Project	**IEEE 802.16 Broadband Wireless Access Working Group** **<http://ieee802.org/16>**
Title	**Submission to IEEE 802.16b MAP Flexibility for Burst Type Definition**
Date Submitted	**2001-04-06**
Source(s)	Lei Wang Brian Gieschen Nghi Lao Wi-Lan Inc. 300, 801 Manning Rd., Calgary. AB. T2E 8J5. Voice: (403)273-9133 Fax: (403)273-5100 mailto:leiw@wi-lan.com; BrianG@wi-lan.com; NghiL@wi-lan.com
Re:	Rev 1. This is a response to the IEEE 802.16.4 Task Group.
Abstract	This document proposes two possible solutions to address how TG4 MAC channel descriptor messages and the MAP messages supports more burst types for TG4 than that specified in the TG1 draft.
Purpose	This document forms a response to the requirement of updating the TG4 MAC strawman document Section 3, as discussed in Session #12.
Notice	
Release	

Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures (Version 1.0) <http://ieee802.org/16/ipr/patents/policy.html>, including 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." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:r.b.marks@ieee.org> as early as possible, in written or electronic form, of any patents (granted or under application) that may cover technology that is under consideration by or has been approved by IEEE 802.16. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Acknowledgements

The following people have contributed to this document:

Shawn Taylor

Ron Murias

Revision History

Release Date	Document Number	Author	Change summary
2001-04-06		Lei Wang	First draft

Table of Contents

1 Introduction

TG1 uses 4-bit DIUC to describe the characteristics of a downlink interval in the burst mode. By using the 4-bit DIUC, 12 different downlink burst types can be defined by the DCD (Downlink Channel Descriptor) and used by the DL-MAP.

TG1 uses 4-bit UIUC to describe the characteristics of an uplink interval. By using the 4-bit UIUC, 6 different uplink burst types can be defined by the UCD (Uplink Channel Descriptor) and used by the UL-MAP.

An issue has been raised by the TG4 (in sessions #11, #11.5 and #12) that questions the applicability of the TG1's burst type definitions to the TG4 PHY layer. In other words, the TG4 PHY might need more than 12 different downlink burst types and/or more 6 different uplink burst types.

The TG4 MAC strawman document Section 3.3.2 mentions that using the Expansion IE (UIUC=15) may allow additional burst type definitions. However, the Expansion IE (UIUC value 15) is used to define an additional number of 32-bit words in an IE, and it can only be used to expand the length of an IE in UL-MAP messages. Using UIUC=15, only one additional burst type can be defined. This is because defining a burst type is done in an uplink channel descriptor (UCD), which only allows one set of TLV to be defined for each UIUC value. The Expansion IE cannot be used to define more than one additional burst type. Therefore using the Expansion IE is not a sensible solution to the burst type shortage problem.

Based on previous TG4 sessions, the TG4 MAC strawman document section 3.4 presents a list of proposed changes to the TG1 draft standard document, to address the issue of burst type definition. However those proposed changes are intended to bring in flexibilities for future TG4 burst definitions by changing the locations of the related tables and figures and avoiding explicit length specifications of the related information fields. They are not solution-oriented changes.

This contribution proposes two possible solutions to the issue that TG4 PHY might need more downlink and/or uplink burst types than TG1. The final choice is pending to the TG4 PHY development.

2 Proposed Solutions

There are two proposed solutions to this issue:

Use the TG1 currently 3 reserved DIUC codes to increase the downlink burst types from 12 to 15 and use the TG1 currently 4 reserved UIUC codes to increase the uplink burst types from 6 to 10. Then, confirm that 15 downlink burst types and 10 uplink burst types are enough for TG4 PHY. So, the current formats of TG1's DCD, UCD, DL-MAP, and UP-MAP remain unchanged.

Extend the DIUC and the UIUC from 4 bits to 5 bits, so that additional 16 burst types can be accommodated. In the DCD and the UCD, one of the currently reserved bits can be used to extend the DIUC and the UIUC. In the DL-MAP, one bit needs to be moved from the Start-PS field to the DIUC field. In the UL-MAP, one bit needs to be moved from the Offset field to the UIUC field. Section 4 of this document addresses the feasibility of this solution.

3 15 Downlink Burst types and 10 uplink burst types

The answer to the question whether or not 15 downlink burst types and 10 uplink burst types are enough for TG4 is highly dependent on the TG4 PHY layer. The feasibility of the proposed first solution is pending to TG4 PHY development.

4 5-Bit DIUC Field and 5-bit UIUC Field

Give one more bit to the DIUC and the UIUC field in the DCD, UCD, DL-MAP, and the UL-MAP messages, i.e., use 5-bit IUC for TG4, instead of 4-bit IUC as in TG1. By having one more bit in the IUC messages, additional 16 burst types can be defined.

In the DCD and the UCD, move one bit from the 4-bit reserved field to the DIUC field and the UICU field, respectively. So, there is no impact on other information fields in the DCD and the UCD.

In the DL-MAP and the, move one bit from the start-PS field to the DIUC field, then resulting in a 5-bit DIUC field and a 15-bit start-PS field.

In the UL-MAP, move one bit from the offset field to the UIUC, then resulting a 5-bit UIUC field and a 11-bit offset field.

4.1 11-bit Offset Field in the UL-MAP

The Offset field specifies the start point of an uplink interval. Its unit is mini-slot. It is relative to the Allocation Start Time given in the same UL-MAP. So, the size of the Offset field directly impacts the coverage of an UL-map and/or the definition of a mini-slot.

11-bit Offset field has its value range from 0 to 2047.

mini-slot = PS*T, where T=1,2,4,8,16,32,64, or 128; and PS denotes a physical slot.

The physical slot (PS) is defined in TG1 as the time to equal the duration of 4 modulation symbols at the baud rate of the downlink transmission. That is, PS=4*SymbolTime.

TG1 symbol rate is in the range of 1 to 40 Msym/s, i.e., SymbolTime = 25 ns (i.e. 1/40 us) to 1 us. With an 11-bit offset field, the TG1UL-MAP coverage can be from 2047*4*25ns=204.7us to 2047*4*1us*128=1.048s, depending on the symbol rate and the mini-slot (i.e., the T value). TG1 frame sizes are 0.5 ms, 1 ms, or 2 ms. Even with the smallest SymbolTime, those frame sizes can be covered by an 11-bit offset field in the UL-MAP through selecting appropriate T value in the mini-slot definition.

TG4 would need larger frame sizes than TG1. TG4 frame size might be in the range of 2 ms to 10 ms. With an 11-bit offset field, the UL-MAP can cover $2047*T_{mini\text{-}slot}$, where $T_{mini\text{-}slot}$ is the size of a min-slot. To cover a 10ms UL-frame, we need $2047*T_{mini\text{-}slot}$ >=10 ms, i.e., $T_{mini\text{-}slot}$ >=4.885us.

4.2 15-bit Start-PS field in DL-MAP

In the DL-MAP in the burst mode (Mode B), each interval is specified by a DIUC field and a Start-PS field. The Start-PS field is used to specify the start point of the interval. Its unit is physical slot (PS). It is relative to the start point of the downlink frame that contains the DL-MAP. So, the size of the Start-PS field directly impacts the coverage of a DL-MAP and/or the definition of a physical slot.

15-bit Start-PS field has its value range from 0 to $2^{15}-1$ (i.e., 32,767).

With a 15-bit Start-PS field, the DL-MAP can cover $(2^{15}-1)*T_{PS}$, where T_{PS} is the size of a physical slot. To cover a 10ms DL-frame, we need $(2^{15}-1)*T_{PS}$ >=10 ms, i.e., T_{ps}>=0.305us=305ns.