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Agenda item:	8
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Title:	High Speed Downlink Packet Access simulation assumptions
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Summary:

Both link level and system level simulations are clearly needed to assess the performance of various techniques proposed to enhance the downlink packet access. As the behavior and performance of the system is difficult to analyze the system level simulations play a crucial role. Yet, link level results are needed as an input to system level simulations.

As the details of implementation and sophistication level of system simulators used by different companies can vary a lot, full harmonization of link and system level simulation assumptions may not be feasible given the time constraints. Instead, we should try to agree on some limited set of assumptions. As this will mean that absolute results by different companies will not be the same the best thing to do is to evaluate what are the improvements of different techniques when compared to a reference case.

In this contribution a limited set of possible link and system level simulation assumptions are presented.

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1. INTRODUCTION

In the RAN #7 a work item on High Speed Downlink Packet Access (HSDPA) was proposed by Motorola with support from Nokia, BT/Cellnet, T-Mobil and NTT DoCoMo [1]. It was agreed in principle and consequently a feasibility study will be done during year 2000. The study results will be collected into a technical report which is to be approved in RAN #10 in December, 2000.

In TSG-R1 meetings #12 and #13 possible technical improvements for downlink packet access were presented and discussed [2, 3, 4]. In order to assess the benefits of different techniques a number of both link and system level simulations need to be performed. In this contribution a set of basic simulation assumptions are proposed.

2. LINK AND SYSTEM LEVEL SIMULATION ASSUMPTIONS

Both link level and system level simulations are clearly needed to assess the performance of various techniques proposed to enhance the downlink packet access. As the behavior and performance of the system is difficult to analyze the system level simulations play a crucial role. Yet, link level results are needed as an input to system level simulations.

As the detail of implementation and sophistication level of system simulators used by different companies can vary a lot, full harmonization of system level simulation assumptions may not be feasible given the time constraints. Instead, we should try to agree on some limited set of assumptions. As this will mean that absolute results by different companies will not be the same the best thing to do is to evaluate what are the improvements of different techniques when compared to a reference case.

2.1 Link level simulations

Main purpose of the link level simulations is to provide the needed input data to system level simulations. The main link level simulation parameters are listed in the Table 1. Tables 2-5 give the detailed DSCH parameters for different modulation orders.

Table 1. A set of link level simulation assumptions for HSDPA.

Parameter	**Explanation/Assumption**
Chip Rate	3.84 Mcps
Closed loop Power Control	DSCH: OFF, associated DCH: ON
Channel Estimation	CPICH
Link quality estimation	CPICH
Spreading factor	DSCH: 32 DCH: TBD
Frame length	10 ms, 3.33 ms
Data modulation scheme	QPSK, 8-PSK, 16-QAM, 64-QAM
Channel codec	Turbo encoder according to 25.212
Encoding rates	1/2, 3/4
Number of samples per chip	Symbol level simulation
Propagation Conditions	Pedestrian A 3 km/h (c = 3*10E8, f = 1.9 GHz)
Number of bits in AD converter	Floating point simulations
Number of Rake Fingers	Equals to number of taps in propagation condition models
Downlink Common Physical Channels and Power Levels	CPICH_Ec/Ior = -10 dB
Number of interfering users	Modeled as AWGN weighted by the geometry factor and added before the channel
Bit rates	QPSK: 120 kbps, 180 kbps (1 code), 2.4 Mbps (20 codes) 8-PSK: 180 kbps, 270 kbps (1 code), 3.6 Mbps (20 codes) 16-QAM: 240 kbps, 360 kbps (1 code),4.8 Mbps (20 codes) 64-QAM: 540 kbps, 360 kbps (1 code), 7.2 Mbps (20 codes)
Packet size	Calculated based on channel bit rate and frame length
TFCI model	Random symbols, ignored in a receiver but it is assumed that receiver gets error free reception of TFCI information.
Used OVSF and scrambling codes	Codes are chosen from the allowed set
STTD encoding	On/off
Other L1 parameters	As Specified in Release –99 specifications (June 2000)

Table 2. Parameters for QPSK in DSCH

	MCS 1	MCS 2	MCS 1 multicode	MCS 2 multicode
Channel symbol rate	120 kbps	120 kbps	120 kbps	120 kbps
Channel bit rate	240 kbps	240 kbps	240 kbps	240 kbps
Encoding rate	½	¾	½	¾
Number of spreading codes (SF = 32)	1	1	20	20
Maximum segmentation block size	5114	5114	5114	5114
Tail bits	6	6	6	6

CRC bits	24	24	24	24
Information bit rate	119.3 kbps	178.9 kbps	2.386 Mbps	3.578 Mbps

Table 3. Parameters for 8-PSK in DSCH

	MCS 3	MCS 4	MCS 3 multicode	MCS 4 multicode
Channel symbol rate	120 kbps	120 kbps	120 kbps	120 kbps
Channel bit rate	360 kbps	360 kbps	360 kbps	360 kbps
Encoding rate	½	¾	½	¾
Number of spreading codes (SF = 32)	1	1	20	20
Maximum segmentation block size	5114	5114	5114	5114
Tail bits	6	6	6	6
CRC bits	24	24	24	24
Information bit rate	178.9 kbps	268.4 kbps	2.386 Mbps	5.368 Mbps

Table 4. Parameters for 16-QAM in DSCH

	MCS 5	MCS 6	MCS 5 multicode	MCS 6 multicode
Channel symbol rate	120 kbps	120 kbps	120 kbps	120 kbps
Channel bit rate	480 kbps	480 kbps	480 kbps	480 kbps
Encoding rate	½	¾	½	¾
Number of spreading codes (SF = 32)	1	1	20	20
Maximum segmentation block size	5114	5114	5114	5114
Tail bits	6	6	6	6
CRC bits	24	24	24	24
Information bit rate	238.6 kbps	357.8 kbps	4.771 Mbps	7.157 Mbps

Table 5. Parameters for 64-QAM in DSCH

	MCS 7	MCS 8	MCS 7 multicode	MCS 8 multicode
Channel symbol rate	120 kbps	120 kbps	120 kbps	120 kbps
Channel bit rate	720 kbps	720 kbps	720 kbps	720 kbps
Encoding rate	½	¾	½	¾
Number of spreading codes (SF = 32)	1	1	20	20
Maximum segmentation block size	5114	5114	5114	5114
Tail bits	6	6	6	6
CRC bits	24	24	24	24
Information bit rate	357.8 kbps	536.8 kbps	7.157 Mbps	10.74 Mbps

2.2 System level simulations

What system level assumptions shall be harmonized between different simulation platforms should be carefully considered. In the following one basic set of assumptions are presented.

Table 6 lists a set of basic system simulation parameters. Many of them are from UMTS 30.03 technical report [5], but some are taken from TSG-R4 technical report on RF system scenarios [6].

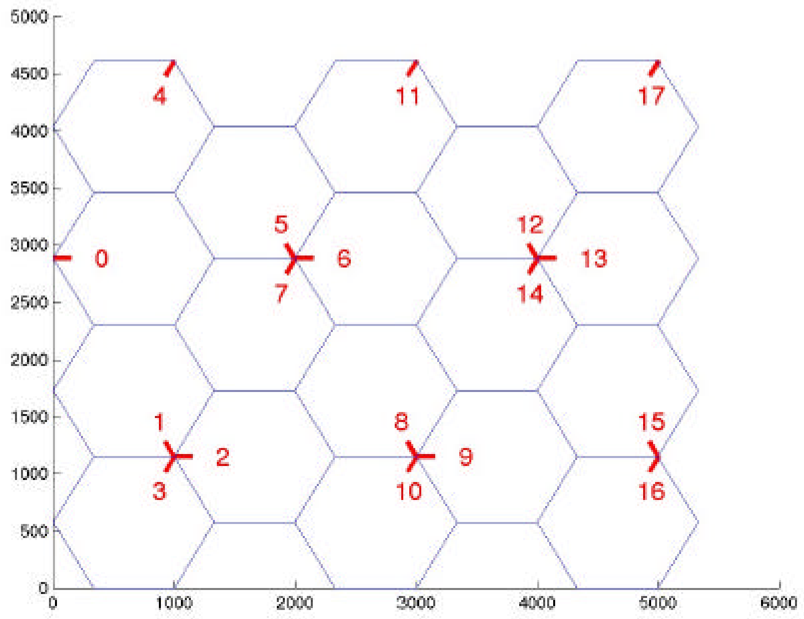

Figure 1. The simulated cellular layout.

Table 6. A set of system level simulation assumptions.

Parameter	Explanation/Assumption
Cellular layout	Hexagonal macro cell grid as defined in UMTS 30.03, B 1.6.4.3 (see Figure 1)
Number of cell sites	18
Number of sectors per site	3
Cell radius	200, 500, 1000 m
Antenna pattern	As defined in UMTS 30.03 B 1.5, both horizontal and vertical pattern used
Propagation model	$L = 128.1 + 37.6\ Log_{10}(R)$
Slow fading	As modeled in UMTS 30.03, B 1.4.1.4
Std. Deviation of slow fading	8 dB
Correlation between sectors	0.7
Correlation between sites	0.3
Correlation distance of slow fading	50 m
UE mobility model	As defined in UMTS 30.03 B 1.6.4.4
UE speed	3 km/h
Traffic model	As specified in UMTS 30.03 B 1.2.2
Source bit rate	2048 kbps
Minimum coupling loss	70 dB
BS antenna gain	11 dB
UE antenna gain	0 dB
UE noise figure	9 dB
BS noise figure	5 dB
Noise power at UE	-99 dBm
Noise power at BS	-103 dBm
Max. # of retransmissions	TBD
HARQ scheme	Type I with soft combining
Active set size (FCSS)	3

In minimum, the system throughput in kbps/MHz/cell should be measured. Other measures, like histogram of the throughput of the users, could be reported. As a reference, Rel.-99 based system with RLC level ARQ should be used.

2.2.1 Fast HARQ

The performance of fast HARQ (Type I with soft combining) with the RLC level ARQ as defined in Rel.-99 is compared. With these simulations hard handover with measurement errors and delays is assumed.

- Frame length for fast HARQ 3.33 and 10 ms
- The feedback error rate is TBD %.

2.2.2 Adaptive modulation and coding

When AMC is studied both static and dynamic adaptation is used. In static adaptation the MCS is selected (based on pathloss) in the beginning of the simulation for each UE and then kept fixed. In dynamic adaptation MCS can be changed based on the UE measurements.

The following parameters will be used:

- C-PICH E_c/I_o measurement error 0, 3, 5 dB
- Measurement delay 10, 100 and 200 ms
- Measurement report error rate TBD %
- Frame length for fast HARQ 3.33 and/or 10 ms (TBD)

2.2.3 FCSS

In FCSS simulations the following parameters will be used:

- C-PICH E_c/I_o measurement error 0, 3, 5 dB
- Measurement time 10, 100 and 200 ms
- Reporting and cell selection delay 0 (ideal) and 2 frames
- Feedback signaling error rate TBD %
- Frame length for fast HARQ 3.33 and/or 10 ms (TBD)

2.2.4 Fast HARQ, AMC and FCSS

All the three techniques are applied jointly. The varied parameters are:

- C-PICH E_c/I_o measurement error 0, 3, 5 dB
- Measurement time 10, 100 and 200 ms
- Reporting and cell selection delay 0 (ideal) and 2 frames
- Feedback signaling error rate TBD %
- Frame length for fast HARQ 3.33 and/or 10 ms (TBD)

3. CONCLUSIONS

In order to assess the performance benefits of the different proposed techniques for improved downlink packet access a set of link and system level simulation assumptions is presented. As the details of the system level simulators of different companies may vary a full harmonization of the simulation assumptions is not feasible. Yet, some basic set of simulation parameters could be agreed upon.

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