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Hardcoded Physical layer parameters for GSM-UTRA handover for GSM Rel. 99 CS-domain services

Introduction.

In TSG RAN WG2 the use of preconfiguration has been discussed, see e.g. (1), after it was noticed that signalling in GSM side (TSG GERAN) does not have room to provide the necessary UTRAN parameters. WG2 has discussed the various solutions for the preconfigurations and is defined ways how to obtain dynamic preconfigurations for GSM-UTRAN handover case. It has been noted that dynamic preconfigurations are not always available, see e.g. the example below, thus also hardocoded preconfigiurations need to be defined as well as a backup solution.

This paper presents the rough details how the GSM CS domain Rel'99 services can be mapped to the UTRA FDD physical layer. For the smaller data rates one set of physical layer parameters is assumed to simplify and to reduce number of parameter sets to be put to the physical layer specifications.

Based on this paper and possible comments and suggestions a detailed CR is to be prepard to WG1 specifications, following the WG2 work. As WG2 has not created CRs at this point of time, the draft CR is to be done for WG1#18 and then to be finalised for WG1#19 to ensure alignment with WG2.

The detailed information which WG1 needs (assuming from WG2) is how much is the information bit rate per TTI for each GSM service, including L2/L3 overhead or e.g. modem control signals as given in GSM side on top of the actual data rate. The mappings are given separately for the uplink and downlink, the exact details with multiplexing etc. is to be derived further in WG1. For the 12.2 kbps (AMR) case the suggestion is to use such a hardcoded preconfiguration that matches the UEP case as given as an example in TR 25.944 for the AMR speech service.

For UTRA TDD the same details can be assumed with obvious UTRA TDD specific diffrences in the number of codes (downlink) and selected spreading factor (uplink). For UTRA TDD all pre-configurations can be mapped to a single slot since the maximum data rate under consideration is 64 kbps.

Why are hardcoded pre-configurations necessary

Generally dynamic pre-configurations should be used if available. However, there are cases when one cannot ensure the availability of dynamic preconfigurations and thus hardcoded ones need to be specified.

Simplest example is a GSM-UMTS dual mode terminal starting the CS domain call in GSM (only) coverage area. In this phase the terminal has no access to UTRAN BCH prior start of the call. During the call the terminal moves to UMTS coverage but with CS domain service in GSM there is no time for the terminal to read UTRAN BCH when the connection is active. Thus there is no other way when handover is desired to use other than hardcoded preconfigurations.

Also other cases can be identified. For example a data only terminal is not necessary powered on until the connection is necessary and upon connection set up to GSM (if happens to be the strongest one) it is not desired to read full cycle of the UTRAN BCH to delay the connection set up to GSM.

GSM CS domain data rates to be considered

Table 1 gives the data rates that are to be considered based on GSM Rel'99 specifications. (Note: the recommendations in (1) need to be taken into account if agreed in TSG RAN WG2)

Table 1. Data rates under consideration.

Service Data rate (as given in Rel'99 GSM 04.21)
4.8 kbps
9.6 kbps
12.2 kbps, + 7.95 kbps for AMR (other rates are: 10.2, 7.4, 6.7, 5.9, 5.15 & 4.75 kbps, these in general are not covered in GSM 04.21)
13.0 kbps
14.4 kbps
19.2 kbps
28.8 kbps
32.0 kbps
38.4 kbps
43.2 kbps
48.0 kbps
56.0 kbps
64.0 kbps

Note: Overhead e.g. due modem control signals etc. not included.

Physical Layer Mapping

The following tables show the proposed mapping in the physical layer, with again details to be decided in WG1. (CC=Convolutional coding, TC=Turbo coding, UEP=Unequal Error Protection)). Note that in the physical layer for the data rates below 14.4 kpbs (excluding AMR) other parameters can be the same but only rate matching is used to match them to the physical channel with the same number of bits used on the DPDCH. The use of slot format No. 8 means that there is no TFCI thus the cases are for BTFD. This should not cause a problem as the cases with that slot format are within the BTFD detection requirements as given in 25.212.

Table 2. Service mapping in the downlink

Data rate	Channel bit rate.	TTI & Channel coding	Slot format No.	Need for puncturing after multiplexing with 3.4 kbps DCCH.
4.8 kbps	60 kbps	20 ms, CC	8	No
7.95 kbps	60 kbps	20 ms, CC	8	No
9.6 kbps	60 kbps	20 ms, CC	8	Yes
12.2 kbps	60 kbps	20 ms, CC	8	See TR 25.944 for mapping (UEP)
14.4 kbps	60 kbps	20 ms, CC	8	Yes
19.2 kbps	120 kbps	40 ms, TC	12	No
28.8 kbps	120 kbps	40 ms, TC	12	Yes
32.0 kbps	120 kbps	40 ms, TC	12	Yes
38.4 kbps	240 kbps	40 ms, TC	14	No
43.2 kbps	240 kbps	40 ms, TC	14	No
48.0 kbps	240 kbps	40 ms, TC	14	No
56.0 kbps	240 kbps	40 ms, TC	14	No
64.0 kbps	240 kbps	40 ms, TC	14	No

Table 3. Service mapping in the uplink

Data rate	DPDCH Channel symbol rate.	TTI & Channel coding	Need for puncturing when multiplexing with 3.4 kbps DCCH (DCCH with 1/3 rate CC)
4.8 kbps	60 kbps	20 ms, CC	No
7.95 kbps	60 kbps	20 ms, CC	No
9.6 kbps	60 kbps	20 ms, CC	No
12.2 kbps	60 kbps	20 ms, CC	See TR 25.944 for mapping (UEP)
14.4 kbps	60 kbps	20 ms, CC	No
19.2 kbps	120 kbps	40 ms, TC	No
28.8 kbps	120 kbps	40 ms, TC	No
32.0 kbps	120 kbps	40 ms, TC	No
38.4 kbps	240 kbps	40 ms, TC	No
43.2 kbps	240 kbps	40 ms, TC	No
48.0 kbps	240 kbps	40 ms, TC	No
56.0 kbps	240 kbps	40 ms, TC	No
64.0 kbps	240 kbps	40 ms, TC	No

It should be noted that for some services GSM 05.03 gives e.g. 60 bits per 5 ms, which mean that if TTI is 20 ms then UTRA has 4 different data rates on the physical layer. This is not a problem and is not causing extra delay compared to GSM where diagonal interleaving is being used and for the e.g. 9.6 kbps 4 blocks of 60 bits are encoded together corresponding to 20 ms TTI in UTRA. Also e.g. data rates such as 28.8 kbps have 20 ms block delivery period but then use diagonal interleaving on top of that thus using 40 ms TTI will provide better performance in the physical layer and will not increase the delay over the UTRA air interface. In this example there is 3 intermediate rates with 40 ms TTI; 0-rate, 14.4 kbps and 28.8 kbps over the air interface.

Suggested action

It is recommended that WG1 does the following:

- ?? Take working assumptions on the mapping (SF, coding etc,) based on discussions on the proposal in this paper and in other potential contributions (none existing during writing of this)
- ?? Based on the information from TSG RAN WG2 on e.g. the exact data rates per TTI and services to be considered for the GSM Rel'99 CS domain services prepare detailed CRs TS 25.212(FDD) and 25.222(TDD)
- ?? Confirm that the parameters assumed for the DCCH (3.4 kbps in TR 25.944 with 40 ms TTI) are valid assumption as well.

For the details such a CRC length etc. those can be set to the equivalent values than in TR 25.944, e.g. 12 bits for lower rates (at or below 14.4 kbits) and 16 bits for higher data rates (19.2 kbps onwards).

REFERENCES:

(1) R2-002390 "Report on discussions: Hard-coded preconfigurations"