Document Number:

IEEE 802.16.1mp-00/17

Title:

MAC Support for Dual PHY Approach

Date Submitted:

2000-05-02

Source:

Glen Sater	Voice:	480-441-8893
Motorola Inc.	Fax:	480-675-2116
8220 E. Roosevelt Street, M/D R1106	E-mail:	g.sater@motorola.com
Scottsdale, AZ 85257		

Co-Contributors

See following page.

Venue:

802.16 Session #7, May 1-5, 2000, Gaithersburg, MD, USA.

Base Document:

IEEE 802.16mc-00/17 (/http://www.ieee802.org/16/mac/contrib/802161mc-00_17.pdf)

Purpose:

This presentation is intended to provide an overview of the submission IEEE 802.16.1mc-00/17, "MAC Support for Dual PHY Approach".

Notice:

This document has been prepared to assist the IEEE 802.16. 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 may be made public by 802.16.

IEEE Patent Policy:

The contributors are is familiar with the IEEE Patent Policy, which is set forth in the IEEE-SA Standards Board Bylaws <http://standards.ieee.org/guides/bylaws> and includes the statement: "IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard."

D+ MAC for Dual-PHY Approach

- Purpose
  - Dual Mode PHY Proposal requires MAC support
  - Raise awareness of some of the issues
  - Show how the D+ MAC can support both modes
    - Most issues handled by the current MAC
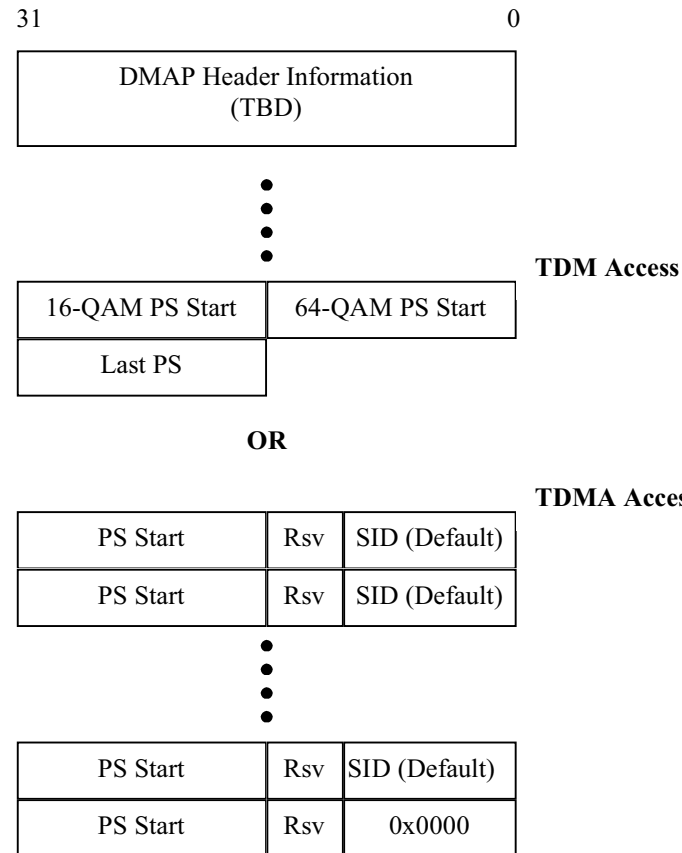   - Some minor additions required

Network Entry

- ## Issue

  - CPE must be able to correctly obtain appropriate downstream

- ## Resolution

  - Mainly a CPE receiver issue (PHY Group)

  - Dual-Mode capable CPEs may require some provisioning

    - Use of non-volatile memory for search parameters
    - Allocation/Authentication of CPE during registration
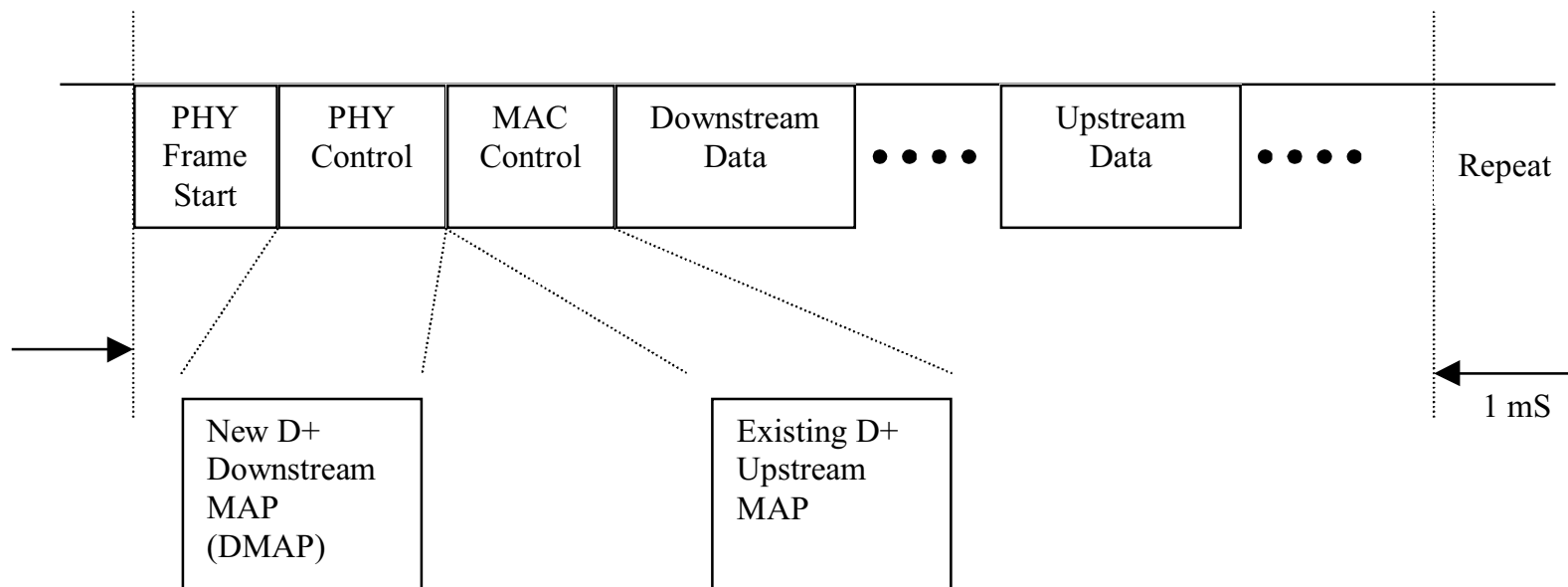   - D+ MAC support via REG-REQ/REG-RSP messages

Downstream MAP

- Issue
  - Mode B requires a downstream MAP message
- Resolution
  - Add new MAP message to D+ MAC
  - SID defines CPE
  - PS defines starting slot within a frame

Downstream MAP Format

```
31                                        0

        ┌────────────────────────────────┐
        │     DMAP Header Information     │
        │             (TBD)              │
        └────────────────────────────────┘

                      •
                      •
                      •
                                              TDM Access
        ┌────────────────┬───────────────┐
        │ 16-QAM PS Start │ 64-QAM PS Start │
        ├────────────────┴───────────────┤
        │     Last PS    │
        └────────────────┘

                     OR
                                              TDMA Access
        ┌────────────┬─────┬──────────────┐
        │  PS Start  │ Rsv │ SID (Default)│
        ├────────────┼─────┼──────────────┤
        │  PS Start  │ Rsv │ SID (Default)│
        └────────────┴─────┴──────────────┘

                      •
                      •
                      •

        ┌────────────┬─────┬──────────────┐
        │  PS Start  │ Rsv │SID (Default) │
        ├────────────┼─────┼──────────────┤
        │  PS Start  │ Rsv │    0x0000    │
        └────────────┴─────┴──────────────┘
```

Downstream Frame Structure (Mode B)

| PHY Frame Start | PHY Control | MAC Control | Downstream Data | ● ● ● ● | Upstream Data | ● ● ● ● | Repeat |

New D+ Downstream MAP (DMAP)
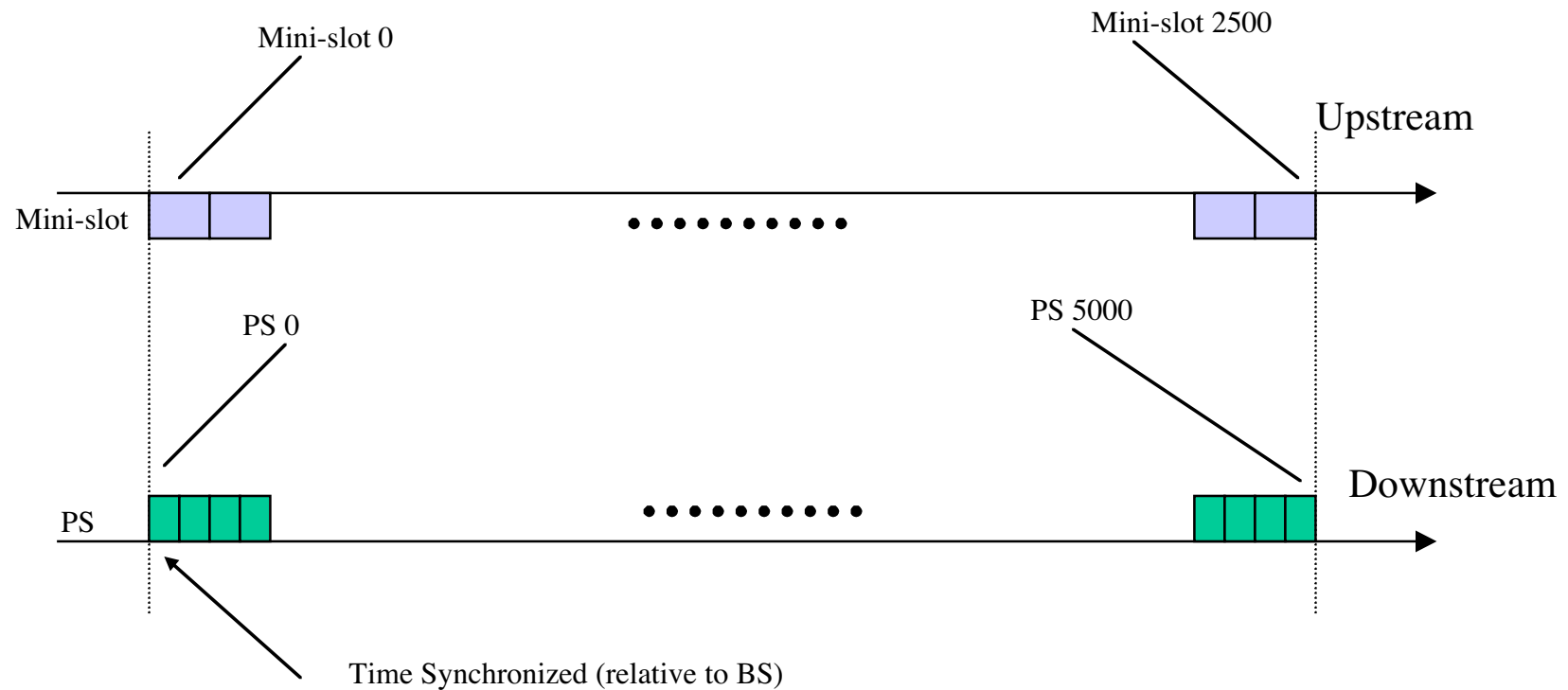
Existing D+ Upstream MAP

1 mS

Framing

- ## Issue

  - Mode B requires framing structure

- ## Resolution

  - PHY has preamble that marks frame start

  - Use flexible MAP structure from D+ MAC

  - Link upstream mini-slots to downstream PS

    - Ex:
      - 5000 PS in downstream
      - 2500 mini-slots in upstream
      - Every two PS map to one mini-slot

Framing Example (cont.)

- Mini-slots synchronized to downstream PS

Mini-slot 0

Mini-slot 2500

Upstream

Mini-slot

• • • • • • • • • •

PS 0

PS 5000

Downstream

PS

• • • • • • • • • •

Time Synchronized (relative to BS)

Bandwidth Allocation

- ## Issue

  - Mode A allocations are in mini-slots (upstream) and PS (downstream

  - Mode B allocations are in PS

- ## Possible Resolution

  - Define a PS to be a multiplier in the mini-slot equation

    - ex: one mini-slot is equal to 2 PS

Downstream Adaptive Modulation

- ## Issue
  - Management messages need to be defined
- ## Resolution
  - Current D+ MAC completely supports management of adaptive modulation
    - Part of normal ranging process
    - CPE measures downstream channel
    - CPE requests modulation change as part of ranging
    - BS controls modulation
      - Can limit if based upon provisioned capabilities
      - Can limit if extra bandwidth not required

Contention Intervals

- ## Issue
  - Mode B defines contention intervals with specific FEC encodings, length, modulation type, etc.

- ## Possible Resolution
  - The D+ MAC provides the ability to define a complete burst profile via UCD
    - Any combination of T and K
    - Any required modulation type
  - MAP message can define any position and length for contention intervals

Security

- ## Issue
  - – The Mode B PHY numbering is used for the encryption Counter Mode

- ## Resolution
  - – The CBC mode as defined by the D+ MAC can support encryption without PHY linkage
  - – PHY should not be linked to encryption sub-layer

Mode A Upstream Timing Synchronization

- ## Issue

  - Mode A requires MAC aid in synchronizing upstream bursts

- ## Resolution

  - Already supported by the SYNC message in the current D+ MAC

    - CPE use mini-slot timing in SYNC message to coordinate upstream bursts

Error Detection

- ## Issue
  - Error detection is done on a TDU basis for Mode B
  - Error detection is left to the MAC for Mode A

- ## Resolution
  - Move error detection to MAC layer

Conclusions

There is no inherent limitation in the D+ MAC that prevents its use with both PHY modes

- ## D+ MAC can support both PHY modes
  - ### Most issues resolved without change
    - New MAP message required for downstream
    - PS mapping to mini-slots required
    - Framing becomes explicit with PHY synchronization and appropriate scheduling of MAPs and PDUs
  - ### Possible because of flexibility in original D+ MAC design