

**TSG-RAN Meeting #12
Stockholm, Sweden, 12 - 15 June 2001**

TSGRP#12(01) 0399

Title: Agreed CRs to TS 25.850

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
R3-011428	25.850	001		TDD related clarifications for UE Positioning	F	agreed	4.0.0	4.1.0	LCS1-UEPos-lublur

CHANGE REQUEST

⌘ **25.850 CR 001** ⌘ re **-** ⌘ 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 Core Network

Title:	⌘ TDD related clarifications for UE Positioning		
Source:	⌘ R-WG3		
Work item code:	⌘ LCS1-UEPos-lublur	Date:	⌘ May 2001
Category:	⌘ F	Release:	⌘ REL-4
	<p>Use <u>one</u> of the following categories:</p> <p>F (essential correction) A (corresponds to a correction in an earlier release) B (Addition of feature), C (Functional modification of feature) D (Editorial modification)</p> <p>Detailed explanations of the above categories can be found in 3GPP TR 21.900.</p>		<p>Use <u>one</u> of the following releases:</p> <p>2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)</p>

Reason for change:	⌘ This documents gives some clarifications on UE positioning methods related to TDD operating mode.
Summary of change:	⌘ Rx Timing Deviation measurement is used in TDD instead RTT measurement in FDD Maximum number of measured neighbouring cells is clarified for TDD. Thus the open item is closed. Additions are made to indicate that SFN-SFN measurements can be performed on individual slot positions. Description of length of idle periods tagged to FDD. In TDD the length of an idle period is one timeslot.
Consequences if not approved:	⌘ UE positioning for TDD remain further unclear. <u>Backward compatibility:</u> This CR is backward compatible to the previous version of the spec.

Clauses affected:	⌘ 6.2, 6.3	
Other specs affected:	⌘ <input type="checkbox"/> Other core specifications ⌘ <input type="checkbox"/> Test specifications <input type="checkbox"/> O&M Specifications	⌘
Other comments:	⌘ This CR is the updated version of R3-011163 from RAN#20. This CR was agreed.	

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6.2 OTDOA Radio Interface Timing

The general principle of the OTDOA method is to use two different types of information:

- Propagation Delay,
- Difference between the propagation delays of signals transmitted by different Node Bs

The first type of information can only be determined using [\[FDD - Round Trip Time\]/\[TDD – Rx Timing Deviation\]](#) measurements in UTRAN and [\[FDD - Rx-Tx Time Difference\]](#) measurements in the UE. These [\[FDD - Round Trip Time\]/\[TDD – Rx Timing Deviation\]](#) measurements can only be performed by Node Bs controlling cells in the Active Set. This leads to very low number of measurements for the purpose of UE Positioning.

The second type of information that be determined is the difference between the propagation delays of signals transmitted by different Node Bs. In this case, this measurement is not limited to Node Bs controlling cells in the Active Set of the considered UE. In order to determine this information the UE performs SFN-SFN Observed Time Difference measurements. However, since the Network is not necessarily synchronised, the frame boundaries of signals may not be simultaneously transmitted by the different Node Bs. Similarly, the frames with the same SFN are not necessarily transmitted simultaneously by two different Node Bs. Then, it is necessary to determine the Relative Time Difference (RTD) which is the difference between the instants of emission of radio frames by the different Node Bs. This information necessary to the position calculation function is determined by the SRNC. It is then stored in the case of the UE-assisted method or sent to the UE in the case of the UE-based method. This Relative Time Difference can be determined using either *UTRAN GPS Timing of Cell Frames for LCS* measurements or *SFN-SFN Observed Time Difference* measurements in UTRAN (see [5] and [6]):

- *UTRAN GPS Timing of Cell Frames for LCS*: In this case, each Node B is requested to perform the $T_{\text{UTRAN-GPS}}$ measurement for the specified cell and reports it to the SRNC. The SRNC determines the Relative Time Difference by considering the measurements for the concerned cells as well as the SFN at which they have been performed.
- *SFN-SFN Observed Time Difference*: In this case, a Node B is requested to perform the SFN-SFN Observed Time Difference measurement between the specified signal received from another Node B and its own signal (identified by the Reference Cell ID). All the relevant information must be transmitted to the Node B concerning the signal to be received. This measurement is transmitted to SRNC. This measurement can be performed during Idle Periods (IPDL) if necessary. On the basis of this measurement and of the knowledge of the Geographical Position of the Node Bs (allowing to compute an estimation of the propagation delay between the two Node Bs), it is possible to determine the Relative Time Difference.

The following section concentrates on the functions in the Node Bs and in the SRNC pertaining to this UE Positioning method.

In this document the terms $T_{\text{UTRAN-GPS}}$ and SFN-SFN are used, in order to make the text easier to read.

$T_{\text{UTRAN-GPS}}$ = UTRAN GPS Timing of Cell Frame for LCS as specified in [5] and [6].

SFN-SFN = SFN-SFN Observed Time Difference as to be specified in [5] and [6].

The measured SFN-SFN observed time difference values shall be reported to the SRNC. The quality of the measured SFN-SFN value may also be reported (especially if there is no accuracy specified in [7] and [8]). It shall be used in the SRNC to evaluate the reliability of the reported value. Since the SFN-SFN will change slowly with the time, SFN-SFN drift rate together with its quality shall be reported as well.

The measured $T_{\text{UTRAN-GPS}}$ shall be reported to the SRNC. The quality of measured $T_{\text{UTRAN-GPS}}$ may also be reported (especially if there is no accuracy specified in [7] and [8]). It shall be used in the SRNC to evaluate the reliability of the reported value. Since the $T_{\text{UTRAN-GPS}}$ will change in almost the same manner as time, $T_{\text{UTRAN-GPS}}$ drift rate with its quality shall be reported as well.

The usefulness of the non-zero time derivative (drift rate) of $T_{\text{UTRAN-GPS}}$ (even after compensating the effect of elapsed time) and SFN-SFN values is the unstability of Node B clocks. In the case of SFN-SFN, its time derivative (or drift rate) is eventually determined by the clock stabilities of Node Bs between which the SFN-SFN is measured. In the case of $T_{\text{UTRAN-GPS}}$, the additional drift rate is coming from the clock stability of the measured Node B.

When the Node B clock stability requirement is 0.05 ppm, it means that in the worst case the SFN-SFN value might change with the drift rate 0.1 ppm (one Node B is drifting 0.05 ppm to one direction while the other is drifting 0.05 ppm

to another direction). Thus SFN-SFN drift rate might be as high as 30 m/s. For $T_{\text{UTRAN-GPS}}$ the worst case is 0.05 ppm drift rate, i.e. 15 m/s.

Expected location accuracy of OTDOA-IPDL can be rather high. For example location accuracy of 14 meters in suburban and 35 m in Urban B environments. Assuming SFN-SFN drift rate to be 30 m/s, even 1 second old SFN-SFN values (i.e. SFN-SFN information is 1 second older than OTDOA measurements from the UE) might be 30 m wrong. The hyperbola between two Node Bs (on which the UE should be) is defined by the Geometric Time Difference $\text{GTD} = \text{OTDOA} - \text{SFN-SFN}$. Thus 30 m error in SFN-SFN means (depending on geometry) at least 30 m location error, i.e. in suburban environment the error might increase 3 times.

Quality merits of $T_{\text{UTRAN-GPS}}$ and SFN-SFN measurements and their drift rates, i.e. standard deviations, are needed in the SRNC for two major reasons:

- They are used for weighting different measurements in order to increase accuracy. Due to physical nature of $T_{\text{UTRAN-GPS}}$ and SFN-SFN measurements, there will be better and worse measurements. For location calculation information about reliability of measurements is of utmost importance.
- They are used to estimate the confidence area for the location estimate. Reference [9] defines a set of confidence areas (area within which the real location is with a certain probability).

If quality numbers are not available location accuracy decreases and confidence area determination is not possible.

6.2.1 Iub Interface

Iub is required to transmit requests for measurements from the CRNC to a Node B and measurement results from a Node B to the CRNC. SFN-SFN and $T_{\text{UTRAN-GPS}}$ measurements may be done on demand, periodically or when there are significant changes in measurement value.

It is most feasible to introduce SFN-SFN and $T_{\text{UTRAN-GPS}}$ measurements to the existing measurements on Common Resources functionality using following EPs in NBAP

- a) Common Measurement Initiation,
- b) Common Measurement Reporting,
- c) Common Measurement Termination, and
- d) Common Measurement Failure.

Measurement initiation for radio interface timing measurements (Common Measurement Initiation)

The request for radio interface timing information $T_{\text{UTRAN-GPS}}$ or SFN-SFN from the CRNC to a cell in the Node B shall contain the following parameters:

Measurement type;

In case of SFN-SFN, instruction about reference cell used as reference for measurements;

In case of SFN-SFN, instructions about neighbouring cells to be measured;

Introduction of how the measurement shall be reported (on demand, periodic or on modification);

In case of $T_{\text{UTRAN-GPS}}$ measurement the minimum required accuracy class for $T_{\text{UTRAN-GPS}}$ measurement

Measurement type

In the measurement type info CRNC indicates whether it wants its cell to perform $T_{\text{UTRAN-GPS}}$ or SFN-SFN measurements.

If requested measurement type is $T_{\text{UTRAN-GPS}}$, the cell shall measure the *UTRAN GPS Timing of Cell Frames for LCS* as defined in reference [5] and [6].

If requested measurement type is SFN-SFN, the cell shall measure the SFN-SFN Observed Time Difference between the reception of the signal sent by the measured neighbour cells and its own signal. To allow a better reception of the signal of other Node Bs, idle periods (IPDL) can be used as specified in [5] and [6].

Reference cell

Cell [FDD - containing the primary CPICH] that is used as a reference for SFN-SFN measurements is identified with its *C-Id* IE. In case of $T_{\text{UTRAN-GPS}}$ measurement *C-Id* IE identifies the cell where the $T_{\text{UTRAN-GPS}}$ is to be measured.

Neighbouring cells to be measured

In FDD mode of operation the neighbouring cells to be measured for SFN-SFN are identified with *UC-Id* IE. This list shall also contain the information on the neighbouring cell CPICH signal i.e. *UARFCN* IE and *Primary Scrambling Code* IE.

The maximum number for measured neighbouring cell in FDD mode of operation is 96 as specified in reference [7] for UE.

In TDD mode of operation the neighbouring cells to be measured for SFN-SFN are identified with *UC-ID IE*. ~~the~~ This list of measured neighbouring TDD cells shall contain ~~identified with~~ *UARFCN* IE and *Cell Parameter Id* IE to indicate the cell information. Since the measurement can be performed on every slot position on individual burst types and midambles, *Time slot IE* and *Midamble shift and burst type IE* shall be contained in addition.

The maximum number for measured neighbouring cell in TDD mode of operation is ~~FPS-96~~ as specified in reference [8].

There is also open item to clarify whether GSM cells can be used as additional neighbouring cells for UE positioning purpose.

Report Characteristics

Introduction of how the measurement shall be reported shall contain the information about how the measurement shall be done. Measurements can be made on demand or periodically. However, existing report criteria event A to F are not applicable for $T_{\text{UTRAN-GPS}}$ and SFN-SFN and a new report criteria on-modification should be defined.

In On modification type of report criteria the Node B shall report the results of measurements immediately and then initiate measurement reporting according to the following triggers:

Change of the $T_{\text{UTRAN-GPS}}$ compared to previously reported value at the initial Common Measurement Reporting or at Common Measurement Reporting when the event was triggered.

Deviation of the actual measurement received from physical layer from the predicted $T_{\text{UTRAN-GPS}}$ value.

Change of the SFN-SFN compared to previously reported value (either in the initial Common Measurement Initiation procedure or at the Common Measurement Reporting when the event was triggered).

Deviation of the actual measurement received from physical layer from the predicted SFN SFN value.

In the first case above, the change of the $T_{\text{UTRAN-GPS}}$ means that timing relation between the UTRAN SFN and GPS TOW has been changed due to the clock drift of the Node B. The criteria for such a trigger is defined according to following:

The change of $T_{\text{UTRAN-GPS}}$ value after n measurements is calculated according to the following formula:

$$F_n = F_{n, n-1} + F_{n-1} \quad (1)$$

Where the F_n and F_{n-1} are the accumulated change after n and n-1 measurement periods respectively and the $F_{n, n-1}$ is the drift during the last measurement period.

The $F_{n, n-1}$ is derived according to the following:

$$\begin{aligned} F_{n, n-1} &= M_n - M_{n, \text{estimated}} = M_n - (M_{n-1} + 10\text{ms} * ((SFN_n - SFN_{n-1}) \text{ mod } 4096)) \\ &= (M_n - M_{n-1}) - 10 * ((SFN_n - SFN_{n-1}) \text{ mod } 4096) \end{aligned} \quad (2)$$

Where:

M_n and M_{n-1} are the actual measurements of the $T_{\text{UTRAN-GPS}}$ received from the physical layer at SFN_n and SFN_{n-1} respectively.

$M_{n, \text{estimated}}$ is the estimated $T_{\text{UTRAN-GPS}}$ at SFN_n which is equal to previous measurement M_{n-1} plus the period between the two measurements.

The *mod* (4096) deals with the fact that the range for SFN is [0..4095].

Inserting (2) in (1), adding the modulo operation to the SFN and M differences, and converting the 10 ms into 1/16 chip unit which is the measurement resolution defined TS 25.133, then the drift F_n can be expressed by following formula:

$$F_n = (M_n - M_{n-1}) \bmod 37158912000000 - ((SFN_n - SFN_{n-1}) \bmod 4096) * 10 * 3.84 * 10^3 * 16 + F_{n-1} \text{ [1/16 chip]} \quad (3)$$

If the Reporting *Report Characteristics* IE is set to 'On Modification', the Node B reports the result of the requested measurement immediately and afterwards the Node B initiates a Common Measurement Reporting procedure every time the absolute value of the F_n rises above the indicated threshold. After each reporting the n is set to zero and the calculation is restarted.

The second case above is based on the assumption that the drift rate (1st derivative) of the Node B internal clock is nearly constant within a period of the time. The drift rate is reported in the measurement report to the CRNC. The Node B and CRNC will periodically make a prediction and update the timing internally resulting in that the amount of signalling due to the measurement reporting is reduced. However if the predicted value deviates from the actual measured value in Node B by more than the indicated threshold, the event is triggered and the new $T_{\text{UTRAN-GPS}}$ value and drift rate are reported to the CRNC. The calculation of the predicted value and the deviation is according to the following:

$$P_n = b \text{ for } n=0$$

$$P_n = ((1+a) * ((SFN_n - SFN_{n-1}) \bmod 4096) * 10 * 3.84 * 10^3 * 16 + P_{n-1}) \bmod 37158912000000 \text{ for } n>0$$

$$F_n = \min(\text{abs}(M_n - P_n), \text{abs}(M_n - P_n - 37158912000000), \text{abs}(M_n - P_n + 37158912000000)) \text{ for } n>0$$

Where:

P_n is the predicted $T_{\text{UTRAN-GPS}}$ value when n measurement results has been received after first Common Measurement Reporting at initiation or after the last event was triggered.

F_n is the calculated deviation of the predicated from measurement result and predicted value. All these values are present to take care of the fact the range of $T_{\text{UTRAN-GPS}}$ measurement is [0.. 37158911999999]. Furthermore, these values implice that the specified threshold shall never exceed 18579456000000 (=37158912000000/2).

a is the last reported $T_{\text{UTRAN-GPS}}$ Drift Rate value.

b is the last reported $T_{\text{UTRAN-GPS}}$ value.

abs is the absolute value.

The reason for having the factor (1+a) is to compensate for the fact that the GPS TOW is a counter that is stepped up regularly. Please see the mapping in the 25.133.

At each measurement result received from physical layer, the P_n and F_n are calculated and if F_n rises above the indicated threshold the event is triggered, n is set to zero and the calculation is restarted.

For the third case, this similar to the first case except that the SFN-SFN measurement does not evolve with time, so the change of the value is handled as follows:

$$F_n = 0 \text{ for } n=0$$

$$F_n = (M_n - a) \bmod 40960 \text{ for } n>0$$

Where:

F_n is the change of the SFN-SFN value expressed in unit [1/16 chip] when n measurement results have been received from the Layer 1 after first Common Measurement Reporting at initiation or after the last event was triggered.

a is the last reported SFN-SFN value.

The $\bmod 40960$ takes care of the fact that the SFN-SFN Observed Time Difference UTRAN measurement has been defined on Time Slot Boundaries (range between -1280 and +1280 chips with a resolution of 1/16th of chip).

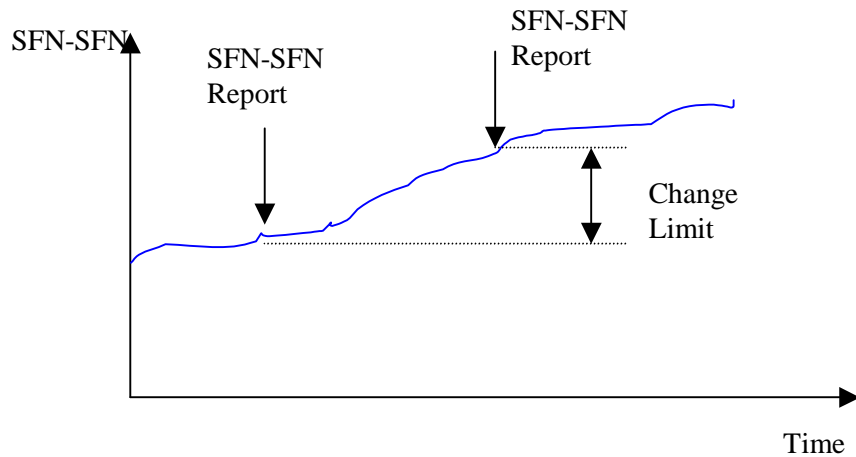


Figure 1: Change Limit based report criteria

Similarly, for the fourth case, above the predicted SFN-SFN value and the deviation are described according to the following:

$$P_n = ((a * (15 * ((SFN_n - SFN_{n-1}) \bmod 4096) + (TS_n - TS_{n-1}) * 2560 * 16 + P_{n-1}) \bmod 40960) - 20480 \text{ for } n > 0$$

$$F_n = \min(\text{abs}(M_n - P_n), \text{abs}(M_n - P_n - 40960), \text{abs}(M_n - P_n + 40960)) \text{ for } n > 0$$

Where:

P_n is the predicted SFN-SFN value when n measurement results have been received from Layer 1 after first Common Measurement Reporting at initiation or after the last event was triggered. The modulo are present for the same reason as stated above, furthermore the -20480 at the end of the equation takes care of the fact that the $T_{\text{UTRAN-GPS}}$ measurement is between -1280 and +1280 chip with a granularity of $1/16^{\text{th}}$ of chip.

a is the last reported SFN-SFN Drift Rate value.

b is the last reported SFN-SFN value.

F_n is the deviation of the last measurement result from the predicted SFN-SFN value (P_n) when n measurements have been received from Layer 1 after first Common Measurement Reporting at initiation or after the last event was triggered. All these values are present to take care of the fact the $T_{\text{UTRAN-GPS}}$ measurement is between -1280 and +1280 chip with a granularity of $1/16^{\text{th}}$ of chip. Furthermore, these values imply that the specified threshold shall never exceed 20480 ($=40960/2$).

M_n is the latest measurement result received from the physical layer measurements, measured at the Time Slot TS_n of the Frame SFN_n .

If the F_n rises above the threshold the event is triggered and the new SFN-SFN value and SFN-SFN Drift rate are reported to CRNC.

Furthermore, the SFN-SFN Drift rate or the $T_{\text{UTRAN-GPS}}$ Drift Rate will always be reported to the CRNC. These drift rates are not a measurement but are determined by the Node B. However, it is assumed that the determination of the drift rate is rather an implementation issue. In a simple Node B implementation, the drift rate may be set to zero or a fixed value based on the characteristics of the internal clock, while in other implementation a more advanced method may be deployed to determine the drift rate. Therefore, no specific way of determining it can be mandated.

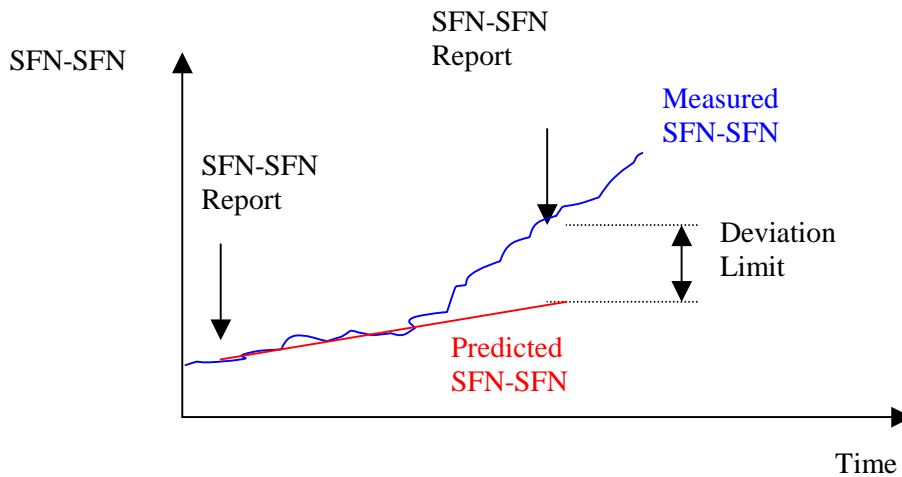


Figure 2: Deviation based Report Criterion

Minimum required accuracy class for $T_{\text{UTRAN-GPS}}$ measurement

For $T_{\text{UTRAN-GPS}}$, different accuracy classes are needed to be specified for UTRAN GPS Timing of Cell Frames for LCS measurements in reference [7] and [8]. In the case where $T_{\text{UTRAN-GPS}}$ measurement is required for OTDOA it shall be indicated in the report initialization with the minimum accuracy class required for OTDOA purpose. The response and report message shall then contain the achieved accuracy class.

Measurement report for radio interface timing measurements (Common Measurement Initiation successfully case and Common Measurement Reporting)

Measurement report for $T_{\text{UTRAN-GPS}}$ measurement or SFN-SFN measurements from a cell in the Node B to the CRNC shall contain the following information:

Identity of measured cell for $T_{\text{UTRAN-GPS}}$ or reference cell used for SFN-SFN measurement

In case of $T_{\text{UTRAN-GPS}}$ measurement, $T_{\text{UTRAN-GPS}}$ of measured cell;

In case of $T_{\text{UTRAN-GPS}}$ measurement, quality of reported $T_{\text{UTRAN-GPS}}$;

In case of $T_{\text{UTRAN-GPS}}$ measurement, $T_{\text{UTRAN-GPS}}$ drift rate;

In case of $T_{\text{UTRAN-GPS}}$ measurement, quality of reported $T_{\text{UTRAN-GPS}}$ drift rate;

In case of $T_{\text{UTRAN-GPS}}$, achieved accuracy class of the $T_{\text{UTRAN-GPS}}$ measurement;

In case of SFN-SFN measurement, identity of measured neighbour cells;

In case of SFN-SFN measurement, SFN-SFN between reference cell and measured neighbouring cells;

In case of SFN-SFN measurement, quality of reported SFN-SFN;

In case of SFN-SFN measurement, SFN-SFN drift rate;

In case of SFN-SFN measurement, quality of reported SFN-SFN drift rate;

In case of $T_{\text{UTRAN-GPS}}$ and SFN-SFN measurement SFN as a time when the measurement is reported by the layer 3 filter

Identity of measured cell for $T_{\text{UTRAN-GPS}}$ or reference cell used for SFN-SFN measurement

Measurement Id in measurement response- or measurement report message is used to implicitly identify the cell used for $T_{\text{UTRAN-GPS}}$ measurement or the reference cell used for SFN-SFN measurements.

$T_{\text{UTRAN-GPS}}$ of measured cell

$T_{\text{UTRAN-GPS}}$ contains the UTRAN GPS Timing of Cell Frames for LCS as specified in reference [7] and [8].

Quality of reported $T_{\text{UTRAN-GPS}}$

$T_{\text{UTRAN-GPS}}$ Quality is the quality of reported $T_{\text{UTRAN-GPS}}$ value that can be used to evaluate the reliability of reported value in the SRNC and to define the confidence area for the position estimate. This quality is the standard deviation (Std) of reported reference cell $T_{\text{UTRAN-GPS}}$.

$T_{\text{UTRAN-GPS}}$ Drift Rate

$T_{\text{UTRAN-GPS}}$ drift rate is needed in the SRNC position calculation function's position estimate to evaluate the evolution of $T_{\text{UTRAN-GPS}}$ due the Node B clock drift.

$T_{\text{UTRAN-GPS}}$ drift range indicates the first time derivative of the reported AT value. It is the best estimate of $T_{\text{UTRAN-GPS}}$ drift rate at the time of last $T_{\text{UTRAN-GPS}}$ measurement.

Quality of reported $T_{\text{UTRAN-GPS}}$ Drift Rate

$T_{\text{UTRAN-GPS}}$ drift rate quality is the quality of reported $T_{\text{UTRAN-GPS}}$ drift rate that can be used to evaluate the reliability of reported drift rate in the SRNC. This quality is the standard deviation (Std) of reported reference cell $T_{\text{UTRAN-GPS}}$ drift rate.

Accuracy class of $T_{\text{UTRAN-GPS}}$ measurement

This field contains the achieved accuracy class for $T_{\text{UTRAN-GPS}}$ measurement that is to be specified in reference [7] and [8].

Identity of measured neighbour cells

In case of SFN-SFN measurement the measured neighbours are identified with *UC-Id* IE in the measurement response and measurement report messages.

SFN-SFN between reference cell and measured neighbouring cell

SFN-SFN shall contain the reported SFN-SFN Observed time difference according to report mapping to be specified for reference [7] and [8].

Quality of reported SFN-SFN

SFN-SFN Quality is the quality of reported SFN-SFN value that can be used to evaluate the reliability of SFN-SFN measurements in the SRNC and to define the confidence area for the position estimate. This quality is the standard deviation (Std) of reported SFN-SFN value.

SFN-SFN Drift Rate

SFN-SFN drift rate is used in the SRNC to evaluate the evolution of SFN-SFN due the frequency difference and jitter between cells in the Node Bs.

SFN-SFN drift rate indicates the first time derivative of the SFN-SFN value between reference cell transmission and the reception of neighbouring cell signal. It is the best estimate of the SFN-SFN drift rate value at the time of last SFN-SFN measurement.

Quality of reported SFN-SFN drift rate

Quality of reported SFN-SFN drift rate is the quality of reported SFN-SFN drift rate that can be used to evaluate the reliability of reported SFN-SFN drift rate in the SRNC. This quality is the standard deviation (Std) of reported SFN-SFN drift rate.

SFN Reporting

In the case of the $T_{\text{UTRAN-GPS}}$ measurement, it is necessary to have the SFN reported in order to identify on which frame the measurement has been performed (otherwise the ambiguity on the SFN cannot be resolved when considering measurements for different cells in the SRNC).

In the case of the SFN-SFN Measurement, it is necessary to have the SFN and the TS reported in order to identify on which slot boundary the measurement has been performed. This should allow to resolve the ambiguity by taking into account the SFN-SFN Observed Time Difference measurement performed by the UE and the fact that an ambiguity of Time Slot is equivalent to an ambiguity of 200 km on the position.

Failure cases

If the cell cannot initialize the request $T_{\text{UTRAN-GPS}}$ or SFN-SFN measurement the Node B shall response with COMMON MEASUREMENT INITIATION FAILURE message with the failure cause value 'Measurement not supported for the object'.

If the measurement were requested on demand and failure occurs due the lack of GPS TOW in case of $T_{\text{UTRAN-GPS}}$ measurement or hearability problem of all the neighbouring cells the Node B shall initiate the Common Measurement failure procedure.

If the required measurement can be initiated by the cell (periodic, on modification) but a temporary failure occurs due to the lack of GPS TOW (in case of $T_{\text{UTRAN-GPS}}$ measurement) or the lack of hearability of all the neighbouring Cells (SFN-SFN) the Node B shall respond with the COMMON MEASUREMENT REPORT message with the Common Measurement value 'Measurement not Available'.

If there is no measurement available for the neighbour cell that shall be measured (SFN-SFN) this is indicated in the list of unsuccessfully measured neighbour cell information in the *Common Measurement value IE*.

There shall be also failure cases for the situation where SFN-SFN measurements are initialized without information of neighbouring cells or $T_{\text{UTRAN-GPS}}$ measurement is initialized without measurement minimum accuracy requirement or AT/SFN-SFN measurement are initialized without FN reporting required.

6.2.3 Open items

Following open items are identified:

1. ~~The maximum number for measured neighbouring cell in TDD mode of operation is FFS in reference [8].~~
2. Can the GSM cells be measured as neighbouring cells for UE positioning.
3. Mapping and accuracy of the SFN-SFN Observed Time Difference UTRAN measurement. Is there a need to report the accuracy of this measurement?
4. Accuracy of the $T_{\text{UTRAN-GPS}}$ UTRAN measurement.

6.3 OTDOA Idle Periods

The Node Bs may provide idle periods in the downlink, in order to potentially improve the hearability of other Cells. The operation and specification of idle periods can be found in [3] and [10].

IPDL method is based on downlink and the service can be provided efficiently to large number of terminals simultaneously that can measure other cells in other Node Bs during the idle periods of it's own reference cell the UE is connected. IPDL is also used for the real time difference measurements between cell transmission that can be carried out during the idle periods

Intention of IPDL is to increase the visibility of further away cells so that the measurements by UE and cell transmissions can be carried out. These measurements rely on the IPDL parameters that do not overlap between different cells in different Node Bs. This can be assured by planning IPDL parameters defining IPDL so that they do not overlap between different cells in different Node Bs (even controlled with different RNCs).

During the IPDL period the cell within Node B ceases it's transmission for short periods of time (idle periods). [FDD - The length of the idle periods is expressed in symbols of the CPICH that can get values 5 or 10 symbols. The function determining the position of this short time of idle period is based on random number generator that spans one IPDL burst to the whole SFN cycle (continuous mode) or cycle determined by burst mode parameters in burst mode of operation. There might be the risk that due the Node B clock drift the IPDL start to overlap. However due the flexibility of the configuring the position of IPD period x and due the short time of IPDL period (5 or 10 symbols) it can be assumed that there is no need to take any signalling actions due to the Node B clock drift (i.e. adapt to the situation by signalling new IPDL parameters to the cell). IPDL parameters need to be specified so that it take account the clock drifts of Node Bs so that not all the IPDL overlap due to this Node B clock drift.]

[TDD - In TDD an idle period has a duration of one time slot, where all channels are silent simultaneously, except for SCH in order to avoid problems with cell search.]

Based on these assumption the preferred solution is that the nature of IPDL parameters defining the IPDL is static. However it shall be possible dynamically activate and deactivate the IPDL period e.g. for capacity reasons. It shall be

also possible to reconfigure IPDL parameters defining the IPDL without deleting and creating the cell first. This is done via Cell Reconfiguration elementary procedure. However it is not possible to configure IPDL parameters and activate IPDL with the Cell Reconfiguration elementary procedure if there is IPDL active in the cell

There are two mode of IPDL operations, continuous mode and burst mode of operation. The parameters presented below defining the IPDL period (continuous mode/ burst mode) are needed to be provided by the CRNC to the cells in the Node B for applying IPDL. IPDL parameters are also provided to the UE over DCCH, so the SRNC shall be aware of used IPDL parameters in the reference UP cell. If the reference UP cell is not controlled by the SRNC IPDL parameters need to be conveyed from the CRNC, controlling the reference UP cell, to the SRNC via Iur interface.

Parameters below defines the IPDL to be applied:

- [FDD - IP_Offset: Cell specific offset that is used to synchronise idle periods from different sectors within a Node B;]
- IP_Spacing: The number of 10 ms radio frames between the start of a radio frame that contains an idle period and the next radio frame that contains an idle period. Note that there is at most one idle period in a radio frame.
- [FDD - IP_Length: The length of the idle periods, expressed in symbols of the CPICH.]
- [FDD - Seed: Pseudo random number generator.]
- [TDD – IP_Start: The number of the first frame with idle periods. In case of continuous mode IP_Start is the SFN of the first frame with idle periods and in case of burst mode IP_Start defines the number of frames after Burst Start with the first frame with idle periods]
- [TDD – IP_Slot: The number of the slot that has to be idle.]
- [TDD – IP_PCCPCH: This logic value indicates, if the P-CCPCH is switched off in two consecutive frames. The first of these two frames contains the idle period.]

In the burst mode of operation addition the parameter mentioned above following parameters are needed.

- **Burst_Start: The SFN where the first burst of idle period startf idle period start**
- Burst_Length: The number of idle periods in a burst of idle periods.
- Burst_Freq: The number of radio frames [FDD - of the primary CPICH] between the start of a burst and the start of the next burst.

6.3.1 Iub Interface

Iub interface is used to control the IPDL mechanism between the CRNC and it's Node Bs. To apply the IPDL in the Node B the CRNC needs to provide parameters described in chapter 6.3 to it's Node Bs. One solution to control the IPDL in the Node B is to use existing Cell Setup and Cell Reconfiguration elementary procedures.

Cell Setup procedure is initiated with a CELL SETUP REQUEST message that shall be used to configure IPDL parameters mentioned in chapter 6.3 and optionally activate the IPDL immediately in the cell. This message shall contain the id uniquely identify the configured cell within CRNC, IPDL configuration parameters and additionally logical information about activation of IPDL if CRNC wants it's cell within Node B to activate IPDL immediately.

[FDD - All the parameters mentioned in the chapter 6.3 excluding the parameter IP offset shall be signalled from CRNC to the cells in the Node B for defining the IPDL to be applied. IP offset is the parameter defining the cell specific offset that is used to synchronise idle periods from different sectors within a Node B. For this purpose the existing *T_Cell* IE in CELL SETUP REQUEST-message is used instead of IP_offset.]

[FDD - If IPDL is going to be activated immediately together with IPDL parameters IP_position(x) can be calculated according the function described below extracted from [4].

The function IP_position(x) described below yields the position of the xth Idle Period relative to a) the start of the SFN cycle when continuous mode or b) the start of a burst when in burst mode. The operator "%" denotes the modulo operator. Regardless of mode of operation, the Idle Period pattern is reset at the start of every SFN cycle. Continuous mode can be considered as a specific case of the burst mode with just one burst spanning the whole SFN cycle. Note also that x will be reset to x=1 for the first idle period in a SFN cycle for both continuous and burst modes and will also, in the case of burst mode, be reset for the first Idle Period in every burst.

Max_dev=150-IP length

rand(x)= (106.rand(x-1) + 1283)mod6075,

rand(0)=seed

$$IP_position(x) = x * IP_spacing * 150 + rand(x \bmod 64) \bmod Max_dev + IP_offset]$$

For detailed information about calculation of idle period position see [3] and [10].

Cell Reconfiguration procedure is initiated with a CELL RECONFIGURATION REQUEST message that may be used to

immediate activation of pre-configured IPDL (IPDL parameters configured in the Cell Setup); or

configure IPDL parameters and immediately activate the IPDL; or

immediate deactivation of ongoing IPDL.

CELL RECONFIGURATION REQUEST message shall contain the id uniquely identify the configured cell within CRNC and

logical information about IPDL activation (immediate activation of pre-configured IPDL parameters);or

IPDL parameters together with logical information about IPDL activation (immediate activation of configured IPDL);
or

logical information about IPDL deactivation. (immediate deactivation of IPDL).

It is assumed that IPDL can be immediately activated and deactivated with Cell Reconfiguration procedure i.e. activation/deactivation of IPDL configuration at runtime is not time critical.

6.4.1 Iub Interface

In order to fully support A-GPS positioning within UTRAN, the following information shall be obtained by the Node B by introducing one new measurement type in the elementary procedures realizing measurements over common resources:

The AT ($T_{UTRAN-GPS}$) measurement type shall contain the same information as described in chapter 6.2 OTDOA Radio Interface Timing with the difference that different accuracy classes as defined in [7] and [8] can be used for A-GPS purposes

In addition, [\[FDD - Round Trip Time\]](#), which has to be corrected by UE Receiving Transmitting Time (UE RxTx, also specified in [5]) [/\[TDD - Rx Timing Deviation\]](#), may be used (provided the measurements are performed from the same Node B with which the AT is referenced) to improve the performance of UE assisted GPS [2]. These parameters are part of OTDOA methods and shall be addressed as part of the OTDOA solution.

6.4.2 Iur Interface

In order to fully support A-GPS positioning within UTRAN, the AT ($T_{UTRAN-GPS}$) information as described in chapter 6.2 with the minimum accuracy level (see [7] and [8]) applicable for A-GPS shall be obtained by the DRNS:

In addition, [\[FDD - Round Trip Time\]](#), which has to be corrected by UE Receiving Transmitting Time (UE RxTx, also specified in [5]) [/\[TDD - Rx Timing Deviation\]](#), may be used (provided the measurements are performed from the same Node B with which the AT is referenced) to improve the performance of UE assisted GPS [2]. These parameters are part of OTDOA methods and shall be addressed as part of the OTDOA solution.

6.7.1 Introduction

For the correct operation of UE Positioning in UTRAN, it is necessary to have the following information available in the SRNC:

- RTD and AT measurements;
- antenna or cell geographic co-ordinates;
- assistance data ([\[FDD - RTT\]](#) [/\[TDD - Rx Timing Deviation\]](#) measurements or IPDL configuration from the CRNC of the Reference Cell);
- reference GPS assistance data;
- GPS receiver geographical position.

This information must be transmitted over the Iur. This support can be realised using procedures called "Inter-RNC Information Exchange" and "Common Measurement" (except for [\[FDD-RTT\]/\[TDD – Rx Timing Deviation\]](#) measurements which are already handled by the Dedicated Measurement procedures). The Information Exchange elementary procedures need to take care of the signalling of information which cannot be regarded as measurements, like for example GPS assistance data, while Common Measurements are needed to support the initiation, reporting and termination of the relevant measurements required for timing assistance purposes.