TSG-RAN Meeting #12 ***TSGRP#12(01) 0371***
Stockholm, Sweden, 12 - 15 June 2001

Title: Agreed CRs to TS 25.402

Source: TSG-RAN WG3

Agenda item: 8.3.3/8.3.4

Tdoc_Num	Specification	CR_Num	Revision_Num	CR_Subject	CR_Category	WG_Status	Cur_Ver_Num	New_Ver_Num	Workitem
R3-011362	25.402	015	2	Additional requirement for timing behaviour of NodeB	F	agreed	3.5.0	3.6.0	TEI
R3-011643	25.402	018	1	Network Synchronisation aspects clarification	F	agreed	3.5.0	3.6.0	TEI
R3-011340	25.402	019		Network Synchronisation aspects clarification	A	agreed	4.0.0	4.1.0	TEI
R3-011363	25.402	020		Additional requirement for timing behaviour of NodeB	A	agreed	4.0.0	4.1.0	TEI
R3-011481	25.402	023		Incorrect Figure references in FDD Radio Interface Synchronisation	F	agreed	3.5.0	3.6.0	TEI
R3-011482	25.402	024		Incorrect Figure references in FDD Radio Interface Synchronisation	A	agreed	4.0.0	4.1.0	TEI

3GPP TSG RAN WG3 Meeting #21
Busan, Korea, 21st – 25th May 2001

R3-011362

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CHANGE REQUEST

⌘	**25.402**	**CR**	**015r2**	⌘ rev	**-**	⌘ Current version:	**3.5.0**	⌘

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

Title: ⌘	Additional requirement for timing behaviour of NodeB			
Source: ⌘	R-WG3			
Work item code: ⌘	TEI		***Date:*** ⌘	May 2001
Category: ⌘	**F**		***Release:*** ⌘	R99
	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: ⌘	Additional requirement for NodeB timing behaviour added in order to ensure multi-vendor interoperability
Summary of change: ⌘	In case of NodeB synchronisation via *TDD Node B Synchronisation Ports* the timing window for start of Radio Frames is explicitly defined.
Consequences if not approved: ⌘	Multi-vendor interoperability is not guaranteed. <u>Backward compatibility:</u> This CR is backward compatible with the intended timing behaviour of NodeBs. However, since the CR relates to an unclear behaviour some implementations may not be compatible with this CR.

Clauses affected: ⌘	6.1.2.1	
Other specs affected: ⌘	[X] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	25.402 CR020 Rel 4
Other comments: ⌘	This CR is the updated version of R3-011154 from RAN#20, which is an identical resubmission of R3-010674 agreed at RAN WG3 meeting #19. Resubmission is done for formal reasons on the new specification version 3.5.0.	

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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.

6.1.2 Inter Node B Node Synchronisation

In the FDD mode Inter Node B Node Synchronisation could be reached via the RNC-Node B Node Synchronisation in order to determine inter Node B timing reference relations.

This could be used to determine Inter-cell relationships (considering T_cell) which can be used in the neighbour cell lists in order to speed up and simplify cell search done by UE at handover.

In TDD Inter Node B Node Synchronisation is used to achieve a common timing reference among Node B's (see Figure 5), that allows to support Intercell Synchronisation.

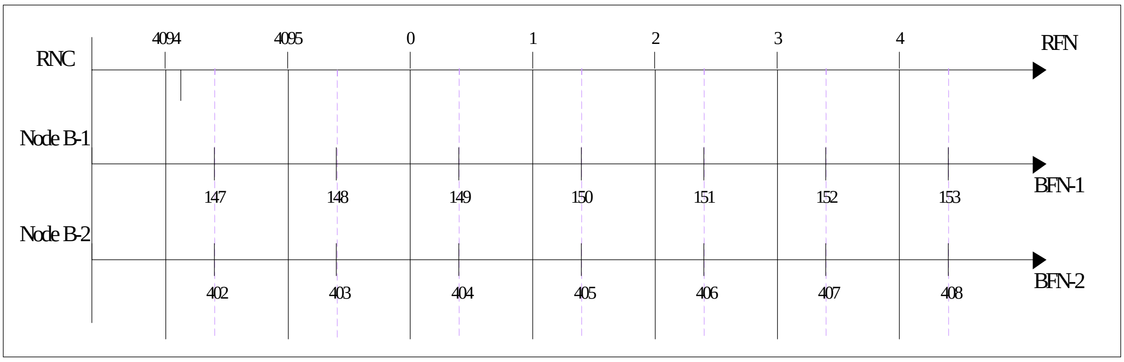

Figure 1: Synchronisation of BFNs through TDD Inter Node B Synchronisation

In TDD Inter Node B Node Synchronisation may be achieved via a standardised synchronisation port (see subclause 6.1.2.1) that allows to synchronise the Node B to an external reference.

6.1.2.1 TDD Node B Synchronisation Ports

This subclause defines the Node B input and an output synchronisation ports that can be used for Inter Node B Node Synchronisation. These synchronisation ports are optional.

The input synchronisation port (SYNC IN) allows the Node B to be synchronised to an external reference (e.g. GPS), while the output synchronisation port (SYNC OUT) allows the Node B to synchronise directly another Node B (see Figure 6).

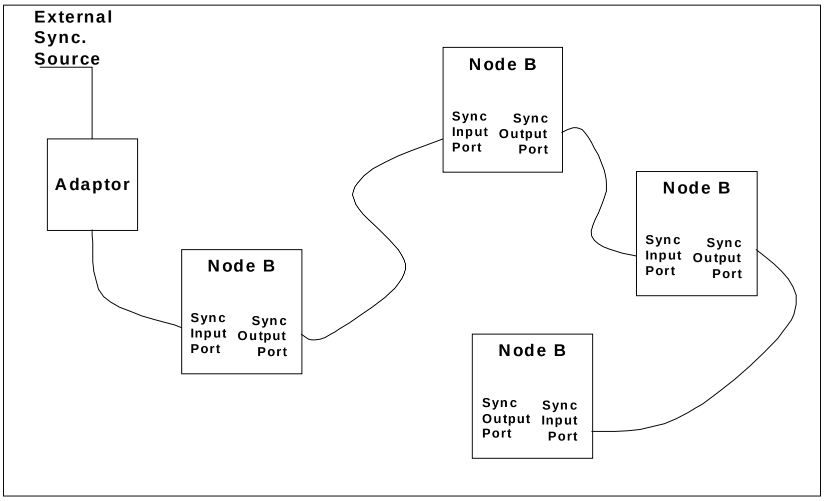

Figure 6: Usage of Synchronisation Ports

This allows connecting Node B's in a daisy chain configuration, so that a single external reference is enough and all remaining nodes B can be synchronised (e.g. in case of indoor operation).

The Node B starts the synchronisation to the external reference when a valid input synchronisation signal is detected at the input synchronisation port.

If a valid synchronisation signal is detected, the Node B regenerates that signal at its output synchronisation port.

The electrical characteristics of the synchronisation ports shall conform to RS422 [6] (output synchronisation port: subclause 4.1; input synchronisation port: subclause 4.2).

The synchronisation signal (illustrated in Figure 7) is a 100 Hz signal having positive pulses of width between 5 µs and 1 ms, except when SFN mod 256 = 0 (every 256th pulse), which has a pulse width between 2 ms and 5 ms. This signal establishes the 10 ms frame interval and the 2.56 s multiframe interval. The start of all frames in the cell of the node B is defined by the falling edge of the pulse. The required accuracy for the phase difference between the start of the 10ms frame interval ~~and the falling edge of the synchronisation pulses~~ is defined in [15]. The time delay from the falling edge of the signal at the SYNC IN port to the start of the transmitted radio frame shall not exceed 500ns.

The start of the 256 frame period is defined by the falling edge of the pulse corresponding to the frames where SFN mod 256 =0 (i.e. of width between 2 ms and 5 ms).

The synchronisation signal at the input port shall have frequency accuracy better than the one of the Node B.

The relative phase difference of the synchronisation signals at the input port of any Node B in the synchronised area shall not exceed 2.5 µs.

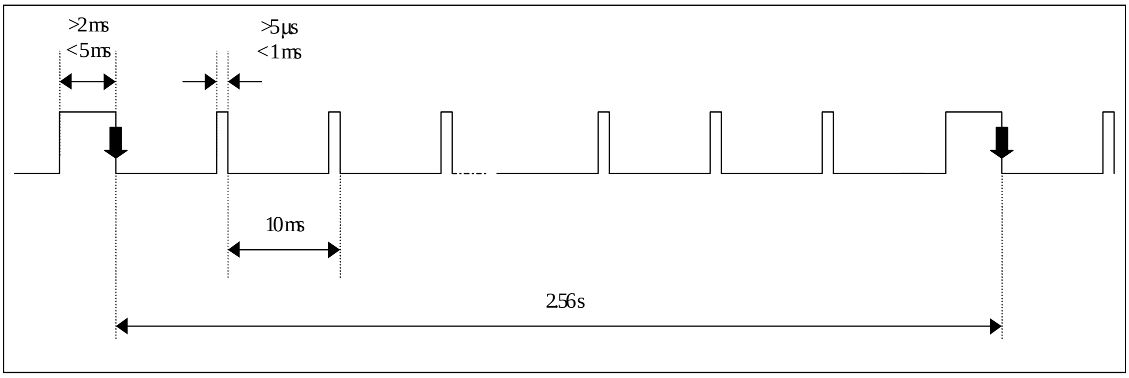

Figure 7: Synchronisation signal

Synchronisation by a GPS receiver

The signal transmitted by a Global Positioning System (GPS) satellite indicates the GPS time that provides an absolute time reference. This makes the GPS receiver suitable for Inter Node B Node Synchronisation.

Inter Node B Node Synchronisation is achieved by relating the synchronisation signal (at the input synchronisation port to the GPS signal. Since the period of this signal is 2.56 s, this implies that every 6400 frames the start of a 256 frame period coincides with an integer GPS second, i.e. a multiframe shall start when GPS time mod 64 = 0.

3GPP TSG-RAN WG3 Meeting #21 **R3-011643**
Busan, Korea, 21th - 25th May 2001

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CHANGE REQUEST

⌘	**25.402**	**CR**	**018**	⌘ rev	**1**	⌘	Current version:	**3.5.0** ⌘

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

Title:	⌘	Network Synchronisation aspects clarification		
Source:	⌘	R-WG3		
Work item code:	⌘	TEI	***Date:*** ⌘	May, 2001
Category:	⌘	**F**	***Release:*** ⌘	R99
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Reason for change:	⌘	In TS 25.402, synchronisation issues and mechanisms in UTRAN are specified. The scope of the specification is mostly related to frame transport timing issues within UTRAN (Transport Channel Synchronisation) and air interface frame timing issues (Radio Interface Synchronisation). Regarding the network synchronisation issue this is only briefly mentioned with its influence on UTRAN internal frame clocks. This contribution proposes some improvements and corrections in the TS 25.402, in order to better align the 3GPP standards with existing ITU-T, ANSI and ETSI standards dealing with network synchronisation. When designing the synchronisation networks, it is very likely that specifications as the TS 25.402 (and TS 25.411), will be highly considered by the network synchronisation planner. In addition, these standards are of great interest also for the manufacturer of UTRAN network elements when it comes to designing network synchronisation characteristics. With the proposed improvements, it is our view that the task for the synchronisation network planner in the UTRAN and for the manufacturer of UTRAN equipment will be easier, when it comes to define the most suitable strategy in terms of network synchronisation.
Summary of change:	⌘	'Several subclauses are clarified with regards to network synchronisation. New text is in particular proposed in clause 4, 6 and 8, with reference to network synchronisation issues and with proper reference to the relevant ITU-T and ETSI recommendations. Some editorial changes, definitions and new references have also been added as consequence of the previous changes.
Consequences if not approved:	⌘	If this CR is not approved the above described unclear references to Network Synchronisation will remain in the specification. Backward compatibility: the changes that are proposed are backward compatible

	with the previous version of the specification. R1: the tdoc number was corrected, however this is not visible as a new tdoc number was allocated for the revised version.

Clauses affected:	⌘	2 , 3.1 , 4.1, 4.2 , 6.1.1 , 8.2.1		
Other specs affected:	⌘	X	Other core specifications	⌘ CR 005 on TS 25.411 R99, CR 006 on TS 25.411 R4, CR 019 on TS 25.402 R4
			Test specifications	
			O&M Specifications	
Other comments:	⌘	This CR has been approved in principle at last 3GPP TSG RAN WG3 #20 meeting held in Beijing last April.		

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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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 25.401: "UTRAN Overall Description".

[2] 3GPP TS 25.423: "UTRAN I_{ur} Interface RNSAP Signalling".

[3] 3GPP TS 25.433: "UTRAN I_{ub} Interface NBAP Signalling".

[4] 3GPP TS 25.435: "UTRAN I_{ub} Interface User Plane Protocols for COMMON TRANSPORT CHANNEL Data Streams".

[5] 3GPP TS 25.427: "I_{ub}/I_{ur} Interface User Plane Protocol for DCH Data Streams".

[6] EIA 422-A-78: "Electrical characteristics of balanced voltage digital interface circuits".

[7] 3GPP TS 25.411: "UTRAN Iu Interface Layer 1".

[8] 3GPP TS 25.421: "UTRAN Iur Interface Layer 1".

[9] 3GPP TS 25.431: "UTRAN Iub Interface Layer 1".

[10] 3GPP TS 25.104: "UTRA (BS) FDD; Radio transmission and Reception".

[11] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[12] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[13] 3GPP TS 25.215: "Physical layer - Measurements (FDD)".

[14] 3GPP TS 25.225: " Physical layer - Measurements (TDD)".

[15] 3GPP TS 25.123: "Requirements for Support of Radio Resource Management".

[16] 3GPP TS 25.224: "Physical Layer Procedures (TDD)".

[17] 3GPP TS 25.1105: "UTRA (BS) TDD, Radio transmission and Reception".

[18] ITU-T G.811 (02/97): “Timing Characteristics of Primary Reference Clocks”

[19] ITU-T G.812 (09/97): “Timing Requirements of Slave Clocks suitable for use as Node Clocks in Synchronisation Network”

[20] ITU-T G.813 (08/96): “Timing Characteristics of SDH equipment slave clocks (SEC)”

[21] EN 300 462-4-1(03/98): “Timing characteristics of slave clocks suitable for synchronisation supply to Synchronisation Digital Hierarchy (SDH) and Plesiochronous Digital Hierarchy”

[22] EN 300 462-5-1 (09/96):“Timing characteristics of slave clocks suitable for operation in Synchronisation Digital Hierarchy (SDH) equipment”.

[23] EN 300 462-7-1 (04/01): “Timing characteristics of slave clocks suitable for synchronisation supply to equipment in local node applications”.

[24] 3GPP TS 25.105: "UTRA (BS) TDD; Radio transmission and Reception".

3.1 Definitions

~~No special definitions are defined in this document.~~

Network Synchronisation: a generic concept that depicts the way of distributing a common frequency to all elements in a network.

Reference Timing Signal: a timing signal of specified performance that can be used as a timing source for a slave clock.

Holdover mode: an operating condition of a clock which has lost its controlling reference input and is using stored data, acquired while in locked operation (that is while controlled by an external input reference), to control its output. The stored data are used to control phase and frequency variations, allowing the locked condition to be reproduced within specifications.

4.1 General

This clause identifies the different UTRAN synchronisation issues, i.e.:

- Network Synchronisation;
- Node Synchronization;
- Transport Channel Synchronisation;
- Radio Interface Synchronisation;
- Time Alignment Handling.

The Nodes involved by the above mentioned synchronisation issues (with the exception of Network and Node Synchronisation) are shown by the Synchronisation Issues Model of Figure 1.

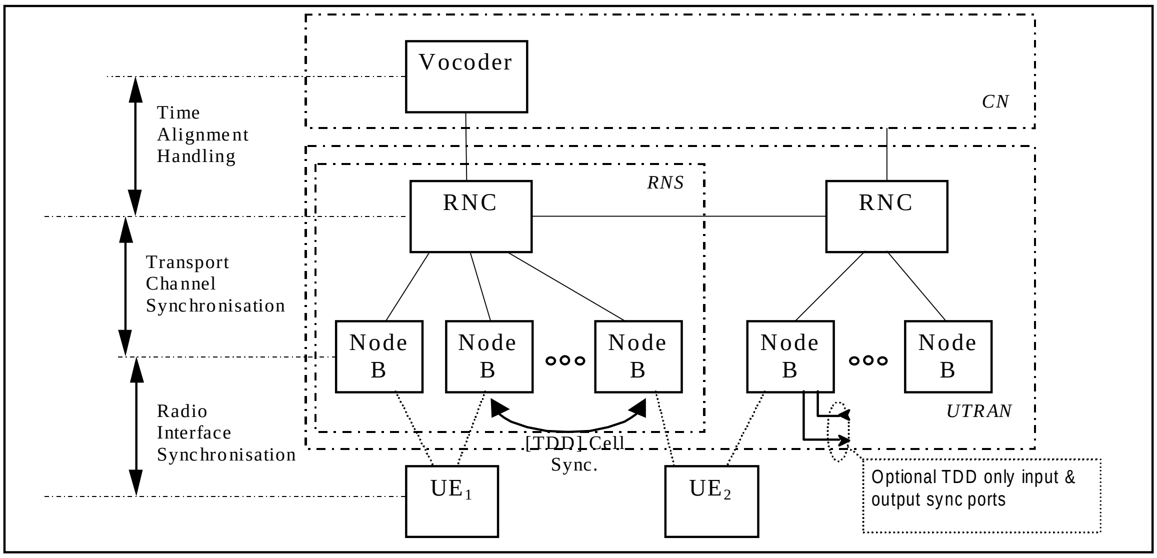


Figure 1: Synchronisation Issues Model

The UTRAN solutions for most of the identified items are described in clauses 6-10. Additional information on UTRAN synchronisation issues and the detailed specification of UTRAN solutions can be found in the following Technical Specifications:

- Summary of UTRAN Synchronisation Issues:

TS 25.401 "UTRAN Overall Description", clause 9.

- Network Synchronisation:

TS 25.411 "UTRAN Iu Interface Layer 1", subclause 4.2.

TS 25.104 “UTRA (BS) FDD; Radio transmission and reception”, subclause 6.3.

TS 25.105 “UTRA (BS) TDD, Radio transmission and reception”, subclause 6.3.

- RNC-Node B Node Synchronisation:

TS 25.427 "Iub/Iur Interface User Plane Protocol for DCH Data Streams", subclause ~~8~~5.5;

TS 25.435 "UTRAN Iub Interface User Plane Protocols for COMMON TRANSPORT CHANNEL Data Streams", subclause 5.2.

- Transport Channel Synchronisation:

TS 25.427 "Iub/Iur Interface User Plane Protocol for DCH Data Streams", subclauses ~~8~~5.2 – ~~8~~5.3;

TS 25.435 "UTRAN Iub Interface User Plane Protocols for COMMON TRANSPORT CHANNEL Data Streams", subclauses 5.3 – 5.4.

- Time Alignment Handling:

TS 25.415 "UTRAN Iu Interface User Plane Protocols", subclauses 6.5.4.

4.2 Network Synchronisation

~~The Network Synchronisation relates to the stability of the clocks in the UTRAN. The standard specifies the performance requirements on UTRAN internal interfaces. Depending on the L1 adopted for each interface, the clock stability required shall be according to references [8] and [9].~~

Network Synchronisation relates to the distribution of synchronisation references to the UTRAN Nodes and the stability of the clocks in the UTRAN (and performance requirements on UTRAN internal interfaces).

The distribution of an accurate frequency reference to the network elements in the UTRAN is related to several aspects. One main issue is the possibility to provide a synchronisation reference with a frequency accuracy better than 0.05 ppm at the Node B in order to properly generate signals on the radio interface (see references [10] and [24]).

A general recommendation is to supply a traceable synchronisation reference according to reference [18].

The clock to be implemented in UTRAN Nodes shall be chosen with characteristics that depends on the L1 adopted (see reference [8] and [9]) and on the Network Synchronisation strategy adopted. Already standardized clocks may be used (see references [19], [20], [21], [22] and [23]).

For example in order to support STM-N interfaces at the RNC, the ITU-T G.813 (see reference [19]) may be sufficient. The implementation in the UTRAN of a better performing clock (in terms of holdover) may be recommended for distribution of a 0.05 ppm during failures in the synchronisation network (EN 300 462-7-1, see reference [23], EN 300 462-4-1, see reference [21], or ITU-T G.812 type 1, type 2 or type 3, see reference [19]).

6.1.1 RNC-Node B Node Synchronisation

The Node Synchronisation between RNC and Node B can be used to find out the timing reference differences between the UTRAN nodes (RFN in RNC and BFN in Node B). The use is mainly for determining good DL and UL offset values for transport channel synchronisation between RNC and their Node B's. Knowledge of timing relationships between these nodes is based on a measurement procedure called RNC-Node B Node Synchronisation Procedure. The procedure is defined in the user plane protocols for Iub (DCH, DSCH, and FACH/PCH) and Iur (DCH).

When the procedure is used from SRNC over the DCH user plane, it allows finding out the actual round-trip-delay a certain service has (as the Node Sync Control Frames are transferred the same way as the DCH frames).

The procedure may also be carried out over a high priority transport bearer (beneficial when used between CRNC and Node Bs for the RNC-Node B Synchronisation purpose). Measurements of node offsets can be made at start or restart as well as during normal operation to supervise the stability of the nodes.

~~If a good Network synchronisation reference is used, the drift between nodes will be low, but could occur. If a Network synchronisation reference isn't available or is poor, the local node reference oscillator must be relied upon. Then the RNC-Node B Node Synchronisation procedure can be used as a background process to find out the frequency drift between nodes. Therefore, a system can be deployed without Network synchronisation references (to e.g. the Node B's).~~

If an accurate Reference Timing Signal is used, the frequency deviation between nodes will be low, but could occur. If no accurate Reference Timing Signal is available, the local node reference oscillator must be relied upon. Then the RNC-Node B Node Synchronisation procedure can be used as a background process to find out the frequency deviation between nodes.

In the RNC-Node B Node Synchronisation procedure, the RNC sends a DL Node Synchronisation control frame to Node B containing the parameter t1. Upon reception of a DL Synchronisation control frame, the Node B shall respond with UL Synchronisation Control Frame, indicating t2 and t3, as well as t1 which was indicated in the initiating DL Node Synchronisation control frame (see Figure 3).

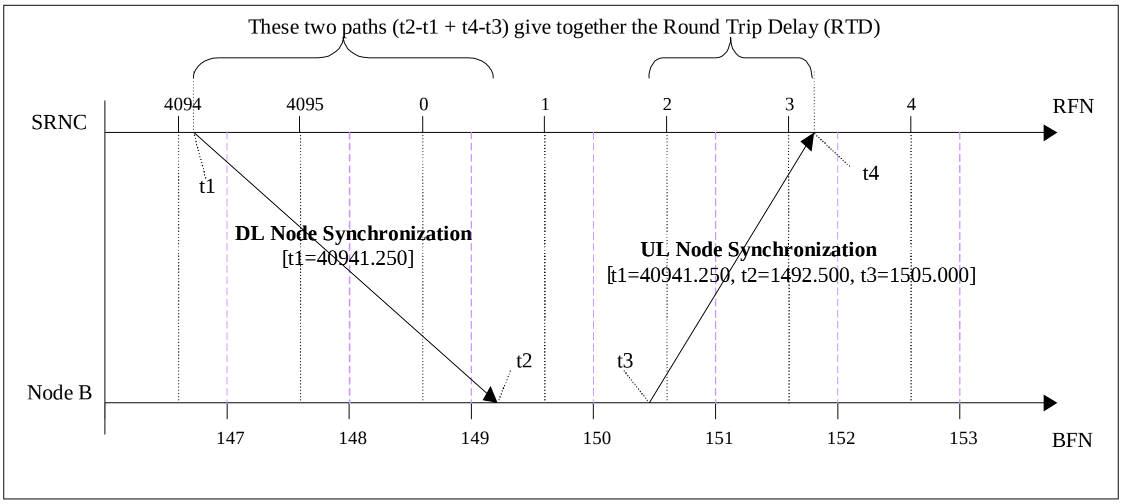


Figure 2: RNC-Node B Node Synchronisation

In case of macrodiversity with recombining in the DRNC, the DL Node Synchronisation control frame is duplicated in the DRNC on the different links, while the UL Node Synchronisation control frames received from all the Node B's are forwarded transparently to the SRNC (see Figure 4).

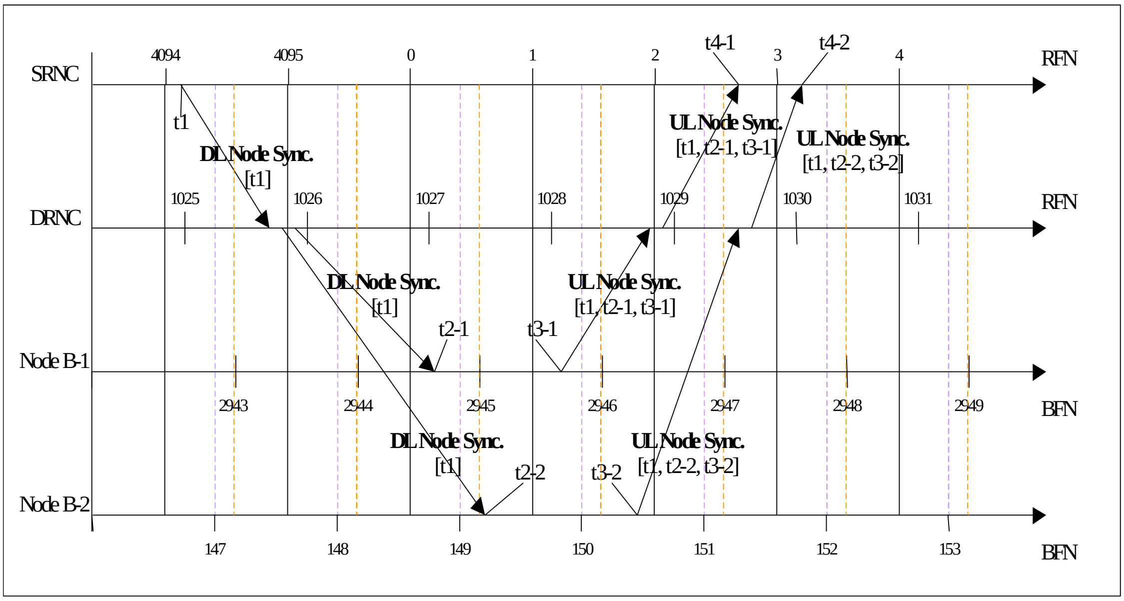


Figure 3: [FDD - RNC-Node B Node Synchronisation during soft handover with selection/recombining in the DRNC]

8.2.1 General

FDD Radio Interface Synchronisation assures that UE gets the correct frames when received from several cells. The UE measures the Timing difference between its DPCH and SFN in the target cell when doing handover and reports it to SRNC. SRNC sends this Time difference value in two parameters Frame Offset and Chip Offset over Iub to Node B. Node B rounds this value to the closest 256 chip boundary in order to get DL orthogonality (regardless of used spreading factor). The rounded value is used in Node B for the DL DPCH.

$DOFF_{FDD}$ is selected by the SRNC considering the interleaving period (e.g. 10, 20, 40 or 80ms) when entering in dedicated state from common channel state.

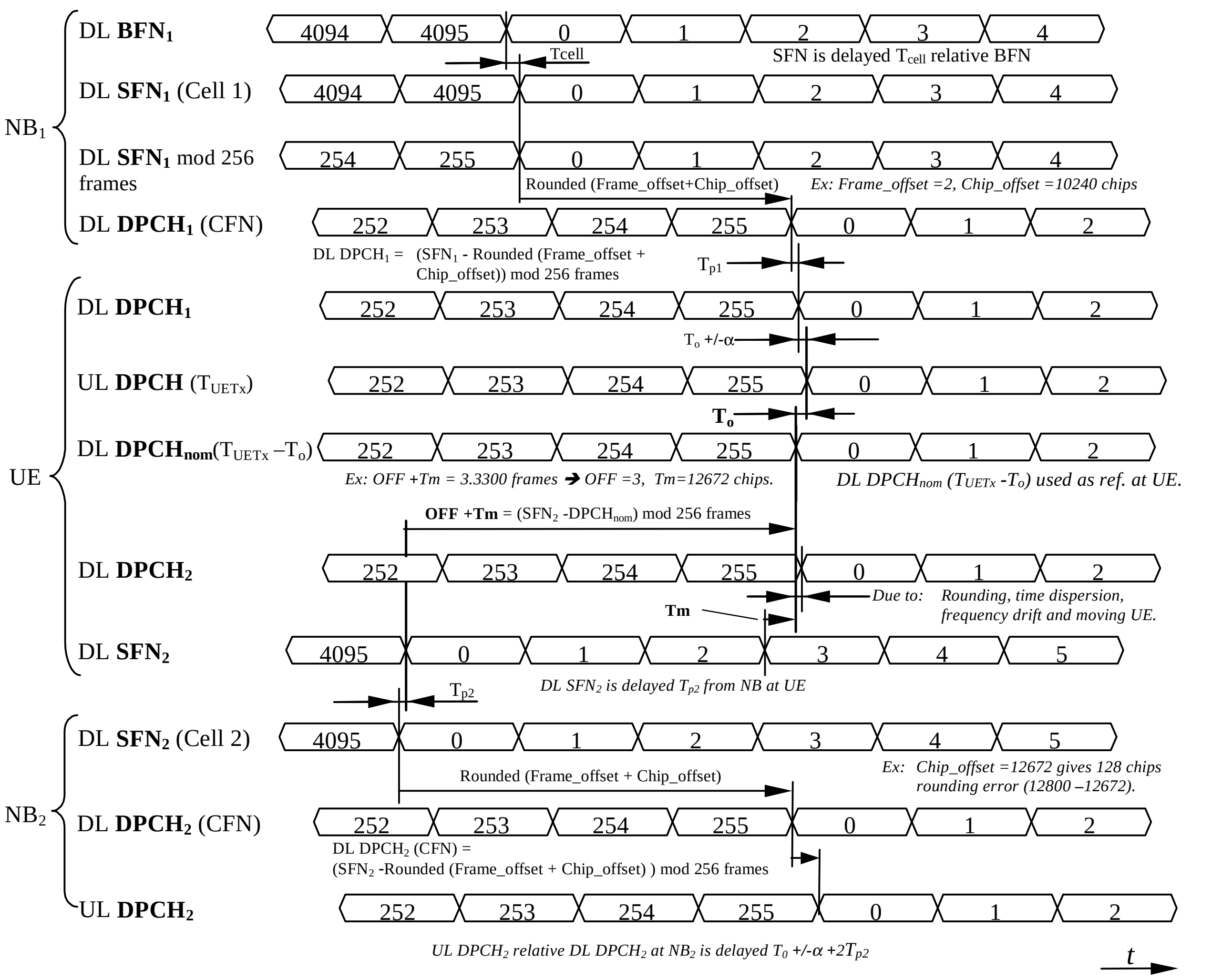
Services are scheduled by using $DOFF_{FDD}$ in order to average out the Iub traffic load and the Node B processing load. $DOFF_{FDD}$ (FDD Default DPCH Offset value) is only used when setting up the first RL in order to initialise Frame Offset and Chip Offset and to tell UE when frames are expected.

UE uses the UL DPCH as it is a more defined time instant compared with DL DPCH.

The handover reference is the time instant T_{UETx} -To, which is called DL $DPCH_{nom}$ in the timing diagram.

T_{cell} is used to skew cells in the same Node B in order to not get colliding SCH bursts, one SCH burst is 1/10 of a slot time.

The timing diagram in Figure 15 shows an example with two cells connected to one UE where handover is done from source cell (Cell 1) to target cell (Cell 2).



α	1st received DL DPCH finger relative DL DPCH$_{nom}$	T_{cell}	Specifies the SFN delay relative BFN
BFN	Node B Frame Number (counter)	T_m	Measured by UE at HO, T_m has a range from 0 to 38399 chips.
CFN	Connection Frame Number (DPCH related)		
DPCH	Dedicated Physical Channel (CFN related)	T_o	Is a constant of 1024 chips, is the nominal difference between first received DPCH finger (DL DPCH$_{nom}$) and T_{UETx} at UE.
HO	Handover		
NB$_x$	Node B (x: 1=source, 2=target)		
OFF	Offset with a range from 0 to 255 frames	T_{pX}	Propagation delay (one way), UE to Cell X
RFN	RNC Frame Number (counter)	T_{UETx}	The time when UE transmits an UL Dedicated Physical Channel.
RNC	Radio Network Controller		
SFN	System Frame Number (counter)		

Figure 15: FDD Radio Interface Synchronisation timing diagram

SFN_1 is found in Cell 1 at Node B_1 and SFN_2 at Cell 2 and Node B_2. SFN_1 is sent T_cell$_1$ after the Node B_1 reference BFN_1. CFN is the frame numbering that is related to each DL and UL Dedicated Physical Channel (DPCH). UL DPCH is sent from UE to both Cells (both Node B's in this example). UL DPCH at Node B_2 is shown to indicate the difference to the DL DPCH$_2$ at Node B_2.

The new RL (DL DPCH$_2$) which is setup at the HO will face some deviation from nominal position due to the rounding of Frame Offset and Chip Offset to 256 chip boundary in Node B. ~~Also Time dispersion, Node B-UE frequency drift and UE movement affects this phase deviation.~~ Time dispersion and UE movements are examples of other factors affecting this phase deviation.

The nominal DL DPCH timing at UE is T_o before the T_{UETX} time instant, which could be expressed:

$$\text{DL DPCH}_{nom} = T_{UETX} - T_o \qquad (8.1)$$

In UE dedicated state, OFF and Tm are measured at UE according to the following equation:

$$OFF + Tm = (SFN_{target} – DL\ DPCH_{nom})\ mod\ 256\ frames\ [chips] \qquad (8.2)$$

NOTE: OFF has the unit Frames and Tm the unit Chips.

Example: assume that OFF + T_m equals "3.3300" frames (as given as an example in Figure 19).
Then OFF = 3 and T_m = "0.33" which corresponds to T_m = 12672 chips.

In other words (referring to the timing diagram in Figure 19):

- How to determine T_m at UE: Select a time instant 1) where frame N starts at DL SFN_2 e.g. frame number 3, the time from that time instant to the next frame border of DL $DPCH_{nom}$ 2) equals T_m
  (if these are in phase with each other, T_m is zero).
- How to determine OFF: The difference between the frame number selected for time instant 1) and the frame number starting at instant 2) mod 256 frames equals OFF.
  Example: (3 –0) mod 256 = 3, another example is (1 –254) mod 256 = 3.

CR-Form-v3

CHANGE REQUEST

⌘	**25.402**	**CR**	**019**	⌘ rev	**-**	⌘ Current version:	**4.0.0**	⌘

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Category: ⌘	**A**	***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: ⌘	In TS 25.402, synchronisation issues and mechanisms in UTRAN are specified. The scope of the specification is mostly related to frame transport timing issues within UTRAN (Transport Channel Synchronisation) and air interface frame timing issues (Radio Interface Synchronisation). Regarding the network synchronisation issue this is only briefly mentioned with its influence on UTRAN internal frame clocks. This contribution proposes some improvements and corrections in the TS 25.402, in order to better align the 3GPP standards with existing ITU-T, ANSI and ETSI standards dealing with network synchronisation. When designing the synchronisation networks, it is very likely that specifications as the TS 25.402 (and TS 25.411), will be highly considered by the network synchronisation planner. In addition, these standards are of great interest also for the manufacturer of UTRAN network elements when it comes to designing network synchronisation characteristics. With the proposed improvements, it is our view that the task for the synchronisation network planner in the UTRAN and for the manufacturer of UTRAN equipment will be easier, when it comes to define the most suitable strategy in terms of network synchronisation.
Summary of change: ⌘	'Several subclauses are clarified with regards to network synchronisation. New text is in particular proposed in clause 4, 6 and 8, with reference to network synchronisation issues and with proper reference to the relevant ITU-T and ETSI recommendations. Some editorial changes, definitions and new references have also been added as consequence of the previous changes.
Consequences if not approved: ⌘	If this CR is not approved the above described unclear references to Network Synchronisation will remain in the specification. Backward compatibility: the changes that are proposed are backward compatible

		with the previous version of the specification.

Clauses affected:	⌘	2 , 3.1 , 4.1, 4.2 , 6.1.1 , 8.2.1		
Other specs affected:	⌘	X	Other core specifications	⌘ CR 005 on TS 25.411 R99, CR 006 on TS 25.411 R4, CR 018 on TS 25.402 R99
			Test specifications	
			O&M Specifications	
Other comments:	⌘	This CR has been approved in principle at last 3GPP TSG RAN WG3 #20 meeting held in Beijing last April.		

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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 25.401: "UTRAN Overall Description".

[2] 3GPP TS 25.423: "UTRAN I_{ur} Interface RNSAP Signalling".

[3] 3GPP TS 25.433: "UTRAN I_{ub} Interface NBAP Signalling".

[4] 3GPP TS 25.435: "UTRAN I_{ub} Interface User Plane Protocols for COMMON TRANSPORT CHANNEL Data Streams".

[5] 3GPP TS 25.427: "I_{ub}/I_{ur} Interface User Plane Protocol for DCH Data Streams".

[6] EIA 422-A-78: "Electrical characteristics of balanced voltage digital interface circuits".

[7] 3GPP TS 25.411: "UTRAN Iu Interface Layer 1".

[8] 3GPP TS 25.421: "UTRAN Iur Interface Layer 1".

[9] 3GPP TS 25.431: "UTRAN Iub Interface Layer 1".

[10] 3GPP TS 25.104: "UTRA (BS) FDD; Radio transmission and Reception".

[11] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[12] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[13] 3GPP TS 25.215: "Physical layer - Measurements (FDD)".

[14] 3GPP TS 25.225: " Physical layer - Measurements (TDD)".

[15] 3GPP TS 25.123: "Requirements for Support of Radio Resource Management".

[16] 3GPP TS 25.224: "Physical Layer Procedures (TDD)".

[17] 3GPP TS 25.1105: "UTRA (BS) TDD, Radio transmission and Reception".

[18] ITU-T G.811 (02/97): “Timing Characteristics of Primary Reference Clocks”

[19] ITU-T G.812 (09/97): “Timing Requirements of Slave Clocks suitable for use as Node Clocks in Synchronisation Network”

[20] ITU-T G.813 (08/96): “Timing Characteristics of SDH equipment slave clocks (SEC)”

[21] EN 300 462-4-1(03/98): “Timing characteristics of slave clocks suitable for synchronisation supply to Synchronisation Digital Hierarchy (SDH) and Plesiochronous Digital Hierarchy”

[22] EN 300 462-5-1 (09/96):“Timing characteristics of slave clocks suitable for operation in Synchronisation Digital Hierarchy (SDH) equipment”.

[23] EN 300 462-7-1 (04/01): “Timing characteristics of slave clocks suitable for synchronisation supply to equipment in local node applications”.

[24] 3GPP TS 25.105: "UTRA (BS) TDD; Radio transmission and Reception".

3.1 Definitions

~~No special definitions are defined in this document.~~

Network Synchronisation: a generic concept that depicts the way of distributing a common frequency to all elements in a network.

Reference Timing Signal: a timing signal of specified performance that can be used as a timing source for a slave clock.

Holdover mode: an operating condition of a clock which has lost its controlling reference input and is using stored data, acquired while in locked operation (that is while controlled by an external input reference), to control its output. The stored data are used to control phase and frequency variations, allowing the locked condition to be reproduced within specifications.

4.1 General

This clause identifies the different UTRAN synchronisation issues, i.e.:

- Network Synchronisation;
- Node Synchronization;
- Transport Channel Synchronisation;
- Radio Interface Synchronisation;
- Time Alignment Handling.

The Nodes involved by the above mentioned synchronisation issues (with the exception of Network and Node Synchronisation) are shown by the Synchronisation Issues Model of Figure 1.

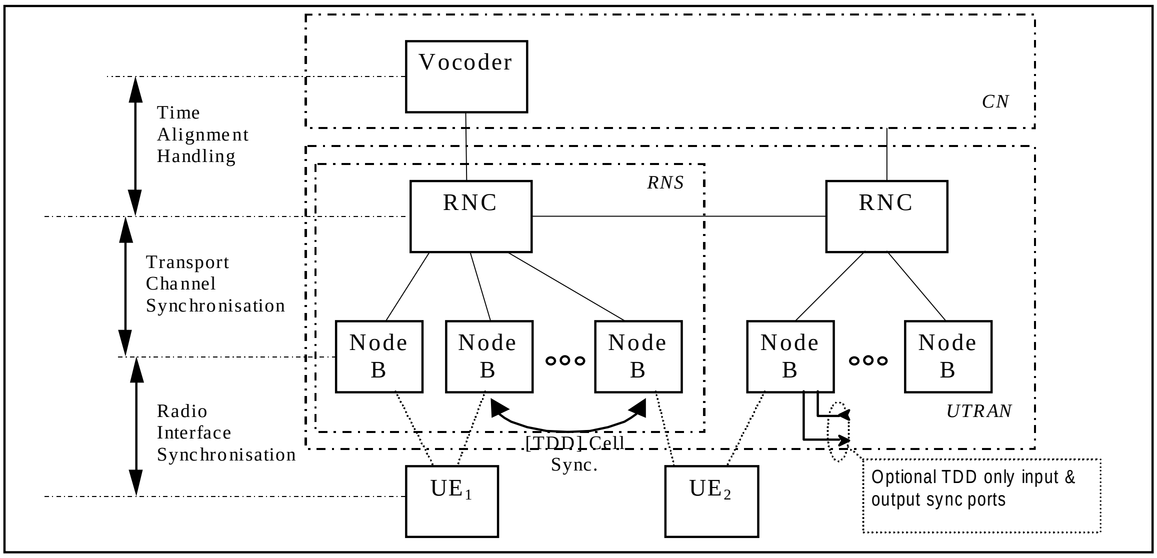


Figure 1: Synchronisation Issues Model

The UTRAN solutions for most of the identified items are described in clauses 6-10. Additional information on UTRAN synchronisation issues and the detailed specification of UTRAN solutions can be found in the following Technical Specifications:

- Summary of UTRAN Synchronisation Issues:

TS 25.401 "UTRAN Overall Description", clause 9.

- Network Synchronisation:

TS 25.411 "UTRAN Iu Interface Layer 1", subclause 4.2.

TS 25.104 “UTRA (BS) FDD; Radio transmission and reception”, subclause 6.3.

TS 25.105 “UTRA (BS) TDD, Radio transmission and reception”, subclause 6.3.

- RNC-Node B Node Synchronisation:

TS 25.427 "Iub/Iur Interface User Plane Protocol for DCH Data Streams", subclause ~~8~~5.5;

TS 25.435 "UTRAN Iub Interface User Plane Protocols for COMMON TRANSPORT CHANNEL Data Streams", subclause 5.2.

- Transport Channel Synchronisation:

TS 25.427 "Iub/Iur Interface User Plane Protocol for DCH Data Streams", subclauses ~~8~~5.2 – ~~8~~5.3;

TS 25.435 "UTRAN Iub Interface User Plane Protocols for COMMON TRANSPORT CHANNEL Data Streams", subclauses 5.3 – 5.4.

- Time Alignment Handling:

TS 25.415 "UTRAN Iu Interface User Plane Protocols", subclauses 6.5.4.

4.2 Network Synchronisation

~~The Network Synchronisation relates to the stability of the clocks in the UTRAN. The standard specifies the performance requirements on UTRAN internal interfaces. Depending on the L1 adopted for each interface, the clock stability required shall be according to references [8] and [9].~~

Network Synchronisation relates to the distribution of synchronisation references to the UTRAN Nodes and the stability of the clocks in the UTRAN (and performance requirements on UTRAN internal interfaces).

The distribution of an accurate frequency reference to the network elements in the UTRAN is related to several aspects. One main issue is the possibility to provide a synchronisation reference with a frequency accuracy better than 0.05 ppm at the Node B in order to properly generate signals on the radio interface (see references [10] and [24]).

A general recommendation is to supply a traceable synchronisation reference according to reference [18].

The clock to be implemented in UTRAN Nodes shall be chosen with characteristics that depends on the L1 adopted (see reference [8] and [9]) and on the Network Synchronisation strategy adopted. Already standardized clocks may be used (see references [19], [20], [21], [22] and [23]).

For example in order to support STM-N interfaces at the RNC, the ITU-T G.813 (see reference [19]) may be sufficient. The implementation in the UTRAN of a better performing clock (in terms of holdover) may be recommended for distribution of a 0.05 ppm during failures in the synchronisation network (EN 300 462-7-1, see reference [23], EN 300 462-4-1, see reference [21], or ITU-T G.812 type 1, type 2 or type 3, see reference [19]).

6.1.1 RNC-Node B Node Synchronisation

The Node Synchronisation between RNC and Node B can be used to find out the timing reference differences between the UTRAN nodes (RFN in RNC and BFN in Node B). The use is mainly for determining good DL and UL offset values for transport channel synchronisation between RNC and their Node B's. Knowledge of timing relationships between these nodes is based on a measurement procedure called RNC-Node B Node Synchronisation Procedure. The procedure is defined in the user plane protocols for Iub (DCH, DSCH, and FACH/PCH) and Iur (DCH).

When the procedure is used from SRNC over the DCH user plane, it allows finding out the actual round-trip-delay a certain service has (as the Node Sync Control Frames are transferred the same way as the DCH frames).

The procedure may also be carried out over a high priority transport bearer (beneficial when used between CRNC and Node Bs for the RNC-Node B Synchronisation purpose). Measurements of node offsets can be made at start or restart as well as during normal operation to supervise the stability of the nodes.

~~If a good Network synchronisation reference is used, the drift between nodes will be low, but could occur. If a Network synchronisation reference isn't available or is poor, the local node reference oscillator must be relied upon. Then the RNC-Node B Node Synchronisation procedure can be used as a background process to find out the frequency drift between nodes. Therefore, a system can be deployed without Network synchronisation references (to e.g. the Node B's).~~

If an accurate Reference Timing Signal is used, the frequency deviation between nodes will be low, but could occur. If no accurate Reference Timing Signal is available, the local node reference oscillator must be relied upon. Then the RNC-Node B Node Synchronisation procedure can be used as a background process to find out the frequency deviation between nodes.

In the RNC-Node B Node Synchronisation procedure, the RNC sends a DL Node Synchronisation control frame to Node B containing the parameter t1. Upon reception of a DL Synchronisation control frame, the Node B shall respond with UL Synchronisation Control Frame, indicating t2 and t3, as well as t1 which was indicated in the initiating DL Node Synchronisation control frame (see Figure 3).

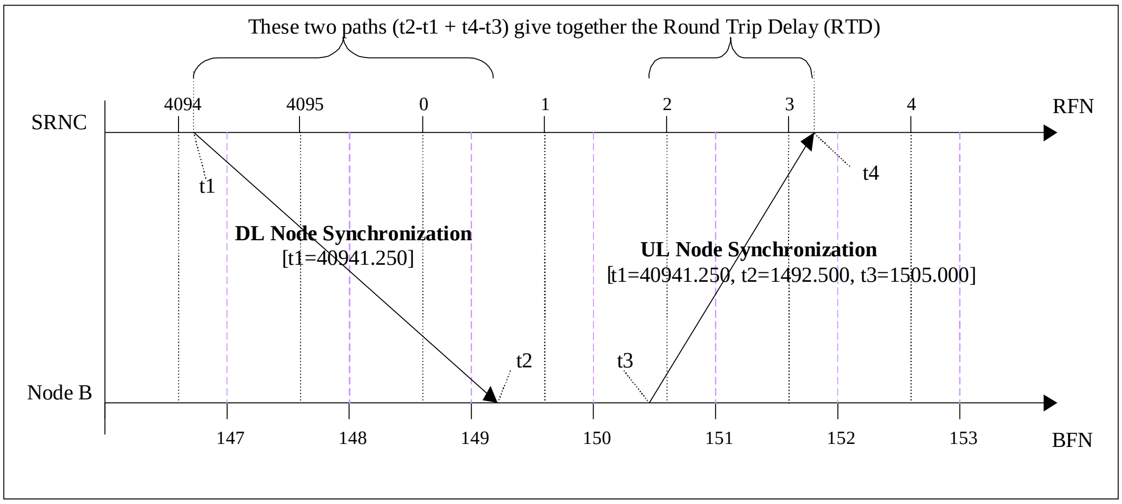


Figure 2: RNC-Node B Node Synchronisation

In case of macrodiversity with recombining in the DRNC, the DL Node Synchronisation control frame is duplicated in the DRNC on the different links, while the UL Node Synchronisation control frames received from all the Node B's are forwarded transparently to the SRNC (see Figure 4).

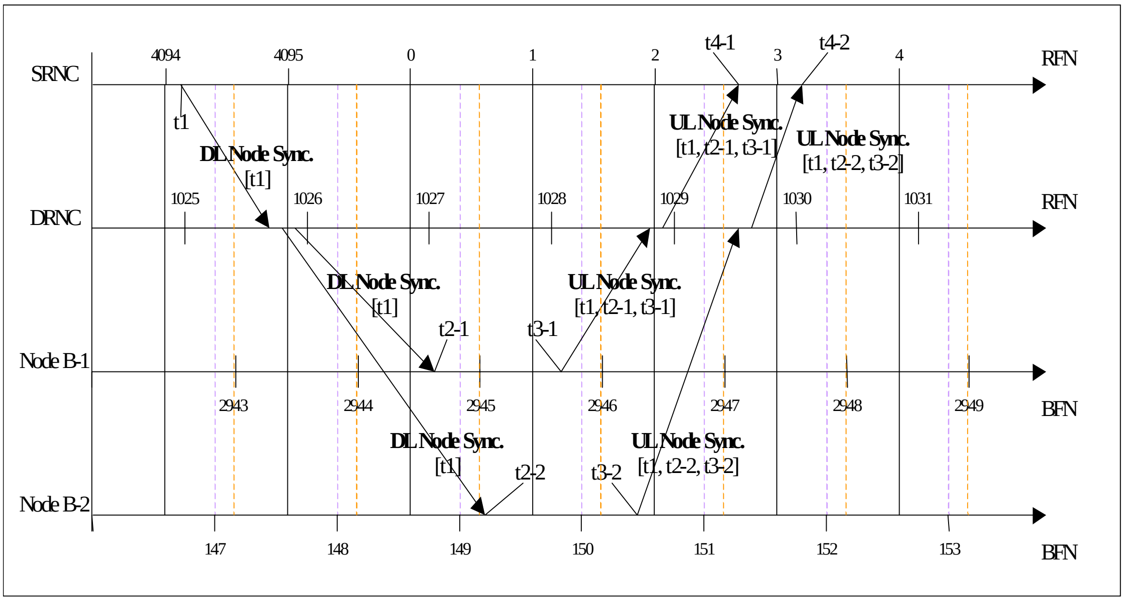


Figure 3: [FDD - RNC-Node B Node Synchronisation during soft handover with selection/recombining in the DRNC]

8.2.1 General

FDD Radio Interface Synchronisation assures that UE gets the correct frames when received from several cells. The UE measures the Timing difference between its DPCH and SFN in the target cell when doing handover and reports it to SRNC. SRNC sends this Time difference value in two parameters Frame Offset and Chip Offset over Iub to Node B. Node B rounds this value to the closest 256 chip boundary in order to get DL orthogonality (regardless of used spreading factor). The rounded value is used in Node B for the DL DPCH.

$DOFF_{FDD}$ is selected by the SRNC considering the interleaving period (e.g. 10, 20, 40 or 80ms) when entering in dedicated state from common channel state.

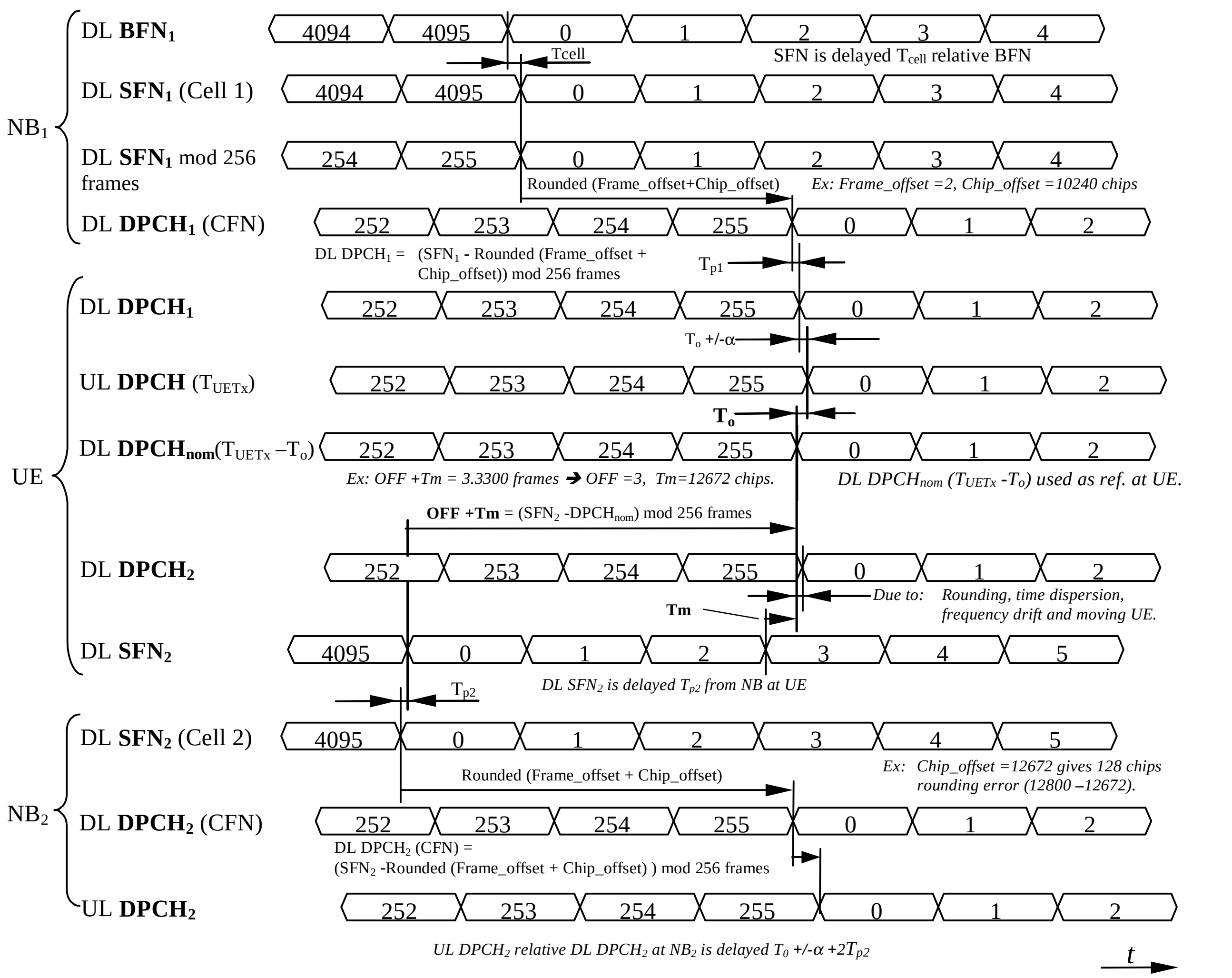
Services are scheduled by using $DOFF_{FDD}$ in order to average out the Iub traffic load and the Node B processing load. $DOFF_{FDD}$ (FDD Default DPCH Offset value) is only used when setting up the first RL in order to initialise Frame Offset and Chip Offset and to tell UE when frames are expected.

UE uses the UL DPCH as it is a more defined time instant compared with DL DPCH.

The handover reference is the time instant T_{UETx} -To, which is called DL $DPCH_{nom}$ in the timing diagram.

T_{cell} is used to skew cells in the same Node B in order to not get colliding SCH bursts, one SCH burst is 1/10 of a slot time.

The timing diagram in Figure 15 shows an example with two cells connected to one UE where handover is done from source cell (Cell 1) to target cell (Cell 2).



α	1st received DL DPCH finger relative DL DPCH$_{nom}$	T$_{cell}$	Specifies the SFN delay relative BFN
BFN	Node B Frame Number (counter)	T$_m$	Measured by UE at HO, T$_m$ has a range from 0 to 38399 chips.
CFN	Connection Frame Number (DPCH related)		
DPCH	Dedicated Physical Channel (CFN related)	T$_o$	Is a constant of 1024 chips, is the nominal difference between first received DPCH finger (DL DPCH$_{nom}$) and T$_{UETx}$ at UE.
HO	Handover		
NB$_x$	Node B (x: 1=source, 2=target)		
OFF	Offset with a range from 0 to 255 frames	T$_{pX}$	Propagation delay (one way), UE to Cell X
RFN	RNC Frame Number (counter)	T$_{UETx}$	The time when UE transmits an UL Dedicated Physical Channel.
RNC	Radio Network Controller		
SFN	System Frame Number (counter)		

Figure 15: FDD Radio Interface Synchronisation timing diagram

SFN_1 is found in Cell 1 at Node B_1 and SFN_2 at Cell 2 and Node B_2. SFN_1 is sent T_cell_1 after the Node B_1 reference BFN_1. CFN is the frame numbering that is related to each DL and UL Dedicated Physical Channel (DPCH). UL DPCH is sent from UE to both Cells (both Node B's in this example). UL DPCH at Node B_2 is shown to indicate the difference to the DL $DPCH_2$ at Node B_2.

The new RL (DL $DPCH_2$) which is setup at the HO will face some deviation from nominal position due to the rounding of Frame Offset and Chip Offset to 256 chip boundary in Node B. ~~Also Time dispersion, Node B-UE frequency drift and UE movement affects this phase deviation.~~ Time dispersion and UE movements are examples of other factors affecting this phase deviation.

The nominal DL DPCH timing at UE is T_o before the T_{UETX} time instant, which could be expressed:

$$DL\ DPCH_{nom} = T_{UETX} - T_o \qquad (8.1)$$

In UE dedicated state, OFF and Tm are measured at UE according to the following equation:

$$\text{OFF} + \text{Tm} = (\text{SFN}_{target} - \text{DL DPCH}_{nom}) \bmod 256 \text{ frames [chips]} \quad (8.2)$$

NOTE: OFF has the unit Frames and Tm the unit Chips.

Example: assume that OFF + T_m equals "3.3300" frames (as given as an example in Figure 19).
Then OFF = 3 and T_m = "0.33" which corresponds to T_m = 12672 chips.

In other words (referring to the timing diagram in Figure 19):

- How to determine T_m at UE: Select a time instant 1) where frame N starts at DL SFN_2 e.g. frame number 3, the time from that time instant to the next frame border of DL $DPCH_{nom}$ 2) equals T_m
  (if these are in phase with each other, T_m is zero).

- How to determine OFF: The difference between the frame number selected for time instant 1) and the frame number starting at instant 2) mod 256 frames equals OFF.
  Example: (3 –0) mod 256 = 3, another example is (1 –254) mod 256 = 3.

3GPP TSG RAN WG3 Meeting #21 **R3-011363**
Busan, Korea, 21st – 25th May 2001

CR-Form-v3

CHANGE REQUEST

⌘ 25.402 CR 020	⌘ rev -	⌘ Current version: 4.0.0 ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

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

Title:	⌘	Additional requirement for timing behaviour of NodeB		
Source:	⌘	R-WG3		
Work item code:	⌘	TEI	***Date:*** ⌘	May 2001
Category:	⌘	**A**	***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:	⌘	Additional requirement for NodeB timing behaviour added in order to ensure multi-vendor interoperability
Summary of change:	⌘	In case of NodeB synchronisation via *TDD Node B Synchronisation Ports* the timing window for start of Radio Frames is explicitly defined.
Consequences if not approved:	⌘	Multi-vendor interoperability is not guaranteed. Backward compatibility: This CR is backward compatible with the intended timing behaviour of NodeBs. However, since the CR relates to an unclear behaviour some implementations may not be compatible with this CR.

Clauses affected:	⌘	6.1.2.1		
Other specs affected:	⌘	[X] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	25.402 CR015 R99
Other comments:	⌘	This CR is the updated version of R3-011155 from RAN#20, which is an identical resubmission of R3-010674 agreed at RAN WG3 meeting #19. Resubmission is done for formal reasons on the new specification version 4.0.0.		

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downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

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.

6.1.2 Inter Node B Node Synchronisation

In the FDD mode Inter Node B Node Synchronisation could be reached via the RNC-Node B Node Synchronisation in order to determine inter Node B timing reference relations.

This could be used to determine Inter-cell relationships (considering T_cell) which can be used in the neighbour cell lists in order to speed up and simplify cell search done by UE at handover.

In TDD Inter Node B Node Synchronisation is used to achieve a common timing reference among Node B's (see Figure 5), that allows to support Intercell Synchronisation.

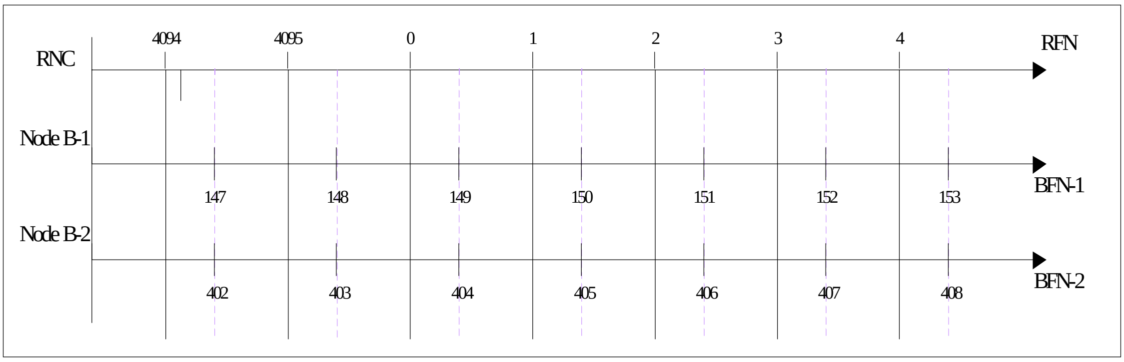

Figure 1: Synchronisation of BFNs through TDD Inter Node B Synchronisation

In TDD Inter Node B Node Synchronisation may be achieved via a standardised synchronisation port (see subclause 6.1.2.1) that allows to synchronise the Node B to an external reference.

Another option to achieve the Inter Node B Node Synchronisation in a TDD system is the synchronisation of cells or Node Bs via the air interface (see subclause 6.1.2.2).

6.1.2.1 TDD Node B Synchronisation Ports

This subclause defines the Node B input and an output synchronisation ports that can be used for Inter Node B Node Synchronisation. These synchronisation ports are optional.

The input synchronisation port (SYNC IN) allows the Node B to be synchronised to an external reference (e.g. GPS), while the output synchronisation port (SYNC OUT) allows the Node B to synchronise directly another Node B (see Figure 6).

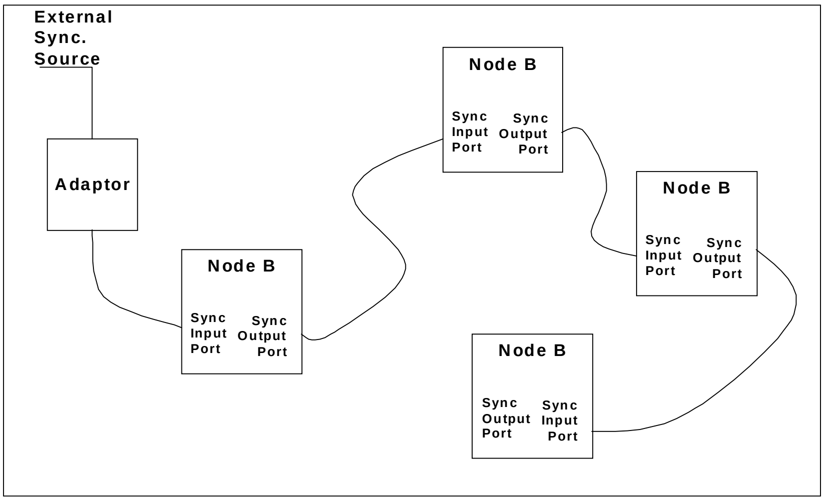

Figure 6: Usage of Synchronisation Ports

This allows connecting Node B's in a daisy chain configuration, so that a single external reference is enough and all remaining nodes B can be synchronised (e.g. in case of indoor operation).

The Node B starts the synchronisation to the external reference when a valid input synchronisation signal is detected at the input synchronisation port.

If a valid synchronisation signal is detected, the Node B regenerates that signal at its output synchronisation port.

The electrical characteristics of the synchronisation ports shall conform to RS422 [6] (output synchronisation port: subclause 4.1; input synchronisation port: subclause 4.2).

The synchronisation signal (illustrated in Figure 7a) is a 100 Hz signal having positive pulses of width between 5 µs and 1 ms, with the following exceptions:

- when (SFN mod 256 = 0) and not (SFN mod 4096 = 0), the pulse shall have a width between 2 ms and 3 ms;

This signal establishes the 10 ms frame interval, the 2.56 s multiframe interval, and the 4096 frames SFN period. The start of all frames in the cell of the node B is defined by the falling edge of the pulse. The required accuracy for the phase difference between the start of the 10ms frame interval ~~and the falling edge of the synchronisation pulses~~ is defined in [15]. The time delay from the falling edge of the signal at the SYNC IN port to the start of the transmitted radio frame shall not exceed 500ns.

The start of the 256 frame period is defined by the falling edge of the pulse corresponding to the frames where SFN mod 256 =0 (i.e. of width between 2 ms and 3 ms, or between 4ms and 5 ms, respectively).

The start of the 4096 frame period is defined by the falling edge of the pulse corresponding to the frames where SFN mod 4096 = 0 (i.e. of width between 4 ms and 5 ms).

The synchronisation signal at the input port shall have frequency accuracy better than the one of the Node B.

The relative phase difference of the synchronisation signals at the input port of any Node B in the synchronised area shall not exceed 2.5 µs.

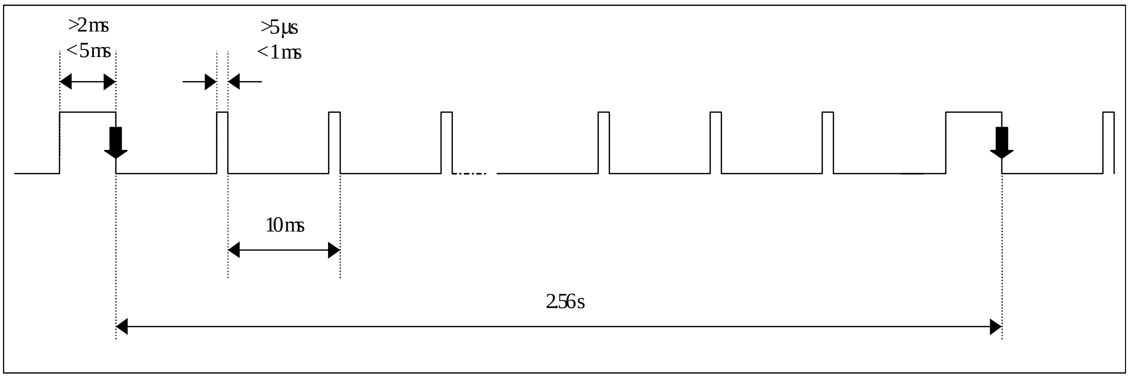

Figure 7: Synchronisation signal with 256 frames markers (Release 99)

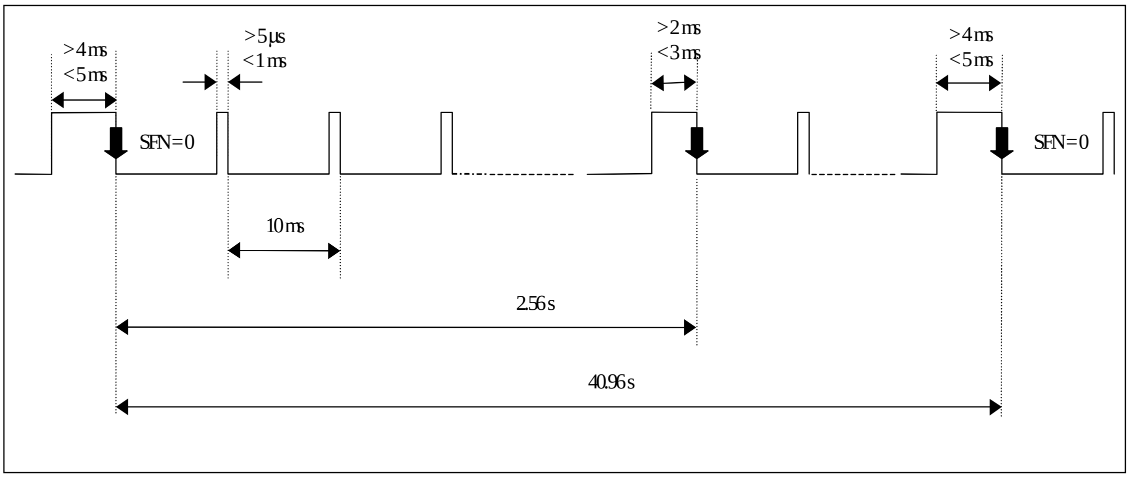

Figure 7a: Synchronisation signal with 256 and 4096 frames markers (Release 4)

Synchronisation by a GPS receiver

The signal transmitted by a Global Positioning System (GPS) satellite indicates the GPS time that provides an absolute time reference. This makes the GPS receiver suitable for Inter Node B Node Synchronisation.

Inter Node B Node Synchronisation is achieved by relating the synchronisation signal (at the input synchronisation port) to the GPS signal. Since the period of this signal is 2.56 s, this implies that every 6400 frames the start of a 256 frame period coincides with an integer GPS second, i.e. a multiframe shall start when GPS time mod 64 = 0.

In general, at each start of a GPS second indicating the GPS time in seconds, the associated full SFN (the 12 bits value) can be derived as: SFN = (GPS time * 100) mod 4096. If the synchronisation port signal shall be derived from GPS, the special pulses for the 256 frames period and the 4096 frames period shall be present in the synch port signal when SFN mod 256 = 0 or SFN mod 4096 = 0, respectively, where the SFN in these equations is linked to the GPS time by the said equation.

Backward compatibility to Release 99

The Release 4 synchronisation port definition is backward compatible with the R99 synch port in the following sense: It is possible to feed a Release 99 Node B with the Rel.4 synchronisation port signal. This results from the fact that the Rel.4 synch port pulses defined for SFN mod 256 = 0 and those defined for SFN mod 4096 = 0 both meet the pulse width tolerance defined for SFN mod 256 = 0 in Release 99. So the Rel.99 Node B will recognise these two classes of Release 4 pulses as valid Release 99 pulses for definition of the 256 frames multiframe start. The Rel.99 Node B will, however, ignore the differences between the 256 frames period pulse and the 4096 frames period pulse: The result is the 256 frames multiframe synchronisation as specified for Release 99.

The opposite scenario, however, i.e. connecting a Release 99 synchronisation port signal (without the 4096 frames marker) to a Release 4 Node B, shall be excluded. This would cause confusion for the "synchronisation via radio interface" procedure. The TDD cells in Rel.4 shall be either "reference" cells where the SFN is fully synchronised to an external reference, or they shall be "non-reference" without any external, local frame clock reference.

3GPP TSG-RAN WG3 Meeting #21 **_Tdoc R3-011481_**
Busan, South Korea, May 21-25 2001

CR-Form-v3

CHANGE REQUEST

⌘	**25.402**	**CR**	**CR-023**	⌘	rev	**-**	⌘	Current version:	**3.5.0**	⌘

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

Title:	⌘	Incorrect Figure references in FDD Radio Interface Synchronisation
Source:	⌘	R-WG3
Work item code:	⌘	TEI
Date:	⌘	2001-05-02
Category:	⌘	**F**
Release:	⌘	R99

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:	⌘	Section 8.2.1 describes FDD Radio Interface Synchronisation where as the figures referenced within this section refer to a TDD diagram.
Summary of change:	⌘	Change referenced Figure from 19 to 18 (From TDD diagram to FDD diagram).
Consequences if not approved:	⌘	The FDD section will point to TDD diagrams when examples are explained. The proposed change is backwards compatible.

Clauses affected:	⌘	8.2.1
Other specs affected:	⌘	[X] Other core specifications ⌘ TS 25.402 v 4.0.0 CR 024 [ ] Test specifications [ ] O&M Specifications
Other comments:	⌘	

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

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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.

8 Radio Interface Synchronisation

8.1 General

This subclause describes the Radio Interface Synchronisation for FDD and TDD.

8.2 FDD Radio Interface Synchronisation

8.2.1 General

FDD Radio Interface Synchronisation assures that UE gets the correct frames when received from several cells. The UE measures the Timing difference between its DPCH and SFN in the target cell when doing handover and reports it to SRNC. SRNC sends this Time difference value in two parameters Frame Offset and Chip Offset over Iub to Node B. Node B rounds this value to the closest 256 chip boundary in order to get DL orthogonality (regardless of used spreading factor). The rounded value is used in Node B for the DL DPCH.

$DOFF_{FDD}$ is selected by the SRNC considering the interleaving period (e.g. 10, 20, 40 or 80ms) when entering in dedicated state from common channel state.

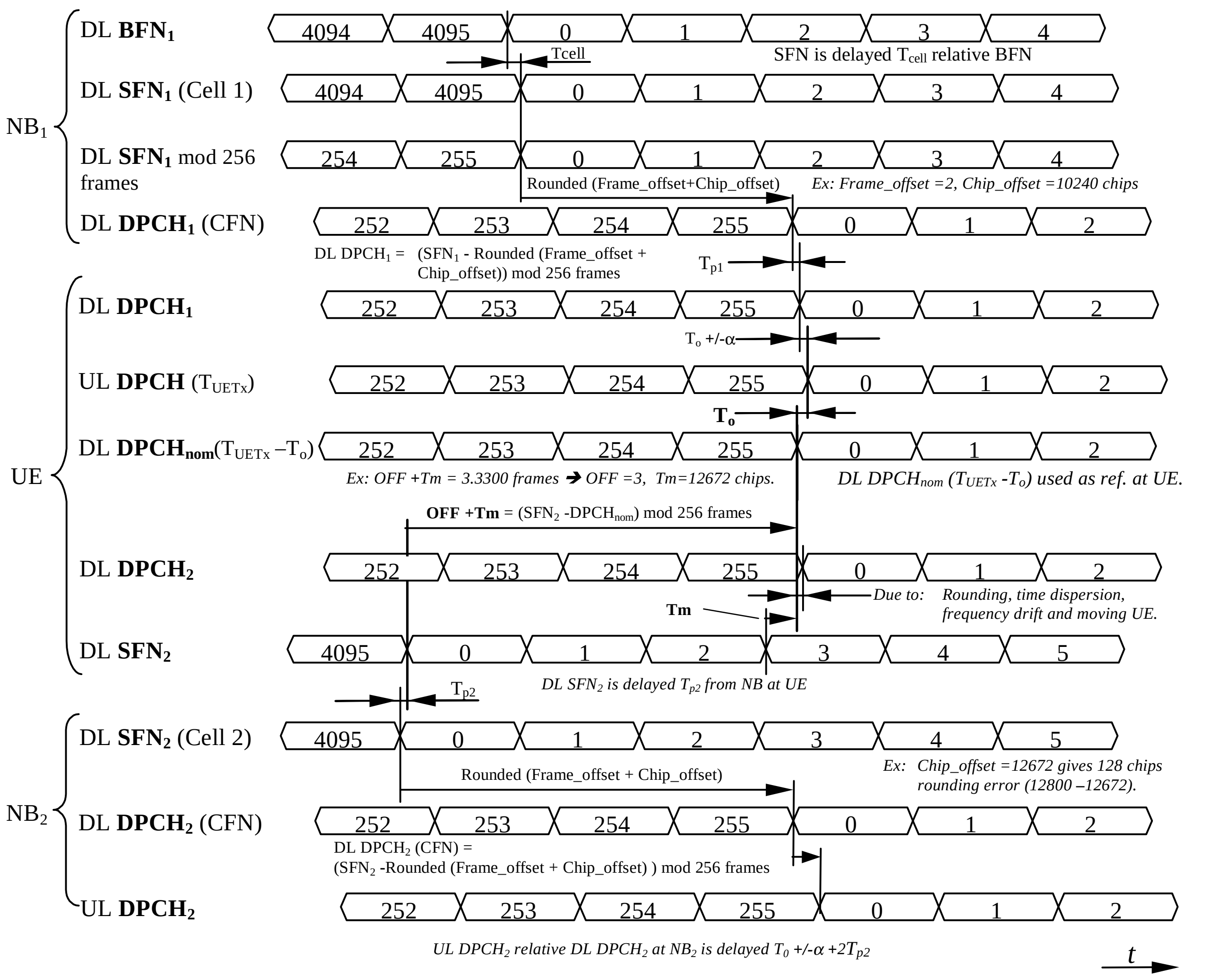
Services are scheduled by using $DOFF_{FDD}$ in order to average out the Iub traffic load and the Node B processing load. $DOFF_{FDD}$ (FDD Default DPCH Offset value) is only used when setting up the first RL in order to initialise Frame Offset and Chip Offset and to tell UE when frames are expected.

UE uses the UL DPCH as it is a more defined time instant compared with DL DPCH.

The handover reference is the time instant T_{UETx} -To, which is called DL $DPCH_{nom}$ in the timing diagram.

T_{cell} is used to skew cells in the same Node B in order to not get colliding SCH bursts, one SCH burst is 1/10 of a slot time.

The timing diagram in Figure 15 shows an example with two cells connected to one UE where handover is done from source cell (Cell 1) to target cell (Cell 2).



α	1st received DL DPCH finger relative DL DPCH$_{nom}$	T_{cell}	Specifies the SFN delay relative BFN
BFN	Node B Frame Number (counter)	T_m	Measured by UE at HO, T_m has a range from 0 to 38399 chips.
CFN	Connection Frame Number (DPCH related)		
DPCH	Dedicated Physical Channel (CFN related)	T_o	Is a constant of 1024 chips, is the nominal difference between first received DPCH finger (DL DPCH$_{nom}$) and T_{UETx} at UE.
HO	Handover		
NB$_x$	Node B (x: 1=source, 2=target)		
OFF	Offset with a range from 0 to 255 frames	T_{pX}	Propagation delay (one way), UE to Cell X
RFN	RNC Frame Number (counter)	T_{UETx}	The time when UE transmits an UL Dedicated Physical Channel.
RNC	Radio Network Controller		
SFN	System Frame Number (counter)		

Figure 15: FDD Radio Interface Synchronisation timing diagram

SFN_1 is found in Cell 1 at Node B_1 and SFN_2 at Cell 2 and Node B_2. SFN_1 is sent T_cell_1 after the Node B_1 reference BFN_1. CFN is the frame numbering that is related to each DL and UL Dedicated Physical Channel (DPCH). UL DPCH is sent from UE to both Cells (both Node B's in this example). UL DPCH at Node B_2 is shown to indicate the difference to the DL $DPCH_2$ at Node B_2.

The new RL (DL $DPCH_2$) which is setup at the HO will face some deviation from nominal position due to the rounding of Frame Offset and Chip Offset to 256 chip boundary in Node B. Also Time dispersion, Node B-UE frequency drift and UE movement affects this phase deviation.

The nominal DL DPCH timing at UE is T_o before the T_{UETX} time instant, which could be expressed:

$$\text{DL DPCH}_{nom} = T_{UETX} - T_o \qquad (8.1)$$

In UE dedicated state, OFF and Tm are measured at UE according to the following equation:

$$\text{OFF} + \text{Tm} = (\text{SFN}_{target} - \text{DL DPCH}_{nom}) \bmod 256 \text{ frames [chips]} \tag{8.2}$$

NOTE: OFF has the unit Frames and Tm the unit Chips.

Example: assume that OFF + T_m equals "3.3300" frames (as given as an example in Figure 18~~9~~).
Then OFF = 3 and T_m = "0.33" which corresponds to T_m = 12672 chips.

In other words (referring to the timing diagram in Figure 18~~9~~):

- How to determine T_m at UE: Select a time instant 1) where frame N starts at DL SFN_2 e.g. frame number 3, the time from that time instant to the next frame border of DL $DPCH_{nom}$ 2) equals T_m
(if these are in phase with each other, T_m is zero).

- How to determine OFF: The difference between the frame number selected for time instant 1) and the frame number starting at instant 2) mod 256 frames equals OFF.
Example: (3 –0) mod 256 = 3, another example is (1 –254) mod 256 = 3.

3GPP TSG-RAN WG3 Meeting #21
Busan, South Korea, May 21-25 2001

Tdoc R3-011482

CR-Form-v3

CHANGE REQUEST

⌘	**25.402**	**CR**	**CR-024**	⌘ rev	**-**	⌘ Current version:	**4.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

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

Title:	⌘ Incorrect Figure references in FDD Radio Interface Synchronisation			
Source:	⌘ R-WG3			
Work item code:	⌘ TEI		***Date:*** ⌘	2001-05-02
Category:	⌘ **A**		***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)*	

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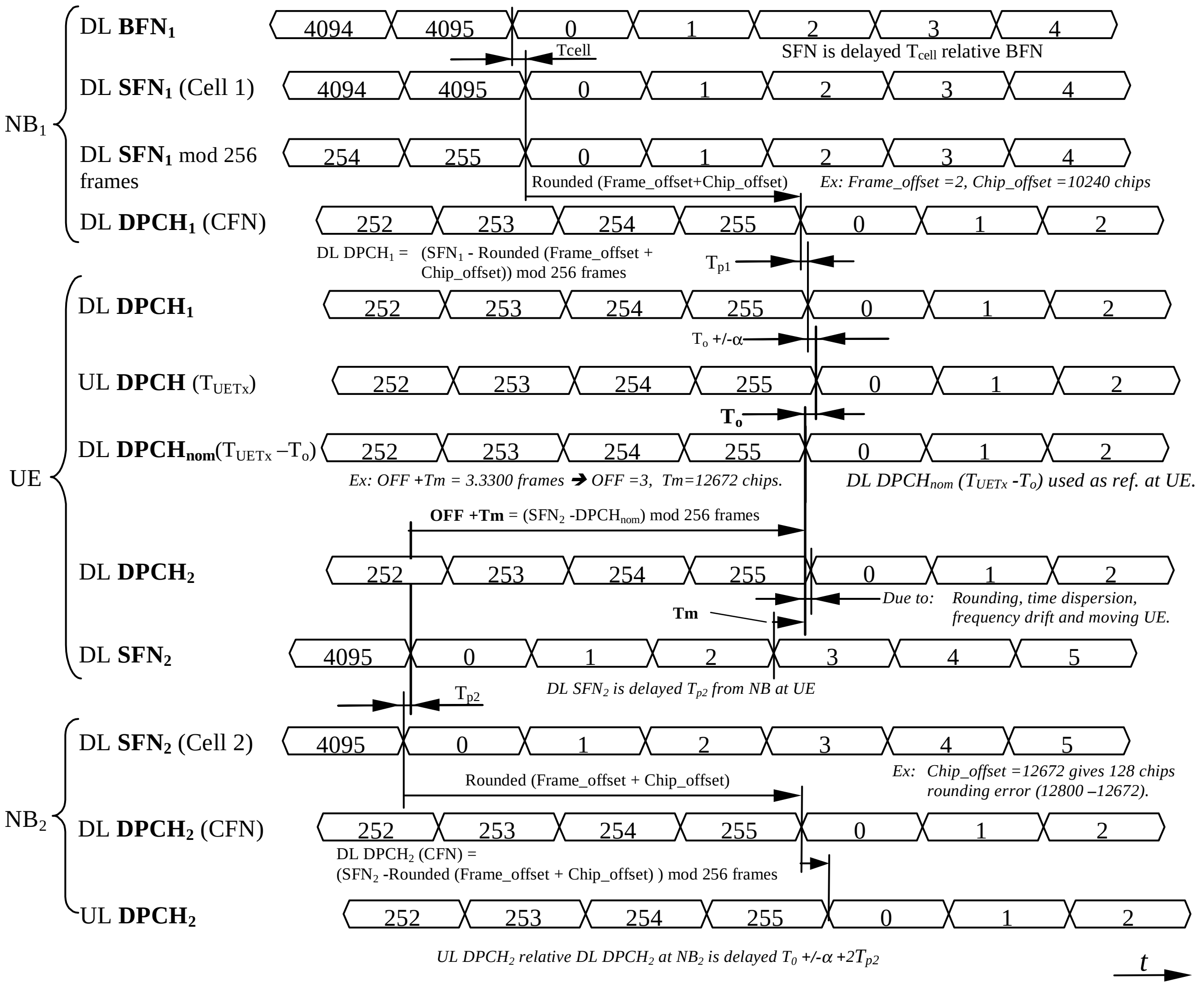

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