3GPP TSG-RAN Working Group 1, Meeting #11 TDoc TSG RAN WG1 (00)0220
San Diego, USA, February 29 – March 3, 2000

Source: Siemens AG
Title: Removal of Synchronisation Case 3 in UTRA TDD
Agenda Item: AdHoc 1
Document for: Approval

Introduction

At WG1 meeting #9 there had been a proposal to remove synchronisation case 3 from the TDD specifications. We have found that indeed there are a lot of drawbacks with this case compared to the situation to have case 1 and 2 only. These drawbacks are listed in the following:

- The original argument for case 3 (strong interference on a particular timeslot, so that BCH can not be read) does not hold any longer, since TS#k can be reconfigured on the same long-term base as this can be done with the P-CCPCH pointer.
- The acquisition performance with case 3 at HOV is very poor if the SSC has to be detected. For instance, in GSM it may be the case that only one SSC within a 120ms period may be observed. With a four slot average in a benign environment, this implies a monitoring time of about 500ms for case 2 and 750ms for case 3, based on the assumption that performance is degraded by about 2dB and one gains about 1dB per slot averaging. This assumptions are based on simulations by Texas Instruments and Interdigital that were presented at WG1#5...WG1#8. Taking into account higher speeds, the acquisition time may even be doubled.
- At initial access, the UE has to assume case 3 always. This degrades access performance, see above. With the former sync scheme case 3 and 2 could be distinguished in the UE. However, with the current sync scheme, case 2 is a subset of case 3 and cannot be distinguished any more.
- The P-CCPCH pointer has to be signalled for neighbour cell measurements if the acquisition of SSC is to be avoided, see above. This may be a problem especially for GSM-TDD HO, when the neighbour cell list is broadcast and the ressources are short.
- An additional bit has to be signalled to distinguish case 3 from case 2 and 1.
- 4 DL time slots are always needed for case 3 (if SCH<>(0,0,0)), which reduces switching point flexibility

Conclusion

Since no absolute reasons are seen to keep case 3 in the UTRA TDD mode, it is proposed to remove this case from the set of WG1 specifications. Moreover, it is proposed to send a LS to TSG RAN WG2 and TSG RAN WG3 to inform them about this decision, since this change will impact the set of specifications within WG2 and WG3.

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25.221	**CR**	**014**		Current Version:	3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	RAN#7	for approval	X	Strategic		*(for SMG use only)*
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Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Siemens AG **Date:** 2000-02-21

Subject: Removal of Synchronisation Case 3 in TDD

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: Performance of SCH acquisition is too low with synchronisation case 3.

Clauses affected: 3, 4.1.2, 5.3.4, 5.4.1, 6, 6.2

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	CR005-223, CR011-224
Other GSM core specifications		→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:

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3 Abbreviations

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

BCH	Broadcast Channel
CCPCH	Common Control Physical Channel
CCTrCH	Coded Composite Transport Channel
CDMA	Code Division Multiple Access
DPCH	Dedicated Physical Channel
DSCH	Downlink Shared Channel
FACH	Forward Access Channel
FDD	Frequency Division Duplex
FEC	Forward Error Correction
GP	Guard Period
GSM	Global System for Mobile Communication
NRT	Non-Real Time
ODCH	ODMA Dedicated Transport Channel
ODMA	Opportunity Driven Multiple Access
ORACH	ODMA Random Access Channel
OVSF	Orthogonal Variable Spreading Factor
P-CCPCH	Primary CCPCH
PCH	Paging Channel
PDSCH	Physical Downlink Shared Channel
PDU	Protocol Data Unit
PICH	Page Indicator Channel
PRACH	Physical Random Access Channel
~~PSCH~~	~~Physical Synchronisation Channel~~
PUSCH	Physical Uplink Shared Channel
RACH	Random Access Channel
RLC	Radio Link Control
RF	Radio Frame
RT	Real Time
S-CCPCH	Secondary CCPCH
SCH	Synchronisation Channel
SFN	Cell System Frame Number
TCH	Traffic Channel
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
USCH	Uplink Shared Channel

4 Transport channels

4.1 Transport channels

Transport channels are the services offered by layer 1 to the higher layers. A transport channel is defined by how and with what characteristics data is transferred over the air interface. A general classification of transport channels is into two groups:

- common channels (where there is a need for in-band identification of the UEs when particular UEs are addressed) and

- dedicated channels (where the UEs are identified by the physical channel)

General concepts about transport channels are described in 3GPP RAN TS25.302 (L2 specification).

4.1.1 Dedicated transport channels

The Dedicated Channel (DCH) is an up- or downlink transport channel that is used to carry user or control information between the UTRAN and a UE.

Two types of dedicated transport channels have been identified:

1) Dedicated Channel (DCH)

2) ODMA Dedicated Transport Channel (ODCH)

4.1.2 Common transport channels

Common transport channels are:

1) Broadcast Channel (BCH)

The Broadcast Channel (BCH) is a downlink transport channel that is used to broadcast system- and cell-specific information.

2) Paging Channel (PCH)

The Paging Channel (PCH) is a downlink transport channel that is used to carry control information to a mobile station when the system does not know the location cell of the mobile station.

3) Forward Access Channel(s) (FACH)

The Forward Access Channel (FACH) is a downlink transport channel that is used to carry control information to a mobile station when the system knows the location cell of the mobile station. The FACH may also carry short user packets.

4) Random Access Channel(s) (RACH)

The Random Access Channel (RACH) is an up link transport channel that is used to carry control information from mobile station. The RACH may also carry short user packets.

5) ODMA Random Access Channel (ORACH)

~~6) Synchronisation Channel (SCH)~~

~~7~~6) Uplink Shared Channel (USCH)

The uplink shared channel (USCH) is a uplink transport channel shared by several UEs carrying dedicated control or traffic data.

~~8~~7) Downlink Shared Channel (DSCH)

The downlink shared channel (DSCH) is a downlink transport channel shared by several UEs carrying dedicated control or traffic data.

5.3.4 The ~~physical~~ synchronisation channel (~~P~~SCH)

In TDD mode code group of a cell can be derived from the synchronisation channel. ~~Additional information, received from higher layers on SCH transport channel, is also transmitted to the UE in PSCH in case 3 from below.~~ In order not to limit the uplink/downlink asymmetry the ~~P~~SCH is mapped on one or two downlink slots per frame only.
There are two~~three~~ cases of ~~P~~SCH and P-CCPCH allocation as follows:

Case 1) ~~P~~SCH and P-CCPCH allocated in TS#k, k=0….14

Case 2) ~~P~~SCH allocated in two TS: TS#k and TS#k+8, k=0…6; P-CCPCH allocated in TS#k.

~~Case 3) PSCH allocated in two TS, TS#k and TS#k+8, k=0…6, and the P-CCPCH allocated in TS#i, i=0…6, pointed by PSCH. Pointing is determined via the SCH from the higher layers.~~

~~These three cases are addressed by higher layers using the SCCH in TDD Mode.~~ The position of ~~P~~SCH (value of k) in frame can change on a long term basis in any case.
Due to this ~~P~~SCH scheme, the position of PCCPCH is known from the ~~P~~SCH.
Figure 15 is an example for transmission of ~~P~~SCH, k=0, of Case 2 or Case 3.

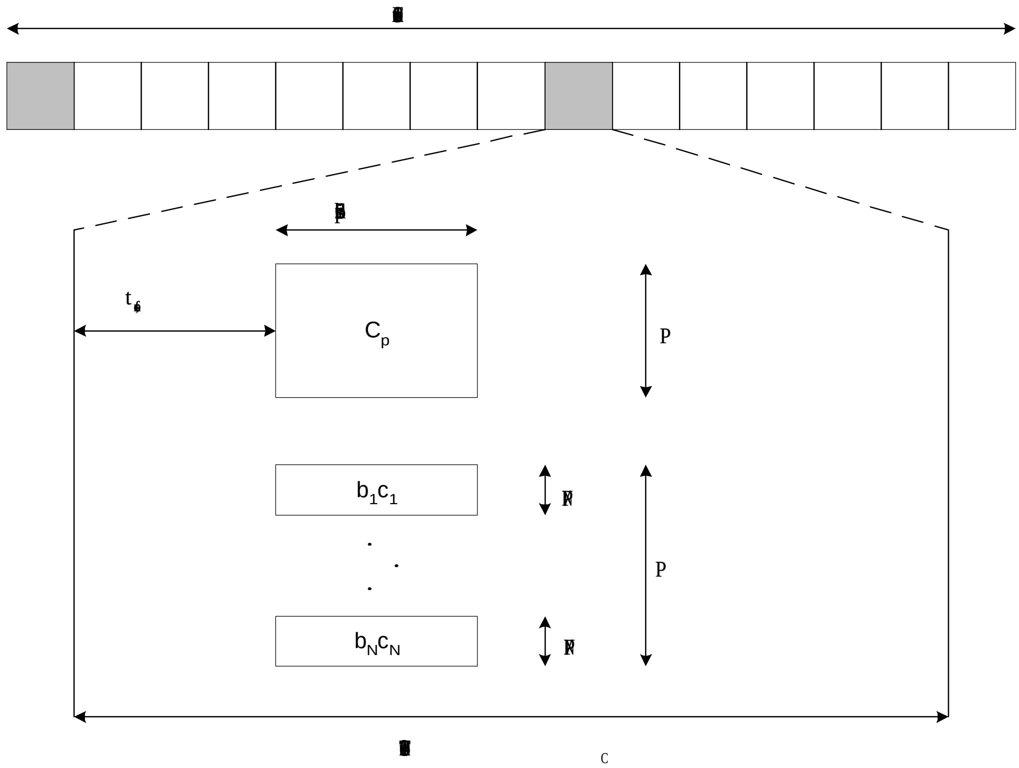

Figure 15: Scheme for ~~Physical~~ Synchronisation channel ~~P~~SCH consisting of one primary sequence C_p and N=3 parallel secondary sequences in slot k and k+8

(example for k=0 in Case 2 ~~or Case 3~~)

As depicted in figure 15, the ~~P~~SCH consists of a primary and three secondary code sequences with 256 chips length. The primary and secondary code sequences are defined in [8] chapter 7 'Synchronisation codes'. The secondary codes are transmitted either in the I channel or the Q channel, depending on the code group.
Due to mobile to mobile interference, it is mandatory for public TDD systems to keep synchronisation between base stations. As a consequence of this, a capture effect concerning ~~P~~SCH can arise. The time offset t_{offset} enables the system to overcome the capture effect.
The time offset t_{offset} is one of 32 values, depending on the cell parameter, thus on the code group of the cell, cf. 'table 7 Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{offset}' in [8]. The exact value for t_{offset}, regarding column 'Associated t_{offset}' in table 7 in [8] is given by:

$$t_{offset,n} = n \cdot T_c \left\lfloor \frac{2560-96-256}{31} \right\rfloor$$
$$= n \cdot 71 T_c \; ; \quad n = 0,\ldots,31$$

Please note that $\lfloor x \rfloor$ denotes the largest integer number less or equal to x and that T_c denotes the chip duration.

5.4.1 Location of physical channels with beacon function

The location of the physical channels with beacon function is determined by the ~~P~~SCH and depends on the ~~P~~SCH allocation case, see 5.3.4:

Case 1) All physical channels that are allocated to channelisation code $a_{Q=16}^{(k=1)}$ and in TS#k, k=0….14 shall provide the beacon function.

Case 2) All physical channels that are allocated to channelisation code $a_{Q=16}^{(k=1)}$ and in TS#k and TS#k+8, k=0…6, shall provide the beacon function.

~~Case 3) All physical channels that are allocated to channelisation code $a_{Q=16}^{(k=1)}$ and in TS#i and TS#i+8, i=0…6, pointed by PSCH, shall provide the beacon function.~~

Note that by this definition the P-CCPCH always provides the beacon function.

6 Mapping of transport channels to physical channels

This section describes the way in which transport channels are mapped onto physical resources, see figure 17.

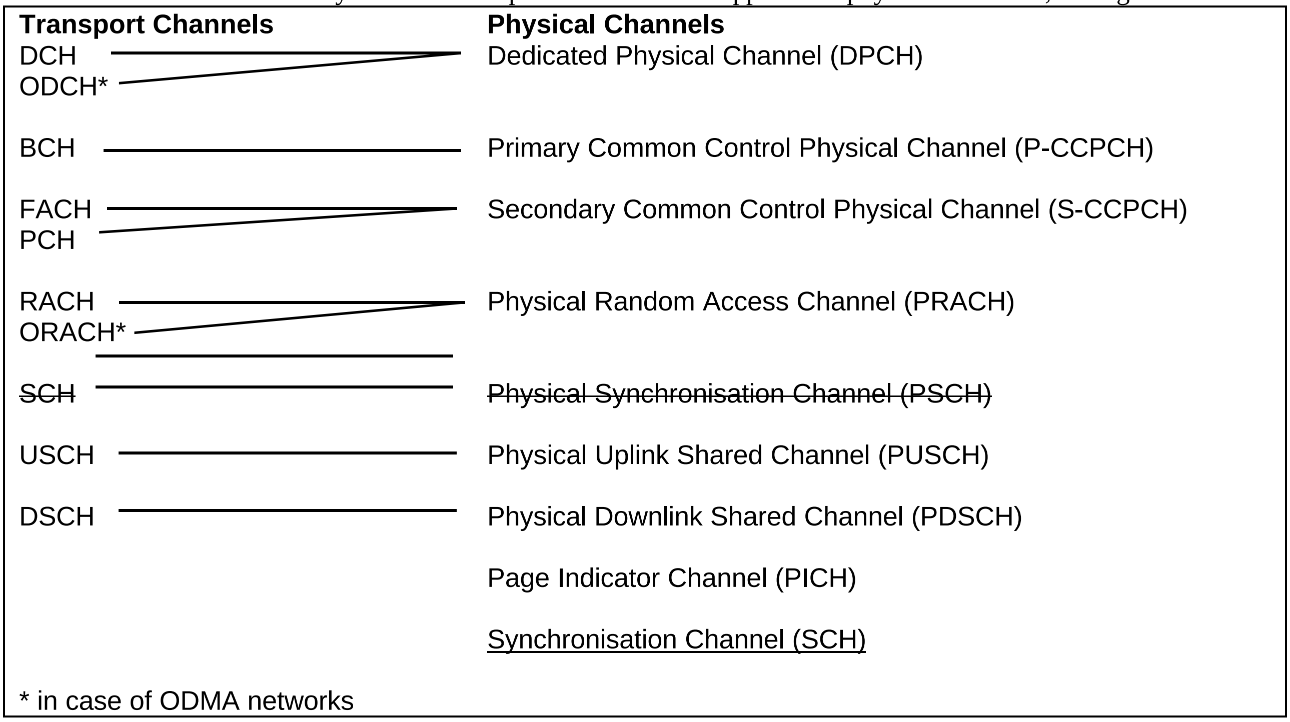

Figure 17: Transport channel to physical channel mapping

6.2 Common Transport Channels

6.2.1 The Broadcast Channel (BCH)

The BCH is mapped onto the P-CCPCH. The secondary SCH indicates in which timeslot a mobile can find the P-CCPCH containing BCH. If the broadcast information requires more resources than provided by the P-CCPCH, the BCH in P-CCPCH will comprise a pointer to additional S-CCPCH resources for FACH in which this additional broadcast information shall be sent.

6.2.2 The Paging Channel (PCH)

The PCH is mapped onto one or several S-CCPCHs so that capacity can be matched to requirements. The location of the PCH is indicated on the BCH. It is always transmitted at a reference power level.

To allow an efficient DRX, the PCH is divided into several paging sub-channels within the allocated multiframe structure. Examples of multiframe structures are given in the Annex B of this document. Each paging sub-channel is mapped onto 2 consecutive frames that are allocated to the PCH on the same S-CCPCH. Layer 3 information to a particular paging group is transmitted only in the associated paging sub-channel. The assignment of UEs to paging groups is independent of the assignment of UEs to page indicators.

6.2.3 The Forward Channel (FACH)

The FACH is mapped onto one or several S-CCPCHs. The location of the FACH is indicated on the BCH and both, capacity and location can be changed, if required. FACH may or may not be power controlled.

6.2.4 The Random Access Channel (RACH)

The RACH has intraslot interleaving only and is mapped onto PRACH. The same slot may be used for PRACH by more than one cell. Multiple transmissions using different spreading codes may be received in parallel. More than one slot per frame may be administered for the PRACH. The location of slots allocated to PRACH is broadcast on the BCH. The PRACH uses open loop power control. The details of the employed open loop power control algorithm may be different from the corresponding algorithm on other channels.

~~6.2.5 The Synchronisation Channel (SCH)~~

~~The SCH is mapped onto the PSCH as described in section 5.4.~~

6.2.6 Common Transport Channels for ODMA networks

The ORACH is used to transfer short probes or short protocol data units (PDU) between one or more nodes for routing and resource allocation control.

To limit the transmission time of short probe PDUs on the ORACH then this data should be transmitted as one burst on one code. That is, one probe burst should be transmitted on one $2560*T_c$ timeslot (which as described in section 5.1 would be configured as an ORACH slot).

Since the ORACH is a common control channel used to transfer probes between one or more nodes a common fixed spreading factor should be adopted.

6.2.7 The Uplink Shared Channel (USCH)

The uplink shared channel is mapped on one or several PUSCH, see section 5.5.

6.2.8 The Downlink Shared Channel (DSCH)

The downlink shared channel is mapped on one or several PDSCH, see section 5.6.

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25.223 CR 005 Current Version: 3.1.0

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Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Siemens AG **Date:** 2000-02-21

Subject: Removal of Synchronisation Case 3 in TDD

Work item:

Category:				**Release:**	
	F Correction	X		Phase 2	
	A Corresponds to a correction in an earlier release			Release 96	
(only one category	B Addition of feature			Release 97	
shall be marked	C Functional modification of feature			Release 98	
with an X)	D Editorial modification			Release 99	X
				Release 00	

Reason for change: Performance of SCH acquisition is too low with synchronisation case 3.

Clauses affected: 3, 7.2, 7.3

Other specs affected:			
	Other 3G core specifications	X	→ List of CRs: CR014-221, CR01-224
	Other GSM core specifications		→ List of CRs:
	MS test specifications		→ List of CRs:
	BSS test specifications		→ List of CRs:
	O&M specifications		→ List of CRs:

Other comments:

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3 Abbreviations

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

CDMA	Code Division Multiple Access
P-CCPCH	Primary Common Control Physical Channel
PN	Pseudo Noise
~~PSCH~~	~~Physical Synchronisation Channel~~
QPSK	Quadrature Phase Shift Keying
RACH	Random Access Channel
SCH	Synchronisation Channel

7.2 Code Allocation

Three SCH codes are QPSK modulated and transmitted in parallel with the primary synchronization code. The QPSK modulation carries the following information.

- The code group that the base station belongs to (5 bits; Cases 1, 2,3)
- The position of the frame within an interleaving period of 20 msec (1 bit, Cases 1, 2,3)
- The position of the slot within the frame (1 bit, Cases 2,3)
- SCH transport channel information, e.g. the location of the Primary CCPCH (3 bits, Case 3)

The modulated codes are also constructed such that their cyclic-shifts are unique, i.e. a non-zero cyclic shift less than 2 (Case 1) and 4 (Cases 2 and 3) of any of the sequences is not equivalent to some cyclic shift of any other of the sequences. Also, a non-zero cyclic shift less than 2 (Case 1) and 4 (Cases 2 and 3) of any of the sequences is not equivalent to itself with any other cyclic shift less than 8. The secondary synchronization codes are partitioned into two code sets for Case 1, and four code sets for Case 2 and thirty two code sets (possibly overlapping) for Case 3. The set is used to provide the following information:

Case 1:

Table 2: Code Set Allocation for Case 1

Code Set	Code Group
1	0-15
2	16-31

The code group and frame position information is provided by modulating the secondary codes in the code set.

Case 2:

Table 3: Code Set Allocation for Case 2

Code Set	Code Group
1	0-7
2	8-15
3	16-23
4	24-31

The slot timing and frame position information is provided by the comma free property of the code word and the Code group is provided by modulating some of the secondary codes in the code set.

Case 3:

Code set k, k=1:32 is associated with Code group k-1. The slot information, the frame position information is provided by the comma free property of the code and the SCH transport channel information is provided by modulating some of the codes in the code set.

The following SCH codes are allocated for each code set:

Case 1

Code set 1: C_0, C_1, $C_{2.}$

Code set 2: C_3, C_4, $C_{5.}$

Case 2

Code set 1: C_0, C_1, $C_{2.}$

Code set 2: C_3, C_4, $C_{5.}$

Code set 3: C_6, C_7, $C_{8.}$

Code set 4: C_9, C_{10}, $C_{11.}$

Case 3

Code set 1: C_0, C_1, $C_{2.}$

Code set 2: C_3, C_4, C_5.

Code set 3: C_6, C_7, C_8.

Code set 4: C_9, C_{10}, C_{11}.

Code set 5: C_{12}, C_{13}, C_{14}.

Code set 6: C_0, C_3, C_6.

Code set 7: C_0, C_4, C_7

Code set 8: C_0, C_5, C_8.

Code set 9: C_0, C_9, C_{12}.

Code set 10: C_0, C_{10}, C_{13}.

Code set 11: C_0, C_{11}, C_{14}.

Code set 12: C_1, C_3, C_7.

Code set 13: C_1, C_4, C_6.

Code set 14: C_1, C_5, C_9.

Code set 15: C_1, C_8, C_{10}.

Code set 16: C_1, C_{11}, C_{12}.

Code set 17: C_1, C_{13}, C_{15}.

Code set 18: C_2, C_3, C_8.

Code set 19: C_2, C_4, C_9.

Code set 20: C_2, C_5, C_6.

Code set 21: C_2, C_7, C_{10}.

Code set 22: C_2, C_{11}, C_{13}.

Code set 23: C_2, C_{12}, C_{15}

Code set 24: C_3, C_9, C_{13}.

Code set 25: C_3, C_{10}, C_{12}.

Code set 26: C_3, C_{11}, C_{15}.

Code set 27: C_4, C_8, C_{11}.

Code set 28: C_4, C_{10}, C_{14}.

Code set 29: C_5, C_7, C_{11}.

Code set 30: C_5, C_{10}, C_{15}.

Code set 31: C_6, C_9, C_{14}.

Code set 32: C_7, C_9, C_{15}.

The following subsections 7.2.1 to 7.2.23 refer to the two three cases of PSCH/P-CCPCH usage as described in [7].

7.2.1 Code allocation for Case 1:

NOTE: Modulation by "j" indicates that the code is transmitted on the Q channel.

Table 4: Code Allocation for Case 1

Code Group	Code Set	Frame 1			Frame 2			Associated t_{offset}
0	1	C_0	C_1	C_2	C_0	C_1	$-C_2$	t_0
1	1	C_0	$-C_1$	C_2	C_0	$-C_1$	$-C_2$	t_1
2	1	$-C_0$	C_1	C_2	$-C_0$	C_1	$-C_2$	t_2
3	1	$-C_0$	$-C_1$	C_2	$-C_0$	$-C_1$	$-C_2$	t_3
4	1	jC_0	JC_1	C_2	jC_0	jC_1	$-C_2$	t_4
5	1	jC_0	$-jC_1$	C_2	jC_0	$-jC_1$	$-C_2$	t_5
6	1	$-jC_0$	JC_1	C_2	$-jC_0$	jC_1	$-C_2$	t_6
7	1	$-jC_0$	$-jC_1$	C_2	$-jC_0$	$-jC_1$	$-C_2$	t_7
8	1	jC_0	JC_2	C_1	jC_0	jC_2	$-C_1$	t_8
9	1	jC_0	$-jC_2$	C_1	jC_0	$-jC_2$	$-C_1$	t_9
10	1	$-jC_0$	JC_2	C_1	$-jC_0$	jC_2	$-C_1$	t_{10}
11	1	$-jC_0$	$-jC_2$	C_1	$-jC_0$	$-jC_2$	$-C_1$	t_{11}
12	1	jC_1	JC_2	C_0	JC_1	jC_2	$-C_0$	t_{12}
13	1	jC_1	$-jC_2$	C_0	JC_1	$-jC_2$	$-C_0$	t_{13}
14	1	$-jC_1$	JC_2	C_0	$-jC_1$	jC_2	$-C_0$	t_{14}
15	1	$-jC_1$	$-jC_2$	C_0	$-jC_1$	$-jC_2$	$-C_0$	t_{15}
16	2	C_3	C_4	C_5	C_3	C_4	$-C_5$	t_{16}
17	2	C_3	$-C_4$	C_5	C_3	$-C_4$	$-C_5$	t_{17}
…	…	…	…	…	…	…	…	…
20	2	jC_3	JC_4	C_5	jC_3	jC_4	$-C_5$	t_{20}
…	…	…	…	…	…	…	…	…
24	2	jC_3	jC_5	C_4	jC_3	JC_5	$-C_4$	t_{24}
…	…	…	…	…	…	…	…	…
31	2	$-jC_4$	$-jC_5$	C_3	$-jC_4$	$-jC_5$	$-C_3$	t_{31}

NOTE: The code construction for code groups 0 to 15 using only the SCH codes from code set 1 is shown. The construction for code groups 16 to 31 using the SCH codes from code set 2 is done in the same way.

7.2.2 Code allocation for Case 2:

Table 5: Code Allocation for Case 2

Code Group	Code Set	Frame 1						Frame 2						Associated t_{offset}
		Slot k			Slot k+8			Slot k			Slot k+8			
0	1	C_0	C_1	C_2	C_0	C_1	$-C_2$	$-C_0$	$-C_1$	C_2	$-C_0$	$-C_1$	$-C_2$	t_0
1	1	C_0	$-C_1$	C_2	C_0	$-C_1$	$-C_2$	$-C_0$	C_1	C_2	$-C_0$	C_1	$-C_2$	t_1
2	1	jC_0	jC_1	C_2	jC_0	jC_1	$-C_2$	$-jC_0$	$-jC_1$	C_2	$-jC_0$	$-jC_1$	$-C_2$	t_2
3	1	jC_0	$-jC_1$	C_2	jC_0	$-jC_1$	$-C_2$	$-jC_0$	jC_1	C_2	$-jC_0$	jC_1	$-C_2$	t_3
4	1	jC_0	jC_2	C_1	jC_0	jC_2	$-C_1$	$-jC_0$	$-jC_2$	C_1	$-jC_0$	$-jC_2$	$-C_1$	t_4
5	1	jC_0	$-jC_2$	C_1	jC_0	$-jC_2$	$-C_1$	$-jC_0$	jC_2	C_1	$-jC_0$	jC_2	$-C_1$	t_5
6	1	jC_1	jC_2	C_0	jC_1	jC_2	$-C_0$	$-jC_1$	$-jC_2$	C_0	$-jC_1$	$-jC_2$	$-C_0$	t_6
7	1	jC_1	$-jC_2$	C_0	jC_1	$-jC_2$	$-C_0$	$-jC_1$	jC_2	C_0	$-jC_1$	jC_2	$-C_0$	t_7
8	2	C_3	C_4	C_5	C_3	C_4	$-C_5$	$-C_3$	$-C_4$	C_5	$-C_3$	$-C_4$	$-C_5$	t_8
9	2	C_3	$-C_4$	C_5	C_3	$-C_4$	$-C_5$	$-C_3$	C_4	C_5	$-C_3$	C_4	$-C_5$	t_9
10	2	jC_3	jC_4	C_5	jC_3	jC_4	$-C_5$	$-jC_3$	$-jC_4$	C_5	$-jC_3$	$-jC_4$	$-C_5$	t_{10}
11	2	jC_3	$-jC_4$	C_5	jC_3	$-jC_4$	$-C_5$	$-jC_3$	jC_4	C_5	$-jC_3$	jC_4	$-C_5$	t_{11}
12	2	jC_3	jC_5	C_4	jC_3	jC_5	$-C_4$	$-jC_3$	$-jC_5$	C_4	$-jC_3$	$-jC_5$	$-C_4$	t_{12}
13	2	jC_3	$-jC_5$	C_4	jC_3	$-jC_5$	$-C_4$	$-jC_3$	jC_5	C_4	$-jC_3$	jC_5	$-C_4$	t_{13}
14	2	jC_4	jC_5	C_3	jC_4	jC_5	$-C_3$	$-jC_4$	$-jC_5$	C_3	$-jC_4$	$-jC_5$	$-C_3$	t_{14}
15	2	jC_4	$-jC_5$	C_3	jC_4	$-jC_5$	$-C_3$	$-jC_4$	jC_5	C_3	$-jC_4$	jC_5	$-C_3$	t_{15}
16	3	C_6	C_7	C_8	C_6	C_7	$-C_8$	$-C_6$	$-C_7$	C_8	$-C_6$	$-C_7$	$-C_8$	t_{16}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
23	3	jC_7	$-jC_8$	C_6	jC_7	$-jC_8$	$-C_6$	$-jC_7$	jC_8	C_6	$-jC_7$	jC_8	$-C_6$	t_{20}
24	4	C_9	C_{10}	C_{11}	C_9	C_{10}	$-C_{11}$	$-C_9$	$-C_{10}$	C_{11}	$-C_9$	$-C_{10}$	$-C_{11}$	t_{24}
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	4	jC_{10}	$-jC_{11}$	C_9	jC_{10}	$-jC_{11}$	$-C_9$	$-jC_{10}$	jC_{11}	C_9	$-jC_{10}$	jC_{11}	$-C_9$	t_{31}

NOTE: The code construction for code groups 0 to 15 using the SCH codes from code sets 1 and 2 is shown. The construction for code groups 16 to 31 using the SCH codes from code sets 3 and 4 is done in the same way.

7.2.3 Code allocation for Case 3:

In addition to the information on code group three bits from SCH transport channel are transmitted to the UE with these codes.

Table 6: Code Allocation for Case 3

Code Group	Code Set	Frame 1						Frame 2						Associated t_{offset}	Addl bits from SCH transport channel
		Slot k			Slot k+8			Slot k			Slot k+8				
0	1	C_0	C_1	C_2	C_0	C_1	$-C_2$	$-C_0$	$-C_1$	C_2	$-C_0$	$-C_1$	$-C_2$	t_0	000
1	1	C_0	$-C_1$	C_2	C_0	$-C_1$	$-C_2$	$-C_0$	C_1	C_2	$-C_0$	C_1	$-C_2$	t_1	000
2	1	jC_0	jC_1	C_2	jC_0	jC_1	$-C_2$	$-jC_0$	$-jC_1$	C_2	$-jC_0$	$-jC_1$	$-C_2$	t_2	000
3	1	jC_0	$-jC_1$	C_2	jC_0	$-jC_1$	$-C_2$	$-jC_0$	jC_1	C_2	$-jC_0$	jC_1	$-C_2$	t_3	000
4	1	jC_0	jC_2	C_1	jC_0	jC_2	$-C_1$	$-jC_0$	$-jC_2$	C_1	$-jC_0$	$-jC_2$	$-C_1$	t_4	000
5	1	jC_0	$-jC_2$	C_1	jC_0	$-jC_2$	$-C_1$	$-jC_0$	jC_2	C_1	$-jC_0$	jC_2	$-C_1$	t_5	000
6	1	jC_1	jC_2	C_0	jC_1	jC_2	$-C_0$	$-jC_1$	$-jC_2$	C_0	$-jC_1$	$-jC_2$	$-C_0$	t_6	000
7	1	jC_1	$-jC_2$	C_0	jC_1	$-jC_2$	$-C_0$	$-jC_1$	jC_2	C_0	$-jC_1$	jC_2	$-C_0$	t_7	000
8	2	C_3	C_4	C_5	C_3	C_4	$-C_5$	$-C_3$	$-C_4$	C_5	$-C_3$	$-C_4$	$-C_5$	t_8	000
9	2	C_3	$-C_4$	C_5	C_3	$-C_4$	$-C_5$	$-C_3$	C_4	C_5	$-C_3$	C_4	$-C_5$	t_9	000
10	2	jC_3	jC_4	C_5	jC_3	jC_4	$-C_5$	$-jC_3$	$-jC_4$	C_5	$-jC_3$	$-jC_4$	$-C_5$	t_{10}	000
11	2	jC_3	$-jC_4$	C_5	jC_3	$-jC_4$	$-C_5$	$-jC_3$	jC_4	C_5	$-jC_3$	jC_4	$-C_5$	t_{11}	000
12	2	jC_3	jC_5	C_4	jC_3	jC_5	$-C_4$	$-jC_3$	$-jC_5$	C_4	$-jC_3$	$-jC_5$	$-C_4$	t_{12}	000
13	2	jC_3	$-jC_5$	C_4	jC_3	$-jC_5$	$-C_4$	$-jC_3$	jC_5	C_4	$-jC_3$	jC_5	$-C_4$	t_{13}	000
14	2	jC_4	jC_5	C_3	jC_4	jC_5	$-C_3$	$-jC_4$	$-jC_5$	C_3	$-jC_4$	$-jC_5$	$-C_3$	t_{14}	000
15	2	jC_4	$-jC_5$	C_3	jC_4	$-jC_5$	$-C_3$	$-jC_4$	jC_5	C_3	$-jC_4$	jC_5	$-C_3$	t_{15}	000
16	3	C_6	C_7	C_8	C_6	C_7	$-C_8$	$-C_6$	$-C_7$	C_8	$-C_6$	$-C_7$	$-C_8$	t_{16}	000
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	4	jC_{10}	$-jC_{11}$	C_9	jC_{10}	$-jC_{11}$	$-C_9$	$-jC_{10}$	jC_{11}	C_9	$-jC_{10}$	jC_{11}	$-C_9$	t_{31}	000
0	5	C_{12}	C_{13}	C_{14}	C_{12}	C_{13}	$-C_{14}$	$-C_{12}$	$-C_{13}$	C_{14}	$-C_{12}$	$-C_{13}$	$-C_{14}$	t_0	001
1	5	C_{12}	$-C_{13}$	C_{14}	C_{12}	$-C_{13}$	$-C_{14}$	$-C_{12}$	C_{13}	C_{14}	$-C_{12}$	C_{13}	$-C_{14}$	t_1	001
2	5	jC_{12}	jC_{13}	C_{14}	jC_{12}	jC_{13}	$-C_{14}$	$-jC_{12}$	$-jC_{13}$	C_{14}	$-jC_{12}$	$-jC_{13}$	$-C_{14}$	t_2	001
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
31	8	jC_5	$-jC_8$	C_0	jC_5	$-jC_8$	$-C_0$	$-jC_5$	jC_8	C_0	$-jC_5$	jC_8	$-C_0$	t_{31}	001
0	9	C_0	C_9	C_{12}	C_0	C_9	$-C_{12}$	$-C_0$	$-C_9$	C_{12}	$-C_0$	$-C_9$	$-C_{12}$	t_0	010
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
30	32	jC_9	jC_{15}	C_7	jC_9	jC_{15}	$-C_7$	$-jC_9$	$-jC_{15}$	C_7	$-jC_9$	$-jC_{15}$	$-C_7$	t_{30}	111
31	32	jC_9	$-jC_{15}$	C_7	jC_9	$-jC_{15}$	$-C_7$	$-jC_9$	jC_{15}	C_7	$-jC_9$	jC_{15}	$-C_7$	t_{31}	111

NOTE: The code construction using code sets 1 to 4 is exactly the same as for Case 2, and the additional bits from the SCH transport channel are "000". The code construction from code sets 5 to 32 is done in the same way with the additional bits for code sets 5 to 8 being "001", code sets 9 to 12 being "010", code sets 13 to 16 being "011", code sets 17 to 20 being "100", code sets 21 to 24 being "101", code sets 25 to 28 being "110", and code sets 29 to 32 being "111".

7.3 Evaluation of synchronisation codes

The evaluation of information transmitted in SCH on code group and frame timing is shown in table 7, where the 32 code groups are listed. Each code group is containing 4 specific scrambling codes (cf. section 6.3), each scrambling code associated with a specific short and long basic midamble code.

Each code group is additionally linked to a specific t_{Offset}, thus to a specific frame timing. By using this scheme, the UE can derive the position of the frame border due to the position of the SCH sequence and the knowledge of t_{Offset}. The complete mapping of Code Group to Scrambling Code, Midamble Codes and t_{Offset} is depicted in table 7.

Table 7: Mapping scheme for Cell Parameters, Code Groups, Scrambling Codes, Midambles and t_{Offset}

CELL PARA-METER	Code Group	Associated Codes			Associated t_{Offset}
		Scrambling Code	Long Basic Midamble Code	Short Basic Midamble Code	
0	Group ~~1~~0	Code 0	m_{PL0}	m_{SL0}	t_0
1		Code 1	m_{PL1}	m_{SL1}	
2		Code 2	m_{PL2}	m_{SL2}	
3		Code 3	m_{PL3}	m_{SL3}	
4	Group ~~2~~1	Code 4	m_{PL4}	m_{SL4}	t_1
5		Code 5	m_{PL5}	m_{SL5}	
6		Code 6	m_{PL6}	m_{SL6}	
7		Code 7	m_{PL7}	m_{SL7}	
. . . .					
124	Group ~~32~~31	Code 124	m_{PL124}	m_{SL124}	t_{31}
125		Code 125	m_{PL125}	m_{SL125}	
126		Code 126	m_{PL126}	m_{SL126}	
127		Code 127	m_{PL127}	m_{SL127}	

For basic midamble codes m_P cf.TS 25.221, annex A ‘Basic Midamble Codes’.

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San Diego, USA, 29 Feb -3 Mar 2000

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CHANGE REQUEST

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25.224	**CR**	**011**	Current Version:	3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	RAN#7	for approval	X	strategic		*(for SMG*
list expected approval meeting # here ↑		for information		non-strategic		*use only)*

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source: Siemens AG **Date:** 2000-02-21

Subject: Removal of Synchronisation Case 3 in TDD

Work item:

Category:	F	Correction	X	**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: Performance of SCH acquisition is too low with synchronisation case 3.

Clauses affected: 3, 4.4

Other specs affected:	Other 3G core specifications	X	→ List of CRs:	CR014-221, CR005-223
	Other GSM core specifications		→ List of CRs:	
	MS test specifications		→ List of CRs:	
	BSS test specifications		→ List of CRs:	
	O&M specifications		→ List of CRs:	

Other comments:

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3 Abbreviations

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

BCCH	Broadcast Control Channel
BCH	Broadcast Channel
CCTrCH	Coded Composite Transport Channel
DCA	Dynamic Channel Allocation
DPCH	Dedicated Physical Channel
DTX	Discontinous Transmission
FACH	Forward Access Channel
NRT	Non-Real Time
ODMA	Opportunity Division Multiple Access
ORACH	ODMA Random Access Channel
P-CCPCH	Primary Common Control Physical Channel
PRACH	Physical Random Access Channel
~~PSCH~~	~~Primary Synchronisation Channel~~
RACH	Random Access Channel
RT	Real Time
RU	Resource Unit
S-CCPCH	Secondary Common Control Physical Channel
SCH	Synchronisation Channel
SSCH	Secondary Synchronisation Channel
STD	Selective Transmit Diversity
TA	Timing Advance
TPC	Transmit Power Control
TSTD	Time Switched Transmit Diversity
TxAA	Transmit Adaptive Antennas
UE	User Equipment
VBR	Variable Bit Rate

4.4 Synchronisation and Cell Search Procedures

4.4.1 Cell Search

During the initial cell search, the UE searches for a cell. It then determines the midamble, the downlink scrambling code and frame synchronisation of that cell. The initial cell search uses the ~~Physical~~ Synchronisation Channel (~~P~~SCH) described in [8]. The generation of synchronisation codes is described in [10].

This initial cell search is carried out in three steps:

Step 1: Slot synchronisation

During the first step of the initial cell search procedure the UE uses the primary synchronisation code c_p to acquire slot synchronisation to the strongest cell. Furthermore, frame synchronisation with the uncertainty of 1 out of 2 is obtained in this step. A single matched filter (or any similar device) is used for this purpose, that is matched to the primary synchronisation code which is common to all cells.

Step 2: Frame synchronisation and code-group identification

During the second step of the initial cell search procedure, the UE uses the modulated Secondary Synchronisation Codes to find frame synchronisation and identify one out of 32 code groups. Each code group is linked to a specific t_{Offset}, thus to a specific frame timing, and is containing 4 specific scrambling codes. Each scrambling code is associated with a specific short and long basic midamble code.

In Case~~s~~ 2 ~~and 3~~ it is required to detect the position of the next synchronization slots. To detect the position of the next synchronization slots, the primary synchronization code is correlated with the received signal at offsets of 7 and 8 time slots from the position of the primary code that was detected in Step 1.

Then, the received signal at the positions of the synchronization codes is correlated with the primary synchronization Code C_p and the secondary synchronization codes $\{C_0,\dots,C_{15}\}$. Note that the correlations can be performed coherently over M time slots, where at each slot a phase correction is provided by the correlation with the primary code. The minimal number of time slots is M=1, and the performance improves with increasing M.

Step 3: Scrambling code identification

During the third and last step of the initial cell-search procedure, the UE determines the exact basic midamble code and the accompanying scrambling code used by the found cell. They are identified through correlation over the P-CCPCH with all four midambles of the code group identified in the second step . Thus the third step is a one out of four decision. This step is taking into account that the P-CCPCH containing the BCH is transmitted using the first channelization code ($a_{Q=16}^{(h=1)}$ in [10]) and using the first midamble $\mathbf{m}^{(1)}$ (derived from basic midamble code $\mathbf{m}_P$ in [8]). Thus P-CCPCH code and midamble can be immediately derived when knowing scrambling code and basic midamble code.