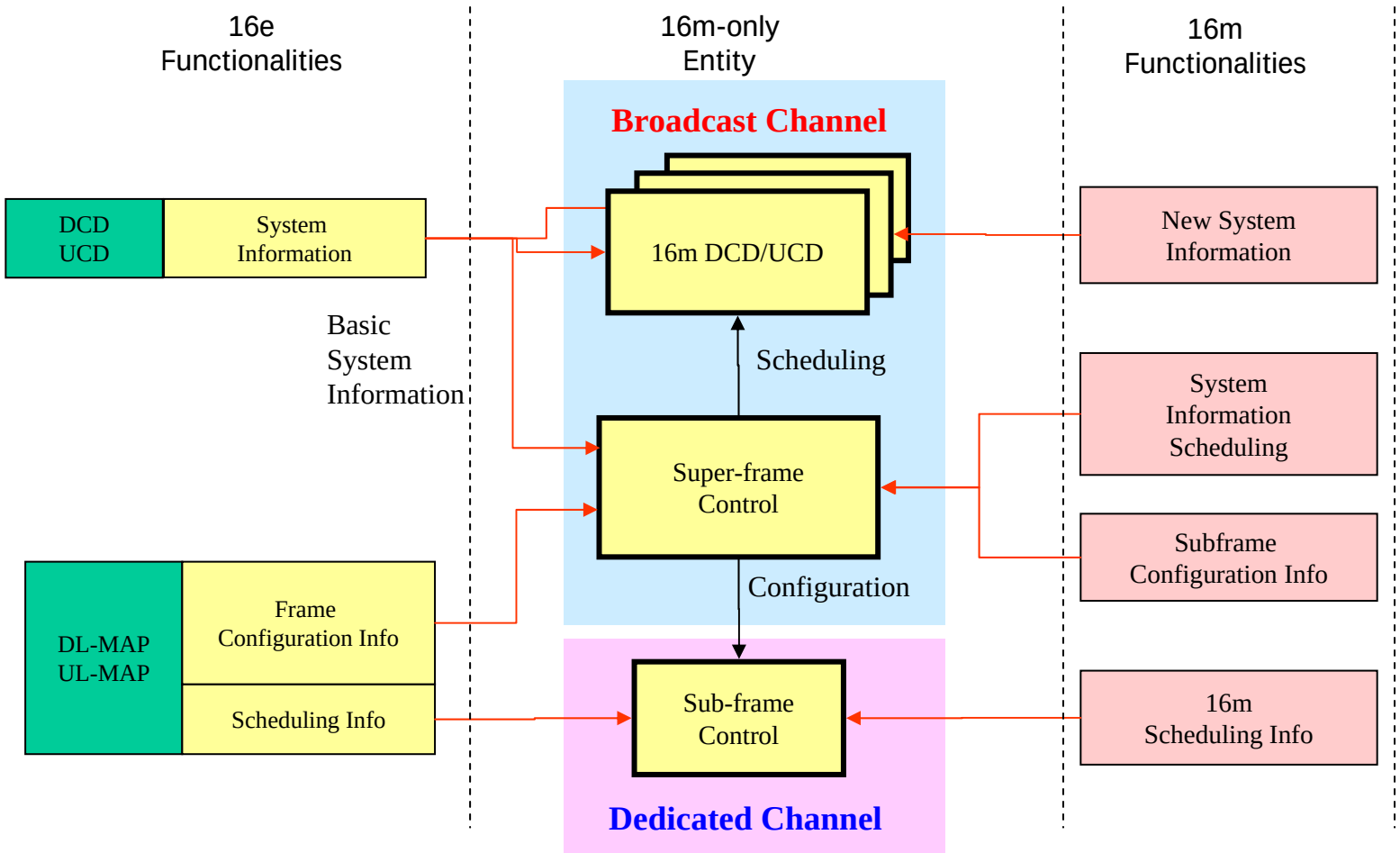


Figure 1. Basic concept of the downlink control channel of 802.16m system

Text Proposal

- **11.x.y Super-Frame Control**

The default super-frame size is 20 ms which is four times of 5 ms frame.

Super-frame controls are located every 4 or 8 frames. The super-frame controls include basic system configuration information. The size and period of super-frame controls can be varied. This period should be determined as an operator's choice according to its trade-off between the overhead and the flexibility and the latency.

The main role of the super-frame control is to transmit the common control information, such as the sub-frame configuration and BS system information and so on. Super-frame control should be transmitted to cover the whole cell area.

Text Proposal

11.x.z Sub-Frame Control

The sub-frame size and the default TTI size is 6 OFDMA symbols. Sub-frame control shall be located in every TTI which is the integer multiples of the sub-frame. Sub-frame control should be transmitted with the optimized MCS format according to the environment of each receiver of MS.

The Sub-frame control shall play the main scheduling role in the 802.16m system.

Text Proposal

11.w Frame Structure for Legacy-Support Mode

11.w.v Super-frame Control Structure

The legacy regions and new regions are mixed in time domain. There are two options for inserting the super frame control into the frame, and Figure x describes two options.

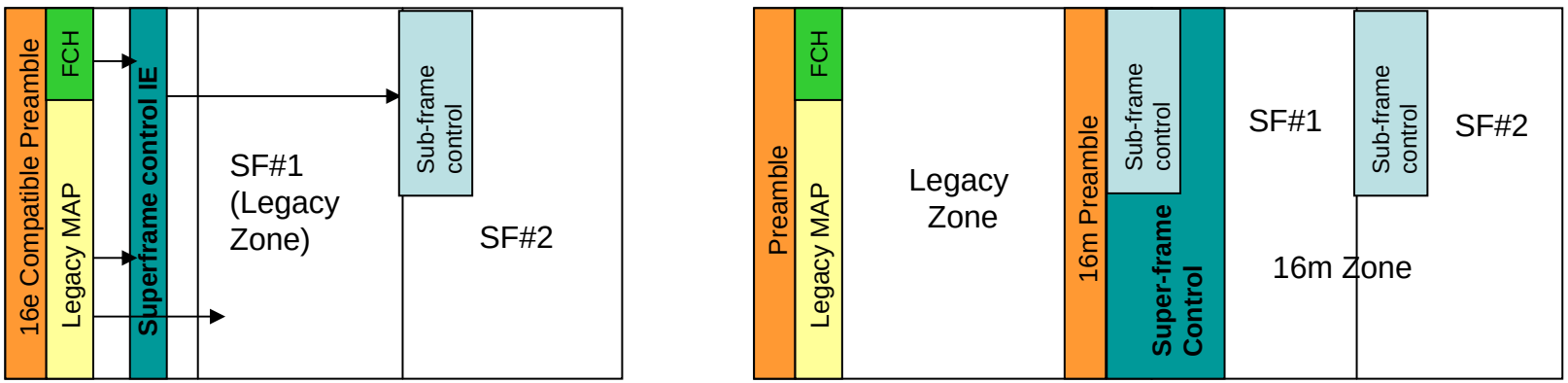
- Super-frame control IE

  Super-frame control shall be inserted as a control IE in the Legacy DL MAP

- TDM zone mapping

  802.16m time zone shall be located in the separate time zone with the legacy system.

Text Proposal



(a) Indicated by Legacy MAP as a New MAP IE

(b) TDM Zone Mapping with a new 16m structure

Figure x The Position of the super frame control in the legacy support mode