Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Corrections to IEEE 802.16-2004 to clarify DFS terminology**
Date Submitted	**2005-04-28**
Source(s)	Andy Sago BT Voice: +44 1473 644383 Fax: +44 1473 647390 mailto:andy.sago@bt.com Barry Lewis Redline Communications Paul Piggin Cygnus Communications Vladimir Yanover Alvarion
Re:	IEEE 802.16 Working Group Letter Ballot #17a, comment resolution on the Maintenance Task Group's IEEE P802.16-2004Cor1/D2 ("Draft Corrigendum to IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems")
Abstract	Specific changes are proposed to standard IEEE 802.16-2004 and IEEE P802.16-2004Cor1/D2 in order to remove ambiguities and prevent potential confusion in current terminology relating to the use of Dynamic Frequency Selection for the avoidance of harmful interference into other services.
Purpose	Provided in support of LB17a comment submitted by Andy Sago on behalf of the above authors
Notice	
Release	
Patent Policy and Procedures	

Corrections to IEEE 802.16-2004 to clarify DFS terminology

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BT, Redline Communications, Cygnus Communications, Alvarion

Introduction

The understanding of sharing scenarios between broadband wireless access systems and other services has been enhanced through studies within Europe, US and elsewhere over the past few years and this is leading to the development of regulatory requirements for particular bands (usually unlicensed (licence-exempt) bands) that impinge on wireless access systems and deployments. In the light of this greater understanding it is necessary to revisit the IEEE 802.16-2004 standard and P802.16-2004/Cor1/D2 in order to update and clarify terminology in relation to the definition and use of Dynamic Frequency Selection, for the purpose of removing ambiguities and conflicts with regulatory terms that have now become established.

Specific changes are proposed, the effect of which is to clarify the procedures currently available in the standard for interference reduction, system coexistence or spectrum sharing. Procedures used for regulatory compliance are then identified as part of those available overall, and the term Dynamic Frequency Selection (DFS) is related solely to a particular mechanism as defined in regulation. DFS is changed to be optional in the standard, since it is not required in all unlicensed (licence-exempt) bands. Whether it is used or not will depend on separate regulatory requirements, outside the standard.

This document addresses two issues relating to DFS:

1) To consider each instance of the term "primary users" in 802.16 and replace each with an alternative term depending on context, to eliminate confusion with regulatory documents. Develop definitions of these terms.
2) To consider each instance of the term "DFS" in 802.16 and, where appropriate, replace each with an alternative term depending on context, to eliminate confusion with regulatory documents. Develop definitions of new terms and revise definition of DFS.

Each instance of the terms under discussion is addressed in the next section, with suggested revised text for incorporation into the Commentary tool as official comments into the 802.16 Working Group Corrigendum group. The source document is IEEE Std 802.16-2004, plus also IEEE P802.16-2004/Cor1/D2 for the draft Corrigendum changes. Changes to these source documents are marked as tracked changes (underlining or in coloured text). Editing instructions to change text (or to leave it the same) are marked in ***bold italics***. Other comments, not part of the original standard or draft corrigendum, are marked in *italics*. The editing instructions only, without the extraneous comments and unchanged paragraphs, have been pasted into the Change field of the Commentary tool.

Analysis and suggested text changes to clarify “Primary Users” and “DFS”

All instances of the terms in question have been reprinted below from the standard, even where no changes are recommended. Also surrounding text is often shown to give context. It is hoped that this will enable readers to use this document without also needing to consult the standard at the same time.
There are 28 instances of the term Primary User in the standard. There are no new instances of the term in Corrigendum 1 Draft 2, but there are two revised sentences containing the term and these are addressed in chronological order below.

There are 32 instances of the term DFS in the standard. There are no new instances of the term in Corrigendum 1 Draft 2, although there is one revised sentence containing the term which is addressed below.

Three instances of the term Primary User occur in the Contents which are auto generated from section headings. DFS for license-exempt operation is a section heading in the standard and hence appears in the Contents.

1.3.3 License-exempt frequencies below 11 GHz (primarily 5–6 GHz)

Change first paragraph as shown, add two new paragraphs *(rationale: clearly separate DFS from other mechanisms, clarify license-exempt term)**:***

The physical environment for the license-exempt bands below 11 GHz is similar to that of the licensed bands in the same frequency range, as described in 1.3.2. However, the license-exempt nature introduces additional interference and co-existence issues, whereas regulatory constraints limit the allowed radiated power. In addition to the features described in 1.3.2, the PHY and MAC introduce mechanisms to facilitate the detection and avoidance of interference and the prevention of harmful interference into other users including specific spectrum users identified by regulation. This includes a mechanism for regulatory compliance called dynamic frequency selection (DFS).

It is recognised that some administrations require notification of terminal location for certain services in some license-exempt bands, which is a form of licensing. Conversely, it is possible to have uncoordinated usage within a licensed allocation. In these and other similar cases the pertinent issues for license-exempt usage remain as described in the preceding paragraph.

In the context of this document the use of the term "license-exempt frequencies" or “license-exempt bands” should be taken to mean the situation where licensing authorities do not coordinate individual assignments to operators, regardless of whether the spectrum in question has a particular regulatory status as license-exempt or licensed. **1.3.4 Air interface nomenclature and PHY compliance**
Move DFS from requirements column to optional column for wirelessHUMAN in Table 1 as amended by P80216_Cor1_D2 *(Rationale: DFS is optional for “licence-exempt usage” as agreed in answer to Question 4f).* ***Note: table not updated below):***

Table 1—Air interface nomenclature

Designation	Applicability	PHY	Additional MAC requirements	Options	Duplexing alternative
WirelessMAN-SC™	10–66 GHz	8.1			TDD FDD
WirelessMAN-SCa™	Below 11 GHz licensed bands	8.2		AAS (6.3.7.6) ARQ (6.3.4) STC (8.2.1.4.3)	TDD FDD
WirelessMAN-OFDM™	Below 11 GHz licensed bands	8.3		AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) STC (8.3.8)	TDD FDD
WirelessMAN-OFDMA	Below 11 GHz licensed bands	8.4		AAS (6.3.7.6, 8.4.4.6) ARQ (6.3.4) H-ARQ (6.3.17) STC (8.4.8)	TDD FDD
WirelessHUMAN™	Below 11 GHz license-exempt bands	[8.2, 8.3, or 8.4] and 8.5	DFS (6.3.15)	AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) (with 8.3 only) STC (8.2.1.4.3/8.3.8/ 8.4.8)	TDD

1.3.4 Air interface nomenclature and PHY compliance

Last paragraph change as shown (Rationale: *DFS is optional for "licence-exempt bands"):*
Implementations of this standard for license-exempt frequencies below 11 GHz (such as those listed in B.1) shall comply with the WirelessMAN-SCa PHY as described in 8.2, the WirelessMAN-OFDM PHY as described in 8.3, or the WirelessMAN-OFDMA PHY as described in 8.4. They shall further comply with the DFS protocols (6.3.15) (where mandated by regulation) and with 8.5.

3. Definitions

Change 3.21 as follows *(Rationale: clearly separate DFS for regulatory purposes from other mechanisms):*
3.21 dynamic frequency selection (DFS): The ability of a system to switch to different physical RF channels based on channel measurement criteria to conform to particular regulatory requirements.

4. Abbreviations and acronyms

No change required:
DFS dynamic frequency selection

6.3.2.3.33 Channel measurement Report Request/Response (REP-REQ/RSP)

Change the description as follows (note: first change, to delete reference to obsolete direct mesh (DM) mode, will be input as a separate Corrigendum comment and not included with the DFS comments):
If the BS, operating in bands below 11 GHz, requires RSSI and CINR channel measurement reports, it shall send the channel measurements Report Request message. IThe Report Request message shall additionally be used to request the results of the measurements the BS has previously scheduled. Table 62 shows the REP-REQ message.
< table goes here unchanged >
The channel measurement Report Response message shall be used by the SS to respond to the channel measurements listed in the received Report Requests. Where regulation mandates detection of specific signals, the SS shall also send a REP-RSP in an unsolicited fashion upon detecting such signals on the channel it is operating in. The SS may also send a REP-RSP containing channel measurement reports, in an unsolicited fashion, or when other interference is detected above a threshold value. Table 63 shows the REP-RSP message.

Clarification point: The references to "in license-exempt bands" in both paragraphs have been removed, which should also be done elsewhere in the document. It is well known that DFS is not always mandated in regulations for operation in LE bands and it is suggested that the changes shown in section 6.3.15 should be made around the term "license exempt bands". Also, it may not only be license exempt bands where DFS is required - the UK 5.8 GHz band is an example of a band where DFS is mandated by regulation but the band is subject to light licensing (registration of terminal location is required). Therefore the specification should, where possible, avoid making a link between the use of DFS and operation in license exempt bands.

6.3.15 DFS for license-exempt operation

Change title to read:
6.3.15 Procedures for shared frequency band usage

The whole of section 6.3.15 is reproduced below for clarity, whether changes are required or not.

***Make changes as follows** (Rationale: better explain DFS to make it a subset of and separate from non-DFS procedures.*

6.3.15.1 Introduction

Procedures are defined in this section which may be used when the 802.16 system is sharing a frequency band with another system or service, either for the reduction of interference to and from other systems, to facilitate coexistence of systems or for other reasons. These procedures generally involve mechanisms to facilitate the detection of other users, and the avoidance and prevention of harmful interference into other users. Included within these procedures for certain sharing scenarios, regulatory requirements specify that DFS (as defined by ITU-R in M.1652 [new reference B11]) shall be used to facilitate sharing with specific spectrum users identified by regulation. A specific spectrum user is a user from a service specifically identified in regulation as requiring protection from harmful interference. In the case DFS is mandated by regulatory requirements then it shall be implemented according to this specification.

.Further, the use of a channel selection algorithm may be required, which results in uniform channel spreading across a minimum number of channels. This specification is intended to be compliant with regulatory requirements such as [B10]. The timing and threshold parameters used for DFS are specified by each regulatory administration.

The procedures specified in this section provide for:
— Testing channels for other users including specific spectrum users (6.3.15.2)
— Discontinuing operations after detecting other users including specific spectrum users (6.3.15.3)
— Detecting other users including specific spectrum users (6.3.15.4)
— Scheduling for channel testing (6.3.15.5).
— Requesting and reporting of measurements (6.3.15.6)
— Selecting and advertising a new channel (6.3.15.7)

6.3.15.2 Testing channels for other users (including specific spectrum users)

A BS or SS implementing these procedures shall not use a channel that it knows contains other users or has not been tested recently for the presence of other users. A BS shall test for the presence of other users based on timing parameters and values that may be set locally, or in the case of DFS and the detection of specific spectrum users, they may be defined in regulation. Timing parameters include:

— **Startup Test Period** before operating in a new channel if the channel has not been tested for other users for at least **Startup Test Period** during the last **Startup Test Valid**.

— **Startup Test Period** before operating in a new channel if a channel was previously determined to contain other users during the last **Startup Test Valid**.

Operating Test Period (where the period is only accumulated during testing) of each **Operating Test Cycle** period while operating in a channel. Testing may occur in quiet periods or during normal operation.

An SS may start operating in a new channel without following the above start-up testing procedures if:

— The SS moves to the channel as a result of the receipt of a Channel Switch Announcement from the BS.

— The SS is initializing with a BS that is not currently advertising, using the Channel Switch Announcement that it is about to move to a new channel.

A BS may start operating in a new channel without following the above start-up testing procedures if it has learned from another device by means outside the scope of this standard that it is usable.

6.3.15.3 Discontinuing operations after detecting specific spectrum users

If a BS or an SS is operating in a channel and detects specific spectrum users, it shall discontinue any transmission of the following:

— MAC PDUs carrying data within **Max Data Operations Period**.

— MAC PDUs carrying MAC Management messages within **Management Operations Period**.

The values of the above parameters may be set locally, or in the case of DFS they may be defined in regulation.

6.3.15.4 Detecting specific spectrum users

Each BS and SS shall use a method to detect specific spectrum users operating in a channel that satisfies the regulatory requirements, where applicable. The particular method used to perform detection is outside the scope of this standard.

6.3.15.5 Scheduling for channel testing

A BS may measure one or more channels itself and request any SS to measure one or more channels on its behalf, either in a quiet period or during normal operation.

For consistency with the IE format description in 8.3.6.2.3 change the start of the second paragraph as follows*:*

To request the SSs to measure one channel, the BS shall include in the DL-MAP a Channel Measurement IE as specified in 8.3.6.2.3. The BS that requests the SSs to perform a measurement shall not transmit MAC PDUs to any SS during the measurement interval. If the channel measured is the operational channel, the BS shall not schedule any uplink transmissions from SSs to take place during the measurement period.

For consistency with the IE format description in 8.3.6.2.3 change the start of the third paragraph (as amended by P80216_Cor1_D2) as follows. Also, remove the parameter value for Max Channel Switch Time as shown *(rationale: Max Channel Switch Time is defined by regulation and should not be defined in the standard)****:***

Upon receiving a DL-MAP with the Channel Measurement IE, an SS shall start to measure the indicated channel no later than **Max. Channel Switch Time** after the start of the measurement period. An SS may stop the measurement no sooner than **Max. Channel Switch Time** before the expected start of the next frame or the next scheduled uplink transmission (of any SS). If the channel to be measured is the operating channel, **Max. Channel Switch Time** shall be equal to the value of RTG, as specified in Table 358, or in the case of DFS Max. Channel Switch Time may be defined in regulation.

6.3.15.6 Requesting and reporting of measurements

The SS shall, for each measured channel, keep track of the following information:

— Frame Number of the frame during which the first measurement was made
— Accumulated time measured
— Existence of a specific spectrum user on the channel
— Whether a WirelessHUMAN using the same PHY system was detected on the measured channel

— Whether unknown transmissions [such as radio local area network (RLAN) transmissions] were detected on the channel

The BS may request a measurement report by sending a REP-REQ message. This is typically done after the aggregated measurement time for one or more channels exceeds the regulatory required measurement time. Upon receiving a REP-REQ the SS shall reply with a REP-RSP message and reset its measurement counters for each channel on which it reported.

If the SS detects a specific spectrum user on the channel it is operating during a measurement interval or during normal operation it shall immediately cease to send any user data and send at the earliest possible opportunity an unsolicited REP-RSP. The BS shall provide transmission opportunities for sending an unsolicited REP-RSP frequently enough to meet regulatory requirements, where applicable. The SS may also send, in an unsolicited fashion, a REP-RSP when other user interference is detected above a threshold value.

6.3.15.7 Selecting and advertising a new channel

Amend second paragraph as follows:

A BS may decide to stop operating in a channel at any time. The algorithm used to decide to stop operating in a channel is outside the scope of this standard, but shall satisfy any regulatory requirements.

A BS may use a variety of information, including information learned during SS initialization and information gathered from measurements undertaken by the BS and the SSs, to assist in the selection of the new channel. The algorithm to choose a new channel is not standardized but in the case of DFS shall satisfy any regulatory requirements, including uniform spreading rules and channel testing rules. If a BS would like to move to a new channel, a channel supported by all SSs in the sector should be selected.

A BS shall inform its associated SSs of the new channel using the Channel Nr in the DCD message. The new channel shall be used starting from the frame with the number given by the Channel Switch Frame Number in the DCD message. The BS shall not schedule any transmissions during the last **Max. Channel Switch Time** before the channel change is to take place.

The uplink burst profiles used on the old channel defined shall be considered valid also for the new channel, i.e., the BS need not define new uplink Burst Profiles when changing channels. When operating in license-exempt bands, the BS shall not send the Frequency (Type=3) parameter as a part of UCD message.

11.11 REP-REQ management message encodings

No change required to the table:

The Report Command consists of the following parameters:

Name	Type	Length	Value
Report type	1.1	1	Bit #0 =1 Include DFS Basic report Bit #1 =1 Include CINR report Bit #2 =1 Include RSSI report Bit #3–6 α_{avg} \ in multiples of 1/32 (range [1/32, 16/32]) Bit #7 =1 Include current transmit power report
Channel number	1.2	1	Physical channel number (see 8.5.1) to be reported on. (license-exempt bands only)
Channel Type request	1.3	1	00 = Normal subchannel, 01 = Band AMC Channel, 10 = Safety Channel, 11 = *Reserved*

11.12 REP-RSP management message encodings

Change Primary User to Specific Spectrum User in table entry for Basic report (Note: table not updated below):

The report consists of the following parameters (see also 8.2.2, 8.3.9, or 8.4.11 for details).

REP-REQ Report type	Name	Type	Length	Value
bit #0 = 1	Channel number	1.1	1	Physical channel number (see 8.5.1) to be reported on
bit #0 = 1	Start frame	1.2	2	Frame number in which measurement for this channel started
bit #0 = 1	Duration	1.3	3	Cumulative measurement duration on the channel in multiples of T_s. For any value exceeding 0xFFFFFF, report 0xFFFFFF
bit #0 = 1	Basic report	1.4	1	Bit #0: WirelessHUMAN detected on the channel Bit #1: Unknown transmissions detected on the channel Bit #2: Primary User detected on the channel Bit #3: Unmeasured. Channel not measured
bit #1 = 1	CINR report	1.5	2	1 byte: mean (see also 8.2.2, 8.3.9, 8.4.11) for details) 1 byte: standard deviation
bit #2 = 1	RSSI report	1.6	2	1 byte: mean (see also 8.2.2, 8.3.9, 8.4.11) for details) 1 byte: standard deviation

12.2.3.2.3 WirelessHUMAN-specific PHY profile features

Change as shown below:

Mandatory features:

- — TDD operation
- — Center Frequency and symbol rate for uplink are not reported in UCD channel encoding
- — Channel Nr is reported in DCD channel encoding
- — UW length 16, 64 and 256 symbols
- — DFS capability (if mandated by regulation)
  - Detection of specific spectrum users as defined by regulatory requirements
  - Channel switching as defined by regulatory requirements

12.3.1.1 ProfM3_PMP: Basic Packet PMP MAC System Profile

Table 401—Optional feature requirements profM3_PMP

Change as shown below (part of table shown):

Optional Feature	Required?	Conditions/Notes
……..	……..	……..
DFS	Conditional	Required if mandated by regulation for license exempt usage. Not required when intended for licensed usage.
……..	……..	……..

12.3.1.2 ProfM3_Mesh: Basic Packet Mesh MAC System Profile

Table 402—Optional feature requirements profM3_mesh

Change as shown below (part of table shown):

Optional Feature	Required?	Conditions/Notes
……..	……..	……..

DFS	Conditional	Required if mandated by regulation for license exempt usage. Not required when intended for licensed usage.

12.3.2.6 profP3_10: WirelessHUMAN(-OFDM) PHY profile for 10 MHz channelization

Change the corrigendum 1 Draft 2 version as shown below:

Mandatory features:

— License-exempt band usage only
— Channel bandwidth BW = 10 MHz
— TDD operation
— BS shall select Frame duration from code set PMP:{2,4,6}, Mesh:{1}. SSs shall be capable of operating with any of the Frame Durations indicated in the code set.
— DFS capability (if mandated by regulation)
  — Ability to detect specific spectrum users as defined by regulatory requirements
  — Ability to switch channel as defined by regulatory requirements

12.4.3 WirelessMAN-OFDMA and WirelessHUMAN(-OFDMA) System PHY Profiles

12.4.2.1 Basic Packet PMP MAC Profile

Change as shown:

Profile identifier: OFDMA_ProfM1.

Mandatory Features:

— Support of Packet convergence sublayer.
— Support of Internet Protocol Ipv4.
— Support IEEE 802.3/Ethernet specific part.
— CRC functionality shall be supported for all connections.
— Support of dynamic services.
— Support of Best effort services.
— Support of Non-Real-Time Polling services.
— Support of CDMA based Initial and Periodic Ranging.
— Support of Contention based CDMA bandwidth requests.
— DFS shall be required for the license exempt bands if mandated by regulation.

12.4.3.1 Common Features of PHY Profiles

12.4.3.1.4 WirelessHUMAN PHY Profiles Features

Change corrigendum 1 Draft 2 version as indicated:

Mandatory features:

— TDD Operation
— Where mandated by regulation, ability to detect specific spectrum users as defined by regulatory requirements
— Center Frequency for uplink is not reported in the UCD channel encoding.
— Channel Nr is reported in DCD channel encoding
— Ability to switch channel as defined by regulatory requirements

Annex A
Bibliography

(Informative)

Update reference B10 *(rationale: ERC Decision has been replaced by an ECC decision)*

[B10] (ECC/DEC/(04)08) *ECC Decision of 09 July 2004 on the harmonised use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs), 9th July*

2004 revised November 2004,
http://www.ero.dk/documentation/docs/doccategory.asp?catid=1&catname=ECC/ERC/ECTRA%20Decisions

Add new reference in the correct order (B11, with existing B11 and later references being renumbered):
[B11] Recommendation ITU-R M.1652, *Dynamic frequency selection (DFS) in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band, 2003,* http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1652

B.2 License-exempt co-existence and interference analyses.
There is one mention of primary users and a further fifteen mentions of DFS in the Informative Annex B.2. Annex B.2 details an analysis of DFS as an interference mitigation and sharing mechanism. The text does not clearly position DFS as a regulatory requirement only and is thus misleading, and it also relies heavily on analysis undertaken in relation to the deployment of radio LANs in spectrum at 5 GHz, which is not always appropriate. It also contains obsolete references. It may be appropriate that ***Annex B.2 should be deleted****, but the no one is likely to develop replacement text since this will be time consuming. If thought appropriate it is possible that Task Group 802.16h may develop alternative text for a later amendment to the standard, or may refer to updated documentation on sharing analyses. In the mean time, a comment will be input into the Corrigendum process (separate from the other DFS comments) to suggest that Annex B.2 is deleted.*

Conclusions and Recommendations for Way Forward

A number of changes to the 802.16-2004 standard have been identified which would address inconsistencies and ambiguities relating to certain terms. Changes already made by others in the Corrigendum 1 Draft 2 text have been taken into account. It is proposed that three Comments are submitted:

1. to address the deletion of text referring to DM mode
2. to address deletion of Informative Annex B.2
3. to address all other corrections in this document. This third Comment will refer out to this document which will be submitted in IEEE approved format as a Contribution.

Annex A Text for use in the Commentary tool, as input to the Corrigendum

This is the same as the text in the main body of this report, but without extraneous comments and rationale statements, and not including text which is unchanged. It should be noted that this text has already been pasted into the Change fields of the Comments that have been submitted.

1.3.3 License-exempt frequencies below 11 GHz (primarily 5–6 GHz)

Change first paragraph as shown, add two new paragraphs:

The physical environment for the license-exempt bands below 11 GHz is similar to that of the licensed bands in the same frequency range, as described in 1.3.2. However, the license-exempt nature introduces additional interference and co-existence issues, whereas regulatory constraints limit the allowed radiated power. In addition to the features described in 1.3.2, the PHY and MAC introduce mechanisms to facilitate the detection and avoidance of interference and the prevention of harmful interference into other users including specific spectrum users identified by regulation. This includes a mechanism for regulatory compliance called dynamic frequency selection (DFS).

It is recognised that some administrations require notification of terminal location for certain services in some license-exempt bands, which is a form of licensing. Conversely, it is possible to have uncoordinated usage within a licensed allocation. In these and other similar cases the pertinent issues for license-exempt usage remain as described in the preceding paragraph.

In the context of this document the use of the term "license-exempt frequencies" or “license-exempt bands” should be taken to mean the situation where licensing authorities do not coordinate individual assignments to operators, regardless of whether the spectrum in question has a particular regulatory status as license-exempt or licensed. **1.3.4 Air interface nomenclature and PHY compliance**

Move DFS from requirements column to optional column for wirelessHUMAN in Table 1 as amended by P80216_Cor_D2, (Note: table not updated below):

Table 1—Air interface nomenclature

Designation	Applicability	PHY	Additional MAC requirements	Options	Duplexing alternative
WirelessMAN-SC™	10–66 GHz	8.1			TDD FDD
WirelessMAN-SCa™	Below 11 GHz licensed bands	8.2		AAS (6.3.7.6) ARQ (6.3.4) STC (8.2.1.4.3)	TDD FDD
WirelessMAN-OFDM™	Below 11 GHz licensed bands	8.3		AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) STC (8.3.8)	TDD FDD
WirelessMAN-OFDMA	Below 11 GHz licensed bands	8.4		AAS (6.3.7.6, 8.4.4.6) ARQ (6.3.4) H-ARQ (6.3.17) STC (8.4.8)	TDD FDD
WirelessHUMAN™	Below 11 GHz license-exempt bands	[8.2, 8.3, or 8.4] and 8.5	DFS (6.3.15)	AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) (with 8.3 only) STC (8.2.1.4.3/8.3.8/ 8.4.8)	TDD

1.3.4 Air interface nomenclature and PHY compliance

Last paragraph change as shown:

Implementations of this standard for license-exempt frequencies below 11 GHz (such as those listed in B.1) shall comply with the WirelessMAN-SCa PHY as described in 8.2, the WirelessMAN-OFDM PHY as described in 8.3, or the WirelessMAN-OFDMA PHY as described in 8.4. They shall further comply with the DFS protocols (6.3.15) (where mandated by regulation) and with 8.5.

3. Definitions

Change 3.21 as follows:

3.21 dynamic frequency selection (DFS): The ability of a system to switch to different physical RF channels based on channel measurement criteria to conform to particular regulatory requirements.

6.3.2.3.33 Channel measurement Report Request/Response (REP-REQ/RSP)

Change the description as follows:

If the BS, operating in bands below 11 GHz requires RSSI and CINR channel measurement reports, it shall send the channel measurements Report Request message. IThe Report Request message shall additionally be used to request the results of the measurements the BS has previously scheduled. Table 62 shows the REP-REQ message.

< table goes here unchanged >

The channel measurement Report Response message shall be used by the SS to respond to the channel measurements listed in the received Report Requests. Where regulation mandates detection of specific signals, the SS shall also send a REP-RSP in an unsolicited fashion upon detecting such signals on the channel it is operating in. The SS may also send a REP-RSP containing channel measurement reports, in an unsolicited fashion, or when other interference is detected above a threshold value. Table 63 shows the REP-RSP message.

6.3.15 DFS for license-exempt operation

Change title to read:

6.3.15 Procedures for shared frequency band usage

Add, amend and delete as follows:

6.3.15.1 Introduction

Procedures are defined in this section which may be used when the 802.16 system is sharing a frequency band with another system or service, either for the reduction of interference to and from other systems, to facilitate coexistence of systems or for other reasons. These procedures generally involve mechanisms to facilitate the detection of other users, and the avoidance and prevention of harmful interference into other users. Included within these procedures for certain sharing scenarios, regulatory requirements specify that DFS (as defined by ITU-R in M.1652 [new reference B11]) shall be used to facilitate sharing with specific spectrum users identified by regulation. A specific spectrum user is a user from a service specifically identified in regulation as requiring protection from harmful interference. In the case DFS is mandated by regulatory requirements then it shall be implemented according to this specification.

.Further, the use of a channel selection algorithm may be required, which results in uniform channel spreading across a minimum number of channels. This specification is intended to be compliant with regulatory requirements such as [B10]. The timing and threshold parameters used for DFS are specified by each regulatory administration.

The procedures specified in this section provide for:

— Testing channels for other users including specific spectrum users (6.3.15.2)
— Discontinuing operations after detecting other users including specific spectrum users (6.3.15.3)
— Detecting other users including specific spectrum users (6.3.15.4)
— Scheduling for channel testing (6.3.15.5).
— Requesting and reporting of measurements (6.3.15.6)

— Selecting and advertising a new channel (6.3.15.7)

6.3.15.2 Testing channels for other users (including specific spectrum users)

A BS or SS implementing these procedures shall not use a channel that it knows contains other users or has not been tested recently for the presence of other users. A BS shall test for the presence of other users based on timing parameters and values that may be set locally, or in the case of DFS and the detection of specific spectrum users, they may be defined in regulation. Timing parameters include:

— **Startup Test Period** before operating in a new channel if the channel has not been tested for other users for at least **Startup Test Period** during the last **Startup Test Valid**.

— **Startup Test Period** before operating in a new channel if a channel was previously determined to contain other users during the last **Startup Test Valid**.

Operating Test Period (where the period is only accumulated during testing) of each **Operating Test Cycle** period while operating in a channel. Testing may occur in quiet periods or during normal operation.

An SS may start operating in a new channel without following the above start-up testing procedures if:

— The SS moves to the channel as a result of the receipt of a Channel Switch Announcement from the BS.

— The SS is initializing with a BS that is not currently advertising, using the Channel Switch Announcement that it is about to move to a new channel.

A BS may start operating in a new channel without following the above start-up testing procedures if it has learned from another device by means outside the scope of this standard that it is usable.

6.3.15.3 Discontinuing operations after detecting specific spectrum users

If a BS or an SS is operating in a channel and detects specific spectrum users, it shall discontinue any transmission of the following:

— MAC PDUs carrying data within **Max Data Operations Period**.

— MAC PDUs carrying MAC Management messages within **Management Operations Period**.

The values of the above parameters may be set locally, or in the case of DFS they may be defined in regulation.

6.3.15.4 Detecting specific spectrum users

Each BS and SS shall use a method to detect specific spectrum users operating in a channel that satisfies the regulatory requirements, where applicable. The particular method used to perform detection is outside the scope of this standard.

6.3.15.5 Scheduling for channel testing

A BS may measure one or more channels itself and request any SS to measure one or more channels on its behalf, either in a quiet period or during normal operation.

For consistency with the IE format description in 8.3.6.2.3 change the start of the second paragraph as follows:

To request the SSs to measure one channel, the BS shall include in the DL-MAP a Channel Measurement IE as specified in 8.3.6.2.3. The BS that requests the SSs to perform a measurement shall not transmit MAC PDUs to any SS during the measurement interval. If the channel measured is the operational channel, the BS shall not schedule any uplink transmissions from SSs to take place during the measurement period.

For consistency with the IE format description in 8.3.6.2.3 change the start of the third paragraph (as amended by P80216_Cor1_D2) as follows. Also, remove the parameter value for Max Channel Switch Time as shown *(rationale: Max Channel Switch Time is defined by regulation and should not be defined in the standard)**:***

Upon receiving a DL-MAP with the Channel Measurement IE, an SS shall start to measure the indicated channel no later than **Max. Channel Switch Time** after the start of the measurement period. An SS may stop the measurement no sooner than **Max. Channel Switch Time** before the expected start of the next frame or the next scheduled uplink transmission (of any SS). If the channel to be measured is the operating channel, **Max. Channel**

Switch Time shall be equal to the value of RTG, as specified in Table 358, or in the case of DFS Max. Channel Switch Time may be defined in regulation.

6.3.15.6 Requesting and reporting of measurements

The SS shall, for each measured channel, keep track of the following information:

— Frame Number of the frame during which the first measurement was made
— Accumulated time measured
— Existence of a specific spectrum user on the channel
— Whether a WirelessHUMAN using the same PHY system was detected on the measured channel

— Whether unknown transmissions [such as radio local area network (RLAN) transmissions] were detected on the channel

The BS may request a measurement report by sending a REP-REQ message. This is typically done after the aggregated measurement time for one or more channels exceeds the regulatory required measurement time. Upon receiving a REP-REQ the SS shall reply with a REP-RSP message and reset its measurement counters for each channel on which it reported.

If the SS detects a specific spectrum user on the channel it is operating during a measurement interval or during normal operation it shall immediately cease to send any user data and send at the earliest possible opportunity an unsolicited REP-RSP. The BS shall provide transmission opportunities for sending an unsolicited REP-RSP frequently enough to meet regulatory requirements, where applicable. The SS may also send, in an unsolicited fashion, a REP-RSP when other user interference is detected above a threshold value.

6.3.15.7 Selecting and advertising a new channel

Amend second paragraph as follows:

A BS may use a variety of information, including information learned during SS initialization and information gathered from measurements undertaken by the BS and the SSs, to assist in the selection of the new channel. The algorithm to choose a new channel is not standardized but in the case of DFS shall satisfy any regulatory requirements, including uniform spreading rules and channel testing rules. If a BS would like to move to a new channel, a channel supported by all SSs in the sector should be selected.

11.12 REP-RSP management message encodings

Change Primary User to Specific Spectrum User in table entry for Basic report (Note: table not updated below):

The report consists of the following parameters (see also 8.2.2, 8.3.9, or 8.4.11 for details).

REP-REQ Report type	Name	Type	Length	Value
bit #0 = 1	Channel number	1.1	1	Physical channel number (see 8.5.1) to be reported on
bit #0 = 1	Start frame	1.2	2	Frame number in which measurement for this channel started
bit #0 = 1	Duration	1.3	3	Cumulative measurement duration on the channel in multiples of T_s. For any value exceeding 0xFFFFFF, report 0xFFFFFF
bit #0 = 1	Basic report	1.4	1	Bit #0: WirelessHUMAN detected on the channel Bit #1: Unknown transmissions detected on the channel Bit #2: Primary User detected on the channel Bit #3: Unmeasured. Channel not measured
bit #1 = 1	CINR report	1.5	2	1 byte: mean (see also 8.2.2, 8.3.9, 8.4.11) for details) 1 byte: standard deviation
bit #2 = 1	RSSI report	1.6	2	1 byte: mean (see also 8.2.2, 8.3.9, 8.4.11) for details) 1 byte: standard deviation

12.2.3.2.3 WirelessHUMAN-specific PHY profile features

Change as shown below:

Mandatory features:

- — TDD operation
- — Center Frequency and symbol rate for uplink are not reported in UCD channel encoding
- — Channel Nr is reported in DCD channel encoding
- — UW length 16, 64 and 256 symbols
- — DFS capability (if mandated by regulation)
  - Detection of specific spectrum users as defined by regulatory requirements
  - Channel switching as defined by regulatory requirements

12.3.1.1 ProfM3_PMP: Basic Packet PMP MAC System Profile

Table 401—Optional feature requirements profM3_PMP

Change as shown below (part of table shown):

Optional Feature	Required?	Conditions/Notes
……..	……..	……..
DFS	Conditional	Required if mandated by regulation for license exempt usage. Not required when intended for licensed usage.
……..	……..	……..

12.3.1.2 ProfM3_Mesh: Basic Packet Mesh MAC System Profile

Table 402—Optional feature requirements profM3_mesh

Change as shown below (part of table shown):

Optional Feature	Required?	Conditions/Notes
……..	……..	……..

DFS	Conditional	Required if mandated by regulation for license exempt usage. Not required when intended for licensed usage.

12.3.2.6 profP3_10: WirelessHUMAN(-OFDM) PHY profile for 10 MHz channelization

Change the corrigendum 1 Draft 2 version as shown below:

Mandatory features:

— License-exempt band usage only
— Channel bandwidth BW = 10 MHz
— TDD operation
— BS shall select Frame duration from code set PMP:{2,4,6}, Mesh:{1}. SSs shall be capable of operating with any of the Frame Durations indicated in the code set.
— DFS capability (if mandated by regulation)
  — Ability to detect specific spectrum users as defined by regulatory requirements
  — Ability to switch channel as defined by regulatory requirements

12.4.3 WirelessMAN-OFDMA and WirelessHUMAN(-OFDMA) System PHY Profiles

12.4.2.1 Basic Packet PMP MAC Profile

Change as shown:

Profile identifier: OFDMA_ProfM1.

Mandatory Features:

— Support of Packet convergence sublayer.
— Support of Internet Protocol Ipv4.
— Support IEEE 802.3/Ethernet specific part.
— CRC functionality shall be supported for all connections.
— Support of dynamic services.
— Support of Best effort services.
— Support of Non-Real-Time Polling services.
— Support of CDMA based Initial and Periodic Ranging.
— Support of Contention based CDMA bandwidth requests.
— DFS shall be required for the license exempt bands if mandated by regulation.

12.4.3.1 Common Features of PHY Profiles

12.4.3.1.4 WirelessHUMAN PHY Profiles Features

Change the corrigendum 1 Draft 2 version as indicated:

Mandatory features:

— TDD Operation
— Where mandated by regulation, ability to detect specific spectrum users as defined by regulatory requirements
— Center Frequency for uplink is not reported in the UCD channel encoding.
— Channel Nr is reported in DCD channel encoding
— Ability to switch channel as defined by regulatory requirements

Annex A
Bibliography

(Informative)

Update reference B10:

[B10] (ECC/DEC/(04)08) *ECC Decision of 09 July 2004 on the harmonised use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs), 9th July 2004 revised November 2004,*
http://www.ero.dk/documentation/docs/doccategory.asp?catid=1&catname=ECC/ERC/ECTRA%20Decisions

Add new reference in the correct order (B11, with existing B11 and later references being renumbered):
[B11] Recommendation ITU-R M.1652, *Dynamic frequency selection (DFS) in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band, 2003,* http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1652

B.2 License-exempt co-existence and interference analyses.
Delete Annex B.2 in its entirety.

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