Adaptive channel coding scheme for QoS guarantees

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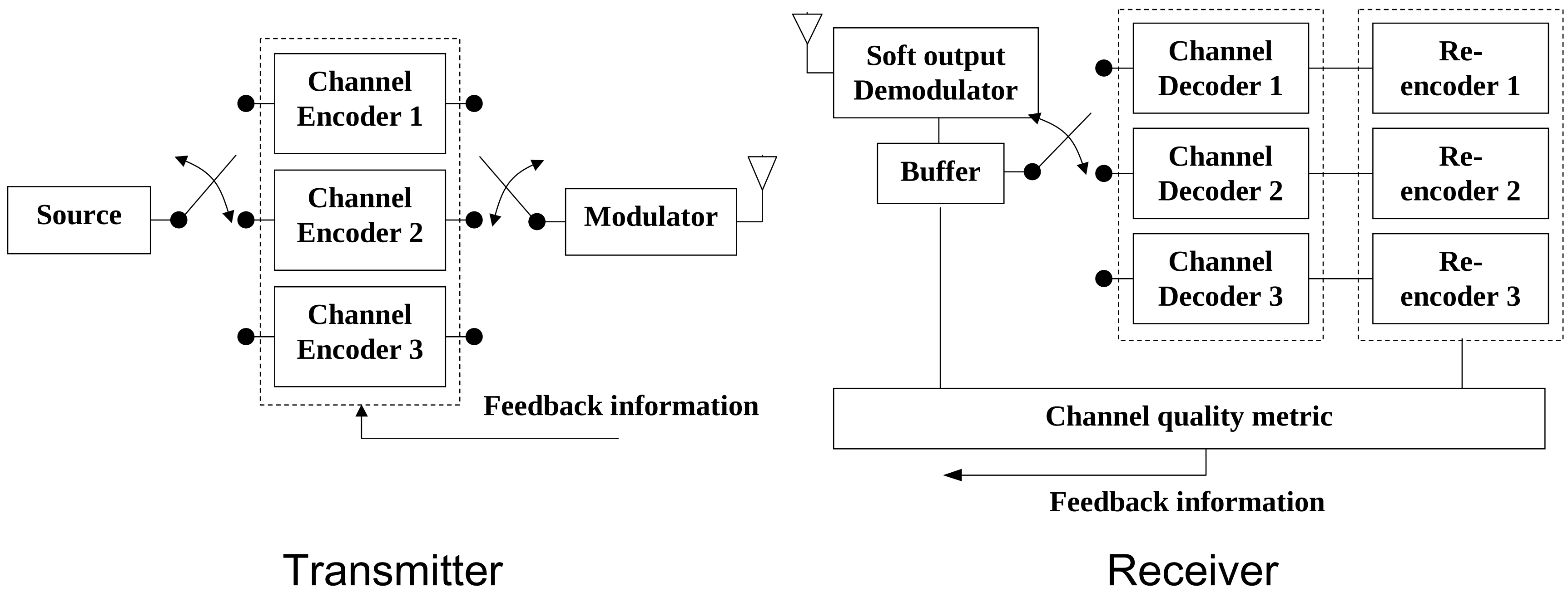
Contents

Introduction

- Due to the advent of software defined radio, the availability of flexible and reconfigurable transceivers has renewed interest in adaptive techniques.
- To maximize the use of wireless channel resources, it is important that the design of wireless multimedia communication systems has to consider the variation in channel condition fluctuation and QoS (Quality of Service) requirements of applications such as voice, data, video and etc.
- One of the methods fully utilizing the channel capacity is the adaptation technique.
- This paper focuses on an adaptive channel coding scheme and proposes new channel quality metric.

System Model



Overview of channel quality metric (1)

- For the use of effective channel resources, it is important to measu re the channel quality.
- The points to be considered, when designing the channel quality m etric, are a variety of wireless channel, measurement period, compl exity, particular signal for measurement and so on.
- So far, there have been some methods such as measuring averag e SNR (Signal to Noise Ratio) and Euclidean distance at demodula tor, counting PER (Packet Error Rate) at link layer, SINR at the eq ualizer's output, and etc.

Overview of channel quality metric (2)

- In TDMA system, channel quality is estimated at the receiver and the information is provided to the transmitter through appropriately defined messages.
- Metric that have been proposed for estimating channel quality are as follow
  - Frame error rate
  - Mean and standard deviation of symbol error rate or BER (Counting error)
  - Average SINR, which may be computed using the minimum Euclidean distance metric derived from a Viterbi decoder or alternatively computed using subspace projection techniques.

Ref : [5] S. Nanda, K. Balachandran, and S. Kumar, "Adaptive Techniques in Wireless Packet Data Services," ***IEEE Communications Magazine*****, Vol. 38, Issue. 1, pp.54-64, Jan. 2000.**

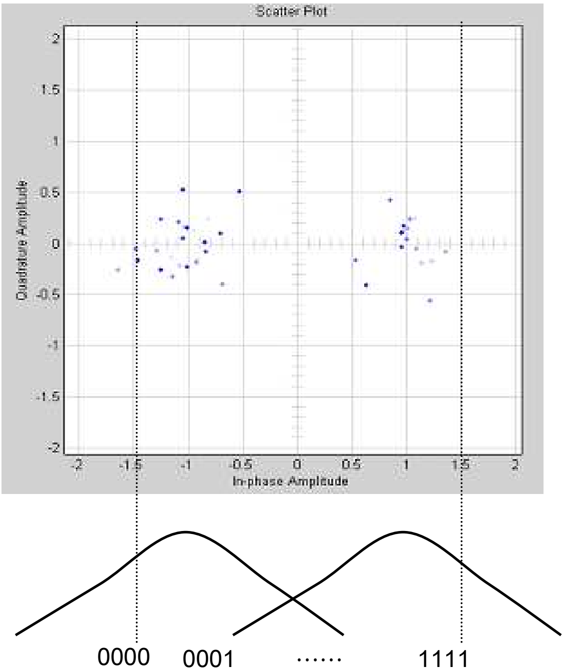
Design of channel quality metric

- Demodulated signals represent points on the signal constellation. These a re distorted by channel noises and represent a channel condition.

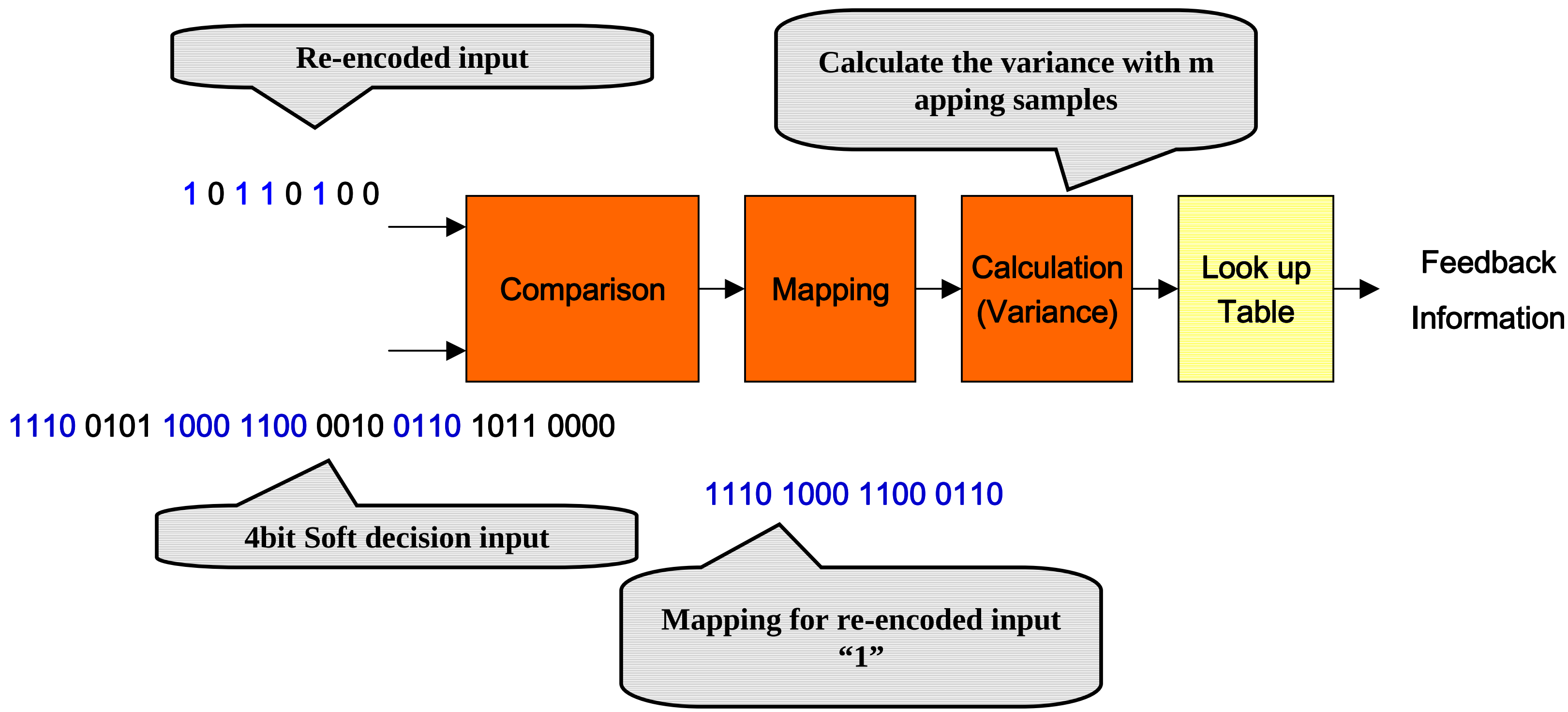
- When varying AWGN channel, variance σ_0^2 and mean change. However mean has a small change because it is revised at demodulator. Therefore pri mary channel quality metric is the variance σ_0^2.

- If channel condition is good (Eb/No is high), they increase. If channel condition is bad (Eb/No is low), they decrease.

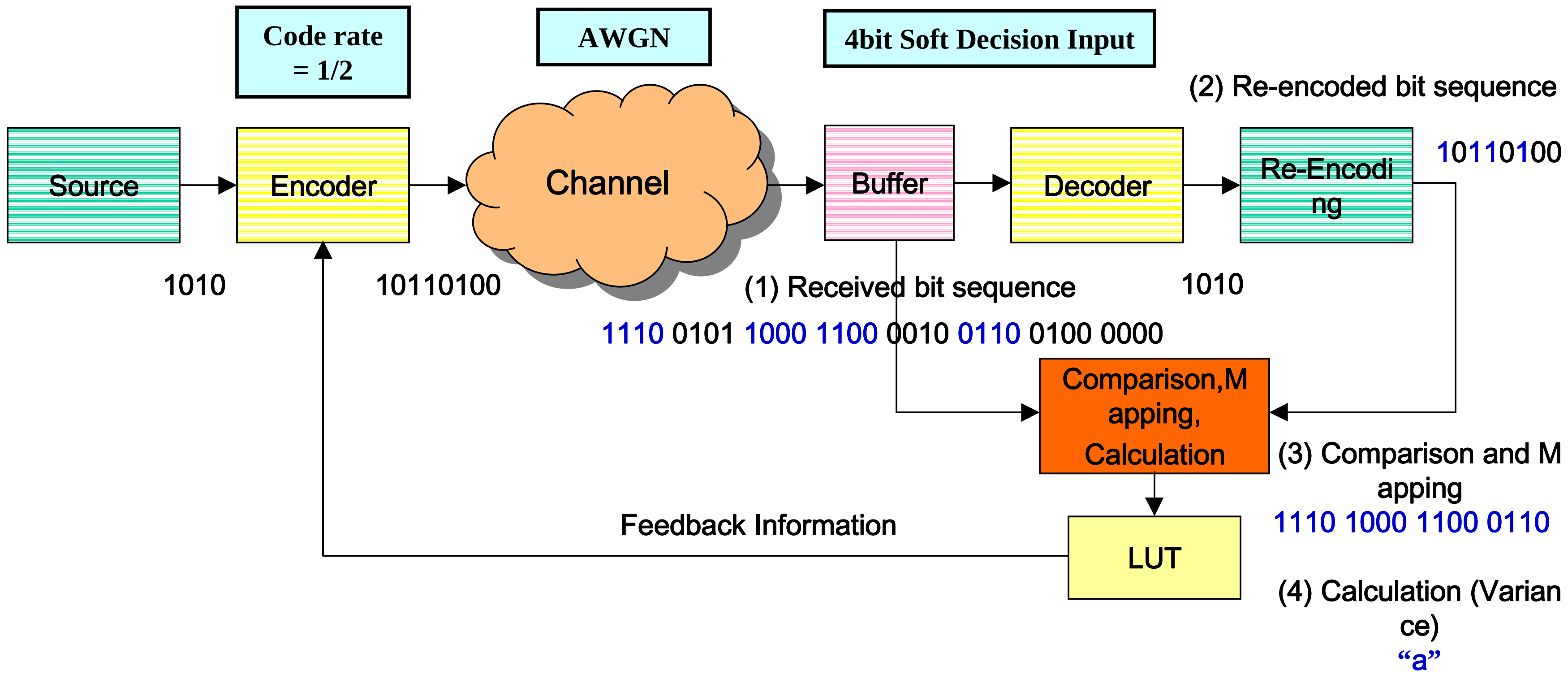
- Therefore Look-up table of channel quality metric is made by simulation results that channel conditio n (Eb/No) correlates to variance σ_0^2.



Procedure of channel quality metric



Example (1)



Code rate = 1/2
AWGN
4bit Soft Decision Input
(2) Re-encoded bit sequence
Source
Encoder
Channel
Buffer
Decoder
Re-Encoding
10110100
1010
10110100
(1) Received bit sequence
1010
1110 0101 1000 1100 0010 0110 0100 0000
Comparison,Mapping, Calculation
(3) Comparison and Mapping
1110 1000 1100 0110
Feedback Information
LUT
(4) Calculation (Variance)
"a"

Example (2)

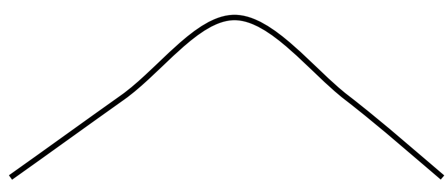
(1) When channel condition is good.

Soft in	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
Num	0	0	0	0	0	0	13	11	37	38	57	57	42	35	6	4

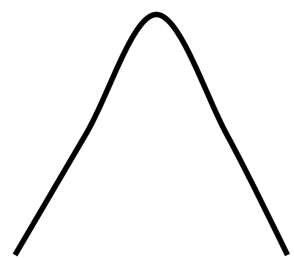
(2) When channel condition is bad

Soft in	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
Num	0	0	0	0	0	0	6	9	14	54	55	71	45	38	8	0

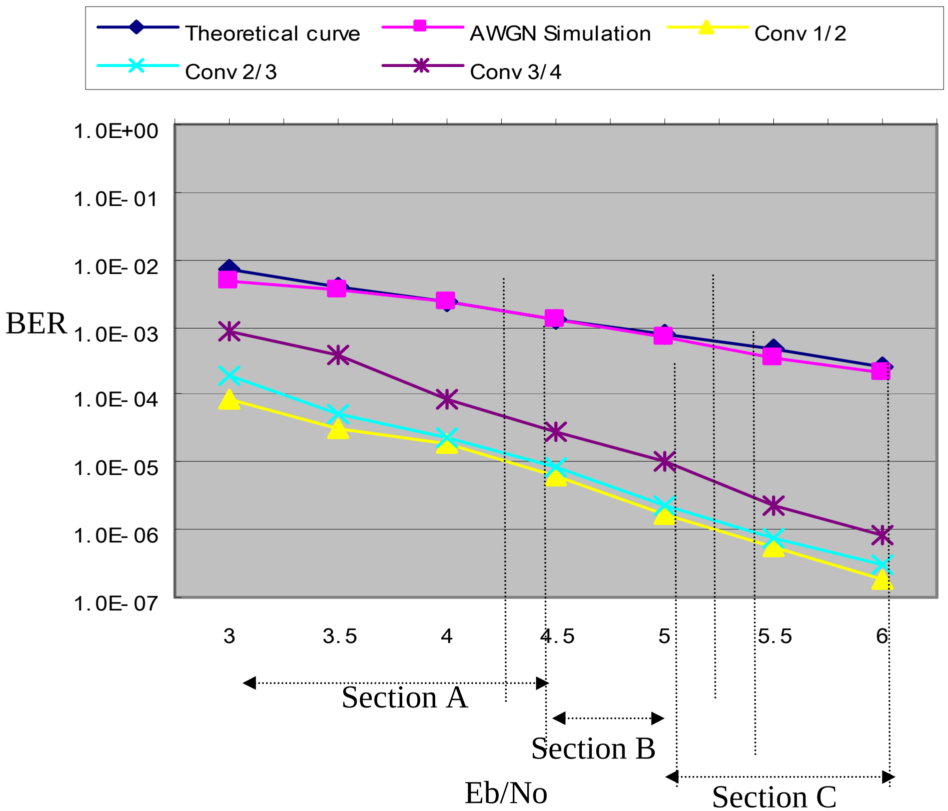
(1)



(2)

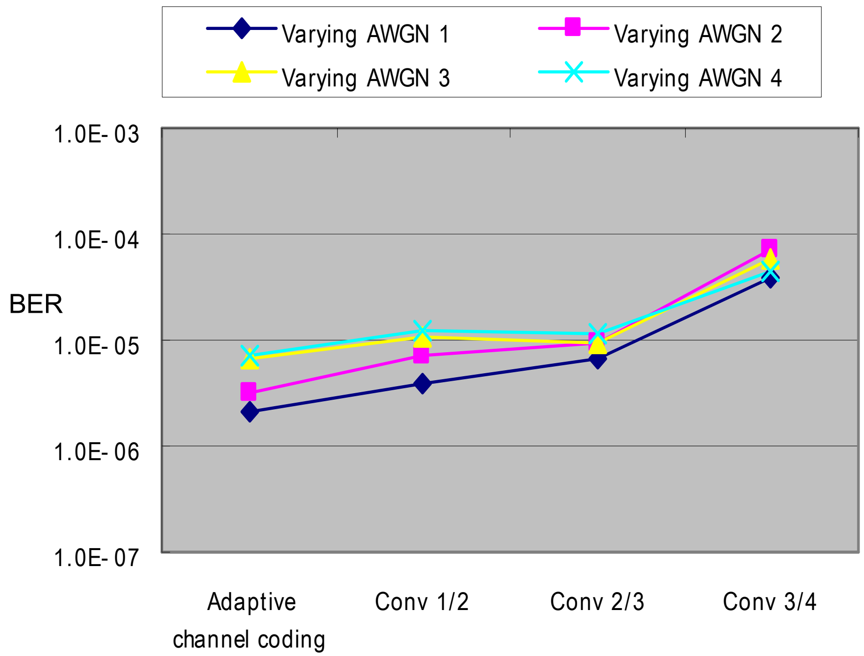


Adaptive channel coding scheme



- For maintaining the desired BER = 1e-6,
- Section is divided as follows.
- Section A (3 ~ 4.5dB) means bad channel condition to use convolution code 1/2.
- Section B (4.5 ~ 5 dB) means not bad channel condition to use convolution code 2/3.
- Section C (5 ~ 6dB) means good channel condition to use convolution code 3/4.

Simulation Results



- Varying AWGN 1, 2, 3, and 4 change Eb/No from 4.5dB to 6dB, 4dB to 6dB, 3.5dB to 6dB, and 3dB to 6dB respectively.
- Adaptive channel coding scheme shows to maintain the desired BER~1e-6

Conclusions

- This paper proposes the simple method to know the channel condi tion and performs a simulation. Through the proposed channel qua lity metric, adaptive channel coding can maintain the desired BER over varying AWGN channel.

Future works

- This paper showed the results of adaptive channel coding scheme with proposed channel quality metric over AWGN environment. Ho wever the real channel environment is close the Rayleigh and Rici an multi-path fading channel. Therefore we are planning to apply it over the multi-path fading channel at more complicated wireless sy stem.

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