

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

Submission Title: [UEP for 802.15.3c PHY]

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Re: [In response to TG3c Call for Proposals (IEEE P802.15-07-0586-02-003c)]

Abstract: [This document contains the partial PHY proposal for TG3c. This proposal provides explanations on the UEP technology in the complete proposal from WirelessHD. In general, UEP can be applied to any other 15.3c PHY proposals.]

Purpose: [To describe the unequal-error-protection (UEP) for supporting video streaming in 802.15.3c PHY]

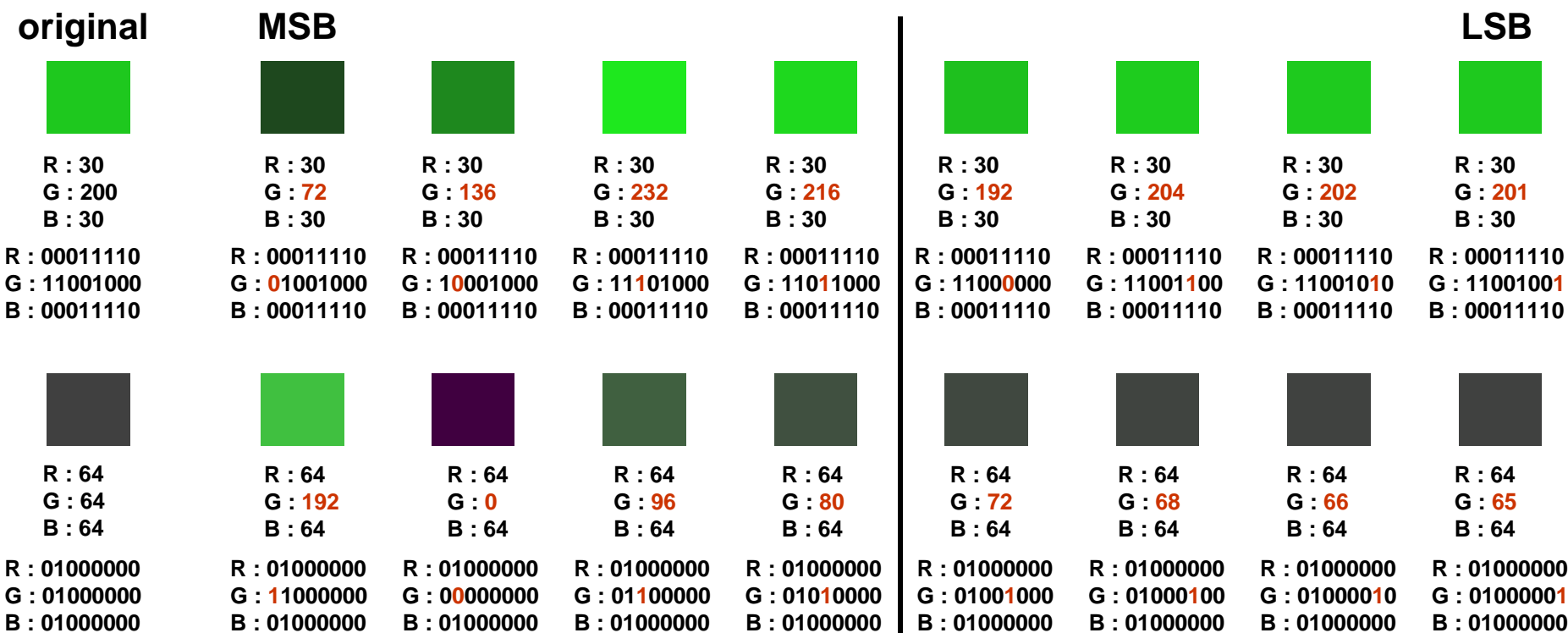
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Motivation for unequal error protection (UEP) for video applications

Bit errors in AV streaming vs. Subjective Picture Quality

- Each bit of RGB bytes has different value in color
- Need protect valuable bits more than the valueless ones
- Especially important for video transmissions



Strategy: Unequal Error Protection (UEP)

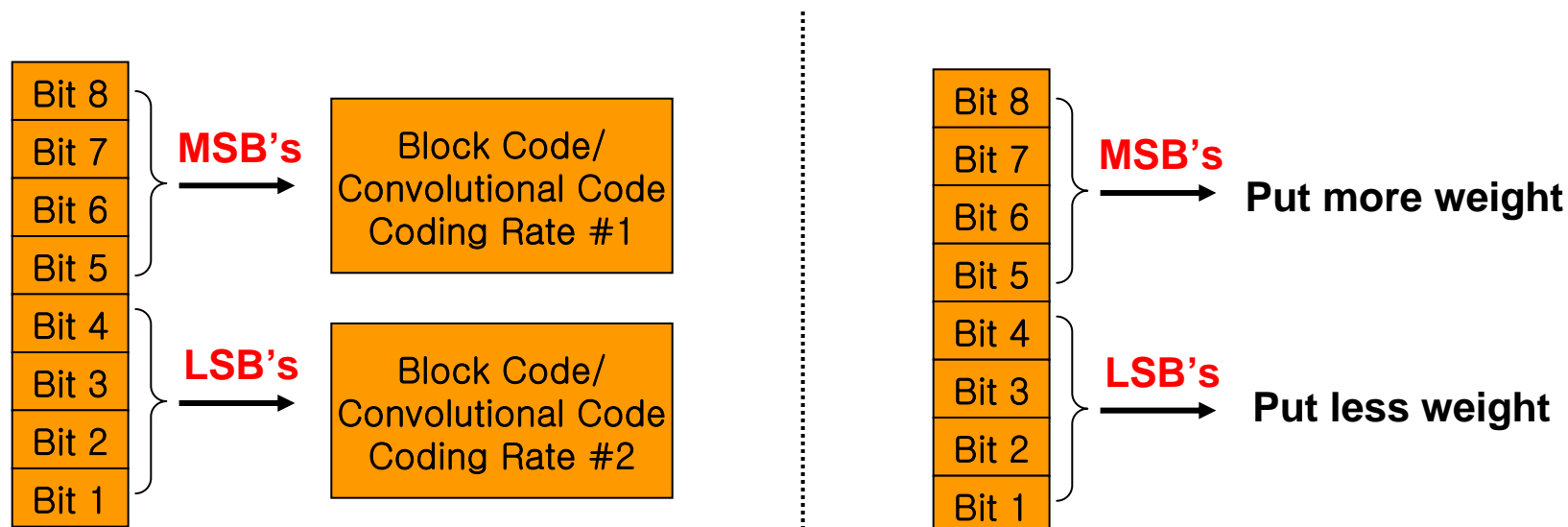
Method 1 : Imposing different coding rates on MSB's and LSB's

→ Effective use of the limited coding redundancy

Method 2 : Weighting MSB's and LSB's separately in the mapping

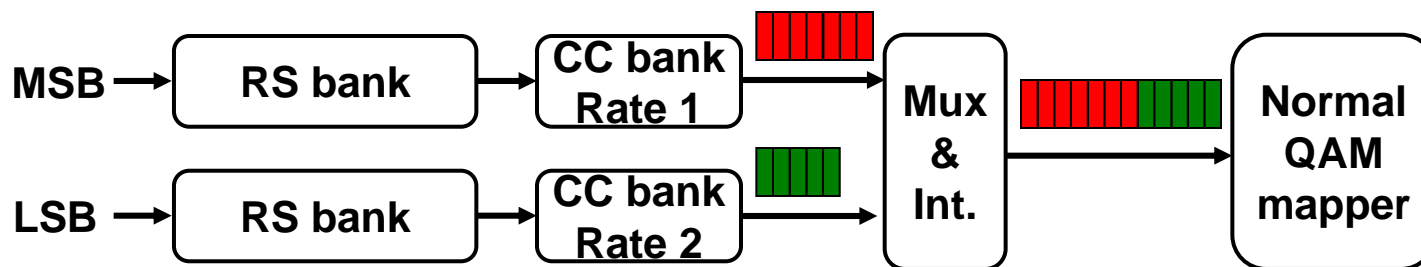
→ Effective use of the limited transmit power

With these two methods, different levels of UEP protection are provided.

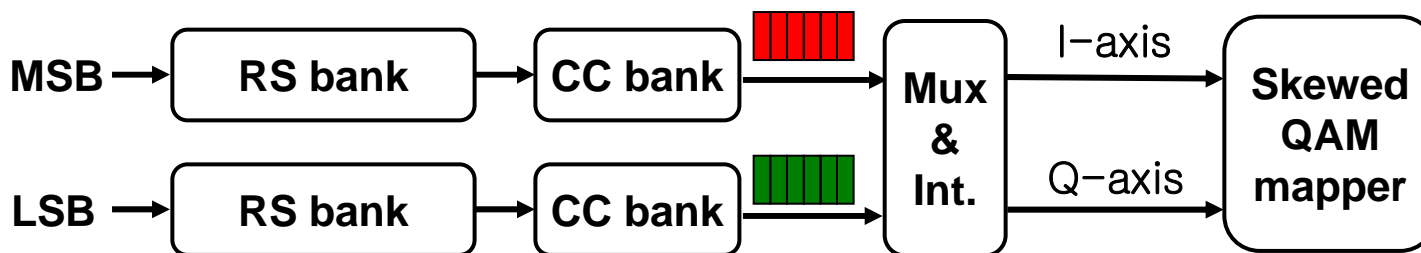


UEP Description

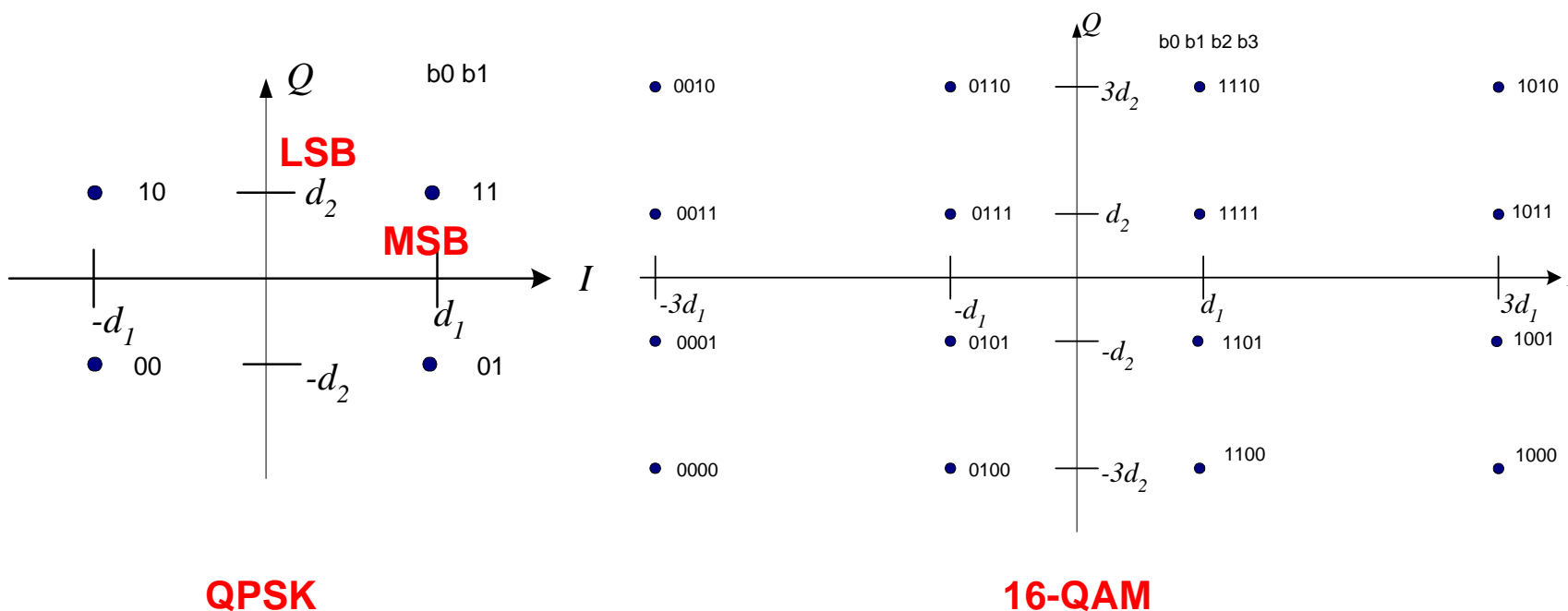
• UEP - Coding



• UEP - Mapping

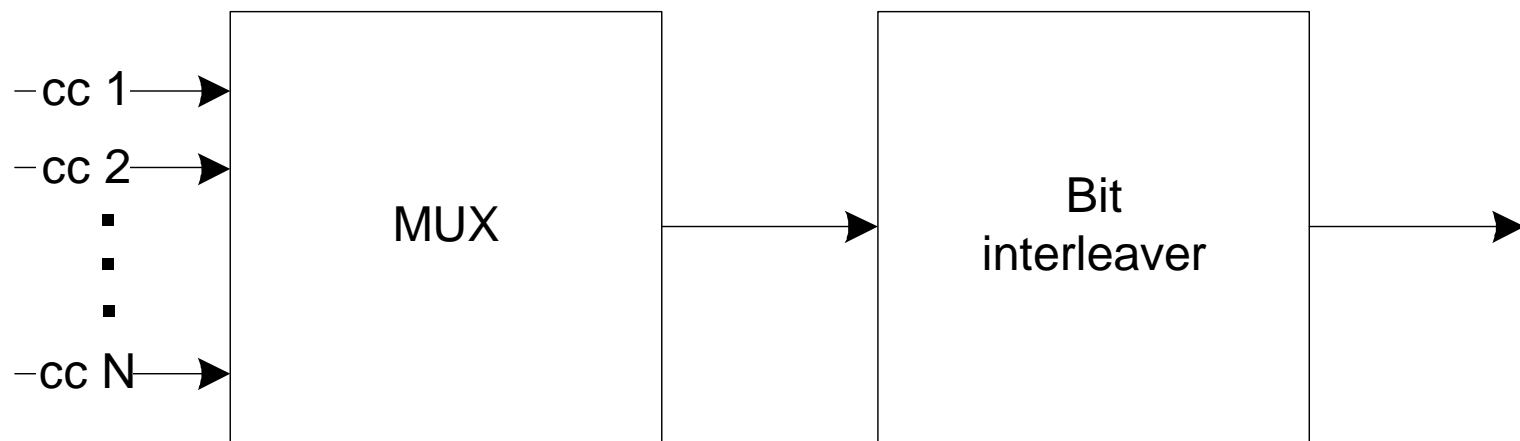


Skewed Constellation for UEP-mapping



Multiplexer and Bit Interleaver

- Parallel convolutional encoders and decoders are needed in order to support multi-gigabit data throughput
- Data multiplexer (MUX) combines data from all parallel convolutional encoders
- Bit interleaver shuffles bits from multiplexer to I/Q constellations



cc : convolutional encoder

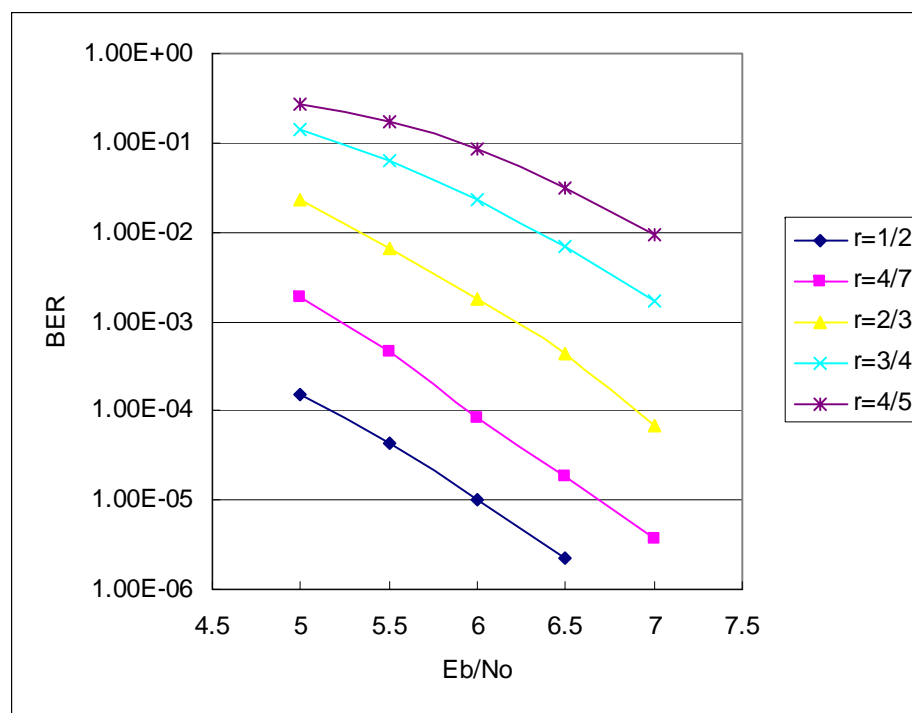
Simulations

Simulation Conditions

- ✓ Convolutional coding (1/3 mother code : 133, 171, 165) over AWGN channel
- ✓ Varying E_b/N_0 from 5dB to 7dB, observe the subjective video quality
- ✓ Randomly distributed additive white noise
- ✓ No outer coding

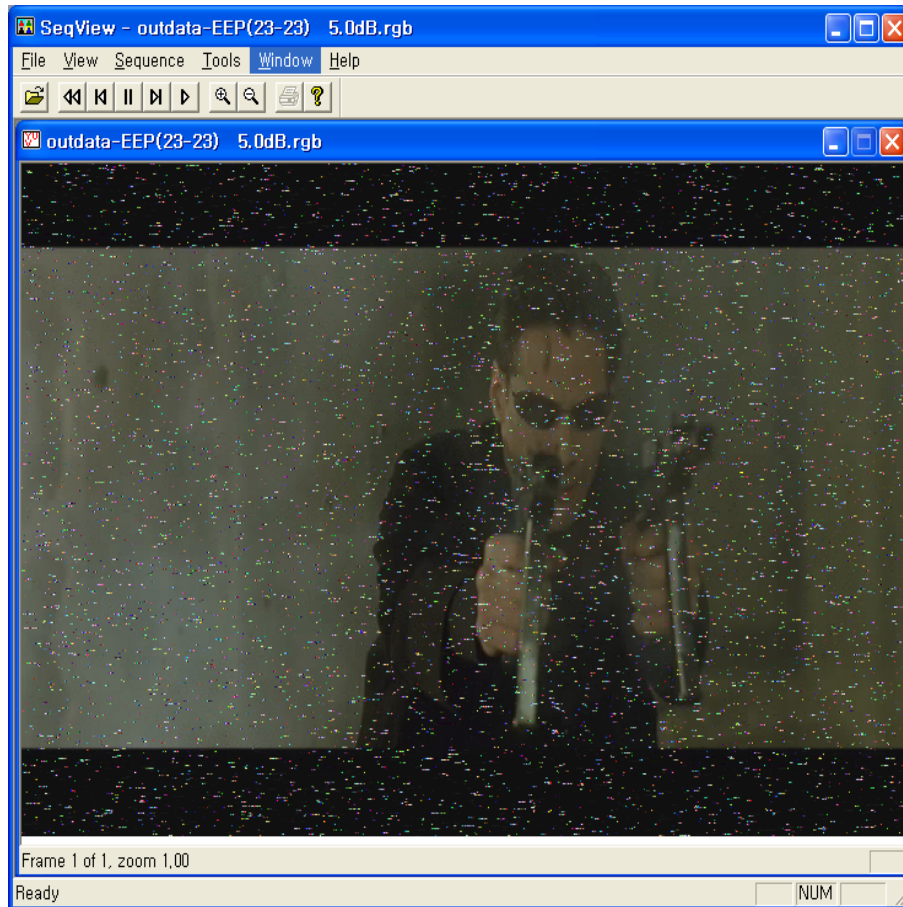
Example :

EEP 2/3 = UEP (MSB : 4/7 + LSB : 4/5)

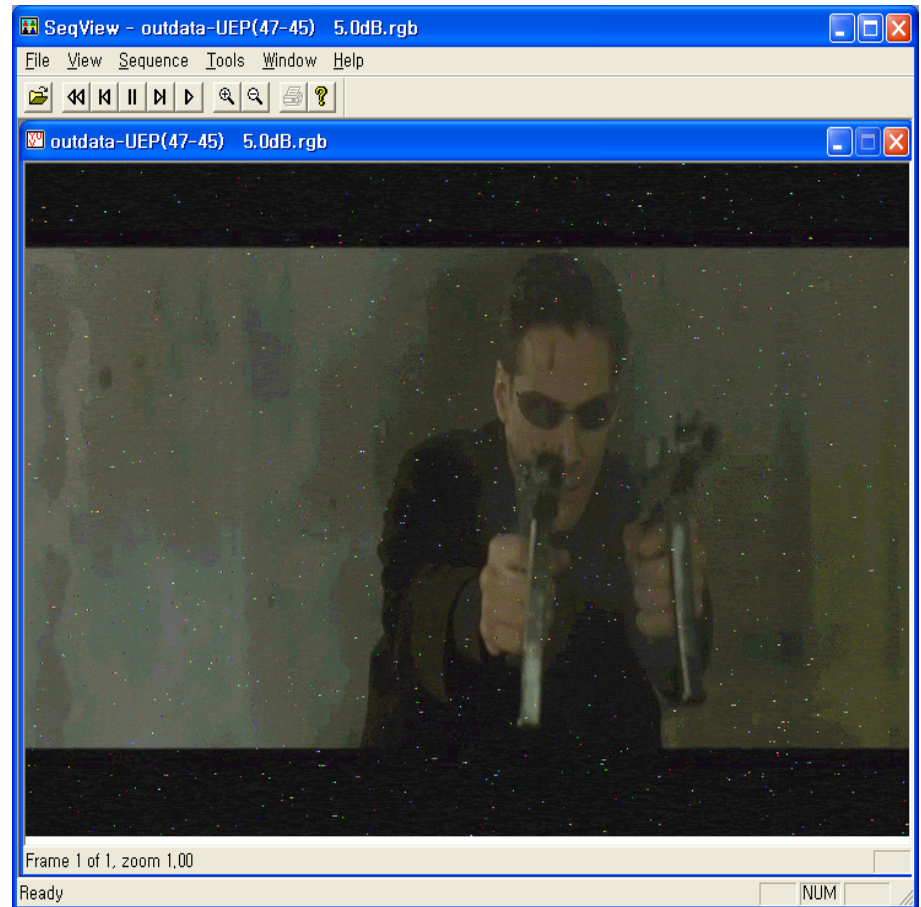


Effect of UEP on Image

$E_b/N_o = 5\text{dB}$



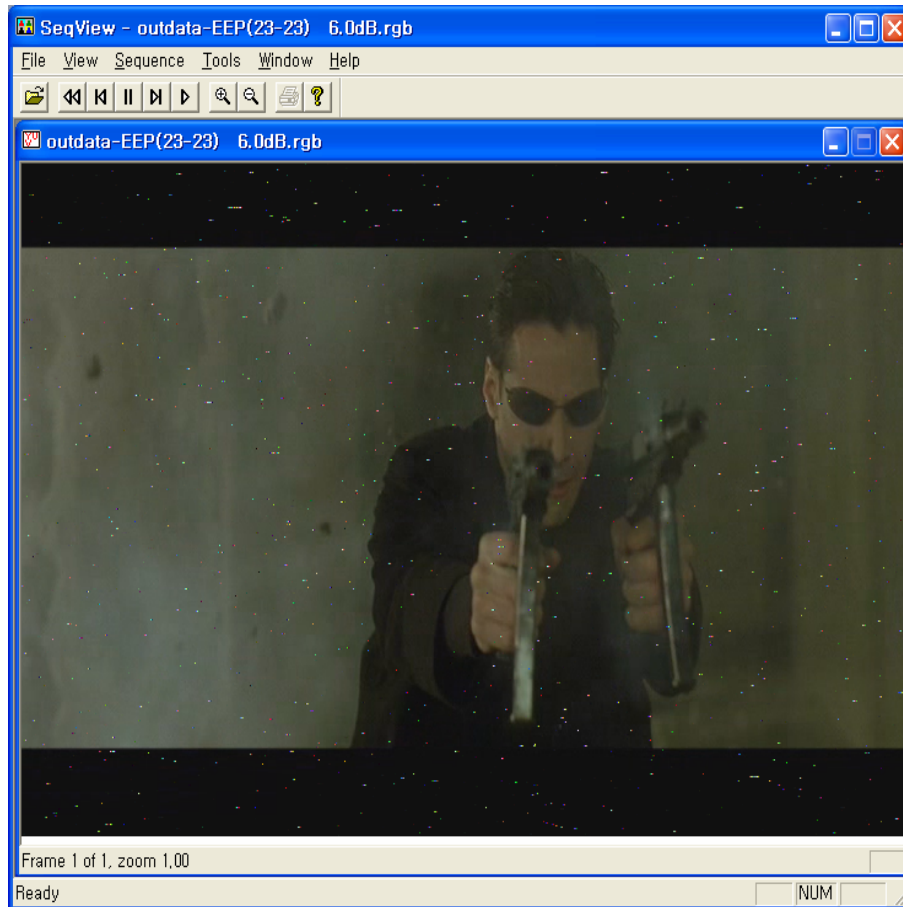
EEP (2/3 rate)



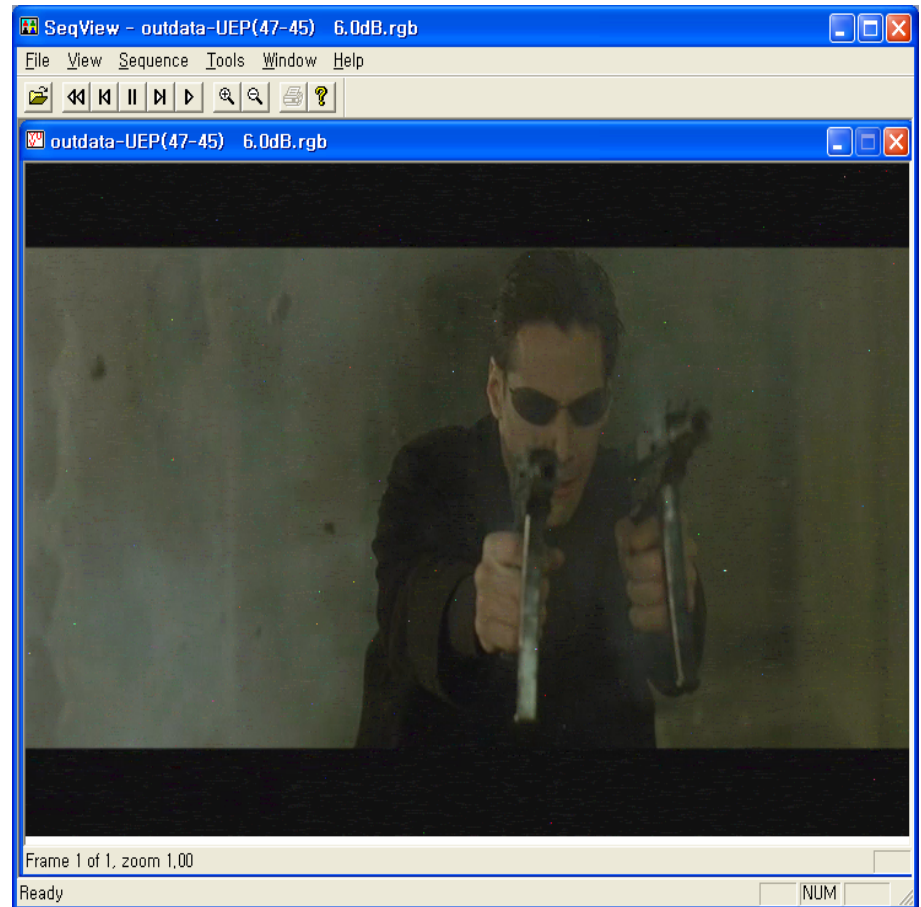
UEP (4/7 + 4/5 rate)

Effect of UEP on Image

$E_b/N_0 = 6\text{dB}$



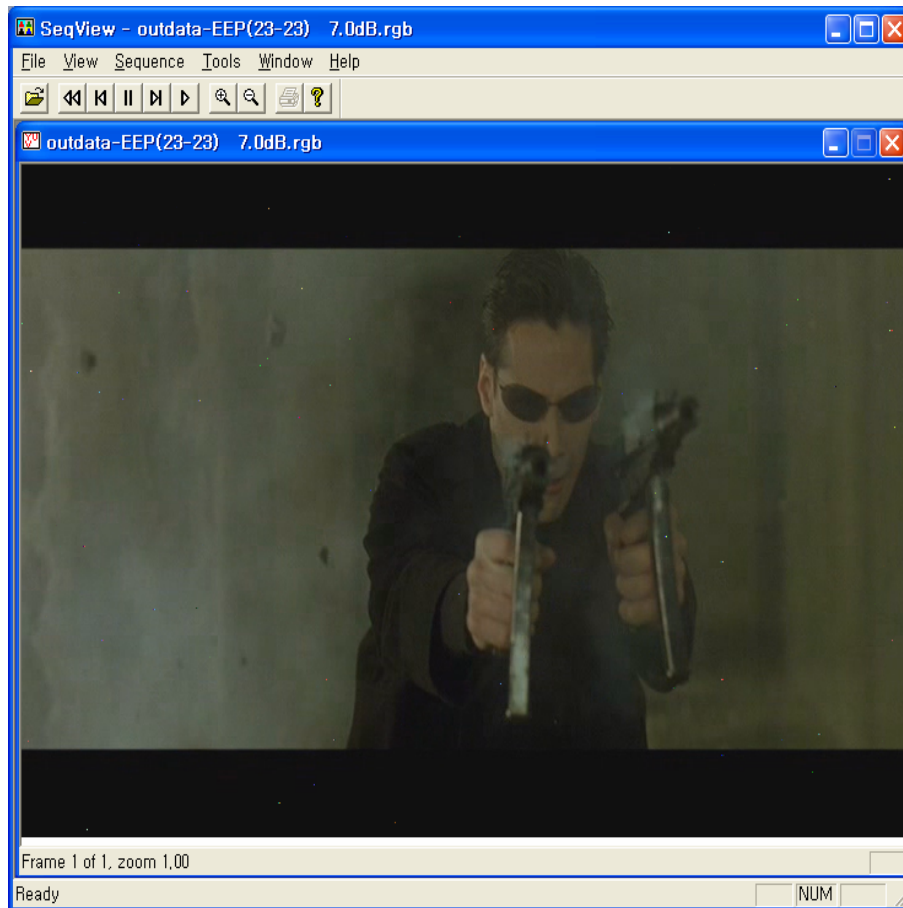
EEP (2/3 rate)



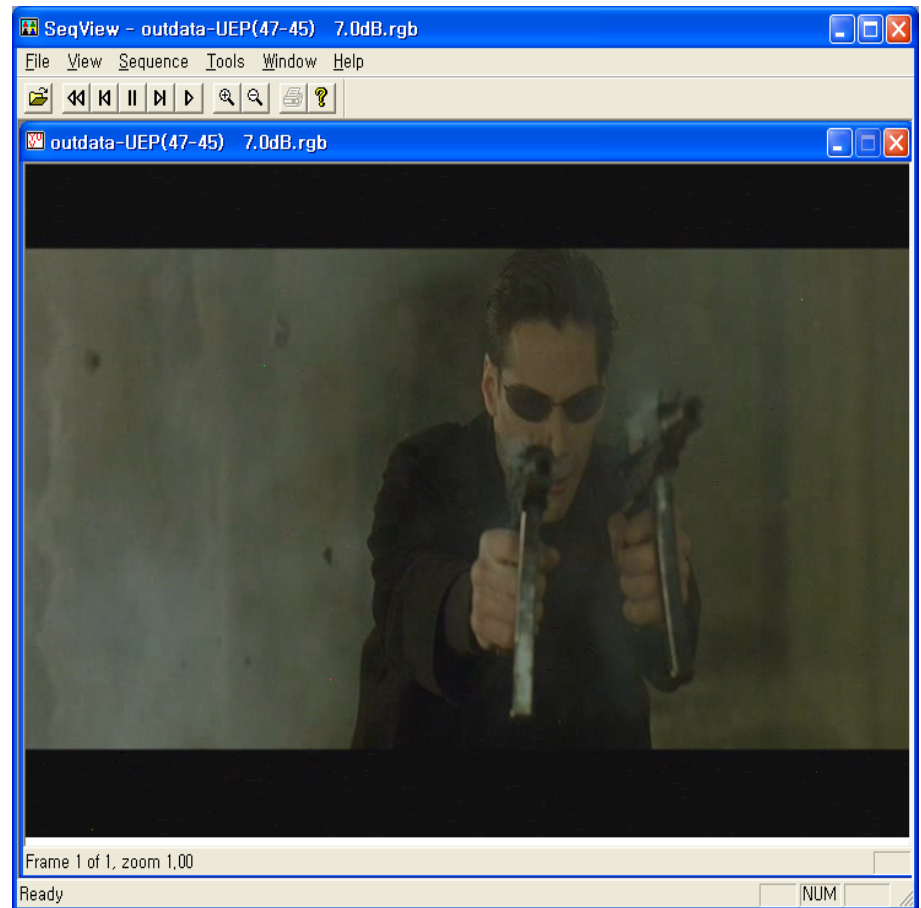
UEP (4/7 + 4/5 rate)

Effect of UEP on Image

$E_b/N_o = 7\text{dB}$

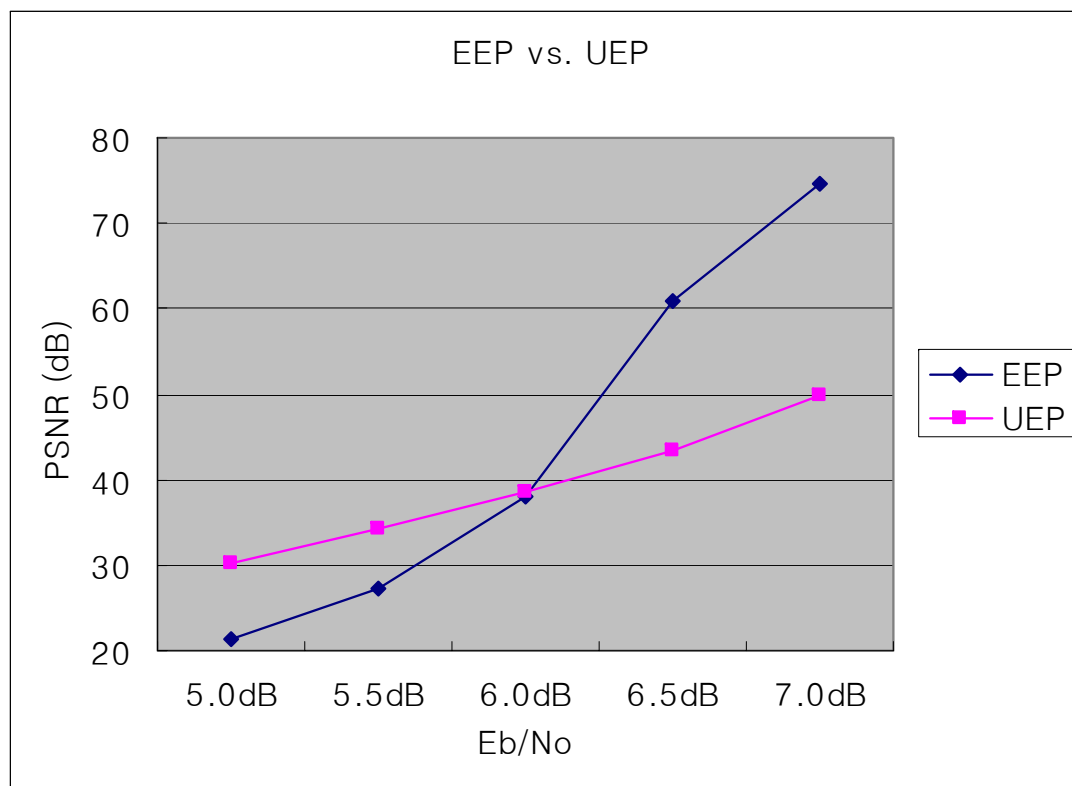


EEP (2/3 rate)



UEP (4/7 + 4/5 rate)

PSNR Performance



Note :

Human eyes hardly recognize degradation beyond 40dB PSNR
(ex : MPEG2 decoding PSNR = 35 ~ 40dB)

Summary

- It is very natural to exploit the nature of input data for channel coding and modulation
- UEP is a key technology to improve QoS for video application
- Two methods of UEP: Coding and Mapping
 - Provide flexible level of UEP protection
- UEP coding can be used with either convolutional codes or block codes