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Techniques to Support HSDPA for TDD Mode

1 Introduction

At the RAN#7 plenary meeting, it was agreed that the appropriate working groups in RAN would conduct feasibility studies in the area of "High Speed Downlink Packet Access" (HSDPA). The study item HSDPA examines the technique and methods that can be introduced to UTRA to enable high speed down link packet access. The proposed HSDPA techniques were considered on FDD mode in the previous RAN1 and RAN2 meetings. This document shortly presents examinations of the proposed techniques for TDD mode HSDPA.

2 Enhancements for Packet Data for TDD Mode

In the previous RAN1 and RAN2 meetings Adaptive Modulation and Coding (AMC), HARQ scheme, and Fast Cell Selection (FCS) were presented to improve the FDD air interface utilisation. More details of the discussed techniques are captured in [1]. The following chapters present applicability considerations of the proposed techniques for TDD mode HSDPA.

2.1 Adaptive Modulation and Coding

Adaptive Modulation and Coding is a kind of link adaptation. The Modulation and Coding Scheme (MCS) may be changed depending on the channel conditions. A high data rate is achieved with high modulation-order and coding rate in good radio conditions. Following considerations show that AMC may be used to compensate long term channel variations.

In order to react correctly on the channel situation, averaging and long term observation of the channel is necessary. In addition H-ARQ may be the appropriate method to counteract fast channel variations. Finally changing of the MCS between HARQ retransmissions should be avoided. Possible benefits do not seem to justify the implementation effort.

In the following table peak data rates for different parameter settings (modulation, code rate, number of codes, and number of Time slots) for TDD mode are calculated. The parameter settings are based on the FDD assumptions in [2]. Optimum parameter settings are for further study.

Chip Rate = 3.84 Mchip/s
Burst Type 2
Frame Length = 10ms
Spreading Factor = 16
Bandwidth = 5 MHz

Modulation	Coderate	1 Time Slot 1 Code (kbps)	1 Time Slot 12 Codes (Mbps)	12 Time Slots 12 Codes (Mbps)	13 Time Slots 14 Codes (Mbps)
64	¾	62,1	0,745	8,94	11,3
16	¾	41,4	0,497	5,96	7,53
16	½	27,6	0,331	3,97	5,02
8	¾	31	0,372	4,46	5,64
4	¾	20,7	0,248	2,97	3,76

4	½	13,8	0,166	1,99	2,51
4	¼	6,9	0,083	1	1,26

Table 1

2.2 Hybrid ARQ (H-ARQ)

H-ARQ may be used to improve the system throughput due to the compensation of the short term variations. For TDD mode it is proposed to support the stop-and-wait protocol that is implemented in n-channel H-ARQ.

To avoid unnecessary delay for the acknowledgements in the stop-and-wait protocol a fast back channel, which is terminated in Node B, is required. The fast back channel can be implemented with either very low bit rate transmitting Ack/Nack only, or with higher bit rate transmitting more detailed information (measurements, PDU sequence numbers,...).

TDD Mode is a time slot based transmission system with the time slot granularity of 666µs. Therefore, there is no need to change the frame size for HSDPA. The flexible configuration of the time slots is already supported in TDD.

2.3 Fast Cell Selection

Fast Cell Selection is expected to improve the system throughput for FDD. The average link quality is increased because for each connection the Node B with the best channel condition is selected.

The impact of the FCS on TDD mode is for further study.

3 Impact on Radio Interface Protocol Architecture

3.1 Function Split

The Radio Interface Protocol Architecture of HSDPA that is proposed for FDD [3] is suited to TDD mode, too. The fast channel allocation (scheduling) and channel termination in Node B improve the system capacity. A concept based on fast scheduling and retransmission functionality in Node B was introduced in [4].

3.2 High Speed Downlink Shared Channel

In order to implement the discussed techniques for HSDPA a new downlink shared channel (HS-DSCH) should be introduced.

To signal the HS-DSCH a control channel between Node B and UE, which is terminated in the Node B, is required.

The de-centralised schedulers in Node Bs allow fast scheduling and allocation of the HS-DSCH.

4 Proposal

In general, the proposed technologies to improve the system capacity and fast packet access are applicable for the TDD mode, too. Therefore, it is proposed that HS techniques for TDD mode are considered for rel 5. To optimise the system for the both modes harmonisation of TDD and FDD is desired.

5 References

[1] Physical Layer Aspects of UTRA High Speed Downlink Packet Access (Release 2000); TR25.848 V0.2.1

[2] Motorola; TSG-RAN WG2#13; High Speed Downlink Packet Access; Oahu, Hawaii, 22-26 May 2000; Tdoc R2-001120

[3] Ericsson, Motorola; TSG-RAN WG2# ; HSDPA Radio Interface Protocol Architecture; Sophia Antipolis, 13-17 Nov.2000; Tdoc R2-002276

[4] Siemens; Radio Interface Protocol Architecture for UMTS; Tdoc SMG2 UMTS-L23 45/98 27-28 April, 1998