Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>
Title	Clarification on the credit token based co-existence protocol principle
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Re:	Recirculation of Working Group Review of Working Document 80216h-06_015r1
Abstract	This contribution provides clarification to comment #1104 (action item) of the session #44's Working Group Review [3]. This contribution proposes some preliminary text remedies on the credit token based protocol principle related to co-existence conflicts avoidance. The proposed text remedies are intended to be included in sections 15.4.2.5.3, 15.4.2.5.4 and 15.5.2 of the working document [1].
Purpose	Clarification to comment #1104 of the session #44's Working Group Review. Text remedies are proposed for sections 15.4.2.5.3, 15.4.2.5.4 and 15.5.2 of the working document [1].
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Clarification on the credit token based co-existence protocol principle

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Overview

This contribution provides clarification to comment #1104 (action item) of the session #44's Working Group Review [3]. This contribution proposes some preliminary text remedies on the credit token based protocol principle related to co-existence conflicts avoidance. The proposed text remedies are intended to be included in sections 15.4.2.5.3, 15.4.2.5.4 and 15.5.2 of the working document [1].

Introduction

During session #44's Working Group Review, comment #1104 has pointed the need to introduce additional material in the Working Document to clarify the principle of credit based co-existence protocol related to the conflicts/partitioning effects avoidance.

Text aims at clearing the following observations raised in [2]:

Case 1:3 Systems / 2 Operators

Relationship between systems:
S1, S2 and S3 are deployed in the relationship of Figure 1:
- S1 is neighbor to S2,
- S2 is neighbor to S3.
- S1 and S3 belongs to the operator A,
- S2 belongs to operator B.

Figure 1: Relationship between the 3 systems

Assumptions:
- The original type 1 frame structure is used,
- S1 wants to rent out an unused part of its master sub frame,
- S2 is candidate to rent in this unused part of S1's master sub frame,
- Negotiation between S1, S2 and + is made with the credit token based co-existence protocol.

- • S3 has a master sub frame operating at the same time as S1's master sub frame at two different geographical locations (no interference between S1 and S3).

Observations:
Figure 2 illustrates the possible co-existence conflict that can appear between master sub frames of the same operator if co-existence coordination is not appropriately considered before the negotiation phase of the renting process is launched. This conflict could be avoided by partitioning the different master sub frames, but this is not what we are looking for since purpose is to provide better spectrum efficiency in a fair fashion with the credit token based rental protocol.
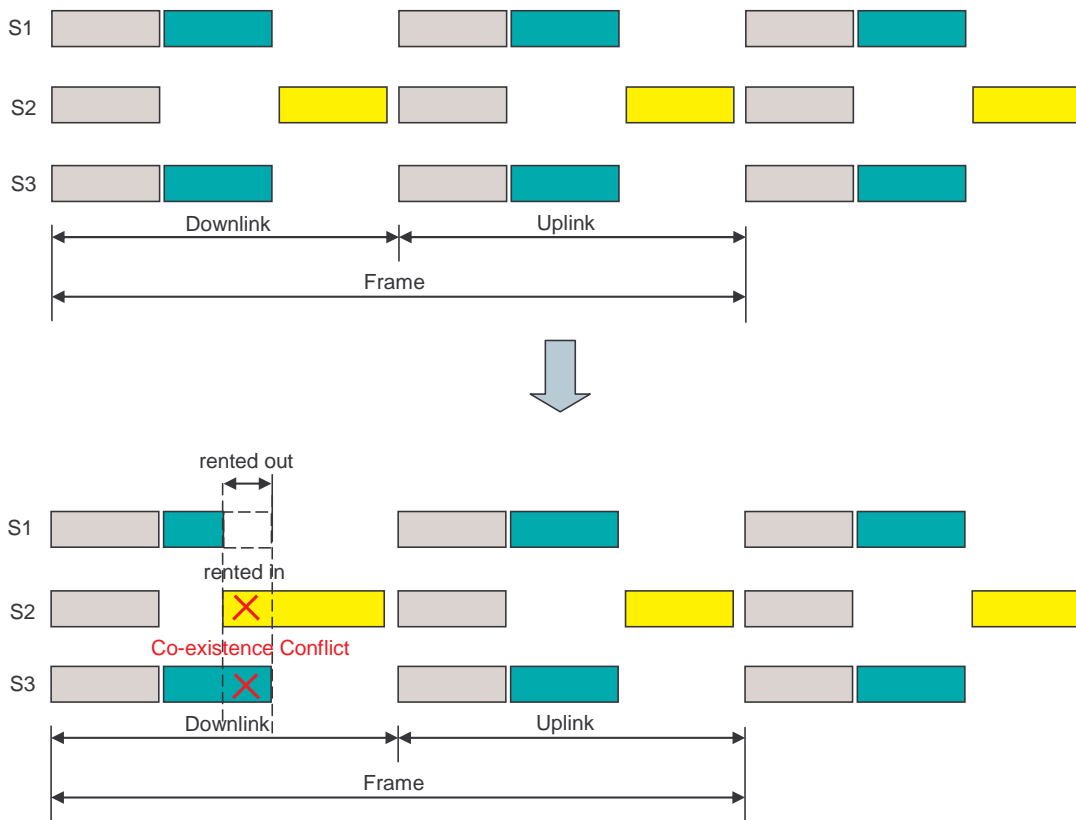

Figure 2: Co-existence conflict if master sub frame partitioning is not considered

Case 2: 3 Systems / 3 Operators

Relationship between systems:
S1, S2 and S3 are deployed in the relationship of Figure 3:
- S1 is neighbor to S2,
- S2 is neighbor to S3.
- S1 belongs to the operator A,
- S2 belongs to operator B.
- S3 belongs to operator C.

Figure 3: Relationship between the 3 systems

Assumptions: same as case 1.

Observations: Same as in case 1 but now co-existence conflicts occur between two different operators (Figure 4).
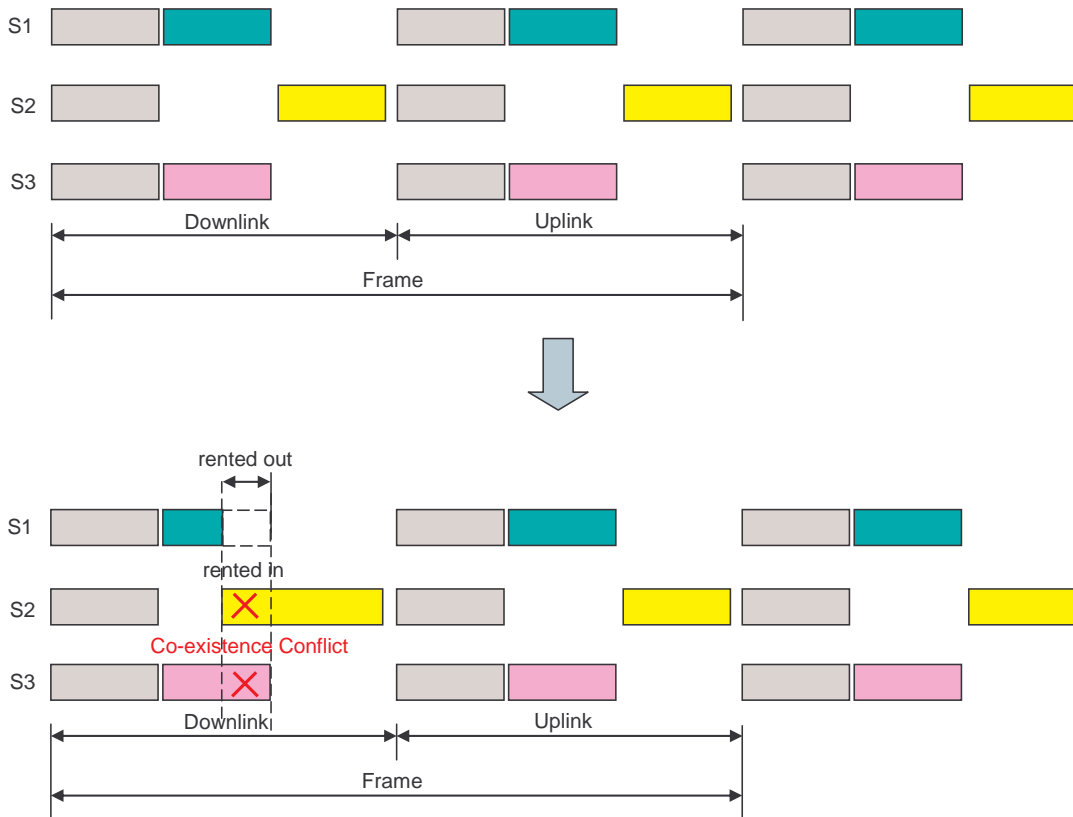

Figure 4: Co-existence conflict if master sub frame partitioning is not considered between operators

Case 3: Combination of cases 1 and 2 (4 Systems / 2 Operators)

Relationship between systems:
S1, S2 and S3 are deployed in the relationship of Figure 5:
- S1 is neighbor to S2,
- S2 is neighbor to S1, S3 and S4.
- S3 is neighbor to S2
- S4 is neighbor to S2
- S1 and S4 belongs to the operator A,
- S2 belongs to operator B.
- S3 belongs to operator C.

Figure 5: Relationship between the 3 systems

Assumptions:
- The original type 1 frame structure is used,
- S1 wants to rent out an unused part of its master sub frame,
- S2 is candidate to rent in this unused part of S1's master sub frame,
- Negotiation between S1, S2 and + is made with the credit token based co-existence protocol.
- S3 has a master sub frame operating at the same time as S1's master sub frame at two different geographical locations (no interference between S1 and S3).
- S4 has a master sub frame operating at the same time as S1's master sub frame at two different geographical locations (no interference between S1 and S4).

Observations:
Figure 6 illustrates the possible conflicts that can appear between the part of the S1's master sub frame to be rented out and the master sub frames operating at the same by the same operator and another operator. This can occur if co-existence coordination is not appropriately considered before the negotiation phase of the renting process is launched. This could be avoided by partitioning the different master sub frames, but this is not what we are looking for since purpose is to provide better spectrum efficiency in a fair fashion with the credit token based rental protocol.
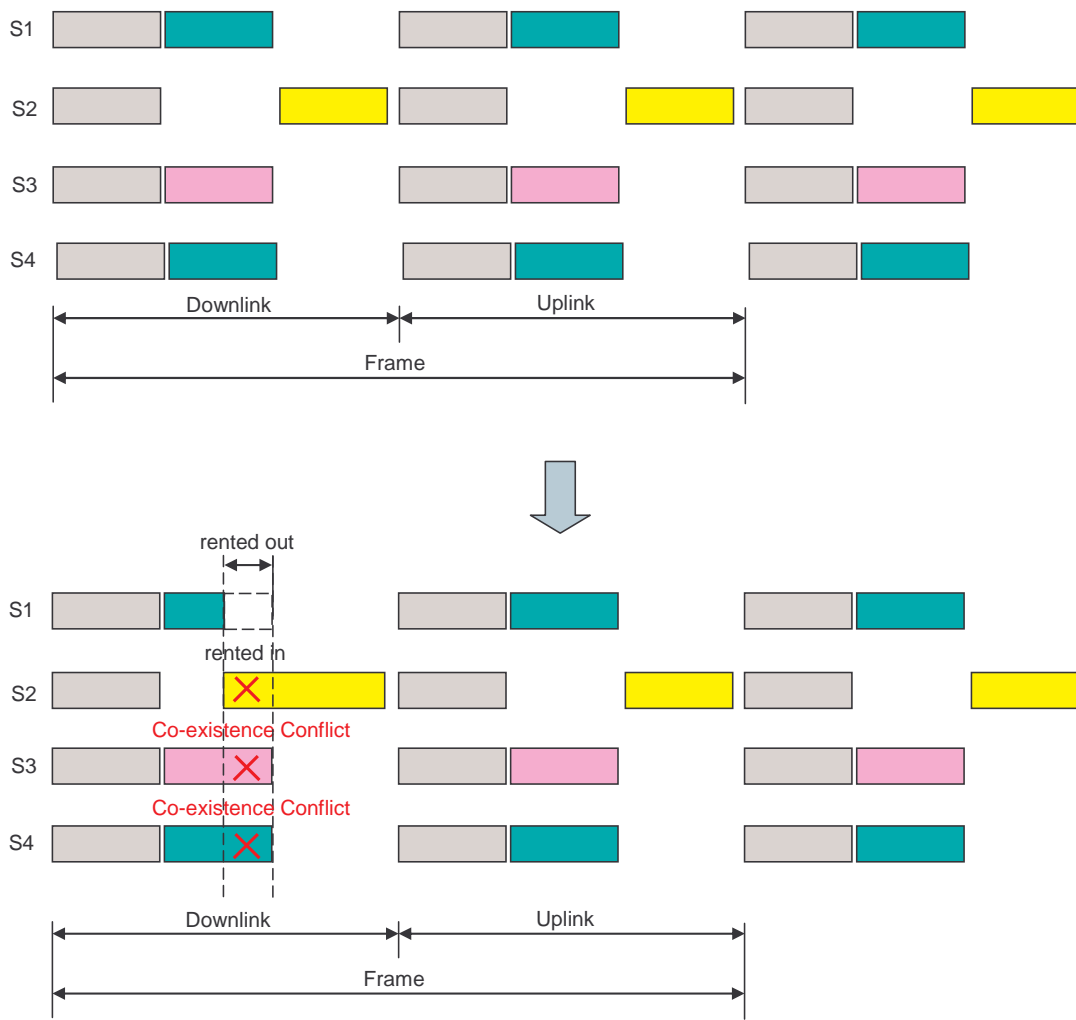
Figure 6: Co-existence conflict if master sub frame partitioning is not considered (jointly same and different operators)

Conclusion
The observations from cases 1, 2 and 3 have shown that renting without partitioning can be considered if co-existence conflicts situations do not occur between master sub frames operated by the same and different operators at the same time.

The next section proposes some preliminary text remedies to be included in the working document [1] so that these co-existence conflicts situations are identified before the credit token based rental protocol is applied. The identification of these co-existence conflicts situations can be done with the usage of the interference identification mechanisms described in sections 15.3 and 15.4.2.1.2 (radio signatures) of the Working Document [1].

Specific editorial changes

This section provides a list of changes to the draft document.

Blue text represents specific editorial additions.

~~Red strikethrough~~ text is to be deleted.

Black text is text already in the draft.

Bold italic text is editorial instructions to the editor.

Text proposal for section 15.4.2.5.3.2

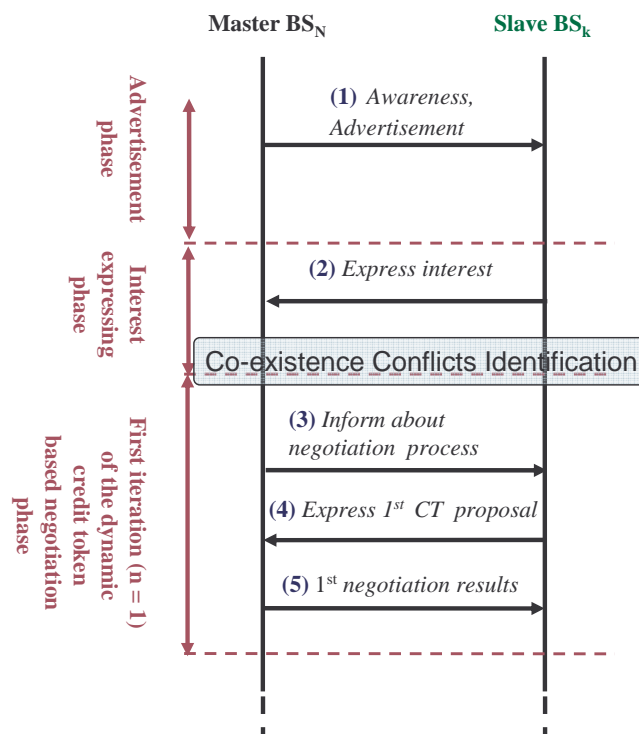*Remove the current Figure h45 of [1] and replace by the one below:*

Figure h45—Dynamic (iterative) credit tokens based scheduling cycle (sequences (1) to (5))

Text proposal for section 15.4.2.5.3.3

Add the text below in section 15.4.2.5.3.3 between the paragraphs "Advertisement/Awareness phase" and the "Interest Expressing Phase"

Co-existence Conflicts Identification phase
This phase aims at identifying the possible co-existence conflicts originated from the renting. This phase identifies the possible conflicts between the offeror (i.e. Master BS) renting out a part of its sub frame and the requestors who are interested to rent it in. Decision (based on co-existence criteria) on the feasibility of the renting follows the process described in section 15.4.2.5.4. If decision show that there are no co-existence conflicts originating from the renting, the next phases of the credit tokens based scheduling cycle of Figure h45

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and Figure h46 are executed. If decision shows that there are co-existence conflicts, the next phases of the cycle are not executed and the renting does not take place.

Text proposal for section 15.4.2.5.4

Insert the following text in a new section after section 15.4.2.5.3. This section number should be 15.4.2.5.4. However, note that the working document already contains the sections 15.4.2.5.4 and 15.4.2.5.5. With respect to this, renumber these existing sections with an increment 1 as follows: existing section 15.2.4.2.4 becomes 15.4.2.5.5, and existing section 15.2.4.2.6 becomes 15.4.2.5.6.

Figure 7 shows the process used to identify the possible co-existence conflicts that could appear if the renting between a master BS and a (or several) slave BSs occur. This process is done prior the renting is actually made. If the co-existence conflicts can be resolved, sequences from (3) to (10) of the scheduling cycle (Figure h45 and Figure h46) are executed. Otherwise, the cycle is stopped and the renting will not occur.

Figure 7 takes into account of the co-existence conflicts between the master sub frames operated by a same operator, or by different operators.

After the master BS has advertised about a period (part of its master sub frame) to rent out, and after some slave BSs have expressed their interest to rent in this period, the identification of the interference in the proposed renting period starts. Each of these slave systems follows the interference detection process described in the flowchart. Based on the interference detection and identification mechanisms of sections 15.3 and 15.4.2.1.2 (radio signatures), each slave system is able to know if it is interfering some other master sub frames (not the one under renting). With respect to this, it can know if there are some co-existence conflicts. In case the conflict is with a master sub frame operated by the same operator, this operator can check if the interfered master sub frame can have the same time duration and starting time as the one proposed for renting. In that case, co-existence conflicts disappear. In case the conflict is with a (or several) master sub frames operated by a (or several operators), it is checked if the interference level in these master sub frames is acceptable. If not, co-existence conflicts cannot be resolved, and the renting process is stopped. In case this level is also acceptable for these other operators, the process goes on. The next step consists in checking if the slave system can support any interference originated from these master sub frames. If the slave system can support this interference, co-existence conflicts can be handled, and next steps of the credit token based scheduling cycle can be pursued.
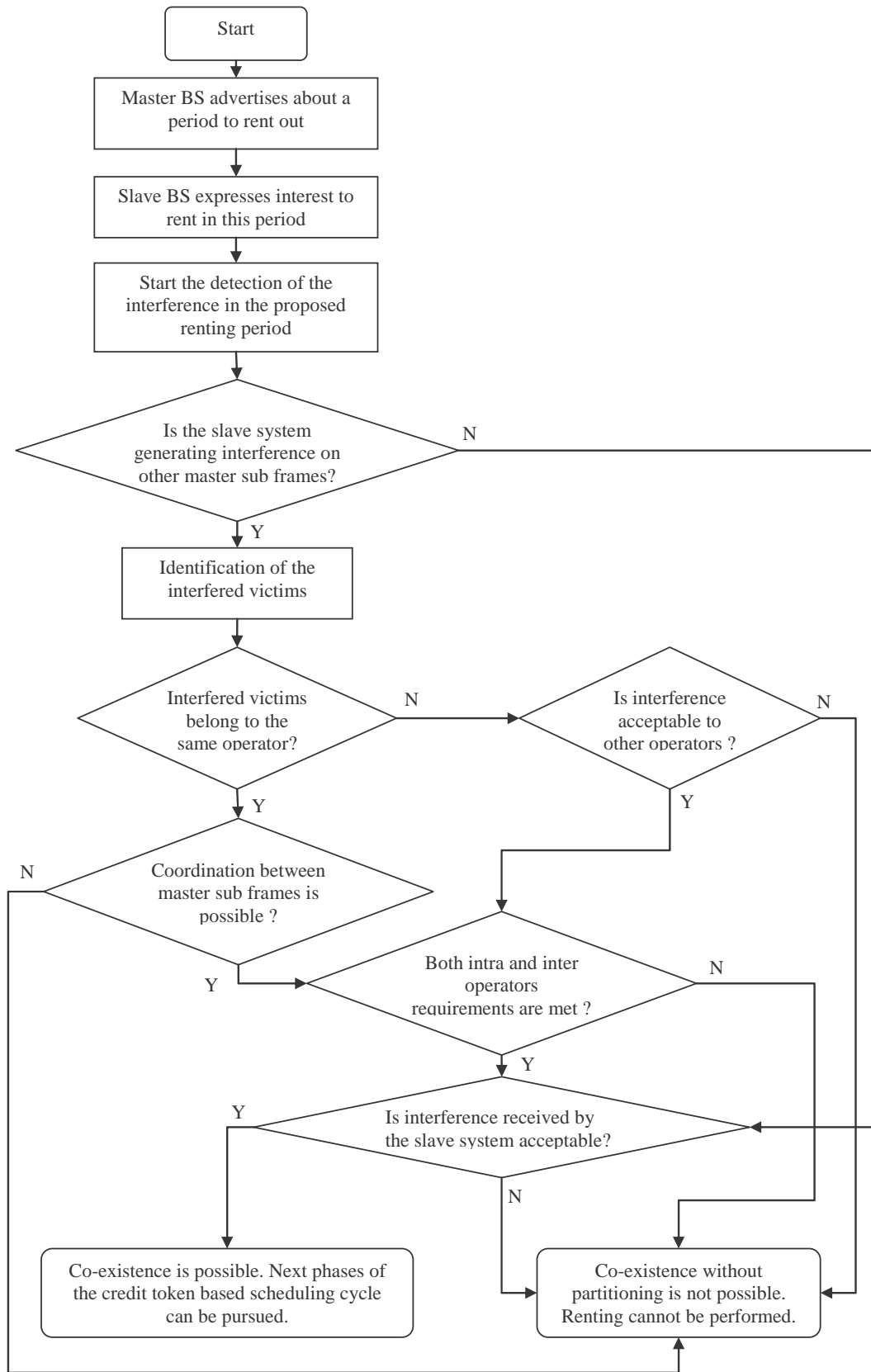
Figure 7: Process of co-existence conflicts identification

Text proposal for section 15.5.2

Add the text below in section 15.5.2

Attributes

Add the following new rows in the existing Table h10, page 102 in [1]

Table h10 – CP Message codes

Code	CP Message Name	CP Mesage Type	Protocol type	Direction
45	Co-existence Conflict Identification Request	CP-REQ	TCP	BS -> BS
46	Co-existence Conflict Identification Reply	CP-RSP	TCP	BS -> BS
47	Intra Operator Co-existence Coordination Request	CP-REQ	TCP	BS -> BS
48	Intra Operator Co-existence Coordination Reply	CP-RSP	TCP	BS -> BS
49	Inter Operator Co-existence Coordination Request	CP-REQ	TCP	BS -> BS
50	Inter Operator Co-existence Coordination Reply	CP-RSP	TCP	BS -> BS
51	Final Co-existence Decision Request	CP-REQ	TCP	BS -> BS
52	Final Co-existence Decision Reply	CP-RSP	TCP	BS -> BS
53-255	reserved	CP-REQ	TCP	BS -> BS

Add the following new rows in the existing Table h11, page 103 in [1]

Table h11 – TLV types for CP payload

Type	Parameter Description	Length (byte)	Comment
50	Operator ID Interfered	16	ASCII stream, max. 40 bytes long
	BSID Interfered	8	
	Intra Operator Co-existence Coordination Status	8	1 - Acceptance 2 - Rejection
	Inter Operator Co-existence Coordination Status	8	1 - Acceptance 2 - Rejection
	Co-existence Decision Status	8	1 - Acceptance 2 - Rejection

15.5.2.45 Co-existence Conflict Identification Request message
Add this new section after section 15.5.2.44 in [1]

The master BS requests to each slave BS that expressed their interest for renting to detect and identify the systems this slave system could interfere during the renting period in its neighbourhood.

Code: 45

Attributes are shown in Table h45.

Table h45 – Co-existence Conflict Identification Request message attributes

BSID	BSID of the master BS
Operator ID	Operator ID of the master system
Latitude	Latitude information of the master BS
Longitude	Longitude information of the master BS

15.5.2.46 Co-existence Conflict Identification Reply message

The slave BS responds to the master BS's Co-existence Identification Request message with a Co-existence Conflict Identification Reply message

Code: 46

Attributes are shown in Table h46.

Table h46 – Co-existence Conflict Identification Reply message attributes

BSID	BSID of the requested slave BS
Operator ID	Operator ID of the requested slave BS
Operator ID Interfered	Operator ID of each identified master system which could interfere during the master sub frame operating in parallel of the rented master sub frame
BSID Interfered	BSID of each identified master BS which could interfere during the master sub frame operating in parallel of the rented master sub frame
Contact IP address	IP address of each identified master BS (or co-existence proxy) which could interfere during the master sub frame operating in parallel of the rented master sub frame

15.5.2.47 Intra Operator Co-existence Coordination Request message

The master BS requests to each identified master BS (which could interfere during the master sub frame operating in parallel of the rented master sub frame – these identified master BSs belong to the same operator as the one renting out) to coordinate with itself to clarify if the interfered master sub frame can have the same time duration and starting time as the one proposed for renting.

Code: 47

Attributes are shown in Table h47.

Table h47 – Intra Operator Co-existence Coordination Request message attributes

BSID	BSID of the master BS
Operator ID	Operator ID of the master system
Contact IP address	IP address of the master BS

15.5.2.48 Intra Operator Co-existence Coordination Reply message

Each requested master BS responds to the master BS's Intra Operator Co-existence Coordination Request message with a Intra Operator Co-existence Coordination Reply message. Either, there is a possibility of co-existence coordination (acceptance) or there is none (rejection).

Code: 48

Attributes are shown in Table h48.

Table h48 – Intra Operator Co-existence Coordination Reply message attributes

BSID	BSID of the requested master BS
Operator ID	Operator ID of the requested master system
Contact IP address	IP address of the required master BS
Intra Operator Co-existence Coordination Status	1 - Acceptance 2 - Rejection

15.5.2.49 Inter Operator Co-existence Coordination Request message

The slave BS requests to each identified master BS (which could interfere during the master sub frame operating in parallel of the rented master sub frame – these identified master BSs do not belong to the same operator as the offering master BS) to check if the interference level in the master sub frame of this other operator is acceptable.

Code: 49

Attributes are shown in Table h49.

Table h49 – Inter Operator Co-existence Coordination Request message attributes

BSID	BSID of the master BS
Operator ID	Operator ID of the master BS
Contact IP address	IP address of the master BS

15.5.2.50 Inter Operator Co-existence Coordination Reply message

Each requested master BS responds to the master BS's Inter Operator Co-existence Coordination Request message with an Inter Operator Co-existence Coordination Reply message. (1) Either the system accepts the interference level (acceptance) or (2) rejects it (rejection).

Code: 50

Attributes are shown in Table h50.

Table h50 – Inter Operator Co-existence Coordination Reply message attributes

BSID	BSID of the requested master BS
Operator ID	Operator ID of the requested master system
Contact IP address	IP address of the required master BS
Inter Operator Co-existence Coordination Status	1 - Acceptance
	2 - Rejection

15.5.2.51 Final Co-existence Decision Request message

The master BS offering the resource requests to the slave BS if the co-existence for renting is feasible.

Code: 51

Attributes are shown in Table h51.

Table h51 –Final Co-existence Decision Request message attributes

BSID	BSID of the master BS
Operator ID	Operator ID of the master system
Contact IP address	IP address of the master BS
BSID	BSID of the master BS

15.5.2.52 Final Co-existence Decision Reply message

Each requested slave BS responds to the master BS's Final Co-existence Decision Request message with a Co-Final Co-existence Decision Reply message: (1) Either the overall co-existence conflict can be resolved and in this case the renting process can be pursued (acceptance), or (2) the co-existence conflict cannot be resolved and this case the renting process cannot be pursued (rejection).

Code: 52

Attributes are shown in Table h52.

Table h52 – Final Co-existence Decision Reply message attributes

BSID	BSID of the requested master BS
Operator ID	Operator ID of the requested master system
Contact IP address	IP address of the required master BS
Co-existence Decision Status	1 - Acceptance 2 - Rejection

References

[1] IEEE 802.16h-06/015r1: Part 16: Air Interface for Fixed Broadband Wireless Access Systems Amendment for Improved Coexistence Mechanisms for License-Exempt Operation, Working document; 2006-08-01
[2] IEEE C80216h-06/056: Some consideration on the credit token principle.
[3] 80216h-06_020r1: Working Group Review Commentary file from session #44.