TSG-RAN Working Group 1 & 4 meeting #11
San Diego, USA
February 29 – March 3, 2000

TSGR1#11(00)0387

Agenda item: Joint RAN1 & RAN4 Ad Hoc

Source: Nokia

Title: Discussion on Location Services parameters in UE Capability

Document for: Discussion

---

1 Introduction

This document is based on tdoc R1-00-0256 that proposed the addition of several entries to the list of UE capabilities in TR 25.926. However recent events have meant that several changes are required and a joint discussion between RAN1 and RAN4 is needed before it is possible for RAN 1 to make any recommendations on the content of the UE capabilities.

Tdoc R1-00-0256 was presented to in RAN2 29/2/00 in Turin and several comments were made these are also discussed in this contribution.

2 The original proposal

In summary 'tdoc R1-00-0256' proposed the following:

- 'SFN-SFN Observed time difference – type 2' measurement be mandatory in all UE
- 'UE Rx-Tx time difference' measurement also be mandatory in all UE
- All other location measurements defined in 25.215 would be option and as such would form part of the list of UE capabilities.
- It was proposed to add the following to this list:

	UE radio access capability parameter	**Value range**
LCS related parameters	Standalone location method(s) supported	Yes/No
	Assisted GPS support	Network based / UE based / No
	GPS reference time capable	Yes/No
	Support for IPDL	Yes/No

A description of these parameters was also proposed, this is repeated here for completeness:

Standalone location method(s) supported

Defines if a UE can measure its location by some means unrelated to UTRAN (e.g. if the UE has access to a standalone GPS receiver)

Assisted GPS support

Defines if a UE supports either of the two types of assisted GPS schemes, namely "Network based" and "UE based", or not.

GPS reference time capable

Defines if a UE has the capability to measure GPS reference time as defined in 25.215.

Support for IPDL

Defines if a UE has the capability to use IPDL to enhance its "SFN-SFN observed time difference –type 2" measurement.

3 Changes arising from RAN4 issues

3.1 Proposed new accuracy requirements

In contributions R1-(00)-0234 and R4-(00)-0136 Lucent Technologies propose that the resolution and accuracy of some physical layer measurements be increased. The accuracy requirements need to be evaluated first and then the resolution needs to be defined in accordance with this. So concentrating on the accuracy requirements the status is as summarised below:

Quantity	Current Accuracy	Proposed new Accuracy
SFN-SFN observed time difference – type 2	+/- 0.5 chips	+/- 0.125 chips
UE Rx-Tx time difference	+/- 1.5 chips	+/- 0.125 chips
UE GPS timing of Cell Frames for LCS	Not defined (resolution is 1uS)	+/- 0.125 chips
Round Trip Time	+/- 0.5 chips	+/- 0.125 chips
UTRAN GPS Timing of Cell Frames for LCS	Not defined (resolution is 1uS)	+/- 0.125 chips

3.2 General comments on how to determine accuracy requirements

It's very easy to say that the higher we make the accuracy the better the achieved location result. This is of course true, but as with everything these benefits needs to be quantified and compared to the extra implementation complexity arising from the increased accuracy.

Unfortunately there have been no results quantifying the benefit of increased accuracy. However in many environments the location accuracy is not determined by how accurately a UE could measure the 1st multipath, but is dominated by the inability of the UE to observe the line-of-sight path due to various obstructions. In view of this it is important to accept that if we continuously increase the accuracy requirements we eventually reach a point of diminishing returns, beyond which there is very little benefit to be had, but the costs can be high.

3.3 Complexity issues

3.3.1 SFN-SFN observed time difference – type 2

If one considers the case of intrafrequency measurements without the use of IPDL first, then it is clear that all the signals to be measured will be distorted (delays etc.) in the same way by the analogue components of the receiver. Given that we are concerned in the relative time difference of these, then variation of the analogue parts of the receiver don't effect this measurement.

The errors in this measurement are wholly due to the baseband processing, i.e. the sampling rate and algorithms etc. The best case is that all the cells to be measured are part of the current active set, in this case it might be reasonable to expect that a UE could report this measurement to an resolution of a typical sampling rate, e.g. 0.25 chips. (Note: that the overall error contains contributions from the measurements on both cells).

So after consideration of the best case it makes sense not to have a resolution any finer than 0.25chips.

As for the accuracy specification it would have to be written with not such an idealised 'best case' scenario in mind and would of course lead to a value that is more lax than the resolution, i.e. 0.5chips as is currently defined.

3.3.2 UE Rx-Tx time difference

The errors in this measurement can be considered to arise from two sources, the error in measurement of the downlink timing, and the delay variations in both the receiver and transmitter analogue components. The first source of error (from the arguments already given) limits the resolution to be no better than 0.25chips.

It is difficult to estimate the magnitude of the errors arising from the variation in delays of the Rx and Tx analogue components, but (as far as I know) there are no other restrictions on these delays. It would be very restrictive to have the UE's RF implementation decided by this location requirement.

In the absence of any input on this it would be unwise to set a stringent accuracy requirement and so I would propose to leave this requirement as it was at 1.5chips, in square brackets.

3.3.3 RTT

Subject to the same errors as UE Rx-Tx time difference above

3.3.4 GPS measurements

Errors in these measurements compose of two parts, the error in measurement of the UTRAN timing and the error in measuring the GPS signal itself. Again the estimation of the UTRAN timing will be subject to the same errors discussed above, so 0.25chips would be a suitable resolution for this part. However measurement of the GPS timing is beyond the scope of WG1 or WG4 work and so is now very difficult to define. I don't have a solution to this, one thing is clear that the proposal of 0.125 chips is not acceptable.

3.4 A requirement is meaningless without a test procedure

It is very difficult to estimate the impact on design of an accuracy requirement without a detailed description of the test procedure (measurement channels, signal levels, multipath profiles, presence of IPDL etc). These need to be specified at the same time as the accuracy requirement.

4 Consequences of increased accuracy

In the original contribution tdoc-(00)-0256 it was proposed that the 'UE Rx-Tx' and 'SFN-SFN time difference type 2' measurements be mandatory in the UE. If the accuracy requirements of these are to be tightened then it would be sensible to make these measurements optional in the UE, otherwise the UE design would be driven by these location services (even if the UE never plans to use LCS). THIS IS THE ISSUE THAT THE JOINT RAN1 & RAN4 MEETING MUST RESOLVE.

This would be a case of 'shooting ourselves in the foot', in an attempt to make the measurements better we would actually reduce the population of terminals supporting the measurements, making the widespread uptake of location services more difficult.

5 Comments from RAN2

The following comments from RAN2 were made:

5.1 Why report IPDL support?

It appears that RAN2 are under the impression that supporting IPDL is not a big issue for the UE and should be mandatory, thus not reported in the UE capabilities.

- To support IPDL the UE needs to have dedicated hardware and software to do the following functions:
- Gather wideband data during the idle periods, which requires control logic and a RAM buffer.
- Perform all necessary off-line correlations on this stored data before the next idle period.
- Perform the combining of the correlations results from many idle periods.

- Depending on receiver properties it may be necessary to adjust the AGC quickly during the idle periods to compensate for the sudden drop in wideband power.

For these reasons it is proposed here that support for IPDL is considered optional in the UE as per the original proposal.

5.2 Assisted GPS support

Here there were two comments:

- Change name to Network Assisted GPS support.
- In the list of possible values, the option for both UE based and Network based should be added.

Both these changes can be made easily.

5.3 OTDOA

The original proposal didn't mention OTDOA, it just considered the L1 measurement 'SFN-SFN observed time difference – type 2' upon which both network based and UE based OTDOA rely on. However in hindsight this was a very L1 driven parameter and it would be better to refer to OTDOA instead.

It is now proposed that that the following UE capability be added:

OTDOA support

Defines if a UE supports either or both of the two types of OTDOA schemes, namely "UE assisted" and "UE based"

LCS related parameters	OTDOA support	UE assisted / UE based / Both / No

5.4 Summary of RAN2 comments

To take into account comments from RAN2 the entries to be added to the List of UE capabilities should be modified as follows:

	UE radio access capability parameter	**Value range**
LCS related parameters	Standalone location method(s) supported	Yes/No
	Network assisted GPS support	Network based / UE based / Both / No
	GPS reference time capable	Yes/No
	Support for IPDL	Yes/No
	OTDOA support	UE assisted / UE based / Both / No

6 Summary of document

If the accuracy of the LCS measurements remain unchanged then the above table (section 5.4) is proposed to be included in the UE capabilities. If however the accuracy requirements were increased then the following table would be proposed.

	UE radio access capability parameter	**Value range**
LCS related parameters	Standalone location method(s) supported	Yes/No
	Network assisted GPS support	Network based / UE based / Both / No
	GPS reference time capable	Yes/No
	Support for IPDL	Yes/No
	OTDOA support	UE assisted / UE based / Both / No
	UE Rx-Tx time difference supported	Yes/No