TSG-RAN Working Group 1 Meeting #17 TSGR1#17(00)1327

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Agenda Item:	AH24: High Speed Downlink Packet Access
Source:	Wiscom Technologies
Title:	Influence of channel estimation on the link level performance of HSDPA
Document for:	Discussion

1 Introduction

Link level simulation results of High Speed Down Link Packet Access (HSDPA) have been presented in several contributions [1-7]. Most of the simulations assume ideal channel estimation. However, it is well known that the link level performance is largely affected by channel estimation, especially in the higher modulation, Turbo code, and high vehicle speed situations. The fundamental reason behind this is that both Turbo code and higher modulation traditionally work well for AWGN channel. This contribution presents the preliminary simulation results regarding the influence of channel estimation on the link level performance of HSDPA.

2 Simulation parameters

Simulation parameters were set according to the presented assumptions [4]. In this contribution the simulations were run in a 1-path Rayleigh fading channel.

Parameter	Value	Comments
Carrier Frequency	2GHz	
Propagation conditions	Flat Rayleigh fading	
Vehicle Speed for Flat Fading	3kmph, 120kmph	
CPICH power	10%(-10dB)	
Ec/Ior	-1dB	80% of total transmission power
Closed loop Power Control	Off	
HSDPA frame Length	3.33 ms (5 slots)	
Ior/Ioc	Variable	
Channel Estimation	Non-Ideal	
Fast fading model	Jakes spectrum	Jakes model
Channel coding	Turbo code (PCCC), rate 1/2.	
Tail bits	6	
Max no. of iterations for Turbo Coder	8	
Metric for Turbo Coder	Max-Log-MAP	
Input to Turbo Decoder	Soft	
Turbo Interleaver	per 3GPP TS25.212	Modified to handle large frame size [3]
Number of Rake fingers	1	1-path Rayleigh channel
Hybrid ARQ	None	
Max number of frame transmissions for H-ARQ	None	
Information Bit Rates (Kbps)	As defined	
Number of Multicodes Simulated	1	Simulate only 1 code
TFCI model	None	
STTD	Off	
Other L1 Parameters	As Specified in Release-99 Specification	

3 Channel Estimation Error Model

The channel estimation errors depend on both the estimation method and the signal conditions, such as SINR and correlation between signal samples. Besides the simple channel estimation by averaging CPICH symbols, the weighted multislot averaging (WMSA) channel estimation and other advanced techniques based on the estimated Doppler frequency can also be used. Without considering a specific channel estimation technique, we formulate a simple and realistic channel estimation error model as follows

$$\hat{h}(t) = h(t) + e(t) \qquad \textbf{(1)}$$

where $\hat{h}(t)$ is the estimate of true channel response *h(t)*, and *e(t)* is a complex Gaussian random variable with zero mean and variance σ_e^2. In the case of Rayleigh fading channel, *h(t)* is also a zero mean complex Gaussian random variable with variance σ_h^2. In the simulation, we use the ratio of σ_e^2 over σ_h^2 to represent the channel estimation accuracy.

4 Simulation Results

Figure 1 and 2 show the FER versus Ior/Ioc for QPSK modulation in a 1-path Rayleigh with vehicle speed of 3kmph and 120kmph respectively. Figure 3 and 4 show the FER versus Ior/Ioc for 16QAM modulation in a 1-path Rayleigh with vehicle speed of 3kmph and 120kmph respectively. Notice that with ideal channel estimation (ICE), the FER performance at higher vehicle speed is better than that at lower vehicle speed for both QPSK and 16QAM due to more un-correlated errors at higher speed. However, in higher speed case, the channel estimation errors are generally large due to the time-variant behaviour of the channel. Such channel estimation errors may dramatically degrade the performance as shown in the figures. For higher modulation, such as 16QAM and 64QAM, the channel estimation accuracy is more important because of the close signal constellation and both phase and magnitude related soft input calculation.

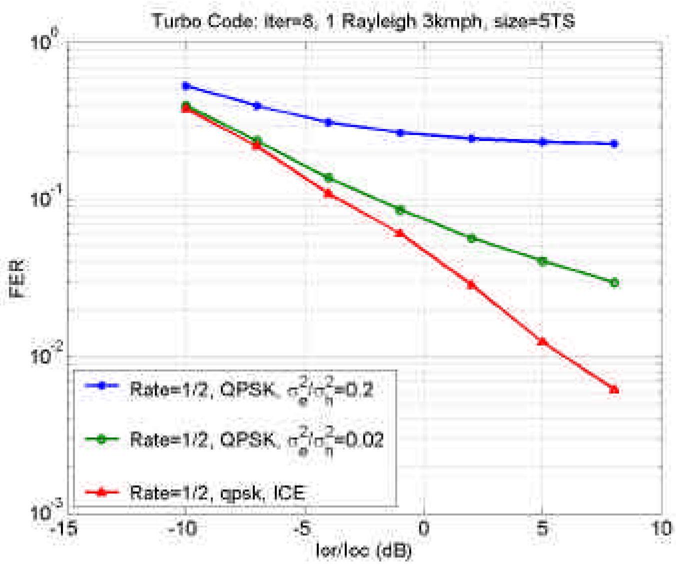

Figure 1. FER versus Ior/Ioc, 1-path Rayleigh channel, speed = 3kmph, Rate = 1/2, frame size = 5 time slot, QPSK.

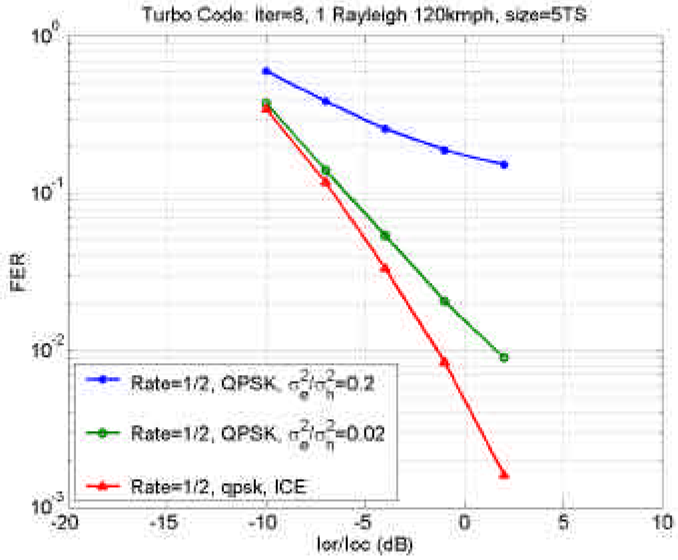

Figure 2. FER versus Ior/Ioc, 1-path Rayleigh channel, speed = 120kmph, Rate = 1/2, frame size = 5 time slot, QPSK.

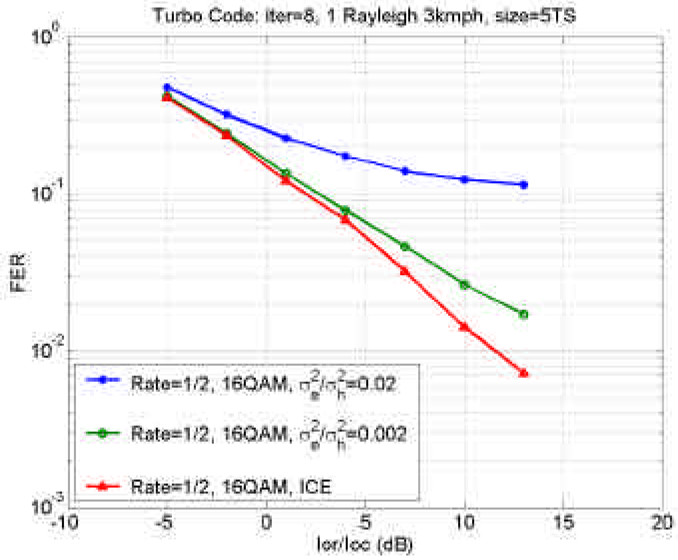

Figure 3. FER versus Ior/Ioc, 1-path Rayleigh channel, speed = 3kmph, Rate = 1/2, frame size = 5 time slot, 16QAM.

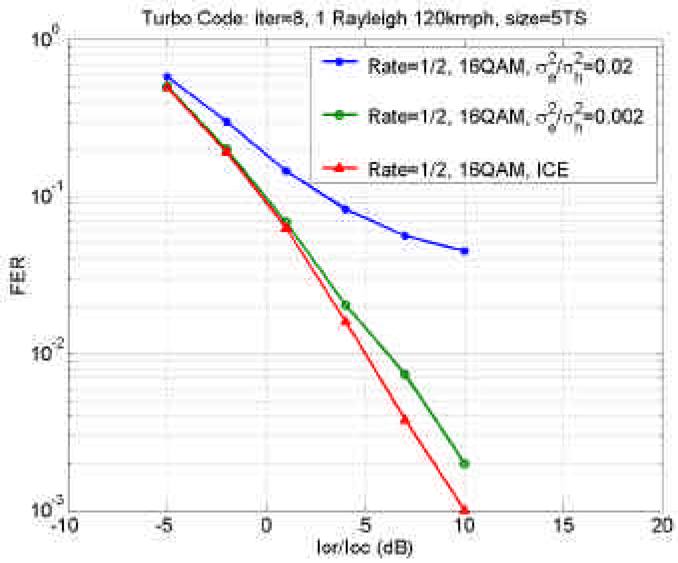

Figure 4. FER versus Ior/Ioc, 1-path Rayleigh channel, speed = 120kmph, Rate = 1/2, frame size = 5 time slot, 16QAM.

4 Conclusion

We presented the preliminary simulation results regarding the effect of channel estimation error on the link level perfomance of HSDPA. To provide HSDPA, the link level performance is very sensitive to the channel estimation (used for channel compensation and other purposes) and thus the accurate channel estimation is essential, especially in the situation of higher modulation, Turbo code and high vehicle speed. More investigation on this topic and novel techniques to handle this practical issue are needed. This issue has fundamental impact on the limitation of HSDPA in terms of peak data rate, throughput, and applicable vehicle speed.

5 References

[1] R1-00-1241, Motorola, “Forward Link Simulation Results for HSDPA”, Pusan, Korea, October 10-13, 2000.

[2] R1-00-1182, Panasonic, “Link level simulation results of HSDPA”, Pusan, Korea, October 10-13, 2000.

[3] R1-00-1326, Wiscom Technologies, “Link level simulation results for HSDPA”, Stockholm, Sweden, November 21-24, 2000.

[4] R1-00-1093, “Link Evaluation Methods for High Speed Downlink Packet Access (HSDPA)”, Berlin, Germany, August 21-24, 2000.

[5] Wiscom Technologies, “Influence of channel estimation on the link level performanc of HSDPA,” TSGR1#17(00) 1327, TSG-RAN Working Group 1 Meeting #17, Stocholm, Sweden, November 21-24, 2000.

[6] Wiscom Technologies, TSG-RAN Working Group 1 Meeting #17,Link Level Simulations for HSDPA, TSGR1#17(00) 1326, TSG-RAN Working Group 1 Meeting #17, Stocholm, Sweden, November 21-24, 2000.

[7]] Wiscom Technologies, “Use of Long-Range Prediction for channel estimation and its application in HSDPA,” TSGR1#17(00) 1393, TSG-RAN Working Group 1 Meeting #17, Stocholm, Sweden, November 21-24, 2000.