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

Submission Title: [LB comment resolution related to 5.5.4]
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Re: [Response to LB comment of TG7]

Abstract: [This document describes LB comment resolution related 5.5.4.]

Purpose: [To resolve LB comments related to 5.5.4]

LB comment resolution related to 5.5.4

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D1 Draft (5.5.3 and 5.5.4)

5.5.3 Cross Layer Consideration

5.5.3.1 Flicker Compensation

5.5.3.1.1 Intra-frame Flicker Compensation

5.5.3.1.2 Inter-frame Flicker Compensation

5.5.3.2 Light Dimming

5.5.3.2.1 VPM Dimming

5.5.3.2.2 Idle Pattern and Adjustment Time Dimming

5.5.3.2.3 Analog Dimming

5.5.3.3 Idle Pattern

5.5.3.4 Idle Pattern

5.5.4 Flicker Mitigation (Informative)

Current D2 Draft (5.5.3 and 5.5.4)

5.5.3 Flicker compensation and dimming

5.5.3.1 Flicker Compensation

5.5.3.1.1 Intra-frame Flicker Compensation

5.5.3.1.2 Inter-frame Flicker Compensation

5.5.3.2 Light Dimming

5.5.3.2.1 VPM Dimming

5.5.3.2.2 Idle Pattern and Adjustment Time Dimming

5.5.3.2.3 Amplitude Dimming

5.5.3.3 Idle Pattern

~~5.5.3.4 Idle Pattern~~

5.5.4 Flicker Mitigation (Informative)

Suggested (according to 10/351/r0)

5.5.3 Flicker Mitigation and Dimming

5.5.3.1 Flicker Mitigation (remedy: see DCN 496/r1 and DCN 497/r2)

5.5.3.1.1 Intra-frame Flicker Mitigation

5.5.3.1.2 Inter-frame Flicker Mitigation

5.5.3.2 Light Dimming

5.5.3.2.1 xxx Dimming (in document 10/0159/r)

5.5.3.2.2 VPPM Dimming

5.5.3.2.3 Idle Pattern and Adjustment Time Dimming

5.5.3.2.4 xxx (or Visibility Pattern) Dimming

5.5.3.2.5 Amplitude Dimming

~~5.5.3.3 Idle Pattern~~ (remedy: see DCN 485/r2)

~~5.5.3.4 Idle Pattern~~ (remedy: see DCN 485/r2)

5.5.4 Flicker Mitigation (Informative) (remedy: see DCN 496/r1)

Merge it with 5.5.3.1, and then delete.

Main Issue related to 5.5.4

- The technical editor has rewritten the subclause 5.5.3.1 and the clause 5.5.4 to implement the editorial comments.
- The text in 5.5.3.1 is still similar to 5.5.4 as you know from their titles.
- We conditionally agreed to delete 5.5.4 on Beijing F2F meeting. → See the doc.10/351/r0.
- However, as the results of analysis on the comments, we'd better merge 5.5.3.1 with 5.5.4 than delete all of 5.5.4. → See the doc. 10/485/r2

5.5.3.1 Flicker compensation in the current D2

- Flicker is defined as 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 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. The details on the flicker compensation technologies are described in 5.5.4 and 6.9.6.

5.5.4 Flicker Mitigation (Informative) in the current D2

- Illumination flicker can be harmful to human health and is defined as unexpected and unpredictable light intensity change. Flickering can be caused by low rate repetition of the light source turning on and off or a slow change of brightness over a time period. ~~There is a flickering in VLC lower data rate than 200 bps.~~
- 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 preceivable by the human eye [B37]. To avoid flickering in VLC, the brightness of each MFTP needs to be all equal.
- A solution for flicker removal during ampltidue modulated data transmission maintaining a constant ratio of positive and negative levels per MFTP. This can be done with the use of run length limiting codes as specified in 6.6.4. , ~~2 PPM, and 4PPM. Manchester code has 50% duty cycle always. 2 PPM is 50% and 4 PPM is 25%. If we use this RLL code or modulation scheme for data stream and at idle time we use same waveform, flickering will not occur. But if we use NRZ OOK, we need another solution. Second solution is we make a ratio of 1 and 0 per MFTP to be constant at data stream.~~
- To prevent the LED from appearing “dimmer” during the packet frame transmission time, an idle pattern is sent between frames that has the same duty cycle as the modulated frame. The pulse repetition rate can be set lower so as not to cause in-band modulation domain interference with any VLC data modulations.

Our Recommendations

1. CIDs 113a and 136 tell us that merge the text in 5.5.4 with 5.5.3.1.
2. The first paragraphs of 5.5.3.1 and 5.5.4 are so similar. We'd better merge the first paragraphs of 5.5.3.1 and 5.5.4 and rewrite.
3. Add the second paragraph of 5.5.4 to 5.5.3.1 because 5.5.3.1 in the current D2 does not have the text associated with MFTP.
4. Delete the third and forth paragraphs of 5.5.4 because they are also described in 5.5.3.1.1, 5.5.3.1.2, and 5.5.3.2.3.

Merged text 5.5.3.1 with 5.5.4 (See 10/485/r0)

- **5.5.3.1 Flicker compensation**

- **Flicker is defined as the fluctuation of the brightness of light that can cause noticeable physiological changes in humans. In some cases flicker can be detrimental to human health; therefore, this standard strives for the mitigation of 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 during each MFTP needs to be 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. ~~The details on the flicker compensation technologies are described in 5.5.4 and 6.9.6.~~"**

The latest text 5.5.3.1 merged with 5.5.4 (See 10/485/r2)

- **5.5.3.1 Flicker ~~compensation~~ mitigation**
- **~~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.~~**
- **Flicker is defined as the fluctuation of the brightness of light that can cause noticeable physiological changes in humans. This standard strives for the mitigation of 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 during each MFTP needs to be 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. ~~The details on the flicker compensation technologies are described in 5.5.4 and 6.9.6.~~"**

CID 113a

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
113 a	Larry Taylor	5	5.5.4	10	36	The section 5.5.3 & 5.5.4 seem to be duplication except for the last part of the last sentence of 5.5.3	Remove one of these sections

- **Recommendation/Instruction to editor**
  - CID 113a : Accept in principle
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 136

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
136	R. Roberts	5.5.4		11		Merge the text in this section with section 5.5.3.1	Merge the text in this section with 5.5.3.1

- **Recommendation/Instruction to editor**
  - CID 136 : Accept
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 78

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
78	David Cypher	5	5.5.3.1	9	18	It states that details are described in 5.5.4, but it is marked as informative. Therefore 5.5.4 is not informative, but normative, No?	Remove "(Informative)" from 5.5.4. Body of standard is always normative.

- **Recommendation/Instruction to editor**
  - CID 78 : Accept in principle
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 117

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
117	David Cypher	5	5.5.4	11	5	2009 IEEE Standards Style Manual 10.1 is not being followed.	Remove "(Informative)". Body of standard is always normative.

- **Recommendation/Instruction to editor**
  - CID 117 : Accept in principle
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 120

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
120	David Cypher	5	5.5.4	11	21	2009 IEEE Standards Style Manual 13.5	Rewrite to remove every use of "we" Also in lines 23, 24, and 25

- **Recommendation/Instruction to editor**
  - CID 120 : Accept in principle
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 124

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
124	Sridhar Rajagopal	5.5.4		11		(informative) comment	why is there explicit mention of informative? Is everything in the spec normative? Can't the reader find out by reading which parts are normative. Can we move purely informative parts to a separate area?

- **Recommendation/Instruction to editor**
  - CID 124 : No suggested remedy.
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 125

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
125	James Gilb	5	5.5.4	11	6	A subclause cannot be declared to be informative. All Clauses and subclauses are normative in the standard. If informative information is required, it shall be in an informative annex.	Delete "(informative)" from the subclause title.

- **Recommendation/Instruction to editor**
  - CID 125 : Accept in principle
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 126

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
126	James Gilb	5	5.5.4	11	7	The WG needs to review the admonitions in the 2009 IEEE Style Guide with respect to safe and safety. It is not the job of the standard to state that something is or is not harmful, or conversely, that something is or is not safe. This is a legal issue. Plus flickering is not harmful, only certain frequencies for certain durations is harmful, so the sentence is incorrect.	Delete the sentence "Flickering of ... for human eyes."

- **Recommendation/Instruction to editor**
  - CID 126 : Accept in principle.
  - Automatically resolved as per 10/485/r2
  - See slide #11.

CID 134

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
134	R. Roberts	5.5.4			11	Delete reference to 200 bps	The generation of flicker is not necessarily directly tied to the data rate. In the case where the optical rate is quite high but coding is used to reduce the data rate, then it is possible to not generate flicker.

- **Recommendation/Instruction to editor**
  - The suggested remedy is correct.
  - CID 134 : Accept
  - If we accept the doc. 10/485/r2, then CID 134 will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

CID 115

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
115	Soo-Young Chang	5	5.5.4	11	9	1. Need to verify the number 200 bps which causes flickering. 2. Need to modify "data rate" which is said to affect flickering.	1. Need to put a reference for this number. 2. Need to modify "lower data rate than 200 bps" to "state changes lower than 200 changes per second".

- **Recommendation/Instruction to editor**
  - CID 115 : If we accept the doc. 10/485/r2, then it will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

CID 135

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
135	R. Roberts	5.5.4		11	23	Delete reference to 2PPM, 4 PPM and NRZ OOK	2PPM, 4PPM and NRZ OOK are not in the standard.

- **Recommendation/Instruction to editor**
  - 2-PPM, 4-PPM and NRZ-OOK is not associated with this standard.
  - CID 135 : Accept
  - If we accept the doc. 10/485/r2, then CID 135 will be automatically resolved because this sentence is not in the latest text.
  - See slide #11.

CID 129

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
129	James Gilb	5	5.5.4	11	23	Manchester, 2 PPM and 4 PPM are not RLLs, they are modulation techniques."	Change "If we use this RLL code or modulation scheme for data stream" to be "Using one of these modulation schemes for the data stream"

- **Recommendation/Instruction to editor**
  - CID 129 : If we accept the doc. 10/485/r2, then CID 129 will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

CID 116

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
116	Soo-Young Chang	5	5.5.4	11	24	Need to explain the last sentence, "But if we ….." more in detail. It is not easy to figure out how this sentence is relevant to the standard if NRZ OOK is not adopted.	Need to put more words for detailed explanation to clarify the meaning and relevance to the standard with the modulation scheme and solution mentioned.

- **Recommendation/Instruction to editor**
  - NRZ-OOK is not associated with this standard.
  - CID 116 : If we accept the doc. 10/485/r2, then CID 116 will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

CID 130

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
130	James Gilb	5	5.5.4	11	24	Comparing to NRZ is not necessary, it is enough to say that Manchester and the PPMs have the same average amplitude regardless of the bit pattern.	Delete "But if we use NRZ OOK ... another solution."

- **Recommendation/Instruction to editor**
  - NRZ-OOK is not associated with this standard.
  - CID 130 : Accept
  - If we accept the doc. 10/485/r2, then CID 130 will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

CID 127

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
127	James Gilb	5	5.5.4	11	9	The three sentences do not make sense.	Replace with "The human eye is sensitive to VLC data rates of less than 200 bps. In addition, some data patterns with long sequences of ones or zeros will create flickering visible to the human eye.

- **Recommendation/Instruction to editor**
  - The three sentences : Human eye can recognize the light status of on or off from light source. Some data pattern like long sequence of 1 or 0 produce off time and on time repeatedly. 0000 0001 0101 0111 1111 1110 1010 1000 0000
  - CID 127 : If we accept the doc. 10/485/r2, then CID 127 will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

CID 114

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
114	Soo-Young Chang	5	5.5.4	11	7	Need to specify modulation schemes that cause flickering.	Need to put detailed information on modulation schemes.

- **Recommendation/Instruction to editor**
  - The definition of flicker and its generation mechanism in VLC are shown in 5.5.3.1 and its subclauses.
  - This section is introductory text.
  - CID 114 : Reject

CID 128

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
128	James Gilb	5	5.5.4	11	13	The sequence of ones and zeros is irrelevant to the discussion. What is relevant is the spectral content of the sequence, which depends on the data rate. As presented, the string of ones and zeros provides no useful information.	Delete the string of ones and zeros.

- **Recommendation/Instruction to editor**
  - The sentence on line 13, page 11, is “0000 0001 0101 0111 1111 1110 1010 1000 0000”.
  - CID 128 : Accept
  - If we accept the doc. 10/485/r2, then CID 128 will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

CID 131

CID	Name	Clause	Subclause	Page	Line	Comment	SuggestedRemedy
131	James Gilb	5	5.5.4	11	29	Where is the pulse repetition rate defined for idle periods?	Add a cross reference for the pulse repetition rate, i.e., "as defined in x.y.z"

- **Recommendation/Instruction to editor**
  - The sentence on line 29, page 11, is “an idle pattern is sent between frames that has the same duty cycle as the modulated frame but the pulse repetition rate is set lower so as not to cause “in band” modulation domain interference with any VLC modulation.”.
  - CID 131 : If we accept the doc. 10/485/r2, then CID 131 will be automatically resolved because this sentence is not longer in the latest text.
  - See slide #11.

Summary

- 18 CIDs related to 5.5.4 have been resolved.
- 18 CIDs : 78, 113a, 115, 116, 117, 120, 124
  125, 126, 127, 134, 135, 136, 114
  128, 129, 130, 131