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UE positioning in UTRAN Iub/Iur protocol aspects

Release 4

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Foreword

This Technical Report (TR) has been produced by the 3rd Generation Partnership Project (3GPP), Technical Specification Group RAN.

The contents of this TR are subject to continuing work within 3GPP and may change following formal TSG approval. Should the TSG modify the contents of this TR, it will be re-released with an identifying change of release date and an increase in version number as follows:

Version m.x.y

where:

m indicates [major version number]

x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated into the specification.

1 Scope

The purpose of the present document is to help the TSG RAN WG3 group to specify the changes to existing specifications, needed for the introduction of the UE positioning in UTRAN for Release 2000.

Based on [1], standard location services are defined as the:

- cell coverage based positioning method;
- OTDOA method with network configurable idle periods; and
- network assisted GPS method.

Since cell coverage based positioning method in WG3 group is already standardised this document will cover the Iub/Iur protocol aspects for OTDOA method with network configurable idle periods and network assisted GPS method.

It is intended to gather all information in order to trace the history and the status of the Work Task in RAN WG3. It is not intended to replace contributions and Change Requests, but only to list conclusions and make reference to agreed contributions and CRs. When solutions are sufficiently stable, the CRs can be issued.

It describes agreed requirements related to the Work Task, and split the Work Task into “Study Areas” in order to group contributions in a consistent way.

It identifies the affected specifications with related Change Requests.

It also describes the schedule of the Work Task.

This document is a ‘living’ document, i.e. it is permanently updated and presented to all TSG-RAN meetings.

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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1.] Work Item Description: "Support of Location Services in UTRA FDD" RP-000135, submitted at RAN#7.
[2.] TS 25.305 Stage 2 Functional Specification of Location Services in UTRAN
[3.] TS 25.214 Physical layer procedures (FDD)
[4.] TS 25.331 RRC Protocol Specification
[5.] TS 25.215 Physical Layer – Measurements (FDD)
[6.] TS 25.225 Physical Layer – Measurements (TDD)
[7.] TS 25.133 Requirements for Support of Radio Resource Management (FDD)
[8.] TS 25.123 Requirements for Support of Radio Resource Management (TDD)
[9.] 3GPP TS 25.433: “UTRAN Iub Interface NBAP Signalling”.
[10.] TS 25.224 Physical layer procedures (TDD)
[11.] ICD-GPS-200: "Navstar GPS Space Segment/Navigation User Interface".
[12.] TS23.032 Universal Geographical Area Description (GAD)

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

3.2 Symbols

3.3 Abbreviations

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

AT	Absolute Time
CN	Core Network
CRNC	Controlling RNC
DRNC	Drift RNC
GPS	Global Positioning System
IPDL	Idle Periods in the DownLink
LCS	LoCation Services
LMU	Location Management Unit
OTDOA	Observed Time Difference of Arrival
RTD	Relative Time Difference
SFN	System Frame Number
SRNC	Serving RNC
TS	Time Slot
UARFCN	UTRA Absolute Radio Frequency Channel Number
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UP	UE Positioning
UTRAN	UMTS Terrestrial Radio Access Network

4 Overview of the OTDOA and network assisted GPS methods

Standard LCS methods OTDOA and network assisted GPS supported within UMTS are described in [2]. The acronym UP used in the reference [2] and this document always refers to UE Positioning.

5 Requirements

The following requirements have been identified:

- When Measurements (or an Information) are required by an entity from another and the reporting of the measurement (or the information) is event-triggered, a mechanism is needed to know whether the lack of update is due to the fact that the triggering event has not occurred or it is due to a Reset or a Failure of the entity providing it.

6 Study Areas

6.1 Architecture

Within the UTRAN SRNC, receives authenticated requests for UE positioning information from the CN across the Iu interface. RNCs then manage the UTRAN resources, including the Node-Bs , LMU, the UE and calculation functions, to estimate the location of the UE and return the result to the CN.

~~1.1.1~~6.1.1 RNC UP operations and functional description of RNC UP elements

Upon the request for UE positioning from the CN the RNC UP function shall;

- request measurements from the one or more cells in the Node Bs;
- perform the position calculation;
- perform any needed co-ordinate transformations; and
- send the results to CN.

In general RNC UP function consist of co-ordination, measurement and calculation functions. These function are divided between SRNC, CRNC and DRNC. RNC entities communicates with others trough the Iur interface and the messages used are part of RNSAP procedures.

SRNC have the following functions:

- receives authenticated requests for UE positioning information from the CN;
- positioning mode selection according the UE and other UTRAN element UP capabilities;
- information requests from other RNCs;
- storage of UP related data;
- assistance data formatting;
- transmission of UP assistance data to UE;
- position calculation (in UE assisted UP method); and
- return the UE positioning result to the CN.

The SRNC requests the information it requires from the CRNC. The CRNC in turn may request the information from it's associated Node Bs and return the response to the SRNC. Information that SRNC may request is;

- OTDOA radio interface timing measurements (RTD or AT);
- reference GPS data for A-GPS assistance data;
- AT for A-GPS timing assistance; and
- cell identity and coordinate information.

OTDOA radio interface measurements consists of measurements SFN-SFN observed time difference (RTD) and UTRAN GPS Timing of Cell Frames for LCS (AT) as specified in [5] and [6]. AT measurement for A-GPS timing assistance is the UTRAN GPS Timing of Cell Frames for LCS measurement as specified in [5] and [6]. The difference between AT measurement for OTDOA and AT measurement for A-GPS timing assistance measurement is that there is specified different accuracy classes A, B and C for the different position method purposes in [7] and [8].

The SRNC shall request the GPS data and AT measurement for A-GPS Timing assistance over the Iur from neighbouring RNS, if there is no reference GPS receiver located in the SRNC,

Upon the response to it's request SRNC stores the UP related data. The UP related data is formatted to the UP assistance data to be sent to the UE over DCCH. This formatting includes the AT information transformation to the RTD information for OTDOA and geographical coordinates of a cell transformation to relative positions. This information is transferred to UE as UP assistance data to support selected positioning method. In the UE assisted UP method where the UE position is calculated in the SRNC the position calculation function in the SRNC uses this information to calculate the UE position with determined accuracy.

Information in the SRNC's UP related database used for UP assistance data and additionally UE position calculation need to be up to date having the most current available measured values (RTD and AT) together with other information (geographical location of cells and reference GPS data) in order to guarantee needed UP result accuracy.

Upon the calculated UP result SRNC translate the UE position in geographical co-ordinates and report this result together with it's accuracy to CN via Iu.

CRNC functions:

CRNC provides following functionality as part of RNC UP function:

- request UP related measurements/data from it's associated cells in the Node B's;
- send the UP measurement results to SRNC;
- send cell identity and coordinate information to SRNC
- broadcast UP information; and
- resource management.

The measurements requested by CRNC depends on used positioning method and following measurements may be requested;

- OTDOA radio interface timing measurements (RTD or AT) performed by its Node Bs on their cells;
- reference GPS data for A-GPS assistance data from it's associated Node B's having reference GPS receiver; and
- AT for A-GPS timing assistance performed by its Node Bs having the reference GPS receiver, on their cells

OTDOA Radio interface timing information (RTD or AT) have a general status and are used both for OTDOA and A-GPS UP methods. Reference GPS data and AT for A-GPS timing may be used in conjunction with radio timing measurements to assist UE GPS receiver when network assisted GPS UP method is used.

If the CRNC is not the SRNC this measurement information is transferred over Iur as part of RNSAP procedures between RNC's.

Broadcast of UP information consist of assistance data to be broadcast in system information. This data includes OTDOA assistance data, DGPS data, GPS navigation data, GPS almanac, GPS ionospheric model and GPS UTC model.

Resource management function in CRNC is responsible for allocating, managing and controlling (e.g. IPDL mechanism) the UTRAN elements involved in the UP.

DRNC functions:

DRNC is the element having the active link to UE that shall be located. DRNC sends RTT(FDD) or RX timing deviation (TDD) measurements to the SRNC if requested by the SRNC. RTT or RX timing deviation measurements can be used in conjunction with radio interface timing measurements to minimize the uncertainty of UP result.

6.1.2 Node B

LMU is the entity that makes UP related measurements and communicates these measurements to the CRNC over Iub as a part of NBAP procedures. From Iub point of view LMU is an integral part of the Node B.
Functionality of the Node B element is to,

- make the OTDOA radio interface timing measurements (AT or RTD) ;
- provide reference GPS data for A-GPS data assistance from reference GPS receiver if it is located in the Node B;
- make the AT measurements for A-GPS timing assistance; and
- apply the IPDL parameters.

The Node B makes its OTDOA radio interface timing measurements in response to request, periodically or when there is significant changes in radio conditions. Measurements are requested and configured by the CRNC.
If there is reference GPS receiver available in the Node B it can receive GPS satellite system information and provide reference GPS data to the CRNC. In the addition the Node B having the reference GPS receiver can provide AT measurements for OTDOA method as well as for A-GPS Timing Assistance.
In the absence of GPS TOW the Node B performs RTD measurements , i.e. measures the time difference between arrival of SFNs.
The Node B applying IPDL ceases its transmission for short periods of time (idle periods). During an idle period of a cell in the Node B, terminals within the cell can measure other cells from other Node Bs and the hearability problem is reduced.

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 Round Trip Time measurements in UTRAN and Rx-Tx Time Difference measurements in the UE. These Round Trip Time 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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ and SFN-SFN are used, in order to make the text easier to read.
$T_{UTRAN-GPS}$ = 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 $T_{UTRAN-GPS}$ shall be reported to the SRNC. The quality of measured $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$will change in almost the same manner as time, $T_{UTRAN-GPS}$ drift rate with its quality shall be reported as well.
The usefulness of the non-zero time derivative (drift rate) of $T_{UTRAN-GPS}$ (even after compensating the effect of elapsed time) and SFN-SFN values is the unstability of Node B clocks. In the case ofSFN-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 $T_{UTRAN-GPS}$, 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 $T_{UTRAN-GPS}$ 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 GTD = OTDOA- 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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ 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.

~~1.1.1~~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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ measurement the minimun required accuracy class for $T_{UTRAN-GPS}$ measurement

Measurement type
In the measurement type info CRNC indicates whether it wants its cell to perform $T_{UTRAN-GPS}$ or SFN-SFN measurements.
If requested measurement type is $T_{UTRAN-GPS}$, 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 containing the primary CPICH that is used as a reference for SFN-SFN measurements is identified with its *C-Id* IE. In case of $T_{UTRAN-GPS}$ measurement *C-Id* IE identifies the cell where the $T_{UTRAN-GPS}$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 with the list of measured neighbouring TDD cells identified with *UARFCN* IE and *Cell Parameter Id* IE.

The maximum number for measured neighbouring cell in TDD mode of operation is FFS 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 $T_{UTRAN-GPS}$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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ 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.

1. In the first case above, the change of the $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ value after n measurements is calculated according to the following formula:

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

   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:

   $$F_{n,\,n-1} = M_n - M_{n,\,estimated} = M_n - (M_{n-1} + 10ms*((SFN_n - SFN_{n-1}) \bmod 4096))$$
   $$= (M_n - M_{n-1}) - 10 * ((SFN_n - SFN_{n-1}) \bmod 4096) \qquad (2)$$

   Where:

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

   $M_{n,\,estimated}$ is the estimated $T_{UTRAN-GPS}$ 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:

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

   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.

2. The second case above is based on the assumption that the drift rate (1^{st} 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 internaly 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 $T_{UTRAN-GPS}$ value

and drift rate are reported to the CRNC. The calculation of the predicted value and the deviation is according to the following:

$P_n = b$ for $n=0$

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

$F_n = \min(abs(M_n – P_n), abs(M_n – P_n – 37158912000000), abs(M_n – P_n + 37158912000000))$ for $n>0$

Where:

P_n is the predicted $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ measurement is [0.. 37158911999999]. Furthermore, these values implie that the specified threshold shall never exceed 18579456000000 (=37158912000000/2).

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

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

3. 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:

$F_n=0$ for $n=0$

$F_n = (M_n – a)) \bmod 40960$ 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 *mod 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 $1/16^{th}$ of chip).

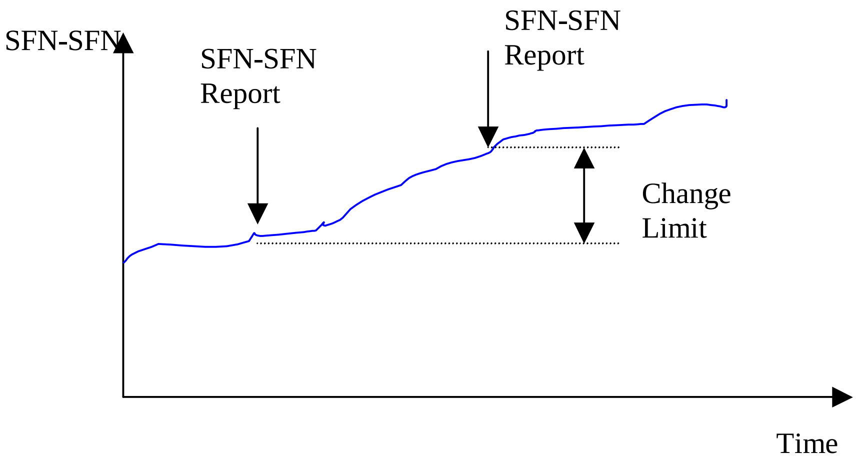

Figure 1: Change Limit based report criteria

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

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

$F_n = min(abs(M_n – P_n), abs(M_n – P_n – 40960), abs(M_n – P_n + 40960)) \quad for\ n>0$

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 $T_{UTRAN-GPS}$ measurement is between –1280 and +1280 chip with a granularity of $1/16^{th}$ 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 $T_{UTRAN-GPS}$ measurement is between –1280 and +1280 chip with a granularity of $1/16^{th}$ of chip. Furthermore, these values implie 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 Fn 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 $T_{UTRAN-GPS}$ 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.

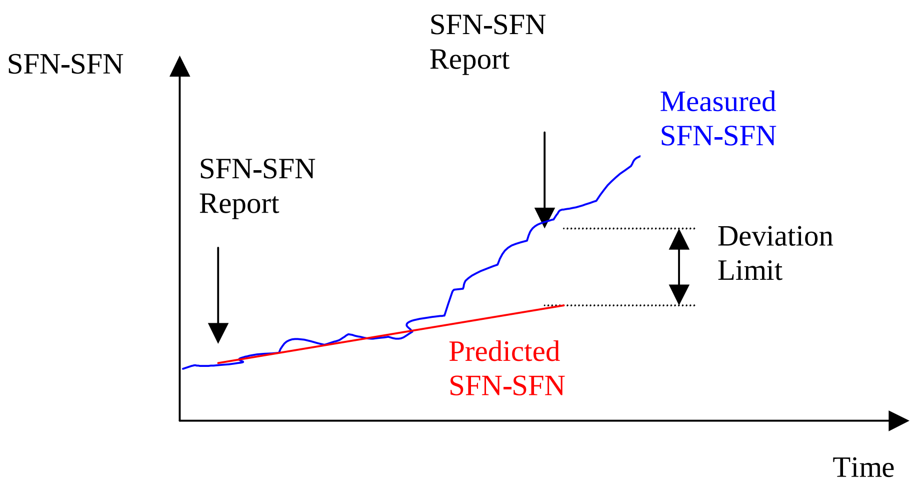

Figure 2: Deviation based Report Criter

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

For $T_{UTRAN-GPS}$, 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 $T_{UTRAN-GPS}$ measurement is required for OTDOA it shall be indicated in the report intialization 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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ or reference cell used for SFN-SFN measurement

- In case of $T_{UTRAN-GPS}$ measurement, $T_{UTRAN-GPS}$ of measured cell;
- In case of $T_{UTRAN-GPS}$ measurement, quality of reported $T_{UTRAN-GPS}$;
- In case of $T_{UTRAN-GPS}$ measurement, $T_{UTRAN-GPS}$ drift rate;
- In case of $T_{UTRAN-GPS}$ measurement, quality of reported $T_{UTRAN-GPS}$ drift rate;
- In case of $T_{UTRAN-GPS}$, achieved accuracy class of the $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ and SFN-SFN measurement SFN as a time when the measurement is reported by the layer 3 filter

Identity of measured cell for $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ measurement or the reference cell used for SFN-SFN measurements.

$T_{UTRAN-GPS}$ of measured cell

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

Quality of reported $T_{UTRAN-GPS}$

$T_{UTRAN-GPS}$ Quality is the quality of reported $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$.

$T_{UTRAN-GPS}$ Drift Rate

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

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

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

$T_{UTRAN-GPS}$ drift rate quality is the quality of reported $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ drift rate.

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

This field contains the achieved accuracy class for $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ 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 intialize the request $T_{UTRAN-GPS}$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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ 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 $T_{UTRAN-GPS}$ measurement is initialized without measurement minimum accuracy requirement or AT/SFN-SFN measurement are initialized without FN reporting required.

~~1.1.1~~6.2.2 Iur Interface

Since the measurements may be requested (by the SRNC) from a Node B whose CRNC is not the SRNC, then the Iur must allow to transmit requests for measurements to another RNC and measurement results from another RNC to the SRNC. As such there is a need for the functionality of Measurement on Common Resources in RNSAP (similar to the NBAP functionality). These 'Common Measurement Procedures' over Iur shall offer the same functionality as the procedures within Iub with regard to the OTDOA UE Positioning Method.

~~1.1.1~~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 $T_{UTRAN-GPS}$ 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 relay 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 cases it's transmission for short periods of time (idle periods). 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.
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, continuos mode and burst mode of operation. The parameters presented below defining the IPDL period (continuos 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 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.

~~1.1.1~~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.

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 x^{th} 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(xmod64)modMax_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.

~~1.1.1~~6.3.2 Iur Interface

IPDL parameters can be provided to the UE over DCCH. In soft handover, the UE may have several signal branches connected to different cells. The reference cell for UP may be selected based on one or more factors and principles. The chosen reference cell may be the cell that is under the DRNC thus not controlled by the SRNC. In this case the SRNC need to know the IPDL parameters of the reference cell for providing this information to UE over DCCH.
One possible solution for this is to introduce the new generic 'information exchange' procedure so that Information exchange initiation request is used by the SRNC to request the IPDL parameters of the UP reference cell (identified with C-Id) from the DRNC. In the information exchange response the DRNC shall provide the IPDL parameters mentioned in table 1 if IPDL are applied in the cell. If IPDL parameters are not applied in the cell logical information "IPDL not used" shall be reported..

6.4 Assisted GPS timing difference

The Absolute Time (AT) between UTRAN radio signals and GPS time needs to be known in order to give timing assistance to the UE.
AT is given by GPS TOW plus the SFN corresponding to that GPS time. This information is specified in [5] as $T_{UTRAN-GPS}$.
The GPS TOW can be provided with different accuracies. An accuracy of the order of µs or higher assumes the GPS receiver to be located at Node Bs and therefore it is necessary to support signalling of this information via the NBAP protocol.
More over, to fully support Assisted-GPS positioning in case of a SRNC-DRNS scenario, AT signalling shall be enabled over Iur via RNSAP at ms and µs level.
In order to enable the acquisition of this information it shall be possible to perform common measurements over Iub and Iur (in this latter case, new elementary procedures shall be introduced). Appropriate measurement reporting criteria shall be specified in a similar way to what is specified in [4], so that the timing assistance measurements can be performed on-demand, periodically or on a event-driven basis.

~~1.1.1~~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, Round Trip Time, which has to be corrected by UE Receiving Transmitting Time (UE RxTx, also specified in [5]), 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.

~~1.1.1~~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, Round Trip Time, which has to be corrected by UE Receiving Transmitting Time (UE RxTx, also specified in [5]), 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.

6.5 Assisted GPS assistance data from reference GPS receiver

To enable the A-GPS positioning-capable UE to receive GPS assistance data, this information has to be acquired either in the SRNC or from the DRNS. The GPS receiver can be located either at RNC or Node B site, given that it can provide valid information for a certain cell, for which the assistance data is requested.

The GPS Navigation Model, UTC Model, Ionospheric Model, Handover and Telemetry Words (for time recovery purposes), Real-Time Integrity, Differential GPS Corrections and Almanac are needed to fully support UE Positioning, in particular the A-GPS method.

The GPS Navigation Model, see [11], for further details, gives information about the satellites orbit models and clock corrections, that should be used to correct clock drifts and orbit uncertainties when calculating the location fix.

The UTC Model is useful to relate the drift of the GPS time from the UTC time.

The Ionospheric Model contains parameters helpful for corrections necessary due to ionospheric disturbances.

The Handover and Telemetry Words are provided to the UE for time recovery purposes.

Real-Time Integrity is provided as a mean to recognise faulty satellites, while the Almanac give long-term information concerning the orbit models and clock corrections.

Differential GPS corrections (see GPS DGPS Corrections in [4] and also [11]) are used to improve the location calculation accuracy by compensating for errors due to atmospheric disturbances and errors in the satellite ephemeris data and clocks. DGPS corrections has not the broad geographic validity of the basic assistance data and therefore there is a need to signal them. The RNC can provide valid DGPS data in a [200] km area around its local GPS receiver, but there is a need to transfer information between RNCs and even between NodeBs and RNCs if the NodeBs (with co-located GPS receivers) are far away.

The signalling of the above information shall be supported over Iub and Iur.

In order to fully support this kind of information provision within UTRAN, new procedures are needed over Iub and Iur.

6.6 Relocation

According to the assumption made by RAN3 Iu SWG, no positioning information has to be transferred from source to target RNC during SRNS Relocation: if the CN wants to perform the Location Reporting procedure after relocation, this procedure has to be re-initiated.

Under this assumption, no further work seems to be needed on this issue.

6.7 Protocol Impacts on Iur

~~1.1.1~~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 (RTT 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 RTT 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.

~~1.1.1~~6.7.2 Information Exchange impact description.

These procedures are necessary in order to enable an RNS to provide relevant assistance information to the SRNC in order to be used for position calculation or to be conveyed to the UE via the Uu interface.

The new set of elementary procedures can be a structure very similar to the one adopted for measurements over common resources and they realize a new function, which is called 'Information Exchange":

The possible structure of these elementary procedures is the following:

- Information Exchange Initiation;
- Information Report;
- Information Exchange Termination;
- Information Exchange Failure.

The Information Exchange procedures can enable the signalling of A-GPS-related data assistance and OTDOA-related data assistance and cover information exchanges relative to a cell, with the possibility for the object structure to be extended to new objects.

One or several different types of information can possibly be requested with one request message.

The criteria for reporting the requested information shall be flexible, therefore the information report characteristics could be set to 'On Demand', 'Periodic' and 'On Modification' (at message level). When the report characteristics is set to 'On Modification', the Node B/DRNC triggers a report when either there is an update (any update), or when the relevant data have changed from the previously reported value more than a certain threshold. The threshold based reporting can be configured by the CRNC/SRNC in the initiation request message. This kind of reporting applies for example to the DGPS Corrections.

The reporting procedure can be initiated by the RNC from which the assistance data were requested only for that specific information type which was updated in order to assure efficiency.

~~1.1.1~~6.7.3 Common Measurements impact description.

These procedures are necessary needed in order to fully support OTDOA and A-GPS positioning method by obtaining the radio interface timing information in the neighbouring RNS.

The new set of elementary procedures can be a structure very similar to the NBAP one.

The possible structure of these elementary procedures is the following:

- Common Measurement Initiation;
- Common Measurement Report;
- Common Measurement Termination;
- Common Measurement Failure.

~~1.1.1~~6.7.4 Insuring the validity of the transmitted Measurements and Information

In case of a partial failure in the RNC_2, this problem is dealt with the Common Measurement Failure procedure (or the Inter-RNC Information Exchange Failure). So the only real problem is the case of the Reset or Failure of the RNC_2, in this case the validity of the information in RNC_1 may be compromised:

- On-demand common measurements or information are not a problem in that they are one-shot procedures.
- Periodic common measurements are not a problem, since if there is no update as expected by the requesting entity a Local Error Handling procedure can be started.
- Event-triggered common measurements are a problem, since there actually is no way to know whether the lack of update (no COMMON MEASUREMENT REPORT message) is due to the fact that the triggering event has not occurred or if the context associated to the considered information has been deleted due to a Reset or a Restart of the concerned CRNC.
- On-modification information exchanges are a problem, since there actually is no way to know whether the lack of update (no INFORMATION REPORT message) is due to the fact that there is no modification of the information value or if the context associated to the considered information has been deleted due to a Reset or a Restart of the concerned CRNC.

The last two cases hints at the necessity of some mechanism insuring that the information is still valid, it means that RNC_1 must be informed if RNC_2 has been reset.

The solution proposed here is to adopt a mechanism similar to the one used on Iub for Common Measurements (use of SSCOP): a specific SCCP connection shall be used between RNCs for Common Measurements (and one for Information Exchange) between the RNCs. It is further proposed to have one SCCP connection for all of the Common Measurements required by RNC_1 from RNC_2 (and a different SCCP connection if Common Measurements are requested the other way around). The same solution is proposed for Inter-RNC Information Exchange

This SCCP connection shall be set up at the first Common Measurement Initiation procedure initiated by RNC_1.

This SCCP connection shall be released when the RNC_2 does not have to provide any Common Measurement to RNC_1 anymore. This means that all the Common Measurements that have been initiated by RNC_1 using the Common Measurement Initiation procedure with a *Report Characteristics* different from "On-Demand" have been terminated either by RNC_1 using the Common Measurement Termination procedure or by RNC_2 (due to e.g. a failure) and indicated to the RNC_1 using the Common Measurement Failure procedure. This can be achieved, for instance, by keeping a list of

the Measurement IDs for the Common Measurements RNC_2 must provide to RNC_1, when this list is empty the SCCP connection is released.
The same is applicable to the Inter-RNC Information Exchange procedures.

6.8 Protocol Impacts over Iub.

It can be said that for Iub there is the same impact described with regards to Iur in the previous subclauses concerning the procedures and the functionality. There is thus the need for information exchange procedures to convey assistance data and new common measurements types to support timing assistance.
It must be noted that no new procedures are needed for the measurements as Common Measurements are already present over Iub.
It must also be noted that, specifically for Iub, there is no need for signalling of IPDL parameters.
Last, it must also be noted that the Common Measurements and Information Exchange NBAP procedures shall use the Node B Control Port.

7 Agreements and associated contributions

7.1 Architecture

It is agreed to map the UTRAN UP functions to UTRAN elements SRNC, CRNC, DRNC and Node B as described in the chapter 6.1. It is also agreed that the information described in chapter 6.1 is needed to be conveyed between CRNC and Node B over the Iub as the part of NBAP procedures and between the CRNC/DRNC and SRNC as part of RNSAP procedures.

7.2 OTDOA Radio Interface Timing

For OTDOA Radio Interface timing following agreements have been made:

- OTDOA Radio Interface Timing measurements SFN-SFN and $T_{UTRAN-GPS}$ need to be introduced as new measurements to the existing measurements on Common Resources functionality in NBAP and new on Common Resources functionality in RNSAP with high similarity to NBAP.
- General names used for radio interface measurements SFN-SFN and $T_{UTRAN-GPS}$ shall have the following meaning:
    - $T_{UTRAN-GPS}$ measurement is the UTRAN GPS Timing of Cell Frames for LCS as specified in [5] and [6]
    - SFN-SFN measurement is the UTRAN SFN-SFN Observed Time difference as to be specified in [5] and [6]. Working assumption is that the SFN-SFN Observed Time difference is defined as in LS-R1-(01)-0147.
    - Working assumption is that the SFN-SFN Observed Time Difference values are between – 20980 and +20979. It needs to be confirmed by RAN4 specification.
- Common Measurement Initiation (REQUEST message) for radio interface timing measurements (Common Measurement Initiation) shall incorporate the information described in chapter 6.2.1 i.e.:
    - Information about neighbouring cells to be measured for SFN-SFN measurements
    - New Report Characteristics 'On Modifications' including
        - $T_{UTRAN-GPS}$ Change Limit
        - Predicted $T_{UTRAN-GPS}$ Deviation Limit
        - SFN-SFN Change Limit
        - Predicted SFN-SFN Deviation Limit
    - Minimum required accuracy class for $T_{UTRAN-GPS}$ measurement according to mapping in [7] and [8]. For OTDOA method the minimum accuracy class C shall be used
- Common Measurement report for radio interface timing measurements (Common Measurement successful case and Common Measurement Reporting) shall be incorporate the information described in chapter 6.2.i .e.:
    - $T_{UTRAN-GPS}$ measurement
        - $T_{UTRAN-GPS}$ of measured cell according to mapping in [7] and [8]
        - Quality of reported $T_{UTRAN-GPS}$
        - $T_{UTRAN-GPS}$ Drift Rate
        - Quality of reported $T_{UTRAN-GPS}$ Drift Rate
        - Accuracy class of $T_{UTRAN-GPS}$ measurement according to mapping in [7] and [8]. This shall be present in the RESPONSE message only. Class C is the minimum requirement for OTDOA method
        - SFN as a time stamp when the measurement was made
        - UC-Id as Identity of measured neighbour cells
    - SFN-SFN Observed Time Difference measurements:
        - SFN-SFN between reference cell and measured neighbouring cell according to the Working Assumption above.
        - Quality of reported SFN-SFN

    - SFN-SFN Drift Rate
    - Quality of reported SFN-SFN drift rate
    - Reference cell SFN + Timeslot of Reference cell as a timestamp of the SFN-SFN measurements
- Determining of drift rates and quality figures are seen as a implementation issues. These figures can be set to fixed values (especially if for instance the accuracy of the SFN-SFN Observed Time Difference UTRAN measurement is specified by RAN4) or determined by some advanced method.
- SFN-SFN measurements from the neighbouring cells are grouped in case of on-demand periodic measurements
- If the report criteria is event trigger based (SFN-SFN measurement) only the particular neighbouring cell measurement that triggers the event is reported
- Common Measurement Failure and Common Measurement Initiation unsuccessful case shall be modified to include the information as described in chapter 6.2.2 for unsuccessful cases.
- It has also been agreed to use the new set of Information Exchange Procedure (see 7.7 for details) to transmit the geographical coordinates of the Node B antenna transmitting on a cell (UTRAN Access Point Coordinates) to an RNC that does not control this Node B.

7.3 OTDOA Idle Periods

For OTDOA Radio Interface timing following agreements have been made:

- IPDL is applicable both for TDD and FDD mode of operation. But the necessary parameters are different for the different DD modes.
- Cell Setup procedure in NBPAP shall be used to configure IPDL parameters defining IPDL and optionally activate the IPDL.
- Cell Reconfigure procedure shall be used to activate IPDL either by the the IPDL parameters provided in the Cell Setup Procedure or the Cell Reconfigure procedure defining IPDL or to deactivate ongoing IPDL.
- IPDL is activated according the IPDL parameters last provided
- IPDL parameters as described in [3] excluding the parameter IP_Offset defines the IPDL to be applied in the cell.
- It is not allowed to reconfigure IPDL parameters defining IPDL if there is active IPDL ongoing in the cell
- Applying the IPDL is not the core function
- New Information exchange procedure in RNSAP is used to request and report the IPDL parameters as described in [3] when the reference cell for UP is controlled by the RNC that is not the SRNC

7.4 Assisted GPS timing difference

For Assisted GPS timing difference the following agreements have been made:

- $T_{UTRAN-GPS}$ measurement for A-GPS timing assistance is the same measurement than the $T_{UTRAN-GPS}$ measurement for OTDOA with the difference of required minimum accuracy class. For A-GPS timing assistance minimum accuracy classes A and B as specified in [7] and [8] are applicable.

7.5 Assisted GPS assistance data from reference GPS receiver

It was agreed to adopt a new set of Information Exchange elementary procedures to convey data assistance on both Iub and Iur. For details about these procedures, refer to the actual change requests.
It was agreed that these new procedures shall support the signalling of:

- DGPS Corrections (applicable to both Iub and Iur);
- GPS Navigation Model and Time Recovery -Handover Word and Telemetry Word are included here (applicable to both Iub and Iur);
- UTC Model (applicable to both Iub and Iur);
- Ionospheric Model (applicable to both Iub and Iur);
- Almanac (applicable to both Iub and Iur);
- Real-Time Integrity (applicable to both Iub and Iur);
- GPS Receiver Geographical Position (applicable to both Iub and Iur);

It was furthermore agreed that no assistance data-related signalling is needed over Iur during SRNS Relocation, given the current TSG RAN3 Iu SWG assumption that any information regarding ongoing location reporting is lost during relocation.

7.6 Relocation

It was agreed that no actions are required for this area, since no positioning information has to be transferred from source to target RNC during SRNS Relocation: if the CN wants to perform the Location Reporting procedure after relocation, this procedure has to be re-initiated.

7.7 Protocol Impacts on Iur

For Protocol Impacts on Iur following agreements have been made:

- Following two new procedures for RNSAP are needed
- Information Exchange procedure
- Common Measurements procedure

Agreements on Information Exchange procedure

- Information Exchange procedure is used between requesting RNC_1 and target RNC_2 where the information is requested
- Information Exchange procedure is used to exchange the following information
  - Cell Position information,
  - UP IPDL Parameters,
  - A-GPS Information
- Information Exchange procedure includes following Eps:
  - Information Exchange Initiation,
  - Information Exchange Reporting,
  - Information Exchange Termination,
  - Information Exchange Failure.
- Information Exchange procedure can be initiated on-demand, periodic or on-modification

Agreements on Common Measurement procedure

- Common Measurement procedure is used between requesting RNC_1 and target RNC_2 where the measurement(s) are requested
- Common Measurement procedure includes the following EPs:
  - Common Measurement Initiation,
  - Common Measurement Reporting,
  - Common Measurement Termination, and
  - Common Measurement Failure.

  with high similarity to corresponding NBAP procedure
- Common Measurement procedure is used to pass and request $T_{UTRAN-GPS}$ and $T_{UTRAN-GPS}$ measurements and possible some other measurements defined in [5] and [6],

Agreements regarding both new procedures

Connection oriented signaling shall be used for these new procedures.
Furthermore, it was agreed to use the same SCCP connection for the purpose of common measurements and information provision.

Finally, it was agreed that there shall be one SCCP connection between the requesting RNC and the RNC from which measurements or information have been requested. So there can be two SCCP connections between two different RNCs (RNC1 and RNC2) for the purpose of common measurements and information provision: one for the common measurements and/or information requested by RNC1 from RNC2 and one for the common measurements and/or information requested by RNC2 from RNC1.

7.8 Protocol Impacts on Iub

For Protocol Impacts on Iub following agreements have been made:

- One new set of procedures for NBAP called 'Information Exchange' are needed

- Information Exchange procedures are used to exchange the A-GPS information if reference GPS received is located in the Node B
- Information Exchange procedures include following EPs:
  - Information Exchange Initiation,
  - Information Exchange Reporting,
  - Information Exchange Termination,
  - Information Exchange Failure.
- Information Exchange procedure can be initiated on-demand, periodic or on-modification

8 Specification Impact and associated Change Requests

The following Technical Specifications are affected by the above described decisions:

- *TS 25.433* UTRAN Iub Interface NBAP Signalling
  - CR 374 'Introduction of Information Exchange procedures over Iub';
  - CR 372 Introduction of the UTRAN-GPS and SFN-SFN timing measurement in NBAP;
  - CR 381 Introduction of the network configurable idle periods for OTDOA UE Positioning function
- *TS 25.423* UTRAN Iur Interface RNSAP Signalling
  - CR 328 'Introduction of Information Exchange procedures in RNSAP';
  - CR 327 Introduction of the Common Measurement Procedures in RNSAP
- *TS 25.420* UTRAN Iur Interface General Aspects and Principles
  - CR 14 Introduction of SCCP Handling for Common Measurements and Information Exchange on Iur

8.1 New Specifications

For the completion of this WI, there is no need for new specifications. The Work Item can be completed within the scope of the current specifications as stated above.

9 Project Plan

9.1 Schedule

Date	Meeting	Scope	[expected] Input	[expected]Output

9.2 Work Task Status

	Planned Date	Milestone	Status
1.			
2.			

10 History

Document history		
V. 0.0.1	2000-10	First proposal.
V. 0.0.2	2000-11	Second proposal. – Title corrected to cover TDD also. – TR restructured and study areas identified according to comments from RAN WG3#16 meeting. – TR number allocated
V.0.1.0	2000-11	Version agreed at RAN3#17.
V.0.1.1	2001-01	Text agreed in RAN3#17 added for study areas Architecture and Radio interface timing.
V.0.2.0	2001-01	Version agreed at RAN3#18.
V.0.2.1	2001-01	Updated according agreed text proposals during RAN3#18 - R3-010097, R3-010098, R3-010099, R3-010042, R3-010110
V.0.3.0	2001-02	Version agreed at RAN3#19.
V.0.3.1	2001-02	Updated according agreed text proposals during RAN3#18 - R3-010544, R3-010844 and R3-010545 and various agreements received during the RAN3#19 meeting
V.2.0.0	2001-03	Version agreed at RAN3#19.
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