Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [LB comment resolution related to 5.5.3.1]
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Re: [Response to LB comment of TG7]

Abstract: [This document describes LB comment resolution related to 5.5.3.1.]

Purpose: [To resolve LB comments related to 5.5.3.1]

LB comment resolution related to 5.5.3.1

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CIDs related to 5.5.3.1

- 7 CIDs : 85, 86, 91, 95a, 95c, 76, 95

Old text in 5.5.3.1 of D1

- The flicker means the periodic or non-periodic brightness fluctuation human eye can perceive. **It can be injurious to human eye and human health.** Therefore, the standard supports flicker compensation. Infrastructure devices and coordinators shall be compliant to all applicable regulations in regards to flicker compensation.

- The flicker in VLC is classified into two categories, intra-frame flicker and inter-frame flicker, according to its generation mechanism. Intra-frame flicker means the flicker appears from the brightness discrepancies between the bit patterns of "1"s and "0"s inside data frame, and inter-frame flicker indicates the flicker appears from the average brightness discrepancy between the packet frame transmission time and the idle time which means non-transmission time. **The possibility which the flicker appears is higher in low data rates than in high data rates.** The details on the flicker compensation technologies are described in 5.5.4 and 6.9.6.

New text 5.5.3.1 merged with 5.5.4 (See 10/463/r1 and 10/485/r0)

- **Flicker is defined as unexpected and unpredictable brightness fluctuations that are perceptible by the human eye and can be injurious to human health; therefore, this standard supports flicker compensation. All devices shall be compliant to all applicable regulations in regards to flicker.**

- **The maximum flickering time period (MFTP) is defined as the maximum time period over which the light intensity can be changing but the resulting flicker is not perceivable by the human eye [B37]. To avoid flickering in VLC, the brightness of each MFTP needs to be all equal.**

- **The flicker in VLC is classified into two categories according to its generation mechanism: intra-frame flicker and inter-frame flicker. Intra-frame flicker is defined as bit pattern dependent brightness discrepancies within the data frame. Inter-frame flicker is defined as the average brightness discrepancy between the packet frame transmissions and the idle time between data transmissions.**

Assumption for the Comment Resolution related to 5.5.3.1

- The new text for 5.5.3.1 merged with 5.5.4 was already given, and the resolution committee did not fully accept the new text.

- I cannot choose but resolve these comments associated with 5.5.3.1 even though the resolution committee does not fully accept it.

- So, I need the assumption that the new text for 5.5.3.1 is valid for these comment resolutions in somewhat range because we need some baseline material to decide whether we accept the suggested remedy or not.

CID 85

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
85	Shusaku Shimada	5.5	5.5.3.1	9	33	Entire clauses of Flicker related parts should be based on adequate criteria of allowed flicker level and frequency based on commonly used standards or regulations, so that numerical limits or recommended value and tolerance should be shown and evaluated with VLC implementations.	Set the allowed values, and/or limits of flicker level and frequency.

• Recommendation/Instruction to editor

- CID 85 will be resolved if the resolution committee approve the final version text for 5.5.3.1 after Joachim modify the new text shown in slide #5 and complete the final version text for 5.5.3.1.

CID 86

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
86	Sridhar Rajagopal	5.5.3.1		9		flicker is related to clock rate and not data rate	change data rate to clock rate

- Intra-frame flicker can be related to clock rate, but inter-frame flicker is not related to clock rate.

- The sentence mentioned at CID 86 is no longer in the new text shown in slide #5.

- **Recommendation/Instruction to editor**
  - CID 86 : Reject

CID 91

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
91	R. Roberts	5.5.3.1		9		Strike sentence at line 17	"Remove the following sentence …""The possibility which the flicker appears is higher in low dat rates than in high data rates.""While this statement is technically true, the fact is that the regulations governing flicker are data rate independent."

- We'd better delete this sentence if we cannot say about the exact data rate value which the flicker occur.
- The sentence mentioned at CID 91 is no longer in the new text shown in slide #5.

- **Recommendation/Instruction to editor**
  - CID 91 : Accept

CID 95a

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
95a	Ed Callaway	5	5.3.1	9	17	"The possibility which the flicker appears is higher in low data rates than in high data rates." Eh? What does this mean?	Possibly "Flicker is more likely at low data rates than at high data rates." . . . ?

- This comment is the same as CID 91 on slide #9.
- This sentence is no longer in the new text shown in slide #5.

- **Recommendation/Instruction to editor**
  - However, we cannot see the suggested remedy exactly.
  - CID 91 : Accept

CID 95c

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
95c	James Gilb	5	5.5.3.1	9	18	Flicker compensation is also defined in this subclause (i.e., in 5.5.3.1.1 and 5.5.3.1.2). Chances are most of this should be deleted in favor of a high level description with a cross reference to 6.9.6.	Move the text from 5.5.4 into this subclause. Remove subclause headers for 5.5.3.1.1 and 5.5.3.1.2. Reduce the text in the subclauses to provide only an overview with no technical information and end subclause 5.5.3.1 with "Detailed description of flicker compenstation is defined in 6.9.6."

CID 95c (cont.)

- **Recommendation/Instruction to editor**
  1. Accept : Move the text from 5.5.4 into this subclause.
  2. Reject : Remove subclause headers for 5.5.3.1.1 and 5.5.3.1.2
  3. Accept : Reduce the text in the subclauses to provide only an overview with no technical information.
  4. Reject : End subclause 5.5.3.1 with "Detailed description of flicker compensation is defined in 6.9.6."
     → Because 6.9.6 mainly describes the light dimming in regards to PHY specifications.

CID 76

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
76	Soo-Young Chang	5	5.5.3.1	9	7	It is not clear what shape of spectrum in the modulation domain VPM for intra-frame flicker compensation has and whether this spectrum covers only one side of the spectrum of Figure 5.	Need to verify this spectrum so as to show that the CCA concept can be applied and to figure out how this concept can be applied to VPM.

- Flicker compensation or mitigation is not directly associated with the shape of spectrum in the modulation domain.

- 5.5.3.1 does not mention VPPM.

- **Recommendation/Instruction to editor**
  - CID 76 : Reject

CID 95

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
95	Ed Callaway	5	5.3	9		The grammar of subclauses 5.5.3 and 5.5.4 is, frankly, terrible, and largely unreadable. I'd submit individual comments, but as there would be an average of more than one comment per line, it would be slow going, and not very productive, since the language is so fractured it's often not clear what the writer's intent is in the first place.	Have someone edit these subclauses. Don't forget to correct "within on layer" on line 4; the placement of particles throughout 5.5.3.1; "can be accomplished by three technologies" on line 23 (only three technologies, or are these three of many possible that are mentioned in this standard?); the use of "4B6B" without definition on line 24; "is resulted in" on line 35; etc., etc., etc.

CID 95 (cont.)

- **Let's see together. So difficult because it covers all of 5.5.3 and 5.5.4, not only 5.5.3.1.**

- **Recommendation/Instruction to editor**

  1. Accept : Have someone edit these subclauses.

  2. Accept : Correct "within on layer" on line 4.

  3. I can't catch the commentator's point : Correct the placement of particles throughout 5.5.3.1.→ Need some help.

  4. Accept : Correct "can be accomplished by three technologies" on line 23 (only three technologies, or are these three of many possible that are mentioned in this standard?)

CID 95 (cont.)

- **Recommendation/Instruction to editor**

    5. Do we need the definition ? : Correct the use of "4B6B" without definition on line 24. → Need some help.

    6. Accept : Correct "is resulted in" on line 35;

    7. Accept : etc., etc., etc.

CID 95 (cont.)

5.5.3 Cross Layer Consideration   < D1 >

Cross layer issues require cooperation between the MAC and PHY to achieve some required specification; that is, the solution does not lie entirely within on layer. The two relevant issues in this specification are the flicker compensation and the dimming function.

→ The text in 5.5.3, not including its subclauses, has been deleted in the baseline text (DCN= 10/485/r0).

5.5.3.1.1 Intra-frame Flicker Compensation   < D1 >

The intra-frame flicker compensation can be accomplished by three technologies, which are the use of Manchester or 4B6B run length limiting code or VPM(Variable Pulse Position Modulation) modulation, in this

5.5.3.1.1 Intra-frame flicker compensation   < Baseline Doc : 10/485/ro >

Intra-frame flicker compensation is accomplished by the use of one of the following mechanisms: Manchester encoding as specified in 6.6.4.2, 4B6B encoding as specified in 6.6.4.1, 8B10B encoding as specified in 6.7.3.2 or VPPM as specified in 6.9.6 and Annex F".

CID 95 (cont.)

5.5.3.1.2 Inter-frame Flicker Compensation < D1 >

The discrepancy of the average brightness between the data transmission time and the idle time is resulted in the inter-frame flicker because the VLC light source may be always "ON" or "OFF" state on the idle time in which no data is transmitted. Therefore, to compensate the inter-frame flicker, the idle pattern whose aver-

→ The text in 5.5.3.1.2 of D1, has been deleted in the baseline text (DCN= 10/485/r0).

5.5.3.1.2 Inter-frame flicker compensation   < Baseline Doc : 10/485/ro >

The compensation method used for inter-frame flicker is the transmission of an idle pattern between data frames whose average brightness is equal to that of the data frames. The idle pattern is not specified and it is allowable to use an idle pattern symbol rate other than that used for data transmissions to avoid in-band modulation domain interference.