Link-to-System Performance Mapping based on Effective SNR

IEEE 802.16 Presentation Submission Template (Rev. 8.3)
Document Number:
IEEE S802.16m-07/059

Date Submitted:
2007-03-13

Source:
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Venue:
IEEE 802.16 Session #48, Orlando, USA

Base Document:
IEEE C802.16m-07/059r1

Purpose:
TGm Evaluation Methodology development

Link-to-System Performance Mapping based on Effective SNR

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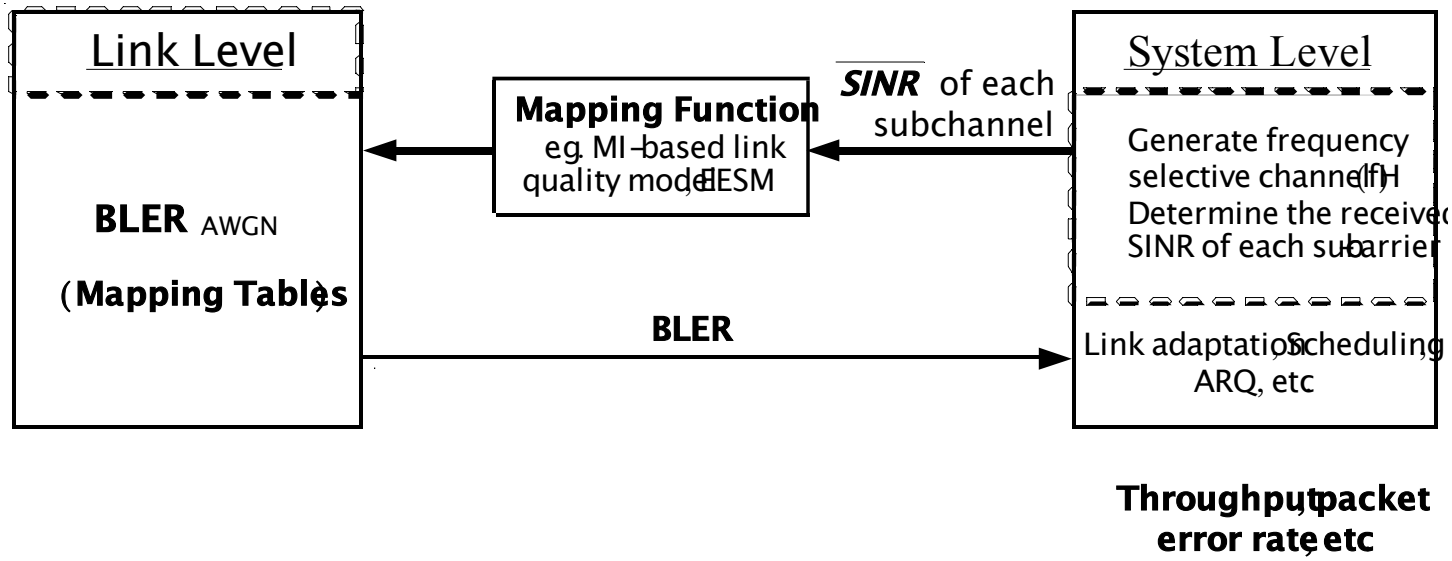
Outline

- **Introduction**
- **MI-based Link Quality Model**
- **Summary**

Introduction

- In IEEE 802.16 OFDMA system, the link-to-system performance mapping is required to translate the effective channel quality index, e.g. effective SINR or RBIR of each sub-channel, into the performance metric, e.g. block error rate (BLER).
  - Note that the received signal quality by each sub-carrier in the same sub-channel is usually different.



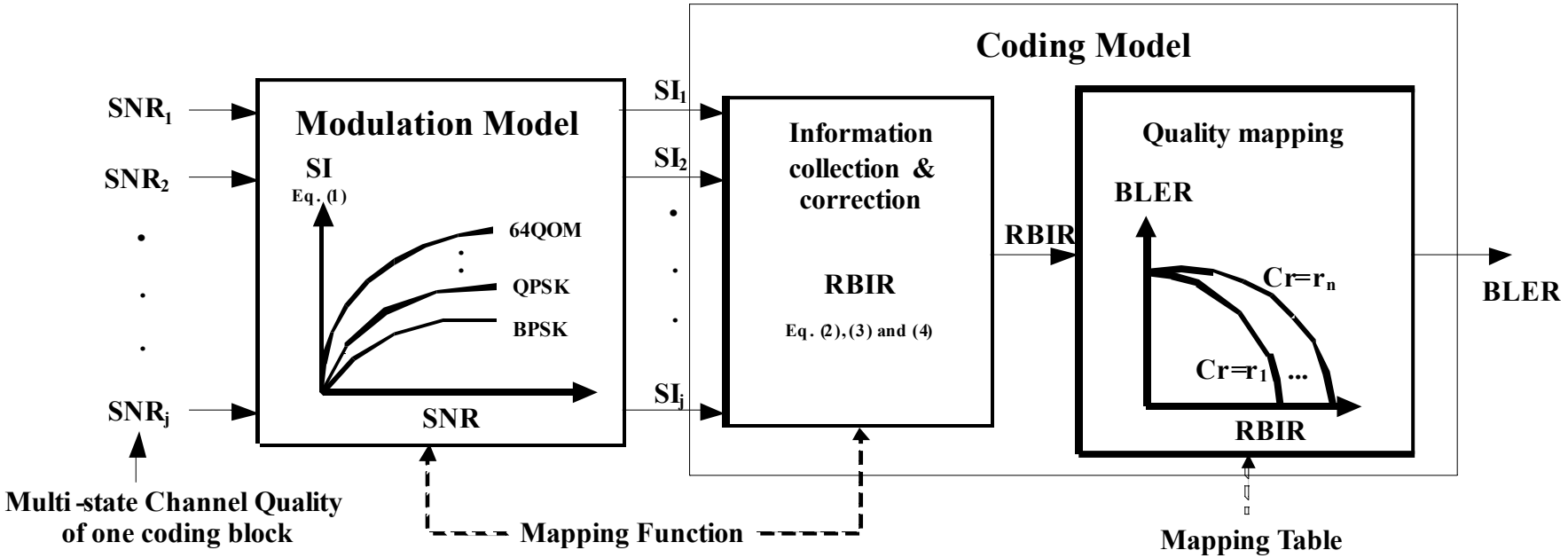
Introduction

- There are several popular mapping functions proposed in literatures, such as:
  - Linear average over the frequency selective fading channel
  - Exponential Effective SINR Mapping (EESM) [1]
  - Mutual Information (MI) based link quality model [2,3]

- According to previous researches [2,3], it shows that the MI-based link quality model can outperform EESM method by its suitability when simulating the HARQ or the coding block with mixed modulation.
  - It also shows that its accuracy is good

MI-based Link Quality Model

- MI-based Link Quality Model Structure
  - SI: Symbol Information
  - RBIR: Received coded Bit Information Rate



MI-based Link Quality Model

Modulation Model

- For M-ary modulation, with modulation order m, the symbol information of the channel symbol SNR value is defined as

$$SI(\gamma, m) = E_{XY}\left\{\log_2 \frac{P(Y \mid X, \gamma)}{\sum_X P(X)P(Y \mid X, \gamma)}\right\} \quad (1)$$

  - where Y is the complex-value channel output symbol with SNR equal to
  - P(Y| X,) is the AWGN channel transition probability density conditioned on the noise-free channel symbol X.
- For the j^{th} symbol with modulation order m_j and channel state SNR $_j$, the symbol information SI($_j$, m_j) can be obtained by a modulation model look-up table.

MI-based Link Quality Model

Coding Model

- The SI collection/correction unit first collects the received coded bit information (RBI) among the J symbols with SNR values { $_1$, $_2$, …, $_J$} and modulation order {m_1, m_2, …, m_J}

(2)

- The received bit information rate (RBIR) is obtained by normalizing RBI of total coded bits, which is equivalent to the sample average of normalized SI over the received code blocks with single modulation mode.

(3)

MI-based Link Quality Model

Adjusting Factor and Performance Mapping

- When considering the practical coding loss from the Shannon limit, there is an adjusting factor $_{cod}$ applying to the SI values before they are combined into RBIR

$$RBI_0 = \sum_j SI(g_j / g_{cod}, m_j) \quad (4)$$

- The channel quality measurement, e.g. block error rate (BLER), based on the simulated AWGN performance can be obtained by a RBIR-to-BLER mapping.

Summary

- An MI-based link quality model is introduced in this contribution to evaluate the effective channel quality for the sub-channel in IEEE 802.16 OFDMA system.

- By transforming multiple-state SNR into the mutual information domain, and then calculating the received bit information rate (RBIR), the BLER of the effective channel can be obtained through a RBIR-to-BLER mapping.

Summary

- From [2,3], the performance of MI-based link quality model is with high accuracy compared with other existing quality models.

- Meanwhile, the MI-based link quality model is simpler and easier to be applied in system level simulation when the modulation and H-ARQ schemes may be time variant.

- Based on the proposed MI-based link quality model, the results collected by system level simulation will be more accurate and closer to real situation.

References

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