TSG-RAN meeting #18 **RP-020891**
New Orleans, US 3-6 December 2002

3GPP TSG-SA WG2 meeting #27 **Tdoc S2-023664**
Bangkok, Thailand, 11th – 15th November 2002 **rev of S2-023651**

Title: LS on Early UE handling

Source: SA WG2

To: RAN 2, RAN 3, CN 4, GERAN 2, TSG RAN, TSG SA

Cc: CN 1, GSMA TWG

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Attachments: S2-023661

1. Overall Description:

SA2 has drafted an "800" series (i.e. 3GPP internal) Technical Report that should help to enable the 3GPP TSG plenaries to decide on the relative merits of the different architectures for early UE handling.

The latest version of the TR is attached as S2-023661. SA2 will send this TR for approval to the December SA plenary meeting. The version of the TR submitted to the SA plenary should have the correct style applied and a TR number allocated, however, there should not be any other differences between it and the attached version.

Hopefully the December TSG meetings will then decide upon a route forward.

In line with SA2's duties, SA2 has considered the benefits and impacts of any changes on the GERAN and the CN as well as on the UTRAN. SA2 leave it to the TSG plenaries to choose the scope of the solution they wish to select.

2. Actions:

a) SA2 requests related groups to study the TR.

b) SA2 requests RAN 2 to consider the issue raised in section 5.1.11 of the TR (UESBI in the RANAP paging message).

3. Date of Next SA2 Meetings:

SA2 #29 20-24-JAN-2003 San Francisco/USA (AWS and Rogers Wireless)

3GPP TSG SA WG2 #28 ***S2-0233661***
Bangkok, Thailand, 11-15/11/02

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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The 3GPP system has many features and it is impractical to fully test all combinations of mobile features with network or test equipment. Hence when one of the un-tested features is “switched on” in a network, there is a risk that some mobiles will not work with this feature (or particular combination of features). As a consequence, it may become desirable that particular network elements adapt or constrain the features that they use with specific types of UE.

This report documents one or more possible signalling mechanisms that can be used to provide UE specific behaviour information to network entities.

A comparison of the pros and cons of the different architectures is included, however, the TR is not expected to make a decisive conclusion. Instead, the TSG plenary meetings are expected to use this TR to recommend how to proceed with further work.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions given in TS 21.905 and the following apply.

<keyword> <Definition>

3.2 Symbols

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

3.3 Abbreviations

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

UESBI UE Specific Behaviour Information

BMUEF Bit Map of UE Faults

BMUEVB Bit Map of UE Validated Behaviour

4 Network Entities that could use UE Specific Behaviour Information

This section attempts to identify those network entities that need UE Specific Behaviour Information (abbreviated to UESBI) and those which do not. The aim is to ensure that independent different solutions are not adopted for UTRAN, the GSM BSS and for the Core Network.

Only R'99 and earlier network entities are discussed.

4.1 Serving RNC

R'99 UMTS is complex and infrastructure makers cannot implement everything immediately. This leads to impracticalities in providing full IOT. Hence the SRNC is one of the principle network entities that needs UESBI.

4.2 Drift RNC

If the drift and serving RNCs are from the same vendor, then the SRNC is unlikely to request the DRNC to provide services that the UE cannot support. However, when the DRNC and SRNC are from different vendors, the SRNC might not know about inter-operability problems between the UE and DRNC functionality.

Hence the DRNC may need the Iur interface to provide functionality for the DRNC to derive the UESBI. However, current advice from RAN 2 is that UESBI is unlikely to need to be transferred on the Iur interface (see LS in S2-023561=R2-023160).

Commonality between any 'solutions' for Iu (or Uu) and Iur interfaces may be useful.

4.3 Node B

For most functions, the Node B is expected to be the slave of the RNC. This might change slightly with R'5 HSDPA where more functionality is moved to the Node B.

Overall, expect that Node B's do not have to adapt autonomously to different UE capabilities.

4.4 GSM BSC (A/Gb mode)

4.4.1 CS domain (A interface)

New GSM functionality has been added in a relatively modular manner; hence IOT testing seems able to cope with it.

However, GSM to UMTS handover is a complex process. The GSM BSC may need to adapt its handover neighbour cell lists according to the UE type, and/or need a mechanism to avoid repeatedly sending handover requests to RNCs which then use the UESBI to (repeatedly) reject the handover request.

Hence the BSC may need the UESBI to influence its behaviour.

4.4.2 PS domain (Gb interface)

Some of the R'97 standardised functionality is not implemented in any infrastructure. Interoperability problems can be expected when parts of this functionality are enabled.

Provision of UESBI across this interface will be useful.

4.5 GSM BTS

In [almost] all matters, the GSM BTS is the slave of the BSC and does not make any autonomous decisions. Hence, assume that the BTS does not need to know the UE's capabilities.

4.6 Visited MSC/VLR

New functionality seems to have been added in a relatively modular manner; hence IOT testing seems able to cope with it. The MSC/VLR is not expected to need the UESBI to influence its behaviour.

4.7 Relay MSC

The relay MSC is not expected to need the UESBI to influence its behaviour to different types of UE, however, it needs to handle inter BSC/RNC handover/relocation between BSCs/RNCs connected to that relay MSC.

4.8 GMSC

This GMSC is not expected to need the UESBI to influence its behaviour to different types of UE, instead it will act as a slave of the HLR (or CAMEL platforms). Hence UESBI does not need to be transferred to this function

4.9 HLR

The HLR could make decisions based on UE capability - eg over which domain to send an SMS, or, how to handle a CS video call being established towards a UE that does not support video.

Within the expected short life of this TR, this issue will not be addressed in any depth. Hence it is expected that R'99 MAP will NOT be modified to carry UESBI to the HLR.

4.10 2G-SGSN

Some of the R'97 standardised functionality is not implemented in any infrastructure. Interoperability problems can be expected when parts of this functionality are enabled (eg LLC and SNDCP XID negotiation). Utilisation of UESBI may be useful.

4.11 3G-SGSN

The R'99 Uu signalling to the SGSN is significantly different to the R'97 Um signalling to the SGSN. Hence new problems will need to be ironed out and so utilisation of UESBI can be expected to be useful.

4.12 GGSN

While the GGSN probably has little need to adapt its own behaviour to different UEs, it could be useful to provide information about the UE to the GGSN, so that this could be sent out via the RADIUS messaging.

Inclusion of IMEISV in the GGSN's CDRs might also reveal useful diagnostic information to the HPLMN.

Within the expected short life of this TR, this issue will not be addressed in any depth. Hence it is expected that R'99 GTP will NOT be modified to carry UESBI to the GGSN.

4.13 SMSC

UESBI might help with issues such as concatenated SMSs, EMS and MMS. Within the expected short life of this TR, this issue will not be addressed in any depth. Hence it is expected that R'99 signalling will NOT be modified to carry UESBI to the SMSC.

4.14 CAMEL platforms

New functionality seems to have been added in a relatively modular manner; hence IOT testing seems able to cope with it. Furthermore CAP is more sensitive to MSC-VLR or SGSN capabilities than to UE capabilities. Hence R'99 is NOT expected to be extended to carry UESBI to the CAMEL platforms.

5 Architectures

To ease maintenance of this document, this section uses the term "UE Specific Behaviour Information" (abbreviated to UESBI) to mean either IMEISV or, the Bit Map of UE Faults (BMUEF), or in some cases of architecture 3, the "Bit Map of UE Verified Behaviour" (BUEVB).

There are 2 main architectural choices:

- Does the UE send its UESBI directly to the RAN or does the UE send them to the CN for it to store and supply to the RAN when needed?
  Architecture 1 and 2 in the sections below deal with UESBI transfer via CN whereas architecture 3 considers direct UESBI transfer from UE to RAN.

- Are these capabilities expressed in terms of IMEISV or in terms of a standardized bitmap of correctable issues?
  In Architecture 1, the capabilities are expressed in terms of IMEISV while Architecture 2 uses a standardised bitmap. Architecture 3 could use either IMEISV or bitmap and is mainly studied by RAN.

These architectures are not necessarily mutually exclusive. Combinations of these architectures should be bourn in mind when reading section 5.

5.1 Architecture 1: full IMEISV distribution

This architecture has much in common with Architecture 2 "Iu interface bitmap derived from IMEISV". As it is required for the CN to obtain and store the IMEISV and to transfer the UESBI between the CN elements for both Architectures 1 and 2, all text in 5.1 applies therefore to 5.2 except where explicitly stated in Architecture 2.

Note: Section 5.1.2, 5.1.3, 5.1.4, 5.1.7, 5.1.8.1 and 5.1.10 discuss implications of UESBI retrieval by MSC (to be able to transfer it to RAN) even though MSC itself may not need this information.

5.1.1 General description

When the mobile Attaches to the MSC/VLR or performs a Normal Location Update to the MSC/VLR (see note 1 below) or Attaches to the SGSN, the IMEISV is retrieved using the MM or GMM Identity Request message. The VLR and the database in the SGSN are used to store the IMEISV.

At subsequent Iu interface connection establishments (both 'initial' and for 'handover'), the MSC/SGSN sends the UESBI to the SRNC as soon as the Iu signaling link between MSC/SGSN and SRNC has been established. The UESBI can be carried e.g in the same message that currently carries the IMSI. This is summarised in Figure 1.

Note 1: It should be an operator choice as to whether to request IMEISV from the mobile at every intra-MSC Normal Location Update. This allows the operator to balance the increase in signaling load against the likelihood of an "inter-location area change and SIM swap". It should be further noted that if any mis-matches between the UE's IMEISV and the IMEISV stored in the VLR lead to the user having problems, then the problems may be cleared by the user switching the UE off and back on, forcing a CS domain Attach to occur.

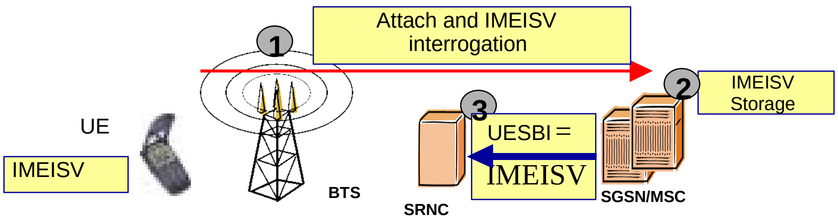

Figure 1: Architecture 1

If the UE state is changed from MM/PMM Connected to MM/PMM Idle, all information derived from the received IMEISV is released in the RNS. Thus if the UE state is changed afterwards back to MM/PMM Connected the delivery of the IMEISV from MSC/SGSN to SRNC must be repeated.

The SRNC then uses the UESBI to derive the capabilities of the UE.

The following subsections deal with specific points.

5.1.2 Gs interface/Network Mode of Operation = 1

When using NMO=1, current MSCs are unlikely to request the IMEISV from the SGSN during the establishment of the Gs interface association. Hence MSC software would need to be upgraded to send the Gs interface MS Information Request message to the SGSN as part of the Gs interface's association establishment procedures.

5.1.3 Emergency Call Handling

5.1.3.1 Attached Mobile with (U)SIM

This poses no problems provided that the IMEISV is stored in the VLR.

5.1.3.2 (U)SIMless mobile

In this case the mobile puts the IMEI into the CM Service Request. This is not the IMEISV, so the MSC could be mandated to assume that the mobile is at revision level zero, and signal this to the RNC. However, a mobile at Software Version = 1 might have different faults to those of a SV=0 mobile. This means that the MSC should send the IMEI (and not the IMEISV) to the RNC, and the RNC uses the IMEI to derive the union of the sets of faults for each SV of that TAC.

(For architecture 2, the MSC would use the IMEI to obtain the BMUEF corresponding to the union of the sets of faults for each SV of that TAC.)

A simpler alternative is that the MSC could request the full IMEISV from the mobile. Typically this would add a couple of hundred ms of delay.

5.1.3.3 Non-attached Mobile with (U)SIM

The MSC interrogates the mobile for the IMEISV. Such a pair of messages (Identity Request, Identity Response) is anticipated to take about 200ms.

Alternatively, information on the superset of all faults for all mobiles could be sent to the RNC.

5.1.4 Inter-MSC Location Updates

These do not occur during a CS call. Hence they are not generally time critical as they are rarely linked to a “follow on call”.

When a (U)SIM is removed from a mobile in one LA and then reinserted into a mobile which is powered up in a different MSC’s LA, the mobile performs a circuit switched “normal location update” rather than an “attach”. If the new MSC used upgraded MAP signalling to retrieve the IMEISV from the old MSC, then the IMEISV information would be incorrect.

Hence it seems necessary to use a 24.008 Identity Request message/Gs MS Information Request message to get the IMEISV from the UE at inter-MSC location updates.

5.1.5 Inter-SGSN Routeing Area Update and Relocation

Routing Area update:

This is the case of RA update and NOT GPRS attach.

Intra-3G in PMM connected mode, the RA Update follows an SRNS relocation, then the RNC will already have the UESBI. In PMM idle mode, the RA Update is not associated with an SRNS relocation, then in UMTS there is little reason for it to be a prelude to data transfer.

There are however a couple of cases where the RAU can happen during an active data transfer session such as an inter-system RAU from 2G to 3G and in the case of handover between RNCs not connected by an Iur interface. In these cases, obtaining the IMEISV over the radio interface using GMM Identity Request procedure will result in additional delay.

GSM RA Updates may also be time critical.

SRNS Relocation:

The UESBI must be transferred between the RNCs during the relocation procedure. This could either be carried in the UTRAN container carried in the GTP Forward Relocation Request, or, the GTP Forward Relocation Request message could be updated to include the IMEISV.

Note that this decision should be aligned with the decision for Inter-MSC Relocation.

Transfer of UESBI to the new SGSN and Target RNC:

Could either use existing GMM Identity Request mechanisms to get the IMEISV from the UE, or, could be carried in the container for relocation, or, GTP could be upgraded.

To cater for 2G-SGSNs using GTPv0, a solution solely based on Gn interface (SGSN-SGSN) signalling would necessitate upgrades to both GTPv0 and GTPv1 signalling.

However using the GMM Identity Request procedure causes additional delay for certain RAU cases, and, for reasons given in section 5.1.7 (Inter-RNC/BSC and Inter-MSC Handover/Relocation), it is proposed to update the GTP SGSN Context Response message and GTP Forward Relocation Request messages.

To avoid upgrading both GTPv0 and GTPv1 it is proposed for simplicity to upgrade only GTPv1.

5.1.6 Long Lived Iu-ps Connections

The use of "long lived Iu-ps connections " may frequently mean that the RNC has the UESBI at the very first stage of the CS domain call from the mobile. This is because the SGSN stores the same UESBI information as the MSC/VLR.

5.1.7 Inter-RNC/BSC and Inter-MSC Handover/Relocation

Should the anchor MSC send the UESBI to the target BSC/RNC, or, should the “transparent container” be used to carry the information between RAN nodes?
This is analyzed below:

a) transparent container
All BSCs and RNCs have to be upgraded to support this use of the transparent container. This could involve changes in up to perhaps 4 different hardware platforms in one PLMN (2 GSM BSC vendors and 2 UMTS RNC vendors).

This method requires all the different RNCs and BSCs to copy the IMEISV from the Common ID message into a new field within the transparent containers. This seems to require the definition of a new Field in BSSMAP (48.008) and a new parameter in RANAP (25.413). These require changes to BSCs and RNCs, These changes do not require changes to relay MSC functionality.

UESBI will need to be carried in the UTRAN container for Architecture 3. If a combination architecture is chosen (such as Architecture 3 with either 1 or 2), then it may be useful to carry all the information in the UTRAN container. Further study is needed on this issue if a combined architecture is selected.

b) UESBI buffered in relay MSC
The UESBI is sent by the anchor MSC in the Relocation Request message. The relay MSC sends it to the target RAN node and also stores it for future BSC/RNC handovers within the relay MSC’s

area. This method requires the relay MSC to store and handle the UESBI in a similar manner to that in which it has to store and handle the IMSI. Hence this should not severely impact the relay MSC functionality. No changes are needed to BSCs or RNCs.

The following points needs to be considered further:

i) A interface (and some E interface) messages have a length limit of around 255 bytes. It needs to be checked that carrying the UESBI in the Handover Request message does not cause problems.

ii) Subsequent inter MSC handover? 2G MSC to 3G MSC handover?

Selection of the best solution needs further study and may well be dependent upon the architecture(s) selected by the TSG plenaries.

5.1.8 Other Impacts on Network elements

5.1.8.1 MSC/VLR and SGSN

For every subscriber, the VLR (and SGSN database) should be able to store the subscriber data received in [2] MAP Insert Subscriber Data messages plus several Security Vectors. Compared to this volume of data, the 8-10 bytes needed to store the IMEISV used by each subscriber is small.

5.1.8.2 RNC

Each RNC in the network should be able to map the IMEISV to the corrective action to be taken.

Multiple different TAC+SV might map to the same corrective behaviour.

A database might be needed to map the IMEISV of the faulty terminal to the corrective action needed for that terminal type.

If the database is stored at the RNC then the implications are that this needs to be synchronized among all the RNCs.

If the RNC needs to access an external database, then a new interface may need to be standardised unless an existing interface can be re-used.

5.1.9 Mandatory IMSI Attach to MSC

The GSM CS domain signaling permits networks to not use Attach/Detach. However, the GSM Association has for more than [10] years required network operators to use Attach/Detach.

This is not seen to be a problem.

5.1.10 Handling of UESBI during the Attach Procedures

In the CS domain it is possible to signal that the mobile wants to make “a follow on call” after the Location Updating procedure is completed. This avoids delay caused by the release and re-establishment of the RR connection.

To avoid problems with ‘follow on calls’, there needs to be a method for getting the UESBI to the RNC during the attach/first location update procedure.

CS domain - no Gs interface
There seems to be about 5 possibilities:

a) delay sending the common ID message until both IMSI and UESBI are available to the MSC,

b) send the common ID twice, once with IMSI and a second time with both IMSI and UESBI.

c) create a new Iu interface message to carry the UESBI for this specific situation.

d) add the UESBI to another Iu interface message that will be sent during the Location Update procedure. The best choice of message seems to be Direct Transfer.

e) not send the UESBI.

CS domain - Gs interface in use
In this situation, any follow on call will appear as a new SCCP connection at the MSC. The UESBI is then sent in the Common ID message along with the IMSI.

PS domain
The same 5 possibilities as for the CS domain exist.

Comparison of the techniques
Receipt of multiple Common ID messages at the RNC ought not to be a serious problem because the RNC frequently receives two of them: one from the MSC and one from the SGSN. However, sending a second Common ID message from the MSC/SGSN is a new MSC/SGSN procedure.

Delaying sending the Common ID message until the UESBI is available, requires changes to the MSC and SGSN procedures and may have negative impacts on ‘class A’ performance.

Adding the UESBI to the Direct Transfer messages requires some new RNC, MSC and SGSN behaviour.

Adding a new Iu interface message seems to be a too heavyweight a solution.

Not sending the UESBI is sub-optimal, but might be acceptable for, say, one RNC software release cycle.

Conclusion
Overall, adding the UESBI to the Direct Transfer message seems to be slightly preferable as the long term solution.

5.1.11 UESBI information in the RANAP paging message

In order to cover all possible failures that UE might have, conveying UESBI information in the RANAP paging message could be used as a safe guard. If the UESBI information is available, the RNC is able to take relevant action for a faulty UE when the RNC sends RRC paging message over the PCH.

However, in general the paging procedure is relatively simpler and fundamental for the UE. In this scene the RNC may never need the UESBI information at all.

As stated above, SA2 sees two contrary views on this issue and cannot conclude at this moment whether the inclusion of the UESBI information in RANAP paging is necessary or not.

5.2 Architecture 2: Iu interface carries Bit Map of UE Faults derived from the IMEISV sent to the CN

5.2.0 Summary

This method is the same as architecture 1, except as listed in the following subsections. Sections 5.1.2 to 5.1.11 inclusive (but excluding 5.1.8) apply to Architecture 2.

5.2.1 General description

When the mobile Attaches to the MSC/VLR or performs a Normal Location Update to the MSC/VLR (see note 2 below) or Attaches to the SGSN, the IMEISV is retrieved using the existing MM or GMM/PMM signaling procedures as defined in 24.008. At the MSC/SGSN the IMEISV is used to derive a standardised Bit Map of UE Faults (BMUEF). The SRNC then uses the BMUEF to take the necessary specific actions. The procedure is illustrated in Figure 2.
At subsequent Iu interface connection establishments (both ‘initial’ and for ‘handover’), the MSC/SGSN sends the BMUEF to the SRNC (instead of the IMEISV used by architecture 1).
If the UE’s state is changed from MM/PMM Connected to the MM/PMM Idle, all information derived from received BMUEF is released in the RNS. Thus if UE state is changed afterwards back to MM/PMM Connected the delivery of the BMUEF from MSC/SGSN to SRNC must be repeated.

Note 2: It should be an operator choice as to whether to request IMEISV from the mobile at every intra-MSC Normal Location Update. This allows the operator to balance the increase in signaling load against the likelihood of an “inter-location area change and SIM swap”. It should be further noted that if any mis-matches between the UE’s IMEISV and the IMEISV stored in the VLR lead to the user having problems, then the problems may be cleared by the user switching the UE off and back on, forcing a CS domain Attach to occur.

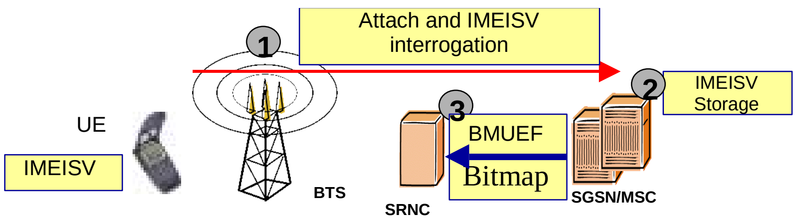

Figure 2. Architecture 2

5.2.2 Nature of Bit Map of UE Faults

Each bit which is “set” in the BMUEF, provided over the Iu interface, points to the specific fault of certain type/s of UE (TAC+SVN). Specific behavior is defined when there is need to have a work around solution for the fault of the certain type/s of UE or when there is a major error in the functionality and this functionality might need to be disabled for certain type/s of UE.
In a case of errors in specifications, the main target should be to fix the problem in the 3GPP specifications. If errors or ambiguities in the 3GPP specifications are identified, the criticality of the

problem should be evaluated on a case-by-case basis in order to decide whether or not to provide a correction by using the BMUEF.

The BMUEF is identified by the Type Allocation Code (TAC) and the Software Version Number (SVN) of IMEISV. All Serial Numbers (SNRs) of same TAC and SVN would result in the same BMUEF. See Figure 3.

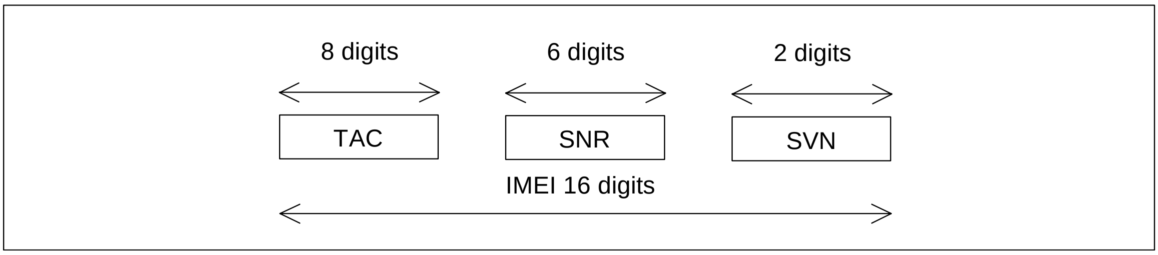

Figure 3: Structure of IMEISV

5.2.3 The content of BMUEF for multivendor UTRAN

The BMUEF content is not dependent on the RNC vendor. Technical specifications maintained by TSG RAN define the meaning of each bit of the BMUEF.

5.2.4 The content and the handling of BMUEF in UTRAN sent by PS and/or CS domains

The content and the structure of the BMUEF shall be the same regardless of whether the BMUEF is sent by either the PS or the CS domain. At UTRAN the received BMUEF will be analyzed and the functions/procedures are initialized based on information from BMUEF.

5.2.5 Storing the IMEISV / BMUEF information at CN side

Once the IMEI-SV is obtained, the MSC/VLR or SGSN needs to obtain the BMUEF from the IMEI-SV. There are two alternatives to perform this conversion:

- The IMEI-SV to BMUEF conversion data base is kept in every MSC/VLR or SGSN node (distributed database)
- A centralized function performs the IMEI-SV to BMUEF conversion (centralized database). It is FFS whether or not the EIR could be used as a basis for such a centralized database.

Figure 4 is one example of the BMUEF database.

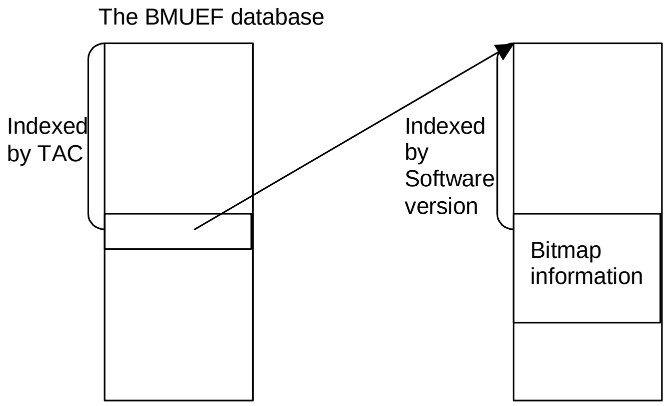

Figure 4: Example of BMUEF database

Given that mobiles could stay attached for many days and that the mapping between IMEISV to BMUEF could be updated daily, it seems to be sensible to store the IMEISV rather than the BMUEF in the VLR/SGSN database.

5.2.6 Other Impacts on Network Elements

5.2.6.1 MSC/VLR and SGSN

For every subscriber, the VLR (and SGSN database) should be able to store the subscriber data received in [2] MAP Insert Subscriber Data messages plus several Security Vectors. Compared to this volume of data, the 8-10 bytes needed to store the IMEISV used by each subscriber is small. Both the MSC/VLR and SGSN need a mechanism to convert IMEISV into the BMUEF.

5.2.6.2 RNC

Each RNC in the network should be able to map the BMUEF to action to be taken.

5.3 Architecture 3: UESBI sent from UE to RAN

5.3.1 General Description

The UE sends its UESBI to the SRNC in one (or more) of the messages sent early in the RRC connection establishment.

There is a benefit in having a mechanism to handle the faulty UEs during early stage of radio connection establishment. The exact set of messages in which UESBI is to be transferred is to be documented in RAN specifications.

In order to handle GSM to UMTS handover, the UESBI is sent by the UE to the GSM BSS within the already-defined “Inter RAT Handover Info” parameter. Existing A interface procedures then carry the UESBI as an additional part of the “Inter RAT Handover Info” which is already included within the already existing “transparent container” sent in the inter BSC/RNC handover signaling.

In case of GSM to UMTS handover, the UESBI might be useful to provide to GSM BSS, in case there may be error in handover procedures.

Other UMTS/GSM handovers/relocations are also enabled by the "transparent container".

The UESBI can be one of the following:

- A Bit Map of UE Verified Behaviour (BMUEVB);
- The IMEISV or a compressed IMEISV (eg TAC plus SV);
- etc

When the BMUEVB is sent across Uu, this mechanism is expected to provide an early indication to the RNC of mobiles that have overcome a known problem previously captured in the TR, and enable the broken feature to be 'switched back on' for the new terminals.

Owing to lack of contributions on the IMEISV over Uu mechanism, the rest of section 5.3 focuses on the BMUEVB mechanism.

5.3.2 BMUEVB

This mechanism may use two components, they are called "Safety Belt" and "General Corrections";

- Safety Belt bits (SB bits)
  Some of the BMUEVB information is sent in the very early RRC messages sent on radio (e.g. RRC CONNECTION REQUEST) to solve problems that arise in the very early phase of the RRC connection establishment. Whether the BMUEVB contains values derived from known faults or is set as a result of passing tests is a RAN matter.

  Due to size limitations of these messages the number of BMUEVB bits added will be limited and so these bits should not be used in cases where sending this part of the BMUEVB information in later messages would be sufficient. These bits can be seen as providing a safety belt in early radio connection phases cases, hence the terminology.

- General Correction bits (GC bits)
  It is intended that these bits are used to solve problems that occur after the RRC connection is established.

  These GC bits are supplied in later RRC/RR messages (e.g. RRC CONNECTION SETUP COMPLETE, RR UTRAN CLASSMARK CHANGE and the HANDOVER TO UTRAN COMPLETE)
  - after the RRC connection is setup on UTRA ; and
  - via A/Iu interfaces to prepare for handover
  - when the RRC connection is setup as a result of a successful incoming handover (e.g. from GSM).

5.3.3 Possibility to update the BMUEVB sent by the UE

When a mobile is put on the market it may happen that a radio feature has been implemented on the mobile (eg as indicated by the classmark) but has never been deployed by any network. It may then happen upon operator deployment of the radio feature that it is discovered that this feature is improperly implemented by some mobiles. If the BMUEVB bits are used to indicate the corrected faults in the UE, then:

For the mobiles launched before a problem has been identified, the default handling by the RNC is "function not corrected". This means that a new value of BMUEVB has to be updated in mobiles that correctly implement the feature for which a relevant position in the bitmap has been reserved by 3GPP. This new BMUEVB value indicates that the UE correctly implements the feature. A mechanism to possibly update the BMUEVB in the UE when it is outdated could rely on SMS issued by a central entity or another method.

The means to send SMSs securely to MEs are FFS. Other issues are also FFS.

5.3.4 Applicability of this Architecture for Use with Other Network Entities

With this architecture the UESBI is only available to the RNCs. The information is located within RAN in the SRNC. In case of SRNC re-location, this information must be provided to the target RNC.

If UESBI is needed by the Gb interface part of the GSM BSS, then architecture 1 or 2 is likely to need to be developed. It is FFS whether 2 phase access can be used to obtain the GPRS-BMUEVB from the GPRS mobile.

If UESBI is needed by the A interface part of the GSM BSS, then either architecture 1 or 2 is needed or GERAN specific techniques comparable to architecture 3 need to be developed.

If the SGSNs or MSCs or other CN nodes need the UESBI, then the RAN level and CN level BMUEVBs are of totally different nature. This implies that:

- UTRAN gets directly UESBI from UE
- The CN node relies on a different mechanism to get CN level UESBI information.

5.3.5 Message length limits on A/E interfaces

A interface (and some E interface) messages have a length limit of around 255 bytes. It needs to be checked whether this architecture does not cause message length problems.

The split of BMUEVB information into several parts may limit the size of additional information to be transmitted on A/E interface.

5.3.6 Extra call set up delay on the GSM radio interface.

The mobile sends the Inter RAT Handover Info in the UTRAN Classmark Change message. The addition of extra information to this message may well cause the message to exceed another [20] octet boundary. If this happens, it is likely all call set ups, SMSes and Location Updates would take an extra 235ms. This has an impact on SDCCH congestion, call set up delay (and obviously, emergency call set up delay).

It needs to be checked whether the use of Safety Belt bits and General Correction bits cause an additional connection set up time delay.

5.3.7 Extra connection set up delay on the UTRAN radio interface

It needs to be checked whether the use of Safety Belt bits and General Correction bits cause an additional connection set up time delay.

5.3.8 Inter-RNC/BSC and Inter-MSC Handover/Relocation

UTRAN containers should carry the BMUEF to the Target RNC. MAP/E already carries these containers and requires no changes.

However changes may be required to GSM BSC to include this information in the containers, eg to combine the Safety Belt bits and General Correction bits into one field to be placed into the "transparent" container.

6 Initial Comparison of the Different Proposed Architectures

An initial comparison of the different possible architectures for the Early Mobile feature are summarized in the table below. No conclusion is drawn from this comparison because there are multiple non-technical issues which are not documented in this TR. The presented architectures are not necessarily mutually exclusive. Some possible combinations are:

Architectures 1 plus 3;
Architectures 2 plus 3;
Architecture 1 on its own;
Architecture 2 on its own;
Architecture 3 on its own;
Architecture 1 plus the Safety Bits part of architecture 3;
Architecture 2 plus the Safety Bits part of architecture 3;
Etc.

	Issue	Architecture 1 IMEISV delivered to CN and sent over Iu	Architecture 2 IMEISV delivered to CN and BMUEF sent over Iu	Architecture 3 BMUEVB delivered from UE to RAN
1	Specification of UESBI	IMEISV is already standardised.	Contents of BMUEF need to be standardised.	Contents of BMUEVB need to be standardised.
2	Mapping of UESBI into modified behaviours	3GPP does not necessarily have [any] visibility of modified behaviour or of detected UE faults	Discussed and agreed within 3GPP	Discussed and agreed within 3GPP
3	Gs interface mode of operation =1	Need changes to MSC functionality.	Same as architecture 1	No changes required.
4	Emergency call handling	Additional delay (eg 200ms) may be incurred in call setup. Specific RNC	Same as architecture 1	No additional delay for emergency calls.

		functionality may be needed to avoid problems early in “emergency RRC connections”		
5	Inter-MSC Location Updates	No changes expected	Same as architecture 1	No changes expected
6	Inter-SGSN Routeing Area updates	Changes needed to GTP	Same as architecture 1	No changes needed to GTP
7	Inter-RNC/BSC Inter-MSC Handover/Relocation	Changes needed either to relay MSC functionality or to BSC+RNC functionality	Same as architecture 1	FFS
8	Handling of UESBI during attach procedures	Passed to RAN by CN. Changes needed for RANAP.	Same as architecture 1	Passed to RNC directly over RRC. No changes needed for RANAP.
9	Can the architecture be used to provide UE Specific Behaviour in other network entities? (See section 4 for impacted network entities.)	Applicable for CN, UTRAN and GERAN-CS and GERAN-PS domains.	Same as architecture 1	Applicable mainly for UTRAN. Possibly applicable to GSM CS domain. It is for further study whether it is at all possible to apply this to the GSM PS domain.
10	Message length limits on A/E Interface	FFS	FFS	FFS
11	Extra call setup delay on GSM radio interface	None	Same as architecture 1	Additional delay (eg 235 ms) could be incurred for all calls but might be minimised by changes to GSM BSC functionality.
12	Applicability for problems encountered “early” in RRC connection	Cannot be used	Same as architecture 1	Yes
13	Applicability for features as soon as NAS signalling available	Yes	Yes	Yes
14	Handles problems with GSM to UMTS handover	Yes	Yes	Solutions have not yet been documented fully
15	Requires R’99 change to Uu standards	No	No	Yes
16	Impact on correctly functioning mobiles when a fault is detected in a different type of	None	None	Either (a) existing mobiles are unable to use this functionality, or

	mobile.			(b), updates of the correctly functioning mobiles are needed.
17	Databases	FFS	FFS	FFS

Annex <X>: Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New