

Joint Iterative Decoding and Authentication (JIDA)

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Performance from Experience

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Report Documentation Page

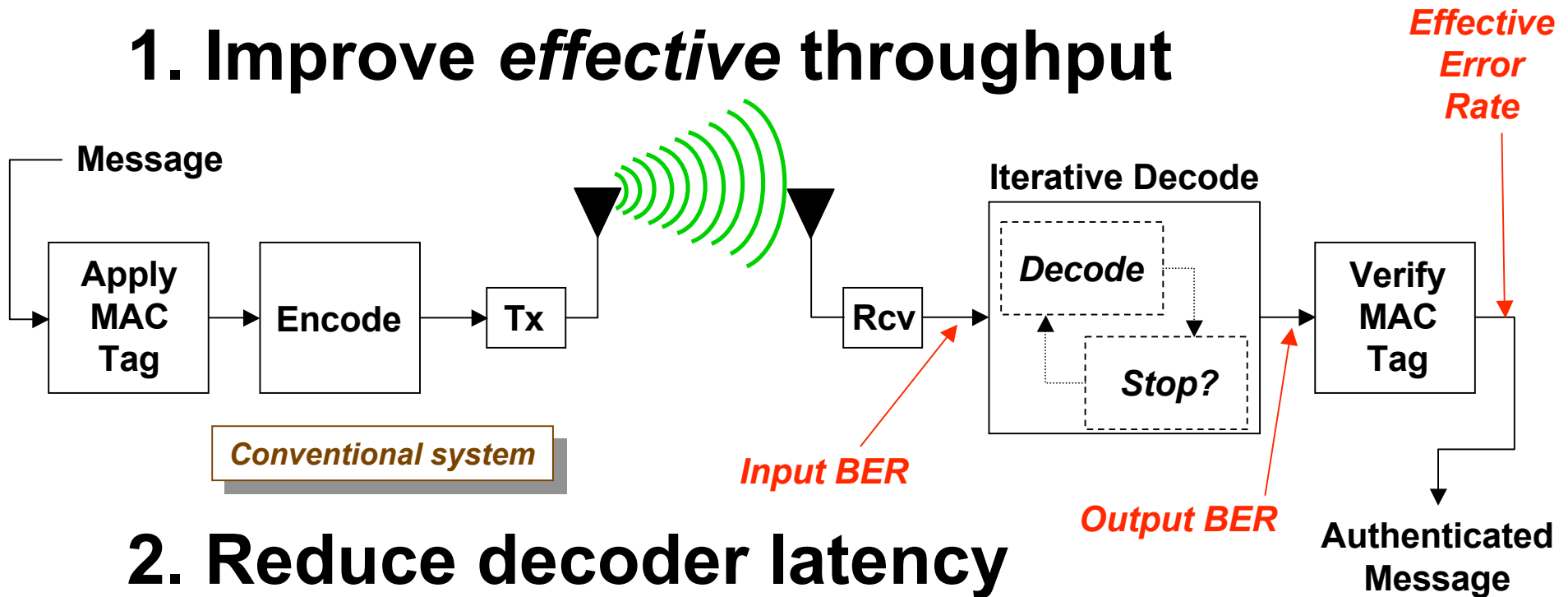
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JIDA Objectives

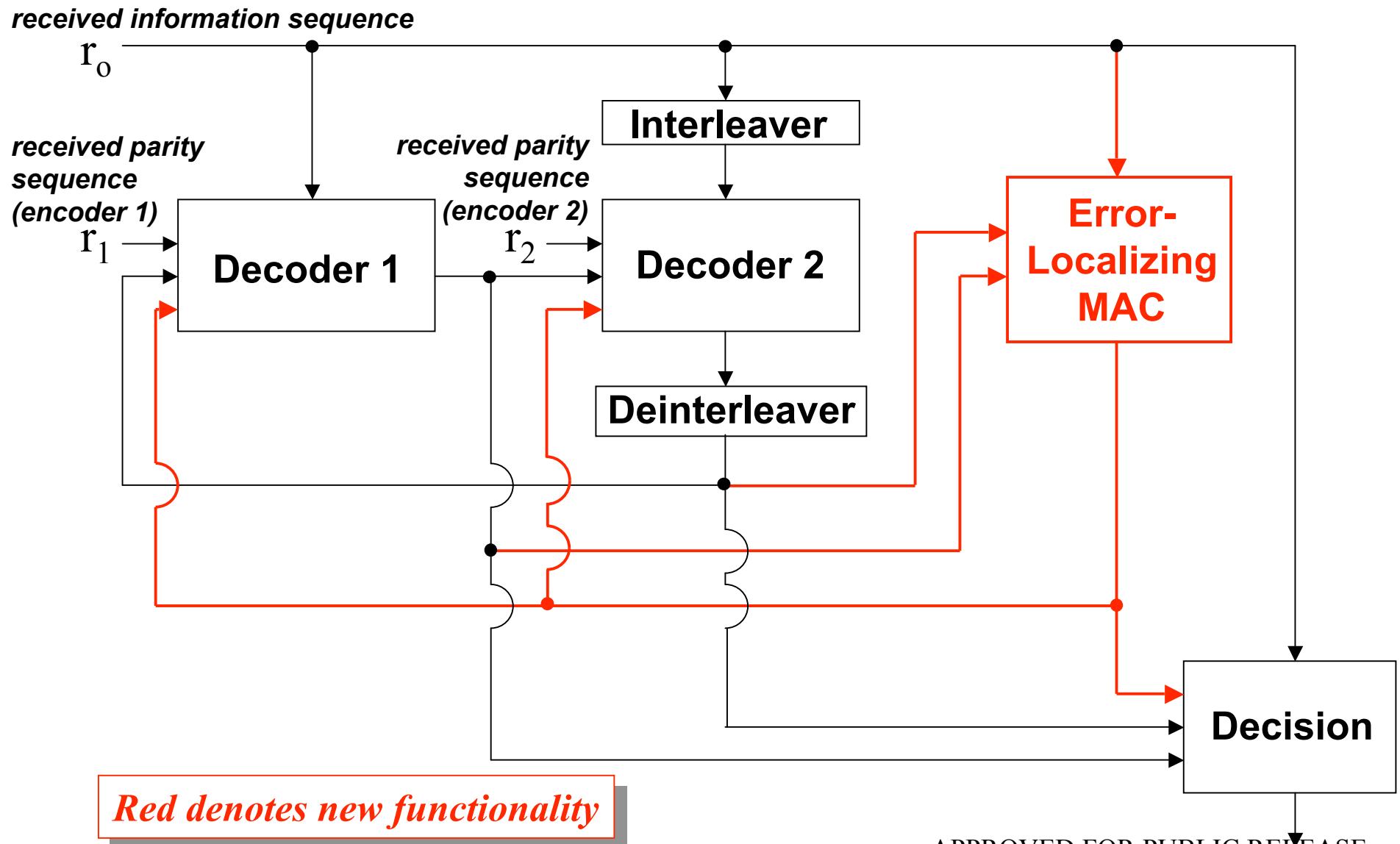
1. Improve *effective* throughput



2. Reduce decoder latency

- Reduce number of decoder iterations by having the authentication module declare packet “authentic” or “correct” packet

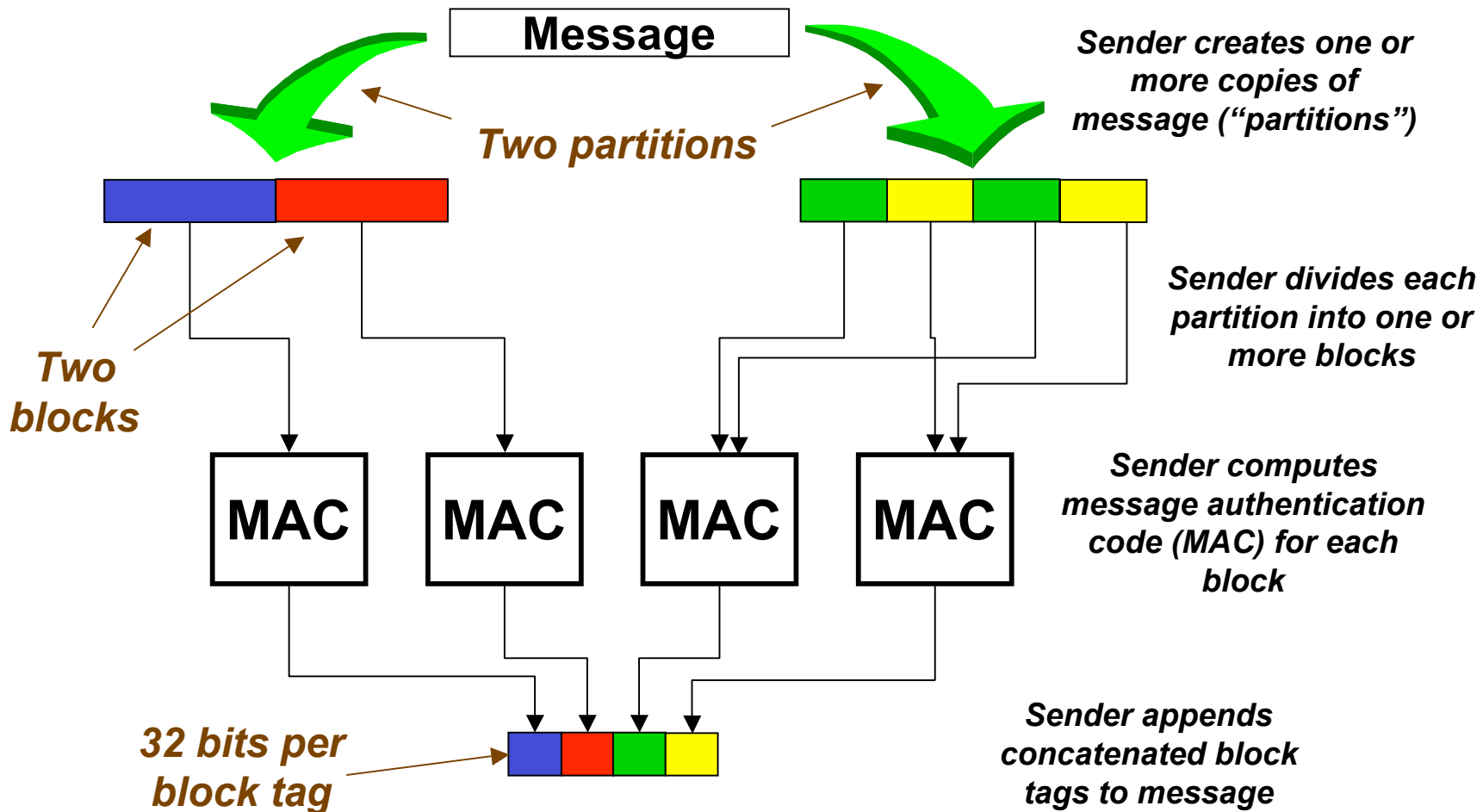
High-Level Approach



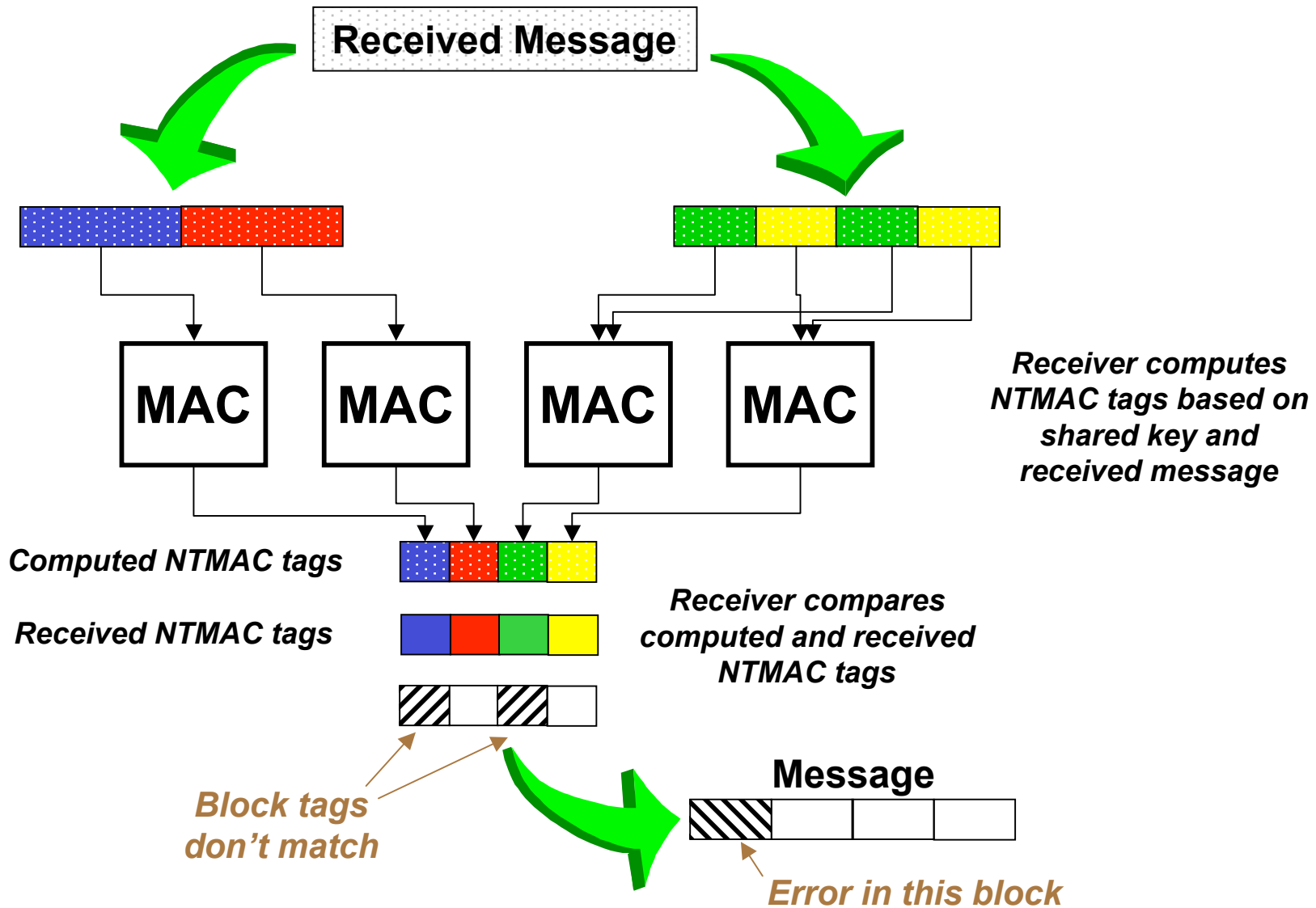
Noise-Tolerant MAC (NTMAC)



- Invented by Dr. Charles Boncelet



NTMAC Receive Processing



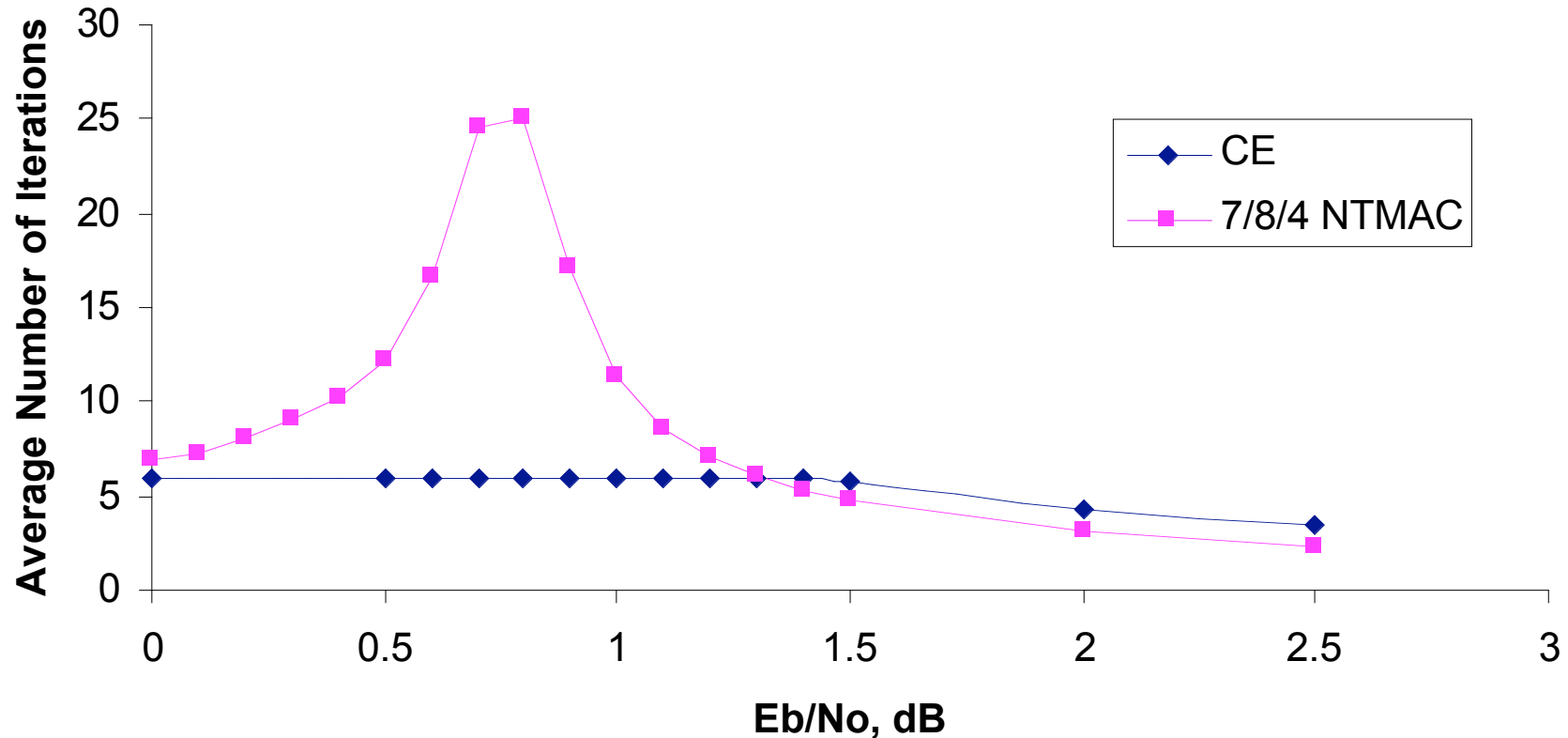
7/8/4 NTMAC

- Tradeoff single-bit forgery security for error localization
 - 7 partitions, 8 blocks/partition, 4-bit block tags → 224-bit NTMAC authentication tag
 - 32-bit BCH parity check over the NTMAC tag ($n=255$, $k=223$, $t=4$ errors)
 - Probability of a *single-bit* forgery is 2^{-28} per attempt
 - security increases for multiple-bit forgery attempts
- Authentication module returns one of four “flags”:
 - “**Authentic**” - the input data/tag pair is authentic
 - “**Authentic when corrected**” - the input data/tag pair is authentic when corrected as denoted
 - “**Estimate provided**” - can not correct the input data/tag pair to authentic result, but an estimate of the log-likelihood ratio of each bit is provided
 - “**Too many errors**” - cannot distinguish correct and error bits
- NTMAC/CE “Hybrid” Termination Criteria
 1. Total Iterations = 30, or
 2. NTMAC returns AUTHENTIC, or
 3. NTMAC returns AUTHENTIC_WHEN_CORRECTED, or
 4. NTMAC returns TOO_MANY_ERRORS *and* CE recommends termination

Monte Carlo Simulation

- Two parallel concatenated rate $\frac{1}{2}$ constituent convolutional coders (generating polynomial 7,5) produce net rate $\frac{1}{3}$ (unpunctured) or rate $\frac{2}{3}$ (punctured) turbo code
- 16384-bit S-random interleaver with $S=52$
- Linear additive white Gaussian (AWGN) channel
- Compare Two Termination Criteria
 1. **Cross-Entropy (CE)**
 - Calculates the approximate cross-entropy between the distributions at the end of successive iterations and terminates decoding of a data frame when the value falls below a user specified value
 - 16384 bits of data per frame (no checksum bits)
 - Terminate after six iterations even if CE threshold not met
 2. **7/8/4 NTMAC/CE “Hybrid”**
 - 16128 bits of data plus 256 total tag/checksum bits per frame
 - Errors occur in both data and tag/checksum portions

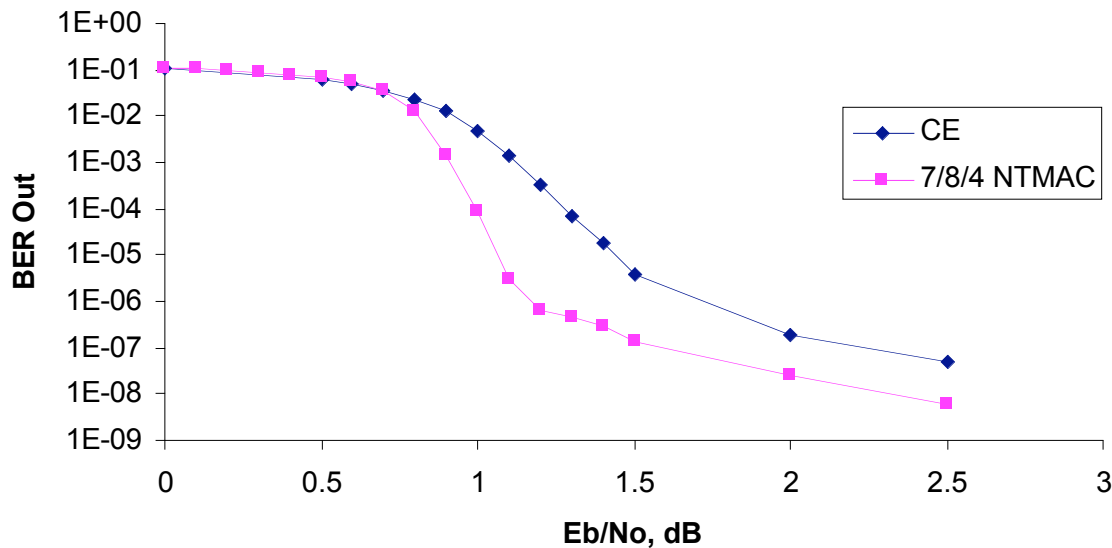
Average Iterations – 16384-bit Frames



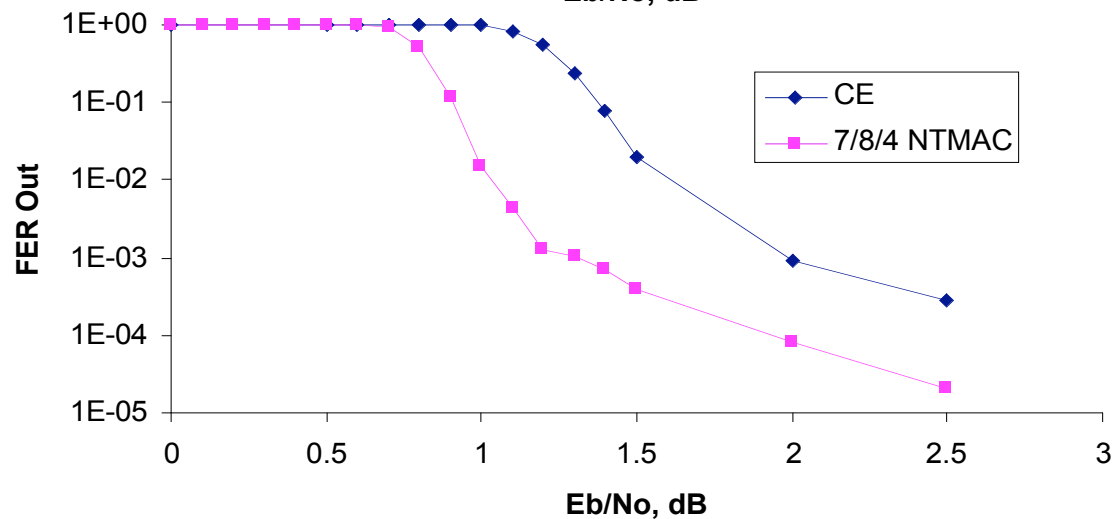
“Hybrid” termination method significantly increases average iterations per frame for low E_b/N_o

Bit and Frame Error Rates

16384-bit Frames



7/8/4 NTMAC significantly improves output bit error rate



7/8/4 NTMAC significantly improves output frame error rate