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SOFTWARE REQUIREMENTS

GRIP MMI: SCIENTIFIC SIGNALS DISPLAY

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Software requirements
GRIP MMI: scientific signals display

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SUMMARY : This document describes the requirements for GRIP scientific display development (GRIP MMI).

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GLOSSARY AND LIST OF TBC AND TBD ITEMS

CADMOS	Centre d'Aide au Développement des activités en Micro-pesanteur et des Opérations Spatiales
CCSDS	Consultative Committee for Space Data Systems
CNES	French Space Agency
CPU	Central Processing Unit
e.g.	exempli gratia (=for example)
EPM	European Physiology Modules Facility
ESA	European Space Agency
HK	Housekeeping
HRD	High Rate Data
LED	Light Emitting Diode
MMI	Man Machine Interface
OS	(ISS) Operations Summary
PTR	Post-Test Review
Rev.	Revision
TM	Telemetry
TRR	Test Readiness Review
US	United States (of America)

List of TBC items:

List of TBD items:

1. OVERVIEW

This document contains all requirements for the GRIP scientific display and its external connections. The GRIP MMI application will run in CADMOS control room as well as in any remote location receiving the GRIP data packets. How GRIP TM data will be available to remote location in accordance with security requirements is not in the scope of this document.

Note: naming GRIP and DEX are equivalent.

2. DOCUMENTATION

2.1. REFERENCE DOCUMENTS

RD1 Handling of science data with potential medical applications
NOLAN John, 20/02/2012, Issue 01, Rev. 00
OPS-SCB-DIR-003

RD2 Space Product Assurance - Software product assurance
25/06/2010, Issue 5
RNC-ECSS-Q-ST-80

RD3 Configuration and Information Management
30/03/2009, Issue 3
RNC-ECSS-M-ST-40

2.2. APPLICABLE DOCUMENTS

AD1 DEXTEROUS Manipulation (GRIP) Experiment Scientific Requirements
SUNDBLAD Patrik, 02/01/2012, Issue 2, Rev. 0
SCI-ESA-HSO-ESR-DEX

AD2 DEX SOFTWARE INTERFACE CONTROL DOCUMENT
QinetiQ Space nv, 14/01/2014, Issue E, Rev. 1
DEX-ICD-00383-QS

3. REQUIREMENTS

3.1. OVERALL DESIGN

DE_010

GRIP MMI shall fit in a single configurable display.

DE_020

By default GRIP MMI should display the latest data received.
It should be possible to scroll the time backward and a button should allow to return to “live” monitoring for strip charts and phase plots (§3.2.1 & §3.2.2). The time range of the “buffer” capability shall be an adjustable parameter of the GRIP MMI .ini file.

3.2. SCIENTIFIC DISPLAY CONTENT

The following is a description based on GRIP scientific team inputs of the data items that are useful to see in real time during the execution of the GRIP experiment. These inputs are based on the GRIP experiment described by AD1[DA1] (DEXTEROUS Manipulation (GRIP) Experiment Scientific Requirements). The purpose of the data display is to monitor the progress of the experiment run and to catch anomalies in either the equipment or in the execution by the subject, to correct the situation in real-time.

3.2.1. Data as a function of time (strip charts)

SCI_010

GRIP MMI shall display a colour status of each markers visibility.
Manipulandum and wrist markers should be together and quickly identifiable that enough markers are visible to allow 3D positioning of these two items.

SCI_020

GRIP MMI shall allow picking into a list of parameters to be displayed as strip charts (function of time):

- Visibility
  - Shall include the visibility of each marker, but also the visibility of the Manipulandum (manipulated object).
  - 0 or 1 as a function of time
- Manipulandum Position
  - X, Y, Z
  - It must be clear when the position of the Manipulandum is visible or not.
- Manipulandum Orientation
  - quaternion to be transformed into roll, pitch, yaw
- Manipulandum Tangential Velocity
  - to be computed from X, Y, Z
  - shall be filtered, with a recursive filter parameter that can be configured to match the one used by the inflight software
  - no need for high accuracy, only used to visually detect movement onset[MM2]
- Grip Force
- Load Force
  - shall include X, Y and Z
- Load Torque
  - around each of 3 axes
- Centre of Pressure (COP)
  - X, Y with respect to the center of the force sensors
  - dashed lines on the strip chart should show the range of permitted values that will assure good moisture measurements
- Target State
  - on/off for each target LED
- Sound State
  - Tone value

SCI_030

A window shall allow to organize the several strip chats in a configurable order, the window should be scrollable if too many parameters are displayed at the same time.

SCI_040

Strip chart time parameter should be adjustable as well as ordinate when applicable with manual and auto-scale capabilities.

3.2.2. Data as XY (phase) plots:

SCI_050

GRIP MMI shall display the following phase plot:

- Manipulandum position in the sagittal plane (side view)
- Manipulandum position in the horizontal plane (top view)
- CoP in X and Y. With a parameter allowing to display a circle to circumscribe the acceptable range of values.

3.2.3. Texts

SCI_060

GRIP MMI shall display permanently the current:

- subject ID
- running protocol
- Task, Step

SCI_070

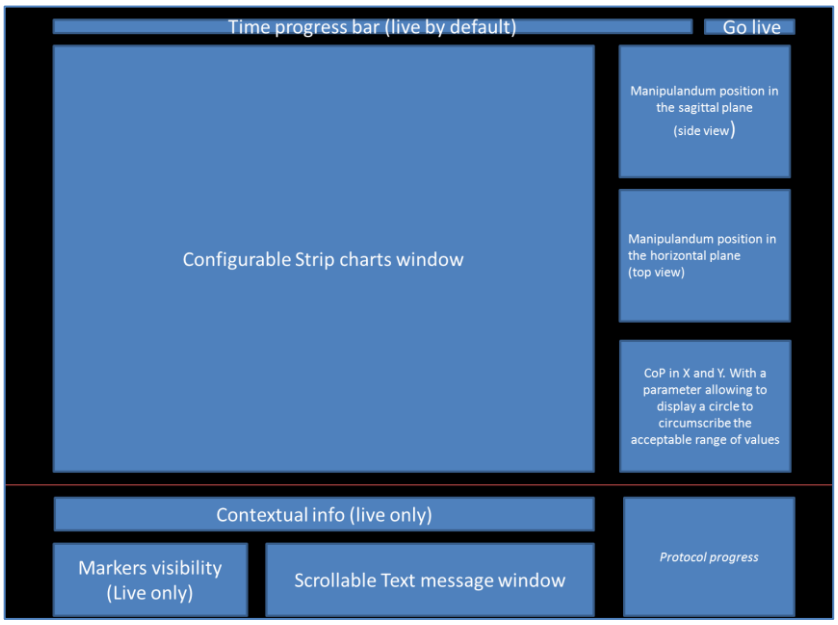
There shall be a scrollable text window at the bottom of the display showing time-stamped packets such as status or error messages that GRIP might generate.
In particular, it is needed to see when exceptions occur, such as a post-hoc test that fails, and the decision taken by the subject (retry, ignore, abandon).

SCI_080

GRIP MMI shall allow following science performance progress step by step using the performed science protocol script as an input. It shall appear the two previous steps, the on-going step and the two next steps.

3.2.4. Graphical User Interface proposal

See above a proposal of GRIP MMI display organization.



3.3. SOFTWARE ENVIRONEMENT REQUIREMENT

SW_010

GRIP MMI shall use as inputs the GRIP data packet. AD2[DA3] (DEX SOFTWARE INTERFACE CONTROL DOCUMENT).

SW_020

GRIP MMI shall run on EPM HRD workstation. The application should fit current workstation configuration and allow future Operating System upgrade (Windows 7 Pro, 64bits).
EPM-HRD current configuration :
- Intel core 2 DUO 2,93Ghz
- Graphical card : ATI RadeonHD 2400 Pro
- Network card : Broadcom netlink Gb configured to 100 Mb/s- Memory : 2 Go
- Hard disk : 150 Go
- OS : Win XP pro US

SW_030

GRIP MMI display size shall fit to control room monitor: 1600x1200 pixels
GRIP MMI display should fit both 4:3 and 16:9 (1600x1080)screens.

SW_040

MMI shall connect either to local IPv4-Address / Port or to external Server IPv4-Address / Port e.g. running in OPS-LAN (connected to CCSDS as data provider) or via Internet connected to EPM-TM-Proxy.

SW_050

MMI shall save connection settings in configuration file. (e.g. INI-File)

SW_060

MMI shall allow secured deletion of all received TM packets to ensure user capability to fulfil ESA data protection policy. RD1[DR4] (Handling of science data with potential medical applications)

SW_070

GRIP MMI shall be updated at each arrival of a GRIP TM packet (2hz[EVD5]) with data resolution of 20Hz resolution. HK parameter are updated with 1Hz frequency.
Period when no packet is received should be clearly identified for both real-time status and strip-charts (e.g. change background color to grey)

3.4. PRODUCT ASSURANCE

PA_010

The vendor shall provide a conformity matrix to the requirements defined in this document.

PA_020

The software development cycle shall include the following phases:
- software specification
- design
- coding / unit tests,
- validation / acceptance.

PA_030

Technical meeting with the CNES (milestone) is needed after software specification and validation phase to confirm the work performed during these phases meet the users' needs. It can be done by teleconference.

PA_040

The specification phase activities consist at least in:

- Identifying the needs expressed by the customer on completion of the latter's needs analysis, and then in translating them in terms of the functions to be fulfilled by the software and of interfaces with the outside and among themselves,
- details on the sequence of functionality,
- details on the constraints (performance, priorities, storage occupancy),
- Analysing, according to the needs to be covered, the part of the software which could be re-used for further experiments using GRIP payload (ie GRASP).
- Designing a man-machine interface mock-up. This mock-up must show:
  - the content of the screen,

The output elements of the specification phase shall be described in a software specification document.

PA_050

Future users must participate in the validation of the man-machine interface mock-up (software specification phase milestone).

PA_060

The design activity consists at least in:

- defining the structural breakdown of the application into software constituents, and in detailing each one of them,
- defining the data flow and the interfaces.
- evaluating resources (core memory, mass storage, CPU, peripheral equipment…).

The output elements of the design phase shall be described in a design document.

PA_070

The coding and unit test activities are:
- the coding of the constituents,
- the performance of unit tests on the constituents
- the integration tests between constituents.

PA_080

The activities in the validation phase consist in conducting the test plans in order to check that the software fulfils its specified functions.

PA_090

Prior testing, the application executable will be generated at CADMOS based on source code provided by the developer. The validation tests must cover all the software specification requirements

PA_100

The validation tests must be performed on stable software whose version is registered by configuration management.
Any modification of the configuration during the validation phase must be recorded.

PA_110

The validation phase at CNES is preceded by a Test Readiness Review board (TRR) and closed by a Post Test Review (PTR). After this meeting, all the updated documentation must be accepted by the CNES.

3.5. CONFIGURATION

CONF_010

The software constituents shall be coded in an advanced programming language with software development environment to be accepted by CNES before the beginning of the coding activity.

CONF_020

The vendor shall deliver all the configuration elements of each software Configuration Items. The configuration elements of software Configuration Item is the organized set of:
- source elements specific to this Item and from which this Item is produced or described (source files, generation and assembly procedures, design and operating documentation, etc.),
- specific means necessary to produce, test or operate it,
- references of the non-specific elements necessary to construct or produce the operable item.

CONF_030

CNES will be proprietary of the software source code and will use them if necessary.

CONF_040

The delivery shall include a Configuration Description File containing:
- Configuration Item identity information (title, role, producing company, version, reference version, etc.)
- Modifications made in comparison to the previous version
- Anomalies and change requests status
- List of files contained in the delivery with checksum md5 list (source files, files in the installable product, files / modules on the operating site, etc…)
- List and applicable version of the reference/delivered documents
- Means required for developing / generating / operating (Inventory (name, version, supplier, and role) of the hardware and software means necessary (operating system, compilers, libraries, packages…).
- Detailed generating instructions (How to recover, from the delivered media, the delivered elements, to generate what is necessary (binaries, documents…), to obtain software ready to be installed, customized and used (in compliance with the Installation Manual)

CONF_050

The vendor shall deliver all the software with a compressed file .zip. The name of the file shall contain the name of the configuration item and its specific version.

CONF_060

All executable binaries shall be able to display their name and version.

CONF_070

The generating procedure shall describe at least the following parameters:
- the root directory of the sources files,
- the directory with required libraries,
- the version of the product to be generated,
- the main compilation option that could be adjusted.
- the list of expected outputs (path, file, size, checksum)
- the list of acceptable warning.

CONF_080

The installation procedure shall control the following tasks:
- Unzip and control the element to be installed (for huge software),
- Create directories and files necessary for the use of the software
- Adjust environment variables and access rights,
- Purge obsolete files.
- Run at the end a fingerprint of the installed product,

CONF_090

The installation procedure shall cover the installation from scratch or from a previous version.

CONF_100

The self-documentation rules intrinsic to the programming language (ex: comments that can be used by javadoc for the Java language) must be applied.

CONF_110

The coding shall complies with the following rules:
- Each code module includes a comment header containing at least the following headings:
  - project name
  - module name
  - release
  - author
  - date
  - role and purpose of the module
- Each order of conditional jump or break in sequence is commented by explaining the purpose of the disconnection.
- Each function or subroutine must specify its input, output or input/output parameters, with, for each one:
  - its name,
  - its meaning,
  - the unit used in case of physical quantity,
  - its degree of accuracy,
  - its value field.
- The interface variables are described in the form of comments in the code.

CONF_120

In cases where the use of existing software (market products, freeware, other products) is considered, the following elements must be taken into account for their selection:
- the assessment of the product in relation with the requirements,
- the conditions for acceptance and guarantee (demonstration of proper operation) and/or maintenance,
- the training and use conditions,
- the industrial property and licence constraints (right to use, distribute or modify).

3.6. DOCUMENTATION

DOC_010

Each document shall be uniquely identified. The following attributes shall be reported as a minimum: document identification, version, title, issue date, status, and document category.

DOC_020

Each document shall be provided signed in .pdf format (unalterable format) in addition to the native format .doc (for future update)

DOC_030

All documents shall be written in English.

DOC_040

The following documents shall be delivered to CNES:

Deliverable	Milestone
Schedule	At the start of each development phases and updated as necessary
Conformity matrix against the initial customer needs (this document)	2 weeks after the beginning of the contract
Software specification document	At the end of software specification phase
Design documents	At the end of design phase
Configuration Description File	With each software delivery
Installation and user manual	At the final acceptance
Acceptance Test plan	At the beginning of the acceptance