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

Submission Title: [Error Rate of Uncompressed Video]
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Abstract: [Consideration on error rate of uncompressed video]

Purpose: [To be considered in 15.3c Usage Model Document]

Error Rates Found in Standards

- Two error rates related to uncompressed video transmission have been found.

HDMI 1.3	TMDS character error rate < 10^{-9}
DVI 1.0	Pixel error rate < 10^{-9}

Corresponding Bit Error Rate

- Pixel error rate of 10^{-9} corresponds to bit error rate of 4×10^{-11}.

Assuming one pixel consists of 24 bits, the bit error rate corresponding to the pixel error rate can be expressed as following equation.

$$\frac{10^{-9}\ \text{[error/pixel]}}{24\ \text{[bit/pixel]}} = 4.167 \times 10^{-11}\ \text{[error/bit]}$$

Quality of the Video

- Pixel error rate of 10^{-9} corresponds to one pixel error in 8 seconds in case of 1080p 60 Hz video.

$$\frac{\text{Number of pixels in which one error is found}}{\text{Number of pixels in one second}} = \frac{\frac{1}{10^{-9}}}{1920 \times 1080 \times 60} = 8.04$$

Note 1: 1920 (H) x 1080 (V) pixels per frame is assumed.

Quality of Video

- Pixel error rate of 10^{-9} produces one pixel error in 8 seconds. (*Note 2)
- The acceptable error rate for a viewer will be significantly different depending on the pixel error concealment method employed.

Note 2: In case of 1080p 60 Hz uncompressed video.

Simulation for Proposal

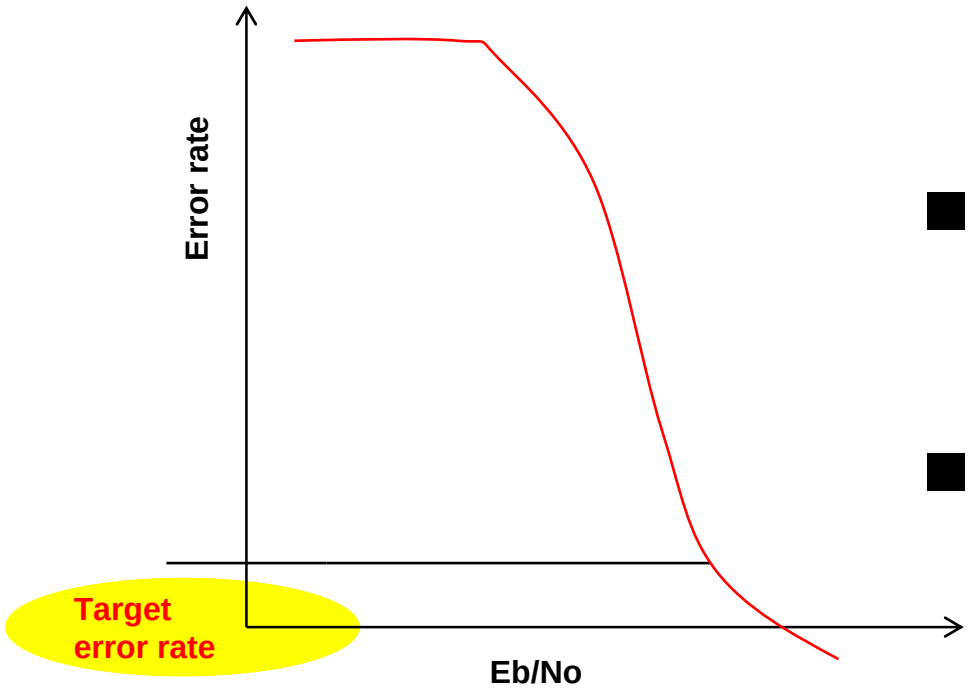
- There seems to be several approaches for video error simulation.

1. **Direct Method**
   - Proposer directly simulates with the error rate.

2. **Indirect Method**
   - Proposer defines FEC used, and shows relation of the error rates before and after the FEC.
   - The simulation is done with the error rate before FEC.
   - The FEC can be integrated in PHY, or can be achieved in Application.

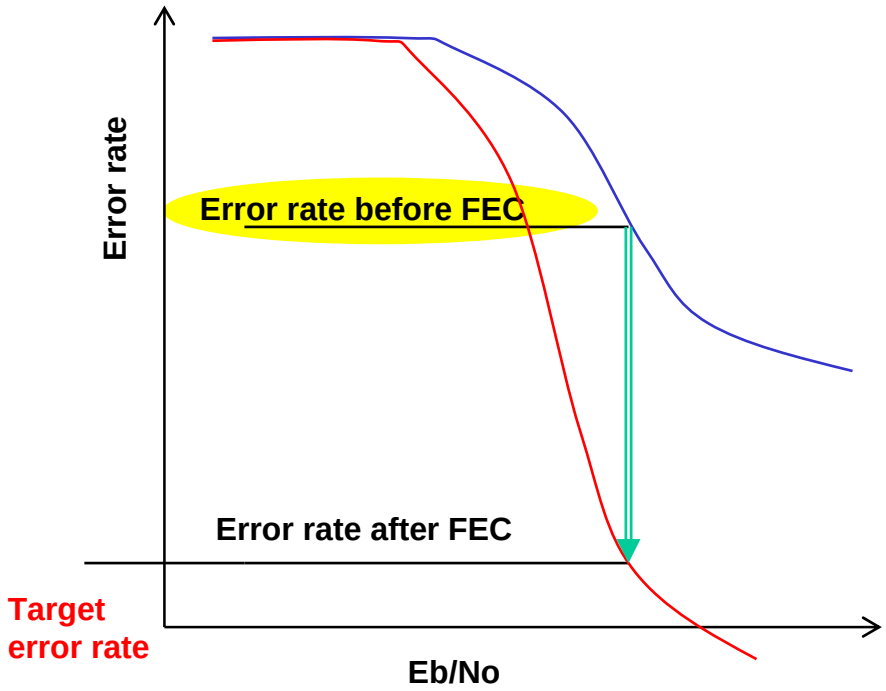
3. **Go with their own video error criteria**
   - Proposer must show the verification of the criteria clearly.

Direct Method



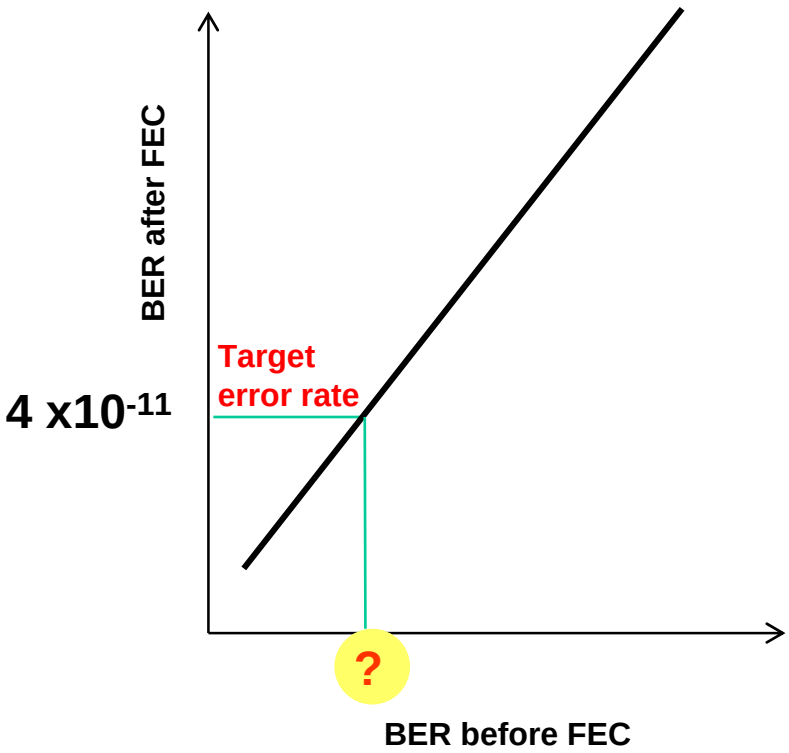
- Proposer directly simulates with the error rate.
- Time consuming?

Indirect Method



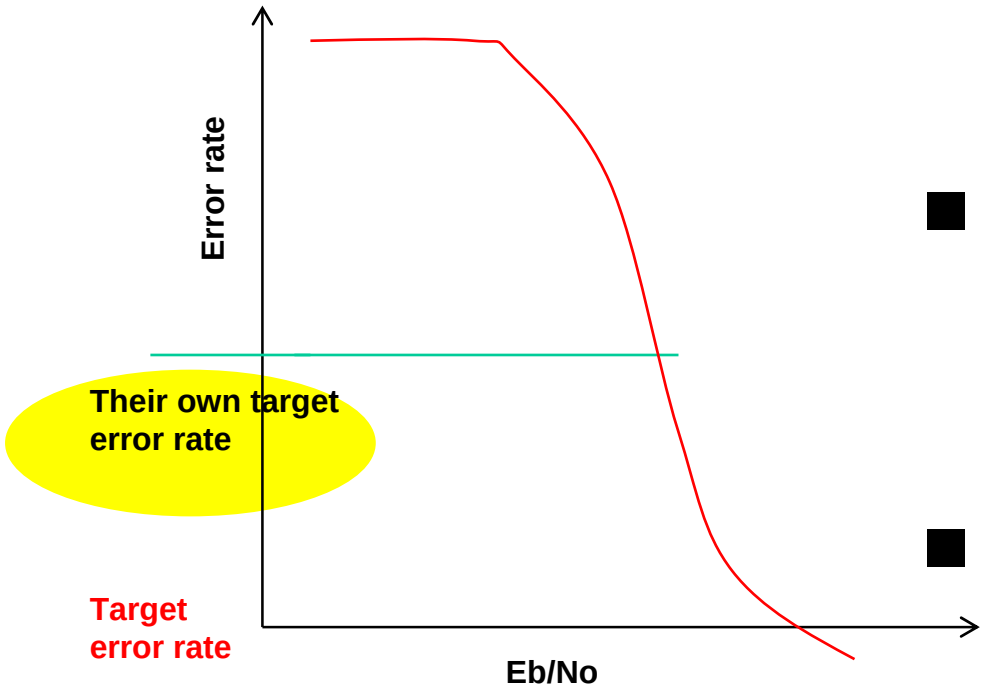
- Proposer defines FEC used. Proposer must show relation of the error rates before and after the FEC.
- The simulation is done with the error rate before FEC.
- The FEC can be integrated in PHY, or can be achieved in Application.
- A practical choice?

Verification of required BER before FEC



- Proposers are recommended to show the relationship between BERs before and after FEC when their proposal is assumed.

Go with their own video error criteria



- Proposer must show the verification of the new criteria clearly.
- Making a new criteria is a large work.

Conclusion

- Quality achieved with the error rates specified in HDMI and DVI is very high.
- We haven't found any alternate error rate references other than those found in HDMI and DVI.
- Some simulation approaches for the video transmission were presented.
- The Indirect Method may be a practical choice.