# Rosetta and Mars Express Mission Control System - R(ME)MCS

# Flight Dynamics System - Mission Control System Interface Control Document

## FDS ICD

## RO-ESC-ID-5003

## Issue B1

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# DOCUMENT APPROVAL

| | | |
|---|---|---|
| Prepared by; | Anite Systems GmbH | |
| | A. Ercolani (TOS-GDS)<br>Rosetta Technical Officer | _____ |
| Approved by (ESA/ESOC); | F. Delhaise (TOS-GDS)Mars Express Technical Officer | _____ |
| | P. Ferri (TOS-OGR)<br>Rosetta Spacecraft Operations Manager | _____ |
| Approved by (ESA/ESOC); | M. Denis (TOS-OGM)<br>Mars Express Spacecraft Operations Manager | _____ |
| | M. Warhaut (TOS-OGR)<br>Rosetta Ground Segment Manager | _____ |
| Approved by (ESA/ESOC); | M. McKay (TOS-OGM)<br>Mars Express Ground Segment Manager | _____ |
| Approved by (ESA/ESOC); | J.Fertig (TOS-GFI)<br>On behalf of TOS-GF | _____ |
| Approved by (Contractor); | R. Corkill (Anite)<br>RMCS/MEMCS Contractor Project Manager | _____ |

# Distribution List

| Recipient | Organisation |
|---|---|
| M. Warhaut | ESOC (TOS-OGR) |
| M. McKay | ESOC (TOS-OGM) |
| P. Ferri | ESOC (TOS-OGR) |
| M. Denis | ESOC (TOS-OGM) |
| N. Peccia | ESOC (TOS-GCM) |
| A. Ercolani | ESOC (TOS-GCM) |
| F. Delhaise | ESOC (TOS-GCM) |
| J. Wardill | ESOC (TOS-ON) |
| J. Fertig | ESOC (TOS-GFI) |
| R. Corkill | ANITE |

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# 1 Introduction

## 1.1 Purpose

The purpose of this document is to specify the interface between the Rosetta and Mars Express Mission Control Systems (RMCS/MEMCS) and the Flight Dynamic System (FDS). It describes the data structures and various file contents pertaining to data flow in both directions as well as any FDS supplied software to be integrated within the MCS.

## 1.2 Scope

This document is solely concerned with the definition of the interface between the MCS and the FDS.

This ICD is applicable for all phases of the Rosetta and Mars Express missions until the end of spacecraft operations.

## 1.3 Summary

This document is the interface control document governing the interfaces between the MCS and the FDS.

### 1.3.1 Data from MCS to FDS

The MCS will provide the following data to the FDS:

- **Flight Dynamics Database**

  The baseline for the provision of Flight Dynamics data (Flight Dynamics Database, FDDB) by the S/C prime contractor foresees the inclusion of such data in the Physical Properties part of the S/C Database of either mission: Rosetta or Mars Express. This approach is currently not being enforced. Flight Dynamics data are delivered by the S/C prime contractor to FD directly via an MS Access database. The future inclusion of the FD data in the S/C Database and hence, the need to transfer these data from the MCS to FD is TBD. [090]

- **MIB Files [090]**

  The MCS packet definitions are extracted from the Source Database and converted into Mission Information Base (MIB) files.

- **Packetised Data [090]**

  Packetised data consists of:

  – Telemetry Source packets

  – Telecommand History packets (TBC)

  – Time Coefficient History packets

  These packets will be extracted from the DAS by the FDS using the SCOS-2000/ORATOS Data Access (SoDA) software provided by Flight Dynamics as described in the [SODA-ICD].

- **Tracking Data Files** [090]

  These files do not originate from the MCS - the MCS acts as part of the delivery mechanism from the originator. The contents of these files are not changed by the MCS. ESA tracking data files are stored on the IFMS at the ESA stations. NASA/DSN tracking data files are stored on the ESA FD-dedicated computer RACSO.

  The MCS, via the Network Interface Subsystem (NIS), obtains the ESA tracking data files from the IFMS and stores them in the MCS FARC. [173]

  As defined in the [IFMS-OCC] document, these data files comprise:

  - Ranging data;
  - Doppler 1 and Doppler 2 data;
  - Meteo[rological] data;
  - Antenna angles (originating from the station computer, not the IFMS);
  - Signal received strength 1 and 2 data. [173, 178]

  The MCS obtains the NASA/DSN tracking data files from RACSO and stores them in the MCS FARC. [173].

  As defined in [JPL-FDS] document, these data files comprise:

  - Orbit Data Files (ODFs), that contain tracking data with any combination of different tracking data types (range, Doppler, Delta-VLBI etc);
  - Media calibrations.
  - NASA/DSN Signal Received Strength [173]

  All the above files will be delivered to the FDS.

- **Payload Auxiliary Data Files** [090]

  Payload pointing and trajectory requests will be based on Scenario Parameter Lists (SPL) during cometary observation. SPL's will be delivered from the RSOC to FD through the MCS. Details of SPL delivery will be defined after launch.

#### 1.3.1.1 Rosetta High Priority Operational Files from MCS to FDS. [173]

The following lists the high priority files (see section 2.2.1) sent from the MCS to the FDS. See [FTS-CONF] for the definition of the FTS node names.

| FTS Type | Description | FTS Source(s) | FTS Destination(s) |
|---|---|---|---|
| D1FD | Flight Dynamics Doppler 1 data | Nlx | FDx, RMx |
| D2FD | Flight Dynamics Doppler 2 data | Nlx | FDx, RMx |
| MTFD | Flight Dynamics Meteorological data | Nlx | FDx, RMx |
| RGFD | Flight Dynamics Ranging data | Nlx | FDx, RMx |
| AAF_ | Antenna Angles data | Nlx | FDx, RMx |
| ODF_ | NASA/DSN Tracking Data | RRA | FDx, RMx |
| CSP_ | NASA/DSN Media Calibration | RRA | FDx, RMx |
| AGC_ | NASA/DSN Signal Received Strength | RRA | FDx, RMx |

NOTE: Signal Received Strength 1 and 2 data (AGC1 and AGC2) files are not in the archive so are routed direct to the FDx systems.

#### 1.3.1.2 Mars Express High Priority Operational Files from MCS to FDS. [173]

The following lists the high priority files (see section 2.2.1) sent from the MCS to the FDS. See [FTS-CONF] for the definition of the FTS node names.

| FTS Type | Description | FTS Source(s) | FTS Destination(s) |
|---|---|---|---|
| D1FD | Flight Dynamics Doppler 1 data | Nlx | FDx, MMx |
| D2FD | Flight Dynamics Doppler 2 data | Nlx | FDx, MMx |
| MTFD | Flight Dynamics Meteorological data | Nlx | FDx, MMx |
| RGFD | Flight Dynamics Ranging data | Nlx | FDx, MMx |
| AAF_ | Antenna Angles data | Nlx | FDx, MMx |
| ODF_ | NASA/DSN Tracking Data | MRA | FDx, MMx |
| CSP_ | NASA/DSN Media Calibration | MRA | FDx, MMx |
| AGC_ | NASA/DSN Signal Received Strength | MRA | FDx, MMx |

NOTE: Signal Received Strength 1 and 2 data (AGC1 and AGC2) files are not in the archive so are routed direct to the FDx systems.

### 1.3.2 Data from FDS to MCS

The FDS will provide the following data to the MCS:

- **Auxiliary Data Files [090]**

  Auxiliary Data are generated by Flight Dynamics to support the experimenters. Auxiliary Data Files are delivered from the FDS to the MCS and archived in the DAS where they will be retrieved from the experimenters through the DDS. All data files are listed in the [DDID] and comprise the following categories:

  - S/C orbit files
  - S/C attitude files
  - Event file
  - cometary environment file
  - comet characteristics file
  - comet kinematics file
  - processed NAVCAM images
  - FORTRAN software source code files

- **Command Request Files**

  FD produces two types of Command Requests Files: [090]

  - Flight Dynamics Requests (FDR), which are used during routine operations by the scheduler subsystem of the MCS.

- Direct Operations Requests (DOR), for commands that are used by the Telecommanding subsystem manual stack on the MCS.

The format of the Command Request Files is described in the [CRID]. [090]

- **Spacecraft Trajectory Data Files [090]**

The MCS is not the end-recipient of spacecraft trajectory data files - the MCS acts as part of the delivery mechanism to the final destination. The contents of these files are not changed by the MCS.

As defined in the [NCTRS-MCS] document, spacecraft trajectory data files intended to support ESA spacecraft tracking are provided by the FDS in the form of Spacecraft Trajectory Data Messages (STDMs). These files are delivered to the MCS and archived in the DAS. They are transferred from the MCS, via the NIS (also passive regarding data file contents), to the station computer of the participating ESA station(s).

As defined in [CCSDS-502], spacecraft trajectory data files intended to support NASA/DSN tracking are provided by the FDS in the form of Ephemeris Messages (EPMs). An example Rosetta EPM is given in the [JPL-FDS] document. The contents of these files are not changed by the MCS. These files will be delivered to the MCS and archived in the DAS. As defined in the [JPL-FDS] document, they are transferred from the MCS to RACSO and onward to the server at JPL. Navigation Interface Files (NIF_)[207], also originating from the FDS, are routed in the same way as EPMs.

- **One-Way Light Time File [090]**

FD generates One Way Light Time (OWLT) files which allows the MCS to compute the time of transmission of a TM frame from its Earth reception time. The files are to be used with the FDS-supplied software as described in section 1.3.3.

- **Interplanetary WIMPY[090]**

The WIMPY is a file which is delivered to the MCS to provide mainly ground station related information.

#### 1.3.2.1 Rosetta High Priority Operational Files from FDS to MCS. [173]

The following lists the high priority files (see section 2.2.1) sent from the FDS to the MCS. See [FTS-CONF] for the definition of the FTS node names.

| FTS Type | Description | FTS Source(s) | FTS Destination(s) |
|---|---|---|---|
| STDM | Spacecraft Trajectory Data Files | FDx | NIx, RMx |
| EPM_ | Ephemeris Messages Spacecraft Trajectory Data | FDx | RRA, RMx |
| NIF | Navigation Interface Files | FDx | RRA, RMx |

#### 1.3.2.2 Mars Express High Priority Operational Files from FDS to MCS. [173]

The following lists the high priority files (see section 2.2.1) sent from the FDS to the MCS. See [FTS-CONF] for the definition of the FTS node names.

| FTS Type | Description | FTS Source(s) | FTS Destination(s) |
|---|---|---|---|
| STDM | Spacecraft Trajectory Data Files | FDx | NIx, MMx |
| EPM_ | Ephemeris Messages Spacecraft Trajectory Data | FDx | MRA, MMx |
| NIF_ | Navigation Interface Files | FDx | MRA, MMx |

### 1.3.3 Installed Software

The FDS will provide the following software for integration with the MCS:

- **Packet Data Extraction software**

  FDS will be provide a version of the SODA software to extract packetised data from the MCS DAS as described in [SODA-ICD]. The SODA server process is not continuously running. It is launched remotely by FD client applications.

- **Propagation Delay software** [090]

  As described in the [TIC-TN], FDS will provide a software routine to calculate the down-link propagation delay as a function of UTC at signal reception at any participating ground station. The computation will use the contents of the FDS-supplied One-Way Light Time (OWLT) files. A single OWLT file will be used for each groundstation and will be identified by a FD Groundstation ID - it should be noted that this FD Groundstation ID does not correspond to the NCTRS Groundstation ID.

## 1.4 Change Forecast

This document is a draft issue of the ICD and updates are expected after initial review.

## 1.5 Applicable Documents. [090]

| | | |
|---|---|---|
| A-1<br>[ROS-GLOSS] | Rosetta Project Glossary<br>RO-ESC-LI-5001 | Issue A0<br>15/05/99 |
| A-2 [090]<br>[CRID] | RMCS/MEMCS Command Request Interface Document<br>RO-ESC-IF-5004 / MEX-ESC-IF-5004 | Issue B3<br>12/03/02 |
| A-3 [090]<br>[DDID] | RMCS/MEMCS Data Delivery Interface Document<br>RO-ESC-IF-5003 / MEX-ESC-IF-5003 | Issue B3<br>12/03/02 |
| A-4 [090]<br>[DDID-H] | RMCS/MEMCS Data Delivery Interface Document - Appendix H FD Products<br>RO-ESC-IF-5003 / MEX-ESC-IF-5003 | Issue 1.3<br>01/03/02 |
| A-5 [090]<br>[DDID-K] | RMCS/MEMCS Data Delivery Interface Document - Appendix K MCS Products<br>RO-ESC-IF-5003 / MEX-ESC-IF-5003 | Issue B3<br>12/03/02 |
| A-6 [090]<br>[JPL-FDS] | ROSETTA/MARS EXPRESS JPL/FDS Navigation Interface<br>RO-ESC-IF-5011 | Issue 3.1<br>23/08/02 |
| A-7 [090]<br>[MPS-POS] | Mars Express MPS - POS ICD<br>TBD | Issue TBD |

| | | |
|---|---|---|
| A-8 [090]<br>[MOD-FDS-ICD] | Rosetta, MOD-FDS ICD<br>RO-ESC-ID-5008 | Issue 1.4<br>Nov/02 |
| A-9 [090]<br>[WIMPY] | Description of WIMPY for interplanetary spacecraft.<br>RO-ESC-TN-5521 | Issue 1.2<br>16/08/02 |
| A-10 [090]<br>[TM/TC-ICD] | TM/TC ICD Status Synthesis<br>RO-MMT-TN-2091/MEX-MMT-TN-0893 | Issue 1.3<br>30/08/01 |
| A-11 [090]<br>[IFMS-OCC] | IFMS-OCC Interface ICD<br>/MakulaMedia/MR/IFMS/ICD/FTP-OCC | Issue 9.2.1<br>20/10/02 |
| A-12 [090]<br>[DSN-ODF] | Tracking System Interface: Orbit Data File Interface<br>DSN 820-013: TRK-2-18 | Change 3<br>15/06/00 |
| A-13 [090]<br>[DSN-MCI] | Media Calibration Interface<br>DSN 820-013, TRK-2-23 | <br>31/05/00. |
| A-14 [090]<br>[NCTRS-MCS] | Interface Control Document - NCTRS - Volume 3 - Detailed interface definition: FDS<br>NCTRS-ICD-3, N2K-MCS-ICD-0003-TOS-GCI | Issue 1.3<br>27/06/01. |
| A-15 [090]<br>[CCSDS-502] | Orbit Data Messages<br>CCSDS 502.0-R-1, Red Book | Issue 2<br>Jun/02 |
| A-16 [090]<br>[TIC-TN] | ROSETTA - Description of the software for the support of the time correlation between the internal clock of ROSETTA and UTC<br>RO-ESC-TN-5518 | Issue 2.4<br>05/11/01 |
| A-17<br>[FTS-CONF] | Rosetta/MEX Mission Control Systems Configuration Control Document; FTS Configuration<br>RO-ESC-IF-5014/ME-ESC-IF-5014 | Issue A2<br>2003-03-07 |

## 1.6 Reference Documents. [090]

| | | |
|---|---|---|
| R-1<br>[MCS-SRD] | R(ME)MCS Software Requirements Document<br>RO-ESC-RS-5320 | Issue A0<br>15/05/99 |
| R-2<br>[FDS-SRD] | FDS Support Requirements Compilation<br>RO-ESC-RS-5510 | Issue 1.0<br>08/01/01 |
| R-3<br>[MIN-1] | Minutes to FDS-MCS interface meeting on 04/02/00 | 14/02/00 |
| R-4 [090]<br>[S2K-PKT-ICD] | SCOS-2000 TM Packet ICD<br>S2K-MCS-ICD-0004-TOS-GCI | Issue 1.1<br>02/03/01 |
| R-5 [090]<br>[SODA-ICD] | Flight Dynamics Infrastructure Software, ORATOS SODA ICD<br>DTOS-FDOS-FDIS-ICD-1422-TOS-GFS | Issue 1.1, Oct/01 |
| R-6 [090]<br>[S2K-MIB-ICD] | SCOS-2000 Database Import ICD<br>S2K-MCS-ICD-0001-TOS-GCI | Issue 4.3<br>16/10/01 |

## 1.7 Abbreviation

All abbreviations and acronyms used in this document are explained in the [ROS-GLOSS] [090].

# 2 Operational Assumptions and Constraints.

## 2.1 Assumptions

The following assumptions have been made in preparing this ICD:

1. The FDS runs on the ORATOS platforms located at ESOC and accessible from the operational LAN. There are two operational ORATOS platforms connected to the ESOC OPSLAN: ORATOS-L for critical operations and ORATOS-R for routine operations. Each ORATOS platform consists of a highly redundant file server and several client workstations. [090]

2. FD applications (including applications interfacing with the MCS, e.g. the telemetry retrieval tasks) may run on any of the client workstations. [090]

3. The RMCS and MEMCS will be running on separate machines, each having Prime and Backup computers [090] located at ESOC and accessible from the operational LAN

4. [207207 207207 207207 207]All packets transferred from the MCS and the FDS systems will be extracted from the DAS by the FDS using the SCOS-2000/ORATOS Data Access (SoDA) software provided by Flight Dynamics as described in the [SODA-ICD]. [207]

5. With the exception of MPTS files for Rosetta, all file transfer between the MCS and FDS systems shall be by means of the File Transfer System (FTS).[198, 207]

6. Rosetta MPTS files shall be retrieved from RONCTRA/RONCTRB to the appropriate FDS system by manual use of FTP from the FDS system. [198]

7. The only acknowledgement of delivery of files between the MCS and FDS shall be that provided by the standard FTS functionality, i.e. reported via the FTS log file. [207]

8. For files automatically injected into the FTS by the FTS polling task the version number of the FTS file will be assigned by the polling task and for each individual file type for a specific destination the version number will also be 1 greater than the previous unless reset by Software Support. Once a version number of 99999 is reached the next version number will wrap round to 00000. [182].

## 2.2 Constraints

The following constraints apply to this ICD:

### 2.2.1 [207]High Priority Operational Files.[173, 189]

Certain files types are deemed to be of high priority operational significance. Such files must be routed as directly as possible from the source node to the destination node. This implies any such files, which have to be stored in the archive and do not have the control system as the final destination must be sent multiple times by the origination source, viz. to the target destination and also to the control system so that they can be put into the archive. Non-high priority files which have to be in the archive are routed to the intended final destination via the control system where they are inserted into the archive via an FTS intermediate action procedure.

### 2.2.2 File Transfer Between OSCARX (OSCARY) and RACSO [207]

Due to security constraints it is not possible to automate file transfer between OSCARX (Backup OSCARY) and RACSO. It is thus necessary to adopt the following procedure to transfer files from OSCARn to RACSO and inject them into the FTS for delivery to the appropriate target;

A manual SFTP connection has to be made from RACSO to OSCAR and the required files on OSCARn selected and copied into the following directory on RACSO;

- /home/sssfts/import

  Where· sss = ros or mex

NOTE 1: Since the FTS polling task periodically checks this directory for files it is essential that when the files are being copied over from OSCARn to RACSO that they are first transferred to a different directory and only when the FTP transferred is completely finished moved to the “import” directory.

NOTE 2: The FTS polling task once it detects a file to be transferred encapsulates the found file into an FTS file with the appropriate name. [180]

### 2.2.3 File Transfer Between RACSO and OSCARX (OSCARY) [207]

Due to security constraints it is not possible to automate file transfer between RACSO and OSCARX (Backup OSCARY). It is thus necessary to adopt the following procedure to transfer files from RACSO to OSCARn;

All files transferred via FTS which have a final destination of OSCARn are delivered to RACSO. On arrival the files are unTARred and copied into the directory specified below, from where they have to be manually transferred via SFTP to the appropriate location on OSCAR.

- /home/sssfts/export

  Where sss = ros or mex

### 2.2.4 File Delivery to Multiple Destinations [175]

The File Transfer System is a file delivery system that works on a point to point basis. That is each file injected into the FTS is delivered to exactly one destination. If it is required for operational reasons that the same file be delivered to 2 or more destinations it is the responsibility of the originating system to submit the same file as many times as required to the FTS each time with the appropriate destination specified in the file name.

For example suppose the file `ZZZZ_FDRxxx_D_AN_EXAMPLE____00000.ROS` has to be delivered to both NIA and NIB from the FDR system. In this case the file has to be injected into the FTS twice, once each with the following names;

- `ZZZZ_FDR`***`NIA`***`_D_AN_EXAMPLE____00000.ROS`
- `ZZZZ_FDR`***`NIB`***`_D_AN_EXAMPLE____00000.ROS`

# 3 Requirements - deleted [090]

# 4 Interface Characteristics

## 4.1 Interface Location and Medium

This document concerns the I/F between the: [090]

- RMCS and the FDS, both based at the ROSETTA Missions Operations Centre in Darmstadt.
- MEMCS and the FDS, both based at the MARS EXPRESS Missions Operations Centre in Darmstadt.

## 4.2 Hardware Characteristics and Limitations

The following table outlines the hardware characteristics and limitations that impact this interface.

| Acronym | Location | Platform | Operating System | Network Connection |
|---|---|---|---|---|
| RMCS | Rosetta Mission Control System | SUN | Solaris | 100 Mbps |
| MEMCS | Mars Express Mission Control System | SUN | Solaris | 100 Mbps |
| FDS | ESOC Flight Dynamics System | SUN | Solaris | 100 Mbps |

## 4.3 Data Source, Destination and Transfer Mechanism.

With the exception of MPTS files for Rosetta the transfer of all files between the MCS and the FDS will be by means of the File Transfer System. This software will be installed on the MCS and FTS machines, with the exception of scripts for the handling of files received on the FDS machines, which will be provided by FDS. [090, 198]

Packetised data is retrieved by the FDS system from the MCS by the SCOS-2000/ORATOS Data Access (SoDA).

The following sections give further information on the various data transfers involved;

- 6.3.1; Rosetta Packetised Data [090]
- 6.3.2; Rosetta Files [207]
- 6.3.2.1; Rosetta MPTS Files [198]
- 6.3.3; Mars Express Packetised Data [090]
- 6.3.4; Mars Express Files [207]

## 4.4 Node and Device Addressing

The following table outlines the node and device addressing that impact this interface. [090]

### 4.4.1 Rosetta Nodes

| Node | Address | Description |
|---|---|---|
| ROMCA | romca.esoc.ops.esa.int | Prime Rosetta Control System |
| ROMCB | romcb.esoc.ops.esa.int | Backup Rosetta Control System |
| RONCTRA | ronctra.esoc.ops.esa.int | Rosetta Network Control A |
| RONCTRB | ronctrb.esoc.ops.esa.int | Rosetta Network Control B |
| LDSA | ldsa.ops.esoc.esa.de | FDS ORATOS LEOP system |
| RDSA | rdsa.ops.esoc.esa.det | FDS ORATOS routine system |
| RACSO | racso.esoc.ops.esa.int | Gateway to OSCAR at JPL |

### 4.4.2 Mars Express Nodes

| Node | Address | Description |
|---|---|---|
| MEMCA | memca.esoc.ops.esa.int | Prime Mars Express Control System |
| MEMCB | memcb.esoc.ops.esa.int | Backup Mars Express Control System |
| MENCTRA | menctra.esoc.ops.esa.int | Mars Express Network Control A |
| MENCTRB | menctrb.esoc.ops.esa.int | Mars Express Network Control B |
| LDSA | ldsa.ops.esoc.esa.de | FDS ORATOS LEOP system |
| RDSA | rdsa.ops.esoc.esa.det | FDS ORATOS routine system |
| RACSO | racso.esoc.ops.esa.int | Gateway to OSCAR at JPL |

## 4.5 Relationships with other Interfaces

The Command Request File definitions for the FDR and DOR are described in detail in the [CRID]. [090]

Documents available to PIs via the DDS are described in detail in the [DDID]. [090]

# 5 Access

## 5.1 Interface Utility Software

It is foreseen that special utility software will be required on both MCS and FDS machines as follows: [090]

- **File Transfer System software**

  The MCS will provide special utility software to manage the transfer of files between the 2 systems. This utility software is called the File Transfer Software (FTS) and will be installed on the MCS and FDS machines as a compiled and linked process running in the FTS environment [090].

- **Packet Data Extraction software [090]**

  FDS will provide a version of the SODA software to extract packetised data from the MCS DAS. Each ORATOS client process will start an instance of the SODA server on an MCS workstation. Packets are retrieved in real time and passed on to the ORATOS Generic Telemetry Processor (GTP) software. The specification of the software is detailed in the [SODA-ICD]. The SODA application is developed, maintained and installed by FD staff on MCS workstations as described in the [SODA-ICD]

- **Propagation Delay software**

  FDS will provide a software routine to calculate the propagation delay to the spacecraft for a given UTC, using the contents of the FDS supplied One-Way Light Time File stored within the MCS environment. This software shall be delivered for installation on the R(ME)MCS as a fully tested software routine in electronic format and will be embedded within the R(ME)MCS Time Correlation component.

## 5.2 Failure Protection, Detection and Recovery Procedures

For files handled within the File Transfer System, failure will be detected by the use of an internally generated version control; files of the same type from the same source are sent in increasing version number order. For the nodes on which FTS is installed, automatic recovery will be performed after a link drop or if there is a discontinuity in version numbers.

Note: The version numbering assigned by the FTS is not the user defined version number within the FTS filenaming convention which is freely definable and is not checked by the FTS.

## 5.3 File Naming Convention

A standardised file naming convention will be used for all files transported within the MCS. This file naming convention is primarily driven by the FTS mechanism. [090]

In summary, the file naming convention is as follows:

`TTTT_SSSDDD_txxxxxxxxxxxxxx_vvvvv.yyy`

Where:

- TTTT is the document type (as defined in Section 6.3)
- SSS is the source of the file (as defined in Section 6.3)

- DDD is the destination of the file (as defined in Section 6.3)
- t is the type of file contents always set to D for data
- xxxxxxxxxxxxxx is a free text field (14 upper case chars)
- vvvvv is the file version number which starts at `00000` and increments, with wraparound at `99999`. 090
- yyy is the mission identifier ROS for Rosetta and MEX for Mars Express

090

Note: All characters within the filename MUST be in UPPER case.

The use of this generic filenaming convention is specialised for specific files as detailed in the tables below.

In addition to the FTS Filename, the table also indicates:

- if a different 'external' filename is required by other systems external to the MCS. In this case, the external file is 'encapsulated' within an FTS file to enable it to be transferred within the FTS system.

  Note: The 'encapsulation' of external files is performed using the unix '*tar c*' command.

- any special processing performed on the file either at the source node or the destination node. Any other processing of the file (e.g. unwrapping of external files at the FTS node) are outside the scope of the FTS and MCS.

It should be noted that all encapsulated files are unwrapped and archived under their external filename), whereas, files with no external filename (i.e. not encapsulated) are filed under the FTS filename.

For full details of the naming conventions applicable to the various file types please send applicable document [FTS-CONF].

## 5.4 , 176, 179, 181, 183, 176, 179, 181Storage and File Detection Requirements

Sufficient space must be available on the FDS and the MCS sides to hold the relevant data. It is the responsibility of the individual systems to ensure that this space is made available.

## 5.5 Security Requirements

Both the FDS and the MCS shall be installed on the operational LAN at ESOC. This LAN is protected from Ext users by a filter, which prohibits remote login

## 5.6 Data Integrity Checks

An error free file transmission, ensured by the FTP and TCP/IP protocols is assumed

## 5.7 Backup Requirements

The MCS has a prime machine and a backup machine. The FDS has a single machine, ORATOS-L, for LEOP/Critical operations and a single machine, ORATOS-R, for Routine operations. 090

Configuration is TBD.

## 5.8 Error Handling

Error handling is performed by the File Transfer System [090] as provided by the FTP and TCP/IP protocols

# 6 Detailed Interface Specifications.

## 6.1 Data Structure

The detailed data structures are defined in section 7.

## 6.2 Generation Method

As per Rosetta and Mars Express MCS SRD, Reference Document R1 [090] and FDS Requirements Compilation Document [FDS-SRD] [090]

## 6.3 Data Passed Across the Interface and their Direction

The data files passed between the FDS and the MCS for the Rosetta and Mars Express Missions are shown below. See [FTS-CONF] for the definition of the FTS node names. [175]

NOTE: The following convention has been adopted as per applicable document [FTS-CONF].

1. RMx is used where a file can be sent to either RMA or RMB
2. MMx is used where a file can be sent to either MMA or MMB
3. FDx is used where a file can be sent to either FDL or FDR
4. NIx is used where a file can be sent to either NIA or NIB

### 6.3.1 Rosetta Packetised Data [090]

Packetised data is retrieved by the FDS system from the MCS by the SCOS-2000/ORATOS Data Access (SoDA) software provided by Flight Dynamics as described in the [SODA-ICD]. [207]

### 6.3.2 Rosetta Files [207]

All files passed between the FDS and the MCS, with the exception of MPTS files, are transferred by means of the FTS. The following table shows the source(s) and destination(s) of the various file types passed between the systems.

| File Type | File Description | Src | Dest |
|---|---|---|---|
| File Type | File Description | Src | Dest |
| AAF_ | Antenna Angle Files | NIX | FDX, RMX |
| AGC_ | NASA/DSN Signal Received Strength | RRA | FDX, RMX |
| AGC1 | AGC 1 data from IFMS | NIX | FDX |
| AGC2 | AGC 2 data from IFMS | NIX | FDX |
| ATNR | S/C attitude | FDX | RMX |
| ATPR | S/C attitude, medium term planning | FDX | RMX |
| CCHA | Comet Characteristics | FDX | RMX, RSO |

| | | | |
|---|---|---|---|
| CENV | Cometary Environment | FDX | RMX, RSO |
| CKIN | Comet Kinematics | FDX | RMX, RSO |
| CSP_ | NASA/DSN Media Calibration | RRA | FDX, RMX |
| D1FD | Flight Dynamics Doppler 1 Data File | NIX | FDX, RMX |
| D2FD | Flight Dynamics Doppler 2 Data File | NIX | FDX, RMX |
| DOR_ | Direct Operation Request | FDX | RMX |
| EPM_ | Ephemeris Messages (EPM) Spacecraft Trajectory Data | FDX | RRA, RMX |
| EVTR | Orbit Event File | FDX | RMX, RSO |
| FDR_ | Flight Dynamics Request | FDX | RMX |
| MIB_ | MCS Database File(s) | RMX | FDX |
| MTFD | Flight Dynamics Meteo[rological] Data File | NIX | FDX, RMX |
| NIF_ | Navigation Interface Files | FDX | RRA, RMX |
| OASW | Orbit and attitude file access software | FDX | RMX |
| ODF_ | Tracking Data (ODF) | RRA | FDX, RMX |
| ORER | Earth centric first Earth swingby S/C orbit | FDX | RMX |
| ORFR | Earth centric second Earth swingby S/C orbit | FDX | RMX |
| ORHO | Heliocentric Otawara orbit | FDX | RMX |
| ORHR | Heliocentric S/C cruise orbit | FDX | RMX |
| ORHS | Heliocentric Siwa orbit | FDX | RMX |
| ORHW | Comet Orbit, heliocentric | FDX | RMX |
| ORMR | Mars centric Mars swingby S/C orbit | FDX | RMX |
| OROR | Otwara centric Otwara flyby S/C orbit | FDX | RMX |
| ORPR | Medium term planning comet centric S/C orbit | FDX | RMX |
| ORSR | Siwa centric Siwa flyby S/C orbit | FDX | RMX |
| ORWR | S/C comet centric orbit | FDX | RMX |
| OWLT | One-Way Light Time File | FDX | RMX |
| PNAV | Processed NAVCAM Images | FDX | RMX, RSO |
| PTR_ | Pointing Request File (DDID-TBC) | RSO | FDX |
| RGFD | Flight Dynamics Ranging Data File | NIX | FDX, RMX |
| SCPR | Science Profiles File (DDID-TBC) | RSO | FDX |
| SPL_ | Scenario Parameter List (DDID-TBC) | RSO | FDX |
| STDM | Spacecraft Trajectory Data Message File | FDX | NIX, RMX |
| WIMP | Interplanetary WIMPY (DDID-TBC) | FDX | RMX |

[FTS-CONF] provides details of the processing carried out on the above files on the MCS and of the encapsulated file names where applicable. [184, 185, 186, 187, 194]

#### 6.3.2.1 Rosetta MPTS Files [198]

MPTS files from the Rosetta NCTRS machines (RONCTRA and RONCTRB) shall be retrieved by manual use of FTP from the Flight Dynamics machines where it is required to have these files.

Naming conventions applicable to these files is as per NCTRS - Volume 3 - Detailed interface definition: FDS, A-14. These files will be stored in the following location on the Rosetta NCTRS machines;

- `/home/esocfd/mpts/ROSE/tkdata`

### 6.3.3 Mars Express Packetised Data [090]

Packetised data is retrieved by the FDS system from the MCS by the SCOS-2000/ORATOS Data Access (SoDA) software provided by Flight Dynamics as described in the [SODA-ICD]. [207]

### 6.3.4 Mars Express Files [207]

All files passed between the FDS and the MCS are transferred by means of the FTS. The following table shows the source(s) and destination(s) of the various file types passed between the systems.

| File Type | File Description | Src | Dest |
|---|---|---|---|
| AAF_ | Antenna Angle Files | NIX | FDX, MMX |
| AGC_ | NASA/DSN Signal Received Strength | MRA | FDX, MMX |
| AGC1 | AGC 1 data from IFMS | NIX | FDX |
| AGC2 | AGC 2 data from IFMS | NIX | FDX |
| ATNM | Predicted / reconstituted S/C attitude | FDX | MMX, POS |
| CSP_ | NASA/DSN Media Calibration | MRA | FDX, MMX |
| D1FD | Flight Dynamics Doppler 1 Data File | NIX | FDX, MMX |
| D2FD | Flight Dynamics Doppler 2 Data File | NIX | FDX, MMX |
| DOR_ | Direct Operation Request | FDX | MMX |
| EPM_ | Ephemeris Messages (EPM) Spacecraft Trajectory Data | FDX | MRA, MMX |
| EVTF | Event File. Long Term Planning | FDX | POS, MMX, MPX |
| EVTM | Orbit Event File. | FDX | MMX, MPX |
| FDR_ | Flight Dynamics Request | FDX, MMX | MMX, MPX |
| FDSW | FORTRAN Software Source Code Files | FDX | MMX |
| FECS | Flight Dynamics Events and Communications Skeleton | FDX | POS, MPX |
| FTL_ | Flight Dynamics Timeline | FDX | POS, MPX |
| MIB_ | MCS Database File(s) | MMX | FDX, MPX, POS |
| MTFD | Flight Dynamics Meteo[rological] Data File | NIX | FDX, MMX |

| | | | |
|---|---|---|---|
| NIF_ | Navigation Interface Files | FDX | MRA, MMX |
| OASW | Orbit and attitude file access software (various) | FDX | MMX |
| ODF_ | Tracking Data (ODF) | MRA | FDX, MMX |
| ORHM | S/C orbit, cruise, heliocentric | FDX | MMX |
| ORMF | S/C orbit, operational, Mars centric. Long Term Planning | FDX | POS |
| ORMM | S/C orbit, operational, Mars centric | FDX | MMX |
| OWLT | One-Way Light Time File | FDX | MMX, MPX |
| PSCN | POS Constraints File | FDX | POS |
| PTR_ | Pointing Timeline Request File | POS, MMX | FDX, MPX |
| RGFD | Flight Dynamics Ranging Data File | NIX | FDX, MMX |
| SECS | Science Events and Communication Skeleton | POS, MMX | FDX, MPX |
| STDM | Spacecraft Trajectory Data Message File | FDX | NIX, MMX |
| STOM | Star occultations | FDX | MMX, MPX, POS |
| VILM | Lander Visibility | FDX | MMX, POS |
| WIMP | Interplanetary WIMPY | FDX | MMX |

[FTS-CONF] provides details of the processing carried out on the above files on the MCS and of the encapsulated file names where applicable. [184, 185, 186, 187, 194]

## 6.4 Size and Frequency of Transfers

The size and the frequency of the transfers are summarised in the table below.

Note: The number of co-existing files are multiple copies of the same file type (i.e. different versions) that are held in the MCS. This is used to calculate the estimated disk space required for storage.

### 6.4.1 Rosetta Data [090]

See [FTS-CONF]. [207]

### 6.4.2 Mars Express Data [090]

See [FTS-CONF]. [207]

## 6.5 Timing and Synchronisation Requirements

There are no explicit timing or synchronisation requirements. [090]

# 7 Data Definition

The following section details the structure and contents of the various interfaces:

## 7.1 Flight Dynamics Request Files (FDRs)

As defined in the [CRID]. 090

## 7.2 Direct Operation Request Files (DORs)

As defined in [CRID]. 090

## 7.3 Tracking Data Files

IFMS files are as defined in the [IFMS-OCC] document.

Antenna angles files are defined in the [NCTRS-MCS] document

ODF files are defined in the [DSN-ODF] document.

Media calibration files are defined in the [DSN-MCI] document.

## 7.4 Spacecraft Trajectory Data Files

STDM files are as defined in the [NCTRS-MCS] document.

EPM files are as defined in the [CCSDS-502] document.

The contents of Navigation Interface Files are TBD.

## 7.5 Packetised Data 090

The SODA server process retrieves the packets from the MCS DAS. The source packets and additional information from the SCOS header of the packets are extracted using the SCOS-2000 FDIF interface as described the [S2K-TM-ICD]. 090

The structure and content of the source packets generated by the spacecraft are detailed in the documents referenced by the [TM/TC-ICD]. 090

The structure and content of packets generated by the MCS are detailed in the [DDID-K]. 090

## 7.6 Auxiliary Data Files 090

The following auxiliary files will be passed from the FDS to the MCS:

### 7.6.1 Orbit Files 090

Orbit files for S/C, asteroids Otawara and Siwa and comet Wirtanen are as described in the [DDID].

### 7.6.2 Attitude Files 090

S/C attitude files are as described in the [DDID].

### 7.6.3 Event File [090]

The event file is as described in the [DDID].

### 7.6.4 Cometary Environment File [090]

Format and contents of the file will be defined and described in the [DDID] after launch.

### 7.6.5 Comet Characteristics File [090]

Format and contents of the file will be defined and described in the [DDID] after launch.

### 7.6.6 Comet Kinematics File [090]

Format and contents of the file will be defined and described in the [DDID] after launch.

### 7.6.7 Orbit and Attitude File Access Software [090]

FORTRAN source code files will be delivered from FDS to the MCS as described in the [DDID].

## 7.7 Mission Information Base (MIB) [090]

The packet definitions are extracted from the Source Database and converted into Mission Information Base (MIB) files. These files are tarred into a single file for archive and distribution.

The MIB file contains separate files for the SCOS-2000 MIB tables, as described in the [S2K-MIB-ICD] with the following mission specific extensions and updates to fields in the SCOS-2000 Tables. The information is presented in a format consistent with the [S2K-DATABASE-ICD]

### 7.7.1 ccf.dat

The ccf has been updated with the following:

- The command description has been increased in size from 24 to 40 characters.
- A new field, CCF_SUBSCH, has been added to identify commands as being in a particular onboard sub-schedule.

| Fi. Nr | Field Name | Field Type | Description | Ma/Def |
|---|---|---|---|---|
| 2 | CCF_DESCR | Char(40) | Textual description of the command | M |
| 20 | CCF_SUBSCH | Number(3) | Contains the onboard sub-schedule number | |

### 7.7.2 pcf.dat

The pcf has been updated with the following:

- The TM parameter description has been increased in size from 16 to 24 characters.
- Four new fields have been added to support the creation of service 3 telecommands. The corresponding onboard Group ID, and Offset are stored for TM parameters. Additionally a flag is also provided to indicate if a TM parameter is global or detailed. Only global parameters are named in the service 3 telecommand. A field ‘type’

(PCF_WDLEN) is also added to indicate whether the parameter should be on an 8 bit or 16 bit boundary.

| Fi. Nr | Field Name | Field Type | Description | Ma/Def |
|---|---|---|---|---|
| 2 | PCF_DESCR | Char(24) | Parameter Description. Free textual description of the parameter | |
| 20 | PCF_WDLEN | Char(1) | Indicates parameter 'type' in the service 3 command. Set to 'O' if 8 bit boundary, or 'W' for 16 bit. | |
| 21 | PCF_GRPID | Number(4) | Group ID of the corresponding on-board parameter. | |
| 22 | PCF_OFFSET | Number(5) | Offset of the corresponding on-board parameter. | |
| 23 | PCF_GLOBAL | Char(1) | Set 'G' if global parameter, or 'D' if detailed | |

### 7.7.3 Utility Files

Several utility files used during the generation of the MIB files are also contained within the MIB file:

| File | Description |
|---|---|
| spid_hash.txt | This file maintains a mapping between the RSDB telemetry packet id (TMPCK.NAME) and the SCOS-2000 SPID number. |
| calib_hash.txt | This file maintains a mapping between the RSDB calibration name (P_CALIBRATION.NAME) and the SCOS-2000 calibration number. It is used for all calibration tables. |
| synparhash.txt | This file is used to maintain a list of expressions for the 'automatically generated' synthetic parameters, and to map a synthetic parameter name for each. |
| list_of_packet_types_not_in_vpd.txt | This file is used to configure a list of packet types which need not be converted into the vpd table. |

## 7.8 One-Way Light Time File (OWLT)

OWLT files are as defined in the [TIC-TN] document.

## 7.9 Payload Auxiliary Data

Payload pointing and trajectory requests will be based on Scenario Parameter Lists (SPL) during cometary observation. SPL's will be delivered from the RSOC to FD through the MCS. Details of SPL delivery will be defined after launch.

## 7.10 Interplanetary WIMPY

The WIMPY is an ASCII file which is delivered to the MCS to provide mainly ground station related information. The format and content of the WIMPY is described in the [WIMPY] document.