Metrics and Techniques for Evaluation of FEC Systems

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Purpose:

Assist the IEEE 802.16 Working Group in assessing candidate FEC systems by providing recommendations on pertinent metrics and techniques.

Metrics and Techniques for Evaluation of FEC Systems

A Presentation of IEEE 802.16.1pc-00/25

Eric Jacobsen

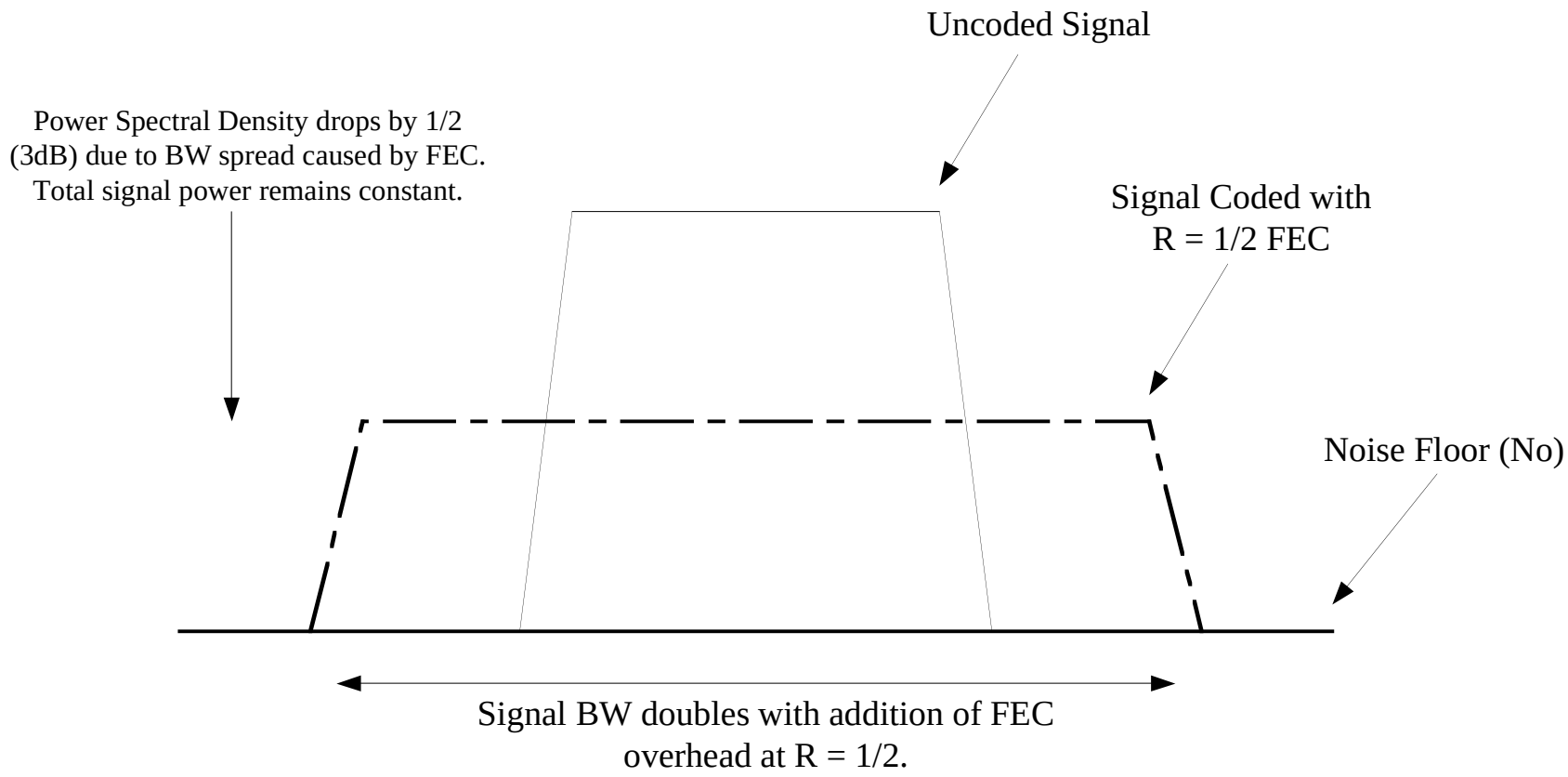
FEC Evaluation Metrics

- Error Performance
  - BER vs. Eb/No curves.
  - Block or Packet Error Rate
  - Coding Gain - Distance from Coded to Uncoded
  - Distance from Channel Capacity
- Latency
  - 2x Interleaver or Block size.
  - Processing delay, additional buffering.
- Complexity
  - Gate count, Memory requirements.
  - “Gates are cheap”, may not be driving concern.

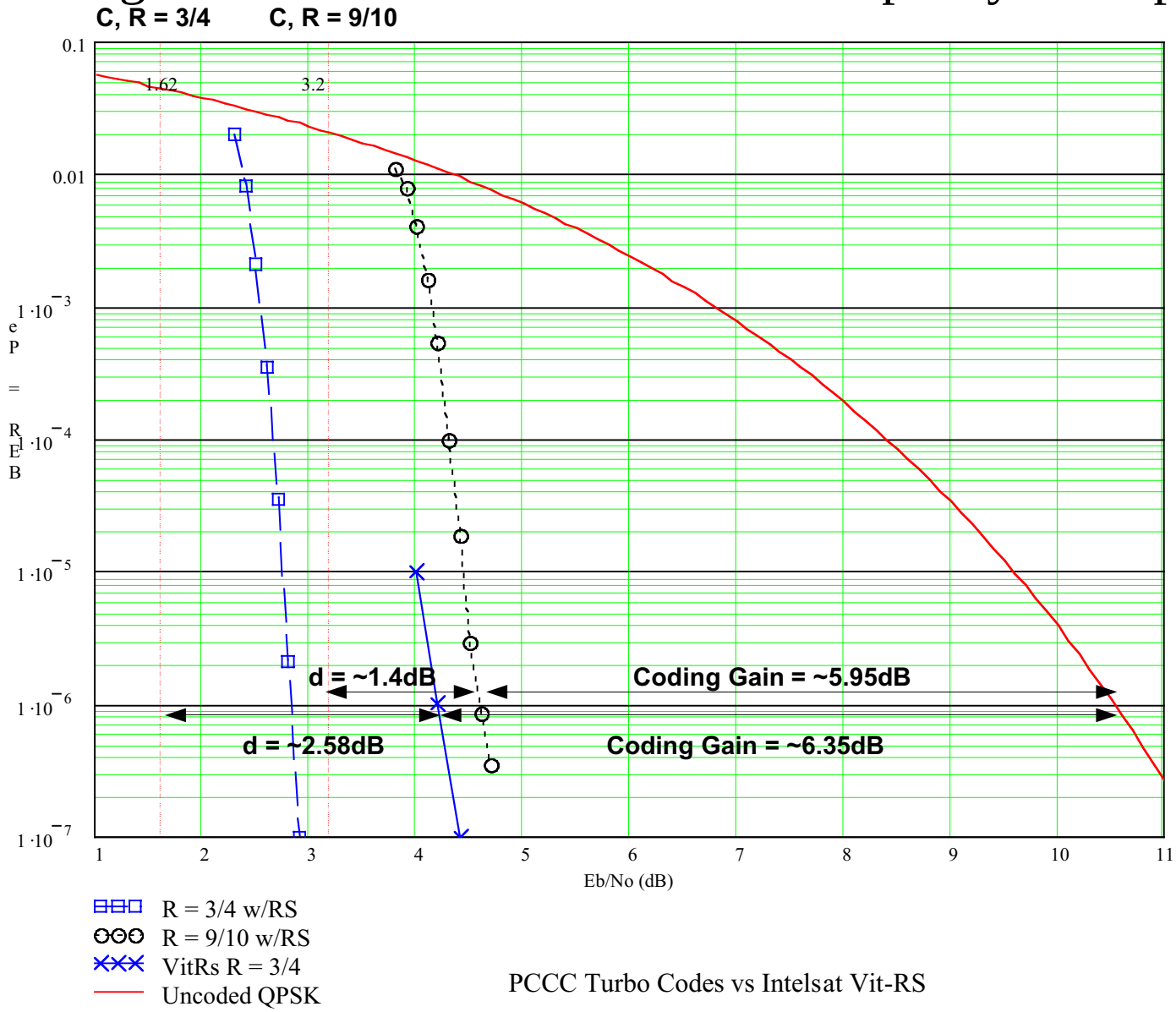
FEC Error Performance Metrics

- BER vs Eb/No
  - Best basis for Apples-Apples comparison.
    - Avoid mixing SNR, CNR, Eb/No, BER, PER, etc.
  - Deals only with Power ratios, not bandwidth.
  - Focus is on payload information, not implementation.
- Coding Gain
  - Deals only with Power Efficiency, not BW.
- Distance from Channel Capacity
  - Measure of Channel Efficiency, rather than Power Efficiency (accounts for both power and bandwidth).

FEC Effect on Signal Spectrum

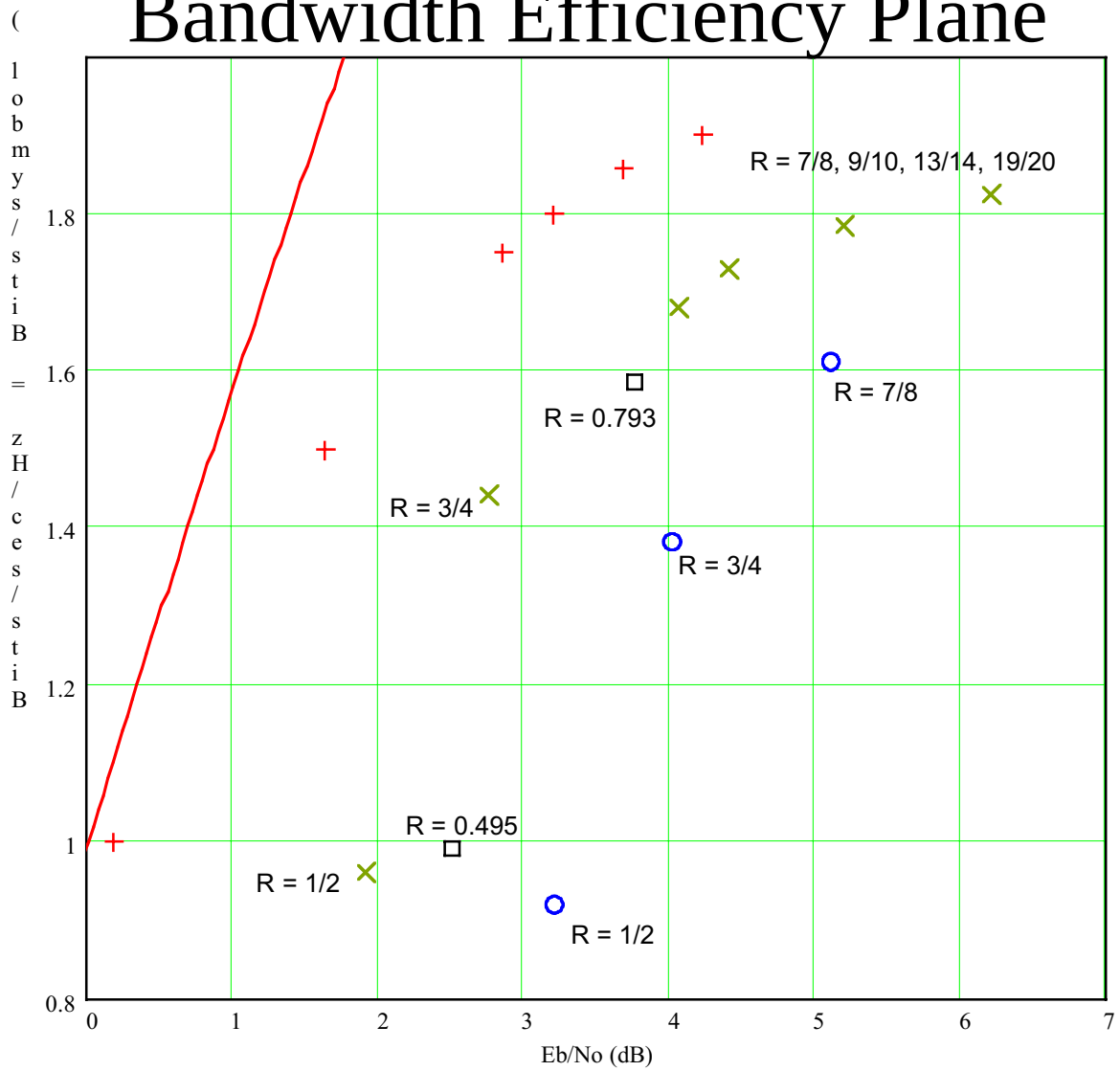


Coding Gain and Distance to Channel Capacity Example



PCCC Turbo Codes vs Intelsat Vit-RS

Bandwidth Efficiency Plane



Channel Capacity (CICO, QPSK)
Channel Capacity (BICO, QPSK)
IDR/IBS Vit-RS
AHA TPC (+0.5db)
PCCC Turbo Code w/RS

Indicated are the power requirements and BW efficiencies for various codes using QPSK modulation to achieve Pe = 10E-5.

Tabular Comparison of Vit-RS and PCCC Turbo Code

All Figures for P_e = 10E-6.

Code	Viterbi-RS	PCCC TC
Code Rate	_	9/10
Coding Gain	6.35dB	5.95dB
Distance to C	2.58dB	1.4dB
Eb/No at $P_e = 10^{-6}$	4.2dB	4.6dB
Decoder Complexity	70k gates + 10kbit memory	250k gates + 16kbit memory
Latency (Tx + Rx)	20kbits	22kbits