

Considerations in BSE vs. FSE Comparisons

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Three ways of modeling a communication system for the purpose of comparing BSE to FSE performance are presented below. One goal of this study is to answer the question “Is the impulse response of a T -spaced analog channel model the same as the decimated impulse response of the $T/2$ -spaced model?”.

All models are discrete and contain $T/2$ -spaced channel dynamics, transmit filters, and receiver filters. For lack of a better term, the part of the diagram appearing to the left of the dashed line will be referred to as the “channel model” even though it incorporates more than just the dynamics of the physical channel.

1 Scenario 1

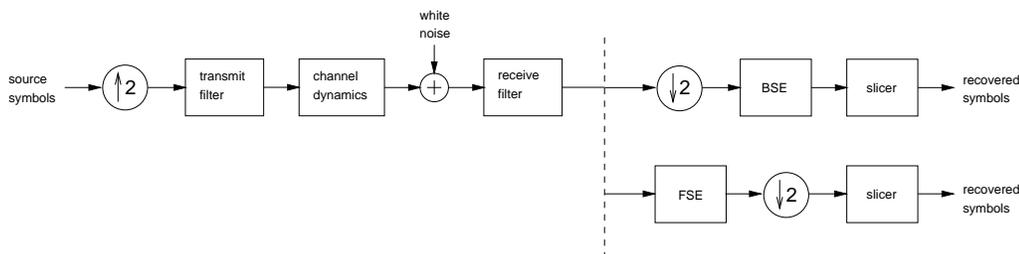


Figure 1: One model of a communication system.

- *BSE channel model related to FSE channel model by straightforward decimation-by-2* (though the choice of delay may be important).
- Noise may be colored by receive filter, such as when using a square-root raised-cosine (SRRC) filter; it is not necessarily white at either equalizer input. Furthermore, the noise is aliased before reaching the BSE input.
- This may not accurately reflect a typical receiver design, as receiver (i.e. matched) filtering is usually accomplished with the FSE.

2 Scenario 2

- BSE channel model related to FSE channel model by straightforward decimation-by-2 (though the choice of delay may be important).

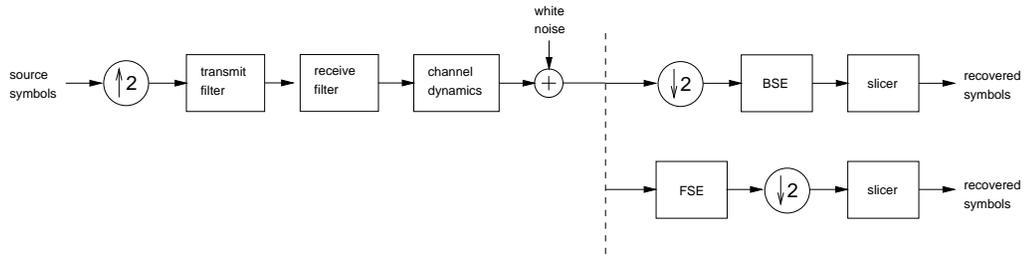


Figure 2: Another model of a communication system.

- Though the noise is white at the input to both equalizer inputs, it is decimated before reaching the BSE.
- *This model definitely does not reflect a typical receiver design*, since matched filtering is not implemented.

3 Scenario 3

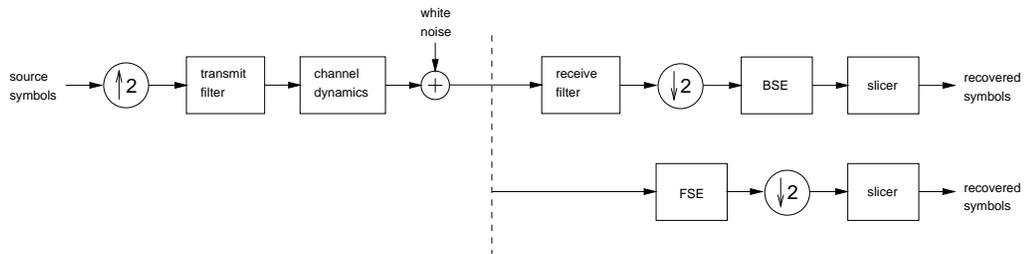


Figure 3: A third model of a communication system.

- *BSE channel model not related to the FSE channel model by straightforward decimation* due to the presence of a separate BSE receiver filter.
- The noise is white at the input to the FSE, but it is not necessarily white at the input to the BSE, such as when the receiver filter is a SRRC filter.
- *This model best reflects typical design practice.* The absence of a fixed receive filter (as the FSE version of Fig. 3) is especially advantageous in a non-cooperative environment.

4 Conclusion

Each model has shortcomings, be it incompatibilities in the BSE/FSE channel models, the inconvenience of modeling the noise coloring, or an inaccurate reflection of typical design practice. The first scenario appears to be the best compromise, should a choice need to be made.

Note that in an email correspondence, I interpreted Lang Tong to favor the first scenario with noise coloring ignored.