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Mobility Events Management in SPIRITS

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Abstract

This document describes the management of the mobility events considered in SPIRITS protocol and the definition of their related parameters.

The mobility events management will allow a SPIRITS server to subscribe to and to be notified of location changes of a mobile user. The events would only be applicable to mobile users reachable through a CS network. The sending of these events must be allowed by setting the related marks in the HLR. Besides, the SPIRITS protocol must be able to translate the CAMEL operations involving mobility information into events that can be transferred to the SPIRITS client.

Table of contents

1. INTRODUCTION

The mobility events management will allow a SPIRITS server to subscribe to and to be notified of location changes of a mobile user. The events would only be applicable to mobile users reachable through a CS network. The sending of these events must be allowed by setting the related marks in the HLR. Besides, the SPIRITS protocol must be able to translate the CAMEL operations involving mobility information into events that can be transferred to the SPIRITS client.

The inclusion of mobility events into SPIRITS protocol provides user location information and allows the smart use of mobile phones in services like Internet Call Waiting.

2. LIST OF MOBILITY EVENTS

The events considered in this document are:

- Location Update in the same VLR service area
- Location Update in another VLR service area
- IMSI attach
- MS initiated IMSI detach
- Network initiated IMSI detach

Every time a mobility event occurs, the subscribed SPIRITS servers will be notified about it, and they will receive the following information elements:

- Service Key. This IE indicates the service logic that the gsmSCF will apply.
- Event type. This IE indicates the type of Mobility Management that lead to the notification.
- Address. This IE identifies the mobile subscriber to whom the Mobility Event applies.
- Location information. This IE indicates the current location of the MS.

The first three parameters will be mandatory, and the last one will be optional, depending on the network capabilities.

3. LOCATION INFORMATION DESCRIPTION

The Location information provided to the SPIRITS client would be very different depending on the mobile network capabilities, as not all the networks are able to supply detailed location information about its users. Therefore all the possible information elements considered into the location information must be marked as optional, and each network will try to make available as much information as possible.

The compound information element Location information consists of the following subordinate information elements, all of them optional:

- Location number

This parameter is used to convey the geographical area address for mobility services. It is used when the calling Party Number does not contain any information about the geographical location of the calling party (for example, origin dependent routing when the calling party is a mobile subscriber). It can be present if the wireless network VLR can derive it from the stored service area identity (for UMTS) or cell global identity (for GSM) or location area identity; otherwise shall be absent. The mapping from service area identity or cell ID and location area to location number is network-specific, and the format is left open to final implementations. For a definition of this information element, see [1].

- Cell Id or Location Area ID

Location area identity or Cell global identity of the cell in which the mobile user is currently in radio contact or in which the mobile user was last in radio contact. Will be present if the mobile user uses radio access and the subscriber record is marked as confirmed by radio contact; otherwise shall be absent.

- Geographical information
Will be present if the VLR can derive it from the stored cell global identity or location area identity; otherwise shall be absent (for a definition of this information element, see 3G TS 23.032).

- Geodetic information
Can be present if the VLR can derive it from the stored cell global identity or location area identity; otherwise shall be absent. (This information element corresponds to the Calling Geodetic Location defined in ITU-T Q.763).

- Age of location information
This parameter represents the elapsed time in minutes since the last network contact with the mobile user (i.e. the actuality of the location information). Will be present if available in the MSC/VLR; otherwise shall be absent.

- Selected LSA Identity
The IE shall only be sent, if SoLSA is supported. It indicates the LSA identity associated with the current position of the mobile user. Will be Sent if the LSA ID of subscription and LSA ID of the used cell matches. In the case of multiple matches the one with the highest priority is sent. See 3G TS 23.073.

3.1 CODING OF LOCATION INFORMATION ELEMENTS

3.1.1 Geographical Information

The GeographicalInformation parameter refers to Geographical Information defined in GSM 03.32 Version 5.0.0. Only the description of an ellipsoid point with uncertainty circle as specified in GSM 03.32 is allowed to be used.

The GeographicalInformation parameter contains the following sub-parameters:

- TypeofShape
Type of shape can only have the value of an ellipsoid point with uncertainty circle.

- LAT is the latitude expressed in degrees, and includes its related sign (expressed as either North or South).

- LON is the longitude expressed in degrees, and includes its related sign (expressed as either East or West).

- UncertaintyCode: K (exponent), defines the numerical representation of the radius R expressed in meters, where:

$$R = 10((1.1)^{K} - 1) \quad 0 <= K <= 127$$

3.1.2 Age Of Location Information

Usually coded as an integer (0..32767). The value represents the elapsed time in minutes since the last network contact of the mobile station.
Some implementations define two special values:
- value "0" indicates that the MS is currently in contact with the network
- value "32767" indicates that the location information is at least 32767 minutes old

3.1.3 CellId Or LAI

It is usually coded as a string. The Cell Global Identification is defined in TS GSM 03.03. The internal structure is not described here (Octets are coded according to TS GSM 04.08).

3.1.4 location Number

It is usually coded as a string (length : 2 - 10 octets). The internal structure is not described here.

3.1.5 Geodetic Information

Information that indicates the geodetic location of the user. This information element is defined in ITU-T Q.763. It consists of the following sub-parameters:

- Screening Indicator
Information sent in either direction to indicate whether the address/location information was provided by the user or network.

- TypeofShape
Described above.

- LAT & LON
Described above.

- Confidence

The confidence by which the position of a target entity is known to

be within the shape description, (expressed as a percentage) is

directly mapped from the 7 bit binary number K, except for K=0 which is used to indicate æno informationÆ, and 100 < K <= 128 which should not be used but may be interpreted as "no information" if no received.

4. WIRELESS-SPECIFIC SECURITY CONSIDERATIONS ON MOBILITY MANAGEMENT

The inclusion of mobility events management in SPIRITS protocol allows locating a mobile user and using this information into new services which can provide several advantages for IP users. But this feature can become also a security problem if a mobile user's location information is provided to non-authenticated applications or users. The location information must be treated with maximum care, and it must be guaranteed that no external parties will be able to get it in any way.

For example, if an enterprise has a set of mobile users and an application over SPIRITS, which periodically provides their location information, there must be a way to authenticate the subscribing IP users (enterprise), in order to provide the information only to the right ones. On the other hand, the enterprise (SPIRITS server) will only be able to access to the information related to their own phones, and not to any other one that is not included into a related list of accessible phones.

It is better to consider authentication and securing as matters to be implemented in the final applications. The security requirements must ensure that an IP user will not be allowed to subscribe to any notifications on mobile phones that are out of its control. This can be carried out by managing access control lists, whose definition is out the scope of this document.

Another difficulty appears in case of connections from users that employ non-fixed IP addresses (i.e. GPRS connections from a mobile user), because those IP addresses couldn't be checked against a list of profiles. A possible alternative could be the inclusion of secret key-codes into every subscription request. These key-codes would be checked by the SPIRITS application before enabling notifications of mobility events about a certain mobile phone. This case is not included into this document, and it would imply adding a new parameter (access-code) into the "Subscribe XML DTD". This point is left open for future discussing.

5. XML DTDS FOR MOBILITY EVENTS

This section presents XML DTDs for managing the mobility events and their related parameters.

5.1 XML DTDS FOR NOTIFY

The next lines comprehend the DTD's for notifying a mobility event. The Event_met parameter can be considered as a subset of the complete events list.

```
<!--
# Author: Daniel Moreno
# Version: 1
# Organization: VODAFONE Spain
# Date: 7/24/2002
-->

<!--
**********************************************************************
ELEMENT: MM_event_notify
COMMENT: root element that contains all the necessary parameters
**********************************************************************
-->
<!ELEMENT MM_event_notify ( ServiceKey, Event_met , ADDRESS ,
LocationInformation?)  >

<!--
**********************************************************************
ELEMENT: ServiceKey
COMMENT: allows the SPIRITS Server to choose the appropriate service
logic. Integer (0..2^31-1)
**********************************************************************
-->
<!ELEMENT ServiceKey (#PCDATA) >

<!--
**********************************************************************
ELEMENT: LocationInformation
COMMENT: contains all the location parameters
**********************************************************************
-->
<!ELEMENT LocationInformation (LocationNumber?, CellIdOrLAI?,
```

```
GeographicalInformation?, GeodeticInformation?,
AgeOfLocationInformation?,
LSAIdentity?)  >


<!--
**********************************************************************
ELEMENT: LSAIdentity
COMMENT: content undefined
**********************************************************************
-->
<!ELEMENT LSAIdentity  (#PCDATA)  >


<!--
**********************************************************************
ELEMENT: AgeOfLocationInformation
COMMENT: USUALLY INTEGER (0..32767). Measured in minutes
**********************************************************************
-->
<!ELEMENT AgeOfLocationInformation  (#PCDATA)  >


<!--
**********************************************************************
ELEMENT: GeodeticInformation
COMMENT: This information element corresponds to the Calling
Geodetic Location defined in ITU-T Q.763
**********************************************************************
-->
<!ELEMENT GeodeticInformation  (ScreeningInd, TypeOfShape, LAT, LON,
Confidence) >


<!--
**********************************************************************
ELEMENT: GeographicalInformation
COMMENT: For a definition of this information element, see 3G TS
23.032
**********************************************************************
-->
<!ELEMENT GeographicalInformation  (TypeOfShape, LAT, LON,
UncertaintyCode)  >


<!--
**********************************************************************
ELEMENT: ScreeningInd
COMMENT: defined values (0..3)
```

```
*********************************************************************
-->
<!ELEMENT ScreeningInd (#PCDATA)  >


<!--
*********************************************************************
ELEMENT: Confidence
*********************************************************************
-->
<!ELEMENT Confidence (#PCDATA)  >


<!--
*********************************************************************
ELEMENT: UncertaintyCode
COMMENT: values (0..127)
*********************************************************************
-->
<!ELEMENT UncertaintyCode  (#PCDATA)  >


<!--
*********************************************************************
ELEMENT: LON
COMMENT: value and sign
*********************************************************************
-->
<!ELEMENT LON  (signLON, valLON) >


<!--
*********************************************************************
ELEMENT: valLON
COMMENT: In degrees
*********************************************************************
-->
<!ELEMENT valLON  (#PCDATA)  >


<!--
*********************************************************************
ELEMENT: signLON
COMMENT:
*********************************************************************
-->
<!ELEMENT signLON ( East | West )  >
```

```
<!--
**********************************************************************
ELEMENT: signLAT
COMMENT:
**********************************************************************
-->
<!ELEMENT signLAT (North|South)  >


<!--
**********************************************************************
ELEMENT: LAT
COMMENT: value and sign
**********************************************************************
-->
<!ELEMENT LAT  (signLAT , valLAT )  >


<!--
**********************************************************************
ELEMENT: valLAT
COMMENT: In degrees (0..90)
**********************************************************************
-->
<!ELEMENT valLAT  (#PCDATA)  >


<!--
**********************************************************************
ELEMENT: South
COMMENT:
**********************************************************************
-->
<!ELEMENT South EMPTY >
<!ATTLIST South South CDATA #FIXED "1" >


<!--
**********************************************************************
ELEMENT: North
COMMENT:
**********************************************************************
-->
<!ELEMENT North  EMPTY  >
<!ATTLIST North North CDATA  #FIXED "0" >


<!--
**********************************************************************
```

```
ELEMENT: West
COMMENT:
*********************************************************************
-->
<!ELEMENT West  EMPTY  >
<!ATTLIST West West CDATA  #FIXED "1" >


<!--
*********************************************************************
ELEMENT: East
COMMENT:
*********************************************************************
-->
<!ELEMENT East  EMPTY  >
<!ATTLIST East East CDATA  #FIXED "0" >


<!--
*********************************************************************
ELEMENT: TypeOfShape
COMMENT: 1 integer
*********************************************************************
-->
<!ELEMENT TypeOfShape  (#PCDATA) >


<!--
*********************************************************************
ELEMENT: CellIdOrLAI
COMMENT:
*********************************************************************
-->
<!ELEMENT CellIdOrLAI  (#PCDATA)>


<!--
*********************************************************************
ELEMENT: LocationNumber
COMMENT: length: 2-10 octets. Content will be passed unchanged. For
a definition of this information element, see ITU-T  Q.763
*********************************************************************
-->
<!ELEMENT LocationNumber ( #PCDATA )  >


<!--
*********************************************************************
ELEMENT: Event_met
```

```
COMMENT: Event type from list of possible values
*********************************************************************
-->
<!ELEMENT Event_met (LUS | LUA | IA | MSID | NID)  >


<!--
*********************************************************************
ELEMENT: NID
COMMENT: Network initiated IMSI detach (implicit detach)
*********************************************************************
-->
<!ELEMENT NID  EMPTY  >


<!--
*********************************************************************
ELEMENT: MSID
COMMENT: MS initiated IMSI detach (explicit detach)
*********************************************************************
-->
<!ELEMENT MSID  EMPTY  >


<!--
*********************************************************************
ELEMENT: IA
COMMENT: IMSI attach
*********************************************************************
-->
<!ELEMENT IA  EMPTY  >


<!--
*********************************************************************
ELEMENT: LUA
COMMENT: Location update to another VLR service area
*********************************************************************
-->
<!ELEMENT LUA  EMPTY  >


<!--
*********************************************************************
ELEMENT: LUS
COMMENT: Location update in the same VLR service area
*********************************************************************
-->
<!ELEMENT LUS  EMPTY  >
```

```
<!-- ADDRESS element is imported here from SPIRITS_ADR.DTD -->
<!ENTITY % spirits_adr.dtd SYSTEM "SPIRITS_ADR.DTD">

%spirits_adr.dtd;
```

5.2 XML DTDS FOR SUBSCRIBE

The DTDs for subscribing to a mobility event could be like this (some of its elements are already defined in the notify section):

```
<!--
# Author: Daniel Moreno
# Version: 1
# Organisation: VODAFONE Spain
# Date: 24/7/2002
-->

<!--
*********************************************************************
ELEMENT: MM_event_subscribe
COMMENT: root element that contains all the necessary parameters
*********************************************************************
-->
<!ELEMENT MM_event_ subscribe (ServiceKey, Event_met , ADDRESS)  >
```

The DTDs for ServiceKey, Event_met and ADDRESS are the same as defined in section 5.1, so they are not included here.

6. REFERENCES

[1] ITU-T Q.763, December 1999: "Specifications of Signalling System No. 7 û Formats and codes of the ISDN user part".
[2] 3G TS 23.032, "Universal Geographical Area Description (GAD)".
[3] 3G TS 23.073, "Support of Localised Service Area (SoLSA); Stage 2"
[4] GSM 03.32 Version 5.0.0, " Digital cellular telecommunications system (Phase 2+) (GSM); Universal Geographical Area Description (GAD) "
[5] TS GSM 03.03, " Digital cellular telecommunications system (Phase 2+) (GSM); Numbering, addressing and identification"

[6] TS GSM 04.08, " Digital cellular telecommunications system (Phase 2+) (GSM); Mobile radio interface; Layer 3 specification"
[7] IETF Spirits Workgroup, "On selection of IN parameters to be carried by the SPIRITS Protocol", <draft-ietf-spirits-in-03.txt>

7. ACKNOWLEDGEMENTS

Thanks to Musa Unmehopa for the comments and suggestions made to the previous version of this draft. They helped me a lot in creating this new one.

8. CHANGES

- Inclusion of Service Key as a mobility event parameter.
- Basic MSISDN parameter has been replaced by Address parameter.
- Definition for Geodetic Information (also in DTD).
- Redefinition of LAT and LON parameters.

9. AUTHOR'S ADRESS

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