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Submission Title: [Implementation and demonstration of 4B6B line code for non-flicker in VLC]

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Abstract: [This document describes an implementation result showing that non-flicker can be obtained by 4B6B line code in VLC.]

Purpose: [To verify the non-flicker effects of 4B6B line code in VLC]

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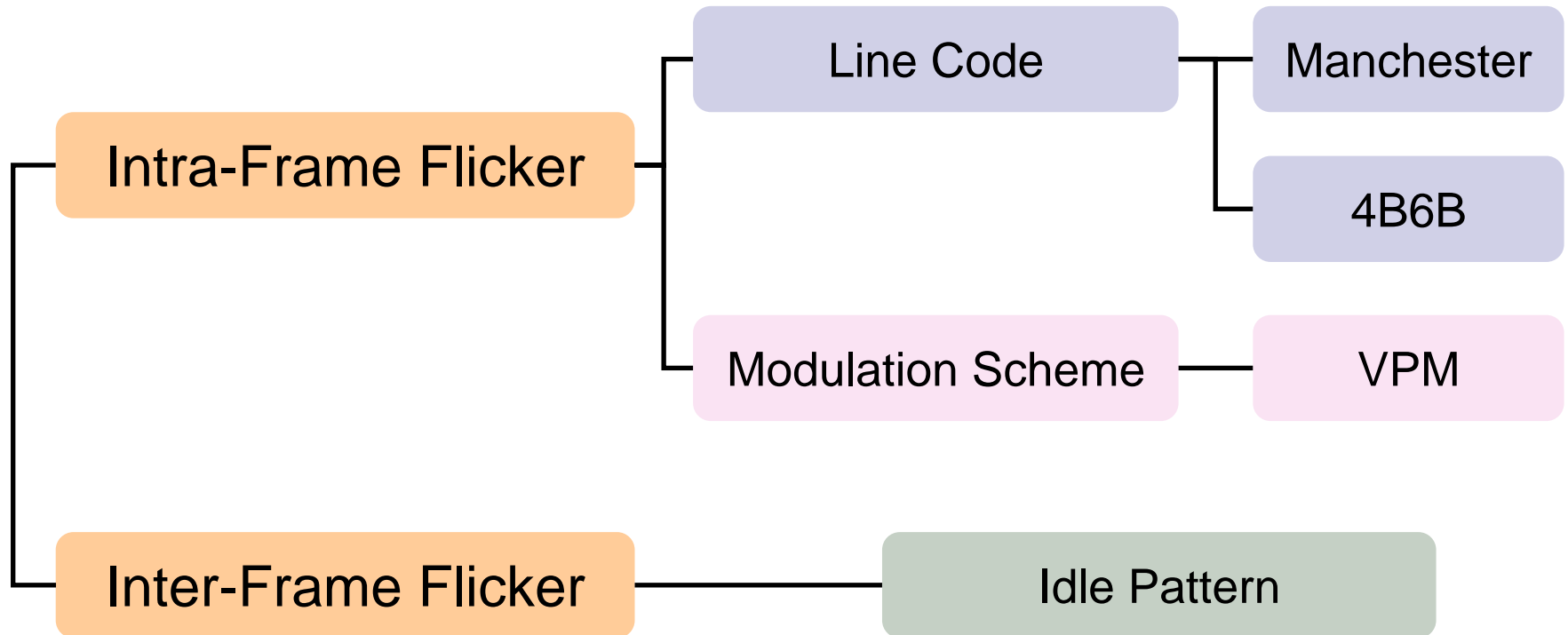
Implementation and Demonstration of 4B6B Line Code for Non-Flicker in VLC

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Flicker Issue in VLC

- ❑ Flicker is an important issue in VLC for human eye safety.
- ❑ Flicker can be generated from the brightness differences depending on bit patterns when OOK modulation is used and also the brightness differences on data frame and idle time.
- ❑ Intel had showed that the flicker can be generated under AM modulation with their contribution [15-09-0297-00-0007] and attached video clips.

Methods for Non-Flicker in Current D0 Doc. of TG7



4B6B Line Codes [15-09-0675-00-0007]

- Expands 4-bit codes to 6-bit symbols
- Same ratio of 1 and 0 (3:3)
 - Constant average brightness
- Idle time pattern
 - 111000 and 000111
- Preamble pattern
 - Combination of 110100 and 001011

	4B	6B
0	0000	001110
1	0001	001101
2	0010	010011
3	0011	010110
4	0100	010101
5	0101	100011
6	0110	100110
7	0111	100101
8	1000	011001
9	1001	011010
A	1010	011100
B	1011	110001
C	1100	110010
D	1101	101001
E	1110	101010
F	1111	101100

Advantages of 4B6B Line Code

[15-09-0675-00-0007]

- Being free from intra-frame flicker
- Short run length
- Error detection
- Easier clock recovery
- DC balancing

Features of Implemented VLC System

Optical Rate	5.5 Mbps
Data Rate	3.67 Mbps
Modulation Scheme	NRZ-OOK
Line Code	4B6B
Idle Pattern	Yes [111000, 000111]
Transmission Mode	Full Duplex
Carrier Color	Red

Experiments on VLC Video file Transmission (1)



Experiments on VLC Video file Transmission (2)



Conclusion

- We implemented full-duplex VLC prototype system with optical rate of 5.5 Mbps being able to transmit video files using NRZ-OOK modulation scheme, 4B6B line code and idle patterns.
- We verify that 4B6B line code and idle pattern technologies in current D0 document of TG7 can remove the intra-frame flicker arising from the brightness differences depending on bit patterns when OOK is used and the inter-frame flicker arising from brightness differences on data frame and idle time.