National Aerospace Laboratory NLR

Executive summary



Using the ESA Demo Payload to verify ground support equipment for the European Drawer Rack



Problem area

The European Drawer Rack (EDR), inside the Columbus Laboratory, is a multi-user facility accommodating and servicing experiments housed in ISIS (International Sub-rack Interface Specification) Drawers and ISS Lockers. The Erasmus User Support and Operation Centre (USOC) is preparing operational support as it is a Facility Responsible Centre (FRC) for EDR for which expertise on interfacing and operations needed to be developed.

Description of work

The Demo Payload's electrical interfaces, the database and the test procedures were developed and tested using the Experiment Ground Support Equipment (ExGSE) before integrating it with the EDR Engineering Model(EM) in clean room facilities in Turin. Integrating the Demo Payload with the EDR EM and subsequent interface test took only a single day, thereby demonstrating the validity of the approach using ExGSE.

The ESA Demo Payload, connected to the EDR Flight Model (FM) installed in the Columbus Proto-Flight Module (PFM) in Bremen-, was used during the SVT-2r test campaign to test the multi-user capability of EDR and remote operations from the EDR FRC.

Results and conclusions

These tests gave confidence that, with the facilities available at the Erasmus USOC, future experiment payloads can be integrated easily after EDR is in orbit.

Applicability

The ESA Demo setup is available for ground reference testing at the Erasmus USOC clean room. Report no. NLR-TP-2007-147

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Using the ESA Demo Payload to verify ground support equipment for the European Drawer Rack

E.A. Kuijpers and J. Spaa

This report is based on a presentation given at the Electrical Ground Support Equipment Workshop at ESTEC on 17-18 October 2006.

The contents of this report may be cited on condition that full credit is given to NLR and the authors.

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Summary

The European Drawer Rack (EDR), inside the Columbus Laboratory, is a multi-user facility accommodating and servicing experiments housed in ISIS (International Sub-rack Interface Specification) Drawers and ISS Lockers. The Erasmus User Support and Operation Centre (USOC) is preparing operational support as it is a Facility Responsible Centre (FRC) for EDR.

As part of the Erasmus USOC preparations the EDR Experiment EGSE (ExGSE) was developed to support development, testing and verification, as well as operation preparation of ISIS Drawers and ISS Lockers on ground. ExGSE has a suite of test and debugging tools for interface test and verification.

The ESA Demo Payload was built to familiarise with the EDR drawer/locker interfaces and the operations. A Spacewire and video link are available to demonstrate EDR image interfaces. The EXPRESS Rack Protocol over the RS-422 and ethernet link is supported for the telemetry and telecommanding. The Demo Payload's electrical interfaces, the database and the test procedures were developed and tested using ExGSE before integrating it with the EDR Engineering Model at Thales Alenia Space Italy premises in Turin. Integrating the Demo Payload with the EDR EM and subsequent interface test took only a single day, thereby demonstrating the validity of the approach.

The ESA Demo Payload, connected to the EDR Flight Model installed in the Columbus Proto-Flight Module (PFM) in Bremen-,was used during the SVT-2r test campaign to test the multiuser capability of EDR and remote operations from the EDR FRC. These tests gave confidence that, with the facilities available at the Erasmus USOC, future experiment payloads can be integrated easily after EDR is in orbit.

The EDR EM has recently been installed at the Erasmus USOC. The first drawer which is part of the Protein Crystallisation Diagnostics Facility PCDF is to be integrated in September 2006. . The ESA Demo Payload will remain in use for EDR operation, testing, familiarisation and for exercising concurrent experiment operations.

The presentation based on the above at the ESA <u>Electrical Ground Support Equipment</u> <u>Workshop</u>, 17-18 October 2006 at ESTEC in Noordwijk is included.



Contents

1	. Introduction				
2	ERASMU	S USOC SVT-2r test campaign and ESA Demo Payload	7		
	2.1	Preparation and objectives	7		
	2.2	Text execution overview	9		
	2.2.1	Test schedule	9		
	2.2.2	Module M10 – EDR operations	11		
	2.2.3	Module M06 - High Rate Data	13		
	2.3	Evaluation, lessons learned and problem reporting	15		
	2.4	SVT-2r evaluation	17		
3	Conclusio	ons	17		
Re	ferences		18		
Ар	pendix A	Poster ESA Demo Payload activities	19		
Ар	pendix B	Presentation for EGSE Workshop ESTEC, 17-10-2006	20		



Acronyms

Acronym	Explanation
CADU	Channel Access Data Unit
CC	Control Centre
CCSDS	Consultative Committee on Space Data System
CD-MCS	Columbus Distributed Monitoring and Control System
CRC	Cyclic Redundancy Checksum
Col-CC	Columbus Control Centre
DPL	Demo Payload
EADS	European Aeronautic Defence and Space Company
EDR	European Drawer Rack
EGSE	Electrical Ground Support Equipment
EM	Engineering Model
ESA	European Space Agency
EuTEF	European Technology Exposure Facility
ESTEC	European Space-research and Technology Centre
FM	Functional Model
FRC	Facility Responsible Centre
GPS	Global Positioning System
GSE	Ground Support Equipment
HRM	High Rate Multiplexer
ICD	Interface Control Document
IFT	InterFace Test
ISDN	Integrated Services Digital Network
ISIS	International Sub-rack Interface Specification
ISS	International Space System
LSU	Light Scattering Unit
MCS	Mission Control Centre
MDB	Mission DataBase
NLR	National Aerospace Laboratory
PaCTS	Payload Computer Test System
PCDF	Protein Crystallisation Diagnostics Facility
PFM	Proto-Flight Module
RLTF	Rack Level Test Facility
RX	Receive
SAS	Software Application

NLR-TP-2007-147



Acronym	Explanation
SID	Software Item Descriptor
SPR	Software Problem Report
SVT	System Validation Test
TAS	Thales Alenia Space
TAXI	Transparent Asynchronous Transmit/Receive Interface
TC	TeleCommand
ТМ	Telemetry
TRR	Test Readiness Review
TX	Transmit
UMI	Universal Measurement Identifier
USOC	User Support and Operation Centre
UTC	Universal Time Coordinated
VDPU	Video Distribution and Processing Unit
VMU	Video Management Unit

Figures

Figure 1 Several displays were developed with one main menu allowing selection.
Figure 2 The ERASMUS USOC during the dry-run preparations.
Figure 3 The main housekeeping display.
Figure 4 Screenshots of image received.
Figure 5 The ESA Demo Payload, drawer and small display, during the IFT-2 test campaign.
Figure 6 PCDF Electronic Unit integrated with EDR during the IFT-2 test campaign.
Figure 7 The DPL and PCDF test images.



1 Introduction

During the Electrical Ground Support Equipment Workshop, 17 October - 18 October 2006, ESTEC, a presentation entitled "Using the ESA Demo Payload to verify ground support equipment for the European Drawer Rack" was presented which is included in the appendices. This report contains further background on the ESA Demo Payload use in the System Validation Test campaign and use for the European Drawer Rack (EDR) Facility Responsible Centre (FRC) developments.

The work on the ESA Demo PayLoad (DPL) has been performed in the EDR FRC pilot in the "EDR FRC System Integration and Management Support" project, Work Order 6.0 entitled "Adaptation and Delivery of EDR Class 2 Demonstration Payload" and "Work Order 2.0, Specification and Implementation of the EDR-FRC Remote User Centre Connection Support" under ESA Contract No 16114/02/NL/PG. The SVT-2r activities were performed under ESA contract 13980/99/NL/PG for the "Implementation and Validation Support for ERASMUS-FRC". This report is part on an effort to document the activities for public presentation.

The ESA Demo Payload development and use of the Experiment Ground Support Equipment (ExGSE) to prepare for EDR integration has been summarized as part of a test report with the EDR Engineering Model (Ref. 1). Major part of the following chapters are based on a summary of SVT-2r activities provided to a dedicated overall SVT-2r test report (Ref. 2).

2 ERASMUS USOC SVT-2r test campaign and ESA Demo Payload

2.1 Preparation and objectives

System Validation Tests have been a serious of tests in which the Columbus flight and ground segment was tested. It included the Columbus Proto Flight Model in Bremen and related test facilities, a simulation of the space to ground link to the Columbus Control Centre in Oberpfaffenhofen and the Erasmus USOC. The Erasmus USOC would be responsible for the EDR operations.

The use of the European Drawer Rack in the integrated setup was validated in the SVT-2 test campaign. In view of SVT-2r being the last opportunity to exercise remote operations with the European Drawer Rack (EDR) and the Protein Crystallisation Diagnostic Facility (PCDF) flight hardware integrated in the Columbus flight module, the SVT-2r test campaign was not limited to a re-run of SVT-2 for the ERASMUS USOC. However, as EDR is a multi-user facility



integrated operations with multiple drawers could not be exercised. Therefore, the ESA Demo Payload development got introduced in the project.

The ESA Demo Payload was previously used to validate an approach in which a future payload would be tested first with the Experiment Ground Support Equipment for EDR (ExGSE) before doing tests with the Engineering Model (see Ref. 1, App. A and App. B).

In summary the ERASMUS USOC objectives for the SVT-2r included:

- To improve test coverage compared to the SVT-2 test campaign of 2004 by including:
 - Realistic drawer operations with the PCDF.
 - EDR Video Management Unit (VMU) control from ERASMUS with dynamic image generation and transfer.
 - o Basic interactive EDR script execution and EDR commanding.
- To verify ground infrastructure upgrades:
 - Receiving an improved set of processed parameters for EDR and Columbus from Col-CC (RX-direction).
 - Sending a limited set of processed parameters from ERASMUS to external entities (TX-direction).
 - o Command acknowledgement implementation verification with CD-MCS.
 - Cascading and integrated operation with B-USOC.
- To have an end-to-end validation test including most important EDR internal drawer interfaces:
 - PCDF interfaces: RS-422 and Spacewire.
 - ESA Demo Payload interfaces: Ethernet and Video.

In order to fulfil these objectives, new procedures were developed. These procedures have been integrated with the original SVT procedures with the support of the payload developer for EDR, Thales Alenia Space, and the payload developer for the PCDF, EADS. In a dedicated effort procedures have been integrated to include B.USOC in cascading mode to exercise future PCDF operations.





Fig. 1 Several displays were developed with one main menu allowing selection

Dedicated displays were developed for the EDR VMU, the PCDF, the PCDF-Light Scattering Unit (LSU), and the ESA Demo Payload (Fig. 1). Using various simulators, the database and displays were tested. The preparations and the test execution were performed by a team coordinated by the Erasmus USOC including Space Applications Services from Belgium and the National Aerospace Laboratory NLR from the Netherlands.

2.2 Text execution overview

2.2.1 Test schedule

The Payload developer and the Erasmus USOC were available on the dry-run days (9, 10 and 11 Jan.). The first telemetry was received from the ESA demo payload. An EDR directory command was executed to verify commanding from the Erasmus USOC and to verify commanding from the B.USOC during the dry-run (Fig. 2). At the TRR on 11 Jan. the starting configuration has been presented.





Fig. 2 The Erasmus USOC during the dry-run preparations

On 18 January the first EDR sub-module was executed. On 20 January in a dedicated test session the cascading with B.USOC was exercised using simulation at the Erasmus USOC parallel to the SVT-2r activities related to systems. The bit stream test was originally scheduled on 13 January but had to be postponed until 24 January because of time limitations. During the test parallel drawer operations were exercised with remote EDR VMU commanding and bit stream transmission for both the PCDF and the ESA Demo Payload. All remaining modules relevant to the test were executed on 26 January. Problems encountered during the testing were reported via the dedicated Columbus Software Problem Report (SPR) database.

synoptic Display [5] - EDR_01, path; vAPMUSOCIERASMUSIEDR_CO n) (Back) (Forward) (Reload) (Interrupt) HLCL: Ready	Unfreeze Freeze
R SVT2 Test (EDR_01): MILBus, LAN, C&W	EDR SVT2 Home
Power and Temperature Overview	Data Counters & Time
caver 1	Via EDR Housekeeping SA#09 15165
	SA#10 15165
atlet Temp. 20.00 20.00 °C	SA#11 15165
ON OFF	
awer 2 (PCDF)	Caution NOALARM NO ALARM
wer Status OFF OFF	Warning NOALADM NO ALADM
atlet Temp. 19.00 19.00 °C	
	STANDDI STANDDI
ON OFF	Commands Drawer 2 120 V
awer 3	Source 141 OFF
wer Status OFF OFF	Destination 129
tlet Temp. 20.00 20.00 °C	Class 128
ON OFF	Туре 145
	Counter for accepted commands 62
R Temperatures	
ack Enclosure Temp. 21.00 21.00 °C	
W Cold Plate Temp. 18.00 °C	COF LAN Status
W Inlet Temp. 17.00 17.00 °C	EDR LAN Status OK OK
ater Temp. 19.00 19.00 °C	APSW Overrun NOTOK NOT_OK
Bitemp. 20.00 20.00 °C	SSL Status
	Serial Connect Status OK OK
Status	RIC Driver Status OK OK Configure RIC
2 Valve Start Pos. XXXX XXXX	AAA Status
2 Valve End Pos. CLOSED CLOSED	FAN/AAA Fan Speed 3135.53 rpm Set Fan Speed

Fig. 3 The main housekeeping display

2.2.2 Module M10 – EDR operations

The following discusses the main observations for the Module M10 involving PCDF and EDR operations.

In the "Milbus" sub-module the basic EDR interfaces were verified. This included the EDR caution and warning. The payload developers had developed a special workaround to be able to generate caution and warning signals with the PCDF. Due to an incompatibility of the architectures of the PCDF EGSE and Dass client, no TM and TC interfacing was possible (tracked via SPR-18350). For the processed parameter comparison at the end of the "Milbus" sub-module, no discrepancies were identified for processed parameters received from Col-CC (RX processed parameters) and the EDR telemetry (Fig. 3). As part of a post-analysis for only one parameter a calibration issue was identified for the processed parameters provided by the Erasmus USOC to the DaSS (TX processed parameters).



As part of the CCSDS sub-module interactive EDR script execution was exercised. The command acknowledgement was verified with a number of basic EDR commands. For the File-transfer sub-module the Col-CC Web-portal was used instead of standard ftp program.

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Acq. Time		Туре	EP Value	Initiator	Radial Position	HeightPosition	Angular Position	Mirror V	Mirror H	Rotate 90	FileName	So
	01/26 10:36:52	IMG	0	95	0.00	0.00	0.00	0		0	Image00002H_20060126_103652.jpg	
	01726 10:36:46 01726 10:36:46	IMG	0	95	0.00	0.00	0.00	U	U	U	Image00001D_20060126_103646.pg Image000001L_20060126_103646.ipg	
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Fig. 4 A screenshot from PCDF Video PC taken in Bremen: two images were recovered, no. 1L (low byte image), no. 2H high byte image),with missing images: 1H and 2L. Image 1D is generated at PCDF EGSE from image 1L and (missing) image 1H, therefore appears black

The execution of the PCDF commissioning was of special interest as this involved B.USOC for remote commanding via the Erasmus USOC (cascading). Start-up issues for the cascading mode were identified and will be further analysed later on. The commissioning procedure proposed for the Light Scattering Unit (LSU) in the PCDF was operated successfully in cascaded mode.

As part of the sub-module a test pattern generation was generated by the PCDF and stored using the Taxi logger system at EADS. The test pattern generation was performed twice due to a commanding problem which proved to be of interest. Instead of four image frames only two



image frames were recovered at the PCDF EGSE in Bremen (see Fig. 4). Post-analysis of the TAXI-logger files at the Erasmus USOC showed that a limited number of CADUs were lost with the first byte of a sync-marker corrupted. A buffering issue in the Columbus VDPU/HRM processing was identified by EADS which needs to be taken into account for future operations.

2.2.3 Module M06 - High Rate Data

The bit stream communication capabilities were constrained by the SVT-2r network data rate allocation. With the support of the payload developer an update was implemented to reduce the EDR VMU data rate to 5 Mbit/s.



Fig. 5 The ESA Demo Payload, drawer and small display, during the IFT-2 test campaign

Based on the experience gained during a Columbus interface test (IFT-2) the execution of the module was modified to have first the Demo PayLoad (DPL) generating video, then the PCDF generating a test pattern image in parallel to the DPL.



Fig. 6 PCDF Electronic Unit integrated with EDR during the IFT-2 test campaign



The DPL configuration is shown in Fig. 5. Both the PCDF (see Fig. 6) and ESA Demo Payload (DPL) were successfully operated in parallel from the Erasmus USOC.

The bit stream data was received from Col-CC via the ops-support network using zip-files and the dropbox. At the Erasmus USOC the images acquired by the EDR VMU were recovered immediately from the recorded bit stream data confirming at the daily debriefing that the data was correctly recorded.



Fig. 7 On the left the images generated by the DPL (left below image number 2635 without illumination on) and on the right the PCDF test image frame

From the data received (825 MBytes) the Erasmus USOC could reconstruct the DPL video and two PCDF test pattern image frames (Fig. 7). The total number of images extracted was 2635 representing approximately 810 MBytes. The parameters inserted by the EDR VMU could be extracted and included the correct UTC time reference. During SVT-2 in 2004 replay of video previously stored on disk did not allow to compare with time information in real-time telemetry. The CRC checksum and the R-S code in the CADUs could be verified.



The ESA Demo Payload was only intended for short simple tests with limited functionality but allowed to enhance the SVT-2r activities to exercise:

- EDR reconfiguration in orbit when installing new drawers requiring "SID-table" updates.
- Identification of a problem with a dynamic ISDN data rate allocation scheme for Col-CC USOC communications.
- CD-MCS and MDB limitations (e.g. PaCTS import tool limitation, identification of an erroneous EDR command).
- PCDF configuration and related impact on EDR VMU operations for other drawers.

2.3 Evaluation, lessons learned and problem reporting

All the sub-modules have been executed successfully. The data generated during the test were stored at EADS (TAXI data logger files), at Col-CC for bit stream data and the Erasmus USOC using CD-MCS for future reference. The as-run-procedures and logfiles are available for future analyses and reuse.

The handling of time was greatly improved compared to the SVT-2 test campaign in 2004 because the CD-MCS systems were properly synchronised with GPS, the MDB changes proved to allow UTC extraction from the CCSDS packet headers and the time inserted by the EDR VMU in the image bit stream data was synchronised with the telemetry data.

The tight schedule for procedure development combined with the additional test objectives compared to previous SVT-2 generated a number of practical problems attributed to workload. However, the end-result was a considerable improvement compared to the SVT-2. The table below gives an overview of the improvements.

Objectives	SVT-2 (2004)	SVT-2r (2006)
Basic operations in Mil-bus	drawer simulator + RX	With PCDF and both TX and
sub-module	Processed parameters	RX processed parameters
File transfer	ftp/ncftp	Using web access
Generic CCSDS command	Raw data dump for command	Interactive script and
packet handling	acknowledgements	acknowledgements
Drawer operations	none	PCDF and ESA Demo
		payload
Interactive EDR Video	None, only monitoring and	VMU commanding + image
Management Unit operations	off-line analysis weeks later	decoding within hours
Commanding and monitoring	24 manual stack files + 4	75 manual stack files + 10



Objectives	SVT-2 (2004)	SVT-2r (2006)	
	synoptic displays	synoptic displays	
Cascading	no	With B.USOC	
Realism	Limited	PCDF commissioning	
Preparation	6 months between RLTF and	2 months between IFT-2 and	
	SVT, a dry-run well in	SVT for PCDF/bits tream,	
	advance	dry-run/test mixed	

The following lists lessons learned are to be included in further work:

- 1. End-to-end link tests should be performed on a regular basis for efficient involvement of the USOC and payload developer teams in preparation of tests and simulations.
- 2. Regression testing after CD-MCS upgrades needs to be improved to cover all processes. In particular the cascading configuration shall be verified after every CD-MCS upgrade.
- 3. Planning should be improved to allow more time for procedure development, implementation, testing and dry-runs. A dry-run opportunity with sufficient time to prepare for the real test is essential. With many new procedure elements this is especially relevant for the Erasmus USOC.
- 4. The Col-CC to USOC ICD should be improved with respect to the information for routing TM.(private header issue). As a baseline wildcards should be supported with exceptions to be agreed with the USOC in the interface document.
- 5. Two consoles were used for telemetry display at the Erasmus USOC. One console was used for commanding. In view of the complexity for operating payloads distribution of workload and displays needs to be improved. The load average measured on one of of the consoles was sometimes too high compared to normal use. Some performance tests should be done with the whole CD-MCS in a realistic scenario.
- 6. The command history integrated in MCS tools should be integrated with the command responses to avoid the use of an independent Response SAS window. The PCDF generates also command acknowledgements. Both for the Erasmus USOC and B.USOC the command history and response visualization needs to be improved together with the monitoring of cascading commanding.
- On processed parameters a number of issues have been reported for further improvement. They relate to organization and planning improvements, single reference file delivery, USOC local test capabilities, standardization for UMI references and displays and processed parameter coverage.

Problems encountered during the SVT2-r test have been inserted into the EADS SPR database. Analyses have been supported for all Erasmus SPRs inserted by all entities involved. Partly they



generated dedicated activities to improve future operations. It proved that updates are needed for the MDB database. One command was rejected by EDR because of an erroneous entry and a number of commands had to be corrected manually. The MDB coverage of the PCDF TM and TC was limited to a restricted PCDF commissioning scenario and shall be extended and completed for future flight operations.

Note that the use of the Erasmus USOC DaSS client security certificates could not be exercised during the SVT-2r. However, just after the SVT-2r activities, a dedicated test with the Col-CC secure communication services for commanding and telemetry was executed, resulting in successful verification of the pertinent interfaces.

2.4 SVT-2r evaluation

The SVT-2r test coverage was satisfactory and all planned objectives were demonstrated successfully. SVT-2r was not just a repeat of SVT-2, but a step forward for preparing real flight operations with B-USOC in the loop. In co-operation with the payload developers all main problems encountered were resolved with considerable flexibility.

Further work remained to be done on the ground segment before flight operations to improve: verification of configuration updates, CD-MCS robustness and realism for end-to-end communications in terms of security and realistic load during operations.

Lessons learned provided valuable information for the SVT-2b test with EuTEF, and will be important as the last ground reference test before EDR and PCDF flight commissioning and later operations.

3 Conclusions

The following conclusions can be drawn on the use of the ESA Demo Payload:

- The ESA demo payload exercise was useful for gaining experience with stand-alone test for new EDR Experiment Container Module development..
- 'Plug-n-Play' integration was successfully demonstrated.
- Compatibility with the EDR EM interface was tested with ExGSE.
- Confidence in on-orbit parallel drawer operations and drawer/locker exchange concept was improved.



The EDR+PCDF EM is available in Erasmus USOC clean room for further work. Since the SVT-2r activities the integrated Columbus has been launched (Ref. 3) and operations have been performed for the flight configuration. Regularly the lessons learned during the SVT-2r test campaign have been proven useful.

Acknowledgements

The ESA Demo Payload development was performed by Robin Stephan during his ESTEC traineeship with support of David Sunderland from ESA. Ton Casteleijn from NLR adapted the software for integration with the EDR EM and FM and provided valuable test assistance at the Columbus test facilities in Bremen. The test team at the Erasmus USOC and the good co-operation with the SVT team in Bremen is also gratefully acknowledged.

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Appendix A Poster ESA Demo Payload activities





Appendix A Presentation for EGSE Workshop ESTEC, 17-10-2006













ESA Demo Payloa





ESA Demo Payload updates

Software development: Implementation of EDR version of EXPRESS Rack Protocol PaCTS database for telemetry and telecommands

Hardware development: PAL to NTSC converter for analogue video output, integration of mini-PC for Spacewire output stimulation, integration of power supply, touch panel to simplify start-up





17 -10-2006













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EDR

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EDR EM

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Testing with EDR EM

ESA Demo Payload and ExGSE transported to AAS-I /Alenia Spazio Turin

Connected to EDR EM after standalone demonstration with ExGSE

Integration of Demo payload PaCTS database in EDR PaCTS database



17 -10-2006 1

First day: preparation





Unpacking Stand-alone test Preparation QA connectors

17 -10-2006





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EDR

With

17 -10-2006

Evaluation with EDR EM

All basic interfaces could be verified at the same day in which the ESA Demo Payload was connected to the EDR EM. This confirmed the validity of the approach using dedicated drawer/locket test equipment (ExGSE) before connecting to EDR.

Discrepancies identified between ExGSE and EDR:

- Electrically the RS-422 interface board in ExGSE is not fully identical to EDR RS-422 at electrical level (pull-up resistor missing).
- The Spacewire interface is not fully consistent with the EDR EM (post-analysis showed checksum verification problem, Spacewire box presets to be modified, link timing to be verified with the EDR VMU EM with dedicated scripts).













Objectives	SVT-2 (Aug. 2004)	SVT-2r (Jan. 2006)
Basic operations in Mil- bus sub-module	drawer simulator + RX PP	With PCDF + TX PP + RX PP
File transfer	ftp/ncftp	Using web access
Generic CCSDS packet handling	Raw data dump for command acknowledgements	Interactive script and acknowledgements
Drawer operations	none	PCDF + Demo payload
Interactive EDR Video Management Unit operations	None, only monitoring and off- line analysis weeks later	VMU commanding + image decoding within hours
Commanding and monitoring	24 manual stack files + 4 synoptic displays	75 manual stack files + 10 synoptic displays
Cascading	no	With B.USOC
Realism	Limited	PCDF commissioning
Preparation	6 months between RLTF and SVT, dry-run well in advance	2 months between IFT- and SVT for PCDF/bitstream, dry- run/test mixed

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	Constructions Construction Construction	All flaw Very All Preventer Very Labelscription Statis
PICTS: SITE LEPT LGGET Transfer Manager LGGET Transfer Manager LGGET Transfer Manager LGGET AD GUT BIGGZ Markor: EuGBE Buildower:		A. CTOD, ACMAY, STIS A. A. MARAOY, STIS A. CTOD, ACMAY, STIS A. M. MARAOY, STIS A. CTOD, ACMAY, STIS A. CTOD, COL, STIMA, JUNI A. VILLY, NOS, CONH, STISS A. CTOD, COL, STIMA, JUNI A. NILLY, NOS, CONH, STISS A. CTOD, COL, STIMA, JUNI A. MILLY, NOS, CONH, STISS A. CTOD, COL, STIMA, JUNI A. MILLY, NOS, CONH, STISS A. LITAS, M. MUMID A. MILLY, NOS, CONH, STISS A. LITAS, JUNI A. MALANOS, CONS, STISS A. LITAS, JUNI, JUNISA A. MALANOS, CONS, STISS A. LITAS, JUNI A. MILLY, SON, ONTH, STISS A. LITAS, JUNI
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Two configurations

Electrical Ground Support

Mechanical Ground Support

MGSE+EGSE Used at B.USOC, Brussels

EGSE available at Erasmus USOC ESTEC



Simple test scenario

EDR/ExGSE initialisation

Power up demo payload, booting and initialisation Initialise communication (starting up ExGSE PaCTS or EDR EGSE) Command demo payload via PaCTS EGSE to interactive mode Interactive commands to control lights/camera/motor EDR commands for initialisation of VMU Spacewire/Analogue initialisation demo payload Viewing and storing EDR bitstream data Returning to standbye Switch off demo payload Switch off EDR/ExGSE

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