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## TTCP Development, Production & Deployment

# *TTCP Software Interface Control Document (ICD) for RM datasets*

## Ref: TTCP-ICD-SOFT-RM

# Document Information

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|---|---|
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# Document Change Record

| Issue | Date | Changes |
|---|---|---|
| 1.0 | 2017-01-10 | First issue. |
| 1.1 | 2017-03-07 | Take into account ESA comments.<br>• §8: Review the format of sample times: millisecond accuracy is enough for all dataset types.<br>• §8.4: Indicate that `spurious_carrier` column is not used.<br>• §8.6: Add `spurious_carrier` and `spurious_tone` columns.<br>• §8.7: `Fband` is `StFreqTXFreq` not `integ_phase_ref_freq`.<br>• §12.2: Provide up-to-date configuration information. |
| 1.2 | 2017-09-04 | Modifications:<br>• §7.2: Document the `gzip` version of datasets.<br>• §8.4: Review derivation of delta-delay in Doppler datasets.<br>• §8.7: Rename $F_{Band}$ to $F_{Tx}$.<br>• §8.8: Description of "`up_carr_phase`": replace "`integ_phase_ref_freq`" with "`StFreqTxFreq`". |
| 1.3 | 2018-03-14 | Modifications:<br>• §8.4.1: Update derivation of delta-delay in Doppler datasets: define `BaseFreq`, invert signs for `DeltaDelay`. |

# Contents

# 1 Introduction

This document describes the structure and content of the Radiometric (RM) datasets collected by the TTCP. It also describes the protocols and services supported on the interface between the TTCP and data clients.

This document completes, with more details, the [TTCP-ICD-SOFT] document.

# 2 Applicable and Reference Documents

[TTCP-REFS] ***TTCP – List of AD and RD references***
Ref: GSY/120214/112175, Issue 1.93, 2013-07-23

[TTCP-TERMS] ***TTCP – List of acronyms and terms***
Ref: GSY/120204/112175, Latest issue

For the full list of applicable and reference documents please refer to the [TTCP-REFS].

# 3 Terms, Definitions and Abbreviated Terms

For the full list of terms, definitions and abbreviated terms please refer to the [TTCP-TERMS].

# 4 Network access.

For the TTCP systems installed in the ESA ESTRACK stations, the RM data interface is accessed via FTP/SFTP over IP. Corresponding user names and passwords are defined in [TTCP-ICF-SOFT].

# 5 Protocols supporting the interface.

The RM Dataset retrieval interface is supported entirely by standard protocols over TCP/IP: FTP and SFTP. RM datasets are made available in read-only mode to users, after relevant login procedure, and can then be copied from the TTCP.

# 6 Services supported on the interface.

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

RM dataset 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.

- **RM dataset catalogue access.**

  Dataset catalogue services are provided by (S)FTP directory listings

- **RM dataset access.**

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

- **File management.**

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

# 7 RM dataset storage.

## 7.1 File-system structure.

The file-system supports a hierarchy of directories as specified below:

```
<rm_dataset_dir>/station/spacecraft/<dataset_file>
```

## 7.2 File naming.

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

```
NNO1_CLU3_2016_108_OP_R1_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. In that case, the TTCP expands the sequence IDs length.

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
- Dataset Kind 2 characters (*)
- DAP Type 2 characters
- DAP Start Time 6 characters (format: "`hhmmss`")
- Dataset Sequence ID 4 characters minimum

(*) The value of these fields is determined from the TTCP configuration (see the [TTCP-SUM-01]) which is currently active at the time of dataset creation, in the "`rmdsm`" 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.:
  `NNO1`

- **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.
  `2016`

- **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 dataset, e.g. a particular mission may decide to use OP for operational, CL for calibration, TS for test, etc.

- **DAP type.**

  The DAP type is identified by a two-character string, among:
  - Meteo `ME`
  - Doppler `D1, D2, D3, D4`
  - AGC `G1, G2, G3, G4`
  - Ranging `R1, R2, R3`
  - Uplink Carrier Frequency `U1, U2`
  - Uplink Carrier Phase `T1, T2`
  - Uplink Tone Frequency `TBD` (Phase 2)
  - Uplink Tone Phase `TBD` (Phase 2)

- **DAP start time.**

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

- **Dataset sequence identification.**

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

  If, due to a large DAP duration, or to frequent configuration changes (causing the current dataset to be closed and a new one open), this maximum sequence identification may exceed 10000; in that case, the Dataset Sequence Identification for the following datasets shall be coded on 5 digits.

- **Note about ranging data.**

  The Ranging DAP procedure includes a process called ambiguity resolution, which may last from a few seconds (in the case of low-earth spacecraft) to hours (in the case of deep-space spacecraft). Range measurements recorded during the ambiguity resolution process are offset by a delay (corresponding to a tone signal phase shift) whose value depends on the further tone shifts applied during ambiguity resolution.

- **File compression.**

  In parallel to the ASCII version of the datasets, 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`").

## 7.3 File format.

Radiometric datasets are stored as ASCII text files, containing:
- ASCII text
- Header with an extract of the active configuration
- One measurement per line with sample number and full timetag

# 8 Datasets content.

Different datasets 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).

## 8.1 Overview & administration.

Datasets contain two content parts: a header and measurement data.

## 8.2 Header information.

Each dataset begins with a header containing the following information:

| Field Name | | Description |
|---|---|---|
| station_id | S | Station Identifier |
| spacecraft_id | S | Spacecraft Identifier |
| dset_kind | S | Dataset kind |
| dap_type | S | DAP type |
| ref_time_tag | T | Time-tag of sample #1 ** See notes below ** |
| first_sample_time | T | Time-stamp of the first measurement |
| last_sample_time | T | Time-stamp of the last measurement |
| request_id | I | Integer value as provided by the requestor <> |
| why_opened | S | Can assume one of the following values:<br>• "DAP_Started"<br>• "Conf_Change"<br>• "Max_Size_Reached"<br>• "Tone_Lost" |
| total_samples | I | Total number of samples collected in this data set <> |
| sample_period | F | Period between samples <s> [0.1] ** See notes below ** |
| internal_reference | B | Flag to indicate whether the internal reference oscillator is used, i.e. if at DAP start, the SPU uses its internal reference instead of the reference provided by the station (as indicated by the SY_RFGS/a data-unit). |
| integ_phase_ref_freq | F | Base frequency to which the carrier phase measurement are relative (DM_CPHA/a) |
| epd_source | S | Can assume one of the following values:<br>• "EPD_from_configuration": the EPD is derived from the configuration parameters in the tracking part of the active table<br>• "EPD_from_Doppler_prediction": the EPD is derived from the Doppler Prediction file currently used<br>• "–": for non-RG datasets |
| seq_id | I | Dataset sequence id <> |

| Field Name | | Description |
|---|---|---|
| configuration | - | Value of an extract of the configuration parameters from the Active Table<br>** See note below ** |

The ref_time_tag is provides a time epoch for the numbering of the samples, so that for each of them, the sample time-tag is:

```
sample_time = ref_time_tag + (sample_num – 1) * sample_period
```

This does not apply to the Uplink Carrier Frequency datasets where the sample times are not evenly spaced, and then ref_time_tag is the DAP start time.

The sampling_period is determined by the configuration parameters (XxSplPer, where Xx is the source DAP), except for Uplink Carrier Frequency datasets, where the sampling period is variable and this parameter should be ignored (it is set to 0 second).

The configuration field provides the value of the parameters of the following parts of the currently active configuration (see the [TTCP-SUM-01]):

| DAP types | Configuration parts |
|---|---|
| All DAP types | rmdcm |
| Doppler | fpstation, fpspacecraft, demod, demodrc, demodsc |
| AGC | fpstation, fpspacecraft, demod, demodrc, demodsc, tmdecod, tmconcat, tmturbo, tmldpc |
| Ranging | fpstation, fpspacecraft, uplink, demod |
| Uplink Carrier Frequency | fpstation, uplink |
| Uplink Carrier Phase | fpstation, uplink |

**Note**: New Meteo datasets are not re-open when the TTCP configuration is changed.

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

## 8.3 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 [YYYYMMDD.hhmmss.mmm] |
| humidity | F | Humidity <%> [0.1] |
| pressure | F | Pressure <hPa> [0.1] |
| temperature | F | Temperature <°C> [0.1] |

## 8.4 Doppler data.

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 [YYYYMMDD.hhmmss.mmm] |
| interval_count | I | Reconstructed 17.5 MHz clock count since arbitrary origin <> |
| unwrapped_phase | F | Unwrapped phase of the internal demodulator carrier NCO <turns> [0.00001] |
| spurious_carrier | B | Flag to indicate that the carrier is presently within the window of a known spurious frequency (not used) |
| 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] |
| CarrLock | S | Demodulator Carrier Lock Status, is: "Unlocked", "Acquiring", or "Locked" |

Note: Measurement source:

- interval_count: Reconstructed from the sample time-tag for compatibility with IFMS datasets
- unwrapped_phase: DM_CPHA/g and following

### 8.4.1 Derivation of the Delta delay measurement

This section describes how the DeltaDelay value in the Doppler datasets is derived by the TTCP from the row measurements.

- **Notations**:

  **(CT)** indicates a Coherent Transponder (`SpFreqTcRgCoherTrs` is `Yes`)
  **(NT)** indicates a to Non-coherent Transponder (`SpFreqTcRgCoherTrs` is `No`)
  **(NI)** applies when receive spectrum is not inverted in the station (`StFreqRxDnSpecInv` is `No`)
  **(IN)** applies when receive spectrum is inverted in the station (`StFreqRxDnSpecInv` is `Yes`)

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

  **(CT)** **`UplinkCarrierFreq`** = `StFreqTxFreq + StFreqTxUpConv`
  **(NT)** This value is not used, as the transponder downlink frequency is predefined by another configuration parameter (`SpFreqDnlkCF`).

- **`DownlinkCarrierFreq`** is the spacecraft down-link carrier frequency, i.e.:

  **(CT)** **`DownlinkCarrierFreq`** = `UplinkCarrierFreq*SpFreqTrNum / SpFreqTrDen`
  **(NT)** **`DownlinkCarrierFreq`** = `SpFreqDnlkCF`

- **`InputCarrierFreq`** is the (spacecraft and ground station at rest) frequency at TTCP input corresponding to no Doppler effect, i.e.:

  **(NI)** `InputCarrierFreq = DownlinkCarrierFreq – StFreqRxDnConv`
  **(IN)** `InputCarrierFreq = StFreqRxDnConv – DownlinkCarrierFreq`

- **`BaseFreq`** is a reference frequency, provided as `integ_phase_ref_freq` in the dataset header. It is the nearest integer MHz value of `InputCarrierFreq`.

- **`IFInputCarrierFreqOffset`** is the (hypothetical) frequency offset from the reference IF at TTCP input corresponding to null Doppler effect, i.e.:

  `IFInputCarrierFreqOffset = InputCarrierFreq – BaseFreq`

- **`DeltaDelay`** measurement is derived from the difference between the actual phase difference and the phase difference corresponding to no Doppler effect:

  **`DeltaPhase(n)`** = `CarrierPhase(n) – CarrierPhase(0)`

  **`DeltaTime(n)`** = `SampleTime(n) – SampleTime(0)`

  `ZeroDopplerDeltaPhase(n) = DeltaTime(n) * IFInputCarrierFreqOffset`

  `DeltaPhaseDoppler(n) = DeltaPhase(n) – ZeroDopplerDeltaPhase(n)`

  `RawDeltaDelay(n) = DeltaPhaseDoppler(n) / DownlinkCarrierFreq`

  **(NI)** **(CT)** **`DeltaDelay(n)`** = `–RawDeltaDelay(n) / 2`
  **(NT)** **`DeltaDelay(n)`** = `–RawDeltaDelay(n)`

  **(IN)** **(CT)** **`DeltaDelay(n)`** = `RawDeltaDelay(n) / 2`
  **(NT)** **`DeltaDelay(n)`** = `RawDeltaDelay(n)`

## 8.5 Gain (AGC) data.

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 `[YYYYMMDD.hhmmss.mmm]` |
| `CarrierLevel` | F | Carrier level <dBm> [0.1] |
| `PolarAngle` | F | Polarization angle <turns> [0.0001] |
| `IncohAgcGain` | F | Incoherent AGC Gain <dB> [0.1] |
| `InpPowChY` | F | Input Power in Channel Y <dBm> [0.1] |
| `InpPowChX` | F | Input Power in Channel X <dBm> [0.1] |

| | | |
|---|---|---|
| CarrLock | S | Carrier Lock Status, is: "Unlocked", "Acquiring", or "Locked" |
| CLPhErrStDev | F | Carrier Loop: Phase Error Std. Dev <turns> [0.1] |
| CLhErrPeak | F | Carrier loop Peak Phase Error <turns> [0.1] |
| CLPhErrMean | F | Carrier loop Mean Phase Error <turns> [0.1] |
| TimPChLock | B | Timing P Channel Lock |
| EsNO_SNR | F | Es/No in data (if Gx_SourceType is "RM demod")<br>SNR in RG tone loop (if Gx_SourceType is "RG demod")<br><dB> [0.1] |
| CarrFreqOffset | F | Carrier Offset Frequency <Hz> [0.001] |
| BestLockFreq | F | Best Lock Frequency <Hz> [0.001] |
| ToneSubcLock | B | Tone / Subcarrier Lock |
| SubcLoopEstPwr | F | Subcarrier Estimated Power <dBc> [0.1] |
| CarrLoopSNR | F | Carrier Loop SNR <dB> [0.1] |
| TmSnrEst | F | TM Decoder SNR <dB> [0.001] |
| TmFrmErrRate | F | TM Decoder Frame Error Rate <> [0.001] |
| TmRxFrames | I | TM Decoder Received frames <> |
| TmGoodFrames | I | TM Decoder Good frames <> |

**Note**: Measurement source, and default values are detailed in [TTCP-SUM-01] section 8.5.7.2 ("AGC DAP Specific Information").

## 8.6 Ranging data.

**Note about ranging datasets:**

The TTCP produces two types of ranging datasets (selection of the dataset format is under user control):

- Datasets identical to the IFMS datasets. This dataset format is only useful when the ranging tone/clock frequency is fixed.
- Datasets containing (either directly or indirectly) integrated uplink and downlink tone phase samples. The definition of this dataset format is TBD but it could either be in some form of existing NASA format or a new TTCP format. This dataset format supports ranging with a variable frequency tone/clock.

The first format is definite and required for backward compatibility. The second format is still TBD and will be determined during the Phase 2 detailed design.

### 8.6.1 Tone/Code Ranging.

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 [YYYYMMDD.hhmmss.mmm] |
| delay | F | Signal round-trip delay, modulo the maximum code ambiguity <s> [free] |
| current_code | I | Current code number, in the set {1...24} <> [4 characters] |
| 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 (not used) |
| spurious_tone | B | Flag to indicate that the tone is presently within the window of a known spurious frequency (not used) |
| 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 | Flag indicating demodulator receiver lock status |
| dsp_integrated_tone | F | Integrated tone level relative to the Carrier Level, and not corrected with the actual Code Modulation Index <dB> [0.1] |
| dsp_integrated_code | F | Normalised integrated code level, relative to the Tone Level <> [0.001] |
| dsp_phase_error | F | Current phase error <turns> [0.001] |
| dsp_toneloop_snr | F | Estimated tone loop signal-to-noise ratio <dB> [free] |
| dsp_mod_index | F | Estimated Downlink ranging modulation index <rad> [free] |

**Note**: Measurement source:

| | |
|---|---|
| current_code | RG_DRPH/g |
| ambiguity_done | RG_DSTA/a |
| prev_correlation | This variable indicates the status of the last Tone/Code Ranging code correlation (and is irrelevant for PN Ranging). It is set to TRUE at Ranging DAP start, and is then updated at the end of each code: it is set to FALSE is the code integration value (DTCS/b) is below 0.4. |
| dsp_rcvr_lock | DM_CLST/b |
| dsp_integrated_tone | RG_DSTA/f |
| dsp_integrated_code | RG_DTCS/e |
| dsp_phase_error | RG_DSTA/c |
| dsp_toneloop_snr | RG_DSTA/d |
| dsp_mod_index | RG_DRPH/d |

### 8.6.2 PN Ranging.

Each Ranging measurement contains the following fields:

| Field Name | | Description |
|---|---|---|
| sample_num | I | Timestamp of the current sample [YYYYMMDD.hhmmss.mmm] |
| 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 chip number, in the range (–1..1009469) where "–1" indicates no shift applied. This value allows subsequent post correction of the Ranging measurements, allowing to recover valid Ranging measurements from the time the code clock is locked. <> [12 characters] |
| 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 (not used) |
| spurious_tone | B | Flag to indicate that the tone is presently within the window of a known spurious frequency (not used) |
| prev_correlation | B | (unused) |
| est_kd-1 | F | Estimated Doppler effect (KD-1) <> [free] |
| dsp_rcvr_lock | B | Flag indicating demodulator receiver lock status |
| dsp_integrated_tone | F | Integrated tone level relative to the Carrier Level, and not corrected with the actual Code Modulation Index <dB> [0.1] |
| dsp_integrated_code | F | Normalised integrated code level, relative to the Tone Level <> [0.001] |
| dsp_phase_error | F | Current phase error <turns> [0.001] |
| dsp_toneloop_snr | F | Estimated tone loop signal-to-noise ratio <dB> [free] |
| dsp_mod_index | F | Estimated Downlink ranging modulation index <rad> [free] |

Note: Measurement source:

| | |
|---|---|
| current_code | RG_DRPH/g |
| ambiguity_done | RG_DSTA/a |
| dsp_rcvr_lock | DM_CLST/b |
| dsp_integrated_tone | RG_DSTA/f |
| dsp_integrated_code | RG_DPNS/e |
| dsp_phase_error | RG_DSTA/c |
| dsp_toneloop_snr | RG_DSTA/d |
| dsp_mod_index | RG_DRPH/d |

## 8.7 Uplink Carrier Frequency data.

Each Uplink Carrier Frequency measurement contains the following fields:

| Field Name | | Description |
|---|---|---|
| `sample_num` | I | Identifier of the current sample <> |
| `sample_time` | T | Timestamp of the current sample `[YYYYMMDD.hhmmss.mmm]` |
| `sweep_start_freq` | F | Sweep start frequency offset (relative to the `integ_phase_ref_freq` value from dataset header) <Hz> `[SX.XXXXXXXXXXXXXXXXESXX]` |
| `sweep_rate` | F | Sweep frequency rate <Hz/s> `[SX.XXXXXXXXXXXXXXXXESXX]` |

The transmit uplink carrier frequency (F Transmit) at any time t between measurements "n" and "n+1" can be derived by performing a linear extrapolation using the recorded sweep start frequency and the sweep rate:

$$F_{Transmit}(t) = F_{Tx} + F_{UC} + sweep\_start\_freq(n) + sweep\_rate(n) \times (t - t(n))$$

where:

$F_{Tx}$ is the carrier base frequency (`StFreqTxFreq` value in header)
$F_{UC}$ is the value of the `StFreqTxUpConv` configuration parameter

**Note**: Measurement source is `UL_USWP` data-unit.

## 8.8 Uplink Carrier Phase data.

Each Uplink Carrier Phase measurement contains the following fields:

| Field Name | | Description |
|---|---|---|
| `sample_num` | I | Identifier of the current sample <> |
| `sample_time` | T | Timestamp of the current sample `[YYYYMMDD.hhmmss.mmm]` |
| `up_carr_phase` | F | Uplink carrier offset phase relative to the `StFreqTxFreq` value from dataset header) <T> `[SX.XXXXXXXXXXXXXXXXESXX]` |

**Note**: Measurement source is `UL_CPHA` data-unit.

# 9 Support-Log files.

Dataset 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 dataset 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 TTCP handles one Support-Log file for each dataset type (Meteo, Doppler 1 to 4, AGC 1 to 4, Ranging 1 to 3, etc.) and makes them accessible via (S)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 TTCP, etc.).

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

The names of the Support-Log files are fixed to: `XxSupportLog`, where `Xx` is the source DAP.

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 | Dataset 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 dataset <s> |
| nb_samples | I | Expected or actual number of samples of a started dataset <> |
| sampling_period | F | Seconds between consecutive samples <s> [0.1] |

**Note**: The open and close reasons is set to "-" when it is not relevant for the type of the entry (see BNF).

# 10 TTCP user access.

## 10.1 User accounts and access rights.

The RM datasets can be retrieved via (S)FTP using the following account:

- User: `rmdset`
- Password: `ttcp_rmdset`

Using this specific (S)FTP account, the remote user is automatically placed, in read-only mode, in the root directory of the RM dataset store:

`/data/RM/dset/`

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 MMI interfaces.

## 10.2 User access.

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

## 10.3 File deletion and modification.

Users accessing the TTCP for RM dataset retrieval are not allowed to modify or delete dataset files or Support-Log files.

Datasets deletion is under control of the MMI and STC users; Support-Log files are under control of the TTCP software only.

# 11 Annex 1: Files syntax specification.

The syntax of TTCP RM datasets and Support-Log files are described in this annex using BNF production rules.

## 11.1 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 datasets
```

## 11.2 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        -- Dataset sequence Id
                         SP EVENT_TYPE     --
                         SP OPEN_REASON    --
                         SP CLOSE_REASON   --
                         SP NUMBER         -- Dataset duration
                         SP STR_INT        -- Number of samples
                         SP NUMBER         -- Sampling period
                         NL

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

## 11.3 Annex 1.3: Dataset file specification.

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

-- ========================================================
-- Dataset 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
 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
 INTEG_PHASE_REF_FREQ_BEG SP NUMBER      SP INTEG_PHASE_REF_FREQ_END NL
 EPD_SOURCE_BEG           SP EPD_SOURCE  SP EPD_SOURCE_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>"
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>"
INTEG_PHASE_REF_FREQ_BEG ::=  "<integ_phase_ref_freq>"
INTEG_PHASE_REF_FREQ_END ::= "</integ_phase_ref_freq>"
EPD_SOURCE_BEG            ::=  "<epd_source>"
EPD_SOURCE_END            ::= "</epd_source>"
SEQ_ID_BEG                ::=  "<sequence_id>"
SEQ_ID_END                ::= "</sequence_id>"
ACTIVE_TABLE_BEG          ::=  "<active_table>"
ACTIVE_TABLE_END          ::= "</active_table>"

-- ========================================================
-- Dataset 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_METEO_BEG   NL INLINE_COMMENT MeteoSamples    NL BODY_METEO_END   NL
   | BODY_RANGING_BEG NL INLINE_COMMENT RangingSamples  NL BODY_RANGING_END NL
   | BODY_UPLCARR_BEG NL INLINE_COMMENT UpCarrFrSamples NL BODY_UPLCARR_END NL
   | BODY_UPLCARR_BEG NL INLINE_COMMENT UpCarrPhSamples NL BODY_UPLCARR_END NL

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

```
-- ============================================================
-- 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
                   SP CARR_LOCK   -- Carrier Lock Status

-- ============================================================
-- 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 Y
                SP NUMBER      -- Input Power in Channel X
                SP CARR_LOCK   -- Carrier Lock Status
                SP NUMBER      -- Carrier Loop: Phase Error Std. Dev
                SP NUMBER      -- Carrier loop Peak Phase Error
                SP NUMBER      -- Carrier loop Mean Phase Error
                SP YESNO       -- Timing P Channel Lock
                SP NUMBER      -- Es/No in data        (if SourceType is "TM demod")
                               -- SNR in RG tone loop  (if SourceType is "RM demod")
                SP NUMBER      -- Carrier Offset Frequency
                SP NUMBER      -- Best Lock Frequency
                SP YESNO       -- Tone / Subcarrier Lock
                SP NUMBER      -- Subcarrier Estimated Power
                SP NUMBER      -- Carrier Loop SNR
                SP NUMBER      -- TCDS SNR
                SP NUMBER      -- TCDS or TURBO Frame Error Rate
                SP NUMBER      -- TCDS or TURBO Received frames
                SP NUMBER      -- TCDS or TURBO Good frames

-- ============================================================
-- 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

-- ============================================================
-- Uplink Carrier Frequency samples
-- ============================================================
UpCarrFrSamples  ::= UpCarrFrSample
                   | UpCarrFrSample    NL  UpCarrFrSample

UpCarrFrSample   ::=    STR_INT     -- Sample number
                     SP TIME_STAMP  -- Sample time
                     SP NUMBER      -- Sweep start frequency offset
                     SP NUMBER      -- Sweep frequency rate

-- ============================================================
-- Uplink Carrier Phase samples
-- ============================================================
UpCarrPhSamples  ::= UpCarrPhSample
                   | UpCarrPhSamples    NL  UpCarrPhSample

UpCarrPhSample   ::=    STR_INT     -- Sample number
                     SP TIME_STAMP  -- Sample time
                     SP NUMBER      -- Uplink carrier offset phase
```

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

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

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

PARAMETERS    ::= PARAMETER
                | PARAMETERS NL PARAMETER

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

PARAMETER_NAME ::= {Alphanumeric}{1,40}

PARAMETER_VAL  ::= NUMBER                      -- limited to 40 characters
                 | YESNO
                 | "\""{ValueChar}{0,50}"\""
```

# 12 Annex 2: Examples.

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

## 12.1 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
```

## 12.2 Header information.

```
<header>
<station_id>              SC01                                  </station_id>
<spacecraft_id>           T003                                </spacecraft_id>
<dset_kind>               AT                                      </dset_kind>
<dap_type>                D1                                       </dap_type>
<ref_time_tag>            20170301.113512.000                   </ref_time_tag>
<first_sample_time>       20170301.113512.700               </first_sample_time>
<last_sample_time>        20170301.113613.300                </last_sample_time>
<request_id>              0                                       </request_id>
<why_opened>              DAP_Started                             </why_opened>
<total_samples>           607                                   </total_samples>
<sample_period>           0.1                                   </sample_period>
<internal_reference>      No                                 </internal_reference>
<integ_phase_ref_freq>    160000000.                      </integ_phase_ref_freq>
<epd_source>              -                                       </epd_source>
<sequence_id>             0                                     </sequence_id>
<active_table>
   ME_DataSource                          = absent                              ; //
   ME_SplPer                              =           10                        ; // s
   ME_MaxDs                               =         1000                        ; //
   ME_DSetKind                            = "AT"                                ; //
   D1_SplPer                              =          0.1                        ; // s
   D1_MaxDs                               =        10000                        ; //
   D1_DSetKind                            = "AT"                                ; //
   D2_SplPer                              =          0.1                        ; // s
```

```
   D2_MaxDs                          =        10000                    ; //
   D2_DSetKind                       = "AT"                            ; //
   G1_SplPer                         =          1.0                    ; // s
   G1_MaxDs                          =         1000                    ; //
   G1_DSetKind                       = "AT"                            ; //
   G1_SourceType                     = RG demod                        ; //
   G2_SplPer                         =          1.0                    ; // s
   G2_MaxDs                          =         1000                    ; //
   G2_DSetKind                       = "AT"                            ; //
   G2_SourceType                     = RG demod                        ; //
   R1_SplPer                         =            1                    ; // s
   R1_MaxDs                          =         1000                    ; //
   R1_DSetKind                       = "AT"                            ; //
   R1_Type                           = PN                              ; //
   R1_TxModIndex                     =        0.000                    ; // rad
   R1_TxInversion                    = No                              ; //
   R1_RxPllBw                        =        1.000                    ; // Hz
   R1_RxModIndex                     =        0.000                    ; // rad
   R1_RxInversion                    = No                              ; //
   R1_RxPresteer                     = No                              ; //
   R1_ToneInteg                      =          1.0                    ; // s
   R1_ToneSettl                      =          1.0                    ; // s
   R1_TcToneF                        =  1000000.000                    ; // Hz
   R1_TcCodeChgTonePeak              = No                              ; //
   R1_CodeModIndScheme               = High&Low                        ; //
   R1_CodeMax                        =           10                    ; //
   R1_CodeInteg                      =          1.0                    ; // s
   R1_CodeRestart                    = No                              ; //
   R1_CodeRepet                      = No                              ; //
   R1_RgPnSignalTypeT4               = No                              ; //
   R1_RgPnSignalTypeSquare           = No                              ; //
   R1_RgPnUpLkChipRate               = No                              ; //
   R1_RgPnUpLkRate_L                 =            1                    ; //
   R1_RgPnUpLkRate_K                 =            6                    ; //
   R1_RgPnExplChipRate               =   100000.000                    ; // cps
   R1_RgPnDnIntegTime                =     10.0                        ; // s
   R1_RgDualDownlink                 = No                              ; //
   R1_EpdTime                        = "19700101.000000.000"           ; //
   R1_Epd                            =         0.00                    ; // s
   R1_EpdDer                         =  0.000000000                    ; // s/s
   U1_MaxDs                          =        10000                    ; //
   U1_DSetKind                       = "AT"                            ; //
   U2_MaxDs                          =        10000                    ; //
   U2_DSetKind                       = "AT"                            ; //
   T1_SplPer                         =            1                    ; // s
   T1_MaxDs                          =        10000                    ; //
   T1_DSetKind                       = "AT"                            ; //
   T2_SplPer                         =            1                    ; // s
   T2_MaxDs                          =        10000                    ; //
   T2_DSetKind                       = "AT"                            ; //
   SpacecraftId                      = "T003"                          ; //
   StFreqTxFreq                      =     70000000                    ; // Hz
   StFreqTxUpConv                    =  8000000000.000                 ; // Hz
   StFreqTxUpSpecInv                 = No                              ; //
   StFreqRxDnConv                    =  8000095000.000                 ; // Hz
   StFreqRxDnSpecInv                 = No                              ; //
   SpFreqTcRgCoherTrs                = Yes                             ; //
   SpFreqTrNum                       =            1                    ; //
   SpFreqTrDen                       =            1                    ; //
   SpFreqDnlkCF                      =   8610000007                    ; // Hz
   SpFreqPnRgRegTrs                  = No                              ; //
   SpFreqTcRgAcqDurT4b               =         10.0                    ; // s
   SpFreqTcRgAcqDurT2b               =         10.0                    ; // s
   DmdModulationType                 = GMSK                            ; //
   DmdModCoding                      = NRZ-L                           ; //
   Dmd2ndSymbolRate                  =    60000.000                    ; //
   DmdSource                         = X                               ; //
   DmdDopAction                      = No Doppler                      ; //
   DmdLpBwChngeTime                  = 100.0                           ; // s
   DmdSearchRange                    =   200000                        ; // Hz
```

```
   DmdMaxDpRate                          =       0                       ; // Hz/s
   DmdAcqStrategy                        = SCFFT                         ; //
   DmdDceMode                            = Manual                        ; //
   DmdDcePolAngle                        =  0.000                        ; //
   DmdDcePhAngle                         =  0.500                        ; //
   DmdDceCorrBw                          =         50.0                  ; // Hz
   DmdRcCLpBw                            =   100.0                       ; // Hz
   DmdRcCLpOrder                         =            2                  ; //
   DmdRcdPllTransRate                    =    0                          ; // s
   DmdRcSubCFreq                         = 1500000.000000                ; // Hz
   DmdRcSubCPreSt                        = No                            ; //
   DmdRcSubCPllBw                        =      0.00010                  ; // fsr
   DmdRcdSymbolRate                      =   262144.000                  ; //
   DmdRcSubCTMLock                       = Yes                           ; //
   DmdRcSubCBitNum                       =            1                  ; //
   DmdRcSubCBitDen                       =            8                  ; //
   DmdRcSubCSqWavSc                      = No                            ; //
   DmdRcTimLoopBw                        =      0.00010                  ; // fsr
   DmdScCLpBw                            =     0.000100                  ; //
   DmdScCLpOrder                         =            2                  ; //
   DmdScdPllTransRate                    =    0                          ; // s
   DmdScMapping                          = Normal                        ; //
   DmdScSrrc                             = Yes                           ; //
   DmdScdSymbolRate                      =  3800000.000                  ; //
   DmdScTimLoopBw                        =     0.000010                  ; // fsr
   DmdScdMchExcBw                        =   50                          ; // %
   DmdGmdBTbSelection                    = 0.50                          ; //
</active_table>
</header>
```

## 12.3 Doppler data.

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

## 12.4 Gain data.

(note: lines are wrapped)

```
<body_Gain>
// Number SampleTime                  CarrierLevel           PolarAngle         IncohAgcGain             InpPowChY
InpPowChX CarrLock                     CLPhErrStDev
 CLPhErrPeak          CLPhErrMean TimPChLock           Es/No-SNR         CarrFreqOffs         BestLockFreq
TonSubLock          SubcEstPwr               CLSNR               TMSNR
           TMFER           TMRxFrames         TMGoodFrames
    20008 20161206.142402.700               -76.0              -1.0000                51.0                -74.7
-67.8 Locked                          0.0000
      0.0000               0.0000 No                          -10.0           552459.873       8160272962.968 No
0.0                26.4                0.000
             nan                   0                   0
    20009 20161206.142402.800               -76.0              -1.0000                51.0                -74.7
-67.8 Locked                          0.0000
      0.0000               0.0000 No                          -10.0           552459.873       8160272962.968 No
0.0                26.4                0.000
             nan                   0                   0
    20010 20161206.142402.900               -76.0              -1.0000                51.0                -74.7
-67.8 Locked                          0.0000
      0.0000               0.0000 No                          -10.0           552459.873       8160272962.968 No
0.0                26.4                0.000
             nan                   0                   0
    20011 20161206.142403.000               -76.0              -1.0000                51.0                -74.7
-67.8 Locked                          0.0000
      0.0000               0.0000 No                          -10.0           552459.873       8160272962.968 No
0.0                26.4                0.000
             nan                   0                   0
</body_Gain>
```

## 12.5 Meteorological data.

```
<body_Meteo>
// Number          SampleTime    Humidity      Pressure     Temperature
     1    20161201.000420.000        30.2         940.2            25.2
     2    20161201.000430.000        30.3         940.2            25.2
     3    20161201.000440.000        30.4         940.2            25.2
     4    20161201.000450.000        30.3         940.2            25.2
     5    20161201.000500.000        30.2         940.2            25.2
     6    20161201.000510.000        30.1         940.2            25.2
     7    20161201.000520.000        30.0         940.2            25.2
     8    20161201.000530.000        30.1         940.2            25.2
     9    20161201.000540.000        30.2         940.2            25.2
    10    20161201.000550.000        30.3         940.2            25.2
    11    20161201.000600.000        30.2         940.2            25.2
    12    20161201.000610.000        30.2         940.2            25.2
</body_Meteo>
```

## 12.6 Ranging data.

(note: lines are wrapped)

```
<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>
```

## 12.7 Uplink Carrier Frequency data.

```
<body_UplinkCarrier>
// Number  SampleTime           SweepStartFreq           SweepRate
         1  20100708.130513.978  +2.0400000037625001E+05  -0.0000000000000000E+00
         2  20100708.152115.000  +2.0400000037625001E+05  -3.0138114226475000E+02
         3  20100708.152119.973  +2.0250115776435001E+05  +9.9825703259170993E+01
         4  20100708.152145.019  +2.0500139100477000E+05  -1.0009770790020001E+02
         5  20100708.152204.972  +2.0300415111706001E+05  +9.9553698618138000E+01
         6  20100708.152214.978  +2.0400000037625001E+05  -0.0000000000000000E+00
</body_UplinkCarrier>
```

## 12.8 Uplink Carrier Phase data.

```
<body_UplinkCarrier>
// Number  SampleTime           UpCarrPhase
         1  20100707.131059.000  +2.0400000036999583E+05
         2  20100707.131100.000  +4.0800000075003505E+05
         3  20100707.131101.000  +6.1200000113001466E+05
         4  20100707.131102.000  +8.1600000149998069E+05
         5  20100707.131103.000  +1.0200000018800199E+06
</body_UplinkCarrier>
```