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Compressed Mode Parameters for UTRA to GSM Handovers

1 Abstract

This paper proposes some values to the parameters related to intersystem handovers. Simulation results are presented to support the determination of the parameter values.

2 Simulations

The purpose of the simulations was to determine the compressed mode patterns that would be the most efficient ones for the search and decoding of the GSM SCH. All sensible (and almost all possible) parameter values were tried and the best ones were selected. The results for the best combinations of parameters are presented in the table below.

The simulations have been run with the assumption that there are 15 slots per frame and a maximum of 7 slots can be removed from any frame to ensure the traffic channel data transmission also in the compressed frames.

The synthesiser settling time is assumed to be 500 μs and an implementation margin of 200 μs is added to this, though it need not be related to the synthesisers.

The search method uses parallel search of FCCH and SCH. The method is described in [1] in more detail.

The effects of noise, interference, or fading have not been included in the simulations, but the signal is assumed to be ideal.

One goal in the use of the compressed mode is that the unavoidable loss of the traffic channel capacity is minimised. The compressed frame pattern must be defined so that as few slots are used for the GSM cell measurements as possible.

Another target is the minimisation of the search time in order to make the handovers as fast as possible. This is especially important in cases where the signal of the serving cell becomes very weak very fast and the handover must be done immediately to maintain the connection.

The "average loss of channel capacity" in the table below is defined as the average number of slots needed to decode the SCH.

The "average" here means the average over the individual search results when all the possible relative timings between the UTRA cell and the GSM cell have been swept through.

TGL (slots)	TGD (frames)	TGP (frames)	Average search time (ms)	Average loss of channel capacity (slots)	Maximum search time (ms)
7	0	2	**106.4**	44.2	400
7	0	3	**142.8**	**40.3**	390
7	2	9	206.8	**40.2**	630
7	3	10	247.6	42.9	1030
7	4	11	257.5	41.5	580
7	4	13	329.8	44.7	1040
7	3	15	345.4	41.6	930
14	0	2	**38.1**	40.7	120
14	0	3	**56.8**	40.5	210
14	0	6	104.2	**38.3**	360
14	2	6	**56.1**	40.2	240
14	2	8	67.7	**39.3**	350
14	2	13	97.1	**38.3**	420
14	0	15	285.7	40.7	750
14	3	15	117.6	**39.0**	450

3 Changes to Specification 25.231

Version 0.3.0 of the specification 25.231 is used as the reference in the subsequent chapters.

3.1 Chapter 7.1.3.3.6.2 "Setting of Compressed Mode Parameters for Power Measurements"

The empty table in this chapter should be filled with the following values:

TGL	TGD	TGP	PD
3	0	8	16

One pattern allows measuring all the adjacent cell signal levels even with the maximum of 32 frequencies, if two measurements are done during each transmission gap. The number of neighbours in the list would usually be significantly lower and several samples per carrier can be taken to average the measurement results. The length of the pattern is about 1.2 s, which also dominates the delay between the measurement request and the measurement report. Therefore, the pattern should not be any longer, although only one sample per carrier can be obtained with the maximum number of neighbours. The pattern can be repeated by sending the measurement request again, if more measurement data is desired.

3.2 Chapter 7.1.3.3.6.3 "Setting of Compressed Mode Parameters for First SCH Decoding without Prior Knowledge of Timing Information"

The empty table in this chapter should be filled with the following values:

	TGL	TGD	TGP	PD
Pattern 1	7	0	2	[40]
Pattern 2	7	0	3	[39]
Pattern 3	7	2	9	[63]
Pattern 4	7	3	12	[99]
Pattern 5	14	0	2	[12]
Pattern 6	14	2	6	[24]
Pattern 7	14	2	8	[35]
Pattern 8	14	2	12	[60]

The PD values are in brackets, because it has not been decided yet whether the parallel search is a mandatory requirement for the terminals. Increasing the values to allow sequential search would increase the average amount of the compressed frames with an effect on the network capacity, so it must be still analyzed whether the loss in the capacity would be too big compared to the much easier implementation of the terminals.

The patterns 5…8 should mainly be used in such cases where the present signal level suddenly drops and very little time to execute the handover is available. Patterns 1…4 are significantly more optimal from the point of view of the transmission power control than the other ones, while patterns 5…8 consume less slots for the measurements on the average.

Patterns 1…4 may use any pattern described in specification 25.212, chapter 4.4.3.1. Patterns 5…8 must use the double frame method.

3.3 Chapter 7.1.3.3.6.4 "Setting of Compressed Mode Parameters for First SCH Decoding with Prior Timing Information between UTRAN Serving Cells and GSM Target Cells"

The following sentence in the chapter should be removed, because the adjustable transmission gap position described in specification 25.212, chapter 4.4.3.2 allows the reception of the GSM SCH in much shorter time. The transmission gap can be scheduled very flexibly and the needed time for decoding SCH with known timing would be in the range of a few frames and is probably mainly limited by the speed of signalling.

~~In such case, a transmission gap is scheduled once over 306 frames, equal to 13 GSM « 51 multi-frame » duration. As the UTRA 720 ms superframe shifts ¼ of superframe during the period, the 4 times 306 period can be used to fully align the timings of a UTRA FDD and a GSM cells.~~

The following sentence is not necessary, because the frame number has already been mentioned in the table of chapter 7.1.3.3.6.4.

~~• The frame number where compressed mode occurs (frame number x+n times 306, where n=0,1,2,3)~~

Part of the following sentence can also be removed, because the pattern is not a continuous one, but has only one transmission gap:

Once the UE has completed the search, it signals the UTRAN with the timing of the associated SCH burst or with SCH-not-found ~~and the UTRAN ceases the compressed mode pattern~~.

It would perhaps be good to mention that the table in chapter 7.1.3.3.6.4 implies using the adjustable transmission gap position described in specification 25.212, chapter 4.4.3.2.

3.4 Chapter 7.1.3.3.6.5 "Setting of compressed mode parameters for SCH decoding for BSIC Reconfirmation and Procedure at the UE"

Parts of the following sentence in the chapter should be removed, because it is in contradiction with the paragraph above it. The patterns related to unknown timing are not relevant in this case, where the UE knows the timing and signals it to the UTRAN.

~~Depending on whether UTRAN has an a priori timing knowledge of neighbouring GSM cells,~~ The compressed mode parameters shall be ~~one of~~ those described ~~in section 7.1.3.3.6.3, or~~ in section 7.1.3.3.6.4.

4 References

1. Tdoc SMG2 UMTS L1 566/98; Reduced search time for GSM synchronisation from UTRA by Siemens