Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	The unified TLV encoding for DCD and UCD in OFDMA PHY mode
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Re:	IEEE 802.16d D5 Draft Corrigenda
Abstract	To correct error in 802.16d/D5. This contribution proposes a additional and single TLV encoding which unifies all the TLV encodings of UCD or DCD
Purpose	Discuss and adopt proposed text and TLV encodings for corrigenda
Notice	
Release	
Patent Policy and Procedures	

The unified TLV encoding for DCD and UCD in OFDMA PHY mode

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1 Introduction

1.1 Problem statement

In OFDMA PHY mode of the IEEE P802.16 REVd/D5, UCD/DCD messages have many TLV encodings. TLV encoding provides flexibility in message formation, but it always requires two-byte overhead: Type and Length fields. In case many TLV encodings are included in UCD/DCD messages, the overheads caused by the two-byte fields can be so large that it can result in severe performance degradation, since DCD/UCD messages shall be broadcast periodically. In addition, the messages could not be even fit into a single frame in the worst case. (UCD/DCD messages for OFDMA PHY with all TLV fields may grow up to about 300 bytes long).

We propose a single TLV encoding that includes only the *Value fields* of TLV encodings in UCD/DCD messages for OFDMA system. The proposed TLV encoding can greatly reduce the size of UCD/DCD messages by removing Type and Length fields.

1.2 Proposed solution

We propose a TLV encoding that combines the Value fields of the multiple TLV encodings defined in current UCD/DCD message. The basic rationale behind our proposal is as follows.

- **We assume that SS/MSS knows the length of each TLV encoding in advance.**

The parameters in UCD and DCD messages are listed in section 11.3 and 11.4 in IEEE802.16REVd/D5-2004. The Length fields in their TLV encodings are defined to have fixed bytes, not variable. Thus it is reasonable to assume that SS/MSS knows the length of each parameter in advance.

- **We assign a new 'TLV index' to each TLV encoding in an order dependent on PHY.**

By TLV index, SS can distinguish the values which are compounded in the Value filed of the proposed single TLV encoding. SS has to know the mapping between TLV index and the parameter instead of the mapping between Type field and the parameters.

Table 1 shows an example for the assignment of 'TLV index' to DCD channel encodings included in DCD message for OFDMA PHY interface. Also, it already provides the length of DCD channel encodings.

Table 1 – the mapping between TLV Indices and DCD channel encodings related to only OFDMA PHY Interface in Table 356

TLV Index	Name	Type (1byte)	Length (1byte)	Value (Variable)	PHY Scope			
					SC	SCa	OFDM	OFDMA
1	Downlink_Burst_Profile	1	1		O	O	O	O
2	BS EIRP	2	2		O	O	O	O
3	Channel Nr	6	1			O	O	O
4	TTG	7	1			O	O	O
5	RTG	8	1			O	O	O
6	$RSS_{IR,max}$	9	2		O	O	O	O
7	Channel Switch Frame Number	10	3			O	O	O

8	Frequency	12	4		O	O	O	O
9	BSID	13	6			O	O	O
10	Size of CQICH_ID field	16	1					O
11	H-ARQ ACK delay for DL burst	17	1					O
12	MAC version	148	1		O	O	O	O

Based on two requirements as described above, we explain the unified TLV encoding that concatenates only the values in existing TLV encodings of UCD/DCD message into a single value, so that it can reduce the size of the message for bandwidth efficiency.

The Value field of the unified TLV encoding is composed of the following items

- **Length of TLV encoding Inclusion bit-map**
  This has 8bit-long value which indicates the length of Inclusion bit-map (in byte).
- **TLV encoding Inclusion bit-map**
  Each bit of *TLV encoding Inclusion bit-map* indicates the existence of Value assigned to the relevant TLV Index. In other words, the most significant bit (MSB) is assigned to TLV index #1, subsequent bit relates to TLV index #2. Whenever a bit of *TLV encoding Inclusion bit-map* is set to '1', Value assigned to the pertinent *TLV index* is added to the *Group of Values*.
- **Group of Values**
  Group of Values is composed of the values whose bit in TLV encoding Inclusion bit-map is set to '1'. In other words, whenever a bit of *TLV encoding Inclusion bit-map* is set to '1', Value mapped to the pertinent *TLV index*, is concatenated to the *Group of Values*.

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Figure 1 depicts the example about the proposed operation of the unified TLV encoding.

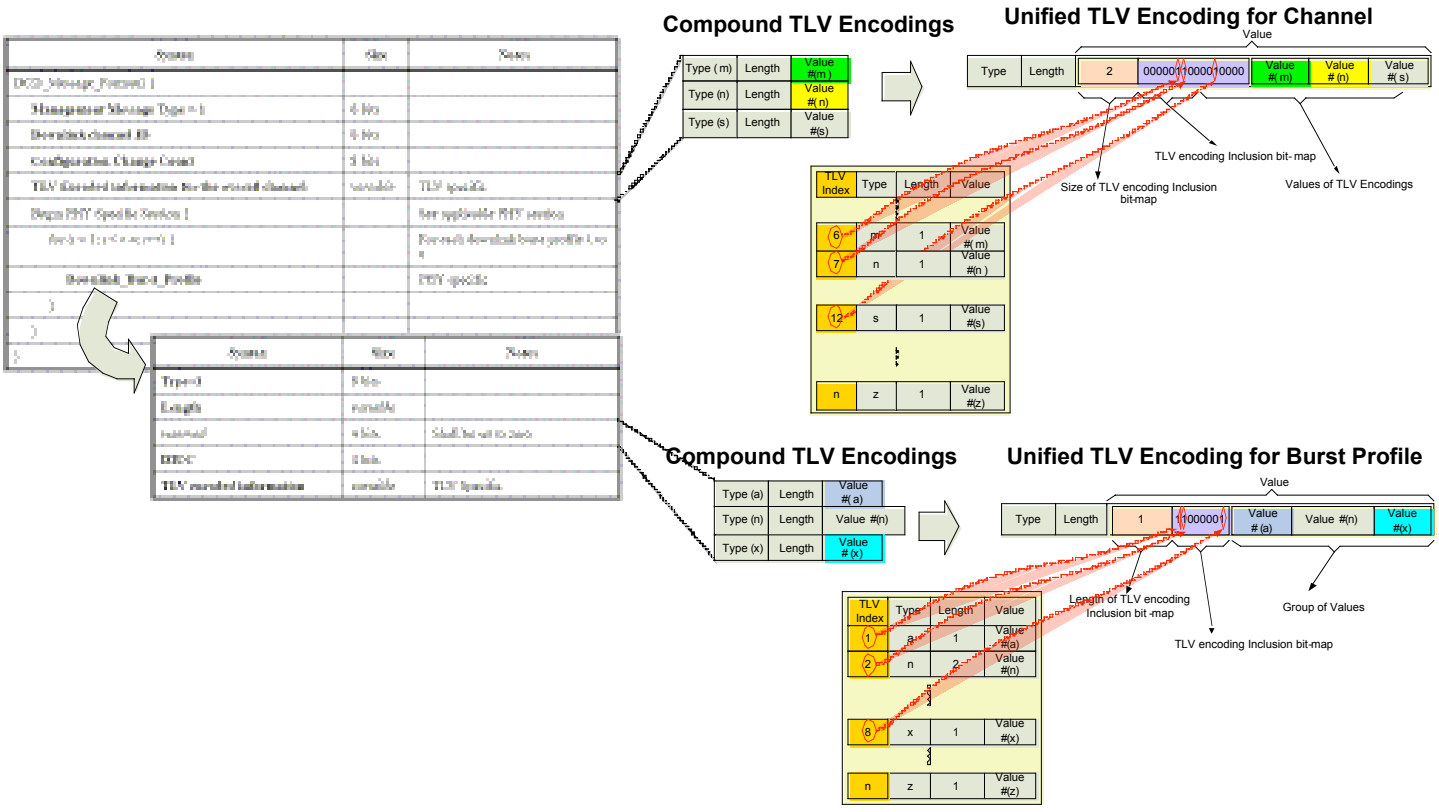

Figure 1 – The proposed operation of the unified TLV encoding

If UCD or DCD message uses the proposed unified TLV encoding instead of compound TLV encodings, it can reduce the size of message as follows.

- UCD message to be omitted

116 [overhead bytes] = 28 *[TLV encoding/Channel encoding]* x 2 *[overhead byte/TLV encoding]* x 1 *[Channel encoding]* +
3 *[TLV encoding/Burst Profile encoding]* x 2 *[overhead byte/ TLV encoding]* x 10 *[Burst Profile encoding]*

- DCD message to be omitted

123 [overhead bytes] = 12 *[TLV encoding/Channel encoding]* x 2 *[overhead byte/TLV encoding]* x 1 *[Channel encoding]* +
4 *[TLV encoding/Burst Profile encoding]* x 2 *[overhead byte/ TLV encoding]* x 13 *[Burst Profile encoding]*

The proposed unified TLV encoding requires only upto 25-byte overhead such as Length of TLV encoding Inclusion bit-map and TLV encoding Inclusion bit-map in case of UCD message; upto 29-byte overhead in case of DCD message.

This unified TLV encoding shall be used exclusively against any other TLV encodings. In other words, if the unified TLV encoding is included in the appropriate Channel Descriptor message (UCD or DCD), other related TLV encodings shall be excluded because the unified TLV encoding plays a role of any other TLV encoding. It is also possible to include the existing TLV encodings into a message instead of the unified TLV encoding. That is consideration about compatibility.

2 Proposed Text

We propose four types of the unified TLV encoding, for UL channel encoding, UL burst profile encoding, DL channel encoding, and DL burst profile encoding.

[Add the following text to Table 351 in Line 52, Page 659 of IEEE802.16REVd/D5-2004 document]

Table 351— UCD PHY-specific channel encodings — WirelessMAN-OFDMA

Name	Type (1 byte)	Length	Value (Variable-length)
..	..	..	..
CQICH Band AMC-Transition Delay	172	1	Frame unit
Unified TLV encoding	xx	Variable	This value is composed of the following items ● **Length of TLV encoding Inclusion bit-map** This has 8bit-long value which indicates the length of Inclusion bit-map (in byte). ● **TLV encoding Inclusion bit-map** Each bit of TLV encoding Inclusion bit-map indicates the existence of Value assigned to the pertinent TLV Index. In other words, the most significant bit (MSB) is assigned to TLV index #1, subsequent bit relates to TLV index #2. Whenever a bit of TLV encoding Inclusion bit-map is set to '1', Value, which is assigned to the pertinent TLV index, is added to the Group of Values. ● **Group of Values** Group of Values is composed of the values whose bit in TLV encoding Inclusion bit-map is set to '1'. In other words, Whenever a bit of TLV encoding Inclusion bit-map is set to '1',

			Value mapped to the pertinent TLV index, is concatenated to the Group of Values. See the table #MMM about TLV Index

In Table ***#MMM***, SS shall know the size of Value as well as Name of parameter which TLV index designates. Table ***#MMM*** defines the mapping between TLV index and encodings described in Table 347 and 351.

Table #MMM --- TLV index allocation to UCD PHY-specific channel encoding for unified TLV encoding --- WirelessMAN-OFDMA

TLV Index	Name	Type (1byte)	Length (1byte)	Value (Variable)	PHY Scope			
					SC	SCa	OFDM	OFDMA
1	Uplink_Burst_Profile	1	1		O	O	O	O
2	Contention-based reservation timeout	2	1		O	O	O	O
3	Bandwidth request opportunity size	3	2		O	O	O	O
4	Ranging request opportunity size	4	2		O	O	O	O
5	Frequency	5	4		O	O	O	O
6	Initial ranging codes	150	1					O
7	Periodic ranging codes	151	1					O
8	Bandwidth request codes	152	1					O
9	Periodic ranging backoff start	153	1					O
10	Periodic ranging backoff end	154	1					O
11	Start of ranging codes group	155	1					O
12	Permutation base	156	1					O
13	UL allocated subchannels bitmap	157	9					O
14	Optional permutation UL Allocated subchannels bitmap	158	13					O
15	Band AMC Allocation Threshold	159	1					O
16	Band AMC Release Threshold	160	1					O
17	Band AMC Allocation Timer	161	1					O
18	Band AMC Release Timer	162	1					O
19	Band Status Reporting MAX Period	163	1					O
20	Band AMC Retry Timer	164	1					O
21	Safety Channel Allocation Threshold	165	1					O
22	Safety Channel Release Threshold	166	1					O
23	Safety Channel Allocation Timer	167	1					O
24	Safety Channel Release Timer	168	1					O
25	Bin Status Reporting MAX Period	169	1					O
26	Safety Channel Retry Timer	170	1					O
27	H-ARQ ACK delay for UL burst	171	1					O
28	CQICH Band AMCTransition Delay	172	1					O

[Add the following text to Table 355 in Line 31, Page 663 of IEEE802.16REVd/D5-2004 document]

Table 355— UCD burst profile encodings — WirelessMAN-OFDMA

Name	Type (1 byte)	Length	Value (Variable-length)
..	..	..	..
Normalized C/N override	152	5	This is a list of numbers, where each number is encoded by one nibble, and interpeted as a signed integer. The nibbles corrsepond in order to the list define by Table 332, starting from the second line, such that the LS nibble of the first byte corresponds to the second line in the table. The number encoded by each nibble represents the difference in normalized C/N relative to the previous line in the table
Unified TLV encoding	xx	Variable	See Table 351 in 11.3. The format of this value is the same as Unified TLV encoding in Table 351 See the table *#NNN* about TLV Index

In Table *#NNN*, SS shall know the size of Value as well as Name of parameter which TLV index designates. Table *#NNN* defines the mapping between TLV index and encodings described in Table 355.

Table *#NNN* --- TLV index allocation to UCD burst profile encoding for unified TLV encoding --- WirelessMAN-OFDMA

TLV Index	Name	Type (1byte)	Length (1byte)	Value (Variable)	PHY Scope			
					SC	SCa	OFDM	OFDMA
1	FEC Code type and modulation type	150	1					O
2	Ranging data ratio	151	1					O
3	Normalized C/N override	152	5					O

[Add the following text to Table 356 in Line 21, Page 665 of IEEE802.16REVd/D5-2004 document]

Table 356—DCD channel encoding

Name	Type (1 byte)	Length	Value (Variable-length)	PHY scope
..	..	..	..	..
MAC version	148	1	See 1.1.3	All
Unified TLV encoding	xx	Variable	See Table 351 in 11.3. The format of this value is the same as Unified TLV encoding in Table 351 See the table *#OOO* about TLV Index	OFDMA

In Table ***#OOO***, SS shall know the size of Value as well as Name of parameter which TLV index designates. Table ***#OOO*** defines the mapping between TLV index and encodings related to OFDMA PHY described in Table 356.

Table #OOO --- TLV index allocation to DCD channel encoding for unified TLV encoding --- WirelessMAN-OFDMA

TLV Index	Name	Type (1byte)	Length (1byte)	Value (Variable)	PHY Scope			
					SC	SCa	OFDM	OFDMA
1	Downlink_Burst_Profile	1	1		O	O	O	O
2	BS EIRP	2	2		O	O	O	O
3	Channel Nr	6	1			O	O	O
4	TTG	7	1			O	O	O
5	RTG	8	1			O	O	O
6	$RSS_{IR,max}$	9	2		O	O	O	O
7	Channel Switch Frame Number	10	3			O	O	O
8	Frequency	12	4		O	O	O	O
9	BSID	13	6			O	O	O
10	Size of CQICH_ID field	16	1					O
11	H-ARQ ACK delay for DL burst	17	1					O
12	MAC version	148	1		O	O	O	O

[Add the following text to Table 361 in Line 64, Page 668 of IEEE802.16REVd/D5-2004 document]

Table 361— DCD burst profile encodings — WirelessMAN-OFDMA

Name	Type (1 byte)	Length	Value (Variable-length)
..	..	..	..
Normalized C/N override	152	5	This is a list of numbers, where each number is encoded by one nibble, and interpeted as a signed integer. The nibbles corrsepond in order to the list define by Table 332, starting from the second line, such that the LS nibble of the first byte corresponds to the second line in the table. The number encoded by each nibble represents the difference in normalized C/N relative to the previous line in the table
Unified TLV encoding	xx	Variable	See Table 351 in 11.3. The format of this value is the same as Unified TLV encoding in Table 351 See the table ***#PPP*** about TLV Index

In Table ***#PPP***, SS shall know the size of Value as well as Name of parameter which TLV index designates.

Table #***PPP*** defines the mapping between TLV index and encodings described in Table 357 and 361.

Table #*PPP* --- TLV index allocation to DCD burst profile encoding for unified TLV encoding --- WirelessMAN-OFDMA

TLV Index	Name	Type (1byte)	Length (1byte)	Value (Variable)	PHY Scope			
					SC	SCa	OFDM	OFDMA
1	Frequency	1	4		O	O	O	O
2	FEC Code type	150	1					
3	DIUC Mandatory exit threshold	151	1					O
4	DIUC Minimum entry threshold	152	1					O