Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Submission to IEEE 802.16b MAP Flexibility**
Date Submitted	**2001-04-23**
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Re:	Rev 1.This is a response to the IEEE 802.16.4 Task Group seesion 12 assignments.
Abstract	This document discusses the MAP flexibility issue.
Purpose	This document forms a response to the requirement of updating the TG4 MAC strawman document as discussed at Session #12.
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MAP Flexibility

1. PHY Parameters

Following the discussions from Session #12, PHY strawman document looks as follows:

- There are three possible modes of FFT size defined: 64,256 TDMA mandatory, 1024 OFDMA optional
- Channelization: 10,20 MHz mandatory, 5 MHz optional
- Guard interval size: 1/32,1/16,1/8,1/4
- Modulation: PSK, QPSK, 16QAM, 64QAM
- Coding: Convolutional 1/2,2/3,3/4, Reed-Solomon (?), turbo-coders (?)
- Preamble: none/shortened (midamble)/full preamble.

It is obvious we have a lot of options to deal with. Because of multiple choices in terms of PHY parameters set, it is clear that we cannot define a specific IUC for every possible combination of Burst Type.
Some of the parameters could be changed dynamically function of link conditions, but part of them cannot be changed on the fly.
We should define at least two sets of parameters:
Operational Set (cannot be changed during normal operations or be different for certain SS's):

- FFT size
- Channelization
- Guard Interval Size
- Coding type: Convolutional, Convolutional +Reed Solomon, Turbo-codes

Dynamic Set (can be changed function of link conditions)

- Constellation size
- Coding Rate (Convolutional)
- Preamble type: none/shortened (midamble)/full preamble

Because Reed-Solomon and Turbo Codes are still under discussion, I did not include them in the Dynamic Set type of parameters.
Putting together the first two combinations of PHY parameters (Constellation size, Coding rate) leads us to an 802.11a like table. The table gives us 8 possible combinations that need 3 bits for encoding.
As these parameters are not fully specified yet, I can give some options in terms of Burst type definition.

Data Rate	Modulation	Coding Rate R	Data bytes /OFDM symbol
6 Mb/s	BPSK	_	3

9 Mb/s	BPSK	_	4.5
12 Mb/s	QPSK	_	6
18 Mb/s	QPSK	_	9
24 Mb/s	16QAM	_	12
36 Mb/s	16QAM	_	18
48 Mb/s	64QAM	2/3	24
54 Mb/s	64QAM	_	27

The last parameter (Preamble type) leads us to an additional need for 2 bits if we consider all three choices on preamble type (or other parameter).

2. Status of Burst Type definition in 802.16.1 MAC Draft and proposed changes

2.1. Downlink

DIUC/UIUC parameters are defined as a 4 bits long field.(IEEE 802.16/D2-2001) Burst Descriptor describes operational Burst Types through DCD/UCD messages. All changes regarding Burst Type parameters are signaled trough the same messages.
As per Table 67 Parameters and Constants the maximum interval between transmissions of DCD/UCD messages is 10 seconds.
Because of unforeseeable link conditions in UNII bands and for the need to have a reliable link we need a fast adaptive system. That requires a comprehensive Burst Type Table (leading us to the necessity of increasing IUC field length) or a fast mechanism to change some of the Burst Type parameters. Intensive use of DCD/UCD messages leads us to an overhead that is not necessary.
Let's examine Table 4 and Table 5 to see what options we have:

Burst Type	Downlink Interval Usage Code (DIUC)
Downlink Burst type 1	0
Downlink Burst type 2	1
Downlink Burst type 3	2
Downlink Burst type 4	3
Downlink Burst type 5	4
Downlink Burst type 6	5
Downlink Burst type 7	6
Downlink Burst type 8	7
Downlink Burst type 9	8
Downlink Burst type 10	9
Downlink Burst type 11	10
Downlink Burst type 12	11
Reserved	12
Reserved	13
Reserved	14
End of DL MAP	15

The above observations suggest that 16 values of DIUC type (table 4) may not be enough.However the odds of using more than 12 Burst Types per frame is very small

and the DCD message lets us change Burst Type parameters if required. The point is that we will need the change more often than it is needed in TG1.

Let us presume that it shall be a set of active Burst Types specified by DCD message and a set of inactive Burst Types that can become active when BS decides to change Burst Type parameters.

In order to optimize transmission BS shall be able to change PHY parameters, following some information from SS's. The only hint is a received DBTC message from a certain SS that basically lead to a decision of BS to move the SS to another active Burst.

Obviously, it would be better that SS's have a broader range of choices in terms of Burst types.

But the only option to resolve this problem would be an increase of DIUC size, which will lead us to an increased overhead in the DL-MAP message.

In conclusion, we propose to maintain the same field for DIUC but to redefine our version of Table 4 as soon as PHY parameters are decided.

Another important issue is to define how the BS will decide to change the set of active Burst Types because this is now not clear.
For instance DBTC messages will be based on active Burst Types defined by DIUC's. A station cannot mention anything else than a request of changing to another active Burst Type.
To examine the rationality of changing Burst Types parameters (DCD) is subject to further discussion with PHY layer group.

2.2. Uplink

Even more important is the IE type definition (Table 5) as well as the size of IE in UL MAP message. Because of the channel characteristics on the uplink transmission, it is very likely that we will have to use more than 6 Data Grant Burst Types and change them in a dynamic manner.

Here it is ' Table 5' as in 802.16 MAC Draft:

IE Name	Uplink Interval Usage Code (UIUC)	Connection ID
Reserved	0	NA

Request	1	Any
Initial Maintenance	2	Broadcast
Station Maintenance	3	Unicast
Data Grant Burst Type 1	4	Unicast
Data Grant Burst Type 2	5	Unicast
Data Grant Burst Type 3	6	Unicast
Data Grant Burst Type 4	7	Unicast
Data Grant Burst Type 5	8	Unicast
Data Grant Burst Type 6	9	Unicast
Null IE	10	Zero
Empty	11	Zero
Reserved	12	Any
Reserved	13	Any
Reserved	14	Any
Expansion	15	Expanded UIUC

We can't accommodate all the combinations for at least 802.11a like Table (8 Burst Types).
However on the Uplink it makes a lot of sense to have a broader range of options in terms of Burst Types.
To be able to accomplish this we have two obvious choices:

- To increase UIUC field from 4 bits to X bits (6?). The modification will increase the overhead on the UL-MAP which is transmitted every single frame. On this topic we can discuss only when all PHY parameters will be specified to see how we can fit them. This will lead to a lot of modifications that must be done in UCD/DCD, UL-MAP/DL-MAP, and DBTC messages structure.
- To maintain the same UIUC using two of the reserved IE Names in order to have 8 Burst Types.

IE Name	**Uplink Interval Usage Code (UIUC)**	**Connection ID**
Reserved	0	NA
Request	1	Any

Initial Maintenance	2	Broadcast
Station Maintenance	3	Unicast
Data Grant Burst Type 1	4	Unicast
Data Grant Burst Type 2	5	Unicast
Data Grant Burst Type 3	6	Unicast
Data Grant Burst Type 4	7	Unicast
Data Grant Burst Type 5	8	Unicast
Data Grant Burst Type 6	9	Unicast
Data Grant Burst Type 7	10	Unicast
Data Grant Burst Type 8	11	Unicast
Null IE	12	Zero
Empty	13	Zero
Reserved	14	Any
Expansion	15	Expanded UIUC

There was requested in some contribution an UIUC number for Parallel Polling mechanism too.

As this solution doesn't seem to resolve our issue, I propose the following for the parameters that have to change dynamically.

To split the Burst Type parameters in 2 sets:

Default Set: (Constellation Size, Coding Rate)
Additional Set: (preamble type, or as needed)

Required Burst Descriptor parameters:
Each Burst Descriptor carried in the UCD/DCD message shall include a set of parameters for instance:

Parameter (1)
Parameter (2)
…
Parameter (k)

The set of parameters shall be classified as follows:

- Operational Set (by default during continuous operation)
- Dynamic Set
- Additional Set

Operational Set shall be announced by DCD/UCD messages and not changed during continuous operation.
Dynamic Set (the most suitable to changes because of link conditions) defined and mapped on Data Grant Burst Types as in Table 5.
I propose to have at least 8 Data Grant Types, to cover the baseline of 802.11a .On this reason we can use 2 values from reserved IE names.
Additional set to be sent by means of Expansion IE in UL-MAP message when it is necessary.

Then if I want to do changes in the ***Dynamic Set*** for a certain connection (CID), I simply change the UIUC Code as specified in IEEE 802.16/D2-2001.
When I need a change for a certain connection (CID) in the Additional Set, I use Expansion IE (UIUC Code=15) as follows:

4 bits	4 bits	4 bits	4 bits
Connection Identifier			
UIUC=15	Additional Set		Power Control

I replace 'Offset' field because is already specified in the regular IE and the expanded IE is only required to provide Additional Set parameters change or Power Control adjustments.
This is just a proposal and it cannot be fully consistent without precise specifications of PHY parameters. The size of the fields 'Additional Set' and 'Power Control' are arbitrary, but at first sight could be satisfactory.
This kind of IE shall be sent only when is needed.

Note: The Insertion of Power Control field come in response to team concerns about a faster Power Control mechanism than the one provided by periodic Ranging protocol.
As presented in the Strawman proposal (John Sydor) there were suggested a range of 18 steps:
"For operation in the 5725-5825 MHz band the power control will be set in the following steps in terms of EIRP spectral density (dBm/MHz):
23 20 17 14 11 8 5 2 -1 -4 -7 -10 -13 -16 -19 -22 -25 -28
For operation in the 5250-5350 MHz band the power control will be set in the following steps in terms of EIRP spectral density (dBm/MHz):
17 14 11 8 5 2 -1 -4 -7 -10 -13 -16 -19 -22 -25 -28 -31 -34 "
I think the proposal can be accommodated on 16 values, modifying a little bit the granularity.
That gives BS the opportunity to do Power Control adjustments without the requirement to use Periodic Ranging more often.
In case of power control adjustment for a certain CID ,BS shall incorporate in UL-MAP message two different IE's designated to the same SS (in case of GPT mode), a regular one pointing active Burst Type (Dynamic Set) by designated UIUC ,Offset and a second Expanded IE (UIUC=15) that contains Power Control adjustments and Additional Set of parameters

3. Conclusions

This proposal is just a try to outline some specific needs of TG4 and to incorporate them in the frame of 802.16 MAC Draft .
As long as the PHY layer parameters are not defined ,the requirements cannot be narrowed down to a clear definition of Burst Type .