

教育部「5G行動寬頻人才培育跨校教學聯盟計畫」
5G行動網路協定與核網技術聯盟中心

課程: 5G系統層模擬技術

第十週：實驗三 通道模型、子載波信號干擾雜
訊比及實體層萃取的觀察分析



國立中正大學
National Chung Cheng University

Outline

- Effective SINR
- EESM
- CESM
- 實驗



Effective SINR

- OFDM技術的運用，使得每個transport block中會有數個subcarriers，每個subcarrier所在的頻率皆不同
- Multipath fading會導致在不同subcarrier所感受到的干擾不同(frequency selective fading)，因此，每個subcarrier的SINR會不同
 - ◆ Different channel quality for different subcarrier

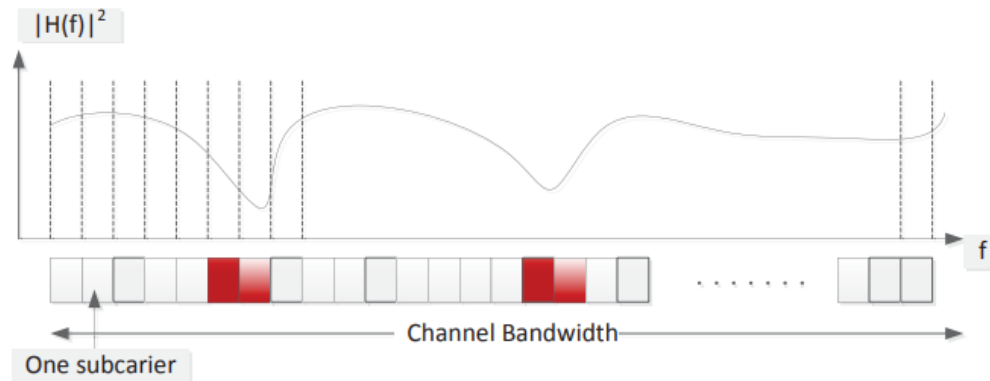


Fig. 1. Effect of multipath fading on one transmitted block.

Effective SINR

- 由於，依據數個SINR值來決定一個transport block整體的BLER是十分的困難
 - ◆ 需要一個機制使數個SINR整合成一個SINR(Effective SINR)

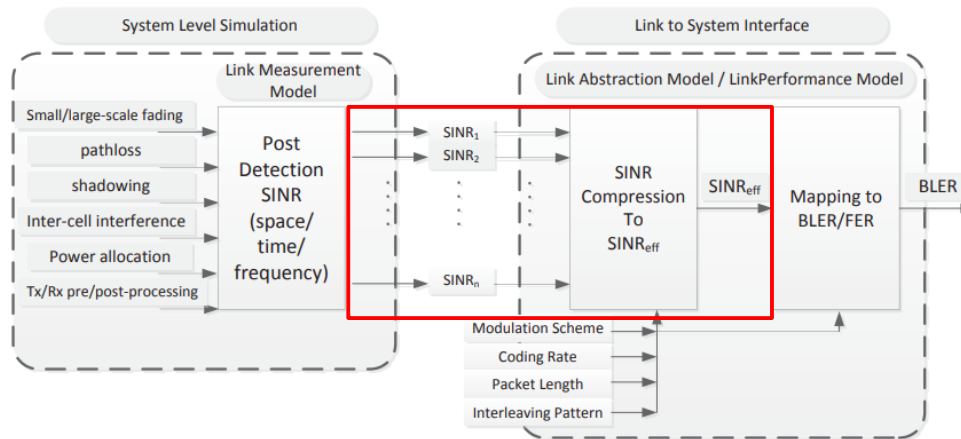


Fig. 2. Link-to-System interface mapping.

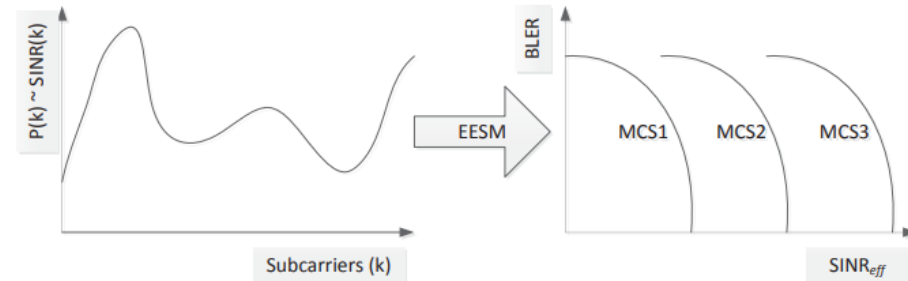


Fig. 3. Mapping in EESM model.

EESM

- The Exponential Effective SINR Mapping model, as its name refers, computes the information measure based on exponential function $\varphi(\text{SINR}) = \exp(-\text{SINRs})$.
- The final derivation of the formula is as follows:

$$\text{SINR}_{eff} = -\beta \ln \left(\frac{1}{N} \sum_{k=1}^N \exp \left(-\frac{\text{SINR}_k}{\beta} \right) \right)$$



CESM

- This approach is based on the channel capacity measure and it is called the Capacity Effective SINR Mapping (CESM). The main formula to calculate the information measure based channel capacity is as follows:

$$I_{\gamma} = \log(1 + \gamma)$$

- The effective SINR value as follows:

先算出每個subcarrier
的capacity

$$SINR_{eff} = \beta * (2^{\left(\frac{1}{N} \sum_{k=1}^N \log_2 \left(1 + \frac{SINR_k}{\beta}\right)\right)} - 1)$$

得到平均的capacity後，回推為對應的
SINR，即為effective SINR



實驗

- 假設有11個subcarriers，每個subcarrier都有其對應之SINR，請算出其average SINR，並以CESM以及EESM公式算出其effective SINR
 - ◆ <https://octave-online.net/>
 - ◆ 假設serving power、noise+interference、 β 皆為1



實驗步驟(1/2)

- <https://octave-online.net/>
- Step 1：求出11個subcarrier的channel

```
octave:2> N=11
N = 11
octave:3> H = complex(randn(N,1),randn(N,1))./sqrt(2)
H =

    0.26183 - 0.56967i
   -0.53113 + 0.57660i
   -1.08549 - 0.31130i
    0.88280 - 0.70446i
   -0.35403 - 0.16401i
   -0.28396 - 0.62286i
   -0.33042 - 0.14149i
    0.27947 - 0.92515i
    0.99409 - 1.14033i
    0.08107 - 0.31856i
    0.38991 + 0.35475i
```



實驗步驟(2/2)

- Step 2：求出channel power gain & SINR

OK!

```
octave:4> abs(H).^2  
ans =
```

```
0.39308  
0.61457  
1.27519  
1.27560  
0.15224  
0.46858  
0.12919  
0.93400  
2.28856  
0.10805  
0.27788
```

若serving power、noise + interference皆為1
Channel power gain = SINR

- Step 3：依照EESM以及CESM公式求出effective SINR

延伸思考

- 相同的average SINR，會因為標準差不同而導致effective SINR不同嗎？

