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*Technical Report*

**3rd Generation Partnership Project;  
Technical Specification Group Services and System Aspects;  
Telecommunication management:  
User Equipment Management (UEM) feasibility study  
(Release 5)**

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Keywords

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# Contents

Foreword .....	5
Introduction .....	5
1 Scope .....	6
2 References.....	6
3 Definitions and abbreviations .....	7
3.1 Definitions.....	7
3.2 Abbreviations .....	7
4 Possible UEM Requirements.....	8
5 UEM Capabilities.....	10
5.1 UE Configuration Query capability .....	11
5.1.1 Service aspects.....	11
5.1.2 MMI aspects.....	11
5.1.3 Charging aspects.....	12
5.1.4 Security aspects.....	12
5.1.5 3GPP Operations System aspects .....	12
5.1.6 User Equipment aspects .....	12
5.1.7 Network aspects.....	12
5.1.8 Benefits.....	12
5.1.8.1 User/subscriber .....	12
5.1.8.2 Network Operator/Service Provider .....	12
5.1.8.3 UE Manufacturer .....	12
5.2 UE Reconfiguration capability .....	12
5.2.1 Service aspects.....	13
5.2.2 MMI aspects.....	13
5.2.3 Charging aspects.....	14
5.2.4 Security aspects.....	14
5.2.5 3GPP Operations System aspects .....	14
5.2.6 User Equipment aspects .....	14
5.2.7 Network aspects.....	14
5.2.8 Benefits.....	14
5.2.8.1 User/subscriber .....	14
5.2.8.2 Network Operator/Service Provider .....	14
5.2.8.3 UE Manufacturer .....	14
5.3 UE Software Update capability .....	14
5.4 Remote UE Diagnostics capability .....	15
5.4.1 Service aspects.....	16
5.4.2 MMI aspects.....	16
5.4.3 Charging aspects.....	16
5.4.4 Security aspects.....	17
5.4.5 3GPP Operations System aspects .....	17
5.4.6 User Equipment aspects .....	17
5.4.7 Network aspects.....	17
5.4.8 Benefits.....	17
5.4.8.1 User/subscriber .....	17
5.4.8.2 Network Operator/Service Provider .....	17
5.4.8.3 UE Manufacturer .....	17
6 Example of a Possible UEM Architecture .....	18
6.1 System component entities and connectivity .....	18
6.1.1 Definition of entities .....	18
6.1.1.1 UEM Client .....	18
6.1.1.2 UEM Server.....	18
6.1.1.3 UEM Gateway.....	19
6.1.1.4 UE Managers.....	19

6.2 Interfaces .....19

6.2.1 UE Access Reference Point .....19

6.3 Protocols.....19

7 Project planning .....20

7.1 Collaboration .....20

7.2 Proposed plan for post-Release 5 UEM work.....20

8 Open issues .....21

9 Risks .....21

10 Conclusions .....21

**Annex A: Additional UEM Requirements.....22**

**Annex B: Change history.....26**

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## Foreword

This Technical Report has been produced by the 3<sup>rd</sup> 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.

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## Introduction

The present document is a feasibility study on User Equipment Management (UEM). UEM is a capability which will allow the Operator, Service Provider and/or UE Manufacturer to remotely manage User Equipment (UE).

The capabilities of the User Equipment in 3G are becoming and will continue to become ever more sophisticated and integrated (high-definition colour screens, faster processors, built-in cameras, integrated media-players etc.). The sophisticated capabilities of 3G User Equipment will require a flexible means to support management of the UE satisfying the need of end-customers, service providers, network operators and UE manufacturers. The purpose of this feasibility study (the present document) is to progress this new management capability.

The present document outlines aspects of UEM which it would be valuable to standardise in post-3GPP-Release 5. The present document evaluates the feasibility of some UEM requirements, identifies some key UEM capabilities that map to the requirements, performs some analysis of those capabilities and proposes an architecture for UEM. A proposal is made for the co-ordination and planning of the UEM standardisation work and the conclusions clause makes some recommendations on UEM. Annex A contains a list of additional UEM requirements not directly related to the UEM capabilities identified; these requirements are included for information-only.

The key UEM capabilities that have been identified are:

1. UE Configuration Query,
2. UE Reconfiguration,
3. UE Software Update and
4. Remote UE Diagnostics.

UEM assist in:

- maximising the user experience and Quality of Service,
- maximise subscriber usage,
- minimise costs and
- help ensure that faults are promptly resolved.

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# 1 Scope

The scope of the present document is a Release 5 feasibility study that evaluate aspects of User Equipment Management (UEM) which would be beneficial to standardise post-Release-5. For Release 5 the present document does not have a factual impact on other 3GPP Work Items (WIs).

User Equipment (UE) includes both the USIM and Mobile Equipment (ME) domains and so it is emphasised that the scope of UEM includes both the USIM and ME domains.

The present document is focussed on the UEM interface to the UE Over-The-Air (OTA). There is a potential direct interface between the UE Managers and the UE; for example, a user may be able to upgrade the operating system in its UE by taking it to the UE manufacturer's service centre. This direct interface is outside the scope of the present document.

The user interface will be important in delivering UEM. However, the user interface is both outside the scope of the present document and outside the scope of the standardisation of UEM.

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# 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*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 22.240: "3GPP Generic User Profile (GUP) requirements; Stage 1".
- [3] 3GPP TS 23.240: "3GPP Generic User Profile (GUP) requirements; Stage 2; Architecture".
- [4] 3GPP TS 23.241: "3GPP Generic User Profile (GUP) requirements; Stage 2; Data description framework".
- [5] 3GPP TS 24.241: "3GPP Generic User Profile requirements; Stage 3; Access; Common objects".
- [6] 3GPP TS 22.057: "Mobile Execution Environment (MExE); Service description, Stage 1".
- [7] 3GPP TS 23.057 (V4.3.1): "Mobile Execution Environment (MExE); Functional description; Stage 2".
- [8] Draft 3GPP TS 32.140: "Services Operations Management; Subscription Management; Stage 1".
- [9] GSM TS 04.02: "GSM Public Land Mobile Network (PLMN) access reference configuration".
- [10] 3GPP TS 22.016: "International Mobile station Equipment Identities (IMEI)".
- [11] 3GPP TS 23.227: "Application and User interaction in the UE - Principles and specific requirements"

NOTE: It is possible that one or more of these references may not be approved in Release 5.

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## 3 Definitions and abbreviations

### 3.1 Definitions

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

**Customer Care Operator (CC Operator):** is a role which provides support to customers.

**User Equipment Management (UEM):** is a capability which will allow the Operator, Service Provider and/or User Equipment Manufacturer/User Equipment Supplier to remotely manage User Equipment.

**User Equipment Management application:** is an application that executes on the UE to provide UEM functionality.

**User Equipment Manager (UE Manager):** is a role that accesses the User Equipment in order to manage the User Equipment. Some examples of UE Managers are: Service Provider, Network Operator, UE manufacturer, Customer Care Operator, Subscriber and User.

**Subscriber:** is an entity (comprising one or more users) that is engaged in a Subscription with a Service Provider. The Subscriber is allowed to subscribe and unsubscribe services, to register a user or a list of user authorised to enjoy these services, and also to set the limits relative to the use that users make of these services.

The other definitions used in the present document can be found in TR 21.905 [1].

### 3.2 Abbreviations

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

CC	Customer Care
CM	Configuration Management
CRM	Customer Relationship Management
FAQ	Frequently Asked Questions
FCAPS	Fault, Configuration, Accounting, Performance, and Security management
FM	Fault Management
GUP	Generic User Profile
IMEI	International Mobile station Equipment Identities
IMSI	International Mobile Subscriber Identity
ME	Mobile Equipment
OTA	Over-The-Air
PC	Personal Computer
PM	Performance Management
SM	Service Management
SW	Software
UEM	User Equipment Management

NOTE: The other abbreviations used in the present document can be found in Reference [1].

## 4 Possible UEM Requirements

This clause contains the possible User Equipment Management (UEM) requirements which are applicable to the subsequent clauses of the present document. Annex A contains additional UEM requirements. Each requirement has a unique reference number (Ref).

**Table 4.1: Possible User Equipment Management (UEM) requirements**

Ref	Management Function	Requirement
1.	FM	Should be possible to easily make a clear/concise FAQ accessible to the user via the UE to solve common problems. For example this could be downloaded to the UE or a link could be sent to the UE which can then be browsed.
4.	FM	Provide support for fault resolution.
5.	FM	Provide support for fault diagnosis.
6.	FM	Remote service fault diagnosis
9.	FM	Self-health check on UE
11.	FM	Remote diagnosis on UE
13.	FM	Provide a service for UE similar to that available today for managing corporate PC networks, particularly for fault finding. For example being able to remotely inspect the UE and remotely install applications.
26.	FM	UEM server interrogates UE to identify and report on element failures
58.	CM	<ul style="list-style-type: none"> <li>• UE type (make, model, OS, version)</li> <li>• Firmware version /level</li> <li>• SW Version</li> <li>• Virus check history</li> <li>• Memory status</li> </ul>
60.	SM	Support the collection of diagnostic information from applications on the UE.
62.	SM	Fast service set-up (e.g. Parameters provisioning)
63.	SM	<ul style="list-style-type: none"> <li>• Set up services</li> <li>• Check service works</li> <li>• Upgrade services – trouble free</li> <li>• Download applications from UE manager to UE</li> <li>• OTA</li> <li>• Update UE software</li> <li>• Virus checks</li> <li>• Software bug fixes - trouble free</li> </ul>
64.	SM	Specific customers should be able to remotely configure the UE.
66.	SM	The ability to inform users that a new version of a UE software component is available.
67.	SM	The ability to inform users that a new service to the UE is available.
72.	SM	PC anywhere for mobiles – tuition, show users how to use their equipment e.g. video clip.
74.	SM	<ul style="list-style-type: none"> <li>• Remote access to view a corporate's personalised settings</li> <li>• Remote access to modify a corporate's personalised settings</li> </ul>
76.	SM	<ul style="list-style-type: none"> <li>• Manage customer data uploads</li> <li>• Manage customer data downloads</li> </ul>
85.	SM	Of apps, services, fixes etc. to UE. See also TS 23.227 [11] subclause 4.2.
90.	SM	Ensure UEM is useful to corporate customers as well as consumers. For corporate customers the subscriber and user are usually different.
Key to Management Function column:		
SM: Service Management.		
CM: Configuration Management.		
FM: Fault Management.		
PM: Performance Management.		



**Tracking Hardware**

95. The following is the minimum set of the UE information that the UE manager needs to know:
- IMEI (as defined in TS 22.016 [10]);
  - Software Version Number (SVN);
96. It should be possible for the UE manager to remotely audit UE information over the radio interface.

**UE Software Update**

107. The UE manager before updating the UE software version should have received the subscriber's agreement.
108. The UE manager should be able to remotely download a new software version to the UE.
109. User data in the UE should remain unaffected.
110. UE configuration information should only be updated as required by the new software version.

**Downloading Application & Services**

111. The UE manager should be able to remotely download applications to the UE.
112. The UE manager should be informed whether the remedial application has been successfully installed in the UE.
113. User data in the UE should remain unaffected.
114. UE configuration information should only be updated as required by the new application.
115. The UE manager before updating the UE with new applications should have received the subscriber's agreement.

**Remote Terminal Diagnostics**

148. It should be possible to collect diagnostic information from the UE. (Note that there are different mechanisms by which this can be achieved including executing a built-in diagnostic application, retrieving diagnostic data directly from the UE and download of the diagnostic application to the UE.).

**Remotely downloaded diagnostic applications**

The requirements in this clause are applicable to remotely downloaded diagnostic applications and not to the situation where the diagnostic application is built into the UE.

99. The UE manager should be able to identify and locate the appropriate diagnostic/remedial application.
101. The UE manager should be informed whether the downloaded remedial application has been successfully installed in the UE.
102. The UE manager should be informed whether the application has completed its tasks successfully.
103. A downloaded remedial application should uninstall and delete itself after completing its tasks unless explicitly instructed not to.
104. User data in the UE should remain unaffected.
105. UE configuration should remain unaffected unless otherwise required by the remedial application.
117. 118. Execution of the application should be possible using certain triggering events.
119. The data gathering application should be under full control of the UE manager.
121. The UE manager should be able to remotely uninstall and delete the diagnostic/remedial application from the UE.
122. Requirement removed.

123. Requirement removed.
124. The UE manager before updating the UE with UEM diagnostic/remedial applications should have received the subscriber's agreement.

#### Miscellaneous Requirements

135. The UE manager should be able to easily search for and discover the appropriate application to fit the purpose for particular equipment.
136. The downloading mechanism should be able to identify and locate the target UE quickly and accurately.
137. Security mechanisms should be in place to authenticate the source and target of the application. In addition, all data should be encrypted and applications only allowed to execute in an expected and non-harmful manner.
138. It should be possible to recover to the UE configuration and data state that existed prior to any new installation. This could be used for example to recover from a faulty installation.
139. An acknowledgement will be returned to the UE manager after installation.
141. A downloaded UEM application will uninstall and delete itself after completing its tasks unless explicitly instructed not to.
142. Authorised UEM applications should have the access they need to complete their tasks.
143. The user's private data and configuration settings should be stored prior to installation of any new software, to enable the new patch or application to be installed with the previous configuration settings.
144. The User Equipment Management application should not, in any way, degrade the Quality of Service or service functionality expected by the user.
145. The scope of UEM could be extend to cover not only the conventional voice-plus User Equipment but also "dumb" terminals such as drinks machines, monitoring equipment etc.

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## 5 UEM Capabilities

With the arrival of the 3G-services, more sophisticated mobiles with download capability and the growth of 3rd party applications and content on the Internet, more and more users will use the User Equipment as a mobile and limited incarnation of their desktop PC. Therefore, it is reasonable to assume that the user will download 3rd party applications to the UE. We then have the situation where an application could actually cause faults on the UE. This raises the complexity of User Equipment fault resolution to a higher level compared with traditional 2G User Equipment. In addition, it is more than likely that the user will contact the network operator or service provider to register the fault and it will be left to the UE manager to handle the query. If mechanisms were available for the UE managers to identify and fix faults, then huge savings could be made in manpower, equipment and revenue loss.

This clause identifies some key UEM capabilities and performs some analysis of those capabilities.

The following key UEM capabilities have been identified:

- 1) UE Configuration Query;
- 2) UE Reconfiguration;
- 3) UE Software Update;
- 4) Remote UE Diagnostics.

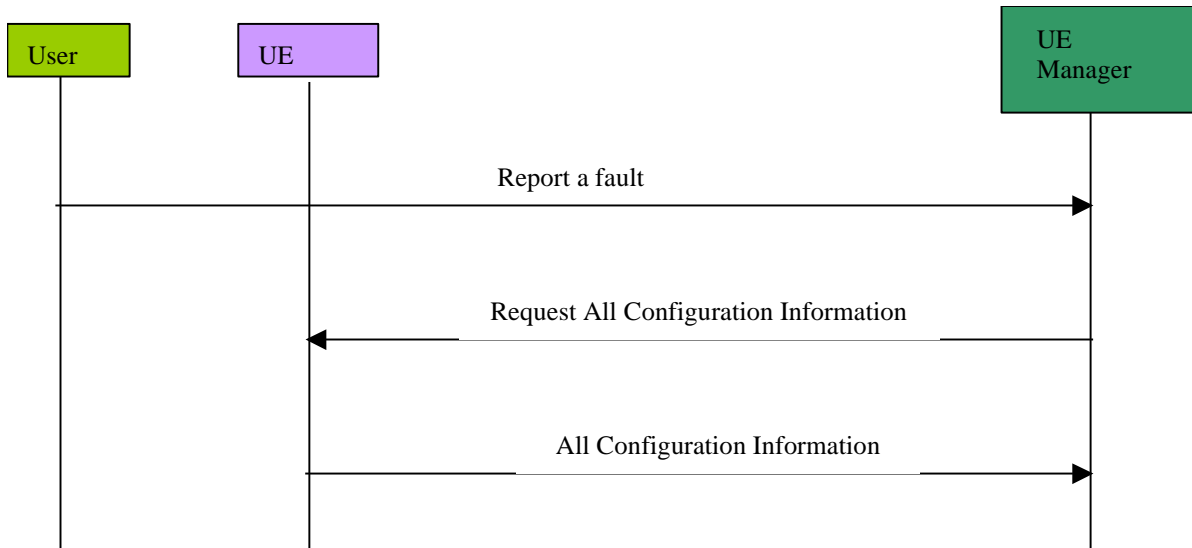
These capabilities should be considered for standardization post-3GPP-Release 5. The term "post-3GPP-Release 5" means in 3GPP Release 6 or in subsequent Releases.

The remainder of clause 5 describes these capabilities and performs some analysis on them. Sequence diagrams are used to provide examples of interactions that could use the UEM capabilities.

## 5.1 UE Configuration Query capability

The 'UE Configuration Query' capability allows UE configuration information to be remotely requested and retrieved. The UE configuration information would include the equipment make, model, software versions, configuration parameters. This is valuable information in for example fault finding; end-users often find it difficult to correctly report UE configuration information.

An example of how the UE Configuration Query capability could be used is illustrated in the sequence diagram in figure 1.



**Figure 1: UE Configuration Query Sequence Diagram**

The configuration information returned by the UE should include:

- IMEI (as defined in TS 22.016 [10]);
- the Software Version Number (SVN);
- the applications installed and their software version. At a minimum the list of applications returned should be those which are remotely manageable (a list of the other non-manageable applications could also be returned).;
- the last error, time, date. The minimum is a single last error on the UE. It would be useful if the last errors for all the applications could be also returned.;
- configuration parameters, e.g. language settings, service related settings.

### 5.1.1 Service aspects

The UE manager (authorised to use this capability for a particular UE) is able to send the command to a particular UE and receive the configuration information in response.

The UE Configuration Query capability should be able to function both when a user is roaming and is not roaming.

### 5.1.2 MMI aspects

It is expected that the UE manager will have a GUI interface to initiated this activity and would have some tools for viewing and analysing the response. It would be useful if this capability could be initiated by manual involvement and also automatically.

### 5.1.3 Charging aspects

Flexibility is required for the charging of the UE Configuration Query capability. In the example illustrated in Figure 1 it is expected that the user would typically be charged for the UEM interaction.

### 5.1.4 Security aspects

It is essential that the requesting party is authenticated. There should be a valid relationship between the requesting party and the UE owner, for example explicit permission granted to perform the UE Configuration Query.

The UE Configuration Query capability does not change the configuration of the UE.

Integrity protection of the messages on both the downlink and the uplink are required.

NOTE: The security checks have been omitted from the sequence diagram.

### 5.1.5 3GPP Operations System aspects

The 3GPP Operations System should be able to send a command to a UE and receive a response back.

The UE manager should have some means of identifying the user if user's IMSI is not forwarded (e.g. if the user contacts CC via the internet).

### 5.1.6 User Equipment aspects

There are UE aspects for both the terminal and the USIM. Some sort of client is required on the User Equipment. There needs to be a way of receiving the command on the UE.

It would be useful if the names/parameters and data structures are standardised. The Generic User Profile / Data Description Framework work is applicable for this, see 22.240 [2], 23.240 [3] and 23.241 [4].

### 5.1.7 Network aspects

No changes to the core network have been identified at this time.

### 5.1.8 Benefits

#### 5.1.8.1 User/subscriber

The user/subscriber often lack the knowledge of how to view parameters so this would remove the need for an explanation for how to view a parameter(s) and save time in reading out the configuration over a voice call. The user would receive an improved service.

#### 5.1.8.2 Network Operator/Service Provider

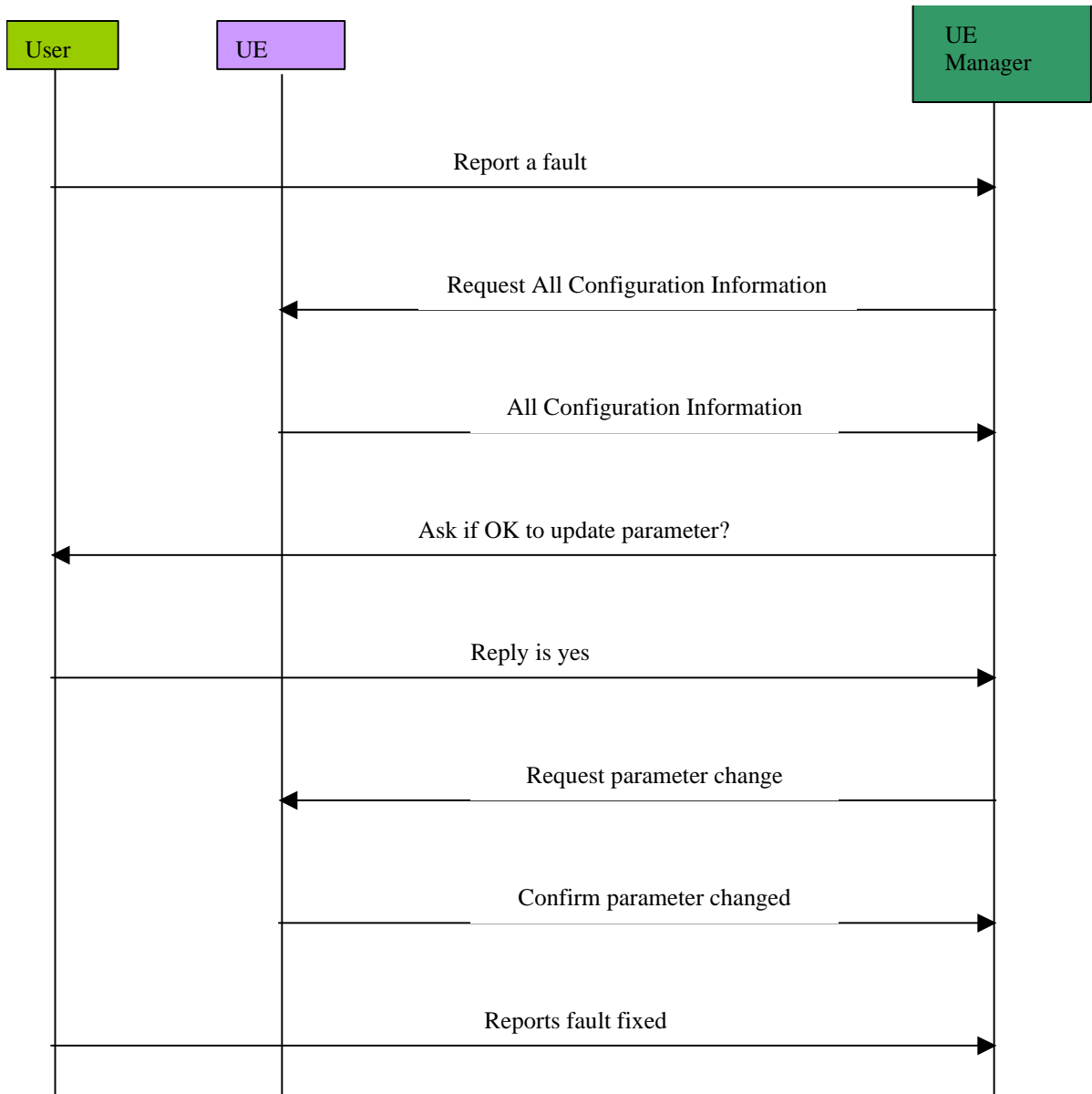
The Operator/Service Provider would be able to handle support calls more quickly and effectively.

#### 5.1.8.3 UE Manufacturer

The User/subscriber would be happier with UE manufacturer/supplier as problems resolved quicker.

## 5.2 UE Reconfiguration capability

The 'UE Reconfiguration' capability builds upon the 'UE Configuration Query' capability in that it allows configuration changes to be made to the UE remotely. UE Reconfiguration could be used as part of a fault resolution process to correct a problem on the UE and an example of this is shown in figure 2. Once the cause of the fault has been identified (which in this example is an incorrect parameter) then the UE Reconfiguration capability is used to correct the fault.



NOTE: The first three interactions in this diagram are identical to the UE Configuration Query sequence diagram (figure 1). The last interaction is optional.

**Figure 2: UE Reconfiguration Sequence Diagram**

### 5.2.1 Service aspects

The UE Reconfiguration capability should be able to function both when a user is roaming and is not roaming.

### 5.2.2 MMI aspects

The UE manager needs to be able to obtain permission from the user to change the parameter.

The UE manager should be able to undo the change.

Permission to update the parameter could be obtained by voice or the question could be displayed on the UE screen and the user key in the response.

### 5.2.3 Charging aspects

Flexibility is required for the charging of the UE Reconfiguration capability. In the example illustrated in Figure 2 it is expected that the user would typically be charged for the UEM interaction.

### 5.2.4 Security aspects

The requesting party should be authenticated. There should be a valid relationship between the requesting party and the UE owner, for example explicit permission granted to perform the UE Configuration Query.

Security is even more important for this capability than the UE Configuration Query capability as the UE is being modified. The approach to security could include signing and/or encryption. Integrity protection of the messages on both the downlink and the uplink are required.

NOTE: The security checks have been omitted from the sequence diagram.

### 5.2.5 3GPP Operations System aspects

The 3GPP Operations System should be able to:

- send a command to a UE and receive a response back;
- query the user if it is OK to update a parameter.

The UE manager should have some means of identifying the user if user's IMSI is not forwarded (e.g. if the user contacts CC via the internet).

### 5.2.6 User Equipment aspects

There are UE aspects for both the terminal and the USIM. There needs to be a way of receiving the command on the UE. It would be useful if the names/parameters and data structures are standardised.

### 5.2.7 Network aspects

No changes to the core network have been identified at this time.

### 5.2.8 Benefits

#### 5.2.8.1 User/subscriber

The user/subscriber often lack the knowledge of how to change parameters so this would remove the need for an explanation for how to change a parameter(s) and would reduce the risk of the wrong parameter being changed or the correct parameter being changed to the wrong value. The user would receive an improved service and ideally the fault would be fixed.

#### 5.2.8.2 Network Operator/Service Provider

The Operator/Service Provider would be able to handle support calls and fix the problem more quickly and effectively.

#### 5.2.8.3 UE Manufacturer

The User/subscriber would be happier with UE manufacturer/supplier as problems resolved quicker.

## 5.3 UE Software Update capability

Being able to update the UE software remotely would enable a fault in the UE software to be fixed without an expensive recall and problems could be resolved more quickly and effectively. The user would be able to easily obtain the latest version of software for the UE and so use any new functionality, bug fixes etc. There are potential high risks

in updating or replacing the terminal software. A recovery process could be created in case the modification leads to an unstable and/or faulty mobile status. Some sort of client would be required on the UE and the UE should be able to update itself while in some form of operation. It would be useful if the download mechanisms, file formats, names/parameters and data structures are standardised.

There are different types of non application software on UE and there are varying degrees of difficulty in updating it. Firmware can be modular e.g. the firmware for a codec and there may be a lower risk of updating this than other types of non application software.

3GPP TSG T WG2 provides framework mechanisms for software download of non application (or native) software, but in terms of detailed (Stage 3) specifications, the matter is considered so complex (and costly) that it has been left out of scope of standardisation. There are today no plans to include this in the TSG T WG2 work plan and any solution is left to proprietary mechanisms. This means that TSG T WG2 presently cannot offer any standardised solution to the UE Software Update capability.

See also TS 23.057 [7] subclause 4.14.

Security is even more important for the UE Software Update than the UE Reconfiguration capability as the UE is altered. It should be ensured that the stated UE manufacturer is the true source of the software update. It is essential to ensure the integrity of the software. It is essential to authenticate the requesting party. There should be a valid relationship between the requesting party and the subscriber. It is essential that UEM is properly authorised, that the UE is satisfactorily protected, that IPRs of the UE manufacturers are protected, that downloads are virus free, etc. The software would need to be encrypted by the UE manufacturer and decrypted on the UE. It should be authenticated that the UE manufacturer has certified the software. If unauthorised parties were able to initiate unapproved UE software updates there could be severe consequences for the service provided to users. Integrity protection of the messages on both the downlink and the uplink are required.

The UE Software Update capability should be able to function both when a user is roaming and is not roaming.

Flexibility would be required for the charging of the UE Software Update capability. In the case where the UE Software Update capability is used to avoid an expensive product recall it is expected that typically the UE manufacturer would pay for the UEM interaction. The charging for the case when recovery mechanisms need to be used should also be considered.

At the present time it is the manufacturer's decision as to whether the IMEI and IMEISV are updated during a UE software upgrade. TS 22.016 [10] includes the text "The IMEI shall not be changed after the UE's final production process. It shall resist tampering, i.e. manipulation and change, by any means (e.g. physical, electrical and software)." If the IMEI and/or IMEISV are not updated during a UE software upgrade then they may not accurately represent the capabilities of the UE.

## 5.4 Remote UE Diagnostics capability

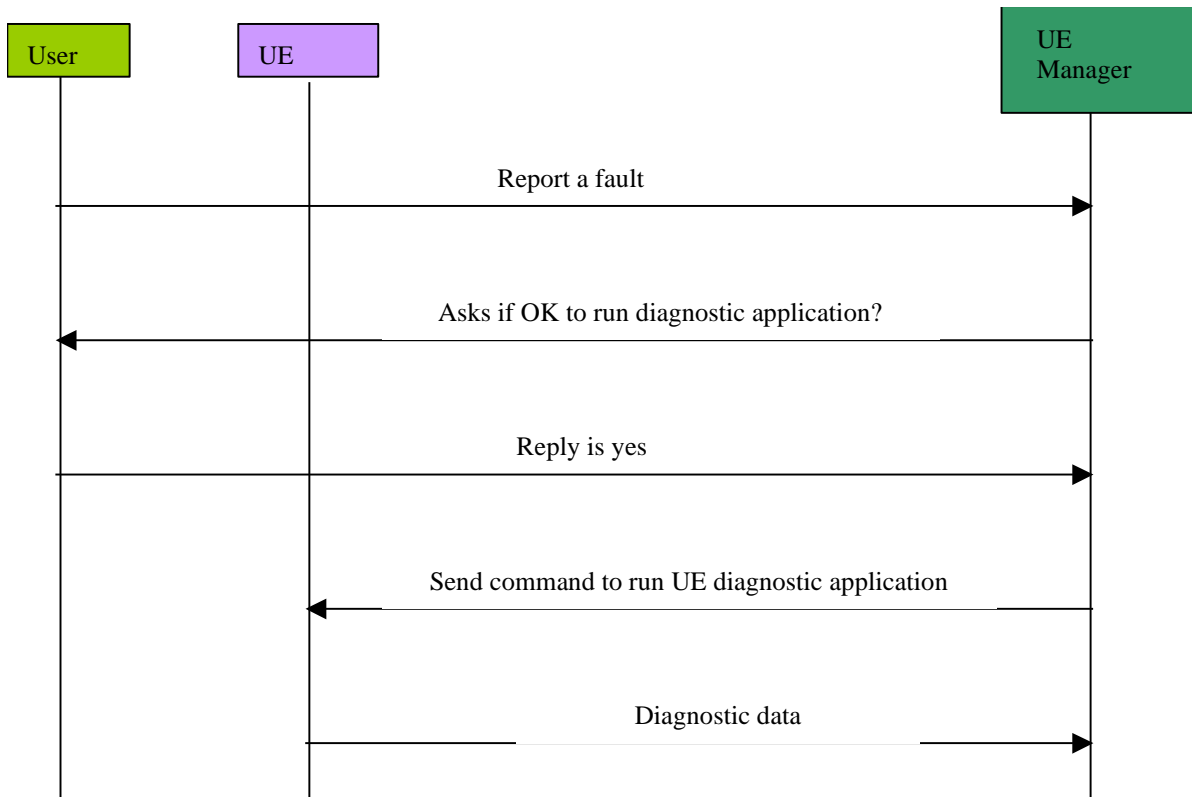
The UE manager could use the 'Remote UE Diagnostics' capability to run diagnostic applications on the User Equipment to aid fault resolution.

There are some different approaches to implementing the Remote UE Diagnostics capability:

- a) Analyse of the responses received by the Configuration Query capability to identify faults for possible rectification using the UE Reconfiguration capability. See subclause 5.2.
- b) A built-in diagnostic application running continuously on the UE so the diagnostic data is available on the UE. On a request from the UE Manager the diagnostic data (from the UE file system or DB) is sent back.
- c) Remotely invoking a diagnostic application built into the UE that sends the diagnostic information back via the network.
- d) Remotely downloading a generic diagnostic application to the UE. The generic diagnostic application would need to use a standardised API in the UE as otherwise an unrealistic degree of standardisation of the internal structure of the UE would be required. In order to use this approach it would need to be possible to download the diagnostic application (see subclause 5.3).
- e) Remotely downloading a diagnostic native software application to the UE. The diagnostic application is invoked and sends diagnostic information back via the network. In order to use this approach it would necessary to

download the diagnostic application (see subclause 5.3). A large number of proprietary diagnostic applications would need to be handled by the UEM system.

Figure 3 is an example of the UE Diagnostics capability utilising a diagnostic application built into the UE that sends the diagnostic information back via the network.



**Figure 3: Remote UE Diagnostics Sequence Diagram utilising diagnostic application built in to UE**

### 5.4.1 Service aspects

Currently when users report a fault the network operator or service provider often finds it difficult to identify whether the fault is with the network or the UE; time and effort is spent investigating this. Being able to remotely identify faults on the UE would reduce the need to investigate the network in order to diagnose faults that are in fact UE related. It is possible that data collected by the UE diagnostic software could assist with the identification of radio network faults, for example by making service availability and performance measurements.

The Remote UE Diagnostics capability should be able to function both when a user is roaming and is not roaming.

### 5.4.2 MMI aspects

The UE manager needs to be able to obtain permission from the user to run and if necessary also download the diagnostic software. Permission could be obtained by voice or the question could be displayed on the UE screen and the user key in the response.

### 5.4.3 Charging aspects

Flexibility is required for the charging of the UE Diagnostics capability. In the case when the UE Diagnostics capability is used to confirm the fault lies with the network and not the UE, it is expected that the UE manager would typically pay for the UEM interaction.



#### 5.4.4 Security aspects

It is essential that the requesting party is authenticated. There should be a valid relationship between the requesting party and the UE owner, for example explicit permission granted to perform the UE Diagnostics capability. It is essential that UEM is properly authorised, that the UE is satisfactorily protected, that IPRs of the UE manufacturers are protected, that downloads are virus free etc. The downloaded software would need to be encrypted by the UE manufacturer and decrypted on the UE. It should be authenticated that the UE manufacturer has certified the downloaded software. The integrity of the software should be ensured and Integrity protection of the messages on both the downlink and the uplink are required.

NOTE: The security checks have been omitted from the sequence diagram.

#### 5.4.5 3GPP Operations System aspects

The 3GPP Operations System should be able to:

- send a command to a UE and receive a response back;
- query the user if it is OK to run a diagnostic application;
- if necessary it should also be possible to download diagnostic applications to the UE.

The UE manager should have some means of identifying the user if the user's IMSI is not forwarded (e.g. if the user contacts CC via the internet).

#### 5.4.6 User Equipment aspects

It should be possible to execute diagnostic applications on the UE. If necessary, it should also be possible to download diagnostic applications to the UE and to delete the executables on completion. It would be useful if the names/parameters and data structures are standardised.

#### 5.4.7 Network aspects

No changes to the core network have been identified at this time.

#### 5.4.8 Benefits

##### 5.4.8.1 User/subscriber

The fault should be fixed faster and so the user would receive an improved service. The user would be less likely to have to return the UE for analysis.

##### 5.4.8.2 Network Operator/Service Provider

The Operator/Service Provider would be able to handle support calls and fix the problem more quickly and effectively.

The problem could be diagnosed remotely rather than have the user return the UE.

##### 5.4.8.3 UE Manufacturer

The User/subscriber would be happier with UE manufacturer/supplier as problems resolved quicker.

## 6 Example of a Possible UEM Architecture

This clause describes an example architecture for the purpose of assessing feasibility.

The User Equipment Management (UEM) architecture provides a collaborative framework to exchange information with a UEM client function to enable the remote management of the Mobile UE.

### 6.1 System component entities and connectivity

Figure 4 provides the basic elements of this architecture and associated interfaces.

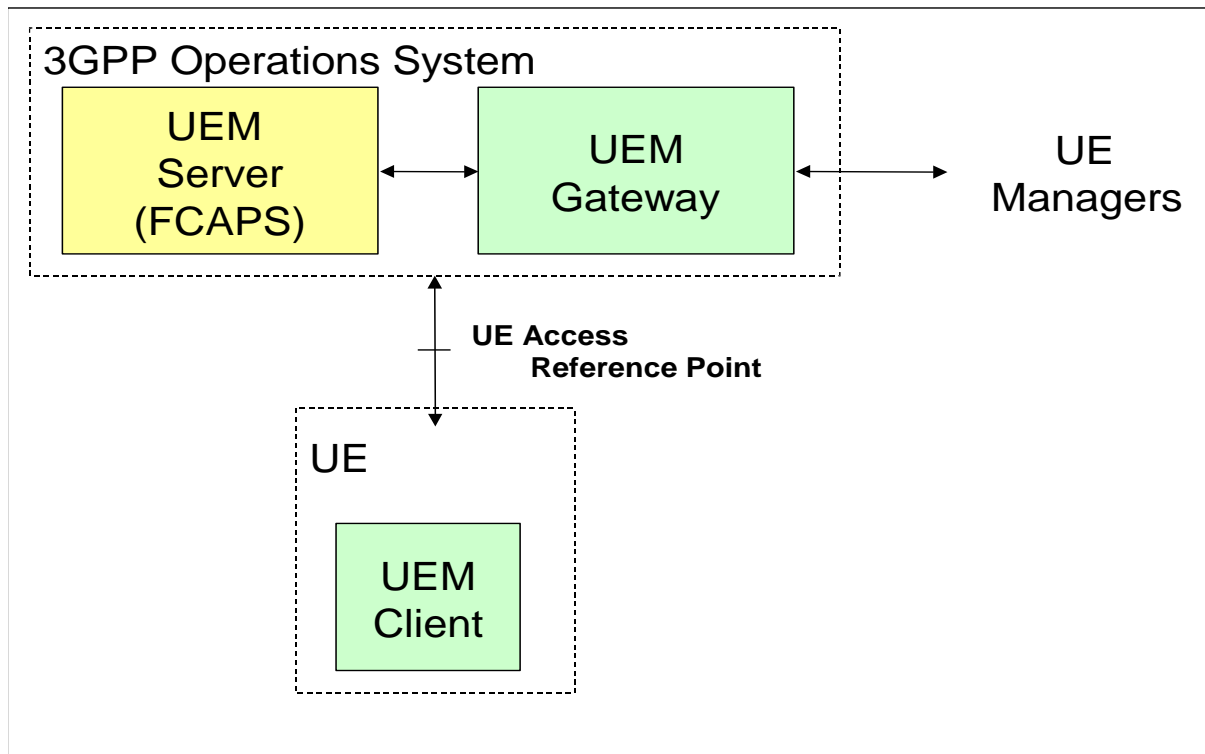


Figure 4: Example User Equipment Management (UEM) architecture

#### 6.1.1 Definition of entities

This subclause describes the entities listed in the architecture (Figure 4).

##### 6.1.1.1 UEM Client

The UEM Client is the component required in the UE to collaborate with the management server to manage the ME and the USIM. Collaboration sessions may include several simultaneous management tasks as instructed by the server.

##### 6.1.1.2 UEM Server

The UEM Server co-ordinates the various UEM functions (FCAPS) that may be performed on clients within its domain. A link from the UEM Server to billing systems would be used to transfer charging information for the UEM interactions. The UEM Server maintains the management clients' session information and forwards the results to the different UE Managers. Example UEM Server functions are:

- UE Reconfiguration;
- Application and Service Reconfiguration;

- Application Error Tracing;
- Remote UE Diagnostics;
- Remote Application Diagnostics;
- Performance Measurements; and
- Virus Detection and Prevention.

NOTE: Not all of these functions are proposed for Release 6.

It is assumed that the network operator will own the UEM Server.

### 6.1.1.3 UEM Gateway

UE managers use the UEM Gateway to provide access (via the UEM server) to the UE client from various UE managers. In this example, the UEM Gateway controls the access available to the UE managers.

It is assumed that the network operator will own the UEM Gateway.

### 6.1.1.4 UE Managers

UE managers use the UEM Gateway to access the UEM clients. Some examples of possible UE managers are:

- Network Operator;
- Network Equipment Provider;
- Service Provider;
- Content Provider;
- User Equipment Manufacturer;
- Application Service Provider;
- Enhanced Service Provider;
- IT-Support Provider;
- Corporate Administrator;
- Customer Care Operator;
- User (via a customer self care service).

## 6.2 Interfaces

This subclause identifies the interface reference points.

### 6.2.1 UE Access Reference Point

Realization of this reference point enables the information exchange between the UEM Server and Clients. Based on the extent of UE equipment capability, this interface may be realized using various connection media and protocols.

## 6.3 Protocols

SyncML Device Management is a strong candidate for the interface between the UE and the UEM Server.

## 7 Project planning

### 7.1 Collaboration

Figure 5 proposes how the UEM work may be structured.

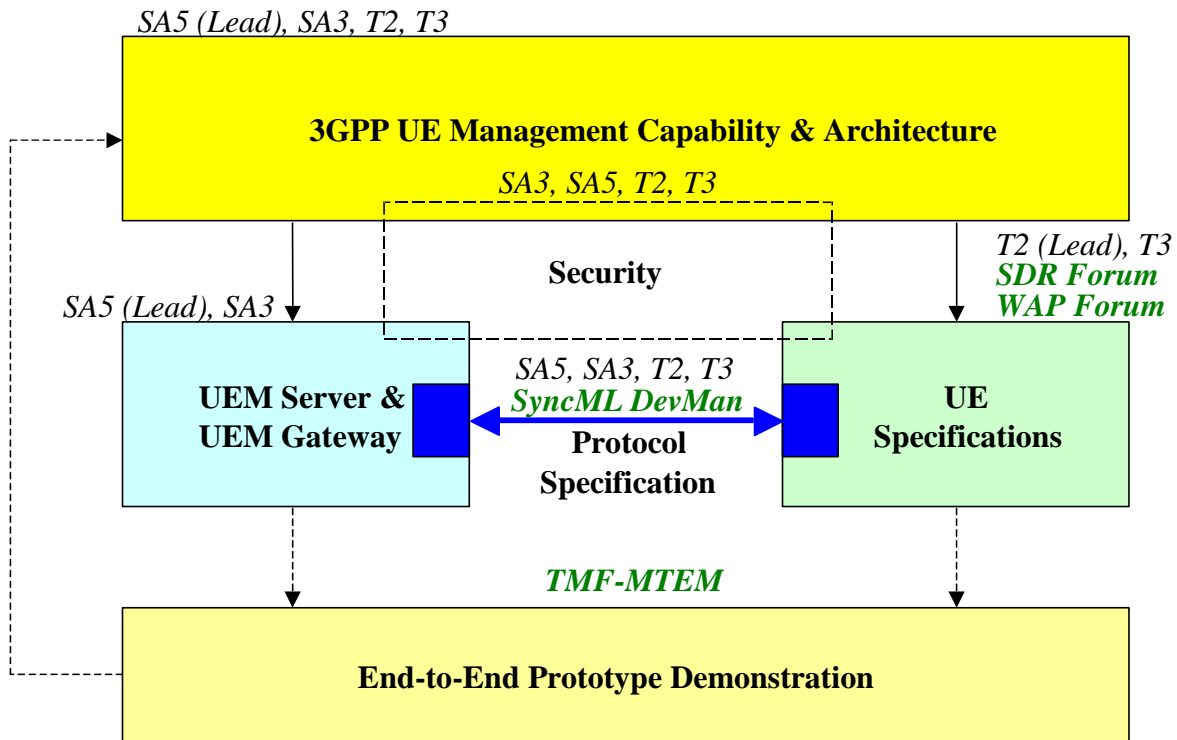


Figure 5: Proposed structure of the User Equipment Management (UEM) work

### 7.2 Proposed plan for post-Release 5 UEM work

The plan for UEM work should be phased. It is expected that the UE Software Update capability would be beyond Release 6. This would also imply that the remote UE Diagnostic capability utilising the UE Software Update capability would be beyond Release 6.

More details on the planning/scheduling have been requested, but are not appropriate for this feasibility study.

The high level UEM plan consists of:

- Produce Work Item Descriptions (WIDs): SA5 Building Block WI, Work Tasks-level WIs for SA3, SA5, T2, T3, etc.
- Produce requirements & architecture: SA5 Work Task-level WI;
- Protocol Specification, Generic User Profile (GUP) & gap analysis: T2 Work Task:

A trusted relationship is needed between the UEM Client and Server. If SyncML Dev Man is selected as the protocol, the content should be specified. It is expected that much of the technology required for UEM is becoming available.

A gap analysis Work Task needs to be performed to determine where there are mismatches between the available technology and that required for UEM.

- UEM security: SA3 Work Task:

A trusted relationship is needed between the UEM client and server, the requestor as well as the UE needs to be authenticated.

- Analysis of compliance to TS 23.227 [11]: T2 Work Task;
- USIM work (e.g. parameter definition) T3 Work Task.

It has been suggested that the first phase of the Remote UE Diagnostics capability should focus on the features which can be remotely fixed in the UE, for example using the UE Reconfiguration capability.

Regarding the GUP work (3GPP TSs 22.240 [2], 23.240 [3], 23.241 [4]), it is today unclear if all of the needed work, such as transport mechanisms and security, based on the GUP concept, can be completed within Release 6.

The SyncML Dev Man is an available standard. However, for maximum efficiency of the solutions, 3GPP TSG T WG2 may request some amendments. The time scales for this is dependent on both the total GUP related work plan and up to the discretion of the SyncML Initiative.

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## 8 Open issues

The following issues have been identified:

- 1 If UE is expanded for example by plugging-in an additional module then how will this be handled? How will the UEM server determine that an additional module has been plugged-in? It is not expected that UEM will extend to PDAs, notebook computers and other devices connected to the UE.
- 2 Can a particular UE or set of UEs be remotely shut down if they are behaving in a way that is detrimental to network performance? The network operator should be able to isolate the faulty User Equipment from the network if it is harming the network; if possible it would be useful to still allow restricted radio and core network access for remedial applications to be downloaded.

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## 9 Risks

- 1 The IMEI and IMEISV returned by some UEs may not be correct. The terminal could have been upgraded and the IMEI/IMEISV not altered to reflect the upgrade, or the terminal may have been subject to unauthorised changes. This means the IMEI and IMEISV cannot be relied on 100% and this should be taken into account.
- 2 An insufficient security framework may be implemented.
- 3 A complete risk analysis has not been done yet.

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## 10 Conclusions

This feasibility study shows that User Equipment Management (UEM) is a very worthwhile area for standardisation and it would bring a number of benefits to the users/subscribers, network operators/service providers and the UE manufacturers/suppliers.

UEM capabilities vary greatly in how easy it will be to implement them so it is recommended that a phased approach be used for planning the UEM standardisation. 3GPP TSG T WG2 presently cannot offer any standardised solution to the UE Software Update capability so it is not recommended that this capability be considered for Release 6. It should be possible for UE manufacturers to implement the capabilities described in the present document independently of one another.

Technology that is becoming available seems to be appropriate for UEM. A gap analysis needs to be performed to identify where there are gaps between what is needed to support UEM and the available technology.

## Annex A: Additional UEM Requirements

This annex contains requirements related to UEM that are in addition to those in clause 4 and are not directly related to the UEM capabilities identified in clause 5. These requirements are included for information-only and the present document does not contain UEM capabilities for these requirements.

**Table A.1: Additional possible User Equipment Management (UEM) requirements**

Ref	Management Function	Requirement
2.	FM	Support the identification of faults
3.	FM	Provide support for the analysis of faults
7.	FM	Show customers the fault process from report of problem to resolution
8.	FM	Video - be able to see what the customer sees on their UE
10.	FM	Ability to "ping" UE for health check/status
12.	FM	Remote control of UE by CSA/second line support
14.	CM	Upgrades - targeted at "problem" models
15.	PM	Highlight capacity levels on the various bearer services to customers
16.	PM	Application Performance
17.	PM	Application history
18.	PM	<ul style="list-style-type: none"> <li>Which applications/products has he/she selected/downloaded (including 3<sup>rd</sup> party applications)?</li> <li>Once an application has been downloaded (e.g. a K-Java game), how often is it used? How is it used, etc.?</li> <li>Include 3<sup>rd</sup> party services/products</li> </ul>
19.	PM	Customer location
20.	PM	Historical customer location
21.	PM	Coverage experience
22.	PM	Customer perceptions of new services
23.	PM	What services/products did he/she use (voice, video...)?
24.	PM	Failed calls details (# dialed, time...)
25.	PM	UE Faults to N/W Ops
27.	PM	Report failure to connect to service(s)
28.	FM	Produce fault logs
29.	FM	Retain fault logs files for fault investigation
30.	PM	Coverage problems – no signal... (location, time)
31.	PM	Return reason for dropped calls/session
32.	PM	Level of radio coverage
33.	PM	<ul style="list-style-type: none"> <li>Radio performance</li> <li>Voice</li> <li>Video</li> <li>Data</li> <li>C/S</li> <li>P/S</li> </ul>
34.	PM	Radio availability
35.	PM	Radio coverage (signal strength)
36.	PM	Data speed probability
37.	PM	Report slow 'data' speeds although signal strength OK
38.	PM	Capacity availability
39.	PM	Capacity experienced

Ref	Management Function	Requirement
40.	PM	Interference/noise
41.	PM	Get network performance data from user equipment
42.	PM	Cell performance from UE - relate to cell site software versions
43.	PM	PS v CS, different bearers, different speeds ↑ and ↓
44.	PM	Historical coverage information for user equipment over all bearers
45.	PM	Cell overlap/multiple cell profiles
46.	PM	Service performance from UE
47.	PM	Provide a regionalised view of service performance
48.	PM	Monitor service performance
49.	PM	Service availability report
50.	PM	Service outage report
51.	PM	SLA reports
52.	PM	For transactions over an earlier period transactions (48 hours?) remotely accessible
53.	PM	For previous "x" transactions
54.	PM	Battery efficiency
55.	PM	<ul style="list-style-type: none"> <li>• Time of day/frequency/duration</li> <li>• Success rates</li> <li>• How is he using the service?</li> <li>• What key did he press when...?</li> <li>• Problems encountered</li> <li>• How often do people turn their mobile on/off?</li> <li>• When do they leave it on/off?</li> <li>• How often/when do user charge batteries, etc.?</li> <li>• Key sequences – Configuration (e.g. WAP)</li> <li>• Key sequences - Usage behaviour (e.g. using phonebook, messages, SIM – toolkit, etc.)</li> <li>• Key sequences – Idiosyncratic behaviour?</li> <li>• How does usage behaviour vary by type of User Equipment, etc.?</li> </ul>
56.	PM	Which bearer was used?
57.	PM	Faster response to usage trends – real-time collection of usage stats via User Equipment
59.	PM	<ul style="list-style-type: none"> <li>• UE performance – application</li> <li>• UE performance by UE type</li> <li>• UE performance data by customer</li> <li>• UE performance by geographic</li> </ul>
61.	SM	Capacity to support volume customers
65.	SM	Maintenance schedule locally
68.	SM	Send questions on new services to UE for customer feedback
69.	SM	Support users setting-up their UE (e.g. from web interface)
70.	SM	Interactive help "don't press that key, press the one above it"
71.	SM	Applications that show what to do next
73.	SM	PC anywhere for mobiles – help customers to add complex services
75.	SM	Modify the user interface to match *owner*
77.	SM	Be able to manage all the elements involved in delivering an application
78.	SM	Monitor the quality of service delivered to customers (video telephony, voice etc.)
79.	SM	Monitor actual coverage as experienced by user
80.	SM	Monitor service delivered to corporates
81.	SM	Monitor service as experienced by user
82.	SM	Ability to recognise degradation of service (ideally before the customer notices and reports it)
83.	SM	UE monitoring of performance and alert the operator when the SLA is being broken
84.	SM	Based on customer priority
86.	SM	<ul style="list-style-type: none"> <li>• By service</li> <li>• Customer specific</li> </ul>

Ref	Management Function	Requirement
87.	SM	"Mr Smith, did you know that your battery is only working at 30% efficiency?..."
88.	SM	Offer trials of services
89.	SM	Add value through experience of 3 <sup>rd</sup> party applications
91.	SM	Set performance thresholds on UE
92.	SM	Re-calibrate/re-tune UE over-the-air
93.	SM	There should be charging mechanisms for UEM.
94.		It is essential the confidentiality of customer personal information is not violated.
149	FM	If a UE has a fault then, under the control of the network, if possible the UE should send information on the fault to the network UEM server.
150	CM	Be able to retrieve the following information from the UE: <ul style="list-style-type: none"> <li>• Applications embedded</li> <li>• Applications added/downloaded</li> <li>• Application version</li> </ul>
Key to Management Function column:		
SM: Service Management.		
CM: Configuration Management.		
FM: Fault Management.		
PM: Performance Management.		

100. Requirement removed.

116. Requirement removed.

117. Requirement removed.

120. Requirement removed.

### Tracking Hardware

97. It should be possible for the UE manager to retrieve the user UE IMEI from at least two sources in order to confirm it:

- The User Equipment;
- A source other than the UE, e.g. subscriber profile database.

98. All existing instances of user UE information should always be up to date and consistent to each other.

### Tracing Errors

106. The UE manager should be able to isolate the faulty UE from the network but still allow restricted remote access for remedial applications to be downloaded. Preventing and Detecting Viruses.

125. The UE manager should be able to verify and guarantee that a downloadable piece of software/application is virus free.

126. The UE manager should be able to remotely download the anti-virus application to the User Equipment.

127. The UE manager should be informed whether the anti-virus application has been successfully installed in the UE.

128. The UE manager should be informed whether the anti-virus application has completed its tasks successfully.

129. The anti-virus application should uninstall and delete itself after completing its tasks unless explicitly instructed not to.

130. It should be possible for an anti-virus application that has already been installed in a UE to automatically check each application and piece of software that is being downloaded to the terminal.

131. It should be possible for the UE manager to remotely trigger an anti-virus application within a UE.



- 132. If a UE is infected with a virus then ideally the UE would be disinfected with a minimum impact on the UE.
- 133. UE configuration should remain unaffected unless otherwise required by the anti-virus application.

**Miscellaneous Requirements**

- 134. UE manager position should be able to retrieve the user UE profile from the subscriber profile or customer relationship database based on IMSI or MSISDN.
- 140. Any collected performance data should be returned to the network UE manager for processing.
- 146. Execution of the application should be possible using certain triggering events.
- 147. It is desirable to be able to manage data on behalf of the customer. Currently SIM card crashes mean the customer has to re-enter all their data. This will be a bigger problem in the future as more data is stored on the UE.

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## Annex B: Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
Dec 2001	S_14	SP-010652	--	--	Submitted to TSG SA #14 (and TSG T #14) for Information	1.0.0	
Mar 2002	S_15	SP-020011	--	--	Submitted to TSG SA #15 for the 2 <sup>nd</sup> time for Information	1.0.0	1.0.4
Jun 2002	S_16	SP-020331	--	--	Submitted to TSG SA #16 for Approval	2.0.0	5.0.0
Sep 2002	S_17	SP-020451	001	--	Corrections to Abbreviations, Architecture, Proposed plan, Risks and Annex A clauses	5.0.0	5.1.0