IFMS

I F and Modem System

IFMS-OCC interface

Interface Control Document

[redacted]

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9.3.1	2003-04-09	**For MM9.3.x:** • §6.2/epd_source: Add "-" value for non-RG data-sets. • §9.1: Add "-" value for non-RG data-sets.
10.1.0	2004-01-05	**For MM10.1.0:** (No change) (Not distributed)
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10.2.0	2004-03-29	**For MM10.2.0:** • Add Open-Loop data-sets.
10.2.1	2004-05-28	**For MM10.2.0:** • §6.7: Correct the description.
10.3.0	2004-07-01	**For MM10.3.0: Change in the data-set header content.** • §1: Remove [ADD]. Refer to [SUM] Issue 10.3.x. • §6.2: Add the "freqplan" table to the configuration part of the Header information. • §10.2: Update the example for the Header information with modified configuration tables, and additional "freqplan" configuration table.
10.3.1	2004-07-09	**For MM10.3.0: Minor corrections.** • §5.2/DAP type: Add "Open-Loop". • §5.3: More details. • §6.2/dap_type: Add "OL". • §7, second paragraph after initial note: Add AGC1, AGC2.
10.4.0	2004-11-05	**For MM10.4.0: Minor corrections.** • Remove change history before issue 9.2.0 (2002-10-28) • §6.3.1: Refer to unified Frequency Plan instead of GDSP-specific. • §10.2: Update data-set header example.
10.5.0	2004-12-01	**For MM10.5.0:** • §2 and §3: Remove mention of IP/X.25. • §6.4: Add the new AGC measurements. • §9.3: Add the new AGC measurements in the definition of GainSample. • §10.4: Add the new AGC measurements.
10.6.0	2005-02-01	**For MM10.6.0:** • Remove change history before issue 9.3.0 (2002-12-06). • §6.2: Addition of the "gmdemod" parameters to the data-set header. • §10.2: Addition of the "gmdemod" parameters to the data-set header.
11.0.0	2005-06-20	**For MM11.0.0:** No change.
11.1.0	2006-01-19	**For MM11.1.0:** • §5.2: The Ranging data are not corrected yet (e.g. only the raw files are available).
11.2.0	2006-02-22	**For MM11.2.0:** No change. Remove change history for 9.3.0.
11.3.0	2006-06-19	**For MM11.3.0:** No change.
11.4.0	2006-08-09	**For MM11.4.0:** No change.

Content.

1 Introduction.

- **Purpose of the document.**

This Interface Control Document (ICD) describes the protocols and services supported on the interface between the Intermediate Frequency & Modem System (IFMS) and data clients such as the Network Control & Telemetry Routing System (NCTRS). For historical reasons, this interface is known as the *IFMS-to-OCC* (Operations Control Centre) interface.

- **References.**

[DOCS] ***IFMS Documentation Index***
Y/DA/980222/D1850

[FTP] ***File Transfer Protocol (FTP)***
ARPA Request For Comment (RFC) 959

[IFMS-SUM] ***IFMS Software User Manual***
Ref.: /MakaluMedia/MR/IFMS/SUM, Issue 11.4.x

[TERMS] ***IFMS Abbreviations and Acronyms***
Y/DA/980234/D1850

others see [DOCS]

- **Terms.**

See [TERMS].

2 Network access.

For the IFMS systems installed in the ESA ESTRACK stations, the IFMS data interface is accessed via FTP over IP.

3 Protocols supporting the interface.

The IFMS-to-OCC interface is supported entirely by the standard File Transfer Protocol (FTP) over TCP/IP. Files are made available in read-only mode to users, after relevant login procedure, and can then be copied from the IFMS.

Actual IP connection to the IFMS depends on the current network architecture where the IFMS is inserted. For the access from the OCC, the IFMS provides an IP/Ethernet interfaces.

3.1 FTP: File Transfer Protocol.

The complete FTP specification is described in [FTP].

3.1.1 Supported FTP commands.

The IFMS FTP server supports, as a minimum, the following commands:
- login, logout: `USER`, `PASS`, `QUIT`
- transfer parameters: `PORT`, `MODE` (`S` only), `TYPE` (`A` and `I` only), `STRU` (`F` only)
- remote directory: `CWD`, `PWD`
- directory access: `LIST`
- file transfer: `RETR`

3.1.2 FTP profile.

This section documents the FTP profile used for data-set transfer.

3.1.2.1 Provided services.

The IFMS FTP access allows the remote user to connect, to move inside the relevant part of the IFMS file system, and to retrieve data-sets.

3.1.2.2 FTP configuration and implementation aspects.

This section lists the various FTP configuration parameters and the value needed for this access. The FTP transfers are handled by the FTP server (FTP daemon, or "`ftpd`") provided by the IFMS UNIX CPU Operating System (Solaris 2.5.1 or higher).

- **Data representation and storage ([FTP], §3.1).**

[FTP] defines the following **data types** (selected by the FTP "`TYPE`" command):
- ASCII
- EBCDIC
- IMAGE (bit stream packed into the 8-bit transfer bytes)
- LOCAL

Only the ASCII and IMAGE types are relevant for this interface.

For the ASCII and EBCDIC data types, an additional **format control** parameter is available with the following values:
- NON PRINT
- TELNET
- CARRIAGE CONTROL (ASA)

This parameter is not applicable for this interface.

[FTP] defines the following **data structures** (selected by the FTP "`STRU`" command):
- FILE (byte stream)
- RECORD
- PAGE

Only the FILE structure is supported.

- **Transmission modes ([FTP], §3.4).**

[FTP] defines the following **transmission modes** (selected by the FTP "`MODE`" command):
- STREAM
- BLOCK
- COMPRESSED

Only the STREAM mode is supported.

Note: No restart procedure (available only for block and compressed modes) is supported.

- **"Experimental" commands.**

Early versions of FTP defined experimental commands (beginning with an "`X`"), subsequently adopted as standard in [FTP] (see [FTP-HostReqs], §4.1.3.1). Only the standard form are available.

- **Error handling and recovery.**

Unless already specified by [FTP], detection and handling of any protocol violation is in charge of the client entity.

3.2 IP.

The IP protocol stack must be properly configured in order to reach the hosts accessing the IFMS (routing information). The standard built-in IP routing configuration files and protocols allow to provide the IFMS with routing information.

The actual IFMS IP configuration for a specific site is performed as part of the IFMS installation procedure.

4 Services supported on the interface.

To provide data services, the IFMS acts as the file server in a client/server environment, providing directory and file delivery services to clients via the standard FTP protocol over TCP/IP.

Data-set identification is provided via a fixed directory and file naming structure (described later in this document), and optionally assisted by a Support-Log mechanism (also described later).

The following sections detail the specific services provided.

4.1 Data-set catalogue access.

Data-set catalogue services are provided by FTP directory listings (e.g. via the commonly supported FTP-client `ls` command.) Typical FTP-client implementations allow regular expressions in order to match filenames of a given criterion.

4.2 Off-line data-set access.

Off-line data-set access (file retrieval) is provided to authorised users via FTP. Typical FTP clients support the transmission of one or multiple files using the `get` and `mget` commands (`mget` often supports regular expressions.)

4.3 Pseudo-On-line data-set access.

In lieu of streaming real-time data to clients, the IFMS supports the concept of a *pseudo-on-line* data delivery mechanism based on small data files representing short measurement duration. The measurement duration (and hence the file size) is determined during the IFMS set-up by configuration parameters (`D1MaxDs`, `D2MaxDs`, `G1MaxDs`, `G2MaxDs`, `MeMaxDs`, `RgMaxDs`).

From a technical point of view, there is no difference between Pseudo-On-line data access and Off-line data access.

4.4 File management.

All file management activities (setting of permissions, deletion, etc.) are performed by the IFMS, and not by any FTP remote client. Creation is done by the IFMS Data Acquisition Processes. Deletion is done either as part of the Automatic Data-set Deletion IFMS function, or upon request of entities interacting via the STC or DCP interfaces.

5 IFMS data-set storage.

5.1 File-system structure.

The file-system supports a hierarchy of directories as specified below:
<data_set_root>/station/spacecraft/<dataset_file>

The Open-Loop data-sets are located in a different hierarchy of directories as specified below:
<OL_data_set_root>/station/spacecraft/<dataset_file>

5.2 File naming.

The filename contains fields separated by underscore "_" characters as shown in the following example:
PER1_CLU3_2002_108_OP_RG_145513_0001

As indicated in the example, the *nominal* length of a filename is 31 characters, and increases only in the case that more than 9999 sequence IDs are needed, or in the case of raw (uncorrected) ranging data (see below). In that case, the IFMS expands the sequence IDs length, or add a filename extension, as needed.

The fields to be included in the filename are:
- Station ID 4 characters (*)
- Spacecraft ID 4 characters (*)
- Year 4 characters
- Day of the Year 3 characters
- Data-set Kind 2 characters (*)
- DAP Type 2 characters
- DAP Start Time 6 characters (format: "hhmmss")
- Data-set Sequence ID 4 characters

(*) The value of these fields is determined from the IFMS configuration (see the [IFMS_SUM]) which is currently active at the time of data-set creation, in the "datasets" configuration part. If the length of the string value of the corresponding configuration parameter is less than the length indicated above, the fields are expanded on the right with additional underscore "_" characters.

These attributes are described in further detail below.

- **Station.**

  The station is identified by a four-character string, e.g.:
  PER1

- **Spacecraft.**

  The spacecraft is identified by a four-character string, e.g.:
  CLU3

- **Year.**

  The year (on four digits) in which the DAP was started, e.g.
  2002

- **Day-of-year.**

  The day of the year (on three digits) in which the DAP was started, e.g.
  108

- **DAP kind identifier.**

  The kind of DAP (e.g. operational, test, calibration, etc.) is identified by a two-character string, e.g.:
  OP, TS, CL

  This is a freeform field to identify the kind of DAP which generated the data-set, e.g. a particular mission may decide to use OP for operational, CL for calibration, TS for test, etc.

  Note: The *kind* is functionally equivalent to the *extended spacecraft identifier* mentioned in the IFMS ITT.

- **DAP type.**

  The DAP type (Doppler 1, Doppler 2, AGC1, AGC2, Meteo, Open-Loop or Ranging) is identified by a two-character string, among:
  D1, D2, G1, G2, ME, OL or **RG**

- **DAP start time.**

  The hour, minute and second at which the DAP was started by the IFMS, e.g., for 14:45:53:
  145513

- **Data-set sequence identification.**

  The data-set sequence is identified by a four-digit number, e.g.:
  `0001`

  The maximum DAP duration is 20 hours (72000 seconds), and the minimum data-set size is 100 samples at 0.1 sampling period, i.e. 10 seconds per data-set; therefore, at minimum, a maximum length DAP may lead to increment the Data-set Sequence Identification up to 7200. If, due to a configuration change, a data-set needs to be closed and a new one open, this maximum may reached 10000; in that case, the Data-set Sequence Identification for the following data-sets shall be coded on 5 digits.

  Events that cause data-sets to be closed and a new one to be opened use the time reference of the *original* DAP start time, and increment the sequence identification. For example, consider a Perth_1, Cluster_3 DAP started on 1999-04-18 (day 108) at 14:55:13, which was operational (OP) ranging (RG). If during the DAP, a configuration change caused the closure of the original data-set, and the opening of a second data-set, the resulting files would be named:
  `PER1_CLU3_2002_108_OP_RG_145513_0001`
  `PER1_CLU3_2002_108_OP_RG_145513_0002`

- **Uncorrected ranging data ("`.raw`" files).**

  The Ranging DAP procedure includes a process called *ambiguity resolution,* which may last from a few seconds, in the case of low-earth orbiters, to hours, in the case of deep-space satellites. Range measurements recorded during the ambiguity resolution process are offset by a delay (corresponding to a tone signal phase shift) which can only be determined once the ambiguity resolution process is successfully completed. The IFMS performs the corresponding corrections, on all dataset since Ranging procedure start, upon the closure of data-set for which ambiguity resolution was successful.

  There may be cases, however, when the uncorrected data is needed, and therefore the IFMS always makes available the *raw* data-sets. These files are named identically to their corrected counterparts, with the addition of the extension, "`.raw`", e.g.:
  `PER1_CLU3_2002_108_OP_RG_145513_0002.raw`

  In addition to the presence of the additional `.raw` extension, corrected and uncorrected data-sets may be further identified by a flag in the file header indicating whether the enclosed data has been corrected.

  Raw (uncorrected) data is stored along with corrected data, but within a further sub-directory named "`raw/`", e.g.:
  `~occ/kir1/ers2/PER1_CLU3_2002_108_OP_RG_145513_0002`
  `~occ/kir1/ers2/raw/PER1_CLU3_2002_108_OP_RG_145513_0002.raw`

  Note: The Ranging data are not corrected yet by the IFMS software (e.g. only raw files are available).

- **File compression.**

  In parallel to the ASCII version of the data-sets, a compressed version is maintained by the system (created, in the same directory, when the corresponding data-set is closed, and removed when the corresponding data-set is deleted). Compression used is `gzip` format (extension "`.gz`"). This does not apply for Open-Loop data-sets.

5.3 File format.

Open-Loop data-sets are binary files (except the first one, containing only the standard header). All other data-sets are stored as ASCII text files, and corresponding compressed data-sets are stored (and must be transferred) as binary files.

6 Data-sets content.

Different data-sets are created for each DAP. This section provides a high-level description of the content of these files. A formal description using Backus-Naur Form (BNF) can be found in the annexes.

For all fields are given:
- The field **name**.
- The field **type**, among:
  B Boolean
  F Float
  I Integer
  S String
  T Time, format is: "`YYYYMMDD.hhmmss.mmm`"
- The field value **unit** (between "< >") for *float* and *integer* fields; can be empty for values without units.
- The field value **accuracy** (between "[ ]") for *float* fields (e.g. [0.001]). This is the absolute accuracy of the representation of the number. It can also be [free] when the value is issued from a calculation: then the maximum available accuracy is given within the float field length (maximum 24 characters).

6.1 Overview & administration.

Data-sets contain two content parts: a **header** and **measurement data**.

6.2 Header information.

Each data-set begins with a *header* containing the following information:

Field Name		Description
station_id	S	Station Identifier
spacecraft_id	S	Spacecraft Identifier
dset_kind	S	Data-set kind
dap_type	S	Is: "D1", "D2", "G1", "G2", "ME", "OL" or "RG"
reference_time_tag	T	Time-tag of sample #0
first_sample_time	T	Time-stamp of the first measurement
last_sample_time	T	Time-stamp of the last measurement
requestor_id	S	Can assume one of two values, DCP or STC
request_id	I	Integer value as provided by the requestor <>
why_opened	S	Can assume one of the following values: • "DAP_Started" • "Conf_Change" • "Max_Size_Reached" • "Tone_Lost"
total_samples	I	Total number of samples collected in this data set <>
sample_period	F	Period between samples <s> [0.1]
internal_reference	B	Flag to indicate whether the internal reference oscillator is used, i.e. if at DAP start, the Common Front End (CFE) uses its internal reference instead of the external 5 or 10 MHz reference
uplink_carrier_230	B	Indicates that the ULM output carrier frequency is based on 230 MHz instead of 70 MHz
actual_carrier_indic	I	Actual Carrier Indicator: <> provides the actual Uplink Carrier Frequency offset (from 70 MHz or 230 MHz) as follows: $\text{ActualCarrierFreqOffset} = 50\text{MHz} - \text{actual\_carrier\_indic} \times \frac{17.5e6}{2^{30}}$
actual_tone_indic	I	Actual Tone Indicator (meaningful only for Ranging data-sets): provides the actual Tone Frequency as follows: <> $\text{ActualToneFreq} = \text{actual\_tone\_indic} \times \frac{17.5e6}{2^{32}}\ \text{Hz}$
epd_source	S	Can assume one of the following values: • "EPD_from_configuration": the EPD is derived from the configuration parameters in the tracking part of the active table • "EPD_from_Doppler_prediction": the EPD is derived from the Doppler Prediction file currently used • "–": for non-RG data-sets
rg_data_corrected	B	Flag to indicate whether the measurements recorded during the ambiguity resolution process have been corrected
seq_id	I	Data-set sequence id <>
configuration	-	Value of the modulator, freqplan, tracking, rcdemod, and scdemod parameters of the Active Table (see below)

Table 1: Data-set Header Contents

The "configuration" field provides the value of the parameters of the "modulator", "freqplan", "tracking", "rcdemod", "scdemod" and "gmdemod" configuration parts of the currently Active Table (see the [IFMS-SUM]).

The sampling period is determined during the IFMS set-up by configuration parameters (D1SplPer, D2SplPer, G1SplPer, G2SplPer, MeSplPer, RgSplPer).

An example of the content of the header is given in annex.

6.3 Doppler data (1 & 2).

Each Doppler measurement contains the following fields:

Field Name		Description
sample_num	I	Identifier of the current sample <>
sample_time	T	Timestamp of the current sample
interval_count	I	Internal G-DSP 17.5 MHz NCO clock count since arbitrary origin <>
unwrapped_phase	F	Unwrapped phase of the internal G-DSP carrier NCO <turns> [0.00001]
spurious_carrier	B	Flag to indicate that the carrier is presently within the window of a known spurious frequency
delta_delay	F	Accumulated delta delay from the DAP start; this value is always one-way (more precisely, half the two-way delta delay), regardless of the spacecraft transponder type. <s> [free]

Table 2: Doppler Data-sets Data Contents

- **Calculation of the "`delta_delay`" field.**

This section describes the algorithm used to derive the delta-delay value, put in the Doppler data-sets, from the corresponding unwrapped carrier phase.

Note:

(CT) apply to coherent transponder (`FreqCoherTrs` is `Yes`)
(NT) apply to non-coherent transponder (`FreqCoherTrs` is `No`)

Constant values during the Doppler DAP:

From the frequency plan:

- **`UplinkCarrierFreq`**: is the actual satellite up-link carrier frequency, i.e.:

  (CT) The Modulator output frequency is defined by the `FreqUlmCarFrSel` (70/230 MHz) and `FreqUlmCarFrOffs` (–1.5 .. 1.5 MHz) parameters, but the ULM will select an actual frequency offset as indicated by the "`actual_carrier_indic`" value in the data-set header (see §6.2). Therefore, the actual uplink carrier frequency will be:
  `UplinkCarrierFreq`
  = `FreqUlmCarFrSel` + `ActualCarrierFreqOffset` + `FreqUplkConv`

  (NT) This value is irrelevant, as the transponder downlink frequency is predefined by another configuration parameter (`FreqDnlkCF`).

- **`DownlinkCarrierFreq`**: is the satellite down-link carrier frequency, i.e.:
  (CT) **`DownlinkCarrierFreq`** = `UplinkCarrierFreq` * `FreqTR1`/`FreqTR2`
  (NT) **`DownlinkCarrierFreq`** = `FreqDnlkCF` (as per configuration table)

- **`InputCarrierFreqOffset`**: is the actual (i.e. taking into account the actual ULM uplink frequency) nominal (i.e. Doppler-free) carrier offset relative to 70 MHz at IFMS input:

  `InputCarrierFreqOffset` = `DownlinkCarrierFreq` – `FreqDnlkConv` – 70MHz

From the first CDOP Data-Unit (received from the RGD, RCD, or SCD) at DAP start:

- **`Count0`**: count (of the accurate 17.5MHz clock)
- **`Phase0`**: phase of the replica Carrier

Measurement processing:

From the current CDOP Data-Unit:
- **`CountN`**: count
- **`PhaseN`**: phase

Derive the time difference since start:
- **`DeltaCount`** = (`CountN` – `Count0`)
- **`DeltaTime`** = `DeltaCount` / 17.5e6 (in seconds)

Derive the actual phase difference since start:
- **`DeltaPhase`** = (`PhaseN` – `Phase0`)

Derive **`DeltaDelay`** from the difference between the actual phase difference and the (hypothetical) phase difference corresponding to null Doppler effect:
- `ZeroDopplerDeltaPhase` = `DeltaTime` * `InputCarrierFreqOffset`
- `DeltaPhaseDoppler` = `DeltaPhase` – `ZeroDopplerDeltaPhase`
- **(CT)** **`DeltaDelay`** = – (`DeltaPhaseDoppler` / (2*`DownlinkCarrierFreq`))
  (NT) **`DeltaDelay`** = – (`DeltaPhaseDoppler` / `DownlinkCarrierFreq`)

6.4 Gain (AGC) data (1 & 2).

Each AGC measurement contains the following fields:

Field Name		Description		
sample_num	I	Identifier of the current sample <>		
sample_time	T	Timestamp of the current sample		
carrier_level	F	Carrier level	<dBm>	[0.1]
polar_angle	F	Polarization angle	<turns>	[0.0001]
incoh_agc_gain	F	Incoherent AGC Gain	<dB>	[0.1]
input_pow_ch_A	F	Input Power in Channel A	<dBm>	[0.1]
input_pow_ch_B	F	Input Power in Channel B	<dBm>	[0.1]
carr_lock_status	S	Carrier Lock Status, is: "`Unlocked`", "`Acquiring`", or "`Locked`"		

Table 2: AGC Data-sets Data Contents

6.5 Meteorological data.

Each Meteo measurement contains the following fields:

Field Name		Description		
sample_num	I	Identifier of the current sample <>		
sample_time	T	Timestamp of the current sample		
humidity	F	Humidity	<%>	[0.1]
pressure	F	Pressure	<hPa>	[0.1]
temperature	F	Temperature	<°C>	[0.1]

Table 3: Meteo Data-sets Data Contents

6.6 Ranging data.

Each Ranging measurement contains the following fields:

Field Name		Description
sample_num	I	Identifier of the current sample <>
sample_time	T	Timestamp of the current sample
delay	F	Signal round-trip delay, modulo the maximum code ambiguity <s> [free]
current_code	I	Current code number, in the set {1...24} <>
ambiguity_done	B	Flag indicating the resolution of ambiguity
spurious_carrier	B	Flag to indicate that the carrier is presently within the window of a known spurious frequency
spurious_tone	B	Flag to indicate that the tone is presently within the window of a known spurious frequency
prev_correlation	B	Flag to indicate the success of the previous code correlation
est_kd-1	F	Estimated Doppler effect (KD-1) <> [free]
dsp_rcvr_lock	B	DSP status: Flag indicating RGD receiver lock status
dsp_integrated_tone	F	DSP status: Integrated tone level relative to the Carrier Level, and not corrected with the actual Code Modulation Index <dB> [0.1]
dsp_integrated_code	F	DSP status: Normalised integrated code level, relative to the Tone Level <> [0.001]
dsp_phase_error	F	DSP status: Current phase error <turns> [0.001]
dsp_toneloop_snr	F	DSP status: Estimated tone loop signal-to-noise ratio <dB> [free]
dsp_mod_index	F	DSP status: Estimated Downlink ranging modulation index <rad> [free]

Table 4: Ranging Data-sets Data Contents

6.7 Open-Loop data.

- **OLP data definition.**

Open-loop measurements come from the GDSP 17.5 Msps 24-bit complex base band stream (containing 1, 2, 4, or 12-bit words each for the I and Q channels) and result from filtering and decimating the 280 Msps 8-bit stream output by the Common Front End (CFE) Analogue to Digital converter. These channels are provided for both RHC and LHC polarizations.

- **OLP data-sets organisation.**

The Open-Loop data-sets contain:

- First data-set (sequence Id 0): standard header and active configuration (with the content of the "`openloop`" configuration part added to the configuration section).
- Following data-sets (sequence Id >0): fixed-length binary records; each record contains a header and 136 measurement blocks; a new data-set is open every minute.

Note: For Open-Loop data-sets, the active configuration in the header data-set also contains the values of the "`openloop`" parameters.

- **OLP data-set content.**

Each OLP data-set contains an integer number of *records*. Each record contains a *header* (44 bytes, described below) and *data*. The data part of the record is made up of `NBLOCKS` *blocks* (`NBLOCKS`=136) and each block consists of `BLOCKSIZE` bytes (`BLOCKSIZE`=6 always).

Each sample consists of four components, X_{re}, X_{im}, Y_{re}, Y_{im} representing the complex RHC and LHC inputs respectively. The number of samples which can be packed into each 6-byte block is dependent on the requested quantization:

Quantisation bits	Samples/block
1	12
2	6
4	3
12	1

Samples are stored into the 48-bit block starting at the most significant bit and in the order Y_{re}, Y_{im}, X_{re}, X_{im}. For example, 4-bit data is as follows (3 samples/block):

```
        7       4 3       0
       +--------+--------+
       | Y(0)re | Y(0)im |     Byte 0
       +--------+--------+
       | X(0)re | X(0)im |     Byte 1
       +--------+--------+
       | Y(1)re | Y(1)im |     Byte 2
       +--------+--------+
       | X(1)re | X(1)im |     Byte 3
       +--------+--------+
       | Y(2)re | Y(2)im |     Byte 4
       +--------+--------+
       | X(2)re | X(2)im |     Byte 5
       +--------+--------+
```

The format of each record is as follows:

```
struct olp_record = {
   unsigned magic;         // fixed magic number (0xA3C725B6)
   unsigned length;        // record length (NBLOCKS*BLOCKSIZE+11*4)
   unsigned sp_message;    // message type (3,4,5 or 6 dep on quantization)
   unsigned sp_samptime;   // Time of first sample (0.1s ticks)
   unsigned sp_sampofs;    // Time of 1st sample (17.5MHz clocks since last 0.1s tick)
   int      sp_centre;     // Filter centre frequency at first sample
   unsigned sp_gain;       // Hardware gain at first sample
   unsigned statusoffset;  // byte offset to status from start of record, 0 if none
   unsigned markeroffset;  // always 0 - no marker
   unsigned dataoffset;    // byte offset to data from start of record (prob 11*4)
   unsigned parityoffset;  // always 0 - no parity
   BLOCK buf[NBLOCKS]      // packed data
}
```

An `int` or `unsigned` is a four byte number with most significant bytes written first (i.e. big-endian representation).

The `sp_*` words above are encoded as follows:

Identifier	Range	Description
`sp_message[2..0]`	7	Fixed OLP message type = 7
`sp_message[5..3]`	0 ... 7	OLP sample quantization (0=>1bit, 1=>2bits, 2=>4bits, 3=>12bits, 4..7 spare)
`sp_message[31..16]`	0 ... 65536	Sample rate given by $17.5 \cdot 10^6$ Hz divided by this value.
`sp_frameid[31..0]`	0 ... 4294967295	Frame counter. Increments by one for every transmitted frame. Wraps at 2^{32}.
`sp_sampofs[26..0]`	0 ... 17499999	Sample time of the first sample in this frame in clock ticks since the last second marker. The clock tick frequency is $17.5 \cdot 10^6$ Hz.
`sp_centre[31..0]`	-2147483647 ... 2147483647	Filter centre frequency at the time of the first sample in this frame is given by this value multiplied by $17.5 \cdot 10^6 / 2^{32}$ ($\approx 4.075 \cdot 10\text{-}3$) Hz.
`sp_gain[7..0]`	-127 ... +128	OLP digital path gain is given by 2^n where n is this value. This gain does not include the CFE gain.
`sp_gain[31..14]`	0 ... 86399	Number of whole unit seconds since midnight for the first sample in the frame.

7 IFMS Support-Log files.

Note: The Support-Log files do not apply to Open-Loop data-sets.

Data-set file events (`open`, `close`, and `delete`) are logged in ASCII text files known as *Support-Log files*. Support-Log files are intended to allow a minimal monitoring information to flow to the clients on their request. By inspection of a Support-Log file, the client can determine whether a data-set is open and predict its closing time. By storing a number of past events, the client can also determine the cause of past events.

The IFMS handles six Support-Log files (one for the following data-set types, Doppler 1 & 2, AGC1, AGC2, Meteo and Ranging) and make them accessible via FTP. Since FTP does not Support-Log file locking, there exists the possibility (although very unlikely) that system management of the Support-Log files (clean up, etc.) occurs concurrently with user access, in which case the data received by the user would be unpredictable. For this reason, Support-Log files are not intended for normal operational use, but only as a backup monitoring mechanism if needed (e.g. if the user gets confused as to the sequence of events happening on the IFMS, etc.).

The location of the Support-Log files is fixed to:
`~ifmsdset/support_logs/`

The names of the Support-Log files are fixed to:
`D1SupportLog`
`D2SupportLog`
`G1SupportLog`
`G2SupportLog`
`MESupportLog`
`RGSupportLog`

The maximum number of logged events in each Support-Log file is defined by a configuration parameter (`AdsdMaxSupLog`).

Each Support-Log file contain the following fields:

Field Name		Description
event_time	T	Time and date stamp of the event
DAPStart_time	T	Start time and date stamp of the DAP
spacecraft	S	Identification of the spacecraft
dataset_seq_id	I	Data-set sequence Id <>
event_type	S	Can be: "`Open`", "`Close`", "`Delete`"
open_reason	S	Can be: "-", "`DAP_Started`", "`Conf_Change`", "`Max_Size_Reached`", "`Tone_Lost`"
close_reason	S	Can be: "-", "`DAP_Stopped`", "`Conf_Change`", "`Max_Size_Reached`", "`Tone_Lost`"
duration	I	Expected or actual duration of a started data-set <s>
nb_samples	I	Expected or actual number of samples of a started data-set <>
sampling_period	F	Seconds between consecutive samples <s> [0.1]

Table 5: Support-Log Files Contents

Note: For open and close reasons, the "`-`" string is used when the "reason" is not relevant for the entry (see BNF).

8 IFMS user access.

8.1 User accounts and access rights.

A standard UNIX account ("dsetuser", with password "dsetuser", and belonging to group "dsetuser") is used to access the IFMS data-sets. When logging in via FTP into the IFMS, the remote user will be placed in the root directory of the data set store.

In the directory structure described above (in "File-system structure."), all directories and files are owned and readable/writable by a *private* UNIX user ("ifms", corresponding to the creator and owner of the files) and its group ("ifms"), and are readable by the all users, i.e. UNIX access rights are "775" ("rwxrwxr-x") for directories, and are "664" ("rw-rw-r--") for files.

Notes:

- Access for creating and writing is never granted to external system users.
- Access for removing files is never granted to external system FTP users, but only to users via the STC and DCP interfaces.

The users are defined at system installation in factory, and does not need any further modification when installing the system in a Ground Station. The support of new spacecrafts and stations does not require any re-configuration at UNIX level.

8.2 User access.

The IFMS data interface supports the login of multiple users. As the IFMS is based on UNIX, multiple concurrent logins by the same user, or different users, is supported.

8.3 File deletion and modification.

Users accessing the IFMS over the OCC interface are not allowed to modify or delete Data-Set files or Support-Log files.

Data-sets deletion is under control of the DCP and STC accesses (see [DCP-OPER] and [ICD-STC] documents respectively); Support-Log files are under control of the IFMS software only.

9 Annex 1: Files syntax specification.

The syntax of IFMS data-sets and Support-Log files are described in this annex using BNF production rules.

9.1 Annex 1.1: Common syntax elements.

```
-- ==========================================================
-- Common syntax elements.
-- ==========================================================
Alpha                ::= [a-zA-Z_]
AlphaAndSpace        ::= [a-zA-Z_ ]
Alphanumeric         ::= [0-9a-zA-Z_]
SpecialChars         ::= [+-.:~@#$%&*^]
BlankChars           ::= [ \t\n\r]             -- space, tab, LF, CR
Numeric              ::= [0-9]

NL                   ::= ({BlankChars}*\n)+    -- NL=New Line
SP                   ::= [ ]+                  -- spaces

ValueChar            ::= Alphanumeric | SpecialChars | SP | "/"
                                               -- limited to 20 characters

CommentChar          ::= Alphanumeric | SpecialChars | SP | "/"

INLINE_COMMENT ::= "//" {CommentChar}* NL

ALPHANUM_2           ::= {Alphanumeric}{2}     -- exactly 2 characters
ALPHANUM_4           ::= {Alphanumeric}{4}     -- exactly 4 characters

TIME_STAMP           ::= {Numeric}{8}"."{Numeric}{6}"."{Numeric}{3}
                                      -- format:   YYYYMMDD.HHMMSS.mmm
                                      -- example: 19991007.000426.000
                                      -- must be a valid date

STR_INT              ::= {Numeric}{1,20}

STR_FLOAT            ::= MANTISSA              -- limited to 20 characters
                       | MANTISSA EXPONENT

MANTISSA             ::= [+-]?{Numeric}+"."{Numeric}*
                       | [+-]?{Numeric}+

EXPONENT             ::= "e"[+-]?{Numeric}{1,3}

NUMBER               ::= STR_INT
                       | STR_FLOAT
```

```
OPEN_REASON            ::= "DAP_Started"
                         | "Conf_Change"
                         | "Max_Size_Reached"
                         | "Tone_Lost"
                         | "-"                   -- for Close / Delete entries

CLOSE_REASON           ::= "DAP_Stopped"
                         | "Conf_Change"
                         | "Max_Size_Reached"
                         | "Tone_Lost"
                         | "-"                   -- for Open / Delete entries

EPD_SOURCE             ::= "EPD_from_configuration"
                         | "EPD_from_Doppler_prediction"
                         | "-"                   -- for non-RG data-sets
```

9.2 Annex 1.2: Support-Log file specification.

```
-- ==============================================================
Support_File ::= INLINE_COMMENT SupportFileEntries
-- ==============================================================

SupportFileEntries     ::= SupportFileEntry
                         | SupportFileEntries SupportFileEntry

SupportFileEntry       ::=    TIME_STAMP      -- Event time
                          SP TIME_STAMP      -- DAP start time
                          SP ALPHANUM_4      -- Spacecraft Id
                          SP STR_INT         -- Data-set sequence Id
                          SP EVENT_TYPE      --
                          SP OPEN_REASON     --
                          SP CLOSE_REASON    --
                          SP NUMBER          -- Data-set duration
                          SP STR_INT         -- Number of samples
                          SP NUMBER          -- Sampling period
                          NL

EVENT_TYPE             ::= "Open"
                         | "Close"
                         | "Delete"
```

9.3 Annex 1.3: Data-set file specification.

```
-- ==========================================================
DataSetFile ::= DataSetFile_Header  NL  DataSetFile_Body
-- ==========================================================

-- ==========================================================
-- Data-set header part
-- ==========================================================
DataSetFile_Header ::=
HEADER_BEG                                                        NL
 STATION_ID_BEG            SP ALPHANUM_4  SP STATION_ID_END       NL
 SPACECRAFT_ID_BEG         SP ALPHANUM_4  SP SPACECRAFT_ID_END    NL
 DSET_KIND_BEG             SP ALPHANUM_2  SP DSET_KIND_END        NL
 DAP_TYPE_BEG              SP DAP_TYPE    SP DAP_TYPE_END         NL
 REF_TIMETAG_BEG           SP TIME_STAMP  SP REF_TIMETAG_END      NL
 FIRST_SAMPLE_TIME_BEG     SP TIME_STAMP  SP FIRST_SAMPLE_TIME_END NL
 LAST_SAMPLE_TIME_BEG      SP TIME_STAMP  SP LAST_SAMPLE_TIME_END NL
 REQUESTOR_ID_BEG          SP DAP_REQ_ID  SP REQUESTOR_ID_END     NL
 REQUEST_ID_BEG            SP STR_INT     SP REQUEST_ID_END       NL
 WHY_OPENED_BEG            SP OPEN_REASON SP WHY_OPENED_END       NL
 TOTAL_SAMPLES_BEG         SP NUMBER      SP TOTAL_SAMPLES_END    NL
 SAMPLE_PERIOD_BEG         SP NUMBER      SP SAMPLE_PERIOD_END    NL
 INTERNAL_REFERENCE_BEG    SP YESNO       SP INTERNAL_REFERENCE_END NL
 UPLINK_CARRIER_230_BEG    SP YESNO       SP UPLINK_CARRIER_230_END NL
 ACTUAL_CARRIER_INDIC_BEG  SP NUMBER      SP ACTUAL_CARRIER_INDIC_END NL
 ACTUAL_TONE_INDIC_BEG     SP NUMBER      SP ACTUAL_TONE_INDIC_END NL
 EPD_SOURCE_BEG            SP EPD_SOURCE  SP EPD_SOURCE_END       NL
 RG_DATA_CORRECTED_BEG     SP YESNO       SP RG_DATA_CORRECTED_END NL
 SEQ_ID_BEG                SP STR_INT     SP SEQ_ID_END           NL
 ACTIVE_TABLE_BEG                                                 NL
    PARAMETERS                                                    NL
 ACTIVE_TABLE_END                                                 NL
HEADER_END

HEADER_BEG                 ::=  "<header>"
HEADER_END                 ::= "</header>"
STATION_ID_BEG             ::=  "<station_id>"
STATION_ID_END             ::= "</station_id>"
SPACECRAFT_ID_BEG          ::=  "<spacecraft_id>"
SPACECRAFT_ID_END          ::= "</spacecraft_id>"
DSET_KIND_BEG              ::=  "<dset_kind>"
DSET_KIND_END              ::= "</dset_kind>"
DAP_TYPE_BEG               ::=  "<dap_type>"
DAP_TYPE_END               ::= "</dap_type>"
REF_TIMETAG_BEG            ::=  "<ref_time_tag>"
REF_TIMETAG_END            ::= "</ref_time_tag>"
FIRST_SAMPLE_TIME_BEG      ::=  "<first_sample_time>"
FIRST_SAMPLE_TIME_END      ::= "</first_sample_time>"
LAST_SAMPLE_TIME_BEG       ::=  "<last_sample_time>"
LAST_SAMPLE_TIME_END       ::= "</last_sample_time>"
REQUESTOR_ID_BEG           ::=  "<requestor_id>"
REQUESTOR_ID_END           ::= "</requestor_id>"
REQUEST_ID_BEG             ::=  "<request_id>"
REQUEST_ID_END             ::= "</request_id>"
WHY_OPENED_BEG             ::=  "<why_opened>"
WHY_OPENED_END             ::= "</why_opened>"
TOTAL_SAMPLES_BEG          ::=  "<total_samples>"
TOTAL_SAMPLES_END          ::= "</total_samples>"
SAMPLE_PERIOD_BEG          ::=  "<sample_period>"
SAMPLE_PERIOD_END          ::= "</sample_period>"
INTERNAL_REFERENCE_BEG     ::=  "<internal_reference>"
```

```
INTERNAL_REFERENCE_END   ::= "</internal_reference>"
UPLINK_CARRIER_230_BEG   ::=  "<uplink_carrier_230>"
UPLINK_CARRIER_230_END   ::= "</uplink_carrier_230>"
ACTUAL_CARRIER_INDIC_BEG ::=  "<actual_carrier_indic>"
ACTUAL_CARRIER_INDIC_END ::= "</actual_carrier_indic>"
ACTUAL_TONE_INDIC_BEG    ::=  "<actual_tone_indic>"
ACTUAL_TONE_INDIC_END    ::= "</actual_tone_indic>"
EPD_SOURCE_BEG           ::=  "<epd_source>"
EPD_SOURCE_END           ::= "</epd_source>"
RG_DATA_CORRECTED_BEG    ::=  "<rg_data_corrected>"
RG_DATA_CORRECTED_END    ::= "</rg_data_corrected>"
SEQ_ID_BEG               ::=  "<sequence_id>"
SEQ_ID_END               ::= "</sequence_id>"
ACTIVE_TABLE_BEG         ::=  "<active_table>"
ACTIVE_TABLE_END         ::= "</active_table>"

-- ==========================================================
-- Data-set body part
-- ==========================================================
DataSetFile_Body ::=
     BODY_DOPPLER_BEG NL INLINE_COMMENT DopplerSamples NL BODY_DOPPLER_END NL
   | BODY_GAIN_BEG    NL INLINE_COMMENT GainSamples    NL BODY_GAIN_END    NL
   | BODY_RANGING_BEG NL INLINE_COMMENT RangingSamples NL BODY_RANGING_END NL
   | BODY_METEO_BEG   NL INLINE_COMMENT MeteoSamples   NL BODY_METEO_END   NL

BODY_DOPPLER_BEG     ::=  "<body_Doppler>"
BODY_DOPPLER_END     ::= "</body_Doppler>"
BODY_GAIN_BEG        ::=  "<body_Gain>"
BODY_GAIN_END        ::= "</body_Gain>"
BODY_RANGING_BEG     ::=  "<body_Ranging>"
BODY_RANGING_END     ::= "</body_Ranging>"
BODY_METEO_BEG       ::=  "<body_Meteo>"
BODY_METEO_END       ::= "</body_Meteo>"

-- ==========================================================
-- Doppler samples
-- ==========================================================
DopplerSamples ::= DopplerSample
                 | DopplerSamples  NL  DopplerSample

DopplerSample  ::=    STR_INT     -- Sample number
                   SP TIME_STAMP  -- Sample time
                   SP NUMBER      -- Interval count
                   SP NUMBER      -- Carrier Phase (in turns)
                   SP YESNO       -- Spurious flag
                   SP NUMBER      -- DeltaDelay

-- ==========================================================
-- AGC samples
-- ==========================================================
GainSamples ::= GainSample
              | GainSamples  NL  GainSample

GainSample     ::=    STR_INT     -- Sample number
                   SP TIME_STAMP  -- Sample time
                   SP NUMBER      -- Carrier level
                   SP NUMBER      -- Polarisation angle
                   SP NUMBER      -- Incoherent AGC Gain
                   SP NUMBER      -- Input Power in Channel A
                   SP NUMBER      -- Input Power in Channel B
                   SP CARR_LOCK   -- Carrier Lock Status
```

```
-- ==========================================================
-- Meteo samples
-- ==========================================================
MeteoSamples    ::= MeteoSample
                  | MeteoSamples    NL  MeteoSample

MeteoSample     ::=    STR_INT      -- Sample number
                    SP TIME_STAMP   -- Sample time
                    SP NUMBER       -- Humidity
                    SP NUMBER       -- Pressure
                    SP NUMBER       -- Temperature

-- ==========================================================
-- Ranging samples
-- ==========================================================
RangingSamples ::= RangingSample
                  | RangingSamples  NL  RangingSample

RangingSample  ::=     STR_INT      -- Sample number
                    SP TIME_STAMP   -- Sample time
                    SP NUMBER       -- Delay (s)
                    SP NUMBER       -- Code number
                    SP YESNO        -- Ambiguity solved
                    SP YESNO        -- Spurious carrier frequency
                    SP YESNO        -- Spurious tone frequency
                    SP YESNO        -- Code correlation
                    SP NUMBER       -- KD-1 (KD is the Doppler effect)
                    SP YESNO        -- Receiver lock status
                    SP NUMBER       -- Integrated Tone level
                    SP NUMBER       -- Normalised integrated Code level
                    SP NUMBER       -- Phase error
                    SP NUMBER       -- Estimated Tone loop S/N ratio
                    SP NUMBER       -- Estimated downlink Ranging modulation index

-- ==========================================================
-- General purpose definitions
-- ==========================================================
YESNO          ::= "Yes" | "No"

DAP_REQ_ID     ::= "STC" | "DCP"

DAP_TYPE       ::= "D1" | "D2" | "G1" | "G2" | "ME" | "RG"

CARR_LOCK      ::= "Unlocked" | "Acquiring" | "Locked"

PARAMETERS     ::= PARAMETER
                 | PARAMETERS NL PARAMETER

PARAMETER      ::= PARAMETER_NAME SP "=" SP PARAMETER_VAL SP ";" SP INLINE_COMMENT

PARAMETER_NAME ::= {Alphanumeric}{1,20}

PARAMETER_VAL  ::= NUMBER                     -- limited to 20 characters
                 | YESNO
                 | "\""{ValueChar}{0,20}"\""
```

10 Annex 2: Examples.

This section provides examples of the content of the data-sets and Support-Log files at the time of writing.

10.1 Support-Log file.

```
//         EventTime      DAPStartTime       SpC  SeqId EventType OpenReason       CloseReason      Duration NbSmpls Period
19990929.000426.000 19990929.000426.000 CLU1 5212  Open      DAP_Started      -                10       100         0.1
19990929.000426.000 19990929.000426.000 CLU1 5212  Close     -                Max_Size_Reached 10       100         0.1
19990929.000426.000 19990929.000426.000 CLU1 5213  Open      Max_Size_Reached -                0        0           0.1
19990929.000426.000 19990929.000426.000 CLU1 5213  Close     -                Max_Size_Reached 10       100         0.1
19990929.000426.000 19990929.000426.000 CLU1 5214  Open      Max_Size_Reached -                0        0           0.1
19990929.000426.000 19990929.000426.000 CLU1 5214  Close     -                Max_Size_Reached 10       100         0.1
```

10.2 Header information.


```
<header>
<station_id>            sjcc                              </station_id>
<spacecraft_id>         NONE                           </spacecraft_id>
<dset_kind>             __                                 </dset_kind>
<dap_type>              RG                                  </dap_type>
<ref_time_tag>          20050127.130806.000             </ref_time_tag>
<first_sample_time>     20050127.130829.000        </first_sample_time>
<last_sample_time>      20050127.130858.000         </last_sample_time>
<requestor_id>          DCP                             </requestor_id>
<request_id>            1                                 </request_id>
<why_opened>            DAP_Started                       </why_opened>
<total_samples>         30                             </total_samples>
<sample_period>         1.                             </sample_period>
<internal_reference>    No                        </internal_reference>
<uplink_carrier_230>    No                        </uplink_carrier_230>
<actual_carrier_indic>  3058630281.             </actual_carrier_indic>
<actual_tone_indic>     209095944.                 </actual_tone_indic>
<epd_source>            EPD_from_configuration            </epd_source>
<rg_data_corrected>     No                         </rg_data_corrected>
<sequence_id>           0                                </sequence_id>
<active_table>
   UlmMode                          = "Normal"                          ; //
   UlmCarNomLvl                     = -10                               ; // dBm
   UlmCarTstLvl                     = 30.0                              ; // dB
   UlmCarSpecInv                    = No                                ; //
   UlmPrior                         = No                                ; //
   UlmTcSrc                         = "None"                            ; //
   UlmTcDataCoding                  = "NRZ-L"                           ; //
   UlmTcTceMode                     = "Continuous"                      ; //
   UlmTcModIdx_Ana                  = 0.0000                            ; // rad/V
   UlmTcModIdx_Dig                  = 0.000                             ; // rad
   UlmTcMod                         = "PM on carrier"                   ; //
   UlmTcRCBRateN                    = 1                                 ; //
   UlmTcRCBRateD                    = 1                                 ; //
   UlmTcSCBRateP                    = 100.00                            ; // bit/s
   UlmTcSCBRateQ                    = 100.00                            ; // bit/s
   UlmTcUnbalRatio                  = -15.0                             ; // dB
   UlmTcSqWavSubc                   = Yes                               ; //
   UlmTcRCBRateSel                  = Yes                               ; //
   UlmTcRCIrrBRate                  = 10.00                             ; // bit/s
   UlmTcSubF                        = 16000                             ; // Hz
   UlmRampTime                      = 0.00                              ; // s
   UlSweep_StartOffset              = 0                                 ; // Hz
   UlSweep_3LegRange                = 500000                            ; // Hz
   UlSweep_3LegRate                 = 10000                             ; // Hz/s
   UlSweep_3LegInitRate             = 10000                             ; // Hz/s
   UlSweep_3LegDpPred               = No                                ; //
   UlSweep_NumberOfLegs             = 4                                 ; //
   UlSweep_Leg01EndFrq              = 1000500                           ; // Hz
   UlSweep_Leg01Rate                = 10                                ; // Hz/s
   UlSweep_Leg01HoldDur             = 30                                ; // s
   UlSweep_Leg02EndFrq              = 1000400                           ; // Hz
   UlSweep_Leg02Rate                = 5                                 ; // Hz/s
   UlSweep_Leg02HoldDur             = 30                                ; // s
   UlSweep_Leg03EndFrq              = 999500                            ; // Hz
```

```
UlSweep_Leg03Rate              = 10                                ; // Hz/s
UlSweep_Leg03HoldDur           = 60                                ; // s
UlSweep_Leg04EndFrq            = 1000000                           ; // Hz
UlSweep_Leg04Rate              = 10                                ; // Hz/s
UlSweep_Leg04HoldDur           = 0                                 ; // s
UlSweep_Leg05EndFrq            = -1500000                          ; // Hz
UlSweep_Leg05Rate              = 1                                 ; // Hz/s
UlSweep_Leg05HoldDur           = 0                                 ; // s
UlSweep_Leg06EndFrq            = -1500000                          ; // Hz
UlSweep_Leg06Rate              = 1                                 ; // Hz/s
UlSweep_Leg06HoldDur           = 0                                 ; // s
UlSweep_Leg07EndFrq            = -1500000                          ; // Hz
UlSweep_Leg07Rate              = 1                                 ; // Hz/s
UlSweep_Leg07HoldDur           = 0                                 ; // s
UlSweep_Leg08EndFrq            = -1500000                          ; // Hz
UlSweep_Leg08Rate              = 1                                 ; // Hz/s
UlSweep_Leg08HoldDur           = 0                                 ; // s
UlSweep_Leg09EndFrq            = -1500000                          ; // Hz
UlSweep_Leg09Rate              = 1                                 ; // Hz/s
UlSweep_Leg09HoldDur           = 0                                 ; // s
UlSweep_Leg10EndFrq            = -1500000                          ; // Hz
UlSweep_Leg10Rate              = 1                                 ; // Hz/s
UlSweep_Leg10HoldDur           = 0                                 ; // s
UlSweep_MulStopRate            = 100                               ; // Hz/s
FreqUlmCarFrSel                = "70MHz Test"                      ; //
FreqUlmCarFrOffs               = 150000                            ; // Hz
FreqSpecInv                    = No                                ; //
FreqUplkConv                   = 9840150000                        ; // Hz
FreqCoherTrs                   = No                                ; //
FreqTR1                        = 1                                 ; //
FreqTR2                        = 1                                 ; //
FreqDnlkCF                     = 10070150000                       ; // Hz
FreqDnlkConv                   = 10000000000                       ; // Hz
RgdPolarisation                = "X"                               ; //
RgdPhEst                       = 0.00                              ; // T
RgdPostProc                    = 1                                 ; //
RgdExpCN0Avail                 = Yes                               ; //
RgdExpCN0                      = 60                                ; // dBHz
RgdCFrUnc                      = 500000                            ; // Hz
RgdCFrRateUnc                  = 0                                 ; // Hz/s
RgdCAcqMode                    = "FFT1"                            ; //
RgdUseAcq                      = Yes                               ; //
RgdCLpNoBw                     = 10.0                              ; // Hz
RgdCLpOrder                    = 2                                 ; //
RgdCLp_ChgDel                  = "STEP"                            ; //
RgdTLpBw                       = 1.000                             ; // Hz
RgdTLPreSt                     = No                                ; //
RgdTLp_ChgDel                  = "STEP"                            ; //
D1Dur                          = 1000                              ; // s
D1SplPer                       = "1"                               ; // s
D1MaxDs                        = 10000                             ; //
D1DSetKind                     = ""                                ; //
D1Source                       = "RGD"                             ; //
D2Dur                          = 1000                              ; // s
D2SplPer                       = "1"                               ; // s
D2MaxDs                        = 10000                             ; //
D2DSetKind                     = ""                                ; //
D2Source                       = "RCD"                             ; //
G1Dur                          = 1000                              ; // s
G1SplPer                       = 0.3                               ; // s
G1MaxDs                        = 100                               ; //
G1DSetKind                     = ""                                ; //
G1Source                       = "RGD"                             ; //
G2Dur                          = 1000                              ; // s
G2SplPer                       = 0.1                               ; // s
G2MaxDs                        = 100                               ; //
G2DSetKind                     = ""                                ; //
G2Source                       = "RCD"                             ; //
MeDur                          = 1000                              ; // s
MeSplPer                       = 10                                ; // s
MeMaxDs                        = 10                                ; //
MeDSetKind                     = ""                                ; //
OLDSetKind                     = ""                                ; //
RgDur                          = 1000                              ; // s
RgSplPer                       = 1                                 ; // s
RgMaxDs                        = 1000                              ; //
RgDSetKind                     = ""                                ; //
RgToneF                        = 851969.000                        ; // Hz
RgToneTxModInd                 = 0.7                               ; // rad
RgToneRxModInd                 = 0.7                               ; // rad
RgToneInteg                    = 4.0                               ; // s
RgToneSettl                    = 1.0                               ; // s
RgCodeModInd                   = "High"                            ; //
RgCodeMax                      = 18                                ; //
RgCodeInteg                    = 4.8                               ; // s
RgCodeRestart                  = No                                ; //
RgCodeRepet                    = No                                ; //
RgDualRanging                  = "no"                              ; //
```

```
   Epd                             = 0.00                              ; // s
   EpdDer                          = 0.000000000                       ; // s/s
   EpdTime                         = "19700101.000000.000"             ; //
   StationId                       = "sjcc"                            ; //
   MissionId                       = "NoMiss"                          ; //
   SpacecraftId                    = "NONE"                            ; //
   RcdPolarisation                 = "X"                               ; //
   RcdPhEst                        = 0.00                              ; // T
   RcdPostProc                     = 1                                 ; //
   RcdExpCN0Avail                  = No                                ; //
   RcdExpCN0                       = 6                                 ; // dBHz
   RcdCFrUnc                       = 0                                 ; // Hz
   RcdCFrRateUnc                   = 0                                 ; // Hz/s
   RcdCAcqMode                     = "Sweep"                           ; //
   RcdUseAcq                       = No                                ; //
   RcdCLpNoBw                      = 0.1                               ; // Hz
   RcdCLpOrder                     = 1                                 ; //
   RcdCLp_ChgDel                   = "STEP"                            ; //
   RcdTLpBw                        = 0.00001                           ; // fsr
   RcdTLpOrder                     = 1                                 ; //
   RcdTLpPhEst                     = "DD"                              ; //
   RcdTLp_ChgDel                   = "STEP"                            ; //
   RcdSCLpFreq                     = 0                                 ; // Hz
   RcdSCLpPreSt                    = No                                ; //
   RcdSCLpBw                       = 0.00001                           ; // fsr
   RcdSCLpModInd                   = 0.01                              ; // rad
   RcdSCLpPhEst                    = "Decision directed"               ; //
   RcdSCLpAcq                      = "None"                            ; //
   RcdSCLpBitNum                   = 1                                 ; //
   RcdSCLpBitDen                   = 1                                 ; //
   RcdSCLpSqWavSc                  = No                                ; //
   RcdSCLpSRateUsed                = No                                ; //
   RcdSCLpSRate                    = 10.00                             ; // sps
   RcdSCLpDecodMode                = "NRZ-L"                           ; //
   RcdSCLp_ChgDel                  = "STEP"                            ; //
   ScdPolarisation                 = "X"                               ; //
   ScdPhEst                        = 0.00                              ; // T
   ScdPostProc                     = 1                                 ; //
   ScdExpCN0Avail                  = No                                ; //
   ScdExpCN0                       = 6                                 ; // dBHz
   ScdCFrUnc                       = 0                                 ; // Hz
   ScdCFrRateUnc                   = 0                                 ; // Hz/s
   ScdCAcqMode                     = "Sweep"                           ; //
   ScdUseAcq                       = No                                ; //
   ScdCLpNoBw                      = 0.1                               ; // Hz
   ScdCLpOrder                     = 1                                 ; //
   ScdCLpPhEst                     = "RCD"                             ; //
   ScdCLp_ChgDel                   = "STEP"                            ; //
   ScdTLpBw                        = 0.00001                           ; // fsr
   ScdTLpOrder                     = 1                                 ; //
   ScdTLpPhEst                     = "DD"                              ; //
   ScdTLp_ChgDel                   = "STEP"                            ; //
   ScdModFormat                    = "Off"                             ; //
   ScdModPRate                     = 100                               ; // sps
   ScdModQRate                     = 100                               ; // sps
   ScdModExpBalAv                  = No                                ; //
   ScdModExpBal                    = 0.0                               ; // dB
   ScdModIChCoding                 = "NRZ-L"                           ; //
   ScdModQChCoding                 = "NRZ-L"                           ; //
   ScdMchPulse                     = No                                ; //
   ScdMchCosine                    = No                                ; //
   ScdMchExcBw                     = 20                                ; // %
   GmdPolarisation                 = "X"                               ; //
   GmdPhEst                        = 0.00                              ; // T
   GmdPostProc                     = 1                                 ; //
   GmdExpCN0Avail                  = No                                ; //
   GmdExpCN0                       = 6                                 ; // dBHz
   GmdCFrUnc                       = 0                                 ; // Hz
   GmdCFrRateUnc                   = 0                                 ; // Hz/s
   GmdCAcqMode                     = "Sweep"                           ; //
   GmdUseAcq                       = No                                ; //
   GmdCLpNoBw                      = 0.1                               ; // Hz
   GmdCLpOrder                     = 1                                 ; //
   GmdCLp_ChgDel                   = "STEP"                            ; //
   GmdTLpBw                        = 0.00001                           ; // fsr
   GmdTLpOrder                     = 1                                 ; //
   GmdTLpPhEst                     = "DD"                              ; //
   GmdTLp_ChgDel                   = "STEP"                            ; //
   GmdModFormat                    = 60000                             ; // bit/s
   GmdModIChCoding                 = "NRZ-L"                           ; //
   GmdBTbSelection                 = "0.25"                            ; //
</active_table>
</header>
```

10.3 Doppler data (1 & 2).

```
<body_Doppler>
// Number SampleTime            IntervalCount        CarrierPhase  Spurious          DeltaDelay
214748364 20000630.163001.000    23458935517     -1340357767.98900  No             -123456.6108
214748364 20000630.163001.100    23460685517     -1340457756.64812  No             -123459.4600
214748364 20000630.163001.200    23462435517     -1340557745.24730  No             -123462.2928
214748364 20000630.163001.300    23464185517     -1340657733.78700  No             -123465.1000
214748364 20000630.163001.400    23465935517     -1340757722.44140  No             -123467.9559
</body_Doppler>
```

10.4 Gain data (1 & 2).

```
<body_Gain>
// Number SampleTime              CarrierLevel   PolarAngle  IncohAgcGain  InpPowChA  InpPowChB  CarrLock
214748364 20020909.071234.000           -110.0       -1.000        23.000     25.000     26.000  Unlocked
214748364 20020909.071234.100           -101.2       -0.689        23.100     25.000     26.000  Acquiring
214748364 20020909.071234.200            -90.5       -0.003        23.200     24.900     25.000  Acquiring
214748364 20020909.071234.300            -82.3        0.123        23.300     24.600     24.000  Locked
214748364 20020909.071234.400            -78.7        0.678        23.400     24.300     23.000  Locked
</body_Gain>
```

10.5 Meteorological data.

```
<body_Meteo>
// Number         SampleTime    Humidity      Pressure     Temperature
     1   19991007.000420.000        30.2         940.2            25.2
     2   19991007.000430.000        30.3         940.2            25.2
     3   19991007.000440.000        30.4         940.2            25.2
     4   19991007.000450.000        30.3         940.2            25.2
     5   19991007.000500.000        30.2         940.2            25.2
     6   19991007.000510.000        30.1         940.2            25.2
     7   19991007.000520.000        30.0         940.2            25.2
     8   19991007.000530.000        30.1         940.2            25.2
     9   19991007.000540.000        30.2         940.2            25.2
    10   19991007.000550.000        30.3         940.2            25.2
    11   19991007.000600.000        30.2         940.2            25.2
    12   19991007.000610.000        30.2         940.2            25.2
</body_Meteo>
```

10.6 Ranging data.

```
<body_Ranging>
// Number SampleTime                          Delay Code AmbF SpCF SpTF CorF KD-1  RecF ToneLevel CodeLevel PhaseError
ToneLoopSN DownModIndex
        1 19990927.000427.000  5.862756052447e-06    0 No   No   No   No   2e-05  No       -5.8     0.771      0.012
25            0.21
        2 19990927.000428.000  5.862735678000e-06    1 No   Yes  Yes  No   2e-05  No       -5.7    -0.825      0.011
25            0.21
        3 19990927.000429.000  5.862711728394e-06    2 No   No   No   No   2e-05  No       -5.8     0.827      0.010
25            0.21
        4 19990927.000430.000  5.862691212120e-06    3 No   No   No   No   2e-05  No       -5.9     0.825     0.0009
25            0.21
        5 19990927.000431.000  5.862671001001e-06    4 No   No   No   No   2e-05  No       -5.8    -0.812      0.010
25            0.21
        6 19990927.000432.000  5.862657660000e-06    5 No   No   No   No   2e-05  No       -5.7     0.811      0.010
25            0.21
        7 19990927.000433.000  5.862633568701e-06    6 No   No   No   No   2e-05  No       -5.6     0.831      0.011
25            0.21
</body_Ranging>
```