

# **SOFTWARE ENGINEERING GUIDELINES FOR THE TELECOM APPLICATIONS PROJECTS**

**BASED ON THE ECSS E40 PART 1B  
STANDARD**

---

prepared by/préparé par Roberto Donadio D/TEN-TSU

reference/référence

issue/édition

1

revision/révision

5b

date of issue/date d'édition

19 January 2007

status/état

Final

Document type/type de document

Technical Note

Distribution/distribution

**European Space Agency  
Agence spatiale européenne**

**ESTEC**

Keplerlaan 1 - 2201 AZ Noordwijk - The Netherlands  
Tel. (31) 71 5656565 - Fax (31) 71 5656040

ECSS E40 for  
TelecomAppProjects ver  
1.5b.doc

## A P P R O V A L

|                       |   |                         |                               |
|-----------------------|---|-------------------------|-------------------------------|
| Title<br><i>titre</i> | SOFTWARE ENGINEERING GUIDELINES FOR THE TELECOM APPLICATIONS PROJECTS | issue 1<br><i>issue</i> | revision 5<br><i>revision</i> |
|-----------------------|---|-------------------------|-------------------------------|

|                         |                 |                                |
|-------------------------|-----------------|--------------------------------|
| author<br><i>auteur</i> | Roberto Donadio | date 19/01/2007<br><i>date</i> |
|-------------------------|-----------------|--------------------------------|

|                                   |                     |
|-----------------------------------|---------------------|
| approved by<br><i>approuvé by</i> | date<br><i>date</i> |
|-----------------------------------|---------------------|

## C H A N G E L O G

| reason for change / <i>raison du changement</i>                                       | issue/ <i>issue</i> | revision/ <i>revision</i> | date/ <i>date</i> |
|---|---------------------|---------------------------|-------------------|
| First issue   | 0                   | 2                         | 15/09/2004        |
| Minor changes in the introduction   | 0                   | 3                         | 23/09/2004        |
| Incorporation of modifications after receiving comments from SiS, Font beautification | 0                   | 4                         | 24/09/2004        |
| Addition of a table of correspondence to ECSS 40 Part 1B                              | 0                   | 5                         | 29/09/2004        |
| Inclusion of tailoring and table of compliance  | 0                   | 6                         | 01/10/2004        |
| Intermediate issue after meeting of Task Force  | 0                   | 7                         |                   |
| Re-issue after final comments of TF   | 0                   | 8                         | 23/02/2005        |
| Finalised version after last round of comments  | 1                   | 0                         | 29/03/2005        |
| Minor format editing  | 1                   | 0b                        | 14/04/2005        |
| Incorporation of comments from TEC-SWE  | 1                   | 1                         | 22/05/2005        |
| Compatibility with the deliverables related to terminal developments                  | 1                   | 2                         | 31/05/2005        |
| Inclusion of comments and edits by XI, FF   | 1                   | 3                         | 13/06/2005        |
| Change from "MTR" to "CDR" term, updated references for SoW User Segment              | 1                   | 4                         | 29/08/2006        |
| Updated acronyms related to SoW User Segment  | 1                   | 5b                        | 19/01/2007        |

# **C H A N G E R E C O R D**

Issue: 1 Revision: 5

| <i>reason for change/raison du changement</i>  | <i>page(s)/page(s)</i>   | <i>paragraph(s)/paragraph(s)</i> |
|--|--------------------------|----------------------------------|
| Update of acronyms related to the SoW ARTES 3 User Segment 2007 and term Satcom Applications | Ch. 3 + Appendix 2 + all | *                                |

## **T A B L E O F C O N T E N T S**

|          |   |          |
|----------|---|----------|
| <b>1</b> | <b>INTRODUCTION AND PURPOSE OF THIS DOCUMENT.....</b>                                   | <b>1</b> |
| <b>2</b> | <b>RELATED DOCUMENTS .....</b>  | <b>1</b> |
| <b>3</b> | <b>LIST OF ACRONYMS .....</b>   | <b>1</b> |
| <b>4</b> | <b>REQUIREMENTS .....</b>   | <b>2</b> |
| 4.1      | System engineering process .....  | 2        |
| 4.1.1    | System requirements analysis .....  | 2        |
| 4.1.1.1  | System requirements specification.....  | 2        |
| 4.1.2    | System partitioning .....   | 2        |
| 4.1.2.1  | System partitioning .....   | 2        |
| 4.1.3    | System level integration of software.....   | 2        |
| 4.1.3.1  | Identification of development constraints.....  | 2        |
| 4.1.3.2  | Control and data interfaces for system level integration.....                           | 3        |
| 4.2      | Software management process.....  | 3        |
| 4.2.1    | Software life cycle management.....   | 3        |
| 4.2.1.1  | Definition of software life cycle phases.....   | 3        |
| 4.3      | Software requirements and architecture engineering process.....                         | 4        |
| 4.3.1    | Software requirements analysis .....  | 4        |
| 4.3.1.1  | Identification of requirement unique identifier.....                                    | 4        |
| 4.3.1.2  | Establishment and documentation of software requirements .....                          | 4        |
| 4.3.1.3  | MMI software mock-up development.....   | 4        |
| 4.3.2    | Software architectural design.....  | 4        |
| 4.3.2.1  | Transformation of software requirements into a software architecture .....              | 4        |
| 4.3.2.2  | Software architectural design description .....   | 5        |
| 4.3.2.3  | Development and documentation of the software interfaces .....                          | 5        |
| 4.3.2.4  | Conducting a baseline design review .....   | 5        |
| 4.4      | Software design and implementation engineering process .....                            | 5        |
| 4.4.1    | Coding and testing .....  | 5        |
| 4.4.1.1  | Development and documentation of the software units, test procedures and test data..... | 5        |
| 4.4.1.2  | Development and documentation of the software user manual .....                         | 6        |
| 4.5      | Software validation process .....   | 6        |
| 4.5.1    | Validation process implementation.....  | 6        |
| 4.5.1.1  | Development and documentation of a validation plan.....                                 | 6        |
| 4.5.2    | Validation activities with respect to the requirements baseline .....                   | 7        |
| 4.5.2.1  | Specification of the test procedures .....  | 7        |
| 4.5.2.2  | Execution of the tests .....  | 7        |
| 4.5.2.3  | Updating the software user manual.....  | 7        |

---

|         |  |    |
|---------|--|----|
| 4.5.2.4 | Conducting a qualification review .....                    | 8  |
| 4.6     | Software delivery and acceptance process .....             | 9  |
| 4.6.1   | Software delivery and installation.....                    | 9  |
| 4.6.1.1 | Preparation of the software product .....                  | 9  |
| 4.6.1.2 | Installation activities reporting.....                     | 9  |
| 4.6.2   | Software acceptance.....                                   | 9  |
| 4.6.2.1 | Acceptance test planning .....                             | 10 |
| 4.6.2.2 | Acceptance test execution .....                            | 10 |
| 4.6.2.3 | Supplier's support to customer's acceptance .....          | 10 |
| 4.6.2.4 | Evaluation of acceptance testing.....                      | 10 |
| 4.6.2.5 | Conducting an acceptance review .....                      | 10 |
| 4.7     | Software operation process .....                           | 11 |
| 4.7.1.1 | Problem handling procedures definition .....               | 11 |
| 4.8     | Software maintenance process during the pilot phase .....  | 11 |
| 4.8.1   | Process implementation .....                               | 11 |
| 4.8.1.1 | Software maintenance process planning .....                | 11 |
| 4.8.1.2 | Problem reporting and handling.....                        | 11 |
| 4.8.2   | Problem and modification analysis .....                    | 12 |
| 4.8.2.1 | Problem analysis .....                                     | 12 |
| 4.8.2.2 | Documentation of problem, analysis and implementation..... | 12 |
| 4.8.3   | Modification implementation.....                           | 12 |
| 4.8.3.1 | Documentation of software product changes.....             | 12 |

## 1 INTRODUCTION AND PURPOSE OF THIS DOCUMENT

The purpose of this document is to describe the software engineering processes which apply to projects in the User Segment area supported by ESA in the frame of the different elements of the ARTES Programme. The document is directly derived from the ECSS 40 Part 1B “Space engineering - Software - Part 1: Principles and requirements”.

ECSS standards have been developed through a partnership between the European Space Agency (ESA), national space agencies and European industries. ECSS standards make maximum use of existing and commonly used international standards, e.g. MIL, ISO, CEN, IEC and are recognised internationally.

## 2 RELATED DOCUMENTS

Ref.[1] ECSS-E-40 Part 1B, “Space engineering Software - Part 1: Principles and requirements”, 28 November 2003

Ref.[2] EUI-T/0002093, Issue 1.6, STATEMENT OF WORK - ARTES Elements 3 - “User Terminals (USER SEGMENT)”, 29 August 2006

Ref.[3] EUI-T/0002094, Issue 1.7, STATEMENT OF WORK - ARTES Elements 3 - “Integrated Applications (USER SEGMENT)”, 29 August 2006

## 3 LIST OF ACRONYMS

BDR: Baseline Design Review {Ref.[2], Par.4.2, and Ref.[3], Par.4.2}

CDR: Critical Design Review {Ref.[2], Par.4.3}

COTS: Commercial-Off-The-Shelf

DJF: Design Justification File {Ref.[2], Par.5.6}

EVD: End-to-End Validation Document {Ref.[2], Par.5.5}

FR: Final Review {Ref.[2], Par.4.4, and Ref.[3], Par.4.5}

MMI: Man Machine Interface

PilUP: Pilot Utilisation Plan {Ref.[3], Par.5.3}

PQR: Pilot Qualification Review {Ref.[3], Par.4.3}

PSA: Pilot System Architecture {Ref.[3], Par.5.1}

RSD: Requirements Specification Document {Ref.[2], Par.5.1}

SDA: System Deployment Acceptance {Ref.[3], Par.4.4}

SDE: Software Development Environment

SVD: System Validation Document {Ref.[3], Par.5.2}

## 4 REQUIREMENTS

### 4.1 *System engineering process*

#### 4.1.1 SYSTEM REQUIREMENTS ANALYSIS

##### 4.1.1.1 *System requirements specification*

System requirements shall be derived from an analysis of the specific intended use of the system to be developed and documented. [ECSS E-40 Part1B 5.2.2.1]

EXPECTED OUTPUT:

- *Functions and performance requirements of the system*
- *Interface requirements*
- *Design constraints*
- *Verification and validation product requirements*
- *MMI Requirements*

#### 4.1.2 SYSTEM PARTITIONING

##### 4.1.2.1 *System partitioning*

As a part of the system design process, a physical architecture and design of the system shall be presented.

This description will include the top-level partitioning of the system. The system design is derived from an analysis of the requirements on the system and its functions. [ECSS E-40 Part1B 5.2.3.1]

EXPECTED OUTPUT:

- *Top-level partitioning*

All system requirements shall be allocated and traceable to the different system design partitions. [ECSS E-40 Part1B 5.2.3.1]

EXPECTED OUTPUT:

- *System requirements to system design traceability*

#### 4.1.3 SYSTEM LEVEL INTEGRATION OF SOFTWARE

##### 4.1.3.1 *Identification of development constraints*

Specific development constraints to support the integration of the software into the system have to be identified, such as: specification of the operating system to be used, specification of COTS to be

used (e.g. database and MMI generator), and specification of the SDE to be used. [ECSS E-40 Part1B 5.2.5.5]

EXPECTED OUTPUT:

- *Development constraints*

#### *4.1.3.2 Control and data interfaces for system level integration*

If the software is integrated into a system, all the interfaces between the software and the system shall be specified. [ECSS E-40 Part1B 5.2.5.2]

The external interfaces, specific to software integrated in a system, can be:

- software interfaces with other software in the system (operating system, files, database management system or other applications software);
- hardware interfaces to the specific hardware configuration;
- communication interfaces (e.g. particular network protocols)

EXPECTED OUTPUT:

- *System level interface requirements*

#### *4.1.3.3 Design Justification*

Design decisions shall be documented in a design justification file, which will be updated by the relevant processes in the course of the project lifecycle, and part of the data packages at each review

EXPECTED OUTPUT:

- *Design Justification File*

## **4.2 Software management process**

Management requirements defining the project milestones are described in the tender documentation. Some of the processes may not be applicable, e.g. in case of embedded software.

### **4.2.1 SOFTWARE LIFE CYCLE MANAGEMENT**

#### *4.2.1.1 Definition of software life cycle phases*

To assure effective phasing and planning, the software development life cycle shall be broken into phases, each having its associated milestones. [5.3.2.1]



EXPECTED OUTPUT:

- *Definition of the software life cycle phases*

### **4.3 *Software requirements and architecture engineering process***

#### **4.3.1 SOFTWARE REQUIREMENTS ANALYSIS**

##### **4.3.1.1 *Identification of requirement unique identifier***

Each requirement shall be separately identified in order to allow for traceability. [ECSS E-40 Part1B 5.4.2.3]

EXPECTED OUTPUT:

- *Requirements of unique identifier*

##### **4.3.1.2 *Establishment and documentation of software requirements***

The contractor shall establish and document software requirements, as part of the system design. [ECSS E-40 Part1B 5.4.2.1]

The software requirements shall include:

- *Software requirements specification*
- *Functional and performance specifications*
- *Security specifications, including those related to factors which can compromise sensitive information*
- *Human factors engineering (ergonomics) specifications, Data definition and database requirements*

EXPECTED OUTPUT:

- **Software Requirements**

##### **4.3.1.3 *MMI software mock-up development***

When applicable, the supplier shall develop a software mock-up of the man-machine interface to support the requirements and architecture engineering process, in accordance with the user requirements. [ECSS E-40 Part1B 5.4.2.6]

#### **4.3.2 SOFTWARE ARCHITECTURAL DESIGN**

##### **4.3.2.1 *Transformation of software requirements into a software architecture***

The contractor shall transform the requirements for the software item into an architecture that describes its top-level structure and identifies the software components, ensuring that all the requirements for the software item are allocated to its software components and later refined to facilitate detailed design. [ECSS E-40 Part1B 5.4.3.1]

EXPECTED OUTPUT:

- *Software architectural design*

#### *4.3.2.2 Software architectural design description*

The architectural design description shall as a minimum cover hierarchy, dependency, interfaces and operational usage for the software components. [ECSS E-40 Part1B 5.4.3.2]

EXPECTED OUTPUT:

- *Hierarchy, dependency and interfaces of software components in the software architectural design*

#### *4.3.2.3 Development and documentation of the software interfaces*

The contractor shall develop and document a software architectural design for the interfaces external to the software item and between the software components of the software item. [ECSS E-40 Part1B 5.4.3.7]

EXPECTED OUTPUT:

- *External Interfaces design*
- *Internal interfaces design*

#### *4.3.2.4 Conducting a baseline design review*

The contractor shall conduct a BDR [ECSS E-40 Part1B 5.4.3.14] in line with what described in Par.A.1.4.2 of Ref.[2]).

NOTE: The successful completion of the review establishes a baseline for the development of the software item.

EXPECTED OUTPUT:

- *Approved Baseline Design consisting of:*
  - *Requirements Baseline*
  - *Technical Specification*
  - *Milestone Report*

## **4.4 Software design and implementation engineering process**

### **4.4.1 CODING AND TESTING**

#### *4.4.1.1 Development and documentation of the software units, test procedures and test data*

The contractor shall develop and document the following:

- the coding of each software unit;
- the build procedures to compile and link software units;

**EXPECTED OUTPUT:**

- *Software component design documents and code*
- *Software configuration file - build procedures*

#### 4.4.1.2 *Development and documentation of the software user manual*

The contractor shall develop and document the software user manual. [ECSS E-40 Part1B 5.5.2.8]

**EXPECTED OUTPUT:**

- *Software user manual*

#### 4.4.2 **CRITICAL DESIGN REVIEW**

At the end of the design, the software contractor shall hold a critical design review (CDR) with the customer. During the CDR, the design definition file, software user manual and the associated design justification file are reviewed.

**EXPECTED OUTPUT:**

*CDR milestone report*

The completeness of the software validation activities with respect to the technical specification and their relevant products (e.g. test case specification and simulators) shall be reviewed.

**EXPECTED OUTPUT:**

- Customer approval of the design definition file (e.g. software architectural design, detailed design, code and software user manual)*
- Customer approval of the design justification file (e.g. software unit test plan, software integration test plan, results of unit and integration tests and results of validation with respect to the technical specifications)*

### 4.5 **Software validation process**

Validation process implementation

#### 4.5.1.1 *Development and documentation of a validation plan*

A validation plan shall be developed and documented, including, as a minimum the following:

- items subject to validation;
- validation tasks to be performed;
- resources, responsibilities, and schedule for validation;

**EXPECTED OUTPUT:**

- *Software validation plan - organization and activities*

## 4.5.2 VALIDATION ACTIVITIES WITH RESPECT TO THE REQUIREMENTS BASELINE AND THE TECHNICAL SPECIFICATION

### 4.5.2.1 *Specification of the test procedures*

The contractor shall develop and document, for each validation task of the software item, a set of tests, test cases (inputs, outputs, test criteria) and test procedures for conducting software validation testing. [ECSS E-40 Part1B 5.6.3.1 and 5.6.4.1]

EXPECTED OUTPUT:

- *Test Procedures*

### 4.5.2.2 *Execution of the tests*

The validation tests shall be conducted as specified in the output of the subclause above, including:

- testing with stress, boundary, and singular inputs;
- testing the software product for its ability to isolate and minimize the effect of errors; that is graceful degradation upon failure, request for operator assistance upon stress, boundary and singular conditions;
- testing that the software product can perform successfully in a representative operational environment. [ECSS E-40 Part1B 5.6.4.2 and 5.6.4.2]

EXPECTED OUTPUT:

- *Validation testing report with respect to the requirements baseline and the technical specification*

For the purpose of the validation, priority shall be given to testing. If not possible, other validation methods such as analysis, inspection or review of design shall be used with an appropriate justification. [ECSS E-40 Part1B 5.6.4.2]

EXPECTED OUTPUT:

- *Verification report*

### 4.5.2.3 *Updating the software user manual*

The contractor shall update the software user manual in accordance with the results of the validation activities with respect to the requirements baseline and technical specification. [ECSS E-40 Part1B 5.6.4.3 and 5.6.4.3]

EXPECTED OUTPUT:

- *Software user manual update*

#### 4.5.2.4 *Conducting a qualification review*

A Qualification Review (QR)<sup>1</sup> shall be conducted. [ECSS E-40 Part1B 5.6.4.5] The aim is to verify that the software meets all the requirements, and in particular that verification and validation process outputs enable transition to “qualified state” for the software products..

EXPECTED OUTPUT:

- *Approved QR including*
  - a. *Software release document*
  - b. *Software delivery*
  - c. *Validation testing report*
  - d. *Test specification evaluation*
  - e. *QR milestone report*

The template in Appendix 2 shall be used, so that each test will be documented by using one form. The collection of the forms will be part of the validation review document.

At the qualification review, the validation report will be reviewed; selected tests will be repeated (compatibly with the available time allocated to the review)

## 4.6 *Software verification process*

### 4.6.1 VERIFICATION ACTIVITIES

#### 4.6.1.1 *Verification of software requirements*

The contractor shall verify the software requirements considering the criteria listed below:

- software requirements are traceable to system partitioning and system requirements;
- software requirements are verifiable;
- feasibility of software design;
- feasibility of operations and maintenance;

EXPECTED OUTPUT:

- *Requirements traceability matrices*

#### 4.6.1.2 *Verification of the software architectural design*

The contractor shall verify the architecture of the software item and the interface design considering:

- the chosen design can be derived from requirements;

---

<sup>1</sup> The Qualification Review will be conducted in conjunction with the Final Review in the case of projects for terminal developments

EXPECTED OUTPUT:

- *Software architectural design to requirements traceability matrices*

#### *4.6.1.3 Verification of test specifications*

The contractor shall demonstrate that the test requirements, test cases, and test specifications cover all software requirements of the technical specification or the requirements baseline.

EXPECTED OUTPUT:

- *Traceability of the requirements baseline to the validation tests*
- *Traceability of the technical specification to the validation tests*

## **4.7 Software delivery and acceptance process**

### **4.7.1 SOFTWARE DELIVERY AND INSTALLATION**

#### *4.7.1.1 Preparation of the software product*

The contractor shall prepare the deliverable software product for its installation in the target platform. [ECSS E-40 Part1B 5.7.2.1]

EXPECTED OUTPUT:

- *Software delivery*
- *Software release document*

The above outputs are expected to remain internal document to the project.

#### *4.7.1.2 Installation activities reporting*

The resources and information to install the software product shall be determined and be available. The supplier shall assist the user with the set-up activities.

It shall be ensured that the software code and databases initialize, execute and terminate as specified in the installation plan.

The installation events and results shall be documented and presented as part of the acceptance package. [ECSS E-40 Part1B 5.7.2.4]

EXPECTED OUTPUT:

- *Installation report*

### **4.7.2 SOFTWARE ACCEPTANCE**

This activity is part of the acceptance milestone.

#### 4.7.2.1 *Acceptance test planning*

The contractor shall establish an acceptance test plan specifying the intended acceptance tests with tests suited to the target environment. The test suite will be a representative set of tests to be selected and proposed by the contractor and agreed in advance of the tests execution with ESA.

[ECSS E-40 Part1B 5.7.3.1]

EXPECTED OUTPUT:

- *Acceptance test plan*

#### 4.7.2.2 *Acceptance test execution*

The contractor shall perform the acceptance testing in presence of a ESA-nominated officer based on the tests suite described in 3.6.3.1 [ECSS E-40 Part1B 5.7.3.2]

EXPECTED OUTPUT:

- *Acceptance test report*

#### 4.7.2.3 *Contractor's support to customer's acceptance*

The contractor shall support the users' acceptance reviews and testing of the software product. [ECSS E-40 Part1B 5.7.3.4]. The results of the acceptance reviews and testing shall be documented.

EXPECTED OUTPUT:

- *SDA milestone report*
- *Acceptance testing documentation*

#### 4.7.2.4 *Evaluation of acceptance testing*

The acceptance tests shall be evaluated with respect to the requirements baseline. [ECSS E-40 Part1B 5.7.3.5]

EXPECTED OUTPUT:

- *Traceability of acceptance tests to the requirements baseline*

#### 4.7.2.5 *Conducting an acceptance review*

The software contractor's acceptance support task shall support the customer's acceptance activities in preparation of the Acceptance Review. [ECSS E-40 Part1B 5.7.3.6]. The acceptance review part of the SDA shall be conducted in accordance with the procedures established in 3.6.3.1. [ECSS E-40 Part1B 5.7.3.6]

EXPECTED OUTPUT:

- *Acceptance testing documentation*
- *Software release document*
- *Software delivery*
- *Acceptance Review milestone report*

## **4.8 Software operation process**

The operation process comprises the activities and tasks of the operator. The process covers the operation of the software product and operational support to users. Because operation of a software product is integrated into the operation of the system, the activities and tasks of this process refer to the system. [ECSS E-40 Part1B 5.9.1]

### **4.8.1.1 Problem handling procedures definition**

The contractor shall establish procedures and tools for receiving, recording, resolving, tracking problems, and providing feedback.

EXPECTED OUTPUT:

- *Problem and nonconformance report* [ECSS E-40 Part1B 5.9.2.2]

## **4.9 Software maintenance process during the pilot phase**

The maintenance process contains the activities and tasks of the contractor. The objective is to modify an existing software product while preserving its integrity. This process includes the upgrades of the software product.

This process consists of the following activities [ECSS E-40 Part1B 5.10]:

- process implementation
- problem and modification analysis
- modification implementation
- conducting maintenance reviews
- software migration

### **4.9.1 PROCESS IMPLEMENTATION**

#### **4.9.1.1 Software maintenance process planning**

The contractor shall develop, document, and execute plans and procedures for conducting the activities and tasks of the maintenance process. Software maintenance shall be performed using the same procedures, methods, tools and standards as used for the development. [ECSS E-40 Part1B 5.10.2.1, 5.10.2.2]

EXPECTED OUTPUT:

- *Maintenance plan - plans and procedures*

#### **4.9.1.2 Problem reporting and handling**

The contractor shall establish procedures for receiving, recording and tracking problem reports and modification requests, providing feedback to the requester. [ECSS E-40 Part1B 5.10.2.3a]

EXPECTED OUTPUT:

- *Maintenance plan - problem reporting and handling*



Whenever problems are encountered, they shall be recorded and entered in accordance with the change control established. [ECSS E-40 Part1B 5.10.2.3b]

EXPECTED OUTPUT:

- *Problem and on-line report*

## 4.9.2 PROBLEM AND MODIFICATION ANALYSIS

### 4.9.2.1 *Problem analysis*

The contractor shall analyse the problem report or modification requests for its impact on the existing system, and the interfacing systems for the following [ECSS E-40 Part1B 5.10.3.1]:

- type (e.g. corrective, improvement, preventive, or adaptive to new environment);
- scope (e.g. size of modification, cost involved, and time to modify);
- criticality (e.g. impact on performance, safety, or security).

-

EXPECTED OUTPUT:

- *Problem analysis report*

### 4.9.2.2 *Documentation of problem, analysis and implementation*

The contractor shall document the problem or the modification request as part of the problem analysis report or in the modification analysis report, respectively [ECSS E-40 Part1B 5.10.3.4].

EXPECTED OUTPUT:

- *Problem analysis report*

## 4.9.3 MODIFICATION IMPLEMENTATION

### 4.9.3.1 *Documentation of software product changes*

All changes to the software product shall be documented in accordance with the procedures for document control and configuration management. This shall be documented as part of the finalised PSA [ECSS E-40 Part1B 5.10.4.2].

EXPECTED OUTPUT:

- *Software Product Change*
- *Design Justification*

## Appendix 1 – Form to be used during validation/acceptance testing

| Test Number - Test Name   |            | Notes            |
|---|------------|------------------|
| <b>Objective :</b>  |            |                  |
| <b>Requirements Trace :</b>                                     |            |                  |
| <b>Test Set-up and Configuration :.</b>                         |            |                  |
| <b>Test Procedure :.</b><br><br>Step 1<br><br>Step 2<br><br>... |            |                  |
| <b>Pass / Fail Criteria:</b>                                    |            |                  |
| <b>Observations</b>   |            |                  |
| <b>Conclusions</b>  |            |                  |
| <b>Signatures</b>   | Print Name | <i>Signature</i> |

## Appendix 2 – Summary of software deliverables

| Ref.    | Contributions  | Satcom Applications |            | User Terminals      |            |
|---------|--|---------------------|------------|---------------------|------------|
|         |  | Project deliverable | Submission | Project deliverable | Submission |
| 4.1.1.1 | Functions and performance requirements of the system   | PSA                 | Proposal   | RSD                 | Proposal   |
|         | Interface requirements   | PSA                 | Proposal   | RSD                 | Proposal   |
|         | Design constraints   | PSA                 | Proposal   | RSD                 | Proposal   |
|         | Verification and validation product requirements   | PSA                 | Proposal   | RSD                 | Proposal   |
|         | MMI Requirements   | PSA                 | Proposal   | RSD                 | Proposal   |
| 4.1.1.2 | Top-level partitioning   | PSA                 | Proposal   | RSD                 | BDR        |
|         | System requirements to system design traceability  | PSA                 | Proposal   | RSD                 | BDR        |
| 4.1.3.1 | Development constraints  | PSA                 | Proposal   | RSD                 | BDR        |
| 4.1.3.2 | System level interface requirements  | PSA                 | Proposal   | RSD                 | BDR        |
| 4.1.3.3 | Design Justification File  | PSA                 | Proposal   | RSD                 | BDR        |
| 4.2.1.1 | software life cycle phases   | PSA                 | Proposal   | RSD                 | BDR        |
| 4.3.1.1 | Requirements of unique identifier  | PSA                 | Proposal   | RSD                 | BDR        |
| 4.3.1.2 | Software Requirements  | PSA                 | BDR        | RSD                 | BDR        |
| 4.3.1.3 | Mock up of the MMI   | PSA                 | BDR        | RSD                 | BDR        |
| 4.3.2.1 | Software architectural design  | PSA                 | BDR        | RSD                 | BDR        |
| 4.3.2.2 | Hierarchy, dependency and interfaces of software components in the software architectural design | PSA                 | BDR        | RSD                 | BDR        |
| 4.3.3.3 | External Interfaces design   | PSA                 | BDR        | RSD                 | BDR        |
|         | Internal interfaces design   | PSA                 | BDR        | RSD                 | BDR        |
| 4.3.2.4 | Approved Baseline Design consisting of:  |                     |            |                     |            |
|         | • BDR milestone report   | PSA                 | BDR        | RSD                 | BDR        |
|         | • Requirements Baseline  | PSA                 | BDR        | RSD                 | BDR        |
|         | • Technical Specification  | PSA                 | BDR        | RSD                 | BDR        |
| 4.4.1.1 | Software component design documents and code   | PSA                 | PQR        | DJF                 | CDR        |
|         | Software configuration file - build procedures   | PSA                 | PQR        | DJF                 | CDR        |
| 4.4.1.2 | Software user manual   | PSA                 | PQR        | DJF                 | CDR        |
| 4.4.2   | Approved CDR documentation consisting of:  |                     |            |                     |            |

|                |   |            |            |            |            |
|----------------|---|------------|------------|------------|------------|
|                | <ul style="list-style-type: none"> <li>• <i>CDR milestone report</i></li> </ul>                               | <i>N/a</i> | <i>N/a</i> | <i>DJF</i> | <i>CDR</i> |
|                | <ul style="list-style-type: none"> <li>• <i>Customer approval of the design definition file</i></li> </ul>    | <i>N/a</i> | <i>N/a</i> | <i>DJF</i> | <i>CDR</i> |
|                | <ul style="list-style-type: none"> <li>• <i>Customer approval of the design justification file</i></li> </ul> | <i>N/a</i> | <i>N/a</i> | <i>DJF</i> | <i>CDR</i> |
| <i>4.5.1</i>   | <i>Software validation plan - organisation and activities</i>   | <i>SVD</i> | <i>BDR</i> | <i>EVD</i> | <i>BDR</i> |
| <i>4.5.2.1</i> | <i>Test Procedures</i>  | <i>SVD</i> | <i>PQR</i> | <i>EVD</i> | <i>CDR</i> |
| <i>4.5.2.2</i> | <i>Validation testing report with respect to the requirements baseline and the technical specification</i>    | <i>SVD</i> | <i>PQR</i> | <i>EVD</i> | <i>FR</i>  |
|                | <i>Verification report</i>  | <i>SVD</i> | <i>PQR</i> | <i>EVD</i> | <i>FR</i>  |
| <i>4.5.2.3</i> | <i>Software user manual update</i>  | <i>PSA</i> | <i>PQR</i> | <i>DJF</i> | <i>FR</i>  |
| <i>4.5.2.4</i> | <i>Approved QR documentation consisting of :</i>  |            |            |            |            |
|                | <ul style="list-style-type: none"> <li>• <i>Software release document</i></li> </ul>                          | <i>PSA</i> | <i>PQR</i> | <i>DJF</i> | <i>FR</i>  |
|                | <ul style="list-style-type: none"> <li>• <i>Software delivery</i></li> </ul>                                  | <i>PSA</i> | <i>PQR</i> | <i>DJF</i> | <i>FR</i>  |
|                | <ul style="list-style-type: none"> <li>• <i>Test specification evaluation</i></li> </ul>                      | <i>PSA</i> | <i>PQR</i> | <i>DJF</i> | <i>FR</i>  |
|                | <ul style="list-style-type: none"> <li>• <i>Validation testing report</i></li> </ul>                          | <i>PSA</i> | <i>PQR</i> | <i>DJF</i> | <i>FR</i>  |
|                | <ul style="list-style-type: none"> <li>• <i>QR milestone report</i></li> </ul>                                | <i>PSA</i> | <i>PQR</i> | <i>DJF</i> | <i>FR</i>  |
| <i>4.6.1.1</i> | <i>Requirements traceability matrices</i>   | <i>PSA</i> | <i>BDR</i> | <i>RSD</i> | <i>BDR</i> |
| <i>4.6.1.2</i> | <i>Software architectural design to requirements traceability matrices</i>                                    | <i>PSA</i> | <i>BDR</i> | <i>RSD</i> | <i>BDR</i> |
| <i>4.6.1.3</i> | <i>Traceability of the requirements baseline to the validation tests</i>                                      | <i>SVD</i> | <i>PQR</i> | <i>EVD</i> | <i>FR</i>  |
|                | <i>Traceability of the technical specification to the validation tests</i>                                    | <i>SVD</i> | <i>PQR</i> | <i>EVD</i> | <i>FR</i>  |
| <i>4.7.1.1</i> | <i>Software delivery</i>  | <i>SVD</i> | <i>SDA</i> |            | <i>FR</i>  |
|                | <i>Software release document</i>  | <i>SVD</i> | <i>SDA</i> | <i>DJF</i> | <i>FR</i>  |
| <i>4.7.1.2</i> | <i>Installation report</i>  | <i>SVD</i> | <i>SDA</i> | <i>DJF</i> | <i>FR</i>  |
| <i>4.7.2.1</i> | <i>Acceptance test plan</i>   | <i>SVD</i> | <i>SDA</i> | <i>EVD</i> | <i>FR</i>  |
| <i>4.7.2.2</i> | <i>Acceptance test report</i>   | <i>SVD</i> | <i>SDA</i> | <i>EVD</i> | <i>FR</i>  |
| <i>4.7.2.3</i> | <i>Acceptance milestone report</i>  | <i>SVD</i> | <i>SDA</i> | <i>DJF</i> | <i>FR</i>  |

|         |   |            |            |            |           |
|---------|---|------------|------------|------------|-----------|
|         | <i>Acceptance testing documentation</i>   | <i>SVD</i> | <i>SDA</i> | <i>EVD</i> | <i>FR</i> |
| 4.7.2.4 | <i>Traceability of acceptance tests to the requirements baseline</i>                          | <i>SVD</i> | <i>SDA</i> | <i>EVD</i> | <i>FR</i> |
| 4.7.2.5 | <i>Acceptance testing documentation including :</i>   |            |            |            |           |
|         | <ul style="list-style-type: none"> <li>• <i>Software release document</i></li> </ul>          | <i>SVD</i> | <i>SDA</i> | <i>DJF</i> | <i>FR</i> |
|         | <ul style="list-style-type: none"> <li>• <i>Software delivery</i></li> </ul>                  | <i>SVD</i> | <i>SDA</i> | <i>DJF</i> | <i>FR</i> |
|         | <ul style="list-style-type: none"> <li>• <i>Acceptance Review milestone report</i></li> </ul> | <i>SVD</i> | <i>SDA</i> | <i>DJF</i> | <i>FR</i> |
| 4.8.1.1 | <i>Problem and non-conformance report</i>   | <i>PSA</i> | <i>FR</i>  | <i>DJF</i> | <i>FR</i> |
| 4.9.1.1 | <i>Maintenance plan - plans and procedures</i>  | <i>SVD</i> | <i>FR</i>  | <i>EVD</i> | <i>FR</i> |
| 4.9.1.2 | <i>Maintenance plan - problem reporting and handling</i>                                      | <i>SVD</i> | <i>FR</i>  | <i>EVD</i> | <i>FR</i> |
| 4.9.1.3 | <i>Problem and on-line report</i>   | <i>SVD</i> | <i>FR</i>  | <i>EVD</i> | <i>FR</i> |
| 4.9.2.2 | <i>Problem analysis report</i>  | <i>SVD</i> | <i>FR</i>  | <i>DJF</i> | <i>FR</i> |
| 4.9.3.1 | <i>Software Product Change</i>  | <i>PSA</i> | <i>FR</i>  | <i>RSD</i> | <i>FR</i> |
| 4.9.3.1 | <i>Design Justification</i>   | <i>PSA</i> | <i>FR</i>  | <i>DJF</i> | <i>FR</i> |