Additional FEC Considerations for Symmetric 10GEPON

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Introduction

- Scope
  - **This presentation shows additional considerations for summarized FEC issues distributed in 10GEPON reflector**
- Outline
  - **FEC: mandatory or optional**
  - **Simulation result of FEC coding gain**
  - **FEC framing for upstream burst**

Assumption

- Assumption of 10GEPON FEC
  - **FEC mandatory or optional is not decided yet**
  - **Increased or same line rate is not decided yet**
  - **Stream FEC will be applied on downstream and upstream of symmetric 10GEPON**

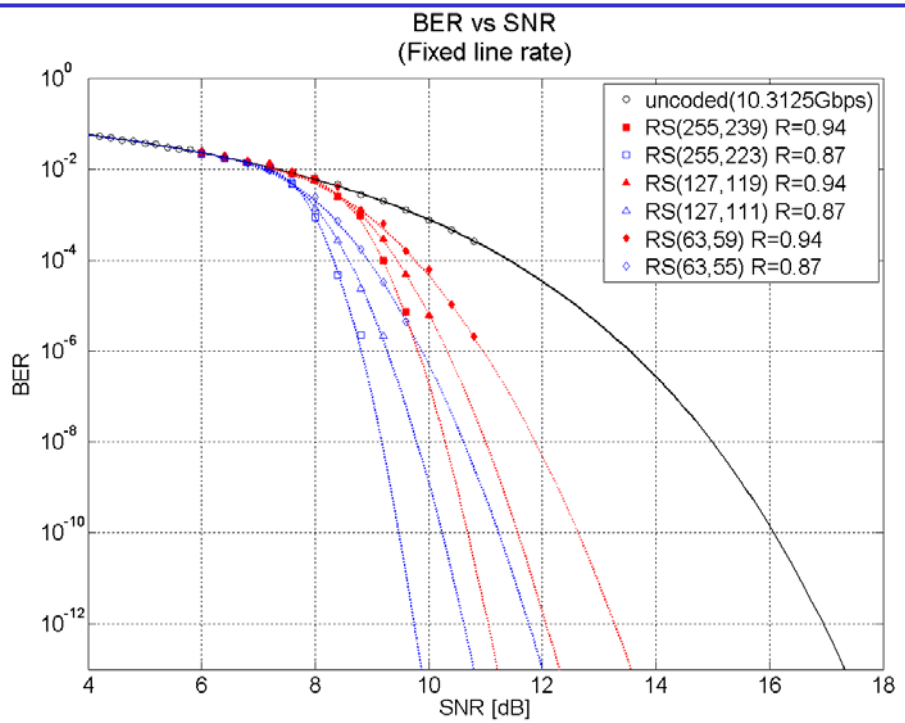
FEC: Mandatory or Optional

- To achieve 29dB power budget, FEC might be necessary
- But FEC is not required in all cases of distance and power budget class
- We have to pay unnecessary cost if FEC is mandatory in all cases
  - **Optical components or data rate to/from MAC layer**
  - **Logic and power consumption of FEC encoder and decoder**
  - **Latency**
- In optional case, to support selection of FEC activate/deactivate, it is preferable that PMD line rate of FEC stream is 10.3125 Gbps from the viewpoint of optical components and CDR

Simulation of FEC Coding Gain

- Purpose of simulation is to show quantitative data for deciding the following items
  - **FEC framing, codeword and parity data length**
  - **Line rate of FEC stream, increased or same**
  - **FEC algorithm, RS or enhanced FEC**
- Contents of simulation
  - **(1) same line rate, Coding gain of RS as a function of codeword length and code rate**
  - **(2) increased line rate, Coding gain of RS as a function of codeword length and code rate**
  - **(3) LDPC coding gain as enhanced FEC algorithm**

Simulation result of coding gain
- same line rate -

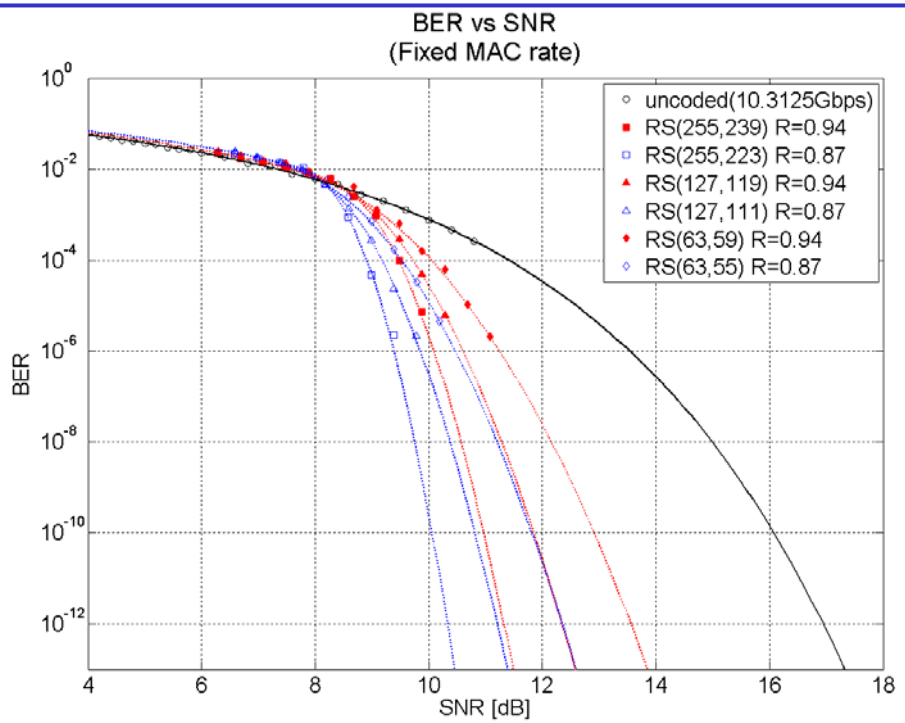


Electrical Coding Gains @ BER 10^{-12}

N: codeword length
R: code rate

	N : 255 [Byte]	N : 127 [Byte]	N : 63 [Byte]
R=0.94	5.9 [dB]	4.9 [dB]	3.7 [dB]
R=0.87	7.2 [dB]	6.3 [dB]	5.2 [dB]

Simulation result of coding gain
- increased line rate -

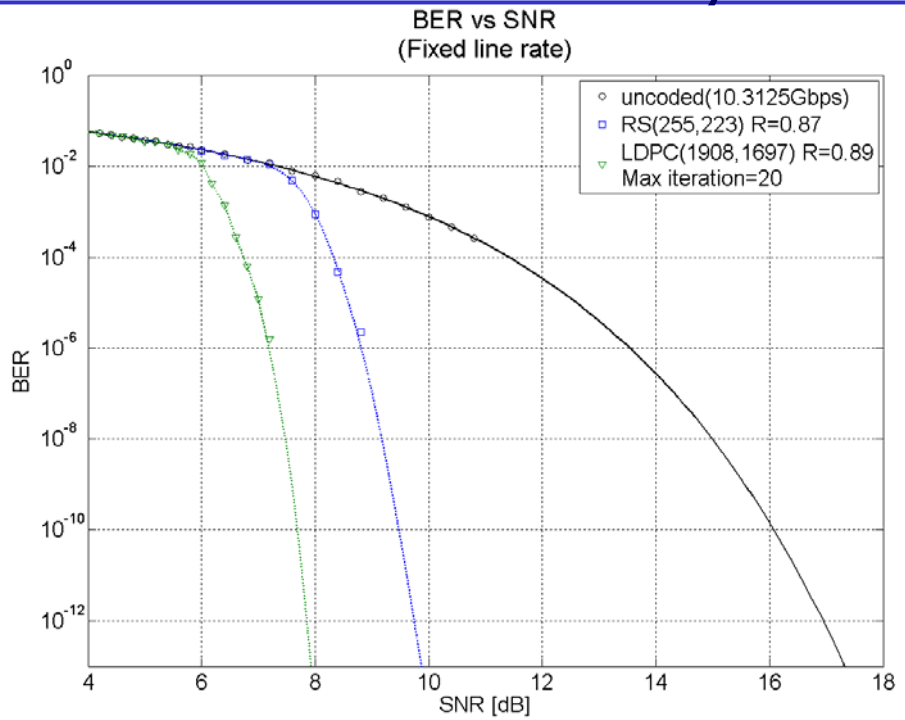


Net Electrical Coding Gains @ BER 10^{-12}

N: codeword length
R: code rate

	N : 255 [Byte]	N : 127 [Byte]	N : 63 [Byte]
R=0.94	5.6 [dB]	4.6 [dB]	3.4 [dB]
R=0.87	6.6 [dB]	5.8 [dB]	4.6 [dB]

Simulation result of coding gain
- Enhanced FEC, LDPC -



Note:

- **LDPC codeword length is bit order**
- **BER for LDPC under 10^{-6} is estimated based on simulation result. There is possibility that error floor will be observed under 10^{-6}.**

Electrical Coding Gains Estimation @ BER 10^{-12}

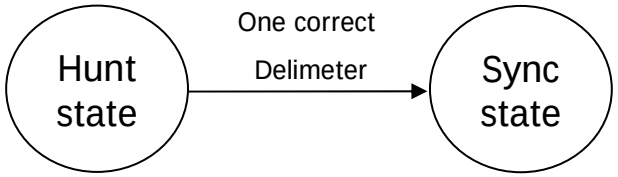
RS(255,223) R=0.87	LDPC(1908, 1697) R=0.89
7.2 [dB]	9.1 [dB]

Simulation Result of Coding Gain
- Summary -

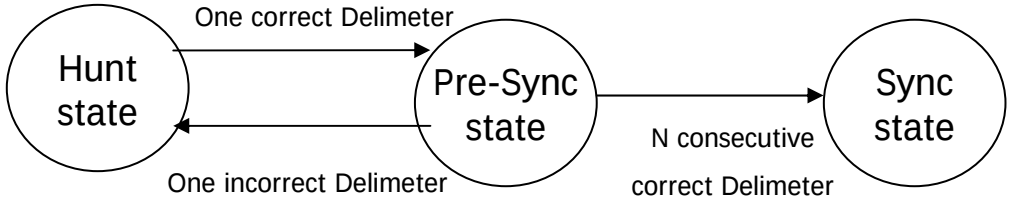
- Quantitative analyses are shown in terms of RS
- Further analyses are needed for enhanced FEC
- LDPC is most powerful FEC in existing technology, so we can think that result of LDPC gain is limitation of FEC technology

FEC Framing
- FEC Frame Sync for Burst -

- FEC frame sync of G-PON : existing technology
  - **One delimeter after preamble is used for synchronization**
  - **Burst over head is very short compared with EPON**

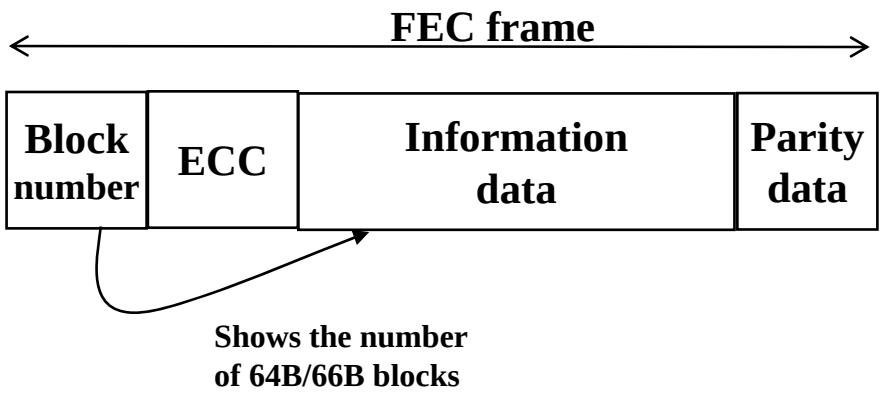


- FEC frame sync for 10G upstream burst
  - **Burst overhead time will be in the order of hundred ns and longer than GPON**
  - **Sequential delimeter match algorithm is needed for preventing false lock of FEC frame**



FEC Framing
- FEC Frame Size -

- Variable FEC frame size
  - If FEC frame size is fixed, the remainder of information field will be inevitable at the last FEC frame in a burst
  - Block number field that shows the number of 64B/66B Blocks in information data can solve the remainder
    - Block number field must be processed prior to FEC correction, so Error Correction Code (ECC) is needed for block number field



Conclusions

- Mandatory or optional use of FEC should be discussed further
- More quantitative analyses are needed to decide the PMD line rate of FEC and if FEC is mandatory or optional
- Sequential lock algorithm and variable length of FEC frame will be needed for 10G burst with FEC