QinetiQ Space nv

DEX
SOFTWARE INTERFACE CONTROL DOCUMENT

(DRD:)

EUROPEAN **S**PACE **A**GENCY CONTRACT REPORT

	Name	Company	Signature	Date
Prepared by:	B. DOBBELAERE	QINETIQ SPACE NV		
Checked by:	P. MATTHIJS	QINETIQ SPACE NV		
Prod. Ass.:	I. DE PRETER	QINETIQ SPACE NV		
Proj. Man.:	B. DESOETE	QINETIQ SPACE NV		

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CHANGE RECORD

Iss.	Rev.	Date	# Pages	Affected P.	Description
A	0	13/06/2012	III+18		Document prepared for S/W PDR; not released, only submitted for internal review
A	01	21/06/2012	III+19		Release at S/W PDR
B	0	11/01/2013	IV+44		Update for S/W DDR; document submitted for internal review Changes called up by S/W PDR RIDs dispositions: • CH-16, CH-17: list of interface requirements extended (section 5.1) NOTE: changes/additions from section to have not been marked with highlighting since the complete set of commands has been subject to modification and the level of detail in which these commands are documented is higher than in the previous version of this document
B	01	28/01/2013	IV+44		Reworked after internal DDR. Tracked changes are highlighting the difference wrt version A/01
C	0	22/04/2013	IV+47		Added nullify, selftest, monitoring limits and parameter conversion commands. Updated parameter layout.
D	0	5/08/2013	IV+72		Remove tone and mass cradle "combined" fields from H&S Add section 5.2.8 for configuration files Add parameter summary table (5.2.4)

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| E | 0 | 23/10/2013 | VI+88 | Introduction of EPM interconnectivity and related TC/TM as replacement for EDR. As this results in a high number of changes, change tracking on table data was mostly omitted to improve readability. Addition of CMD_SET_PICTURE. Addition of picture_file parameter to most science commands that contain a configurable user message. Increased CODA separate coordinate packets to contain up to 28 markers instead of 20 (future readiness). Wait and hold times now specified in milliseconds. Moved filter constant from ASW.ini configuration file to a parameter of the affected commands, ensuring science team has control. Add config file example Detail how to retrieve length occupied by string parameters |
| E | 1 | 14/01/2014 | VI+88 | Added section on GUI design Updated requirement traceability matrix Corrected layout issue |

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TABLE OF CONTENTS

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1. INTRODUCTION

This document describes the external interfaces for DEX S/W.

Interface requirements have been incorporated in DEX SRS [AD33], therefore reference to that document are made in each section relative to interface requirements.
The core of information carried by this document is about interface design, this being covered in section 5.2. For a complete description of DEX S/W design, please refer to [RD3].

The DEX instrument and its S/W are designed for use in the Columbus module of the International Space Station, with the European Physiology Modules (EPM) Rack as power/data interface.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

This list contains the DEX applicable documents as originating from DEX Statement of Work DEX-ESA-SOW-002 Issue 1 Revision 1 of 19/03/2012, and updated based on Change Requests DEX-003 (Inclusion of SpaceX Dragon as an additional launch vehicle) and DEX-004 (Change of Rack Interfaces from EDR to EPM).
The list can be extended where needed with additional documents that are applicable to the preparation of the present document.
Documents in the below list are only applicable to the extent as called-up in this document.

AD	Doc. Number	Issue/Rev	Issue date	Title/Applicability
AD1	SCI-ESA-HSO-ESR-DEX	2.0	2/01/2012	Experiment Scientific Requirements For Dexterous Manipulation (GRIP)
AD2	COL-RIBRE-SPE-0164	2 +PIRN-103 +PIRN-0110 Iss 1A	01.11.2010	Columbus Pressurized Payloads Interface Requirements Document
AD3	SSP-57000	L	May 2011	Pressurized Payloads Interface Requirements Document
AD4	COL-RIBRE-MA-0007-00	1	30.03.2001	Columbus Payload Accommodation Handbook APM
AD5	GPQ-010	3	January 2010	Product assurance requirements for payload projects
AD6	GPQ-010-PSA-103	3	August 2011	Reliability and Maintainability for ESA Research Payloads
AD7	GPQ-010-PSA-101	4.0	Nov. 2010	Safety and materials requirements for ESA payloads on ISS
AD8	MS-ESA-RQ-108	1.0		Documentation Requirements for small and Medium Sized MSM Projects
AD9	OPS-IDD-0-200	3.1	18 January 2010	ATV Dry Cargo Integration Interface Definition Document
AD10	SSP-52005	D	March 2008	International Space Station Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures

AD	Doc. Number	Issue/Rev	Issue date	Title/Applicability
AD11	P32928-103		10/07/2001	Requirements for International Partners Transported on Russian Progress and Soyuz Vehicles
AD12	ECSS-E-ST-32-01C	C Rev.1		Fracture control
AD13	ECSS-E-ST-40C	C		Space engineering – software
AD14	ECSS-Q-ST-80C	C		Software product assurance
AD15	ATV 17.00 7b	1	Nov 2004	Safety requirements for payloads/cargos on board the ATV
AD16	ATV 13830	1/1	May 2009	ATV Pressurised Payload/Cargo Safety Certification Process
AD17	GPQ-PR-01	1		Processing and Reporting of non- conformances for ISS payloads developed by ESA
AD18	DELETED			
AD19	SSP 51700	Baseline	April 2010	Payload Safety Policy and Requirements for the International l Space Station
AD20	ECSS-E-ST-20C	C	31 July 2008	Space engineering – Electrical and electronic
AD21	DELETED			
AD22	NASDA-ESPC-2857	B Draft	May 9, 2007	HTV Cargo Standard Interface Requirement Document, Part 1 Vol. 1
AD23	SSP 30599	E + DCN001 + DCN002	June 2009	Safety Review Process
AD24	ECSS/M-ST-80C	C	31 July 2008	Risk management
AD25	COL-RIBRE-PL-0144	2 +PIRN-0020 +PIRN-0025	01.12.2010	Columbus Pressurized Payload Generic Verification Plan
AD26	JMR-002B	Rev. B	March 27, 2008	Launch Vehicle Safety Standard
AD27	JSX-2008041A	A	March, 2010	HTV Cargo Safety Review Process
AD28	JSX-2009059	Initial release	March, 2010	HTV Cargo Safety Certification Process for Disposal
AD29	ESO-IT-TN-0173	2	23.07.2010	Payload Engineering Integration Requirements
AD30	SSP 50621	E	November 2006	Generic On-Orbit Stowage Capabilities and Requirements: Pressurized Volume
AD31	ATV-HB-AI-0001	07	20/Nov/2004	ATV Cargo Accommodation Handbook
AD32	OPS-PL-0-008-ESA	2.1	08 Feb 2011	ATV Cargo Integration Plan

QinetiQ

AD	Doc. Number	Issue/Rev	Issue date	Title/Applicability
AD33	DEX-SP-00125-QS	F/0	12/08/2013	DEX SRS
AD34	DELETED			
AD35	DELETED			
AD36	DEX-PL-00065-QS	E/0	10/10/2012	DEX SW V&V plan
AD37	SPX-00001047	Appendix 15		C3-1 Vehicle Interface Definition Document
AD38	SSP 50835 and associated PIRN's	C	Nov. 2011	ISS Pressurized Volume Hardware Common Interface Requirements Document (only applicable in relation to SpaceX)
AD39	SSP 57008 and associated PIRN's	D	August 2011	Unique Pressurized Payload Non-Rack ICD Template (only applicable in relation to SpaceX)
AD40	EPM-OHB-RQ-0001/1-4 and associated PIRN's	4	30/04/2010	EPM SMIRD Vol. 1 – Vol. 4 (Software requirements in Vol. 3)
AD41	EPM-OHB-SP-0005	4	30/04/2010	EPM Standard Protocol Definition
AD42	EPM-OHB-LI-0039	4	30/04/2010	EPM Application Data TM/TC Data Definition Template
AD43	EPM-OHB-MAN-0004	5	30/04/2010	EPM LTU Environment and Services
AD44	EPM-OHB-RQ-0006	2/B	7/09/2011	EPM EMC Requirements Definition
AD45	EPM-OHB-PL-0030	2	30/04/2010	EPM Science Modules Generic Verification Plan
AD46	DEX-LI-03029	B/0	30/05/2013	DEX-EPM requirements applicability matrix

2.2 REFERENCE DOCUMENTS

RD	Doc. number	Issue/Rev	Issue date	Title
RD1	DEX-LI-00259-QS	E/0	03/01/2014	DEX Abbreviation List
RD2	DELETED			
RD3	DEX-RP-00169-QS	D/1	14/01/2014	DEX Software Design Document
RD4	DEX-TN-00885-QS	A/0	18/10/2012	DEX Science data backup storage
RD5	DEX-PR-05189-QS	A/0	14/01/2014	DEX Software User Manual

3. TERMS, DEFINITIONS AND ABBREVIATIONS

For definitions and abbreviations please refer to [RD1], for EPM specific terms see [AD40] Appendix A.

4. SOFTWARE OVERVIEW

For an overview on DEX S/W please refer to DEX SRS [AD33].

5. REQUIREMENTS AND DESIGN

5.1 INTERFACE REQUIREMENTS

Interface requirements are covered by DEX SRS [AD33].
The following requirements are defined as interface requirements:
- SRS-17
- SRS-45
- SRS-52
- SRS-53
- SRS-55
- SRS-57
- SRS-73
- SRS-88
- SRS-132

5.2 EPM INTERFACE DESIGN

5.2.1 GENERAL

The primary external data interface of DEX is its Ethernet connection to the EPM, on top of which the IP based EPM standard protocols are running adhering to the DEX tailoring of the EPM SMIRD [AD40], [AD46]. A secondary external interface is provided to allow future extension and is not in use by the current implementation. DEX S/W (ASW, Updater, EGSE) is designed to comply with the above mentioned IRD, and a number of features are implemented exploiting the services provided by EPM. All of the science script commands, as well as most of the telecommand / telemetry exchange are mapped to a DEX internal packet definition.

DEX feature	DEX packets	EPM concept	EPM packet type
File system related operations	CMD_EPM_*	Standardised telecommands	EPM TC packet, standardised command ID
File content and directory listing telemetry	none	Standardised telemetry	EPM TM packets, standardised TM ID
Science commands Session/protocol/task control & logging. System administration	CMD_* (except CMD_EPM_*)	DEX specific telecommands.	EPM TC packet, custom command ID
Interface status messages Command execution status	none	EPM messages	EPM messages (TM ID 0x0302)

Housekeeping parameter status			
Time synchronisation request/response	none	SNTP	NTP protocol
Health and status data	DATA_BULK_HK (corresponds to HK-value section of TM packet)	Bulk housekeeping data report	EPM TM (standard ID 0x0301)
Realtime science data Shell response	DATA_RT_SCIENCE RESP_SHELL	DEX specific telemetry	EPM TM packet, custom TM ID
Science data logging and internal data packets	DATA_* (except DATA_BULK_HK, DATA_RT_SCIENCE and RESP_SHELL)	none	none

Table 1 : Dex feature to EPM concept mapping

More detail about what DEX packets are is provided in section 5.2.2.
A brief description of features requiring packet exchange is provided below.

- Remote control
  The DEX instrument is designed to be steered locally via experiment scripts and user interaction via its GUI, but for testing and troubleshooting purposes the possibility of sending commands over EPM to simulate a session (login, protocol/task selection, ...) or to control the instrument (acquisition, setting targets/tones, ...) has been foreseen. These commands are only allowed as telecommand in test mode. Although data acquisition and running of DEX scripts is possible in test mode, sending telecommands during science script execution can lead to undesired side effects and should be regarded as an intrusive debugging capability.
- File system related commands
  The standard set of file system related commands as described in [AD41], chapter 9 has been implemented. Related telecommands are first converted to DEX packets before being executed. No DEX packet conversion is performed on messages and file/directory telemetry data.
- System administration
  Feature designed primarily for testing and troubleshooting purposes. It allows simulating a remote OS shell.
- H&S data downlink
  Sends H&S data to ground in the form of bulk housekeeping data packets.
- Real time science data downlink
  A subset of science data collected during the execution of an experiment task is sent to ground for data quality analysis by means of telemetry packets.
- Shell command response
  The shell command allows execution of a system command on DEX. This telemetry packet contains the command output after execution.

- DEX<->Station time synchronization
  Synchronizes the DEX system clock with the station time.
- Programmable experiments
  Users, associated protocols/tasks and steps in each task can be programmed on DEX by means of script files. The latter can be uplinked from ground via EPM file telemetry.
- Science data downlink
  Science data is stored in files on disk by DEX S/W, these files can be downlinked via EPM and their content postprocessed/analyzed on ground. The file format is proprietary, but a Science Data Extractor S/W has been foreseen to access the content of these files (see [RD3]). The Science Data Extractor S/W is aware of all packets and parameters defined in 5.2.4, making it able to decode executed telecommands, produced log messages and of course the collected science data.
- Software upgrade
  S/W upgrade (for ASW only) can be performed by uplinking S/W upgrade packages over EPM.

5.2.2 THE DEX PACKET CONCEPT

There are several parts of DEX software system that are dealing with the same kind of packet based information:
- TM data
  This is the payload of the EPM TM packets; the information carried by these is data sent to ground by the DEX instrument. Notable exception is file data telemetry, which is sent and received by DEX and does not follow the DEX packet concept
- TC data
  This is the payload of the EPM TC packets; the information carried by these is commands sent from ground to the DEX instrument
- H&S data
  Also in this case this is the payload of EPM packets, with the distinction that the carried information is specifically about health and status of DEX; this data is sent by the DEX instrument to ground
- DEX scripts
  By design DEX reads information about users and experiments to be performed from ASCII based files residing on DEX's filesystem; the information carried by these scripts is about user credentials, sessions/protocols/tasks to be performed by a given user and commands constituting a task
- Logging
  All system activity is stored on local storage by the DEX instrument; the logged information includes science data, H&S data, login/logout of users, protocol/task selection and command execution

As it can be noted there is a considerable overlap between the above categories for what concerns the kind of information they are handling. For this reason DEX has

been designed to have a unified approach to encapsulate and handle this information.

The basic idea is to define the concept of "DEX packet" as an entity being identified by the following properties:

1. type
2. parameters

The way this packet manifests depends on which of the different parts of the system identified above is handling it:

- TM/TC data -> binary encapsulated in EPM packet
- H&S data   -> binary encapsulated in EPM packet (bulk housekeeping)
- DEX scripts -> ASCII
- Logging   -> binary encapsulated in proprietary file format

For a complete list of packet types and their purpose/content refer to section 5.2.4.

5.2.3 COMMAND SUMMARY TABLE

The table below makes the link between telecommand names and IDs as known to the CLSW and the associated DEX command packets. It contains the following fields:

- Command display: displayed name of the command on EPM CLSW and EGSE
- TC Group/ID: Respectively the 8 MSBs and 8 LSBs of the TC ID that identifies the associated EPM TC packet (see [AD41] par 7.1)
- DEX packet: name of the associated DEX packet that also defines the layout of the EPM TC user words
- Setup mode: Specifies whether the command is a valid TC while DEX is in setup mode
- Nominal mode: Specifies whether the command is a valid TC while DEX is in nominal mode
- Test mode: Specifies whether the command is a valid TC while DEX is in test mode
- Science script: Specifies whether the command is allowed to be part of a science script.
- Updater: Specifies whether the command is supported by the updater application
- Delayed execution: Specifies whether the actual execution of the TC can happen after the transmission of a MSG_ID_EXECUTION_SUCCESS message. This feature is implemented to ensure the command response is transmitted timely. For commands with the delayed execution flag, a "delayed execution" additional response will be transmitted after completion.

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Command Display	TC Group/ID		DEX Packet	Setup mode	Nominal mode	Test mode	Science script	Updater	Delayed execution
Change to Check-Out Mode	0x01	0x01	CMD_EPM_CHMODE_CO	Y	Y	Y	Y	Y	Y
Change to Nominal Mode	0x01	0x02	CMD_EPM_CHMODE_NOMINAL	Y	N	Y	N	Y	Y
Change to Setup Mode	0x01	0x03	CMD_EPM_CHMODE_SETUP	N	Y	Y	N	Y	Y
Change to Test Mode	0x01	0x04	CMD_EPM_CHMODE_TEST	Y	Y	N	N	Y	Y
Get bulk HK data	0x03	0x05	CMD_EPM_GET_BULKHK	Y	Y	Y	N	N	N
DownLink File	0x05	0x01	CMD_EPM_DOWNLINK	Y	N	Y	N	Y	Y
Send File	0x05	0x02	CMD_EPM_SEND_FILE	Y	N	Y	N	Y	Y
Copy File	0x05	0x03	CMD_EPM_COPY	Y	N	Y	N	Y	Y
Delete File	0x05	0x04	CMD_EPM_DELETE	Y	N	Y	N	Y	Y
Rename File	0x05	0x05	CMD_EPM_RENAME	Y	N	Y	N	Y	Y
Directory	0x05	0x06	CMD_EPM_DIR	Y	N	Y	N	Y	Y
Change Directory	0x05	0x07	CMD_EPM_CD	Y	N	Y	N	Y	N
Make Directory	0x05	0x08	CMD_EPM_MKDIR	Y	N	Y	N	Y	Y
Remove Directory	0x05	0x09	CMD_EPM_RMDIR	Y	N	Y	N	Y	Y
Cancel File Transfer	0x05	0x0A	CMD_EPM_CANCEL_XFER	Y	N	Y	N	Y	N
Start acquisition	0x21	0x01	CMD_ACQ_START	N	N	Y	Y	N	Y
Stop acquisition	0x21	0x02	CMD_ACQ_STOP	N	N	Y	Y	N	Y
Align Coda	0x21	0x03	CMD_ALIGN_CODA	N	N	Y	Y	N	Y
Cfg camera	0x21	0x04	CMD_CFG_CAMERA	N	N	Y	Y	N	Y
Check alignment	0x21	0x05	CMD_CHK_CODA_ALIGNMENT	N	N	Y	Y	N	Y
Check FOV	0x21	0x06	CMD_CHK_CODA_FIELDOFVIEW	N	N	Y	Y	N	Y
Check Placement	0x21	0x07	CMD_CHK_CODA_PLACEMENT	N	N	Y	Y	N	Y
Check Collision Force	0x21	0x08	CMD_CHK_COLLISIONFORCE	N	N	Y	Y	N	Y
Check Early Starts	0x21	0x09	CMD_CHK_EARLYSTARTS	N	N	Y	Y	N	Y
Check HW Config	0x21	0x0A	CMD_CHK_HW_CONFIG	N	N	Y	Y	N	Y
Check Manip Visibility	0x21	0x0B	CMD_CHK_MANIP_VISIBILITY	N	N	Y	Y	N	Y
Check Mass Selection	0x21	0x0C	CMD_CHK_MASS_SELECTION	N	N	Y	Y	N	Y
Check Movement Amplitude	0x21	0x0D	CMD_CHK_MOVEMENTS_AMPL	N	N	Y	Y	N	Y
Check Movement Cycles	0x21	0x0E	CMD_CHK_MOVEMENTS_CYCLES	N	N	Y	Y	N	Y
Check Movement Direction	0x21	0x0F	CMD_CHK_MOVEMENTS_DIR	N	N	Y	Y	N	Y
Check Start Position	0x21	0x10	CMD_CHK_START_POS	N	N	Y	Y	N	Y
Ctrl Camera	0x21	0x11	CMD_CTRL_CAMERA	N	N	Y	Y	N	Y
Ctrl Targets	0x21	0x12	CMD_CTRL_TARGETS	N	N	Y	Y	N	Y
Ctrl Tone	0x21	0x13	CMD_CTRL_TONE	N	N	Y	Y	N	Y

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Command Display	TC Group/ID		DEX Packet	Setup mode	Nominal mode	Test mode	Science script	Updater	Delayed execution
Nullify Forces	0x21	0x14	CMD_NULLIFY_FORCES	N	N	Y	Y	N	Y
Wait target	0x21	0x15	CMD_WAIT_MANIP_ATTARGET	N	N	Y	Y	N	Y
Wait grip	0x21	0x16	CMD_WAIT_MANIP_GRIP	N	N	Y	Y	N	Y
Wait gripforce	0x21	0x17	CMD_WAIT_MANIP_GRIPFORCE	N	N	Y	Y	N	Y
Wait slip	0x21	0x18	CMD_WAIT_MANIP_SLIP	N	N	Y	Y	N	Y
Start shell	0x22	0x01	CMD_SHELL	Y	N	Y	Y	Y	Y
Kill shell	0x22	0x02	CMD_SHELL_KILL	Y	N	Y	Y	Y	Y
Cleanup	0x22	0x03	CMD_CLEANUP	N	N	Y	Y	N	Y
Log Event	0x24	0x01	CMD_LOG_EVENT	N	N	Y	Y	N	Y
Log Message	0x24	0x02	CMD_LOG_MESSAGE	N	N	Y	Y	Y	Y
Change Protocol	0x24	0x03	CMD_PROTOCOL	N	N	Y	N	N	Y
Set Monitor Limits	0x24	0x04	CMD_SET_MON_LIMITS	N	N	Y	N	N	Y
Set Parameter Conversion	0x24	0x05	CMD_SET_PARAM_CONV	N	N	Y	N	N	Y
Change Task	0x24	0x06	CMD_TASK	N	N	Y	N	N	Y
Change User	0x24	0x07	CMD_USER	N	N	Y	N	N	Y
Wait	0x24	0x08	CMD_WAIT	N	N	Y	Y	N	Y
Wait subject ready	0x24	0x09	CMD_WAIT_SUBJ_READY	N	N	Y	Y	N	Y
Selftest	0x24	0x0A	CMD_SELFTEST	N	N	Y	Y	N	Y
Restart task	0x24	0x0B	CMD_TASK_RESTART	N	N	Y	N	N	Y
Resume task	0x24	0x0C	CMD_TASK_RESUME	N	N	Y	N	N	Y
Suspend task	0x24	0x0D	CMD_TASK_SUSPEND	N	N	Y	N	N	Y
Subject ready	0x24	0x0E	CMD_SUBJ_READY	N	N	Y	N	N	Y
Set Picture	0x24	0x0F	CMD_SET_PICTURE	N	N	Y	Y	N	Y

5.2.4 PACKET TYPES AND CONTENT

DEX implements the communication over its Ethernet with EPM via the EPM
standard protocols and general packet layout as specified per [AD41].

The contents of the DEX packet are mapped to the "user words" section of EPM TC
or TM packets (except bulk HK data). Contents are binary identical after string
expansion of TCs. DEX packets have a fixed layout and are dimensioned to hold
strings with a certain maximum size, while EPM TCs like the file related commands
grow and shrink depending on the names in the strings they contain. Therefore,

incoming TCs are expanded by adding padding, so the strings occupy their maximum size and the layout lines up with the definition of the DEX packet.

For each packet a table is describing its contents as follows:

<PACKET_NAME>	<EPM PACKET ID>				<packet_description>
size: <packet_size>					
direction: <direction>					
<parameter_name>	<byte_offset>:<bit_offset>	<parameter_type>	<eng_unit>	<conversion>	<parameter_description>

Where:
- <packet_size> is intended as the size of the 'Data field' section only
- <direction> can be EPM->DEX, DEX->EPM or internal; internal means the packet is never exchanged over the connection to EPM (in other words is never encapsulated in an EPM packet)
- <parameter_name> is a name from which parameter type and range can be uniquely derived using the table in par 5.2.5.
- <parameter_type> is one of the following:
  t_bit   = parameter uses 1 bit in the packet to store the value
  t_l_bit   = parameter uses 32 bit in the packet to store a 1 bit value (0x00000000 or 0x00000001)
  t_u8   = unsigned 8-bit
  t_u16   = unsigned 16-bit
  t_s16   = signed 16-bit
  t_u32   = unsigned 32-bit
  t_s32   = signed 32-bit, two's complement
  t_f32   = 4-byte float, IEEE 754
  t_f64   = 8-byte float, IEEE 754
  t_c_str   = 0-terminated string of ASCII characters. The size in bytes occupied in the DEX packet is equal to 1 + the maximum length as provided in the matching entry of the table in par 5.2.5.
  t_f_str   = fixed length string of ASCII characters, where the first two bytes express the length of the following string. The size in bytes occupied in the DEX packet is equal to 2 + the maximum length as provided in the matching entry of the table in par 5.2.5.
  packet   = this does not represent a real parameter, but an embedded packet with layout according to the packet's type description
- <eng_unit> engineering unit in which the parameter value is expressed
- <conversion> type of conversion to be applied to obtain an SI unit expressed value out of the provided binary value

Note that every packet can contain more than one parameter, in which case the respective table contains multiple rows with white background.
All multi-byte numerical parameters are Big Endian, i.e. MSB first. For instance: in DEX telemetry and telecommands floats shall be inverted on Intel. So the floating point value '1.2345' shall be in communication transmitted as 0x19049E3F and byte swapped by the ground station, if on Intel or equivalent CPU architecture.

Additionally, bit numbering in DEX is reversed from that in EPM documentation. EPM designates the most significant bit as bit 0 and DEX designates the least significant bit as bit 0.

What follows is the detailed description of all the defined packets and their layout. For future document update and reference this document reflects the packet layout definition as checked in with SVN revision 423 and data layout CRC 0x8B64.

5.2.4.1 CMD_ACQ_START

CMD_ACQ_START	TC: 0x2101			Used to start a sampling block that collects science data from all sensors and stores it to disk. Filenames used for saved science data will be extended with acquisition_tag.
size: 10				
direction: EPM->DEX				
acquisition_tag	0:00	t_f_str		Identifies the data collected during this sampling block.

5.2.4.2 CMD_ACQ_STOP

CMD_ACQ_STOP	TC: 0x2102			Used to stop a sampling session. This command can fail in case the acquisition has stopped earlier due to limited acquisition buffer size.
size: 130				
direction: EPM->DEX				
error_message	0:00	t_f_str		Text message to be presented to the subject in case of command failure.

5.2.4.3 CMD_ALIGN_CODA

CMD_ALIGN_CODA	TC: 0x2103			Used to trigger coordinates alignment procedure on the motion tracker system (this recalculates the transform from intrinsic unit coordinates to reference frame relative coordinates).
size: 152				
direction: EPM->DEX				
error_message	0:00	t_f_str		Text message to be presented to the subject in case of command failure.
picture_file	130:00	t_f_str		Picture to display in case of command failure

5.2.4.4 CMD_CFG_CAMERA

CMD_CFG_CAMERA	TC: 0x2104			Used to configure the crew camera with specified parameters.
size: 2				
direction: EPM->DEX				
camera_framerate	0:00	t_u16	Hz	Image acquisition rate (1=1Hz; 2=2Hz)

5.2.4.5 CMD_CHK_CODA_ALIGNMENT

CMD_CHK_CODA_ALIGNMENT	TC: 0x2105			Used to check that the specified markers' aligned coordinates (any set out of the 28) from each CODA unit match within specified tolerance.
size: 160				
direction: EPM->DEX				
Markers	0:00	t_u32		Bitfield indicating which markers to run the check

					on (0=don't check; 1=check). LSB corresponds to marker with lowest ID. Marker IDs are according to DEX system design definition.
tol_distance	4:00	t_u16	mm		Maximum allowed distance between expected and measured position.
n_good	6:00	t_u16			Minimum number of markers the check has to succeed for.
error_message	8:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	138:00	t_f_str			Picture to display in case of command failure

5.2.4.6 CMD_CHK_CODA_FIELDOFVIEW

CMD_CHK_CODA_FIELDOFVIEW	TC: 0x2106				Used to check whether the installation of the CODA units is such that the reference frame markers fall within a specified volume within the CODA field of view.
size: 170					
direction: EPM->DEX					
coda_unit	0:00	t_u16			CODA unit to run the check on.
markers	2:00	t_u32			Bitfield indicating which markers to run the check on (0=don't check; 1=check). LSB corresponds to marker with lowest ID. Marker IDs are according to DEX system design definition.
min_posX	6:00	t_s16	mm		Minimum expected value for marker posX.
max_posX	8:00	t_s16	mm		Maximum expected value for marker posX.
min_posY	10:00	t_s16	mm		Minimum expected value for marker posY.
max_posY	12:00	t_s16	mm		Maximum expected value for marker posY.
min_posZ	14:00	t_s16	mm		Minimum expected value for marker posZ.
max_posZ	16:00	t_s16	mm		Maximum expected value for marker posZ.
error_message	18:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	148:00	t_f_str			Picture to display in case of command failure

5.2.4.7 CMD_CHK_CODA_PLACEMENT

CMD_CHK_CODA_PLACEMENT	TC: 0x2107				Used to check whether the position and orientation of the CODA units is as expected within specified tolerance. exp_oriX, exp_oriY, exp_oriZ, exp_oriM quaternion refers to orientation of the CODA unit.
size: 180					
direction: EPM->DEX					
coda_unit	0:00	t_u16			CODA unit to run the check on.
exp_posX	2:00	t_s16	mm		Expected position - X component.
exp_posY	4:00	t_s16	mm		Expected position - Y component.
exp_posZ	5:00	t_s16	mm		Expected position - Z component.
exp_oriX	8:00	t_f32			Expected orientation - X component.
exp_oriY	12:00	t_f32			Expected orientation - Y component.
exp_oriZ	16:00	t_f32			Expected orientation - Z component.
exp_oriM	20:00	t_f32			Expected orientation - M component.
tol_distance	24:00	t_u16	mm		Maximum allowed distance between expected and measured position.
tol_angle	26:00	t_u16	°		Maximum allowed mis-orientation.
error_message	28:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	158:00	t_f_str			Picture to display in case of command failure

5.2.4.8 CMD_CHK_COLLISIONFORCE

CMD_CHK_COLLISIONFORCE	TC:				Used to check on subject performance by analyzing

	0x2108				the data collected during the last sampling block. This command verifies that the intensity of the collisions against the tapping surfaces falls within specified limits. ("Post hoc" analysis command)
size: 162					
direction: EPM->DEX					
min_force	0:00	t_f32	N		Minimum expected force peak for impacts.
max_force	4:00	t_f32	N		Maximum expected force peak for impacts.
max_bad_peaks	8:00	t_u16			Maximum allowed number of bad force peaks.
error_message	10:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	140:00	t_f_str			Picture to display in case of command failure

5.2.4.9 CMD_CHK_EARLYSTARTS

CMD_CHK_EARLYSTARTS	TC: 0x2109				Used to check on subject performance by analyzing the data collected during the last sampling block. This command compares the start instant of each movement with the auditory stimulus given to the subject for the same movement (indicating to start the movement), and it verifies that the movement has not started too early. max_bad_starts represents the maximum number of movements starting too early. ("Post hoc" analysis command)
size: 164					
direction: EPM->DEX					
max_bad_starts	0:00	t_u16			Maximum allowed number of bad starts.
hold_time	2:00	t_u16	ms		Minimum amount of time the expected condition has to remain true.
threshold_velocity	4:00	t_f32	mm/s		Minimum velocity for a movement to be considered motionless.
filter_constant	8:00	t_f32			Filter constant controlling motion speed low pass filter
error_message	12:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	142:00	t_f_str			Picture to display in case of command failure

5.2.4.10 CMD_CHK_HW_CONFIG

CMD_CHK_HW_CONFIG	TC: 0x210A				Used to check whether the following DEX H/W: 1) subject posture (sitting/supine) indicated by the position of the horizontal bar of the reference frame; 2) vertical bar of reference frame ("in use" position/set aside); has been configured by the subject according to specified criteria. Where this is not the case, the specified message and picture are presented to the user to indicate the desired configuration, and the subject is prompted to acknowledge (via a button press) when the configuration has been corrected.
size: 162					
direction: EPM->DEX					
message	0:00	t_f_str			Text message to be presented to the subject.
picture_file	130:00	t_f_str			Filename of picture file (24 bit BMP) to be displayed to the subject. The file must be located in a specific picture directory on the file system.
posture	152:00	t_l_bit			Desired subject posture (0=sitting; 1=supine)
vertical_bar	156:00	t_l_bit			Desired vertical bar configuration (0=in use, vertical movements; 1=aside, horizontal movements)
timeout	160:00	t_u16	s		Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)

QinetiQ

5.2.4.11 CMD_CHK_MANIP_VISIBILITY

CMD_CHK_MANIP_VISIBILITY	TC: 0x210B				Used to check on subject performance by analyzing the data collected during the last sampling block. This command verifies that the visibility of the manipulandum falls within specified limits. ("Post hoc" analysis command)
size: 160					
direction: EPM->DEX					
cumul_invisible_time	0:00	t_f32	s		Cumulative time during which the manipulandum can be invisible.
cont_invisible_time	4:00	t_f32	s		Continuous time during which the manipulandum can be invisible.
error_message	8:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	138:00	t_f_str			Picture to display in case of command failure

5.2.4.12 CMD_CHK_MASS_SELECTION

CMD_CHK_MASS_SELECTION	TC: 0x210C				Used to check whether the manipulandum mass selected by the subject matches the specified one. Where this is not the case, the specified message and picture are presented to the user to indicate the desired configuration, and the subject is prompted to acknowledge (via a button press) when the configuration has been corrected.
size: 156					
direction: EPM->DEX					
message	0:00	t_f_str			Text message to be presented to the subject.
picture_file	130:00	t_f_str			Filename of picture file (24 bit BMP) to be displayed to the subject. The file must be located in a specific picture directory on the filesystem.
desired_mass	152:00	t_u16			Desired mass (0=small mass; 1=medium mass; 2=big mass)
timeout	154:00	t_u16	s		Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)

5.2.4.13 CMD_CHK_MOVEMENTS_AMPL

CMD_CHK_MOVEMENTS_AMPL	TC: 0x210D				Used to check on subject performance by analyzing the data collected during the last sampling block. This command verifies that the amplitude of the movements performed with the manipulandum falls within specified limits. exp_dir represents the direction along which to evaluate the movement. ("Post hoc" analysis command)
size: 168					
direction: EPM->DEX					
min_amplitude	0:00	t_u16	mm		Minimum expected amplitude for manipulandum movements.
max_amplitude	2:00	t_u16	mm		Maximum expected amplitude for manipulandum movements.
exp_dirX	4:00	t_f32			Expected direction - X component.
exp_dirY	8:00	t_f32			Expected direction - Y component.
exp_dirZ	12:00	t_f32			Expected direction - Z component.
error_message	16:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	146:00	t_f_str			Picture to display in case of command failure

QinetiQ

5.2.4.14 CMD_CHK_MOVEMENTS_CYCLES

CMD_CHK_MOVEMENTS_CYCLES	TC: 0x210E				Used to check on subject performance by analyzing the data collected during the last sampling block. This command verifies that the frequency of the (oscillatory) movements performed with the manipulandum falls within specified limits. exp_dir represents the direction along which to evaluate the movement. ("Post hoc" analysis command)
size: 170					
direction: EPM->DEX					
min_cycles	0:00	t_u16			Minimum expected number of cycles for manipulandum movements.
max_cycles	2:00	t_u16			Maximum expected number of cycles for manipulandum movements.
exp_dirX	4:00	t_f32			Expected direction - X component.
exp_dirY	8:00	t_f32			Expected direction - Y component.
exp_dirZ	12:00	t_f32			Expected direction - Z component.
hysteresis	16:00	t_u16	mm		Minimum displacement from manipulandum mean position to count the movement as a cycle.
error_message	18:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	148:00	t_f_str			Picture to display in case of command failure

5.2.4.15 CMD_CHK_MOVEMENTS_DIR

CMD_CHK_MOVEMENTS_DIR	TC: 0x210F				Used to check on subject performance by analyzing the data collected during the last sampling block. This command compares the start direction of each movement with the auditory stimulus given to the subject for the same movement (indicating upward/downward direction), and it verifies that the movement has been performed in the correct direction. max_bad_starts represents the maximum number of movements starting in the wrong direction. exp_dir represents the correct movement direction. ("Post hoc" analysis command)
size: 168					
direction: EPM->DEX					
max_bad_starts	0:00	t_u16			Maximum allowed number of bad starts.
exp_dirX	2:00	t_f32			Expected direction - X component.
exp_dirY	6:00	t_f32			Expected direction - Y component.
exp_dirZ	10:00	t_f32			Expected direction - Z component.
threshold_distance	14:00	t_u16	mm		Minimum distance for a movement to be considered a start.
error_message	16:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	146:00	t_f_str			Picture to display in case of command failure

5.2.4.16 CMD_CHK_START_POS

CMD_CHK_START_POS	TC: 0x2110				Used to check on subject performance by analyzing the data collected during the last sampling block. This command compares the start position of each movement with the illuminated target shown to the subject for the same movement (indicating the start position for the movement), and it verifies that the movement's start position is correct considering a specified tolerance. LEDs_x parameters are interpreted as the expected start position, therefore only one bit over both bitfields can be set to 1. max_bad_starts represents the maximum number

QinetiQ

					of movements starting at the wrong position. ("Post hoc" analysis command)
size: 164					
direction: EPM->DEX					
LEDs_h	0:00	t_u16			Requested status of LEDs on horizontal bar (aggregated)
LEDs_v	2:00	t_u16			Requested status of LEDs on vertical bar (aggregated)
tol_posX	4:00	t_u16	mm		Maximum allowed distance along X axis between expected and measured position (max value=infinite).
tol_posY	6:00	t_u16	mm		Maximum allowed distance along Y axis between expected and measured position (max value=infinite).
tol_posZ	8:00	t_u16	mm		Maximum allowed distance along Z axis between expected and measured position (max value=infinite).
max_bad_starts	10:00	t_u16			Maximum allowed number of bad starts.
error_message	12:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	142:00	t_f_str			Picture to display in case of command failure

5.2.4.17 CMD_CLEANUP

CMD_CLEANUP	TC: 0x2203				Intended for internal use, to be run at the end of a task. Will ensure sound is muted, LEDs are off, camera is stopped and science data acquisition is stopped if needed.
size: 0					
direction: EPM->DEX					

5.2.4.18 CMD_CTRL_CAMERA

CMD_CTRL_CAMERA	TC: 0x2111				Used to control the crew camera to start or stop acquiring images and storing them to disk.
size: 14					
direction: EPM->DEX					
camera_start	0:00	t_l_bit			Start/stop image acquisition (0=stop acq; 1=start acq)
acquisition_tag	4:00	t_f_str			Identifies the data collected during this sample block

5.2.4.19 CMD_CTRL_TARGETS

CMD_CTRL_TARGETS	TC: 0x2112				Used to control the target LEDs by specifying any on/off state for each of them.
size: 4					
direction: EPM->DEX					
LEDs_h	0:00	t_u16			Requested status of LEDs on horizontal bar (aggregated). LSB is closest to the subject
LEDs_v	2:00	t_u16			Requested status of LEDs on vertical bar (aggregated). LSB is closest to the reference frame

5.2.4.20 CMD_CTRL_TONE

CMD_CTRL_TONE	TC: 0x2113				Used to control the tone generator by specifying its on/off state and tone to be emitted.
size: 6					
direction: EPM->DEX					
mute	0:00	t_l_bit			Requested status of tone mute (0=unmuted; 1=muted)

QinetiQ

tone	4:00	t_u16			Requested status of tone selection (0-7=index of selected tone, ascending frequency)

5.2.4.21 CMD_EPM_CANCEL_XFER

CMD_EPM_CANCEL_XFER	TC: 0x050A				Cancels an ongoing EPM file transfer
size: 4					
direction: EPM->DEX					
epm_coarsetime	0:00	t_u32			Coarse time field to identify file transfer to be cancelled

5.2.4.22 CMD_EPM_CD

CMD_EPM_CD	TC: 0x0507				Changes the local directory as kept by EPM interface
size: 202					
direction: EPM->DEX					
epm_dirname	0:00	t_f_str			Directory name parameter

5.2.4.23 CMD_EPM_CHMODE_CO

CMD_EPM_CHMODE_CO	TC: 0x0101				Change to EPM checkout mode. Checkout mode is a state in which the SM (Science module) can be safely powered off without loss of data
size: 0					
direction: EPM->DEX					

5.2.4.24 CMD_EPM_CHMODE_NOMINAL

CMD_EPM_CHMODE_NOMINAL	TC: 0x0102				Change to nominal operation mode
size: 0					
direction: EPM->DEX					

5.2.4.25 CMD_EPM_CHMODE_SETUP

CMD_EPM_CHMODE_SETUP	TC: 0x0103				Change to setup mode. In this mode, file transfer operations are supported, but no science
size: 0					
direction: EPM->DEX					

5.2.4.26 CMD_EPM_CHMODE_TEST

CMD_EPM_CHMODE_TEST	TC: 0x0104				Change to test mode. This mode is mainly intended for troubleshooting. It must be noted that conflicting commands with science operation are not prevented in this mode.
size: 0					
direction: EPM->DEX					

5.2.4.27 CMD_EPM_COPY

CMD_EPM_COPY	TC: 0x0503				Perform a local file system copy
size: 428					
direction: EPM->DEX					
epm_srcfile	0:00	t_f_str			Source file
epm_localdstfile	214:00	t_f_str			Local (on DEX) destination file

5.2.4.28 CMD_EPM_DELETE

CMD_EPM_DELETE	TC: 0x0504				Delete a file from the local file system
size: 214					
direction: EPM->DEX					
epm_srcfile	0:00	t_f_str			File to be deleted

5.2.4.29 CMD_EPM_DIR

CMD_EPM_DIR	TC: 0x0506				Creates a local directory listing and sends it to EPM in a way compliant to EPM-OHB-SP-0005.
size: 0					
direction: EPM->DEX					

5.2.4.30 CMD_EPM_DOWNLINK

CMD_EPM_DOWNLINK	TC: 0x0501				Downlink a file from EPM to an external destination. Downlink differs from SEND_FILE in the possible destinations
size: 449					
direction: EPM->DEX					
epm_address	0:00	t_u16			Destination address, should be FRC (2) and/or USOC (4)
epm_srcfile	2:00	t_f_str			Source file
epm_remotedstfile	216:00	t_f_str			Remote destination file

5.2.4.31 CMD_EPM_GET_BULKHK

CMD_EPM_GET_BULKHK	TC: 0x0305				Standard EPM command to retrieve bulk housekeeping data. Added for test script support.
size: 0					
direction: EPM->DEX					

5.2.4.32 CMD_EPM_MKDIR

CMD_EPM_MKDIR	TC: 0x0508				Create a directory on the local file system
size: 202					
direction: EPM->DEX					
epm_dirname	0:00	t_f_str			Directory to be created

5.2.4.33 CMD_EPM_RENAME

CMD_EPM_RENAME	TC: 0x0505				Rename a file or directory on the local file system
size: 428					
direction: EPM->DEX					
epm_srcfile	0:00	t_f_str			Existing file or directory
epm_localdstfile	214:00	t_f_str			New name of file or directory

5.2.4.34 CMD_EPM_RMDIR

CMD_EPM_RMDIR	TC: 0x0509				Remove a directory from the local file system
size: 202					
direction: EPM->DEX					
epm_dirname	0:00	t_f_str			Directory to be removed

5.2.4.35 CMD_EPM_SEND_FILE

CMD_EPM_SEND_FILE	TC: 0x0502				Send a file from DEX to an EPM internal destination. Downlink differs from SEND_FILE in the possible destinations
size: 449					
direction: EPM->DEX					
epm_address	0:00	t_u16			Internal destination address
epm_srcfile	2:00	t_f_str			Source file
epm_remotedstfile	216:00	t_f_str			Remote destination file

5.2.4.36 CMD_LOG_EVENT

CMD_LOG_EVENT	TC: 0x2401				Used to log a numerical event. This event will be stored along with science data on disk. The latest event logged will also be sent to ground as part of the H&S packet. Additionally, a predefined subset of event numbers will be used to mark the progress of the experiment in order to enable identification of the relevant sections of data for the subject performance algorithms.
size: 2					
direction: EPM->DEX					
event	0:00	t_u16			Event number to be logged.

5.2.4.37 CMD_LOG_MESSAGE

CMD_LOG_MESSAGE	TC: 0x2402				Used to log a text message along with science data on disk.
size: 148					
direction: EPM->DEX					
logtype	0:00	t_u16			Type discriminator for text log entries. Possible values defined by enum LogEventType (see below).
logmessage	2:00	t_f_str			Text message logged to disk on request of the user script or the application. 0 terminated with maximum netto length of 144 bytes.

enum LogEventType	Value	Use	Description
evtScriptMessage	0	script	Message logged as part of a user script
evtScriptMessageUser	1	script	Message logged as part of a user script, filling the text box visible to the subject
evtAswInfo	2	ASW	Info message informing about application events
evtShellOutput	3	ASW	Shell output message
evtAswWarning	4	ASW	Warning against not nominal SW condition
evtAswError	5	ASW	Software error
evtScienceError	6	ASW	Science data related error
evtConfigError	7	ASW	Application configuration error
evtCommunicationError	8	ASW	Communication related error
evtParameterError	9	ASW	Invalid parameter error
evtBufferOverflow	10	ASW	Internal buffer overflow
evtMonitorAlarmClear	11	ASW	Monitored alarm cleared event
evtMonitorAlarmTrip	12	ASW	Monitored alarm trip event
evtGenericError	13	ASW	Other error
evtLogContinuation	14	ASW	Special marker indicating continuation of a previous log entry (message too long to fit in one packet)

5.2.4.38 CMD_NULLIFY_FORCES

CMD_NULLIFY_FORCES	TC: 0x2114				Used to set the zero point of force and torque for both FT sensors. This command must be run as a post-hoc test i.e. it needs acquired samples to operate.
size: 130					
direction: EPM->DEX					
error_message	0:00	t_f_str			Text message to be presented to the subject in case of command failure.

5.2.4.39 CMD_PROTOCOL

CMD_PROTOCOL	TC: 0x2403				Used to select the active protocol. This command can be issued internally as a consequence of UI interaction or remotely as a telecommand. Additionally, it is the only type of packet of which the Session file is constituted (or other types are ignored).
size: 72					
direction: EPM->DEX					
protocol_id	0:00	t_u16			Numerical identification number for the protocol. This id will be used for logging purposes and to identify science data collected while executing this protocol (0=reserved).
protocol_file	2:00	t_f_str			Filename of script file for this protocol (Protocol file). The file must be located in a specific scripts directory on the filesystem. This parameter is only meaningful when the command is coming from a Session file.
displayname	40:00	t_f_str			Contains the contents of the list item text on the GUI

5.2.4.40 CMD_SELFTEST

CMD_SELFTEST	TC: 0x240A				Run the self test. Note that a self test will be run before any command in a task script, so it is not required to include this command in the script.
size: 0					
direction: EPM->DEX					

5.2.4.41 CMD_SET_MON_LIMITS

CMD_SET_MON_LIMITS	TC: 0x2404				Internal command. Used to set monitoring limits for a specified parameter. This command will implicitly enable the monitoring of the specified parameter.
size: 60					
direction: EPM->DEX					
param_name	0:00	t_f_str			Name of the parameter affected by the command.
lower_warning_limit	22:00	t_f32			Lower warning monitoring limit.
lower_caution_limit	26:00	t_f32			Lower caution monitoring limit.
upper_caution_limit	30:00	t_f32			Upper caution monitoring limit.
upper_warning_limit	34:00	t_f32			Upper warning monitoring limit.
alarm_param_name	38:00	t_f_str			Name of parameter to indicate alarm status of a(nother) monitored parameter.

5.2.4.42 CMD_SET_PARAM_CONV

CMD_SET_PARAM_CONV	TC: 0x2405				Internal command. Used to set conversion function and respective coefficients for a specified parameter.
size: 44					

QinetiQ

direction: EPM->DEX					
param_name	0:00	t_f_str			Name of the parameter affected by the command.
conversion_function	22:00	t_u16			Function to be used for parameter value conversion. Values are according to conversion_type_t.
conv_a0	24:00	t_f32			Coefficient a0 to be used for parameter value conversion.
conv_a1	28:00	t_f32			Coefficient a1 to be used for parameter value conversion.
conv_a2	32:00	t_f32			Coefficient a2 to be used for parameter value conversion.
conv_a3	36:00	t_f32			Coefficient a3 to be used for parameter value conversion.
conv_a4	40:00	t_f32			Coefficient a4 to be used for parameter value conversion.

enum conversion_type_t	Value	Description
no_conversion	0	No conversion is performed for this parameter
polynomial	1	Parameter will undergo polynomial conversion via the formula $a0 + a1*x + a2*x^2 + a3*x^3 + a4*x^4$
steinhart_hart	2	Parameter will undergo conversion via the formula $T = a3*X^3 + a2*X^2 + a1.X + a0$ with $X = ln(R)$ and $R = 2000.x/(a4-x)$

5.2.4.43 CMD_SET_PICTURE

CMD_SET_PICTURE	TC: 0x240F				Direct display of a picture on the screen (if current screen supports it)
size: 22					
direction: EPM->DEX					
picture_file	0:00	t_f_str			Filename of picture file (24 bit BMP) to be displayed to the subject. The file must be located in a specific picture directory on the filesystem.

5.2.4.44 CMD_SHELL

CMD_SHELL	TC: 0x2201				Used to execute a system command in an OS shell. This packet generates an extended response by means of a telemetry packet (RESP_SHELL).
size: 202					
direction: EPM->DEX					
shell_cmdline	0:00	t_f_str			Command line to be executed.

5.2.4.45 CMD_SHELL_KILL

CMD_SHELL_KILL	TC: 0x2202				Used to kill the currently executing OS shell command.
size: 0					
direction: EPM->DEX					

5.2.4.46 CMD_SUBJ_READY

CMD_SUBJ_READY	TC: 0x240E				Used to interrupt CMD_WAIT_SUBJ_READY.
size: 0					
direction: EPM->DEX					

5.2.4.47 CMD_TASK

CMD_TASK	TC: 0x2406				Used to select the active task. This command can be issued internally as a consequence of UI

					interaction or remotely as a telecommand. Additionally, it is the only type of packet of which the Protocol file is constituted (or other types are ignored).
size: 72					
direction: EPM->DEX					
task_id	0:00	t_u16			Numerical identification number for the task. This id will be used for logging purposes and to identify science data collected while executing this task (0=reserved).
task_file	2:00	t_f_str			Filename of script file for this task (Task file). The file must be located in a specific scripts directory on the filesystem. This parameter is only meaningful when the command is coming from a Protocol file.
displayname	40:00	t_f_str			Contains the contents of the list item text on the GUI.

5.2.4.48 CMD_TASK_RESTART

CMD_TASK_RESTART	TC: 0x240B				Used to restart the active task.
size: 0					
direction: EPM->DEX					

5.2.4.49 CMD_TASK_RESUME

CMD_TASK_RESUME	TC: 0x240C				Used to resume the active task.
size: 0					
direction: EPM->DEX					

5.2.4.50 CMD_TASK_SUSPEND

CMD_TASK_SUSPEND	TC: 0x240D				Used to suspend the active task.
size: 0					
direction: EPM->DEX					

5.2.4.51 CMD_USER

CMD_USER	TC: 0x2407				Used to log a user onto the system. This command can be issued internally as a consequence of UI interaction or remotely as a telecommand. Additionally, it is the only type of packet of which the Users file is constituted (or other types are ignored).
size: 74					
direction: EPM->DEX					
user_id	0:00	t_u16			Numerical identification number for the user. This id will be used for logging purposes and to identify science data associated with this user (0=reserved).
user_pin	2:00	t_u16			4 digit numerical pin used to authenticate user login.
session_file	4:00	t_f_str			Filename of script file to be used for this user (Session file). The file must be located in a specific scripts directory on the filesystem. This parameter is only meaningful when the command is coming from a Users file.
displayname	42:00	t_f_str			Contains the contents of the list item text on the GUI.

5.2.4.52 CMD_WAIT

CMD_WAIT	TC:				Used to implement a pause of a specified duration

	0x2408				in the task execution.
size: 4					
direction: EPM->DEX					
pause	0:00	t_u32	ms		Pause duration expressed in units of 1ms (range is 0-300000)

5.2.4.53 CMD_WAIT_MANIP_ATTARGET

CMD_WAIT_MANIP_ATTARGET	TC: 0x2115				Used to implement a pause in the task execution lasting until the manipulandum has been brought next to a specified position (identified by a visual target) by the subject. LEDs_x parameters are interpreted as the desired target position, therefore only one bit over both bitfields can be set to 1. exp_oriX, exp_oriY, exp_oriZ, exp_oriM quaternion refers to orientation of the manipulandum.
size: 184					
direction: EPM->DEX					
LEDs_h	0:00	t_u16			Requested status of LEDs on horizontal bar (aggregated)
LEDs_v	2:00	t_u16			Requested status of LEDs on vertical bar (aggregated)
exp_oriX	4:00	t_f32			Expected orientation - X component.
exp_oriY	8:00	t_f32			Expected orientation - Y component.
exp_oriZ	12:00	t_f32			Expected orientation - Z component.
exp_oriM	16:00	t_f32			Expected orientation - M component.
tol_posX	20:00	t_u16	mm		Maximum allowed distance along X axis between expected and measured position (max value=infinite).
tol_posY	22:00	t_u16	mm		Maximum allowed distance along Y axis between expected and measured position (max value=infinite).
tol_posZ	24:00	t_u16	mm		Maximum allowed distance along Z axis between expected and measured position (max value=infinite).
tol_angle	26:00	t_u16	°		Maximum allowed mis-orientation.
hold_time	28:00	t_u16	ms		Minimum amount of time the expected condition has to remain true.
timeout	30:00	t_u16	s		Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)
error_message	32:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	162:00	t_f_str			Picture to display in case of command failure

5.2.4.54 CMD_WAIT_MANIP_GRIP

CMD_WAIT_MANIP_GRIP	TC: 0x2116				Used to implement a pause in the task execution lasting until the manipulandum has been correctly (according to specified parameters) gripped by the subject. Tolerance is expressed in terms of distance between the center of pressure and the center of the contact surface.
size: 160					
direction: EPM->DEX					
min_grip	0:00	t_f32			Minimum expected grip force.
tol_distance	4:00	t_u16	mm		Maximum allowed distance between expected and measured position.

QinetiQ

					Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)
timeout	6:00	t_u16	s		
error_message	8:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	138:00	t_f_str			Picture to display in case of command failure

5.2.4.55 CMD_WAIT_MANIP_GRIPFORCE

CMD_WAIT_MANIP_GRIPFORCE	TC: 0x2117				Used to implement a pause in the task execution lasting until the manipulandum has been gripped by the subject with a specified force/load. The current grip force is presented to the user by the target LEDs as facilitation means to reach the correct force. exp_dir represents the expected direction of the load force.
size: 188					
direction: EPM->DEX					
min_grip	0:00	t_f32	N		Minimum expected grip force.
max_grip	4:00	t_f32	N		Maximum expected grip force.
min_load	8:00	t_f32	N		Minimum expected load force.
max_load	12:00	t_f32	N		Maximum expected load force.
exp_dirX	16:00	t_f32			Expected direction - X component.
exp_dirY	20:00	t_f32			Expected direction - Y component.
exp_dirZ	24:00	t_f32			Expected direction - Z component.
hold_time	28:00	t_u16	ms		Minimum amount of time the expected condition has to remain true.
timeout	30:00	t_u16	s		Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)
filter_constant	32:00	t_f32			Filter constant determining force low pass filtering
error_message	36:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	166:00	t_f_str			Picture to display in case of command failure

5.2.4.56 CMD_WAIT_MANIP_SLIP

CMD_WAIT_MANIP_SLIP	TC: 0x2118				Behaviour is the same as CMD_WAIT_MANIP_GRIPFORCE. Here, however, the command waits until the finger slips by at least slip_threshold.
size: 184					
direction: EPM->DEX					
min_grip	0:00	t_f32	N		Minimum expected grip force.
max_grip	4:00	t_f32	N		Maximum expected grip force.
min_load	8:00	t_f32	N		Minimum expected load force.
max_load	12:00	t_f32	N		Maximum expected load force.
exp_dirX	16:00	t_f32			Expected direction - X component.
exp_dirY	20:00	t_f32			Expected direction - Y component.
exp_dirZ	24:00	t_f32			Expected direction - Z component.
slip_threshold	28:00	t_u16	mm		Distance that the fingers must slip.
timeout	30:00	t_u16	s		Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)
filter_constant	32:00	t_f32			Filter constant determining force low pass filtering
error_message	36:00	t_f_str			Text message to be presented to the subject in case of command failure.
picture_file	166:00	t_f_str			Picture to display in case of command failure

5.2.4.57 CMD_WAIT_SUBJ_READY

CMD_WAIT_SUBJ_READY	TC: 0x240E				Used to implement a pause in the task execution lasting until the subject has acknowledged a message on the GUI by pressing a button.
size: 154					
direction: EPM->DEX					
message	0:00	t_f_str			Text message to be presented to the subject.
picture_file	130:00	t_f_str			Filename of picture file (24 bit BMP) to be displayed to the subject. The file must be located in a specific picture directory on the filesystem.
timeout	152:00	t_u16	s		Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)

5.2.4.58 DATA_BULK_HK

Note: The table below represents the DEX packet corresponding to the bulk HK report and is restricted to the value section. The check status will be appended before transmission.

DATA_BULK_HK	TM: 0x0301				Bulk housekeeping data report HK value section according to EPM-OHB-LI-0039 par 6.2.3.1 (excluding check status)
size: 114					
direction: DEX->EPM					
EPM_current_mode	0:00	t_u16			
EPM_next_mode	2:00	t_u16			
EPM_timer_status	4:00	t_u16			
EPM_corrective_action_enb	6:00	t_u16			
EPM_file_xfer_status	8:00	t_u16			
temp_SCU	10:00	t_s16	degC		Temperature sensor Signal Conditioning Unit
temp_ECU1	12:00	t_s16	degC		Temperature sensor Experiment Control Unit 1
temp_ECU2	14:00	t_s16	degC		Temperature sensor Experiment Control Unit 2
temp_ECU3	16:00	t_s16	degC		Temperature sensor Experiment Control Unit 3
temp_ECU4	18:00	t_s16	degC		Temperature sensor Experiment Control Unit 4
temp_ECU5	20:00	t_s16	degC		Temperature sensor Experiment Control Unit 5
temp_ECU6	22:00	t_s16	degC		Temperature sensor Experiment Control Unit 6
temp_RF	24:00	t_s16	degC		Temperature sensor Reference Frame
cpu_board_temp	26:00	t_s16			CPU board temperature (degC)
cpu_core_temp	28:00	t_s16			CPU core temperature (degC)
voltage_P14V_SCU	30:00	t_s16	mV		Voltage sensor +14V on Signal Conditioning Unit
voltage_N14V_SCU	32:00	t_s16	mV		Voltage sensor -14V on Signal Conditioning Unit
voltage_P8V_GLM	34:00	t_s16	mV		Voltage sensor +8V on Grip Lift Manipulandum
voltage_P12V_PSB	36:00	t_s16	mV		Voltage sensor +12V on Power Supply Board
voltage_P5V_PSB	38:00	t_s16	mV		Voltage sensor +5V on Power Supply Board
current_P12V_PSB	40:00	t_s16	mA		Current sensor +12V on Power Supply Board
current_P3V3_cPCI	42:00	t_s16	mA		Current sensor +3V3 on compact PCI bus
current_P5V_cPCI	44:00	t_s16	mA		Current sensor +5V on compact PCI bus
selftest_status	46:00	t_u16			Selftest status according to EPM-OHB-LI-0039 par 8.2.2
EPM_RxDataRate	48:00	t_f32	kbps		Receive datarate in kbps on EPM ethernet interface

EPM_TxDataRate	52:00	t_f32	kbps		Transmit datarate in kbps on EPM ethernet interface
status_fans	56:00	t_u16			Status of cooling fans (aggregated)
status_fan_RF	57:00	t_bit			Status of cooling fan on Reference Frame (0=turning; 1=not turning)
status_fan_ECU1	57:01	t_bit			Status of cooling fan 1 on Experiment Control Unit (0=turning; 1=not turning)
status_fan_ECU2	57:02	t_bit			Status of cooling fan 2 on Experiment Control Unit (0=turning; 1=not turning)
status_fan_ECU3	57:03	t_bit			Status of cooling fan 3 on Experiment Control Unit (0=turning; 1=not turning)
status_fan_ECU4	57:04	t_bit			Status of cooling fan 4 on Experiment Control Unit (0=turning; 1=not turning)
status_fan_ECU5	57:05	t_bit			Status of cooling fan 5 on Experiment Control Unit (0=turning; 1=not turning)
status_fan_ECU6	57:06	t_bit			Status of cooling fan 6 on Experiment Control Unit (0=turning; 1=not turning)
epminterface_status	58:00	t_u16	enum		Status of CDexEpmInterface, values according to epminterface_status_t.
smoke_detector_ECU	64:00	t_bit			Status of smoke detector for Experiment Control Unit (0=not triggered; 1=triggered)
smoke_detector_RF	64:01	t_bit			Status of smoke detector for Reference Frame (0=not triggered; 1=triggered)
status_OCDs_power	66:00	t_u16			Status of overcurrent detectors and power supplies (aggregated)
status_OCD_SCU	66:00	t_bit			Status of overcurrent detector for Signal Conditioning Unit (0=not triggered; 1=triggered)
status_OCD_MDB_RF	66:01	t_bit			Status of overcurrent detector for Marker Driver Board on Reference Frame (0=not triggered; 1=triggered)
status_OCD_MDB_M	66:02	t_bit			Status of overcurrent detector for Marker Driver Board on Manipulandum (0=not triggered; 1=triggered)
status_OCD_MDB_arm	66:03	t_bit			Status of overcurrent detector for Marker Driver Board on arm (0=not triggered; 1=triggered)
status_OCD_MDB_ETD	66:04	t_bit			Status of overcurrent detector for Marker Driver Board on Eye Tracking Device (0=not triggered; 1=triggered)
status_OCD_Touch	66:05	t_bit			Status of overcurrent detector for Touchscreen (0=not triggered; 1=triggered)
status_OCD_Webcam	66:06	t_bit			Status of overcurrent detector for crew camera (0=not triggered; 1=triggered)
status_OCD_CODA1	66:07	t_bit			Status of overcurrent detector for CODA unit 1 (0=not triggered; 1=triggered)
status_OCD_CODA2	67:00	t_bit			Status of overcurrent detector for CODA unit 2 (0=not triggered; 1=triggered)
status_OCD_RF	67:01	t_bit			Status of overcurrent detector for Reference Frame (0=not triggered; 1=triggered)
status_power_SCU	67:02	t_bit			Status of power supply towards Signal Conditioning Unit (0=not triggered; 1=triggered)
status_power_CODA1	67:03	t_bit			Status of power supply towards CODA unit 1 (0=not triggered; 1=triggered)
status_power_CODA2	67:04	t_bit			Status of power supply towards CODA unit 2 (0=not triggered; 1=triggered)
LEDs_h_fb	68:00	t_u16			Status of LEDs on horizontal bar (aggregated)
LED_h1_fb	69:00	t_bit			Status of LED 1 on horizontal bar (0=off; 1=on)
LED_h2_fb	69:01	t_bit			Status of LED 2 on horizontal bar (0=off; 1=on)
LED_h3_fb	69:02	t_bit			Status of LED 3 on horizontal bar (0=off; 1=on)
LED_h4_fb	69:03	t_bit			Status of LED 4 on horizontal bar (0=off; 1=on)
LED_h5_fb	69:04	t_bit			Status of LED 5 on horizontal bar (0=off; 1=on)
LED_h6_fb	69:05	t_bit			Status of LED 6 on horizontal bar (0=off; 1=on)
LED_h7_fb	69:06	t_bit			Status of LED 7 on horizontal bar (0=off; 1=on)
LED_h8_fb	69:07	t_bit			Status of LED 8 on horizontal bar (0=off; 1=on)
LED_h9_fb	68:00	t_bit			Status of LED 9 on horizontal bar (0=off; 1=on)
LED_h10_fb	68:01	t_bit			Status of LED 10 on horizontal bar (0=off; 1=on)
LEDs_v_fb	70:00	t_u16			Status of LEDs on vertical bar (aggregated)
LED_v1_fb	71:00	t_bit			Status of LED 1 on vertical bar (0=off; 1=on)

QinetiQ

LED_v2_fb	71:01	t_bit			Status of LED 2 on vertical bar (0=off; 1=on)
LED_v3_fb	71:02	t_bit			Status of LED 3 on vertical bar (0=off; 1=on)
LED_v4_fb	71:03	t_bit			Status of LED 4 on vertical bar (0=off; 1=on)
LED_v5_fb	71:04	t_bit			Status of LED 5 on vertical bar (0=off; 1=on)
LED_v6_fb	71:05	t_bit			Status of LED 6 on vertical bar (0=off; 1=on)
LED_v7_fb	71:06	t_bit			Status of LED 7 on vertical bar (0=off; 1=on)
LED_v8_fb	71:07	t_bit			Status of LED 8 on vertical bar (0=off; 1=on)
LED_v9_fb	70:00	t_bit			Status of LED 9 on vertical bar (0=off; 1=on)
LED_v10_fb	70:01	t_bit			Status of LED 10 on vertical bar (0=off; 1=on)
LED_v11_fb	70:02	t_bit			Status of LED 11 on vertical bar (0=off; 1=on)
LED_v12_fb	70:03	t_bit			Status of LED 12 on vertical bar (0=off; 1=on)
LED_v13_fb	70:04	t_bit			Status of LED 13 on vertical bar (0=off; 1=on)
mute_fb	72:00	t_bit			Status of tone mute (0=unmuted; 1=muted)
tone1_fb	72:01	t_bit			Status of tone selection bit 1
tone2_fb	72:02	t_bit			Status of tone selection bit 2
tone3_fb	72:03	t_bit			Status of tone selection bit 3
Masscradle 1 fields:					Mass detected in cradle 1 (00=no mass; 01=400gr; 10=600gr; 11=800gr)
masscradle_1_0	73:00	t_bit			Cradle 1 mass detection - bit 0
masscradle_1_1	73:01	t_bit			Cradle 1 mass detection - bit 1
Masscradle 2 fields:					Mass detected in cradle 2 (00=no mass; 01=400gr; 10=600gr; 11=800gr)
masscradle_2_0	73:02	t_bit			Cradle 2 mass detection - bit 0
masscradle_2_1	73:03	t_bit			Cradle 2 mass detection - bit 1
Masscradle 2 fields:					Mass detected in cradle 3 (00=no mass; 01=400gr; 10=600gr; 11=800gr)
masscradle_3_0	73:04	t_bit			Cradle 3 mass detection - bit 0
masscradle_3_1	73:05	t_bit			Cradle 3 mass detection - bit 1
current_user	74:00	t_u16			Numerical ID of logged in user. This maps to the user ID of the respective user packet in the users file. current_user=0 is a special value, meaning that no user is logged in.
current_protocol	76:00	t_u16			Numerical ID of active protocol. This maps to the protocol ID of the respective protocol packet in the active session file. current_protocol=0 is a special value, meaning no protocol is active.
current_task	78:00	t_u16			Numerical ID of active task. This maps to the task ID of the respective task packet in the active protocol file. current_task=0 is a special value, meaning no task is active.
current_step	80:00	t_u16			Numerical ID of task step being executed. This maps to the packet sequence number of the command in the loaded task file (script). NOTE: when current_task=0 this parameter has no meaning and its value is undefined.
scriptengine_status	82:00	t_u16	enum		Status of CDexScriptEngine, values according to scriptengine_status_t. NOTE: when current_task=0 this parameter has no meaning and its value is undefined.
iochannels_status	84:00	t_u16	enum		Status of CDexIoChannels, values according to iochannels_status_t.
motiontracker_status	86:00	t_u16	enum		Status of CDexMotionTracker, values according to motiontracker_status_t
crewcamera_status	88:00	t_u16	enum		Status of CDexCrewCamera, values according to crewcamera_status_t.
crewcamera_rate	90:00	t_u16	fps		Current framerate for CDexCrewCamera (Hz)

QinetiQ

shell_cmd_running	92:00	t_bit			Running status of shell command (0=not running; 1=running)
system_acquiring	92:01	t_bit			Indicates whether there is a data acquisition ongoing (0=not acquiring; 1=acquiring)
cpu_usage	94:00	t_u16	%		CPU utilization (%)
memory_usage	96:00	t_u16	%		System memory utilization (%)
free_disk_space_C	100:00	t_u32	kB		Available disk space on system drive (kB)
free_disk_space_D	104:00	t_u32	kB		Available disk space on data drive (kB)
free_disk_space_E	108:00	t_u32	kB		Available disk space on backup drive (kB)
data_layout_crc	112:00	t_u16			CRC calculated over the active packet/parameter layout

enum scriptengine_status_t	Value	Description
Unloaded	0	No script is loaded
Loaded	1	A script has been loaded but is not running yet
Running	2	The loaded script is running
Suspend_Requested	3	The loaded script is processing a request to suspend
Suspended	4	The loaded script is suspended
Completed	5	The loaded script execution has completed
Error	0x1000	The loaded script is in an error state

enum iochannels_status_t	Value	Description
Uninitialised	0	IO channels not initialized yet
Initialised	1	IO channels initialized
Acquiring	2	Running science acquisition
Stopping_Acquisition	3	Processing acquired data logging
Error	0x1000	IO channels in error state

enum motiontracker_status_t	Value	Description
Uninitialised	0	Motion tracker uninitialised
Initialised	1	Motion tracker initialised
Acquiring	2	Running science acquisition
Stopping_Acquisition	3	Processing acquired data logging
Error	0x1000	Motion tracker in error state

enum crewcamera_status_t	Value	Description
Uninitialised	0	Crew camera not initialized
Initialised	1	Crew camera initialized
Acquiring	2	Crew camera acquiring images
Error	0x1000	Crew camera in error state

5.2.4.59 DATA_IOC_FT_CALC

DATA_IOC_FT_CALC					Packet containing computed force and torque values from the Force/Torque sensors.
size: 24					
direction: internal					
manip_FX_L	0:00	t_s16	1/100 N		X force component calculated from left F/T sensor
manip_FY_L	2:00	t_s16	1/100 N		Y force component calculated from left F/T sensor
manip_FZ_L	4:00	t_s16	1/100 N		Z force component calculated from left F/T sensor
manip_TX_L	6:00	t_s16	Nmm		X torque component calculated from left F/T sensor

QinetiQ

manip_TY_L	8:00	t_s16	Nmm		Y torque component calculated from left F/T sensor
manip_TZ_L	10:00	t_s16	Nmm		Z torque component calculated from left F/T sensor
manip_FX_R	12:00	t_s16	1/100 N		X force component calculated from right F/T sensor
manip_FY_R	14:00	t_s16	1/100 N		Y force component calculated from right F/T sensor
manip_FZ_R	16:00	t_s16	1/100 N		Z force component calculated from right F/T sensor
manip_TX_R	18:00	t_s16	Nmm		X torque component calculated from right F/T sensor
manip_TY_R	20:00	t_s16	Nmm		Y torque component calculated from right F/T sensor
manip_TZ_R	22:00	t_s16	Nmm		Z torque component calculated from right F/T sensor

5.2.4.60 DATA_IOC_FTG

DATA_IOC_FTG					Subset of DATA_IOC_SCIENCE, containing only Force/Torque and LowG accelerometer data. Additionally, it contains the sample number relative to the same data.
size: 40					
direction: internal					
science_data_tick	0:00	t_u32			Timestamp for manipulandum sensors values
manip_FX_L	4:00	t_s16	1/100 N		X force component calculated from left F/T sensor
manip_FY_L	6:00	t_s16	1/100 N		Y force component calculated from left F/T sensor
manip_FZ_L	8:00	t_s16	1/100 N		Z force component calculated from left F/T sensor
manip_TX_L	10:00	t_s16	Nmm		X torque component calculated from left F/T sensor
manip_TY_L	12:00	t_s16	Nmm		Y torque component calculated from left F/T sensor
manip_TZ_L	14:00	t_s16	Nmm		Z torque component calculated from left F/T sensor
manip_FX_R	16:00	t_s16	1/100 N		X force component calculated from right F/T sensor
manip_FY_R	18:00	t_s16	1/100 N		Y force component calculated from right F/T sensor
manip_FZ_R	20:00	t_s16	1/100 N		Z force component calculated from right F/T sensor
manip_TX_R	22:00	t_s16	Nmm		X torque component calculated from right F/T sensor
manip_TY_R	24:00	t_s16	Nmm		Y torque component calculated from right F/T sensor
manip_TZ_R	26:00	t_s16	Nmm		Z torque component calculated from right F/T sensor
manip_Low_Acc_X	28:00	t_s32	mm/s²		Data from low range accelerometer - X axis
manip_Low_Acc_Y	32:00	t_s32	mm/s²		Data from low range accelerometer - Y axis
manip_Low_Acc_Z	36:00	t_s32	mm/s²		Data from low range accelerometer - Z axis

5.2.4.61 DATA_IOC_SCIENCE

DATA_IOC_SCIENCE					Contains one frame of science data from the IO channels, collecting analog data from all manipulandum sensors plus status (feedback) of all LEDs and audio output. Additionally, it contains the sample number relative to the same data.
size: 52					
direction: internal					
science_data_tick	0:00	t_u32			Timestamp for manipulandum sensors values
manip_G0_L	4:00	t_s16	mV		Data from left F/T sensor - G0
manip_G1_L	6:00	t_s16	mV		Data from left F/T sensor - G1
manip_G2_L	8:00	t_s16	mV		Data from left F/T sensor - G2
manip_G3_L	10:00	t_s16	mV		Data from left F/T sensor - G3
manip_G4_L	12:00	t_s16	mV		Data from left F/T sensor - G4
manip_G5_L	14:00	t_s16	mV		Data from left F/T sensor - G5
manip_G0_R	16:00	t_s16	mV		Data from right F/T sensor - G0

QinetiQ

manip_G1_R	18:00	t_s16	mV		Data from right F/T sensor - G1
manip_G2_R	20:00	t_s16	mV		Data from right F/T sensor - G2
manip_G3_R	22:00	t_s16	mV		Data from right F/T sensor - G3
manip_G4_R	24:00	t_s16	mV		Data from right F/T sensor - G4
manip_G5_R	26:00	t_s16	mV		Data from right F/T sensor - G5
manip_Gyro_A	28:00	t_s16	mV		Data from gyroscope – A component
manip_Gyro_B	30:00	t_s16	mV		Data from gyroscope – B component
manip_Gyro_C	32:00	t_s16	mV		Data from gyroscope – C component
manip_High_Acc	34:00	t_s16	mV		Data from high range accelerometer
manip_Low_Acc_A	36:00	t_s16	mV		Data from low range accelerometer – A component
manip_Low_Acc_B	38:00	t_s16	mV		Data from low range accelerometer – B component
manip_Low_Acc_C	40:00	t_s16	mV		Data from low range accelerometer – C component
manip_MEv2_L	42:00	t_s16	mV		Data from left moisture sensor
manip_MEv2_R	44:00	t_s16	mV		Data from right moisture sensor
LEDs_h_fb	46:00	t_u16			Status of LEDs on horizontal bar (aggregated)
LED_h1_fb	47:00	t_bit			Status of LED 1 on horizontal bar (0=off; 1=on)
LED_h2_fb	47:01	t_bit			Status of LED 2 on horizontal bar (0=off; 1=on)
LED_h3_fb	47:02	t_bit			Status of LED 3 on horizontal bar (0=off; 1=on)
LED_h4_fb	47:03	t_bit			Status of LED 4 on horizontal bar (0=off; 1=on)
LED_h5_fb	47:04	t_bit			Status of LED 5 on horizontal bar (0=off; 1=on)
LED_h6_fb	47:05	t_bit			Status of LED 6 on horizontal bar (0=off; 1=on)
LED_h7_fb	47:06	t_bit			Status of LED 7 on horizontal bar (0=off; 1=on)
LED_h8_fb	47:07	t_bit			Status of LED 8 on horizontal bar (0=off; 1=on)
LED_h9_fb	46:00	t_bit			Status of LED 9 on horizontal bar (0=off; 1=on)
LED_h10_fb	46:01	t_bit			Status of LED 10 on horizontal bar (0=off; 1=on)
LEDs_v_fb	48:00	t_u16			Status of LEDs on vertical bar (aggregated)
LED_v1_fb	49:00	t_bit			Status of LED 1 on vertical bar (0=off; 1=on)
LED_v2_fb	49:01	t_bit			Status of LED 2 on vertical bar (0=off; 1=on)
LED_v3_fb	49:02	t_bit			Status of LED 3 on vertical bar (0=off; 1=on)
LED_v4_fb	49:03	t_bit			Status of LED 4 on vertical bar (0=off; 1=on)
LED_v5_fb	49:04	t_bit			Status of LED 5 on vertical bar (0=off; 1=on)
LED_v6_fb	49:05	t_bit			Status of LED 6 on vertical bar (0=off; 1=on)
LED_v7_fb	49:06	t_bit			Status of LED 7 on vertical bar (0=off; 1=on)
LED_v8_fb	49:07	t_bit			Status of LED 8 on vertical bar (0=off; 1=on)
LED_v9_fb	48:00	t_bit			Status of LED 9 on vertical bar (0=off; 1=on)
LED_v10_fb	48:01	t_bit			Status of LED 10 on vertical bar (0=off; 1=on)
LED_v11_fb	48:02	t_bit			Status of LED 11 on vertical bar (0=off; 1=on)
LED_v12_fb	48:03	t_bit			Status of LED 12 on vertical bar (0=off; 1=on)
LED_v13_fb	48:04	t_bit			Status of LED 13 on vertical bar (0=off; 1=on)
mute_fb	50:00	t_bit			Status of tone mute (0=unmuted; 1=muted)
tone1_fb	50:01	t_bit			Status of tone selection bit 1
tone2_fb	50:02	t_bit			Status of tone selection bit 2
tone3_fb	50:03	t_bit			Status of tone selection bit 3
					Mass detected in cradle 1 (00=no mass; 01=400gr; 10=600gr; 11=800gr)
masscradle_1_0	51:00	t_bit			Cradle 1 mass detection - bit 0
masscradle_1_1	51:01	t_bit			Cradle 1 mass detection - bit 1
					Mass detected in cradle 2 (00=no mass; 01=400gr; 10=600gr; 11=800gr)
masscradle_2_0	51:02	t_bit			Cradle 2 mass detection - bit 0
masscradle_2_1	51:03	t_bit			Cradle 2 mass detection - bit 1
					Mass detected in cradle 3 (00=no mass; 01=400gr; 10=600gr; 11=800gr)
masscradle_3_0	51:04	t_bit			Cradle 3 mass detection - bit 0
masscradle_3_1	51:05	t_bit			Cradle 3 mass detection - bit 1

5.2.4.62 DATA_MANIP_POSE

DATA_MANIP_POSE				Contains the computed position, orientation and visibility of the manipulandum. Additionally, it contains the CODA frame sequence number relative to the data used to compute the position.
size: 35				
direction: internal				
manip_pose_tick	0:00	t_u32		Timestamp for manipulandum position and orientation values.
manip_posX	4:00	t_s16	1/10 mm	Manipulandum position - X coordinate, computed (1/10 mm)
manip_posY	6:00	t_s16	1/10 mm	Manipulandum position - Y coordinate, computed (1/10 mm)
manip_posZ	8:00	t_s16	1/10 mm	Manipulandum position - Z coordinate, computed (1/10 mm)
manip_oriX	10:00	t_f32		Manipulandum orientation - X component.
manip_oriY	14:00	t_f32		Manipulandum orientation - Y component.
manip_oriZ	18:00	t_f32		Manipulandum orientation - Z component.
manip_oriM	22:00	t_f32		Manipulandum orientation - M component.
markers_visib1	26:00	t_u32		CODA markers visibility, CODA unit 1 (aggregated). Least significant bit represents visibility of marker 1.
markers_visib2	30:00	t_u32		CODA markers visibility, CODA unit 2 (aggregated). Least significant bit represents visibility of marker 1.
manip_visib	34:00	t_bit		Manipulandum visibility, computed (0=not visible; 1=visible)

5.2.4.63 DATA_MT_COMB

DATA_MT_COMB				Contains one frame of data from the motion tracker, collecting position and visibility information for each of the CODA markers in the system. Coordinates are reported as the combined result of both CODA units (one x,y,z triplet per marker). Additionally, it contains the CODA frame sequence number relative to the same data.
size: 128				
direction: internal				
markers_tick	0:00	t_u32		Timestamp for markers' position values, combined.
marker_1_posX	4:00	t_s16	1/10 mm	CODA marker 1 position - X coordinate, combined (1/10 mm)
marker_1_posY	6:00	t_s16	1/10 mm	CODA marker 1 position - Y coordinate, combined (1/10 mm)
marker_1_posZ	8:00	t_s16	1/10 mm	CODA marker 1 position - Z coordinate, combined (1/10 mm)
marker_2_posX	10:00	t_s16	1/10 mm	CODA marker 2 position - X coordinate, combined (1/10 mm)
marker_2_posY	12:00	t_s16	1/10 mm	CODA marker 2 position - Y coordinate, combined (1/10 mm)
marker_2_posZ	14:00	t_s16	1/10 mm	CODA marker 2 position - Z coordinate, combined (1/10 mm)
marker_3_posX	16:00	t_s16	1/10 mm	CODA marker 3 position - X coordinate, combined (1/10 mm)
marker_3_posY	18:00	t_s16	1/10 mm	CODA marker 3 position - Y coordinate, combined (1/10 mm)
marker_3_posZ	20:00	t_s16	1/10 mm	CODA marker 3 position - Z coordinate, combined (1/10 mm)

marker_4_posX	22:00	t_s16	1/10 mm		CODA marker 4 position - X coordinate, combined (1/10 mm)
marker_4_posY	24:00	t_s16	1/10 mm		CODA marker 4 position - Y coordinate, combined (1/10 mm)
marker_4_posZ	26:00	t_s16	1/10 mm		CODA marker 4 position - Z coordinate, combined (1/10 mm)
marker_5_posX	28:00	t_s16	1/10 mm		CODA marker 5 position - X coordinate, combined (1/10 mm)
marker_5_posY	30:00	t_s16	1/10 mm		CODA marker 5 position - Y coordinate, combined (1/10 mm)
marker_5_posZ	32:00	t_s16	1/10 mm		CODA marker 5 position - Z coordinate, combined (1/10 mm)
marker_6_posX	34:00	t_s16	1/10 mm		CODA marker 6 position - X coordinate, combined (1/10 mm)
marker_6_posY	36:00	t_s16	1/10 mm		CODA marker 6 position - Y coordinate, combined (1/10 mm)
marker_6_posZ	38:00	t_s16	1/10 mm		CODA marker 6 position - Z coordinate, combined (1/10 mm)
marker_7_posX	40:00	t_s16	1/10 mm		CODA marker 7 position - X coordinate, combined (1/10 mm)
marker_7_posY	42:00	t_s16	1/10 mm		CODA marker 7 position - Y coordinate, combined (1/10 mm)
marker_7_posZ	44:00	t_s16	1/10 mm		CODA marker 7 position - Z coordinate, combined (1/10 mm)
marker_8_posX	46:00	t_s16	1/10 mm		CODA marker 8 position - X coordinate, combined (1/10 mm)
marker_8_posY	48:00	t_s16	1/10 mm		CODA marker 8 position - Y coordinate, combined (1/10 mm)
marker_8_posZ	50:00	t_s16	1/10 mm		CODA marker 8 position - Z coordinate, combined (1/10 mm)
marker_9_posX	52:00	t_s16	1/10 mm		CODA marker 9 position - X coordinate, combined (1/10 mm)
marker_9_posY	54:00	t_s16	1/10 mm		CODA marker 9 position - Y coordinate, combined (1/10 mm)
marker_9_posZ	56:00	t_s16	1/10 mm		CODA marker 9 position - Z coordinate, combined (1/10 mm)
marker_10_posX	58:00	t_s16	1/10 mm		CODA marker 10 position - X coordinate, combined (1/10 mm)
marker_10_posY	60:00	t_s16	1/10 mm		CODA marker 10 position - Y coordinate, combined (1/10 mm)
marker_10_posZ	62:00	t_s16	1/10 mm		CODA marker 10 position - Z coordinate, combined (1/10 mm)
marker_11_posX	64:00	t_s16	1/10 mm		CODA marker 11 position - X coordinate, combined (1/10 mm)
marker_11_posY	66:00	t_s16	1/10 mm		CODA marker 11 position - Y coordinate, combined (1/10 mm)
marker_11_posZ	68:00	t_s16	1/10 mm		CODA marker 11 position - Z coordinate, combined (1/10 mm)
marker_12_posX	70:00	t_s16	1/10 mm		CODA marker 12 position - X coordinate, combined (1/10 mm)
marker_12_posY	72:00	t_s16	1/10 mm		CODA marker 12 position - Y coordinate, combined (1/10 mm)
marker_12_posZ	74:00	t_s16	1/10 mm		CODA marker 12 position - Z coordinate, combined (1/10 mm)
marker_13_posX	76:00	t_s16	1/10 mm		CODA marker 13 position - X coordinate, combined (1/10 mm)

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marker_13_posY	78:00	t_s16	1/10 mm		CODA marker 13 position - Y coordinate, combined (1/10 mm)
marker_13_posZ	80:00	t_s16	1/10 mm		CODA marker 13 position - Z coordinate, combined (1/10 mm)
marker_14_posX	82:00	t_s16	1/10 mm		CODA marker 14 position - X coordinate, combined (1/10 mm)
marker_14_posY	84:00	t_s16	1/10 mm		CODA marker 14 position - Y coordinate, combined (1/10 mm)
marker_14_posZ	86:00	t_s16	1/10 mm		CODA marker 14 position - Z coordinate, combined (1/10 mm)
marker_15_posX	88:00	t_s16	1/10 mm		CODA marker 15 position - X coordinate, combined (1/10 mm)
marker_15_posY	90:00	t_s16	1/10 mm		CODA marker 15 position - Y coordinate, combined (1/10 mm)
marker_15_posZ	92:00	t_s16	1/10 mm		CODA marker 15 position - Z coordinate, combined (1/10 mm)
marker_16_posX	94:00	t_s16	1/10 mm		CODA marker 16 position - X coordinate, combined (1/10 mm)
marker_16_posY	96:00	t_s16	1/10 mm		CODA marker 16 position - Y coordinate, combined (1/10 mm)
marker_16_posZ	98:00	t_s16	1/10 mm		CODA marker 16 position - Z coordinate, combined (1/10 mm)
marker_17_posX	100:00	t_s16	1/10 mm		CODA marker 17 position - X coordinate, combined (1/10 mm)
marker_17_posY	102:00	t_s16	1/10 mm		CODA marker 17 position - Y coordinate, combined (1/10 mm)
marker_17_posZ	104:00	t_s16	1/10 mm		CODA marker 17 position - Z coordinate, combined (1/10 mm)
marker_18_posX	106:00	t_s16	1/10 mm		CODA marker 18 position - X coordinate, combined (1/10 mm)
marker_18_posY	108:00	t_s16	1/10 mm		CODA marker 18 position - Y coordinate, combined (1/10 mm)
marker_18_posZ	110:00	t_s16	1/10 mm		CODA marker 18 position - Z coordinate, combined (1/10 mm)
marker_19_posX	112:00	t_s16	1/10 mm		CODA marker 19 position - X coordinate, combined (1/10 mm)
marker_19_posY	114:00	t_s16	1/10 mm		CODA marker 19 position - Y coordinate, combined (1/10 mm)
marker_19_posZ	116:00	t_s16	1/10 mm		CODA marker 19 position - Z coordinate, combined (1/10 mm)
marker_20_posX	118:00	t_s16	1/10 mm		CODA marker 20 position - X coordinate, combined (1/10 mm)
marker_20_posY	120:00	t_s16	1/10 mm		CODA marker 20 position - Y coordinate, combined (1/10 mm)
marker_20_posZ	122:00	t_s16	1/10 mm		CODA marker 20 position - Z coordinate, combined (1/10 mm)
markers_visib	124:00	t_u32			CODA markers visibility, combined (aggregated)
marker_1_visib	127:00	t_bit			CODA marker 1 visibility, combined (0=not visible; 1=visible)
marker_2_visib	127:01	t_bit			CODA marker 2 visibility, combined (0=not visible; 1=visible)
marker_3_visib	127:02	t_bit			CODA marker 3 visibility, combined (0=not visible; 1=visible)
marker_4_visib	127:03	t_bit			CODA marker 4 visibility, combined (0=not visible; 1=visible)
marker_5_visib	127:04	t_bit			CODA marker 5 visibility, combined (0=not visible; 1=visible)

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marker_6_visib	127:05	t_bit			CODA marker 6 visibility, combined (0=not visible; 1=visible)
marker_7_visib	127:06	t_bit			CODA marker 7 visibility, combined (0=not visible; 1=visible)
marker_8_visib	127:07	t_bit			CODA marker 8 visibility, combined (0=not visible; 1=visible)
marker_9_visib	126:00	t_bit			CODA marker 9 visibility, combined (0=not visible; 1=visible)
marker_10_visib	126:01	t_bit			CODA marker 10 visibility, combined (0=not visible; 1=visible)
marker_11_visib	126:02	t_bit			CODA marker 11 visibility, combined (0=not visible; 1=visible)
marker_12_visib	126:03	t_bit			CODA marker 12 visibility, combined (0=not visible; 1=visible)
marker_13_visib	126:04	t_bit			CODA marker 13 visibility, combined (0=not visible; 1=visible)
marker_14_visib	126:05	t_bit			CODA marker 14 visibility, combined (0=not visible; 1=visible)
marker_15_visib	126:06	t_bit			CODA marker 15 visibility, combined (0=not visible; 1=visible)
marker_16_visib	126:07	t_bit			CODA marker 16 visibility, combined (0=not visible; 1=visible)
marker_17_visib	125:00	t_bit			CODA marker 17 visibility, combined (0=not visible; 1=visible)
marker_18_visib	125:01	t_bit			CODA marker 18 visibility, combined (0=not visible; 1=visible)
marker_19_visib	125:02	t_bit			CODA marker 19 visibility, combined (0=not visible; 1=visible)
marker_20_visib	125:03	t_bit			CODA marker 20 visibility, combined (0=not visible; 1=visible)

5.2.4.64 DATA_MT_SEP_1

DATA_MT_SEP_1					Contains one frame of data from the motion tracker, collecting position and visibility information for each of the CODA markers in the system. Reported coordinates are relative to CODA unit number 1 (one x,y,z triplet per marker). Additionally, it contains the CODA frame sequence number relative to the same data.
size: 176					
direction: internal					
markers_tick_1	0:00	t_u32			Timestamp for markers' position values, CODA unit 1.
marker_1_posX_1	4:00	t_s16	1/10 mm		CODA marker 1 position - X coordinate, CODA unit 1 (1/10 mm)
marker_1_posY_1	6:00	t_s16	1/10 mm		CODA marker 1 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_1_posZ_1	8:00	t_s16	1/10 mm		CODA marker 1 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_2_posX_1	10:00	t_s16	1/10 mm		CODA marker 2 position - X coordinate, CODA unit 1 (1/10 mm)
marker_2_posY_1	12:00	t_s16	1/10 mm		CODA marker 2 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_2_posZ_1	14:00	t_s16	1/10 mm		CODA marker 2 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_3_posX_1	16:00	t_s16	1/10 mm		CODA marker 3 position - X coordinate, CODA unit 1 (1/10 mm)
marker_3_posY_1	18:00	t_s16	1/10 mm		CODA marker 3 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_3_posZ_1	20:00	t_s16	1/10 mm		CODA marker 3 position - Z coordinate, CODA unit 1 (1/10 mm)

marker_4_posX_1	22:00	t_s16	1/10 mm		CODA marker 4 position - X coordinate, CODA unit 1 (1/10 mm)
marker_4_posY_1	24:00	t_s16	1/10 mm		CODA marker 4 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_4_posZ_1	26:00	t_s16	1/10 mm		CODA marker 4 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_5_posX_1	28:00	t_s16	1/10 mm		CODA marker 5 position - X coordinate, CODA unit 1 (1/10 mm)
marker_5_posY_1	30:00	t_s16	1/10 mm		CODA marker 5 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_5_posZ_1	32:00	t_s16	1/10 mm		CODA marker 5 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_6_posX_1	34:00	t_s16	1/10 mm		CODA marker 6 position - X coordinate, CODA unit 1 (1/10 mm)
marker_6_posY_1	36:00	t_s16	1/10 mm		CODA marker 6 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_6_posZ_1	38:00	t_s16	1/10 mm		CODA marker 6 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_7_posX_1	40:00	t_s16	1/10 mm		CODA marker 7 position - X coordinate, CODA unit 1 (1/10 mm)
marker_7_posY_1	42:00	t_s16	1/10 mm		CODA marker 7 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_7_posZ_1	44:00	t_s16	1/10 mm		CODA marker 7 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_8_posX_1	46:00	t_s16	1/10 mm		CODA marker 8 position - X coordinate, CODA unit 1 (1/10 mm)
marker_8_posY_1	48:00	t_s16	1/10 mm		CODA marker 8 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_8_posZ_1	50:00	t_s16	1/10 mm		CODA marker 8 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_9_posX_1	52:00	t_s16	1/10 mm		CODA marker 9 position - X coordinate, CODA unit 1 (1/10 mm)
marker_9_posY_1	54:00	t_s16	1/10 mm		CODA marker 9 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_9_posZ_1	56:00	t_s16	1/10 mm		CODA marker 9 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_10_posX_1	58:00	t_s16	1/10 mm		CODA marker 10 position - X coordinate, CODA unit 1 (1/10 mm)
marker_10_posY_1	60:00	t_s16	1/10 mm		CODA marker 10 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_10_posZ_1	62:00	t_s16	1/10 mm		CODA marker 10 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_11_posX_1	64:00	t_s16	1/10 mm		CODA marker 11 position - X coordinate, CODA unit 1 (1/10 mm)
marker_11_posY_1	66:00	t_s16	1/10 mm		CODA marker 11 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_11_posZ_1	68:00	t_s16	1/10 mm		CODA marker 11 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_12_posX_1	70:00	t_s16	1/10 mm		CODA marker 12 position - X coordinate, CODA unit 1 (1/10 mm)
marker_12_posY_1	72:00	t_s16	1/10 mm		CODA marker 12 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_12_posZ_1	74:00	t_s16	1/10 mm		CODA marker 12 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_13_posX_1	76:00	t_s16	1/10 mm		CODA marker 13 position - X coordinate, CODA unit 1 (1/10 mm)

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marker_13_posY_1	78:00	t_s16	1/10 mm		CODA marker 13 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_13_posZ_1	80:00	t_s16	1/10 mm		CODA marker 13 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_14_posX_1	82:00	t_s16	1/10 mm		CODA marker 14 position - X coordinate, CODA unit 1 (1/10 mm)
marker_14_posY_1	84:00	t_s16	1/10 mm		CODA marker 14 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_14_posZ_1	86:00	t_s16	1/10 mm		CODA marker 14 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_15_posX_1	88:00	t_s16	1/10 mm		CODA marker 15 position - X coordinate, CODA unit 1 (1/10 mm)
marker_15_posY_1	90:00	t_s16	1/10 mm		CODA marker 15 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_15_posZ_1	92:00	t_s16	1/10 mm		CODA marker 15 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_16_posX_1	94:00	t_s16	1/10 mm		CODA marker 16 position - X coordinate, CODA unit 1 (1/10 mm)
marker_16_posY_1	96:00	t_s16	1/10 mm		CODA marker 16 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_16_posZ_1	98:00	t_s16	1/10 mm		CODA marker 16 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_17_posX_1	100:00	t_s16	1/10 mm		CODA marker 17 position - X coordinate, CODA unit 1 (1/10 mm)
marker_17_posY_1	102:00	t_s16	1/10 mm		CODA marker 17 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_17_posZ_1	104:00	t_s16	1/10 mm		CODA marker 17 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_18_posX_1	106:00	t_s16	1/10 mm		CODA marker 18 position - X coordinate, CODA unit 1 (1/10 mm)
marker_18_posY_1	108:00	t_s16	1/10 mm		CODA marker 18 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_18_posZ_1	110:00	t_s16	1/10 mm		CODA marker 18 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_19_posX_1	112:00	t_s16	1/10 mm		CODA marker 19 position - X coordinate, CODA unit 1 (1/10 mm)
marker_19_posY_1	114:00	t_s16	1/10 mm		CODA marker 19 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_19_posZ_1	116:00	t_s16	1/10 mm		CODA marker 19 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_20_posX_1	118:00	t_s16	1/10 mm		CODA marker 20 position - X coordinate, CODA unit 1 (1/10 mm)
marker_20_posY_1	120:00	t_s16	1/10 mm		CODA marker 20 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_20_posZ_1	122:00	t_s16	1/10 mm		CODA marker 20 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_21_posX_1	124:00	t_s16	1/10 mm		CODA marker 21 position - X coordinate, CODA unit 1 (1/10 mm)
marker_21_posY_1	126:00	t_s16	1/10 mm		CODA marker 21 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_21_posZ_1	128:00	t_s16	1/10 mm		CODA marker 21 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_22_posX_1	130:00	t_s16	1/10 mm		CODA marker 22 position - X coordinate, CODA unit 1 (1/10 mm)
marker_22_posY_1	132:00	t_s16	1/10 mm		CODA marker 22 position - Y coordinate, CODA unit 1 (1/10 mm)

QinetiQ

marker_22_posZ_1	134:00	t_s16	1/10 mm		CODA marker 22 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_23_posX_1	136:00	t_s16	1/10 mm		CODA marker 23 position - X coordinate, CODA unit 1 (1/10 mm)
marker_23_posY_1	138:00	t_s16	1/10 mm		CODA marker 23 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_23_posZ_1	140:00	t_s16	1/10 mm		CODA marker 23 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_24_posX_1	142:00	t_s16	1/10 mm		CODA marker 24 position - X coordinate, CODA unit 1 (1/10 mm)
marker_24_posY_1	144:00	t_s16	1/10 mm		CODA marker 24 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_24_posZ_1	146:00	t_s16	1/10 mm		CODA marker 24 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_25_posX_1	148:00	t_s16	1/10 mm		CODA marker 25 position - X coordinate, CODA unit 1 (1/10 mm)
marker_25_posY_1	150:00	t_s16	1/10 mm		CODA marker 25 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_25_posZ_1	152:00	t_s16	1/10 mm		CODA marker 25 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_26_posX_1	154:00	t_s16	1/10 mm		CODA marker 26 position - X coordinate, CODA unit 1 (1/10 mm)
marker_26_posY_1	156:00	t_s16	1/10 mm		CODA marker 26 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_26_posZ_1	158:00	t_s16	1/10 mm		CODA marker 26 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_27_posX_1	160:00	t_s16	1/10 mm		CODA marker 27 position - X coordinate, CODA unit 1 (1/10 mm)
marker_27_posY_1	162:00	t_s16	1/10 mm		CODA marker 27 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_27_posZ_1	164:00	t_s16	1/10 mm		CODA marker 27 position - Z coordinate, CODA unit 1 (1/10 mm)
marker_28_posX_1	166:00	t_s16	1/10 mm		CODA marker 28 position - X coordinate, CODA unit 1 (1/10 mm)
marker_28_posY_1	168:00	t_s16	1/10 mm		CODA marker 28 position - Y coordinate, CODA unit 1 (1/10 mm)
marker_28_posZ_1	170:00	t_s16	1/10 mm		CODA marker 28 position - Z coordinate, CODA unit 1 (1/10 mm)
markers_visib_1	172:00	t_u32			CODA markers visibility, CODA unit 1 (aggregated)
marker_1_visib_1	175:00	t_bit			CODA marker 1 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_2_visib_1	175:01	t_bit			CODA marker 2 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_3_visib_1	175:02	t_bit			CODA marker 3 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_4_visib_1	175:03	t_bit			CODA marker 4 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_5_visib_1	175:04	t_bit			CODA marker 5 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_6_visib_1	175:05	t_bit			CODA marker 6 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_7_visib_1	175:06	t_bit			CODA marker 7 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_8_visib_1	175:07	t_bit			CODA marker 8 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_9_visib_1	174:00	t_bit			CODA marker 9 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_10_visib_1	174:01	t_bit			CODA marker 10 visibility, CODA unit 1 (0=not visible; 1=visible)

marker_11_visib_1	174:02	t_bit			CODA marker 11 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_12_visib_1	174:03	t_bit			CODA marker 12 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_13_visib_1	174:04	t_bit			CODA marker 13 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_14_visib_1	174:05	t_bit			CODA marker 14 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_15_visib_1	174:06	t_bit			CODA marker 15 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_16_visib_1	174:07	t_bit			CODA marker 16 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_17_visib_1	173:00	t_bit			CODA marker 17 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_18_visib_1	173:01	t_bit			CODA marker 18 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_19_visib_1	173:02	t_bit			CODA marker 19 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_20_visib_1	173:03	t_bit			CODA marker 20 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_21_visib_1	173:04	t_bit			CODA marker 21 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_22_visib_1	173:05	t_bit			CODA marker 22 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_23_visib_1	173:06	t_bit			CODA marker 23 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_24_visib_1	173:07	t_bit			CODA marker 24 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_25_visib_1	172:00	t_bit			CODA marker 25 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_26_visib_1	172:01	t_bit			CODA marker 26 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_27_visib_1	172:02	t_bit			CODA marker 27 visibility, CODA unit 1 (0=not visible; 1=visible)
marker_28_visib_1	172:03	t_bit			CODA marker 28 visibility, CODA unit 1 (0=not visible; 1=visible)

5.2.4.65 DATA_MT_SEP_2

Completely identical to DATA_MT_SEP_1, except all values are for CODA2 instead.
All parameter names have the suffix "_2" instead of "_1".

5.2.4.66 DATA_MT_TRANSF_1

DATA_MT_TRANSF_1				Contains the rotation and translation transform applied to convert coordinates from raw (CODA unit intrinsic) to aligned (relative to the reference frame). Transform data is relative to CODA unit number 1 (one 3x3 rotation matrix and 1 x,y,z translation vector).
size: 96				
direction: internal				
motiontracker_transform_R11_1	0:00	t_f64		Rotation matrix of coordinate transform for CODA unit 1 - elem 1,1
motiontracker_transform_R12_1	8:00	t_f64		Rotation matrix of coordinate transform for CODA unit 1 - elem 1,2
motiontracker_transform_R13_1	16:00	t_f64		Rotation matrix of coordinate transform for CODA unit 1 - elem 1,3
motiontracker_transform_R21_1	24:00	t_f64		Rotation matrix of coordinate transform for CODA unit 1 - elem 2,1
motiontracker_transform_R22_1	32:00	t_f64		Rotation matrix of coordinate transform for CODA unit 1 - elem 2,2
motiontracker_transform_R23_1	40:00	t_f64		Rotation matrix of coordinate transform for CODA unit 1 - elem 2,3

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motiontracker_transform_R31_1	48:00	t_f64			Rotation matrix of coordinate transform for CODA unit 1 - elem 3,1
motiontracker_transform_R32_1	56:00	t_f64			Rotation matrix of coordinate transform for CODA unit 1 - elem 3,2
motiontracker_transform_R33_1	64:00	t_f64			Rotation matrix of coordinate transform for CODA unit 1 - elem 3,3
motiontracker_transform_t1_1	72:00	t_f64			Translation vector of coordinate transform for CODA unit 1 - elem 1
motiontracker_transform_t2_1	80:00	t_f64			Translation vector of coordinate transform for CODA unit 1 - elem 2
motiontracker_transform_t3_1	88:00	t_f64			Translation vector of coordinate transform for CODA unit 1 - elem 3

5.2.4.67 DATA_MT_TRANSF_2

DATA_MT_TRANSF_2					Contains the rotation and translation transform applied to convert coordinates from raw (CODA unit intrinsic) to aligned (relative to the reference frame). Transform data is relative to CODA unit number 2 (one 3x3 rotation matrix and 1 x,y,z translation vector).
size: 96					
direction: internal					
motiontracker_transform_R11_2	0:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 1,1
motiontracker_transform_R12_2	8:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 1,2
motiontracker_transform_R13_2	16:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 1,3
motiontracker_transform_R21_2	24:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 2,1
motiontracker_transform_R22_2	32:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 2,2
motiontracker_transform_R23_2	40:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 2,3
motiontracker_transform_R31_2	48:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 3,1
motiontracker_transform_R32_2	56:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 3,2
motiontracker_transform_R33_2	64:00	t_f64			Rotation matrix of coordinate transform for CODA unit 2 - elem 3,3
motiontracker_transform_t1_2	72:00	t_f64			Translation vector of coordinate transform for CODA unit 2 - elem 1
motiontracker_transform_t2_2	80:00	t_f64			Translation vector of coordinate transform for CODA unit 2 - elem 2
motiontracker_transform_t3_2	88:00	t_f64			Translation vector of coordinate transform for CODA unit 2 - elem 3

5.2.4.68 DATA_RT_SCIENCE

DATA_RT_SCIENCE	TM: 0x1001				Concatenation of 10 pairs of DATA_MANIP_POSE and DATA_IOC_FTG. Used for real time telemetry of science data for quality analysis during execution of an experiment task (frequency=2Hz). All embedded packet contain data acquired at 20Hz and they are then all packed and sent at once with the present packet type.
size: 758					
direction: DEX->EPM					
rtdata_acq_id	0:00	t_u32			Acquisition block identifier for real time science data packets. Starts at 0 after system startup and increments by 1 for every start/stop acquisition cycle.
rtdata_pkt_counter	4:00	t_u32			Packet counter for real time science data packets. Resets to 0 every time rtdata_acq_id increments.
DATA_MANIP_POSE[0]	8:00	packet			Manipulandum pose packet 0.

QinetiQ

DATA_IOC_FTG[0]	43:00	packet			Force/Torque/Acceleration packet 0.
DATA_MANIP_POSE[1]	83:00	packet			Manipulandum pose packet 1.
DATA_IOC_FTG[1]	118:00	packet			Force/Torque/Acceleration packet 1.
DATA_MANIP_POSE[2]	158:00	packet			Manipulandum pose packet 2.
DATA_IOC_FTG[2]	193:00	packet			Force/Torque/Acceleration packet 2.
DATA_MANIP_POSE[3]	233:00	packet			Manipulandum pose packet 3.
DATA_IOC_FTG[3]	268:00	packet			Force/Torque/Acceleration packet 3.
DATA_MANIP_POSE[4]	308:00	packet			Manipulandum pose packet 4.
DATA_IOC_FTG[4]	343:00	packet			Force/Torque/Acceleration packet 4.
DATA_MANIP_POSE[5]	383:00	packet			Manipulandum pose packet 5.
DATA_IOC_FTG[5]	418:00	packet			Force/Torque/Acceleration packet 5.
DATA_MANIP_POSE[6]	458:00	packet			Manipulandum pose packet 6.
DATA_IOC_FTG[6]	493:00	packet			Force/Torque/Acceleration packet 6.
DATA_MANIP_POSE[7]	533:00	packet			Manipulandum pose packet 7.
DATA_IOC_FTG[7]	568:00	packet			Force/Torque/Acceleration packet 7.
DATA_MANIP_POSE[8]	608:00	packet			Manipulandum pose packet 8.
DATA_IOC_FTG[8]	643:00	packet			Force/Torque/Acceleration packet 8.
DATA_MANIP_POSE[9]	683:00	packet			Manipulandum pose packet 9.
DATA_IOC_FTG[9]	718:00	packet			Force/Torque/Acceleration packet 9.

5.2.4.69 RESP_SHELL

RESP_SHELL	TM: 0x1002				Used to send to ground the response (generated output) by the shell command issued with CMD_SHELL.
size: 1026					
direction: DEX->EPM					
shell_output	0:00	t_c_str			Output generated by a CMD_SHELL command execution. If generated output is longer than the maximum length, it will be truncated.

5.2.5 PARAMETER SUMMARY

All packet parameters mentioned in 5.2.4 have built in explicit or implicit validity limits, apart from the optional caution/warning limits that can be defined.
Implicit limits depend on the parameter type, e.g. a "t_s16" type parameter can only hold integer values in the range [-32768,32767]. Explicit validity limits, if any, are mentioned in the table below. For string types, the limits correspond to the length of the parameter.

Parameter	Description	Unit	Type	Min value	Max value
temp_SCU	Temperature sensor Signal Conditioning Unit (degC)	degC	t_s16		
temp_ECU1	Temperature sensor Experiment Control Unit 1 (degC) - mounted in PSU, most critical	degC	t_s16		
temp_ECU2	Temperature sensor Experiment Control Unit 2 (degC)	degC	t_s16		
temp_ECU3	Temperature sensor Experiment Control Unit 3 (degC)	degC	t_s16		

temp_ECU4	Temperature sensor Experiment Control Unit 4 (degC)	degC	t_s16		
temp_ECU5	Temperature sensor Experiment Control Unit 5 (degC)	degC	t_s16		
temp_ECU6	Temperature sensor Experiment Control Unit 6 (degC)	degC	t_s16		
temp_RF	Temperature sensor Reference Frame (degC)	degC	t_s16		
voltage_P14V_SCU	Voltage sensor +14V on Signal Conditioning Unit (mV)	mV	t_s16		
voltage_N14V_SCU	Voltage sensor -14V on Signal Conditioning Unit (mV)	mV	t_s16		
voltage_P8V_GLM	Voltage sensor +8V on Grip Lift Manipulandum (mV)	mV	t_s16		
voltage_P12V_PSB	Voltage sensor +12V on Power Supply Board (mV)	mV	t_s16		
voltage_P5V_PSB	Voltage sensor +5V on Power Supply Board (mV)	mV	t_s16		
current_P12V_PSB	Current sensor +12V on Power Supply Board (mA)	mA	t_s16		
current_P3V3_cPCI	Current sensor +3V3 on compact PCI bus (mA)	mA	t_s16		
current_P5V_PSB	Current sensor +5V on Power supply board (mA)	mA	t_s16		
status_fans	Status of cooling fans (aggregated)		t_u16		
status_fan_RF	Status of cooling fan on Reference Frame (0=turning; 1=not turning)		t_bit	0	1
status_fan_ECU1	Status of cooling fan 1 on Experiment Control Unit (0=turning; 1=not turning)		t_bit	0	1
status_fan_ECU2	Status of cooling fan 2 on Experiment Control Unit (0=turning; 1=not turning)		t_bit	0	1
status_fan_ECU3	Status of cooling fan 3 on Experiment Control Unit (0=turning; 1=not turning)		t_bit	0	1
status_fan_ECU4	Status of cooling fan 4 on Experiment Control Unit (0=turning; 1=not turning)		t_bit	0	1
status_fan_ECU5	Status of cooling fan 5 on Experiment Control Unit (0=turning; 1=not turning)		t_bit	0	1
status_fan_ECU6	Status of cooling fan 6 on Experiment Control Unit (0=turning; 1=not turning)		t_bit	0	1
status_OCDs_power	Status of overcurrent detectors and power supplies (aggregated)		t_u16		

status_OCD_SCU	Status of overcurrent detector for Signal Conditioning Unit (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_MDB_RF	Status of overcurrent detector for Marker Driver Board on Reference Frame (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_MDB_M	Status of overcurrent detector for Marker Driver Board on Manipulandum (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_MDB_arm	Status of overcurrent detector for Marker Driver Board on arm (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_MDB_ETD	Status of overcurrent detector for Marker Driver Board on Eye Tracking Device (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_Touch	Status of overcurrent detector for Touchscreen (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_Webcam	Status of overcurrent detector for crew camera (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_CODA1	Status of overcurrent detector for CODA unit 1 (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_CODA2	Status of overcurrent detector for CODA unit 2 (0=not triggered; 1=triggered)		t_bit	0	1
status_OCD_RF	Status of overcurrent detector for Reference Frame (0=not triggered; 1=triggered)		t_bit	0	1
status_power_SCU	Status of power supply towards Signal Conditioning Unit (0=not triggered; 1=triggered)		t_bit	0	1
status_power_CODA1	Status of power supply towards CODA unit 1 (0=not triggered; 1=triggered)		t_bit	0	1
status_power_CODA2	Status of power supply towards CODA unit 2 (0=not triggered; 1=triggered)		t_bit	0	1
smoke_detector_ECU	Status of smoke detector for Experiment Control Unit (0=not triggered; 1=triggered)		t_bit	0	1
smoke_detector_RF	Status of smoke detector for Reference Frame (0=not triggered; 1=triggered)		t_bit	0	1
current_user	Numerical ID of logged in user. This maps to the user ID of the respective user packet in the users file. current_user=0 is a special value, meaning that no user is logged in.		t_u16		
current_protocol	Numerical ID of active protocol. This maps to the protocol ID of the respective protocol packet in the active session file. current_protocol=0 is a special value, meaning no protocol is active.		t_u16		
current_task	Numerical ID of active task. This maps to the task ID of the respective task packet in the active protocol file. current_task=0 is a		t_u16		

	special value, meaning no task is active.				
current_step	Numerical ID of task step being executed. This maps to the packet sequence number of the command in the loaded task file (script). The value 0 is used during self test execution before the script start. NOTE: when current_task=0 this parameter has no meaning and its value is undefined.		t_u16		
scriptengine_status	Status of CDexScriptEngine, values according to scriptengine_status_t. NOTE: when current_task=0 this parameter has no meaning and its value is undefined.	enum	t_u16		
iochannels_status	Status of CDexIoChannels, values according to iochannels_status_t.	enum	t_u16		
LEDs_h	Requested status of LEDs on horizontal bar (aggregated)		t_u16	0	0X3FF
LED_h1	Requested status of LED 1 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h2	Requested status of LED 2 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h3	Requested status of LED 3 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h4	Requested status of LED 4 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h5	Requested status of LED 5 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h6	Requested status of LED 6 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h7	Requested status of LED 7 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h8	Requested status of LED 8 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h9	Requested status of LED 9 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h10	Requested status of LED 10 on horizontal bar (0=off; 1=on)		t_bit	0	1
LEDs_v	Requested status of LEDs on vertical bar (aggregated)		t_u16	0	0x1FFF
LED_v1	Requested status of LED 1 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v2	Requested status of LED 2 on vertical bar (0=off; 1=on)		t_bit	0	1

QinetiQ

LED_v3	Requested status of LED 3 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v4	Requested status of LED 4 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v5	Requested status of LED 5 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v6	Requested status of LED 6 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v7	Requested status of LED 7 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v8	Requested status of LED 8 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v9	Requested status of LED 9 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v10	Requested status of LED 10 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v11	Requested status of LED 11 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v12	Requested status of LED 12 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v13	Requested status of LED 13 on vertical bar (0=off; 1=on)		t_bit	0	1
mute	Requested status of tone mute (0=unmuted; 1=muted)		t_l_bit	0	1
tone	Requested status of tone selection (0-7=index of selected tone, ascending frequency)		t_u16	0	7
tone1	Requested status of tone selection bit 1		t_bit	0	1
tone2	Requested status of tone selection bit 2		t_bit	0	1
tone3	Requested status of tone selection bit 3		t_bit	0	1
LEDs_h_fb	Status of LEDs on horizontal bar (aggregated)		t_u16	0	1023
LED_h1_fb	Status of LED 1 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h2_fb	Status of LED 2 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h3_fb	Status of LED 3 on horizontal bar (0=off; 1=on)		t_bit	0	1

LED_h4_fb	Status of LED 4 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h5_fb	Status of LED 5 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h6_fb	Status of LED 6 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h7_fb	Status of LED 7 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h8_fb	Status of LED 8 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h9_fb	Status of LED 9 on horizontal bar (0=off; 1=on)		t_bit	0	1
LED_h10_fb	Status of LED 10 on horizontal bar (0=off; 1=on)		t_bit	0	1
LEDs_v_fb	Status of LEDs on vertical bar (aggregated)		t_u16	0	8191
LED_v1_fb	Status of LED 1 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v2_fb	Status of LED 2 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v3_fb	Status of LED 3 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v4_fb	Status of LED 4 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v5_fb	Status of LED 5 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v6_fb	Status of LED 6 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v7_fb	Status of LED 7 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v8_fb	Status of LED 8 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v9_fb	Status of LED 9 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v10_fb	Status of LED 10 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v11_fb	Status of LED 11 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v12_fb	Status of LED 12 on vertical bar (0=off; 1=on)		t_bit	0	1
LED_v13_fb	Status of LED 13 on vertical bar (0=off; 1=on)		t_bit	0	1

QinetiQ

mute_fb	Status of tone mute (0=unmuted; 1=muted)		t_bit	0	1
tone1_fb	Status of tone selection bit 1		t_bit	0	1
tone2_fb	Status of tone selection bit 2		t_bit	0	1
tone3_fb	Status of tone selection bit 3		t_bit	0	1
masscradle_1_0	Cradle 1 mass detection - bit 0		t_bit	0	1
masscradle_1_1	Cradle 1 mass detection - bit 1		t_bit	0	1
masscradle_2_0	Cradle 2 mass detection - bit 0		t_bit	0	1
masscradle_2_1	Cradle 2 mass detection - bit 1		t_bit	0	1
masscradle_3_0	Cradle 3 mass detection - bit 0		t_bit	0	1
masscradle_3_1	Cradle 3 mass detection - bit 1		t_bit	0	1
manip_G0_L	Data from left F/T sensor - G0	mV	t_s16		
manip_G1_L	Data from left F/T sensor - G1	mV	t_s16		
manip_G2_L	Data from left F/T sensor - G2	mV	t_s16		
manip_G3_L	Data from left F/T sensor - G3	mV	t_s16		
manip_G4_L	Data from left F/T sensor - G4	mV	t_s16		
manip_G5_L	Data from left F/T sensor - G5	mV	t_s16		
manip_G0_R	Data from right F/T sensor - G0	mV	t_s16		
manip_G1_R	Data from right F/T sensor - G1	mV	t_s16		
manip_G2_R	Data from right F/T sensor - G2	mV	t_s16		
manip_G3_R	Data from right F/T sensor - G3	mV	t_s16		
manip_G4_R	Data from right F/T sensor - G4	mV	t_s16		

QinetiQ

manip_G5_R	Data from right F/T sensor - G5	mV	t_s16		
manip_FX_L	X force component calculated from left F/T sensor	1/100 N	t_s16		
manip_FY_L	Y force component calculated from left F/T sensor	1/100 N	t_s16		
manip_FZ_L	Z force component calculated from left F/T sensor	1/100 N	t_s16		
manip_TX_L	X torque component calculated from left F/T sensor	Nmm	t_s16		
manip_TY_L	Y torque component calculated from left F/T sensor	Nmm	t_s16		
manip_TZ_L	Z torque component calculated from left F/T sensor	Nmm	t_s16		
manip_FX_R	X force component calculated from right F/T sensor	1/100 N	t_s16		
manip_FY_R	Y force component calculated from right F/T sensor	1/100 N	t_s16		
manip_FZ_R	Z force component calculated from right F/T sensor	1/100 N	t_s16		
manip_TX_R	X torque component calculated from right F/T sensor	Nmm	t_s16		
manip_TY_R	Y torque component calculated from right F/T sensor	Nmm	t_s16		
manip_TZ_R	Z torque component calculated from right F/T sensor	Nmm	t_s16		
manip_Gyro_A	Data from gyroscope - A component	mV	t_s16		
manip_Gyro_B	Data from gyroscope - B component	mV	t_s16		
manip_Gyro_C	Data from gyroscope - C component	mV	t_s16		
manip_High_Acc	Data from high range accelerometer	mV	t_s16		
manip_Low_Acc_A	Raw data from low range accelerometer - A component (mV)	mV	t_s16		
manip_Low_Acc_B	Raw data from low range accelerometer - B component (mV)	mV	t_s16		
manip_Low_Acc_C	Raw data from low range accelerometer - C component (mV)	mV	t_s16		
manip_Low_Acc_X	Data from low range accelerometer - X component (mm/s^2)	mm/s^2	t_s32		

manip_Low_Acc_Y	Data from low range accelerometer - Y component (mm/s^2)	mm/s^2	t_s32		
manip_Low_Acc_Z	Data from low range accelerometer - Z component (mm/s^2)	mm/s^2	t_s32		
manip_MEv2_L	Data from left moisture sensor	mV	t_s16		
manip_MEv2_R	Data from right moisture sensor	mV	t_s16		
science_data_tick	Timestamp for manipulandum sensors values		t_u32		
manip_ST_ECU	Requested status for manipulandum Self Test pin (0=inactive; 1=active)		t_bit	0	1
manip_SW_MEv2_L	Status of left moisture sensor control line (0=not excited; 1=excited)		t_bit	0	1
manip_SW_MEv2_R	Status of right moisture sensor control line (0=not excited; 1=excited)		t_bit	0	1
motiontracker_status	Status of CDexMotionTracker, values according to motiontracker_status_t	enum	t_u16		
motiontracker_transform_R11_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 1,1		t_f64		
motiontracker_transform_R12_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 1,2		t_f64		
motiontracker_transform_R13_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 1,3		t_f64		
motiontracker_transform_R21_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 2,1		t_f64		
motiontracker_transform_R22_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 2,2		t_f64		
motiontracker_transform_R23_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 2,3		t_f64		
motiontracker_transform_R31_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 3,1		t_f64		
motiontracker_transform_R32_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 3,2		t_f64		
motiontracker_transform_R33_1	Rotation matrix of coordinate transform for CODA unit 1 - elem 3,3		t_f64		
motiontracker_transform_t1_1	Translation vector of coordinate transform for CODA unit 1 - elem 1		t_f64		
motiontracker_transform_t2_1	Translation vector of coordinate transform for CODA unit 1 - elem 2		t_f64		
motiontracker_transform_t3_1	Translation vector of coordinate transform for CODA unit 1 - elem 3		t_f64		

QinetiQ

motiontracker_transform_R11_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 1,1		t_f64		
motiontracker_transform_R12_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 1,2		t_f64		
motiontracker_transform_R13_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 1,3		t_f64		
motiontracker_transform_R21_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 2,1		t_f64		
motiontracker_transform_R22_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 2,2		t_f64		
motiontracker_transform_R23_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 2,3		t_f64		
motiontracker_transform_R31_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 3,1		t_f64		
motiontracker_transform_R32_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 3,2		t_f64		
motiontracker_transform_R33_2	Rotation matrix of coordinate transform for CODA unit 2 - elem 3,3		t_f64		
motiontracker_transform_t1_2	Translation vector of coordinate transform for CODA unit 2 - elem 1		t_f64		
motiontracker_transform_t2_2	Translation vector of coordinate transform for CODA unit 2 - elem 2		t_f64		
motiontracker_transform_t3_2	Translation vector of coordinate transform for CODA unit 2 - elem 3		t_f64		
marker_1_posX	CODA marker 1 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_1_posY	CODA marker 1 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_1_posZ	CODA marker 1 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_2_posX	CODA marker 2 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_2_posY	CODA marker 2 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_2_posZ	CODA marker 2 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_3_posX	CODA marker 3 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_3_posY	CODA marker 3 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_3_posZ	CODA marker 3 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		

QinetiQ

marker_4_posX	CODA marker 4 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_4_posY	CODA marker 4 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_4_posZ	CODA marker 4 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_5_posX	CODA marker 5 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_5_posY	CODA marker 5 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_5_posZ	CODA marker 5 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_6_posX	CODA marker 6 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_6_posY	CODA marker 6 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_6_posZ	CODA marker 6 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_7_posX	CODA marker 7 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_7_posY	CODA marker 7 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_7_posZ	CODA marker 7 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_8_posX	CODA marker 8 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_8_posY	CODA marker 8 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_8_posZ	CODA marker 8 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_9_posX	CODA marker 9 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_9_posY	CODA marker 9 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_9_posZ	CODA marker 9 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_10_posX	CODA marker 10 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_10_posY	CODA marker 10 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_10_posZ	CODA marker 10 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		

QinetiQ

marker_11_posX	CODA marker 11 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_11_posY	CODA marker 11 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_11_posZ	CODA marker 11 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_12_posX	CODA marker 12 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_12_posY	CODA marker 12 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_12_posZ	CODA marker 12 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_13_posX	CODA marker 13 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_13_posY	CODA marker 13 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_13_posZ	CODA marker 13 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_14_posX	CODA marker 14 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_14_posY	CODA marker 14 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_14_posZ	CODA marker 14 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_15_posX	CODA marker 15 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_15_posY	CODA marker 15 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_15_posZ	CODA marker 15 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_16_posX	CODA marker 16 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_16_posY	CODA marker 16 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_16_posZ	CODA marker 16 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_17_posX	CODA marker 17 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_17_posY	CODA marker 17 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_17_posZ	CODA marker 17 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		

marker_18_posX	CODA marker 18 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_18_posY	CODA marker 18 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_18_posZ	CODA marker 18 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_19_posX	CODA marker 19 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_19_posY	CODA marker 19 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_19_posZ	CODA marker 19 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_20_posX	CODA marker 20 position - X coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_20_posY	CODA marker 20 position - Y coordinate, combined (1/10 mm)	1/10 mm	t_s16		
marker_20_posZ	CODA marker 20 position - Z coordinate, combined (1/10 mm)	1/10 mm	t_s16		
markers_visib	CODA markers visibility, combined (aggregated)		t_u32		
marker_1_visib	CODA marker 1 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_2_visib	CODA marker 2 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_3_visib	CODA marker 3 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_4_visib	CODA marker 4 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_5_visib	CODA marker 5 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_6_visib	CODA marker 6 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_7_visib	CODA marker 7 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_8_visib	CODA marker 8 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_9_visib	CODA marker 9 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_10_visib	CODA marker 10 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_11_visib	CODA marker 11 visibility, combined (0=not visible; 1=visible)		t_bit	0	1

marker_12_visib	CODA marker 12 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_13_visib	CODA marker 13 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_14_visib	CODA marker 14 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_15_visib	CODA marker 15 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_16_visib	CODA marker 16 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_17_visib	CODA marker 17 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_18_visib	CODA marker 18 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_19_visib	CODA marker 19 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
marker_20_visib	CODA marker 20 visibility, combined (0=not visible; 1=visible)		t_bit	0	1
markers_tick	Timestamp for markers' position values, combined.		t_u32		
marker_1_posX_1	CODA marker 1 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_1_posY_1	CODA marker 1 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_1_posZ_1	CODA marker 1 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_2_posX_1	CODA marker 2 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_2_posY_1	CODA marker 2 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_2_posZ_1	CODA marker 2 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_3_posX_1	CODA marker 3 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_3_posY_1	CODA marker 3 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_3_posZ_1	CODA marker 3 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_4_posX_1	CODA marker 4 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_4_posY_1	CODA marker 4 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		

marker_4_posZ_1	CODA marker 4 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_5_posX_1	CODA marker 5 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_5_posY_1	CODA marker 5 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_5_posZ_1	CODA marker 5 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_6_posX_1	CODA marker 6 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_6_posY_1	CODA marker 6 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_6_posZ_1	CODA marker 6 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_7_posX_1	CODA marker 7 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_7_posY_1	CODA marker 7 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_7_posZ_1	CODA marker 7 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_8_posX_1	CODA marker 8 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_8_posY_1	CODA marker 8 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_8_posZ_1	CODA marker 8 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_9_posX_1	CODA marker 9 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_9_posY_1	CODA marker 9 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_9_posZ_1	CODA marker 9 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_10_posX_1	CODA marker 10 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_10_posY_1	CODA marker 10 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_10_posZ_1	CODA marker 10 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_11_posX_1	CODA marker 11 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_11_posY_1	CODA marker 11 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		

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marker_11_posZ_1	CODA marker 11 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_12_posX_1	CODA marker 12 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_12_posY_1	CODA marker 12 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_12_posZ_1	CODA marker 12 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_13_posX_1	CODA marker 13 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_13_posY_1	CODA marker 13 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_13_posZ_1	CODA marker 13 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_14_posX_1	CODA marker 14 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_14_posY_1	CODA marker 14 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_14_posZ_1	CODA marker 14 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_15_posX_1	CODA marker 15 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_15_posY_1	CODA marker 15 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_15_posZ_1	CODA marker 15 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_16_posX_1	CODA marker 16 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_16_posY_1	CODA marker 16 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_16_posZ_1	CODA marker 16 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_17_posX_1	CODA marker 17 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_17_posY_1	CODA marker 17 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_17_posZ_1	CODA marker 17 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_18_posX_1	CODA marker 18 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_18_posY_1	CODA marker 18 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		

marker_18_posZ_1	CODA marker 18 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_19_posX_1	CODA marker 19 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_19_posY_1	CODA marker 19 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_19_posZ_1	CODA marker 19 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_20_posX_1	CODA marker 20 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_20_posY_1	CODA marker 20 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_20_posZ_1	CODA marker 20 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_21_posX_1	CODA marker 21 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_21_posY_1	CODA marker 21 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_21_posZ_1	CODA marker 21 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_22_posX_1	CODA marker 22 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_22_posY_1	CODA marker 22 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_22_posZ_1	CODA marker 22 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_23_posX_1	CODA marker 23 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_23_posY_1	CODA marker 23 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_23_posZ_1	CODA marker 23 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_24_posX_1	CODA marker 24 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_24_posY_1	CODA marker 24 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_24_posZ_1	CODA marker 24 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_25_posX_1	CODA marker 25 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_25_posY_1	CODA marker 25 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		

marker_25_posZ_1	CODA marker 25 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_26_posX_1	CODA marker 26 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_26_posY_1	CODA marker 26 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_26_posZ_1	CODA marker 26 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_27_posX_1	CODA marker 27 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_27_posY_1	CODA marker 27 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_27_posZ_1	CODA marker 27 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_28_posX_1	CODA marker 28 position - X coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_28_posY_1	CODA marker 28 position - Y coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
marker_28_posZ_1	CODA marker 28 position - Z coordinate, CODA unit 1 (1/10 mm)	1/10 mm	t_s16		
markers_visib_1	CODA markers visibility, CODA unit 1 (aggregated)		t_u32		
marker_1_visib_1	CODA marker 1 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_2_visib_1	CODA marker 2 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_3_visib_1	CODA marker 3 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_4_visib_1	CODA marker 4 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_5_visib_1	CODA marker 5 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_6_visib_1	CODA marker 6 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_7_visib_1	CODA marker 7 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_8_visib_1	CODA marker 8 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_9_visib_1	CODA marker 9 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_10_visib_1	CODA marker 10 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1

QinetiQ

marker_11_visib_1	CODA marker 11 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_12_visib_1	CODA marker 12 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_13_visib_1	CODA marker 13 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_14_visib_1	CODA marker 14 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_15_visib_1	CODA marker 15 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_16_visib_1	CODA marker 16 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_17_visib_1	CODA marker 17 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_18_visib_1	CODA marker 18 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_19_visib_1	CODA marker 19 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_20_visib_1	CODA marker 20 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_21_visib_1	CODA marker 21 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_22_visib_1	CODA marker 22 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_23_visib_1	CODA marker 23 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_24_visib_1	CODA marker 24 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_25_visib_1	CODA marker 25 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_26_visib_1	CODA marker 26 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_27_visib_1	CODA marker 27 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
marker_28_visib_1	CODA marker 28 visibility, CODA unit 1 (0=not visible; 1=visible)		t_bit	0	1
markers_tick_1	Timestamp for markers' position values, CODA unit 1.		t_u32		
marker_1_posX_2	CODA marker 1 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_1_posY_2	CODA marker 1 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		

QinetiQ

marker_1_posZ_2	CODA marker 1 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_2_posX_2	CODA marker 2 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_2_posY_2	CODA marker 2 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_2_posZ_2	CODA marker 2 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_3_posX_2	CODA marker 3 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_3_posY_2	CODA marker 3 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_3_posZ_2	CODA marker 3 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_4_posX_2	CODA marker 4 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_4_posY_2	CODA marker 4 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_4_posZ_2	CODA marker 4 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_5_posX_2	CODA marker 5 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_5_posY_2	CODA marker 5 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_5_posZ_2	CODA marker 5 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_6_posX_2	CODA marker 6 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_6_posY_2	CODA marker 6 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_6_posZ_2	CODA marker 6 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_7_posX_2	CODA marker 7 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_7_posY_2	CODA marker 7 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_7_posZ_2	CODA marker 7 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_8_posX_2	CODA marker 8 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_8_posY_2	CODA marker 8 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		

marker_8_posZ_2	CODA marker 8 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_9_posX_2	CODA marker 9 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_9_posY_2	CODA marker 9 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_9_posZ_2	CODA marker 9 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_10_posX_2	CODA marker 10 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_10_posY_2	CODA marker 10 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_10_posZ_2	CODA marker 10 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_11_posX_2	CODA marker 11 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_11_posY_2	CODA marker 11 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_11_posZ_2	CODA marker 11 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_12_posX_2	CODA marker 12 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_12_posY_2	CODA marker 12 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_12_posZ_2	CODA marker 12 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_13_posX_2	CODA marker 13 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_13_posY_2	CODA marker 13 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_13_posZ_2	CODA marker 13 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_14_posX_2	CODA marker 14 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_14_posY_2	CODA marker 14 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_14_posZ_2	CODA marker 14 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_15_posX_2	CODA marker 15 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_15_posY_2	CODA marker 15 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		

QinetiQ

marker_15_posZ_2	CODA marker 15 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_16_posX_2	CODA marker 16 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_16_posY_2	CODA marker 16 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_16_posZ_2	CODA marker 16 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_17_posX_2	CODA marker 17 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_17_posY_2	CODA marker 17 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_17_posZ_2	CODA marker 17 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_18_posX_2	CODA marker 18 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_18_posY_2	CODA marker 18 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_18_posZ_2	CODA marker 18 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_19_posX_2	CODA marker 19 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_19_posY_2	CODA marker 19 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_19_posZ_2	CODA marker 19 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_20_posX_2	CODA marker 20 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_20_posY_2	CODA marker 20 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_20_posZ_2	CODA marker 20 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_21_posX_2	CODA marker 21 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_21_posY_2	CODA marker 21 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_21_posZ_2	CODA marker 21 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_22_posX_2	CODA marker 22 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_22_posY_2	CODA marker 22 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		

QinetiQ

marker_22_posZ_2	CODA marker 22 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_23_posX_2	CODA marker 23 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_23_posY_2	CODA marker 23 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_23_posZ_2	CODA marker 23 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_24_posX_2	CODA marker 24 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_24_posY_2	CODA marker 24 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_24_posZ_2	CODA marker 24 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_25_posX_2	CODA marker 25 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_25_posY_2	CODA marker 25 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_25_posZ_2	CODA marker 25 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_26_posX_2	CODA marker 26 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_26_posY_2	CODA marker 26 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_26_posZ_2	CODA marker 26 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_27_posX_2	CODA marker 27 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_27_posY_2	CODA marker 27 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_27_posZ_2	CODA marker 27 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_28_posX_2	CODA marker 28 position - X coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_28_posY_2	CODA marker 28 position - Y coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
marker_28_posZ_2	CODA marker 28 position - Z coordinate, CODA unit 2 (1/10 mm)	1/10 mm	t_s16		
markers_visib_2	CODA markers visibility, CODA unit 2 (aggregated)		t_u32		
marker_1_visib_2	CODA marker 1 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1

QinetiQ Space nv

marker_2_visib_2	CODA marker 2 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_3_visib_2	CODA marker 3 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_4_visib_2	CODA marker 4 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_5_visib_2	CODA marker 5 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_6_visib_2	CODA marker 6 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_7_visib_2	CODA marker 7 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_8_visib_2	CODA marker 8 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_9_visib_2	CODA marker 9 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_10_visib_2	CODA marker 10 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_11_visib_2	CODA marker 11 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_12_visib_2	CODA marker 12 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_13_visib_2	CODA marker 13 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_14_visib_2	CODA marker 14 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_15_visib_2	CODA marker 15 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_16_visib_2	CODA marker 16 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_17_visib_2	CODA marker 17 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_18_visib_2	CODA marker 18 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_19_visib_2	CODA marker 19 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_20_visib_2	CODA marker 20 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_21_visib_2	CODA marker 21 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_22_visib_2	CODA marker 22 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1

QinetiQ

marker_23_visib_2	CODA marker 23 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_24_visib_2	CODA marker 24 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_25_visib_2	CODA marker 25 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_26_visib_2	CODA marker 26 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_27_visib_2	CODA marker 27 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
marker_28_visib_2	CODA marker 28 visibility, CODA unit 2 (0=not visible; 1=visible)		t_bit	0	1
markers_tick_2	Timestamp for markers' position values, CODA unit 2.		t_u32		
manip_posX	Manipulandum position - X coordinate, computed (1/10 mm)	1/10 mm	t_s16		
manip_posY	Manipulandum position - Y coordinate, computed (1/10 mm)	1/10 mm	t_s16		
manip_posZ	Manipulandum position - Z coordinate, computed (1/10 mm)	1/10 mm	t_s16		
manip_visib	Manipulandum visibility, computed (0=not visible; 1=visible)		t_bit	0	1
manip_oriX	Manipulandum orientation - X component.		t_f32		
manip_oriY	Manipulandum orientation - Y component.		t_f32		
manip_oriZ	Manipulandum orientation - Z component.		t_f32		
manip_oriM	Manipulandum orientation - M component.		t_f32		
manip_pose_tick	Timestamp for manipulandum position and orientation values.		t_u32		
rtdata_acq_id	Acquisition block identifier for real time science data packets. Starts at 0 after system startup and increments by 1 for every start/stop acquisition cycle.		t_u32		
rtdata_pkt_counter	Packet counter for real time science data packets. Resets to 0 every time rtdata_acq_id increments.		t_u32		
crewcamera_status	Status of CDexCrewCamera, values according to crewcamera_status_t.	enum	t_u16		
crewcamera_rate	Current framerate for <font	fps	t_u16		

QinetiQ

	color="#0000ff"><u>CDexCrewCamera</u> (Hz)				
epminterface_status	Status of CDexEpmInterface, values according to epm_interface_status_t.	enum	t_u16		
shell_cmd_running	Running status of shell command (0=not running; 1=running)		t_bit	0	1
system_acquiring	Indicates whether there is a data acquisition ongoing (0=not acquiring; 1=acquiring)		t_bit	0	1
cpu_usage	CPU utilization (%)	%	t_u16		
memory_usage	System memory utilization (%)	%	t_u16		
free_disk_space_C	Available disk space on system drive (kB)	kB	t_u32		
free_disk_space_D	Available disk space on data drive (kB)	kB	t_u32		
free_disk_space_E	Available disk space on backup drive (kB)	kB	t_u32		
cpu_core_temp	CPU core temperature (degC)	degC	t_s16		
cpu_board_temp	CPU board temperature (degC)	degC	t_s16		
data_layout_crc	CRC calculated over the active packet/parameter layout		t_u16		
ERP_HS_Caution	obsolete		t_u8		
ERP_HS_Warning	obsolete		t_u8		
alarms_active	Alarm indicator status		t_bit	0	1
recording_active	Recording indicator status		t_bit	0	1
EPM_HK_validity	HK group validity pattern		t_u16		
EPM_current_mode	Current mode of the DEX SM encoded according to EPM-OHB-SP-0005 Table 3-4		t_u16		
EPM_next_mode	Next mode of the DEX SM encoded according to EPM-OHB-SP-0005 Table 3-4		t_u16		
EPM_timer_status	Timer status of the DEX SM encoded according to EPM-OHB-SP-0005 Table 3-5		t_u16		
EPM_corrective_action_enb	Corrective action standard field - not used		t_u16		

QinetiQ

EPM_file_xfer_status	EPM file transfer status see EPM-OHB-LI-0039 par 8.1.5		t_u16		
EPM_RxDataRate	Receive datarate in kbps on EPM ethernet interface	kbps	t_f32		
EPM_TxDataRate	Transmit datarate in kbps on EPM ethernet interface	kbps	t_f32		
Webcam_RxDataRate	Receive datarate in kbps on Webcam interface (debug)	kbps	t_f32		
Webcam_TxDataRate	Transmit datarate in kbps on Webcam interface (debug)	kbps	t_f32		
selftest_status	Selftest status according to EPM-OHB-LI-0039 par 8.2.2		t_u16		
acquisition_tag	Identifies the data collected during this sampling block.		t_f_str	0	8
error_message	Text message to be presented to the subject in case of command failure. It is a 0 terminated ASCII string with maximum length 64 bytes (including terminating character).		t_f_str	0	128
camera_framerate	Image acquisition rate (1=1Hz; 2=2Hz)	Hz	t_u16	1	2
markers	Bitfield indicating which markers to run the check on (0=don't check; 1=check). LSB corresponds to marker with lowest ID. Marker IDs are according to DEX system design definition.		t_u32	0	0xFFFFFFFF
marker_1	Run check on marker 1 (0=don't check; 1=check)		t_bit	0	1
marker_2	Run check on marker 2 (0=don't check; 1=check)		t_bit	0	1
marker_3	Run check on marker 3 (0=don't check; 1=check)		t_bit	0	1
marker_4	Run check on marker 4 (0=don't check; 1=check)		t_bit	0	1
marker_5	Run check on marker 5 (0=don't check; 1=check)		t_bit	0	1
marker_6	Run check on marker 6 (0=don't check; 1=check)		t_bit	0	1
marker_7	Run check on marker 7 (0=don't check; 1=check)		t_bit	0	1
marker_8	Run check on marker 8 (0=don't check; 1=check)		t_bit	0	1
marker_9	Run check on marker 9 (0=don't check; 1=check)		t_bit	0	1

marker_10	Run check on marker 10 (0=don't check; 1=check)		t_bit	0	1
marker_11	Run check on marker 11 (0=don't check; 1=check)		t_bit	0	1
marker_12	Run check on marker 12 (0=don't check; 1=check)		t_bit	0	1
marker_13	Run check on marker 13 (0=don't check; 1=check)		t_bit	0	1
marker_14	Run check on marker 14 (0=don't check; 1=check)		t_bit	0	1
marker_15	Run check on marker 15 (0=don't check; 1=check)		t_bit	0	1
marker_16	Run check on marker 16 (0=don't check; 1=check)		t_bit	0	1
marker_17	Run check on marker 17 (0=don't check; 1=check)		t_bit	0	1
marker_18	Run check on marker 18 (0=don't check; 1=check)		t_bit	0	1
marker_19	Run check on marker 19 (0=don't check; 1=check)		t_bit	0	1
marker_20	Run check on marker 20 (0=don't check; 1=check)		t_bit	0	1
message	Text message to be presented to the subject. It is a 0 terminated ASCII string with maximum length 64 bytes (including terminating character).		t_f_str	0	128
logmessage	Text message logged to disk on request of the user script or the application. 0 terminated with maximum netto length of 80 bytes.		t_f_str	0	144
logtype	Type discriminator for text log entries. Possible values defined by enum LogEventType.		t_u16		
picture_file	Filename of picture file (24 bit BMP) to be displayed to the subject. The file must be located in a specific picture directory on the filesystem.		t_f_str	0	20
posture	Desired subject posture (0=sitting; 1=supine)		t_l_bit	0	1
vertical_bar	Desired vertical bar configuration (0=in use, vertical movements; 1=aside, horizontal movements)		t_l_bit	0	1
timeout	Maximum allowed wait time, expressed in seconds. If the condition is not met before timeout, this results in an error (range is 0-300)	s	t_u16	0	300

QinetiQ

desired_mass	Desired mass (0=small mass; 1=medium mass; 2=big mass)		t_u16	0	2
camera_start	Start/stop image acquisition (0=stop acq; 1=start acq)		t_l_bit	0	1
epm_coarsetime	Coarse time field to identify file transfer to be cancelled		t_u32		
epm_address	Generic address field for both internal and external destinations		t_u16		
epm_srcfile	Source file or directory packet parameter		t_f_str	1	212
epm_localdstfile	Local (on DEX) destination file		t_f_str	1	212
epm_remotedstfile	Remote (non DEX) destination file		t_f_str	1	231
epm_dirname	Directory name parameter		t_f_str	1	200
displayname	Contains the contents of the list item text on the GUI.		t_f_str	1	30
protocol_id	Numerical identification number for the protocol. This id will be used for logging purposes and to identify science data collected while executing this protocol (0=reserved).		t_u16		
protocol_file	Filename of script file for this protocol (Protocol file). The file must be located in a specific scripts directory on the filesystem. This parameter is only meaningful when the command is coming from a Session file.		t_f_str	5	36
shell_cmdline	Command line to be executed. It is a 0 terminated ASCII string with maximum length 96 bytes (including terminating character).		t_f_str	1	200
task_id	Numerical identification number for the task. This id will be used for logging purposes and to identify science data collected while executing this task (0=reserved).		t_u16		
task_file	Filename of script file for this task (Task file). The file must be located in a specific scripts directory on the filesystem. This parameter is only meaningful when the command is coming from a Protocol file.		t_f_str	5	36
user_id	Numerical identification number for the user. This id will be used for logging purposes and to identify science data associated with this user (0=reserved).		t_u16		

QinetiQ

user_pin	4 digit numerical pin used to authenticate user login.		t_u16		
session_file	Filename of script file to be used for this user (Session file). The file must be located in a specific scripts directory on the filesystem. This parameter is only meaningful when the command is coming from a Users file.		t_f_str	5	36
pause	Pause duration expressed in units of 1ms.	ms	t_u32	0	300000
shell_output	Output generated by a CMD_SHELL command execution. It is a 0 terminated ASCII string with maximum length 1024 bytes (including terminating character). If generated output is longer than the maximum length, it will be truncated.		t_f_str	0	1024
n_good	Minimum number of markers the check has to succeed for.		t_u16	0	28
coda_unit	CODA unit to run the check on.		t_u16	1	2
min_posX	Minimum expected value for marker posX.	mm	t_s16	-3000	3000
min_posY	Minimum expected value for marker posY.	mm	t_s16	0	4000
min_posZ	Minimum expected value for marker posZ.	mm	t_s16	-3000	3000
max_posX	Maximum expected value for marker posX.	mm	t_s16	-3000	3000
max_posY	Maximum expected value for marker posY.	mm	t_s16	0	4000
max_posZ	Maximum expected value for marker posZ.	mm	t_s16	-3000	3000
exp_posX	Expected position - X component.	mm	t_s16	-3000	3000
exp_posY	Expected position - Y component.	mm	t_s16	-3000	3000
exp_posZ	Expected position - Z component.	mm	t_s16	-3000	3000
tol_distance	Maximum allowed distance between expected and measured position.	mm	t_u16	0	2000
exp_oriX	Expected orientation - X component.		t_f32	-1	1
exp_oriY	Expected orientation - Y component.		t_f32	-1	1

QinetiQ

exp_oriZ	Expected orientation - Z component.		t_f32	-1	1
exp_oriM	Expected orientation - M component.		t_f32	-1	1
tol_posX	Maximum allowed distance along X axis between expected and measured position (max value=infinite).	mm	t_u16	0	2000
tol_posY	Maximum allowed distance along Y axis between expected and measured position (max value=infinite).	mm	t_u16	0	2000
tol_posZ	Maximum allowed distance along Z axis between expected and measured position (max value=infinite).	mm	t_u16	0	2000
tol_angle	Maximum allowed mis-orientation.	degrees	t_u16	0	180
hold_time	Minimum amount of time the expected condition has to remain true.	ms	t_u16	0	10000
min_grip	Minimum expected grip force.	N	t_f32	0	30
max_grip	Maximum expected grip force.	N	t_f32	0	30
min_load	Minimum expected load force.	N	t_f32	0	30
max_load	Maximum expected load force.	N	t_f32	0	30
exp_dirX	Expected direction - X component.		t_f32	-1	1
exp_dirY	Expected direction - Y component.		t_f32	-1	1
exp_dirZ	Expected direction - Z component.		t_f32	-1	1
slip_threshold	Distance that the fingers must slip.	mm	t_u16	0	30
filter_constant	Filter constant for commands requiring low pass		t_f32	0	1000
cumul_invisible_time	Cumulative time during which the manipulandum can be invisible.	s	t_f32	0	30
cont_invisible_time	Continuous time during which the manipulandum can be invisible.	s	t_f32	0	30
min_amplitude	Minimum expected amplitude for manipulandum movements.	mm	t_u16	0	2000
max_amplitude	Maximum expected amplitude for manipulandum movements.	mm	t_u16	0	2000

QinetiQ

min_cycles	Minimum expected number of cycles for manipulandum movements.		t_u16	0	300
max_cycles	Maximum expected number of cycles for manipulandum movements.		t_u16	0	300
hysteresis	Minimum displacement from manipulandum mean position to count the movement as a cycle.	mm	t_u16	0	300
max_bad_starts	Maximum allowed number of bad starts.		t_u16	0	300
max_bad_peaks	Maximum allowed number of bad force peaks.		t_u16	0	300
threshold_distance	Minimum distance for a movement to be considered a start.	mm	t_u16	0	2000
threshold_velocity	Minimum velocity for a movement to be considered motionless.	mm/s	t_f32	0	2000
min_force	Minimum expected force peak for impacts.	N	t_f32	0	50
max_force	Maximum expected force peak for impacts.	N	t_f32	0	50
event	Event number to be logged.		t_u16	0	255
param_name	Name of the parameter affected by the command.		t_f_str	1	20
lower_warning_limit	Lower warning monitoring limit.		t_f32		
lower_caution_limit	Lower caution monitoring limit.		t_f32		
upper_caution_limit	Upper caution monitoring limit.		t_f32		
upper_warning_limit	Upper warning monitoring limit.		t_f32		
alarm_param_name	Name of parameter to indicate alarm status of a(nother) monitored parameter.		t_f_str	1	20
conversion_function	Function to be used for parameter value conversion. Values are according to conversion_type_t.		t_u16		
conv_a0	Coefficient a0 to be used for parameter value conversion.		t_f32		
conv_a1	Coefficient a1 to be used for parameter value conversion.		t_f32		
conv_a2	Coefficient a2 to be used for parameter value conversion.		t_f32		

QinetiQ

conv_a3	Coefficient a3 to be used for parameter value conversion.		t_f32		
conv_a4	Coefficient a4 to be used for parameter value conversion.		t_f32		
alarms_HW	Active HW alarms		t_u32		
temp_SCU_al	Alarm for temp_SCU		t_bit	0	1
temp_ECU1_al	Alarm for temp_ECU1		t_bit	0	1
temp_ECU2_al	Alarm for temp_ECU2		t_bit	0	1
temp_ECU3_al	Alarm for temp_ECU3		t_bit	0	1
temp_ECU4_al	Alarm for temp_ECU4		t_bit	0	1
temp_ECU5_al	Alarm for temp_ECU5		t_bit	0	1
temp_ECU6_al	Alarm for temp_ECU6		t_bit	0	1
temp_RF_al	Alarm for temp_RF		t_bit	0	1
cpu_core_temp_al	Alarm for cpu_core_temp		t_bit	0	1
cpu_board_temp_al	Alarm for cpu_board_temp		t_bit	0	1
voltage_P14V_SCU_al	Alarm for voltage_P14V_SCU		t_bit	0	1
voltage_N14V_SCU_al	Alarm for voltage_N14V_SCU		t_bit	0	1
voltage_P8V_GLM_al	Alarm for voltage_P8V_GLM		t_bit	0	1
voltage_P12V_PSB_al	Alarm for voltage_P12V_PSB		t_bit	0	1
voltage_P5V_PSB_al	Alarm for voltage_P5V_PSB		t_bit	0	1
current_P12V_PSB_al	Alarm for current_P12V_PSB		t_bit	0	1
current_P3V3_cPCI_al	Alarm for current_P3V3_cPCI		t_bit	0	1
current_P5V_PSB_al	Alarm for current_P5V_PSB		t_bit	0	1

QinetiQ

alarms_SW	Active SW alarms		t_u32		
scriptengine_al	Alarm for scriptengine_status		t_bit	0	1
iochannels_al	Alarm for iochannels_status		t_bit	0	1
motiontracker_al	Alarm for motiontracker_status		t_bit	0	1
crewcamera_al	Alarm for crewcamera_status		t_bit	0	1
cpu_usage_al	Alarm for cpu_usage		t_bit	0	1
memory_usage_al	Alarm for memory_usage		t_bit	0	1
free_disk_space_C_al	Alarm for free_disk_space_C		t_bit	0	1
free_disk_space_D_al	Alarm for free_disk_space_D		t_bit	0	1
free_disk_space_E_al	Alarm for free_disk_space_E		t_bit	0	1
alarms_manip_ST	Active manipulandum self-test alarms		t_u16		
manip_Gyro_A_al	Alarm for manip_Gyro_A (used for manipulandum self-test)		t_bit	0	1
manip_Gyro_B_al	Alarm for manip_Gyro_B (used for manipulandum self-test)		t_bit	0	1
manip_Gyro_C_al	Alarm for manip_Gyro_C (used for manipulandum self-test)		t_bit	0	1
manip_High_Acc_al	Alarm for manip_High_Acc_al (used for manipulandum self-test)		t_bit	0	1
manip_Low_Acc_A_al	Alarm for manip_Low_Acc_A (used for manipulandum self-test)		t_bit	0	1
manip_Low_Acc_B_al	Alarm for manip_Low_Acc_B (used for manipulandum self-test)		t_bit	0	1
manip_Low_Acc_C_al	Alarm for manip_Low_Acc_C (used for manipulandum self-test)		t_bit	0	1

5.2.6 DEX EPM MESSAGES

The following list describes the notifications that can be transmitted by DEX in the form of EPM messages as described in [AD41]. The list is maintained on the CLSW as file DEXMsgTable.csv Most message are standardised and line up with the definition in [AD42]. The non standardised messages are described in the next paragraphs

QinetiQ

Message ID	Message Name	Display Text
0x0101	MSG_ID_MODE_CHANGE	Mode change Message after transition
0x0203	MSG_ID_HK_TOO_LOW	HK value is lower than lowest limit
0x0204	MSG_ID_HK_TOO_HIGH	HK value is higher than highest limit
0x0208	MSG_ID_STATUS_NOT_NOMINAL	Status value is not nominal
0x0209	MSG_ID_HK_NOMINAL	HK value back to nominal
0x0500	MSG_ID_EXECUTION_SUCCESS	Command Execution successful
0x0501	MSG_ID_INVALID_MODE	TC not allowed in current mode
0x0502	MSG_ID_TIMETAG_VIOLATION	TC not allowed as time tagged TC
0x0503	MSG_ID_INVALID_LENGTH	Invalid length of TC
0x0504	MSG_ID_UNKNOWN_ID	TC does not exist
0x0505	MSG_ID_PARAM_RANGE_VIOLATION	Parameter range out of limits
0x0509	MSG_ID_INVALID_CHECKSUM	The check sum is not correct
0x050A	MSG_ID_INVALID_SYNC_MARKER	The synchronization marker is not correct
0x0511	MSG_ID_SCHEDULE_FULL	Scheduler is full
0x0513	MSG_ID_INVALID_IN_MODE_TRANSITION	Command not allowed in current mode transition
0x0550	MSG_ID_DELAYED_EXEC_OK	Delayed command execution successful
0x0551	MSG_ID_DELAYED_EXEC_NOK	Delayed command execution failed
0x0552	MSG_ID_EXEC_NOK	Direct command execution failed
0x05FF	MSG_ID_EXECUTION_REJECTED	Command Execution rejected
0x0601	MSG_ID_FILE_TRANSFER_STARTED	File Transfer started
0x0602	MSG_ID_FILE_TRANSFER_FINISHED	File Transfer terminated nominally
0x0603	MSG_ID_FILE_TRANSFER_ABORTED	File Transfer aborted
0x0604	MSG_ID_FILE_TRANSFER_TIMEOUT	File Receive timeout
0x0605	MSG_ID_FILE_TRANSFER_FILE_NOT_EXIST	File does not exist
0x0608	MSG_ID_FILE_TRANSFER_FILE_TOO_LARGE	File is too large
0x0609	MSG_ID_FILE_TRANSFER_FILE_ID_ERROR	File ID error
0x060A	MSG_ID_FILE_TRANSFER_SEQ_CNT_ERROR	File sequence count mismatch
0x060B	MSG_ID_FILE_TRANSFER_SIZE_MISMATCH	File size mismatch
0x060F	MSG_ID_FILE_TRANSFER_WRITE_FAILED	File write failed
0x0701	MSG_ID_UPDATER_REQUEST	Updater request
0x0702	MSG_ID_UPDATER_ACTIVE	Updater active notification
0x0703	MSG_ID_UPDATER_EXIT	Updater exit notification

5.2.6.1 MSG_ID_DELAYED_EXEC_OK

Applies to commands for which an execution success message (0x0500) has already been transmitted to satisfy the 2 seconds response time, but for which execution was not completed at that time.
The message indicates that the command has finished execution successfully.
Follows the layout definition of a command execution message [AD42] par 7.2.5.1, but using message ID 0x0550

5.2.6.2 MSG_ID_DELAYED_EXEC_NOK

Applies to commands for which an execution success message (0x0500) has already been transmitted to satisfy the 2 seconds response time, but for which execution was not completed at that time.
The message indicates that the command has completed execution (after successful acceptance), but failed during the actual execution.
Follows the layout definition of a command execution message [AD42] par 7.2.5.1, but using message ID 0x0551

5.2.6.3 MSG_ID_EXEC_NOK

Applies to commands that fulfill the validity criteria to start execution and are eligible for immediate execution.
The message indicates that the command has completed execution (after successful acceptance), but failed during the actual execution.
Follows the layout definition of a command check violation [AD42] par 7.2.5.2, using message ID 0x0552

5.2.6.4 MSG_ID_UPDATER_REQUEST

Parameterless info message (message type = 1), indicating the updater application is awaiting a "change to setup mode" command.

5.2.6.5 MSG_ID_UPDATER_ACTIVE

Parameterless info message (message type = 1), indicating the updater application has been activated and will accept file transfer and shell commands

5.2.6.6 MSG_ID_UPDATER_EXIT

Parameterless info message (message type = 1), indicating the updater application is exiting and the ASW application will be started next.

5.2.7 DEX FILE SYSTEM

The DEX file system consists of three physical devices: one HDD with operating system, BSW, ASW and programmable experiment script files (C drive) and two HDD for storing recorded data: science data, image files and system activity log (D and E drives). DEX ASW will automatically only record data on the D drive, while the E drive

is intended as a backup storage that will be regularly synchronized by operations to replicate the content of the D drive. The synchronization operation will be triggered via a specific shell command (or sequence of) sent from ground.
The file system follows conventional DOS naming and the following paths are of relevance:

C:\ASW   DEX application software and configuration files
C:\ASW\config   Configuration files for ASW (see section 5.2.10)
C:\ASW\scripts   Script files (see section 5.2.9)
C:\ASW\scripts\pictures   Pictures to be shown on GUI by script commands (e.g.
                    CMD_CHK_HW_CONFIG, section 5.2.4.10)
C:\Updater   The DEX Updater application, only used for ASW updates
C:\Updater\config   Configuration file for Updater
C:\transfer   File transfer folder
D:\DATA   Root folder for storage of science data, image data etc.
D:\DATA\img   Crew camera image file data
D:\DATA\log   Recorded science and system activity data
D:\DATA\updlog   Updater log files
D:\DATA\rtnet   CODA RTNet server log files

5.2.8 FILE PROTECTION

In principle the folders described in the previous section, with the exception of the Updater software location, are writable during the mission. Files can be created, modified and deleted using the CMD_SHELL packet type and as a result of file exchange and file system affecting commands over the EPM interface. The DEX ASW itself creates and writes to science, image and system activity data files. Other folders than those listed, for example the folder with the DEX OS, can at least in theory be modified. In any case, all modifications made to the file system to other folders than those listed in the section before will be reverted by the time of the next boot of the DEX system.

5.2.9 PROGRAMMABLE EXPERIMENTS

A set of ASCII based script files defines the experiment execution flow for DEX. Each of these files contains a number of DEX packets, one per line, according to the following syntax:

<COMMAND_NAME>, <PARAMETER_1>, ... <PARAMETER_N>

Where the parameter list is defined per command.
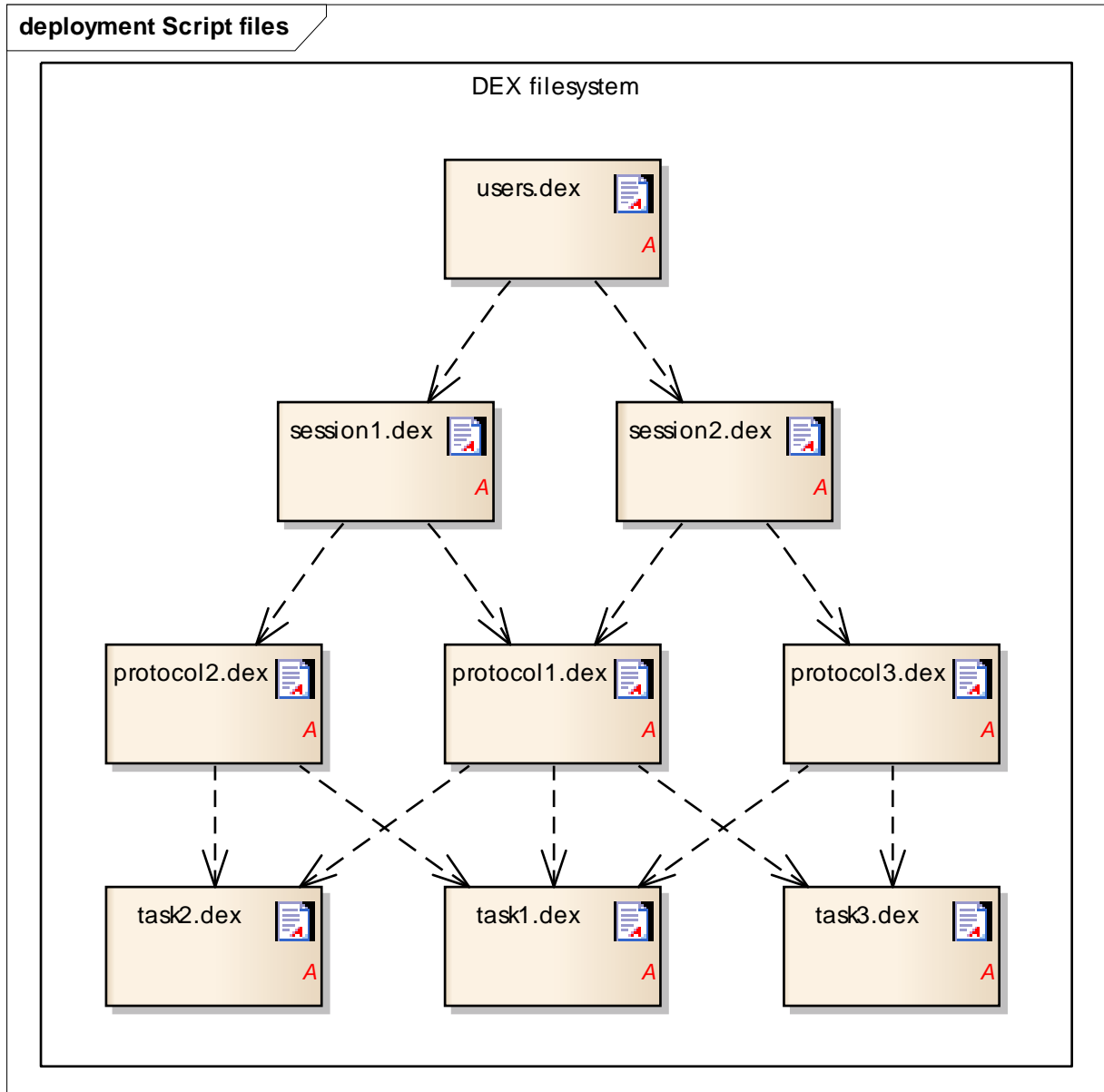The structure of this file set and an example of their content is illustrated here below.

Figure 1: Script files (Deployment diagram)

Diagram description:

This diagram represents an example file structure for script files describing DEX's experiments. Each of them is represented by a UML document artifact element, which allows attaching an example script to each element.
Each of the files refers to one or more of the others as graphically represented by the dependency relationships, except for the task files which are a list of commands. This translates, from experiment flow point of view, to allow performing the following operations in this order:

- user login (this leads to the selection of a session file)
- protocol selection

QinetiQ

- task selection
- task execution (sequence of commands)

DEX S/W parses this file structure and executes it allowing for programmable experiments.

Diagram elements:

users.dex

DEX Users file
this file contains the list of all allowed users for DEX
#CMD_USER, <ID>, <password>, <session_filename>, <display name>

blank lines like the above one are allowed
comment lines start with the hash symbol

the first two users share the same session file
CMD_USER, 1, 1234, session1.dex, User X
CMD_USER, 2, 2341, session1.dex, User Y
the third user has a different session file
CMD_USER, 3, 3412, session2.dex, User Z

session1.dex

DEX Session file: session1.dex
this file contains the list of protocols for a known DEX user
#CMD_PROTOCOL, <ID>, <protocol_filename>, <display_name>

blank lines like the above one are allowed
comment lines start with the hash symbol

this session is constituted of protocols 1 and 2
CMD_PROTOCOL, 1, protocol1.dex, First protocol
CMD_PROTOCOL, 2, protocol2.dex, Second protocol

session2.dex

DEX Session file: session2.dex
this file contains the list of protocols for a known DEX user
#CMD_PROTOCOL, <ID>, <protocol_filename>, <display_name>

blank lines like the above one are allowed
comment lines start with the hash symbol

this session is constituted of protocols 1 and 3
CMD_PROTOCOL, 1, protocol1.dex, First protocol
CMD_PROTOCOL, 3, protocol3.dex, Third protocol

protocol1.dex

DEX Protocol file: protocol1.dex
this file contains the list of tasks constituting a DEX protocol

#CMD_TASK, <ID>, <task_filename>, <display_name>

blank lines like the above one are allowed
comment lines start with the hash symbol

CMD_TASK, 1, task1.dex
CMD_TASK, 2, task2.dex
CMD_TASK, 3, task3.dex

protocol2.dex

DEX Protocol file: protocol2.dex
this file contains the list of tasks constituting a DEX protocol
#CMD_TASK, <ID>, <task_filename>, <display_name>

blank lines like the above one are allowed
comment lines start with the hash symbol

CMD_TASK, 1, task1.dex,First task
CMD_TASK, 2, task2.dex,Second task

protocol3.dex

DEX Protocol file: protocol3.dex
this file contains the list of tasks constituting a DEX protocol
#CMD_TASK, <ID>, <task_filename>, <display_name>

blank lines like the above one are allowed
comment lines start with the hash symbol

CMD_TASK, 1, task1.dex,First task
CMD_TASK, 3, task3.dex,Next task

task1.dex

DEX Protocol file: task1.dex
this file contains the list of tasks constituting a DEX protocol
#CMD_*, <param1>, <param2>, ...

blank lines like the above one are allowed
comment lines start with the hash symbol

the following are fictitious commands
following command has a single numeric parameter
CMD_A, 0
following command has no parameters
CMD_B
following command has a string as second parameter
CMD_C, 3, test

task2.dex

DEX Protocol file: task2.dex
this file contains the list of tasks constituting a DEX protocol

```
#CMD_*, <param1>, <param2>, ...

# blank lines like the above one are allowed
# comment lines start with the hash symbol

# the following are fictitious commands
CMD_F, 1
CMD_B
CMD_B
CMD_B
CMD_B
CMD_B
CMD_F, 0
```

task3.dex

```
# DEX Protocol file: task3.dex
# this file contains the list of tasks constituting a DEX protocol
#CMD_*, <param1>, <param2>, ...

# blank lines like the above one are allowed
# comment lines start with the hash symbol

CMD_A
CMD_B, 1
CMD_A
CMD_B, 2
CMD_A
CMD_B, 1
CMD_A
CMD_B, 2
CMD_A
CMD_B, 1
CMD_A
CMD_B, 2
CMD_D, 2, text, 0
CMD_E, 55
```

5.2.10 CONFIGURATION FILES

A number of configurable parameters for the ASW (e.g. IP address of SMSC, calibration data for analog sensors, nominal value ranges for monitored parameter) will be stored in ASCII based files and read by the latter at startup.

Configuration files are stored in the C:\ASW\config directory. They contain various parameters that control numerical values, identifiers, limits and calibration factors used by the ASW.

The top level configuration file is ASW.ini, which will determine the names of any other configuration files required. A description of the meaning of each parameter is present in the .ini file itself. Most important parameters of the ASW.ini file are:
- Locations of other files/directories used by ASW
- Serial numbers of connected hardware
- Filter constants and dimensions
- Nominal geometric coordinates of markers
- Marker numbering scheme

An example of an ASW.ini file is provided in Appendix A.

The config data file (extention ".dex") is a dedicated configuration file which contains conversion parameters and limits for named parameters known by ASW. It contains two types of entries:
- Monitoring limits definition commands (see 5.2.4.41)
  E.g. `CMD_SET_MON_LIMITS, temp_RF, -1,-1, 67, 70, temp_RF_al`
  define the parameter to be monitored, the upper and lower caution and warning limits and the associated alarm variable
- Parameter conversion specification commands (see 5.2.4.42)
  E.g. `CMD_SET_PARAM_CONV, temp_RF, polynomial, -50.542, 82.04e-3, -34.988e-6, 6.3425e-9, 0`
  define how acquired data will be transformed before visualization and monitoring

Finally, two separate calibration files (extention ".cal") for the left and right force/torque sensors of the manipulandum are part of the configuration file set. These files are supplied by the manufacturer of the sensors and must match the serial number of the sensor.

5.3 GUI INTERFACES

Both the ASW flight software and the Science Data Extractor EGSE software support a graphical user interface and are using the WxWidgets library.

The conceptual design and flow of the ASW GUI is described in [RD3]. The screens allow the user (nominally the test subject) to log in and log out from a session using his/her pin code, to select protocols from a list and tasks within the protocols, and to execute these tasks. As part of the scripts defining the tasks, customized user messages and pictures can be displayed to the user. At all times the user has access to a status screen displaying important housekeeping data. The graphical elements present on the ASW GUI and how the user will interact with it are detailed in the Software User manual [RD5].

 The Science Data Extractor is a tool containing one dialog as main screen (LogExtractFrame, see design info in [RD3]). User interaction with the tool is again detailed in [RD5].

6. VALIDATION REQUIREMENTS

Validation method of interface requirements follows the same approach of all other DEX S/W requirements and it is documented in DEX SRS [AD33].

7. TRACEABILITY

SRS requirement	ICD section
SRS-17	5.2.4.58 5.2.4.68
SRS-45	5.2.1
SRS-52	5.3
SRS-53	5.3
SRS-55	5.3
SRS-57	5.3
SRS-73	5.2.1
SRS-88	5.2.1
SRS-132	5.3

ICD section	SRS requirement
5.2.1	SRS-45 SRS-73 SRS-88
5.2.4.58	SRS-17
5.2.4.68	SRS-17
5.3	SRS-52 SRS-53 SRS-55 SRS-57 SRS-132

APPENDIX A: ASW CONFIG FILE EXAMPLE

The following is an example of a ASW.ini configuration file.

```
; DEX sample initialisation file - for test purposes only.
;

[Setup]
;Storage location of initialization and calibration files [input]
ConfigRoot = config
ConfigDataFile = config\config_data.dex
;Storage location of user scripts [input]
ScriptRoot = scripts
ScriptPictures = scripts\pictures
UserFile = users.dex
;Storage location of science data and logs [output]
LogfileDir = D:\DATA\log
;Storage location of crew camera images
CrewCameraDir = D:\DATA\img
;Codamotion RTNet server port number
RTNetPort = 7000
;National Instruments PXI-6229 serial numbers
SerialPXI_A = 23658351
SerialPXI_B = 24257657
SerialPXI_C = 24257592
; IP address of the SNTP server. Port is assumed to be 123 (NTP standard)
SNTPServerIP = 192.168.200.102
; IP address and port of the SMSC
SMSCIP = 192.168.200.102
SMSCPort = 2345
; Maximum allowed TX data rate (bps) over EPM interface
EPM_MaxDataRate = 1000000
; DEX subsystem ID
DEX_SSID = 33


[Algorithms]
; FT sensor 1 = LEFT of subject calibration file, relative vs LogRoot
FTSensor1CalibrationFile = FT13517.cal
; FT sensor 2 = RIGHT of subject calibration file, relative vs LogRoot
FTSensor2CalibrationFile = FT13518.cal
; ATI force-torque sensor rotations in degrees around manipulandum X axis
(sensor Z axis)
LeftAtiRotation = 30.0
RightAtiRotation = 30.0

[MEMS]
; Offsets in mV of A,B,C signals in zero G.
Low_Acc_Offset = 4663, 4443, 4457
; linear coefficients to convert A,B,C signals [mV] to X,Y,Z accelerations
[mm/s^2]
Low_Acc_A_Coeff = -11.46, 0, 0
Low_Acc_B_Coeff = 0, 11.46, 0
Low_Acc_C_Coeff = 0, 0, 11.2
; Expected delta values in mV during self test
Low_Acc_ST_DeltaMinABC = 450,-1800,450
```

```
Low_Acc_ST_DeltaMaxABC = 3000,-450,1800
Hi_Acc_ST_DeltaMin = 770
Hi_Acc_ST_DeltaMax = 1155
Gyro_ST_DeltaMinABC = 300,300,300
Gyro_ST_DeltaMaxABC = 1000,1000,1000


[Geometry]
; LED Target reference positions (unrotated)
; Format X,Y,Z [mm] - Warning no whitespace allowed before comma
TargetPosition_H1  = -70, -10, -480
TargetPosition_H2  = -70, -10, -430
TargetPosition_H3  = -70, -10, -380
TargetPosition_H4  = -70, -10, -330
TargetPosition_H5  = -70, -10, -280
TargetPosition_H6  = -70, -10, -230
TargetPosition_H7  = -70, -10, -180
TargetPosition_H8  = -70, -10, -130
TargetPosition_H9  = -70, -10, -80
TargetPosition_H10 = -70, -10, -30
TargetPosition_V1  = -60, 65, -220
TargetPosition_V2  = -60, 115, -220
TargetPosition_V3  = -60, 165, -220
TargetPosition_V4  = -60, 215, -220
TargetPosition_V5  = -60, 265, -220
TargetPosition_V6  = -60, 315, -220
TargetPosition_V7  = -60, 365, -220
TargetPosition_V8  = -60, 415, -220
TargetPosition_V9  = -60, 465, -220
TargetPosition_V10 = -60, 515, -220
TargetPosition_V11 = -60, 565, -220
TargetPosition_V12 = -60, 615, -220
TargetPosition_V13 = -60, 665, -220
; Bar markers to targets offset vector
BarMarkersToTargets = -70, 30, -120


; One-based numbers of the manipulandum markers
; Order: TL, TR, T45L, T45R, FL, FR, BL, BR
Manipulandum_Markers = 2,1,4,3,6,5,8,7


; Manipulandum marker reference positions (unrotated, origin=manipulandum
centre)
Manipulandum_RefPos_TopLeft     =  13, 49.5, -22.5
Manipulandum_RefPos_TopRight    = -13, 49.5, -22.5
Manipulandum_RefPos_Top45Left   =  13, 43.9, 28
Manipulandum_RefPos_Top45Right  = -13, 43.9, 28
Manipulandum_RefPos_FrontLeft   =  13, 16.5, 32.6
Manipulandum_RefPos_FrontRight  = -13, 16.5, 32.6
Manipulandum_RefPos_BottomLeft  =  13,  -46, 33.9
Manipulandum_RefPos_BottomRight = -13,  -46, 33.9


; One-based numbers of the reference frame markers
; Order: Negative Box, Positive Box, Negative Bar, Positive Bar
ReferenceFrame_Markers = 10,9,12,11


; Reference frame positions (unrotated, coda aligned coordinates)
BoxMarker_RefPos_Negative =   0.0,   0.0,   0.0
BoxMarker_RefPos_Positive = 500.0,   0.0,   0.0
```

```
BarMarker_RefPos_Negative =   36.0,   36.0,   -124
BarMarker_RefPos_Positive =   36.0, 590.0,   -124

; Manipulandum MEv2 thickness in mm
Manipulandum_MEv2_Thickness = 1.6
```