TSG-RAN Meeting #11 ***RP-010073***
Palm Springs, CA, U.S.A., 13-16 March 2001

Title: **Agreed CRs (Release 4) for WI "Node B synchronization for TDD"**
Work Item Code : ***RANimp-NBsync***

Source: **TSG-RAN WG1**

Agenda item: **6.6.7**

CRs to TS

No.	R1 T-doc	Spec	CR	Rev	Subject	Cat	V_old	V_new
1	R1-01-0381	25.221	042	2	Introduction of the Physical Node B Synchronization Channel	B	3.5.0	4.0.0
2	R1-01-0202	25.223	016	-	Cell synchronisation codes for R'4 Node B sync over air interface in UTRA TDD	B	3.4.0	4.0.0
3	R1-01-0383	25.224	044	2	Layer 1 procedure for Node B synchronisation	B	3.5.0	4.0.0
4	R1-01-0013	25.225	022	-	Measurements for Node B synchronisation	B	3.5.0	4.0.0

CR to TR

No.	R1 T-doc	TR	CR	Rev	Subject	Cat	V_old	V_new
1	R1-01-0382	25.836	001	1	Additions to the node B synchronisation procedure	C	4.0.0	4.1.0

R1-01-0381

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CHANGE REQUEST

⌘ **25.221**	**CR 042**	⌘ rev **2**	⌘	Current version: **3.5.0**	⌘

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [ ]

Title:	⌘ Introduction of the Physical Node B Synchronization Channel			
Source:	⌘ TSG RAN WG1			
Work item code:	⌘ RANimp-NBsync		***Date:*** ⌘	10.02.2001
Category:	⌘ **B**		***Release:*** ⌘	REL-4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*	

Reason for change:	⌘ There is no PCH where the Node B sync burst can be transmitted
Summary of change:	⌘ Introduction of the PNBSCH in order to support NB sync operation over the air
Consequences if not approved:	⌘ Work item Node B synchronisation is not feasible

Clauses affected:	⌘ 6, New section 5.3.8	
Other specs affected:	⌘ [X] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘ 25.223, 25.302, 25.331
Other comments:	⌘	

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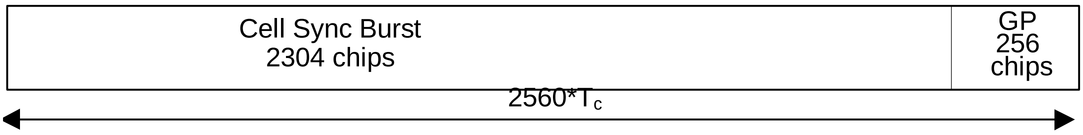
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.3.8 The physical node B synchronisation channel (PNBSCH)

In case cell sync bursts are used for Node B synchronisation the PNBSCH shall be used for the transmission of the cell sync burst [8]. The PNBSCH shall be mapped on the same timeslot as the PRACH acc. to a higher layer schedule. The cell sync burst shall be transmitted at the beginning of a timeslot. In case of Node B synchronisation via the air interface the transmission of a RACH may be prohibited on higher layer command in specified frames and timeslots.



6 Mapping of transport channels to physical channels

This clause describes the way in which transport channels are mapped onto physical resources, see figure 19.

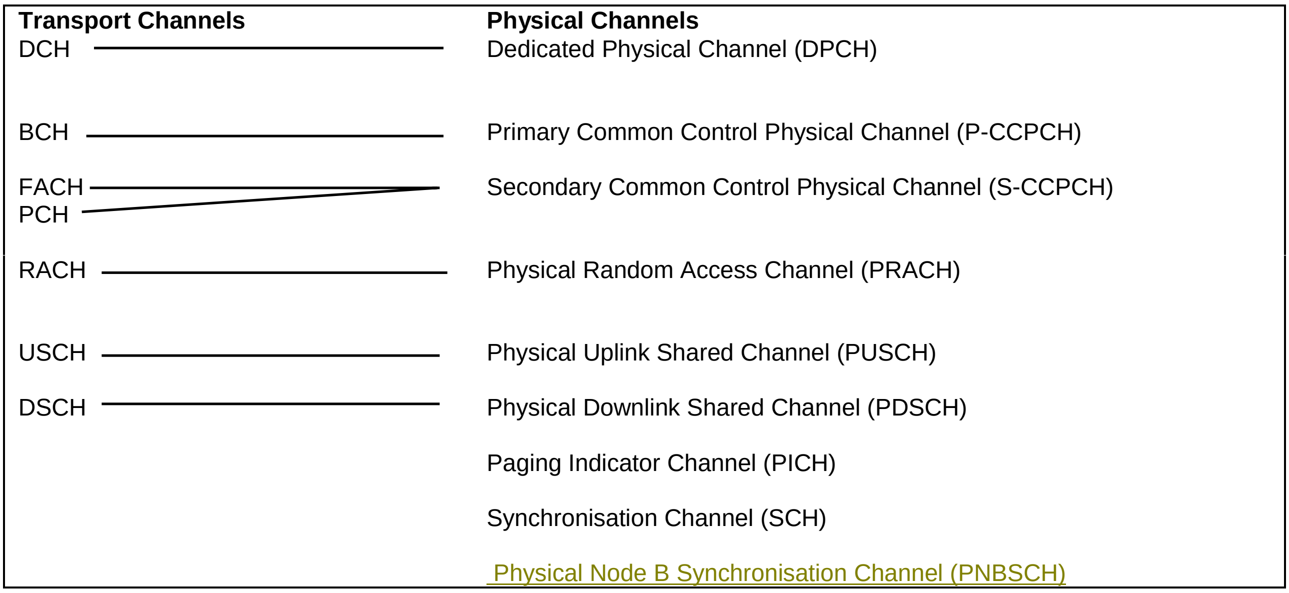


Figure 19: Transport channel to physical channel mapping

6.1 Dedicated Transport Channels

A dedicated transport channel is mapped onto one or more physical channels. An interleaving period is associated with each allocation. The frame is subdivided into slots that are available for uplink and downlink information transfer. The mapping of transport blocks on physical channels is described in TS 25.222 ("multiplexing and channel coding").

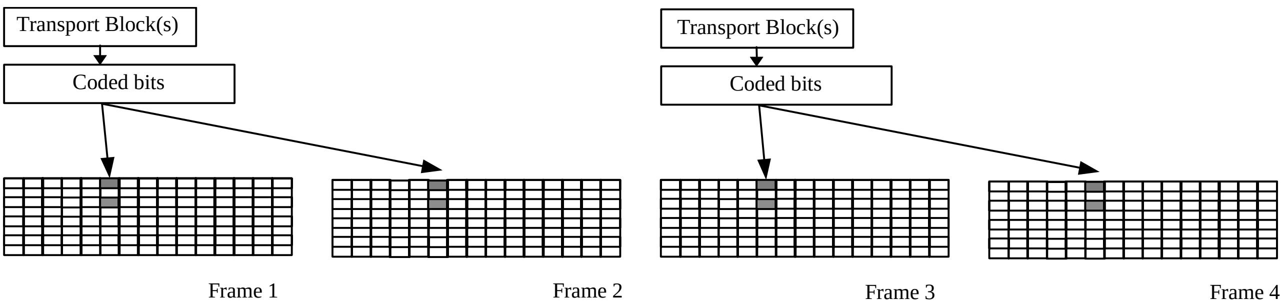


Figure 20: Mapping of Transport Blocks onto the physical bearer

For NRT packet data services, shared channels (USCH and DSCH) can be used to allow efficient allocations for a short period of time.

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CHANGE REQUEST

⌘ **25.223**	**CR** **016**	⌘ rev **-**	⌘	Current version: **3.4.0**	⌘

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [ ]

Title: ⌘	Cell synchronisation codes for R'4 Node B sync over air interface in UTRA TDD		
Source: ⌘	TSG RAN WG1		
Work item code: ⌘	RANimp-NBsync	***Date:*** ⌘	14/02/2001
Category: ⌘	**B**	***Release:*** ⌘	REL-4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	This CR contains the description of the cell synchronisation codes for the R'4 work item Node B sync over air interface in UTRA TDD.
Summary of change: ⌘	Proposes the introduction of a new section 10 into TS 25.223 R'4 that describes how to generate cell synchronisation codes from Golay Complementary Pairs and their respective code offset versions.
Consequences if not approved: ⌘	Work item not feasible.

Clauses affected: ⌘	New section 10	
Other specs affected: ⌘	[X] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	R'4 - CR042 to 25.221, CR044 to 25.224, CR022 to 25.225
Other comments: ⌘	(1) Additional new sections introduced into TS25.223 R'4 by the working CR on 1.28 Mcps TDD are taken into account. (2) More details on the generation of the cell synchronisation codes can be found in R1-00-1351 or TR25.836 V2.0.0.	

3 Symbols and abbreviations

3.1 Symbols

For the purposes of the present document, the following symbols apply:

C_p:	PSC
C_i:	i:th secondary SCH code
$C_{CSC,\,m}^{(k)}$:	CSC derived as *k*:th offset version from *m*:th applicable constituent Golay complementary pair

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CDMA	Code Division Multiple Access
CSC	Cell Synchronisation Code
OVSF	Orthogonal Variable Spreading Factor
P-CCPCH	Primary Common Control Physical Channel
PN	Pseudo Noise
PRACH	Physical Random Access Channel
PSC	Primary Synchronisation Code
QPSK	Quadrature Phase Shift Keying
RACH	Random Access Channel
SCH	Synchronisation Channel

10 Cell synchronisation codes

The cell synchronisation codes (CSCs) are constructed as so-called CEC sequences, i.e. concatenated and periodically extended complementary sequences. They are complex-valued sequences that are derived as cyclically offset versions from a set of possible constituent Golay complementary pairs.

The CSCs are chosen to have good aperiodic auto correlation properties. The aperiodic auto correlations of the applicable constituent Golay complementary pairs and every pair of their derived cyclically offset versions are complementary. Furthermore, orthogonality is preserved for all CSCs which are derived from the same constituent Golay complementary pair due to this complementary property.

The delay and weight matrices for the set of M = 8 possible constituent Golay complementary pairs are listed in the table below:

Code ID m	Delay matrices D_m and weight matrices W_m of constituent Golay complementary pairs
0	D_0 = <512, 64, 128, 1, 16, 4, 256, 32, 8, 2>, W_0 = <1, 1, 1, 1, -1, -1, 1, 1, 1, 1>
1	D_1 = <2, 16, 32, 256, 1, 8, 128, 4, 512, 64>, W_1 = <1, -1, 1, -1, 1, -1, -1, 1, -1, -1>
2	D_2 = <16, 512, 32, 256, 4, 1, 64, 8, 2, 128>, W_2 = <-1, 1, 1, -1, -1, 1, -1, 1, -1, -1>
3	D_3 = <512, 16, 8, 4, 2, 256, 128, 64, 32, 1>, W_3 = <-1, -1, -1, -1, -1, 1, -1, 1, 1, 1>
4	D_4 = <512, 128, 256, 32, 2, 4, 64, 1, 16, 8>, W_4 = <1, -1, 1, -1, -1, -1, -1, -1, -1, 1>
5	D_5 = <1, 2, 4, 64, 512, 16, 32, 256, 128, 8>, W_5 = <-1, 1, 1, 1, 1, -1, -1, 1, -1, 1>
6	D_6 = <8, 16, 128, 2, 32, 1, 256, 512, 4, 64>, W_6 = <-1, -1, 1, 1, 1, 1, -1, -1, -1, 1>
7	D_7 = <1, 2, 128, 16, 256, 32, 8, 512, 64, 4>, W_7 = <1, 1, -1, -1, -1, -1, 1, -1, -1, -1>

A constituent Golay complementary pair of length N = 1024, defined as:

$$\mathrm{s}_m = \langle s_m(0), s_m(1), s_m(2), \ldots, s_m(1023)\rangle \text{ and } \mathrm{g}_m = \langle g_m(0), g_m(1), g_m(2), \ldots, g_m(1023)\rangle$$

shall be derived from the selected delay and weight matrices:

$$\mathrm{D}_m = \langle D_m(0), D_m(1), D_m(2), \ldots, D_m(9)\rangle \text{ and } \mathrm{W}_m = \langle W_m(0), W_m(1), W_m(2), \ldots, W_m(9)\rangle$$

as follows.

Define:

$$\mathrm{a}^{(0)} = \langle a^{(0)}(0), a^{(0)}(1), a^{(0)}(2), \ldots, a^{(0)}(1023)\rangle = \langle 1, 0, 0, \ldots, 0\rangle \text{ and}$$

$$\mathrm{b}^{(0)} = \langle b^{(0)}(0), b^{(0)}(1), b^{(0)}(2), \ldots, b^{(0)}(1023)\rangle = \langle 1, 0, 0, \ldots, 0\rangle.$$

Then, the elements of the set of auxiliary sequences:

$$\mathrm{a}^{(n)} = \langle a^{(n)}(0), a^{(n)}(1), a^{(n)}(2), \ldots, a^{(n)}(1023)\rangle \text{ and } \mathrm{b}^{(n)} = \langle b^{(n)}(0), b^{(n)}(1), b^{(n)}(2), \ldots, b^{(n)}(1023)\rangle$$

are given by the recursive relations:

$$a^{(n+1)}(i) = a^{(n)}(i) + W_m(n) \times b^{(n)}(i - D_m(n)) \text{ and}$$

$$b^{(n+1)}(i) = a^{(n)}(i) - W_m(n) \times b^{(n)}(i - D_m(n))$$

with element index i = 0, 1, 2, …, 1023 and iteration index n = 0, 1, 2, …, 9. Operations on the element index shall be performed modulo 1024.

The elements of the constituent Golay complementary pairs s_m and g_m are then obtained from the output of the last iteration step using:

$$s_m(i) = a^{(10)}(i) \text{ and } g_m(i) = b^{(10)}(i) \text{ for } i = 0, 1, 2, \ldots, 1023$$

From each applicable constituent Golay complementary pair s_m and g_m, up to K = 8 different cyclically offset pairs $s_m^{(k)}$ and $g_m^{(k)}$, with offset index k = 0, 1, 2, …, K-1, of length 1152 chips can be derived. The complementary property of the respective aperiodic auto correlation is preserved for each particular pair of sequences $s_m^{(k)}$ and $g_m^{(k)}$. The generation of the K cyclically offset pairs from s_m and g_m is done in a similar way as the generation of the user midambles from a periodic basic midamble sequence as described in [7].

With N = 1024, K = 8, W = 128, the elements of a cyclically offset pair:

$$s_m^{(k)} = \langle s_m^{(k)}(0), s_m^{(k)}(1), s_m^{(k)}(2), \ldots, s_m^{(k)}(1151)\rangle \text{ and } g_m^{(k)} = \langle g_m^{(k)}(0), g_m^{(k)}(1), g_m^{(k)}(2), \ldots, g_m^{(k)}(1151)\rangle$$

for a particular offset k, with k = 0, 1, 2, …, K-1, shall be derived from the elements of the constituent Golay complementary pairs s_m and g_m using:

$$s_m^{(k)}(i) = (j)^i \times s_m(i + k \times W) \text{ and } g_m^{(k)}(i) = (j)^i \times g_m(i + k \times W) \text{ for } i = 0, 1, 2, ..., N - k \times W - 1,$$

$$s_m^{(k)}(i) = (j)^i \times s_m(i - N + k \times W) \text{ and } g_m^{(k)}(i) = (j)^i \times g_m(i - N + k \times W) \text{ for } i = N - k \times W, N - k \times W + 1, ..., 1151.$$

Hence, the elements of $s_m^{(k)}$ and $g_m^{(k)}$ are alternating real and imaginary.

Note that both $s_m^{(0)}$ and $g_m^{(0)}$ simply correspond to s_m and g_m respectively, followed by its first W elements as post extension and that both $s_m^{(7)}$ and $g_m^{(7)}$ simply correspond to the last W elements of s_m and g_m in form of a pre extension, followed by s_m and g_m respectively.

Finally, the CSC $C_{CSC,m}^{(k)}$ derived from the m:th applicable constituent Golay complementary pair s_m and g_m, and for the k:th offset is then defined as a concatenation of $s_m^{(k)}$ and $g_m^{(k)}$ by:

$$C_{CSC,m}^{(k)} = \langle s_m^{(k)}(0), s_m^{(k)}(1), s_m^{(k)}(2), \ldots, s_m^{(k)}(1151), g_m^{(k)}(0), g_m^{(k)}(1), g_m^{(k)}(2), \ldots, g_m^{(k)}(1151)\rangle$$

where the leftmost element $s_m^{(k)}(0)$ in the sequence corresponds to the chip to be first transmitted in time. An CSC has therefore length 2304 chips.

Note that due to this construction method, the auto correlations for all CSCs derived from one particular constituent Golay complementary pair s_m and g_m can be obtained simultaneously and in sequential order from the sum of partial correlations with s_m and g_m, these CSCs remaining orthogonal.

CSCs derived according to above have complex values and shall not be subject to the channelisation or scrambling process, i.e. its elements represent complex chips for usage in the pulse shaping process at modulation.

3GPP TSG RAN Meeting #11
Palm Springs, CA, U.S.A., March 13-16, 2001

R1-01-0383

CR-Form-v3

CHANGE REQUEST

⌘ **25.224**	**CR 044**	⌘ rev **2** ⌘	Current version:	**3.5.0**	⌘

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [ ]

Title:	⌘	Layer 1 procedure for Node B synchronisation		
Source:	⌘	TSG RAN WG1		
Work item code:	⌘	RANimp-NBsync	***Date:*** ⌘	28.02.2001
Category:	⌘	**B**	***Release:*** ⌘	REL-4
		Use one of the following categories: ***F** (essential correction)* ***A** (corresponds to a correction in an earlier release)* ***B** (Addition of feature),* ***C** (Functional modification of feature)* ***D** (Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	Introduction of L1 procedure necessary for work item
Summary of change:	⌘	A new chapter is added with the L1 procedure for Node B synchronisation, an indication is given, that some frames are blocked for PRACH transmissions. A new section contains power control for the PNBSCH.
Consequences if not approved:	⌘	Work item Node B synchronisation is not feasible

Clauses affected:	⌘	4.7, 4.9		
Other specs affected:	⌘	[X] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	25.221, 25.223, 25.331, 25.402, 25.433
Other comments:	⌘			

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3GPP TS 25.201: "Physical layer - general description".

[2] 3GPP TS 25.102: "UE physical layer capabilities".

[3] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[4] 3GPP TS 25.212: "Multiplexing and channel coding (FDD)".

[5] 3GPP TS 25.213: "Spreading and modulation (FDD)".

[6] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[7] 3GPP TS 25.215: "Physical Layer - Measurements (FDD)".

[8] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[9] 3GPP TS 25.222: "Multiplexing and channel coding (TDD)".

[10] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[11] 3GPP TS 25.225: "Physical Layer - Measurements (TDD)".

[12] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[13] 3GPP TS 25.302: "Services Provided by the Physical Layer".

[14] 3GPP TS 25.401: "UTRAN Overall Description".

[15] 3GPP TS 25.331: "RRC Protocol Specification"

[16] 3GPP TS 25.433: " UTRAN Iub Interface NBAP Signalling"

[17] 3GPP TS 25.105: " UTRA (BS) TDD; Radio transmission and Reception"

[18] 3GPP TS 25.321: " MAC protocol specification"

[19] 3GPP TS 25.303: " Interlayer Procedures in Connected Mode"

[20] 3GPP TS 25.402: ” Synchronisation in UTRAN Stage 2”

4.2.3.4 PNBSCH

The PNBSCH transmit power is set by higher layer signalling [16]. The value given is relative to the power of the P-CCPCH

4.2.3.53 DPCH, PDSCH

The initial transmission power of the downlink DPCH and the PDSCH is set by the network. After the initial transmission, the UTRAN transits into SIR-based inner loop power control.

The UE shall generate TPC commands to control the network transmit power and send them in the TPC field of the uplink DPCH and PUSCH. An example on how to derive the TPC commands in given in Annex A.2

The association between TPC commands sent on uplink DPCH and PUSCH, with the power controlled downlink DPCH and PDSCH is signaled by higher layers.

In the case that no associated downlink data is scheduled within 15 timeslots before the transmission of a TPC command then this is regarded as a transmission pause. The TPC commands in this case shall be derived from measurements on the P-CCPCH. An example solution for the generation of the TPC command is given in Annex A 2.

Each TPC command shall always be based on all associated downlink transmissions received since the previous related TPC command. Related TPC commands are defined as TPC commands associated with the same downlink CCTrCHs. If there are no associated downlink transmissions between two or more uplink transmissions carrying related TPC commands, then these TPC commands shall be identical and they shall be regarded by the UTRAN as a single TPC command. This rule applies both to the case where the measurements are based on a CCTrCH or, in the case of a pause, on the P-CCPCH.

As a response to the received TPC command, UTRAN may adjust the transmit power. When the TPC command is judged as "down", the transmission power may be reduced by one step, whereas if judged as "up", the transmission power may be raised by one step. The UTRAN may apply an individual offset to the transmission power in each timeslot according to the downlink interference level at the UE. The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power of the complex QPSK symbols of a single DPCH before spreading.

During a downlink transmission pause, the UTRAN may accumulated the TPC commands received. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits.

The total downlink transmission power at the nodeB within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. In case the total power of the sum of all transmissions would exceed this limit, then the transmission power of all downlink DPCHs is reduced by the amount that allows fulfilling the requirement. The same amount of power reduction is applied to all DPCHs.

A higher layer outer loop adjusts the target SIR.

4.7 Random access procedure

The physical random access procedure described below is invoked whenever a higher layer requests transmission of a message on the RACH. The physical random access procedure is controlled by primitives from RRC and MAC. Retransmission on the RACH in case of failed transmission (e.g. due to a collision) is controlled by higher layers. Thus, the backoff algorithm and associated handling of timers is not described here. The definition of the RACH in terms of PRACH sub-channels and associated Access Service Classes is broadcast on the BCH in each cell. Parameters for common physical channel uplink outer loop power control are also broadcast on the BCH in each cell. The UE needs to decode this information prior to transmission on the RACH. Higher layer signalling may indicate, that in some frames a timeslot shall be blocked for RACH uplink transmission.

4.7.1 Physical random access procedure

The physical random access procedure described in this subclause is initiated upon request of a PHY-Data-REQ primitive from the MAC sublayer (see [18] and [19]).

Before the physical random-access procedure can be initiated, Layer 1 shall receive the following information by a CPHY-TrCH-Config-REQ from the RRC layer:

- the available PRACH sub-channels for each Access Service Class (ASC);
- the timeslot, spreading factor, channelisation code, midamble, repetition period and offset for each PRACH sub-channel. (There is a 1:1 mapping between spreading code and midamble as defined by RRC);
- the set of Transport Format parameters;
- the set of parameters for common physical channel uplink outer loop power control.

NOTE: The above parameters may be updated from higher layers before each physical random access procedure is initiated. At each initiation of the physical random access procedure, Layer 1 shall receive the following information from the higher layers (MAC):

- the Transport Format to be used for the PRACH message;
- the ASC of the PRACH transmission;
- the data to be transmitted (Transport Block Set).

In addition, Layer 1 may receive information from higher layers, that a timeslot in certain frames shall be blocked for PRACH uplink transmission.

The physical random-access procedure shall be performed as follows.

1 Randomly select the PRACH sub-channel from the available ones for the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.

2 Derive the acess slots that are available and not blocked in the next N frames, defined by SFN, SFN+1, ..., SFN+N-1 for the selected PRACH sub-channel with the help of SFN (where N is the repetition period of the selected PRACH sub-channel). Randomly select an uplink access slot from the available access slots in the next frame, defined by SFN, if there is one available. If there is no access slot available in the next frame, defined by SFN then, randomly select one access slot from the available access slots in the following frame, defined by SFN+1. This search is performed for all frames in increasing order, defined by SFN, SFN+1, ..., SFN+N-1, until an available access slot is found. The random function shall be such that each of the allowed selections is chosen with equal probability.

3 Randomly select a spreading code from the available ones for the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability. The midamble is derived from the selected spreading code.

4 Set the PRACH message transmission power level according to the specification for common physical channels in uplink (see subclause 4.2.2.2).

5 Transmit the random access message with no timing advance.

4.8 DSCH procedure

The physical downlink shared channel procedure described below shall be applied by the UE when the physical layer signalling either with the midamble based signalling or TFCI based signalling is used to indicate for the UE the need for PDSCH detection. There is also a third alternative to indicate to the UE the need for the PDSCH detection and this is done by means of higher layer signalling, already described in [8].

4.8.1 DSCH procedure with TFCI indication

When the UE has been allocated by higher layers to receive data on DSCH using the TFCI, the UE shall decode the PDSCH in the following cases:

- In case of a standalone PDSCH the TFCI is located on the PDSCH itself, then the UE shall decode the TFCI and based on which data rate was indicated by the TFCI, the decoding shall be performed. The UE shall decode PDSCH only if the TFCI word decode corresponds to the TFC part of the TFCS given to the UE by higher layers.
- In case that the TFCI is located on the DCH, the UE shall decode the PDSCH frame or frames if the TFCI on the DCH indicates the need for PDSCH reception. Upon reception of the DCH time slot or time slots, the PDSCH slot (or first PDSCH slot) shall start *SFN n+2* after the DCH frame containing the TFCI, where n indicates the SFN on which the DCH is received. In the case that the TFCI is repeated over several frames, the PDSCH slot shall start *SFN n+2* after the frame having the DCH slot which contains the last part of the repeated TFCI.

4.8.2 DSCH procedure with midamble indication

When the UE has been allocated by higher layers to receive PDSCH based on the midamble used on the PDSCH (midamble based signalling described in [8]), the UE shall operate as follows:

- The UE shall test the midamble it received and if the midamble received was the same as indicated by higher layers to correspond to PDSCH reception, the UE shall detect the PDSCH data according to the TF given by the higher layers for the UE.
- In case of multiple time slot allocation for the DSCH indicated to be part of the TF for the UE, the UE shall receive all timeslots if the midamble of the first timeslot of PDSCH was the midamble indicated to the UE by higher layers.
- In case the standalone PDSCH (no associated DCH) contains the TFCI the UE shall detect the TF indicated by the TFCI on PDSCH.

4.9 Node B Synchronisation Procedure over the Air

An option exists to use cell sync bursts to achieve and maintain Node B synchronisation [20]. This optional procedure is based on transmissions of cell synchronisation bursts [10] in predetermined timeslots normally assigned to contain PRACH, according to an RNC schedule. Such soundings between neighbouring cells facilitate timing offset measurements by the cells. The timing offset measurements are reported back to the RNC for processing. The RNC generates cell timing updates that are transmitted to the Node Bs and cells for implementation.

When Cell Sync Bursts are used to achieve and maintain intercell Synchronisation there are three distinct phases, with a potential additional sub-phase involving late entrant cells.

4.9.1 Frequency Acquisition Phase

The frequency acquisition phase is used to bring cells of an RNS area to within frequency limits prior to initial synchronisation. No traffic is supported during this phase. In this phase cell(s) identified as master time reference shall transmit cell sync bursts [10] specified by higher layers continuously, i. e. one in every timeslot. All other cells shall listen for transmissions and shall perform frequency locking to the transmissions received. They shall signal completion of frequency acquisition to the RNC and begin continuous transmission of cell sync bursts specified by higher layers.

4.9.1 Initial Synchronisation

For Initial Phase, where no traffic is supported, the following procedure for initial synchronisation may be used to bring cells of an RNS area into synchronisation at network start up. In this phase each cell shall transmit cell sync bursts [10] according to the higher layer command. All cells use the same cell sync burst code and code offset. Each cell shall listen for transmissions from other cells. Each cell shall report the timing and received SIR of successfully detected cell sync bursts to the RNC. The RNC uses these measurements to adjust the timing of each cell to achieve the required synchronisation accuracy.

4.9.2 Steady-State Phase

The steady-state phase is used to maintain the required synchronisation accuracy. With the start of the steady-state phase, traffic is supported in a cell. A procedure that may be used for the steady-state phase involves cell synch bursts [10] that are transmitted and received without effect on existing traffic. Higher layers signal the transmit parameters, i. e. when to transmit which code and code offset, and which transmit power to use. The higher layers also signal to appropriate cells the receive parameters i. e. which codes and code offsets to measure in a certain timeslot. Upon determination of errors in timing, the RNC may adjust the timing of a cell or cells.

4.9.3 Late entrant cells

A procedure that may be used for introducing new cells into an already synchronised RNS involves the one time transmission of a single cell sync burst [10] (scheduled by higher layers) by all neighbour cells of the late entrant cell. and received by the late entrant cell. The RNC may use this information to adjust the late entrant cell sufficiently to allow the cell to enter steady state phase.

3GPP TSG RAN Meeting #11
Palm Springs, CA, U.S.A., March 13-16, 2001

R1-01-0013

CR-Form-v3

CHANGE REQUEST

⌘ **25.225**	**CR 022**	⌘ rev **-** ⌘	Current version: **3.5.0** ⌘

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [ ]

Title: ⌘	Measurements for Node B synchronisation		
Source: ⌘	TSG RAN WG1		
Work item code: ⌘	RANimp-NBsync	***Date:*** ⌘	10.01.2001
Category: ⌘	**B**	***Release:*** ⌘	REL-4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	Introduction of measurements necessary for work item
Summary of change: ⌘	Two new UTRAN measurements are necessary for node B synchronisation: Cell Sync Burst Timing and Cell Sync Burst SIR
Consequences if not approved: ⌘	Work item Node B synchronisation is not feasible

Clauses affected: ⌘	5.2	
Other specs affected: ⌘	[X] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	25.302, 25.123
Other comments: ⌘		

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2 UTRAN measurement abilities

NOTE 1: If the UTRAN supports multiple frequency bands then the measurements apply for each frequency band individually.

NOTE 2: The Interference part of the SIR measurement will be dependent on the receiver implementation, and will normally be different from the Timeslot ISCP measurement

NOTE 3: The term "antenna connector" used in this sub-clause to define the reference point for the UTRAN measurements refers to the "BS antenna connector" test port A and test port B as described in [18]. The term "antenna connector" refers to Rx or Tx antenna connector as described in the respective measurement definitions.

5.2.1 RSCP

Definition	Received Signal Code Power, the received power on one DPCH, PRACH or PUSCH code. The reference point for the RSCP shall be the Rx antenna connector.

5.2.2 Timeslot ISCP

Definition	Interference Signal Code Power, the interference on the received signal in a specified timeslot measured on the midamble. The reference point for the ISCP shall be the Rx antenna connector.

5.2.3 Received total wide band power

Definition	The received wide band power in a specified timeslot including the noise generated in the receiver, within the bandwidth defined by the pulse shaping filter. In case of receiver diversity the reported value shall be the linear average of the power in the diversity branches. The reference point for the Received total wideband power measurement shall be the output of the pulse shaping filter in the receiver.

5.2.4 SIR

Definition	Signal to Interference Ratio, defined as: (RSCP/Interference)xSF. Where: RSCP = Received Signal Code Power, the received power on the code of a specified DPCH, PRACH or PUSCH. Interference = The interference on the received signal in the same timeslot which can't be eliminated by the receiver. SF = The used spreading factor. The reference point for the SIR shall be the Rx antenna connector.

5.2.5 Transport channel BER

Definition	The transport channel BER is an estimation of the average bit error rate (BER) of DCH or USCH data. The transport channel (TrCH) BER is measured from the data considering only non-punctured bits at the input of the channel decoder in Node B. It shall be possible to report an estimate of the transport channel BER for a TrCH after the end of each TTI of the TrCH. The reported TrCH BER shall be an estimate of the BER during the latest TTI for that TrCH. Transport channel BER is only required to be reported for TrCHs that are channel coded.

5.2.6 Transmitted carrier power

Definition	Transmitted carrier power, is the ratio between the total transmitted power and the maximum transmission power. Total transmission power is the power [W] transmitted on one DL carrier in a specific timeslot from one UTRAN access point. Maximum transmission power is the power [W] on the same carrier when transmitting at the configured maximum transmission power for the cell. The measurement shall be possible on any carrier transmitted from the UTRAN access point. The reference point for the transmitted carrier power measurement shall be the Tx antenna connector. In case of Tx diversity the transmitted carrier power for each branch shall be measured and the maximum of the two values shall be reported to higher layers, i.e. only one value will be reported to higher layers.

5.2.7 Transmitted code power

Definition	Transmitted Code Power, is the transmitted power on one carrier and one channelisation code in one timeslot. The reference point for the transmitted code power measurement shall be the Tx antenna connector.

5.2.8 RX Timing Deviation

Definition	'RX Timing Deviation' is the time difference $T_{RXdev} = T_{TS} – T_{RXpath}$ in chips, with T_{RXpath}: time of the reception in the Node B of the first detected uplink path (in time) to be used in the detection process. The reference point for T_{RXpath} shall be the Rx antenna connector. T_{TS}: time of the beginning of the respective slot according to the Node B internal timing

NOTE: This measurement can be used for timing advance calculation or location services.

5.2.9 UTRAN GPS Timing of Cell Frames for LCS

Definition	$T_{UTRAN-GPS}$ is defined as the time of occurrence of a specified UTRAN event according to GPS Time Of Week. The specified UTRAN event is the beginning of the transmission of a particular frame (identified through its SFN) transmitted in the cell. The reference point for $T_{UTRAN-GPSj}$ shall be the Tx antenna connector.

5.2.10 Cell Sync Burst Timing

Definition	Cell sync burst timing is the time of start (defined by the first detected path in time) of the cell sync burst of a neighbouring cell. Type 1 is used for the initial phase of Node B synchronization. Type 2 is used for the steady-state phase of Node B synchronization. Both have different range. The reference point for the cell sync burst timing measurement shall be the Rx antenna connector. **Type 1:** Cell sync burst timing = T_{Rx} - T_{slot} in chips, where T_{slot} : time of start of the cell sync timeslot in the frame, where the cell sync burst was received. T_{RX} : time of start (defined by the first detected path in time) of a cell sync burst received from the target UTRA cell. **Type 2:** Cell sync burst timing = T_{Rx} - T_{slot}, in chips, where T_{slot} : time of start of the cell sync timeslot in the frame, where the cell sync burst was received. T_{RX} : time of start (defined by the first detected path in time) of a cell sync burst received from the target UTRA cell.

5.2.11 Cell Sync Burst SIR

Definition	Signal to Interference Ratio for the cell sync burst, defined as: RSCP/Interference, where: RSCP = Received Signal Code Power, the received power on the code and code offset of a cell sync burst. Interference = The interference on the received signal in the same timeslot which can't be eliminated by the receiver The reference point for the cell sync burst SIR shall be the Rx antenna connector.

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Palm Springs, CA, U.S.A., March 13-16, 2001

R1-01-0382

CR-Form-v3

CHANGE REQUEST

⌘	**25.836**	**CR**	**001**	⌘	rev	**1**	⌘	Current version:	**4.0.0** ⌘

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [ ]

Title:	⌘	Additions to the node B synchronisation procedure		
Source:	⌘	TSG RAN WG1		
Work item code:	⌘	RANimp-NBsync	***Date:*** ⌘	28.02.2001
Category:	⌘	**C**	***Release:*** ⌘	REL-4
		Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	Support of frequency acquisition
Summary of change:	⌘	An optional phase was added to the synchronisation procedure
Consequences if not approved:	⌘	No support of low-cost node B implementations

Clauses affected:	⌘	7.1, 7.2	
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments:	⌘		

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7 Concept of Node B Synchronisation

7.1 General

In addition to proprietary means there are two ways to achieve cell synchronisation in a TDD system:

- Synchronisation of nodes Bs to an external reference via the synchronisation port standardised for Rel. 99
- Synchronisation of cells or Node Bs via the air interface described in this report for Rel. 4

The solution described in this report allows a mixture of both schemes, i. e. some cells may be synchronised over the air, some via the synchronisation port. In general, at least one time reference (e. g. GPS) is needed for each island of cells having connectivity to each other.

The RNC shall be the master of the synchronisation process, since the measurements either performed by a cell or by a UE, shall be signalled to and processed by the RNC.
A new procedure facilitates the transmission of measurements and commands between the RNC and the node B as well as allows the adjustment of the node B timing. Details of this procedure can be found in TR 25.838.
An optional phase may facilitate the frequency acquisision of node Bs at start-up prior to over-the-air synchronisation.

7.2 Synchronisation Procedure

The synchronisation procedure is based on using transmissions of cell synchronisation bursts in predetermined PRACH time slots based on an RNC schedule. Such soundings between neighbouring cells facilitate timing offset measurements by the cells. The timing offset measurements are reported back to the RNC for processing. The RNC generates cell timing updates that are transmitted to the Node Bs and cells for implementation. CEC sequences with multiple offsets are used as cell synchronisation bursts. The synchronisation procedure has three phases, the frequency acquisition phase, the initial phase and the steady-state phase. For Node Bs and cells with high accuracy frequency references, the frequency acquisition phase may be omitted. The procedure for late entrant cells is slightly different and is described separately.

Frequency Acquisition Phase

The procedure for frequency acquisition is used to bring cells of an RNS area to within frequency limits prior to initial synchronisation. This phase would allow cells to use low cost reference oscillators with accuracies in the order of several ppm. No traffic is supported during this phase:

1. The cell(s) identified as master time reference (e.g. containing the GPS receiver) shall transmit continuously cell sync bursts specified by higher layers (i.e. one in every time slot).
2. Initially all other cells shall be considered as unlocked (i.e. not in frequency lock).
3. While in this state, a cell shall not transmit, but shall listen for transmissions from other cells. The cell shall perform frequency locking to any transmission received.
4. When a cell has detected that it has locked its frequency to within 50 ppb of the received signal it shall signal completion of frequency acquisition to the RNC and begin transmitting the specified code. The exact timing of the code phase is unimportant.
5. When the RNC has received completion of frequency acquisition signals from all cells the frequency acquisition phase is completed.

Initial Synchronisation

1. The RNC sends a request over the relevant Iub to the cell(s) with ~~GPS~~ reference clock for a timing signal. The RNC adjusts its clock appropriately, compensating for the known round trip Iub delay.
2. The RNC sends timing updates over the Iub to all the cells, apart from the one containing the reference clock~~GPS~~, instructing them to adjust their clocks towards its own timing. Each of the timing offsets is again adjusted by the Iub round trip delay for that cell.
3. At this point, none of the cells is supporting traffic so a large proportion of the time can be given over to achieving synchronisation. It is assumed that there is as yet no information available on which to base the generation of a re-use pattern for sync transmissions. Thus all cells are instructed to transmit their cell sync bursts in turn one after the other with *no re-use*, i. e. the same sync burst sequence and offset is used by all cells.

4. All cells listen for transmissions and those which successfully detect a cell sync burst report their timing and received S/(N+I) to the RNC over the relevant Iub. Knowing the schedule, the RNC is able to determine the cell which made the transmission and place a measurement entry in the relevant place in its measurement matrix. After all cells have made their transmissions, the RNC computes the set of updates which will bring the cells nominally into synchronisation.
5. Steps 3 and 4 are repeated several times (typically 10). This serves two purposes:-
    - The rapid updates allow the correction of the clock frequencies as well as the clock timings to be adjusted in a short space of time. This rapidly brings the network into tight synchronisation.
    - The S/(N+I) values are averaged over this period. This provides more accurate measurements (averaging over noise and fading) which can be used in the automatic generation of a re-use plan.
6. The S/(N+I) values are used, automatically, to plan a re-use pattern. This is performed as follows:-
    - A matrix of minimal connectivity is computed on the basis of designating pairs of cells are minimal neighbours if either their estimated average S/(N+I) exceeds a threshold or if they have mutual neighbours.
    - The set of cells is divided into partitions of cells. Each partition must satisfy the requirement that no pairs of cells within that partition are minimally connected. All cells within a partition transmit the same code offset in parallel.

Steady-State Phase

7. All of the cells in the same partition are arranged to transmit / receive in the same cell sync frames according to the above procedure and they transmit the same code offset in parallel. All cells report the reception times for all relevant code offsets back to the RNC.
8. At the end of each cycle, the RNC collates the information. In general there should always exist a path of bidirectional valid measurements that link every cell either directly or indirectly to the cell with UTC capability. However, the model is arranged such that only those cells which have such a path will be updated on any given occasion.
9. The process of partition transmissions and updating then continues indefinitely.

Late entrant Node Bs

The scheme for introducing new nodeBs into a synchronized RNS is as follows:

1. There is a specialised sync transmission scheduled by higher layers~~at regular intervals or event driven~~. A single common code (i.e. with the same, nominally zero, shift) is transmitted in parallel by *all* NodeBs addressed~~which are synchronised in the system~~. The late entrant NodeB will correlate against the specialised sync transmissions. The late entrant NodeB will take the earliest reception as the timing of the system.
2. Thus, at this point, the late entrant NodeB has obtained system time, subject to an unknown propagation delay between it and its nearest neighbour. The late entrant NodeB cannot, at this time, tell which of its neighbours *is* the nearest. However, this level of synchronisation is good enough that from then on the late entrant NodeB can distinguish the overlaid normal sync transmissions unambiguously for the various code shifts.
3. After this time the late entrant NodeB can measure the timings of sync transmissions received from specific NodeBs and report these to the RNC. In turn, the RNC can give the late entrant NodeB its own schedules for sync transmission and to use one or more of these. The RNC can then use the bi-directional sounding, which will then be available, to compute the true timing error and to instruct the NodeB to adjust its timing appropriately.

If the late entrant has an inaccurate clock the specialised cell sync burst transmission may be repeated often enough to allow full frequency searching.