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

Submission Title: [FEC simulation results]
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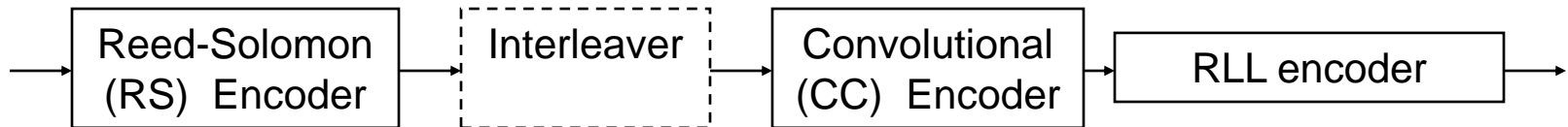**Contact:** sasurra@sta.samsung.com

Abstract: Provides details on FEC simulations for VLC

Purpose: [Contribution to IEEE 802.15.7 VLC TG]

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TX System block diagram

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          ┌──────────────────┐   ┌ ─ ─ ─ ─ ─ ─ ┐   ┌──────────────────┐   ┌──────────────────┐
─────────▶│  Reed-Solomon    │──▶│ Interleaver │──▶│  Convolutional   │──▶│   RLL encoder    │─────▶
          │  (RS)  Encoder   │   └ ─ ─ ─ ─ ─ ─ ┘   │  (CC)  Encoder   │   └──────────────────┘
          └──────────────────┘                     └──────────────────┘
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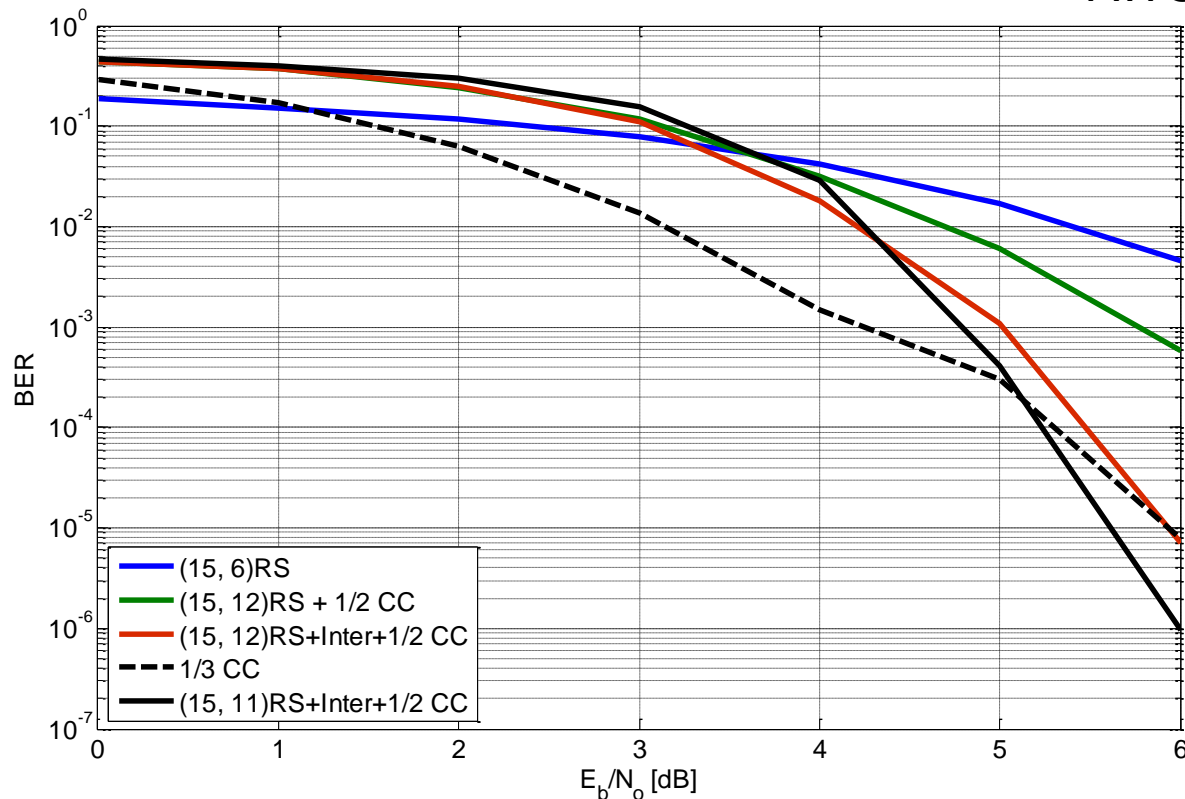
Hard-decision decoding is used in the RS and the CC decoders.

Random interleaver is used in these simulations. In practice, other interleavers such as block interleavers can also be considered.

Manchester RLL encoder is considered.

# Does the convolutional code (CC) need an interleaver?

AWGN Channel

Yes, an interleaver between the RS code and the CC achieves >1dB gain.

No need for interleaver at the output of the CC.

It is better to reduce coding rate of CC instead of RS, given a choice to attain same coding rate. RS code is also better for high rate implementation from complexity standpoint.
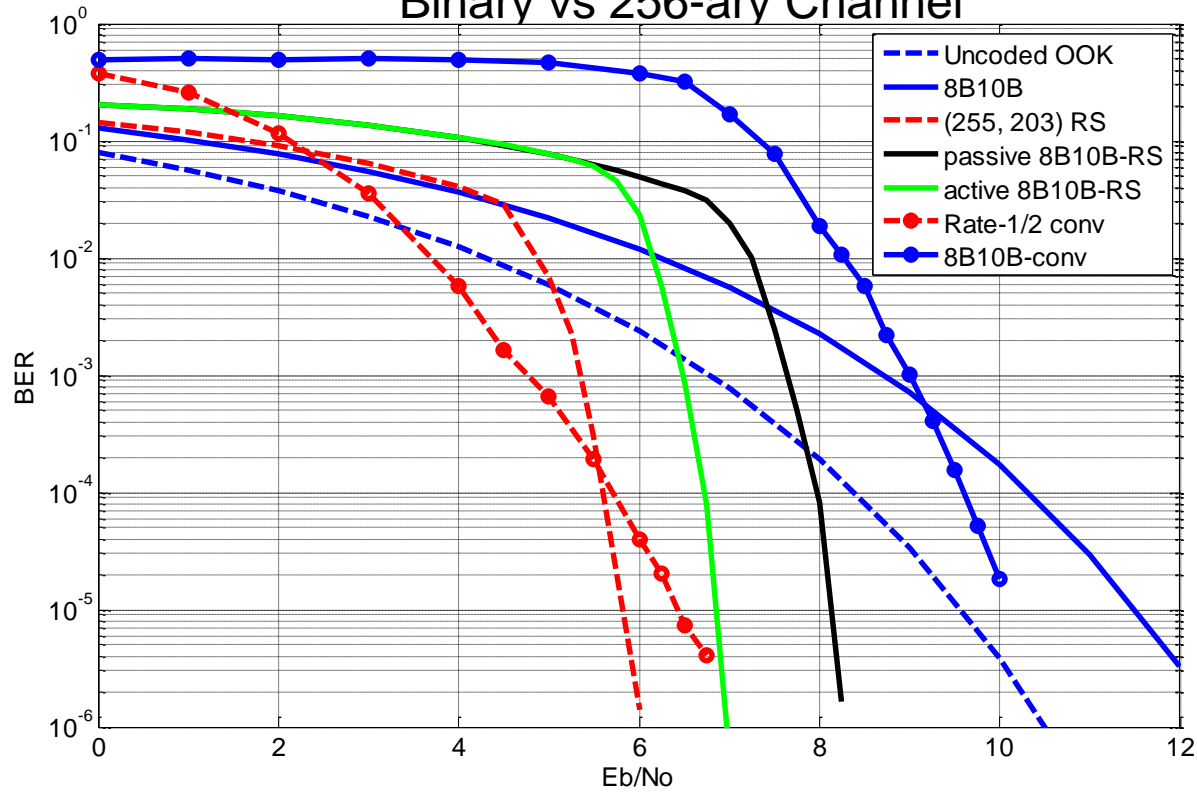
CC vs. RS+CC
AWGN Channel
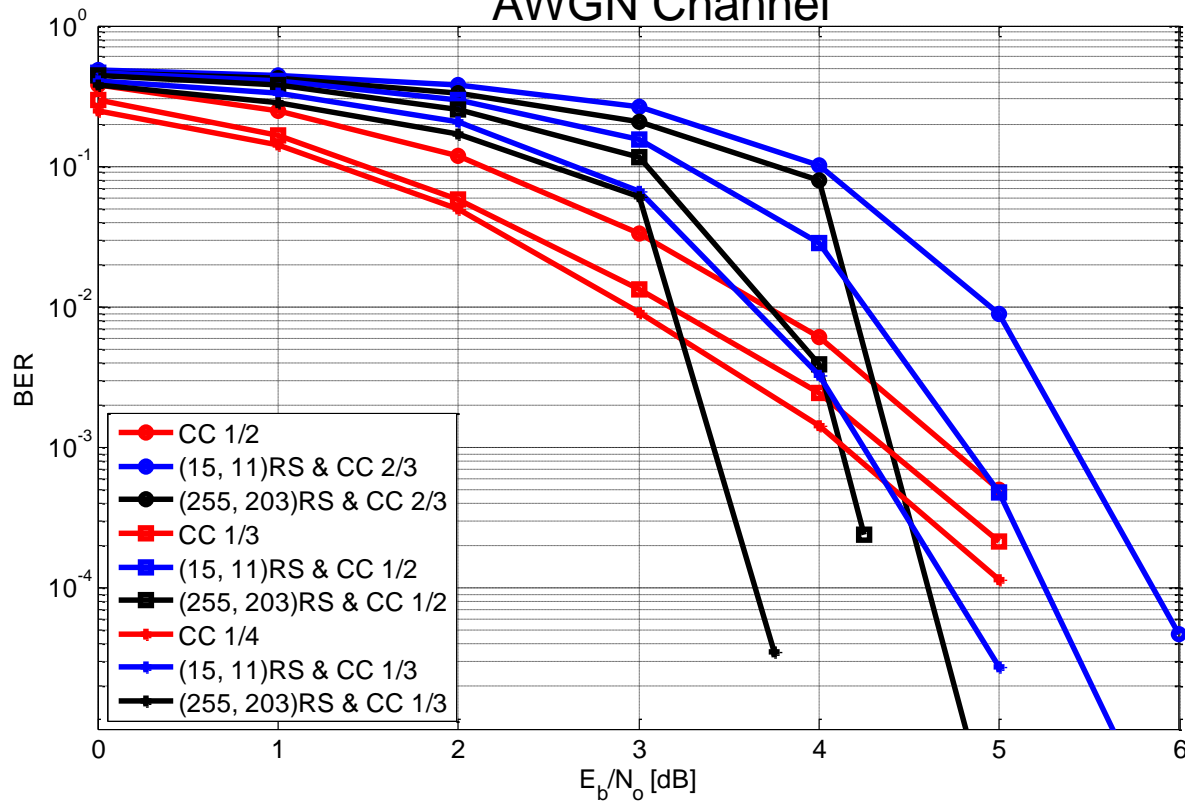
Operating in BER>1e-3: Use CC (without RS)

Operating in BER<1e-3 (practical for PER <1e-1) : Use RS+CC

Operating at coding rates < ¼ : Use RS+CC
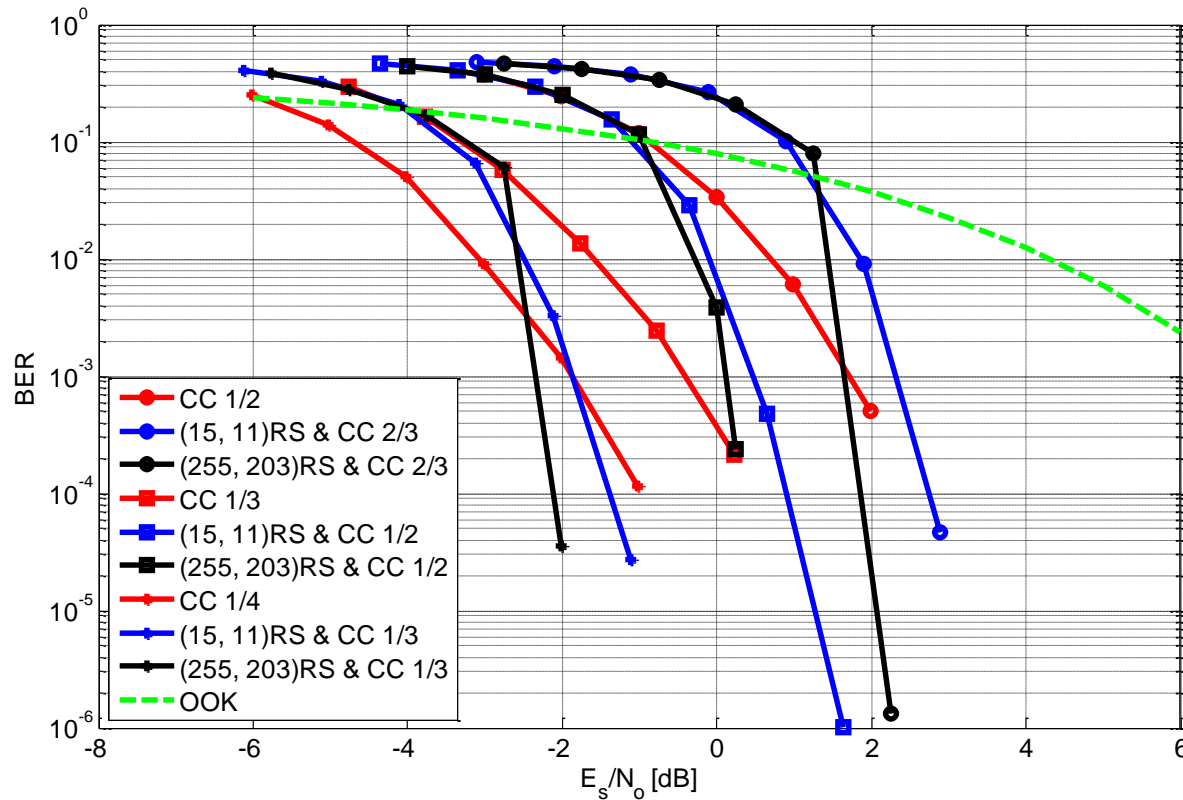
CC vs. RS

Binary vs 256-ary Channel

PHY I (Manchester): RS+CC

PHY I (4B6B): RS on GF(16)

PHY II : RS on GF(256)

Dynamic SNR Range

Assuming same optical rate, 2dB between rate-1/2 and rate-1/3, 2dB between rate-1/3 and rate-1/4, and >8dB between rate-1/4 and un-encoded OOK.

More simulations are needed to verify the dynamic range for all proposed MCSs, and to guarantee that there is no overlapping MCSs.

Recommendations

PHY I :

- use RS + CC for Manchester coding
- Given a choice, reduce coding rate in CC over RS code.
- Avoid use of repetition coding.
- Use RS only for 4B6B code
- Use GF(16) for RS code (short packet sizes)

PHY II

- Use RS GF(256) with 4B6B code
- Use RS GF(256) with 8B10B code